Please check our wiki for help on navigating the form.

Horizon 2020

Call: H2020-LC-CLA-2018-2019-2020

(Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement)

Topic: LC-CLA-12-2020

Type of action: RIA

Proposal number: SEP-210641521

Proposal acronym: ASTERISKS

Deadline Id: H2020-LC-CLA-2020-2

Table of contents

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 steps in the submission wizard.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

1 - General information

Topic	LC-CLA-12-2020	Type of Action	RIA
Call Identifier	H2020-LC-CLA-2018-2019-2020	Deadline Id	H2020-LC-CLA-2020-2

Acronym	ASTERISKS
Proposal title	Artificial Intelligence for Climate Services To Enhance Adaptation towards RISKS of Extremes

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

Duration in months	*36*
Fixed keyword 1	Detection and attribution of extreme events using Artificial Intelligen
Fixed keyword 2	Artificial intelligence, intelligent systems, multi agent systems
Fixed keyword 3	Climate change adaptation
Fixed keyword 4	Climatology and climate change
Fixed keyword 5	Meteorology and atmospheric sciences
Free keywords	*Socio-economic impact research*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Abstract

In a changing climate, robust understanding of changing extreme events and their impacts, including detection and attribution to physical or societal drivers, is paramount to develop the best possible climate services that enable decision-making. Artificial Intelligence (AI) has the potential to improve our scientific understanding about the predictability of e.g. storms, heatwaves, precipitation and droughts and their direct and indirect impacts. We will tap AI into its full potential for Earth System Sciences including climate services with ASTERISKS.

ASTERISKS will tackle four major obstacles that currently hinder the adoption of AI in climate services: (i) Shortcomings of data efficiency; (ii) Lack of understandability/explainability of AI; (iii) Fragmented understanding of the potential, limitations and applicability of AI solutions for the needs of climate services by climate scientists and other practitioners; and iv) Lack of data-driven approaches applicable for extreme event detection that fluently combine traditional methods, AI-methods and various datatypes including impact data.

ASTERISKS employs a common case-study framework to assess and validate the applicability of the AI methods on a set of well-selected case studies from all across Europe and its outermost regions, exploring the entire chain from meteorological event detection to the impacts. The case studies are used to demonstrate the added value of using AI for the provisioning of improved and novel climate services for a wide range of extreme event types in various geographical settings.

ASTERISKS will integrate the findings from the case studies with a rigorous analysis of user segments to create markets for AI-based climate services regarding detection and attribution of extreme events. This concept will break new grounds in supporting stakeholders with advanced climate services for decision making enabling improved adaptation to the impacts of extreme events under climate change.

Remaining characters 9

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

Please give the proposal reference or contract number.	
xxxxxx-x	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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 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.

2 - Participants & contacts

#	Participant Legal Name	Country	Action
1	ILMATIETEEN LAITOS	Finland	
2	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	ES	
3	METEOROLOGISK INSTITUTT	NO	
4	EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS	UK	
5	CICERO SENTER KLIMAFORSKNING STIFTELSE	NO	
6	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	DE	
7	DANMARKS TEKNISKE UNIVERSITET	DK	
8	KOBENHAVNS UNIVERSITET	DK	
9	KARLSRUHER INSTITUT FUER TECHNOLOGIE	DE	
10	CONSIGLIO NAZIONALE DELLE RICERCHE	IT	
11	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	SE	
12	ACCADEMIA EUROPEA DI BOLZANO	IT	
13	FORSCHUNGSZENTRUM JULICH GMBH	DE	
14	BAYERISCHE AKADEMIE DER WISSENSCHAFTEN	DE	
15	HELSINGIN YLIOPISTO	FI	
16	POLITECNICO DI TORINO	IT	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

2 - Administrative data of participating organisations

PIC	***Legal name***
999591306	*ILMATIETEEN LAITOS*

Short name: FMI

Address of the organisation

Street Erik Palmenin aukio 1

Town HELSINKI

Postcode 00560

Country Finland

Webpage www.fmi.fi

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

Industry (private for profit).....no

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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Weather and Climate Change Impact Research ☐ not applicable

☒ Same as proposing organisation's address

Street: Erik Palmenin aukio 1

Town: HELSINKI

Postcode: 00560

Country: Finland

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Hilppa** Last name: **GREGOW**

E-Mail: **hilppa.gregow@fmi.fi**

Position in org.: Head of Unit

Department: ILMATIETEEN LAITOS ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: Erik Palmenin aukio 1

Town: HELSINKI Post code: 00560

Country: Finland

Website: www.fmi.fi

Phone: +358 505986881 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Anna	Salonen	anna.salonen@fmi.fi	*+358 415446223*
Antti	Mäkelä	antti.makela@fmi.fi	*+358 503011988*
Adriaan	Perrels	adriaan.perrels@fmi.fi	*+xxx xxxxxxxxx*

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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

Industry (private for profit).....no

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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Weather and Climate Change Impact Research ☐ not applicable

☒ Same as proposing organisation's address

Street: Calle Jordi Girona 31

Town: BARCELONA

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **Markus** Last name: **Donat**

E-Mail: **markus.donat@bsc.es**

Position in org.: Climate Prediction Group Co Leader

Department: Earth Science Department ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: NEXUS II building, Jordi Girona 29

Town: Barcelona Post code: 08034

Country: Spain

Website: www.bsc.es

Phone: +34934054290 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Kim	Serradell	kim.serradell@bsc.es	*+34934137725*
Mar	Rodriguez	mar.rodriguez@bsc.es	*+34934137566*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999510893	*METEOROLOGISK INSTITUTT*

Short name: METEOROLOGISK INSTITUTT

Address of the organisation

Street HENRIK MOHNS PLASS 1

Town OSLO

Postcode 0313

Country Norway

Webpage www.met.no

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....12/03/1995 - no

SME self-assessment ..... unknown

SME validation sme.....12/03/1995 - no

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development Department ☐ not applicable

☒ Same as proposing organisation's address

Street: HENRIK MOHNS PLASS 1

Town: OSLO

Postcode: 0313

Country: Norway

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **Rasmus** Last name: **Benestad**

E-Mail: **rasmus.benestad@met.no**

Position in org.: Senior Scientist

Department: Research and Development Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: HENRIK MOHNS PLASS 1

Town: OSLO Post code: 0313

Country: Norway

Website: www.met.no

Phone: + 47 22 96 30 00 Phone 2: +47 41 12 26 62 Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Abdelkader	Mezghani	abdelkaderm@met.no	*+47 45 79 87 66*
Per Helmer	Skaali	per.helmer.skaali@met.no	*+xxx xxxxxxxxx*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999916741	*EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS*

Short name: ECMWF

Address of the organisation

Street SHINFIELD PARK

Town READING

Postcode RG2 9AX

Country United Kingdom

Webpage www.ecmwf.int

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....yes

International organisation of European interest .....yes

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Research Department ☐ not applicable

☒ Same as proposing organisation's address

Street: SHINFIELD PARK

Town: READING

Postcode: RG2 9AX

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. | Sex: ○ Male ◉ Female

First name: **Magdalena** | Last name: **Balmaseda**

E-Mail: **magdalena.balmaseda@ecmwf.int**

Position in org.: Head of Earth Predictability Section

Department: Research Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: SHINFIELD PARK

Town: READING | Post code: RG2 9AX

Country: United Kingdom

Website: www.ecmwf.int

Phone: +441189499112 | Phone 2: +xxx xxxxxxxxx | Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Peter	Dueben	peter.dueben@ecmwf.int	+xxx xxxxxxxxx
Daniel	Thiemert	daniel.thiemert@ecmwf.int	+xxx xxxxxxxxx

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
998157161	*CICERO SENTER KLIMAFORSKNING STIFTELSE*

Short name: CICERO

Address of the organisation

Street Gaustadallèen 21

Town Oslo

Postcode 0349

Country Norway

Webpage www.cicero.oslo.no

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....29/05/2009 - no

SME self-assessment ..... unknown

SME validation sme.....29/05/2009 - no

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Weather and Climate Change Impact Research ☐ not applicable

☒ Same as proposing organisation's address

Street: Gaustadallèen 21

Town: Oslo

Postcode: 0349

Country: Norway

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: ○ Male ◉ Female

First name: **Jana** Last name: **Sillmann**

E-Mail: **jana.sillmann@cicero.oslo.no**

Position in org.: Research Director

Department: Weather and Climate Change Impact Research ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Gaustadallèen 21

Town: Oslo Post code: 0349

Country: Norway

Website:

Phone: +xxx xxxxxxxxx Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Sigrid Rian	Song	sigrid.rian.song@cicero.oslo.no	+xxx xxxxxxxxx
Elise	Hafskjold	elise.hafskjold@cicero.oslo.no	+xxx xxxxxxxxx

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999978433	*LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN*

Short name: LMU MUENCHEN

Address of the organisation

Street GESCHWISTER SCHOLL PLATZ 1

Town MUENCHEN

Postcode 80539

Country Germany

Webpage www.uni-muenchen.de

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....06/03/2014 - no

SME self-assessment .....06/03/2014 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Department of Geography ☐ not applicable

☐ Same as proposing organisation's address

Street: Luisenstr. 37

Town: Munich

Postcode: 80333

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Prof. Sex: (•) Male ( ) Female

First name: **Ralf** Last name: **Ludwig**

E-Mail: **r.ludwig@lmu.de**

Position in org.: University Professor

Department: Department of Geography ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Luisenstr. 37

Town: Munich Post code: 80333

Country: Germany

Website: www.geographie.uni-muenchen.de

Phone: +49 89 2180 6677 Phone 2: *+xxx xxxxxxxxx* Fax: +49 89 2180 17858

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999990655	*DANMARKS TEKNISKE UNIVERSITET*

Short name: DTU

Address of the organisation

Street ANKER ENGELUNDSVEJ 1 BYGNING 101 A

Town KGS LYNGBY

Postcode 2800

Country Denmark

Webpage www.dtu.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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/01/2001 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: DTU Management (Sustainability Division) ☐ not applicable

☐ Same as proposing organisation's address

Street: Produktionstorvet, building 424

Town: Kgs. Lyngby

Postcode: 2800

Country: Denmark

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr.

Sex: (•) Male ( ) Female

First name: **Martin**

Last name: **Drews**

E-Mail: **mard@dtu.dk**

Position in org.: Senior researcher

Department: DTU Management ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Produktionstorvet, building 424

Town: Kgs. Lyngby

Post code: 2800

Country: Denmark

Website: www.man.dtu.dk

Phone: +45 46 77 51 55

Phone 2: +45 22 86 33 80

Fax: *+xxx xxxxxxxxx*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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

Industry (private for profit).....no

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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Weather and Climate Change Impact Research ☐ not applicable

☒ Same as proposing organisation's address

Street: NORREGADE 10

Town: KOBENHAVN

Postcode: 1165

Country: Denmark

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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** Last name **Hesselbjerg Christensen**

E-Mail **hesselbjerg@nbi.ku.dk**

Position in org. Professor

Department Weather and Climate Change Impact Research, NBI ☐ Same as organisation name

☐ Same as proposing organisation's address

Street Tagensvej 16

Town Copenhagen N Post code 2200

Country Denmark

Website https://www.nbi.ku.dk/english/research/pice/

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Sannie Kristine	Henriksen	henriksen@nbi.ku.dk	+xxx xxxxxxxxx

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
990797674	*KARLSRUHER INSTITUT FUER TECHNOLOGIE*

Short name: KIT

Address of the organisation

Street KAISERSTRASSE 12

Town KARLSRUHE

Postcode 76131

Country Germany

Webpage www.kit.edu

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/10/2009 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Atmospheric Trace Gases and Remote Sensing (IMK-ASF) ☐ not applicable

☐ Same as proposing organisation's address

Street: Hermann-von-Helmholtz-Platz 1

Town: Eggenstein-Leopoldshafen

Postcode: 76344

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Peter** Last name: **Braesicke**

E-Mail: **peter.braesicke@kit.edu**

Position in org.: Professor and Section Head Modelling

Department: IMK-ASF ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Hermann-von-Helmholtz-Platz 1

Town: Eggenstein-Leopoldshafen Post code: 76344

Country: Germany

Website: https://www.imk-asf.kit.edu/english/staff_1638.php

Phone: +49 721 608 22191 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Kristine	Bentz	eu@for.kit.edu	*+49 721 608 45192*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999979500	*CONSIGLIO NAZIONALE DELLE RICERCHE*

Short name: CNR

Address of the organisation

Street PIAZZALE ALDO MORO 7

Town ROMA

Postcode 00185

Country Italy

Webpage www.cnr.it

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....18/05/2016 - no

SME self-assessment ..... unknown

SME validation sme.....05/12/2008 - no

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Institute of Atmospheric Sciences and Climate ☐ not applicable

☒ Same as proposing organisation's address

Street: PIAZZALE ALDO MORO 7

Town: ROMA

Postcode: 00185

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Paolo** Last name: **Davini**

E-Mail: **p.davini@isac.cnr.it**

Position in org.: Researcher

Department: Institute of Atmospheric Sciences and Climate ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: PIAZZALE ALDO MORO 7

Town: ROMA Post code: 00185

Country: Italy

Website: http://www.isac.cnr.it

Phone: +390113839834 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Jennifer	Urbinati	j.urbinati@isac.cnr.it	+390516399623

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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

Industry (private for profit).....no

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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Rossby Centre, Research Department ☐ not applicable

☒ Same as proposing organisation's address

Street: Folkborgsvaegen 1

Town: NORRKOEPING

Postcode: 601 76

Country: Sweden

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Nikulin** Last name: **Grigory**

E-Mail: **grigory.nikulin@smhi.se**

Position in org.: Researcher

Department: Rossby Centre, Research Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Folkborgsvaegen 1

Town: NORRKOEPING Post code: 601 76

Country: Sweden

Website: https://www.smhi.se/forskning/forskningsomraden/klimatforskning

Phone: +46114958652 Phone 2: +46114958000 Fax: +xxx xxxxxxxxx

Other contact persons

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999887253	*ACCADEMIA EUROPEA DI BOLZANO*

Short name: EURAC

Address of the organisation

Street VIALE DRUSO 1

Town BOLZANO

Postcode 39100

Country Italy

Webpage www.eurac.edu

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....28/08/2014 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Weather and Climate Change Impact Research ☐ not applicable

☒ Same as proposing organisation's address

Street: VIALE DRUSO 1

Town: BOLZANO

Postcode: 39100

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Marc** Last name: **Zebisch**

E-Mail: **marc.zebisch@eurac.edu**

Position in org.: Head of Institute

Department: Institute for Earth Observation ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: VIALE DRUSO 1

Town: BOLZANO Post code: 39100

Country: Italy

Website: www.eurac.edu

Phone: +39 0471 055380 Phone 2: *+xxx xxxxxxxxx* Fax: +39 0471 055389

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Alice	Crespi	alice.crespi@eurac.edu	*+39 0471 055264*
Marco	Sciortino	marco.sciortino@eurac.edu	*+39 0471 055234*
Eva Maria	Moar	evamaria.moar@eurac.edu	*+xxx xxxxxxxxx*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999980470	*FORSCHUNGSZENTRUM JULICH GMBH*

Short name: FZJ

Address of the organisation

Street WILHELM JOHNEN STRASSE

Town JULICH

Postcode 52428

Country Germany

Webpage www.fz-juelich.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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....05/12/1967 - no

SME self-assessment ..... unknown

SME validation sme.....05/12/1967 - no

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Institute of Bio- and Geosciences, Agrosphere (IBG-3) ☐ not applicable

☒ Same as proposing organisation's address

Street: WILHELM JOHNEN STRASSE

Town: JULICH

Postcode: 52428

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Klaus** Last name: **Görgen**

E-Mail: **k.goergen@fz-juelich.de**

Position in org.: Senior Researcher

Department: Institute of Bio- and Geosciences, Agrosphere (IBG-3) ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: WILHELM JOHNEN STRASSE

Town: JULICH Post code: 52428

Country: Germany

Website: http://www.fz-juelich.de/ibg/ibg-3/EN/Home/home_node.html

Phone: +492461616456 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Petra	Insberg	p.insberg@fz-juelich.de	+xxx xxxxxxxxx

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999580054	*BAYERISCHE AKADEMIE DER WISSENSCHAFTEN*

Short name: BADW-LRZ

Address of the organisation

Street ALFONS-GOPPEL-STRASSE 11

Town MUENCHEN

Postcode 80539

Country Germany

Webpage www.badw.de

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/01/1900 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Leibniz Supercomputing Centre ☐ not applicable

☐ Same as proposing organisation's address

Street: Boltzmannstraße 1

Town: Garching near Munich

Postcode: 85748

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Wolfgang** Last name: **Kurtz**

E-Mail: **wolfgang.kurtz@lrz.de**

Position in org.: Research Scientist

Department: Research ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Boltzmannstraße 1

Town: Garching near Munich Post code: 85748

Country: Germany

Website: www.lrz.de

Phone: +49 89 35831 8763 Phone 2: *+xxx xxxxxxxxx* Fax: +49 89 35831 8563

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Megi	Sharikadze	megi.sharikadze@lrz.de	*+49 89 35831 8873*
Anton	Frank	anton.frank@lrz.de	*+49 89 35831 7841*
Dieter	Kranzlmueller	dieter.kranzlmueller@lrz.de	*+49 89 35831 8700*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999994535	*HELSINGIN YLIOPISTO*

Short name: UHEL

Address of the organisation

Street YLIOPISTONKATU 3

Town HELSINGIN YLIOPISTO

Postcode 00014

Country Finland

Webpage www.helsinki.fi

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....31/12/2018 - no

SME self-assessment .....31/12/2018 - no

SME validation sme.....09/02/2009 - no

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

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Faculty of Science / Department of Computer Science ☐ not applicable

☐ Same as proposing organisation's address

Street: Pietari Kalmin katu 5

Town: University of Helsinki

Postcode: 00014

Country: Finland

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Kai** Last name: **Puolamäki**

E-Mail: **kai.puolamaki@helsinki.fi**

Position in org.: Associate Professor

Department: Department of Computer Science ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Pietari Kalmin katu 5

Town: University of Helsinki Post code: 00014

Country: Finland

Website: www.helsinki.fi/en/researchgroups/exploratory-data-analysis

Phone: +358505560226 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Satu	Väisänen	satu.vaisanen@helsinki.fi	+xxx xxxxxxxxx
Ulrika	Backman	ulrika.backman@helsinki.fi	+xxx xxxxxxxxx

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999977754	*POLITECNICO DI TORINO*

Short name: POLITO

Address of the organisation

Street CORSO DUCA DEGLI ABRUZZI 24

Town TORINO

Postcode 10129

Country Italy

Webpage www.polito.it

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

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....05/07/2001 - 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.

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Dept. of Environment, Land and Infrastructure Engineering ☐ not applicable

☒ Same as proposing organisation's address

Street: CORSO DUCA DEGLI ABRUZZI 24

Town: TORINO

Postcode: 10129

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

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: **Jost** Last name: **von Hardenberg**

E-Mail: **j.vonhardenberg@isac.cnr.it**

Position in org.: Ful professor

Department: Dept. of Environment, Land and Infrastructure Engineering ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: CORSO DUCA DEGLI ABRUZZI 24

Town: TORINO Post code: 10129

Country: Italy

Website: http://www.diati.polito.it/en/

Phone: +39-0110905645 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Silvia	Antonietti	silvia.antonietti@polito.it	*+390110907745*
Luca	Ridolfi	luca.ridolfi@polito.it	*+390110905668*

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

3 - Budget

Total requested EU contribution for the proposal/ €	6 000 000

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Call: H2020-LC-CLA-2018-2019-2020 **Topic: LC-CLA-12-2020**

Proposal title: Artificial Intelligence for Climate Services To Enhance Adaptation towards RISKS of Extremes (ASTERISKS)

1. Excellence

Extreme weather events are disruptive and damaging, and it is often difficult to issue warnings and assess risks to societies. Extreme events include a wide range of atmospheric phenomena, some of which can be predicted applying state-of-the-art weather forecasting techniques. However, Artificial Intelligence (**AI) has the potential to provide great benefits and scientific breakthroughs by supporting better informed climate services and decision-making.** AI has been the most transformative technology in recent years. The trend is predicted to accelerate, as AI evolves from its initial areas of success, such as image and speech recognition, to applications in the physical domain including Earth Sciences. As the European Union (EU) is the global market leader in Climate Service development e.g. through the Copernicus Programme and its Climate Change Service (C3S), new breakthroughs and novel concepts designed and validated by European high-level research institutes will further strengthen Europe's leading position in this field.

ASTERISKS combines the expertise of 16 partners from 8 countries for creating added-value of AI in climate services, especially in the analysis of extremes, risks and impacts (including economic, social and health) known to be reformed due to the changing climate. The partners are determined to tackle the following **four major obstacles** that **currently hinder the adaptation of AI in climate services: (i) Shortcomings of data efficiency**; **(ii) Lack of understandability/explainability of AI**; (**iii) Fragmented understanding** of the potential, limitations and applicability of AI solutions for the needs of climate services by climate scientists and other practitioners; and **iv) Lack of data-driven approaches applicable for extreme events that fluently combine traditional methods, AI-methods and various datatypes.** There is an urgent need to overcome these four obstacles because climate change impacts, as shown in trends of extreme events[1], are a global concern for societies, economies, politics and ecosystems. We need to design and validate breakthroughs and novel concepts, thereby also contributing to the EU's continuous role as a global market leader in climate service development.

Within ASTERISKS we have the required expertise to develop the primary elements needed **for novel AI-based climate services for detection and attribution of climate change with respect to extreme events and their impacts.** ASTERISKS provides beyond state-of-the-art development in the applicability of AI that combines atmospheric, computational, socioeconomic and environmental sciences. ASTERISKS's ambition relates strongly to the four major obstacles, which will be tackled by the excellence of the highly interdisciplinary consortium, i.e. **high specialization in understanding extreme events and their impacts**; **excellent understanding of the applicability of AI; high involvement of end-users; excellent contacts with key stakeholders** based on governmental channels and previous projects and collaboration with **SMEs and City Councils**.

1.1. Objectives

The overall objective of ASTERISKS is to **enhance and further develop applicability of innovative AI in provision of climate services for detection of spatial and temporal patterns of extreme weather events.** This will lead to innovations predicting impacts and attribution to climate change with explainable AI techniques. Thus, ASTERISKS will increase the level of operationality of climate services through advancing development of early warning systems with help of validated, developed and tested AI. The project builds on already-available data and data platforms to ensure effective uptake by different user segments (Table 1).

Table 1. *From the objectives of ASTERISKS to concrete outcomes and results that create impacts. The abbreviations I1 to I8 refer to the impacts in Section 2.1.*

OBJECTIVES	OUTCOMES	RESULTS	IMPACTS
O1 Establish optimal methods for the **detection and localisation** of resolved and unresolved extreme events in the past climate, using data especially from C3S climate data store (CDS).	A validated set of open source traditional and novel AI algorithms for the detection of extremes, which operate on public climate databases.	**R1** Collection of fit-for-purpose traditional and novel AI-algorithms for the detection of hydro-meteorological extremes such as storms, heavy precipitation, heat waves and drought applicable to automatizing catalogues of historical extreme events.	Breakthroughs in interdisciplinary science (I1). Strengthened scientific knowledge on climate (I7).

[1] https://easac.eu/publications/details/extreme-weather-events-in-europe/

This proposal version was submitted by **Hilppa GREGOW** on **12/02/2020 10:50:14** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

O2 Develop AI-techniques (e.g., deep learning) to detect spatial and temporal patterns and evolutions including trends of climatological fields associated with hydro-meteorological extreme events and their impacts in today's and future climate.	A Proof-of-Concept for an automatized catalogue for extreme events including socio-economic information. An analysis of trends of resolved and unresolved extreme events in the past, current and future climate change scenarios.	**R2** Trained, validated and documented "explainable" AI-algorithms targeting physical characterization of extremes and their linkages with large scale drivers, together with an automated catalogue of the events used in the training.	Breakthroughs in interdisciplinary science (I1). Enhanced action on adaptation (I6). Novelties in operational climate services (I2).
O3 Assess which AI-techniques can discriminate between different variables, based on the event type, and capable of handling single and compound extreme events at various spatial scales.	A maturity matrix of applicability of traditional and novel AI-techniques for both resolved and unresolved scales and event types to improve skills in weather, seasonal and climate predictions.	**R3** Demonstrator (as support to early warning development) of the added value of AI algorithms compared to traditional methods for the prediction of extremes at extended and seasonal forecast range.	Breakthroughs in interdisciplinary science (I1). Novelties in operational climate services (I2).
O4 Determine where impacts are **attributable** to i) anthropogenic climate change, ii) anthropogenic climate change and societal change, or iii) societal change.	Novel methods for attribution of observed impacts and detection between observed impacts, relevant climatic drivers and social drivers (e.g., management practices) and to project possible changes in the future (using RCP-SSP scenarios).	**R4** Open-source library of AI-algorithms for extreme event detection, prediction and attribution, interoperable with the C3S data store and with a catalogue of detected events.	Novelties in operational climate services (I2). Reduced vulnerability to climate change impacts (I5).
O5 Co-design and co-develop a novel AI-analysis platform for piloting climate extreme event detection and assessing impacts and attribution.	AI-analysis platform with openly available HPC(High-Performance-Computing) -enabled AI-workflows that are compatible with C3S technical design principles.	**R5** Best practices for benchmarking and validating AI-algorithms aimed at detecting and attributing climate change impacts on extreme events.	Enhanced adaptive capacity (I4). Better informed climate services and decision-making (I8).
O6 Enhance interaction with known and new stakeholders for offering needed localized critical climate information to **support decision-making** in updating/implementing of adaptation strategies.	A forum of users and providers of AI-based climate services is established and engaged with a co-creation process. This forum advances the use of climate services.	**R6** AI-based climate services are validated and tested with cases studies. Support to stakeholders in enhancing adaptation planning is evaluated. AI-based services are in use and gaps are identified.	High socio-economic and political impacts (I3). Better informed climate services and decision-making (I8).

1.2. Relation to the work programme

The topic areas of the call and the specific scope b) are addressed in Table 2 (referring to Table 1 Objectives O1-O6).

Table 2. *Description of topic areas and specific challenges (scope b) noted in the call against objectives (Table 1) of ASTERISKS.*

LC-CLA-12-2020 topic areas	ASTERISKS framing to the topic areas and response
Enhance adaptive capacity, strengthening resilience and reducing vulnerability to climate change.	**Detection and localisation of resolved and unresolved extreme events is challenging due to lack of data-driven approaches.** We establish optimal methods for the detection and localisation of extreme events, including e.g., tropical storms and heat waves especially using said data (O1-O3). We test and iteratively refine these in collaboration with sectoral stakeholders. (O6)
Contribute to sustainable development and ensuring an adequate adaptation response.	**Extreme events can cause impacts due to poor management of climatic risks.** We create novel climate services for detection and attribution of climate change impacts with respect to occurrence and risks related to extreme events (O5-O6). We interact with decision/policy-makers (nationally, in Europe and via WMO (World Meteorological Organization)

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	and WHO (World Health Organization) globally). The developed methods can be used to support obtaining e.g., SDG (sustainable development goal) 13 (urgent action to combat climate change and its impacts) and SDG 15 (protect, restore and promote sustainable use of land).
Enhance action on adaptation regarding 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, including the socio-economic analysis of adaptation options for key impact areas.	**Attribution chain of impacts is difficult to understand.** We assess where impacts are attributable to i) anthropogenic climate change, ii) anthropogenic climate change and societal change, or iii) societal change (O4). We assess which AI-techniques can discriminate different variables, based on the event type, and are capable of handling single and compound extreme events at various spatial scales (O1-O3). We co-design and co-develop a novel AI-analysis platform for piloting climate extreme event detection, assessing impacts and attribution (O5). We enhance interaction with known and new stakeholders to offer needed critical climate information to support decision-making and updating and implementation of adaptation strategies. (O6)
Use said data (e.g., provided by the Copernicus programme) and create services that communicate and deliver bespoke critical climate information to better inform risk-aware decision making and adaptation strategies.	**To have global outreach for novel AI-based climate services using said data is critical.** We develop AI techniques (e.g., deep learning) to detect spatial and temporal patterns and evolutions of climatological fields associated with extreme events (O1-O3). Our case studies target the most severe extremes and a range of socio- economic sectors. We involve a broad group of stakeholders from the local to the global level and ensure that climate information and the services are tailored but are through said data transferable to other locations (O4-O6).
LC-CLA-12-2020 specific challenge for Scope b)	**ASTERISKS response to Scope b)**
Explore novel approaches for detection and localisation of extreme events, including tropical cyclones and heat waves, and for quantifying extreme events trends in current day and future climate change scenarios.	By establishing optimal methods for the detection and localisation of extreme events using also socio-economic data, we can visualise the risk areas in the past, current and future climate in more detail with respect to trends of extreme event impacts. We explore how the methods can be applied from e.g., CMIP3 to CMIP5 and from CMIP5 to CMIP6 to learn about the potential in delivering novel AI-based operational climate services that are no longer data type dependent but easily applicable to new data (which is essential for the Copernicus Programme).
Develop artificial intelligence techniques (e.g., deep learning) to detect spatial and temporal patterns and evolutions of climatological fields (e.g., temperature) associated with extreme events.	By combining time series of impact data (e.g., falling trees over land due to storms; authorities reporting numbers of people without clean drinking water due to drought/heatwaves), with traditional meteorological data (e.g., wind gust observations, temperatures and no rain, respectively) we develop AI techniques to detect patterns and evolutions of extreme climatic events. We explore downscaling and upscaling effects and assess the possibility to employ scarce data. We start by applying state-of-the-art AI methods (such as deep neural networks, random forests) that are best suited to the tasks at hand: e.g., deep learning when we have large enough quantities of labelled data available and Bayesian probabilistic approaches when data are scarce and interpretability and characterization of uncertainties are important.
Discriminate between different variables based on the event type and capable of handling events at various spatial scales considering associated impacts and attribution to climate change.	By developing methods that divide the extreme event impacts between i) anthropogenic climate change, ii) anthropogenic climate change and societal change, or iii) societal change we can show the full attribution chain. We fill in the knowledge gap by employing AI in detection and can employ spatially scarce data in a much more robust way than currently.

ASTERISKS recognises the importance to closely follow and cooperate with other relevant projects, either on-going or starting ones, such as the Finnish Center for Artificial Intelligence (https://fcai.fi). Of special relevance are the other projects funded in this Call, i.e., in LC-CLA-12-2020 sub-topics a) "Mapping European coastal infrastructure at risk from sea-level rise", and c) "Impacts of overshooting", respectively. The project partners have been and are involved in various national, European (including Copernicus contracts) and international projects that directly support ASTERISKS thematics.

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1.3 Concept and Methodology

a) Concept

ASTERISKS enhances the use of AI in climate services with respect to the detection of spatial and temporal patterns of extreme events, to understand their socioeconomic and biophysical impacts, and attribute long-term changes to anthropogenic modifications of climate or other societal factors. It uses an **interdisciplinary, stakeholder-informed approach** that enables close collaboration between climate and socioeconomic impact scientists with experts in data sciences and AI technologies. It analyzes the current state and future dynamics of several overarching extreme event types (see Table 3, Figure 1,), as well as their respective impact hazards, such as floods, flash floods or landslides. **Socioeconomic implications of direct impacts by hazard type are analyzed using ex-post impact evaluation.**

The project develops and implements a novel approach for using the benefits of AI for better exploiting big and scarce data available through climate modeling, impact modeling, socioeconomic data, and earth observations (e.g., Copernicus). ASTERISKS explores the vast possibilities provided by high-performance computing (HPC) in terms of computational needs, fast implementation and state-of-the-art workflows to develop and apply new AI technologies on very large, functional data repositories and the connection of multi-model environments. AI technologies are explored to improve data mining and modeling efficiency for the detection of explainable, attributable, and scalable process interactions which can result in high-impact events.

The project employs a common case-study framework to assess and validate the applicability of the scientific methods on a set of well-selected case studies from across Europe and its outermost regions (Table 4). The case studies are used to confirm the added value of using AI for the provisioning of improved and novel climate services for a wide range of extreme event types in various geographical settings. ASTERISKS will integrate the findings from the case studies with a rigorous analysis of user segments (e.g., science, industries, administration, municipalities) to create sub-markets for AI-based climate services and to ensure their quick and efficient market-uptake. This will directly contribute to the training of relevant stakeholders and support the reduction of vulnerability and risk. The focus on Europe and the European climate service market is considered necessary to ensure sufficient data availability, quality and accessibility for a robust application of AI technology. Lessons learned from the case studies that apply AI technologies locally will be instrumental to provide recommendations for computing and data services **at a global scale** and to strengthen Europe's leading role in establishing and driving the climate service market. This concept will break new grounds in **supporting stakeholders with advanced climate services for decision making for an improved adaptation to the impacts of extreme events under climate change.**

Table 3. *Selected events for examining the AI potential. Shortcomings when studied with conventional methods, and explanation of the potential for AI for providing improved understanding of these events.*

	Motivation for the choice	**Expected AI impact/added value**
Storms (tropical, extra-tropical, convective).	Storms are one of the most hazardous weather events. There is a lack of knowledge on past and future storm trends as well as on the changes in storm tracks, storm intensity and occurrence. Relevant physical processes are not fully resolved by current climate models. Climate and environmental changes play a role in the storm impacts, such as in sea level rise. Compounded by sea level rise and tides, storm surges are likely to become one of the most critical consequences of climate change.	AI methods combining meteorological and non-meteorological data provide more robust conclusions of storm trends, and their attribution to climate change. AI can learn relationships between partly unresolved features and large-scale conditions and enable more robust detection of storms in climate model simulations, weather analysis/forecasts, and satellite data. More specific understanding of storm trends, their characteristics and the potentially compound effect of storm surges in a future climate will prove great benefits for adaptation.
Precipitation (heavy rainfall, convective rain)	Extreme precipitation from persistent to high-intensity convective rainfall causes flooding globally and insured losses worth billions of euros. Relevant physical processes are not resolved by current climate projections, and, while a new generation of convection permitting regional climate models are advancing, robust projections of the impacts of flash floods is urgently needed for adaptation decisions, which often happens at scales unresolved by climate models.	AI offers a potential to analyse the large-scale drivers of heavy precipitation more comprehensively than previously, based on a range of new and existing data sets, to better understand and monitor trends, and for downscaling to urban scales. AI can play an important role for distilling relevant knowledge from climate and flood models and for attributing the impacts of hydro-meteorological events in terms of both climate change drivers, land surface processes and human activities. New AI methods will be benchmarked against existing approaches to establish added value.

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Heatwaves	During the past decades deaths of tens of thousands of people have been attributed to heat waves solely in Europe. Agriculture and other sectors are affected impacting the European resilience. There is no standard definition for heatwave; traditional analyses are using e.g. different climatologically based thresholds, and analyses of past and future changes differ as various metrics are used. Atmospheric models predict temperatures but do not label which of the predicted temperatures correspond to heatwave conditions.	AI-based detection of heatwaves is developed, combining sectoral impact data (e.g., energy, agriculture, health), climate data and environmental impact data (related to vegetation, land and sea). The consideration of impacts in the detection of heatwaves will overcome the need of (partly arbitrary) climatological-based thresholds in current heatwave analyses. The analysis of long-term changes and attribution of impact-relevant heat extremes will be more informative to develop adaptation strategies.
Drought	Drought and its related hazards (e.g., forest fires) have recently caused tremendous economic and environmental losses, as well as losses of life. The drivers of droughts across various spatial and temporal scales must be understood to develop adaptation mechanisms to increase resilience against a growing number and severity of droughts.	AI methodology will be applied to a variety of data sources (meteorological and non-meteorological, such as vegetation images) to better detect the severity of a past, developing and future drought events, as well as the economic sector affected by it and its impacts on groundwater as a resource.
Arctic extremes	The Arctic is warming much faster than the global mean, associated with changes in extreme atmospheric and snow/ice conditions. Often coinciding with or following extremes in the Arctic, Europe has experienced several cold, snowy winter events with problems for e.g. traffic. The preconditions for extreme events related to Arctic–midlatitude linkages are quantitatively poorly known. Atmospheric models predict such events, but further analysis is needed to diagnose and attribute them to the global system.	AI will be applied in exploring (a) preconditions for cold outbreaks in the past and future and (b) attribution of changes in the extreme events to climate change. By testing the skill of AI-methods to detect trends in the past, we will explore which AI-methods can minimise the uncertainty estimates of the future. We expect that this effort will result in improved understanding of dynamics of extreme events and their improved prediction via AI-based complementary support for dynamic forecasting models.

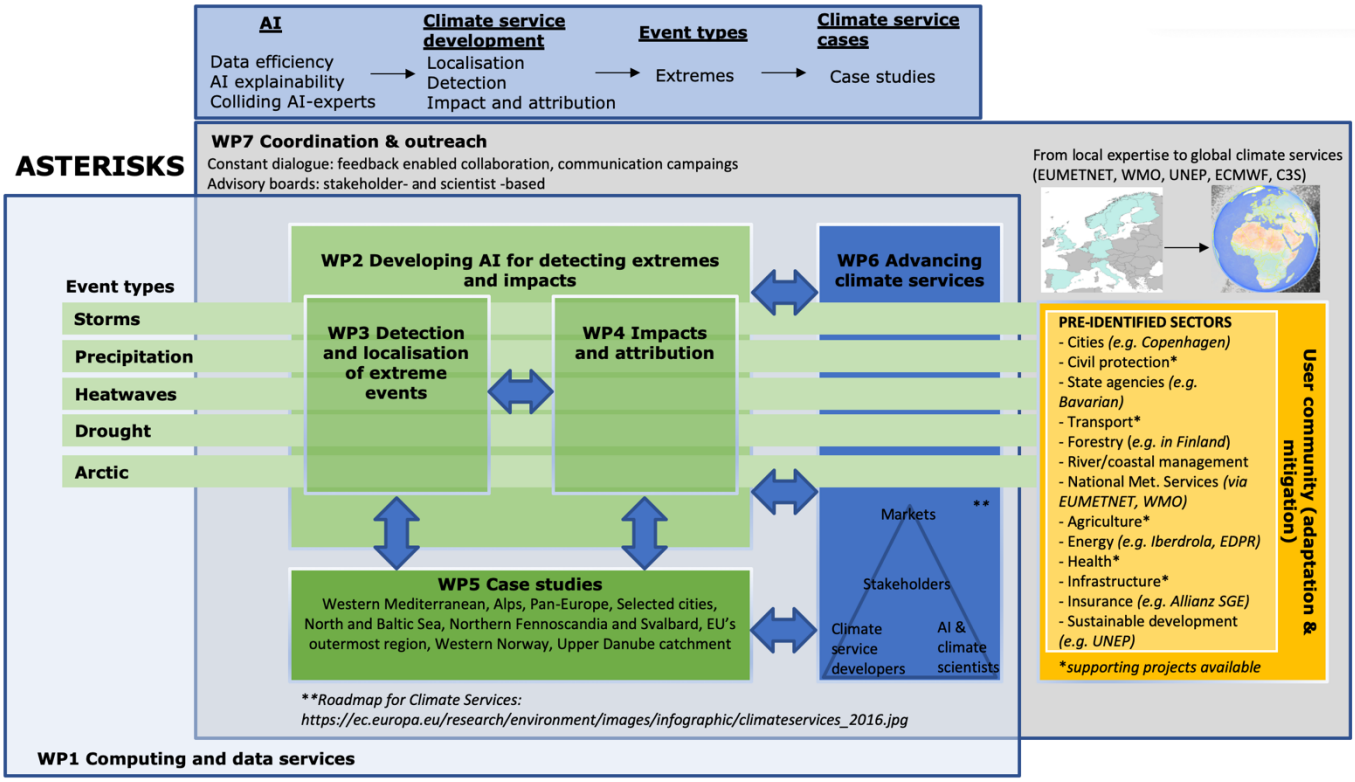

Figure 1*. ASTERISKS concept and methodology indicating the work packages (WP's), workflow, case studies with specific regions and extreme events of interest together with recognized sectors stakeholders/end-users.*

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b) Methodology

ASTERISKS is planned for the duration of **36** months and divided into seven WPs, building the bridge from various data sources to the advanced use of climate services (below and Fig. 1). Most importantly, ASTERISKS will establish a collaboration between AI and other experts to ensure that the four main obstacles in the use of AI (i.e., shortcomings of data efficiency, lack of understandability/explainability of AI, fragmented understanding of the potential and limitations of AI, and the lack of data-driven approaches applicable for extreme events that fluently combine traditional methods, AI-methods and various datatypes) are addressed in the project.

WP1 Computing and data services. WP1 will provide a project-wide technical infrastructure for data handling, analytics and computation in close collaboration with all other WPs, on the basis of a comprehensive data management plan. To cope with the ASTERISKS big data volume (and data variety) challenges, the AI computational needs, and to allow for a fast implementation, AI-workflows will be based on existing state-of-the-art infrastructures (data repositories, compute facilities, software, C3S workflows) and adhere to FAIR principles and provenance tracking for an efficient reuse of the HPC-enabled AI workflows and data. ASTERISKS rely on large, highly functional data repositories (e.g., C3S, ESGF serving, CMIP and CORDEX data) as well as on less conventional repositories and data sources (e.g., self-hosted datasets for CORDEX-FPS and ClimEx experiments). As not all data (types) can be efficiently stored centrally, WP1 will provide multiple ways to access data (download and centrally store; via interfaces and WPS; by pre-processing data in parts at the federated repository sites). A rapid AI method and tools prototyping will be based on an extensive, existing data repository and a complete AI software stack that will speed up agile development. Via web-based (e.g., Jupyter Notebooks) interfaces to the AI tools and data flow paths, consortium members will be efficiently able to analyse data and derive new products. Data and compute services will be federated using the available (heterogeneous) compute resources of participating supercomputing centres (LRZ, FZJ, BSC).

WP2 Developing AI for detecting extremes and impacts. WP2 will work together with WP1 to make sure that the collected data is usable with the AI methods (e.g., the data is in suitable format and all necessary information is gathered). WP2 will provide an assessment of the current approaches and their strengths and limitations and provide suitable metrics to evaluate developed novel approaches. This WP will also adjust existing and develop new AI methods to the particular needs of this project. Issues here involve the nature of the data and the property that although the data is often high-dimensional, the events of interest are rare. Furthermore, the AI methods need to be statistically sound and understandable in order for them to provide actionable information. The specific problems addressed are the detection and localisation of extreme weather and climate events and linking the re-analyses data sets (and other public climate databases) to sectoral impact data. WP2 will work in close collaboration with other WPs, with WP1 and WP3-4. We will implement and apply state-of-the-art AI methods (such as deep neural networks, random forests) that are best suited to the tasks at hand: e.g., deep learning when we have large enough quantities of labelled data available and Bayesian probabilistic approaches when data is scarce and interpretability and characterizing uncertainties are important.

WP3 Detection and localisation of extreme events. WP3 lays the foundations for developing and training AI algorithms for detecting extremes, focusing on identifying physics-based drivers for their attribution. The new AI-methods will be applied to global and regional re-analyses data sets from C3S (ERA5, UERRA, MESCAN, CARA), and trained targeting the identification and localisation of realised extreme events. We identify AI-algorithms targeted to the identification of linkages of extreme events with large-scale drivers and physical process, to assist the narrative of storylines. This contributes to what is called an "explainable AI", and its ability will be demonstrated for a selected number of recent extreme events in Europe, also including some EU Outermost Regions. We assess the skill of the new AI-algorithms using independent data, in cross-validation mode, and benchmark these against existing methodology, when applicable. We evaluate the potential of the new AI algorithms for advancing the attribution and prediction capabilities of extremes at multiple time scales: early warning, extended-seasonal predictions, and climate projections.

WP4 Impacts and attribution. An overview of available databases of climate-related impacts across Europe is established, building on and collecting existing information from the Earth observations provided through the Copernicus Programme and assessing their usefulness for impact detection and attribution (link to WP1). Existing process-based hydro-ecological impact models are utilized and further developed to perform in a "big data" context. Earth observations are assimilated into the process-based impact models to improve parameterization, calibration, and validation for the detection and attribution of (multiscale) impact hazards, such as floods and droughts. Climate-related impacts that may be driven by a sequence of moderate to extreme events or compound events in combination (link to WP3) with socially constructed exposure or vulnerabilities to such events (e.g., changes management, changes in resource demand, maladaptation to water and land resources) or combinations thereof are investigated using hydro-climatological model and in-situ data as well as Earth observation data applying explainable AI (link to WP2). Finally, a socio-economic analysis of direct impacts by hazard type will be done using ex-post impact evaluation studies and socioeconomic statistics based on collected data (WP1). We advance existing econometric approaches to estimate causal effects of climate variables on economic outcomes to investigate sectoral economic

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implications (i.e., impacts on commodity prices and sectoral value added) and the performance of several alternative non-linear functional forms to find a best-fit model. We identify a collection of most suitable AI methods for our impact assessment together with WP2. The most skillful methods are applied to produce projections of future impacts including socio-economic impacts due to climate extremes and compound events (link to WP5).

WP5 Case Studies. This WP assesses and validates the applicability of the developed scientific concepts and methods into real-life environments by looking at selected case studies, listed in Table 4, covering the addressed extreme events (Table 3). The WP focuses on the development of a common case-study framework, including standardized structure and feature description, and on the validation and assessment of novel AI-based climate services in supporting and enhancing future adaptation planning. The developed AI-based methods (WP2) as well as the data access systems (WP1) for climate extreme trend detection (WP3), attribution and impact analysis (WP3 and WP4) will be applied and adapted to the specific case. The role of provided information in improving the risk assessment capacity and in promoting the enhancements in adaptation is assessed in close collaboration with stakeholders, who are engaged as core partners in each case study. WP5 represents a "laboratory" providing continuous feedback to improve the development process of infrastructure (WP1) and methodologies (WP2, WP3, WP4) and it supports WP6 in designing advanced uses of climate services and in selecting operative-oriented products.

Table 4. *Research regions and cases examined in ASTERISKS.*

REGION	DESCRIPTION	SECTORS (S), PARTNERS (P)
C1: West. Mediterr.	**Storms** (wind speeds of ~ 100–200 km/h) **and heavy precipitation events** during late summer/early autumn have been becoming more frequent over the **western Mediterranean**. AI-based methods are used to assess current trends based on meteorological and impact data, attribute these to climate change and provide robust future climate projections.	**S**: Agriculture, infrastructure, insurance. **P**: ECMWF, CNR
C2: Alps	**Extreme precipitation**, **drought** and **windstorms** affecting human and natural environments are particularly emphasized in the **Alpine regions**. AI-tools are used to improve the detection and the trend analysis of such events, e.g. by integrating meteorological observations with impact data derived from Earth Observation databases (e.g. forest damages and landslides).	**S**: Agriculture, hydropower, insurance. **P**: EURAC, CNR, POLITO
C3: Upper Danube	**Fluvial floods** and **flash floods** caused by **heavy/extreme precipitation** have increased in intensity and frequency in the **Upper Danube catchment**. The area has also recently experienced several episodes of severe **droughts**. An abundance of hydro-meteorological data as well as flood and drought impact data exist. AI can improve detection and attribution of such events at basin scale and evaluate the role of improved climate services in supporting the future management of the catchment.	**S**: Agriculture, forestry, infrastructure, insurance **P**: LMU
C4: Western Norway	**Atmospheric rivers (AR)** hitting the **Western Coast of Norway** are expected to cause more frequent and intense **heavy precipitation** events in the future. A number of these events occurred in the last decades, leading to devastating floods, landslides and damages in several valleys. AI will be used to explore the link between remnants of tropical cyclones and the precipitation intensity associated with an AR event and to identify in advance the areas that will be hit hardest by an AR event.	**S**: Infrastructures, transport, hydropower, flood regulation. **P**: CICERO
C5: European cities (place TBD)	**Cities** with their increasing population density and high concentration of assets and infrastructure are especially vulnerable to extremes like **heatwaves** and **flash floods**. Improved risk assessments at urban scales using AI to more comprehensively distil relevant information from available data sources, including earth observation and impact-related data, may pave the way for more climate-resilient urban planning and adaptation.	**S**: Urban planning, infrastructure, insurance. **P**: DTU
C6: EUs Outer regions (place TBD)	**Tropical cyclones** regularly threaten the **EU's outermost regions**, causing damage through **extreme winds, excessive rain, waves, and storm surges**. Tropical cyclones can be linked to extreme winds and precipitation in the European region itself through atmospheric rivers. Novel information obtained using AI could improve current risk assessments and lead to improved resilience towards the compounded impacts of tropical cyclones through better-informed planning and coastal management.	**S**: Coastal management and planning. **P**: University of Copenhagen, DTU

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C7: North Sea and Baltic Sea	**Storm surges,** waves, as well as **wind- and precipitation-related** impacts caused by **extra-tropical cyclones** like Xaver (2013) when compounded by sea level rise, pose as a challenge to European coastal communities. AI-based methods will be used to understand and attribute current trends based on meteorological and impact data, and to provide tailored future projections of risk to facilitate improved and climate-resilient coastal planning and management.	**S**: Coastal management and planning, infrastructure, insurance. **P**: DTU
C8: Northern Fennoscandia and Svalbard	**Arctic extremes** are often caused by extra-tropical cyclones with strong advection of warm, moist air masses from the south. These cases are associated with high temperature anomalies, **stormy winds, freezing rain** (if the lower air layer is below freezing)**, rapid snow and ice melt, heavy precipitation** (often **rain on snow**, which is a major problem for reindeer), and sometimes result **in avalanches and landslides**. Application of AI is expected to improve risk assessments response strategies in present and future climate.	**S**: Infrastructure, navigation, emergency, reindeer herding. **P**: FMI
C9: Pan-Europe	**Drought** has devastating impacts especially for the agriculture and forests in Europe; yet, **it is extremely challenging to predict**. Regarding improved early warning services for drought prediction (meteorological and impacts), AI is seen to have great benefits. We will combine weather-pattern recognition with AI methods, and test semi-supervised approach in clustering the weather types relevant for drought conditions by combining the AI techniques and the historical recognition (human expertise) techniques. The forecasts will be tested with the sectoral users.	**S**: Agriculture, forestry, health. **P**: FMI

WP6 Advancing climate services. Building on the innovations and new insights from WP2-WP5, WP6 will facilitate the transition towards AI-enhanced, market-ready climate services that are based on user needs. WP6 facilitates the transition from an R&D product towards a climate service as well as helping the creation of sub-markets for AI-based climate services. WP6 supports and promotes a cumulating and lasting uptake of AI-based climate services, be it directly based on ASTERISKS concepts or from other comparable sources. The activities in this WP explore, facilitate, and improve the matching of AI-enhanced climate service capabilities with user needs. In WP6, we prepare a gap analysis of user segment profiles versus supply of current and future feasible AI based climate services, including decision support types, quality requirements (hit rates, resolution, etc.), degree of consultancy embedded, and time perspectives, aimed at identifying (priority) development needs and overall most promising application potentials. We enhance learning of the AI process for impacts and impact attribution regarding the differential effect of climate service use, in cooperation with WP4 and WP5; assessing options for user feedback and related schooling needs. For different use contexts, a benefit evaluation tool will be developed using also the experiences in WP5. We explore the fitness of particular delivery & resourcing models and data sharing options for different user segments, and consequences for data logistics and responsibility. We also enhance the uptake of AI based climate services by establishing linked communities of users and providers

WP7 Coordination and outreach. WP7 takes care of efficient coordination and management, and outreach, communication and stakeholder engagement with actors outside of the project core team (Fig. 1). This involves the screening of scientific actors, public authorities, cities, companies, national hydro-meteorological services and their networks (e.g., EUMETNET, WMO, AMAP) who could benefit from the results of the project and could be involved to contribute to the project, or to be informed. WP7 is constantly in a two-way communication process with the other WPs to design extensive communication campaigns, increase visibility and impact, maintain dialogue with identified stakeholders on several levels (political, economic, scientific) and enable a iterative feedback process between the WPs. To ensure broad and immediate uptake of the scientific advances and climate services innovations, WP7 will disseminate direct implications of ASTERISKS through the pan-European network of the European Climate Research Alliance (ECRA) as well as global networks, such as the World Climate Research Programme (WCRP) Grand Challenges for Weather and Climate Extremes and the newly established Knowledge Action Network for Emergent Risks and Extreme Events (Risk KAN).

c) Gender dimension

The gender dimension is often neglected in climate research as there is a considerable lack of awareness due to insufficient information and evidence. However, women are (a) disproportionately vulnerable to climate change and (b) seldomly on a level playing-field with men in decision-making processes. ASTERISKS will fully take the above-mentioned issues into account and aims to advance the integration of the gender dimension in climate research:

a) In view of their vulnerability, it is vital to include gender aspects in the research activities of ASTERISKS (e.g. in WP4), thereby also taking into account SDG 13.B raising adaptive capacity, including focusing on women, youth and local/ communities; and SDG 2 concerning the predicaments of rural women due to extreme events.

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b) That being said, women could take up a critical role in response to climate change due to their local knowledge of and leadership in sustainable resource management/ practices at the household and community level. ASTERISKS will consider this in its stakeholder engagement (WP5), establishing linked provider-end-user communities (WP6) and outreach activities (WP7), thus contributing to SDG 5 providing females with representation in decision-making processes to enable sustainable economies (SDG 5.5, 5.A, 5.B).

1.4 Ambition

Ambition of ASTERISKS is related to tackling the four major obstacles that currently hinder the adaptation of AI in climate services. **Obstacle 1: Shortcomings in data efficiency**. Many of the events of interest are rare and large meticulously annotated/labeled datasets (that have been a key contributor to many of the successes of, e.g., deep learning) are not available. Methods that can cope with scarce, heterogenous, and imperfect data sources, such as probabilistic methods, are therefore essential. **Obstacle 2: Lack of understandability/explainability of AI.** We need such AI tools and methods that domain experts (e.g., scientists specialised in droughts, floods, storms) can interpret and understand. To allow for a scientific interpretation of the functionality of "black-box" AI algorithms, building trust among domain scientists is required. **Obstacle 3: Fragmented understanding of the potential, limitations and applicability of AI solutions.** Big efforts to decrease fragmentation is needed to meet the needs of climate services by climate scientists and other practitioners, such as decision-support experts and decision-makers. **Obstacle 4: Data-driven approaches that fluently combine traditional methods, AI-methods and various datatypes are missing.** It is vital to compare how traditional methods work since AI is not only "deep learning" but also application of probabilistic methods that address data efficiency issues mentioned above. Thus, **our ambition is to enable data-driven approaches for climate research and climate services** and demonstrate their added value over traditional/conventional statistical methods especially in risk management. To overcome these four obstacles, constructive collaboration between AI researchers, climate scientists, and impact assessment experts is needed. This enables defining a set of data-driven methods fit for the purpose and proves the added value of AI.

Table 5. *Challenges and ASTERISKS contribution beyond state-of-the-art and innovation potential.*

Advancement (related obstacle)	**Beyond the State-of-the-art and innovation potential**
Provide AI algorithms for detection of extreme events and linking sectoral impacts to climate conditions. (Obstacle 1)	There are currently no concerted efforts for developing AI algorithms interoperable with the C3S data store. Data from sectoral applications is scattered. ASTERISKS will orchestrate a concerted approach for detection of extremes with AI-algorithms, which can be integrated in a software toolbox, interoperable with C3S datasets, and suitably validated and documented.
Develop AI strategy for climate applications: define a benchmarking and validation procedure and conduct a gap analysis. (Obstacle 3)	The benchmarking procedure for the new AI-algorithms is sorely absent, and ASTERISKS will pioneer these efforts by designing benchmarking procedures against existing methodology, as well as defining a best practice for validation of AI. ASTERISKS will also provide a gap analysis of existing resources (e.g., regarding insufficient data).
Develop "explainable AI" to support the attribution of climate events and impacts to multiple drivers in past, present and future climates. (Obstacle 2)	AI-derived results often lack the attribute of "authoritative information". ASTERISKS will enhance the credibility of the AI-algorithms by developing the concept of explainable AI, by which the extremes detected by "AI" are linked with physical drivers and processes also via AI networks. This will contribute to the elaboration of credible narratives associated with the occurrence, prediction and attribution of extremes.
Improve understanding of the benefits of investments in disaster risk reduction. (Obstacle 4)	The data-driven approaches go beyond state-of-the-art and form the basis of novel climate services of ASTERISKS. These support important stakeholders (from cities, critical infrastructure planners, renewable energy providers) whose actions/non-actions affect millions of people and billions of Euros as shown in the RoadMap for Climate Services[2].

2. Impact

2.1 Expected impacts

ASTERISKS provides robust and accurate information of changes in extreme events in a changing climate, and examines the ways to identify the full chain of attribution. ASTERISKS is expected to offer first class support to planning actions and investments with respect to climatic risks, the Green Deal and renewing climate laws/policies. This is highly relevant because the EU has committed to pave the road regarding carbon-neutrality and will invest

[2] https://ec.europa.eu/research/environment/images/infographic/climateservices_2016.jpg

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substantially to renewable energy[3]. Through its wide and topical outreach and dissemination campaigns, ASTERISKS advances co-development, uptake and use of climate services and through this process improves adaptation planning and decision making. Worldwide, exceptional economic and humanitarian losses are foreseen due to extreme weather and climate events, emphasized especially by UNDRR and Sendai Framework[4]. ASTERISKS will minimize uncertainty regarding attribution of losses of lives due to extreme events and can identify where, when and how extreme events are attributable to climate change or other factors. ASTERISKS will directly provide first aid guidance on how impacts can be avoided by implementing suitable adaptation measures through case studies. In addition, ASTERISKS will enable improvements in early warning systems that are extremely important for the most vulnerable regions see, e.g., the IPCC SREX (2012)[5]. The developments of new explainable AI algorithms will allow for a more complete physical interpretation of drivers behind extreme events, including how to attribute their relative importance. This will enhance predictability of these events, which are poorly represented by existing models. The impacts of ASTERISKS are extensive and cover impacts in science, co-creative advancement of climate services and applicability of climate services provided by the C3S.

Impact 1: Breakthroughs in interdisciplinary science. ASTERISKS does a comprehensive assessment of the two components, anthropogenic change and societal change, that can lead to an impact. It disentangles their individual or combined contribution by using novel, and explainable AI techniques. ASTERISKS makes scientific breakthroughs regarding the construction of robust time series with scarce data by applying explainable AI. At the start of writing, the Technology Readiness Level (TRL) of the applications are considered to be at level 2. By the end of the project, ASTERISKS will have advanced to TRL4-5 with respect to AI, meteorology, climate and hydrology.

Impact 2: Novelties in operational climate services. ASTERISKS establishes the use of AI for climate extremes and impacts research, and for climate services. ASTERISKS leads the development of an openly available implementation of AI for climate data analysis. ASTERISKS assesses the potential and limitations of AI to be used for operational climate services, by co-creating proofs of concepts for dissemination and visualisation of trends and attribution of extreme events. This development is liaised with the Copernicus Programme development to foster the engagement with current and new users of climate services. The TRL of the applications is considered to be at level 2. By the end of the project, those related with socio-economic impacts will have advanced to TRL4.

Impact 3: High socio-economic and political impacts. The membership of the consortium partners in the ECRA, their contributions to C3S, in EEA (European Environmental Agency), WMO, IPCC and in e.g., national adaptation monitoring groups and climate panels will guarantee coordination of influential outreach to policymakers in Europe (in EU and national/partner country levels).

Impact 4: Enhanced adaptive capacity. The improved climate projections, early warning systems development, and their testing in real-life environments together with end-users will prepare Europe better for extreme events and their socio-economic impacts in a changing climate. This relates especially to the sustainability goals (e.g., SDG 13, SDG 15, and SDG 1; indicator target 1.5, SDG 6) of the UN.

Impact 5: Reduced vulnerability to climate change impacts. The better climate services of extreme event trends provided by ASTERISKS have the potential to save billions of euros, especially in vulnerable areas, not only in Europe but also globally. ASTERISKS will tailor the results so that especially adaptation planners can utilize them.

Impact 6: Enhanced action on adaptation. Improved confidence in projections of extremes will facilitate decision-making on climate adaptation actions and greatly reduce the risk of maladaptation. To maximize the societal impact of ASTERISKS, and to underpin ongoing adaptation efforts, case studies target all of the most severe extremes affecting European communities and a range of socio-economic sectors. Areas considered include rural and urban, coastal and in-land communities and cover virtually all European climates. By involving a broad group of stakeholders ranging from the local to the global level ensures that results are transferable to other locations.

Impact 7: Strengthened scientific knowledge on climate. Novel information provided by combining different data sources (atmospheric, impact and socio-economic data) makes it possible to distinguish trends with respect to climatic variability and anthropogenic climate change. By testing the skill of AI-methods to detect trends in the past, we will learn how, and which AI-methods can minimise the uncertainty estimates in the future climate.

Impact 8: Better informed climate services and decision-making. ASTERISKS endeavors to create a community of both users and providers, including options for sharing experiences and data, and the prospect to continue beyond the lifetime of the project. In combination with the insights and tools arising from this work, the aim is to create the best circumstances for the take-off of an own market segment of AI based climate information. The collection of data and tools developed in ASTERISKS creates an excellent basis for offering decision-making oriented climate services.

[3] https://ec.europa.eu/info/policies/climate-action_en

[4] https://www.unisdr.org/we/coordinate/sendai-framework

[5] IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

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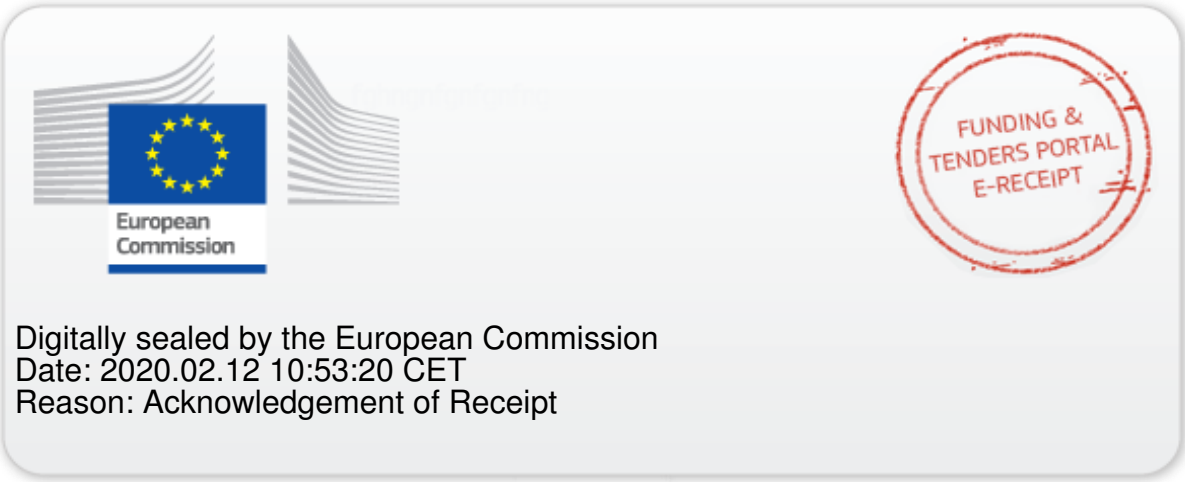

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