Horizon 2020

Call: H2020-MSCA-IF-2016

(Marie Skłodowska-Curie Individual Fellowships)

Topic: MSCA-IF-2016

Type of action: MSCA-IF-EF-ST

(Standard EF)

Proposal number: 748551

Proposal acronym: STRATOCAST

Deadline Id: H2020-MSCA-IF-2016

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How to fill in the forms?

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

This proposal version was submitted by **Francisco J. DOBLAS-REYES** on **13/09/2016 16:28:22** Brussels Local Time. Issued by the Participant Portal Submission Service.

Proposal ID **748551** *Acronym* **STRATOCAST**

1 - General information

Topic	MSCA-IF-2016
Call Identifier	H2020-MSCA-IF-2016
Type of Action	MSCA-IF-EF-ST
Deadline Id	H2020-MSCA-IF-2016

Acronym	STRATOCAST
Proposal title	Predictability of sudden stratospheric warming events in a seasonal forecast system

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

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	*Meteorology, atmospheric physics and dynamics*
Descriptor 2	*Climatology and climate change*
Descriptor 3	*Ozone, upper atmosphere, ionosphere*

Remove

Add

Free keywords	*Sudden stratospheric warming, stratospheric predictability, wave-mean flow interactions, seasonal forecasting, European climate variability, outreach activities*

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Abstract

STRATOCAST aims at exploring the predictability of sudden stratospheric warming (SSW) events during the Northern Hemisphere winter. SSWs are known to influence storm tracks in the North Atlantic-European sector, thereby altering the climate conditions (i.e. surface winds, temperature, rainfall) in Europe for up to two months after the events. This is particularly relevant since the Euro-Atlantic winter is currently the region and season with the lowest prediction skill from both dynamical and statistical forecasts. Hence, a better understanding and modelling of SSWs could have an immediate impact on the climate forecasting community, and on different socio-economic sectors.

The scientific objective of this project is to gain insight into the dynamical mechanisms that trigger SSW events and, in particular, to identify the relative roles of tropospheric wave injection and stratospheric preconditioning in SSW predictability. The capability of a state-of-the-art Earth System Model to reproduce the observed stratospheric behaviour will be also addressed. Concrete plans for society outreach, favouring the impact and dissemination of results, will be carried out in a targeted work-package. The novelties of this project are (i) the first comprehensive evaluation of the stratospheric circulation and its influence on surface climate variability in the forecast system EC-Earth, and (ii) the unprecedented set of model experiments to tackle the predictability of simulated and observed SSWs.

Remaining characters 496

Has this proposal (or a very similar one) been submitted to a Horizon 2020 Marie Skłodowska-Curie Individual Fellowship call? ○ Yes ◉ No

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Declarations

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

4) The applicant (future beneficiary) confirms:

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

5) The applicant (future beneficiary) hereby declares:

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

The applicant (future beneficiary) is only responsible for the correctness of the information relating to his/her own organisation. Where the proposal to be retained for EU funding, the applicant (future beneficiary) will be required to present a formal declaration in this respect.

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

Personal data protection

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

Your personal data may be registered in the Early Warning System (EWS) only or both in the EWS and Central Exclusion Database (CED) by the Accounting Officer of the Commission, should you be in one of the situations mentioned in:
-the Commission Decision 2008/969 of 16.12.2008 on the Early Warning System (for more information see the Privacy Statement), or
-the Commission Regulation 2008/1302 of 17.12.2008 on the Central Exclusion Database
(for more information see the Privacy Statement) .

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List of participants

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

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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

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... no
Research organisation ..... yes
Small and Medium-sized Enterprises (SMEs) ..... no
Academic Sector ..... yes

Legal person ..... yes

NACE Code: 72 - Scientific research and development

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

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Department(s) carrying out the proposed work

Department 1

Department name: Earth Sciences ☐ not applicable

☐ Same as organisation 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.

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Researcher

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

Researcher ID	*If you have a researcher identifier number (e.g. ResearcherID, ORCID) please enter it here.*		
Last Name*	DE LA CAMARA	Last Name at Birth	de la Camara Illescas
First Name(s)*	Alvaro	Gender*	(•) Male ( ) Female
Title	Dr.	Country of residence*	United States
Nationality*	Spain	Nationality 2	
Date of Birth (DD/MM/YYYY)	12/07/1981	Country of Birth*	Spain
		Place of Birth	Madrid

Contact address

Current organisation name	National Center for Atmospheric Research
Current Department/Faculty/Institute/ Laboratory name	Atmospheric Chemistry Observations and Modelling

☐ Same as organisation address

Street	3450 Mitchell Lane		
Postcode/Cedex	80301	Town	Boulder
Phone	+13034971874	Country	United States
Phone2 / Mobile	+13038950049		
E-Mail*	acamarai@outlook.com		

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Qualifications

University Degree	Date of award (DD/MM/YYYY)	30/06/2007
Doctorate (in progress)	Date of award (DD/MM/YYYY)	
Doctorate	Date of award (DD/MM/YYYY)	20/12/2012
Full time postgraduate research experience	Number of months	111
Other Academic qualifications	Date of award (DD/MM/YYYY)	30/09/2005

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, until the call deadline (14/09/2016).

Period from	Period to	Duration (days)	Country
09/09/2015	14/09/2016	372	United States
01/02/2013	08/09/2015	950	France
16/05/2012	31/01/2013	261	Spain
15/03/2012	15/05/2012	62	United States
14/09/2011	14/03/2012	183	Spain
	Total	1828	

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Supervisor

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

Title: Prof. Sex: (•) Male ( ) Female

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

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

Position in org.: Earth Sciences Department Director

Department: Earth Sciences

[ ] Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona Post code: 08034

Country: Spain

Website: https://www.icrea.cat/Web/ScientificStaff/francisco-javier-doblas

Phone: +34934137719 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

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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	0,976	24	108921,60	14400,00	12000,00	19200,00	15600,00	170121,60
Total				24	108921,60	14400,00	12000,00	19200,00	15600,00	170121,60

Partner Organisation from Third Country does not sign the Grant Agreement, does not recruit the researcher and does not directly claim costs from the action. The entire EC contribution is transmitted to the Host organisation located in Members States or Associated Countries.

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4 - Ethics issues table

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

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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

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5 - Call specific questions

Eligibility Researcher (future fellow)

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

Other Questions

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

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

2. Is there a secondment in Member States or Associated Countries 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: Met Office

Country: United Kingdom

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Data management activities

A new focus within Horizon 2020 is data management, for example through the use of Data Management Plan (DMP).

DMPs detail what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved.

The use of a DMP is required for projects participating in the Open Research Data Pilot in the form of a deliverable in the first 6 months of the project (possible updates during the project).

Other projects are invited to submit a DMP if relevant for their planned research.

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

Open Research Data Pilot in Horizon 2020

All applicants can participate in the Pilot on Open Research Data in Horizon 2020[1] on a voluntary basis. This Pilot aims to improve and maximise access to and re-use of research data generated by actions.

Participants in the Pilot will be invited to formulate a Data Management Plan (DMP). DMPs detail what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved.
Participating in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. Rather, projects can define certain datasets to remain closed via a Data Management Plan (DMP).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be evaluated favourably because they participate in the Pilot on a voluntary basis.

We wish to participate in the Pilot on Open Research Data in Horizon 2020 on a voluntary basis	○ Yes	◉ No

[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.*

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DOCUMENT 1

START PAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2016

PART B

"STRATOCAST"

"Predictability of sudden stratospheric warming events in a seasonal forecast system"

This proposal is to be evaluated as:

[Standard EF]

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LIST OF PARTICIPATING ORGANISATIONS

Participating organizations	Legal entity short name	Academic	Non-academic	Country	Dept./ Division	Supervisor	Role of the partner organization
Beneficiary Barcelona Supercomputing Centre	BSC	✓		Spain	Earth Sciences Department	Prof. Francisco J. Doblas-Reyes	Host institution
Partner organization Met Office	Met Office	✓		United Kingdom	Hadley Centre	Prof. Adam A. Scaife	Secondment

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1. EXCELLENCE

1.1 Quality and credibility of the research/innovation action (level of novelty, appropriate consideration of inter/multidisciplinary and gender aspects)

Introduction, state-of-the-art, objectives and overview of the action

Twice every three years on average, the strong, cyclonic stratospheric polar vortex (SPV) centred on the pole that dominates the wintertime stratospheric circulation in the extratropical Northern Hemisphere (NH) is subject to one of the most impressive dynamical events in the climate system: the so-called sudden stratospheric warming[1] (SSW). During an SSW, the SPV is severely displaced off the pole (i.e. "displacement" event) or split into two smaller vortices (i.e. "split" event) in a matter of few days[2]. Driven by enhanced planetary wave activity, polar temperatures in the stratosphere increase several tens of degrees, and the direction of the zonal mean winds reverses from westerly to easterly[3]. **SSWs are important because associated temperature and wind anomalies descend from the stratosphere to the troposphere, where they induce changes in the storm tracks and impact surface weather for up to two months**[4,5,6]. In particular, the anomalous weather conditions in Europe after SSW events resemble those associated with a negative phase of the North Atlantic Oscillation[5] (NAO), namely anomalously wet and warm conditions in southern Europe and the opposite anomalous conditions in northern Europe.

This stratospheric influence on winter climate variability has been detected and studied for almost two decades, but not until recently have seasonal forecast systems started exploring the enhanced prediction skill provided by this connection[7,8]. Increasing evidence suggests that SSWs are a source of additional predictability in long-range forecasting of winter climate in Europe and eastern North America[9,10]; hence the **importance of assessing the capability of forecast systems to predict SSWs and their potential impacts at the surface**. Unfortunately, the mechanisms behind the explosive growth of stratospheric wave activity that ultimately triggers an SSW are still unclear. Succinctly, two explanations have been proposed. The first and more predominant is that SSWs are initiated by the anomalous injection of wave activity from the troposphere[11,12,13]. Indeed, different processes have been identified to alter the tropospheric planetary wave patterns and thus contribute to the occurrence of SSW events – i.e. blocking anticyclones[14,15], El Niño Southern Oscillation[15,16] (ENSO), the phase of the Quasi-Biennial Oscillation[17] (QBO), etc. The second proposes that the wave amplification that accompanies SSWs is indicative of nonlinear resonance[18,19]. Under this approach, it is the vortex geometry that determines the development of an SSW event, and no anomalously intense tropospheric wave activity is needed to trigger the event[20].

Interestingly, while some studies stress the key role of tropospheric wave activity in providing predictability of SSWs[21,22], Taguchi[23] has recently shown that skilful SSW forecasts depend on the ability of the model to predict the vortex geometry prior to the event, with split events being more challenging than displacement events. On their part, Marshall and Scaife[8] reported an improved SSW predictability as the stratospheric resolution is increased, which suggests that both mechanisms might be at play –with a better resolved stratosphere, stratospheric conditions and wave-mean flow interactions will be better represented. **Disentangling the relative roles of tropospheric precursors and stratospheric conditions on the development of SSWs is, therefore, a much-needed effort**, which will help clarify the predictability sources of SSW events. Does the stratosphere passively respond to tropospheric dynamics during SSWs? Or does it play an active role triggering SSWs? The answer to these questions, in turn, will guide modellers towards improved simulations/predictions of these events and their surface impact in the wintertime European region. The interest of contributing to a better climate prediction in this region is twofold. First, it is one of the most populated areas in the world, and hence the economic and societal benefits of improved climate prediction are broad. And second, this is a region of major scientific challenge since the Euro-Atlantic winter is currently the season with the lowest prediction skill from persistence-based forecasts[24], which can be explained by the high level of atmospheric internal variability. The winter in this region is also the season

[1] Butler et al. (2015), *Bull. Amer. Meteor. Soc.*, **96**, 1913-1928. [2] Mitchell et al. (2011), *J. Atmos. Sci.*, **68**, 1194-1213. [3] Charlton and Polvani (2007), *J. Clim.*, **20**, 449-469. [4] Baldwin and Dunkerton (2001), *Science*, **294**, 581-584. [5] Thompson et al. (2002), *J. Clim.*, **15**, 1421-1428. [6] Kidston et al. (2015), *Nature Geosci.*, **8**, 433-440. [7] Sigmond et al. (2013), *Nature Geosci.*, **6**, 98-102. [8] Marshall and Scaife (2010), *J. Geophys. Res.*, **16**, D16114. [9] Scaife et al. (2016), *Atmos. Sci. Lett.*, **17**, 51-56. [10] Tripathi et al. (2015), *Quart. J. Roy. Meteor. Soc.*, **141**, 987-1003. [11] Matsuno (1971), *J. Atmos. Sci.*, **27**, 871–883. [12] Limpasuvan et al. (2004), J. *Climate*, **17**, 2584–2596. [13] Ayazagüena et al. (2011), *J. Geophys. Res.*, **116**, D18114. [14] Martius et al (2009), *Geophys. Res. Lett.*, **36**, L14806. [15] Barriopedro and Calvo (2014), *J. Clim.*, **27**, 4704-4720. [16] Butler et al (2011), *Geophys. Res. Lett.*, **38**, L13807. [17] Scaife et al. (2014), *Geophys. Res. Lett.*, **41**, 2514–2519. [18] Matthewman and Esler (2011), *J. Atmos. Sci.*, **68**, 2481-2504. [19] Esler and Matthewman (2011), *J. Atmos. Sci.*, **68**, 2505-2523. [20] Albers and Birner (2014), *J. Atmos. Sci.*, **71**, 4028-4054. [21] Sun et al. (2012), *J. Atmos. Sci.*, **69**, 768,783. [22] Taguchi (2014), *J. Atmos Sci.*, **71**, 2886-2904. [23] Taguchi (2016), *Atmos. Sci. Lett.*, **17**, 33-38. [24] Doblas-Reyes et al. (2013), *WIREs Clim. Change – Advanced Review*, **4**, 245-268. [25] Doblas-Reyes et al. (2009), *Quart. J. Roy. Meteor. Soc.*, **135**, 1538–1559.

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with the overall largest systematic error in dynamical prediction systems, particularly for the pressure field, surface temperature and precipitation[25].

Generally, the above-mentioned studies focus on the forecast skill of observed SSWs. This adds complexity to the analysis of the predictability, this complexity mainly arising from the model drift towards its climatology when it is initialized with an observed state. Thus, a sensible first step should **tackle the capability of models to predict SSWs that are internally generated by the model**. This way, those inherent problems of predicting an SSW observed in nature will be absent, and the dynamical mechanisms that trigger an SSW event should be easier to identify.

In this context, **STRATOCAST aims at giving an important step forward in assessing the capabilities of current seasonal forecast systems to predict SSW events**. Targeted experiments with the state-of-the-art Earth system model EC-Earth are proposed to evaluate the individual role of tropospheric wave injection and stratospheric state for triggering SSWs. The outcome of this action will provide valuable and unique information to design strategies toward the improvement of long-range climate forecasts during the European winter.

The specific objectives that are pursued in STRATOCAST are:

- *Objective 1:* **Assess the EC-Earth model performance in the stratosphere**. We will use long control runs of the EC-Earth model to evaluate the model's ability to reproduce the observed stratospheric variability and the vertical coupling with the troposphere. Note that the atmospheric component of EC-Earth is the Integrated Forecast System (IFS) model, which is also the atmospheric model of the European Centre for Medium-range Weather Forecasts (ECMWF). The possibility of providing feedback to this operational centre is very attractive. *Expected results:* This analysis will provide detailed information on the model's behaviour in the stratosphere and its interaction with other components of the climate system, and will allow us to identify relevant model biases.
- *Objective 2:* **Estimate the stratospheric predictability during SSW events.** After assessing the model's performance in the coupled stratosphere-troposphere system, we will perform model experiments of SSWs with controlled initial and boundary conditions, as well as controlled injection of tropospheric wave activity. *Expected results:* These experiments will allow us to estimate the range of predictability of SSWs in the forecast system, and to gain further insight into the dynamical mechanisms responsible for their occurrence.

The objectives proposed have not been achieved before in the scientific community. On the one hand, we will perform the first comprehensive evaluation of the EC-Earth model regarding the stratospheric dynamics and interaction with other components of the climate system. On the other hand, we will tackle the issue of SSW predictability with an unprecedented design of sensitivity experiments (see next subsection). Given the observed impact of the stratosphere on climate variability, this is of great importance since EC-Earth is currently used in the host institution to generate seasonal and decadal climate forecast products.

Research methodology and approach

To achieve the above mentioned objectives, the following set of tasks are proposed:

Objective 1: Assess the EC-Earth model performance in the stratosphere

Task 1.1: *Evaluation of the stratospheric mean state and variability in EC-Earth.*

Two control runs several centuries long under pre-industrial and current climate conditions, already performed and available at BSC-ES with EC-Earth3.2 (CMIP6 version), will be employed.

A set of metrics will be applied to characterize the model performance in the stratosphere, and will be compared to three reanalysis products to estimate observational uncertainty: ECMWF ERA-Interim[26], NASA MERRA[27], and JMA (Japan Meteorological Agency) JRA-55[28]. Reanalyses are suitable datasets for climate monitoring and research, consisting of an unchanging data assimilation scheme and model that ingest all available observations every 6-12 hours. The metrics to be applied include, but are not limited to, 1) vertical cross-sections of zonal-mean zonal wind and temperature, 2) strength, position, and variability of the stratospheric jet, 3) leading variability modes of the geopotential field north of 20°N using Principal Components Analysis, 4) amplitude and phase of the large-scale planetary waves, and 5) frequency of SSWs (intraseasonal distribution). The potential preference of SSWs in the model to occur during ENSO events (El Niño/La Niña), after the occurrence of a tropospheric blocking anticyclone, and during a particular phase of the QBO will also be explored.

[26] Dee et al. (2011), *Quart. J. Roy. Meteor. Soc.*, **137**, 533-597. [27] Rienecker et al. (2011), *J. Climate*, **24**, 3624-3648. [28] Kobayashi et al. (2015), *J. Meteor. Soc. Jpn.*, **93**, 5–48.

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Task 1.2: *Analysis of tropospheric conditions after SSW events.*

After exploring the stratospheric variability, the tropospheric impacts of the SSWs previously identified, both in EC-Earth and the different reanalyses, will be addressed. Composites of surface variables (2 m temperature, precipitation, sea level pressure) from 10 to 60 days after SSW events will be performed for each dataset. The preferred NAO phase after SSWs will be evaluated by calculating Probability Density Functions during that time period.

It has been suggested that displacement and split events produce different tropospheric signatures[29,30]. To evaluate this potential behaviour, we will repeat the analysis stratifying the composites according to the SSW type.

Objective 2: Estimate the stratospheric predictability during SSW events.

Task 2.1: *Predictability of simulated SSWs.*

We will select a number of SSWs identified in Task 1.1. For each SSW, the model will be restarted a number of days before the event (20, 15, 10, and 5 days) and run over approximately 30 days, nudging the winds and temperature in the troposphere to the model free run; these will be the control runs (CTL). The nudging frequency will be set as high as possible, ideally every one hour, and a nudging strength given by a relaxation time of 50 h, which is the value used with the WACCM model at NCAR[31]. A set of sensitivity experiments will be additionally performed:

i. *EXP-S:* The model is restarted with the nudged tropospheric evolution, but this time perturbing the stratospheric state in the initial conditions. Two types of perturbations will be apply: 1) zonally-symmetric perturbations of wind and temperature in geostrophic balance, which will effectively modify the propagation path of the planetary waves throughout the stratosphere, and 2) singular vector perturbations method[32], which is currently used by the Climate Prediction group at the host institution for the ensemble climate forecast system.

ii. *EXP-T:* With the stratospheric initial conditions (before the SSW) unperturbed, several tropospheric evolutions simulated in different model times that are not linked to the development of an SSW will be imposed. There is an obvious risk in these simulations associated with the dynamical mismatch of introducing inconsistent tropospheric data. To minimize the potentially negative effects, such as spurious reflection of planetary waves, the tropospheric initial conditions will be selected in a way that the phases of the planetary waves in the upper troposphere (zonal harmonics one, two and three) are as close as possible to those in the lower stratosphere.

These sensitivity experiments aim at evaluating the relative roles of the stratospheric initial conditions and the injection of tropospheric wave activity in triggering an SSW. The achievement of this goal is ensured by the unprecedented design of the experiments: nudging the tropospheric winds, and letting the stratosphere free, will allow us to evaluate whether a given tropospheric injection of wave activity is enough to trigger an SSW; while perturbing the initial state of the stratosphere will allow us to identify vortex geometries that are more/less likely to trigger an SSW. The set of simulations proposed are schematically presented in Figure 1.

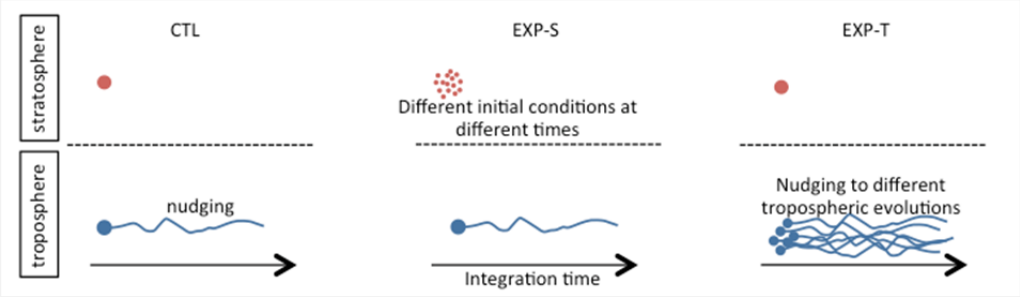

Figure 1: Schematic illustration of the experiments proposed in Task 2.1.

Task 2.2: *Predictability of observed SSWs.*

Predictability has two aspects: predicting something that happened, and not predicting something that did not happen (false alarms and correct rejections). In this task, the focus is on assessing the predictability of events that did happen. Observed SSWs from Task 1.1 will be selected as case studies. A set of retrospective forecasts (i.e. re-forecasts or hindcasts), mimicking the set-up in Task 2.1 concerning the different lead-times, will be carried out using observational estimates of the atmospheric state from ERA-Interim. For each lead-time, a first experiment

[29] Mitchell et al. (2013), *J. Clim.*, **26**, 2668-2682. [30] Maycock and Hitchcock (2015), *Geophys. Res. Lett.*, **42**, 10,943-10,951. [31] Smith et al. (2016), *submitted to J. Atmos. Sci.* [32] Buiza and Palmer (1995), *J. Atmos. Sci.*, **52**, 1434-1456.

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will aim at reproducing the SSW event by initialising the model with actual atmospheric initial conditions in both the troposphere and stratosphere (INI). Two additional hindcast experiments will be performed initializing the model with either tropospheric (INI-T) or stratospheric (INI-S) conditions respectively. In the three sets of experiments observed sea surface temperature and sea-ice concentration anomalies will be prescribed as boundary conditions. INI will provide information about the forecast quality in EC-Earth, while the comparison with INI-T and INI-S will identify the key predictability sources.

Task 2.3: *Analysis of false alarms.*

In this task, the focus is on events that were predicted by the forecast system, but did not occur in nature (also referred to as false alarms, FA). FAs will be identified in forecast runs that are already performed and available at the host institution. In particular, we will use 7-month long retrospective forecasts initialized on November 1st from 1979 to 2015 with EC-EARTH3.2; 5 members each re-forecast initialized from the 5 members of ECMWF's Ocean Reanalysis System 4[33], the associated 5-member sea ice reconstruction[34], and atmospheric initial conditions from ECMWF's ERA-Interim including singular vector perturbations. An evaluation of the FAs will be performed, analysing the differences between the forecasts and the reanalysis in tropospheric wave sources and propagation into the stratosphere, stratospheric mean winds and vorticity gradients, and quasi-geostrophic index of refraction for planetary waves. The aim is to identify key differences that help understand the occurrence of these FAs in the forecast system. The analysis will be compared to the assessment performed in Task 1.1 (e.g. frequency and type of simulated SSWs) in order to detect fundamental model biases that could potentially limit prediction skill and to reduce the number of FA events.

Originality and innovative aspects of the research programme

SSWs are an emerging major source of skill in subseasonal-to-seasonal climate forecasts in Europe[6,7,9,10], and as such are acknowledged by the Stratospheric-tropospheric Processes And their Role in Climate initiative (SPARC, funded by the World Climate Research Programme) through its activity *Stratospheric Network for the Assessment of Predictability* (SNAP). However, **many aspects concerning the ability of forecast systems to simulate SSWs remain poorly understood**. In particular, the relative role and importance of tropospheric forcing versus stratospheric control on triggering SSW events is still an unresolved scientific question[10,20]. **STRATOCAST will address it following an unprecedented protocol**: targeted experiments in which the tropospheric evolution is fixed ("nudged" experiments) and the stratospheric initial conditions are perturbed during SSW events. We will target the predictability of SSWs both internally simulated by the model, and observed in nature. This approach **will help disentangling the two mechanisms responsible for the SSW generation and translating potential predictability into actual skill in a common, unique model framework**, close to an operational system.

This action also presents the novelty of evaluating the dynamics and variability of the polar stratosphere, as well as its impact on surface climate, in the EC-Earth model, which is currently used in the host institution to provide seasonal and decadal climate predictions. Besides, STRATOCAST is aligned with a framework of international research interest in using stratospheric dynamics to improve climate forecast systems. **The expected outcome will allow us to have a better knowledge of the predictability of SSWs, and therefore will provide useful information to operational centres**. In this regard, the proposed secondment at Met Office will be most valuable.

The ground-breaking research proposed in this action will introduce me into an area of active research in the climate forecasting community (i.e. prediction of SSWs), while guiding me into the novel approach of contributing to meet societal interest and users' needs (i.e. climate services). STRATOCAST will also open a new research line in the host institution, bringing new collaboration opportunities and envisioning cutting-edge, future initiatives.

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

Transfer of knowledge from the host institution to the candidate, and training objectives

The implementation of STRATOCAST in the Earth Sciences Department at BSC (BCS-ES) offers the best opportunities to strengthen and expand my competences. In particular, I will fill the gap in my training between my theoretical background in stratospheric dynamics and climate variability diagnosis, and the practical requirements of stratospheric forecasting and climate predictability assessment. In this context, the following training objectives are envisaged during the action:

- The first training objective will be to **deepen my abilities and experience** analysing and running a climate model. During my postdoctoral studies, I have developed a strong understanding of the issues inherent to

[33] Balsameda et al. (2013), *Quart. J. Roy. Meteor. Soc.*, **139**, 1132-1161. [34] Guemas et al. (2014), *Clim. Dyn.*, **43**, 2813-2929.

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stratospheric parameterization and post-processing data. The proposed analysis and validation of the EC-Earth model performance in the stratosphere, while learning the model characteristics and how to perform experiments with it, will allow me to strengthen my knowledge on stratospheric dynamics and modelling. In this regard, the experience of the host group in designing model experiments will certainly benefit both the action and me as a researcher.

- The second training objective **introduces me to a new field: stratospheric and climate prediction**. I will learn tools and quality scores to both running and evaluating seasonal forecasts (initialization, ensemble generation, drift, etc.). This will take place first at the host institution under the supervision of Prof. Doblas-Reyes, who has a vast experience in the field, but also in the secondment under the supervision of Prof. Scaife (Met Office), who is a pioneer in combining stratospheric dynamics and climate forecasting. In this context, I will strongly benefit from participating in discussions and meetings within the H2020-funded PRIMAVERA[35] and APPLICATE projects, in which both BSC-ES and the Met Office participate, and the Spanish project DANAE.
- The third objective is to **improve my coding and data analysis skills** via the PATC[36] courses and the regular training of the Computational Earth Sciences group of the BSC-ES, **my proposal preparation and management skills** via the informal training that the BSC Project Management Office offers, and **my presentation skills** through the formal courses that Human Resources at BSC organizes and the participation in the regular seminars organized by the department.
- And finally, a fundamental training objective is the **assumption of new responsibilities**. Pursuing my own research line, managing a project (scientifically and financially), leading international collaborations, are all required competences to successfully develop a productive and long-lasting scientific career, which the host institution actively encourages.

Transfer of knowledge from the candidate to the host institution

The host department will also benefit from my experience and skills acquired in different international research institutions: Universidad Complutense de Madrid (UCM) during my PhD, Laboratoire de Météorologie Dynamique (LMD) and Centre de Mathématiques et de Leurs Applications (CMLA) at the École Normale Supérieure (Paris and Cachan, France), and the National Center for Atmospheric Research (NCAR, USA), apart from short stays during my PhD program at the University of California Los Angeles (UCLA, USA). A transfer of knowledge is expected from me to the host group concerning my **skills in stratospheric dynamics and their role in climate, stratospheric model development, and parameterizations of unresolved processes** (i.e. gravity waves). Also, the skills and key knowledge derived from the secondment will feed back the BSC-ES, particularly the use of stratospheric processes for climate prediction. These skills will be highly appreciated at BSC-ES since little effort in the EC-Earth consortium[37] is devoted to the improvement of the model stratosphere.

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

Qualification and experience of the supervisors

Prof. Francisco J. Doblas-Reyes, Research Professor at ICREA (Institució Catalana de Recerca i Estudis Avançats) and the leader of the BSC-ES, formerly head of the Climate Forecasting Unit at IC3. He is extremely well regarded in the field, having received in 2006 the Norbert Gerbier-MUMM International Award of the World Meteorological Organization (WMO), and being lead author of chapter 11 "Near-term Climate Change: Projections and Predictability" in the fifth assessment report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) Working group I – The Physical Science Basis. He is a member of several international scientific committees: e.g. co-chair of the Working Group on Seasonal-to-Interannual Prediction (WGSIP) and member of the Decadal Climate Prediction Panel (DCPP) of the World Climate Research Programme (WCRP); European Climate, Observations and Modeling for Services panel of the European Commission; European Network for Earth System Modeling High-Performance Computing Task Force. Prof. Doblas-Reyes is a prominent researcher in the fields of climate dynamics and climate prediction with excellent proven project management skills. Besides a long list of more than 100 scientific peer-review papers with high citation impact, this is also demonstrated by the fact that he is currently leading numerous projects at the Earth Sciences Department, mostly funded by the European Commission, the Spanish Government and some private partners. He is actively collaborating with climate research institutions in three continents, like ECMWF, KNMI, SMHI, Met Office, CERFACS, Météo-France, NOAA, APCC, CPTEC and IPSL, among other less frequent collaborations. Both at BSC-ES and IC3, Prof. Doblas-Reyes

[35] https://www.primavera-h2020.eu/ . [36] http://www.bsc.es/marenostrum-support-services/hpc-trainings/prace-trainings. [37] Twenty-two research institutes from ten European countries collaborate on the development of the EC-Earth Earth System Model, see http://www.ec-earth.org/

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has provided researchers with exceptional training support and conditions for their scientific growth in many different ways, including improvements in their research and management skills. He has mentored 11 post-doctoral researchers in Climate Prediction, two of them with an MSCA grant (FP7-IEF-2010 and H2020-EF-2014), and 3 post-doctoral researchers and 2 managers in Climate Services.

Prof. Adam A. Scaife is head of Monthly to Decadal Prediction at the Met Office Hadley Centre, which includes monthly to seasonal forecasting, decadal forecasting and modelling climate variability. These groups produce ensembles of climate predictions and carry out research to improve the forecasts for adaptation to climate variability and change. His personal research is focused on long range forecasting and predictability, climate variability and change with a focus on Europe, interannual variability and dynamics of the middle atmosphere, and climate model development, and has published more than 130 peers reviewed articles. He is also an honorary visiting Professor at Exeter University, where he is involved in mentoring students (he has supervised nine PhD thesis). Prof. Scaife is co-chair of the World Meteorological Organisation's Working Group on Seasonal to Interannual Prediction, and a fellow of the Royal Meteorological Society. He has been awarded with the Atmospheric Sciences Ascent Award of the American Geophysical Union (2016), the Royal Meteorological Society's Adrian Gill Award (2014), L.G. Groves Memorial prize (2013), Met Office Chief Executive award for Scientific Discovery (2012), and Lloyds Science of Risk Prize for Climate Science (2011). He is also engaged in public outreach, and has been interviewed by tens of media (press, radio, and television).

Hosting arrangements

The BSC-ES offers a vibrant and stimulating environment to develop and grow as a scientist. The high quality research and training provided at BSC-ES is demonstrated by current participation in 30 research projects and initiatives, publication of 74 scientific articles in the last 3 years, supervision of 6 PhD students, and mentoring 108 postdoctoral researchers (7 of which are MSCA fellows) also in the last 3 years. The proposed project will be managed through **weekly meetings with the supervisor to ensure full coherence between my research and the general objectives of BSC-ES**. At all meetings with Prof. Doblas-Reyes, the advancements of my research will be discussed and the supervisor will provide adequate mentoring in the general background of climate prediction and adapt the research programme to the difficulties encountered and to make progress in the most promising aspects of the research undertaken. **Regular meetings will take place involving the rest of the BSC-ES members**, especially those in the Climate Prediction and Earth System Services teams, **to ensure an adequate integration of this action into the rest of the research carried out in the host department**. In this context, I will be encouraged to participate in discussions and meetings involving the H2020-funded projects PRIMAVERA (high-resolution global modelling) and APPLICATE (polar prediction and links with lower latitudes), and the national project DANAE (seasonal predictability of European climate), ensuring my integration into and building-up of an international networking. I will also have freedom to manage the fellowship research funds. **Monthly meetings with members of the Project Management Office at BSC will ensure the correct and timely execution of the action**, obtaining as well all the necessary support for applying to other research funding. The third work package (WP3) of the action will be partially dedicated to monitoring the progress of the action through the achievement of milestones and elaboration of deliverables (see section 3).

1.4 Capacity of the researcher to reach or re-enforce a position of professional maturity/independence

During my PhD, I did a challenging and rewarding exercise of studying and applying novel mathematical tools in the framework of dynamical systems (i.e. Lagrangian descriptors[38]) developed by my co-advisor Dr. Ana M. Mancho (Mathematical Sciences Institute, CSIC, Spain) to the study of open questions in stratospheric transport. This application successfully complemented my training in atmospheric dynamics, acquired during the MSc and the PhD programs at UCM and during my visits to the Atmospheric and Oceanic department at UCLA; and also provided me with the skills and vision to address scientific problems from different angles. Then, in February 2013 I was offered a postdoctoral position at the LMD in Paris (France) under the supervision of Dr. François Lott. The work was focused on the development, validation against observations, and implementation in a climate model of a non-orographic gravity wave drag parameterization that for the first time relates the amplitude of the waves to the resolved dynamics in the model. This postdoctoral stay allowed expanding my knowledge of stratospheric dynamics, this time from the point of view of climate modelling, with very productive results[39,40,41,42,43,44,45,46]. Also,

[38] Mendoza and Mancho (2010), *Phys. Rev. Lett.*, **105**, 038501. [39] de la Cámara et al. (2014), *J. Geophys. Res. Atmos.*, **119**, 11,905-11,919. [40] de la Cámara and Lott (2015), *Geophys. Res. Lett.*, **42**, 2071-2078. [41] Jewtoukoff et al. (2015), *J. Atmos. Sci.*, **72**, 3449-3468. [42] García-Serrano et al. (2015), *J. Clim.*, **28**, 5195-5216. [43] de la Cámara et al. (2016a), *J. Atmos. Sci.*, **73**, 3213-3226. [44] Plougonven et al. (2016), *J. Atmos. Sci.*, under review. [45] de la Cámara et al. (2016b), *J. Adv. Model. Earth Syst.*, accepted. [46] Berner et al. (2016), *Bull. Amer. Meteor. Soc.*, accepted. [47] García et al. (2016), *J. Atmos. Sci.*, under review. [48] de la Cámara et al. (2016c), *J. Geophys. Res. Atmos.*, in preparation. [49] de la Cámara and Abalos (2016), *Atmos. Chem. Phys.*, in preparation.

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I took advantage of a 6-month stay at CMLA in Cachan (Paris area, France), under the supervision of Dr. Millet and Dr. Lott, to apply the developed gravity-wave parameterization to the study of infrasound propagation in the atmosphere. In September 2015, my research career development was supported with a competitive postdoctoral fellowship in the Advanced Study Program at NCAR. This prestigious fellowship has allowed me to pursue my own research interests with independence, manage a limited travel budget, and participate in internal committees, while interacting with the most prominent scientists in the atmospheric research community. The position at NCAR is beginning to give fruitful results[47,48,49].

During my research career, I have demonstrated the capacity to perform independent research, undertaking new challenges and expanding my area of expertise. I have also developed abilities for teamwork, as demonstrated by the number of authors in the publications I have led. I have presented and disseminated my results in the most important meetings in the climate research area, such as several general assemblies of the European Geosciences Union, and a variety of SPARC meetings (sponsored by the World Climate Research Programme); and I have been invited to give seminars in several university departments (UMD, Goethe University, UCLA, UCM). Besides, I have collaborated as teaching assistant in undergraduate courses, and participated in an Innovative Educational Project (funded by the Spanish Ministry of Science) aimed at disseminating the atmospheric sciences among the non-scientific community.

My incorporation in a highly motivated group in the host institution with an outstanding track record, participation in the main European research projects, and a world-leading position in the area of climate prediction, will lay the foundations for the development of fruitful international collaborations while developing my line of research. The accomplishment of the novel research proposed will allow to crucially expand my expertise towards stratospheric and climate prediction, an area of societal interest and impact. This, along with the cutting-edge training gained at BSC-ES (which includes advanced programming, communication, and project management skills), will undoubtedly put me in a favourable position to decisively advance my research career.

2. IMPACT

2.1 Enhancing the potential and future career prospects of the researcher

BSC-ES offers a unique opportunity for postdocs to further develop their careers and become scientific leaders in their fields. I will be trained and acquire new scientific and technical knowledge through the mentoring from a supervisor with substantial experience, and through specific training provided by the PATC courses and the Computational Earth Sciences group in computer. Working in the exceptionally cooperative environment at BSC-ES, and participating in the frequent inter-group and inter-departmental meetings and project discussions, will deepen my teamwork and interpersonal skills. Besides, I will take part in the synergistic cooperation already established between researchers at BSC and the Human Resources and Education departments to improve the skills in professional writing and grantsmanship. These extremely valuable skills, along with the acquired experience managing the project from top to bottom, are fundamental to become a multidisciplinary and accomplished researcher, thereby will positively impact my career. The secondment planned at the Met Office will emphasize the scientific and technical training, and will provide me with an application-oriented view of climate forecasting. Likewise, it offers an invaluable opportunity to learn different techniques and make new contacts, an important part of the training as an independent researcher.

STRATOCAST will also enhance my creative and innovative potential with a proposed research that represents a step-forward with respect to my previous interests and focus, tackling for the first time stratospheric and climate predictability. The scientific objectives are aligned with the goals of SPARC, a WCRP core project, which coordinates international efforts to gain knowledge about climate variability and prediction. The implementation of the action, with a comprehensive set of work packages, milestones and deliverables (see section 3) and the support and training of the Project Management Office at BSC, will ensure the timely achievement of the objectives. The expected results will provide new insights into the mechanism behind the development of SSW events, and will contribute to design strategies towards the improvement of winter climate forecasting in Europe. Importantly, being the only researcher with track experience on stratospheric dynamics at BSC-ES, and one of the few in the EC-Earth consortium, will increase the visibility of my work. All in all, STRATOCAST will allow me not only to reinforce and expand my skills on atmospheric science, but also to complement my training with the acquisition of the necessary qualifications to successfully attract funding, manage and execute research projects, opening excellent prospects to my career and placing me in a good position to gain a tenure track soon afterwards.

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

The third work package (WP3) of the action will ensure the timely accomplishment of the following dissemination and exploitation activities (see also the Gantt chart in section 3.1):

Dissemination of the research results

The potential impact of the action on climate forecasting shares common ground with the objectives of some of the projects in which both the host and secondment institutions participate (like PRIMAVERA). The corresponding **project meetings**, in which I will participate, **will constitute an excellent framework to disseminate my results and maximize the impact of the action results on interested research groups**. The achievements of STRATOCAST will also be submitted for **publication to scientific journals of high impact** in the atmospheric and climate research area, such as Nature Geoscience, Science, Journal of Climate, Journal of Geophysical Research, or Climate Dynamics. The action aims at complying with the European Commission's policy on **open access articles**. Likewise, the **results will be presented in the most important scientific meetings**: General Assemblies of the European and American Geosciences Union (EGU, and AGU, d1 and d2 in the Gantt chart, section 3.1), and targeted workshops organized by the different activities of the SPARC initiative, usually around 1-2 meetings per year. My participation in these meetings will also improve my communication skills, key for disseminating results and engaging in new international collaborations and projects. Besides, the project activity will be posted in the BSC web site, news channel and the Earth Sciences department wiki.

Exploitation of the action results

- **The scripts, metrics and diagnostic tools** to evaluate the stratospheric dynamics and predictability, developed during the action, **will be open source and available through the BSC-ES facilities/repository** (E1 in the Gantt chart, next section). I will also distribute these products among the EC-Earth consortium, for use in their research projects, ECMWF, and the Spanish Meteorological Agency (AEMET) (E2). Likewise, the secondment institution will be able to easily take advantage of the technological development derived from the fellowship for specific operational applications, the Met Office having competence on application of stratospheric dynamics to seasonal forecasting.
- SSWs have a robust impact on the NAO, which largely controls the large-scale surface wind variability over Europe in the winter months. **The results of this action will be of high potential interest to companies in the wind energy sector, and will be directly used by the Earth System Services group at BSC-ES to provide more reliable information to end users** in the energy and other economic sectors (E3).

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

It is of great importance to ensure that the research activities of STRATOCAST are made known to society at large. In this regard, a significant effort will be carried out to guarantee that the results of this action reach and are understood by the broader public. The specific goals here are to 1) **effectively disseminate upon the public the importance of the interactions between the stratosphere and the closest part of the atmosphere, the troposphere**, with an emphasis on the significant impacts of these interactions on weather and climate variability in the North Atlantic-European region, and 2) **communicate the scientific results funded by the EU**. **I will participate in the open day that BSC organizes every year for high school students** (with the Barcelona Open House event, C1 in the Gantt Chart), where I will take advantage of the opportunity to engage with young students into science. I will contribute as well to **the European Researchers Night in Spain** (C2 in the Gantt Chart), funded by the H2020 programme through the Marie Skłodowska-Curie Actions. Also, my close connection to the Department of Geophysics and Meteorology at UCM (Madrid, Spain), where I did my undergraduate and graduate studies, will allow me to participate in the yearly "**Semana de la Ciencia" (Science Week)** (C3 in the Gantt Chart). This event is organized and funded by the local and regional governments of Madrid, and aims at disseminating science to non-specialist public with different outreach activities. I have experience organizing activities and participating in this event (see section 4). Importantly, the **outcomes derived from STRATOCAST will greatly benefit from the BSC Communication and Outreach groups**, which will further warrant a wide disclosure and public engagement.

All the proposed activities will ensure a direct contact with the public, helping me understand their interests and priorities for science, as well as helping disseminate my results, and the scientific method. A concrete planning of the proposed activities are included in the Gantt chart in section 3.1, and are an important part of WP3.

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3. QUALITY AND EFFICIENCY OF THE IMPLEMENTATION

3.1 Coherence and effectiveness of the work plan

The action is divided into three different work packages, two for research (WP1 and WP2) and one for management and dissemination (WP3).

It is assumed in the following Gantt chart that the start month of the project will be September 2017 (pm01).

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	T1.1																								
	T1.2																								
WP2	T2.1																								
	T2.2																								
	T2.3																								
WP3	Communication		C1											C2	C1	C3									
	Dissemination								d1								d2				d1				
	Exploitation								E1														E1	E2	E3
Milestone		M1						M2		M3	M4											M5	M6		
Deliverable											D1											D2			D3
Meeting																									
Secondment								At Met Office																	

Work Package description

- WP1: *Model assessment*. This work package is devoted to the analysis of the model performance in terms of stratospheric circulation variability and its connection with tropospheric processes and climate. It comprises tasks 1.1 and 1.2, and will be monitored by M2 and D1.
- WP2: *Stratospheric predictability*. The goal of this work package is to identify the key mechanisms responsible for the development of SSW events in a hindcast framework, and to assess the prediction skill of the EC-Earth forecast system in properly recapturing this phenomenon. It comprises Tasks 2.1, 2.2, and 2.3, and will be monitored by M4, M5, and D2.
- WP3: *Project management and dissemination of results*. This work-package will ensure the appropriate implementation of the action, and the dissemination/communication and exploitation of the results. The strong administrative support at BSC (i.e. the Project Management, and Communication and Outreach offices) guarantees the proper execution of this work-package. WP3 will monitor the progress of the action through the preparation of scientific reports (deliverables) and outreach activities. Two project meetings (milestones M3 and M6) will be held at BSC to smooth communication among the partner organizations (BSC and Met Office) and facilitate targeted interaction with other researchers (e.g. from H2020 projects like PRIMAVERA, APPLICATE, or from the SPARC community; some budget will be devoted to cover expenses).

List of milestones (tracking progress)

- M1: Career development plan drafted (see section 3.3). Due date: project month 1 (pm01).
- M2: Model assessment performed. Due date: pm07.
- M3: First project meeting. Due date: pm09.
- M4: Model set up for experiments accomplished. Due date: pm10.
- M5: Prediction skill of SSWs assessed. Due date: pm21.
- M6: Second project meeting. Due date: pm22.

List of deliverables (tracking achievements)

- D1: Scientific report on model assessment. Due date: pm10.
- D2: Scientific report on prediction skill of SSWs and the responsible mechanisms. Due date: pm21.
- D3: Final action report and recommendations. Due date: pm24

Secondments

The mobility of researchers is of crucial importance for the successful implementation of an ambitious project, as this fellowship would be, since the exchange of ideas and the transfer of knowledge constitute an essential basis for any scientific cooperation and ensure progress and achievements. It is also essential for an adequate training. One secondment, with duration of four months, has been designed for this purpose. The objective of this secondment is to bring together expertise in stratospheric dynamics, modelling and prediction. *Met Office* (pm7-10): The visit to the Met Office is planned to take full advantage of the renowned experience of the group in stratospheric dynamics, stratospheric influence on climate, and climate prediction. The secondment will start at the time Task 1.2 is

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finishing and Task 2.1 is starting, which will help discuss the results of the model evaluation, and provide guidance on the forthcoming experimental set-up and analysis.

3.2 Appropriateness of the allocation and tasks and resources

STRATOCAST is envisioned to squeeze the training capabilities of the host and secondment institutions and their commitment with scientific excellence, while ensuring a successful two-way transfer of knowledge between the candidate and the host institution and maximizing my potential to grow as a researcher and reach a mature stage in my career. The Gantt chart presented in the previous subsection embraces this conception. The nine-month period proposed to execute WP1 is based on my previous experience using and evaluating the output of long climate simulations. The secondment at the Met Office is planned at the end of WP1 to exploit the experience of Prof. Scaife and his group in evaluating and identifying climate model biases in the coupled stratosphere-troposphere system, as well as to provide feedback on the experimental design in WP2. The model experiments of WP2, dealing with stratospheric predictability during SSW events, will be performed using the world-class computing facilities at BSC. A total of 1 year and 4 months is schedule for Tasks 2.1, 2.2, and 2.3 within WP2, which accounts not only for the model set-up, realisation of the model runs, and analysis of the output, but also for the specific training on stratospheric and climate predictability. Throughout the action, permanent communication with the Project Management and Finance, and Communication and Outreach offices at BSC will guarantee a learning process on the day-to-day management of a research project, and an efficient accomplishment of the dissemination activities.

3.3 Appropriateness of the management structure and procedures, including risks management

Organization and management structure

The organization structure of BSC maximizes the prospects of success of the research projects executed in this institution. Periodic (monthly) meetings with the Project Management and Finance offices will help me during the Grant Agreement Preparation Phase, and managing the grant (WP3). These meetings will also be useful to identify potential problems and design the solutions well in advance. The Human Resources office will provide valuable guidance with the employment contract and the Fellowship Agreement. A Career Development Plan will be drafted with the supervisor during the first month of the fellowship (M1, see Gantt chart), which will include specific training and research objectives and will help me monitor the outcomes of the fellowship. Likewise, weekly meetings with the supervisor will monitor the advancements and provide scientific advice, which will ensure a correct execution of the action and will help disseminate the results.

Research and administrative risks

No substantial weaknesses or risks have been identified, apart from occasional delays with the milestones/deliverables. BSC is the reference institution in Spain in high performance computing (HPC), and I will have enough computing allocation on their machines, ensuring the execution of the planned model experiments. Moreover, the simulations to be analysed in WP1 and Task 2.3 are already done and available, and the model experiments to be performed in WP2 are very short (around 30 days of model time each run), so no expected setbacks in this regard are foreseen. Even so, the fellowship will rely on the management work-package (WP3; see Section 3.1) in case the project has to face unexpected delays, in which case appropriate correction measures will be taken.

3.4 Appropriateness of the institutional environment (infrastructure)

BSC has hosted outstanding HPC facilities since its inception in 2006. All the computational resources that the centre has –described in section 5– are going to be available to the candidate to carry out the research plan. In particular, I will have computing allocation to perform the model experiments, as well as store and analyse the output. The high-quality and diverse training that BSC provides covers all aspects of the action, from scientific training to project management, including coding abilities, proposal preparation, and communication/presentation training. In terms of attraction of talent, during the period 2011-2015, the BSC has recruited 75 pre-doctoral students, 51 postdocs and senior scientist, 83 technical support staff members and 31 management staff, 146 from Spain, 39 coming from EU countries and 55 from outside Europe, being currently more than 380 staff members, from around 40 countries. Recruitment procedures are based on principles of merit, transparency, competition and gender balance and the centre has been awarded with the badge of Human Resources Excellence in Research (HRS4R) in April 2015. The host (BSC-ES) and the secondment institution (Met Office) are international leaders for climate research and foster high-level education in the study of climate sciences (particularly on variability, dynamics and predictability) and its effects on society. Hence, the proposal fits extremely well with their goals, ensuring the successful accomplishment of the project. The two institutions are recognized world-class centres that attract talent, but at the same time top-level knowledge providers. The institutional environments and provided facilities, thus, will fruitfully benefit the derived results with proper outreach activities.

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DOCUMENT 2

4. CV OF THE EXPERIENCED RESEARCHER

Personal information

Alvaro de la Cámara, PhD.
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Phone: (+1) 303-497-1874.
E-mail: acamarai@outlook.com / acamara@ucar.edu
Web: https://staff.ucar.edu/users/acamara

Education

- December 2012. **PhD in Physics (Atmospheric Dynamics)**, Universidad Complutense de Madrid (UCM), and ICMAT (CSIC), Madrid, Spain. Title: "Study of Lagrangian transport of air masses in the stratospheric polar vortex of the Southern Hemisphere". Advisors: Prof. E. Serrano (UCM, Spain), Dr. A. M. Mancho (ICMAT-CSIC, Spain), and Prof. C. R. Mechoso (UCLA, USA).
- June 2007. **MSc in Meteorology and Geophysics**, UCM, Spain. Master project title: "Stratosphere-troposphere connection and the wintertime rainfall variability in Europe". Advisor: Prof. E. Serrano.
- September 2005. **BSc in Physics** (5 year program), UCM, Spain. Academic project: "The influence of ENSO on the precipitation anomalies in the Iberian Peninsula". Advisor: Prof. E. Serrano.

Research experience (employment record)

- September 2015 – August 2017. **ASP post-doctoral fellow** at the National Center for Atmospheric Research (**NCAR**), USA. Working on dynamics and modelling of the middle atmosphere.
- March 2015 – August 2015. **Post-doctoral researcher** at Centre de Mathématiques et de Leurs Applications (**CMLA**), Ecole Normale Supérieure de Cachan, France. Working with Dr. C. Millet on the impact of gravity waves on infrasound propagation in the atmosphere, under the European project ARISE2 (Horizon 2020, GAN653980)
- February 2013 – February 2015. **Post-doctoral researcher** at Laboratoire de Météorologie Dynamique (**LMD**), Ecole Normale Supérieure de Paris, France. Working with Dr. F. Lott on stochastic parameterizations of gravity waves for general circulation models, under the European project EMBRACE (FP7, grant agreement 282672).
- January 2009 – December 2012. **Ph.D. student** at Dept. Geofísica y Meteorología, **UCM**, Madrid, Spain. Working on mass transport and dynamics of the stratospheric polar vortex, under an FPI-UCM fellowship.
- September 2008 – December 2008. **Graduate researcher** at Dept. Geofísica y Meteorología, **UCM**, Madrid, Spain. Working with Prof. E. Serrano on climate variability (stratosphere-troposphere coupling), under the Spanish Ministry of Science project AVACOA (ref: CGL2005-06600-C03-02).
- January 2008 – August 2008. **Graduate researcher** at AOS dept (**UCLA**, USA). Working with Prof C. R. Mechoso on mass transport and dynamics of the Antarctic stratospheric polar vortex, under the NSF project NSFATM-0732222.
- April 2006 – December 2007. **Graduate researcher** at Dept. Geofísica y Meteorología, **UCM**, Madrid, Spain. Working with Prof. E. Serrano on climate variability (stratosphere-troposphere coupling), under the Spanish Ministry of Science project AVACOA (ref: CGL2005-06600-C03-02).

Teaching experience

- Academic years 2012/2013 and 2011/2012.

  Teaching Assistant, "Laboratory of Scientific Computation" at Dept. Geophysics and Meteorology, Universidad Complutense de Madrid, Spain.

Short stays in research centres

- March-May 2012. Atmospheric and Oceanic Department at UCLA (Los Angeles, California, USA). Supervisor: Prof. Mechoso. Funding: Travel budget within the FPI-UCM fellowship program.
- April-July 2011. Atmospheric and Oceanic Department at UCLA (Los Angeles, California, USA). Supervisor: Prof. Mechoso. Funding: Travel budget within the FPI-UCM fellowship program.

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Fellowships and public funding

- September 2015 – August 2017. 2-year postdoctoral competitive fellowship in the Advanced Study Program (ASP) of NCAR, USA.
- January 2009 – December 2012. 4-year predoctoral competitive fellowship FPI-UCM, Universidad Complutense de Madrid, Spain.

Participation in research projects without contractual relationship

- Jun 2016 – May 2018. Spanish national project 'Dynamics and predictability of the ENSO teleconnection in the North Atlantic-European region (DANAE)' (ref: CGL2015-68342-R). PI: Dr. J. García-Serrano (BSC).
- 2013 – 2016. ANR French National project 'Stratospheric Dynamics and Variability (STRADYVARIUS)' (ref: ANR-13-BS06-0011-01). PI. Prof. R. Plougonven (LMD, Ecole Polytechnique).
- Jan 2013 – Dec 2015. Spanish national project 'Precursors of stratosphere-troposphere coupling affecting European climate: observational and modelling studies (PRESTAMOS)' (ref: CGL2012-34997). PI: Prof. E. Serrano (UCM).
- Jan 2009 – Dec 2011. Spanish national project 'Stratosphere-troposphere coupling in the Northern Hemisphere and its connection to climate change' (ref: CGL2008-06295). PI: Prof. E. Serrano (UCM).
- Sep 2008 – Jun 2012. Spanish national project 'Modelling global climate variability using a hierarchy of climate models. Relevance for the Iberian Peninsula climate (MOVAC)' (ref: 2008-00050084028). PI: Prof. M. L. Montoya (UCM).

Publications

Peer-reviewed:

1. **de la Cámara, A.**, F. Lott, and M. Abalos (2016b), Climatology of the middle atmosphere in LMDz: Impact of source-oriented parameterizations of gravity wave drag. *J. Adv. Model. Earth Syst.*, accepted September 2016.
2. Berner, J., and 26 other co-authors, including **A. de la Cámara** (2016), Stochastic parameterization: Towards a new view of weather and climate models. *Bull. Amer. Meteor. Soc.*, in press, doi: 10.1175/BAMS-D-15-00268.1.
3. **de la Cámara, A.**, F. Lott, V. Jewtoukoff, R. Plougonven, and A. Hertzog (2016a), On the gravity wave forcing during the southern stratospheric final warming in LMDz. *J. Atmos. Sci.*, 73, 3213-3226, doi:10.1175/JAS-D-15-0377.1.
4. Jewtoukoff, V., A. Hertzog, R. Plougonven, **A. de la Cámara**, and F. Lott (2015), Comparison of gravity waves in the Southern Hemisphere derived from balloon observations and the ECMWF analyses. *J. Atmos. Sci.*, 72, 3449-3468, doi:10.1175/JAS-D-14-0324.1.
5. García-Serrano J., C. Frankignoul, G. Gastineau, and **A. de la Cámara** (2015), On the predictability of the winter Euro-Atlantic climate: lagged influence of autumn Arctic sea-ice. *J. Clim.*, 28, 5195–5216, doi:10.1175/JCLI-D-14-00472.1.
6. **de la Cámara, A.**, and F. Lott (2015), A parameterization of gravity waves emitted by fronts and jets. *Geophys. Res. Lett.*, 42, 2071–2078, doi:10.1002/2015GL063298.
7. **de la Cámara, A.**, F. Lott, and A. Hertzog (2014), Intermittency in a stochastic parameterization of nonorographic gravity waves. *J. Geophys. Res. Atmos.*, 119, 11,905-11,919, doi:10.1002/2014JD022002.
8. **de la Cámara, A.**, C. R. Mechoso, A. M. Mancho, E. Serrano, and K. Ide (2013), Isentropic transport within the Antarctic polar vortex: Rossby wave breaking evidence and Lagrangian structures. *J. Atmos. Sci.*, 70, 2982-3001, doi:10.1175/JAS-D-12-0274.1.
9. **de la Cámara, A.**, A. M. Mancho, K. Ide, E. Serrano, and C. R. Mechoso (2012), Routes of transport across the Antarctic polar vortex in the southern spring. *J. Atmos. Sci.*, 69, 741-752, doi:10.1175/JAS-D-11-0142.1.
10. García-Serrano, J., B. Rodríguez-Fonseca, I. Bladé, P. Zurita-Gotor, and **A. de la Cámara** (2011), Rotational atmospheric circulation during North-Atlantic European winter: The influence of ENSO. *Clim. Dyn.*, 37, 1727-1743, doi:10.1007/s00382-010-0968-y.
11. **de la Cámara, A.**, C. R. Mechoso, K. Ide, R. Walterscheid, and G. Schubert (2010), Polar night vortex breakdown and large-scale stirring in the southern stratosphere. *Clim. Dyn.*, 35, 965-975, doi:10.1007/s00382-009-0632-6.

Submitted to peer-review journals:

- Plougonven, R., **A. de la Cámara**, A. Hertzog, V. Jewtoukoff, and F. Lott (2016), On the relation between

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gravity waves and wind speed in the lower stratosphere over the Southern Ocean. *Under review for publication in J. Atmos. Sci.*

- García, R. R., A. K. Smith, D. E. Kinnison, **A. de la Cámara**, and D. Murphy (2016), Modification of the gravity wave parameterization in the Whole Atmosphere Community Climate Model: Motivation and results. *Under review for publication in J. Atmos. Sci.*
- Díaz-Durán, A., B. Ayarzagüena, E. Serrano, M. Abalos, and **A. de la Cámara** (2016), Intra-seasonal variability of extreme boreal stratospheric polar vortex events and their precursors. *Under review for publication in Clim. Dyn.*

Other publications, including book chapters:

- Rodríguez-Fonseca, B., C. Rodríguez-Puebla, and co-authors including **A. de la Cámara** (2010), *Teleconnections*. Chapter 4 in 'Climate in Spain: past, present, and future'. Eds. F. F. Fernández and R. Boscolo, CLIVAR España.
- **de la Cámara, A.**, J. García-Serrano, B. Ayarzagüena, M. Ábalos, B. González, and E. Serrano (2009), ENSO influence on the variability modes of the boreal winter stratosphere. *Física de la Tierra*, 21, 167-178. Link.

In preparation:

- Lott, F., D. Cugnet, **A. de la Cámara**, and C. Millet, The representation of non-orographic gravity waves in the LMDz climate model. *In preparation as a book chapter contribution to* "Infrasound Monitoring: Challenges and New Perspectives", Springer.
- **de la Cámara, A.**, A. K. Smith, R. R. García, J. R. Albers, T. Birner, P. A. Hitchcock, and D. E. Kinnison. Stratospheric control on sudden stratospheric warming events. *In preparation for submission to J. Geophys. Res. Atmos.*
- **de la Cámara, A.**, and M. Abalos. The impact of sudden stratospheric warmings on transport: advection and mixing. *In preparation for submission to Atmos. Chem. Phys.*

Selected oral contributions to congresses

- 2016 SPARC Gravity Wave Symposium, May 16-20 2016, State College (PA), USA. **de la Cámara, A.**, F. Lott, V. Jewtoukoff, R. Plougonven, A. Hertzog: *The relevance of parameterized momentum flux intermittency during the austral stratospheric final warming as simulated by LMDz.*
- EGU General Assembly April 2015, Vienna, Austria. **de la Cámara, A.**, F. Lott: A stochastic parameterization of the gravity waves emitted by jets and fronts for general circulation models.
- SPARC regional Workshop on the "Role of the stratosphere in climate variability and prediction, January 2015, Granada, Spain. **de la Cámara, A.**, F. Lott, A. Hertzog: *Momentum-flux intermittency in a stochastic parameterization of non-orographic gravity waves*.
- Mathematics and Geosciences: Global and Local Perspectives, November 2013, Madrid, Spain. **de la Cámara, A.**, C. R. Mechoso, A. M. Mancho, E. Serrano and K. Ide: *Unravelling the geometric structures of the stratospheric flow*. **[Solicited Oral Presentation].**
- Symposium on Stochastic Parameterisation in Weather and Climate Models, September 2013, Bonn, Germany. **de la Cámara, A.**, F. Lott, P. Maury, L. Guez, A. Hertzog: *A stochastic parameterization of gravity waves: formalism, tests in a GCM, and validation against observations.*
- EGU General Assembly April 2013, Vienna, Austria. **de la Cámara, A.**, C. R. Mechoso, A. M. Mancho, E. Serrano and K. Ide: Rossby wave breaking and Lagrangian structures inside the Antarctic stratospheric polar vortex during Vorcore and Concordiasi campaigns.
- 2nd Workshop on Nonlinear Processes in Oceanic and Atmospheric Flows, July 2012, Madrid, Spain. **de la Cámara, A.** , A. M. Mancho, K. Ide, E. Serrano and C. R. Mechoso: *Isentropic transport outside, inside and across the Antarctic stratospheric polar vortex*.
- AGU Fall Meeting December 2011, San Francisco, USA. **de la Cámara, A.**, A. M. Mancho, K. Ide, E. Serrano and C. R. Mechoso: *A Lagrangian analysis of transport across the Antarctic polar vortex edge in the southern spring*
- EGU General Assembly May 2010, Vienna, Austria. **de la Cámara, A.**, C. R. Mechoso, K. Ide, R. Walterscheid and G. Schubert: *Large-scale stirring in the southern stratospheric polar vortex during the final warming of 2005*.

Invited seminars

- April 27, 2016. Ciclo de Seminarios en Física de la Atmósfera, Facultad de Ciencia Físicas, UCM, Madrid,

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Spain. *Ondas de gravedad en la atmósfera: Modelizando sus efectos en el clima*.

- February 5, 2016. AOS271 Seminar Series at the Department of Oceanic and Atmospheric Sciences, UCLA, Los Angeles, California, USA. *Gravity waves from fronts and jets: Parameterizing their effects on the middle atmospheric circulation*.
- December 12, 2013. Seminar at the Theory of Atmospheric Dynamics and Climate Group at the Geosciences Department, Goethe University, Frankfurt, Germany. *A stochastic parameterization of gravity waves: formalism, tests in a GCM, and validation against observations*.
- June 2011. Department of Atmospheric and Oceanic Sciences, University of Maryland, College Park, Maryland, USA. *Quasi-horizontal transport across the stratospheric polar vortex*.
- March 2009. AOS271 Seminar Series at the Department Atmospheric and Oceanic Sciences, UCLA, Los Angeles, California, USA. *Polar night vortex breaking and air mixing in the southern stratosphere*.

Reviewer of Scientific journals

- Journal of Atmospheric Sciences
- Journal of Geophysical Research: Atmospheres
- Annales Geophysicae

Committee work

- Oct 2015 – present. Research Review Committee member, Advanced Study Program, NCAR.
- 3-6 July 2012. Local committee member in the 2nd International Workshop Nonlinear processes in oceanic and atmospheric flows, ICMAT, Campus Cantoblanco UAM, Madrid, Spain.
- April 2009 – June 2010. Co-founder and organizer of "UCM Seminar Series: Atmospheric Physics Seminars", UCM, Madrid, Spain.
- November 2009. Organizer of "Experiments to understand the Atmosphere and the Ocean, IX Science Week (Dept. Geophysics and Meteorology, UCM, Madrid Spain).

Scientific outreach activities

- January 2016. Poster participation in the exposition "ConCiencia Climática" (Climate Awareness), at the College d'Espagne, Cité Internationale Universitaire de Paris, France.
- Member of the team that developed the webpage http://meteolab.fis.ucm.es, in which homemade experiments are shown to explain atmospheric processes.
- November 2006, 2007, 2008, 2010, 2011, 2012. Teacher of the "Experiments to understand the Atmosphere and the Ocean, VI, VII, VII and X Science Week (Dept. Geophysics and Meteorology, UCM, Madrid Spain).

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5. CAPACITY OF THE PARTICIPATING ORGANIZATIONS

Beneficiary: Barcelona Supercomputing Center	
General description	The Barcelona Supercomputing Center (BSC) was established in 2005 and it is the national supercomputing facility in Spain. The mission of BSC, as a unique fusion of a classic national scientific support structure and a cutting-edge research institute, is to research, develop and manage information technologies in order to facilitate scientific progress in Computer Sciences, Life Sciences, Earth Sciences (ES) and Computational Applications in Science and Engineering.
Role and Commitment of the supervisor	**Prof. Doblas-Reyes** is a worldwide expert in the development of seasonal-to-decadal climate prediction systems and the head of BSC-ES CFU. He is involved in the development of the EC-Earth climate model since its inception. He was involved in the preparation of the IPCC Fifth Assessment Report (Working Group 1) as a lead author, serves in WCRP and WWRP scientific panels, and has participated in more than 20 FP4 to FP7 projects. He is coordinator of the FP7 project Seasonal-to-decadal climate Prediction for the improvement of European Climate Services (SPECS). He is shaping BSC-ES's plans for the development of a climate services capability with focus on the energy sector and contributes to the international Climate Services Partnership.
Key Research Facilities, Infrastructure and Equipment	- The MareNostrum III, a supercomputer based on Intel SandyBridge processors, iDataPlex Compute Racks, Linux Operating System and Infiniband interconnection. It has a total of 48896 cores, a peak computing power of 1017 TFlops and was ranked the 29th fastest supercomputing facility in June 2013 by the Top500 list (106th in June 2016). - The MinoTauro supercomputer (3 TB RAM, 182.9 Tflops peak), which combines traditional CPU cores with GPU accelerators, is also hosted at the BSC facilities. It was ranked the 442th fastest machine in the world in June 2013. - The Nord cluster (392 GB RAM, 196 cores, 1.72 Tflops peak).
Independent research premises?	As an independently managed institution, BSC headquarters is located in an isolated building of the UB-UPC university campus. BSC hosts HPC systems in the former Torre Girona chapel in Barcelona.
Previous Involvement in Research and Training Programmes	BSC-ES has a vast experience and marked presence in international initiatives (it has coordinated and participated in more than 150 projects including 43 individual grants and fellowships, 9 EU-FP6 projects; 38 EU-FP7 and 73 national projects). Previous experience includes FP7-funded IS-ENES1 (Infrastructure for the European network for Earth System modeling – phase 1) and FIELD-AC (Fluxes, interactions and environment at the land-ocean boundary: downscaling, assimilation and coupling) projects. Professors at BSC have been able to provide post-doctoral researchers with exceptional training support and conditions for their scientific growth in many different ways, including improvements in their scientific and management skills. It is also worth mentioning the facts, that the BSC participated in the MC ITN project (SCALUS: FP7-PEOPLE-ITN-2008-238808) and three Marie Curie IEFs (EEPPIBM: FP7-PEOPLE-2012-IEF-327899, MatComPhys: FP7-PEOPLE-2011-IEF-302320 and MDRAF: FP7-PEOPLE-2013-IEF-622662).
Current Involvement in Research and Training Programmes	Prof. Doblas-Reyes is participating in 3 national projects, 2 private-funded projects and 6 European projects (CLIMRUN 265192 FP7-ENV-2010, IS-ENES2 312979 FP7-INFRASTRUCTURES-2012, EUPORIAS 308291 FP7-ENV-2012, EUCLEIA 607085 FP7-SPACE-2013, PREFACE 603521 FP7-ENV-2013, SPECS 308378 FP7-ENV-2012). BSC-ES is participating in two European projects (IS-ENES2 312979 FP7-INFRASTRUCTURES-2012, APPRAISAL 308395 FP7-ENV-2012). BSC-ES is in close collaboration with several universities and their Master program (e.g. Universitat de Barcelona, Universitat Politècnica de Catalunya), and in the near future several PhD students will graduate.
Relevant Publications and/or research/innovation products	- Bellprat, O. and **F. J. Doblas-Reyes** (2016). Attribution of extreme weather and climate events overestimated by unreliable climate simulations. Geophysical Research Letters, 43, 2158-2164, doi:10.1002/2015GL067189. - Guemas, V., M. Chevallier, M. Déqué, O. Bellprat and **F. J. Doblas-Reyes** (2016). Impact of sea ice initialization on sea ice and atmosphere prediction skill on seasonal timescales. Geophysical Research Letters, 43, 3889-3896, doi:10.1002/2015GL066626. - **Doblas-Reyes, F. J.**, J. García-Serrano, F. Lienert, A. Pintó Biescas and L.R.L. Rodrigues (2013). Seasonal climate predictability and forecasting: status and prospects. WIREs Climate Change, 4, 245-268, doi:10.1002/WCC.217. - **Doblas-Reyes, F. J.**, I. Andreu-Burillo, Y. Chikamoto, J. García-Serrano, V. Guemas, M. Kimoto, T. Mochizuki, L.R.L. Rodrigues and G.J. van Oldenborgh (2013). Initialized near-term regional climate change prediction. Nature Communications, 4, 1715, doi:10.1038/ncomms2704.

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Partner Organization: Met Office	
General description	The Met Office was established in 1856, and it is the United Kingdom's national weather service. It is recognised as one of the world's most accurate forecasters, using more than 10 million weather observations a day, an advanced atmospheric model and a high performance supercomputer to create 3,000 tailored forecasts and briefings a day. These are delivered to a huge range of customers from the Government, to businesses, the general public, armed forces, and other organisations.
Key Persons and Expertise	**Prof. Scaife** is a leading expert in climate variability and change, stratospheric dynamics, and long-range forecasting and predictability. He leads the Met Office Hadley Centre monthly to decadal forecasting activities since 2008, and has received eight academic awards acknowledging his scientific contributions, including the Adrian Gill Prize of the Royal Meteorological Society (2014), and the Atmospheric Sciences Ascent Award of the American Geophysical Union (2016). He currently co-chairs the *Grand Challenge on near term climate prediction* of the World Climate Research Programme.
Key Research Facilities, Infrastructure and Equipment	Met Office supercomputers: - Two machines (numbers 29th and 30th on the current Top500 list, June 2016), both containing 560 Haswell and 2496 Broadwell nodes. Each Broadwell node contains 36 cores.
Previous and Current Involvement in Research and Training Programmes	Prof. Scaife has been involved in, and is currently leading and participating in, a wide variety of collaborative research projects funded by different international institutions: HCCP Hadley Centre Climate Program - Climate Dynamics, CSSP Climate Science to Service Partnership - Climate Dynamics, C3S Copernicus Climate Change Service - Operational Seasonal Forecast Provision, SSI International Space Science Institute's Scenarios of future solar variability for climate modelling, UK Department for Transport Long Range Forecasting for Transport and Local Authority Planners, SPECS - European Union project (4.5 years) - Seasonal to Decadal Predictions for European Climate Services, UK Department For International Development Climate Science Research Partnership, ISSI International Space Science Institute's Gravity Wave project, DYNAMITE - European Union project (3 years) - understanding the dynamics of the coupled climate system, SHARP - Stratospheric Change and its Role for Climate Prediction, Frei Universitaat Berlin, PACE - Predictability for Atlantic Climate and Europe: Met Office and Reading University, CLIVAR C20C - Climate of the 20th Century project, World Climate Research Program, EMULATE - European Union project (3 years) - European and north atlantic daily to MULTIdecadal climATE variability, HADLEY CENTRE Theme: Interannual to Decadal Forecasting, UK NERC - "Atmospheric Teleconnections with the Tropical Stratosphere" with Prof. Lesley Gray, Reading University, UK, UK NERC - "The Role of the Stratosphere in Climate Change" with Prof. Lesley Gray, Reading University, UK., UK NERC - "Southern Hemisphere Climate Change in an era of ozone recovery" with Dr. Nathan Gillett, University of East Anglia, UK., GRIPS - "GCM-Reality Intercomparison for SPARC", with Dr. Steven Pawson (NASA GSFC, USA) and Prof. Kunihiko Kodera (MRI, Japan).
Relevant Publications and/or research/innovation products	- **Scaife A. A.**, A.-Yu. Karpechko, M.P. Baldwin, A. Brookshaw, A.H. Butler, R. Eade, M. Gordon, C. MacLachlan, N. Martin, N. Dunstone and D. Smith (2016). Seasonal forecasts and the stratosphere, Atm. Sci. Lett., DOI: 10.1002/asl.598. - Kidston J., **A. A. Scaife**, Steven C. Hardiman, Daniel M. Mitchell, Neal Butchart, Mark P. Baldwin and Lesley J. Gray (2015). Stratospheric influence on tropospheric jet streams, storm tracks and surface weather, Nature Geoscience, 8, 433-440, doi:10.1038/ngeo2424. - Ineson S. and **A.A Scaife** (2009). The role of the stratosphere in the European climate response to El Nino. Nature Geoscience, 2, 32-36.

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6. ETHICAL ASPECTS

This project concerns research in atmospheric dynamics and predictability using numerical simulations of climate models, and does not involve any ethical issues of any sort, nor it is expected to have any undesired social implications. Therefore, in this proposal there is not any issue entered in the Ethical Issues Table in Part A, and any text for the Ethics Self-Assessment in Part B.

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ENDPAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2016

PART B

"STRATOCAST"

"Predictability of sudden stratospheric warming events in a seasonal forecast system"

This proposal is to be evaluated as:

[Standard EF]

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