Horizon 2020

Call: H2020-MSCA-IF-2014

Topic: MSCA-IF-2014-EF

Type of Action: MSCA-IF-EF-ST

Proposal Number: SEP-210197644

Proposal Acronym: PredEx

Table of contents

Section	Title	Action
1	General information	
2	Participants & contacts	
3	Budget	
4	Ethics	
5	Call-specific questions	

How to fill in the forms?

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

Proposal ID **656038**		*Acronym* **PredEx**

1 - General information

Topic　MSCA-IF-2014-EF

Type of action　MSCA-IF-EF-ST

Call identifier　H2020-MSCA-IF-2014

Acronym　| PredEx |

Proposal title　| Seasonal-to-interannual predictability of extreme winters at mid-latitudes |

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

Duration in months　| 24 |

Panel　| ENV - Environmental and Geosciences |

Please select up to 5 descriptors (and at least 1) that best characterise the subject of your proposal, in descending order of relevance.

Descriptor 1　| *Climatology and climate change* |　Add

Free keywords　| *Climate extremes and impacts, probabilistic climate predictions, seasonal-to-decadal variability, high-mid latitudes connections* |

Abstract

Northern mid-latitude continents, including Europe, have experienced a suite of harsh winters since a decade, having devastating consequences on agriculture, causing major transport disruptions and heavily affecting human societies. The observational record is too short to ascertain whether these extreme climatic events are the possible consequence of rapid changes in the high-latitude cryosphere –out of which the dramatic Arctic sea ice depletion stands out− or random manifestations of pure climate variability. It is also unclear, to date, whether the possible outcome of such extremes could ever be predicted a few months/years in advance. This research project will address those questions from end-to-end using a state-of-the-art climate model, large ensemble simulations and advanced techniques of initialization of the sea ice state for seasonal-to-interannual climate prediction. Beyond its scientific objectives, the project will also contribute to increase the surface of contact between academic and non-academic sectors: the candidate will realize a two-month secondment in a reinsurance company with marked interests in any form of risk associated to climate change.

This 24-month research project will be punctuated by frequent scientific visits to world-class institutes, presentations in international conferences, the publication of scientific papers in high-impact journals and the dissemination of results in the popular media. Its international and multidisciplinary nature will enlarge the network, publication record and skills of the applicant and will place him in favourable position to eventually reach a permanent academic position.

Remaining characters　　　336

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under the 7th Framework Programme, Horizon 2020 or any other EU programme(s)?　　○ Yes　◉ No

Proposal ID **656038**	Acronym **PredEx**

Declarations

1) The applicant (future beneficiary) declares to have the explicit consent of all partner organisations (if applicable) 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 applicant (future beneficiary) confirms:

- to have carried out the self-check of the financial capacity of the organisation on https://ec.europa.eu/research/participants/portal4/desktop/en/organisations/lfv.html. Where the result was "weak" or "insufficient", the applicant (future beneficiary) 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 applicant (future beneficiary) hereby declares:

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

The applicant (future beneficiary) is only responsible for the correctness of the information relating to his/her own organisation. Where the proposal to be retained for EU funding, the applicant (future beneficiary) 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

Your reply to the grant application will involve the recording and processing of personal data (such as your name, address and CV), which will be processed 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 processing of your personal data are available on 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 Warning System (EWS) only or both in the EWS and Central Exclusion Database (CED) by the Accounting Officer of the Commission, should you be in one of the situations mentioned in:
-the Commission Decision 2008/969 of 16.12.2008 on the Early Warning System (for more information see the Privacy Statement), or
-the Commission Regulation 2008/1302 of 17.12.2008 on the Central Exclusion Database
(for more information see the Privacy Statement) .

2 - Administrative data of participating organisations

Future Host Institution

PIC	Legal name
994170073	FUNDACIO INSTITUT CATALA DE CIENCIES DEL CLIMA

Short name: IC3

Address of the organisation

Street   CALLE BALDIRI REIXAC 2

Town   Barcelona

Postcode   08028

Country   Spain

Webpage   www.ic3.cat

Legal Status of your organisation

Research and Innovation legal statuses

Public body ……………………………………… no   Legal person ………………………… yes

Non-profit ………………………………………… yes

International organisation ……………………… no

International organisation of European interest …… no

Secondary or Higher education establishment ……. no

Research organisation ………………………… yes

Small and Medium-sized Enterprises (SMEs) ……… no

Academic Sector ……………………………… yes

Nace code   721 -

Does this participant deliver doctoral degrees that are recognised as such by the relevant national authorities?   ◯ Yes ⦿ No

Proposal ID **656038**   *Acronym* **PredEx**

Department(s) carrying out the proposed work

Department 1

Department name | The Climate Forecasting Unit

Street | Doctor Trueta, 203, Planta 3

☐ Same as organisation address

Town | Barcelona

Postcode | 08005

Country | Spain

Proposal ID **656038**	*Acronym* **PredEx**

Supervisor

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

Title Prof.

Sex ● Male ○ Female

First name* **Francisco**

Last name* **Doblas reyes**

E-Mail* **francisco.doblas-reyes@ic3.cat**

Position in org. Head of Unit

Department The Climate Forecasting Unit

Street Doctor Trueta 203, Planta 3

☐ Same as organisation address

Town Barcelona

Post code 08005

Country Spain

Website www.ic3.cat

Phone +34935679977

Phone 2 *+xxx xxxxxxxxx*

Fax +34933097600

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Cristina	Pulido	cristina.pulido@ic3.cat	

Proposal ID **656038** *Acronym* **PredEx**

Researcher

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

Researcher ID | *If you have a researcher identifier number (e.g. ResearcherID, ORCID) please enter it here.*

Last Name*	Massonnet	Last Name at Birth	
First Name(s)*	François	Gender*	⦿ Male ○ Female
Title	Dr.	Country of residence*	Belgium
Nationality*	Belgium	Nationality 2	
Date of Birth (DD/MM/YYYY)	22/03/1986	Country of Birth*	Belgium
		Place of Birth	Ixelles

Contact address

☐ Same as organisation address

Current organisation name	Georges Lemaître Centre for Earth and Climate Research
Current Department/Faculty/Institute/ Laboratory name	Earth and Life Institute, Université catholique de Louvain
Street	Place Louis Pasteur 3, bte L4.03.08
Postcode/Cedex	1348	Town	Louvain-la-Neuve
Phone	+3210473067	Country	Belgium
Phone2 / Mobile	*+xxxx xxxxxxxxxxx*		
E-Mail*	francois.massonnet@uclouvain.be		

Qualifications

University Degree	Date of award (DD/MM/YYYY)	30/06/2009
Doctorate (in progress)	Date of award (DD/MM/YYYY)	
Doctorate	Date of award (DD/MM/YYYY)	25/04/2014
Full time postgraduate research experience	Number of months	62
Other Academic qualifications	Date of award (DD/MM/YYYY)	

Proposal ID **656038**	Acronym **PredEx**

Place of activity/place of residence (previous 5 years - most recent one first)

Indicate the period(s) and the country/contries in which you have legally resided and/or had your main activity (work, status, ..) during the last 5 years up until the deadline for the submission of the proposal. Please fill in this section without gaps, until the call deadline (11/09/2014).

Period from	Period to	Duration (days)	Country	
				Add
10/09/2009	11/09/2014	1.828	Belgium	Remove
	Total	1828		

Proposal ID **656038**	Acronym **PredEx**

3 - Budget

Is the Researcher eligible for family allowance?   ○ Yes   ◉ No

Participant Number	Organisation Short Name	Country	Country Coefficient	Number of Person Months	Researcher Unit Cost			Institutional Unit Cost		TOTAL
					Living Allowance	Mobility Allowance	Family Allowance	Research, training and networking costs	Management and Overheads	
1	IC3	ES	0,976	24	108 922	14 400	0	19 200	15 600	158 122
Total				24	108 922	14 400	0	19 200	15 600	158 122

Proposal ID **656038**	Acronym **PredEx**

4 - Ethics

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		Page
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
Does it involve invasive techniques?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		Page
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA (ii)		Page
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	○ Yes ◉ No	
5. ANIMALS (iii)		Page
Does your research involve animals?	○ Yes ◉ No	

Proposal ID **656038**	Acronym	**PredEx**

6. THIRD COUNTRIES		Page
Does your research involve non-EU countries?	⦿ Yes ○ No	11
A scientific visit to the National Center for Atmospheric Research (Boulder, CO, USA) is scheduled.		
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)? (v)	○ Yes ⦿ No	
Do you plan to import any material from non-EU countries into the EU? *For data imports, please fill in also section 4.* *For imports concerning human cells or tissues, fill in also section 3.*	○ Yes ⦿ No	
Do you plan to export any material from the EU to non-EU countries? *For data exports, please fill in also section 4.* *For exports concerning human cells or tissues, fill in also section 3.*	○ Yes ⦿ No	
If your research involves low and/or lower middle income countries, are benefits-sharing measures foreseen? (vii)	○ Yes ⦿ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ⦿ No	

7. ENVIRONMENT & HEALTH and SAFETY See legal references at the end of the section. (vi)		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants? *For research involving animal experiments, please fill in also section 5.*	○ Yes ⦿ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	○ Yes ⦿ No	
Does your research involve the use of elements that may cause harm to humans, including research staff? *For research involving human participants, please fill in also section 2.*	○ Yes ⦿ No	

8. DUAL USE (vii)		Page
Does your research have the potential for military applications?	○ Yes ⦿ No	

9. MISUSE		Page
Does your research have the potential for malevolent/criminal/terrorist abuse?	○ Yes ⦿ No	

Proposal ID **656038**   *Acronym* **PredEx**

10. OTHER ETHICS ISSUES		Page
Are there any other ethics issues that should be taken into consideration? Please specify	◯ Yes ⦿ No	

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

Proposal ID **656038**   *Acronym*   **PredEx**

5 - Call specific questions

Eligibility Researcher (future fellow)

1. Were you in the last 5 years in military service?   ○ Yes ◉ No

Other Questions

For communication purposes only, the REA asks for permission to publish the name of the researcher (future fellow) should the proposal be retained for funding.

1. Does the researcher (future fellow) give this permission?   ◉ Yes ○ No

2. Is there a secondment in Member States or Associated Countries evisaged in Part B of this proposal?   ◉ Yes ○ No

In which sector is the secondment in Member States / Associated Countries foreseen?

☐   Academic   ☒   Non Academic

Do you already know the organisation to which this secondment will be?   ◉ Yes ○ No

Name | Munich RE

Country | Germany

Proposal ID **656038**	*Acronym* **PredEx**

Open Research Data Pilot in Horizon 2020

If selected, all applicants have the possibility to participate in the [Pilot on Open Research Data in Horizon 2020](1), which aims to improve and maximise access to and re-use of research data generated by actions. Participating in the Pilot does not necessarily mean opening up all research data. Actions participating in the Pilot will be invited to formulate a Data Management Plan in which they will determine and explain which of the research data they generate will be made open.

We wish to participate in the [Pilot on Open Research Data in Horizon 2020](on a voluntary basis) on a voluntary basis	○ Yes	⦿ No

Participation in this Pilot does not constitute part of the evaluation process. Proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for not participating.

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

Data management activities

The use of a [Data Management Plan (DMP)](#) is required for projects participating in the [Open Research Data Pilot in Horizon 2020](#), in the form of a deliverable in the first 6 months of the project.

All other projects may deliver a DMP on a voluntary basis, if relevant for their research.

Are data management activities relevant for your proposed project?	○ Yes	⦿ No

Part B

START PAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2014

PART B

"PredEx"

Seasonal-to-interannual predictability
of extreme winters at mid-latitudes

This proposal is to be evaluated as:

Standard EF

TABLE OF CONTENTS

LIST OF PARTICIPANTS

START PAGE COUNT

1. **SUMMARY**
2. **EXCELLENCE**
3. **IMPACT**
4. **IMPLEMENTATION**

STOP PAGE COUNT

5. **CV OF THE EXPERIENCED RESEARCHER**
6. **CAPACITIES OF THE PARTICIPATING ORGANISATIONS**
7. **ETHICAL ASPECTS**

List of Participants

Participants	Legal Entity Short Name	Academic (tick)	Non-academic (tick)	Country	Dept./ Division / Laboratory	Supervisor	Role of Partner Organisation
<u>Beneficiary</u> Institut Català de Ciències del Clima	IC3	X		Spain	Climate Forecasting Unit	Prof F. J. Doblas-Reyes	
<u>Partner Organisation</u> Munich RE	Munich RE		X	Germany	Geo Risks Research/Corporate Climate Centre	Prof P. Höppe	Hosting the experienced researcher during secondment

1. Summary

Northern mid-latitude continents, including Europe, have experienced a suite of harsh winters since a decade, having devastating consequences on agriculture, causing major transport disruptions and heavily affecting human societies. The observational record is too short to ascertain whether these extreme climatic events are the possible consequence of rapid changes in the high-latitude cryosphere –out of which the dramatic Arctic sea ice depletion stands out− or random manifestations of pure climate variability. It is also unclear, to date, whether the possible outcome of such extremes could ever be predicted a few months/years in advance. This research project will address those questions from end-to-end using a state-of-the-art climate model, large ensemble simulations and advanced techniques of initialization of the sea ice state for seasonal-to-interannual climate prediction. Beyond its scientific objectives, the project will also contribute to increase the surface of contact between academic and non-academic sectors: the candidate will realize a two-month secondment in a reinsurance company with marked interests in any form of risk associated to climate change.

This 24-month research project will be punctuated by frequent scientific visits to world-class institutes, presentations in international conferences, the publication of scientific papers in high-impact journals and the dissemination of results in the popular media. Its international and multidisciplinary nature will enlarge the network, publication record and skills of the applicant and will place him in favourable position to eventually reach a permanent academic position.

2. Excellence

2.1 Quality, innovative aspects and credibility of the research

<u>Context, state-of-the-art and overview of the action</u>

Context: cold extremes in a warming world. From a climatic point of view, the past decade has been remarkable in two respects. First, the Earth global mean surface temperature has risen to unprecedented levels since the beginning of the pre-industrial era, having far-reaching consequences extending from the rise of the global mean sea level to the dramatic depletion of Arctic sea ice[1]. Second, and more unexpectedly, northern mid-latitude continents have experienced a chain of extreme winters since a few years[2], among which anomalously cold temperatures and large snowfalls during winters 2009-2011 in Europe, major snow storms ("snowmageddon" events) in the U.S. (2011, 2014) and Japan (2014), and extremely cold air temperatures in China (2013) unseen since three decades. This series of extreme conditions at mid-latitudes have caused major damages to industrialized centres: prolonged public transport disruptions, power outages and, more tragically, death tolls. Replacing the paradoxical occurrence of extreme winters in a global warming context is an important scientific question that can help orient and shape the public perception about climate change. It is also a priority for the adaptation of our societies on a near-term timescale.

State-of-the-art: Arctic sea ice as the smoking gun. The association between Arctic sea ice and mid-latitude atmospheric variability has long been recognized[3]. From this point of view, the accelerated retreat of Arctic sea ice since the mid-2000s[4] could partly explain the occurrence of extreme events in winter. With expected continued decline in Arctic sea ice[5], such cold winter events could even persist in the future[6]. Beyond simple association, the very existence of *causal* connections between Arctic sea ice loss and severe winters is, however, still debated[7]: it is not clearly established, to date, whether the recent extreme winters are ultimately related to the rapid changes in sea ice boundary conditions, or are purely random events[8]. On top of that, Arctic sea ice has so far not been exploited as a source for

---

[1] (IPCC, 2013)

[2] (Cohen, et al., 2012) (Liu, et al., 2012) (Overland, 2014) (Petoukhov, et al., 2010) (Tang, et al., 2013)

[3] (Honda, et al., 1999) (Alexander, et al., 2004) (Deser, et al., 2004) (Budikova, 2009)

[4] (Fetterer, et al., 2012)

[5] (Massonnet, et al., 2012)

[6] (Yang, et al., 2012)

[7] (Cohen, et al., 2014) (Barnes, 2013) (Wallace, et al., 2014)

[8] (Overland, 2014) (Thomas, 2014)

mid-latitude seasonal-to-interannual (S2I) *predictability*, even though it might play an important role for the lower-latitude climate.

Climate models are unique and appropriate tools to (1) compensate for the shortness of the observational record and (2) explore the predictability of the climate system. Several studies using Atmosphere General Circulation Models (AGCMs) have investigated the link between Arctic/mid-latitudes dynamics[9]. The main limitation of such setups is the total absence of feedbacks between the ocean−sea ice system and the atmosphere, as well as the absence of information regarding sea ice thickness, to which the atmospheric circulation response may be precisely sensitive[10]. In addition, the models used so far run at quite coarse resolution (~1° in the atmosphere at least) and may be inappropriate to resolve and represent the complex processes linking high- to mid-latitudes.

Finally, the communication of information from climate modellers to end-users (energy and transport managers, insurance companies, policymakers) has frequently been, if not overlooked, suboptimal. To ensure an optimal end-to-end climate service, the end-users and their needs should be identified. The complex information from ensemble climate model forecast should be made easier to visualize and interpret, and this information should be disseminated on appropriate platforms.

Objectives and overview of the action. The proposed action has four objectives, ranked from the most theoretical to most applied.

1. *Investigate the **intrinsic seasonal-to-interannual predictability** of a state-of-the art climate model*

The candidate will explore the predictability of severe winters given knowledge of the Arctic sea ice state, using the reference GCM EC-Earth (see details next page). The experiments will be conducted assuming that the truth is given by the model itself. This will give upper bounds, or theoretical levels, of the predictability that can be expected when turning to realistic predictions (objective 3).

2. *Implement a comprehensive **sea ice initialization scheme in EC-Earth***

An advanced sea ice data assimilation scheme (the ensemble Kalman filter, EnKF) will be implemented in EC-Earth. This will extend the initialization capabilities of EC-Earth which are currently focused on the ocean (sea ice initialization is considered in a simplistic way). The EnKF is a well-suited method for data assimilation in geophysical systems[11] and its interest for sea ice seasonal prediction has already been illustrated by the applicant[12] in a configuration close to the EC-Earth one.

3. *Produce **realistic retrospective and future seasonal-to-interannual climate predictions***

The applicant will perform and evaluate retrospective S2I predictions with sea ice and ocean initialization (see objective 2) for winters 1994-2014 (training period). He will run large ensembles (25 members) of simulations since the imprint of natural variability on atmospheric variables is large in the regions of interest[13]. He will evaluate model skill against various reanalyses and compare the reliability of predictions with those of traditional operational systems. He will finally issue realistic predictions for winters 2015-2018.

4. *Develop the tools to translate climate model output into an **appropriate risk-oriented language***

The candidate will integrate his scientific results into a more applied framework. Because the concept of *risk* in the non-academic sector is the counterpart of *probabilistic prediction* in climate science, a secondment of two months will be realized in a renowned reinsurance company with manifested interests in climate change and impacts[14]. Following a work plan that has already been discussed with the company, the candidate will develop the software to aggregate, transform and display outputs from ensemble simulations with EC-Earth in a language that is adapted to the insurance sector.

---

[9] (Honda, et al., 2009) (Peings, et al., 2013) (Screen, et al., 2014)
[10] (Gerdes, 2006)
[11] (Evensen, 2003) (Evensen, 2007)
[12] (Massonnet, et al., 2013) (Massonnet, et al., 2014)
[13] (Screen, et al., 2014)
[14] Munich RE, www.munichre.com

Research methodology and approach

The candidate will address each of the four objectives listed above sequentially but will make sure that the technical and computational skills are all in place whenever he enters into a new objective. Assuming that the contract relative to the present proposal will start in May 2015, he will have had already seven months of technical and scientific experience at the host institution (IC3) since he is moving there as a F.R.S.-FNRS Post-doctoral Fellow in October 2014. This will allow working on the present project without delay and following the proposed schedule. Details on the practical implementation of the four objectives presented above are as follows:

1. *Intrinsic seasonal-to-interannual predictability (Work Package 1)*

   a. EC-Earth[15] is a world-leading climate model that includes the most recent developments in ocean, atmosphere, vegetation and sea ice physics. It runs at a cutting-edge high resolution (1/4° in the ocean, down to 30 km in the atmosphere) and allows for an accurate representation of the dynamical processes connecting high- and mid-latitudes. The applicant will analyze an existing long (100 yr) EC-Earth pre-industrial simulation and develop a simple metric for characterizing the extreme nature of winters (winter severity index, WSI), aggregating the information of near-surface air temperatures, wind speeds and snowfall between December and February inclusive. He will identify, in the simulation, the three most extreme winters of the time series (when the WSIs averaged over Europe are the largest). Working under pre-industrial conditions excludes the possible interference of a long-term, forced trend with the signal that is to be detected.

   b. The applicant will then examine to what extent the extreme winters identified in a. are predictable a season, a year or two years ahead, assuming perfect model physics but slightly imperfect initial sea ice conditions. To this end, he will launch five streams of ensemble (25 members) simulations started the 1st of October (end of the sea ice melt season) before the winter of interest, the 1st of October one year before the winter of interest and two years before the winter of interest. Each member will start from modified sea ice initial conditions, by superimposing random perturbations on the sea ice restart file (the ocean and atmosphere restart files will be identical). He will measure the prognostic potential predictability[16] (PPP) of the ensemble as a function of lead time for surface air temperature and cumulative snowfall in Europe. He will also establish the capability of EC-Earth to reproduce the extremeness of the winter of interest by comparing, for each stream of experiments, the statistical distribution of the WSI as simulated by the ensemble and the reference one.

   c. In order to establish the physical mechanisms that could transport predictability from high- to mid-latitudes, the PPP of intermediary variables such as the waviness of the jet stream, the geopotential height of several pressure levels or the sea ice-atmosphere fluxes, will be traced back. This will emphasize the relevant processes that contribute to sustain memory in the system.

2. *Sea ice initialization scheme in EC-Earth (Work Package 2)*

After the theoretical prediction levels of predictability have been estimated, the candidate will prepare the transition to realistic predictions. In current operational S2I forecasting systems, the ocean state is initialized, but the sea ice initialization is rarely considered (or when it is, in a simplistic way). On top of that, a critical issue in near-term climate prediction is to maintain a physical balance in the initial state, i.e. ensuring that no initial shock occurs in the first time steps of the prediction, which would immediately ruin the prediction skill. This is a particularly relevant issue when initializing the thin and responsive sea ice layer. The candidate will perform the sea ice data assimilation with EC-Earth in *coupled* mode while relaxing the oceanic state towards reanalyses as is currently done in the model. This setup will ensure a consistent and balanced initialization of the sea ice state, compatible at all times with the oceanic state. No data assimilation will be applied in the atmosphere, which will adapt rapidly to the ocean and sea ice states owing to its much faster timescales. Both sea ice concentration and thickness will be assimilated, and an ensemble of 25 members will be propagated in time. It is expected that the chaotic nature of the atmosphere will be sufficient to maintain ensemble spread. If

---

[15] (Hazeleger, et al., 2010)
[16] (Pohlmann, et al., 2004)

this is not the case, critical parameters affecting the atmosphere-sea ice coupling, such as the atmospheric drag parameter, will be perturbed.

3. Realistic retrospective forecasts and future predictions (Work Package 3)

a. The set of 25 members evolving during the data assimilation stage (objective 2.) can be used, at all times, as an ensemble of oceanic and sea ice initial conditions for S2I predictions. Retrospective predictions of wintertime conditions, initialized the 1st of October of each year between 1993 and 2014, will first be conducted for lead times of 6 and 18 months. The skill of the ensemble will be assessed against the ERA-Interim atmospheric reanalyses for the mean December-February near-surface air temperature and snowfall, but also the WSI metric developed in 1a., using probabilistic metrics such as the Brier skill score[17]. The skill of these retrospective predictions will be compared to (1) the skill of EC-Earth with simple initialization (from climatological restarts), and (2) the skill of models issuing predictions in the framework of the European SPECS[18] project, coordinated by the host institution IC3.

b. The candidate will, in a second step, identify and examine EC-Earth's systematic biases for the key atmospheric variables identified in 3a., compared to the best reanalyses available. He will complete the set of S2I predictions for the winters 2014-2018 (initialized in 2014 and 2015) and bias-correct them. Both biases in the mean and in the variance (spread of the ensemble) will be accounted for. The classical procedures of bias correction assume that model errors are stationary; the candidate will therefore investigate the sensitivity of the results by applying his method over different periods.

4. Communication to non-academic sectors (Work Package 4)

The applicant will join the Corporate Climate Centre of the Munich RE group in München, Germany, for a period of two months.

a. He will first identify, jointly with the operational division of Munich RE, the needs of the company: which (combination of) variables are needed, and at which space and time frequency this is required. It is likely that the requirements will be incompatible with the standard outputs of EC-Earth. As a simple example, the climate model temperatures are meaningless if one wishes to quantify how humans feel "coldness". Wind-chill temperatures (accounting for the effect of wind speed) are, in this respect, much more appropriate.

b. He will develop a suite of scripts to successively read the EC-Earth ensemble predictions, transform the standard variables into the variables of interest for the practical purposes and display the probabilistic information in an appropriate language. He will produce, for the 2014-2018 period, maps of risks associated to extreme winter conditions in Europe based on the output obtained in 3b.

<u>Originality and innovative aspects of the programme</u>

Seasonal-to-decadal prediction has been identified as a high-priority research area by the World Climate Research Programme[19]. The Intergovernmental Panel on Climate Change (IPCC) devoted part of a chapter to this topic in its 2013 assessment report. The reliability of climate forecasts at these strategic timescales is indeed crucial for better planning of human activities in response to climate change. The emerging results are, so far, convincing for the prediction of large-scale averaged quantities, such as the annual mean global surface temperatures[20]. Nonetheless, human societies are more vulnerable to changes in climate variability and extremes than changes in averages[21]. Therefore, at least three directions − which make the backbone of this proposal− should be further explored:

---

[17] (Brier, 1950)
[18] « Seasonal-to-decadal climate Prediction for the improvement of European Climate Services » (EU FP7 project).
[19] http://www.wcrp-climate.org/
[20] (Doblas-Reyes, et al., 2013) (Smith, et al., 2013) (Guemas, et al., 2013)
[21] (Katz, et al., 1992)

1. ***The initialization should extend beyond the ocean****.* The role of the ocean on decadal climate variability and its predictability has become clear over years. Faster climate components ruling shorter-term variability have received less attention so far. Their initialization could provide additional skill in some cases. This project makes a novel and ambitious step into this direction.

2. ***Larger ensembles should be run at higher resolutions****.* Climate exhibits marked variability in the European sector. A large ensemble of simulations is therefore necessary to avoid under-sampling, detect extremes and extract a relevant signal from the background noise. In addition, the processes connecting high- to mid-latitudes are complex and require sufficient resolution to model them accurately. The GCM, the size of ensemble simulations and the computational infrastructures mobilized for this project meet these high-standard requirements.

3. ***The climate information should reach users who need them most****.* The communication of information from climate model output to end-users (energy and transport managers, insurance companies, policymakers) is often neglected. To ensure optimal end-to-end service, the project develops a strong inter-sector dimension and proposes to make the complex information from ensemble climate model forecast easier to visualize, use and understand for a specific non-academic sector.

2.2 Clarity and quality of transfer of knowledge/training for the development of the researcher in light of the research objectives

The candidate (F. Massonnet), his former research environment (Université catholique de Louvain; PhD supervisors Profs T. Fichefet and H. Goosse) and the host institution (IC3; supervisor Prof. F. J. Doblas-Reyes) have been in regular contact since 2009. They are part of the EC-Earth consortium and are involved jointly in the preparation of a H2020 project (PRIMAVERA). The candidate undertook a one-week scientific visit to IC3 in 2013. He is also in the local organizing committee (along with IC3 scientists) of the Polar Prediction Project's *Polar-Lower Latitude Workshop* (Barcelona, Dec. 2014).

<u>Host expertise in training experienced researchers</u>

Exposure to the highly dynamic research environment at the IC3 will allow the applicant to hugely advance his maturity and widen his research interests and intellectual curiosity. The project content, and the applicant profile, will place him in the ideal condition to take full advantage of all benefits and expertise that IC3 has to offer. Moreover, under the guidance of Prof. Doblas-Reyes he will advance his knowledge in climate dynamics, variability and prediction by means of an individual personalized action. The formative background of Prof. Doblas-Reyes is very extensive and has demonstrated a very successful experience in training postdoctoral scientists. Postdoctoral researchers at IC3 have published a high number of scientific papers, wrote numerous successful research and computing grants, and substantially advanced their careers. Many of them are now widely recognized as promising scientists in Europe and beyond, and have efficiently expanded their networks of international collaborators while being postdoctoral scientists at IC3. To date the applicant has shown to be an enthusiastic and ambitious researcher and he will certainly exploit at the best the opportunity offered by the EF fellowship.

<u>Potential for the applicant to transfer knowledge to the host organization</u>

The IC3 will reciprocally benefit from the recognized expertise of the applicant in sea ice modelling, data assimilation, and the development of various metrics to evaluate climate model performance. The candidate is currently the contact person in the EC-Earth consortium for the sea ice component of the model. His presence at IC3's premises (where EC-Earth is run extensively) will hugely facilitate the interpretation of model results in the polar regions, in particular for long-term projections since he was contributing author of the fifth assessment report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) Working group I Assessment Report (chapter 12). The candidate will be a key person bridging his former (UCL) and future (IC3) host institutions.

2.3   Quality of the supervision and the hosting arrangements

<u>Qualifications and experience of the supervisor</u>

Prof. Doblas-Reyes is a Research Professor at ICREA (Institució Catalana de Recerca i Estudis Avançats) and the leader of the Climate Forecasting Unit (CFU). He is extremely well regarded in the field, having received in 2006 the Norbert Gerbier-MUMM International Award of the World Meteorological Organization, and is a lead author of chapter 11 "Near-term Climate Change: Projections and Predictability" in the 5th IPCC report. Prof. Doblas-Reyes obtained his Ph.D. in Physics with honours at the Universidad Complutense of Madrid (Spain) in 1996. His thesis was on atmospheric blocking simulation and associated precipitation patterns. He then moved to the Centre National de Recherches Météorologiques (CNRM, Météo-France, France) for a first postdoc of two years. This period was followed by another postdoc of one year at the Instituto Nacional de Técnica Aerospacial (INTA, Spain) in 1999, before moving to the European Centre for Medium-Range Weather Forecasts (UK), where he worked on seasonal climate forecasting in two groundbreaking European projects, the "Development of a European Multimodel Ensemble system for seasonal to inTERannual prediction" (DEMETER: http://www.ecmwf.int/research/demeter/) and the "Ensembles-Based Predictions of Climate Changes and Their Impacts" (ENSEMBLES: http://www.ensembles-eu.org/). Both projects led to the development of operational products on climate prediction and risk estimates. Prof. Doblas-Reyes has been working at IC3 since 2009. He is a member of several international scientific committees (e.g. co-chair of the Working Group on Seasonal-to-Interannual Prediction and Decadal Climate Prediction Panel of the World Climate Research Programme; Polar Prediction Project of the World Weather Research Programme; European Climate, Observations and Modelling for Services panel of the European Commission; European Network for Earth System Modelling High-Performance Computing Task Force), and over the course of his career he has organized and been part of scientific committees of a number of international meetings. Prof. Doblas-Reyes is a prominent researcher in the fields of climate dynamics and climate prediction with excellent proven project management skills. Besides a long list of more than 100 scientific peer-review papers with high citation impact, this is also demonstrated by the fact that Prof. Doblas-Reyes is currently leading numerous projects at the CFU, mostly funded by the European Commission, the Spanish Ministerio de Economía y Competitividad and some private partners. He is actively collaborating with climate research institutions in three continents, like ECMWF, KNMI, SMHI, Met Office, CERFACS, Météo-France, NOAA, APCC, CPTEC and IPSL, among other less frequent collaborations.

<u>Hosting arrangements</u>

IC3 is organized in research units and laboratories with a high-profile and experienced senior scientist leading the research lines and ensuring that the training and integration of the researcher into his/her team takes place according to the strict rules applied to all the CERCA centres. All newcomers are thus incorporated into the main stream of the research activities of the corresponding group, where team work, transparency and coordinated organization is at the core of the working practices from the beginning of his/her stage.

The applicant will become part of the CFU to contribute to the forecast initialization activity. The first stages of the stay will require the applicant 1) to join in the unit's periodic meetings, which take place at least once a week, 2) an in-depth reading of the CFU wiki repository (http://ic3cfu.wikispot.org) where all the relevant technical and scientific information for the unit's activities is stored and regularly updated, 3) to engage in the monthly descriptions of the state of the climate system during the previous month, an activity that the CFU members regularly prepare as a continuous training in climate variability and prediction for both the IC3 staff and the climate scientists in Barcelona and 4) attend the training courses in supercomputing and efficient programming held by the supercomputing team of the CFU, at the different Barcelona universities and the Barcelona Supercomputing Centre. The applicant will be supervised during his whole stage by Prof. Doblas-Reyes, becoming part of the group of junior scientists that are members of the CFU. The mentoring will include not only a thorough training in global climate science and climate prediction, but have a strong component oriented towards gaining experience in competitive fund- and computing time-raising, participation in international committees and organization of scientific meetings. Besides, the applicant will be exposed to the activities of the climate services group at IC3, which work on the delivery of climate information to a wide range of stakeholders on aspects like temperature-related human health and climate-sensitive energy yield and consumption.

2.4   Capacity of the researcher to reach and re-enforce a position of professional maturity

Despite his young age (28) and short career (PhD in 2014 under the guidance of Profs. T. Fichefet and H. Goosse), the candidate François Massonnet has already a very good presentation and publication record, and some of his achievements were prized. His work is well cited and he is has already participated to several trans-national research projects, including the EU FP7 COMBINE project, the EC-Earth project and the IPCC 5th assessment report. Exposure to IC3 will guarantee to maintain the high pace of scientific productivity that he has demonstrated during his PhD, while confronting him with practical realities such as project management from head-to-tail and engagement with non-academic sectors. The quick-learning character of the applicant, his ability to make connections between different research fields as well as his recognized human qualities will allow him to take the best advantage of the 24 months of the fellowship and integrate the new research teams rapidly. This will eventually place him in favourable position to engage a fruitful scientific career afterwards, and increase severely his chances to reach a permanent academic position in Europe.

3.   Impact

3.1   Enhancing research- and innovation-related human resources, skills, and working conditions to realise the potential of individuals and to provide new career perspectives

The next stream of worldwide climate research programmes will need to include multi-disciplinary and trans-sectorial approaches: the outcome of scientific projects can no longer be restricted to the scope of the scientific community alone. The present proposal anticipates this trend and maximizes the impacts that the candidate's research will have (1) on his own career and his research environment through an ambitious (pp. 6-7) but well-structured (pp. 11-13) implementation plan, (2) on the non-academic sector, through a secondment in a reinsurance company, and (3) on the European society through frequent interactions with the popular media and non-scientists (see the measures below).

3.2   Effectiveness of the proposed measures for communication and results dissemination

<u>Communication and public engagement strategy of the action</u>

European Researcher's Night (month 17). A short (~5 min) movie will be edited by the candidate and broadcasted during the European Researcher's Night 2016. He will put the focus on the concept of *ensemble* predictions, why such methods are important in climate science and how relevant information can be extracted from these ensembles. He will pay particular attention to data visualization by exporting the EC-Earth output files into a format that can be read by the software Google Earth – he is already familiar with this technique.

IC3 Open Lab Day (month 22). Near the end of his contract, the applicant will schedule and coordinate the organization of an Open Lab Day at IC3 in the framework of the European Network of Living Labs (http://www.openlivinglabs.eu/). Three central themes central at IC3 will be approached: high-performance computing, climate variability and climate services. Popularized talks will be given by senior scientists to replace the importance of IC3 services for the European society. A guided tour will be organized at the MareNostrum (high performance computing facilities) in the afternoon, followed by a poster session where researchers will present their topics of research in an accessible way. The event will be advertised by IC3 and by its close institutional partners: the *Universitat de Barcelona*, the *Departament d'Economia i Coneixement* and the *Departament de Territori i Sostenibilitat*.

<u>Dissemination of the research results</u>

The researcher's results will be disseminated on both scientific and public platforms. The candidate is expected to publish three major articles as first author in international and peer-reviewed journals. He will participate on a regular basis (at least four times a year) to international conferences with abstract selection and workshops where he will present his results as oral communications, preferably. In addition, he plans to spend one month as a scientific visitor at the ECMWF and the MetOffice (UK) and one month at the NCAR (Boulder, USA), three other renowned centres in the field of seasonal-to-interannual climate prediction.

As he has already done during his PhD, the candidate will maintain an up-to-date personal website with videos of his performances and easy visualisation of his key results (examples can be found here: www.climate.be/u/fmasson). Besides, the researcher will distribute press releases when one of his article has been published, in order to broadcast in an accessible language some of his key results.

<u>Exploitation of results and intellectual property</u>

The **model output** generated during the realization of the data assimilation, and the climate predictions, will remain the property of the host institution IC3 but will be shared with all interested scientists upon requests. If there is enough interest, these simulations will be moved to IC3's external data node for public dissemination. The **scientific output**, including scientific articles, will be made open to public ("open acess") whenever it is possible, in order to enhance sharing, knowledge and exploitation. The **software** created during the secondment at Munich RE will remain the property of the candidate but open access to the source code will be granted to the company.

4.   Implementation

4.1   Overall coherence and effectiveness of the work plan

The projects consists in 4 Work Packages (described pp. 6-7). **The Gantt Chart (next page)** provides an overview of how these WPs are laid out, which output is expected, how the researcher will exploit inter-sector and international mobility and how, when and where he will disseminate the results.

4.2   Appropriateness of the management structure and procedures, including quality management and risk management

<u>Project organisation and management structure</u>

The project will be managed through weekly meetings to ensure full coherence between the applicant's research and the general objectives of the unit. At all meetings with the supervisor, Prof. Doblas-Reyes, the advancements of the applicant's research will be discussed and the supervisor will provide adequate mentoring in the general background of the climate prediction and adapt the research programme to the difficulties encountered and to make progress in the most promising aspects of the research undertaken. Regular meetings will take place involving the rest of the CFU members to ensure an adequate integration of this activity into the rest of the research carried out in the CFU. Periodic written reports detailing the progress and the issues raised during the development of the research plan will be prepared and stored to monitor the evolution. The applicant will have freedom to manage the fellowship research funds and will have all the required autonomy and all the necessary support for applying for research and computing projects during his stage at IC3. Specifically, IC3 has additional mechanisms of compensation to encourage all research staff to bring in external funding for their research by means of access to management of overheads and well-defined promotional procedures.

<u>Risks that might endanger reaching project objectives and, if applicable, contingency plans</u>

The host institution and the candidate are aware that running large ensemble simulations at high resolution requires considerable computing time. The HPC infrastructure at IC3 and that of its partners should be appropriate to handle such a task. Should this not be the case, the candidate will focus the ocean-sea ice data assimilation and the climate forecasts on specific test cases: retrospective predictions of the extreme winters 2009-2010 and 2010-2011, and future predictions for 2014-2018.

4.3   Appropriateness of the institutional environment (infrastructure)

<u>IC3 – Legal entity and main tasks</u>

The IC3 was established in July the 29th 2008 as an independent, non-profit foundation by the University of Barcelona and the Catalan Government. Members of the institution are participating in core activities of the United Nations World Climate Research Programs (WCRP) or the elaboration of

the IPCC Fourth and Fifth Assessment Report published in 2007 and 2013, respectively. IC3's mandate consists in becoming a leading international centre for climate research in Europe, with a regional focus on the Mediterranean area, and in providing quality climate information to society and stakeholders through cutting-edge research, education and the development of applications and tools for assessing current and future climate-related risks.

IC3's main end is to evaluate, understand, and predict climate variability and change at both global and regional scales, and simulate how this former generates and modulates variability and change in societies and ecosystems. The topic of this proposal fits extremely well on the scientific goals of the IC3, ensuring the successful implementation of the project and the continuity of the fellow career development.

The CFU, one of the research units of the IC3, undertakes research on the development and assessment of dynamical and statistical methods for the prediction of global and regional climate on time scales ranging from a few weeks to several years. Sources of predictability and processes at the origin of model error play a major role in the assessment. The formulation of the predictions includes the development and implementation of techniques to statistically downscale, calibrate and combine dynamical ensemble and simple statistical forecasts to satisfy specific user needs. The CFU is composed by a core team of 1 senior scientist, Prof. Doblas-Reyes, 1 junior scientist, 6 postdocs, 3 PhD students, 1 master student, 1 project manager, 4 climate services officers, 3 software engineers, and 1 system administrator.

<u>Adequacy of infrastructures</u>

In the context of climate sciences and computing sciences, the cutting-edge research question is to explore the characteristics of climate change and variability, its impacts and other related phenomena in an optimum time scale by using advanced simulation and modelling tools and techniques. Thanks to IC3 infrastructures and unique human resources (a ratio of one technician for every two researchers) the CFU can run state-of-art regional seasonal-to-decadal ensemble climate prediction system.

The IC3 cluster is made of 48 homogeneous server blades. Each server blade has two "quadcore" processors, 48 GB main memory, 146 GB disk space and fast network interconnect (Infiniband). In order to share data (model code, input data and output data) among computing nodes, there is an I/O node which comprises 48 disks of 1 TB each. In short, the computing cluster has 384 cores, 8.81 TB memory (RAM) and 55 TB of shared disk capacity. Moreover, the cluster has 97.2 TB tape backup capacity. Thanks to many national and international partnerships with high-performance computing centers, the CFU is able to run state-of-the art climate models with a sufficient number of ensemble members. Available computing time worth more than 1 M€ just in electricity costs have been obtained on the following institutions and programmes 1) Red Española de Supercomputación (RES); 2) PRACE Tier 0 and 1 (platforms in Sweden, Spain and the UK); 3) European Centre for Medium-Range Weather Forecasts (ECMWF); 4) INCITE (US DoE's programme, offering computing time on Titan). The remaining resources are obtained from the IC3 cluster (around 10% of the total computing time used).

A local data storage with 0.5 PB of capacity with high availability and replication is available, as well as a set of associated computing nodes for post-processing (fat nodes). The local storage hosts at this stage a unique set of global climate predictions performed by IC3 in research mode and operationally by global producing centers around the world. A comprehensive dataset including observations and re-analyses is also available to the CFU members. All these datasets are regularly brought up to date.

4.4 *Competences, experience and complementarity of the participating organisations and institutional commitment*

The H2020 EU Framework programme has identified adaptation to climate change as a key research line of the *Climate action, environment, resource efficiency and raw materials* societal challenge. The present research proposal emphasizes that grand societal challenges are often paired with complex scientific questions. That climate models will become more reliable over time makes little doubt; how to design the appropriate simulations, extract the relevant information and turn model predictions into an adapted language, can however only be achieved through intense mixing of the host institution experience, the researcher ambition and the partner organization's interests. If awarded, this project will be another example of the leading vision of Europe in the climate research area.

Gantt Chart - PredEx

	2015								2016													2017		
Indicative month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Month	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
Work Package	1a	1a	1b	1b	1b	1b	1c	2	2	2	2	3a	3a	3a	3a	3a	3a	3a	3b	3b	3b	3b	4a	4b-c
Deliverable							Art.				Tech rep.							Art.				Art.		Soft.
Milestone		Metrics done		Simu 1b done			Analysis 1b done		EnKF stable			Assim done				Simu 3a done		Analysis 3a done			Simu 3b done	Analysis 3b done		
Secondment/ scientific visit													ECMWF & MetOffice							NCAR			Munich RE	Munich RE
Conference / workshop					ECE			AGU		ECE		EGU					ECE			AGU		ECE		
Dissemination / Public Engagement																	EU Research night					IC3 Open Lab Day		

Summary of research plan (see the text for details, pp 6-7)

WP1 Intrinsic seasonal-to-interannual predictability of EC-Earth

  1a: Design winter severity index

  1b: Examine seasonal-to-interannual predictability of extreme winters (perfect model assumption)

WP2 Sea ice initialization in EC-Earth

WP3 Realistic retrospective forecasts

  3a: Realization of 1993-2014 seasonal-to-interannual predictions + skill assessment + comparison to other prediction systems

  3b: Evaluation of EC-Earth systematic biases + 2014-2018 seasonal-to-interannual predictions

WP4 Communication to non-academic sectors

  4a: Atlas of needs from the Munich RE company (partner organization)

  4b: Development of software interface EC-Earth/Munich RE

Art. = Article in peer-reviewed international journal   A/EGU=American/European Geophysical Union's General Assembly

Tech. Rep. = Technical report; Soft. = Software release   ECE=EC-Earth International meeting

STOP PAGE COUNT – MAX 10 PAGES

5. CV of the Experienced Researcher (max 5 p.)

PERSONAL INFORMATION
MASSONNET François
22nd of March, 1986
www.climate.be/u/fmasson

- **EDUCATION**

April 2014	**PhD in Sciences**. Supervisors: Profs T. Fichefet and H. Goosse. Georges Lemaître Centre for Earth and Climate Research Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium
2009	**Master in civil engineering** *(highest honours)* Major: Applied mathematics; minor: geography. Ecole Polytechnique de Louvain, Université catholique de Louvain, Louvain-la-Neuve, Belgium.
2007-2008	**1-year exchange** at the Simon Fraser University, Vancouver, Canada (Mercator Programme)

- **EMPLOYMENT**

2014 (Oct.)	F.R.S.-FNRS Post-doctoral Researcher Georges Lemaître Centre for Earth and Climate Research Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium
2010-2014 (Sept.)	F.R.S.-FNRS Research Fellow Georges Lemaître Centre for Earth and Climate Research Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium
2009-2010	Teaching and Research Assistant in Physics Georges Lemaître Centre for Earth and Climate Research Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium

- **RESEARCH INTERESTS**
  Seasonal-to-decadal predictability and prediction, the role of sea ice in the climate system, data assimilation, climate model evaluation, high- to mid-latitude teleconnections

- **PUBLICATIONS**

  Articles in preparation

1. **F. Massonnet**, T. Fichefet, H. Goosse, M. Vancoppenolle, D. Notz, C. M. Bitz, *The response of Arctic sea ice to a global forcing in a simple model*, in preparation for a note in The Cryosphere
2. P. Hezel, H. Goosse, C. Bitz, **F. Massonnet**, T. Fichefet, *Recent Arctic sea ice loss from the perspective of a Rapid Ice Loss Event (RILE) using CMIP5*, in preparation for Nature

Geoscience

3. N. Steiner, C. Deal, D. Lannuzel, D. Lavoie, **F. Massonnet**, L. Miller, S. Moreau, E. Popova, J. Stefels, L. Tedesco, *What sea-ice biogeochemical modellers need from observationalists*, in preparation for Elementa

4. A. Bellucci, R. Haarsma, N. Bellouin, B. Booth, C. Cagnazzo, B. van den Hurk, N. Keenlyside, T. Koenigk, **F. Massonnet**, S. Materia, M. Weiss, *Advancements in decadal climate predictability: beyond the ocean*, in preparation for Review of Geophysics

Articles submitted

5. **F. Massonnet**, H. Goosse, T. Fichefet, 2014, *Prospects for better seasonal Arctic sea ice predictions from multivariate initialization*, submitted to Ocean Modelling.

6. O. Lecomte, T. Fichefet, **F. Massonnet**, M. Vancoppenolle (2014). *Benefits from representing snow properties and related processes in coupled ocean - sea ice models*, submitted to Ocean Modelling

Articles published

7. P. J. Hezel, T. Fichefet, **F. Massonnet**, 2014, *Modeled Arctic sea ice evolution through 2300 in CMIP5 extended RCPs*, **8** 1195-1204, doi:10.5194/tc-8-1195-2014.

8. **F. Massonnet**, H. Goosse, T. Fichefet, F. Counillon, 2014 *Calibration of sea ice dynamic parameters in an ocean-sea ice model using an ensemble Kalman filter*, Journal of Geophysical Research, **119**, doi:10.1002/2013JC009705.

9. O. Lecomte, T. Fichefet, M. Vancoppenolle, F. Domine, **F. Massonnet**, P. Mathiot, S. Morin, P. -Y. Barriat, 2013, *On the formulation of snow thermal conductivity in large-scale sea ice models*, Journal of Advances in Modeling Earth Systems, **5**, doi:10.1002/jame.20039

10. **F. Massonnet,** P. Mathiot, T. Fichefet, H. Goosse, C. König Beatty, M. Vancoppenolle, T. Lavergne, 2013, *A model reconstruction of the Antarctic sea ice thickness and volume changes over 1980-2008 using data assimilation*, Ocean Modelling, **64** 67-75, doi:10.1016/j.ocemod.2013.01.003

11. V. Zunz, H. Goosse and **F. Massonnet**, 2013, *How does internal variability influence the ability of CMIP5 models to reproduce the recent trend in Southern Ocean sea ice extent?*, The Cryosphere, **7** 451-468.

12. P. Mathiot, C. König Beatty, T. Fichefet, H. Goosse, **F. Massonnet**, M. Vancoppenolle, 2012, *Better constraints on the sea-ice state using global sea-ice data assimilation*, Geosci. Model Dev., **5** 1501-1515.

13. **F. Massonnet**, T. Fichefet, H. Goosse, C. M. Bitz, G. Philippon-Berthier, M. M. Holland, P. -Y. Barriat, 2012, *Constraining projections of summer Arctic sea ice*, The Cryosphere, **6** 1383-1394.

14. P. J. Hezel, X. Zhang, C. M. Bitz, B. P. Kelly and **F. Massonnet**, 2012, *Projected decline in spring snow depth on Arctic sea ice caused by progressively later autumn open ocean freeze-up this century*, Geophys. Res. Lett., 39, L17505, doi:10.1029/2012GL052794

15. **F. Massonnet**, T. Fichefet, H. Goosse, M. Vancoppenolle, P. Mathiot, and C. König Beatty, 2011, *On the influence of model physics on simulations of Arctic and Antarctic sea ice*, The Cryosphere, **5** 687-699.

Proceedings of Conferences

16. **F. Massonnet**, T. Fichefet, H. Goosse, P. Mathiot, C. König Beatty, M. Vancoppenolle, *Comparative study of sea ice response from NEMO-LIM3 to two atmospheric forcings*, in *Proceedings of the IPY Belgian Symposium*, 100 pp., 2010.

Other publication

17. **F. Massonnet**, A. Jahn, *Observational needs for sea ice models* (2012), Summarizing note for

participants to a 2-day CLIC Arctic Sea ice workshop held in Boulder, USA, 31st Oct.-1st Nov. 2012.
http://www.elic.ucl.ac.be/modx/users/fmasson/obs_CLIC_note.pdf

Referee for
- Journal of Climate
- Geophysical Research Letters
- Journal of Geophysical Research
- Journal of Physical Oceanography
- The Cryosphere

- **CITATION STATISTICS**
  Number of citations: 117
  H-index: 5
  I10-index: 4

  (source: Google Scholar, 5th of September, 2014)

- **ORAL/POSTER PRESENTATIONS (all available at www.climate.be/u/fmasson)**

1. **(ORAL, INVITED)** *Data assimilation in sea ice modeling* (Seminar in the LEGI/LGGE teams, Grenoble, July 2014).
2. **(ORAL)** *Future of the Louvain-la-Neuve sea ice model* (NEMO Users meeting, Grenoble, July 2014).
3. **(ORAL, INVITED)** *Data assimilation with sea ice models* (SIPN Workshop, NCAR, Boulder, April 2014).
4. **(ORAL)** *Constraining projections of summer Arctic sea ice* (IGS symposium on sea ice in a changing environment, Hobart, March 2014)
5. **(ORAL)** *Modelling recent and future sea ice changes* (Belgium National Committee for Antarctic Research, Brussels, December 2013).
6. **(ORAL)** *Calibration of sea ice dynamic parameters* (Scientific visit at IC3, Barcelona, December 2013).
7. **(ORAL)** *Modeling recent and future sea ice changes - An assessment of COMBINE/CMIP5 results* (COMBINE Final General Assembly, Wageningen, October 2013).
8. **(ORAL)** *Ensemble Kalman filter in sea ice modeling.* (IICWG Workshop, Bremen, May 2013).
9. **(ORAL)** *Climate change and computational compromises* (CÉCI annual scientific meeting, Namur, April 2013).
10. **(ORAL)** *Constraining projections of summer Arctic sea ice* (EGU General Assembly, Vienna, April 2013).
11. **(ORAL, INVITED)** *Changes in Southern Ocean sea ice thickness and volume reconstructed with data assimilation* (EGU General Assembly, Vienna, April 2013)
12. **(POSTER)** *Ensemble sea ice data assimilation with NEMO-LIM* (EGU General Assembly, Vienna, April 2013).
13. **(ORAL)** *21st century changes in the Arctic sea ice cover: what can we learn from CMIP5 models?* (3rd International Conference on Earth System Modelling, Hamburg, September 2012).
14. **(POSTER)** *Constraining projections of summer Arctic sea ice* (Climate Change in High Latitudes, Bergen, September 2012)
15. **(ORAL)** *Climate projections of Arctic sea ice: what can we learn from global models?* (MeteoClim, Liège, June 2012)
16. **(ORAL)** *The recent decadal variability of the sea ice cover as viewed from a numerical model* (UNITER, Brussels, December 2011).
17. **(ORAL)** *Sea ice modelling with LIM* (CLIC meeting, Boulder, October 2011)
18. **(POSTER AWARD, ORAL)** *A data assimilation approach for reconstructing sea ice volume in the Southern Hemisphere* (WCRP Open Science Conference, Denver, October 2011; Harmony on Ice meeting, Paris, November 2011; 3rd International Conference on Earth System Modelling, Hamburg, September 2012).

19. **(POSTER AWARD)** *What is the importance of sea ice physics in global simulations at decadal time scales?* (ResClim Summer School, UNIS, June2011; WCRP Open Science Conference, Denver, October 2011).
20. **(ORAL)** *Global sea-ice data assimilation in NEMO-LIM: towards systematic biases reduction in sea-ice concentration and thickness* (COMBINE General Assembly, MetOffice, May 2011).
21. **(ORAL)** *Importance of physics for global hindcast simulations of sea ice with NEMO-LIM* (EC-Earth meeting, ECMWF, January 2011 ; EGU General Assembly, Vienna, April 2011)
22. **(ORAL)** *Importance of physics, resolution and forcing in hindcast simulations of Arctic and Antarctic sea ice variability and trends* (WCRP Seasonal to Multi-decadal Predictability of Polar Climate, Bergen, October 2010).
23. **(ORAL, POSTER)** *Comparative study of sea ice response from NEMO-LIM3 to two atmospheric forcings* (EGU General Assembly, Vienna, May 2010; IPY Belgian Symposium, Brussels, May 2010; EC-Earth meeting, Barcelona, June2010).

- **PARTICIPATION TO (INTER)NATIONAL EFFORTS/PROJECTS**
  - Contributing author to the **International Panel on Climate Change (IPCC)** Working Group 1 Fifth Assessment Report, Chapter 12 (Long-term projections). The candidate processed and analyzed the CMIP5 sea ice data, participated actively to the analysis of this data and to the writing of the sea ice section.
  - Participation to the **EU FP7 COMBINE Project** (2009-2013): "Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection". The candidate was involved in the generation of sea ice initial states for decadal prediction, and in the analysis of these predictions, in two work packages.
  - Involvement in the **EC-Earth project**, as the reference contact for the Université catholique de Louvain.
  - Participation to the national project **PREDANTAR**: "Understanding and Predicting Antarctic Sea Ice variability at the decadal timescale".
  - Participation to the analysis of the 2014 **ARCUS Sea ice Outlook** (http://www.arcus.org/sipn/sea-ice-outlook/2014), an international effort aimed at collecting and analysing seasonal predictions of Arctic sea ice.

- **AWARDS**
  - ResClim Summer School Best Poster Award (2011)
  - WCRP Open Science Conference Best Poster Award (2011)

- **TRAINING**
  - **Short course in climate extreme analysis**, Hannover, Germany, August 2014
  - ResClim **summer school: the role of sea ice in the climate system**, Longyearbyen, Svalbard, June/July 2011

- **SCIENTIFIC APPOINTMENTS**
  - Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway (1 week in June 2013)
  - Catalan Institute of Climate Sciences (IC3), Barcelona, Spain (1 week in December 2013)

- **TEACHING ACTIVITIES**

2009-2014   Teaching Assistant in Physics, 1st year classes
2010-2014   Co-supervision of 3 master theses

(Université catholique de Louvain)

- **OUTREACH/DISSEMINATION**
  - Research highlighted in the media: newspapers, radio and TV interviews.
  - Active participation in outreach & dissemination activities at university and visit to high schools, including an extensive presentation of the European Commission FP7 COMBINE project for high school students in 2014.

- **OTHER SKILLS**
  Computing, hardware and software
  Programming: Fortran, Matlab, KornShell
  Operating Systems: Linux
  Editing: LaTeX, Office Suite
  Able to run complex models in parallel on supercomputers with SLURM/SGI
  Able to handle ensemble simulations and the analysis thereof

  Languages
  French   Mother tongue
  English   Fluent (written & spoken)
  Dutch   Good (written & spoken)

6.   Capacity of the Participating Organisations

Beneficiary IC3	
General Description	The Institut Català de Ciències del Clima (IC3, Spain) is funded by the Catalan government and aims at developing high-quality research on climate variability and its impacts. The Climate Forecasting Unit (CFU) undertakes research on the development of dynamical and statistical methods for the prediction of global and regional climate on time scales from a few weeks to several years.
Role and Commitment of key persons (supervisor)	Prof. Doblas-Reyes is a worldwide expert in the development of seasonal-to-decadal climate prediction systems and the head of CFU. He is involved in the development of the EC-Earth ESM since its inception. He was involved in the preparation of the IPCC Fifth Assessment Report (Working Group 1) as a lead author, serves in WCRP and WWRP scientific panels, has participated in more than 20 FP4 to FP7 projects, and is author of more than 90 peer-reviewed papers. He is coordinator of the FP7 project Seasonal-to-decadal climate Prediction for the improvement of European Climate Services (SPECS). He is shaping IC3's plans for the development of a climate services capability with a focus on the energy sector and contributes to the international Climate Services Partnership.
Key Research Facilities, Infrastructure and Equipment	A sizeable allocation in the IC3 linux cluster, as well as competitive computing allocations on a range of supercomputing platforms. Desktops with multi-core processors, fat nodes for post-processing and a mass storage system all under NFS.
Previous Involvement in Research and Training Programmes	IC3 has been playing a relevant national and international role in geosciences, mathematics, climate physics and ecology, as reflected through the participation of IC3 in 7 national projects, 3 private-funded projects, and 4 European projects (FLUXPYR INTERREG 2009, QWECI 243964 FP7-ENV-2009, VIROCLIME 243923 FP7-ENV-2009, INCLIDA 275505 FP7-PEOPLE-2010-IEF supervised by Prof. Doblas-Reyes). Professors at IC3 have been able to provide IC3 researchers with exceptional training support and conditions for their scientific growth in many different ways, including improvements in their scientific and management skills.
Current involvement in Research and Training Programmes	Currently IC3 is participating in 3 national projects, 2 private-funded projects and 9 European projects (CLIMRUN 265192 FP7-ENV-2010, INGOS 284274 FP7-INFRASTRUCTURES-2011, DENFREE 282378 FP7-HEALTH-2011, IS-ENES2 312979 FP7-INFRASTRUCTURES-2012, EUPORIAS 308291 FP7-ENV-2012, EUCLEIA 607085 FP7-SPACE-2013, PREFACE 603521 FP7-ENV-2013), among SPECS (308378 FP7-ENV-2012, Seasonal-to-decadal climate Prediction for the improvement of European Climate Services) coordinated by IC3, and 2 FP7-PEOPLE projects (TREE-RINGS & CLIMATE 253277 FP7-PEOPLE-2009-IOF and MEMENTO 300727 FP7-PEOPLE-2011-IOF). IC3 is in close collaboration with several universities (e.g. University of Barcelona, University of Heidelberg, University of Malawi, Universidad Complutense de Madrid) and their Master program and in the near future 6 theses are expected to be defended.
Relevant Publications and/or research/innovation products	- **Doblas-Reyes, F.J., I. Andreu-Burillo**, Y. Chikamoto, J. García-Serrano, **V. Guemas**, M. Kimoto, T. Mochizuki, **L.R.L. Rodrigues** and G. J. van Oldenborgh (2013) Initialized near-term regional climate change prediction. Nature Communications, 4, 1715, doi:10.1038/ncomms2704 - **Guemas, V.**, **F.J. Doblas-Reyes**, **I. Andreu-Burillo** and **M. Asif** (2013) Retrospective prediction of the global warming slowdown in the last decade. Nature Climate Change, 3, 649-653, doi:10.1038/nclimate1863. - B. Kirtman, S. Power, J.A. Adedoyin, G.J. Boer, R. Bojariu, I. Camilloni, **F.J. Doblas-Reyes**, A.M. Fiore, M. Kimoto, G.A. Meehl, M. Prather, A. Sarr, C. Schär, R. Sutton, G.J. van Oldenborgh, G. Vecchi and H.J. Wang (2013) Near-term climate change: Projections and predictability. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Ed. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley eds., Cambridge University Press.

Partner Organisation: Munich RE	
General description	Munich RE, founded in 1880, is the global leader in reinsurance. In the financial year 2013, the Group – which combines primary insurance and reinsurance under one roof had a premium income of over €51bn. It operates in all lines of insurance, with ~45,000 employees throughout the world. Munich RE is also a leader in the provision of insurance covers for losses caused by natural catastrophes. It hosts the world´s most comprehensive database on losses caused by natural disasters, currently documenting more than 35,000 events. These data show that about 90% of all losses since 1980 caused by natural disasters have been weather related (floods and storms) and thus potentially can be affected by climate change. Munich RE has been the first company worldwide to address climate change as a potential risk of change for its business already in 1973. Since the foundation of its "Geo Risks Research" department in 1974 Munich RE has built up expertise on the processes and trends of all kinds of natural perils. In 2008 the group has defined "Climate Change" as one of only two strategic topics and has founded the "Corporate Climate Centre", as the central coordinating and steering unit for all climate change related activities. Part of Munich RE´s business model also is "weather insurance", i.e. covering risks for e.g. utility providers or investors into renewable energies caused by unusual seasonal or interannual weather patterns.
Key Persons and Expertise	Prof. Peter Höppe, head of Geo Risks Research/Corporate Climate Centre (GRR/CCC) (supervisor of the applicant during the secondment)
Key Research facilities, infrastructure and equipment	Munich RE has two divisional units pertaining to natural hazards and related nat cat risks. Together there are some 30 people with an educational background in geosciences and related fields working in these units, some of them developing and maintaining nat cat risk models. Within the GRR/CCC Munich RE has in particular a research team focusing on hazard-relevant research topics, mainly on the atmospheric side. Munich RE does not run climate models. For risk modelling and model development, the company's computers are equipped with the appropriate softwares, such as Matlab, R, GIS systems, etc.
Previous and Current Involvement in Research and Training Programmes	Since long Munich RE has been engaging in collaborative projects with scientific facilities and input. For instance, the group had a cooperative project together with the Institute of Meteorology of the Freie Universitaet Berlin, with the Institute of Atmospheric Physics of the German Aerospace Center, with the London School of Economics and Political Science. P. Höppe is Professor at the Ludwig Maximilian University in Munich where he is involved in the training of scientists. Munich RE has been engaging in supervising PhD and master theses, and offers interns for students with a geo-science background.
Relevant Publications and/or research/innovation product	- Renggli, D., G.C. Leckebusch, U. Ulbrich, S.N. Gleixner, and E. Faust, 2011: The skill of seasonal ensemble prediction systems to forecast wintertime wind storm frequency over the North Atlantic and Europe. Monthly Weather Review, 139, 3052 - 3067. - Sander, J., J.F. Eichner, E. Faust, M. Steuer, 2013: Rising variability in thunderstorm-related U.S. losses as a reflection of changes in large-scale thunderstorm forcing. Weather, Climate, and Society, 5, 317 - 331. - Welker, C. and E. Faust, 2013: Tropical cyclone-related socio-economic losses in the western North Pacific region. Nat. Hazards Earth Syst. Sci., 13, 115 - 124.

7. Ethics Issues

Ethics is an integral part of research funded by the European Union within Horizon 2020. Compliance with the relevant ethics provisions is essential from the beginning to the end of the project.

Although research ethics is most developed within the context of medical research and life sciences, research ethics is of crucial importance for all scientific domains. Informed consent and confidentiality are as important for a sociological study as they are for clinical research. There is a strong connection between research ethics and human rights. Ethical research conduct implies the application of fundamental ethical principles to scientific research.

Applicants submitting research proposals for funding within Marie Skłodowska-Curie actions in Horizon 2020 should demonstrate proactively to the REA that they are aware of and will comply with European and national legislation and fundamental ethics principles, including those reflected in the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols. Applicants applying for funding should clearly identify ethics issues and proactively address them in their proposal.

The Ethics Review Procedure in Horizon 2020

All research proposals submitted to the European Commission are evaluated both on their scientific merit and on its ethical and social impact. When submitting a proposal to Horizon 2020, all applicants are required to complete an "**Ethics Issues Table (EIT)**". Applicants who flag ethics issues in the Ethics Issues Table have to complete in addition a more in depth **Ethics Self-Assessment**.

Please note that all proposals retained with a view of funding will be submitted to the Ethics Review procedure. A careful analysis and description of any potential ethics issues in a given proposal and a detailed self-assessment will help all actors involved to undergo the Ethics Review in an efficient manner without unnecessary delays.

Ethics Issues Table (EIT) in Part A

If you entered one or more ethical issue/s in the Ethical Issues Table in Part A of the proposal, you are asked to submit an Ethics Self-Assessment in Part B.

Please ensure that a careful analysis of any potential ethics issues which may arise in the proposed research is done **before** the Ethics Issues Table (EIT) is completed.

For more information, please consult the Ethics- section on the Research Participant Portal which comprises the **Ethics Self-Assessment Guidelines** and an Ethics-Issues-Table Checklist:

http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/ethics_en.htm

Ethics Self-Assessment in Part B

Once you have flagged an ethical issue in the Ethics Issues Table of Part A, the Ethics Self-Assessment in Part B must:

1) For each area flagged in the Ethics Issues Table, describe how the proposal meets:

- the EU legislation on Ethics (e.g. Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes, existing EU legislation on data protection and privacy etc.);
- national legislation and good practices on research ethics;
- ethical requirements of any TC where research raising ethical issues are to be carried out.

For more information on how to deal with Third Countries please see Article 34 of the Model Grant Agreement, as well as the following link:

http://ec.europa.eu/justice/data-protection/document/international-transfers/adequacy/index_en.htm

Please list the documents provided with their expiry date.

Ensure early compliance of the proposed research with EU and national legislation on ethics in research. Should your proposal be selected for funding, and if you have not done this already, you will be required to provide as soon as possible the following documents:

- an opinion from an Ethics Committee/Authority, required under national law;
- any other ethics-related documents mandatory under EU or national legislation;
- if you didn't apply for/ receive the ethics approval/ required ethics documents yet when submitting the proposal, please indicate in the proposal the approximate date when you will provide a missing approval/ any other ethics documents to the REA (scanned copy). Please state explicitly that you will not proceed to any research with ethics implications before the REA received a scanned copy of all documents proving compliance with existing EU/ national legislation on ethics.

If these ethics documents are not issued in English, you are requested to submit also an English summary (containing notably, if available, the conclusions of the Committee or Ethics Authority concerned).

If you plan to request these documents specifically for your proposed project, your request must contain an explicit reference to its title.

2) Explain in detail how you intend to address the ethics issues flagged in the Ethical Issues Table of Part A of your proposal, in particular with regard to:

- the research **objectives** (e.g. study of vulnerable populations like elderly people, sick or illiterate persons, cooperation with a Third Country, dual use, etc.);
- the research **methodology** (e.g. clinical trials, involvement of children and related information and consent/assent procedures, use of human tissues from blood banks, interviews with healthy adult volunteers, data protection and privacy issues related to data collected, etc.);
- the potential **impact** of the research (e.g. dual use issues, environmental damage, stigmatisation of particular social groups, political or financial retaliation, benefit-sharing, malevolent use, etc.).

References

Alexander Michael A. [et al.] The Atmospheric Response to Realistic Arctic Sea Ice Anomalies in an AGCM during Winter [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 2004. - 5 : Vol. 17. - pp. 890-905. - ISSN: 0894-8755.

Barnes Elizabeth A. [et al.] Exploring recent trends in Northern Hemisphere blocking [Journal] // Geophys. Res. Lett.. - 2014. - pp. 2013GL058745--. - ISSN: 1944-8007.

Barnes Elizabeth A. Revisiting the evidence linking Arctic amplification to extreme weather in midlatitudes [Journal] // Geophys. Res. Lett.. - 2013. - 17 : Vol. 40. - pp. 4734-4739. - ISSN: 1944-8007.

Brier G. W. Verification on forecasts expressed in terms of probability [Journal] // Monthly Weather Review. - 1950. - Vol. 78. - pp. 1-3.

Budikova Dagmar Role of Arctic sea ice in global atmospheric circulation: A review [Journal] // Global Planetary Change. - 2009. - Vol. 68. - pp. 149-163.

Cohen Judah [et al.] Recent Arctic amplification and extreme mid-latitude weather [Journal] // Nature Geosci. - [s.l.] : Nature Publishing Group, a division of Macmillan Publishers Limited. All Rights Reserved., 2014. - 9 : Vol. 7. - pp. 627-637. - ISSN: 1752-0894.

Cohen Judah L [et al.] Arctic warming, increasing snow cover and widespread boreal winter cooling [Journal] // Environmental Research Letters. - 2012. - 1 : Vol. 7. - p. 014007.

Deser Clara [et al.] The Effects of North Atlantic SST and Sea Ice Anomalies on the Winter Circulation in CCM3. Part II: Direct and Indirect Components of the Response [Journal] // Journal of Climate. - 2004. - Vol. 17. - pp. 877-889.

Deser Clara [et al.] The Seasonal Atmospheric Response to Projected Arctic Sea Ice Loss in the Late Twenty-First Century [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 2010. - 2 : Vol. 23. - pp. 333-351. - ISSN: 0894-8755.

Deser Clara, Tomas Robert A. and Peng Shiling The Transient Atmospheric Circulation Response to North Atlantic SST and Sea Ice Anomalies [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 2007. - 18 : Vol. 20. - pp. 4751-4767. - ISSN: 0894-8755.

Doblas-Reyes F. J. [et al.] Initialized near-term regional climate change prediction [Journal] // Nat Commun. - [s.l.] : Nature Publishing Group, a division of Macmillan Publishers Limited. All Rights Reserved., 2013. - Vol. 4. - pp. 1715--.

Evensen G. Data assimilation - The ensemble Kalman filter [Book]. - [s.l.] : Springer, 2007.

Evensen G. The ensemble Kalman filter for combined state and parameter estimation [Journal] // Control Systems, IEEE. - 2009. - 3 : Vol. 29. - pp. 83-104. - ISSN: 1066-033X.

Evensen Geir The Ensemble Kalman Filter: theoretical formulation and practical implementation [Journal] // Ocean Dynamics. - 2003. - Vol. 53. - pp. 343-367.

Fetterer F. [et al.] Sea Ice Index // Sea Ice Index. - Boulder, Colorado USA : [s.n.], 2012.

Francis J A The where and when of wetter and drier: disappearing Arctic sea ice plays a role [Journal] // Environmental Research Letters. - 2013. - 4 : Vol. 8. - pp. 041002--. - ISSN: 1748-9326.

Francis J. and Vavrus S. Evidence linking Arctic amplification to extreme weather in mid-latitudes [Journal] // Geophysical Research Letters. - 2012. - Vol. 39. - p. L06801.

Francis Jennifer A. [et al.] Winter Northern Hemisphere weather patterns remember summer Arctic sea-ice extent [Journal] // Geophys. Res. Lett.. - 2009. - 7 : Vol. 36. - pp. L07503--. - ISSN: 1944-8007.

Gerdes Rüdiger Atmospheric response to changes in Arctic sea ice thickness [Journal] // Geophys. Res. Lett.. - 2006. - 18 : Vol. 33. - pp. L18709--. - ISSN: 1944-8007.

Guemas Virginie [et al.] Retrospective prediction of the global warming slowdown in the past decade [Journal] // Nature Clim. Change. - [s.l.] : Nature Publishing Group, 2013. - 7 : Vol. 3. - pp. 649-653. - ISSN: 1758-678X.

Hazeleger Wilco [et al.] EC-Earth: A Seamless Earth-System Prediction Approach in Action [Journal] // Bulletin of the American Meteorological Society. - 2010. - 10 : Vol. 91. - pp. 1357-1363. - DOI: 10.1175/2010BAMS2877.1.

Honda Meiji [et al.] Dynamic and Thermodynamic Characteristics of Atmospheric Response to Anomalous Sea-Ice Extent in the Sea of Okhotsk [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 1999. - 12 : Vol. 12. - pp. 3347-3358. - ISSN: 0894-8755 DOI: 10.1175/1520-0442(1999)012<3347:DATCOA>2.0.CO;2.

Honda Meiji, Inoue Jun and Yamane Shozo Influence of low Arctic sea-ice minima on anomalously cold Eurasian winters [Journal] // Geophys. Res. Lett.. - 2009. - 8 : Vol. 36. - pp. L08707--. - ISSN: 1944-8007.

IPCC Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)]. // Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)].. - 2013. - Vol. in press. - Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jung Thomas [et al.] Arctic influence on subseasonal midlatitude prediction [Journal] // Geophys. Res. Lett.. - 2014. - 10 : Vol. 41. - pp. 3676-3680. - ISSN: 1944-8007.

Katz Richard W. and Brown Barbara G. Extreme events in a changing climate: Variability is more important than averages [Journal]. - [s.l.] : Kluwer Academic Publishers, 1992. - 3 : Vol. 21. - pp. 289-302--. - ISSN: 0165-0009.

Liu Jiping [et al.] Impact of declining Arctic sea ice on winter snowfall [Journal] // Proceedings of the National Academy of Sciences. - 2012. - pp. --. - DOI: doi:10.1073/pnas.1114910109.

Magnusdottir Gudrun, Deser Clara and Saravanan R. The Effects of North Atlantic SST and Sea Ice Anomalies on the Winter Circulation in CCM3. Part I: Main Features and Storm Track Characteristics of the Response [Journal] // Journal of Climate. - 2004. - Vol. 17. - pp. 857-876.

Massonnet F. [et al.] Calibration of sea ice dynamic parameters in an ocean--sea ice model using an ensemble Kalman filter [Journal] // Submitted. - 2014.

Massonnet F. [et al.] Constraining projections of summer Arctic sea ice [Journal] // The Cryosphere. - [s.l.] : Copernicus Publications, 2012. - 6 : Vol. 6. - pp. 1383-1394. - ISSN: 1994-0424.

Massonnet F. [et al.] On the influence of model physics on simulations of Arctic and Antarctic sea ice [Journal] // The Cryosphere. - 2011. - 3 : Vol. 5. - pp. 687-699. - DOI: 10.5194/tc-5-687-2011.

Massonnet F., Goosse H. and Fichefet T. Prospects for better seasonal Arctic sea ice predictions from multivariate data assimilation [Journal] // Submitted. - 2014.

Massonnet François [et al.] A model reconstruction of the Antarctic sea ice thickness and volume changes over 1980--2008 using data assimilation [Journal] // Ocean Modelling. - 2013. - 0 : Vol. 64. - pp. 67-75. - ISSN: 1463-5003.

Mathiot P. [et al.] Better constraints on the sea-ice state using global sea-ice data assimilation [Journal] // Geosci. Model Dev.. - [s.l.] : Copernicus Publications, 2012. - 6 : Vol. 5. - pp. 1501-1515. - ISSN: 1991-9603.

Overland James E. Atmospheric science: Long-range linkage [Journal] // Nature Clim. Change. - [s.l.] : Nature Publishing Group, a division of Macmillan Publishers Limited. All Rights Reserved., 2014. - 1 : Vol. 4. - pp. 11-12. - ISSN: 1758-678X.

Peings Yannick and Magnusdottir Gudrun Response of the Wintertime Northern Hemisphere Atmospheric Circulation to Current and Projected Arctic Sea Ice Decline: A Numerical Study with CAM5 [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 2013. - 1 : Vol. 27. - pp. 244-264. - ISSN: 0894-8755 DOI: 10.1175/JCLI-D-13-00272.1.

Petoukhov Vladimir and Semenov Vladimir A. A link between reduced Barents-Kara sea ice and cold winter extremes over northern continents [Journal] // Journal of Geophysical Research. - 2010. - Vol. 115.

Pohlmann Holger [et al.] Estimating the Decadal Predictability of a Coupled AOGCM [Journal] // J. Climate. - [s.l.] : American Meteorological Society, 2004. - 22 : Vol. 17. - pp. 4463-4472. - ISSN: 0894-8755.

Screen J. A., Deser C. and Simmonds I. Local and remote controls on observed Arctic warming [Journal] // Geophys. Res. Lett.. - 2012. - 10 : Vol. 39. - pp. L10709--. - ISSN: 1944-8007.

Screen JamesA. [et al.] Atmospheric impacts of Arctic sea-ice loss, 1979--2009: separating forced change from atmospheric internal variability [Journal]. - [s.l.] : Springer Berlin Heidelberg, 2014. - 1-2 : Vol. 43. - pp. 333-344--. - ISSN: 0930-7575.

Smith DougM. [et al.] Real-time multi-model decadal climate predictions [Journal]. - [s.l.] : Springer Berlin Heidelberg, 2013. - 11-12 : Vol. 41. - pp. 2875-2888--. - ISSN: 0930-7575.

Tang Qiuhong [et al.] Cold winter extremes in northern continents linked to Arctic sea ice loss [Journal] // Environmental Research Letters. - 2013. - 1 : Vol. 8. - pp. 014036--. - ISSN: 1748-9326.

Thomas Katie Linkages between Arctic warming and mid-latitude weather patterns: summary of a workshop [Journal]. - 2014. http://www.nap.edu/catalog.php?record_id=18727 (accessed 9th Sept 2014).

Wallace et al Global Warming and Winter Weather [Journal] // Science.

Wallace John M. [et al.] Global Warming and Winter Weather [Journal] // Science. - 2014. - 6172 : Vol. 343. - pp. 729-730.

Yang Shuting and Christensen Jens H. Arctic sea ice reduction and European cold winters in CMIP5 climate change experiments [Journal] // Geophys. Res. Lett.. - 2012. - 20 : Vol. 39. - pp. L20707--. - ISSN: 1944-8007.

ENDPAGE

MARIE SKŁODOWSKA-CURIE ACTIONS
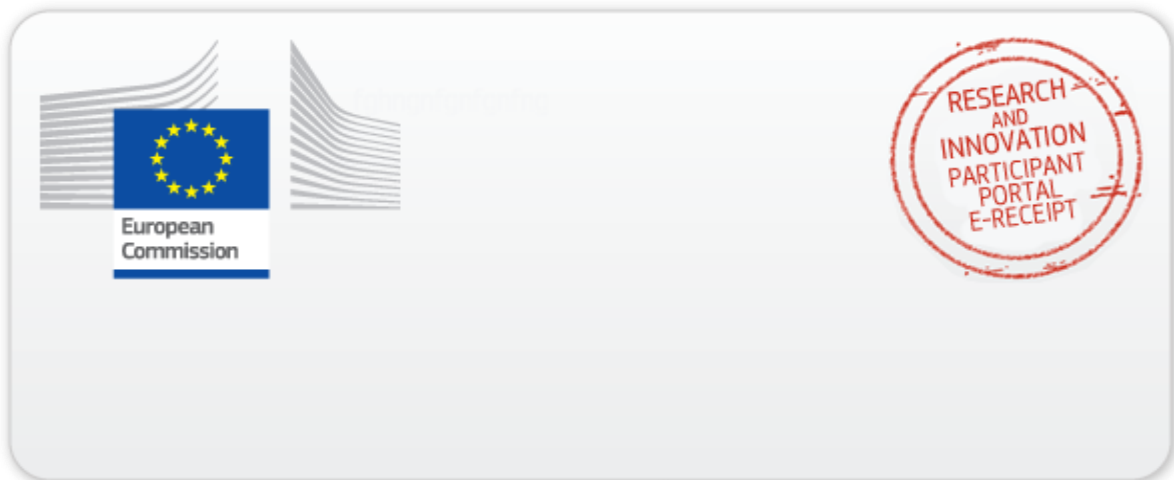
Individual Fellowships (IF)
Call: H2020-MSCA-IF-2014

PART B

"PredEx"

Seasonal-to-interannual predictability
of extreme winters at mid-latitudes

This proposal is to be evaluated as:

Standard EF

This electronic receipt is a digitally signed version of the document submitted by your organisation. Both the content of the document and a set of metadata have been digitally sealed.

This digital signature mechanism, using a public-private key pair mechanism, uniquely binds this eReceipt to the modules of the Participant Portal of the European Commission, to the transaction for which it was generated and ensures its full integrity. Therefore a complete digitally signed trail of the transaction is available both for your organisation and for the issuer of the eReceipt.

Any attempt to modify the content will lead to a break of the integrity of the electronic signature, which can be verified at any time by clicking on the eReceipt validation symbol.

More info about eReceipts can be found in the FAQ page of the Participant Portal. (http://ec.europa.eu/research/participants/portal/page/faq)