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Horizon 2020

Call: H2020-MSCA-IF-2018

(Marie Skłodowska-Curie Individual Fellowships)

Topic: MSCA-IF-2018

Type of action: MSCA-IF-EF-ST

(Standard European Fellowships)

Proposal number: 836379

Proposal acronym: VEGETA

Deadline Id: H2020-MSCA-IF-2018

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How to fill in the forms

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

1 - General information

Topic	MSCA-IF-2018	Type of Action	MSCA-IF-EF-ST
Call Identifier	H2020-MSCA-IF-2018	Deadline Id	H2020-MSCA-IF-2018

Acronym	VEGETA
Proposal title	Volcanic Eruptions and Greenland mElting: Taming the future of Arctic climate change

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

Duration in months	24
Scientific Area	ENV - Environmental and Geosciences (ENV)

Please select up to 5 descriptors (and at least 3) that best characterise the subject of your proposal, in descending order of relevance.

Descriptor 1	Climatology and climate change
Descriptor 2	Cryosphere, dynamics of snow and ice cover, sea ice, permafrost and ice sheets
Descriptor 3	Oceanography, marine science, coastal engineering
Descriptor 4	Numerical analysis, simulation, optimisation, modelling tools
Descriptor 5	Natural hazards
Free keywords	*Arctic climate variability; strong volcanic eruptions; Greenland ice sheet melting; near-term climate prediction*

Please choose the scientific area and descriptors carefully, and in order of importance, since this will guide the REA in the selection of experts for proposal evaluation and the allocation of proposals to experts. To help you select the most relevant area for your proposal, please consult the Guide for Applicants which provides a breakdown of each scientific area into a number of descriptors.

Abstract

The Arctic has warmed faster than anywhere else on Earth since preindustrial times and, thus, has experienced accelerating melting of its ice and snow covered areas. These changes are projected to continue in the future, opening new business opportunities yet threatening the stability of local ecosystems and communities. Accurate constraints of future Arctic climate change are hence essential to numerous socioeconomic sectors in the region. In this context, climate predictions with global general circulation models emerge as powerful tools to anticipate future changes; however, despite recent advances, two key contributions to Arctic climate are still overlooked in current prediction systems: the effects of a strong volcanic eruption and of the accelerating Greenland ice sheet melting in the near-term Arctic climate.

i) Volcanic eruptions are unpredictable and their effects are therefore bound to be neglected in operational predictions, although they can largely disrupt the Arctic climate for decades. This proposal will systematically explore the impacts of different volcanic forcing scenarios and background climate conditions to constrain potential Arctic climate change due to future eruptions.

ii) Most prediction systems do not include a Greenland ice sheet model among their components and thus lack the ability to simulate interactions between the Greenland melting and the Atlantic circulation (with recent evidence pointing that Greenland melting have already started to weaken it). Understanding such interactions—the second goal of this proposal—is key to robustly characterizing future Arctic climate change, since the Atlantic Ocean controls the poleward heat and salt transports and hence drives critical aspects of the Arctic climate, like the sea ice and the atmospheric circulation aloft.

Altogether, this action is set to provide essential knowledge to further the understanding of fundamental processes shaping future Arctic climate change.

Remaining characters 21

Has a similar proposal in terms of research objectives been submitted to a Horizon 2020 Marie Skłodowska-Curie Individual Fellowship call? ○ Yes ◉ No

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) 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

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

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

2 - Participants & contacts

#	Participant Legal Name	Country	Action
1	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain	

2 - Administrative data of participating organisations

Future Host Institution

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

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Specific Legal Statuses

Research and Innovation legal statuses

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

Public body .....yes

Academic Sector ..... yes

Department(s) carrying out the proposed work

Department 1

Department name: Earth Sciences ☐ not applicable

☐ Same as proposing organisation's address

Street: Jordi Girona, 29

Town: Barcelona

Postcode: 08034

Country: Spain

If the location of the Department carrying out the proposed work is not the same as the location of the Host Institute, please note that although the proposal submission system calculates the budget of the project based on the location of the Host Institute, the budget of the project for the grant agreement will be calculated by using the country coefficient of the location of the Department carrying out the proposed work.

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.

Last Name*	Moreno-Chamarro	Last Name at Birth	
First Name(s)*	Eduardo	Gender*	(•) Male ( ) Female
Title	Dr.	Country of residence*	Spain
Nationality*	Spain	Nationality 2	
Date of Birth (DD/MM/YYYY)	16/01/1987	Country of Birth*	Spain
		Place of Birth	Madrid

Contact address

Current organisation name	Barcelona Supercomputing Center		
Current Department/Faculty/Institute/ Laboratory name	Earth Sciences		
	☐ Same as organisation address		
Street	Jordi Girona, 29		
Postcode/Cedex	08034	Town	Barcelona
Phone	+34 934137672	Country	Spain
Phone2 / Mobile	+xxx xxxxxxxxx		
E-Mail*	eduardo.moreno@bsc.es		

ORCID ID	0000-0002-7931-5149	
Researcher ID		*The maximum length of the identifier is 11 characters (ZZZ-9999-2010) and the minimum length is 9 characters (A-1001-2010).*
Other ID	*Please enter the type of ID here*	*Please enter the identifier number here*

Qualifications

Doctorate Date of (expected) award	Select the exact date (DD/MM/YYYY)	13/07/2016
Doctorate start date	Select the exact date (DD/MM/YYYY)	01/03/2013
University Degree giving access to PHD	Date of award (DD/MM/YYYY)	10/07/2012

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

Indicate the period(s) and the country/countries in which you have legally resided and/or had your main activity (work, studies, etc) during the last 5 years up until the deadline for the submission of the proposal.

Please fill in this section without gaps. Short stays (as defined in the Guide for Applicants) shall not be listed in this box.

Period from	Period to	Duration (days)	Country
23/01/2018	12/09/2018	233	Spain
18/09/2016	22/01/2018	492	United States
23/02/2013	17/09/2016	1303	Germany
16/01/1987	22/02/2013	9535	Spain
	Total	11563	

Proposal ID **836379** *Acronym* **VEGETA** *Short name* **BSC**

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: Dr. Sex: (•) Male ( ) Female

First name* **Pablo** Last name* **Ortega Montilla**

E-Mail* **portega@bsc.es**

Position in org.: Climate Prediction Group co-leader

Department: Earth Sciences

[ ] Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona Post code: 08034

Country: Spain

Website:

Phone: +34 934137679 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Dorota	Chmielewska	dorota.chmielewska@bsc.es	*+34 934134082*
Mar	Rodriguez	mar.rodriguez@bsc.es	*+34 934137566*

3 - Budget

Is the Researcher eligible for family allowance? (•) Yes ( ) No

Participant Number	Organisation Short Name	Country	Country Coefficient	Number of Months	Researcher Unit Cost			Institutional Unit Cost		Total
					Living Allowance	Mobility Allowance	Family Allowance	Research, training and networking costs	Management and Overheads	
1	BSC	ES	0,954	24	111732,48	14400,00	12000,00	19200,00	15600,00	172932,48
Total					111732,48	14400,00	12000,00	19200,00	15600,00	172932,48

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

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

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

How to Complete your Ethics Self-Assessment

5 - Call specific questions

Eligibility Researcher (future fellow)

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

2. Did you spend time on procedures for obtaining refugee status (according to the 1951 Geneva Refugee Convention and the 1967 Protocol) in a Member State or Associated Country? ○ Yes ◉ No

Other Questions

1. For communication purposes only, the European Commission REA asks for permission to publish the name of the researcher (future fellow) should the proposal be retained for funding. Does the researcher (future fellow) give this permission? ◉ Yes ○ No

2. Some national and regional public research funding authorities run schemes to fund MSCA applicants that score highly in the MSCA evaluation but which cannot be funded by the MSCA due to their limited budget. In case this proposal could not be selected for funding by the MSCA, do the researcher and supervisor consent to the European Commission disclosing to such authorities the results of its evaluation (score and ranking range) together with their names and contact details, non-confidential proposal title and abstract, proposal acronym, and host organisation? ◉ Yes ○ No

3. Is there a secondment in Member States or Associated Countries envisaged 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: Ca'Foscari University of Venice

Country: Italy

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: Université Catholique de Louvain

Country: Belgium

Extended Open Research Data Pilot in Horizon 2020

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

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

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

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

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

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

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

1. Excellence

1.1. Quality and credibility of the research/innovation project; level of novelty, appropriate consideration of inter/multidisciplinary and gender aspects

1.1.1. Introduction, state-of-the-art, specific objectives and overview of the action

The Arctic has warmed faster than anywhere else on Earth since preindustrial times in a phenomenon known as Arctic Amplification[1]. Related to this, the Arctic has experienced severe declines in perennial sea ice, snow, and permafrost extensions, and increases in Greenland melting and iceberg calving[1]. These changes, which not only have accelerated in the last few decades but are projected to continue in the future[1], can actually have contrasting impacts in the region: while they can provide new business opportunities like shorter shipping routes, they can severely threaten societies, and local communities and ecosystems due to, for example, extreme and fast changes in environmental conditions. Substantial uncertainty, however, still remains about the physical mechanisms that have so far driven and will drive Arctic climate change[2] and the extent to which Arctic changes can impact the weather and the climate of mid-latitude regions in the North Atlantic, Eurasia, or North America[3]. Developing improved predictions of Arctic climate for the near-future (this is, the next 10 years and beyond) can address such uncertainties by exploring the role of different driving mechanisms and helping constrain the magnitude of future changes—a source of information that is indeed strategic for the numerous socioeconomic sectors in the region.

Climate predictions are mainly produced with global general circulation models (GCMs), powerful, complex tools that allow for hypothesis testing (e.g., process-based analysis to investigate driving mechanisms or source regions of predictability) and that have already shown significant prediction skills at decadal time scales, especially in the North Atlantic[4]. In this context, the Arctic region has comparatively received less attention[5], hampered by a limited observational network to initialize predictions through assimilation[6], and by local systematic biases in the simulated mean state of current forecast systems linked to the misrepresentation of potentially key processes[5]. The research we propose here will assess the impact on the near-term climate prediction skill over the Arctic of two currently neglected potential major contributions: a hypothetical yet possible future strong volcanic eruption, and the meltwater flux into the ocean from the Greenland ice sheet.

i) Strong volcanic eruptions

Strong volcanic eruptions have repeatedly disrupted the global and, in particular, the Arctic climate in the past and will again do so in the future; they are thus a key driver of forced climate variability on seasonal up to (multi)decadal time scales[1,7]. Yet, volcanic eruptions are random events and their timing, location, and magnitude are unpredictable. For their effect to be included in real-time climate predictions, producing accurate estimates of the climatically relevant volcanic aerosol parameters readily after the eruption would be needed. This however still poses a strong challenge as it requires the observational determination of emission profiles, such as SO_2 amounts and injection height, and their inclusion in global aerosol model simulations to generate input forcing for GCMs. Real-time prediction systems are for such reasons bound to exclude potential future eruptions in their assessments. There is, nonetheless, an evident need to understand the Arctic climate response under different eruption scenarios and its sensitivity to the background climate to characterize their impact on the prediction skill at the time of the eruption[8]. Only thus, we will be able to constrain reliably potential climate changes due to future eruptions.

Sulfate aerosols formed in the stratosphere during strong volcanic eruptions can largely disrupt the Arctic climate for decades afterward[9,10]. Stratospheric volcanic aerosol clouds persist for a couple of years after major eruptions and thus temporarily alter the radiative balance of the atmosphere, mainly cooling the Earth's surface while warming the tropical lower stratosphere. These short-lived radiative anomalies induce further dynamical changes and positive feedbacks in the Earth system that in the Arctic are observed as a cascade of changes in

1 **References:** **1** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Cambridge University Press, 1535pp. **2** Meehl et al., 2014. *BAMS*, 95(2), 243–267. **3** Jung et al., 2014. *Geophysical Research Letters*, 41(10),3676–3680. **4** Pohlmann et al., 2009. *Journal of Climate*, 22.14:3926–3938. **5** Jung et al., 2016. *BAMS*, 97.9:1631–1647. **6** Eicken, 2013. *Nature*, 497(7450),431–433. **7** Schurer et al., 2014. *Nature Geoscience*, 7.2:104–108. **8** Illing et al., (2018) *Earth System Dynamics* 9.2: 701–715. **9** Zanchettin et al., 2014. *Earth System Dynamics*, 5.1: 223–242. **10** Gagné, et al., 2017. *Journal of Geophysical Research: Atmospheres*, 122.15: 8071–8078. **11** Swingedouw et al., 2017. *Global and Planetary Change*, 150: 24–45. **12** Moreno-Chamarro et al., 2017. *Climate Dynamics*, 48.3-4: 727–744. **13** Zanchettin et al., 2013. *Journal of Geophysical Research: Atmospheres*, 118.10: 4090–4106. **14** Luterbacher and Pfister, 2015. *Nature Geoscience*, 8.4: 246. **15** Thordarson and Self, 2003. *Journal of Geophysical Research: Atmospheres*, 108. D1. **16** Van den Broeke et al., 2016. *The Cryosphere*, 10.5: 1933–1946. **17** Swingedouw et al., 2015. *Climate Dynamics*, 44.11–12: 3261–3279. **18** Thornalley et al., 2018. *Nature*, 556.7700: 227. **19** Doblas-Reyes et al., 2017. *Nature Communications*, 4:1715. **20** Zanchettin et al., 2016. *Geoscientific Model Development*, 9.8:2701–2719.

the atmosphere and ocean circulations and ice caps[9,10]. In fact, many of the mechanisms proposed so far to explain global or Northern Hemisphere (NH) climatic responses to strong eruptions include the Arctic as key ingredient[11]. For example, the observed regional warming emerging over Eurasia and North America in the winter following an eruption has been linked to a post-eruption strengthening of the polar vortex[11]; also, widespread hemispheric cold conditions have been connected to multidecadal Arctic cooling and sea ice growth in simulations of past eruptive events during the Little Ice Age[12] and in the 20th century[10]; and changes in Arctic sea ice after strong eruptions have been found sensitive to the state of the Atlantic meridional overturning circulation (AMOC) and the Atlantic Multidecadal Variability[11]. Climate variability forced by a strong eruption is however very sensitive to the climate conditions at the eruption's time[13]: due to the chaotic nature of the climate system, a strong eruption can trigger a variety climatic responses depending on the background climate, as the candidate's previous research showed for the export of Arctic sea ice into the North Atlantic after the 1600's Huaynaputina eruption in Earth system model simulations[12]. The links and driving mechanisms of volcanically driven Arctic climate change are thus still widely discussed in the literature[11], and no consensus upon the role of the Arctic has been reached yet. Unfortunately, volcanically altered climate variability can exert substantial stress on and hence puts at risk the sustainability of ecosystems and societies especially in the Arctic, where they can remain largely isolated. For all such reasons, this project aims at exploring volcanically driven Arctic climate variability to help reduce current uncertainties about its impacts.

The specific characteristics of an eruption are crucial for the climatic impacts afterward. An example is its magnitude and duration[11]: although less frequent, eruptions as strong as the Mount Tambora's one in 1815 can force more widespread and longer-lasting climate variability than middle-sized events like the Mount Pinatubo's one in 1991. A critical aspect shaping the impact of an eruption especifically on the Arctic is the poleward dispersion of the volcanic aerosol cloud. A tropical eruptions needs to be strong enough for its aerosol load to reach the stratosphere; there, the prevailing circulation advects it poleward, albeit, most times, evenly between the two hemispheres. At NH extratropical latitudes, by contrast, the volcanic aerosol cloud is generated and remains confined into the Arctic atmosphere and can therefore force regional climate change more effectively through direct radiative effects, even if the eruption's magnitude is comparatively weaker. Historical records show that these two scenarios are indeed possible: both the eruptions of Mount Tambora in Indonesia[14] and the volcanic fissure Laki in Iceland[15] (in 1783/84) disrupted the global climate for years, with multiple reports of famines and socioeconomic distress across Europe and North America. Yet, open questions remain about the magnitude of the climatic impacts of and how much more sensitive the Arctic climate is to a NH extratropical eruption compared to a tropical one, or about whether the mechanisms behind forced Arctic climate variability and the teleconnections with the mid-latitudes vary between these two scenarios. Since a NH high-latitude eruption is a major, direct threat to the Arctic climate stability and, by extension, to the surrounding regions in Europe and North America, we also aim to address these open questions in this research.

ii) Greenland ice sheet melting

As a result of the increases in surface temperatures and iceberg calving driven by global warming and Arctic Amplification, Greenland ice sheet melting has accelerated since 2000[16]. Widespread evidence[1,17,18] suggests that an increase in the Arctic freshwater export into the North Atlantic can potentially disrupt its circulation by freshening and hence limiting oceanic deep mixing in the subpolar region. Projections of future climate change performed with GCMs show that substantial Arctic melting might weaken the North Atlantic circulation, even abruptly in just a few years[1]. Attempts to study the climatic impacts of the Greenland melting in climate models include idealized sensitivity experiments in which anomalous freshwater fluxes (or hosing) are imposed upon the subpolar North Atlantic region to reduce or shut down the AMOC[17]. Most of the models used so far, however, lack a Greenland ice sheet model among their components and, thus, the ability to simulate in a more realistic way interactions between the Greenland melting and the Atlantic Ocean. Very recently, observational studies have started to suggest that modern Greenland melting could already have weakened the North Atlantic circulation[18]. For the Arctic region, a weakening of the Atlantic Ocean circulation (which is, in fact, a key contribution to the decadal prediction skill in the North Atlantic and the neighboring regions[19]) represents a net reduction in the oceanic heat and salt transports from lower latitudes. This can directly alter the climate of the entire Arctic region, via changes in the sea ice volume and the atmospheric circulation aloft, and by extension that over immediate lower-latitude regions[1]. Constraining the magnitude of the weakening in the Atlantic Ocean circulation due to Greenland melting is therefore crucial, as well as the extent to which it has

affected recent past climate variability in the Arctic and surrounding areas and will do in the near future. Coupling the current generations of GCMs to ice sheet models represents a decisive step forward to accounting for the sensitivity to Greenland ice sheet melting and, thus, to improving near-term prediction of the North Atlantic and Arctic regional climate. This is also crucial for local communities in the region: as recently reported on the global news, strong concern has grown among them due to increasing rates of Greenland iceberg calving as this poses a severe threat for their coastal areas. This research will aim to explore the impacts of Greenland melting on the prediction skill in the North Atlantic and Arctic region through a realistic implementation of Greenland meltwater fluxes in a state-of-the art climate model.

In summary, although the two specific contributions we propose to investigate here are clearly different in nature, with volcanic eruptions being unpredictable, short-lived events while Greenland melting a relatively slow process potentially subject to accelerate in next decades, they both can impact the ability to predict accurately the near-term climate of the Arctic and neighboring regions[2]. This project is thus set to provide key knowledge to further our understanding of fundamental processes driving Arcitc climate variability; by reducing the current knowledge gaps, this project will immediately and directly benefit a wide range of socioeconomic sectors.

Specific objectives and overview of the action

This action aims to shed light on the roles that both future potential volcanic eruptions and the currently misrepresented Greenland meltwater fluxes can potentially play in the near-term Arctic climate. Toward this goal this project articulates around 3 work packages (WPs), each addressing a narrower scientific question:

1. What is the near-term response of the Arctic and lower-latitude climate to a strong volcanic eruption and to what extent is this response modulated by the pre-existing background climate conditions? (WP1)
2. How different is the Arctic climate response to a substantially stronger tropical (Tambora-like) or a neighboring smaller (NH extratropical) eruption? (WP2)
3. What is the effect that a realistic Greenland melting plays on the near-term North Atlantic and Arctic climate variability and predictability? (WP3)

1.1.2. Research methodology and approach

WP1: Constraining the Arctic response to a strong eruption and sensitivity to the background climate. This WP will systematically investigate the impacts of a strong volcanic eruption on the Arctic climate variability and how these impacts are shaped by the different states of its background climate. Benefiting from the extensive computing capabilities at BSC, we will perform ensembles of sensitivity experiments with the fully coupled GCM EC-Earth of a Pinatubo-size eruption imposed upon a broad spectrum of background climate conditions. These conditions will especially emphasize the Arctic region and will include anomalously high and low sea-ice extent or volume and Eurasian snow cover, as well as different phases of important climate modes such as the Atlantic Multidecadal Variability, the Quasi-Biennial Oscillation, the El Niño–Southern Oscillation, and the AMOC, all sampled from a long control simulation with constant forcing at preindustrial levels. The implementation of the volcanic forcing and the sampling of the background conditions will follow the protocol for the volc-pinatubo-full experiment of the Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP)[20] within CMIP6; our approach, however, will go a step forward by specifically analysing how the background Arctic climate and its interaction with other relevant climate modes can shape volcanically driven climate variability. Due to the relatively low signal-to-noise ratio of the climatic signature of a Pinatubo-size eruption, large ensemble of experiments of at least 40 members will be performed to ensure climate anomalies and the underlying mechanisms are robustly capture. Each experiment will be run for at least 3 years.

The analysis of these experiments will consist of an in-depth study of the physical mechanisms underlying forced Arctic climate variability on annual time scales, including, for example, the post-eruption polar vortex intensification and Eurasian winter warming. In addition, if precursors of changes in the oceanic circulation are found (for example, in the Labrador Sea deep water formation or sea ice), we will extend those experiments to explore forced variability on decadal and longer time scales. Differences across sensitivity experiments will be computed, as well as between these and the control (which provides a measure of unforced variability) or observations of surface temperature and precipitation of past eruptions. The analysis will thus allow identifying

leading mechanisms of Arctic climate variability after strong eruptions and will thus provide sources of potential climate predictability for future events. Following VolMIP's recommendations will have the advantage to allow our results to be directly comparable with simulations performed with other climate models participating in the intercomparison to search for similarities and differences in the Arctic climate response. In addition, recent developments toward an improved representation of the volcanic aerosols in the EC-Earth (as a function of time, latitude, altitude, and wavelength) will also be included to allow for a more realistic implementation of the volcanic forcing and its climatic impacts.

WP2. Annual-to-decadal Arctic response to a very strong equatorial and a medium-size NH high-latitude eruption. This WP will investigate climatic impacts of an eruption expected to force more profound and persistent (up to decadal time scales) changes in the Arctic and its surroundings. To this aim two separate sets of experiments are planned. The first one will follow a similar protocol to the volc-long-eq Tier-1 experiment of VolMIP and will use a volcanic forcing comparable to that of the 1815's Mount Tambora eruption. The second will follow a similar setup, but targeting a middle-sized eruption at NH high latitudes, as in the volc-long-hlN Tier2 experiment of VolMIP. These two forcing scenarios will be generated using the Easy Volcanic Aerosol (EVA) module, which can provide the volcanic forcing for any eruption sulfur injection and latitude in a format readily readable by any climate model (in our case, the EC-Earth). As in WP1, we will use a set covering different background Arctic climate states, sampled from a control simulation. All experiments will be run for at least 20 years to let the Arctic climate evolve after the eruption and adjust to slow potential changes in, for example, the ocean circulation—which are expected for these two eruption scenarios.

The analysis of the experiments will explore mechanisms underlying volcanically forced climate variability in the Arctic, Europe, and North Atlantic up to decadal time scales, focusing on changes in sea ice, surface temperature, precipitation, and oceanic and atmospheric circulation. Comparing experiments run under the two scenarios will allow identifying mechanisms that activate for a NH high latitude eruption alone and how these differ from the tropical case. To separate different mechanisms into their components, we plan to perform further sensitivity experiments in which one model component, such as the ocean, is uncoupled from the others or set to a constant climatology. All such sensitivity experiments will be compared with those in WP1 to investigate nonlinearities in the dependency of forced Arctic climate variability on the forcing characteristics. Since VolMIP will also provide a common protocol for the forcing implementation (as in WP1), these experiments will also be compared with those performed at other participating climate research centers with other climate models.

WP3. North Atlantic and Arctic near-term response to Greenland melting. This WP aims to investigate to which extent present and future Greenland melting can alter the North Atlantic Ocean circulation and can thus ultimately impact the near-term Arctic climate. These questions will be tackled through groundbreaking near-term climate predictions in which information from three different climate models will be involved: the EC-Earth; the regional atmospheric model MAR, whose domain extends over the Greenland ice sheet and part of the North Atlantic and Arctic oceans, and that will provide fluxes to the Greenland ice sheet; and the Greenland ice sheet model GISM, which will be run at its highest possible resolution of 1–2 km. Developing these simulations will require designing new interfaces for the exchanges between the different model components and updating the existing ones (e.g., to account for melting at the ice-shelf base, calving fronts, icebergs, or meltwater fluxes between ice sheet and ocean); this task will be achieved in 2019 by our partners from research centers at the UCL, ULg, ULB, KUL, and VUB within the context of the Belgian project PARAMOUR. To produce realistic Greenland melting fluxes, a first set of predictions for the period 2015–2045 will be produced with the EC-Earth standard model version; these simulations will provide the boundary conditions for an ensemble of 3–5 simulations with the Greenland regional models; eventually, the latter experiments will provide updated meltwater fluxes to constrain a new set of predictions for the same period performed with the EC-Earth model as well.

These experiments will be analyzed and compared with the initial predictions not accounting for Greenland melting to explore whether and how ongoing and potential future Greenland melting can shape Arctic climate variability. We will investigate changes in upper-ocean salinity due to Greenland melting and iceberg calving, and how these impact on oceanic deep convection in the Labrador Sea and, by extension, on the Atlantic Ocean circulation. We will further examine how such circulation changes can propagate downstream and force further changes in the Arctic and European climate via changes in the oceanic heat transport and sea ice extent.

1.1.3. Originality and innovative aspects of the research program

This research aims to investigate the role in the near-term Arctic climate of two key climate components that are not sufficiently accounted in current climate prediction systems, despite the evidence they can influence their predictive skills on annual and longer time scales: the effects of a strong volcanic eruption and the Greenland ice sheet melting. This research will combine two approaches to advance our understanding of future Arctic climate variability and, in particular, of two contributions that can significantly modulate future global warming.

First, this project will use the wealth of the computing capabilities available at BSC to study systematically Arctic climate variability forced by a strong eruption and its sensitivity to diverse background climate conditions. We will explore various volcanic forcing scenarios of a strong and a substantially stronger tropical eruptions, and of a NH high-latitude one to investigate differences and potential nonlinearities in their related Arctic climatic responses. To ensure robust responses are captured, a variety of background climate conditions specifically related or relevant to the Arctic will be systematically sampled, upon which these volcanic forcings will be imposed. The novelty of our approach thus lies in that **it will explore for the first time a wide range of relevant scenarios, both in terms of volcanic forcing and climate conditions all focused on the Arctic,** to constrain the climatic impacts of future eruptions.

Second, **this project will be one of the first attempts to investigate realistically the role of the Greenland melting in the near-term climate of the Arctic and North Atlantic**. This will be achieved through original experiments in which a state-of-the-art, regional model of the Greenland ice sheet will provide refined boundary conditions to a GCM to produce improved predictions of the near-future. This approach will make a substantial leap forward with respect to previous methodologies and will certainly set a benchmark for future research.

1.2 Quality and appropriateness of the training and of the two way transfer of knowledge between the researcher and the host

The implementation of this proposal in the Earth Sciences Department at BSC (ES-BSC) is an unquestionable opportunity to strengthen and expand both the candidate's and the ES-BSC's competences. Previous research by the candidate on the impacts of volcanic eruptions on the North Atlantic and Arctic climate in the context of the past millennium has provided him with a broad understanding of the ocean–atmosphere–ice system in the region, and how this can be shaped by external forcing, while developing excellent skills in data processing and analysis; furthermore, his previous experience with other GCMs is ideal for this research as it will help the candidate, for example, identify easily potential driving mechanisms of Arctic climate change and whether they are model dependent. The past several months in the ES-BSC have made the candidate familiar with the EC-Earth climate model, the main tool that will be used in this research, which places him in a perfect position to start the project immediately. The work proposed here will thus allow the candidate to apply and expand his previous research experience on the study of Arctic climate variability in state-of-the-art climate models. Nevertheless, the candidate still lacks the convenient skills and experience on decadal forecasting, volcanic forcing implementation, and Greenland ice sheet modeling; this fellowship will provide him such competences. Hosted by the Climate Prediction group of ES-BSC under the supervision of Dr. Pablo Ortega, an expert in Atlantic ocean circulation and variability, the candidate will gain expertise in the study of North Atlantic and Arctic climate variability and their importance for seasonal and decadal prediction. He will equally benefit from participating in discussions and meetings within the H2020-funded APPLICATE and the Spanish project VOLCADEC, both closely linked to this proposal and in which the ES-BSC is involved.

In addition, two three-month secondments are envisaged to guarantee a successful completion of this proposal. The candidate will first visit Ass. Prof. Davide Zanchettin at the Ca'Foscari University of Venice (CFUV), an internationally recognised researcher on the role of volcanic eruptions on decadal variability who is currently leading the VolMIP initiative (endorsed for CMIP6). In another secondment, the candidate will visit Prof. Hugues Goosse at the Université Catholique de Louvain (UCL), where we will benefit from the extensive knowledge of Prof. Goosse's group on forced versus internal decadal variability in polar climates. This visit will also allow the candidate to interact with other partners of the PARAMOUR project and, in particular, with those in charge of running the Greenland regional models.

BSC's experience and expertise in project planning and resource management (especially in hosting Marie Skłodowska-Curie fellows: four in the last two years only in the Climate Prediction Group) will be key to ensuring an optimal implementation of the action by the candidate. The candidate will benefit from the strong internal programmes developed at the BSC to guide his professional and personal development. The backbone of the BSC's career guidance, training, and supervision programme is the centre's Personal Development Programme. At the start of the project, the candidate will be guided to create a personalised development plan that includes annual objectives, and a two-year training plan. Individual objectives, based on the applicant's own perceived needs and those identified by the supervisor, will be agreed at the beginning of each year, revised in the middle of it, and evaluated at the end. Many of such training needs are already satisfied by various programmes run by the centre; for specific needs that cannot be met this way, external training will be organised.

The candidate will also improve his coding and data analysis skills via PATC courses (organized by PRACE, Partnership for Advanced Computing in Europe; www.bsc.es/education/training/patc-courses) and regular training by the Computational Earth Sciences group of the ES-BSC. The candidate will further be trained in improving his scientific and project writing abilities and will be introduced to project management through formal courses and seminars organized by the Education and Training Team, Human Resources, and the ES-BSC itself.

1.3 Quality of the supervision and of the integration in the team/institution

The Earth Science Department at the Barcelona Supercomputing Center (ES-BSC), led by Prof. Francisco J. Doblas-Reyes, conducts multifaceted research in Earth system modeling and is a leading actor in the development of climate predictions and services in Europe. The ES-BSC enjoys a very dense international collaborative network of at least 50 other institutions worldwide. By focusing on improving current understanding of Arctic climate, this proposal is fully in line with BSC's key interests, and those of the Climate Prediction Group (which belongs to ES-BSC) in particular.

The Climate Prediction group of the ES-BSC undertakes advance research in climate forecasting from month up to a few decades into the future, both on regional and global scales. These objectives rely on expanding the current understanding of climate processes through detailed analyses of the strengths and the weaknesses of state-of-the-art climate forecast systems in comparison with the most up-to-date observational data sets. The group is a highly productive scientific entity, with more than 150 research articles in peer-reviewed journals over the past five years, including 13 in high-impact journals.

Dr. Pablo Ortega is a co-leader of the Climate Prediction group at ES-BSC. He directly supervises the work of eight postdocs (including one Marie Skłodowska-Curie fellow), one PhD, and two undergraduate students, and he is currently coordinating BSC's participation in two H2020 projects (INTAROS and APPLICATE; the latter as WP leader), an ESA project (CMUG-CCI-phase3), the Belgian project PARAMOUR, and the Spanish MINECO-funded project DANAE. Dr. Ortega is an expert in decadal climate variability and predictability with more than ten years of experience as climate modeller and paleoclimatologist, with particular interest in the fate of the ocean circulation and associated climatic impacts. His broad expertise has allowed him to secure recently a senior-track position, through the Spanish Ramón y Cajal Fellowship Program. Dr. Ortega, in particular, and the ES-BSC, in general, have provided researchers with exceptional training support and conditions for their scientific growth, steering improvements in their scientific and management skills alike. BSC's training capability of researchers is very extensive and has been demonstrated through the successful experience of numerous doctoral and postdoctoral scientists. Former postdocs and PhD students hosted at the ES-BSC hold or have held positions at several well-known scientific institutions and energy companies world-wide, such as the NASA Goddard Institute for Space Studies in the USA (Dr. Carlos Pérez García-Pando, currently at BSC), the School of Geography and Environment at the University of Oxford in UK (Dr. Karsten Haustein), and the EnBW Energie Baden-Württemberg AG in Germany (Dr. Matthias Piot).

This project will be managed through weekly meetings with Dr. Ortega to ensure full coherence between the planned research and the general objectives of the ES-BSC. Regular meeting will involve other group members, especially in the Climate Prediction group, to ensure an adequate integration of this research into the rest of the research carried out in the host department. In this context, the candidate will be encouraged to participate actively in discussions and meetings involving the H2020-funded projects APPLICATE (GA727862) and PRIMAVERA (GA641727, as well as the Belgian project PARAMOUR (EOS-30454083),

and the CMIP6-endorsed activity VolMIP, which will ensure his full integration into and the building-up of an extensive international network.

1.4 Potential of the researcher to reach or re-enforce professional maturity/independence during the fellowship

The candidate has experience in the use and development of Earth system models and in the coupling of atmosphere, ocean, and ice; he has further demonstrated the ability to learn and grow professionally during his postdoctoral positions at the Massachusetts Institute of Technology and the BSC by developing research and publishing in fields relatively distinct from previous research. The candidate has also proved interest in developing his future in teaching by lecturing and tutoring other doctorate candidates in the course Earth System Modeling at the Max Planck Institute for Meteorology during his PhD studies (lectures that he designed and developed himself) and participating in a teaching course at university level at the Hamburg University. The applicant has worked in leading research institutes worldwide, has published scientific papers in high-impact journals, and has participated in a national (the NOAA-funded “Exploring linkages between AMOC and ITCZ variability”) and two international (the H2020-funded APPLICATE and PRIMAVERA) projects.

The ES-BSC represents the ideal environment to carry out the proposed activities and help the candidate improve his expertise in the field of Arctic climate. The ES-BSC is a highly dynamic department with a high-rate of funded research grants. The researcher will take advantage of this aspect by improving his skills in the preparation of grant applications to secure the necessary funding to achieve his long-term career goals. Centered at BSC, the proposed project will allow the researcher to be involved in several European projects at the center of a large collaborative network. Collaborating with the CFUV will reinforce the candidate’s knowledge on volcanically driven climate variability, whereas that with the UCL will do so on Arctic decadal climate predictability and the implementation and analysis of simulations of the Greenland ice sheet. The candidate will also be able to participate in the training activities on predictability of the Atmosphere–Sea-Ice–Ocean–Ice-Sheet system planned in the framework of PARAMOUR. The multidisciplinary nature of this project will promote a further widening of the candidate’s international profile and network and help him develop a new research line within the Climate Prediction group, will extend his expertise in the field of Arctic climate variability and decadal prediction, project management and leadership, which will eventually consolidate him as a recognised researcher in the international climate modelling community.

2. Impact

2.1. Enhancing the future career prospects of the researcher after the fellowship

This fellowship will allow the candidate to become an expert in the study of Arctic climate variability. On the one hand, the candidate will substantially expand his understanding of the impacts of volcanic eruptions on the climate system. On the other, he will add new research experience in the study of the interactions between the Greenland ice sheet and the North Atlantic and Arctic climate. Altogether, it will lay the groundwork for an extended future research programme on an in-depth study of Arctic climate change. In addition, the candidate will gain and improve his competences in High-Performance Computing, global modelling and evaluation, project management, and science dissemination to different audiences. As a part of his training, the proposed project will allow the candidate to pursue his own research line within BSC, managing a project (scientifically and financially), coordinating international collaborations, and tutoring young scientists (both master and PhD students). These skills are in fact fundamental in securing independent research positions, in the preparation of cover letters, curriculum vitae, statements of research interest and so on, all competences required to develop a productive and long-lasting scientific career successfully. During the time with the host, the applicant will take part in writing and reviewing grant applications and will attend sessions covering outlining of new proposals and finding sources of funding. Similarly, the candidate will participate in all the group and department meetings, particularly those where the research and funding strategies are discussed and decided, in dedicated meetings and working groups for the discussion of new research and tool development (which usually involve research engineers and scientists from the different groups of the department, who are expected to work closely together).

The networking opportunities provided by the participation of the ES-BSC in multiple European projects, the two planned secondments at the CFUV and UCL, together with the presentation of the outcomes of this work at various international conferences (e.g., European Geophysical Union Annual Meeting) and in high-

impact journals (e.g., Geophysical Research Letters) will increase the candidate's international presence in the field of Arctic climate. The leadership, professional, and personal skills that the candidate will develop at BSC, combined with the increased research expertise and enhanced international research presence he will gain, will put him in an excellent position to apply for independent research grants and build his own research group by the end of this fellowship.

2.2. Quality of the proposed measures to exploit and disseminate the action results

The research activities and the results of this project will be disseminated to multiple audiences: the scientific community, end users of climate forecast data (in particular, in the Arctic Cluster User Group stirred by other colleagues at BSC within the context of the H2020 project APPLICATE), and the general public. Regarding the scientific community, at least three publications are planned in international peer-reviewed journals, these of high-impact such as Science, Nature, or PNAS, if results allow it (Deliverables in Section 3.1). To guarantee open access to all publications related to this project, BSC will deposit all papers in a open repository, for which BSC uses the institutional repository UPCommons. BSC's engagement in a variety of scientific projects will also be ideal to disseminate the outcomes of this research.

In addition, project results will be disseminated at high-level international interdisciplinary conferences such as the American and European Geophysical Union General Assemblies, and Ocean Sciences, and at more specific conferences and workshops in the fields of Arctic climate and volcanically driven climate change. The candidate will also present the results of his research during the secondments at UCFV and UCL. This will also provide him with further networking opportunities and potential new collaborations, which will raise his international profile.

The results from the proposed work will directly benefit climate prediction systems world-wide by providing a measure of the impacts that future volcanic eruptions and the Greenland ice sheet melting can have on their assessment. The results of this action will be disseminated by the Earth System Services group of the ES-BSC, which develops close contacts with end users in key socio-economic sectors of applications of climate prediction such as wind energy, agriculture and insurance, to ensure their products benefit from the most recent advances in understanding and improving climate prediction capability in the Arctic and its surroundings.

2.3. Quality of the proposed measures to communicate the project activities to different target audiences

One of the priorities of the fellowship will be to seek public engagement through active and effective communication of the science developed to non-specialized audiences and students. The BSC's communication department and the Earth System Services group of the ES-BSC will support the candidate in the following planned activities:

- ➔ Inclusion of the project information, progresses, and results in several dissemination activities at BSC, for example, on his personal website or via seminars, leaflets, brochures, and videos.
- ➔ Development and maintenance of a webpage in which two parallel levels of communication are maintained, one for the specialized audience and one for the non-specialized. The webpage will be rich in visual contents like animations from results of the project's simulations and simple explanations of the mechanisms observed in the animations. Once the webpage is active, it will be advertised by reaching public media channels and popular scientific divulgation journals.
- ➔ Participation in the MareNostrum Open Day events, aimed at high school and graduate students and the general public.
- ➔ Academic cooperation with the Universitat Politecnica de Catalunya in joint PhD programs and MSc courses and programs (e.g., Master degree in Oceanography and Marine Management)

In addition, for the overall of this project and each published article, the candidate will take advantage of the multiple opportunities offered by scientific journals and social media to include interactive contents such as dissemination videos and webinars and thus promote further his research. The candidate, who enjoys scientific outreach work, will actively seek opportunities to hold outreach events on climate science topics, either locally (for example, at Barcelona's Pint of Science events), or further afield in Europe.

3. Quality and Efficiency of the Implementation

3.1 Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources

The planning of the project in terms of person-months has been thought through carefully and allows for delays and re-planning, if necessary. Tasks (T) to be completed within each WP (1–3; Section 1.1.2), and the associated deliverables (D) and milestones (M) are described in the following and illustrated in a Gantt Chart.
D0.1–Career Development Plan.
D0.2 and D0.3–Annual reports.
M.0.1–Project plan implemented.
M0.2–Project completed.
WP1: Constraining the Arctic response to a strong eruption and sensitivity to the background climate.
T1.1–Identification and extraction of the different background climate conditions in the control experiment.
T1.2–Performance of ensemble of volcanically forced sensitivity experiments.
T1.3–Analysis of these experiments.
D1.1–Article on the sensitivity of the volcanically driven Arctic climatic response to background conditions.
M1.1–Database of background climate conditions completed.
M1.2–Sensitivity runs completed.
WP2. Annual-to-decadal Arctic response to a very strong equatorial and a medium-size NH high-latitude eruption.
T2.1–Use of EVA model to produce volcanic loading of a Tambora and a NH high-latitude eruption.
T2.2–Performance of ensemble of volcanically forced sensitivity experiments.
T2.3–Analysis of the experiments.
D2.1–Article on the sensitivity of the Arctic climate to a very strong eruption and a NH high-latitude eruption.
M2.1–New volcanic forcing estimates completed.
M2.2–Sensitivity runs completed.
WP3. North Atlantic and Arctic near-term response to Greenland melting.
T3.1–Producing baseline predictions with no Greenland melting.
T3.2–Producing refined predictions including Greenland melting freshwater fluxes.
T3.3–Comparison of the two sets of predictions.
D3.1–Article on role of the Greenland melting in shaping the near-term North Atlantic and Arctic climate.
M3.1–Model coupling fully operative.
M3.2–Experiments completed.

Communication: communication to the public will be ongoing throughout this research project (Section 2.3).

Trainings: Training on effective coding is planned for the first two months. All other training will be ongoing throughout the fellowship, based on the availability of seminars and courses.

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
WP1	**Task 1.1**																								
	Task 1.2																								
	Task 1.3																								
WP2	**Task 2.1**																								
	Task 2.2																								
	Task 2.3																								
WP3	**Task 3.1**																								
	Task 3.2																								
	Task 3.3																								
Deliverables		0.1											0.2	1.1			2.1						3.1 & 0.3		
Milestones		0.1	1.1			2.1	1.2	2.2					3.1				3.2								0.2
Secondments				CFUV										UCL											

3.2. Appropriateness of the management structure and procedures, including risk management

A Career Development Plan will be drafted with the supervisor in the first month of the fellowship (D0.1) which will include specific training and research objectives (following the S.M.A.R.T. criteria) and which will help the applicant monitor the outcomes of the fellowship. The ongoing project will be monitored through annual project reports (D0.2 and D0.3) and managed through weekly meetings with the supervisor to ensure

full coherence between the ongoing research and project objectives. In these meetings, the advancements of the research will be discussed and the supervisor will provide adequate mentoring in the general background of climate variability and predictability, helping with the adaptation of the research program to the difficulties encountered and encouraging progress in the most promising aspects of the research undertaken.

A project manager will support the researcher in all legal, financial, and administrative arrangements, and will work with the Education, Human Resources, and Communication departments for training arrangements and dissemination and outreach activities. BSC has implemented measures to foster research careers and strengthen international training based on the principles of the European Charter for Researchers EURAXESS and on the Code of Conduct for Recruitment. As a result, BSC was awarded with the badge of Human Resources Excellence in Research (HRS4R) in April, 2015. Finances of the project will be managed according to MSC funding rules and will follow established processes at the centre.

The potential research risks identified at this stage do not pose a threat to endanger the successful implementation of the project goals. Nonetheless, we list below the minor risks and contingency measures associated with each one:

Risk	**WP**	**Risk level, reasoning, contingency plan**
Mismanagement	All	*Low*. Project management will be supported by project managers at BSC.
No more HPC resources at BSC	1,2	*Low.* Analyze simulations performed by other research centers participating in VolMIP.
Sensitivity runs do not provide robust results	1, 2	*Medium.* A scientific results in itself. Consider increasing the ensemble size. Explore experiments performed at other research centers for comparison.
Delay in the development of the Greenland regional models	3	*Low.* Since it is the last WP, its implementation can be delayed enough to allow for the model development to get completed and become operative.
Little role of Greenland melting in Arctic climate variability	3	*Medium.* A scientific results in itself since it will dispute most theories proposed so far.

3.3. Appropriateness of the institutional environment (infrastructure)

The outstanding high performance computing infraestructures, computational resources, and IT support available at BSC are more than sufficient for attaining the project objectives. The candidate has already extensive experience in computational analysis, and BSC has a highly skilled and well trained team of technicians who will advice and support the candidate on the use of the available high-performance computing infrastructure. Within the ES-BSC, the Computation Earth Science group provides strong support to researchers, develops tools to automate running, post-processing, and detailed analyses of climate experiments and helps them manage the computing resources efficiently.

BSC will facilitate the fellow immediate access to a personal workstation, laptops, BSC’s high-performance computing facilities, library, conference rooms, and other services such as internal training and seminars, language classes, health insurance, and entry permits. BSC is an ideal institution for hosting the fellow, as it has made a Declaration of Endorsement to the principles of the “European Charter for Researchers” and “The Code of Conduct for the recruitment of researchers” and has been awarded with the “HR Excellence in Research” logo. BSC is one of the eight research institutes recognised as a Severo Ochoa Center of Excellence by the Spanish Government. The fellow will fully benefit from participating in the various projects that BSC is involved in and will be exposed to many networking opportunities. The combination of outstanding available supercomputing facilities, high quality user support, and experience in hosting fellows at BSC will provide the candidate a very strong basis of scientific infrastructure to be successful in his research project.

Part B-2 Section 4 - CV of the experienced researcher

Eduardo Moreno-Chamarro

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RESEARCH INTERESTS

North Atlantic and Arctic climate variability; Atmosphere–ocean–ice interactions on decadal to millennial time scales; climate modeling

APPOINTMENTS

Barcelona Supercomputing Center (Barcelona)

02/2018–Present *Research Scientist*
Earth Science Department. Climate Prediction Group.

Massachusetts Institute of Technology (Cambridge)

10/2016–12/2017 *Postdoctoral Associate*
Department of Earth, Atmospheric and Planetary Science. John Marshall's research group

Max Planck Institute for Meteorology (Hamburg)

07/2016–09/2016 *Postdoctoral Scientist*
"Ocean in the Earth System" Department. Director's Scientific Group.

EDUCATION

Max Planck Institute for Meteorology (Hamburg)

03/2013–07/2016 PhD (*magna cum laude*)

Complutense University (Madrid)

2011–2012 Master in Geophysics and Meteorology

2005–2011 Physics (Specialty: Atmospheric Physics)

SUPPLEMENTARY EDUCATION

September, 2014 *DPG Physics School on Physics of the Ocean.* Physizentrum Bad Honnef, Germany

September, 2013 *Summer School on Earth System Modeling.* MPI-M. Hamburg, Germany

July, 2013 *Summer School in Paleoclimatology.* University of Urbino, Italy

September, 2012 *European Campus of Excellence International Summer School: Climate Change in the Marine Realm.* Alfred Wegener Institute. Sylt and University of Bremen, Germany

PUBLICATIONS

McGee, D., **Moreno-Chamarro, E.**, Marshall, J., & Galbraith, E. (in review). Western US lake expansions during Heinrich stadials linked to Pacific Hadley circulation

Thirumalai, K., Quinn, T. M., Okumura, Y., Richey, J. N., Partin, J. W., Poore, R. Z., & **Moreno-Chamarro, E.** (2018). Pronounced centennial-scale Atlantic Ocean climate variability correlated with Western Hemisphere hydroclimate. *Nature Communications*, 9(1), 392.

McGee, D., **Moreno-Chamarro, E.**, Green, B., Marshall, J., Galbraith, E., & Bradtmiller, L. (2018). Hemispherically asymmetric trade wind changes as signatures of past ITCZ shifts. *Quaternary Science Reviews*, 180, 214-228.

Moreno-Chamarro, E., Zanchettin, D., Lohmann, K., Luterbacher, J., & Jungclaus, J. H. (2017). Winter amplification of the European Little Ice Age cooling by the subpolar gyre. *Scientific Reports*, 7, 9981

Kilbourne, H., Klockmann M., **Moreno-Chamarro E**., Ortega P., Romanou A., Srokosz M., Szuts Z., Thirumalai K., Hall I., Heimback P., Oppo D., Schmittner A., and Zhang R. (2017). *Connecting paleo and modern oceanographic data to understand AMOC over decades to centuries.* A US CLIVAR Workshop Report, Report 2017–3, 26pp.

Moreno-Chamarro, E., Zanchettin, D., Lohmann, K., & Jungclaus, J. H. (2017). An abrupt weakening of the subpolar gyre as trigger of Little Ice Age-type episodes. *Climate Dynamics*, 48(3), 727–744

Moreno-Chamarro, E., Ortega, P., González-Rouco, P., & Montoya, M. (2017). Assessing reconstruction techniques of the Atlantic Ocean circulation variability during the last millennium. *Climate Dynamics*, 48(3), 799–819

Moreno-Chamarro, E., Zanchettin, D., Lohmann, K., & Jungclaus, J. H. (2015). Internally generated decadal cold events in the northern North Atlantic and their possible implications for the demise of the Norse settlements in Greenland. *Geophysical Research Letters*, 42(3), 908–915

L. Bush, Ö. Can, **E. Chamarro**, I. J. Illers, A. Lauss, J. Maxwell, L. Pettit, C. Sheldon, K. Thirumalai. (2013). "Module 3 The ocean in the climate system" in: Dummermuth, A. and Grosfeld, K. (eds.): "Climate change in the marine realm: an international summer school in the framework of the European Campus of Excellence", *Berichte zur Polar- und Meeresforschung = Reports on polar and marine research*, Bremerhaven, Alfred Wegener Institute for Polar and Marine Research, 662, 75 p. hdl:10013/epic.41554

CONFERENCES AND PRESENTATIONS

"AMV in the context of CMIP6" Workshop. Barcelona Supercomputing Center. July, 2018

Seminar. Barcelona Supercomputing Center. March, 2018 (Talk)

SLS Seminar. MIT, US. November, 2017 (Invited talk)

1st PMIP4 Conference. Stockholm, Sweden. September, 2017 (Poster presentation)

Seminar. Complutense University of Madrid, Spain. June, 2017 (Invited talk)

Paleoclimate Seminar. Woods Hole Oceanographic Institution (WHOI), US. June, 2017 (Invited talk)

5th Pages Open Science Meeting. Zaragoza, Spain. May, 2017 (Talk and poster presentation)

Southern Ocean Workshop. Boulder, Colorado. April, 2017 (Poster presentation)

AMOC Workshop. Boulder, Colorado. May, 2016 (Poster presentation)

1st Ocean Pages2K Workshop. Barcelona. October, 2015 (Invited talk)

Past Earth Network Conference. Crewe, UK. Septermber, 2015 (Poster presentation)

AGU Fall Meeting. San Francisco. 2015 (Poster presentation)

EGU General Assembly. Vienna, Austria. 2014, 2015 (Poster presentations)

Seminar at Max Planck Institute for Meteorology. Hamburg, Germany. October, 2014 (Talk)

Invited speaker at SICSS Scientific Writing Group. Hamburg, Germany. October 2014

Poster presentations at DPG Physics School on Physics of the Ocean. Bad Honnef, Germany. September, 2014

Poster presentation at Summer School in Paleoclimatology. Urbino, Italy. July, 2014

TEACHING EXPERIENCE

April, 2016	*Three-day workshop on "Effective strategies of teaching at university"* Hamburg University, Germany
2014–2016	Tutor for Ocean Exercises during the "Introduction to Earth System Science and Modelling" course at the International Max Planck Research School on Earth System Modelling
September, 2014	PhD Seminar on Empirical Orthogonal Functions Max Planck Institute for Meteorology

OUTREACH

"The Morning of the Research" (Talk at a secondary school). European Researchers' Night. Barcelona.

September, 2018

"An Ocean of Plastic". Cambridge Science Festival. MIT Museum. Cambridge, US. May, 2017

AWARDS

Young Scientist Outstanding Poster Award. EGU General Assembly. Vienna, Austria. 2014.

OTHER SKILLS AND ACTIVITIES

Reviewer for Nature Geoscience, Earth System Dynamics, and Climate of the Past.

Languages:

Spanish:	Native
English:	Fluent
German:	Intermediate (B2 Level)

Computing:

Operating systems:	Linux, Windows
Modeling experience:	User of EC-Earth, MITgcm, MPI-ESM, and Climber-3α
	Familiar with GFLD GCMs, CCSM/CESM, ECHO-G, and Speedy.
Data analysis:	Pyferret; Climate Data Operators (cdo); Matlab; Fortran; R; GrADS
	Familiar with proxy, observational, reanalysis, and modeling (CMIP5/PMIP3) data

Part B-2 Section 5 - Capacity of the Participating Organisations

List of participating organisations

Participating organisations	**Legal Entity Short Name**	**Country**	**Supervisor**	**Role of partner organisation**
Beneficiary				
Barcelona Supercomputing Center	BSC	Spain	Dr. Pablo Ortega	
Partner Organisation				
Ca'Foscari University of Venice	UCFV	Italy	Ass. Prof. Davide Zanchettin	Secondment
Université Catholique de Louvain	UCL	Belgium	Prof. Hugues Goosse	Secondment

No inter-relationships exist between the participating organization(s), individuals, and any other entities or persons.

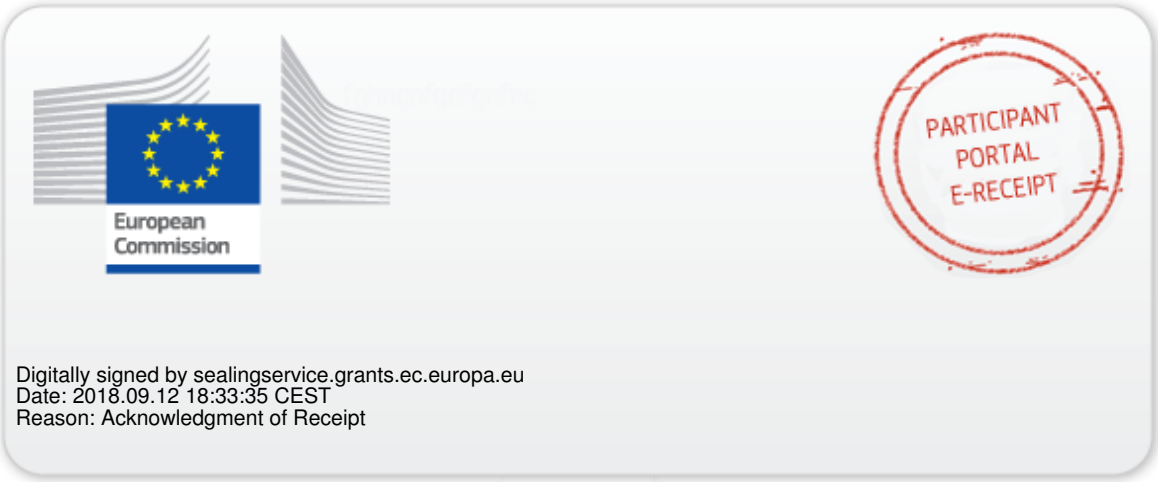
Beneficiary: Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC), Spain	
General description	**The Barcelona Supercomputing Center (BSC)** is the national supercomputing facility of Spain, hosting the MareNostrum, one of the most powerful supercomputers in the world. It employs over 500 researchers focusing on a multidisciplinary research in Earth and Life Sciences and Scientific Computing. BSC has been accredited as one of the first eight Severo Ochoa Centers of Excellence. This award is given by the Spanish Government as recognition for leading research centers in Spain that are internationally well-know institutions in their respective areas. Established in 2006, the **Earth Sciences Department** of the BSC (ES-BSC) works on climate modeling. The designation of Prof. Francisco J. Doblas-Reyes as Director of the ES-BSC in 2014 initiated the merging of the Climate Forecast Unit of the Intititut Català de Ciències del Clima (IC3-CFU), which he was leading and that in a short time had became a main European actor in the development of climate predictions and climate services. The newly merged department is structured around four groups, with more than 70 employees, including technical and support staff. Dr. Moreno-Chamarro will be carrying out his project within the **Climate Prediction Group** (**CPG**) that carries out advanced research in seasonal-to-decadal climate forecasting. It is one of the world leaders in the field of climate prediction with more than 186 peer-reviewed research articles published over the last 5 years, including 13 in high-impact journals (see https://earth.bsc.es/wiki/doku.php?id=publications: publications for a complete list of the publications). The candidate will be supervised by Dr. **Pablo Ortega**, co-leader of the Climate Prediction Group.
Academic organisation	Yes. In addition, BSC closely collaborates with Universidad Politècnica de Catalunya (UPC), including a joint Master degree in Environmental Engineering.
Role and profile of key persons (supervisor)	**Dr. Pablo Ortega** is a co-leader of the Climate Prediction group at BSC-ES. He directly supervises the work of eight postdocs (including 1 MSC fellow), one PhD, and two undergraduate students, and he is currently coordinating BSC's participation in two H2020 projects (INTAROS and APPLICATE; the latter as WP leader), an ESA project (CMUG-CCI-phase3), the Belgian project PARAMOUR, and the Spanish MINECO-funded project DANAE. Dr. Ortega is an expert in decadal climate variability and predictability with more than ten years of experience as climate modeler and paleoclimatologist, with particular interest in the fate of the ocean circulation and associated climatic impacts. His broad expertise and trajectory has allowed him to secure recently a senior-track position, through the Spanish Ramón y Cajal Fellowship Program.
Dept./Division/Laboratory	Earth Sciences Department, Climate Prediction Group
Key research facilities, Infrastructure and Equipment	The Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) is the national supercomputing facility of Spain. BSC-CNS's mission is to develop and manage information technology in order to facilitate scientific and technological progress. BSC-CNS hosts a range of high-performance computing (HPC) systems, including MareNostrum IV, with 165,888 cores and 11.15 Pflops of peak performance.
Independent research premises?	Yes. All key research facilities, infrastructure, and equipment will be available for the fellow.
Previous and current involvement in research and training programmes	The BSC-ES Department is a highly productive scientific institution that has been granted 24 EU Horizon 2020 projects, 6 EU FP7 projects, 10 Copernicus contracts, 11 national projects and 4 European Space Agency projects in the last five years. The most relevant projects for this MSC proposal in which the CPG participates are Spanish-funded project **VOLCADEC** (CGL2015-70177-R, running some of the VolMIP experiments), the Belgian-funded project **PARAMOUR** (EOS O010718F-RG81, performing the Greenland meltwater experiments) and the H2020 projects **EUCP** (H2020-SC5-2016-2017-776613, producing the real-time decadal predictions), **APPLICATE** (H2020-BG-2016-2017-727862, producing the initial conditions of sea-ice for the predictions) and **PRIMAVERA** (H2020-SC5-01-2014-641727, which has helped develop the last version of EC-Earth employed to produce the different simulations to be used in this proposal). The BSC is also the beneficiary of Marie Skłodowska-Curie Action COFUND program for postdoctoral fellows (STARS; H2020-MSCA-COFUND-754433). The BSC-ES is currently awarded 6 early stage postdoctoral fellowships (5 Juan de la Cierva and 1 Beatriu de Pinos), 5 senior research grants (4 Ramon y Cajal, ICREA) and hosts 7 MSCA-IF research projects: NeTNPPAO, ACRoNNim, SPFireSD, DUST.ES, PROTECT, INADEC and CLIM4CROP.
Relevant publications and/or research/innovation products	Selected list of 5 publications by Dr. Ortega most relevant for this proposal: Thornalley et al. (2018), Anomalously weak Labrador Sea convection and Atlantic overturning during the past 150 years. *Nature*, 556, 227–230. Swingedouw et al (2018), Impact of explosive volcanic eruptions on the main climate variability modes", *Global and Planetary Change*, 150, 24-45. Ortega et al (2017) Mechanisms of decadal variability in the Labrador Sea and the wider North Atlantic in a high-resolution climate model. *Climate Dynamics*, 49, 2625–2647. Guillet et al. (2017), Climate response to the Samalas volcanic eruption in 1257 revealed by proxy records, *Nature Geoscience*, 10,123–128. Ortega et al. (2015), A model-tested North Atlantic Oscillation reconstruction for the past millennium. *Nature*, 523, 71–74.

Partner Organization for secondment: Ca' Foscari University of Venice (Italy)	
General description	The Ca'Foscari University of Venice (Italy) is a leading university in Italy in Economics and Management, Humanities, Languages and Literature, and Science. The university has a nationally and internationally outstanding reputation for academic excellence in the fields of teaching and research; in 2017, it was rated among the top 150 for Modern Languages, and among the 250 top universities for Economics & Econometric, Linguistics and Arts & Humanities in the QS World University Ranking by Subject. Since 2014, it has been awarded with 97 grants in the frame of individual and collaborative European and International projects, 61 of which had been funded in the frame of Horizon 2020.
Academic organization	Yes
Role and profile of key persons (supervisor)	**Ass. Prof. Davide Zanchettin** is chair of the CMIP6-endorsed activity VolMIP and member of the CLIVAR panel on Decadal Climate Variability and Predictability. He has been affiliated to the Ca'Foscari University of Venice, the Euro-Mediterranean Center for Climate Change, and the Max Planck Institute for Meteorology, collecting more than 15 years of experience in the study of decadal climate variability and predictability. He has published more than 45 original contributions in international scientific journals, particularly on natural forcing of decadal and multidecadal climate variability, and co-authored an award-winning book on climate change. His student supervision experience includes co-supervision of Master students at the Ca'Foscari University of Venice, and of PhD students at the International Max Planck School on Earth System Modelling and the University Parthenope of Naples.
Dept./Division / Laboratory	Department of Environmental Sciences, Informatics and Statistics (DAIS)
Key research facilities, Infrastructure and Equipment	The Ca'Foscari University of Venice is equipped with a set of hardware and software facilities for intensive scientific computation for research purposes (Scientific Computation System – Ca'Foscari, www.dais.unive.it/scscf). The system currently consists of a cluster of computational nodes and some auxiliary devices; several parallel computing software and libraries are available.
Independent research premises?	Yes. All key research facilities, infrastructure, and equipment will be available for the fellow.
Previous and current involvement in research and training programmes	The Department of Environmental Sciences, Informatics, and Statistics (DAIS) brings together world-leading faculty members and research personnel committed to work in cutting-edge research topics such as climate, complexity, cultural heritage conservation, monitoring, risk, security, and sustainability. DAIS has a well-structured organization and a solid expertise in the management of research externally funded by major national and EU funding bodies. It is engaged in cooperation projects with a wide network of research institutions, industrial partnerships and SMEs: 1. Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP, www.volmip.org); Role: Leader; Description: VolMIP is an international CMIP6-endorsed activity which coordinates the activities of different Research Institutes involved in numerical climate modeling focused on a multi-model assessment of climate models' performance under strong volcanic forcing conditions. Twelve climate models and more than 50 scientists from around the world are currently involved in VolMIP. Action duration: 2016–2020. 2. "Enhancing Prediction of Tropical Atlantic Climate and its Impacts (PREFACE, n. 603521, https://preface.w.uib.no/)"; Role: partner (WP leader); Description: PREFACE was funded by the European Union 7th Framework Program to improve our understanding of the functioning of the tropical Atlantic climate and our capabilities to predict it and its impacts, with a particular focus on Atlantic African fishing communities. The Ca'Foscari University of Venice contributed to WP10 (Statistical methods to assess and improve forecast of tropical Atlantic variability) and developed a Bayesian hierarchical modeling strategy to re-calibrate forecasts and improve prediction of tropical Atlantic variability and its impact. Action duration: 2014–2018. 3. CLARITY. Clarity is a Marie Skłodowska-Curie Individual Fellowship project, financed under the H2020-MSCA-IF-2015 call. It is a multidisciplinary collaboration in DAIS that aims to incorporate physical perspectives of complex systems into climate modeling strategies to help advance our understanding of climate variability and improve our ability to simulate the climate evolution. Action duration: 2016–2018. 4. "Droughts and Water Scarcity in the EU: Economic Impact, Adaptation, Policy Implications, and Integrated Assessment Modeling" (WATER DROP, n. 705408); Role: coordinator; Description: WATER DROP is a Marie Skłodowska-Curie Individual Fellowship project, financed under the H2020-MSCA-IF-2015 call. It aims at measuring the economic impacts of droughts and test for the existence of adapting behavior in the context of responses to droughts and, on the other hand, respond the demands of the IPCC that urge for progress in the integration and modeling of adaptation into climate-economy models. It applies econometric techniques envisaged by the new climate-economy literature to regionally detailed data and obtain estimates of the economic impacts of droughts and adapting behavior. Action duration: 2018–2019. 5. "Aerosols, Clouds, and Trace gases Research Infrastructure" (ACTRIS-2, n. 654109); Role: partner; Description: ACTRIS is the European Research Infrastructure for the observation of Aerosol, Clouds, and Trace gases, financed under the H2020-INFRAIA-2014-2016 call. ACTRIS is composed of observing stations, exploratory platforms, instrument calibration centers, and a data center. ACTRIS serves a vast community of users working on atmospheric research, climate and Earth system and air quality models, satellite retrievals, weather analysis, and forecast systems by offering high quality data and research infrastructure services for atmospheric aerosols, clouds, and trace gases. Action duration: 2015–2019.
Relevant publications and/or research/innovation products	Zanchettin et al. (2017). *Scientific Reports*. 7, 12862. Zanchettin et al. (2016). *Geoscientific Model Development*, 9, 2701–2719. Winter et al. (2016). *Nature Communications*, 6, 7627. Zanchettin et al. (2012). *Climate Dynamics*, 39:1–2, 419–444 Zanchettin et al. (2014). *Earth System Dynamics*, 5, 223–242.

Partner Organization for secondment: Université Catholique de Louvain (Belgium)	
General description	The international reputation of the Earth and Climate division (ELIC) of the Earth and Life Institute of the Georges Lemaître Center for Earth and Climate Research (TECLIM; www.climate.be) in the area of climate modeling is well established. Their members have produced seminal studies focused on glacial–interglacial cycles, the abrupt climate change 8200 years ago, climate variability and change during the Holocene (including the last millennium), interannual climate variability over the last decades, and future climate change. Current climate-related research efforts in ELIC include (1) past climate change, (2) the present state of the Earth system, (3) human–environment interactions, and (4) modeling tools. A significant fraction of the research carried out in ELIC is related to polar climate. Among the 100 members of ELIC, three permanent researchers (professors), 8 postdoctoral researchers, and 7 PhD students devote their activity to polar regions mainly. Over the past decade, the polar group has produced several important papers on the mechanisms responsible for past and future climate change at high latitudes of both hemispheres and the role of polar oceans and sea ice in observed and projected climate change; recently, it has also been involved in studies analyzing the predictability on interannual time scales of the polar climate under both idealized and realistic conditions.
Academic organization	Yes
Role and profile of key persons (supervisor)	**Prof. Hugues Goosse** is research director with the Fonds National de la Recherche Scientifique (F.R.S.-FNRS-Belgium) and professor at the Université de Louvain in Belgium where he teaches climate related topics. His research is devoted to the development of climate models, model-data comparison, and the application of models to study past, current and future climate change, analyzing both natural variability and the response to human-induced perturbations. More specifically, his recent work is focused on sea-ice–ocean–atmosphere interactions, decadal to centennial climate variations over the past millennium, and data assimilation using ensemble methods in climate models. He currently coordinates the project PARAMOUR, funded in the framework of Excellent of Science program, the most prestigious and competitive one in Belgium. The goal of PARAMOUR is to study the predictability of ice sheets and surrounding regions using regional coupled models including components for the atmosphere, the ocean, the sea ice and the ice sheets. The main contribution of the partnership with UCL will be on the analysis of the changes in the cryosphere and their impact on the predictability of the system as well as to provide connections with the other partners of PARAMOUR.
Dept./Division / Laboratory	Earth and climate division of the Earth and Life Institute
Key research facilities, Infrastructure and Equipment	Members of ELIC have local access to several relatively small computer clusters to perform diagnostics and analyze results of simulations. Through the Consortium des Equipments de Calcul Intensif (CECI; www.cecihpc.be, supported by the Fonds de la Recherche Scientifique – FNRS), members of UCL also have a free access to a range of 'Tier 2' clusters hosted at the universities of the Féderation Walonnie–Bruxellest and to the Zénobe cluster ('Tier 1') hosted at and operated by Cenaero (www.cenaero.be), which currently features a total of 11,496 cores. The members of ELIC have a long experience of high performance computing on those machines and on other infrastructures abroad.
Independent research premises?	Yes. All key research facilities, infrastructure, and equipment will be available for the fellow.
Previous and current involvement in research and training programmes	ELIC's members are heavily involved in teaching at bachelor, master (mainly in the fields of physics and geography), and graduate levels at the Université catholique de Louvain, and supervising master and PhD students, with about 23 nationalities currently represented among the 60 PhD students and postdocs. ELIC's polar group is developing and maintaining, in collaboration with the with the Institut Pierre Simon Laplace (IPSL, Paris, France), the Louvain-la-Neuve Ice Model (LIM for short; www.climate.be/lim), a state-of-the-art sea ice model designed for climate studies and operational oceanography. LIM is coupled to the ocean general circulation model OPA (Ocean Parallélisé) and is part of the NEMO (Nucleus for European Modeling of the Ocean; www.nemo-ocean.eu) platform, which is routinely used in about 30 countries by more than 1500 scientists. In addition, the group has contributed to the coupling of LIM to several other climate models, in particular the general circulation models IPSL-CM and EC-Earth. The group has participated in several intercomparison projects, including the Coupled Model Intercomparison Project (CMIP). It has deeply been involved in the assessment reports of the Intergovernmental Panel on Climate Change (IPCC), some of its members being lead authors and contributing authors in charge of polar climate changes and model evaluation in polar regions. Members of the group are well anchored in polar research networks and have also been appointed in international organizations such as the World Climate Research Programme (WCRP)'s CliC (www.climate-cryosphere.org) and the Southern Ocean Region Panel (SORP, http://www.scar.org/ssg/physical-sciences/sorp). Finally, the group is currently contributing to ongoing international polar initiatives like the Year of Polar Prediction (www.polarprediction.net/yopp) and two H2020 EU projects related to polar climate high-resolution modeling, APPLICATE, and PRIMAVERA.
Relevant publications and/or research/innovation products	Massonnet et al. (2018). *Nature Climate Change*, 8, 599–603. Goosse et al. (2018). *Nature Communications*, 9, 1919. Lecomte et al. (2017). *Nature Communications*, 8, 258. Jones et al. (2016). *Nature Climate Change*, 6, 917–926. Goosse & Zunz (2014). *The Cryosphere*, 8, 453–470.

Part B-2 Section 6 - Ethical Issues

No ethical issues were flagged in the Ethics Issues Table, and thus the proposal meets the EU and national legal and ethics requirements.



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