Horizon 2020

Call: H2020-SC5-2016-2017
(Greening the Economy)

Topic: SC5-02-2017

Type of action: RIA
(Research and Innovation action)

Proposal number: 776613

Proposal acronym: EUCP

Deadline Id: H2020-SC5-2017-OneStageB
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How to fill in the forms

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the previous steps in the submission wizard.

Proposal ID **776613** *Acronym* **EUCP**

1 - General information

Topic	SC5-02-2017
Call Identifier	H2020-SC5-2016-2017
Type of Action	RIA
Deadline Id	H2020-SC5-2017-OneStageB

Acronym: EUCP

Proposal title*: European Climate Prediction system

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months: *48*

Fixed keyword 1: *Climatology and climate change* Add

Fixed keyword 2: *Meteorology, atmospheric physics and dynamics* Add Remove

Free keywords: *climate prediction, climate projection, , regional modelling, actionable climate information for users, harmonisation*

Proposal ID **776613** *Acronym* **EUCP**

Abstract

The European Climate Prediction system project (EUCP) has four objectives, all directly relevant to the work programme, and fully meet the challenge, scope and impact of the work programme.
1. Develop an innovative ensemble climate prediction system based on high-resolution climate models for Europe for the near-term (~1-40years), including improved methods used to characterise uncertainty in climate predictions, regional downscaling, and evaluation against observations.
2. Use the climate prediction system to produce consistent, authoritative and actionable climate information. This information will be co-designed with users to constitute a robust foundation for Europe-wide climate service activities to support climate-related risk assessments and climate change adaptation programmes.
3. Demonstrate the value of this climate prediction system through high impact extreme weather events in the near past and near future drawing on convection permitting regional climate models translated into risk information for, and with, targeted end users.
4. Develop, and publish, methodologies, good practice and guidance for producing and using authoritative climate predictions for 1-40year timescale.
The system (objective1) will combine initialised climate predictions on the multi-annual timescale with longer-term climate projections and high resolution regional downscaling, using observations for evaluation. Methodologies will be developed to characterise uncertainty and to seamlessly blend the predictions and projections. Users will be engaged through active user groups. The system will be utilised (objective2) with users to co-produce information suitable for European climate service activities. A set of demonstrators will show the value of this information in real-world applications with user involvement (objective3). Key outputs will include disseminating and publishing the project's methodologies, and user-relevant data and knowledge (objective4).

Remaining characters 23

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

Proposal ID **776613** *Acronym* **EUCP**

Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him/her and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection

The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database).

Proposal ID **776613** *Acronym* **EUCP**

List of participants

#	Participant Legal Name	Country
1	MET OFFICE	United Kingdom
2	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain
3	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	France
4	STICHTING DELTARES	Netherlands
5	DANMARKS METEOROLOGISKE INSTITUT	Denmark
6	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	Switzerland
7	HELMHOLTZ-ZENTRUM GEESTHACHT ZENTRUM FUR MATERIAL- UND KUSTENFORSCHUNG GMBH	Germany
8	FONDAZIONE CENTRO EURO-MEDITERRANEO SUI CAMBIAMENTI CLIMATICI	Italy
9	UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION -UNESCO	France
10	INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE	Austria
11	KONINKLIJK NEDERLANDS METEOROLOGISCH INSTITUUT-KNMI	Netherlands
12	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Sweden
13	THE UNIVERSITY OF EDINBURGH	United Kingdom
14	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD	United Kingdom
15	KOBENHAVNS UNIVERSITET	Denmark
16	STICHTING NETHERLANDS ESCIENCE CENTER	Netherlands

2 - Administrative data of participating organisations

PIC	***Legal name***
999892685	*MET OFFICE*

Short name: Met Office

Address of the organisation

Street FitzRoy Road

Town EXETER

Postcode EX1 3PB

Country United Kingdom

Webpage www.metoffice.gov.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... no

International organisation ..... unknown

International organisation of European interest ..... unknown

Secondary or Higher education establishment ..... unknown

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Met Office ☐ not applicable

☒ Same as organisation address

Street: FitzRoy Road

Town: EXETER

Postcode: EX1 3PB

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **Met Office**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Chris** Last name: **Hewitt**

E-Mail: **chris.hewitt@metoffice.gov.uk**

Position in org.: Head of Climate Service Development

Department: MET OFFICE ☒ Same as organisation

☒ Same as organisation address

Street: FitzRoy Road

Town: EXETER Post code: EX1 3PB

Country: United Kingdom

Website: www.metoffice.gov.uk

Phone 1: +44 1392884520 Phone 2: +44 7753880749 Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Paula	NEWTON	paula.newton@metoffice.gov.uk	+441392884834
Stacey	Squires	stacey.squires@metoffice.gov.uk	+441392886681

Proposal ID **776613** *Acronym* **EUCP** *Short name* **BSC**

PIC	***Legal name***
999655520	*BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION*

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 01/03/2005 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Earth Science Department ☐ not applicable

☐ Same as organisation address

Street: Nexus II - 1C, Calle Jordi Girona 29

Town: Barcelona

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **BSC**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Francisco** Last name: **Doblas-Reyes**

E-Mail: **francisco.doblas-reyes@bsc.es**

Position in org.: Department Director

Department: Earth Science ☐ Same as organisation

☐ Same as organisation address

Street: Nexus II - 1C, Calle Jordi Girona 29

Town: Barcelona Post code: 08034

Country: Spain

Website: www.bsc.es

Phone 1: +34934137719 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Mar	Rodriguez	mar.rodriguez@bsc.es	+34934137566

Proposal ID **776613** *Acronym* **EUCP** *Short name* **CNRS**

PIC	***Legal name***
999997930	*CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS*

Short name: CNRS

Address of the organisation

Street RUE MICHEL ANGE 3

Town PARIS

Postcode 75794

Country France

Webpage www.cnrs.fr

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 18/11/2008 - no

SME self-assessment ..... unknown

SME validation sme ..... 18/11/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Institut Pierre Simon Laplace (IPSL - FR636) ☐ not applicable

☐ Same as organisation address

Street: 11 Boulevard d'Alembert

Town: Guyancourt

Postcode: 78280

Country: France

Department 2

Department name: Centre National de Recherches Météorologiques UMR3589 ☐ not applicable

☐ Same as organisation address

Street: 42 Avenue Gaspard Coriolis

Town: Toulouse cedex 01

Postcode: 31057

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **CNRS**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr. Sex: (•) Male ( ) Female

First name **Philippe** Last name **Cavelier**

E-Mail **philippe.cavelier@cnrs.fr**

Position in org.: Regional Delegate

Department: CNRS - Délégation Ile de France Ouest & Nord ☐ Same as organisation

☐ Same as organisation address

Street: 1 Place Aristide Briand

Town: Meudon Post code: 92195

Country: France

Website:

Phone 1: +331 45075301 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Philippe	Cavelier	spv@dr5.cnrs.fr	
Nizar	Larabi	nizar.larabi@cnrs.fr	
Sophie	Bastin	sophie.bastin@latmos.ipsl.fr	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **Deltares**

PIC	***Legal name***
999520302	*STICHTING DELTARES*

Short name: Deltares

Address of the organisation

Street BOUSSINESQWEG 1

Town DELFT

Postcode 2629 HV

Country Netherlands

Webpage www.deltares.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 30/11/1990 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Inland Water Systems ☐ not applicable

☒ Same as organisation address

Street: BOUSSINESQWEG 1

Town: DELFT

Postcode: 2629 HV

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **Deltares**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Albrecht** Last name: **Weerts**

E-Mail: **albrecht.weerts@deltares.nl**

Position in org.: Senior Researcher

Department: Inland Water Systems ☐ Same as organisation

☒ Same as organisation address

Street: BOUSSINESQWEG 1

Town: DELFT Post code: 2629 HV

Country: Netherlands

Website: www.deltares.com

Phone 1: +31620332696 Phone 2: +31883358273 Fax: +31883358582

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Herman	Scholten	herman.scholten@deltares.nl	+31655413028

Proposal ID **776613** *Acronym* **EUCP** *Short name* **DANMARKS METEOROLOGISKE INSTITUT**

PIC	***Legal name***
999509438	*DANMARKS METEOROLOGISKE INSTITUT*

Short name: DANMARKS METEOROLOGISKE INSTITUT

Address of the organisation

Street Lyngbyvej 100

Town KOBENHAVN

Postcode 2100

Country Denmark

Webpage www.dmi.dk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... unknown
International organisation of European interest ..... unknown
Secondary or Higher education establishment ..... unknown
Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown
SME self-assessment ..... unknown
SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Proposal ID **776613**	*Acronym* **EUCP**	*Short name* **DANMARKS METEOROLOGISKE INSTITUT**

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development ☐ not applicable

☒ Same as organisation address

Street: Lyngbyvej 100

Town: KOBENHAVN

Postcode: 2100

Country: Denmark

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613**	*Acronym* **EUCP**	*Short name* **DANMARKS METEOROLOGISKE INSTITUT**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Shuting**

Last name: **Yang**

E-Mail: **shuting@dmi.dk**

Position in org.: Senior Researcher

Department: Research and Development

☐ Same as organisation

☒ Same as organisation address

Street: Lyngbyvej 100

Town: KOBENHAVN

Post code: 2100

Country: Denmark

Website: www.dmi.dk

Phone 1: +45 3915 7463

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Katrine	Sandvad	kat@dmi.dk	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **ETH Zürich**

PIC	***Legal name***
999979015	*EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH*

Short name: ETH Zürich

Address of the organisation

Street Raemistrasse 101

Town ZUERICH

Postcode 8092

Country Switzerland

Webpage www.ethz.ch

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 06/01/2009 - no
SME self-assessment ..... unknown
SME validation sme ..... 06/01/2009 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Institute for Atmospheric and Climate Science ☐ not applicable

☐ Same as organisation address

Street: Universitaetstrasse 16

Town: Zurich

Postcode: 8092

Country: Switzerland

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **ETH Zürich**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Reto** Last name: **Knutti**

E-Mail: **reto.knutti@env.ethz.ch**

Position in org.: Professor

Department: Institute for Atmospheric and Climate Science ☐ Same as organisation

☐ Same as organisation address

Street: Universitaetstrasse 16

Town: Zurich Post code: 8092

Country: Switzerland

Website: http://www.iac.ethz.ch/

Phone 1: +41 44 632 35 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Barbara	Wittneben	barbara.wittneben@env.ethz.ch	
Agatha	Keller	grants@sl.ethz.ch	+41446345350
Christoph	Schär	christoph.schaer@env.ethz.ch	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **HZG**

PIC	***Legal name***
999507401	*HELMHOLTZ-ZENTRUM GEESTHACHT ZENTRUM FUR MATERIAL- UND KUSTENFORSCHUNG G*

Short name: HZG

Address of the organisation

Street MAX PLANCK STRASSE 1

Town GEESTHACHT

Postcode 21502

Country Germany

Webpage www.hzg.de

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 07/07/2008 - no

SME self-assessment ..... unknown

SME validation sme ..... 07/07/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Climate Service Center Germany ☐ not applicable

☐ Same as organisation address

Street: Fischertwiete 1

Town: Hamburg

Postcode: 20095

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **HZG**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Claas** Last name: **Teichmann**

E-Mail: **claas.teichmann@hzg.de**

Position in org.: Scientist

Department: Climate Service Center Germany ☐ Same as organisation

☐ Same as organisation address

Street: Fischertwiete 1

Town: Hamburg Post code: 20095

Country: Germany

Website: www.climate-service-center.de

Phone 1: +4940226338441 Phone 2: +xxx xxxxxxxxx Fax: +4940226338163

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Hans-Jörg	Isemer	hans-joerg.isemer@hzg.de	+494152871661

Proposal ID **776613** *Acronym* **EUCP** *Short name* **FONDAZIONE CENTRO EURO-MEDITERRA**

PIC	***Legal name***
999419422	*FONDAZIONE CENTRO EURO-MEDITERRANEO SUI CAMBIAMENTI CLIMATICI*

Short name: FONDAZIONE CENTRO EURO-MEDITERRANEO SUI CAMBIAMENTI CLIMATICI

Address of the organisation

Street VIA A IMPERATORE 16

Town LECCE

Postcode 73100

Country Italy

Webpage www.cmcc.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 11/05/2005 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: CSP - Climate Simulation and Prediction Division ☐ not applicable

☐ Same as organisation address

Street: via M. Franceschini, 31

Town: Bologna

Postcode: 40128

Country: Italy

Department 2

Department name: RAAS & ECIP Divisions ☐ not applicable

☐ Same as organisation address

Street: Isola di San Giorgio Maggiore, 8

Town: Venezia

Postcode: 30124

Country: Italy

Department 3

Department name: REMHI - Regional Models and geo-Hydrological Impacts ☐ not applicable

☐ Same as organisation address

Street: via Maiorise

Town: Capua (CE)

Postcode: 81043

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **FONDAZIONE CENTRO EURO-MEDITERRA**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. | Sex: (•) Male ( ) Female

First name: **Silvio** | Last name: **Gualdi**

E-Mail: **silvio.gualdi@ingv.it**

Position in org.: Head of CSP - Climate Simulation and Prediction Division

Department: CSP - Climate Simulation and Prediction Division ☐ Same as organisation

☐ Same as organisation address

Street: via M. Franceschini, 31

Town: Bologna | Post code: 40128

Country: Italy

Website: www.cmcc.it

Phone 1: +39 051 4151217 | Phone 2: +39 051 4151463 | Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Alessio	Bellucci	alessio.bellucci@cmcc.it	+39 051 4151209
Giulia	Galluccio	giulia.galluccio@cmcc.it	+39 02 43986856

Proposal ID **776613**	*Acronym* **EUCP**	*Short name* **UNITED NATIONS EDUCATIONAL, SCIENT**

PIC	***Legal name***
999454245	*UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION -UNESCO*

Short name: UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION - UNESCO

Street PLACE DE FONTENOY 7

Town PARIS

Postcode 75352

Country France

Webpage www.unesco.org

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... yes

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 16/11/1945 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: The Abdus Salam International Centre for Theoretical Physics/ICTP ☐ not applicable

☐ Same as organisation address

Street: Strada Costiera, 11

Town: Trieste

Postcode: 34151

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UNITED NATIONS EDUCATIONAL, SCIENT**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Filippo** Last name: **Giorgi**

E-Mail: **giorgi@ictp.it**

Position in org.: Head of Earth System Physics (ESP) Section, ICTP

Department: Earth System Physics (ESP) Section, ICTP ☐ Same as organisation

☐ Same as organisation address

Street: Strada Costiera, 11

Town: Trieste Post code: 34151

Country: Italy

Website: https://www.ictp.it/research/esp.aspx

Phone 1: +390402240425 Phone 2: +390402240426 Fax: +39040224163

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Erika	Coppola	coppolae@ictp.it	+390402240407
Susanne	Henningtsen	hennings@ictp.it	+390402240426

Proposal ID **776613** *Acronym* **EUCP** *Short name* **IIASA**

PIC	***Legal name***
999452596	*INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE*

Short name: IIASA

Address of the organisation

Street Schlossplatz 1

Town LAXENBURG

Postcode 2361

Country Austria

Webpage www.iiasa.ac.at

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Water Program ☐ not applicable

☒ Same as organisation address

Street: Schlossplatz 1

Town: LAXENBURG

Postcode: 2361

Country: Austria

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **IIASA**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Yoshihide** Last name: **Wada**

E-Mail: **wada@iiasa.ac.at**

Position in org.: Deputy Direct of Water Program

Department: Water Program ☐ Same as organisation

☒ Same as organisation address

Street: Schlossplatz 1

Town: LAXENBURG Post code: 2361

Country: Austria

Website:

Phone 1: +43 2236 807 241 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Hans	Benzinger	benzing@iiasa.ac.at	+43 2236807 420

Proposal ID **776613** *Acronym* **EUCP** *Short name* **KNMI**

PIC	***Legal name***
999518944	*KONINKLIJK NEDERLANDS METEOROLOGISCH INSTITUUT-KNMI*

Short name: KNMI

Address of the organisation

Street UTRECHTSEWEG 297

Town DE BILT

Postcode 3731 GA

Country Netherlands

Webpage www.knmi.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 15/05/2008 - no

SME self-assessment ..... unknown

SME validation sme ..... 15/05/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: R&D Weather and Climate Modelling ☐ not applicable

☒ Same as organisation address

Street: UTRECHTSEWEG 297

Town: DE BILT

Postcode: 3731 GA

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **KNMI**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Bart** Last name: **Van Den Hurk**

E-Mail: **bart.van.den.hurk@knmi.nl**

Position in org.: Head of Dept of R&D Weather and Climate Modelling

Department: R&D Weather and Climate Modelling ☐ Same as organisation

☒ Same as organisation address

Street: UTRECHTSEWEG 297

Town: DE BILT Post code: 3731 GA

Country: Netherlands

Website: http://www.knmi.nl

Phone 1: +3130 22 06 338 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Geert	Lenderink	geert.lenderink@knmi.nl	+31 30 2206 438
Annemarie	Koot	annemarie.koot@knmi.nl	+31 6 54902096

Proposal ID **776613** *Acronym* **EUCP** *Short name* **SMHI**

PIC	***Legal name***
999507983	*SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT*

Short name: SMHI

Address of the organisation

Street Folkborgsvaegen 1

Town NORRKOEPING

Postcode 601 76

Country Sweden

Webpage www.smhi.se

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Enterprise Data

SME self-declared status ..... unknown

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Rossby Centre ☐ not applicable

☒ Same as organisation address

Street: Folkborgsvaegen 1

Town: NORRKOEPING

Postcode: 601 76

Country: Sweden

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **SMHI**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Erik** Last name: **Kjellstrom**

E-Mail: **erik.kjellstrom@smhi.se**

Position in org.: Head of Rossby Centre

Department: Rossby Centre ☐ Same as organisation

☒ Same as organisation address

Street: Folkborgsvaegen 1

Town: NORRKOEPING Post code: 601 76

Country: Sweden

Website: https://intranat.smhi.se/avdelningar/fou/enheter/rossby-centre-fo

Phone 1: +46114958501 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Monica	Wallgren	monica.wallgren@smhi.se	+46114958104

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UEDIN**

PIC	***Legal name***
999974941	*THE UNIVERSITY OF EDINBURGH*

Short name: UEDIN

Address of the organisation

Street OLD COLLEGE, SOUTH BRIDGE

Town EDINBURGH

Postcode EH8 9YL

Country United Kingdom

Webpage www.ed.ac.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 12/12/2008 - no

SME self-assessment ..... unknown

SME validation sme ..... 12/12/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: School of Geosciences ☐ not applicable

☐ Same as organisation address

Street: The King's Buildings, James Hutton Road

Town: Edinburgh

Postcode: EH9 3FE

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UEDIN**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: ○ Male ◉ Female

First name: **Gabi** Last name: **Hegerl**

E-Mail: **gabi.hegerl@ed.ac.uk**

Position in org.: Professor of Climate System Science

Department: School of Geosciences ☐ Same as organisation

☐ Same as organisation address

Street: The King's Buildings, James Hutton Road

Town: Edinburgh Post code: EH9 3FE

Country: United Kingdom

Website: http://www.geos.ed.ac.uk/homes/

Phone 1: +44 131 6519092 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Brendan	Martin	brendan.martin@ed.ac.uk	+44131 650 4843
Gordon	Marshall	gordon.marshall@ed.ac.uk	+44 131 651 4386

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UOXF**

PIC	***Legal name***
999984350	*THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD*

Short name: UOXF

Address of the organisation

Street University Offices, Wellington Square

Town OXFORD

Postcode OX1 2JD

Country United Kingdom

Webpage www.ox.ac.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 22/12/1570 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Department of Physics ☐ not applicable

☐ Same as organisation address

Street: AOPP, Clarendon Laboratory, Parks Road

Town: Oxford

Postcode: OX1 3PU

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UOXF**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name **Antje** Last name **Weisheimer**

E-Mail **antje.weisheimer@physics.ox.ac.uk**

Position in org.: Senior NCAS Research Fellow

Department: Department of Physics ☐ Same as organisation

☐ Same as organisation address

Street: AOPP, Clarendon Laboratory, Parks Road

Town: Oxford Post code: OX1 3PU

Country: United Kingdom

Website: https://www2.physics.ox.ac.uk/contacts/people/weisheimer

Phone 1: +441865282441 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Joanna	Frost	joanna.frost@physics.ox.ac.uk	+441865283109
Jane	Kent	grants@physics.ox.ac.uk	+441865282442
Gill	Wells	ecresearch@admin.ox.ac.uk	+441865289842

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UCPH**

PIC	***Legal name***
999991043	*KOBENHAVNS UNIVERSITET*

Short name: UCPH

Address of the organisation

Street NORREGADE 10

Town KOBENHAVN

Postcode 1165

Country Denmark

Webpage www.ku.dk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 01/01/2005 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Niels Bohr Institute ☐ not applicable

☐ Same as organisation address

Street: Blegdamsvej 17

Town: Copenhagen

Postcode: 2100

Country: Denmark

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **UCPH**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Jens Hesselbjerg** Last name: **Christensen**

E-Mail: **jhc@dmi.dk**

Position in org.: Professor

Department: Niels Bohr Institute ☐ Same as organisation

☐ Same as organisation address

Street: Juliane Maries Vej 30

Town: Copenhagen Post code: 2100

Country: Denmark

Website: www.nbi.ku.dk/english/

Phone 1: +45 3915 7428 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Katja	Pedersen	katp@science.ku.dk	+4535324236
Christopher	Sturrock	stur@science.ku.dk	+4535324233

Proposal ID **776613**	*Acronym* **EUCP**	*Short name* **STICHTING NETHERLANDS ESCIENCE CE**

PIC	***Legal name***
946813800	*STICHTING NETHERLANDS ESCIENCE CENTER*

Short name: STICHTING NETHERLANDS ESCIENCE CENTER

Address of the organisation

Street SCIENCE PARK 140

Town AMSTERDAM

Postcode 1098 XG

Country Netherlands

Webpage www.esciencecenter.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Enterprise Data

SME self-declared status ..... 14/06/2016 - no

SME self-assessment ..... 14/06/2016 - no

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: STICHTING NETHERLANDS ESCIENCE CENTER ☐ not applicable

☒ Same as organisation address

Street: SCIENCE PARK 140

Town: AMSTERDAM

Postcode: 1098 XG

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **776613** *Acronym* **EUCP** *Short name* **STICHTING NETHERLANDS ESCIENCE CE**

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Wilco** Last name: **Hazeleger**

E-Mail: **w.hazeleger@esciencecenter.nl**

Position in org.: Director

Department: STICHTING NETHERLANDS ESCIENCE CENTER ☒ Same as organisation

☒ Same as organisation address

Street: SCIENCE PARK 140

Town: AMSTERDAM Post code: 1098 XG

Country: Netherlands

Website: https://www.esciencecenter.nl/

Phone 1: +31 20 4604770 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Susan	Branchett	s.branchett@esciencecenter.nl	+31 20 4604770
Otto	van Rhee	o.vanrhee@esciencecenter.nl	+31 20 4604770

Proposal ID **776613** *Acronym* **EUCP**

3 - Budget for the proposal

No	Participant	Country	(A) Direct personnel costs/€	(B) Other direct costs/€	(C) Direct costs of sub-contracting/€	(D) Direct costs of providing financial support to third parties/€	(E) Costs of inkind contributions not used on the beneficiary's premises/€	(F) Indirect Costs / € (=0.25(A+B-E))	(G) Special unit costs covering direct & indirect costs / €	(H) Total estimated eligible costs / € (=A+B+C+D+F+G)	(I) Reimburse-ment rate (%)	(J) Max.EU Contribution / € (=H*I)	(K) Requested EU Contribution/ €
1	Met Office	UK	1486142	60750	33600	0	0	386723,00	0	1967215,00	100	1967215,00	1967215,00
2	Bsc	ES	756000	65275	0	0	0	205318,75	0	1026593,75	100	1026593,75	1026593,75
3	Cnrs	FR	1267646	127600	20000	0	0	348811,50	0	1764057,50	100	1764057,50	1764057,50
4	Deltares	NL	663784	62000	0	0	0	181446,00	0	907230,00	100	907230,00	907230,00
5	Danmarks Meteorologisk e Institut	DK	222714	12000	0	0	0	58678,50	0	293392,50	100	293392,50	293392,50
6	Eth Zürich	CH	613519	14864	0	0	0	157095,75	0	785478,75	100	785478,75	785478,75
7	Hzg	DE	467424	66500	0	0	0	133481,00	0	667405,00	100	667405,00	667405,00
8	Fondazione Centro Euro-mediterraneo	IT	797500	71000	0	0	0	217125,00	0	1085625,00	100	1085625,00	1085625,00
9	United Nations Educational, Scientific And	FR	349800	52000	0	0	0	100450,00	0	502250,00	100	502250,00	502250,00
10	Iiasa	AT	375271	28700	0	0	0	100992,75	0	504963,75	100	504963,75	504963,75

11	Knmi	NL	604704	89100	0	0	0	173451,00	0	867255,00	100	867255,00	867255,00
12	Smhi	SE	652800	64000	0	0	0	179200,00	0	896000,00	100	896000,00	896000,00
13	Uedin	UK	195554	12150	0	0	0	51926,00	0	259630,00	100	259630,00	259630,00
14	Uoxf	UK	401382	69531	0	0	0	117728,25	0	588641,25	100	588641,25	588641,25
15	Ucph	DK	215022	55500	0	0	0	67630,50	0	338152,50	100	338152,50	338152,50
16	Stichting Netherlands Escience	NL	373500	63000	0	0	0	109125,00	0	545625,00	100	545625,00	545625,00
	Total		9442762	913970	53600	0	0	2589183,00	0	12999515,00		12999515,00	12999515,00

Proposal ID **776613** *Acronym* **EUCP**

4 - Ethics issues table

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	○ Yes ◉ No	
5. ANIMALS		**Page**
Does your research involve animals?	○ Yes ◉ No	
6. THIRD COUNTRIES		**Page**
In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	○ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	○ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	○ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	○ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ◉ No	

Proposal ID **776613** *Acronym* **EUCP**

7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	○ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	○ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	○ Yes ◉ No	
8. DUAL USE		**Page**
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	○ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		**Page**
Could your research raise concerns regarding the exclusive focus on civil applications?	○ Yes ◉ No	
10. MISUSE		**Page**
Does your research have the potential for misuse of research results?	○ Yes ◉ No	
11. OTHER ETHICS ISSUES		**Page**
Are there any other ethics issues that should be taken into consideration? Please specify	○ Yes ◉ No	

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

Proposal ID **776613** *Acronym* **EUCP**

5 - Call specific questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

Title of Proposal: **EU**ropean **C**limate **P**rediction system

Proposal Acronym: EUCP

H2020 Call: H2020-SC5-02-2017

Proposal id: SEP-210403392

List of participants

Participant No	Participant organisation name	Country
1 (Coordinator)	Met Office (Met Office)	United Kingdom (UK)
2	Barcelona Supercomputing Center – Centro Nacional de Supercomputacion (BSC)	Spain (ES)
3	Centre National de la Recherche Scientifique (CNRS/IPSL and CNRS/CNRM)	France (FR)
4	Stichting Deltares (Deltares)	Netherlands (NL)
5	Danmarks Meteorologiske Institut (DMI)	Denmark (DK)
6	Eidgenoessische Technische Hochschule Zürich (ETH Zürich)	Switzerland (CH)
7	Helmholtz-Zentrum Geesthacht – Zentrum für Material – und Küstenforschung GmbH (HZG)	Germany (DE)
8	Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC)	Italy (IT)
9	United Nations Educational, Scientific and Cultural Organization - UNESCO (UNESCO ICTP)	France (FR)
10	Internationales Institut Für Angewandte Systemanalyse (IIASA)	Austria (AT)
11	Koninklijk Nederlands Meteorologisch Instituut (KNMI)	Netherlands (NL)
12	Sveriges Meteorolgiska Och Hydrologiska Institut (SMHI)	Sweden (SE)
13	The University of Edinburgh (UEDIN)	United Kingdom (UK)
14	The Chancellor, Masters and Scholars of the University of Oxford (UOXF)	United Kingdom (UK)
15	Kobenhavns Universitet (UCPH)	Denmark (DK)
16	Stichting Netherlands EScience Center (NLeSC)	Netherlands (NL)

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1. EXCELLENCE

European Climate Prediction system: producing actionable climate information for risk-based planning

Key definitions: "climate predictions" are based on simulations of the future that are initiated from the present day state of the climate and can extend out to several years in the future (typically a decade or less). "Climate projections" simulate the longer term response to a scenario of changes in greenhouse gas and other radiative forcings, and typically are not started from the current state of the climate system. Here we make use of these terms to refer to these two different sources of climate data. Where the term "European climate prediction" is used it covers both predictions and projections, and our project will develop methods to stitch/blend these timescales seamlessly.

1.1 Objectives

The climate is clearly changing and society is confronted with extreme weather phenomena and climate-related hazards that it is often ill-prepared for, despite efforts to anticipate and mitigate against adverse effects. **The overarching objective of the European Climate Prediction (EUCP) system is to develop an innovative European regional ensemble climate prediction system based on a new generation of improved and typically higher-resolution climate models, covering timescales from seasons to decades initialised with observations, and designed to support practical and strategic climate adaptation and mitigation decision-taking on local, national and global scales.**

EUCP will link current observed climate conditions, near future predictions and more distant future projections out to 40 years ahead. Such a climate prediction system and framework are currently lacking. It will provide an authoritative framework to assess the impacts and risks of variations in climatic conditions across, but not limited to, Europe from regional to local scale suitable for use in a range of sectoral applications as a solid basis for investment decisions, spatial planning, and policy and adaptation options.

EUCP will produce credible probabilistic statements on near future (less than 10 years) high impact extreme events that bear their origin in the current state of the system and its expected evolution. This is needed for risk based planning and decision making. It will also provide robust information of the envelope of the potential occurrence of these events further into the future (to 40 years), tailored to enhance the resilience of vulnerable sectors in our society. It will therefore satisfy users of probability distributions and those requiring plausible realisations of future climate. It will provide clear guidance on how these can be exploited together. This will add significant extra value to raw climate observations and model simulations.

Past observations, and future predictions and projections will be integrated components in a seamless climate prediction system. The system will harvest from the wealth of existing and planned predictions and projections at the global and regional scale, and create tools to combine the information derived from these components into impact-relevant analyses. It will address the many barriers to providing seamless forecasts, such as the strong initialisation shocks, the need for corrections to match observed variability and increase forecast reliability in the nearer term, and the use of constraints to bound uncertainty in the longer term.

The system and methodologies to be developed will be sustainable. As newer experiments with climate models become available they can be included in the EUCP framework to incorporate their benefits for decision making. The evolving experience with tailoring climate information to better serve user needs will be continuously integrated into the EUCP system. This represents a step change in how we make use of, for instance, future Intergovernmental Panel on Climate Change (IPCC) assessments.

The top-level objectives of the project are as follows (the work packages (WPs) addressing each objective are listed in parenthesis):

1. Develop an ensemble climate prediction system based on high-resolution climate models for the European region for the near-term (~1-40 years), including improved methods used to characterise uncertainty in climate predictions, regional downscaling, and evaluation against observations [WP1, WP2, WP3, WP5]
2. Use the climate prediction system to produce consistent, authoritative and actionable climate information [WP1, WP2, WP3, WP4, WP5, WP6]. This information will be co-designed with users to constitute a robust foundation for Europe-wide climate service activities to support regional, national and local climate-related risk assessments and climate change adaptation programmes
3. Demonstrate the value of this climate prediction system through high impact extreme weather events in the near past and near future (1-40 years) drawing on convection permitting regional climate models translated into risk information for, and more importantly with, targeted end users [WP3, WP4, WP5, WP6]
4. Develop, and publish, methodologies, good practice and guidance for producing and using EUCP's authoritative climate predictions for 1-40 year timescales [WP1, WP2, WP3, WP4, WP5, WP6]

1.2 Relation to the work programme

EUCP relates to work programme topic "SC5-02-2017: Integrated European regional modelling and climate prediction system" and fully addresses the specific challenge and scope within this call as follows, linking to the top-level objectives listed in Section 1.1, and the WPs and their associated Objectives, Tasks and Deliverables described in more detail in Section 3.1.

There are four elements to the **Specific Challenge** in topic SC5-02-2017:

1. *To develop and provide access to a consistent and authoritative Europe-wide set of climate simulations at high resolution upon which regional, national and local climate-related risk assessments and climate change adaptation programmes and businesses can be built upon by European decision makers and businesses*.
EUCP will do this through all four of its top-level objectives, in particular through the activities in WP1 to assess and provide initialised climate predictions from ~1 up to ~10 years, in WP2 to provide probability distributions and future climate scenarios and extreme weather event sets further out (to 40+ years), WP3 to downscale climate simulations to local scales and WP5 to synthesise the information to provide seamless predictions on the ~1 to 40 year timescale. WP4 will provide real world demonstration projects and WP6 will work with a range of users to tailor and co-develop the outputs to maximise usability across sectors.

2. T*o develop, integrated multi-model ensemble climate predictions at European scale which can provide actionable climate information and assessments*.

EUCP will do this through all four of its top-level objectives, in particular through the activities as described above in WPs 1, 2, 3 and 5, but also in WP4 to provide a set of demonstration applications highlighting how the climate variability and climate change information on different time and space scales can be applied to user relevant decision making. Again, WP6 will make the lessons learned from the demonstrators applicable to a wider range of users.

3. *The integrated climate prediction system will go hand in hand with coordinated regional modelling and observational studies to constitute a robust foundation for Europe-wide climate service activities*.

EUCP will do this through the activities and links between WPs1, 2, 3 and 5 where the integration of the different climate prediction and projection systems will be forged and coordinated with regional climate modelling and observations, and then link with the demonstrators and user engagement in WPs 4 and 6 to ensure a robust foundation for European climate service activities. Estimates of observed trends and the systematic consideration of observational uncertainty are integral parts of the work plan and EUCP system.

4. *It will be based on user requirements and provide trustworthy and easily accessible climate information which can be utilised across Europe and beyond*.

EUCP will do this through top-level objectives 2 and 3, and the activities of WP6, a work package dedicated to ensuring user requirements and co-development are the basis for the work in the other WPs, particularly in WP4 and WP5 to work with users taking the information from different time and spatial scales and synthesising it into information that can be used for a range of user applications.

In addition to the points made above, our work programme addresses the nine further elements listed in the **Scope** in topic SC5-02-2017, some of which reiterate parts of the Specific Challenge, as follows:

a. *The main research objective is to develop an innovative European regional ensemble climate prediction system based on a new generation of high-resolution climate models, covering timescales from seasons to decades initialised with observations.* EUCP will do this through top-level objective 1, and the activities in WPs 1, 2, 3 and 5, providing information with seasonal time resolution. For the first time, the challenge of continuity of the climate information across time scales will be addressed (WP5).

b. The a*ction should conduct a series of multi-method and multi-model experiments in order to better capture uncertainties, and provide user-centred and demand-driven information which addresses user needs at various levels*. EUCP will do this through all of its top-level objectives, and activities in all WPs, particularly WP1 to develop a new multi-model near term prediction system, WP2 to better capture uncertainties, and WPs4 and 6 providing user-centred and demand-driven information. Methods will be compared and guidance given on optimum choice for particular applications.

c. *The system will focus on near term (~1-40 years) predictions, which is the time span most relevant for many decisions of businesses and public authorities for infrastructure and other planning*. EUCP will do this through top-level objective 1 and the activities in WPs1, 2, 3 and 5. Given the different sources of climate data relevant to a time horizon of 40+ years, WP5's ambitious goal of merging the simulations across time scales represents a groundbreaking effort to address a long-standing challenge in the community.

d. T*he regional downscaling programme, an integral part of the multi-model ensemble prediction system, will target Europe at the best technically achievable spatial resolution*. As noted in the Specific Challenge 3, EUCP will do this through the activities in WPs 3, 4 and 5 using very high spatial resolution.

e. *Methodologies will be transferable to other geographical areas*. EUCP will do this through top-level objective 4 and the research findings from WPs1-6, publishing methodologies, good practice and guidance which can be used outside of Europe. EUCP will promote its findings at international meetings, and will engage outside of Europe through the World Meteorological Organization (WMO), World Climate Research Programme (WCRP) and Coupled Model Intercomparison Project (CMIP). Strong links with the Copernicus Climate Change Services (C3S) will be established, building on the work being undertaken in the C3S Roadmap for European Climate Projections, coordinated by the Met Office. C3S intends to develop an operational service with reach beyond Europe, and EUCP will provide essential methodologies for such an operational service. This will create a direct link between Research and Technological Developments investments in Horizon 2020 with operational services in other parts of the European Commission (EC).

f. *Evaluation of model results against observations is essential*. EUCP will do this through top-level objective 1, using observations and their uncertainty estimates to evaluate model results in WPs1-5 and also use them as constraints on future climate.

g. *Climate model data will be widely disseminated, and will be easily accessible and available in line with C3S specifications*. EUCP will do this through the activities of WP6 which has specific tasks to assess what climate model data will be useful and to ensure it is made available and in line with C3S specifications.

h. *Strong engagement with stakeholders and climate information end-users, including public sector policy-makers, business organisations and customers representing specific market sectors is essential*. EUCP will do this through top-level objectives 2-4, and WPs 4 and 6 which have stakeholder engagement and co-development as core activities, including public sector policy-makers, businesses and customers representing specific market sectors.

i. *In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged, in particular with countries having developed similar systems and with countries wishing to develop capacities*. While there are no similar systems to EUCP because it is so innovative and ground-breaking, WPs1, 2, 3 and 5 will actively cooperate with international activities which are linked to some parts of our prediction system (e.g., WCRP, CMIP, and the Commission for Basic Systems of the WMO), and with other countries that have some experience with similar systems. WP6 also has tasks to develop collaboration strategies which will build the necessary international cooperation, exploiting the unique set of links that the partners bring to EUCP.

1.3 Concept and methodology

1.3.1 Concept

The aim of EUCP is to develop and demonstrate a climate prediction/projection system to inform and underpin decision making on the 1 to 40 year, time horizon. It will make use of the best available information, in the face of uncertainty, on how the climate system is likely to respond to projected future emissions resulting from socio-economic changes, and how the predictions and projections can be constrained by initial-condition information. Depending on the user requirements, the climate data provided will range from individual plausible realisations or exemplars, to full probabilistic prediction and projection of future change. In doing so, EUCP will address needs identified in a number of previous dedicated surveys of user requirements for climate services to be as seamless as possible, but actionable at the local scale (e.g., Bruno Soares & Dessai, 2016 from the Framework Programme 7 (FP7) EUPORIAS project). This will allow users of climate information to look across different time-scales without worrying about the underlying modelling approach (See *Figure 1.3.1* below).

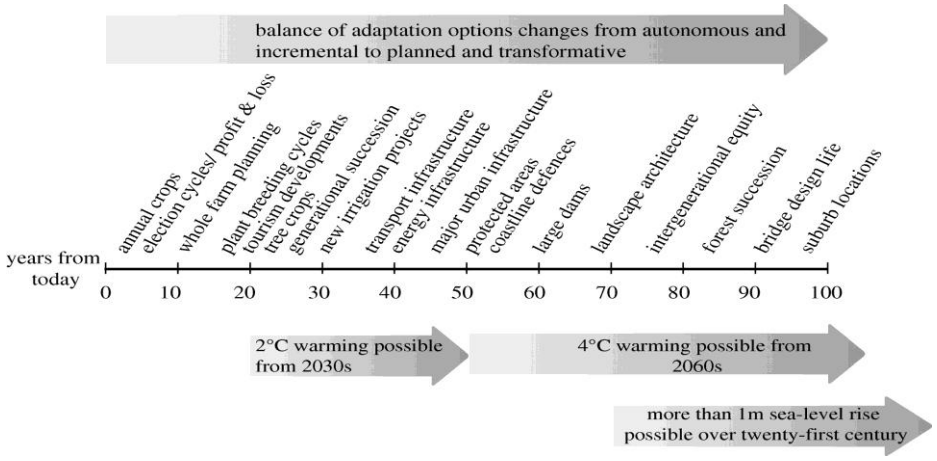


Figure 1.3.1: Illustrating lead time plus consequence times of different types of decisions, compared with time-scale of major climate changes

From a scientific point, the separation between short-term initialised and long-term non-initialised simulations is somewhat artificial. For example, non-initialised projections can show significant skill for decadal global climate change (Lee et al, 2006), or significant skill in predicting changes in heatwave metrics even within the first decade, while initialised forecasts show only little added skill (Hanlon et al., 2013, 2015). On the other hand, for other metrics, such as Atlantic hurricane frequencies and North Atlantic ocean state, initial conditions hold long-term advantages compared to non-initialised simulations (Smith et al., 2010; Garcia-Serrano, 2015). Merging the timescales poses scientific and practical challenges, which we will address in this project. For example, in Kirtman et al. (2013), projections started from the recent hiatus period required corrections of the near-term, something that was not required by the long-term forecasts (Doblas-Reyes et al., 2013). Developing new methodologies to merge predictions from initialised and non-initialised global climate simulations into one seamless product will be a major focus of EUCP.

The approach in EUCP is to make use of existing global and regional climate model simulations in novel ways in order to understand the risk of near-term (typically 1 up to 10 years) and longer term (out to 40 years) climate change. The focus will be on climate diagnostics that are of most societal relevance, including changes in future weather extremes (influencing flooding and drought). New research in EUCP will lead to a better understanding of future weather and climate change by a much more extensive use of observations in constraining the range of plausible simulations, and enhance the physical understanding of extreme events by supplementing existing experiments with new simulations capable of partially resolving convective processes. The fine spatial scales required to do this go beyond existing climate model tools. The merging of these different sources of information across timescales and spatial scales in EUCP will make extracting the useful information from the model simulations easier and produce an original and innovative approach that is much better suited to users of climate information of timescales from 1 to 40 years.

An important part of EUCP is to provide clear demonstrations of how the climate information can be carried through to impact modelling, including taking account of both climate and non-climate drivers (Mehta et al., 2013). This can only be achieved with adequate user knowledge and interaction, enabling co-development of

the approaches and guidance we produce. It is our aim to build on the lessons of earlier work by utilising two panels of user representatives and engaging a smaller number of super-users. The first panel will focus on high level derived messages and policy advice, and the second panel on technical based practitioners consisting of consultancies, academics and utility providers (such as water supply companies) who typically use climate data as input to sector specific models. Such an approach has recently been trialled in the UK and is standard practice in the Netherlands, and the level of engagement is found to be high. In the future we expect the second of these groups to include climate service providers, often providing services for the types of user in the first group. In addition a small number of super-users (e.g. the Joint Research Centre, JRC) will work directly with the project to provide demonstrators of using the new information for real world adaptation and planning decisions. Within the user groups, members will be encouraged and supported to produce their own additional applications. E-science approaches will be applied to deliver the data in the most appropriate manner.

1.3.1.1 Positioning of the project

EUCP covers a spectrum of innovation, ranging from (i) scientific insight and ideas (e.g. researching how to apply multiple climate constraints together; and (ii) how to develop a combined uncertainty quantification/pdf across time-scales) through to (iii) the delivery of a system for applying future climate predictions and projections to societal problems out to 40+ years on the European scale. It will provide guidance on how this may be maintained if adopted later as an operational service component, for example under C3S. It also will produce real-world applications as demonstrators of its usefulness. The extended user group will ensure co-development using input from potential users is central to the concept, and a by-product will be the increase in awareness of techniques available to this group to build a climate resilient future. At the completion of the project it will be possible for C3S, or other relevant programmes, to take the research and innovation-led approach from EUCP and transfer the methodologies and system to an operational service. We will be able to discuss this with C3S in the latter stages of EUCP to agree next steps. This will build on the work being undertaken in the C3S Roadmap for European Climate Projections project which will be closely linked to EUCP.

The project is expected to reach Technology Readiness Level (TRL) 2 to 4 in the early stages of the project and then, through the demonstrators and interaction with relevant users to reach TRL 5 and 6, where the technology has been demonstrated in relevant environments (industrially relevant environment in the case of key enabling technologies). EUCP will: (i) support and implement key elements of the European Roadmap for Climate Services across TRL 2 to 6; (ii) be able to be offered as a significant evolution to parts of C3S; and (iii) complement and support national climate services (both at TRL 7-9).

1.3.1.2 Links to national and international research and innovation activities

The consortium members have strong links to national and international research and innovation activities, and these links will be drawn upon to ensure the project successfully undertakes its tasks, and new links will be developed. Some key examples are listed here.

<u>International Programmes:</u>

- Global climate model simulations from CMIP (CMIP5 and CMIP6) will be directly used in EUCP, in particular simulations from the DECK, HighResMIP, ScenarioMIP and Decadal Climate Prediction Project (DCPP).
- EUCP's advances in decadal predictability will draw on WMO's coordination of operational decadal predictions, and EUCP consortium members will be providing coordination to the WMO's collation and dissemination of operational decadal prediction.
- The project will form important links to C3S including aligning European climate prediction planning via the C3S development of a Roadmap for European Climate Projections. Coordination with the C3S-MAGIC project will provide an interface to access available global climate projections via the C3S Climate Data Store (CDS).
- EUCP will draw on regional climate simulations from the European branch of the COrdinated Regional climate Downscaling Experiment (EURO-CORDEX).
- EUCP will make strong links with active observational efforts to facilitate model verification, benchmarking, evaluation and constraints on future spread. This will include Observations for Model Intercomparison Projects (Obs4MIPs), who facilitate NASA satellite records (such as the International Satellite Cloud Climatology Project (ISCCP) cloud data for emergent constraints in WP2) and ESA's Climate Change Initiative (CCI).

- EUCP will establish a strong clustering activity with projects funded under FP7 and Horizon 2020 Societal Challenge 5 (SC5) (including IMPREX, PRIMAVERA, CRESCENDO); relevant projects funded under other parts of Horizon 2020 (such as ESiWACE in e-infrastructures, and projects funded under the Blue Growth topics); and relevant projects funded by the Belmont Forum and Joint Programming Initiative (JPI) Climate calls. EUCP will benefit from active involvement in the Horizon 2020 Climateurope Coordination and Support Action (CSA) that is creating a network of such projects and is coordinated by the Met Office.
- As strong engagement with stakeholders and climate information end-users within Europe is central to the success of this project, linking with European climate information user-requirement activities will be essential. The project will draw on outcomes of projects with a user interaction and dissemination focus, such as FP7 EUPORIAS and CLIP-C, the Climate-KIC, and the current C3S Sector Information Service (SIS) projects, such as SECTEUR.
- EUCP will benefit from and contribute to at least two of WCRP's Grand Challenges: *Near-term Climate Prediction* and *Understanding and Predicting Weather and Climate Extremes*.

National Activities:

It is essential that EUCP aligns with the existing national climate projection programmes of European countries, not only to ensure coordination, but also to build upon scientific and stakeholder engagement approaches developed, and important lessons learnt. These include:

- A strong link to the UKCP18 project in the UK, which is part of the Met Office Hadley Centre Climate Programme, funded by UK Government, to provide national climate projections for the UK to a range of stakeholders. The research and innovation taking place in UKCP18 will directly feed into the methodologies being developed in EUCP. There will also be a link to activities within the UK's National Environment Research Council (NERC), including the ACSIS project which will deal with North Atlantic variability, directly relevant to European climate predictions.
- In the Netherlands the preparations for a next release of the KNMI climate change scenarios planned to take place in 2021, will benefit from EUCP, and vice versa. Methods used in generation of the previous climate scenarios for the Netherlands will be further developed in EUCP. It grants access to a large collection of global and regional climate model products, with an emphasis on user-readiness. Several consultancy firms, who in the past have made use of KNMI-scenario outputs, have supplied support letters to EUCP (see Appendix 2), illustrating their confidence that an authoritative EUCP will supply information that is needed for their advice work for clients.
- The latest French national report on climate change and associated web portal of the national climate service (DRIAS, http://www.drias-climat.fr/) are based on high-resolution CMIP5-based EURO-CORDEX downscaled projections, and the French approach will inform EUCP developments.
- In Switzerland, the generation of climate scenarios CH2018 is currently being developed based on the EURO-CORDEX simulations. EUCP will benefit from the model evaluation, downscaling and uncertainty quantification tools developed in this effort, as well as the experience with end users.
- While not in Europe, the recent Australian Climate Future programme has placed more emphasis than others on identifying levels of confidence that could be placed on climate projections, depending on the location and impact. EUCP will consider the lessons from these efforts.
- Finally, the case of Denmark (which is illustrative of most other European countries) is that there is increasing demand for climate change information that can better portray plausible climate change within the coming ~40 years. Pressure on authorities, such as DMI, will increase to provide scientifically sound assessments for the near-term climate, and their experiences will benefit EUCP.

1.3.2 Methodology

EUCP will provide authoritative, consistent and actionable climate information and new methods to sustainably incorporate new simulations from the global community as they become available. The research and outputs will inform future operational climate services for users needing scenarios for climate risk assessment. The project's methodology and WP structure are illustrated in section 3.1 and summarised here.

1.3.2.1 WP 1: Development of an interannual-to-decadal climate forecast system

This WP will focus on the skill arising from initialised predictions. These require accurate information about the contemporaneous state of the climate system and robust estimates of their quality. This makes them slightly more complex than other climate simulations because, for instance, they require sets of hindcasts

(forecasts for the past performed with the same system), need an ensemble initialisation procedure to represent observational uncertainty and rely strongly on the homogeneity in time of the observing system.

The main outputs from this WP will be the underlying prediction data and detailed guidance notes on their skill and usage to be provided for end users. The WP will collate interannual-to-decadal predictions from the global operational centres and data from CMIP5 and CMIP6. The guidance will draw on multiple sources, with input from WP4 and WP6 on user requirements (see below). A central aim is the development of new forecast verification tools and common case studies that will provide a new international standard to assess prediction systems. There will be an assessment of their skill at capturing climate modes of variability (such as the Atlantic Multidecadal Variability (AMV), Arctic sea ice, Interdecadal Pacific Oscillation (IPO), Arctic Oscillation (AO)), and their links to European impacts (including the ability to simulate unprecedented and extreme events). They will consider both intraseasonal and interannual events as well as trends (for instance in temperature and precipitation). The assessment of forecast quality (both skill and reliability) will examine a range of temporal (interannual to decadal) and spatial (local to global) scales according to well-identified user requests. Common verification tools enable the impact of different approaches to the ensemble initialisation (full field and anomaly initialisation, optimal perturbations), ensemble sizes (and their impact on reliability of different key variables) to be assessed. The correspondence between skill and ensemble spread will be analysed and the impact of the initialisation choices will be estimated.

Beyond these products, the WP will seek to improve the decadal climate predictions over land areas, with a focus on the Euro-Mediterranean region, using information from the observed teleconnections of the main modes of ocean variability that are skillfully predicted, like the AMV, and the multi-model predictions of these modes. A key new climate product will be an aggregating multi-model approach, and the methods (mainly Bayesian), to better characterise the uncertainty in the formulated predictions. The relative merits of weighted multi-models using methodologies, traditionally in either medium-range or seasonal forecasting, will be tested. The WP will also look towards future modelling systems and explore strategies to improve the climate information provided to users. These will include upgrading climate forecast systems to ~25 km resolution, following the recent developments in high-resolution global modelling (e.g., Horizon 2020 PRIMAVERA), and improved data assimilation (coupled initialisation). Computational expense will be minimised by running only selected case studies (e.g. the mid-1990s Atlantic warming).

Our project will have particular impact because it delivers outputs not only with European partners but a broad group of international collaborators, via the WMO who will be sub-contractors for their support in delivering a set of good practice guidance rules and standards for decadal prediction including international verification standards, and designing and issuing real-time annual-to-decadal outlooks each year with the WCRP Grand Challenge on Near Term Climate Prediction which is co-chaired by the Met Office. The WP will coordinate part of the European contribution to the Decadal Climate Prediction Project, a CMIP6-endorsed project to provide initialised climate predictions. The co-chair of this MIP is also a participant.

1.3.2.2 WP2 - Producing uncertainty quantifications/PDFs and realisations of future climate on time-scales beyond 10 years

This WP aims to improve the methods used to characterise uncertainty in future projections of climate change and variability, and to develop and test methods to provide new realisations of climate within the envelope of uncertainty. The outputs will be suitable for risk based decision making.

This part of the work package will draw climate data in from several existing and planned climate model experiments, including: CMIP5, CMIP6 (including HiRESMIP, LUMIP, AirchemMIP and C4MIP), Cordex ensembles, Perturbed Physics Ensembles (PPE - such as CDPN and UKCP18 ensembles), and ensembles with perturbed initiation conditions (which can be used to quantify the natural variations of the climate system and changes in risks of very rare extremes). The first task will focus on constraints on future climate, by considering climate model performance against a much wider range of observed changes. Many techniques have been proposed in the literature to better constrain future projections, for instance by Sherwood et al. (2014), Qu and Hall (2014), Boé and Terray (2014) and Grose et al. (2017) and literature focusing on targeted observations of key climate processes (e.g. Bellenger et al. 2014). A further category of constraints is based on observed climate change, and are often derived from detection and attribution studies (see e.g., the ASK method, Stott et al 2006). Precipitation sensitivity (% change per degree warming) also provides a potentially useful constraint on large-scale precipitation changes (see Polson et al., 2016), but may

also be used on a regional level for extreme precipitation (Lenderink and Attema, 2015). Advances will come from assessing the relevance of the proposed constraints, and combining together (a possibly large number of) different constraints.

The second task will focus on combining multiple strands of climate information into a quantification of uncertainty (UQ) or, when appropriate, a probability distribution function (PDF). The strands of information include model simulations, observations, and understanding of constraints (from the first task in this WP) and the physical behaviour of the climate system. We will apply several of these methods in a single study in order to understand their pros and cons in a practical application and their interactions. The approach will be to apply the constraints to the model datasets and where appropriate extended emulated distributions derived from the model datasets. An important aspect will focus on overcoming the scientific challenges of making practical use of these ensembles on the European scale, including the various degrees of interdependency between models where recent techniques will be applied to account for this (e.g., Knutti et al. 2013, Sanderson et al., 2015a/b, Knutti et al. 2017). The UQs/PDFs will account for model uncertainty and internal variability, building on work, for instance, by Sexton and Harris (2015). From a climate and statistics point of view, the limits of providing robust probabilistic information will be evaluated (e.g., Frigg et al. 2015).

The final element of this WP will evaluate a range of different methods for generating ensembles of realisations of future climate and future weather that are consistent with the UQs/PDFs from the previous task. The approach will include providing realisations by sub-selecting from the available EURO-CORDEX and CMIP6 simulations. Methods based on clustering of the modelling results will be further developed to provide an optimal sub-selection that spans most of the uncertainty in the determined PDFs from this WP. Sanderson et al. (2015a/b) provide methods that will be tested for EURO-CORDEX and CMIP6, and alternative methods are being developed. Sampling from initial perturbed ensembles is particularly suitable for selecting very rare events in the tails of the distribution, such as a 2003 European heatwave event. This element of the WP will also provide a set of transient realisations using a perturbed physics ensemble (as applied in the UKCIP09/18 projects). In addition, climate model simulations using sea surface temperature (SST) perturbations will be used from FP7 HELIX project and Horizon 2020 PRIMAVERA.

1.3.2.3 WP3 - Demonstrator of high impact weather in a changing climate on regional and local scales

The WP will provide a demonstration of the value of using innovative high resolution atmospheric simulations (with a spatial resolution of 1.5 to 3km) that are able to permit explicit representation of convection (CP-RCMs, Prein et al. 2015). These offer the potential to improve the simulation of some types of extreme weather, such as very intense convection (Kendon et al. 2014), and offer access to a higher temporal frequency of model data. Different versions of seven CP-RCMS are used:

- RegCM4-NH run by ICTP
- HARMONIE run by SMHI, DMI, KNMI
- REMO run by HZG
- UKMO-RCM run by the UK Met Office
- WRF-ORCHIDEE run by CNRS/IPSL
- AROME run by CNRS/CNRM
- COSMO-CLM run by ETH and CMCC

Two approaches will be followed. In the first, we will use the CP-RCMs for continuous General Circulation Model (GCM)-driven multi-decadal simulations over a common domain covering the pan-Alpine region. This region is affected by a wide range of extreme climate phenomena, including summer thunderstorms, Mediterranean heavy precipitation, Alpine snow cover, strong storm. This is also a suitable domain because several CP-RCMs have been tested over different Alpine sub-domains and because it is the focus region of a CP-RCM CORDEX Flagship Pilot Study (FPS), and hence EUCP will benefit from a strong synergy with this FPS. The CP-RCMs will be run for continuous decadal or multidecadal time-slices over the domain. Outputs from the historic period will be assessed and compared against high resolution observations for the region (Isotta et al. 2014). The second set of experiments will follow an event-based approach for the pan-European region. Different types of high impact extreme meteorological events of relevance for different European regions will be identified in coarser model simulations, such as the global models in WP2 or regional model experiments completed as part of the EURO-CORDEX and C3S programmes. The very high resolution CP-RCMs will then be applied to simulate these events. A goal of this task will be the design of an optimal matrix of GCM/RCM/Scenario experiments to cover the different sources of uncertainty affecting the prediction of extreme events. This will be deployed in the initial stages of the work.

Building on previous projects (e.g., FP7 EURO4M, CORDEX, COST action GNSS4SWEC) available high temporal and spatial resolution observation datasets for different European regions will be assembled for an in-depth validation of the models, and this dataset will be made available to the scientific community for further use. WP3 will assess changes in structure, characteristics and frequency of high impact events in response to global warming over the next decades and investigate relevant underlying processes. Techniques such as surrogate climate change scenario will be considered to assess the importance of different factors in determining the response of extreme events to warming. The major output will be a multi-model based portfolio of high impact events for both the Alpine focus sub-domain and the event-based approach at the pan-European level. The data will be post-processed to optimize its use in the risk-assessment applications of WP4, which may require the use of post-processing techniques such as bias-correction.

1.3.2.5 WP4 - user demonstration projects

WP4 will apply the European Climate Prediction System for a selection of end users (e.g., public sector policy makers, business organisations and other customers) and purveyors of downstream climate services drawn from user panels in WP6. Key inputs for this analysis are the climate projections of rainfall, wind, and other relevant variables provided as gridded time-series by WP2 and, at a higher spatial resolution, by WP3. Where possible the synthesis information from WP5 will also be used. The WP will work with WP6 to review existing stakeholder knowledge and to collect new information from the user panels.

Building on this knowledge several examples will then be explored in more detail and in collaboration with interested users translating predictions into actionable information. These will take driving data and information from WPs 1, 2, 3 and 5 as needed, with particular demands from WPs 2 and 3. These demonstration cases are likely to include:

- Urban *rainfall extremes* - using Delft3D-FM (Kernkamp et al., 2011) to produce current and future urban flood hazard maps based upon extremes estimated in WP3. The city of Rotterdam, which is part of the '100 resilient cities' challenge and for which long observational records are available, will be a suitable test city but the approach can be executed for other cities in Europe.
- *Pan-European scale coastal flooding and local scale high resolution erosion hazards and risks* - The Delft3D-FM global tide and surge model (Muis et al., 2016) will be applied, driven with time-varying wind fields, as well as WaveWatchIII for wave parameters. The higher resolution XBeach (Roelvink et al., 2009) surge and wave models will be used to obtain surge levels, storm erosion, overland flooding and wave hazards. The impact model FIAT (Wagenaar et al., 2016) will be used to calculate economic impacts. This task will collaborate with the JRC that has developed a European-wide model for coastal storm surge risk (Vousdoukas et al., 2016 a, b).
- *Communicating Pan-European scale hydrological extremes and risks* - Hereto hydrological extremes from the ensemble of climate predictions from WP3 will be derived. The focus will be on how to best utilise assessed hydrological impacts in climate risk management, information of value for climate adaptation. Relevant hazards will include decreasing surface and groundwater resources, drought and floods. This task will collaborate with the JRC.
- Wind impacts - The study will include the multiannual and multidecadal trend in surface winds, known as the "wind stilling" (Vautard et al., 2010). Additionally there will be new analysis of the changing risk of long calm winds, sometimes called "wind droughts", which induce significant lack of revenues for wind energy producers. In this case, ensemble of climate projections and decadal predictions from past, current and future climate produced in WP2 will be used, in combination with a Generalised Extreme Value theory at the regional scale, or even for a specific region or a set of wind farms locations.

The final component of this WP will be to consider the relative importance of climate and non-climate drivers. Non-climate drivers will use the socio-economic, population, and human water management data from the IIASA's Water Futures and Solutions Initiative (WFaS) (Wada et al., 2016). The scenarios are designed to be consistent with the community-developed Shared Socio-economic Pathways (SSPs).

1.3.2.4 WP5: Development of seamless evidence

The goal of this cross-cutting work package is to develop scientific methodologies to merge initialised predictions from the 1 up to 10 year time scale with non-initialised scenario projections out to 40+ years. *Figure 1.3.2* illustrates the overall task, of blending information from the two simulation approaches and shows the decreasing impact of the initial conditions over time and, simultaneously, the increasing relative importance of the boundary forcings during the course of the prediction.

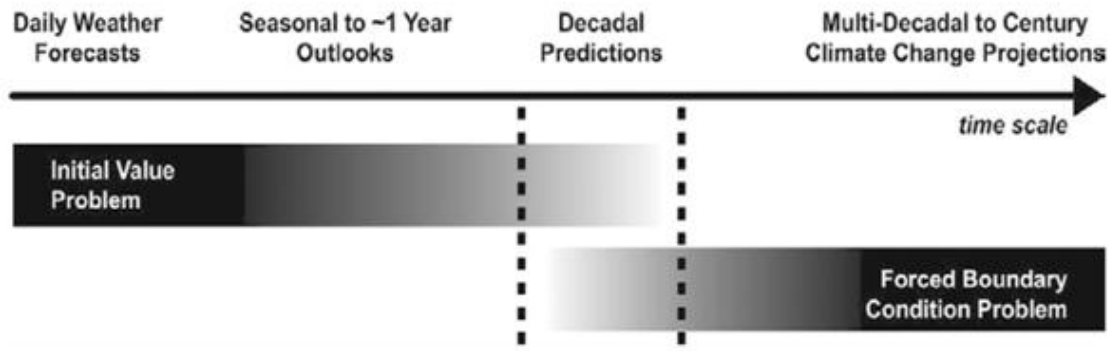


Figure 1.3.2: Schematic illustrating the relationship of decadal predictions as a combined initial and boundary value problem and climate change projections as a forced boundary condition problem (from Meehl et al., 2009)

The first component of this WP will focus on making seamless uncertainty quantifications and PDFs across time-scales. This will include developing a better understanding of the skill in initialised and non-initialised global projections for overlapping prediction time scales including estimation of the prediction time until which the initialised predictions add skill compared to the non-initialised predictions, for different variables, seasons and the European focus region, following e.g., Hanlon et al. (2013) but using a probabilistic metric. It will also provide an assessment of the evolution of the ensemble spread with forecast time in both initialised and non-initialised simulations and estimate whether the spread of the initialised predictions is adequate compared to the spread of the non-initialised projections. Using this information the WP will then explore and test a range of methodologies for generating multi-model seamless uncertainty quantifications and PDFs at the regional scale using global initialised and non-initialised simulations from WP1 and WP2, including answering key questions of the length of period of overlap and merging points in time.

The next component of the WP will focus on combining information on different spatial scales. Atmospheric variables where we expect added value from higher resolution include convective precipitation extremes, cold extremes in particular near land-sea borders and strong orography, local winds, and mean precipitation changes in areas with strong orography. The WP will estimate what fraction of the total uncertainty is contributed to by these regional simulations compared with the global model uncertainty and establish for which variables the regional models are successful in adding value. It will employ techniques to blend information from global climate models with results of regional climate models, many of which use a decomposition of the local response in the regional climate models into circulation and non-circulation components, and use information from global climate models (e.g. circulation changes) to inform blending.

The final component will take in initialised and non-initialised results and develop storylines and cases of plausible future weather consistent with the result of the combined forecasts across the full range of 1 to 40+ years by drawing on the ensemble members from WP1 and WP2. This will involve deriving new methods to construct small ensembles of realisations from the initialised simulations until the merge point in time. The approaches will include matching indices of the major modes of variability, especially those most relevant to the European region, from the two simulation periods, and compare power spectra of non-initialised simulation segments with those from the initialised runs in order to locate periods in the non-initialised runs that share common characteristics with the initialised forcing. The output will be combined time-series and event sets from the initialised and non-initialised simulations. A major theme in this work is the use of multiple strands of evidence to build a robustness statement, which will be provided to end users alongside projected changes of key climate variables. This task will address questions such as whether the projected changes are robust to the use of new observations in evaluating model performance, whether the processes driving the projected changes are understood, and whether models adequately resolve the processes.

1.3.2.6 WP6: Documentation, data exchange and integrating science with users

This WP will examine the user information and lessons learned from recent projects, Working closely with WP4 the first task will be to gather and review stakeholder analysis, interviews and surveys conducted within C3S projects (e.g. SIS, SECTEUR, QA4Seas, DECM) and ongoing Horizon 2020 projects (e.g., IMPREX,

BINGO, CLARA, EUMACS, MARCO, PRIMAVERA) to list and sort user needs for the EUCP service.

EUCP will create, and engage with, many users and stakeholders in order to ensure a co-designed approach throughout its activities. There are two main groups of user representations (these definitions will be consistently used throughout the proposal):

- Multi-user forum 1 – policy user groups: definition - Group of policy- and decision-makers that EUCP will engage with throughout the project. They will be at the national, European and international level. Examples include the EC, International bodies both governmental and non-governmental (e.g. Food and Agriculture Organization (FAO), United Nations, Red-Cross), and regional authorities (i.e., regional water authorities).
- Multi-user forum 2 – practitioner user groups: definition – Group of users from the business and academic sectors. Examples include consultancy companies, industrial companies including utilities, private and public companies from a wide range of sectors. National meteorological services will also be recognised through this group.

A select group of engaged end users of climate information who are already aware of some of their own climate exposure and wish to work with EUCP to develop applications will be identified as super users. They will be a subset of the practitioner user group, and will work with WP4 to develop the content for the set of demonstration applications. Example sectors include flooding, water management and renewable energy.

These multi-user forums will play a crucial role in co-designing the European Climate Prediction System. The WP will also be aligned with the priority areas of the Global Framework for Climate Services (GFCS) (water, energy, agriculture and food security, disaster risk reduction, health).

WP6 will act as a facilitator to ensure user connection to all of the other WPs (see *Figure 1.3.3* below). It will also lead on producing tailored guidance material for users and appropriate data and knowledge access tools. This WP will organise the data storage and curation activities.

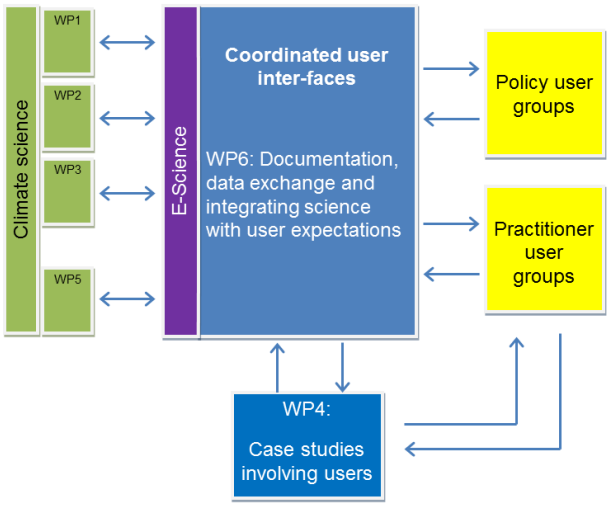


Figure 1.3.3: User interaction between the work packages (especially WPs 4 and 6)

1.3.2.7 Sex and/or Gender analysis

SC5-02-2017 does not have a gender dimension explicitly integrated into it. The EUCP consortium does recognise, however, the importance of considering whether sex and/or gender analysis can be taken account in the project's content. It also recognises its obligation under Horizon 2020 to promote gender equality, but notes the results will be gender neutral. Areas where the project may need to consider the gender dimension in more detail will be in the context of dissemination, exploitation, communication and engagement activities; in general, those activities where the project is in contact with groups external to the project. The project will consider how these activities can be designed to avoid gender bias or discrimination.

A Gender Strategy and Action Plan (Milestone 35, MS35) will be produced by Month 3 (M3) of the project, and will act as a living document, detailing how gender considerations will be managed within the project.

The Action Plan will be a way of bringing the EC's three top level strategies for gender equality into the project through a series of actionable activities and targets. For example:

- 'Gender balance in decision making': the consortium will be proactive in striving for gender balance amongst individuals who are on evaluation panels such as the External Expert Advisory Board. EUCP will encourage equality in the involvement in decision making processes within the project itself (i.e., decisions of the General Assembly). This will include the adoption of family friendly mechanisms for meetings.
- 'Gender balance in research teams at all levels': EUCP will aim for gender balanced participation in the consortium activities, taking into account the situation in the field of the project and complying with national and EU legislation concerning gender equality. Best-practice recruitment and working arrangements will be identified and promoted by all participants.
- 'Gender dimension in research and innovation content': EUCP will consider the mechanisms that it adopts when identifying the relevant parties for the Multi-user Forums and Super-users, thus ensuring that there is no gender bias in selection and in the fora where the relevant parties will network. Also, gender considerations can be highly relevant when communicating, so consideration will be given to the project's communication and dissemination activities, and the design of communication material; for example, avoiding stereotypes. There will be a focus on the external workshops organised through work packages 2, 3 and 5, ensuring that there is no accessibility bias.

Further information on this can be found in Section 3.2.12.

1.4 Ambition

1.4.1 State-of-the-art

There is widespread scientific consensus of a clear human impact on climate. Whilst Europe in many ways leads the field in incorporating information on likely future climate changes into planning and decision making, stark differences exist between different member states. In the latest European Economic Community (EEC) report on the status of climate adaptation, 27 EEC countries reported some form of formal assessment (with only Croatia and Slovenia not reporting). However, reporting in Climate-ADAPT indicates very large country to country differences in the development and application of climate adaptation information. In some countries climate adaptation advice has already entered routine planning and decision making processes (Füssel and Hilden, 2014). For example, in the UK government planning is underpinned by a statutory five yearly obligation to assess national exposure to climate change risks, and building regulations affected by river flow and flood risks account for the likely impacts of climate change. Swiss Federal bodies are obliged to consider decisions for optimistic and pessimistic climate scenarios. At the other end of this spectrum, climate change information is only just entering the decision making sphere for many countries. Romania, for example, reports only basic collection of adaptation options that fall considerably short of the guidelines on implementation and evaluation available in countries like Finland (Hanger et al, 2013). These country to country differences are compounded by different resources and capacities in accounting for and incorporating complex, diverse and uncertain climate change information.

The range of climate data (observations, climate projections and seasonal to decadal predictions) continues to increase. And yet inherent uncertainties, disparate and sometimes contradictory data sources and complexity represent real barriers for use in most decision making. National Climate Projections are developed as a way to synthesise currently available information into a form that can be used. Of the 27 countries in the EEA's report (*Adaptation in Europe*) who have reported Climate Change Impact Vulnerability and Risk assessments (CCIVs), top level National Adaptation Plans (NASs) and/or more detailed National Adaptation Action Plans (NAAPs), most draw on individual National Climate Projections of one form or another. However, current National Climate Projections across European states differ markedly in:

- Official status. Large differences exist between those that are officially recommended or mandated and those countries where national climate projections have no official recognition.
- Treatment of uncertainty. Uncertainties are inherent in climate projections (representing limitations of knowledge, fundamental uncertainties when dealing with any complex system, socio-economic scenarios, and uncertainties due to natural variations of the climate system). The treatment of these uncertainties varies between those that explicitly quantify the impact of uncertainty on projected changes, to those who acknowledge and discuss the sources of known uncertainties but provide little

guidance as to how decisions can include it. There is little consistency between countries in the data they draw on or the presentation (for example the Norwegian projections group socio-economic and climate uncertainties together, others separate them out). At their most comprehensive, climate projections quantify and account for the relative plausibility of various climate model simulations relative to observed climate and present the information in a probabilistic context.

- Spatial and temporal scales of projections. These range from a few key variables presented for large regional and multi-decadal averages to high resolution regional data (e.g., 25 km or river basin resolution, UKCP09).
- Presentation and data availability. These can range from regional average changes, to maps of changes; based on single models, multiple models or estimates of the probability distributions; for few variables to multivariate, multi-scale changes. Large differences also exist between whether the underlying climate model data is made available to end users, and how accessible this may be. For example, it is possible to access the underlying climate data that underpinned UKCP09; however, this is only accessible to highly skilled users. Most users are presented some form of higher level climate projection information.

Previous EU-funded projects such as FP5 PRUDENCE and FP6 ENSEMBLES provided some consolidation of information, producing simulations of global and European regional climate changes that provide common data that underpins projections in a number of member countries. Still, adaptation measures are currently considered against different climate future baselines, which may or may not account for different factors not only between countries but also within them (e.g. Climate Projections developed independently for Flanders and Walloon drew on different underlying projection data) or for different sectors (e.g., Flood Risk in Ireland – Bastola et al., 2011 - that based its findings on comprehensive but especially developed bespoke climate projections). One key factor to these country to country differences in European Climate Projections arises due to different capabilities and resources of individual member states. But other factors also play important roles. For example, the recent Dutch (KNMI'14), Swiss (CH2011), French (DRIAS) and UK (UKCP09) are four of the most well resourced of the recent climate projections yet the large differences in temporal and spatial scales, treatment of uncertainties (narrative vs probabilistic, and the level of separation between systematic changes due to changed (greenhouse) forcing and random changes due to natural variability of the climate system) and depth of information reflect both different internal drivers (Skelton et al, 2016) and targeting at different end users and perceptions of their requirements.

On shorter timescales, research, development and implementation cycles have seen rapid developments in near term (out to 10 year) climate prediction capabilities. And yet the diverse number of operational systems, insufficient knowledge of where initialised states add value, and the lack of detailed guidance on use and application have contributed to the lack of uptake of near term climate predictions in European decision making processes compared to that for longer term climate projections.

EUCP will advance the current state of the art in two significant and substantial ways. The first strand identifies actual improvements to the climate simulations, the prediction/projection systems and the tools via which these will be synthesised for end user requirements, to lead to better quality climate information that is actionable, to be available to European stakeholders. This will build on European strengths, both in terms of producing climate data and in synthesising and presenting this to end users. The second strand focuses on delivering the spatially and temporally coherent climate data across Europe, addressing the large existing inequality in data provision across member states and impact sectors. This will include both a range of climate products, drawing from the same consistent data, but also guidance on the robustness or not of climatic changes on a variable and regional scale.

1.4.2 Beyond State of the Art: advancements and benefits

1.4.2.1 Providing pan-European coherent climate predictions/projections across temporal and spatial scales

EUCP addresses the large differences in country capability when it comes to synthesising climate prediction and projection information, by developing a climate prediction system that provides consistent information on the range of spatial and temporal scales from ~1 to 40 years into the future across Europe. This will provide a baseline of climate change information that will address much of the current inequality and heterogeneity that underpins the current differences in country to country adaptation capability. Ensuring that all European decision makers will have access to consistent information, regardless of geographical location, is an important outcome.

Different user communities have very different user requirements for climate information. These range from requirements for information, such as summary statements of likely regional changes; through maps of regional and time averaged changes; access to high resolution realisations of how natural variability can combine with climate changes to produce future extremes and impacts; to emerging signals from near term predictability. EUCP will provide climate information across this range of user requirements. Importantly, it will do so in a coherent package so that different communities drawing on different components will be drawing on information which retains a consistent assessment based on the same underlying data. This will make EUCP a truly unique climate prediction/projection system in this regard, ensuring that the underlying climate information is harmonised for the range of sectors and decision makers has not previously been realised on this scale (and is a key aspect of addressing top-level objective 2).

1.4.2.2 Better Climate predictions/projections

EUCP outlines a number of approaches across initialised predictions (WP1) and longer term scenario projections (WP2) which are intended to improve current climate data beyond what current state of the art, in line with EUCP's top-level objective 1. The first major strand of this focuses on development of new simulation-observation comparisons. EUCP will develop new forecast verification tools, analysis and benchmarks for initialised near term prediction systems in WP1. This will provide an immediate benefit of new baseline information identifying where and when current systems have prediction skill over uninitialised simulations. It will do so in a common framework across prediction systems to enable, for the first time, the relative strengths of different systems to be assessed (both regionally and temporally). In doing so, this will provide the information on where the initialised predictions provide skill required to make them decision ready (this information will feed into the synthesis of climate data for end users, in WP5). There is a longer term benefit of the common implementation of these tools in that they provide an important basis to assess the benefits of new science changes as they are incorporated. EUCP will specifically advance the field by:

- Processing evaluation relevant to European impacts (capturing important teleconnections in models, focus on European relevant dynamics) in both WP1 and WP2
- Focussing on incorporating non-ocean drivers of decadal predictability
- Evaluating the benefits to predictability of stepping up to 25km spatial resolution
- Assessing the improvements from incorporating perturbed physics and stochastic physics schemes

On longer timescales, EUCP will explore multiple approaches to quantify the spread in future changes (for example contrasting constraints from Detection and Attribution approaches to more traditional probability weighting) so that the results can more reliably be used for risk based decision making. EUCP outlines new approaches to provide future realisations that sample ways that natural variability and climate change can combine (WP2). This will provide realisations that are specifically designed to span the magnitude of future changes considered plausible. This will support analysis of impacts and extremes coherent across regions and time by providing an extended "event set" to assess the impact of future extreme events on Europe. Data in this form is necessary for downstream impact models (such as flood forecasting tools). The event sets will include information from state of the art convection permitting regional models (WP3) which will be used to meet EUCP's top-level objective 3.

1.4.2.3 Management of uncertainty and quantification of risks in climate assessments

A core component of EUCP is the quantification and treatment of uncertainty in the information provided in order to improve estimates of risk, in line with top-level objective 2. The climate data will draw on a wider range of assessments of skill (WP1&WP2), utilise methods that give more weight to models which have demonstrated stronger skill (WP1, WP2), assess the robustness of projected changes in high resolution regional climate models capable of resolving convective processes (WP3), contrast information from different methodologies and projection/prediction systems (WP1&2) and provide consistency of these various sources (WP5). The synthesis will provide quantitative estimates of the range of future climate consistent with natural variations in European climate and uncertainties in the magnitude of climate changes. The knowledge will be expressed in a layered manner from high level statements of regional change to provision of data, for instance for use by impact models, such as flood modelling requiring individual realisations of how climate variability and change can combine. Emerging signals provided by the near term climate predictions will be presented within this context from the longer term changes, with EUCP focusing on how to merge the prediction/projections to be consistent across these time horizons. EUCP will provide consistent information in the form of distributions of future risk and realisation of future weather and climate.

A second core component is the detailed guidance notes that will be developed on the use of the global

outlook data from the initialised operational systems for near term predictions. This will draw on new benchmarking and skill verification tools that will form new international standards to assess skill and added value. These guidance notes will draw on best-practice co-development and communication approaches to address the current user focused information shortfall in climate information.

1.4.2.4 Context within non-Climate drivers of change

One of the key limitations in the use of current National Climate Projections (regardless of their sophistication, delivery, end user engagement and underlying attention to detail) is the lack of recognition of the non-climate factors that also play roles in many of the planning and adaptation decision horizons.

Often social, population or economic changes represent important factors in adaptation decisions to ensure future resilience. Examples are changes in local population, building design, and coastal defences in the face of sea level rise. And yet this information is not widely available across Europe. Füssel and Hilden (2014) identified only Finland, the Netherlands and the UK as having developed quantitative scenarios for non-climatic variables specifically for CCIV assessments. The absence of these quantified estimates of impacts from non-climatic drivers restricts the application of more quantitative climate change risk assessments (relevant to the SDGs) as the relative importance of any climate signal and its interplay with socio-economic changes cannot be estimated. WP4 will provide context to aid this decision process by exploring the attribution of hydro-meteorological stresses (e.g. floods, storm surge, drought, wind and heat wave impacts and losses) to both climatic and non-climatic factors, drawing on socio-economic, population, and (where relevant) human water management data, over different sectors. This attribution will help identify which impacts (and what scales, variables and regions) the climatic changes play important, or leading order roles.

1.4.3 Innovation Potential

1.4.3.1 Groundbreaking objectives

Development and evaluation of the world's first multi-model near term prediction system.

Initialised multi-year predictions have evolved to the point where semi-operational predictions are produced annually from ten global modelling centres. This represents both an opportunity and a challenge for decision makers in how they make use of this information. New forecast verification tools and establishment of common case studies (1.4.2.2) provide a common basis to evaluate the skills and relative strengths of the different prediction systems. One of the ground breaking objectives of EUCP is to explore whether a new multi-model/multi-operational centre near term prediction system is able to provide more skillful information over individual single model predictions (WP1). The multi-model ensemble is less sensitive to individual model structural errors and is therefore able to better capture climate variations. Evaluation of the new multi-model near term prediction system will draw heavily on the new forecast verification tools developed in WP1. This evaluation of where this new system has skill over individual operational systems will inform the evaluation and data synthesis (WP5) and the nature of the initialised forecasts presented to end users.

Including a much wider climate model-observational evaluation targeting specific processes that have been shown to link to the plausibility of future changes.

Many of the high profile climate science advances in the past five or so years have been in the development of "emergent constraints". Larger collections of climate simulations (CMIP3, CMIP5) that explore a greater diversity of historical and future pathways have enabled relationship between historical climate model biases and the magnitude of future changes to be identified. These relationships combined with good observations point to the potential for using targeted climate model-observed comparisons to narrow the range of projected climate changes that can be considered plausible. To date information from the growing collection of such "emergent constraints" has not yet fed through into National Climate Projections. However, at the same time very little work has been done to confront climate model projections with multiple emergent constraints or explore how well, if at all, these combine. EUCP will first provide a synthesis of the current global status of emergent constraints and then explore the impact of each on the range of future changes. The challenge in doing so is how to make sense of a wider range of different constraint information, some of which will be complementary and some contradictory (that may arise due to current structural model errors for example). By applying these constraints consistently (WP2), EUCP will provide a coherent picture of how information from these different sources will be combined. This will ensure that EUCP projections will be able to down-weight less credible projections but the use of multiple observational metrics will also avoid overly tight constraints that can arise from single metrics due to structural model errors. This will be a world first, and will offer insights that will inform the wider scientific understanding of the information and value

of current "emergent constraints" for future climate projections. Assessing the various projection data against these multiple observational comparisons will represent a key basis of confidence that will inform their use in risk based decision making.

The impact of explicitly resolving convective scale processes in regional climate modelling.

Many of the uncertainties in modelling the climate response are due to the need to parameterise processes that occur on smaller scales than the models are able to explicitly resolve. As advances in computing enable higher resolutions, processes that previously were parameterised can be resolved explicitly. Regional climate models are approaching a resolution barrier, with the release of simulations that can, for the first time, be considered "convection permitting" (resolving many but not all of the convective scale process) (Prein et al., 2015). Early results suggest that while such models reproduce similar pictures of mean projected rainfall changes, they suggest a shift in when rainfall occurs to less frequent but heavier rainfall events (Kendon, 2017). Any change in the intensity of heavy rainfall events can be expected to impact a number of sectors, but the small number of existing studies make it difficult to infer robust messages on what this new modelling capability will bring. EUCP will coordinate a set of new regional climate model simulations, at the convective permitting scale (1-3 km, both with a pan European domain and with more targeted modelling of the Alpine region) across models from nine contributing regional modelling centres. This will enable a first systematic assessment of what new insights these convection permitting models bring and what (and where) are the robust messages for climate change projections. In doing so it will address important open questions on the implications for climate impact that early model studies have raised.

1.4.3.2 Novel concepts and approaches

EUCP draws on data from a very broad range of climate simulations and develops new and novel climate model-observational benchmarks and constraints, verification tools and comparisons and makes use of existing observational evaluations. An overarching objective of EUCP is to synthesise these diverse strands of evidence to support each of the climate products (from probabilistic near term predictions and longer term projections, through ensembles of climate simulations, to storyline scenarios used as entry points for end users). Whilst many of the underpinning climate data sources are not unique to EUCP, it is the coherent evaluation of the consistency of these multiple lines of evidence that represents the novel outcome (*Figure 1.4.1*).

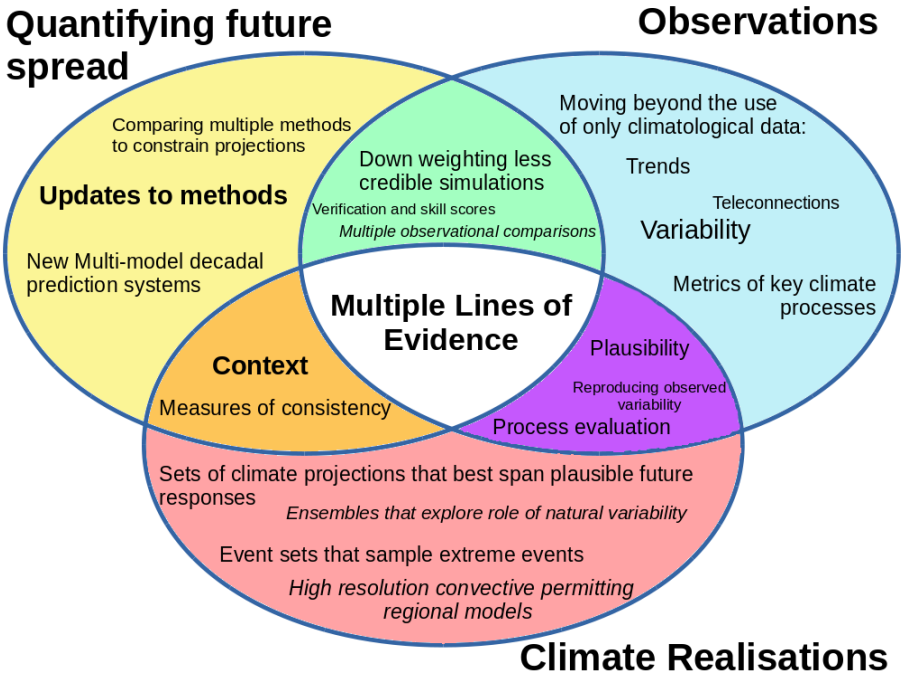


Figure 1.4.1: Venn diagram illustrating how the Multiple Lines of evidence drawn from EUCP's WP strands will combine to contribute to the overall picture of confidence in the projection data

Amongst the multiple lines of evidence, EUCP will include:

- Consistency of future changes. Do projections/predictions agree on the sign and magnitude of future changes? Do different climate projection approaches lead to agreement? Do the new convection permitting models agree or diverge from the existing resolution climate projections, and if so for what temporal and spatial scales and locations and what variables?
- Evaluation of the climate model skill at reproducing a broad range of observed metrics (going beyond the current evaluation of climatological fields). This includes new near term forecast verification benchmarks, new observational insights that draw on process led assessments and the field of "emerging constraints" in longer term projections); Consistency with observed trends (e.g., are projected increases in high intensity rainfall evident in tendencies found in the observations?); and constraints on the forced response arising from detection and attribution results.
- Assessment of how individual storyline scenarios, or plausible future realisations, sit within the wider range of projected climate changes. This includes exploration of where, and for what variables and scales should we expect the signal to emerge from natural climate variability? Where does a particular future realisation sit within the context of wider estimates of future climate risk?
- Assessments of the underlying physical mechanisms that drive these changes and how consistent these are to our physical understanding of these processes in the real world. For example, do the models adequately resolve or represent the processes that are known to affect a particular impact? Is there added value in addressing certain high impact events in models that meet certain criteria (e.g. use of new non-hydrostatic model simulations to look at heavy precipitation; "high top" model to capture blocking) and how can we best make use of this added value?

In some cases the proposed analysis can be envisaged to lead to narrower, more tightly constrained climate predictions/projections. However, the intended outcome of this process is to provide a better quantified estimate of the risk and a greater confidence base to the users. Information on the evidence base (types of sources, consistency, quality) and the level of agreement provides the important context that helps inform how and where this information can be used.

1.4.3.3 New products and services

Co-development of Climate Projections

In many of the existing National Projections, the science drivers have often shaped the form that projections have been delivered in (e.g., the need to incorporate new sources of uncertainties; new modelling capability and analysis approaches). Users of the projection data bring their own drivers and expectations (needs for accessibility, data to inform risk assessments or to drive impacts models, or provide a top level narrative). There is a growing recognition of benefits and the need to co-develop climate projections, iterating between science and user bases. This act of co-development enables the realisation of climate products that meets user's needs whilst being consistent with best available information from science drivers. The recent KNMI'14 illustrates how a co-developed set of Climate Projections can change the nature of climate products that are delivered. The various sources of uncertainties are not transparent in the climate narratives produced. Instead they represent storylines that span the underlying climate and socio-economic uncertainty. By providing a limited number of narratives they lowered the barrier of entry for end users (who, for example, do not require understanding their own climate vulnerabilities prior to using the projections).

EUCP establishes targeted engagement with super-users (engaged end users of climate data who are already aware of some of their own climate exposure) in a series of demonstration studies (WP4). These studies are city scale urban flooding; coastal erosion and flooding; how information on changes in hydroclimatic extremes can be effectively communicated; and working with the wind energy sector to explore climate drivers of wind stilling trends and calming events. In each case, the project (via WP4 and WP6) establishes two way interactions with WP1-3 in identifying and developing the information which will inform their decisions. These demonstration studies will occur within the context of a wider end user engagement. WP6 will feed developments in climate prediction and projection data into wider discussions about bridging the gaps between providers and users. Through the Multi-user Forums (WP6), EUCP will bring together representatives from user organisations drawn from financial organisations, public bodies and authorities, civil society organisations, businesses, risk-related partnerships, and academic institutions, to reflect on the scientific, technical and economic questions underpinning the EUCP objectives; and to review, discuss, co-design and disseminate the preliminary and final results. This framework will play a crucial role co-developing the EUCP innovation and will stimulate collaboration and co-production of knowledge among the end-users, purveyors and climate service providers. The Platform will comprise user organisations and

will work through focussed teams addressing individual sectors and will provide the overview of EUCP development via a series of annual conferences that will inform the science directions in WPs 1-3.

Provision of a baseline of climate information that will facilitate downstream adaptation
Beyond the targeted user engagement, EUCP intends to build on existing EC-funded projects, including those under Horizon 2020 SC5 and Blue Growth. Central to this, will be the interactions with Climateurope, as outlined in WP6. This will include working with the Blue-Action project to support emergent businesses in rethinking/redesigning their business models in light of climate data that they receive through this project.

EUCP will demonstrate the delivery of a pan-European climate prediction system, and is not intended to address all user needs. However, outside the planned collaboration, the release and availability of data will provide a new common baseline of climate data across Europe, that is consistent, coherent and represents the best available scientific data to date. The impact of this is expected to be most obvious for those European countries where National Climate Projection data does not currently exist. In doing so, it removes one of the many barriers to informed climate adaptation decision making. The knowledge and data portal will also provide the guidance documentation in the information and use of EUCP data, as well as documenting the case studies that exploit this data (WP4). In doing so, it should raise the accessibility to current information on how climate variability and climate change will affect Europe as a whole and remove much of the current geographical inequality that exists in climate data access.

2. IMPACT

2.1 Expected impacts

The work plan and objectives of the EUCP project will contribute to all of the expected impacts mentioned in the work programme under SC5-02-2017. These impacts are listed below.

2.1.1 Impacts in the Work Programme

A wealth of climate observations, model predictions and projections, data processing tools, impact assessments and user interfaces are currently available, as a result of continuous investment in climate research and development both from public and private sources. However, the information and tools are scattered over spatial domains and time scales, tailored to specific sectors or players, rely on different assumptions and methodologies, and at best support a scattered patchwork of practical and strategic decisions. EUCP recognises the need to provide a **coherent** information system based on the **widest possible set of relevant and credible sources**, to give access to **information seamlessly** from ~1 to 40 years designed to serve as an **authoritative benchmark** for a large portfolio of decision takers.

By combining observations, initialised predictions, scenario projections at global and regional scales, and supplementing these with narratives of high impact future weather events and appropriate user relevant guidance, EUCP will have an unparalleled impact on climate-dependent decision- and policy-making in Europe. The expected impacts (itemised from the call text) and the way in which EUCP will contribute to each of these expected impacts are as follows, linking directly to EUCP's top-level objectives:

(i) "increasing the credibility and usability of climate predictions, and the identification and characterisation of trends in regional climate extremes" (linked to top-level objectives 1, 2, 3, 4)
EUCP is based on the principle that information on varying time scales, spatial scales and sectors is retrieved from various high-quality sources, and brought into a single framework. **Credibility** is enhanced by harvesting information from state-of-the art multi-model programmes with long heritage and critical mass from the global scientific community: initialised predictions from the CMIP6 special project DCPP and a strong link to WMO coordination activities, regional climate projections from the multi-model CORDEX programme, impact indicators from the high-profile ISI-MIP programme, and an innovative set of multi-model ultra-high resolution regional model experiments developed in EUCP and partner C3S projects. A key aspect is that we will combine the model simulations with observations of the past and current state of the climate system in order to better estimate the range of future outcomes. **Usability** is ensured by focusing on the time scales that are relevant for most decision taking processes in this area: 1-40 years spans the lifetime of strategic decisions of private companies on investments or market opportunities, major infrastructure projects, political agendas and variability in socio-economic conditions. Usability is also enhanced by

constructing a seamless information chain that effectively combines multiple sources of climate information and by co-developing, with users, suitable guidance material and appropriate e-science access tools.

(ii) "providing an authoritative foundation of climate information to assess the impact of climate change" (top-level objective 2)
EUCP's information is targeted to assess the adverse and positive impacts of climate change and mitigation and adaptation measures. The **authoritative** foundation of the results are ensured by direct retrieval from the world leading climate information programmes, including CMIP, WCRP, Horizon 2020 projects and C3S. EUCP is targeting the mapping of climate **impacts** by selecting user relevant hydrometeorological quantities (Essential Climate Variables, ECVs), allocating specific resources to the demonstration of climate impacts and a focus on the socio-economic decision taking for which these ECVs are essential inputs.

(iii) "boosting climate service market applications at European level for a variety of sectors, based on the new information" (linked to top-level objectives 3, 4)
The authoritative nature of the data compiled and disseminated by EUCP provides a **benchmark** for climate service providers, consultancies and other users. They usually need to develop tailored services for their clients, and the use of the EUCP system as starting point for their tailored services acts as a reference methodology that leads to the creation of traceable and quality-assessed products and services. As indicated in various support letters from consultancy firms, the possibility to explore a *European* (rather than national) *scientifically based* (rather than empirical) climate information service will support the development of market applications for various sectors. EUCP will engage with players currently active in the climate service market (providers and users of climate services, including business users) who will **boost the climate service market** potential of EUCP outputs and stimulate growth of such a market at the European level. EUCP will be closely linked to the implementation of the European Roadmap for Climate Services, for example through the Project Coordinator who is part of the Roadmap implementation working group.

(iv) "supporting the building of a climate resilient economy and strengthening civil protection" (linked to top-level objectives 2, 3, 4)
As noted in (i) and (ii) above, in areas of policy- and decision-making where climate has a strong impact, EUCP will provide access to relevant, useable, credible and authoritative information as an essential basis for enabling them to make better informed climate-related decisions, thereby building a climate resilient economy and strengthening civil protection. EUCP allows **comparison** and **integration** across regions and time scales: multiple domains, time scales and sectors can be subjected to a similar set of climate information, allowing the investigation of trade-offs, cause-effect-chains and quality differences across these different scales and sectors, in a risk based manner, including looking at rare events. This ensures that the probability of overlooking unexpected surprises is reduced, and the ability to link climate impact analyses to other drivers of economic **resilience** and safety is enhanced.

(v) "*closing the gap between 'top-down' climate information provisions and 'bottom-up' end user requirements"* (linked to top-level objectives 2, 3, 4)
EUCP will be used by both **policy makers** interested in key messages and by **well informed experts and practitioners** that look for a reference data source to prepare major decisions. It allows consultancy firms and trained policy support experts to serve their clients (private sector, regional and national authorities, Non-governmental organisations (NGOs)) by getting access to well designed and well described climate change information. The involvement of these primary users particularly in WPs4 and 6, will force a clear connection between the **top-down** climate expertise and **bottom-up** climate information needs.

(vi) "implementing the Sustainable Development Goals (SDGs), in particular SDG 13 "Take urgent action to combat climate change and its impacts", as well as conclusions of the COP21 Paris Agreement" (linked to top-level objectives 2, 3, 4)
The Paris Agreement Article 7 (7c) "Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making" is strongly supported by the ambitions of EUCP. **Scientific knowledge** on the climate system and impacts of changes in that system is gained by the combination of information sources and detailed analyses of processes, procedures and case studies. EUCP provides early warning messages and decision support by developing **narratives** of climate variations and impacts containing a high level of detail and relevance for climate sensitive sectors Europe wide (and beyond). The impact sectors that will be served by EUCP cover a significant number of the SDGs, including those on climate, food, water and the urban environmental.

2.1.2 Other substantial impacts not mentioned in the work programme

EUCP will **integrate** the wealth of climate information into a single generic framework and specific narratives that allow the development of benchmarked **customised tools and services**. For instance, it will use climate projections in concert with detailed hydrodynamic calculations for urban areas to map current and future flood risks for areas with limited observational records. Similarly, climate predictions and projections will be mapped into risk assessments for the wind power industry, and climatic drivers of trends in impacts of extreme events will be compared to non-climatic drivers, to avoid overadaptation.

EUCP will provide leadership in a range of important topics, including coordinating intercomparison of decadal scale initialised forecasts, feedback on future needs to the CMIP panel on scenario experiments, new guidance on optimising choices of global/regional/convective permitting models for future projects and CORDEX, and case studies and learning from EUCP will be provided to the GFCS.

2.1.3 Barriers to implementation

The impacts listed above have some dependence on factors external to EUCP's scope, influence and objectives, and so the impacts could be lessened as a result. Some of the potential barriers are described here.

It is clearly not possible to insist that decision- and policy-makers use the climate information that the project produces. In line with the work programme topic, this is not a climate service project per se, and it is more for climate service providers to ensure the information is used in decision- and policy-making. As described above though, the project will ensure that the information is as credible, useable, authoritative, and impactful as possible through strong user engagement.

Inertia in some user communities exists, with new innovations taking considerable time to reach common use. This can be partly mitigated through early engagement and involvement in key users in co-design. We will seek to select users who can act as a beacon for their wider community.

Access to ongoing training can provide a barrier beyond the end of the project, but will be minimised through guidance, tools and data curation policies.

2.2 Measures to maximise impact

2.2.a Dissemination and exploitation of results

Dissemination involves distributing results to partners and users, as effectively and as widely as possible. Exploitation is primarily about the user exploitation of the outcomes and results generated. It is also important to consider exploitation of the results by the consortium partners.

The dissemination and exploitation of EUCP results is based on the principle of layered information, tailored to users with a varying interest and degree of involvement. For professionals in the field of climate change impact assessment, a demonstration of the concept of blending climate information from different sources for a specific set of applications is provided, constructed in WP5 and disseminated in WP6. It aims to produce information for consultancy and scientific experts targeting a climate assessments for a specific sector and/or area. For scientific analysis of the state of the climate system, access and guidance is provided to model products and processing tools that are used and developed within EUCP. Dissemination is done via the coordinated dissemination tasks in WP6 and via the networks of EUCP partners involved in all WPs. For stakeholders with in depth involvement in the assessment of model quality, various modes of uncertainty about past and future evolution, and construction of alternative communication methodologies, access to the climate data exploring and manipulation software and datasets is organised in devoted tasks in WP6.

The draft plan for the dissemination and exploitation of EUCP results is given below. Appropriate methods of dissemination and exploitation are identified, ensuring that EUCP achieves maximum impact. An updated version of this draft plan is a deliverable in Month 6 at which time further details will be given about specific requirements, target audiences, deadlines, methods, procedures and evaluation measures. This will be a working document to ensure effective management of these activities and their integration across the project.

2.2a.1 Draft plan for the dissemination and exploitation of EUCP results

We have identified three areas where EUCP will make an impact, and for each area we describe here who the potential users are of our results, how we intend to use appropriate channels of dissemination and interaction

with the potential users, and we identify any possible follow-up from our project once it is finished. The potential users include research, commercial, social, environmental, policy-making and educational training.

2.2a.1.1 European Climate Prediction System methodology
The methodology to combine various sources of information on climate change and its impacts into a single climate prediction system is of interest to potential climate service providers, and (scientific) organisations that will further analyse or develop components of the system. For climate service providers who will make use of the system a proper documentation and understanding of its functioning is of high importance to tailor their services to the needs of their clients. For analysts and developers a (scientific) documentation is crucial to ensure the quality standards that peer review and scientific collaboration will deliver.

Dissemination and Exploitation (during and after the project)
For potential climate service providers a brochure and/or infographics will be compiled that will illustrate the components and their contribution to the overall system. In addition a technical documentation describing the methodology of all components of the system and their interaction will be developed and be subjected to internal and external review for clarity and completeness. Seminars at climate services science conferences will be carried out. It would be possible relatively easy after the project, for training courses on the system to be set up, for example through the training component being developed under C3S. The main story to be told by these media is that many drivers and impacts of climate change operate in parallel and interact mutually, and that a careful combination and selection of source of information will boost the development of high quality tailored climate services.

For scientific analysts and developers who wish to contribute or further develop the system, peer reviewed journal articles and conference submissions are the main means of dissemination and exploitation of the EUCP system. Contributions to the 6th IPCC assessment report will be provided via these publications. The scientific network that is formed through these activities will be further exploited by construction of targeted consortia and collaboration programmes to address future research calls or product requests.

How these measures help to achieve the impacts of EUCP
Brochures, infographics and training courses will raise awareness of the opportunities provided by the EUCP system to a target group that is well positioned to use it for generating and expanding climate services. The methodology should inspire service providers who have limited resources available for detailed analyses and exploitation of all possible sources of climate change information, by giving guidance on the relative contribution of various components to their specific needs. The selected case studies in WP4 and WP5 will further illustrate the potential applications of the system, providing another source of inspiration to climate service practitioners. The dissemination of results via the peer review system provides essential scientific quality assessments of the approach that is needed to give it the authoritative nature that is required.

2.2a.1.2 Estimates of future pdfs and plausible weather for policy makers and practitioners
The results generated by EUCP during the course of the project will be disseminated and exploited to a wider audience. Intermediate climate service providers and end users involved in climate (impact) assessment will potentially be very interested in the pdfs generated and the plausible realisations of future weather and climate. For instance, national climate projection programmes in EUCP member states will be involved in EUCP via the consortium, and feedback from these national programmes will be incorporated into EUCP.

Dissemination and Exploitation (during and after the project)
External stakeholders will be invited to engage with the development of these PDFs and narratives through the user panels and interaction with the case studies explored in WP4. Pan-European and regionalised results on changes in probabilities of extreme events, and storylines of future weather, will be disseminated via high-level brochures, website messages and open literature publications.

At the end of the EUCP project, publications will reflect the different advantages and disadvantages of the approach, guided by the scientific and user experience gained in demonstration results and findings during the project. A practical "how to" guide aimed at stakeholders and practitioners will be produced.

How these measures help to achieve the impacts of EUCP
The landscape of tailored climate services will be shaped by the EUCP system, its products and the demonstration activities. The uptake of project results in climate change impact assessment programmes will

be enhanced through the involvement of stakeholders and practitioners in the user panels and case studies, and the close interaction with stakeholders.

2.2a.1.3 Legacy of Tools, software, data and metadata

EUCP will disseminate and exploit data, metadata and software during and after the project targeting two stakeholder groups (the Multi-user Forums). We distinguish between scientists including professional end-users (practitioners), and policymakers. The first group will be able to actively access data and manipulate it using professional research software tools and scientific methods developed during the project. The second group will be engaged via workshops and a targeted web-interface building upon C3S services. Accepted data and metadata standards will be used to allow for re-use and interoperability of the data (see also Open Data Research pilot below). EUCP will promote and adhere to the FAIR (findable, accessible, interoperable, re-usable) data principles for climate data, enhancing re-use of data and reproducibility of the outcome.

Dissemination and Exploitation (during and after the project)

Data is available to users through standard, well-developed repositories including the Earth System Grid Federation (ESGF), CORDEX and C3S CDS archives. All developed software will be made available through open software repositories. The developed tools allow the data generated in the project to be disseminated to the partners and user groups as described above. During the project we will organise training activities for the groups within the Multi-user Forums (see WP6).

A flexible software analytics infrastructure will be developed allowing exploitation of the data in support of climate service activities. The legacy of the project outcome after the project is ensured by preserving the software tools and the scientific workflows used to obtain climate and climate impact data in the eScience Technology Platform of the Netherlands eScience Center. This includes documentation of the software, data and metadata standards. By preserving the workflows, using modern and professional provenance tools, the project outcome can be reproduced after the project has ended. This targets the scientific partners and practitioners to develop targeted products for climate services. The information made available through the web-interface allows exploitation by the second user group, the policymakers.

How these measures help to achieve the impacts of EUCP

An important conduit to maximise impact of EUCP outcome is the alignment with C3S to provide access to the major climate data sets archived in the C3S CDS. We will align our project with C3S by building upon the same software for data access. Also, since our developed tools allow for access to distributed data, new datasets produced by partners in the project will remain available for manipulation and further dissemination to end-users. The aforementioned infrastructure is flexible, open source and made available through open software repositories. Hence this will allow users to re-use data, generate products for climate services and obtain scientific results that will be published in peer-reviewed literature and assessed by IPCC Assessment Report 6 (AR6). The data and workflow activities will therefore maximally support the impact of EUCP in scientific research, climate services and climate assessment activities.

Open Data Research Pilot

EUCP will take part in the Horizon 2020 'Pilot on Open Research Data', with project budget allocated. Data management is integral to EUCP and will be coordinated by NLeSC (WP6) and the Met Office (WP7). A comprehensive Data Management Plan has been included as a deliverable in WP6 provided in Month 6.

Further data management considerations

The project will primarily collect existing climate model data from existing data repositories. These are gridded data products of atmospheric, oceanic, ice and terrestrial climate variables. The data originates from existing repositories of the international CMIP6 and EURO-CORDEX projects and from large climate modelling activities from partners. The main sources of data are the ESGF servers and the C3S CDS, and several EUCP partners (for example ETH Zürich) also have large CMIP5 and CORDEX archives.

Data is archived using the NetCDF CF (Climate and Forecast metadata conventions) compliant data standard. We will generally use CMOR-3 software for this purpose. When appropriate, extensions to the CF conventions will be made (e.g. for initialised climate forecasts, such as applied in the FP7 SPECS project).

The data in the ESGF and in the C3S CDS is findable, accessible, interoperable and re-usable, as much as possible following the FAIR principles for responsible data management in scientific research. The protocols of the CMIP5, CMIP6 and EURO-CORDEX are documented already (e.g., Geoscientific Model

Development special issue on CMIP6). Some new simulations are proposed and these will be stored locally by partners. Relevant user-informed subsets of data will be made available by partners and centrally archived and made accessible through open standards. These include the ECVs defined by WMO Global Climate Observing System that are also stored in the C3S CDS. The data management plan developed in the first stage of the project will elaborate on dissemination of the additional subsets. WP6 develops an infrastructure, building upon C3S software, made by one of the partners (NLeSC) that enables scientists to find, access and use these distributed data sources. Appropriate authentication and authorisation tools will also be developed.

Provenance and workflow tools will be further developed and made available in WP6 such that derived data sets from the other WPs can be reproduced from the abovementioned data ensuring reproducibility and re-use of derived data, even beyond the end of the EUCP project which ensures sustainability of the results.

The basis climate and climate impact model data will be preserved at the above mentioned repositories and at the partners of the project when it concerns new data sets. NLeSC will preserve the workflows needed to obtain the derived data using workflow and provenance tools. In addition, subsets of data generated from high resolution global and regional climate models within the project will be archived centrally.

Costs of basis climate and climate impact model data are covered by partners outside this project. SURFSara, linked partner of NLeSC, will provide 100 Tbyte of storage and support for curation throughout the project. The data will be accessible through OPeNDAP. Central archiving will be used for the additional ECV data and user-informed subsets of data from initialised global and high resolution regional simulations. WP6 contains budget for NLeSC for central archiving, data management and building open source software needed to ensure the coupling and software interoperability to C3S. NLeSC is one of the software architects and developers of C3S and can ensure this compliance to C3S.

2.2a.2 Outline strategy for knowledge management and protection

EUCP will adopt a strategy for knowledge (intellectual property, IP) management and protection that will encapsulate the guiding principles of Horizon 2020 both on openly accessible research and effective exploitation of results. The processes for this will be guided by the Consortium Agreement (CA) which will be agreed by all partners and the processes will be managed by the Met Office as project Coordinator (through WP7). Procedures for governing access and the use of IP, plus the type of IP rights, will also be included in the CA. Details of the innovation and knowledge management strategy will be produced within the Project Dissemination and Exploitation plan (D7.3 and D7.4), both during and at the end of the project.

Background management and protection

Achieving EUCP's objectives will involve accessing a large number of different existing data sources. Many of these are already identified, and are listed in this proposal; for example, model datasets (e.g., CMIP5, CMIP6, CORDEX), observational and reanalysis datasets (e.g., HadCRUT4, C3S regional reanalyses). An internal project catalogue of these data sources will be created upon project start. Details will include the licenses of each of these data sources, and a statement as to any restrictions on their use and subsequent incorporation within any products and knowledge generated by EUCP. It is already established that access to most of the required source data will be open, but EUCP recognises that it will need to identify all data sources (including new sources that are only identified once the project starts) that may be provided to us on the condition that they will not be further disseminated.

The EUCP partners will also bring their own pre-existing knowledge (e.g., new model simulations, approaches to measure skill and apply observational constraints). This will be included in the catalogue referenced above, along with the appropriate protection level. Each of the partners will have the right to exclude specific pre-existing knowledge from the other partners' access, though these restrictions must be announced before the signature of the Grant and Consortium Agreements. All records above will be maintained electronically, providing audit trails, such as documented proof of ownership, if necessary.

Results management and protection

Of the new simulation data generated within EUCP (such as new flagship convection permitting regional climate models), the large data volumes (running into many 10s of Petabytes) is one factor that limits wide spread dissemination. For example, WP1 tasks will lead to new decadal hindcasts for targeted case studies. These will provide a common framework to assess individual model skill in capturing changes during these hindcast events. The underlying model data from these case studies will not be disseminated outside WP1 partners, instead these simulations will provide information on the skill of these prediction systems and will

be provided to end users as part of detailed guidance notes developed by WP1 and feed into synthesis statements on robustness (WP5) that will form an important part of the context provided to end users of the future predictions from the decadal prediction systems. So where this data will be used to underpin climate projections provided to end users, it will be made accessible through open standards.
The following products and results will be openly disseminated beyond the project partners:

- Best practice guidance on: choosing and using initialised projections; choosing and constraining scenario projections; combining predictions and projections of different spatial resolutions into a seamless product.
- Uncertainty quantifications and probability distributions for user relevant metrics over Europe and for some key global quantities.
- Event sets of future weather and plausible climates from global and regional models.
- Data and interpretation of impact case studies.
- Peer reviewed literature related to the advances in the project.
- Communication material designed to promote and explain the project.

The above methodologies, product designs and newly generated datasets will be developed between the partners. Therefore, there needs to be a clear strategy for joint ownership, which may subsequently include joint ownership agreements. Software and datasets will be documented with appropriate metadata and standards to capture their provenance and derivation, plus facilitating access and use beyond the project end.

The foreground IP detailed above, will be identified at the point of creation, and steps taken to ensure its protection. Partners will respect their own, and each others, protection protocols/IP Rights. In the event the creation of a new piece of knowledge as a result of the work of a single partner of the project and solely the result of individual intrinsic skills rather than shared knowledge, this partner will be the exclusive owner of the results, subject to granting access rights to the other partners where necessary for their execution of the project or to the use of their own results. For the case in which the designated owner of the results waives its option to start registration proceedings the coordinator will follow a procedure outlined in the Consortium Agreement to allow other project partners the opportunity to obtain or maintain such protection.

Open access to peer-reviewed scientific publications
EUCP will adopt the "gold" model for open access to peer-reviewed journal articles where possible, and funding is provided specifically for this. In parallel, "green" open access will also be adopted by using the institutional and subject-based repositories made available through the partners. Authors will avoid entering into any copyright agreements with publishers that will not allow them to fulfil the EC Open Access requirement. The Project Office will be involved in the process, and these publications will be advertised and logged through the project website. All published material will contain an acknowledgement to the research funding from the European Union and Horizon 2020.

2.2b Communication Activities

In order to successfully promote the EUCP project, its progress, results and achievements, it is important that carefully constructed key messages are communicated at a suitable time and level to appropriately targeted audiences. There will be agreement on who will carry out the communicating, and on how the successful communication will be measured, monitored and evaluated. All of these elements will be included in the communications plan which will be part of D7.2. The activities around promotion and communication are within WP6, with overall management and strategic direction provided by WP7. WP7 will also report on the monitoring and evaluation measures within the communications plan, when providing summary updates to the EC. The Coordinating organisation has an experienced Communications department who will support EUCP with social media and other communication activities. In coordination with the Press Offices of the partner institutions, the project will decide how to manage ad hoc media enquiries, FOI requests, routine communication of research results and any negative media coverage, amongst other things.

The audiences included in the communication plan have been identified based on the impacts described in Section 2.1. The communication matrix (*Table 2.2.1*) lists some already identified measures for communication by the project.

Table 2.2.1: Communication measures for promoting EUCP

Audience	**Objective**	**Material/content (and responsibility)**	**Method/communication measures**	**Frequency**
EUCP partners	Ensure an effective and integrated project	·Progress and results of WP tasks (WP7) ·Risks/benefits/issues (WP7) ·Queries/questions (WP7)	·Internal project wiki ·WP and Management Board (MB) meetings, General Assemblies (GAs) ·Email, Web and teleconferencing	·Regular updates of wiki ·Quarterly MB meetings ·Five GAs
Advisory Board	Inform on progress and get useful information	·Progress and results of project (WP7) ·Risks/benefits/issues (WP7) ·Queries/questions (WP7)	·Internal project wiki and GAs ·Targeted communications ·E-mail and teleconferencing	·Regular updates of wiki ·Five GAs
EC Project Officer	Ensure EC is fully informed of progress	·Overall project progress (WP7) ·Issues (WP7) ·Deliverable progress (WP7)	·Short progress reports/summaries ·Deliverable and periodic reports ·EUCP website	·Six monthly throughout project and deliverable dates/ reporting period
Multi-user Forum – Policy maker user group	Understand user requirements, engage key users, co-design EUCP innovation and exploit developments	·Discussion of needs (WP6 with WPs4 and 7) ·Plans, concepts and results (All WPs) ·Mapping of knowledge gaps (WP6) ·Letting users work with products (WPs5, 6) ·Test case results and good practice guidance (all WPs via WP6)	·User meetings and feedback to project ·Plans and concept documentation and presentations ·'Gap maps' [T6.4] ·Policy reports and briefings ·Key meetings of policy makers	·Regular updates on public website ·Continual dialogue on digital platform ·As per milestone and deliverable dates
Multi-user Forum – Practitioner user groups	Understand user requirements, engage key users, co-design EUCP innovation and exploit developments	·Discussion of needs (WP6 with WPs 4 and 7) ·Plans, concepts and results (All WPs) ·Mapping of knowledge gaps (WP6) ·Letting users work with products (WPs5, 6) ·Test case results and good practice guidance (all WPs via WP6)	·User meetings and feedback to project ·Plans and concept documentation and presentations ·'Gap maps' [T6.4] ·Key meetings of practitioners ·Targeted sessions at international events	· Regular updates on public website ·Continual dialogue on digital platform ·As per milestone and deliverable dates
Super-users	Co-design indicators and outlooks, engage key users	·Discussion of needs (WP4, with WP6) ·Plans, concepts and results (All WPs via WP4)	·User meetings, feedback to rest of project ·Plans, documentation and presentations	·Continual dialogue on digital platform

Specialist researchers	Share knowledge between programmes and integrate EUCP with other projects	·Plans, concepts and results (All WPs)	·Public website ·Communities' development meetings ·Conferences and joint workshops	·Regular updates to website ·As meetings occur
C3S	Raise awareness and exploit capabilities, ensure compliance and use of datasets	·Plans, concepts and results (All WPs)	·Attend meetings organised by or for them - C3S General Assemblies ·Teleconferencing	·As required
Wider policy and decision makers groups	Raise awareness of capabilities, exploit developments and capabilities	·Plans, concepts and results (All WPs)	·Policy reports and briefings ·EUCP web site ·Presentations to government departments and Conference of Parties	·Regular updates to project website ·Policy briefings, M42 & M48
Wider business groups	Raise awareness of capabilities, exploit developments and capabilities	·Plans and results, including experiences with users (All WPs, but mainly WPs6, 7)	·Project web-site ·Plans, documentation, presentations ·Regular targeted bulletins ·Direct contact with climate officers	·Regular updates to project website ·At conferences ·Annual bulletins
Wider scientific communities	Maximise impact and exploitation, integrate with other projects and programmes	·Project progress, plans and results	·Project website ·Meetings organised by EC (or presence at meetings of other EU projects) ·Scientific conferences	·Regular updates of the project website ·Meetings as required
Public	Raise project visibility and public awareness, provide credible information on research	·Relevant results and their implications (WPs6, 7) ·Frequently asked questions (WPs6, 7)	·website, multimedia content, social media, e-newsletters, educational movie presenting European climate change ·Public lectures/presentations	·Regular website updates ·Proactive media and social media activity, e-newsletters and flyers
Media	Ensure project is visible to public and reliably communicated	·Project progress and results (WPs6, 7) ·Significance of results and impacts (WPs6, 7) ·EUCP methodologies (All WPs via WPs6, 7)	·EUCP website and multimedia content ·Press briefings and media contacts ·Regular social media updates	·Regular website updates ·Press Briefings ·Invite to relevant events
Education /training	Ensure knowledge is passed on through education	·Project progress and results (WPs6, 7) ·Significance of results and impacts (WPs6, 7) ·Methodologies of EUCP (All WPs)	·CNRS/CNRM's educational movie ·EUCP website ·Conferences, lectures, Summer Schools	·Regular website updates ·At Summer Schools

3. IMPLEMENTATION

3.1 Overview of the work plan

To deliver the required specific challenge and scope of the work programme topic EUCP will have six scientific and technical WPs (WPs1-6), supported by a dedicated WP for project management (WP7):

- **WP1:** Assesses and provides initialised climate prediction from 1 up to 10 years, yielding data and guidance for risk based applications. *WP1 supplying initialised decadal predictions and guidance on this skill and usage to WP5.*
- **WP2:** Derives uncertainty quantifications/probability distributions and future weather and climate event sets from non-initialised climate projections (to 40+ years), with associated guidance material, for risk based decision making. *WP2 supplying: quantitative estimates of future spread (e.g., pdfs), optimal sets of individual model realisations and event sets to WP5; Providing lateral boundary conditions (or guidance on LBC choices) to WP3; and climate scenarios to WP4.*
- **WP3:** Downscale projections of future climate to local-scales, where people live and work. This provides a first comprehensive assessment of climate modelling at the "convection permitting" scale (<3km) that will improve projections of extremes and sub-daily weather. *WP3 supplying: regional climate data and event sets of extreme weather to WP4 and WP5.*
- **WP4:** Provides a set of impacts demonstration applications, highlighting how climate variability and change information from WPs1-3 and WP5 on different time and spatial scales can be applied to user relevant decision making. The climatic events are translated into geophysical and societal impacts, including storm surge, food production and energy security.
- **WP5:** Provides seamless predictions/projections, taking the information from different time and spatial scales and synthesising it into information that can be used for a range of user applications.
- **WP6:** Coordinate and facilitate user interaction so that co-development becomes a feature of the project and informs all of the science aspects in WPs 1 to 5. This is especially important for WP4 and the need to make demonstration examples user relevant. *WP6 will facilitate user input to WPs1-5, receive input from WPs1-5 for developing guidance material and comms material; receive data for archiving from WPs1-5.*

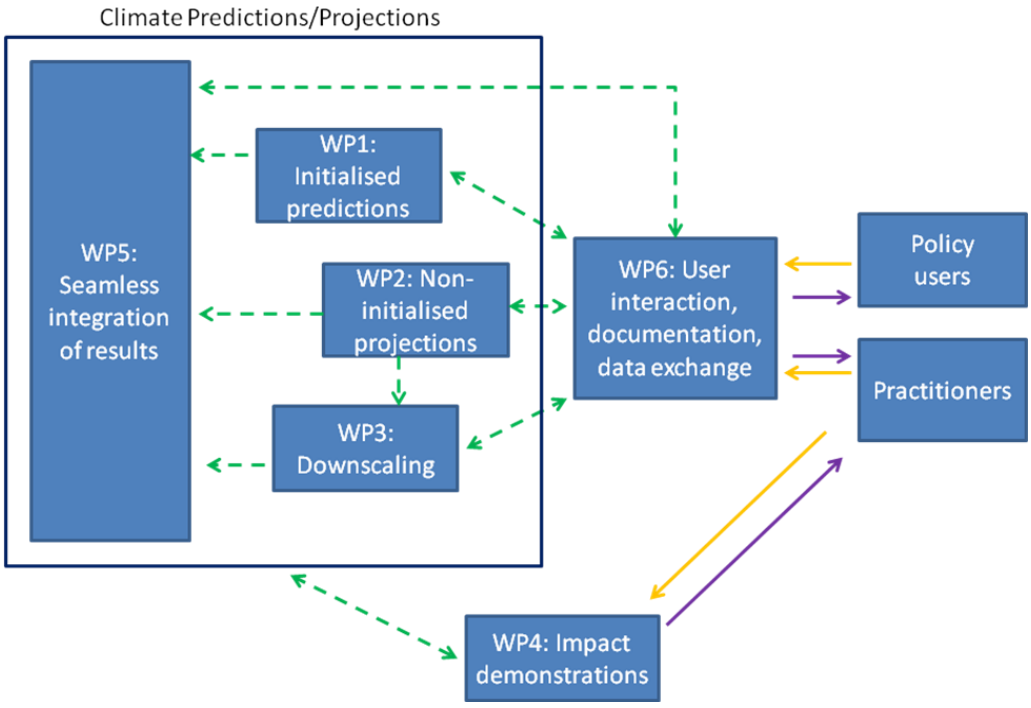
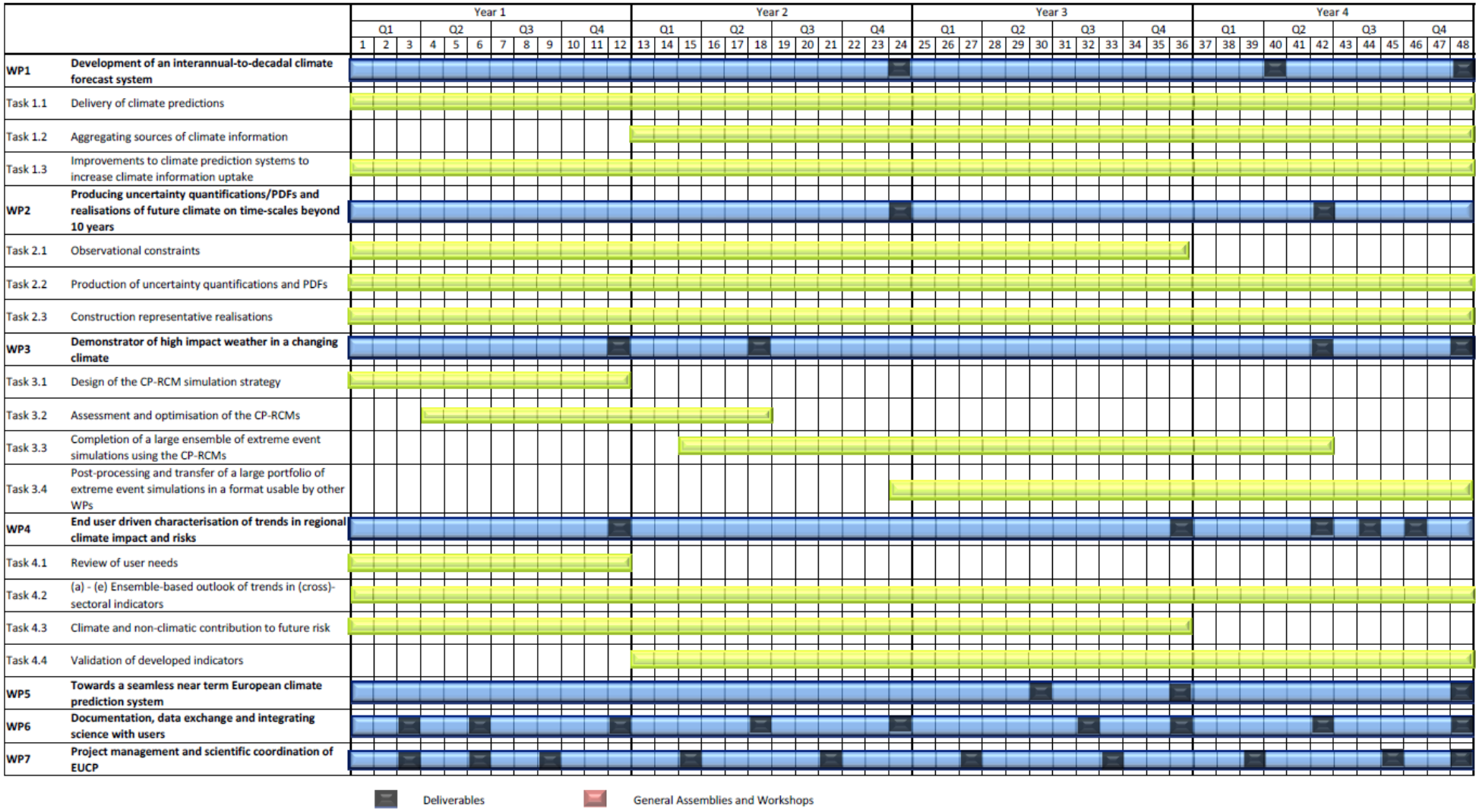


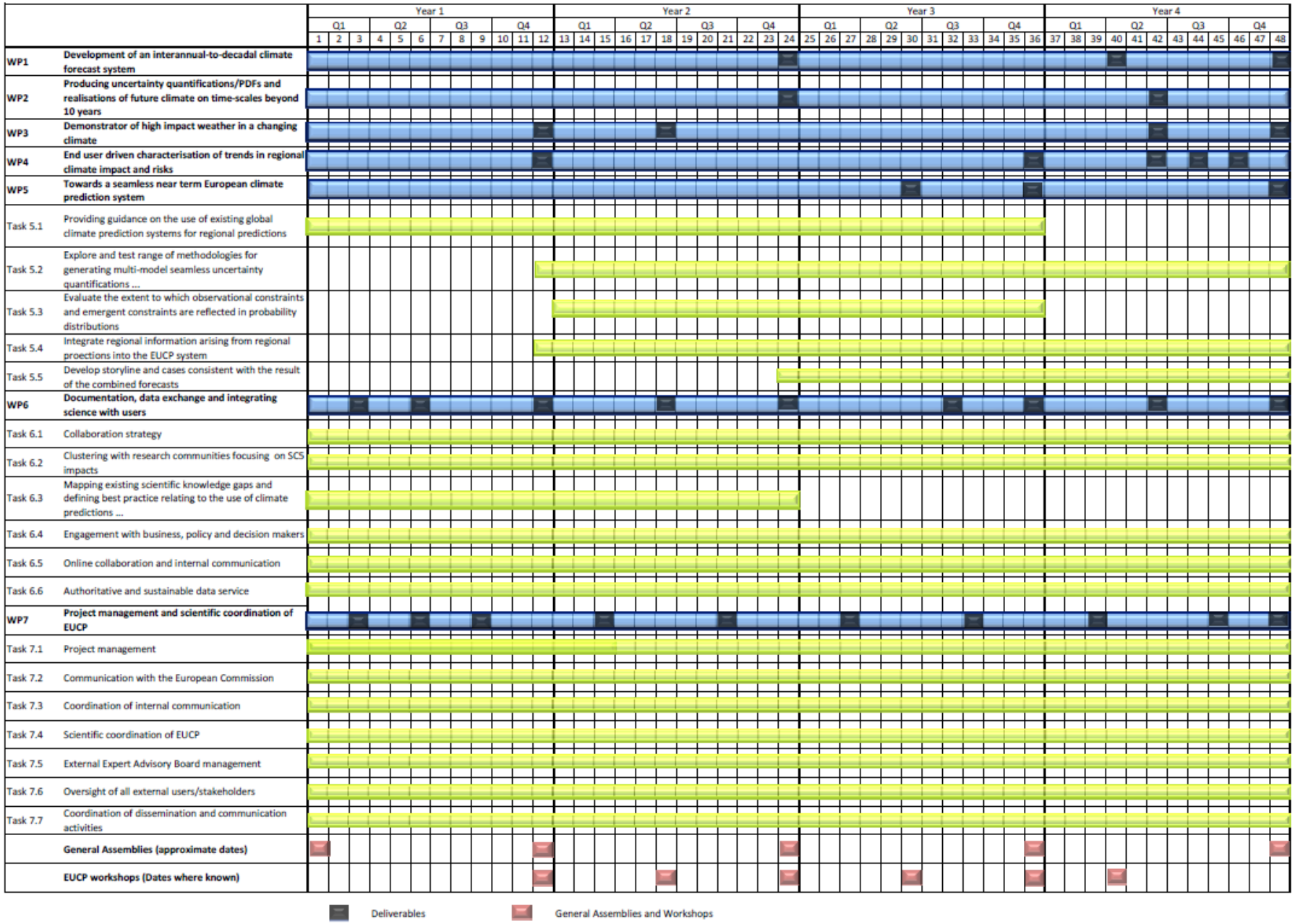
Figure 3.1.1: Scientific and Technical WP interactions. Green dashed lines are internal communications. Yellow solid lines are user information into the project, blue solid lines are supply of information to users

EUCP is carried out by experienced players in the research and innovation (R&I) arena of state-of-the-art climate predictions and services. The consortium has active links to major European R&I projects, C3S, and a myriad of regional, national and European stakeholders. The grouping and connection of this wealth of experience, managed in WP6, will lead to a truly authoritative European Climate Prediction System.

Timings of the work packages and their components

Table 3.1.2: Timing of the Work Packages and their Components





EUCP Work Package descriptions (*Tables 3.1.1***)**

The following tables describe each Work Package in turn, and give details of the work involved.

Work package number	1	**Lead Beneficiary**			BSC	
Work package title	Development of an interannual-to-decadal climate forecast system					
Participant number	1	**2**	3a	5	8	12	14
Short name of participant	Met Office	**BSC**	CNRS/ IPSL	DMI	CMCC	SMHI	UOXF
Person/months per participant:	40	**72**	27	16	42	20	26
Start month	M01			**End month**	M48		

Objectives

This work package will draw on existing global climate prediction systems, collecting all the latest information and identifying the main factors that could improve their societal impact by:

- Outlining best practices in decadal climate prediction experimental design, real-time operations and analysis.
- Identifying the relative merits of climate decadal predictions, including the representation of regional climate trends.
- Providing guidance on the use of existing climate predictions.
- Exploring avenues to improve the next generation of climate predictions with experiments on the impact of resolution, initialisation, forecast drift reduction and short-term forcings.

The final goal is the integration across the European climate forecast systems developed for CMIP6 and those that will be built on them, making them a credible, reliable, authoritative, and action-oriented source of climate information to support more climate-resilient European economies and societies.

This work package is led by **BSC** (Francisco Doblas-Reyes) and co-led by **CMCC** (Alessio Bellucci)

Description of work

Climate forecast systems, which include systems based on empirical/statistical relationships and global dynamical models, predict the future evolution of climate, taking into account internal and external sources of variability, for timescales that range from a month to a few decades. The main characteristics of these systems are that they require accurate information about the contemporaneous state of the climate system and robust estimates of their quality. This makes them slightly more complex than other climate simulations because, for instance, they require sets of hindcasts (forecasts for the past performed with the same forecast system) that are very expensive to run, need an ensemble initialisation procedure to represent observational uncertainty, and rely strongly on the homogeneity in time of the observing system. Climate forecast systems are quickly becoming operational. The time scales of operational systems are expanding as decadal climate forecasting is moving towards its operationalisation following the real-time exchange of global forecasts from ten contributing centres, several of them European. Roles and responsibilities reside on the operational WMO Lead Centres for seasonal (and in the future decadal) forecasts.

The WP will collect decadal climate predictions, assess their quality, and combine them into single probabilistic sources of information according to the user needs identified both in the project and in previous initiatives and with a special focus on Europe and the North Atlantic. It will also explore new avenues for the improvement of the decadal prediction systems beyond the CMIP6 exercise. The WP will coordinate part of the European contribution to the DCPP, a CMIP6-endorsed project, and the real-time exchange of decadal predictions for WMO. The activity is split into three different tasks:

T1.1 [M1-M48] Delivery of climate predictions (**Lead: Met Office**, Participants: BSC, CNRS/IPSL, DMI,

CMCC, SMHI, UOXF**)**

This task aims at delivering the latest and more complete information on climate prediction to the rest of the project. This is particularly needed because climate predictions have a higher cycling frequency than either reanalyses or other CMIP initiatives, its information being spread across a number of initiatives coordinated by varied actors. The partners participating in this task will:

- Collect all existing sources of climate information based on interannual-to-decadal climate predictions from both CMIP5 and CMIP6, as well as from the real-time decadal prediction systems recently developed, to assess (i) their variability, including the ability to simulate unprecedented and extreme events, as well as trends, (i) the ability to reproduce the main variability modes (AMV, IPO, AO, El Niño–Southern Oscillation (ENSO)), and (iii) investigate sources of predictability including, where relevant, the concept of windows of opportunity.
- Evaluate forecast quality (both skill and reliability) on a range of time (interannual to decadal) and space (local to global) scales according to well-identified user requests using a multi-faceted forecast quality assessment that also considers the role of observational uncertainty and assess the impact of different approaches to the ensemble initialisation. The correspondence between skill and ensemble spread will be analysed.
- Share illustrations of the added value of the initialisation and forecast reliability with WPs 4 and 6.
- Process-based analysis of forecast drift and initial shock in the CMIP6 multi-model ensemble.
- Produce a set of good practice guidance rules and standards for decadal prediction including international verification standards, prepare real-time annual-to-decadal outlooks each year in collaboration with WMO and the WCRP Grand Challenge on Near Term Climate Prediction, and contribute to the documentation for users with different levels of knowledge.

T1.2 [M13-M48] Aggregating sources of climate information (**Lead: BSC**, Participants: Met Office, CNRS/IPSL, DMI, SMHI**)**

Methods to improve and better characterise the forecast uncertainty in climate predictions have widely been tested in sub-seasonal to seasonal forecasting. However, very little has been done in the decadal climate prediction context. In particular, the advantage of the multi-model approach and the methods (mainly Bayesian) to better characterise the uncertainty in the formulated predictions have not yet been assessed, in spite of the large sensitivity of a range of users to aspects like the forecast reliability. The aim is to turn the large amount of raw simulations and information of a varied nature for the upcoming ten years into, for the first time, actionable information in a probabilistic form. The partners participating in this task will:

- Combine multiple forecast systems using methodologies based on past performance to provide a single source of information in probabilistic form. Particular attention will be paid to the prediction of climate extreme events.
- Link the forecast system weights to the information provided by T1.1 about the processes responsible of the forecast drift and those at the origin of relevant aspects of the forecast quality.
- Evaluate the advantages of single-model calibration versus the multi-model in terms of forecast quality. Explore the relative merits of different calibration approaches.
- Improve the decadal climate predictions over land areas, with a focus on the Euro-Mediterranean region, using information from the observed teleconnections of the main modes of ocean variability, or from the middle troposphere, that are skilfully predicted, like the AMV.
- Explore the advantages of constraining large ensembles with empirical information available at the initial state, increasing the skill of the final result.
- Provide guidance for the use of the resulting PDFs/uncertainty quantification based on the best current scientific understanding in an iteration process with WP4 and WP6.

T1.3 [M1-M48] Improvements to climate prediction systems to increase climate information uptake (**Lead: CMCC**, Participants: Met Office, BSC, CNRS/IPSL, SMHI, UOXF**)**

Climate prediction experiences a fast evolution that is often the result of inherited discoveries in weather forecasting and long-term climate change simulation. Those advances can make their way quickly into operational systems, although often going through an experimental phase that decides about their suitability. This task will explore strategies that allow improving the climate information provided by the evolving climate prediction systems. The partners participating in this task will:

- Upgrade climate forecast systems following the recent developments in high-resolution global modelling (e.g., Horizon 2020 PRIMAVERA project) and data assimilation (coupled initialisation). This will be achieved by running selected case studies (e.g., the mid-1990s Atlantic warming, although the selection will follow a consultation process with the user panel).
- Assess the relative merits of different initialisation methods like coupled ensemble initialisation.
- Assess the role of non-oceanic drivers on decadal climate prediction.
- Investigate the relative merits of different methods for the representation of forecast uncertainties (multi-model ensemble of opportunities, perturbing physical model parameters and stochastic approaches) to produce more reliable and action-oriented climate predictions.
- Investigate the sensitivity of decadal forecast systems to both natural and anthropogenic aerosols by repeating some of the decadal forecasts (DCPP component C).
- Explore the suitability of the decadal predictions as a source of information for the UN Framework Convention on Climate Change (UNFCCC) global stocktake cycle. Estimate the probability of crossing the 1.5ºC threshold for the first time.

Deliverables (Summary)

D1.1: Compilation and combination of multiple initialised climate predictions and delivery of real time climate predictions in collaboration with WMO **(M24)**

D1.2: Construction of probability forecasts for the near term horizon (up to 10 years) from multiple sources of information for a number of the most commonly used variables and tailored to specific applications **(M40)**

D1.3: Recommendations for the development of a new generation of climate forecast systems **(M48)**

Work package number	2		**Lead Beneficiary**			Met Office		
Work package title	Producing uncertainty quantifications/PDFs and realisations of future climate on time-scales beyond 10 years							
Participant number	**1**	3b	6	8	9	11	12	13	14
Short name of participant	**Met Office**	CNRS/ CNRM	ETH Zürich	CMCC	UNESCO ICTP	KNMI	SMHI	UEDIN	UOXF
Person/months per participant:	**68**	42	36	24	30	43	20	15	6
Start month	M01			**End month**	M48				

Objectives

This work package will improve the methods used to characterise uncertainty in future projections of climate change and variability out to around 40+ years, and to develop and test methods to provide new realisations of future climate within the envelope of uncertainty. As such, we have the following objectives:

- Test existing and develop new emergent/observational constraints in order to produce uncertainty distributions/probability density functions (PDFs) of future climate change.
- Apply these constraints to produce uncertainty quantifications/PDFs of future climate change, and compare with other traditional methods (unweighted model results, Reliability Ensemble Averaging).
- Determine contributions of natural variability, model uncertainty and scenario uncertainty to the provided uncertainty quantifications.

- Produce a limit set of climate scenarios ("future climate") and extreme weather situations ("future weather") that sample the PDFs in a number of user relevant statistics, and provide these as boundaries for further downscaling with non-hydrostatic model (for WP3).

This work package is led by **Met Office** (Ben Booth) and co-led by **KNMI** (Geert Lenderink)

Description of work

We will produce new estimates of UQ and, where appropriate, PDFs for future climate on projection time-scales out to 40+ years, building on previous assessments, for instance in the UK, Australia, and Switzerland using the latest climate models and more recent consideration of suitable constraints from other Horizon 2020 projects, such as CRESCENDO, APPLICATE and PRIMAVERA. Additionally, we will produce a range of plausible realisations of future climate and extreme weather (building on progress in, e.g., The Netherlands).

This WP will draw climate data in (for instance from CMIP6), and assess/evaluate historic and present day performance using observations and regional reanalyses (from C3S). A major part of the work will then be to develop and apply advances in applying emergent constraints to these model simulations, including those constraints that emerge from attribution approaches. This first aspect can be summarised as making use of observations, ensembles of 20th Century simulations, and re-analyses to constrain the models and generate a UQ/PDF of future response. The second aspect will then be to place existing and a small number of new simulations in the context of the PDFs, including providing realisations of future climate for use directly or with further downscaling, for instance in WP3. We will look at results on a seasonal and sub-seasonal time resolution. The work is divided into three main tasks:

1. Evaluation of the utility of observational and emergent constraints.
2. Explore, test and apply a range of methodologies for producing UQs/PDFs, including estimates of the contributions of natural variability, model uncertainty and forcing uncertainty to the UQs/PDFs.
3. Deriving methods to produce a small, but efficient, ensemble of realisations.

T2.1 [M1-M36] Observational constraints (Lead: ETH, Participants: Met Office, CNRS/CNRM, KNMI, UEDIN**)**

This task deals with, applies and evaluates constraints on future climate change that arise from observed climate. Possibly useful constraints involve global metrics (e.g., on climate sensitivity or precipitation sensitivity, as regional and global changes are statistically related), or direct constraints of regional changes (e.g., based on observed regional warming, or relevant physical processes). The task will compile existing work on observational constraints, reassess them against the CMIP archives and a Perturbed Physics Ensemble, and further develop some of the constraints, in order to determine the relevance and applicability to narrowing uncertainty on future projections for variables, timescales and regions of interest to users. Challenges will come from: (i) assessing the relevance of the proposed constraints, and (ii) combining together (a possibly large number of) different constraints.

The first category of constraints considered are called emergent constraints and typically build statistical relationships between observable climate variables and future changes. They are often based on physical insight and derived in order to narrow uncertainty in the range of future climate. The second category, constraints based on observed climate change, use the observed warming to date in order to reduce uncertainty on the future warming. These constraints are often derived from detection and attribution studies (see e.g., the ASK method). We will also explore the usefulness of recent methods of dynamical adjustments, which partition the observed changes into forced thermodynamic, forced dynamic changes and unforced variability. Tasks include:

- Select from available literature constraints arising from observed climate. This will be done both for global sensitivity and the European climate in winter / summer, specifically. Reassess these constraints with CMIP6 models.
- Apply detection and attribution techniques to derive constraints from observed climate change. This will be done both for the global climate and European climate in winter / summer, specifically. This could take advantage of new CMIP6 simulations and methods recently introduced in the literature.
- Quantify implications of the selected global constraints in terms of European climate.
- The task will supply the constraint information to task 2.2 to use to derive aggregated information

for each season and variable at the European level.

T2.2 [M1-M48] Production UQs/PDFs (Lead: Met Office, Participants: CNRS/CNRM, ETH Zürich, UNESCO ICTP, KNMI, UEDIN, UOXF)

Several approaches have been devised for combining multiple strands of climate information into a distribution for risk assessment. This task will use approaches that involve weighting models according to past performance, using constraints from observations, including an ASK type method, from task 2.1. We will also consider methods that take account of clustering of results, and of filtering model ensembles using a range of criteria. Our approach is, for the first time, to apply several methods in a single study in order to understand their pros and cons in practice. An important ingredient to the methods is the existence of climate model ensembles. Several types of numerical experiments are or will be available to quantify uncertainty in future changes at various spatial scales, including:

- CMIP ensembles. Including both CMIP5 and the emerging CMIP6 archive, providing a larger sample of climate models than possible in the past. There will be the opportunity from CMIP6 of better isolating particular aspects of climate response, for instance using HiResMIP, LUMIP, AirchemMIP and C4MIP.
- CORDEX ensembles with various regional models of (relatively) high resolution.
- PPEs where one single climate model is run with a large number of parameter sets (or parameterisations) to explore sensitivity/uncertainty (e.g. the CPDN or UKCP18 ensembles). Models that include stochastic physics schemes will be considered, for instance simulations with the EC-Earth model as part of Horizon 2020 PRIMAVERA and Climate-SPHINX (Stochastic Physics HIgh resolutioN eXperiments).
- Regional and global model ensembles from a single climate model configuration (initial condition ensembles).

This task will merge information from these ensembles, as well as selected observational and emergent constraints to generate UQs/PDFs representative of current knowledge / understanding of future changes. An important aspect will focus on overcoming the scientific challenges of making practical use of these ensembles, including issues of interdependency between models in CMIP5, between generations of different CMIPs, and even more so for PPE and initial condition ensembles. The UQs/PDFs will be presented in the form that includes contributions from both model uncertainty and natural variability. From a climate and statistics point of view, the limits of providing robust probabilistic information will be evaluated. The participants in this task will:

- Select constraints to apply based on Task 2.1 and climate model variables with input from WP6 and the user panels. There will also need to be consideration of what spatial scales these can be applied to. Select final set of climate model data to use as inputs and assemble input data.
- Apply individual constraints to model datasets and where appropriate extended emulated distributions derived from the model datasets. Consider the physical credibility of each constraint.
- Apply multiple constraints to the datasets in order to investigate the interactions.
- Produce outputs of weighted distributions of model data, filtered distributions and, where appropriate, pdfs of model response. Assess the role of natural variability of the spread, including using results from Task 2.1.

T2.3 [M1-M48] Construction representative realisations (Lead: KNMI, Participants: Met Office, ETH Zürich, SMHI, UEDIN**)**

This part of the project will evaluate a range of different methods for generating ensembles of realisations of future climate and future weather that are consistent with the UQs/PDFs from Task 2.2, for use, for instance, in impact studies and further dynamical downscaling.

In evaluating the methods to produce the ensembles of realisations, we will use a range of criteria, including ease of obtaining the input data, the reliability in both the middle of the distribution and the tails and the treatment of different types of uncertainty. We will consider issues such as the relative merits of a smaller ensemble made using a more physically credible climate model compared to a larger ensemble with a more simplified model. The output from this task will be event sets of future weather events and all plausible transient climate pathways. We will also work with the other work packages in order to understand the

usability and usefulness. The participants in this task will:

- Provide a set of realisations by sub-selecting from the available EURO-CORDEX and CMIP6 simulations. Methods, based on clustering of the modelling results, are further developed to provide an optimal sub-selection that spans most of the uncertainty in the determined PDFs from this WP.
- Provide a set of realisations using a perturbed physics ensemble. This could give a broad range of long term changes, for instance associated with soil drying feedback in summer and cloud feedbacks
- Provide a set of realisation using initial condition perturbed ensembles, and selecting members using the natural variability (Lenderink et al. 2014). This is in particular suitable for selecting very rare events in the tails of the distribution, such as a European summer 2003 event.
- Convene a workshop jointly with WP5. The focus for Task 2.3 will be to bring together expertise on producing storylines and future plausible weather realisations... This will complement the WP5 focus in assessing the consistency of trends between projection data and establishing the physical basis of the projected changes.
- Information will be provided to WP4 for the development of user guidance.

Deliverables (Summary)

D2.1: Report on the evaluation and combination of potential observational/emergent constraints relevant to European climate projections **(M24)**
D2.2: Evaluation report on difference methods to product UQs/PDFs **(M24)**
D2.3: Production of UQs/PDFs, including separation into different components (natural variability, model uncertainty, forcing uncertainty) **(M42)**
D2.4: Set of plausible scenarios optimised for the climate around 2050 and optimised for the transient period, that are set in the context of the UQs/PDFs from D2.3. In addition, selection of a set of short extreme weather episodes in present and future climate **(M42)**

Work package number	3			**Lead Beneficiary**				UNESCO ICTP			
Work package title	Demonstrator of high impact weather in a changing climate										
Participant number	1	3a	3b	4	5	6	7	8	**9**	11	12	15
Short name of participant	Met Office	CNRS/ IPSL	CNRS/ CNRM	Deltares	DMI	ETH Zürich	HZG	CMCC	**UNESCO ICTP**	KNMI	SMHI	UCPH
Person/months per participant:	22	39	52	10	12	36	40	21	**84**	31	44	12
Start month	M01					**End month**	M48					

Objectives

This work package will provide a demonstration of the value of the EUCP system through the investigation of high-impact extreme weather events. The specific objectives of this work package are:

- To develop a simulation strategy for validating CP-RCMs and for generating a comprehensive portfolio of extreme event simulations for the historical period (1980-2015) and the near term future (~1-40 years), including continuous decadal-scale simulations over a focus domain (a pan-Alpine region) and event-based simulations at the pan-European level.
- To develop and optimise the CP-RCMs for the simulation of high impact weather events by employing simulations of observed extreme events in the historical period.

- To simulate high impact weather events for the historical period and the near term future and to assess changes in the characteristics and frequency of high impact events for the next decades.
- To generate a portfolio of high impact weather events, suitably processed for use in other WPs.

This work package is led by **UNESCO ICTP** (Filippo Giorgi) and co-led by **SMHI** (Erik Kjellström)

Description of work

WP3 will develop and utilise seven state-of-the-art regional climate models at convection permitting resolutions (or CP-RCMs; RegCM4-NH [UNESCO ICTP], HARMONIE [SMHI, DMI, KNMI], REMO [HZG], UKMO-RCM [Met Office], WRF-ORCHIDEE [CNRS/IPSL], AROME [CNRS/CNRM], COSMO-CLM [ETH Zürich, CMCC]) to produce a large portfolio of simulations of high impact weather events for an historical period (1980-2015) and a near future time period (1-40 years). Two approaches will be pursued: (i) the CP-RCMs will be run at 1.5-3 km resolution for continuous multi-decadal simulations over a common domain covering the pan-Alpine region; (ii) extreme events of different types will be simulated throughout the pan-European region via short, event-based experiments. Changes in structure, characteristics and frequency of high impact events will be assessed, along with relevant underlying processes An in depth model validation will be carried out against high-resolution observation datasets. The data will be provided to WP4 for translation into hazard and risk information for targeted end-users.

T3.1 [M1-M12] Design of the CP-RCM simulation strategy (**Lead: UNESCO ICTP**, Participants: Met Office, CNRS/IPSL, CNRS/CNRM, Deltares, DMI, ETH Zürich, HZG, CMCC, KNMI, SMHI, UCPH)

This task will design a simulation strategy aimed at (1) testing and optimising the CP-RCMs for the simulation of extreme events; and (2) producing an optimal multi-model based portfolio of high impact extreme events for the historical period (1980-2015) and the near term future (~ 1-40 years) over Europe. This strategy will follow two approaches: (i) the CP-RCMs will be run for continuous multi-decadal (10-20 years) time-slice simulations over a focus sub-domain of Europe, the greater Alpine region, at grid spacings of 1.5 to 3 km (This is the focus region of a CP-RCM CORDEX FPS, and hence EUCP will benefit from a strong synergy with this FPS); (ii) event-based simulations throughout Europe, which will allow the completion of relatively large ensembles of extreme events and the in depth study of underlying processes. Different types of high impact events will be considered (e.g. intense precipitation episodes, severe storms, strong winds, medicanes) through meteorological indicators based on variables simulated in a robust way by the models (e.g., sea level pressure, geopotential height, vertical profiles, precipitation and temperature) in order to maximise common cross-model behaviours. Events will be selected from high-resolution (0.11 degrees) RCM experiments completed as part of the EURO-CORDEX, MED-CORDEX and COPERNICUS programmes. The application needs of WP4 will be considered and an optimal matrix of GCM/RCM/Scenario experiments will be designed to cover the different sources of uncertainty affecting the changes in extreme events.

T3.2 [M4-M18] Assessment and optimisation of the CP-RCMs (**Lead: ETH Zürich**, Participants: Met Office, CNRS/IPSL, CNRS/CNRM, DMI, HZG, CMCC, UNESCO ICTP, KNMI, SMHI,UCPH)

This task will assess and optimise the CP-RCMs for the simulation of high impact weather events based on the protocol derived in Task 3.1. The models will be run using boundary conditions from 0.11 EURO-CORDEX simulations driven by ERA-Interim reanalysis fields for both the continuous simulation approach for the focus Alpine domain and the pan-European event-based approach. The continuous simulations will cover multidecadal time slices (10-20 years) within the ERA-Interim period (1980-2015). For the event-based approach, high impact events that occurred across Europe during the entire ERA-Interim period will be selected and simulated. Two of the CP-RCMs (COSMO-CLM by ETH Zürich and the Met Office's UKMO-RCM) will run a continuous decade-long simulation over a larger domain covering most of the European region. The models will be compared to available high resolution observation datasets.

T3.3 [M15-M42] Completion of a large ensemble of extreme event simulations using the CP-RCMs (**Lead: SMHI**, Participants: Met Office, CNRS/IPSL, CNRS/CNRM, DMI, ETH Zürich, HZG, CMCC, UNESCO ICTP, KNMI, UCPH)

This task will produce large ensembles of high impact weather events with the CP-RCMs assessed in Task 3.2 for the historical period (1980-2015) and near future (~1-40 years), following the experiment protocol devised in Task 3.1. The simulations will be carried out using a double nesting method employing

intermediate GCM-driven 0.11 RCMs to drive the CP-RCMs or by using high resolution GCMs to drive directly the CP-RCMs. The simulations will include continuous time slices of 10-20 year length for the historical and future periods over the Alpine focus sub-region, and large ensembles of high impact events throughout Europe. CMIP5 as well as available CMIP6 GCM experiments will drive the simulations through double nesting or direct nesting in high resolution GCMs. Changes in statistics, structure and characteristics of the high impact events in response to different levels of warming will be assessed and uncertainties deriving from the use of large multi model ensembles will be characterised. Techniques such as the "surrogate climate change" scenario will be considered to assess underlying processes.

T3.4 [M24-M48] Post-processing and transfer of a large portfolio of extreme event simulations in a format usable by other WPs (**Lead: HZG**, Participants: Met Office, CNRS/IPSL, CNRS/CNRM, Deltares, DMI, ETH Zürich, CMCC, UNESCO ICTP, KNMI, SMHI, UCPH)
This task will generate a multi-model based ensemble of high impact events for the historical and future period based on the results of the simulations of Task 3.3, including both the time-slice approach for the Alpine focus sub-region and the event-based approach at the pan-Europe level. The data will be post-processed to optimise its use in the risk-assessment applications of WP4, which may require the use of post-processing techniques such as bias-adjustment. The dataset will be made available to other WPs of the project as it is incrementally produced (most noticeably WPs4, 5 and 6).

Deliverables (Summary)

D3.1: Report on simulation strategy for the continuous experiment approach over the Alpine focus sub-region and the event-based approach at the pan-European level **(M12)**

D3.2: Fully assessed CP-RCMs for the simulation of high impact events **(M18)**

D3.3: Fully assessed multi-model based ensembles of simulations of high impact weather events for the historical and near future periods (~1-40) **(M42)**

D3.4: Portfolio of suitable post-processed high-impact weather events for the present day and near future **(M48)**

Work package number	4		**Lead Beneficiary**		Deltares		
Work package title	End user driven characterisation of near term trends in regional climate impact and risks						
Participant number	1	2	3a	**4**	7	8	10
Short name of participant	Met Office	BSC	CNRS/ IPSL	**Deltares**	HZG	CMCC	IIASA
Person/months per participant:	2	36	20	**56**	8	40	66
Start month	M01			**End month**	M48		

Objectives

This work package will pursue the following main objectives:

- Conduct user needs assessment of the EUCP System.
- Develop an ensemble-based outlook of trends in pan European hydro-meteorological hazards for the near term (~1-40 year).
- Develop sectoral and cross-sectoral indicators to assess future hydro-meteorological risks (e.g., flash flood, river flood, storm surge, drought, heat waves) at various spatial scales relevant to end users in support of monitoring SDGs 13 and 6 for the near term (~1-40 year).

- Advance climate and non-climatic attribution of hydro-meteorological events and impacts at various spatial scales focussing on indicators defined in Task 4.2.
- Develop an event catalogue of past and future impacts for various sectors.
- Validate usability (agile approach) of the EUCP service products with and by end users (public sector, private sector, science and the general public).

This work package is led by **Deltares** (Albrecht Weerts) and co-led by **CNRS/IPSL** (Robert Vautard)

Description of work

WP4 will corroborate the EUCP System for and by end users (e.g., public sector policy makers, business organisations and other customers) and purveyors of downstream climate services. We will establish a reliable and quality-assured translation of climate predictions into impact indicators, co-designed and co-developed by relevant end users and purveyors. The indicators will support monitoring the progress for the SDGs, as well as the relevant targets of the EU Sendai Framework for Disaster Risk reduction (SFDRR). Indicators will be developed in support of various sectors/priority areas of the Global Framework for Climate Services (e.g., water, energy, agriculture and food security, disaster risk reduction, health, urban environments). Key-input for this analysis are the high resolution climate projections of rainfall, wind and other relevant variables provided as gridded time-series by WP2. In addition case studies of Task 4.2 will directly interact with WP3 to ensure the applicability of developed projections of weather extremes.

We will undertake research into attribution of climate versus non-climatic (e.g. population growth and socio-economic development) drivers as benchmark to analyse the trends in hydro-meteorological risks and demonstrate where climate risks will be amplified in Europe in the near term. Finally, the service products of the European Prediction System (e.g., hydro-meteorological hazards and developed indicators) will be corroborated with and by end users and stakeholders applying an agile approach.

T4.1 [M1-M12] Review of users' needs (Lead: HZG, Participants: CMCC)
This task will gather and review stakeholder analysis, interviews and surveys conducted within C3S projects (e.g., SIS, SECTEUR, QA4Seas, DECM) and ongoing Horizon 2020 projects (e.g., IMPREX, BINGO, CLARA, EUMACS, MARCO, PRIMAVERA, APPLICATE) to list and sort user needs for the EUCP service.

T4.2 [M1-M48] Ensemble-based outlook of trends in (cross)-sectoral indicators (**Lead: Deltares,** Participants: BSC, CNRS/IPSL, CMCC, IIASA)

Task 4.2a [M1-M48] Urban rainfall extremes (**Deltares)**
This task will construct a multi-method approach for detection of trends in precipitation extremes using rainfall projections from WP2 and PDFs of future extremes derived in WP3. The task will be conducted for the city of Rotterdam that is part of the Rockefeller Foundation's '100 resilient cities' challenge and for which long observational records are available but can be executed for any city in Europe / the world. Regular interaction with the local government will help to produce user-centred and demand-driven information. A selection of past and future extreme events will be run through a 2D flood model (Delft-FM) to produces maps with current and future urban flood risk.

Task 4.2b [M1-M48] Coastal flooding and erosion hazards and risks (**Deltares**, CMCC)
We will develop a multi-resolution technique to estimate coastal flooding, storm erosion and resulting damages. The modelling-chain will require high spatial and temporal resolution climate projections of wind, air pressure and sea level rise from WP2. Resolutions should be high enough to capture tidal movement, surge and extremes therein. The Delft3D-FM global surge and tide model (Muis et al., 2016) will be applied, driven with time-varying wind fields, as well as WaveWatchIII for wave parameters. The higher resolution XBeach (Roelvink et al., 2009) surge and wave models will be used to obtain surge levels, storm erosion, overland flooding and wave hazards. The impact model FIAT (Wagenaar et al., 2016) will be used to calculate economic impacts. This task will collaborate with the Joint Research Centre (JRC) that has developed a European-wide model for coastal storm surge risk (Vousdoukas et al., 2016 a,b).

Task 4.2c [M1-M48] Hydrological extremes and risks - communicating uncertainties in climate risk (**IIASA**, CMCC)
Future climate extremes and their impacts on hydrology vary widely for different regions of Europe. Various

hydrological impact assessments have been produced in for example ISI-MIP and FP6 WATCH. We will use the ISI-MIP simulations to benchmark new flood, drought and groundwater resources projections derived from the European Climate Predictions in WP2 and WP3. In addition, by interaction between data providers and end-users we will answer open research questions as: (1) how to represent uncertainty quantitatively in a way that is both scientifically correct and meaningful to the diverse users, (2) how to integrate information with quantified uncertainty into participatory assessments of water-related climate risks and adaptation strategies. This will be defined via end-user interaction in WP6 and together with BSC and CMCC in task 4.4. We plan to collaborate with the JRC that has developed a European-wide flood forecasting system (European Flood Awareness System (EFAS)) for flood risk assessment.

Task 4.2d [M1-M48] Wind impacts with attribution to climate change and other factors (**CNRS/IPSL**, BSC)
CNRS/IPSL and BSC will work with the wind energy stakeholders to define case studies where climate projections (CNRS/IPSL) and decadal predictions (BSC) for wind energy have an added value to the current business. Two main topics will be covered. The first topic is the multiannual and multidecadal trend in surface winds, known as the "wind stilling" or potential surface wind declines [Vautard et al., 2010] and whether these will affect wind energy production. The second case that will be analysed is the changing risk of long wind calms, sometimes called "wind droughts", which induce significant lack of revenues for wind energy producers. In this case, ensemble of climate projections and decadal predictions from past, current and future climate produced in WP2 will be used, in combination with a Generalised Extreme Value theory to estimate changes in risks of such events, at the regional scale, or specific wind farms locations.

Task 4.3 [M1-M36] Climate and non-climatic contribution to future risk (**Lead: IIASA**, Participants: Deltares, CMCC)
Using the above indicators for (cross-) sectoral climate impacts, attribution of hydro-meteorological events and impacts will be developed as a service. In order to better understand the underlying mechanisms of climate impacts, assessments will be performed for both climate and non-climatic drivers at various spatial scales. To analyse non-climate drivers, we will use the socio-economic data from the IIASA's Water Futures and Solutions Initiative (WFaS; Wada et al., 2016). A key component of the WFaS analysis is the assessment of human water management that help to understand the extent of water resources challenges consistently with the community-developed SSPs and newly adopted SDGs.

Task 4.4 [M13-M48] Validation of developed indicators (**Lead: BSC**, Participants: CMCC, IIASA)
This task will validate the usability of WP4 products (e.g. indicators, event catalogue, hazard outlook, flood risk maps). End users will be engaged from the start of the project and will be consulted regularly to tune the EUCP service products and guarantee translation of the climate predictions into actionable indicators and event triggers, where focus will be on the case-studies of Task 4.2. Within Task 4.4 we will narrow down the list of indicators to those most relevant to the potential EUCP end users. The development of the event catalo and the hazard outlook will be accompanied with regular user engagement activities to assure that most useful information is provided in a way that will support decision making. The user panel established in WP6 will be the initial group that participates in the co-design and evaluation of the EUCP service products. The group will grow throughout the project.

Deliverables (Summary)

D4.1: Report on end user requirements for the EUCP **(M12)**
D4.2: Report on climate/non-climatic attribution of hydro-meteorological events and losses **(M36)**
D4.3: Report on outlook of future hazards **(M42)**
D4.4: Event catalogue of past and future impacts **(M44)**
D4.5: Report on usability of EUCP service products for end users **(M46)**

Work package number	5	**Lead Beneficiary**	UOXF
Work package title	Towards a seamless near term European climate prediction system		

Participant number	1	2	3a	3b	5	6	9	11	12	13	**14**	15
Short name of participant	Met Office	BSC	CNRS/ IPSL	CNRS/ CNRM	DMI	ETH Zürich	UNESCO ICTP	KNMI	SMHI	UEDIN	**UOXF**	UCPH
Person/months per participant:	29	36	20	14	4	12	6	12	6	15	**34**	8
Start month	M01					**End month**	M48					

Objectives

The aim of this cross-cutting work package is to develop methodologies to bring together initialised decadal climate predictions (WP1), non-initialised climate projections (WP2) based on global climate models, and high-resolution regional climate projections (WP3) in order to provide seamless climate information for users over a period of 1 to 40 years into the future with a focus on the European region. Its objectives are:

- Comparison of predictions based on global initialised versus non-initialised simulations for common prediction time horizons. Estimation of the prediction time until which the initialised predictions show skill compared to non-initialised simulations for different large-scale and local variables.
- Combine global initialised forecasts with non-initialised forced-only predictions. Tests of the combining methods with a perfect model setting. Estimation of added value for combined predictions for different variables and regions.
- Develop methods to merge information from the high-resolution regional model simulations with global climate predictions.
- Evaluate the extent to which observational, physical and emerging constraints are reflected in the predictions of variables of direct relevance for (local) users.
- Develop storylines and cases consistent with the result of the combined forecasts and according to the user needs identified.

This work package is led by **UOXF** (Antje Weisheimer) and co-led by **UEDIN** (Gabi Hegerl)

Description of work

The goal of this cross-cutting work package is to develop and test scientific methodologies to merge predictions from the regional and global (initialised and non-initialised) model simulations into a seamless prediction system, and to provide useful information for the stakeholders at the regional scale. Such a seamless prediction system will ultimately not only provide actionable climate information but also be used for climate-related risk assessments, climate change adaptation programmes and businesses operating at a regional and local scale.

Deriving seamless climate information across the 1-40 year prediction time scale involves assessing the performance of each system depending on the prediction lead time, identifying situations where one of the systems can be shown to have added value over the other and over any benchmark that can be identified. A key element will be applying approaches to understand when the information provided by the initial conditions is no longer adding value and under which conditions the information provided by the non-initialised forced predictions will be useful at the regional scale. The merging of regional and global climate information will be explored further in this work package for three methodologies: blending of PDFs, creation of discrete scenarios, and storylines of individual events. The different predictions will be combined such that users of the seamless system are presented with trustworthy, self-consistent climate information about the future. This work package has five tasks:

T5.1 [M1-M36] Providing guidance on the use of existing global climate predictions systems for regional predictions (**Lead: UOXF**, Participants: BSC, CNRS/CNRM, UEDIN**)**

- Comparison of skill in initialised and non-initialised global predictions for overlapping prediction time scales.
- Assess the evolution of the ensemble spread and model reliability with forecast time in both initialised and non-initialised simulations.
- Assess the role of the forced and natural variability in the PDFs generated in WPs 1 and 2.
- Characterise the drift in climate predictions and the quasi-stationary systematic errors of the same set of models in historical simulations.

T5.2 [M12-M48] Explore and test a range of methodologies for generating multi-model seamless uncertainty quantifications for climate predictions at the regional scale using global initialised and non-initialised simulations (Lead: BSC, Participants: Met Office, UEDIN, UOXF, UCPH**)**

- Test combination methodologies with a perfect model setting based on using coupled model simulations from the CMIP archive and on using simplified toy models of the climate that can replicate both predictions and projections but under controlled conditions.
- Estimate relative merits of initialised and non-initialised methods in global simulations during the first 10 years when data from both approaches exist.
- Estimation of added value for combined predictions in terms of merge point and the merged forecast for different variables and regions compared to non-initialised forced-only simulations.
- Test methods traditionally used to quantify uncertainty and combine different members in projections and assess the forecast quality of the resulting predictions.
- Determine the reliability of constrained spread and its relevance to the users.
- Application of reliability calibration techniques for climate predictions based on reliability information of verified past climate forecasts.

T5.3 [M13-M36] Evaluate the extent to which observational constraints and emergent constraints are reflected in the probability distributions (**Lead: UEDIN**, Participants: Met Office, CNRS/IPSL, ETH Zürich**)**

- Evaluate to what extent the constraints on decadal subpolar gyre predictability and subsurface stratification are reflected in the merged seamless information.
- Assess the risk of abrupt (<10 years) subpolar gyre change in the seamless information.
- Evaluate to what extent the constraints on seasonal-mean and extreme temperature and seasonal precipitation over large European regions are reflected in the merged seamless information.

T5.4 [M12-M48] Integrate information arising from high-resolution regional projections into the overall prediction system for Europe (**Lead:** KNMI, Participants: CNRS/CNRM, DMI, ETH Zürich, UNESCO ICTP, SMHI, UCPH**)**

- Add value and fine-scale information to the global predictions using high-resolution regional climate simulations for specific conditions.
- Employ methods to blend information from global climate model with results of regional climate models. Simple blending techniques such as pattern scaling and more advanced using global temperature rise and circulation statistics will be employed.
- Determine the added value of the very high resolution, non-hydrostatic simulations compared to standard hydrostatic regional model simulations.

T5.5 [M24-M48] Develop storyline and cases consistent with the result of the combined forecasts (**LEAD: Met Office**, Participants: UOXF, UEDIN, UCPH)

- Derive methods to construct small ensembles of realisations from the initialised simulations until the merge point in time.
- Identify periods in the non-initialised runs that share common characteristics in terms of biases, key modes of variability and power spectra with the initialised forcing.
- Produce combined time-series and event sets from the initialised and non-initialised simulations. To understand at what point in the initialised simulations the join to the non-initialised results should commence to get the minimum distortion of the results.
- Examine how well the combined event sets and transient simulations from the two forecast types span the range of the uncertainty quantifications/pdfs globally and regionally. In dialogue with the users expectations to provide guidance on how these combined series might be applied and their limitations for decision making.

- Bring together multiple strands of evidence to build a robustness statement to be provided to end users alongside projected changes of key climate variables. To assess the degree of agreement in the sign and magnitude of projected changes across the climate projection tools including an assessment of whether the projections are robust to regional downscaling and are consistent with observed trends.
- Run a workshop in conjunction with WP2 (T2.3) to discuss the physical basis of these projected changes. The synthesis of the outcomes from the workshop and the consistency of projected changes will contribute to a statement on the robustness of the various projected changes and indication of whether the storylines and users cases span the projected changes, on a variable and temporal basis.

Deliverables (Summary)

D5.1: Report on relevance of observational and emerging constraints and their reflection in the prediction distribution functions **(M30)**

D5.2: Report on the evaluation of forecast quality over the 1-40 year time span for both the global initialised forecasts and the non-initialised projections **(M36)**

D5.3: Report on the development of methods to merge probabilistic forecasts based on global initialised and non-initialised predictions to provide a seamless prediction system **(M48)**

D5.4: Report on merging methods based on, and added value of, the high-resolution regional climate simulations **(M48)**

D5.5: Report on merging method developed for storylines, and the production of combined time-series and events sets generated from a combination of initialised and non-initialised model simulations with guidance on their use **(M48)**

Work package number	6			**Lead Beneficiary**			UCPH		
Work package title	Documentation, data exchange and integrating science with users								
Participant number	1	2	4	7	8	9	10	12	**15**	16
Short name of participant	Met Office	BSC	Deltares	HZG	CMCC	UNESCO ICTP	IIASA	SMHI	**UCPH**	NLeSC
Person/months per participant:	9	24	10	24	18	12	30	6	**16**	54
Start month	M01					**End month**	M48			

Objectives

This work package will refine and execute EUCP strategic work plans on how to deliver the EUCP products – to ensure EUCP is being recognised as an authoritative seamless prediction system. This work package will coordinate the handling of data and metadata, information, concepts etc., in order to match what is needed by other projects and particularly as specified by C3S. More specifically the objectives are:

- To define the EUCP documentation/standards and implement them through cross-project activities.
- Exploit EUCP science to assess scientific robustness of project deliverables.
- To capitalise on end users expectations of usefulness and value of project deliverables.
- To ensure the delivery of an *authoritative* climate prediction system.

This work package is led by **UCPH** (Jens Hesselbjerg Christensen) and co-led by **HZG** (Claas Teichmann)

Description of work

WP6 will have a close link to all other WPs (e.g., WP4 activities become generic and applicable to other interested parties through WP6). The need to ensure strong engagement with a variety of stakeholders and end users is essential to EUCP. The provision of a Europe-wide prediction system can only be realised through up-front involvement with a variety of users, including the EC and its funded programmes and projects (e.g., C3S, ERA4CS), National Met. Services including their collaborative bodies, and large international organisations as well as their more specialised programmes and end users. WP6 is structured to ensure a coordinated involvement of users within and across other WPs as well as to optimise the involvement of the identified users and central stakeholders of the expected scientific outcome of EUCP. WP6 will draw on a range of stakeholders, including people in the External Expert Advisory Board (managed by WP7) and two Multi-User forums (one for policy-maker users and one for practitioner users, both managed by WP6) to advise on how to make best use of scientific developments.

WP6 will ensure proper connection and information exchange within EUCP to ensure a coherent system design and will keep information and intra-project communication up to date.

EUCP is set to deliver an ambitious amount of downstream data. The EUCP data service has two goals: (i) to assist the scientists with accessing, blending and analysing the data, and (ii) to interact with the users of the new products. Most of the data will become available through C3S. We will build upon the software architecture developed for the C3S MAGIC project to provide access to the different data sets for the scientists and professional end-users. A flexible analytics platform will be build to effectively assess the data and allow computing the desired products. To re-use algorithms that produce the blended products, notebooks (e.g., Jupyter for Python) will be implemented in line with the FAIR data principles, building upon the climate4impact framework developed in the FP7 IS-ENES2 project, with more flexibility to access the products for preferred regions and timeframe and to interact with the scientists on the information.

T6.1 [M1-M48] Collaboration strategy (**Lead: CMCC**, Participants: all other WP6 partners**)**
Terms of reference (ToR) covering scope, composition, working rules and technical support of the Multi-user Forums will be established. A set of professionally designed and facilitated thematic workshops involving the Platforms will be organised, timed to match milestones and deliverables of other WPs, will centre around the following themes:

- Workshop 1: Perception of skill in decadal prediction
- Workshop 2: Users of decadal forecasts
- Workshop 3: The role of climate predictions in refining policies

Platform activities will inform and use the European Roadmap for Climate Services. To encourage further buy-in from end users, we will collaborate with the members to co-host seminars and panel discussions at industry events, help to define procedures for collaboration and how to ensure user involvement and implementation of recommendations from EUCP reviewers. We will define and implement documentation/standards necessary to ensure delivery of an *authoritative climate prediction system*.

T6.2 [M1-M48] Clustering with research communities focusing on SC5 impacts (**Lead: UCPH**, Participants: all other WP6 partners**)**

EUCP establishes a strong clustering activity with European and international scientific communities focussing on SC5 expectations (beyond our own community) and more specifically with: (i) projects funded by the SC5 strategy under current and earlier calls - e-infrastructures (e.g., ESiWACE www.esiwace.eu), and SC5 (e.g., PRIMAVERA, CRESCENDO, IMPREX) and other societal challenges (SPICES) and other EU (e.g., FP7 ICE-ARC and NACLIM); (ii) projects funded under other parts of the Horizon 2020 programme relevant for the SC5 strategy implementation - Blue Growth BG9 and BG10 (e.g., INTAROS, APPLICATE and Blue-Action); and (iii) Initiatives such as Copernicus, and projects funded by the Belmont Forum/JPI Climate calls and H2020 Climateurope**.**

Main outcome will be a series of joint activities for allowing the exchange of data and results between the scientific communities beyond the project. Clustering will be fostered to ensure smooth exchange of data and

results between projects having common or related goals.

T6.3 [M1-M24] Mapping existing scientific knowledge gaps and defining best practice relating to the use of climate predictions in climate change response and adaptation (**Lead: IIASA**, Participants: all other WP6 partners)

In WP4, Task 4.1 serves as a vehicle for co-generation of climate prediction, consultation, dialog, external review and collaboration with a range of user organisations and networks with a shared interest in climate simulations at various scales. T6.3 takes this one step further and feed these developments into the more general discussions bridging the gaps between providers and users of climate prediction information. As a result of joint workshops and white papers, the 'gap maps' will be produced as input for Task 6.4. Joint workshops ("Mapping the gaps" events) will be organised with Task 6.2 and members of the Multi-user Forums to (re)formulate open research questions of joint interest also within the different scientific WPs in EUCP. The Task 6.1 thematic workshops will be used as a vehicle, if possible. Questions to address together, could be (list non-exhaustive): What are the optimal methods to initialise ocean heat content, snow cover and sea ice to and to represent the initial uncertainty in prediction systems? How is seasonal to decadal predictive skill modulated by multi-decadal climate variability? Are predictive systems and the observational network adequate? How will improved representation of small-scale processes affect the predictability (e.g., droughts or large scale flooding and flash floods)?

T6.4 [M1-M48] Engagement with business, policy and decision makers (**Lead: HZG**, Participants: all other WP6 partners**)**

(1) Emerging business actors need climate information for developing new innovative climate-related services and products. In order to engage with emerging business actors, EUCP will build upon existing initiatives (e.g. Blue-Action, Climateurope and Climate-KIC) and will take part in relevant, focussed events. Together with business partners from selected sectors, proofs of concept for prototype products and best practice examples will be designed and developed in order to foster climate service market applications, based on the EUCP system.

(2) Established businesses rely on improved climate forecasts. Engagement with the established business sector will be achieved, e.g., through existing contacts by EUCP partners and the involvement of *Climateurope* and will support their partner businesses in developing concepts for new sustainable business models and/or strategies that improve their capacity to respond to the impact of climate change. EUCP will investigate possibilities for implementing sustainable business development strategies based on EUCP results for key European private sector business activities. As a focus, the necessary update frequency of climate change information from EUCP and the implication for newly developed and existing adaptation strategies will be investigated.

(3) Policy-makers involved in developing or implementing climate and related policies at European level will be addressed by EUCP (e.g., representatives of European Institutions, JPIs - in particular JPI Climate - International governmental and non-governmental bodies, involved in determining key policy issues relating to weather observation, prediction, climate change response and adaptation). It is envisaged that collaborative policy briefings and gap maps[1] will be circulated to policy-makers, organised together with T6.2 – T6.3. A policy report will be prepared by the project and presented in month 48 in a policy briefing.

T6.5 [M1-M48] Online collaboration and internal communication (**Lead: CMCC**, Participants: all other WP6 partners**)**

A digital platform dedicated only to project partners, allowing for the exchange of data and information in a private environment will be developed facilitating the dialogue among partners and the integration of the outcomes provided by the different WPs. Similarly, a digital platform dedicated to the dialogue with/among selected stakeholder and users will be developed. This platform will be accessible upon invitation by EUCP and will be the project tool to share data, to get feedback from stakeholders and users, to promote polls and questionnaires, to deliver information about the project. The digital platforms will be highly flexible and adapted to the different needs of users within EUCP. The internal discussion will be moderated and

[1] Gap maps drafted as an outcome of the exchanges with the scientific communities in T6.3, these maps indicate what we know and do not know in terms of climate prediction and related adaptation preparedness.

structured throughout the project.

T6.6 [M1-M48] Authoritative and sustainable data service (**Lead: NLeSC**, Participants: all other WP6 partners**)**

To deliver the internal and external data services this task needs to and will provide the C3S MAGIC software that allows for data access in the Copernicus CDS for scientists in WPs 1-5 and extend it to access other distributed data through open standards (OPeNDAP). An analytics software layer on top of the data access to manipulate data (e.g., with R or Python), with as option to include with Jupyter notebooks (Python) to ensure provenance will be developed. Furthermore, a Docker image of the data access and analytics and develop interface to flexibly compute the analytics on any system (e.g. private or public cloud) will be provided. Visual analytics software for users to explore different approaches to regionalised climate information for different time frames will be provided. Related to this we need to build upon Climate4impact to provide access to blended products by end-users.

An important demonstrator will be to collect, document and provide algorithms to generate blended products: metric calculation, calibration of pdfs for full probabilistic assessment, time series extraction for storylines and blending of data.

From these developments and from other activities in WP6 training to EUCP scientific users to effectively use the infrastructure needs to be provided and the engagement in end-user workshops needs to be ensured.

Deliverables (Summary)

D6.1: Project website and internal collaboration platform accessible (**M3)**
D6.2: Report about activities in research communities related to climate prediction (**M6)**
D6.3: Report on Data Management Plan in EUCP (**M6)**
D6.4: Report on literature research about existing scientific knowledge gaps and best practices related to the use of climate predictions in climate change response and adaptation (**M12)**
D6.5: Report about exchange of data and results and further planned joint activities (**M18)**
D6.6: Intermediate collection of reports about feedback and EUCP-design decisions (**M24)**
D6.7: Policy briefing about knowledge gaps and best practices (**M24)**
D6.8: Report on recommendations for collaboration protocols for identified cluster-projects (**M32)**
D6.9: Data access, analytics and provenance infrastructure for scientists (**M36)**
D6.10: Quality checker for EUCP-data to check the CDS-compliance (metadata and consistency of EUCP data itself) (**M42)**
D6.11: Data access infrastructure for end-users (**M42)**
D6.12: Final collection of reports about feedback and design decisions, and joint activities between research communities (**M48)**
D6.13: Report about concepts for prototype products and business and adaptation strategies making use of the EUCP system (**M48)**
D6.14: Policy briefings – ready for dissemination (**M48)**

Work package number	7	**Lead Beneficiary**				Met Office	
Work package title	Project management and scientific coordination of EUCP						
Participant number	**1**						
Short name of participant	**Met Office**						
Person/months per participant:	**46**						
Start month	M01			**End month**	M48		

Objectives

Project Management

- Establish and maintain top-level project management of EUCP to ensure that the objectives and impacts are efficiently and effectively achieved, on time and within the resources budgeted.
- Establish and maintain an effective working relationship between EUCP and the European Commission (EC), which includes regular reporting on project progress.
- Coordinate and facilitate effective relationships, collaboration and coordination between partners within EUCP, including sharing information associated with all project management aspects.

Scientific Coordination

- Establish and maintain the scientific excellence and coordination of EUCP activities, to ensure that the objectives, outcomes and impacts are fully achieved.
- Ensure that the appropriate level of consultation with the External Expert Advisory Board (EEAB) is established and maintained, and that their advice is integrated into the project.
- Establish and coordinate the communications strategy.
- Oversee and manage the governance associated with knowledge management and data management.

This work package is led by: Met Office (lead)

Description of work

This Work Package will manage the day to day running of the project, ensuring that all obligations under the Grant Agreement and the Consortium Agreement are successfully fulfilled.

T7.1 [M1-M48] Project management (Lead: Met Office)

Manage the project using effective management procedures based on PRINCE2 (Projects IN Controlled Environments) formal methodology. This includes the following, non-exhaustive activities:

(i) Implementation and maintenance of the Grant Agreement and the preceding Consortium Agreement;

(ii) Overall legal, financial, administrative management and reporting, including:

- Designing and maintaining partner specific templates for collecting inputs to the required EC documents.
- Implementing and maintaining a project-specific process for reporting.
- Preparing for periodic reviews by the EC and supporting the implementation of recommendations.
- Handling of project correspondence and day-to-day requests from partners and external bodies.
- Adaptation of project and management structure after changes in the work plan and the consortium.
- Organisation, execution and post-processing of meetings relating to the management of the project and other major project meetings (i.e., agendas, invitations, locations, distribution and archiving of material, minutes and action lists).
- Financial management - including transfer of project funds to partners (in compliance with directives from EC), providing clarification on budget/financial issues, monitoring and controlling the budget.

(iii) Appropriate management of ethical dimension (e.g., management of personal data, MS34); gender aspects and equality (MS35); and risks/benefits on behalf of the General Assembly;

(iv) Handling of/facilitating the resolution of any ethics issues, and any disputes/complaints in accordance with the Consortium Agreement;

(v) Implementation of competitive calls by the consortium for the participation of new beneficiaries.

T7.2 [M1-M48] Communication with the European Commission (EC) (Lead: Met Office)

Provide regular and comprehensive communication with the EC. The conduit for this will be the EUCP Coordinator and the Project Manager. This will be partly fulfilled through the provision of regular summary reports outlining the project's progress and developments (D7.1).

This task will ensure the appropriate follow-up of project obligations from the Grant Agreement (formal reporting – of science results and finances, project reviews, communication, and management). The EUCP Coordinator will ensure that the appropriate EC representative is invited to the General Assembly meetings.
If there are any major problems within the project that cannot be resolved through the appropriate management structure, the Coordinator will liaise with the EC in order to seek advice and a solution.

T7.3 [M1-M48] Coordination of internal communication (Lead: Met Office)

Share knowledge as widely as possible across the project. The Project Office will ensure optimal internal information exchange through regular and routine communications. This coordination task will be carried out in close consultation with WP6 and make use of the information sharing platform (See Task 6.5) by using a partitioned section of the platform that will be password-protected and accessible to project partners only. This will also host links to milestones, deliverables, templates, documents and tools that the project office will develop to aid the management and reporting. There will be space for each partner and work package in order to encourage continual conversations, dialogue and knowledge exchange amongst the partners. This task will also ensure the implementing and maintenance of mailing lists for scientific contacts and administrative contacts. Annual General Assemblies will also be organised.

T7.4 [M1-M48] Scientific coordination of EUCP (including risk management) (Lead: Met Office)
Maintain a holistic view of the ongoing strands of work and activities and provide technical direction. The Scientific Coordinator will carry out the coordination and monitoring of scientific excellence within the project, by regular discussion with the Coordinator and WP leaders and by scientific review of reports and deliverables to the EC. In addition, he will monitor contemporary results within the community relevant to the project, in conjunction with the EEAB and ensure that any necessary scientific aspects are incorporated into the project. WP leaders will ensure that the progress of milestones and deliverables is actively monitored and that they are delivered on time. This task will also include verifying the quality, consistency and timeliness of work. In conjunction with WP5, the Scientific Coordinator will monitor the cross-cutting aspects and linkages of EUCP. The Scientific Coordinator will manage the scientific risks. It will mean acting on unforeseen events, adapting work packages as required, highlighting possible risks early on in the project, and considering any necessary mitigation.

T7.5 [M1-M48] External Expert Advisory Board (EEAB) management (Lead: Met Office)
This task will ensure the appropriate level of consultation with the EEAB. It is essential that the project receives independent advice and feedback from the EEAB, especially in relation to the direction of the scientific research and its user applications. This task will be led by the Coordinator to ensure that the consultations with the EEAB are organised and coordinated in an efficient and effective manner, and that advice given is reviewed and acted on appropriately. The Coordinator will also ensure that the appropriate level of project information is provided to the EEAB.

T7.6 [M1-M48] Oversight of all external users/stakeholders (Lead: Met Office)
A key component will be the engagement with stakeholder and climate information end-users. Their focus and requirements are varied. Therefore, working closely with the other work packages (especially WPs 4 and 6), this task will ensure that these external entities are fully involved and integrated into the project and that they are formally represented by the Coordinator on the Management Board and at the General Assemblies.

T7.7 [M1-M48] Coordination of Dissemination and Communication Activities (Lead: Met Office)
The management of the communication activities will be undertaken in this task. An updated communications plan based on Section 2.2b (D7.2) will provide guidance for the project. Typical activities will include presenting and promoting EUCP at scientific events. This will be the responsibility of the Scientific Coordinator and all partners, who will each undertake to do this as part of their work packages.
This task will work especially closely with WP6 in ensuring that there is the appropriate level of governance around the dissemination and exploitation activities within EUCP; for example, the dissemination and exploitation plan is updated (D7.3) with a final plan produced at the end of the project (D7.4).

The project will be participating in the 'Pilot on Open Research Data in Horizon 2020. This task will link with WP6 to ensure that knowledge (including data) collected, generated and disseminated is appropriately protected and shared (intellectual property). The Coordinator is responsible for the project's knowledge management strategy and ensuring it is kept up to date and that the associated protocols are adhered to.

Deliverables (Summary)

D7.1: Short summary reports on project progress (**M 3, 9, 15, 21, 27, 33, 39, 45**)
D7.2: Updated communications plan (**M6**)
D7.3: Updated dissemination and exploitation plan (**M6**)
D7.4: Final dissemination and exploitation plan (**M48**)
D7.5: EUCP final summary and synthesis report (**M48**)

List of work packages
The table below lists the seven work packages within EUCP.

Table 3.1.2: EUCP Work Packages

WP no.	WP Title	Lead Participant No	Lead Participant Short Name	Person Months	Start Month	End month
1	Development of an interannual-to-decadal climate forecast system	**2**/8	**BSC**/ CMCC	243	1	48
2	Producing uncertainty quantifications/PDFs and realisations of future climate on time-scales beyond the near term horizon	**1**/11	**Met Office**/ KNMI	284	1	48
3	Demonstrator of high impact weather in a changing climate	**9**/12	**UNESCO ICTP**/ SMHI	403	1	48
4	Characterising trends in climate impacts	**4**/3	**Deltares**/ CNRS/IPSL	228	1	48
5	Towards a seamless near term European climate prediction system	**14**/13	**UOXF**/ UEDIN	197	1	48
6	Documentation, data exchange and integrating science with users	**15**/7	**UCPH**/ HZG	203	1	48
7	Project management and coordination	**1**	**Met Office**	46	1	48
				1,603		

List of Deliverables
The table below lists the deliverables in chronological order.

Table 3.1.3: EUCP deliverables

Deliv. (no.)	Deliverable name	WP no.	Short name of lead participant	Type	Diss. level	Delivery date (M)
D6.1	Project website and internal collaboration platform	6	CMCC	DEC	PU/ CO	M3
D7.1	Summary reports on project progress	7	Met Office	R	CO	M3, 9, 15, 21, 27, 33, 39, 45
D6.2	Activities in research communities related to climate prediction	6	UCPH	R	PU	M6
D6.3	Data Management Plan	6	NLeSC	R	PU	M6
D7.2	Updated communications plan	7	Met Office	R	CO	M6

D7.3	Updated dissemination and exploitation plan	7	Met Office	R	CO	M6
D3.1	Simulation strategy for the continuous experiment approach over the Alpine focus sub-region and event-based approach at the pan-European level	3	UNESCO ICTP	R	PU	M12
D4.1	End user requirements for the EUCP including selection of indicators	4	HZG	R	PU	M12
D6.4	Literature research about existing scientific knowledge gaps and best practices relating to use of climate predictions	6	BSC	R	PU	M12
D3.2	Fully assessed CP-RCMs for the simulation of high impact events	3	ETH Zürich	R	PU	M18
D6.5	Exchange of data and results and planned joint activities amongst research communities	6	UCPH	R	PU	M18
D1.1	Compilation and combination of multiple initialised climate predictions and delivery of real time climate predictions (in collaboration with WMO)	1	Met Office	R	PU	M24
D2.1	Evaluation and combination of potential observational/emergent constraints relevant to European climate projections	2	ETH Zürich	R	PU	M24
D2.2	Evaluation of difference methods to produce uncertainty quantifications/PDFs	2	Met Office	R	PU	M24
D6.6	Feedback and EUCP-design decisions (intermediate)	6	CMCC	R	PU	M24
D6.7	Policy briefing about knowledge gaps and best practices	6	BSC	R	PU	M24
D5.1	Relevance of observational and emerging constraints and their reflection in the prediction distribution functions	5	UEDIN	R	PU	M30
D6.8	Recommendations for collaboration protocols for identified cluster-projects	6	UCPH	R	PU	M32
D4.2	Climate and non-climatic attribution of past hydro-meteorological events and losses	4	IIASA	R	PU	M36
D5.2	Evaluation of forecast quality over the 1-40 year time span for both global initialised forecasts and the non-initialised projections	5	UOXF	R	PU	M36
D6.9	Data access, analytics and provenance infrastructure for scientists	6	NLeSC	OTHER	PU	M36
D1.2	Construction of probability forecasts for the near term horizon (up to 10 years) from multiple sources of information for a number of the most commonly used variables and tailored to specific applications	1	BSC	R	PU	M40
D2.3	Production of uncertainty quantifications/PDFs, including separation into different components	2	Met Office	R	PU	M42

D2.4	Identification of optimal subset of future climate realisations and provision of event set of present and future extreme events	2	KNMI	R	PU	M42
D3.3	Fully assessed multi-model based ensemble of simulations of high impact weather events for the historical and near future periods (~1 – 40 years)	3	SMHI	R	PU	M42
D4.3	Outlook of future hazards	4	Deltares	R	PU	M42
D6.10	Quality checker for EUCP-data to check CDS-compliance	6	NLeSC	OTHER	PU	M42
D6.11	Data access infrastructure for end-users	6	NLeSC	DEC	PU	M42
D4.4	Event catalogue of past and future impacts	4	CNRS/IPSL	R	PU	M44
D4.5	Usability of EUCP service products for end users	4	BSC	R	PU	M46
D1.3	Recommendations for the development of a new generation of climate forecast systems	1	CMCC	R	PU	M48
D3.4	Portfolio of suitably post-processed high-impact weather events for the present day and near future	3	HZG	R	PU	M48
D5.3	Development of methods to merge probabilistic forecasts based on global initialised predictions to provide a seamless prediction system	5	BSC	R	PU	M48
D5.4	Merging methods based on, and added value of, the high-resolution regional climate simulations	5	KNMI	R	PU	M48
D5.5	Merging method developed for storylines, and the production of combined time-series and event sets	5	Met Office	R	PU	M48
D6.12	Feedback and EUCP-design decisions (final)	6	UCPH	R	PU	M48
D6.13	Concepts for prototype products and business and adaptation strategies making use of EUCP system	6	HZG	R	PU	M48
D6.14	Policy briefings – ready for dissemination	6	HZG	R	PU	M48
D7.4	Final dissemination and exploitation plan	7	Met Office	R	CO	M48
D7.5	EUCP final summary and synthesis report	7	Met Office	R	PU	M48

3.2 Management structure and procedures

EUCP brings together 16 partners from across Europe and is considered to be a large project, as per the DESCA (Development of a Simplified Consortium Agreement) definition. It requires, and will have, a highly effective management structure and efficient decision making processes, ensuring that the project is well managed, delays are prevented and that all objectives are achieved. There is an overarching work package (WP7) which will provide the project management and the scientific coordination. This WP will allow the Coordinator and Scientific Coordinator to maintain a holistic view of the project, but each WP also has distinct responsibilities. WP7 will ensure the efficient day to day management of the project. It will also ensure that the science of EUCP is fully synthesised and a harmonised approach is taken, including working

in conjunction with external projects, meaning that the objectives and potential impacts are fully realised. The Coordinator and the Scientific Coordinator will be supported by the Project Manager. As the Project Office will be at the Met Office, the project will also be able to draw on in-house expertise in teams such as Legal, Finance, Communications and Climate Programme Knowledge Integration team.

3.2.1 Overview of structure and decision-making bodies/mechanisms

The structure that has been adopted for EUCP follows the DESCA Model Consortium Agreement for Horizon 2020 projects (the model favoured by the Coordinating Institution), and specific roles and decision making responsibilities have been assigned accordingly. These are illustrated in *Figure 3.2.1*, and further detail is given below.

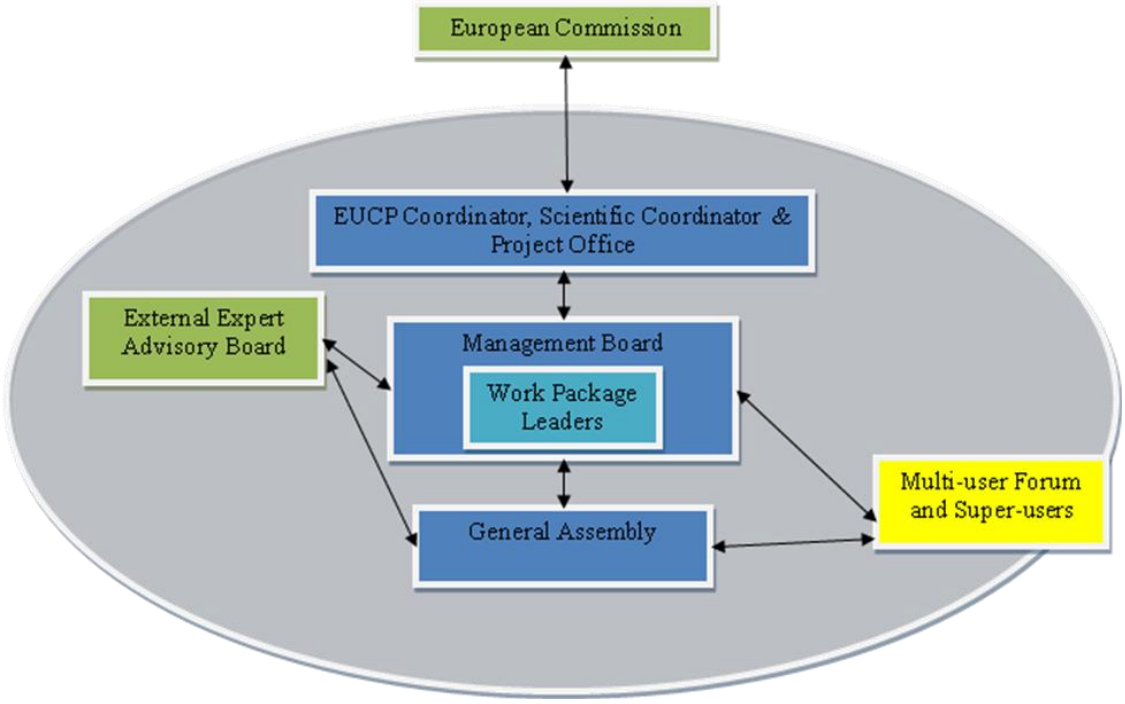


Figure 3.2.1: EUCP Management Structure

- The **General Assembly** is the ultimate decision making body for EUCP. This will be chaired by the Coordinator and will consist of representatives from all of the partner organisations.
- The **Management Board** will be the supervisory body ensuring successful execution of the project, and will be accountable to the General Assembly.
- The **Coordinator** is responsible for the overall coordination of the project and will act as the point of contact for the European Commission (EC). The Coordinator has ultimate responsibility for ensuring the scientific and technical integrity of the project and that it delivers what is expected.
- The **Scientific Coordinator** is responsible for overseeing the scientific content of the project and ensuring that all work packages are contributing to the outcomes and scientific excellence of EUCP.
- The **Project Office** will conduct the routine management of EUCP on behalf of the General Assembly and includes the **Project Manager**.
- The **WP Leaders** (and their **co-leaders**) have a responsibility to ensure delivery of their WP objectives and deliverables, working closely with the Coordinator and Scientific Coordinator to support the outcomes of EUCP as a whole.
- The **External Expert Advisory Board** is a group of independent experts, whose role is to provide advice on project progress and plans.
- The external user and stakeholder groups that EUCP will interact with through the **Multi-user Forum** are defined in Section 1.3. They will be represented on the General Assembly and the Management Board by the Coordinator.

3.2.2 General Assembly (GA)

The GA consists of all the partner organisations. It will be chaired by the EUCP Coordinator. The purpose of the General Assembly will be to:

- Act as the overall decision-making body for the project;
- Oversee political and strategic orientation of the project;
- Discuss the progress of the project and plans for the future of the project;
- Advise the Management Board on any matters relating to the work plan;
- Share and disseminate knowledge as widely as possible across and beyond the project (including adherence to Open Access, intellectual property and data management requirements);
- Ensure the proper operation of the consortium, including financial management, reporting and communication (and any alterations to the Consortium Agreement);
- Approve recommendations in the event of changes to the consortium composition or major budget re-allocations;
- Determination of a defaulting partner;
- Oversee and resolve risks; any ethical issues that may arise; disputes and complaints;
- Oversee the cross-cutting theme of gender balance.

There will be five GA meetings; the first at project inception and then annually thereafter until project end.

Extraordinary meetings of the General Assembly can be called as required by any member of the General Assembly. These can be conducted via video-conferencing/Skype/Webex. In principle, approval by the General Assembly to any decisions taken outside of the five core meetings shall be given by e-mail vote. The framework for these voting procedures will be laid down in the Consortium Agreement.

3.2.3 Management Board (MB)

The MB provides overall scientific/technical management, oversight and steering for the project. It will have the delegation from the GA to make technical decisions (if not significant) or make recommendations to the GA to approve (if significant and impacts the wider project and partners). In particular the purpose of the MB will be to:

- Execute and implement the decisions made by the GA;
- Ensure the WPs are fully integrated and contributing to the overall work plan and objectives;
- Ensure a harmonised approach and consistent methodology across EUCP;
- Deliver the aims, deliverables and milestones of the project;
- Agree the work plan, and any changes to the plan;
- Make recommendations in the event of changes to the consortium composition or budget allocations;
- Act on any necessary alterations to the Consortium Agreement.

Membership of the MB is as follows: EUCP Coordinator and Scientific Coordinator (Chair), Project Manager and all Work Package Leaders (WPL) and Co-Leaders. The WPLs and Co-Leaders will represent their work package partners.

The MB meetings will coincide with the General Assemblies (if necessary meeting directly before in order to discuss and agree what to present at the GA; and directly afterwards to discuss what was agreed). For intermediate meetings (the suggestion is at least quarterly), methods such as teleconferences will be used in order to reduce travel costs and the carbon footprint.

3.2.4 Project Coordination and Project Office

At the delegation of the General Assembly, all administrative, financial and management aspects of EUCP will be coordinated by the Met Office. Specific day to day management tasks are listed in WP7 (Section 3.1).

Coordination

The overall coordination of the project is provided by the Coordinator (Chris Hewitt) and Scientific Coordinator (Jason Lowe).

EUCP Coordinator (Dr Chris Hewitt)

The Coordinator will be responsible for the overall coordination of the project; acting as an intermediary between the EC and the project for all aspects of the project, including communicating any agreements and proposed deviations from agreed plans; and acting as the project point of contact for the independent External Expert Advisory Board (EEAB). Other responsibilities include overseeing effective innovation management for the project (along with the Scientific Coordinator); coordinating and monitoring the

project's gender balance strategy, plan and activities, plus the knowledge management strategy (which including managing dissemination and exploitation (D7.3) and communication (D7.2) plans); representing the external users on the GA and MB; managing overall risks to the project and providing formal reports to the EC. The Coordinator is assisted by the Project Manager.
(15% of the Coordinator's time is allocated here)

EUCP Scientific Coordinator (Dr Jason Lowe)

The Scientific Coordinator is responsible for monitoring scientific progress of the WPs; providing science leadership and quality assurance for the project; coordinating the scientific work; identifying any gaps; manages the scientific risks within EUCP, and ensuring harmonisation in approaches and methodologies in order to fully realise the benefits and impacts agreed. The Scientific Coordinator will be the chairperson for the MB.
(20% of the Scientific Coordinator's time is allocated here)

EUCP Project Manager

The Project Manager will be responsible for facilitating internal communications; providing support and planning tools for WP management; scheduling and organising project meetings; regular communications to the EC and EUCP; managing, monitoring and reporting the project finances and budget; managing the risks, benefits and issues registers; production of, and reporting on, the Gender Strategy and Action Plan; reporting on dissemination, exploitation and communication activities and plans; providing administrative support to the EUCP Coordinator and Scientific Coordinator. The project manager reports to the GA.

The Project Manager will be appointed from a pool of specialist project management staff at the Met Office, which has extensive experience of European research programmes. Specialist support (e.g. finance, legal and communications) will be provided to the project office by the appropriate Met Office departments (who also have extensive experience of European research programmes); and other partners' institutes when necessary.
(50% of the Project Manager's time is allocated here)

3.2.5 Work Package Leaders (WPLs)

WPLs (and Co-Leads) have been appointed. They will have the autonomous responsibility for coordinating the tasks within their WP to contribute to the delivery of the project goals and deliverables. These WPLs will therefore provide the necessary support to the project's scientific coordination. They will ensure that the progress of their WP is tracked, monitored and reported on; including highlighting and discussing any departure from the proposed work and any problems with the Scientific Co-ordinator as early as possible. The WPLs will assist with exchanges with other projects and the scientific community. To achieve these aims, the WPLs will meet face-to-face at the GAs, and take advantage of other meetings that they will be attending outside of the project. More formally, they are members of the MB, each representing the other partners in their WPs. Therefore they will communicate regularly with each other and the Scientific Coordinator through the MB meetings.

3.2.6 Multi-user Forum

The external user and stakeholder groups, through the Multi-user Forum, work primarily through WPs 4 and 6. However, to ensure that these external organisations and groups are fully and consistently involved and integrated into the project, they will be formally represented by the Coordinator at the GAs and on the MB.

3.2.7 External Expert Advisory Board (EEAB)

This small independent group will be established by the Coordinator and Scientific Coordinator (and agreed by the GA) at the start of the project. It will consist of approximately four experts whose specialist subject matter and experience is specifically relevant to EUCP. The EEAB will provide independent evaluation and recommendations about improvements to the project's work plans, progress, tools, techniques and orientation. They will provide links to related activities both inside and outside of Europe.

The EEAB will receive information detailing the project status and results. They will be invited to attend each of the GA meetings (arrangements will be made for those who cannot attend to participate via, for example, video-conferencing). However, the aim is to involve the EEAB members as 'consultants', thus involving them in some of the technical developments and discussions throughout the project duration.

Although there are no experts named here, we have already prepared a shortlist of potential people that could be approached; both working in Europe and beyond – therefore able to bring a European and Global perspective. Also the intention is to ensure there is a gender balance within the EEAB.

3.2.8 Affiliated Partners

Once the project has started we will open a register of organisations interested in being affiliated to EUCP, to facilitate engagement with researchers in relevant external activities. Affiliates will keep us updated on relevant work, allowing EUCP to draw on wider knowledge and expertise, and affiliates might attend some of the EUCP meetings. By being affiliated it means that we can be more proactive in our engagement and can send appropriate communications and invitations to appropriate meetings. Some information within the project will, by necessity, only be available to formal project participants. Affiliated partners do not sign the Grant Agreement or Consortium Agreement. WMO and University of Reading/National Centre for Atmospheric Science (NCAS) will become the two initial members of this group.

3.2.9 How the organisational structure is appropriate to EUCP

As this is a large project and due to the complexity of the technical scope, there is a two tier management and decision making structure (GA and MB). This will ensure that EUCP is well governed. The Coordinator and Scientific Coordinator have worked together for over 10 years, and they have well defined areas of responsibility to ensure effective coordination.

It is vital that EUCP works closely with interested parties who are external to the project, which is why there is much importance placed on ensuring that the end-users are represented at all levels (including at the GA and MB). Similarly, the consortium will be able to ensure its connections and relevance to the wider scientific community; for example, through the involvement of the EEAB.

The WPLs play a key role in the scientific management, thus allowing the Scientific Coordinator to use their feedback and expertise to successfully take the overview of the project. WPLs will be supported by their co-leads and Task Leaders to make sure that deliverables are provided according to the work plan.

Management of gender, ethics and IP will be done centrally through the Project Office. The Project Office will be at the centre of coordination, meaning that they will have visibility of all project activities and be able to liaise effectively with the EC.

3.2.10 List of EUCP Milestones

Table 3.2.1 details the project's milestones. These milestones will ensure that the project's progress is continually monitored.

Table 3.2.1 List of EUCP Milestones

Milestone number	Milestone name	Related work package(s)	Due date (month)	Means of verification
MS1	Compendium of existing sources of interannual-to- decadal climate predictions (Lead, **Met Office**)	WP1	M6	Report and table with the list of sources available on the project website and announced to the climate prediction community in general
MS2	Preliminary illustration of the relative merits of the forecast combination and description of the methods identified (**BSC**)	WP1	M24	Report available on the project website and a table with the description of the upgrades
MS3	Systems upgraded with high resolution with illustration of first test cases (**Met Office**)	WP1	M30	Report available on the project website and a table with the description of the upgrades
MS4	Preliminary results of the comparison of methodologies to address model uncertainty (**UOXF**)	WP1	M30	Report available on the project website
MS5	Preliminary results from the assessment of the impact of new	WP1	M30	Report available on the project website

	initialisation methods (**CNRS/IPSL**)			
MS6	Decision on constraints to use in Task T2.1 (**ETH Zürich**)	WP2	M18	Draft paper written documenting the options of constraints considered and those that were agreed to be carried forward
MS7	Decision on the use of the modelling results used in Task T2.2 (**Met Office**)	WP2	M24	Short report describing which of the model simulations and observations will be used to produce the PDFs and make the uncertainty quantifications
MS8	Organise and run a meeting of the International Detection and Attribution ad-hoc Group (IDAG) to discuss choices about constraints and uncertainty quantification with a broader community (**CNRS/CNRM**)	WP2	M24	Workshop programme and post-workshop report produced
MS9	Decision on the use of the modelling results used in Task T2.3 (**KNMI**)	WP2	M30	Short report describing which of the model simulations will be used to produce the climate scenarios and event sets
MS10	Organise and run a workshop on production and user of storylines and future plausible weather realisations (**Met Office**)	WP2	M26	Workshop programme and post-workshop report produced
MS11	Experiment framework finalised, both for the continuous simulation and event-based approaches (**UNESCO ICTP**)	WP3	M12	Completion of a report detailing the experiment framework
MS12	CP-RCMs fully assessed and customised (**ETH Zürich**)	WP3	M18	Results produced of the analysis of the ERA-Interim driven CP-RCM simulations
MS13	International workshop of the CP-RCM CORDEX Flagship Pilot Study in Toulouse, Fr (**CNRS/CNRM**)	WP3	M24	Workshop held and report produced
MS14	Check on the schedule for the completion of the scenario simulations (**SMHI**)	WP3	M30	Document produced detailing the list of simulations completed by each participant mid-way through the full completion of the task T3.4
MS15	Produce list of most relevant indicators ready for us for further analysis in case studies and end users in WP6 (**HZG**)	WP4	M12	Report produced listing the indicators of relevance to the EUCP end users
MS16	EUCP service products have been extensively exchanged and tested with end users (**BSC**)	WP4	M44	Report produced on usability of EUCP service products by end users
MS17	Completion of the analysis on	WP5	M30	Decisions made if

	observational and emerging constraints and their reflection in the prediction uncertainty quantifications (**UEDIN**)			uncertainty quantifications needs to change to account for emergent and observational constraints
MS18	Internal workshop on spatial merging. Workshop reviews results on spatial merging of regional and large scale information and added value of the very high resolution model results (**KNMI**)	WP5	M30	Informal workshop report or publication
MS19	Internal workshop on length of initialised skill to review research quantifying the time at which added skill from initialised predictions fades out, for multiple climate variables, regions and seasons (**UOXF)**	WP5	M36	Informal workshop report produced, or publication, on skill range of initial conditions for regions and variables
MS20	Illustration of merging methodologies for global initialised simulations with the non-initialised forced-only simulations with uncertainty quantification. Methods tested in perfect model setting (**BSC**)	WP5	M36	Catalogue of examples available via the EUCP website
MS21	Development of seamless storylines and demonstration of top level robustness assessment (**Met Office**)	WP5	M48	Storyline simulations available across merge points, consistent with UQ/PDFs
MS22	Definition of collaboration protocols established (**CMCC**)	WP6	M6	Brief description available internally
MS23	Identification of key scientists from other communities (**UCPH**)	WP6	M6	List of key scientists internally available
MS24	Internal agreement about EUCP data and metadata characteristics (**NLeSC**)	WP6	M6	Short document will be internally available
MS25	Identification of a variety of key business actors, policy and decision makers for Multi-user forum who will benefit from EUCP system (**HZG**)	WP6	M10	List of business actors, policy and decision makers internally available
MS26	Workshop (possibly online) with key scientists about exchange of data/results and planning of further joint activities (**UCPH**)	WP6	M12	Short report produced after the workshop (see D6.5)
MS27	Establish workshop concept to identify knowledge gaps (**BSC**)	WP6	M14	Workshop concept document available internally
MS28	First feedbacks from business and policy stakeholders for the EUCP scientists about applicability of EUCP system (**HZG**)	WP6	M18	Feedback presented internally, and discussed via internal communications platform
MS29	Workshop held on scientific knowledge gaps and best	WP6	M18	Workshop minutes produced

	practices related to climate predictions (**BSC**)			
MS30	Training (possible online) about EUCP data services infrastructure and use for scientists (**NLeSC**)	WP6	M24	Training documents and minutes of the training produced
MS31	Concept and first design of policy briefing available (co-developed with Multi-user Forum) (**HZG**)	WP6	M36	Design of draft and concept is internally available
MS32	Workshop about EUCP end user data services infrastructure held (**NLeSC**)	WP6	M36	Training documents and minutes of the training produced
MS33	All suggested updates are implemented into the website (**CMCC**)	WP6	M48	All outstanding issues discussed on internal communication platform are address and implemented in website (if applicable)
MS34	Description of process and procedures for treatment of personal data (**Met Office**)	WP7	M2	Procedures will be implemented for the collection, storage, protection, access, retention and destruction of any personal data. These procedures will be documented through a milestone report
MS35	Gender strategy and action plan for EUCP defined and adopted by the consortium (**Met Office**)	WP7	M3	Plan written and agreed by consortium

3.2.11 Innovation Management in EUCP

Effective innovation management within this project will require an overview of the project in its entirety and for this reason the Coordinator and Scientific Coordinator will be responsible for the process. They will work with the WPLs and the dissemination and exploitation and data management leads within WP6 to ensure innovation is identified, recorded and communicated in order to maximise its exploitation. Thus EUCP will achieve its aim to develop an innovative European regional ensemble climate prediction system, whose outcomes have clear benefits to society, state and business. Two further innovation areas were identified in Section 1.4, namely the development of new and novel concepts and approaches, and new state-of-the-art products and services.

The project is designed to use co-development between the scientific and technical experience of the WPs and the user community. A key aspect of this is to understand how innovative outputs can be used, then facilitate the delivery of these innovations (with WP6) and then gather feedback from the users. The approach will be to form an iterative loop incorporating users and science providers. The user involvement will enable us to be challenge led and solution focused. To ensure that the project can respond to this end-user feedback, the timings of the deliverables and milestones have been planned to allow sufficient time to incorporate feedback. This intrinsic co-design will ensure that the innovation potential of all the elements developed will be fully realised, as the developments and outcomes will be rigorously tested and challenged.

At each stage of the project, the innovation management tasks will be slightly different. Early on in the project, the focus will be on the potential research outcomes, including understanding where innovation is required and channels for communicating it. These will form an integral part of the Dissemination and Exploitation Plan (D7.3). At a more mature stage of the project, the Plan will apply best practice methods of maximising the value of Intellectual Property for dealing with technology exploitation. Finally, the focus will be on defining a strategy for the Intellectual Property exploitation after the project (D7.4).

3.2.12 Further Management Considerations

Gender Balance within EUCP

The EUCP consortium will commit to promoting equal opportunities during the implementation of the project, and will be designed to avoid gender bias or discrimination at all levels of personnel assigned to the project, including at supervisory, management and decision-making levels, as well as in the research teams (Article 33.1 Grant Agreement). In EUCP, there is currently a 1:3 ratio of females to males as named individuals to work on the project; three of the WPLs/co-leads are female; and four of the Principal Investigators are female. This is recognised as a low ratio. However, the consortium will produce a Gender Strategy and Action Plan in order to put in place measures which aim towards a balanced participation of women and men in the consortium activities, though again taking into account the situation in the field of the project and complying with legislation concerning gender equality.

Gender Strategy

The promotion and monitoring of equal opportunities throughout the project will be the responsibility of the Coordinator, with support from the Project Manager. A Gender Strategy and Action Plan (MS35, M3) will be produced, then will be monitored and updated during the project. The strategy and plan will detail specific activities under each of the Horizon 2020 gender equality objectives, and associated measures. Links will be made with existing initiatives, policies and commitments within each partner organisation to promote gender equality and advance women's careers in science, thus EUCP will benefit from existing efforts and expertise in this area and pull through lessons learnt to this project and to the wider climate modelling community within Europe. For example, a number of the partners have the EC's 'HR excellence in research' badge, acknowledging alignment with the principles of the European Charter for Reaearchers and the Code of Conduct for their recruitment. In the UK, both UEDIN and UOXF have a silver Athena Swan Award. Athena Swan is a charter implemented by the UK Research Centre that recognises and celebrates good practice towards the advancement of gender equality.

All partners will be encouraged to stay up to date with gender training and latest associated legislation. If partners ask for support, then the Project Office will facilitate gender training.

Ethics

The Ethics criteria have been considered. However, the nature of the activities proposed under EUCP means that there are very few ethical issues and it is not anticipated that the criteria will need to be invoked. Consideration has been given to the external groups and organisations who will be involved in the project as organisational data will be collected. On occasions where any personal data is collected, procedures will be followed for the collection, storage, protection, retention and destruction of such data. These will be formally detailed by Month 3 of the project (MS34). Where commercially sensitive data is concerned, this will be identified and the relevant information will be withheld accordingly. All information will be gathered in accordance with guidelines laid down by the European Commission, and national legal requirements.

Knowledge Management

The partners have a collective responsibility to ensure that any knowledge collected, developed and disseminated by EUCP, is appropriately protected and shared. However, the Coordinator is responsible for the project's knowledge management strategy and processes, ensuring they are kept up to date and that the associated protocols are adhered to. More detail on this is given in Section 2.2.

Climate Friendly Climate Research

EUCP commits to the EC's aims for a minimum carbon footprint, thus following the JPI-strategy for climate friendly climate research (http://www.jpi-climate.eu/jpi-strategy/climatefriendlyclimateresearch). Therefore, the project will use technology wherever possible to reduce the need for travel, utilising for example, Skype and Webex to hold regular project meetings. Where possible, face-to-face meetings and internal workshops will be organised in order to coincide with other scientific events that partners are already attending.

Consortium Agreement

A Consortium Agreement will be signed by all partners before the project starts. It will be based on the DESCA template. The Consortium Agreement will provide the internal framework for the way that the project is run and managed, and also lays out the procedures for resolving possible problems, such as dispute resolution, or breach by a partner. It gives details on partners' responsibilities and the relationships amongst the partners, the project management structure, rights and obligations of the partners, and will mirror many

of the clauses laid out in the Grant Agreement such as Confidentiality, Ownership of project results, access rights etc. to be finalised.

3.2.13 EUCP Critical risks for implementation

The General Assembly will be responsible for risks, issues and benefits realisation of the project. The Project Co-ordinator will be responsible for risk management in the project, and the day-to-day maintenance of the registers will be undertaken by the project office.

Critical risks to project implementation have been identified and described in table 3.2.2 below. They are risks that have been considered and that will be actively managed and monitored throughout the duration of the project. Different areas of risk have been identified, and those in the table can be identified as project management risks, data management risks or scientific risks.

Those given in *Table 3.2.2* are critical risks that may have the potential to impact the project objectives being achieved. Where there are risks that exist specifically within individual WPs, these have been identified already and the design of the WPs has taken account of preventative measures for these.

Table 3.2.2: Critical Risks for Implementation

Description of risk (indicate level of likelihood: Low/Medium/High)	**WP(s) involved**	**Proposed risk-mitigation measures**
Key staff assigned to the project become unavailable for any reason	All	All consortium members to have appropriate succession planning, with deputies for all key roles. Coordinate between partners to ensure expertise is available
Individual partners are unable to complete tasks assigned to them	All	Regular communication within WPs and with Project Manager to monitor, gain early sight of any issues and manage/reassign work as required
CMIP6 decadal prediction simulations (DCPP component A) not available when planned (L)	1, 5	Use the forecast system contributing to the DCPP multi-model as they are available (this will be the case of at least the Met Office, EC-EARTH and CNRS/IPSL contributions); make use of the systems contributing to the annual real-time decadal prediction exchange
The forecast PDFs are not skilful enough for WP4 applications (M)	1, 4	Skill is not the only useful information in a decadal prediction; reliability being a particularly relevant characteristic of the climate information; the forecast uncertainty information will be optimised to satisfy the reliability requirements of the users
Difficulties in defining and selecting relevant extreme events for the proposed event-based studies (M)	3	Definition of atmospheric structure precursors at synoptic scales for selecting cases
Lack of computing power and data storage facilities for the high-resolution regional climate projections (M)	3	Work distributed between several partners. Careful design of minimum experiment matrix to best characterise uncertainties. Research and application driven selection of a minimum set of output variables
Too small ensemble of high-resolution regional climate projections (H)	3	Use techniques to allow the use of results also from courser-scale data such as EURO-CORDEX ensemble at 12km grid spacing
UK organisation unable to lead project after UK	7	If the UK's exit negotiations from the

leaves EU (L)		EU results in the UK not being able to lead projects already underway, then three project partners have offered to take over the role of Coordinator if needed and the procedures laid out in the Consortium Agreement for change of Coordinator would be followed
UK organisations unable to participate in the project after UK leaves EU (L) Note: this is deemed Low likelihood because the UK government has stated that where UK organisations bid directly to the EC for EU funding projects while still a member of the EU, the Treasury will underwrite the payments of such awards, even when specific projects continue beyond the UK's departure from the EU, see https://www.gov.uk/government/news/chancellor-philip-hammond-guarantees-eu-funding-beyond-date-uk-leaves-the-eu	All	If the UK's exit negotiations from the EU results in the UK not being able to participate in projects already underway, then: if UK project expertise is viewed as non-unique then tasks could be moved to non-UK partners; if UK project expertise is viewed as unique then negotiations within the consortium and with the EC should agree on how the tasks could be achieved or if there is a need to de-scope/change as a result of the loss of the unique expertise

3.3 The Consortium as a whole

The EUCP consortium consists of 16 partners from 10 European countries. All of the partners are nationally and internationally renowned in their fields, representing a well complemented mix of:

- National Meteorological Services (Met Office, DMI, KNMI, SMHI) undertaking both research and operations, and closely linked to a range of users including end users and policy makers.
- Additional scientific institutes (BSC, CNRS/IPSL, CNRS/CNRM, Deltares, ETH Zürich, CMCC, UNESCO ICTP, IIASA, UEDIN, UOXF, UCPH, NLeSC, which are government institutes, universities and independent institutes), undertaking research relating to climate prediction, downscaling, environmental and social issues, information technology and software solutions.
- Climate Service Centres engaging closely with stakeholders (Met Office, BSC, DMI, HZG, CMCC, KNMI, SMHI).

Decadal Prediction Systems have been undergoing rapid development, implementation and delivery cycles. Met Office, BSC, CNRS/IPSL, DMI, CMCC Met Office and SMHI are all active in developing, testing and implementing current generation operational Decadal Climate Prediction Systems. The development of new verification tools and standards will draw on individual insights and expertise from each of these centres, as well as on the participation and leadership of several of these partners in the WCRP Grand Challenge on Near-Term Climate Prediction.

This mix of organisations and their extensive expertise brings together world-class and world-leading expertise as described below which fully address the work programme and delivers the top-level objectives of the project:

- Research and operations for multi-model climate prediction systems covering timescales from seasons to decades, including the capability to post-process the predictions to provide local (whenever required), highly reliable, action-oriented climate information.
- Research into how to capture uncertainties in climate projections and predictions.
- User-centred and demand-driven information with several partners being prominent climate service institutes nationally and internationally, with extensive experience engaging closely with a range of stakeholders and end users including public sector policy-makers, businesses and sectoral customers.
- Regional downscaling for Europe using seven regional climate models (RegCM-NH, AROME, HARMONIE, COSMO-CLM, WRF-ORCHIDEE, REMO, UKMO-RCM) at high spatial resolution of between 1.5 and 3 km.
- Evaluating model results against observations, including estimates of observational uncertainty in the model evaluation process.

- Dissemination of climate model data, in particular through engagement with C3S.
- International cooperation as described in Section 1.3.

As outlined in the work programme, "the main research objective of this action is to develop an innovative European regional ensemble climate prediction system...". In order to ensure this system provides user-centred and demand-driven information the project will engage closely with climate information end-users, including commercial users, as described in Section 2.2, to enable downstream use and exploitation of the climate information in a range of decision- and policy-making. Since the main objective therefore is a research-focussed one, the project is not focussing on delivering an operational climate service (which is more the remit of climate service centres and C3S) and the actual use and exploitation of the project's outputs is beyond the scope of the project.

Each member of the consortium will have adequate resources to fulfil their role and to ensure the project successfully delivers. Modelling institutions have substantial computing resources in house or large experience in obtaining computing time. A large fraction of the partners have extensive experience in data dissemination (including the capability to ensure data documentation and full provenance) and resources to efficiently engage with a large number of users and stakeholders through the transformation of the climate generated into action-oriented climate information. This last aspect illustrates that the capability to design a pathway to assess the industrial/commercial usefulness of the project output exists.

The consortium includes ICTP which is a UNESCO institution eligible to participate in EU projects and receive funding because of a specific agreement between the EU and UNESCO. The participation of UNESCO ICTP is essential for the project for several reasons: (i) UNESCO ICTP researchers play a leading role as co-chair in CORDEX, MED-CORDEX and the CORDEX FPS on convection permitting modelling, programmes that will have strong interactions and synergies with EUCP; (ii) UNESCO ICTP is the only group in the project running the RegCM-NH model which is needed to enlarge the multi-model ensemble; (iii) UNESCO ICTP will add to the multi-method approach in WP2 by using a different method for producing PDFs; and (iv) UNESCO ICTP researchers have a long lasting leading international role and experience in regional climate modelling.

3.4 Resources to be committed

The total requested EC contribution for EUCP is 12,999,517 €. The 16 partners have allocated 1,603 person months to this project. The call suggests 13M € as a requested budget, and the consortium has decided to accept this as an upper limit. The requested contribution for EUCP is close to this upper limit but the total cost of the project will exceed this, through additional in-kind personnel efforts from most of the Principal Investigators in the project, large in-kind resources from those partners who are using their own High Performance computing (to carry out model simulations) and data storage facilities (to locally store data). The magnitude of this in-kind contribution is difficult to quantify.

3.4.1 Financial planning approach

The largest percentage of funding for EUCP is required for personnel costs, as the project will rely on the skills and many years of expertise of the partner organisations and key personnel involved. Therefore it was key that the budget was calculated using an estimation of the costs for the time needed by these experts to achieve the project's objectives. We have carefully iterated the amount of time, and hence cost, of these experts as the tasks and the scope and description of EUCP developed. This iterative approach to calculating the required budget will ensure a good estimate of the resources required, and associated funding required.

3.4.2 Distribution and breakdown of resources

3.4.2.1 Personnel costs

Personnel costs represent 91% of the direct costs budget. *Table 3.4.1* shows the amount of staff effort broken down by beneficiary and by work package.

The allocation of the 1,603 person months is justified as follows: WPs 1 and 2 will analyse exiting simulations, from either the initialised predictions or scenario projections, and then work closely with WP5 to combine them. The effort is mainly focused on analysis approaches but without the need to design and set-up large new model experiments, which is very time intensive. The effort estimates are based on previous experience of analysis projects. WP3 has more effort required because it involves both design, set up and

analysis of simulations. WP4 also involves new modelling, but with a range of impacts models of differing complexity. Unlike WP3, only one model type is used in each part of the impact calculation so the effort is less than needed in WP3, where multiple models are required for each step in the process. The effort in WP6 is estimated based on the number of stakeholder fora and approaches to communicating with them. Previous experience provides an estimate of how much effort is required for each of these tasks. WP7 effort is based on experience in previous projects of this scale.

Management activities - 46 person months (PM) are allocated to project management and coordination under WP7. These are allocated to the Met Office. This includes dedicated effort to oversee and manage innovation management, knowledge management and exploitation strategies. This work package will also coordinate the project's communications activities and plans.

Table 3.4.1: Summary of staff effort

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total PM per participant
1/Met Office	40	**68**	22	2	29	9	**46**	216
2/BSC	**72**	0	0	36	36	24	0	168
3/CNRS/IPSL	27	0	39	20	20	0	0	106
3/CNRS/CNRM	0	42	52	0	14	0	0	108
3/CNRS(IPSL/CNRM)	27	42	91	**20**	34	0	0	214
4/Deltares	0	0	10	**56**	0	10	0	76
5/DMI	16	0	12	0	4	0	0	32
6/ETH Zürich	0	36	36	0	12	0	0	84
7/HZG	0	0	40	8	0	**24**	0	72
8/CMCC	**42**	24	21	40	0	18	0	145
9/UNESCO ICTP	0	30	**84**	0	6	12	0	132
10/IIASA	0	0	0	66	0	30	0	96
11/KNMI	0	**43**	31	0	12	0	0	86
12/SMHI	20	20	**44**	0	6	6	0	96
13/UEDIN	0	15	0	0	**15**	0	0	30
14/UOXF	26	6	0	0	**34**	0	0	66
15/UCPH	0	0	12	0	8	**16**	0	36
16/NLeSC	0	0	0	0	0	54	0	54
Total Person Months	243	284	403	228	196	203	46	**1,603**

3.4.2.2 Other direct costs

Travel budget – Based on a top level meeting/conference plan that was drafted, each partner was asked to provide their associated travel budgets. This is not just for partners to travel. 10,000 € (direct cost) is allocated to cover the travel of the Advisory Board in order for them to attend the General Assemblies and possibly other project meetings. CNRS/CNRM has put aside 30,000 € for external speakers to attend two workshops that they will host in WPs 2 and 3. The Met Office has allocated 5,000 € for experts to attend the workshop on the 'production and use of storylines' in WP5, plus put aside a similar amount for the University of Reading/NCAS to provide input from aligned research into appropriate project workshops. Also, amongst the budgets of those partners participating in WP6, a small number of thousands of euros has been put aside for engagement activities with the various external user groups.

Other travel and meeting/workshop costs – The following external meetings and workshops are planned:

- IDAG meeting to discuss choices about constraints and uncertainty quantification (WP2); hosted by CNRS/CNRM; MS8.
- International workshop of the CP-RCM CORDEX Flagship Pilot Study (WP3); hosted by CNRS/CNRM; MS13.
- International workshop on the production and use of storylines and future plausible weather

realisations (WP2 with WP5); hosted by Met Office; MS10.

- Workshop with cluster projects on the exchange of data and results (WP6); hosted by UCPH; MS26.
- Workshop on scientific knowledge gaps and best practices related to climate predictions (WP6); hosted by BSC; MS29.
- Workshop on EUCP end-user data services instrastructure (WP6); hosted by NLeSC; MS32.

Further workshops and events involving the Multi-user Forums are planned within WPs 4 and 6, and the dates and scope will be agreed as the project progresses.

All unnecessary travel will be avoided, and alternative forms of communication will be used if possible (i.e., teleconference/Skype); certainly in the case of internal meetings and discussions. We will also consider which training can be done either remotely or online.

Computing and storage (317,675 €) – As is evident from this proposal, the majority of the partners will devote significant in-kind resources to the project in the form of (i) high performance computing, (ii) local data storage and (iii) technical support staff . Therefore the associated budget requested from the project, will be kept at a minimum. NLeSC is tasked with providing the storage and support for curation throughout the project, and 50,000 € has been put aside for this.

Dissemination costs (92,131 €) – Each partner has a budget to cover open access charges for publications.

Audit costs (50,414 €) – For 13 of the partners, the EC will require an external audit at the end of the project. Although CNRS will require an audit, they have an internal audit process that means no charge will be made to the project.

Three of the partners have other direct costs budgets that are great than 15% of their personnel costs. *Table 3.4.2* provides the breakdown in detail of these other direct costs.

Table 3.4.2: Summary of other direct costs for participants (UOXF, UCPH and NLeSC)

14/ UOXF	Cost (euros)	Justification
Travel	27,000	Travel/subsistence to WP and project meetings & conferences to disseminate results (WPs 1, 2, 5)
Equipment	0	None
Other goods/services	19,440	Computer cluster and storage node
	2,160	High specification computer for PDRA
	15,931	Publication/open access
	5,000	Audit
Total	69,531	

16/ NLeSC	Cost (euros)	Justification
Travel	10,000	Travel/subsistence to WP meetings
Equipment	0	None
Other goods/services	50,000	Archiving of all data (100Tb) online including OPenDAP service
	3,000	Audit
Total	63,000	

15/ UCPH	Cost (euros)	Justification
Travel	10,000	Travel/subsistence to WP meetings and events
Equipment	0	None
Other goods/services	40,000	Technical and logistical support in organising/hosting WP6 workshops
	1,500	Laptop
	4,000	Publication/open access
Total	55,500	

Large research infrastructure – None of the project participants will be declaring costs of large research infrastructure under Article 6.2 of the General Model Grant Agreement.

Subcontracts – The Met Office and CNRS/CNRM are planning to sub-contract discrete elements of the EUCP work. These partners will comply with applicable national law on public procurement procedures and the rules for subcontracting as laid out in the Horizon 2020 General Model Grant Agreement (Article 13). This includes awarding the sub-contracts under conditions of transparency and equal treatment and ensuring best value for money. See Section 4.2 for further details of the planned subcontracts.

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Appendix 2: Letters of Support

The following are verbatim extracts from the support letters received from organisations including SMEs, international organisations, national government departments and international research programmes.

Dear Chris,
The World Climate Research Programme advises international research groups and provides strategic direction to National Climate Research Centres worldwide through their core projects, working groups and grand challenges in climate science. To advance its Grand Challenge activity on Near-Term Climate Prediction, and consistent with its overall mission of analysis and prediction of climate, WCRP would be delighted to coordinate and host international discussions and facilitate global coordination of work in WP1 of the H2020 EUCP proposal, to:

- Facilitate interactions between this project and parallel international activities occurring under the auspices of the Grand Challenge on Near Term Climate Prediction;
- Serve as a collection point for decadal climate predictions from European and international prediction systems;
- Prepare a set of good practice guidance rules and standards including international verification standards; and
- Facilitate the preparation and dissemination of real time global annual to decadal outlooks each year.

WCRP facilitation will strengthen global impact of work done for this project and enable these efforts to fit seamlessly into international efforts and the WMO Global Framework for Climate Services.
Respectfully submitted,
David Carlson, Director WCRP, email: DCarlson@wmo.int

Dear Prof. Dr. Doblas-Reyes,
I here express my interest and support for the project proposal 'European Climate Prediction system EUCP' you are going to submit to the next H2020 SC5-02-2017 call on 'Integrated European regional modelling and climate prediction system'.
I fully endorse the EUCP aims and objectives as they will foster the use of decadal predictions in the agro-climatic context, and thus contribute to improve the related activities of the European Commission Joint Research Centre.
Sincerely,
Andrea Toreti, Joint Research Centre, Italy

This letter is to affirm my support for the development of a European Climate Prediction (EUCP) system. BEIS' remit includes promoting ambitious international action to mitigate future climate change and hence understanding the full impacts associated with greenhouse gas emissions is important to us. This project will look to bridge a gap between long-term centennial climate projections and seasonal forecasts of a few months ahead, and would provide information on climate risks that would be of great benefit to a number of different sectors, both public and private.
We are therefore interested in projects such as EUCP and believe that it would be important to policy and decision-makers, both in the UK and internationally, by informing them of the potential risks associated with future global greenhouse gas emissions pathways.
I therefore fully support this proposal.
Yours faithfully,
Dr Miguel Martinez-Boti, Head of Climate Science, Department for Business, Energy & Industrial Strategy, UK

Dear Chris,
With this letter I, Jean-Noël Thépaut, Head of the Copernicus Climate Change Service at ECMWF, would like to express my interest for all the projects that will be submitted in response to the call Integrated European regional modelling and climate prediction system, SC5-02-2017. Developing a European climate prediction system, focussing on decadal to multi-decadal time scales is of high importance, complementary to and in line with the operational agenda of C3S and its evolution beyond 2020.
We would be happy to collaborate with, and wherever possible support (through membership of Advisory Board or otherwise) the European Climate Prediction System project, should this be funded.
We wish you all the best with your proposal.
Yours sincerely,
Dr. Jean-Noël Thépaut, Head, Copernicus Climate Change Service, UK, jean-noel.thepaut@ecmwf.int

Dear Mr Vautard,
With this letter, *aj (anemos-jacob GmbH)* expresses its support to the development of a "European Climate Prediction (EUCP) system".
aj is an independent consultancy focussing on the assessment of the wind resource and projected energy production of wind energy projects as well as on the analysis of operational results of wind farms in Europe and beyond. *aj* was founded in 1995 and houses one of the largest independent teams of wind resource specialists in Europe. *aj* is working on projects totalling 3 GW per year.
Since more than a decade, *aj* has been one of the leading parties addressing the inter-annual variation of wind resource. *aj* is therefore often asked by a large range of entities such as banks, investors and press to comment on observations and trends. *aj* observes an important lack of reliable information on past and future developments and of understanding of past variability in wind resource. Knowing the important of such information and the high general interest in this matter, *aj* supports the planned development of the EUCP system. *aj* will benefit from it since it will help *aj* improving the reliability of its predictions and answering the questions raised by its clients. However, the major benefit will be with *aj*'s clients.
Yours sincerely,
Herbert Schwartz

Dear Prof. Jens Hesselbjerg Christensen,
With this letter, we in the World Bank that are working on ENSO and other climate events and food and agriculture in the Middle-East, North Africa and Eastern Europe and Central Asia want to support the development of a "European Climate Prediction (EUCP) system".
Agriculture can help reduce poverty for 78% of the world's poor, who live in rural areas and work mainly in farming. It can raise incomes, improve food security and benefit the environment.
We are therefore interested in having developed such an EUCP, because the ability to predict weather and climate events from seasons to decades in advance occurs to be of socioeconomic value across our client countries and will increase the quality of our knowledge products and lending operations.
Sincerely,
Julian Lampietti, Practice Manager, Middle-East, North Africa and Eastern Europe and Central Asia
The World Bank

Dear Jens Hesselbjerg Christensen,
With this letter, AGRHYMET Regional Center wants to support the development of a “European Climate Prediction (EUCP) system”.
Agriculture can help reduce poverty of West-African poor people, who live in rural areas and work mainly in farming. AGRHYMET is mandated to Inform and Train on Sahelian food security, desertification control and water control & management.
We are therefore interested in such an EUCP, and will benefit from it, because the ability to predict weather and climate events from seasons to decades in advance occurs to be of extreme economic value across West Africa and is at the hard of AGRHYMET’s mandate.
Yours sincerely
Dr Abdou Ali, Senior Hydroclimatologist, AGRHYMET Regional Centre, Niamey, a.ali@agrhymet.ne

Dear professor Van den Hurk:
With this letter FutureWater wants to support the development of a “European Climate Prediction (EUCP) system”.
FutureWater is a research and consulting organization that works throughout the world to combine scientific research with practical solutions for water management. FutureWater works at both global, national and local levels with partners on projects addressing water for food, irrigation, water excess, water shortage, climate change, and river basin management.
We are very interested in such an EUCP as currently our clients are requesting regularly detailed climate information that could be provided by such a system. Currently, we can offer them the so-called KNMI’14 product, but there is an urgent need to enhanced information so we can serve our clients better. We foresee a close collaboration with KNMI and partners in supporting the development of the EUCP.
Yours sincerely,
Dr. Peter Droogers, Director FutureWater, p.droogers@futurewater.nl

Dear Professor Van den Hurk,
HKV is highly interested in the proposed project. Developing a European climate prediction system would be very helpful in our practice as a water-related consultancy firm.
In our projects, the impact of climate change on both flooding and water scarcity plays a large and increasing role, as our customers need to incorporate future developments in their policy making.
Within the Netherlands, we frequently make use of the KNMI’14 climate scenarios, which translate raw climate model output into numbers that are directly usable in practice. To have such a tool available for entire Europe would be a great asset.
HKV therefore strongly recommends funding the proposed project.
Yours sincerely,
ir. D. Klopstra, director, HKV Consultants

4. MEMBERS OF THE CONSORTIUM

4.1 Participants (applicants)

Participant 1: Met Office (Met Office)
The Met Office is a world leading centre for weather and climate research, and has been heavily involved in all the major IPCC assessments and associated CMIPs. There are over 500 people involved in a wide range of areas of weather and climate science, including observational research, model development and assessment on all timescales from days to centuries, as well as climate impacts and consultancy for both governmental and industry partners. The Met Office has extensive and long-standing experience of EU projects including coordinating several under FP6, FP7 and Horizon 2020, and it plays an active role in WMO activities (often leading). There is significant expertise in the Information Technology and supercomputer areas, with over 40 staff directly involved. Met Office Hadley Centre staff will be involved in many aspects of this proposal, with significant experience and expertise beyond the staff named below.

An independent review of the Met Office Hadley Centre commissioned by UK government in 2007 concluded that: 'It is beyond dispute that the Met Office Hadley Centre occupies a position at the pinnacle of world climate science and in translating that science into policy advice.' When it comes to making long-term decisions based on climate projections for the 21st century, the costs and risks are potentially high. Met Office consultants are on-hand to offer advice to help governments and businesses around the world on issues such as protecting global security, safeguarding the provision of energy and growing the economy, now and in a changing climate.

The Met Office has been at the forefront of many of the aspects of science needed for EUCP, notably leading the way in producing and boosting the skill in seasonal and decadal initialised forecasts, producing climate scenarios for use in national risk assessments, and applying high resolution global and regional modelling in order to better study weather and climate extremes. It presently contributes to a range of WCRP activities and provides a range of expertise to relevant MIP experiments.

Stakeholder engagement and dissemination will be vital for EUCP. Throughout its 160+ year history, the Met Office has demonstrated its drive to provide outreach and dissemination across all levels, ensuring that its science is useable for making real world decisions. This is clearly evidenced from the public facing weather and climate forecasts, the contributions to climate change risk assessments (such as that in the UK) organisation and delivery of workshops and conferences for the scientific research community, the publication of scientific papers in leading science journals and briefings, papers and graphics for policy makers. The Met Office is skilled in co-developing climate services, with important contributions to the GFCS and numerous projects to co-develop service elements with partners around the world.

The Met Office will project manage EUCP. It has a team of experienced project managers, who hold formal project management qualifications and have much experience in managing projects involving multiple partners and users. It will also provide scientific coordination, building on considerable experience of time-limited, policy relevant projects and programmes, such as the UK Government's major direct climate research programme. The Met Office has co-ordinated projects such as the FP6 ENSEMBLES project, the FP7 EUPORIAS project and is currently coordinating and managing other large Horizon 2020 projects including PRIMAVERA and Climateurope.

Short profile of key personnel involved:
Dr Chris Hewitt (male), Head of International Climate Service Development [EUCP Coordinator]: Chris is responsible for developing strategic partnerships and networks in Europe and worldwide to improve, and maximise the use of, climate service capabilities. He has over 25 years experience covering climate research, team leadership, project management and senior management. He is currently the Coordinator for the Horizon 2020 Climateurope coordination and support action on climate modelling and climate services, the Coordinator for the C3S project delivering the C3S Roadmap for European Climate Projections, and was the Science Coordinator for the EC's FP6 ENSEMBLES project on climate change and climate change impacts, and the Coordinator for the FP7 EUPORIAS project on climate services, a project shortlisted as a success story for FP7. He has considerable international networking experience through research collaborations, project and programme management, international panels, as a lead writer for the GFCS, Chair of the WMO Expert Team on User Interfaces for Climate Services, Chair of the WMO Team for monitoring and evaluating the GFCS, founding member of the international Climate Services Partnership, and last but not least, Chair of the EC's European Climate observations, Modelling and Services (ECOMS) Board which provided recommendations to the EC with regard to climate observations, modelling and services.

Prof Jason Lowe (male), Deputy Director of the Met Office Hadley Centre and its Head of Climate Services [EUCP Scientific Coordinator]: In this role Jason has worked across a range of programmes ensuring they are both fit for the purpose of delivering policy relevant results and doing so in a scientifically robust manner. As part of this task he leads the Hadley Centre theme on prediction and projection, and in particular is the lead scientist on the major project to update the UK's climate projections for risk assessment (UKCP18). Recent activities have also involved acting as chief scientist on collaborative projects involving a range of climate disciplines in UK government funded AVOID1 and AVOID2 ('Avoiding Dangerous Climate Change'), which have involved both innovative research and extensive engagement of stakeholders and results dissemination. His 20+ years of experience in climate science have included involvement with numerous EU projects, most recently through FP7 HELIX. He is a serving member of the IPCC Task Group on Scenarios for Climate and Impact Assessment (TGICA), which aims to make climate results more accessible and usable. On a part time basis Jason occupies the Priestley Chair in Climate Research at the University of Leeds and is a visiting Professor at the University of Reading. His extensive research activities include the assessment of mitigation pathways and their constraints, non-linearity of climate responses, climate impacts and sea-level rise. Jason is a member of the expert group for the Copernicus Roadmap for European Climate Projections.

Ben Booth (male), Met Office Job Title [Leader WP2]: Ben is a core member of the Climate Prediction Team that produced UKCP09 and is currently developing UKCP18. He played a key role in the design and running of the climate model ensembles that are under the current UK national projections. These experiments quantified the impact of uncertainties in atmospheric, oceanic, aerosol and carbon cycle components of the climate system, on future projections. He has over 12 years experience in the development and production of national climate projections. Through that time he has published on a broad range of subjects crossing the EUCP theme, from forced drivers of decadal changes; the use of Detection and Attribution approaches to constrain future projections; to emergent constraints on longer term climate. These include nine publications authored and co-authored in Nature journals. Currently, Ben also leads work on projected impacts of aerosol emissions on East Africa (through UK government funded Future Climate for Africa programme, FCFA – HYCRYSTAL) and West Africa (FCFA – AMMA2050) over the next 10-40 years.

Prof Adam Scaife (male), Head of Monthly to Decadal Prediction team, Met Office Hadley Centre [Scientist WP1]: Adam leads research and production of long range forecasts at the Met Office. His group issues climate forecasts on a regular basis and carries out world leading research to improve predictions for adaptation to climate variability and change. Adam's personal research is focused on climate variability. He has published more than 100 peer reviewed articles on the predictability, mechanisms and improved computer modelling of climate variability. His research group recently made an important breakthrough in seasonal forecasting for winter which allows new applications of long range forecasts for Europe and North America. In recent years, Adam was awarded the American Geophysical Union's ASCENT Award and the Royal Meteorological Society's Adrian Gill prize. Adam has played a key role in numerous EU projects including FP5 EMULATE, FP6 DYNAMITE and FP7 SPECS. He currently co-chairs the WCRP Grand Challenge on Near Term Climate Prediction and spent several years co-chairing the WCRP Working Group on Seasonal to Interannual Prediction.

Lizzie Kendon (female), Manager, Understanding Regional Climate Change, Met Office Hadley Centre [Scientist WP3]: Lizzie has 11 years of experience working at the Met Office Hadley Centre on regional climate modelling. She currently leads a team of scientists using very high resolution (kilometre-scale) models to study climate change, with a main focus on gaining a better understanding of extreme rainfall processes and their future change. Her work has been pioneering in the field of convection-permitting climate modelling, with a high profile paper in Nature Climate Change. She is currently leading work to run an ensemble of simulations at convection-permitting scale over the UK for the next set of climate projections (UKCP18). She also has key roles in the FCFA IMPALA, HyCRISTAL and AMMA-2050 projects involving convection-permitting climate simulations over Africa, European Research Council (ERC) INTENSE project analysing intense rainfall, and is participating in CORDEX-FPS carrying out coordinated convection-permitting climate simulations over Europe and the Mediterranean.

Relevant publications, and/or products, services, achievements:

Smith, Doug M.; **Scaife, Adam A**.; Eade, Rosie; et al. (2016): Seasonal to decadal prediction of the winter North Atlantic Oscillation: emerging capability and future prospects. Quarterly Journal of the Royal Meteorological Society, Volume: 142 Issue: 695.

Sexton, David M. H.; Harris, Glen R. (2015): The importance of including variability in climate change projections used for adaptation. Nature Climate Change, Volume: 5 Issue: 10.

Kendon, Elizabeth J.; Roberts, Nigel M.; Fowler, Hayley J.; et al. (2014): Heavier summer downpours with climate change revealed by weather forecast resolution model. Nature Climate Change, Volume: 4 Issue: 7.

Murphy, J.M., **Booth, B.B.**, Boulton, C.A., Clark, R.T., Harris, G.R., **Lowe, J.A.** and Sexton, D.M.H. (2014): Transient climate changes in a perturbed parameter ensemble of emissions-driven earth system model simulations. Climate Dynamics, Volume: 43 Issue: 9-10. doi: 10.1007/s00382-014-2097-5, web link for UKCP09: http://ukclimateprojections.metoffice.gov.uk/.

Ranger, N., Reeder, T., **Lowe, J.A.** (2013): Addressing 'deep' uncertainty over long-term climate in major infrastructure projects: four innovations of the Thames Estuary 2100 Project. EURO Journal on Decision Processes 1 (3-4), 233-262.

Relevant previous projects or activities:

The **Met Office Hadley Centre Climate Programme** (MOHCCP) is a major programme of research for the UK Government providing their primary source of climate science information and delivering major infrastructure for use by other researchers in the UK. The programme includes components on observational datasets, attribution, model development, understanding and constraining climate change, climate dynamics, and the production of predictions and projections. In addition to specific deliverables the programme yields up to 150 journal articles per year, with most involving significant collaboration. Development in EUCP will build on a strong foundation provided by previous research in MOHCCP, especially around how to evaluate and constrain prediction and projections, and high resolution modelling. As part of the present and previous MOHCCPs, the Met Office developed the UKCP09 climate projections, and is currently well advanced in the production of UKCP18.

The Met Office has contributed to each of the IPCC-related CMIPs, which involves strong coordination between many aspects of climate science (IT systems, model development, delivery of model integrations and their assessment), which are all important aspects of this proposal. During the CMIP6 round we have already played a large role in the design of many of the MIPs, and plan on submitting large numbers of simulations and analysis.

A lead contribution to **Horizon 2020 CRESCENDO** has been provided by the Met Office. This work has involved setting up the latest generation of earth system models and developing new approaches to evaluation of the models, which can be drawn on in EUCP. Additionally the project has advanced understanding and use of emergent constraints, which will be used directly in EUCP.

The Met Office provides a major contribution to **Horizon 2020 PRIMEVERA**, which aims to develop a new generation of advanced and well-evaluated high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity. Model simulations, evaluation approaches and process understanding from this study will feed into EUCP.

The Met Office coordinates an informal exchange of near-real time decadal predictions. Many institutions around the world are developing decadal prediction capability and this informal exchange is intended to facilitate research and collaboration on the topic. The contributing prediction systems are a mixture of dynamical and statistical methods. This work has been supported by **FP7 SPECS** project and will help us collect and handle initialised forecasts for EUCP.

Relevant significant infrastructure and/or any major items of technical equipment:

The Met Office has benefited from a recent £97 Million (approximate €130 Million) investment by the UK government in supercomputing, and operates a powerful High Performance Computing (HPC) facility based on a CRAY XC40 supercomputer system. It has approximately 6,000 user nodes, with a further ~6,000 nodes due to be added in March 2017, by which stage it will be able to perform more than 16,000 trillion calculations per second.

Third parties involved in the project:

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted?	Y
The Met Office will sub-contract the World Climate Research Programme (WCRP) to coordinate and host international discussions and facilitate global coordination of the EUCP work. See Section 4.2.4	
Does the participant envisage that part of its worked is performed by linked third parties?	N

Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 2: Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC)

The Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC), created in 2005, has the mission to research, develop and manage information technology in order to facilitate scientific progress. At the BSC, more than 350 people from 40 different countries perform and facilitate research into Computer Sciences, Life Sciences, Earth Sciences and Computational Applications in Science and Engineering. The BSC is one of the four hosting members of the European Partnership for Advanced Computing (PRACE) Research Infrastructure as well as one of the first eight Spanish "Severo Ochoa Centre of Excellence" awarded by the Spanish Government.

The Earth Sciences Department of the BSC (ES-BSC) was established with the objective of carrying out research in Earth system modelling (ESM). The ES-BSC activities are focused on global climate modelling and prediction are based on research, development and predictions with the EC-Earth climate forecast system. It also undertakes research on the development of dynamical and statistical methods for the prediction of global and regional climate on time scales ranging from a few weeks to several years, with a special focus on technologies that allow high-resolution modelling. The formulation of the predictions includes the development and implementation of techniques to statistically downscale, calibrate and combine dynamical ensemble and empirical forecasts to satisfy specific user needs in the framework of the development of a climate service.

The assessment of the sources of predictability and the limitations of current climate prediction systems to exploit them, especially over Europe, inspires many of the publications by the unit. Besides contributing to the 5th phase of the CMIP (CMIP5) critical for the UN IPCCAR5, global climate research activities at ES-BSC enable provision of various historical reconstructions and initial conditions to the EC-Earth community for analysis of climate dynamics and for seasonal to decadal climate predictions. The ES-BSC is already active in the planning and design of the future coupled CMIP, CIMP6, and is preparing to make key contributions including the groundbreaking high-resolution climate simulations with EC-Earth. Over the years, the department has been very active in numerous European Projects including, in FP7 and Horizon 2020 not only as a partner but also as coordinator. It is also currently involved in at least five COPERNICUS projects coordinating one of the actions.

Short profile of key personnel involved:

Prof Francisco Doblas-Reyes (male), Director of Earth Science Department [Leader WP1]: Francisco is involved in the development of the EC-Earth ESM, and has been since its inception. He is a worldwide expert in the development of seasonal-to-decadal climate prediction systems and has more than 20 years of experience in weather and climate modelling, climate prediction, as well as the development of climate services. For his work in seasonal forecasting, he was awarded the Norbert Gerbier-MUMM International Award from the WMO in 2006. He serves in several panels of the WCRP and the World Weather Research Programme (WWRP) under the UN WMO (among them the steering group of the Polar Prediction Project), is a member of the European Network for Earth System modelling HPC Task Force and has participated in numerous national and European FP4, FP7 and Horizon 2020 projects. Currently, Francisco is the principal investigator (PI) or co-investigator (Co-I) in six FP7 and Horizon 2020 European projects, was coordinator of the FP7 collaborative SPECS project, is also leading a COPERNICUS action and supervises numerous postdoctoral scientists and software engineers. He has won 50 Million hours of computing time for the High Resolution Ensemble Climate Modelling project through the PRACE network. He is a lead author of the IPCC and member of the steering group of the Polar Prediction Project. Overall, Francisco has authored and co-authored more than 100 peer-reviewed papers on climate modelling and prediction, as well as climate services, and currently has a total of 6,103 citations with an h-index of 39.

Dr Virginie Guemas (female), Expert on Seasonal to decadal climate prediction at BSC [Scientist WPs, 1, 2, 5]: Virginie's main scientific expertise is on polar climate predictability and its linkages with the mid-latitudes. She was awarded the 2010 Adrien Gaussail PhD prize, granted every two years to a scientific PhD. She is member of the WCRP CLIVAR (Climate and Ocean Variability, Predictability, and Change) SSG (Scientific Steering Group). She has participated in 13 national and international research projects. She was the PI or Co-I of six European projects and the PICA-ICE national project focused on Arctic climate predictions. She contributed to the IPCC AR5. She is author of 33 articles on climate modelling and predictions in international peer-reviewed journals, among which six in high-impact journals. She has supervised one PhD student and several post-doctoral scientists and she is the tutor of the MSC-IF-NeTNPPAO (GA 708063).

Dr Javier García-Serrano (male), Junior Researcher H2020 MSCA-IF-EF fellow [**Scientist WPs 1, 2, 5]**: During his scientific career, Javier has worked on exploring teleconnection dynamics for climate prediction, thoroughly building a bridge between his theoretical background in atmospheric dynamics and the practical requirements of climate forecasting. The former dates from his PhD stage at UCM, Madrid. The latter started out during his post-doc on the pioneering field of decadal climate prediction, first hired at IC3 (Barcelona) and then via his own funding at the University of Tokyo (AORI; private grant from the CANON Foundation in Europe). More recently, at LOCEAN/IPSL (Paris), Javier merged both research lines and showed broad capabilities to develop and lead the tasks undertaken by his institution in the FP7 NACLIM project. The investigation focussed on the teleconnections between Arctic sea-ice changes and European climate. García-Serrano et al. (2015) developed for the first time empirical predictions of interannual variability in Europe based on Arctic sea-ice concentration.

Javier led the project's multi-model assessment (García-Serrano et al. 2016). At BSC, he is PI of a national project dealing with the ENSO influence on European climate and is currently leading the Atlantic Variability and Predictability research line.

Dr Dragana Bojovic (female), Research in Earth System Services team [Scientist WPs 4, 6]: Dragana works on user engagement, communication and knowledge transfer. She currently coordinates user engagement and dissemination activities in the Horizon 2020 projects PRIMAVERA, APPLICATE, and C3S MAGIC. Before coming to BSC, she worked on various European and International initiatives on improving adaptation to climate change in different sectors, by overcoming communication and technological barriers that prevent effective use of climate and environmental information. She collaborated with scientists, policy-makers and communities from Chile to Nepal, supporting knowledge transfer to enhance resilience to climate and other socio-ecological changes and foster environmental governance. Dragana holds a PhD in Science and Management of Climate Change from the Ca' Foscari University of Venice and an MSc in Environmental Change and Management from the University of Oxford.

Relevant publications, and/or products, services, achievements:

Massonnet, F., O. Bellprat, **V. Guemas** and **F. J. Doblas-Reyes** (2016). Using climate models to estimate the quality of global observational data sets. *Science*, 6311, 452-455, doi:10.1126/science.aaf6369.

García-Serrano, **J.**, V. Guemas and F.J. Doblas-Reyes (2015) Added-value from initialization in predictions of Atlantic multi-decadal variability. *Climate Dynamics*, 44, 2539-2555, doi:10.1007/s00382-014-2370-7.

Doblas-Reyes F.J., I. Andreu-Burillo, Y. Chikamoto, J. **García-Serrano**, V. **Guemas**, M. Kimoto, T. Mochizuki, L. R. Rodrigues and G. J. van Oldenborgh (2013) Initialized near-term regional climate change prediction. *Nature Communications*, 4, 1715, doi:10.1038/ncomms2704.

Guemas V., **F. J. Doblas-Reyes**, I. Andreu-Burillo, M. Asif (2013) Retrospective prediction of the global warming slowdown in the past decade. *Nature Climate Change*, 3, 649-653, doi : 10.1038/nclimate1863.

Doblas-Reyes, F.J., **J. García-Serrano**, F. Lienert, A. Pintó Biescas and L.R.L. Rodrigues (2013) Seasonal climate predictability and forecasting: status and prospects. *WIREs Climate Change*, 4, 245-268, doi:10.1002/WCC.217.

Relevant previous projects or activities:

H2020 project: Advanced Prediction in Polar regions and beyond: Modelling, observing system design and LInkages associated with ArctiC ClimATE change (**APPLICATE**-727862) will develop a comprehensive framework for observationally constraining and assessing weather and climate models using advanced metrics and diagnostics. This framework will be used to establish the performance of existing models and measure the progress made within the project. It will make significant model improvements, focusing on aspects that are known to play pivotal roles in both weather and climate prediction, namely: the atmospheric boundary layer including clouds; sea ice; snow; atmosphere-sea ice-ocean coupling; and oceanic transports. In addition to model developments, APPLICATE will enhance predictive capacity.

H2020 project*:* PRocess-based climate sIMulation: AdVances in high resolution modelling and European climate Risk Assessment (**PRIMAVERA**-641727). The main objective is to develop a new generation of advanced and well-evaluated high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity, for the benefit of governments, business and society in general.

H2020 project: IMproving PRedictions and management of hydrological Extremes (**IMPREX**- 641811). IMPREX will improve forecast skill of meteorological and hydrological extremes in Europe and their impacts, by applying dynamic model ensembles, process studies, new data assimilation techniques and high resolution modelling. Novel climate change impact assessment concepts will focus at increasing the realism of relevant events by specific high resolution regional downscaling, explore compounding trans-sectoral and trans-regional risks, and design new risk management paradigms. As a key outreach product, a periodic hydrological risk outlook for Europe is produced, incorporating the dynamic evolution of hydro-climatic and socio-economic processes.

COPERNICUS project QA4Seas - Quality Assessment Strategies for Multi-model Seasonal Forecasts: BSC is the leader of this project, which is aimed at developing a strategy for the evaluation and quality control (EQC) of the multi-model seasonal forecasts provided by C3S to respond to the needs identified among a wide range of stakeholders. The quality assessment will be user-driven and will put at work the best expertise available on the evaluation of the multi-faceted quality aspects of state-of-the-art seasonal forecast systems.

FP7 project: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services (**SPECS**-308378). SPECS aimed to identify the main problems in climate prediction and investigate a battery of solutions from a seamless perspective. SPECS has undertaken research and dissemination activities to deliver a new generation of European climate forecast systems, with improved forecast quality and efficient regionalisation tools to produce reliable, local climate information over land at seasonal-to-decadal time scales, and provided an enhanced communication protocol and services to satisfy the climate information needs of a wide range of public and private stakeholders.

Relevant significant infrastructure and/or any major items of technical equipment:

BSC-CNS is the National Supercomputing Facility of Spain and hosts a range of HPC systems including MareNostrum IV the new supercomputer, will be 12.4 times more powerful than the current MareNostrum 3 that will have a performance capacity of 13, 7 Petaflop/s. The general purpose element will have 48 racks with more than 3,400 nodes with next generation Intel Xeon processors and a central memory of 390 Terabytes. The second element of MareNostrum 4 will be formed of clusters of three different technologies that will be added and updated as they become available. These are technologies currently being developed in the US and Japan to accelerate the arrival of the new generation of pre-exascale supercomputers.

The BSC-CNS is a key element of and coordinates the Spanish Supercomputing Network, which is the main framework for granting competitive HPC time to Spanish research institutions. Furthermore, BSC-CNS is one of six hosting nodes in France, Germany, Italy and Spain that form the core of the PRACE network. PRACE provides competitive computing time on world-class supercomputers to researchers in the 25 European member countries.

Third parties involved in the project:

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted?	N
Does the participant envisage that part of its worked is performed by linked third parties?	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Y
BSC applies a Third Party modality with the "Institut Català de Recerca i Estudis Avançats" (ICREA). See Section 4.2.1	

Participant 3a: Centre National de Reserches Scientifiques – Institut Pierre-Simon Laplace (CNRS/IPSL)
CNRS, the French National Center for Scientific Research, is a large interdisciplinary research organisation in France. CNRS has joint research units in partnership with other institutions such as the Atomic Energy and Alternative Energies Commission (CEA), and with universities and engineering schools such as Ecole Polytechnique. The laboratories of these institutions that are located in Paris area, and for which the research activity is mainly related to weather and climate science, are grouped together to form Institut Pierre-Simon Laplace (IPSL). IPSL develops large collaborative projects, such as earth system modelling and observation networks. Thus, this project will be developed under the entity CNRS/IPSL which joins five units of CNRS (LATMOS/IPSL, LMD/IPSL, LSCE/IPSL, LOCEAN/IPSL and EPOC).

IPSL is specialised in water, energy and carbon cycles at different scales, in climate variability (from paleoclimate to future climate), impacts and several other environmental fields. IPSL, through its climate modelling center, has developed a coupled earth system that participated to the CMIP3 and CMIP5 programmes through a number of simulations. It has thus been heavily involved in all the IPCC reports. IPSL has participated in the EURO and MED-CORDEX international programmes by providing simulations using NCAR's (National Center for Atmospheric Research) Weather Research and Forecasting (WRF) model, downscaling the IPSL climate model. The development of a regional modelling earth system was also undertaken, using WRF for the atmospheric component and other IPSL models for other components and in particular ORCHIDEE for land surface/hydrology. IPSL has strong experience in data management since IPSL is an ESGF node for CMIP simulations.

IPSL is involved at a high level in the development of observations for earth systems, through the device, realisation, and exploitation of spatial missions, the development of new instruments (in-situ or remote-sensing), and the active participation to ground-based networks. The combination of these observing and modelling systems allow the study of dynamical (and chemical, biological) processes from events to multi-decadal scales, an expertise that is essential for this project. IPSL has been elected as a laboratory of excellence (LABEX) for climate activity by the French government and it is often consulted by governmental and industry partners.

IPSL has developed strong collaboration with other international centres. It leads or has led several international projects such as the FP7 IS-ENES and IS-ENES2, which developed a common distributed modelling research infrastructure in Europe to better fulfil the societal needs with regards to climate change issues. It has also led many regional research efforts as the AMMA and HyMex projects. It also leads (through CEA organisation) the CLIM4ENERGY C3S/SIS project. It participated to several consortia regarding European climate research or societal applications (see list of projects).

Short profile of key personnel involved:

Sophie Bastin (female), Expert in high-resolution modelling [CNRS/IPSL Principal Investigator]: Sophie has research experience in mesoscale and regional atmospheric dynamics, boundary-layer and cloud processes, and climate variability at regional scale. Sophie is involved in both modelling (WRF; Hymex/MED-CORDEX) and observations communities (CALIPSO/CLOUDSAT/Earthcare; ACTRIS; GNSS4WEC). She participated in several international projects and produced and analysed WRF and multi-model regional simulations in the framework of HYMEX/Med-CORDEX. Her expertise in high-resolution modelling will be important to fulfil WP3 objectives.

Jan Polcher (male), Senior Scientist [Scientist, WPs 3, 4]: Jan has 25 years of experience in climate modelling and research. He has been the initiator of the IPSL land surface model ORCHIDEE and has adapted this model for regional application. Its coupling with WRF now allows simulation of hydrology at daily scale enabling better assessment of the interaction between heavy precipitation and land surface processes, which will be a useful tool for WPs 3 and 4 of EUCP. Jan has been the coordinator of the AMMA project which gathered more than 200 scientists of Europe and Africa to further the understanding of the West Africa Monsoon and the sensitivity of human activities to climate change. He organised the land surface modelling at the WCRP level by creating the GLASS panel and has chaired the GHP panel. He is currently in charge of the Water for Food Baskets of the World grand challenge of the WCRP.

Robert Vautard (male), Senior Scientist [Scientist WP4]: Robert has over 25 year research experience in atmospheric variability analysis and regional climate modelling and applications. He was a review editor for the IPCC AR5. He has expertise in regional climate modelling, with the first high-resolution EURO-CORDEX simulations using the WRF model. He has published over 170 peer-reviewed articles. He is leading national and international projects such as the SIS C3S project CLIM4ENERGY.

Juliette Mignot (female), Researcher at IRD (third party) [Scientist WPs 1, 5]: Juliette specialises in physical oceanography and climate variability. Her objectives are to better understand the climatic low frequency variability and predictability, and in particular the role of the ocean. She uses several statistical tools and climate models. She has been one of the initiators of the decadal predictability activities at IPSL/LOCEAN. She is also a member of the steering committee of the IPSL modelling group. She is co-investigator in the Horizon 2020 Blue-Action project related to climate predictability and teleconnections in the Arctic climate. In EUCP, she will contribute to providing and analysing decadal prediction simulation and analysis of the North Atlantic Ocean.

Didier Swingedouw (male), Scientist [Scientist WP1]: Didier has been a CNRS scientist since 2010. He is an expert in physical oceanography and climate dynamics especially of the high latitudes. In 2013, he moved to EPOC in Bordeaux, where he is now developing his own modelling group on climate dynamics of the North Atlantic and Southern Ocean. He has been involved in four European projects (including Horizon 2020 Blue-Action), as well as four national projects (i.e., ANR-ESCARSEL or ANR-GREENLAND) where he is a work package leader in two of them. He received three awards, one from the French marine academy for his PhD thesis in 2008, one from the EGU as Young Scientists Outstanding Poster Paper in 2007 and, in 2015, the "Christian Le Provost" prize from French Académie des Sciences recompensing outstanding early career oceanographers. In EUCP, he will contribute to providing and analysing decadal prediction simulation and analysis of the North Atlantic Ocean.

Eric Guilyardi (male), Senior Scientist [Scientist WPs 1, 5]: Eric holds a joint appointment between LOCEAN and NCAS Climate, University of Reading (UK). His research spans tropical climate variability, ocean and climate, climate change, decadal predictability. He is an author or co-author of more than 80 publications and has extensive experience in multi-model analysis, ocean- atmosphere model development, and software infrastructures for Earth System Models. He was a Lead Author for IPCC AR5. He has been co-investigator of several EU-funded (FP5, 6, 7. Horizon 2020) and national (NERC, ANR) projects, and has coordinated the FP7 METAFOR project (2008-2011).

Relevant publications, and/or products, services, achievements:

J. Polcher, M. Piles, E. Gelati, A. Barella Ortiz and M. Tello (2016) Comparing surface-soil moisture from the SMOS mission and the ORCHIDEE land-surface model over the Iberian Peninsula, Remote Sens. *Environ*., Vol. 174, 69–81, doi:10.1016/j.rse.2015.12.004.

Ortega P., E Guilyardi, **D. Swingedouw**, **J. Mignot**, S. Nguyen (2017). Reconstructing extreme AMOC events through nudging of the ocean surface: A perfect model approach. *Clim. Dyn*. doi:10.1007/s00382-017-3521-4.

Vautard, R., A. Gobiet, S. Sobolowski, E. Kjellström, A. Stegehuis, P. Watkiss, T. Mendlik, O. Landgren, G. Nikulin, C. Teichmann, D. Jacob, 2014, The European climate under a 2°C global warming. Environ. Res. Lett., doi:10.1088/1748-9326/9/3/034006.

Drobinski P., Da Silva N., Panthou G., **Bastin S.,** Muller C., Borga M., Conte D., Fosser G., Güttler I., Kotroni V., Li L., Morin E., Onol B., Quintana-Segui P., Romera R., 2016: Temperature-precipitation extremes relationship in the Mediterranean: past climate assessment and projection in anthropogenic scenarios. *Clim. Dyn.* <10.1007/s00382-016-3083-x> - insu-01294073.

Mignot J., Garcia-Serrano J., **Swingedouw D**., Germe A., Nguyen S., Ortega P., **Guilyardi E**., Ray S. Decadal prediction skill in the ocean with surface nudging in the IPSL-CM5A-LR climate model *Climate Dynamics* 47, pp 1225-1246, DOI 10.1007/s00382-015-2898-1.

Relevant previous projects or activities:

FP7 IMPACT2C: CNRS/IPSL was leading WP8 of this project concerning impacts of climate change on air quality and health. It also participated to other WPs to produce regional climate simulations over Europe and analyse them.

FP7 IS-ENES/IS-ENES2: CNRS/IPSL was the leader of this project with the objective to develop a common distributed modelling research infrastructure in Europe.

H2020 BLUE ACTION: Juliette Mignot is co-investigator of this Horizon 2020 project related to climate predictability and teleconnections in the Arctic climate. CNRS is also involved through the participation of Didier Swingedouw and more generally of IPSL.

FP7 EARTH2OBSERVE: CNRS (and more specifically Jan Polcher and Sophie Bastin) is one of the 27 partners of this consortium. Its objective is to use available, and develop new, Earth Observation datasets for water resources assessment in combination with global land-surface and hydrological models.

COPERNICUS CLIM4ENERGY: Robert Vautard is PI of this SIS project which aims at providing climate products tailored for energy sectors. CNRS is involved in other aspects along with several energy practitioners.

Relevant significant infrastructure and/or any major items of technical equipment:
Data management: IPSL is an ESGF node for CMIP simulations; it also hosts the HYMEX dataset for observations.
Computing resources: The team already has experience in using large scale Linux clusters and national supercomputing resources through several different projects.

Third parties involved in the project:

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted?	N
Does the participant envisage that part of its worked is performed by linked third parties?	Y
The "Institute of Research for the Development" (IRD) is participating as third party through the contribution of Juliette Mignot. See Section 4.2.2	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 3b: Centre National de Reserches Scientifiques - Centre National de Recherches Météotologiques (CNRS/CNRM)

The Centre National de Recherches Météorologiques (CNRM) is a research department (laboratory) of the Centre National de Recherches Scientifiques (CNRS). Primarily oriented towards the needs of public utility in the domain of meteorology, the research actions encompass the atmosphere, extending to, and including, closely related fields and boundaries, such as climate, stratospheric ozone chemistry, upper ocean, physics and dynamics of the snow cover, surface hydrology etc. To carry out its missions, the CNRM hosts approximately 225 permanent positions (one third being research scientists) and about 60 students and visitors, working in specialised divisions. The climate group is one of these divisions. Its main specific research activities are global and regional climate modelling, climate variability including detection and attribution of climate change, projection of climate change at global and regional scales, climate change impacts, atmospheric chemistry and ocean-air interactions. The CNRM has a wide access to super-computer facilities in Météo-France and in the European Centre for Medium-Range Weather Forecasts (ECMWF). In EUCP, CNRM will bring its 25-year long expertise in regional climate modelling (WP3, WP5), in particular in running the ALADIN-Climate regional climate model and the AROME-Climate convection-permitting regional climate model. CNRM will also bring its world-class expertise in global climate projections and detection and attribution techniques (WP2, WP5). The climate department of CNRM is deeply involved in the WCRP international programmes CMIP and CORDEX and in particular in relevant tasks such as DAMIP and the recently-endorsed CORDEX FPS on convection processes. CNRM was part of former European projects on similar scientific topics such as FP5 PRUDENCE, FP6 ENSEMBLES, FP7 IMPACT2C and FP7 EUCLIPSE projects.

Short profile of key personnel involved:

Dr Samuel Somot (male), Senior Researcher [CNRS/CNRM Principal Investigator, Scientist WPs 3, 5]: Samuel has been working at the research centre since 2000. He has been responsible for the regional modelling activity at CNRM since 2003 and is leading the recently-created Regional Climate Modelling team at CNRM (since 2016). He has also led the development of the ALADIN-Climate limited area model at CNRM. His main focus has been on the Mediterranean area (ocean and climate) and on the regional air-sea coupling since his arrival at Météo-France in 2000. He has been involved in EU-funded and national-funded projects focussing on regional climate modelling (among them FP5 PRUDENCE, FP6 ENSEMBLES, FP6 CIRCE, FP7 CLIM-RUN in which he led the regional climate modelling WP). He is currently WP leader in the national funded project ANR REMEMBER and he is involved in the international HyMeX, MerMex and Charmex programmes, all dealing with regional climate modelling for the Mediterranean climate and sea. He is also currently the leader of the Regional Climate Modelling Task in HyMeX (www.hymex.org) and of the Med-CORDEX initiative (www.medcordex.eu). Since 2006 (Ph-D), he has been author or co-author of more than 90 publications in peer-reviewed journals or books (Total citations: 4827, h-factor: 35, i-10: 69 – source: Google scholar on 13th of February 2017). In parallel to his scientific activities at MF-CNRM, Samuel was a visiting scientist at ESSC (U.K., Reading, 2003), OURANOS (Canada, Montréal, 2007), NASA/GISS (U.S.A., New-York, 2010) and LOCEAN (France, Paris, 2012-2013-2014).

Dr Aurélien Ribes (male), Research Scientist [Scientist WPs 2, 5]: Aurélien is a scientist on the detection and attribution of climate change (D&A). His main research focuses on improving the statistical methods used in D&A, and better understanding recent changes in near-surface temperature at the global scale. He was a contributing author of the IPCC AR5 on these topics. He has 10 years experience with more than 20 research articles and contribution to several national and European research projects.

Dr Hervé Douville (male), Head of Analysis & Modelling of the Atmosphere, Climate and its Sensitivity team [Scientist WP2]: Hervé was head of the VDR team on climate Variability, Detection and Feedbacks from 2009 to 2015, before he became head of the AMACS team. The team's objectives are to: (i) develop the atmospheric component of the global climate model of CNRM; (ii) understand the mechanisms and drivers of the recent climate variability, including through the use of formal detection-attribution techniques; and (iii) understand the mechanisms and uncertainties of global climate projections, including through the participation in and the analysis of CMIP experiments. Hervé is author or co-author of more than 100 publications in peer-reviewed journals. He has been involved in many EU-funded projects such as FP6 ENSEMBLES, FP7 EUCLIPSE and Horizon 2020 APPLICATE. He was a member of the WCRP Working Group on Seasonal to Interannual Prediction (WGSIP) from 2009 to 2015.

Dr Olivier Nuissier (male). Permanent Scientist [Scientist WP3]: Olivier received his PhD in 2013 in atmospheric physics, University of Toulouse, France. His field of expertise are the dynamics and fine-scale predictability of heavy precipitation events and the convective-scale modelling with the AROME model.

Antoinette Alias (female), Full-time Staff Research Engineer [Scientist WP3]: Antoinette is in charge of developing and maintaining the CNRM regional climate models such as ALADIN-Climate and AROME-Climate. She has 30 years of experience in research engineer in various fields and laboratories including ECMWF and she has 10 years experience in regional climate modelling since her arrival at CNRM.

Relevant publications, and/or products, services, achievements:

Chadwick R., **H. Douville**, C.B. Skinner (2017): Timeslice experiments for understanding regional climate projections: Applications to the tropical hydrological cycle and European winter circulation. *Clim. Dyn*., doi:10.1007/s00382-016-3488-6.

Ribes A., F. Zwiers, J.-M. Azaïs, P. Naveau (2017): A new statistical method for climate change detection and attribution, *Climate Dynamics*, 48(1-2), 367–386, doi :10.1007/s00382-016-3079-6.

Ruti P.M., **Somot S.**, Giorgi F, et al. (2015): MED-CORDEX initiative for Mediterranean Climate studies. *BAMS*, 10:1187-1208, July 2016, doi: http://dx.doi.org/10.1175/BAMS-D-14-00176.1.

Déqué M., **Somot S.**, Sanchez-Gomez E., Goodess C.M., Jacob D., Lenderink G., O.B. Christensen O.B. (2012) "The spread amongst ENSEMBLES regional scenarios: Regional Climate Models, driving General Circulation Models and interannual variability", *Clim. Dyn*., 38:5-6, pp. 951-964, DOI: 10.1007/s00382-011-1053-x.

Douville H., B. Decharme, **A. Ribes**, R. Alkama, J. Sheffield (2012) Anthropogenic influence on multi-decadal changes in reconstructed global evapotranspiration. *Nature Climate Change*, doi:10.1038/NCLIMATE1632.

Relevant previous projects or activities:

FP6 ENSEMBLES: The project aimed to (1) Develop an ensemble prediction system for climate change based on the principal state-of-the-art, high resolution, global and regional Earth System models developed in Europe, validated against quality controlled, high resolution gridded datasets for Europe, to produce for the first time, an objective probabilistic estimate of uncertainty in future climate at the seasonal to decadal and longer timescales, (2) Quantify and reduce the uncertainty in the representation of physical, chemical, biological and human-related feedbacks in the Earth System (including water resource, land use, and air quality issues, and carbon cycle feedbacks) and (3) Maximise the exploitation of the results by linking the outputs of the ensemble prediction system to a range of applications, including agriculture, health, food security, energy, water resources, insurance and weather risk management.

FP6 CIRCE: The project goal was to deal with regional climate change and impacts for the Mediterranean area. This includes to (1) model the Mediterranean regional climate change with the use, for the first time, of an ensemble of coupled Atmosphere-Ocean Regional Climate Models dedicated to the Mediterranean study, (2) study the regional impact of climate change for the Mediterranean in particular applying regional detection techniques and (3) study the adaptation and mitigation strategies for the Mediterranean region.

FP7 IMPACT2C: The key objective of IMPACT2C was to examine the impacts of +2°C global warming on Europe and the key vulnerable global regions in Africa (Nile and Niger river basins), Bangladesh and the Maldives. Studies were undertaken for a range of different sectors such as water, energy, agriculture, infrastructure and health. The project provided easily accessible climate-related information to policymakers, the media and other interested parties in a series of Policy Brief Notes. A web atlas (www.atlas.impact2c.eu) was produced to provide input for the development of recommendations on possible adaptations strategies. 1 of 29 partners.

FP7 CLIM-RUN: Climate Local Information in the Mediterranean region Responding to User Needs aimed at developing a protocol for applying new methodologies and improved modelling and downscaling tools for the provision of adequate climate information at regional to local scale that is relevant to and usable by different sectors of society (policymakers, industry, cities, etc.). CLIM-RUN provided an important instrument for the development of a Mediterranean-wide network of climate services that would eventually confluence into a pan-European network. 1 of 16 partners.

H2020 APPLICATE: Advanced Prediction in Polar regions and beyond: Modelling, observing system design and LInkages associated with a Changing Arctic climaTE. Among other objectives, APPLICATE aims to narrow the uncertainty of global projections that are associated with Arctic climate change. To this end, two different approaches will be followed: model development efforts but also the development of emergent constraints – physical relationships between (observable) present-day and projected future climate – by analysing statistical relationships between future and historical model runs in multi-model ensembles. A particular attention will be paid

to the polar-midlatitude linkages at intraseasonal to multidecadal timescales and their possible use as emergent constraints of projected climate change in the northern midlatitudes.

Relevant significant infrastructure and/or any major items of technical equipment:

A Bull High-Performance Computing system with a total of 2000 nodes of 40 “Broadwell” cores and associated storing capabilities at the Meteo-France computer center.
Météo-France ESGF datanode, a Tier-2 node in the ESGF federation.
The ALADIN-Climate regional climate model in its version 6 and the AROME-Climate convection-permitting regional climate model in its version 1.

No third parties involved.

Participant 4: Stichting Deltares (Deltares)
Deltares is a Dutch institute for applied research and development on issues related to living and working in delta areas. The mission of Deltares is to develop, acquire, apply and disseminate integral, multidisciplinary knowledge and knowledge products related to living and working in delta areas supporting public authorities, private parties and society, related to sustainable development of delta regions.

The primary task of Deltares is to bring together science and practice: translating scientific knowledge into innovative solutions needed in sustainable development of deltas. Deltares plays an active role in innovation networks with the ultimate goal of creating societal value, by supporting and speeding up innovation.

Deltares has extensive experience as both research partner and project coordinator in the European research arena. Relevant EU research projects which Deltares has lead are eartH2Observe, DEWFORA, GLOWASIS, furthermore Deltares participate(d)s in IMPREX, MARS, GRACeFUL, INFORM, FAST, RASOR, RISES, REFRESH, REFORM, BASE and many others.

Short profile of key personnel involved:

Dr Albrecht Weerts (male), Expert on data model integration and hydrological forecasting [Deltares Principal Investigator, Leader WP4, Scientist WPs 3, 6]: Albrecht has been leading research and development projects on data assimilation techniques for improving flood forecasting system (quantification and reduction of uncertainties). Within the EU FP7 project GLOWASIS he contributed to the improvement of seasonal forecasting of global water scarcity. Currently, he is actively engaged in amongst others Horizon 2020 IMPREX, which aims to improve forecast skill of meteorological and hydrological extremes in Europe and management of their impacts. Albrecht (co)-authored over 40 peer reviewed journal papers and is professor Hydrological Predictability (0.2 fte) at Wageningen University & Research Centre.

Dr Laurens Bouwer (male), Senior Researcher [Scientist WPs 4, 6]: At Deltares, Laurens focuses on three topics: (i) assessing climate change influence on extreme weather hazards, specifically flooding; (ii) modelling of impacts and damages; and (iii) analysing finance options for adaptation, including insurance. He has lead several (inter)national research and consultancy projects, and has published extensively in the academic literature on these topics. He was a Lead Author for the AR3 and AR5, a Contributing Author for the IPCC's Special Report on Extremes, and a member of the Munich Climate Insurance Initiative (MCII). He has been involved in several EU funded research projects, including RESPONSES, ConHaz, ENHANCE, BASE, GREEN-WIN and IMPREX. He is also an editorial board member of the journal Climate Services.

Dr Frederiek Sperna Weiland (female), Scientist [Scientist WPs 2, 3, 4]: Frederiek has been working at Deltares since 2006. She has extensive experience in hydrological modelling, climate change assessments, forecasting and satellite data retrieval. She holds a PhD on the uncertainties in global hydrological climate change assessments focussing on river discharges. At present she is co-leading the FP7 project eartH2Observe and was involved in the FP7 project BASE and the FP6 project SCENES.

Dr Ap van Dongeren, (male), Senior Specialist [Scientist WPs 2, 3, 4]: Ap has experience in wave dynamics, low-frequency (long) waves and coastal impact. He has been project leader on a number of national and international projects for the Dutch government, Dutch water boards, the Office of Naval Research, the Asian Development Bank and the European Union. He is currently Coordinator on an FP7 project called RISC-KIT on coastal resilience and extreme coastal events. He is the programme manager on the strategic research programme on "Hydro- and Morphodynamics during Extreme Events", and member of the Deltares Scientific Board. He served on the U.S. National Academies' Committee on Coastal Risk Reduction for the U.S. Corps of Engineers. He has been Work Package Leader for the MICORE project, which has developed online dune erosion models for the European Union.

Dr Alessio Giardino (male), Senior Adviser [Scientist WPs, 4, 6]: Alessio works at Deltares in the field of coastal erosion management, adaptation to climate change and multi-hazard and risk assessment. He holds a PhD in numerical modelling of coastal morphodynamics from the University KULeuven (Belgium), and he is author of several Journal publications. He has also been working as specialist adviser in several projects related to climate change risks for different national government, the World Bank (WB), the Asian Development Bank (ADB) and the private sector.

Relevant publications, and/or products, services, achievements:

Roelvink, D., Reniers, A., **van Dongeren, A.**, van Thiel de Vries, J., McCall, R., Lescinski, J., 2009. Modelling storm impacts on beaches, dunes and barrier islands. *Journal of Coastal Engineering*, 56, 1133-1152.

Sperna Weiland, F.C., Van Beek, L.P.H., **Weerts**, **A.H.**, Bierkens, M.F.P. (2012): Extracting information from an ensemble of GCMs to reliably assess future global runoff change, *Journal of Hydrology*, 412, 66-75.

Sperna Weiland, F. C., van Beek, L. P. H., Kwadijk, J. C. J., and Bierkens, M. F. P. (2012): Global patterns of change in discharge regimes for 2100, Hydrol. Earth Syst. *Sci*., 16, 1047-1062, doi:10.5194/hess-16-1047-2012.

Van den Hurk, B., **L. M. Bouwer**, C. Buontempo, R. Döscher, E. Ercin, C. Hananel, J. Hunink, E. Kjellström, B. Klein, M. Manez, F. Pappenberger, L. Pouget, M.-H. Ramos, P.J. Ward, **A.H. Weerts (**2016): Improving Predictions and Management of Hydrological Extremes – The IMPREX perspective, *Journal of Climate Services*, 1, 6-11, 2016.

Photiadou, C., B.J.J.M. van den Hurk, A. van Delden and **A.H. Weerts (** 2016): Incorporating circulation statistics in bias correction of CMIP5 models and a climate ensemble: Hydrological application for the Rhine basin, *Climate Dynamics*, 46, 187-203, doi:10.1007/s00382-015-2578-1.

Relevant previous projects or activities:

Deltares has led the FP7 projects **BASE** (Bottom-up Climate Adaptation Strategies Towards a Sustainable Europe) and **RISC-KIT** (Resilience-Increasing Strategies for Coasts – toolkit). Deltares is currently co-ordinator of FP7 **eartH2Observe** (Global Earth Observation for Integrated Water Resource Assessment) and work package leader within Horizon 2020 **IMPREX** (IMproving PRedictions and management of hydrological Extremes). These are all examples of projects that focus on the interaction between meteorology / climate and riverine and coastal impacts. Deltares will extend and improve the in these projects applied methodologies and tools within EUCP.

Relevant significant infrastructure and/or any major items of technical equipment:

Not applicable.

No third parties involved.

Participant 5: Danmarks Meteorologiske Institut (DMI)

The Danish Meteorological Institute (DMI, www.dmi.dk) is an institution under the Danish Ministry of Energy, Utilities and Climate and has an annual turnover of approx. 300 million Danish Kroners (about 40 M€). DMI provides meteorological services in the Commonwealth of the Realm of Denmark, the Faroe Islands, Greenland, and surrounding waters and airspace. Founded in 1872, DMI has collected and processed meteorological, climatological and oceanographic measurements/observations, and measures, collects and compiles related geophysical parameters throughout the Realm. Through scientific research and development, DMI secures the optimum accomplishment of its tasks and serves the community with up-to-date information on weather and climate and other geophysical issues. The Department of Research and Development (R&D) at DMI has extensive experience in climate research, including development of state-of-the-art global and regional climate models (i.e., EC-Earth, HIRHAM) and studies of climate processes. DMI's R&D provides in-depth information and advice on climate and climate change to governmental institutions and the general public. It had been contributed to CMIP5 and CORDEX. Currently DMI's R&D is involved in the development of the new version of the EC-Earth ESM for the coming CMIP6, and working on an experimental initialisation system for decadal climate predictions applying the new EC-Earth model under a number of research projects and in collaboration with the EC-Earth consortium. DMI has a long history of administrating and maintaining in-house HPC infrastructure, and is currently hosting a CRAY XC (located at the Icelandic Meteorological Office, Iceland) which serves for the daily operational numerical weather prediction, R&D model experiments, as well as long-term regional and global climate prediction and projection experiments.

Short profile of key personnel involved:

Dr Shuting Yang (female), Senior Scientist [DMI Principal Investigator, Scientist WPs 1, 5]: Shuting has worked at DMI since 1996. She has a long experience in areas of climate modelling and research of climate variability and climate change. She has worked on a number of topics including atmospheric circulation regimes, climate sensitivity and feedbacks, and climate prediction and projections, by using both idealised, simplified circulation model and general circulation models. Her research interests cover global climate modelling; climate variability; Seasonal to decadal prediction; Cryospheric change with focus on Arctic sea ice change and impacts, and understanding and modelling of Greenland ice sheet change and feedbacks in the climate system. She has been in charge of global climate model development at DMI, and is currently involved in the development of the European ES model, EC-Earth. She was the group leader in EC-Earth consortium for working groups 'EC-Earth model tuning' (2008-2009), 'EC-Earth CMIP5' (2009-2010) and, is currently responsible for coordination of the EC-Earth CMIP6 activities. She is a reviewer for international scientific journals e.g., *Advances in Atmospheric Physics, Atmospheric and Oceanic Science Letters, Climate Dynamics, Environmental Research Letters and Tellus.* She was a panel member for Natural and Engineering Sciences under the Swedish Research Council, 2012, 2013.

Dr Ole Bøssing Christensen (male), Senior Scientist [Scientist WPs 3, 5]: Ole has worked at the DMI since 1993, working with regional climate models and data archiving and analysis. He has a Master's degree in physics, minors in mathematics and computer science, and a PhD (1992) in solid state physics. Ole was a Contributing Author on the WG-I of the IPCC's AR5 (Chapter 14: Climate Phenomena and their Relevance for Future Regional Climate Change). He has been a reviewer for e.g., the international scientific journals Climate dynamics, Geophysical Research Letters, Tellus, Monthly Weather Review, Climatic Change, International Journal of Climatology, Global and Planetary Change, Theoretical and Applied Climatology, Journal of Hydrology, Urban Water Journal, Journal of Hydrometeorology, Acta Geophysica, and Journal of Geophysical Research. He has also been a project reviewer for the Norwegian, Belgian, Dutch, Canadian and Austrian Research Councils and for FP7. He was an advisory board member for the EU-funded PESETA, PESETA2 and PESETA3 projects, and a member of the BALTEX steering group 2006-2009.

Relevant publications, and/or products, services, achievements:

Bellucci, A., R. Haarsma, S. Gualdi, P. Athanasiadis, M. Caian, C. Cassou, A. Germe, J. Jungclaus, J. Kröger, D. Matei, W. Müller, H. Pohlmann, D. Salas y Melia, E. Sanchez, D. Smith, L. Terray, K. Wyser, and **S. Yang**, 2014: An assessment of a multi-model ensemble of decadal climate predictions. *Clim. Dyn.*, doi:10.1007/s00382-014-2164-y.

Christensen, O. B., S. Yang, F. Boberg, C. F. Maule, P. Thejll, M. Olesen, M. Drews, H. J. D. Sørup, J. H. Christensen, 2015: Scalability of regional climate change in Europe for high-end scenarios. *Climate Research* 64 (1), 25-38.

Christensen, **O. B.**, Kjellström, K., Zorita, E. "Projected Change—Atmosphere" in "Second Assessment of Climate Change for the Baltic Sea Basin", doi: 10.1007/978-3-319-16006-1_10. Springer Verlag 2015.

Jerez, S., I. Tobin, R. Vautard, J. P. Montávez, J. M. López-Romero, F. Thais, B. Bartok, **O. B. Christensen**, A. Colette, M. Déqué, G. Nikulin, S. Kotlarski, E. van Meijgaard, C. Teichmann and M. Wild, 2015: The impact of climate change on photovoltaic power generation in Europe. Nature Comm. 6:10014, doi:10.1038/ncomms10014.

Shuting, Y., and Christensen, J.H. 2012: Arctic sea ice reduction and European cold winters in CMIP5 climate change experiments. *Geophys. Res. Lett*., **39**, doi:10.1029/2012GL053338.

Relevant previous projects or activities:

Nordic Centre of Excellence "Arctic Climate Predictions: Pathways to Resilient, Sustainable Societies" (**ARCPATH**, NordForsk Project Greant 76654, running from 2016 to 2020) which aims at establishment of new and improved Arctic climate prediction services that will go beyond the current State-of the-Art.

Horizon2020 project **Blue-Action** which is to improve our ability to describe, model and predict Arctic climate change and its impact on Northern Hemisphere climate, weather and their extremes, coordinated by DMI.

FP7 COMBINE in which DMI co-led the activities on improvement of modelling the cryosphere component in ESMs and participated in the activity on improvement of decadal climate predictions.

FP6 ENSEMBLES in which DMI lead the research theme on regional climate downscaling.

FP5 PRUDENCE in which DMI is the coordinator**.**

Relevant significant infrastructure and/or any major items of technical equipment:

Not applicable.

No third parties involved.

Participant 6: Eidgenössische Technische Hochschule Zürich (ETH Zürich)
The Swiss Federal Institute of Technology (ETH) was founded in 1855 and is the leading Swiss university in the areas of natural sciences and engineering, with about 13,000 students and 6,000 staff. Currently it is ranked among the top five universities in Europe according to the Shanghai Jiao Tong University ranking. The Institute of Atmospheric and Climate Science at ETH Zurich has long and wide-ranging expertise in atmospheric physics and chemistry, climate research, and hydrology. The institute has a staff of about 130 researchers, technicians and PhD students.

The main contributions of ETH will lie in (i) the development of methods to better quantify regional climate projection uncertainties from different types of model simulations, taking into account new developments of emergent constraints, model weighting and information about model dependence; and (ii) the assessment of high impact extreme events in current and near future climate using high-resolution regional climate models at convection-resolving scales.

Short profile of key personnel involved:

Prof Reto Knutti (male), Chair of the Climate Physics research group [ETH Zürich Principal Investigator, Scientist WPs 2, 5]: Reto works on projections of future climate with models of different complexity, statistical methods to quantify uncertainty in global and regional climate change, climate model evaluation, detection and attribution, constraints on future climate provided by observations, quantification of physical and biogeochemical feedbacks, climate sensitivity, energy balance, ocean heat uptake and its implications for long-term climate projections. He was a coordinating lead author of the chapter "Long-term Climate Change: Projections, Commitments and Irreversibility" in the IPCC AR5.

Prof Christoph Schär (male), Chair of the Climate and Water Cycle group, Head of the Institute for Atmospheric and Climate Science [Scientist WP3]: His research is concerned with climate dynamics, climate change, the water cycle, numerical weather prediction and climate modelling. His group is using a wide range of numerical models, among these regional climate models and hydrological models. Current projects address the role of the water cycle in a changing climate with particular consideration of extreme events (heat waves, floods and droughts). He, and his group, have contributed influential research on European summer heatwaves and heavy precipitation events. He is currently leading a major project that pioneers high-resolution climate models (see http://www.c2sm.ethz.ch/research/crCLIM). In addition to journal publications, he has contributed to the UN IPCC, as a contributing author of the AR3 and AR4, and as a lead author of AR5 (chapter 11, 2013, http://www.climatechange2013.org/).

Relevant publications, and/or products, services, achievements:

Ban N., J. Schmidli and **Schär, C**. (2015): Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster? *Geophys*. Res. Lett., 42 (4), 1165–1172 http://dx.doi.org/10.1002/2014GL062588.

Leutwyler, D., O. Fuhrer, X. Lapillonne, D. Lüthi, **C. Schär**, (2016): Towards European-scale convection-resolving climate simulations with GPUs: A study with COSMO 4.19. *Geosci*. Model Dev., 9, 3393– 3412, doi:10.5194/gmd-9-3393-2016.

Knutti, R., R. Furrer, C. Tebaldi, J. Cermak and G.A. Meehl (2010): Challenges in combining projections from multiple models, *J. Climate, 23*, 2739-2758, doi:10.1175/2009JCLI3361.1.

Knutti, **R.**, D. Masson, and A. Gettelman (2013), Climate model genealogy: Generation CMIP5 and how we got there, Geophys. Res. Lett., 40(6), 1194–1199, doi:10.1002/grl.50256.

CH2011, 2011, Swiss Climate Change Scenarios CH2011, published by C2SM, MeteoSwiss, ETH, NCCR Climate, and OcCC, Zurich, Switzerland, 88 pp. ISBN: 978-3-033-03065-7.

Relevant previous projects or activities:

ETH Zürich was, and is, involved in several large EU projects proposals funded by the Swiss National Science Foundation and ETH, including:

FP7 EMBRACE: Evaluation and improvement of current Earth System Models with respect to land-climate interactions.

FP7 EUCLEIA: Coordination of the compilation of observational datasets, experiments to understand the processes contributing to the occurrence of extreme events, assessment of drought attribution methods.

Horizon 2020 CRESCENDO: Development of methods to constrain uncertainties in ensembles of multiple, including weighting of models, evaluation of models on observations.

Relevant significant infrastructure and/or any major items of technical equipment:

Not applicable.

No third parties involved.

Participant 7: Helmholtz-Zentrum Geesthacht, Zentrum für Material- und Küstenforschung GmbH (HZG)
The Helmholtz-Zentrum Geesthacht, Zentrum für Material- und Küstenforschung GmbH (HZG) is one of 18 members of the Helmholtz Association of German Research Centres, Germany's largest science organisation. HZG comprises four research institutes – among them the Climate Service Center Germany (GERICS, http://www.gerics.de). GERICS was initiated by the German Federal Government in 2009 as a fundamental part of the German hightech-strategy for climate protection. Since June 2014, GERICS is a scientific organisational entity of HZG. It is located in Hamburg with a current staff size of about 40 employees. GERICS offers in a scientifically sound manner products, advisory services and decision-relevant information in order to support government, administration and business in their efforts to adapt to climate change. It builds up a national and international network structure in order to integrate existing competences and knowledge, and to link various actors within the complex area of climate change.

Role in EUCP

HZG will co-lead WP6 and the task on the engagement with business sector, where prototype products will be co-created together with selected partners from the business sector. In addition, HZG will participate in WP3 and will contribute with its regional climate model REMO and its large expertise in regional climate modelling by performing climate simulations at very high resolution, by analysing simulations and by leading the task on post-processing of simulations for follow-up usage. HZG will also participate in WP4 by leading the task on the review of user needs.

Short profile of key personnel involved:

Prof Dr Daniela Jacob (female), Director of the Climate Service Center Germany (GERICS) and visiting Professor at the Faculty of Sustainability (University of Lüneburg) [Scientist WPs 3, 4 & 6]: Daniela developed the regional climate model REMO at the Max Planck Institute for Meteorology in Hamburg in 1993. She participated in more than 30 (inter-)national projects such as FP6 ENSEMBLES and FP7 CLIP-C, and coordinated (inter-) national projects such as Impact2C. In 2010 she was appointed as a Leading Author of the IPCC AR5 (Working Group 2). Daniela was leading the "Climate System" department of the Climate Service Center from 2010. Since June 2015, she has been the Director of the Climate Service Center Germany (GERICS). Daniela is (co)-author of more than 188 publications (about 130 peer-reviewed) and has an h-index of 33.

Dr Claas Teichmann (male), Postdoctoral Researcher at the Climate Service Center [HZG Principal Investigator, Co-leader WP6]: Claas is an expert in regional climate modelling. He contributed to several international projects (e.g., FP7 IMPACT2C which investigated climate change and its impacts under a 2°C warming) and contributed to various publications. He supports the coordination of EURO-CORDEX, aiming at high resolution regional climate simulations, their analysis and distribution among users. He is co-chair of the CMIP6-endorsed Vulnerability, Impact, Adaptation and Climate Services Advisory Board.

Dr Lars Buntemeyer (male), Scientific Programmer [Scientist WP3]: Lars is an expert in the field of regional climate modelling. He works mainly on the optimisation of regional climate models and supports different projects on running models, including pre- and post-processing of forcing and output data. He has experience in running and processing regional climate simulations on several domains of the CORDEX initiative as well as special expertise in scientific programming with Fortran, C and the NetCDF API.

Relevant publications, and/or products, services, achievements:

Jacob, D.; Petersen, J.; Eggert, B.; Alias, A.; Christensen, O.; Bouwer, L.; Braun, A.; Colette, A.; Déqué, M.; Georgievski, G.; Georgopoulou, E.; Gobiet, A.; Menut, L.; Nikulin, G.; Haensler, A.; Hempelmann, N.; Jones, C.; Keuler, K.; Kovats, S.; Kröner, N.; Kotlarski, S.; Kriegsmann, A.; Martin, E.; van Meijgaard, E.; Moseley, C.; Pfeifer, S.; Preuschmann, S.; Radermacher, C.; Radtke, K.; Rechid, D.; Rounsevell, M.; Samuelsson, P.; Somot, S.; Soussana, J.-F.; Teichmann, C.; Valentini, R.; Vautard, R.; Weber, B. & Yiou, P. (2014): EURO-CORDEX: new high-resolution climate change projections for European impact research *Regional Environmental Change*, *Springer Berlin Heidelberg, 14*, 563-578.

Jacob, D.; Elizalde, A.; Haensler, A.; Hagemann, S.; Kumar, P.; Podzun, R.; Rechid, D.; Remedio, A. R.; Saeed, F.; Sieck, K.; **Teichmann**, C. & Wilhelm, C. Assessing the Transferability of the Regional Climate Model REMO to Different COordinated Regional Climate Downscaling EXperiment (CORDEX) Regions (2012): *Atmosphere, 3*, 181-199.

Ruane, A. C.; **Teichmann**, C.; Arnell, N. W.; Carter, T. R.; Ebi, K. L.; Frieler, K.; Goodess, C. M.; Hewitson, B.; Horton, R.; Kovats, R. S.; Lotze, H. K.; Mearns, L. O.; Navarra, A.; Ojima, D. S.; Riahi, K.; Rosenzweig, C.; Themessl, M. & Vincent, K. The Vulnerability, Impacts, Adaptation and Climate Services Advisory Board (VIACS AB v1.0) contribution to CMIP6 *Geoscientific Model Development*, 2016, 9, 3493-3515.

Otto, J., Brown, C., Buontempo, C., Doblas-Reyes, F., **Jacob**, D., Juckes, M., Keup-Thiel, E., Kurnik, B., Schulz, J., Taylor, A., Verhoelst, T. and Walton, P.: Uncertainty: Lessons learned for climate services (2016): *Bull. Am. Meteorol. Soc.*, BAMS-D-16-0173.1, doi:10.1175/*BAMS*-D-16-0173.1.

GERICS Climate Fact Sheets (see http://www.climate-service-center.de/products_and_publications/fact_sheets/climate_fact_sheets/index.php.en).

Relevant previous projects or activities:

HZG/GERICS has had key roles in the following projects and work packages in the last five years:

ReKliEs-De Regionale Klimaprojektionen Ensemble für Deutschland (2014-2017). This nationally coordinated effort evaluates the new set of EURO-CORDEX simulations for Germany and systematically complements it by further simulations with both dynamical and statistical downscaling methods. GERICS has been evaluating existing surveys of sectoral-specific user needs regarding climate data and derived climate indicators. Sectors covered are human health, building and construction, water, coastal protection, biodiversity, agriculture and forestry, energy, finance and insurance, transport and logistics, tourism, and urban planning.

CORDEX. This initiative organises an internationally coordinated framework to produce improved regional climate change projections for all land regions world-wide. GERICS co-leads the European branch EURO-CORDEX and provides data for EURO-CORDEX and other domains; i.e., Africa,- MENA-, South Asia- and South-East Asia CORDEX.

FP7 IMPACT2C. The key objective of IMPACT2C was to examine the impacts of +2°C global warming on Europe and the key vulnerable global regions in Africa (Nile and Niger river basins), Bangladesh and the Maldives. HZG/GERICS was leading the project and coordinating all partner activities.

FP7 ECLISE. The central objective of ECLISE was to take the first step towards the realisation of a European Climate Service. ECLISE aimed at developing local climate services in four areas: COASTS, CITIES, WATER and ENERGY, and to make concrete demonstrations of the utility of these services in support of local climate adaptation policies. HZG/GERICS le the work package on the conceptualisation of the future European Climate Services working closely with the results of the user cases in ECLISE. HZG/GERICS also contributed to the work package Models, in which climate change information was developed and tailored for end users.

FP7 CLIP-C provides access to climate information of direct relevance to a wide variety of users. Information includes data from satellite and in-situ observations, climate models and reanalyses, transformed data products to enable impacts assessments and climate change impact indicators. The platform complements existing Copernicus pre-operational components, but focuses on datasets which provide information on climate variability from observed and projected climate change impacts in Europe, and provides a toolbox to generate, compare and rank key indicators.

Relevant significant infrastructure and/or any major items of technical equipment:

HZG/GERICS has permanent access to high-performance computing facilities at the German Climate Computing Center (DKRZ).

HZG/GERICS owns the dedicated blade server eddy (located at the DKRZ) including large data storage capacities used to process and prepare data for product development and production. In addition local computing facilities equipped with dedicated licensed software are used for visualisation.

No third parties involved.

Participant 8: Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC)
The Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (Fondazione CMCC) is a non-profit research institution (www.cmcc.it). CMCC's mission is to investigate and model our climate system and its interactions with society to provide reliable, rigorous, and timely scientific results, which will in turn stimulate sustainable growth, protect the environment, and develop science driven adaptation and mitigation policies in a changing climate. CMCC collaborates with experienced scientists, economists, and technicians, who work together in order to provide full analyses of climate impacts on various systems such as agriculture, ecosystems, coasts, water resources, health, and economics. CMCC also supports policymakers in setting and assessing costs, mitigation, and adaptation policies.

CMCC benefits from the extensive applied research experience of its members and institutional partners: Istituto Nazionale di Geofisica e Vulcanologia (INGV); Università del Salento; Centro Italiano di Ricerche Aerospaziali (CIRA S.c.p.a.); Università Ca' Foscari Venezia; Università di Sassari, Università della Tuscia, Politecnico di Milano.

CMCC's research activities are distributed among eight research divisions that share different knowledge and skills in the field of climate science: Advanced Scientific Computing (ASC) Division; Climate Simulation and Prediction (CSP) Division; Economic analysis of Climate Impacts and Policy (ECIP) Division; Impacts on Agriculture, Forests and Ecosystem Services (IAFES) Division; Ocean modelling and Data Assimilation (ODA) Division; Ocean Predictions and Applications (OPA) Division; Risk Assessment and Adaptation Strategies (RAAS) Division; Regional Models and geo-Hydrological Impacts (REHMI) Division.

CMCC is one of the leading centres for climate research and is extensively involved in the IPCC assessments and associated CMIP simulations. CMCC staff will be involved in many aspects of this proposal, with significant experience and expertise beyond the staff named here below. Specifically, CMCC will contribute to the WPs 1 and2. The CMCC regional modelling group will be involved in the WP3 activities, contributing to a demonstrator of high impact weather in a changing climate. Furthermore, CMCC will contribute to WP4 providing its sizable expertise and long-standing experience in climate risk analysis and economic impact assessment.

CMCC's acquired portfolio of research projects includes 205 funded projects: two funded projects in FP6, 35 funded projects in FP7, 24 funded projects in H2020 and 144 funded projects under other EU and international research grants. In about a half of the implemented projects, CMCC acted as the coordinator.

For further information on CMCC please see Annual Report 2015 (http://www.cmcc.it/it/publications/annual-report-2015) and CMCC Strategic Plan (www.cmcc.it/publications-type/annual-report**).**

Short profile of key personnel involved:

Dr Alessio Bellucci (male), Coordinator of the Climate Variability and Prediction group, CSP Division [Co-Leader WP1]: Alessio holds a PhD in physical oceanography from the University of Southampton/NOCS and is a climate modeller. His major field of expertise is the role of the ocean on the global climate system, focussing in particular on climate variability and predictability at decadal and inter-decadal timescales. Within CMCC, he has been the reference person for the near-term climate prediction experiments performed under the framework of CMIP5 and is currently covering the same role within the CMIP6-endorsed DCPP. He has been involved in several EU-funded FP and Horizon 2020 projects, including, among others COMBINE , CLIM-RUN, PRIMAVERA and Blue-Action. He is also lecturer in Geophysical Fluid Dynamics and member of the scientific board for the PhD Programme in Science and Management of Climate Change at the University of Venice. His major contribution to WP1 will be through investigations of predictive ability of CMIP5 and CMIP6 decadal hindcasts associated to specific events and exploit the concept of "windows of opportunity" within the decadal climate prediction experimental framework.

Dr Francesco Bosello (male), Director of the ECIP (Economic Analysis of Climate Impacts and Policy) Research Division: Francesco graduated at Ca' Foscari University of Venice. He has a Master's degree in Economics from the University College of London (UK) and a PhD in Economics from Ca' Foscari University of Venice. He is also a senior researcher at the Fondazione Eni Enrico Mattei (FEEM), and assistant professor of economics at the University Statale of Milan. His research expertise is focussed on climate-change policy and modelling with particular emphasis on negotiation aspects of international environmental agreements and on optimal policy design considering adaptation and mitigation options.

Mauro Buonocore (male), Coordinator of the Institutional Communication Activities at CMCC [Scientist WP6]: Mauro's role includes the development of online and offline communication strategies, the management of

media contact, and the dissemination activities. He has a background in journalism, and expertise in designing, producing and publishing of editorial content for offline supports (articles for magazines and newspapers, books, reports). In the last years, Mauro's activities focused particularly on the design and the publication of online tools for the dissemination of data and knowledge related to scientific research, with a specific focus on climate change (websites, web applications, mobile applications). Mauro is involved in Horizon 2020 Climateurope (www.climateurope.eu/). For Climateurope he deals with the activities related to the website, and to the creation and the maintenance of the Internet Communication Platform and the Climateurope Network Platform, which are digital environments created for the exchange of information and data among the Consortium Partners and the stakeholders. In the framework of EUCP, Mauro will lead Task 6.5 that will provide a digital platform for internal communication and sharing contents.

Dr Silvio Gualdi (male), Director of the CSP Division and Senior Scientist at INGV [CMCC Principal Investigator]: Silvio holds a degree in Physics (from University of Modena, Italy) and a PhD in Geophysics (University Hamburg, Germany) and has more than 20 years of experience in climate modelling and simulations, and more than 70 peer-reviewed papers and book chapters. He has been, and currently is, responsible for the CMCC contribution to WCRP's CMIP3, CMIP5 and CMIP6. Furthermore, he has been involved in numerous international projects and, currently, he is responsible for the CMCC tender for ECMWF's ITT C3S_433 Lot 2, Seasonal Forecasts, for the provision of pre-operational seasonal predictions. Finally, he is teacher for the 'Science and Management of the Climate Change' PhD Programme of the University of Venice Cà Foscari. He will be mostly involved in WP1, contributing to investigations of predictive ability of CMIP5 and CMIP6 decadal hindcasts.

Dr Paola Mercogliano (female), Director of the REHMI Division and Head of the Research Laboratory 'Meteo System & Instrumentation Laboratory' at the Italian Aerospace Research Centre [Scientist WP3]: Paola holds a Master's degree in Physics from the University of Naples "Federico II" and a Master in computational fluid dynamics from the Research Centre for advanced studies of Sardinia. Her main areas of competence include development and use of statistical and dynamical methods and tools for regionalisation of the climatic signal up to urban areas, qualitative and quantitative analysis of the variation of landslide, flood and hydrological drought hazards induced by climate change. She has a vast expertise in the development and application of RCM model; from 2008 she is member of the CLM Assembly for the development of the regional climate model COSMO-CLM. She participated in several European and international projects, including FP7 project INTACT. Paola will contribute to the definition, implementation and running of a very high-resolution configuration of the regional climate model COSMO CLM, including urban parameterisation scheme.

Dr Jaroslav Mysiak (male), Director of the RAAS Research Division [Scientist WP4]: Jaroslav is also an external teacher at the Ca'Foscari University Venice and senior scientist at the Fondazione Eni Enrico Mattei (FEEM). Jaroslav is a key expert of the European Environmental Agency's (EEA) Topic Centre on Climate Change impacts, vulnerability and adaptation (ETC-CCA), and coordinating author of the EEA report on disaster risk reduction and climate adaptation. He is lead author of the EC Disaster Risk Management Knowledge Centre's report on State of Science on DRR. Jaroslav is a member of the scientific advisory board of the CIMA International Centre on Environmental Monitoring and the BlueAp - Bologna Local Urban Environment Adaptation Plan for a Resilient City. He is an interlocutor of major international (such as UN Office for Disaster Risk Reduction) and national organisations (e.g. Italian Department for Civil Protection). He was a lead author of the Italian National Adaptation Strategy. Jaroslav coordinated major research projects and assessments exercises in Europe and beyond. He was the team leader of the UNDP coordinated project which developed the disaster risk reduction strategy and action plan for the Republic of Mauritius, and contributed to similar assessments elsewhere (e.g. Nigeria, St. Lucia). He also coordinated several European FP projects, including the EPI-WATER and XEROCHORE, as well as other international projects such as PREEMPT, WATER2ADAPT, and CostAdapt. Jaroslav and Francesco will contribute to the WP4 - focusing on economic assessment of risk and adaptation options based on the improved risk assessment. Furthermore, both Jaroslav and Francesco will lead the Task 6.1, developing the terms of reference (ToR) and working rules of the Multi-User Forum.

Dr Antonio Navarra (male), President of the CMCC [Scientist WP2]: Antonio got a PhD at the Geophysical Fluid Dynamics Laboratory at Princeton University. He is Dirigente di Ricerca at the INGV, where he carries out his activity in the field of the climate simulation with numerical models. Antonio teaches in the PhD Programme on "Science and Management of Climate Science" at Universita' Ca' Foscari, Venice. He is the author of several books and articles of general interest, and contributes to national newspapers. Within EUCP he will contribute to

the definition and implementation of new methods to characterise uncertainty in future projections of climate change and climate variability.

Dr Veronica Villani (female), Scientist [Scientist WP3]: In 2014 Veronica took a Master's degree in Mathematics with honours at the Second University of Naples of Caserta. She works on definition of statistical/stochastic models for the disaggregation of precipitation at sub-daily scale and implementation of post processing analysis in the Geographical Information System (GIS) environment. Since 2014 she has been working for CMCC Foundation as junior researcher. Furthermore, since 2016 she has been a member of the CLM Community. In EUCP, Veronica will work on implementing the urban parameterisation scheme, developed at CMCC, in to the high-resolution COSMO-CLM regional model. Besides, she will contribute to the development of advanced bias-correction techniques.

Relevant publications, and/or products, services, achievements:

Bellucci, A., R. Haarsma, N. Bellouin, B. Booth, C. Cagnazzo, B. van den Hurk, N. Keenlyside, T. Koenigk, F. Massonnet, S. Materia and M. Weiss, 2015: Advancements in decadal climate predictability: the role of non-oceanic drivers, *Reviews of Geophysics*, 53, 165–202, doi:10.1002/2014RG000473.

Bellucci, A. , R. Haarsma, S. **Gualdi**, P. Athanasiadis and Co-Workers, 2015: An assessment of a multi-model ensemble of decadal climate predictions, *Climate Dynamics*, 44(9), 2787-2806, DOI:10.1007/s00382-014-2164-y.

Bosello F, Nicholls R.J., Richards, J., Roson, R. and Richard S. J. Tol (2012), "Economic impacts of climate change in Europe: sea-level rise", *Climatic Change*, 112:63–81.

Mysiak, J., & Pérez-Blanco, C. D. (2016). Partnerships for disaster risk insurance in the EU. Nat. Hazards Earth Syst. Sci., 16(11), 2403–2419. http://doi.org/10.5194/nhess-16-2403-2016.

Zollo A.L., Rillo V., Bucchignani E., Montesarchio M., **Mercogliano** P. (2015). Extreme temperature and precipitation events over Italy: assessment of high resolution simulations with COSMO-CLM and future scenarios. *International Journal of Climatology* doi: 10.1002/joc.4401.

Relevant previous projects or activities:

Horizon 2020 PRIMAVERA

Horizon 2020 EUMACS - European Market for Climate Services, EC H2020-SC5-03B-2016, 11/2016 - 10/2018, http://cordis.europa.eu/project/rcn/206092_en.html

Horizon 2020 CRESCENDO

FP7 COMBINE - Comprehensive Modelling of the Earth system for better climate prediction and projection, EC FP7-ENV.2008.1.1.4.1, 05/2009 - 10/2013, www.combine-project.eu

ORIENTGATE - A structured network for integration of climate knowledge into policy and territorial planning, South East Europe Transnational Cooperation Programme, 07/2012 - 12/2014, www.orientgate.org

Relevant significant infrastructure and/or any major items of technical equipment:

CMCC operates its own SuperComputing Center - SCC (located in the "Ecotekne" Campus of the University of Salento, Lecce) whose HPC facilities have been ranked, since 2008 until 2014, in the 500 most powerful supercomputing systems in the world (Top500) and among the most powerful computational facilities in Italy. Currently, Athena, is the most powerful supercomputer operating at CMCC SCC (about 8000 Intel Xeon Sandy Bridge cores , 160 TFlops peak performance). Thanks to Athena, the CMCC HPC infrastructure is one of the most powerful computational facilities in Italy. Athena is integrated with two DDN SFA10000 storage subsystems capable to offer a storage capacity of about 840TB in total and an I/O performance of 6GBytes/sec per disk array.

No third parties involved.

Participant 9: UNESCO-The Abdus Salam International Centre for Theoretical Physics (UNESCO-ICTP) - International

ICTP was founded in 1964 with the primary goal of fostering advanced scientific research in developing countries through forefront research and educational activities. It operates under a tri-partite agreement including UNESCO the IAEA and the Italian Government, which provides about 85% of its funding. The ICTP includes five research sections, one of them being the Earth System Physics (ESP) section, which is directly involved in Accelerage. ESP includes eight permanent scientific staff members and 15-20 post-doctoral fellows and long term visiting scientists. Research in ESP covers a wide range of areas, including regional and global climate modelling, climate variability and change, air quality and aerosol modelling, oceanography, impacts of climate on different sectors (including health, water resources and agriculture), chemistry-climate and biosphere-atmosphere interactions, natural hazards and extreme events, seismology and volcanology. Research is mostly carried out using advanced computer models and analysis of observation datasets. ESP also organises every year a range of educational activities including a diploma course and training programmes of various type (schools, workshops, conferences).

UNESCO ICTP will lead WP3 concerning the development and completion of a demonstration project of the value of the EUCP prediction system applied to high impact weather events. This will include leading the design of the experiment framework, conducting a series of simulations with the RegCM-NH regional climate model at convection permitting resolutions over a focus Alpine domain and, using an event-based approach, at the pan-European level. ICTP will also participate in WP2 by extending and applying the Reliability Ensemble Averaging method to the production of future climate PDFs; WP5 in the assessment of the added value of convection permitting simulations; and in WP6 on the dissemination of knowledge and data.

UNESCO ICTP has an international leading group in regional climate modelling. The UNESCO ICTP regional climate model RegCM has been developed for the last 25 years and it is one of the most used worldwide for a wide range of applications. Recently a non-hydrostatic version of the model has been developed, RegCM-NH, which will be used for the convection permitting resolution experiments planned in WP3. The UNESCO ICTP team has a long standing experience in issues pertaining to regional climate variability and change, and extreme events. UNESCO ICTP staff has a leading role in both the CORDEX and MED-CORDEX programmes, which will have strong synergies with EUCP. UNESCO ICTP has also a strong experience in assessing climate change information and interacting with stakeholder communities.

Short profile of key personnel involved:

Dr Filippo Giorgi (male). Head of Earth System Physics Section [UNESCO ICTP Principal Investigator, Leader WP3]: Filippo has an Italian University degree in Physics (U. L'Aquila, Italy) and a PhD in Geophysical Sciences (Georgia Institute of Technology, Atlanta, USA). He is a leading international expert in climate modelling, climate variability and change. He co-authored over 300 scientific papers and is included in the 2001 list of ISI most highly cited scientists in geophysics. He pioneered the field of regional climate modelling, has contributed to the design, launch and implementation of the CORDEX international programme (as co-chair of the CORDEX advisory team), and has contributed to all IPCC reports since 1992.

Dr. Erika Coppola (female), Research Scientist in Earth System Physics Section [Scientist, WPs 2, 3, 5 & 6]: Erika has an Italian University degree in Physics (U. L'Aquila, Italy) and PhD in Atmospheric Sciences (University of reading, UK). She is an international expert in regional climate and hydrology modelling, with specific application to extreme events and flood forecasting. She co-authored over 60 scientific papers and contributed to the development of RegCM-NH. She is currently the co-chair of MED-CORDEX and of the CORDEX Pilot Study on convection permitting modelling over the European Alps.

Relevant publications, and/or products, services, achievements:

Giorgi F., Im E-S., **Coppola E**., et al. (2011): Higher hydroclimatic intensity with global warming. *Journal of Climate*, 24, 5309-5324.

Giorgi F., Coppola E., et al. (2012): RegCM4: Model description and preliminary tests over multiple CORDEX domains. *Climate Research* 52:7-29.

Giorgi F. et al. (2014): Change of extremes and hydroclimatic regimes in the CREMA ensemble projections *Climatic Change* doi: 10.1007/s10584-014-1117-0.

Giorgi F., Gutowski WL, (2015): Regional dynamical downscaling and the CORDEX initiative. *Annual Review of Environment and resources*, 40, 467-490.

Ruti P., Somot S., **Giorgi F.** et al. (2016): Med-CORDEX initiative for Mediterranean climate studies. *Bulletin of the American Meteorological Society*, 97, 1187-1208.

Relevant previous projects or activities:

FP7 ACQWA, "Assessment of Climatic change and impacts on the Quantity and quality of Water". UNESCO ICTP carried out a series of regional climate projections over Europe and analysed ensembles of model simulation outputs with a focus on water resources.

FP7 MEGAPOLI, "Megacities: Emissions, urban, regional and Global Atmospheric POLlution and climate effects, and Integrated tools for assessment and mitigation". UNESCO ICTP carried out simulations of the effects of megacity emissions on regional climate using a couple regional climate-air quality model.

FP7 HEALTHY FUTURES, "Health, environmental change and adaptive capacity: mapping, examining and anticipating future risks of water-related vector-borne diseases in eastern Africa". UNESCO ICTP carried out research on the effects of climate variability and change on vector borne diseases in Africa using climate and malaria models.

FP7 CLIMRUN, " Climate Local Information in the Mediterranean region: Responding to User Needs". UNESCO ICTP carried out high resolution regional climate projections over the Mediterranean region and analysis of ensembles of model simulation output.

FP7 ATOPICA, "Atopic diseases in changing climate, land use and air quality". UNESCO ICTP carried out and analysed climate, ambrosia pollen and air quality projections over the European region.

Relevant significant infrastructure and/or any major items of technical equipment:

Computer cluster with about 2000 cores plus ~ 400 terabytes disk storage for carrying out climate simulations and analysis.

No third parties involved.

Participant 10: International Institute for Applied Systems Analysis (IIASA)

The International Institute for Applied Systems Analysis/ Internationales Institut Für Angewandte Systemanalyse (IIASA) is an international scientific institute that conducts research into the critical issues of global environmental, economic, technological, and social change that we face in the twenty-first century. Our findings provide valuable options to policymakers to shape the future of our changing world. IIASA is independent and funded by prestigious research funding agencies in Africa, the Americas, Asia, Europe, and Oceania.

IIASA was founded in 1972 with representatives of the Soviet Union, United States, and 10 other countries from the Eastern and Western blocs in order to establish scientific cooperation to build bridges across the Cold War divide and to confront growing global problems on an international scale. In the 1970s most research organisations focussed on national issues. Few encouraged researchers from different countries or disciplines to work together for the greater good. To achieve its ambitious research vision, IIASA would have to break down the barriers between nations and disciplines. This it did, building international interdisciplinary teams that used advanced systems analysis to study innumerable global challenges, both long-standing and emerging. For example, a study on water pollution carried out by a team of IIASA chemists, biologists, and economists in the 1980s is still the basis of modern water policy design in Japan, the USA, and the former USSR. When the Cold War ended, IIASA's sponsoring countries could have said "mission accomplished" and disbanded the Institute. However, as well as helping foster mutual understanding among scientists from East and West, IIASA had shown the scientific benefits of different nationalities and disciplines working together toward common goals. This approach has been widely imitated, for example, in the IPCC and the International Geosphere-Biosphere Programmes. Thus the Institute remained and, in the 1990s broadened its mandate to achieve a greater global focus. Today IIASA brings together a wide range of scientific skills to provide science-based insights into critical policy issues in international and national debates on global change, with three central research focuses.

In 2011. IIASA began developing a more focused research agenda, centering its studies on three interconnected global problem areas: Energy & Climate Change, Food & Water, and Poverty & Equity. To complement these foci, drivers of global transformations, methods of systems analysis, and policy and governance were also examined by in-house research. During the past five years, IIASA research has become increasingly focussed on the interlinkages between the three global problem areas. This is not surprising, as systems analysis is one of the few research methods that has the breadth and depth to uncover the synergies and trade‑offs arising from our increasingly interconnected and complex world. This strategic direction is increasing collaboration and integration across disciplines, which have been facilitated through new cross‑cutting projects and futures initiatives. Research and policy impacts in 2011–2015 have been numerous, both in terms of scientific advances and of shaping national and international policies. Examples include: (i) the production of the first ever fully integrated Global Energy Assessment, which provided the scientific basis and key objectives for the UN Secretary‑General's 'Sustainable Energy For All' initiative; (ii) a new set of world population projections, that for the first time systematically and quantitatively address the role of human capital and demonstrate the critical part that education plays in development; and (iii) the latest scientific analysis on how to reduce air pollution in Europe, which has shaped European Commission policies and the Convention on Long-range Transboundary Air Pollution.

The IIASA network includes some 2,500 collaborating scholars from over 65 countries and 3,875 alumni encompassing 90 nationalities. In 2015, 333 researchers from 49 countries worked at IIASA, compared to 209 in 2010. IIASA was a partner in 160 externally funded projects in 2015 and has 600 partner institutions in more than 75 countries. IIASA researchers have been awarded seven prestigious ERC grants. IIASA had 1,815 visitors and collaborators in 2015. IIASA featured in the media over 3,000 times in 2015, compared to 1,300 in 2010. Since 2010 there has been a 74% increase in the number of journal articles published by IIASA researchers and a 146% increase in the number of citations. IIASA researchers now serve on over 112 advisory boards and steering committees, compared to just 60 in 2010.

Short profile of key personnel involved:

Dr Yoshihide Wada (male), Leader of scientific team at IIASA Water Programme [IIASA Prinicipal Investigator, Scientist WPs4 & 6]: Yoshihide has developed an open source continental-scale hydrological and water resources model that is able to quantify hydrological extremes including floods, drought, and water scarcity, and water use for agriculture, industry and households. Yoshihide leads the IIASA Water Futures and Solutions (WFaS) initiative that is funded by UNESCO, ADB, and Austrian Development Agency (ADA). He also leads IIASA Integrated Solutions for Water, Energy and Land (ISWEL) project that is funded by the United Nations Industrial Development Organization (UNIDO) and Global Environmental Facility (GEF). Both WFaS and ISWEL

are flagship projects of IIASA that are multi-layered, cross-sector, stakeholder informed, scenario-based assessment of the state of water resources and water demand using state-of-the-art socio-economic and hydrological models, based on the SSPs and Representative Concentration Pathways (RCPs) in the context of the SDGs. Jointly develops World Resources Institute (WRI) Aqueduct Water Risk Atlas. Aqueduct's global water risk mapping tool helps companies, investors, governments, and other users understand where and how water risks and opportunities are emerging worldwide. The Atlas uses a robust, peer reviewed methodology and the best-available data to create high-resolution, customisable global maps of water risk. He is sub-leader of the ISI-MIP Project which is a community-driven modelling effort with the goal of providing cross-sectoral global impact assessments. He was a contribution author to the IPCC AR5. Yoshihide has over 10 years of experience in the development of hydrological and water resources model and data sets, including the development of the widely used the PCR-GLOBWB model, and water use and groundwater depletion analysis which combines information from model simulations and country statistics to create a globally complete analysis since 1900. He has co-authored more than 100 publications, 60 of which appeared in international peer-reviewed journals (h-index: 20 in Scopus). He has been invited by more than 100 conferences and workshop including AGU, EGU, WCRP, UNEP, UNDP, UNESCO and IEA.

Dr Peter Burek (male), [Scientist WPs4 & 6]: Peter is on the Task Team for the WFaS and ISWEL projects. He is a regularly invited speaker to workshops and conferences on European flood forecasting. He has over 20 years' experience in the development of regional hydrological models and data sets, including the development of the LISFOOD model and quantification of uncertainties for regional flood forecasting. He is the developer and a contributor to the European Flood Awareness System (EFAS), which is an EC initiative to increase preparedness for riverine floods across Europe. He has worked for seven years at the JRC.

Dr Yusuke Satoh (male), [Scientist WPs4 & 6]: Yusuke has developed ~50km resolution analysis of global hydrological extremes under different climate change and socio-economic scenarios as part of the ISI-MIP project, combining information from hydrological models, climate models, and other historical climate variables from satellites with measurements of air temperature, precipitation, and radiation. He has over five years experience of developing land surface models, including the development of the MASTIRO model.

Relevant publications, and/or products, services, achievements:

Wada, Y., M. Flörke, N. Hanasaki, S. Eisner, G. Fischer, S. Tramberend, **Y. Satoh**, M. T. H. van Vliet, P. Yillia, C. Ringler, **P. Burek**, and D. Wiberg (2016): Modeling global water use for the 21st century: the Water Futures and Solutions (WFaS) initiative and its approaches, *Geosci. Model Dev.*, *9*, 175-222, doi:10.5194/gmd-9-175-2016, 2016 (*EGU Highlight Article*).

Wada, Y., L. P. H. van Beek, N. Wanders, and M. F. P. Bierkens (2013): Human water consumption intensifies hydrological drought worldwide, *Environ. Res. Lett.*, *8*, 034036, doi:10.1088/1748-9326/8/3/034036.

Wada, Y., L. P. H. van Beek, and M. F. P. Bierkens (2011): Modelling global water stress of the recent past: on the relative importance of trends in water demand and climate variability, *Hydrol. Earth Syst. Sci.*, *15*, 3785-3808, doi:10.5194/hess-15-3785-2011.

Wada, Y., I. E. M. de Graaf, and L. P. H. van Beek (2016): High-resolution modeling of human and climate impacts on global water resources, *J. Adv. Model. Earth Syst.*, *8*, 735–763, doi:10.1002/2015MS000618.

Wada, Y., and M. F. P. Bierkens (2014): Sustainability of global water use: past reconstruction and future projections, *Environ. Res. Lett.*, *9*, 104003, doi:10.1088/1748-9326/9/10/104003.

Relevant previous projects or activities:

The Water Futures and Solutions (WFaS) Initiative is a ground-breaking study into sustainable solutions to meet local, national, and global water challenges. It is looking for additional partners from the development, business, and scientific community. Absent or unreliable water supply, sanitation and irrigation services, unmitigated floods and droughts, and degraded water environments severely impact half of the planet's population. Spillovers from these impacts, including supply chain failures, financial shocks, migration and political instability, now ripple across our interconnected world. The impacts of rapidly changing economies, populations and climate on fresh water fluxes, on which all terrestrial life depend, are unknown – although it is clear that most of the impacts of climate change on society will be transmitted by water. Building on its long history of applying world-class science to the resolution of grand challenges, IIASA launched a new initiative "Water Futures and Solutions" (WFaS) in 2012, bringing to bear its unique skills, datasets, policy links and reputation. The WFaS initiative was

launched with four additional partners, all institutions that are committed to promoting the scientific evidence base for global water security. In addition, IIASA is working closely with complementary efforts of other scientific groups around the world, in the belief that this will enhance the delivery and quality of outcomes and strengthen the scientific capacity to sustain policy-relevant research into the future. IIASA now seeks funding to move the initiative beyond its initial scoping phase.

Integrated Solutions for Water, Energy, and Land (ISWEL), aims to identify integrated approaches to energy, water, food, and ecosystem security in selected regions of the world. ISWEL project has been launched by IIASA, together with the GEF and the UNIDO. This new project aims to identify integrated solutions to energy, water, food, and ecosystem security in selected regions of the world. These are regions facing multiple energy and land use challenges and rapid demographic and economic changes, and are hardest hit by increasing climate variability and change. The new project aims to answer questions about how to achieve the new SDGs that were set in 2015 with respect to climate change and sustainable development, including:

- how these goals can be jointly addressed;
- the costs of inaction; and
- how problems in one area may exacerbate or mitigate problems in other areas.

Relevant significant infrastructure and/or any major items of technical equipment:
Not applicable.

N*o third parties involved.*

Participant 11: Koninklijk Nederlands Meteorologisch Instituut (KNMI)

Koninklijk Nederlands Meteorologisch Instituut/The Royal Netherlands Meteorological Institute (KNMI) is the national research and information centre for weather, seismology, climate and climate change in the Netherlands. KNMI has a long tradition in operational and scientific activities. Climate research at KNMI aims at observing, understanding and predicting changes in the climate system. KNMI produces climate scenarios to support stakeholders for developing adaptation and mitigation strategies. KNMI has initiated the development of the global climate model EC-Earth and has been a leading partner in the consortium ever since. It co-developed the regional climate model RACMO, which has played a high-profile role in many national and international research and scenario projects.

KNMI has developed multiple generations of national climate change scenarios, based on an advanced blending of global and regional climate model simulations. The scenarios have a legal status in the Netherlands and are widely used for national and regional planning of safety infrastructure, socio-economic developments and sectoral climate change assessments.

Its large track record on data collection, processing and dissemination has lead to strong roles in the generation of the IPCC climate change atlas using the Climate Explorer, and leadership of research and infrastructure projects for Copernicus and Horizon 2020.

In EUCP, KNMI will play an important role in the leadership of the regional modelling workload (co-leading WP2); contributing to the added value of high resolution modelling (in WP3); and blending information into a core product (WP5).

Short profile of key personnel involved:

Prof Bart van den Hurk (male), Head of the Modelling R&D Division [Scientist WPs 2, 3 & 5]: Bart holds a chair at VU University, Amsterdam. His main expertise is on diagnosing and understanding land-atmosphere interaction, developing climate scenarios for the Netherlands, and the interpretation of complex climate information for society stakeholders. He coordinated an EU and national climate research projects, including being PI of the Horizon 2020 project IMPREX.

Dr Geert Lenderink (male), Senior Scientist at the Modelling R&D Division [KNMI Principal Investigator, Co-Leader WP2]: Geert's research fields include modelling of clouds and turbulence, regional climate modelling and analysis, and the production of climate scenarios. Presently he investigates how small scale precipitation extremes could evolve in the future climate using observations, climate models and atmospheric mesoscale models. He is/has been involved in many EU and national projects, including WP coordinator in the EU projects FP6 ENSEMBLES and FP7 IMPACT2C.

Relevant publications, and/or products, services, achievements:

Van den Hurk, B., Geert Jan van Oldenborgh, Geert Lenderink, Wilco Hazeleger, Rein Haarsma and Hylke de Vries, (2014): Drivers of mean climate change around the Netherlands derived from CMIP5; *Climate Dynamics*, **42**, 1683-1697; doi: 10.1007/s00382-013-1707-y.

Van den Hurk, B., A. Klein Tank, C. Katsman, G. Lenderink, and A. te Linde, 2013. Vulnerability Assessments in the Netherlands Using Climate Scenarios. Climate Vulnerability: Understanding and Addressing Threats to Essential Resources. Elsevier Inc., Academic Press, 257–266 pp.

Hazeleger, W., **B.J.J.M. van den Hurk**, E. Min, G.J. van Oldenborgh, X. Wang, A.C. Petersen, L. Smith, D.A. Stainforth and E. Vasileiadou, *Tales of Future Weather*. Nature Climate Change, 2015, 5, 107-113, doi:10.1038/nclimate2450.

Lenderink, G., **B.J.J.M. van den Hurk**, A.M.G. Klein Tank, G.J. van Oldenborgh, E. van Meijgaard, H. de Vries and J.J. Beersma (2014): *Preparing local climate change scenarios for the Netherlands using resampling of climate model output.* Environmental Research Letters, 2014, 9, 11, 115008, doi:10.1088/1748-9326/9/11/115008.

Attema, J.J., J.M. Loriaux and **G. Lenderink** (2014): Extreme precipitation response to climate perturbations in an atmospheric mesoscale model. Environmental Research Letters, 2014, 9, 14003, doi:10.1088/1748-9326/9/1/014003.

Relevant previous projects or activities:

Horizon 2020 PRIMAVERA: Development of high resolution future climate projections: co-leading the work package that contributes to the IPCC HighResMIP.

Horizon 2020 IMPREX: Climate services for the European water sector, including development of better physical models and improved stakeholder interaction; KNMI is the Coordinator (and PI) of the project.

KNMI'14 climate change scenarios for The Netherlands (www.klimaatscenarios.nl): new climate change scenarios for many Dutch stakeholders.

FP7 EUPORIAS: Development of climate services to maximise the social benefit of new coping technologies.

C3S-MAGIC: Copernicus project connecting global climate projections to the Copernicus Data Store; KNMI leads the project.

Relevant significant infrastructure and/or any major items of technical equipment:

EC-Earth (ecearth.knmi.nl): European consortium climate model, participating in the IPCC climate change assessments and used for generating tailored (high resolution) climate information products.

RACMO: National regional climate model, participating in CORDEX and used for generating tailored (high resolution) climate information products.

Harmonie-Climate: the non-hydrostatic operational NWP system tailored for climate applications.

BULL Supercomputer and Mass Storage System.

No third parties involved.

Participant 12: Sveriges Meteorolgiska Och Hydrologiska Institut (SMHI)

Sveriges Meteorolgiska Och Hydrologiska Institut/Swedish Meteorological and Hydrological Institute is a public body with some 670 employees under the Swedish Ministry of Environment and Energy, running both governmental services and commercial businesses. SMHI is providing decision support to a broad range of end-users, based on meteorology, hydrology, oceanography and climate information. SMHI is responsible for national monitoring and modelling in these fields, data archives and refinement of information for societal needs. On behalf of the government SMHI runs a national knowledge centre for adaptation to climate change. SMHI has a long tradition in developing customised products and services, as well as 24/7 production of forecasts with early warnings, and operates the dissemination of flood alerts to other EU member states in the EFAS system for EU Copernicus. It has a strong R&D focus with 110 full time scientists. SMHI is active in many Global Earth Observation System of Systems (GEOSS), Copernicus and ESA projects. SMHI is representing Sweden in relevant international organisations, e.g., ECMWF, WMO, EUMETSAT and IPCC. The institute is involved in many national and international projects including those under FP7, Horizon 2020 and Copernicus. The SMHI management system has been certified under the quality standards ISO 9001 and ISO 14001.

The Rossby Centre, that is part of the R&D at SMHI, has been deeply involved in RCM development and evaluation since its establishment in 1997. The group was one of the first to develop and use coupled RCMs involving not only the atmosphere and land surface but also regional ocean areas and dynamical vegetation on land. A long-term strategy has been to produce and make available large ensembles of RCM projections. This activity has grown from the 2x2 matrix with downscaling 30-year timeslices of two GCMs and two emission scenarios, via the first long transient 150-year regional climate scenarios to one of the largest existing RCM-ensembles with one RCM, which is now being used in Sweden in a national climate service perspective.

Short profile of key personnel involved:

Prof Erik Kjellström (male), Head of the Rossby Centre at SMHI since 2013 [Co-leader WP3]: Since 2012 Erik has also acted as Adjunct Professor at the Department of Meteorology at the Stockholm University. He has more than 20 years of experience from atmospheric modelling covering atmospheric chemistry, biogeochemical cycles and climate modelling. During the last 15 years he has worked in the field of regional climate modelling at the Rossby Centre. His main research interests relate to aspects of RCM evaluation, regional climate change and use of RCM data for climate impact research. He has been working in a series of European research projects involving regional climate modelling starting with FP5 PRUDENCE and FP6 ENSEMBLES. In recent years he has been, and is, work package leader on climate scenarios in the EU projects FP7 IMPACT2C, FP7 ECLISE and Horizon 2020 IMPREX, as well as the Nordic project on Climate and Energy. He has more than 60 peer review publications and an ISI web of science h-index of 28.

Dr Grigory Nikulin (male), Leading Scientist in the Rossby Centre [WP3]: Grigory's main research activity is analysis of both global and regional climate models. He is involved in the analysis of climate information in many European and international projects (IMPACT2C, HEALTHY FUTURES, EUPORIAS, GLOBAQUA, FRACTAL, HELIX, IS-ENES2, CLIP-C and CORDEX). His current focus is on providing climate information for impact studies. He is one of co-authors of the Data Reference Syntax (DRS) for CORDEX and bias-adjusted CORDEX simulations; was the work package leader in FP7 EUPORIAS; and is responsible for CORDEX data management as the member of the WRCP CORDEX Science Advisory Team (SAT).

Dr Torben Koenigk (male), Senior Research Scientist at Rossby Centre [Scientist WP1]: Torben has 13 years of experience of global and regional coupled climate modelling. His major research focuses on Arctic climate variability and future change, sea ice-ocean-atmosphere interactions and exchanges between mid and high latitudes. He is leading the Arctic climate modelling activities at Rossby Centre. He is strongly involved in the development of the EC-Earth model and is chairing the EC-Earth working group on ocean and sea ice modelling. He has contributed to a number of EU-projects (DAMOCLES, COMBINE, EMBRACE and SPECS).

Dr Danijel Belusic (male), Research Scientist in the Rossby Centre [Scientist WP3, Task 3.2]. Danijel's main research interests are development and analysis of regional climate models, and analysis of observational data. He has extensive experience in using and developing different numerical models and data analysis techniques, and in working with multiple observational platforms and data sources. He has participated in a number of European and international research projects and has published more than 35 peer-reviewed papers.

Dr Renate Wilcke (female), Research Scientist in the Rossby Centre [Scientist WP2]. Renate's main research interests are related to further use of regional climate model simulations for impact studies including bias correction

methods and model selection procedures for reduced climate scenario ensembles. She has been participating in a number of European and international research projects.

Relevant publications, and/or products, services, achievements:

Kjellström, E., Bärring, L., **Nikulin**, **G.**, Nilsson, C., Persson, G., and Strandberg, G. (2016): Production and use of regional climate model projections – a Swedish perspective on building climate services. *Climate Services*, 2-3, 15-29. Doi: 10.1016/j.cliser.2016.06.004.

Koenigk, **T.**, Caian, M., **Nikulin**, **G.**, Schimanke, S. (2016): Regional Arctic sea ice variations as predictor for winter climate conditions. *Clim Dyn*, 46 (1), 317-337, doi:10.1007/s00382-015-2586-1.

Koenigk, T., C. König Beatty, M Caian, R. Döscher, K. Wyser (2012): Potential decadal predictability and its sensitivity to sea ice albedo parameterization in a global coupled model. *Clim. Dyn*. 38(11-12), 2389-2408, DOI: 10.1007/s00382-011-1132-z.

Lind, P., Lindstedt, D., **Kjellström, E.**, and Jones, C. (2016): Spatial and Temporal Characteristics of Summer Precipitation over Central Europe in a Suite of High- Resolution Climate Models. *J Clim*, 3501-3518. doi:10.1175/JCLI-D-15-0463.1.

Wilcke, R.A.I. and Bärring, L. (2016): Selecting regional climate scenarios for impact modeling studies, Environmental Modeling & Software, 78, 191-201.

Relevant previous projects or activities:

FP7 CLIP-C: **–** This FP7 project provides access to climate information of direct relevance to a wide variety of users. The platform at which this takes place has been designed to complement existing Copernicus pre-operational components. SMHI led the work package on transformation of climate data, which included development of methods and tools for bias correction, representative reduced ensembles, and calculation of climate indices. Additionally, SMHI has developed meta-data standards for regional reanalysis and published EURO4M data within CLIP-C, which includes developing a mapping between Grib and NetCDF formats for EURO4M.

FP7 ECLISE: SMHI was one of 12 partners leading the work package on climate scenarios that included provision of regional climate model projections.

FP7 IMPACT2C: SMHI was one of 28 partners leading WP2 on climate scenarios that included provision of regional climate model projections.

FP7 SPECS – Seasonal-to-decadal climate Prediction for the improvement of European Climate Services was a FP7 project aimed to deliver a new generation of European climate forecast systems, with improved forecast quality and efficient regionalisation tools to produce reliable, local climate information over land at seasonal-to-decadal time scales, and provide an enhanced communication protocol and services to satisfy the climate information needs of a wide range of public and private stakeholders.

C3S UrbanSIS: Is a SIS project aiming at producing high-resolution meteorological, air quality and hydrological data for urban climate change impact assessment. A range of ECVs will be produced with 1x1 km2 resolution in 150x150 km^2 domains covering European cities. From the ECVs, key impact indicators will be calculated to assist planners and decision makers. Impacts focus mainly in infrastructure and health and the concept will be demonstrated in Stockholm, Bologna and Amsterdam/Rotterdam. Various end-users involved in the project will evaluate the products using local models. SMHI coordinates UrbanSIS, which has a futher six subcontractors.

Relevant significant infrastructure and/or any major items of technical equipment:

SMHI will make extensive use of the computer cluster Bi at the Swedish National Supercomputer Centre (NSC). All high-resolution regional climate model simulations will be run on this computer. To store the output SMHI will make use of its mass-storage facility, Accumulus (2.7 Pb online disks plus tape storage), which is co-located with Bi at NSC. SMHI has in-house software tools for pre- and post-processing as well as visualisation of model output.

No third parties involved.

Participant 13: University of Edinburgh (UEDIN)

With nearly 2,000 staff and 7,500 students, the College of Science and Engineering at the University of Edinburgh is one of the largest science and engineering groupings in the UK. It is also in the front rank of the UK University science and engineering groupings for research quality and research income. In the most recent (2014) UK Research Excellence Framework (REF) the College of Science & Engineering continues to be a top performer and was classified as world-leading in terms of originality, significance and rigour. The results reveal that overall 84% of the University's research activity is in the highest categories – 4* and 3*– which are classified as 'world leading' or 'internationally excellent'. The *School of GeoSciences* investigates what shapes our world and the environments in which we live, in order to understand the interactions between Earth's geology, atmosphere, oceans, biosphere and human responses and roles, with the UEDIN staff involved in this proposal being part of the Atmospheric Chemistry& Climate of the Anthropocene Group at the Institute of Global Change, which comprises expertise in computer modelling and climate analysis (Profs Tett, Doherty, Stevenson, Palmer and Hegerl; Dr Bollasina and Dr. Pumphrey) and a vibrant community of postdoctoral researchers and early career scientists.

The School of GeoSciences has involved in a wide range of Horizon 2020 projects and scientists involved in them are supported by administrative staff.

Short profile of key personnel involved:

Prof Gabriele Hegerl (female), Professor of Climate System Science [UEDIN Principal Investigator, Co-Leader]: Gabriele has over 25 years experience in climate research, focussing on understanding the causes of observed climate variability and change. This includes changes in precipitation, changes in climate extremes, and temperature over the long historical record and the last two millennia. Gabi is also interested in, and has written several highly cited papers on, constraining climate system parameters from observed change, including climate sensitivity and precipitation sensitivity.

Gabriele has a PhD in applied mathematics, and did her postdoctoral work at the Max-Planck Institute for Meteorology, and the University of Washington. She has published more than 130 papers, an h-index of 41 and has played key roles in three recent IPCC Assessments (Member of the core writing team IPCCAR5 Synthesis report; co-leading one of four topics of the report; Member of the core writing team of the Summary for Policymakers for the AR4, Working Group 1 and member of the extended Summary for Policymakers writing team, AR5; Coordinating Lead Author of WG1 AR4 Chapter 9 (Understanding and Attributing Climate Change) and Lead Author of the IPCC WG1 AR5 chapter 10 and of the AR3, Chapter 12; Contributing Author to several other chapters SAR, AR4, AR5). She is the recipient of the Hans Sigrist prize of the University of Bern, and a fellow of both the American Geophysical Union and the Royal Society of Edinburgh. She also serves as one of the leads on the WCRP grand challenge on Weather and Climate Extremes and serves on a number of high level committees (e.g., Chair of the scientific advisory board of the UK Met Office Hadley Centre 2014-2016; member of the review team for the UK's climate change predictions UKCP18, May 2016 onwards; and member of the Royal Society of Edinburgh's International Committee).

Gabriele is the PI on an ERC Advanced Grant 'Transition Into the Anthropocene', which constrains variability and forced response from the past 200 years of observations, and was involved as a Co-I in FP7 EUCLEIA. She has been PI and Co-I on a large number of NERC grants, US National Science Foundation grants, and US NOAA grants.

Relevant publications, and/or products, services, achievements:

Hegerl G.C., Black E., Allan R. P., Ingram W.J. Polson D., Trenberth K.E., Chadwick R.S., Arkin P.A. Balan Sarojini B., Becker A., Blyth E., Dai A,, Durack P., Easterling D., Fowler H., Kendon E., Huffman G.J., Liu C., Marsh R., New M., Osborn T.J., Skliris N., Stott P.A.,, Vidale P.L., Wijffels S.E., Wilcox L.J., Willett K., Zhang X. (2015): Quantifying changes in the global water cycle . *Bull. Am. Met. Soc. 96*, 1097-1115.

Polson D., **Hegerl G.C.** (2017): Strengthening contrast between precipitation in tropical wet and dry regions. , *Geophys. Res. Lett.* 44, 365-373 doi: 10.1002/2016GL071194.

Hanlon H., **Hegerl, G.C.**, Tett, S.F.B., Smith, D. (2013): Can a decadal forecasting system predict temperature extreme indices? *J Climate*, 26, 3728-3744.

Hegerl G. C., T. Crowley, W. T. Hyde and D. Frame (2006): Climate sensitivity constrained by temperature reconstructions of the last seven centuries, *Nature*, 440, doi:10.1038/nature04679.

Knutti, R and **G. Hegerl** (2008): The equilibrium sensitivity of Earth's temperature to radiation changes. *Nature GeoSciences*,(1), no 11, 735-743.

Relevant previous projects or activities:

NERC Horyuji PAGODA: Understanding via process-based global detection attribution and prediction: Consortium addressing the changing water cycle, Gabriele was Lead-PI of Edinburgh contribution. The grant analysed causes of precipitation change and constraints on future changes from observations, including the precipitation sensitivity. Gabriele's group showed that there is evidence for human influences on global precipitation change from satellite data (Polson et al., Geophys. Res. Let 40, 1-5 doi:10.1002/grl.50923, 2013) and long island records (Polson et al., 2016), and that monsoon changes in the historical record show a detectable influence of anthropogenic aerosols.

Gabriele was CO-I on **FP7 EUCLEIA**. She was involved in the WP on model evaluation, determining that the HadGEM (Met Office Climate Prediction model suite) model is suitable to attribute extreme heat waves, largely representing physics and mechanisms correctly with significant atmospheric variability.

Gabriele is PI of Transition Into The ANthropocene (**ERC TITAN**), ERC advanced grant. TITAN investigates, among other topics, constraints on climate and precipitation sensitivity from the long historical record and will be finishing 1/2018, providing timely input into EUCP. Work on the grant has shown key modes of variability involved in hiatus and surge events of global warming (Schurer et al., Geophys. Res. Lett. 42, 5974-5982.2015). Also, a method has been developed to integrate across individual model fingerprints to arrive at constraints on transient climate response that account for model uncertainty (Schurer, to be submitted).

Gabriele is also the UEDIN PI of Securing Multidisciplinary UndeRstanding and Prediction of Hiatus and Surge events (**NERC SMURPHS**; overall grant led by Forster, Leeds), Ideas Grant. This grant focusses on the effect of rapid and slow warming periods on the energy budget of the planet and constraints of climate system parameters and will be far advanced at the time EUCP begins, providing useful input.

Gabriele was Edinburgh PI on the **NERC EQUIP** consortium project: End to End Quantification of Uncertainty for Impacts Prediction; 1.1.2010-31.7.2013. Her contribution focussed on the added value by initialised predictions of climate change, developing a method to quantify the added skill of initialised compared to forcing only predictions for European heat wave indices (Hanlon et al., 2013, 2014).

Relevant significant infrastructure and/or any major items of technical equipment:

The Earth system dynamics group (involving Tett, Hegerl) includes a computer specialist supporting simulations and storage/processing of climate data in Edinburgh. The project funds a small fraction of his time for support with day to day activities. The Edinburgh computer cluster is available for high-throughput simulations and some funds have been allocated in the project for storage.

No third parties involved.

Participant 14: The Chancellor, Masters and Scholars of the University of Oxford (UOXF)
The University of Oxford is relatively unusual on the national and international scene, in focussing on atmospheric and climate research within a world-class Physics department. The traditional strength of the Atmospheric, Oceanic and Planetary Physics (s) sub-department is in atmospheric measurements, including the development of sensors and instrumentation, data analysis and inverse theory. These activities are complemented by a flourishing research programme in theoretical climate dynamics, physical oceanography, and climate modelling. The University of Oxford has designated Physical Climate Science as a key area for expansion and investment, within which AOPP is taking a leading role alongside the Departments of Earth Sciences and Mathematics.

AOPP has strong links both within the UK and internationally, collaborating with centres as diverse as ECMWF, NERC NCAS, the Oxford Martin School and the Smith School for Enterprise and the Environment. In addition, Oxford University has recently formalised a partnership with the UK Met Office – the Met Office Academic Partnership (MOAP) – and has also recently signed an MOU with the Australian Research Council's Centre of Excellence for Climate System Science.

AOPP employs 14 lecturers and 35 post-doctoral researchers across 10 research groups. Within AOPP, the Predictability of Weather and Climate group, the research group involved in this proposal, consists of 11 postdoctoral researchers headed by Royal Society Research Professor, Tim Palmer, and Senior NCAS Research Fellow, Antje Weisheimer. The key focus of the group is the reliable quantification of uncertainty in weather and climate predictions, together with the reduction of current levels of forecast uncertainty. Within these areas, the group was and is involved in a wide range of research projects such as FP7 DEMETER, FP6 ENSEMBLES, FP7 SPECS, FP7 EUCLEIA and Horizon 2020 PRIMAVERA.

Short profile of key personnel involved:

Dr Antje Weisheimer (female), [UOXF Principal Investigator, Leader WP5]: Antje has more than 15 years of experience in research on reliable climate predictions. She holds a Senior NCAS Research Fellow position at AOPP and is a joint group leader of the Predictability of Weather and Climate group. Her expertise includes model-based weather and climate forecasts and the uncertainties associated with them. Antje has published more than 40 peer-reviewed articles (h-index 17). She has been involved in several national and international research projects on seasonal-to-interannual predictability, such as the EU projects FP6 ENSEMBLES, FP6 THOR, FP7 SPECS (where she was a work package leader and a cross-cutting theme leader), FP7 EUCLEIA (PI from AOPP) and Horizon 2020 PRIMAVERA, and the NERC-funded projects IMPETUS and SummerTIME (where she is a work package leader). Antje served as an expert reviewer and contributing author for the AR5 of the IPCC and is a Research Fellow at Wolfson College Oxford. While she holds a joint research position in the Predictability Section at ECMWF in Reading, her involvement in this proposal is exclusively through her AOPP affiliation. Antje is the PI of the project and leader of Work Package 5 which integrates the different types of global and regional climate predictions. The nature of the seamless WP5 requires that she will be closely involved in the scientific work in other work packages, in particular WPs 1, 2 and 3.

Prof Tim Palmer (male), Royal Society Research Professor in Climate Physics [Scientist WP5]: Tim is a Professorial Fellow at Jesus College, Oxford, Co-Director of the Oxford Martin Programme on Modelling and Predicting Climate, and a Fellow of the Royal Society and a Fellow of ECMWF. He was lead author and review editor of IPCC WG1, and President of the Royal Meteorological Society (2010-2012). He also coordinated two EC climate projects, and was co-chair of the international scientific steering group of the WCRP CLIVAR project on climate variability and predictability. Tim's expertise lies in dynamics and predictability of weather and climate. He pioneered the development of probabilistic ensemble forecasting techniques for weather and climate prediction and has worked on the application of weather and climate forecasts. He has served on advisory committees, and government committees looking at issues from climate adaptation to the role of science in helping mitigate the humanitarian impact of natural disasters. Tim won prizes from a number of learned societies and academies, in the UK and overseas, including the top prizes of the American and European Meteorological Societies, and was elected a Fellow of the American Geophysical Union and of the American Philosophical Society. Tim Palmer is the Co-PI for UOXF's contribution. He leads the Predictability of Weather and Climate group at Oxford in brings to the project a wealth of experience on many relevant aspects of climate predictions, e.g., pioneering seasonal and decadal climate prediction, expert on anthropogenic climate change and dynamics, involvement in advisory committees for climate change and adaptation at the international and national level. Tim will work on this project, and will support Antje with leading the project during any times when Antje is not available because of her part-time employment at Oxford.

Both Antje and Tim are permanent staff at UOXF and will enable continuity in UOXF's contribution to the project. They will both supervise the staff to be recruited for the project on a short-term contract basis (non-permanent).

Relevant publications, and/or products, services, achievements:

Palmer, T.N., F. Doblas-Reyes, A. **Weisheimer**, and M. Rodwell (2008). Reliability of climate change projections of precipitation: Towards "seamless" climate predictions. *Bull. Amer. Meteor. Soc.*, 89, 459-470, DOI: 10.1175/BAMS-89-4-459.

Weisheimer, A., F.J. Doblas-Reyes, **T.N. Palmer,** A. Alessandri, A. Arribas, M. Deque, N. Keenlyside, M. MacVean, A. Navarra and P. Rogel (2009): ENSEMBLES - a new multi-model ensemble for seasonal-to-annual predictions: Skill and progress beyond DEMETER in forecasting tropical Pacific SSTs. *Geophys. Res. Lett.*, **36**, L21711, doi:10.1029/2009GL040896.

Weisheimer, A., **T.N. Palmer** and F. Doblas-Reyes (2011): Assessment of representations of model uncertainty in monthly and seasonal forecast ensembles. *Geophys. Res. Lett.*, **38**, L16703, doi:10.1029/2011GL048123.

Weisheimer, A. and **T.N. Palmer** (2014): On the reliability of seasonal climate forecasts. *J. R. Soc. Interface* , **11**, 9620131162, doi:10.1098/rsif.2013.1162.

Matsueda, M., **A. Weisheimer** and **T.N. Palmer** (2016): Calibrating climate change predictions with estimates of seasonal forecast reliability. *J. Clim.*, **29**, 3831-3840. doi:10.1175/JCLI-D-15-0087.1.

Relevant previous projects or activities:

FP7 SPECS. Antje was leader of the work package "Addressing Model Inadequacy" and cross cutting theme leader on Dealing with Uncertainty. UOXF's role was primarily the development, testing and implementation of schemes to represent model uncertainty in the land surface and oceanic components of Earth System Model based on perturbed parameters and stochastic perturbations. UOXF's contribution has led to a total of 16 peer-reviewed publications.

H2020 PRIMAVERA. UOXF's role is to assess the benefits of increasing model resolution on the representation of European weather regimes and to investigate the use of stochastic parametrisation schemes as a novel representation of sub-grid scale variability in climate models. Both Antje and Tim are part of UOXF's team for the project. The PRIMAVERA climate simulations with stochastic perturbations will be available for use in WP2 of this project proposal. We declare that there is no double-funding.

FP6 ENSEMBLES was a major European project with more than 70 partners to develop an ensemble prediction system for climate change based on the principal state-of-the-art, high resolution, global and regional Earth System models developed in Europe, validated against quality controlled, high resolution gridded datasets for Europe, to produce for the first time, an objective probabilistic estimate of uncertainty in future climate at the seasonal to decadal and longer timescales. Both Antje and Tim worked under their ECMWF affiliations in Research Theme 1 which dealt with the development of the first global, high resolution, fully comprehensive, ensemble based, modelling system for the prediction of climate change at different time scales, from seasons to decades and beyond. The publication by *Weisheimer et al. (2009)* documenting the progress of the new ENSEMBLES multi-model ensemble for seasonal-to-annual predictions attracted more than 100 citations.

FP5 DEMETER was coordinated by Tim through his ECMWF affiliation at the time. The objective of the project, which involved 12 European partners, was to develop a well-validated European coupled multi-model ensemble forecast system for reliable seasonal to interannual prediction. There was a particular focus on ensuring the system would produce useful, practical output for the health and agriculture industries.

FP7 EUCLEIA aimed at studying the attribution of weather and climate risks for Europe. The contribution from UOXF's AOPP group led by Antje focussed on improving the reliability of statements for event attribution.

Relevant significant infrastructure and/or any major items of technical equipment:

We have costed in a computer cluster consisting of one storage head node and four compute nodes, each of which has two quad-core Intel Xeon E5630 processors and 48GB of RAM. The group also currently have access (at no charge) to the computing infrastructure at ECMWF, including HPC and storage, and expect this to continue in the future.

No third parties involved.

Participant 15: Kobenhavns Universitet (UCPH)

The Niels Bohr Institute (NBI; www.nbi.ku.dk) at the Kobenhavns Universitet/University of Copenhagen (UCPH) consists of 10 research sections and 12 science centres and has approximately 150 full-time and project-based academic staff, 90 technical staff and currently about 130 PhD-students and approximately 100 foreign researchers. The Climate and Geophysics Section (CGS) at NBI is the main educational organisation for meteorology, atmospheric dynamics and physical oceanography in Denmark. CGS has a long tradition for collaboration with the Danish Meteorological lnstitute (DMI) both on education at all academic levels, and on research. The section works with climate and geophysics of the Earth. The geophysical activities include the physics of the atmosphere, the oceans, and the geophysics of the solid Earth. Process-understanding, simulation, mapping and prediction of these components are our paramount topics. Key words : Numerical weather prediction, climate physics, anthropogenic climate change, carbon cycle, paleo-climate. Our tools are to a large extent computer models. It is important for UCPH to utilise and compare measured data with the calculations in the models, and to this end UCPH use e.g., classical meteorological measurements, many different types of satellite data, new ocean measurements from deep sea buoys and many seismic measurements. UCPH has access to powerful super computers with its partner institutions and has built its own independent cluster, which can also be used for Bachelor´s and Thesis projects.

Short profile of key personnel involved:

Prof Jens Hesselbjerg Christensen (male), Professor Climate Physics [UCPH Principal Investigator, Co-Leader WP6]: Jens moved to NBI as of 1st March 2017. He was lead scientist and scientific head of regional climate research at DMI. He has managed climate science at DMI as a scientific head for more than 10 years. He was the coordinator of FP5 PRUDENCE (2001-2004), which had 21 partners and focussed on regional climate change (from modelling to impacts and adaptation awareness) using multiple RCMs with a European focus. He has been the PI in several large EU FP consortia, including FP6 ENSEMBLES, FP6 WATCH and FP7 IMPRESSIONS. Here GCM and RCM activities focusing on reducing uncertainty in regional climate projections with a clear focus on high risk events were key elements in the research. In FP7 IMPRESSIONS, a strong transdisciplinary approach, with a very intense stakeholder involvement, was taken. For about 5½ years he directed the multi-disciplinary Centre for Regional Change in the Earth System (CRES) that received praise as a leading national (Danish) research centre in climate research having a broad portfolio of climate related agendas with and interdisciplinary approach. Alongside this; he was affiliated with the Greenlandic Climate Research Centre (GCRC) based in Nuuk, Greenland. Together with colleagues at the University of Copenhagen and the University of Bergen, he received acknowledgement and financial support from an ERC Synergy grant for the project Ice2Ice, which aimed at understanding the role of sea-ice in rapid climate change during the last ice age with possible bearings on the ongoing rapid climate change in the Arctic. He participated in the AR2, AR3, AR4 and AR5; in the latter two as Coordinating Lead Author. He has more than 100 peer review publications with many papers as first author and an ISI web of science H-index of 36. He is frequently cited in Danish media and has often appears in national radio and television programmes. He will co-lead WP6 and together with DMI participate in WP1. In WP3 and WP5 also together with DMI, NBI will contribute to the modelling analyses.

Relevant publications, and/or products, services, achievements:

Larsen, M.A.D., **J.H. Christensen**, M. Drews, M.B. Butts and J.C. Refsgaard (2016): Local control on precipitation in a fully coupled climate-hydrology model. *Sci. Rep.*, **6**, 22927; doi: 10.1038/srep22927.

Christensen, J. H., K. Krishna Kumar, E. Aldrian, S.-I. An, I. F. A. Cavalcanti, M. de Castro, W. Dong, P. Goswami, A. Hall, J. K. Kanyanga, A. Kitoh, J. Kossin, N.-C. Lau, J. Renwick, D. Stephenson, S.-P. Xie and T. Zhou (2013): Climate Phenomena and their Relevance for Future Regional Climate Change. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1217–1308, doi: 10.1017/CBO9781107415324.028.

Kjellström, E., P. Thejll, M. Rummukainen, **J.H. Christensen**, F. Boberg, O.B. Christensen and C.F. Maule (2013): Emerging regional climate change signals for Europe under varying large-scale circulation conditions, *Clim. Res.* **56**, 103-119, doi: 10.3354/cr01146.

Yang, S. and **J.H. Christensen** (2012): Arctic sea ice reduction and European cold winters in CMIP5 climate change experiments, *Geophys. Res. Lett.*, **39**, L20707, doi: 10.1029/2012GL053338.

Christensen, J.H. and F. Boberg (2012): Temperature Dependent Model Deficiencies Affect CMIP5 Multi Model Mean Climate Projections, *Geophys. Res. Lett.*, **39**, L24705, doi: 10.1029/2012GL053650.

Relevant previous projects or activities:

See Partner 5, DMI (as Jens has very recently moved from DMI).

Relevant significant infrastructure and/or any major items of technical equipment:

Not applicable.

No third parties involved.

Participant 16: Stichting Netherlands EScience Center (NLeSC)
The NLeSC (www.esciencecenter.nl) coordinates and conducts a scientific programme, working with both academia and industry, on the interface of e-infrastructure (computing, data), data science and domain sciences varying from climate science, astronomy, chemistry to humanities amongst others. The Center is primarily funded by the national research council (NWO) and the national e-infrastructure organisation (SURF). NLeSC has expertise in data handling, big data analytics and efficient computing. In climate science the expertise of NLeSC is in efficient computing of large codes on heterogeneous (including accelerated hardware) and the combination of disparate compute resources as well as in data management and visualisation of large data sets. NLeSC coordinates a platform for national and European e-Science activities.

NLeSC maintains an eScience technology platform containing tools, interfaces, and libraries to deal with and extract information from large amounts of (distributed) data, requiring large computing infrastructures, high-speed networks, and high-resolution visualisation equipment. NLeSC has a staff of about 40 eScience Research Engineers from varying background, including climate science.

In this project NLeSC will be actively involved in WP6 developing a data management and analytics software infrastructure.

Short profile of key personnel involved:

Prof Wilco Hazeleger (male), Director/CEO of NLeSC [NLeSC Principal Investigator, Scientist WP6]: Wilco is an expert in climate modelling and climate scenario development. He has a chair in climate dynamics at Wageningen University. He initiated and led the EC-Earth consortium, a leading Earth system modelling consortium in Europe. He has been involved in many EC funded FP7 projects, such as THOR, SPECS, COMBINE, IS-ENES, IS-ENES2 and EMBRACE, and the Horizon 2020 PRIMAVERA and Blue-Action projects. He has published over 100 peer-reviewed papers on climate variability, predictability, climate and sea level scenario's, extremes, modelling and climate adaptation. He serves on advisory committees of ECMWF, the UK Met Office Hadley Centre and the Swedish eScience Center and is involved in the Research Data Alliance (RDA).

Dr Willem van Hage (male), Senior eScience Research Engineer NleSC [Scientist WP6]: Willem is a guest researcher at the VU University Amsterdam. He obtained his PhD in computer science while working for the Netherlands Organisation for Applied Scientific Research (TNO) in 2009. He was head of research of the visual analytics tech startup SynerScope B.V. His main research topics in the past 10 years are augmented sense making, visual analytics, information integration, and semantics. He was PI in the US ONRG funded SAGAN and COMBINE projects and work package leader in the EU FP7 project NewsReader and the Dutch BSIK COMMIT Metis and Data2Semantics projects, all dealing with large scale information analysis.

Dr Drost (male), Dr Kuzniar (male) and Dr Goncalves (male) are computer scientists with expertise in data management**; Dr Maassen (male), Dr Bakhski (female)** and **Dr van Oord (male)** are computer scientists with expertise in heterogeneous and distributed computing **[Scientists WP6**].

Relevant publications, and/or products, services, achievements:

da Silva Santos, L.B., Wilkinson, M.D., **Kuzniar, A.**, Kaliyaperumal, R., Thompson, M., Dumontier, M., Burger, K. FAIR Data Points Supporting Big Data Interoperability. In: Zelm M, Doumeingts G, Mendonça JP, editors. Enterprise Interoperability in the Digitized and Networked Factory of the Future. London (2016): *ISTE*; 2016. pp. 270-279.

Goncalves R., van Tilburg T., Kyzirakos K., Alvanaki F., Koutsourakis P., **van Werkhoven** B., **van Hage W. A.**: Spatial column-store to triangulate The Netherlands on the fly. ACM *SIGSpatial* 2016.

Hazeleger, W. et al (2015): Tales of Future Weather. *Nature Climate Change*, 5, 107-114.

B. van Werkhoven, **J. Maassen,** M. Kliphuis, H.A. Dijkstra, S.E. Brunnabend, M. van Meersbergen, F.J. Seinstra, and H.E. Bal (2014): "A distributed computing approach to improve the performance of the Parallel Ocean Program (v2.1)". *Geosci*. Model Dev., 7, 267-281.

Hazeleger, W. Wang, X. Severijns, C., S. S_tef_anescu, R. Bintanja, A. Sterl, K. Wyser, T. Semmler, S. Yang, B. van den Hurk, T. van Noije, E. van der Linden, and K. van der Wiel. EC-Earth V2.2 (2012): Description and validation of a new seamless earth system prediction model. *Climate Dynamics*, 39(11):2611{2629}.

Relevant previous projects or activities:

FP7 IS-ENES2: Developing software infrastructures for climate modelling. PI, Wilco, leads the Climate4Impact.eu activities which gives users access to CMIP5 climate model data. The software infrastructure of EC-Earth, one of the main European coupled climate models, was further developed in IS-ENES2.

H2020 PRIMAVERA: Coordinated high resolution climate modelling. The Netherlands eScience Center was subcontracted by KNMI to optimise and perform high resolution global simulations by EC-Earth. The simulations will be part of CMIP5 and HighResMIP.

ERA-URBAN: Netherlands eScience Center funded project on developing urban reanalysis data set for Amsterdam in collaboration with Wageningen University by downscaling global reanalysis with the regional model WRF and assimilates local non-meteorological data, such as surface and water data.

Copernicus C3S MAGIC: **D**eveloping software infrastructure for validating coupled climate model projections. This software builds upon the Climate Data Store and gives users flexibly access to climate model data and standard metrics packages for validation such as IRIS and ESMVALTOOL.

Horizon 2020 Blue Action: NLeSC performs high resolution atmospheric and coupled model simulations to address the impact of Arctic climate change on mid-latitudes and vice versa.

Relevant significant infrastructure and/or any major items of technical equipment:

NLeSC maintains the eStep software technology platform where research software and a knowledgebase is provided and maintained (estep.esciencecenter.nl). Furthermore, NLeSC makes use of SURF's national e-infrastructure, which consists of high performance computing and data storage facilities and networks (www.surf.nl).

Third parties involved in the project:

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted?	N
Does the participant envisage that part of its worked is performed by linked third parties?	Y
SURFSara is participating as third party through participant NLeSC. See Section 4.2.3	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

4.2 Third parties involved in the project (including use of third party resources)

4.2.1 Third party (ICREA) and their relation to partner BSC

BSC applies a Third Party modality with the "Institut Català de Recerca i Estudis Avançats" (ICREA), where the third party is making its resources available to the beneficiary under Article12 of the Grant Agreement - Use of in-kind contributions provided by third parties free of charge. According to this situation, ICREA will not carry out any part of the work and just lends resources to the beneficiary. These resources are directly used by the beneficiary, the work is performed in its premises and there is no reimbursement by the beneficiary to the third party. The third party makes available resources (dedicated time of Prof Francisco J. Doblas-Reyes, who is employed by ICREA) to the beneficiary, which does not reimburse the cost to the third party, but which charges the costs of the third party as an eligible cost of the project. Its costs will be declared by the beneficiary in its Form C but must be recorded in the accounts of the third party. ICREA resources will be available for the whole duration of the project, mainly for RTD activities. Main activities are on WP1.

4.2.2 Third party (IRD) and their relationship to partner CNRS (/IPSL)

The "Institute of Research for the Development" (IRD) will be participating to this consortium as third party through the contribution of Juliette Mignot. This institute is strongly linked with CNRS. The laboratory of Juliette Mignot (LOCEAN) which is one component of IPSL is a Mixed Unit of Research (UMR) with partnership between

University Pierre et Marie Curie, CNRS, IRD and National Museum of Natural History. Numerous projects involve both IRD and CNRS either as two entities or one as third party. Juliette Mignot will contribute to WP1 and WP5 by providing and analysing decadal prediction simulation and analysis of the North Atlantic ocean in collaboration with Didier Swingedouw and Eric Guilyardi and by supervising the selected post-doctorates.

4.2.3 Third party (SURFSara) and their relationship to partner NLeSC

"SURFSara" will be participating as third party through partner NLeSC. Storage of data will be done at SURFSara infrastructure, which is part of the SURF foundation. This foundation is one of the founders of NLeSC. NLeSC has a Joint Research Unit agreement with SURFSara.

4.2.4 Implementation of action tasks by subcontractors to Met Office and CNRS/CNRM

The Met Office (WP1) and CNRS/CNRM (WP6) are planning to subcontract discrete elements of the EUCP work.

Met Office (WP1, 33,600 €): The Met Office will subcontract the World Climate Research Programme (WCRP) to coordinate and host international discussions and facilitate global coordination of the EUCP work in WP1. WCRP facilitation will strengthen global impact of work done for this project and enables these efforts to seamlessly fit into international efforts and the WMO Global Framework for Climate Services.

CNRS/CNRM (WP6, 20,000 €): CNRS/CNRM will subcontract the creation of an educational movie dealing with expected European climate change based in EUCP scientific results. CNRS/CNRM will write the specification for this movie in collaboration with communication experts from WPs 6 and 7.

5. ETHICS AND SECURITY

5.1 Ethics

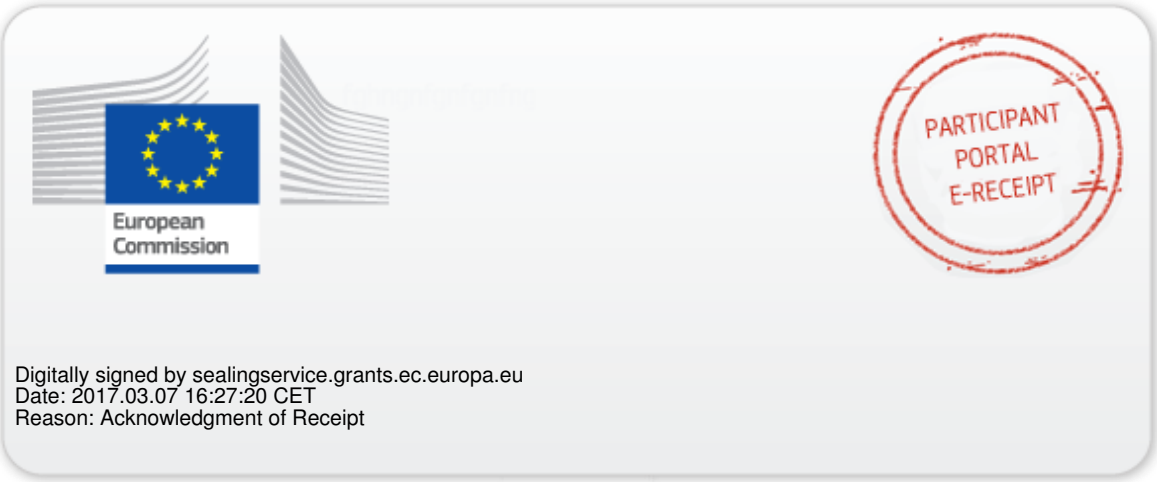
There are no ethics issues to declare. However, we will only collect personal information that is necessary for the project, and use it exclusively for the relevant objectives of EUCP. All beneficiaries will ensure that they adhere to EC legislation and their own national legislation with regard to data protection (including EU Directive 95/46/EC and any subsequent updates to this directive).

Procedures will be implemented for data collection, storage, protection, access, retention and destruction (MS2). This includes an informed consent procedure, thus ensuring that all interviewees, workshop attendees etc.. will understand and agree to how the data they provide will be handled. These procedures will be developed by the end of the second month of the project. No personal data will be collected until these procedures are in place.

5.2 Security

Project EUCP will NOT involve:

- Activities or results raising security issues; nor
- 'EU-classified information' as background or results.



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