MINISTERIO
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SECRETARÍA DE ESTADO
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DESARROLLO E INNOVACIÓN

SECRETARÍA GENERAL
DE CIENCIA, TECNOLOGÍA
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DIRECCIÓN GENERAL
DE INVESTIGACIÓN
CIENTÍFICA Y TÉCNICA

SUBDIRECCIÓN GENERAL
DE RECURSOS HUMANOS
PARA LA INVESTIGACIÓN

AYUDAS RAMÓN Y CAJAL

MEMORIA DE LA TRAYECTORIA INVESTIGADORA Y LA LÍNEA DE INVESTIGACIÓN PRINCIPAL QUE HA DESARROLLADO

(*SUMMARY OF THE RESEARCH CAREER OF THE CANDIDATE AND THE MAIN RESEARCH LINE THAT SHE/HE HAS CARRIED OUT)*

Esta memoria debe rellenarse preferiblemente en inglés - *Summary to be completed preferably in English*

INVESTIGADOR SOLICITANTE / *RESEARCHER APPLICANT*: Virginie Guemas

PALABRAS CLAVE / *KEY WORDS:* climate prediction, seasonal, decadal, climate modelling, Arctic, Atlantic, Europe

RESUMEN (aprox. 300 palabras) / SUMARY (approx. 300 words):

I am currently ***leading the polar climate prediction research line*** at the Institut Català de Ciències del Clima (IC3). My PhD, carried out at Météo-France (Toulouse, France) and funded by a ***highly competitive PhD grant*** from the Commissariat à l'Energie Atomique, was defended in 2009 and awarded the ***Adrien Gaussail PhD prize***, granted every 2 years to a scientific PhD. After a one-year postdoctoral stay at the LMD (Paris, France), I joined IC3 in December 2010. I have ***supervised,*** so far, one PhD student and several post-doctoral scientists. I have participated in a total of ***13 national and international projects*** and I am ***collaborating with 17 research institutes***. I am currently ***Principal Investigator (PI) of the 3-year national PICA-ICE project***, with a budget of €149.760. I have been ***invited to a total of 10 different events***: conferences, workshops or visits to other institutes. I have co-authored ***32 articles*** in peer-reviewed journals, ***28*** of them ***in the first SCI quartile, 4*** of them ***in prestigious high-impact journals: Nature Climate Change, Nature Communications, and Bulletin of the American Meteorological Society.*** I have a ***H-index of 10***, with a total of 269 citations until December 2014, among which ***132 citations in 2014*** and 76 citations in 2013. I have also been contributing author to the ***Fifth Assessment Report (AR5) of the IPCC*** (Intergovernmental Expert Panel on Climate Change). In 2014, I was appointed as a member of the ***Scientific Steering Group (SSG)*** of the ***CLIVAR project*** (Climate and Ocean Variability Predictability and Change) from the WMO (World Meteorological Organization) until at least December 2017, which is an honour bestowed for the first time ever to a member of a Spanish Research Institute. My activities focus on the generation and analysis of predictions of the Arctic, Atlantic and European climate based on coupled general circulation models.

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Highlights a maximum of 5 relevant achievements from the ones included in the cv

1) International recognition and participation in international activities :

I have been appointed, in 2014, as a member of the ***Scientific Steering Group (SSG) of the CLIVAR project*** (Climate and Ocean Variability Predictability and Change) from the WCRP (World Climate Research Program) / WMO (World Meteorological Organization). The CLIVAR SSG monitors the progress of 9 Core Panels, 7 Research Foci (RF) and 5 Grand Challenges (GC) from CLIVAR, each comprising about 20 experts of exceptional worldwide recognition. This is the first time a scientist is nominated to represent Spain at the CLIVAR SSG. The initial appointment is valid until 2017 and can be extended to 2 years afterward. This nomination demonstrates an outstanding scientific recognition at the international level.

I have participated to the ***Fifth Assessment Report (AR5) of the IPCC*** (Intergovernmental Expert Panel on Climate Change) as a WGI ***contributing author*** to the chapter 11 "Near-term climate change: projections and predictability". This activity has strengthened the representation of Spain in this crucial international effort.

I am a member of the ***SEARCH Sea ice Outlook*** (SIO, http://www.arcus.org/search-program/seaiceoutlook) ***Action Team*** since 2014. The SEARCH SIO consists in a quasi-operational seasonal forecast of the September Arctic sea ice extent, each year since 2008, gathering and compiling contributions for a large variety of institutes, under the framework of the Arctic Research Consortium of the United States (ARCUS). Its Action Team is in charge of the compilation and reporting of the SIO conclusions. This membership demonstrates the recognition of my polar prediction activities at the North American level.

I was ***invited*** to the ECMWF (European Center for Medium Range Weather Forecasts, Reading, England) ***WWRP/THORPEX workshop on Polar Prediction*** in 2013 to give the course "The role of sea-ice in extended range prediction of atmosphere and ocean" published as a proceeding. I was, at the same time, invited to the joint ***Year of Polar Prediction (YOPP) Planning Meeting*** organized by the ***WWRP/THORPEX Polar Prediction Project (PPP)*** - the YOPP is an extended period of coordinated intensive observational and modeling activities in order to improve polar prediction capabilities planned for 2017-2018. This invitation represented a key opportunity to strengthen the contribution of Spain to the planning and organization of polar research at the international level. Following this YOPP Planning Meeting, I was invited to write a **review article**: "A review on Arctic sea ice predictability and predictions on seasonal to decadal timescales" published in 2014 and included in a special issue from the WWRP/THORPEX PPP.

Finally, I have participated in ***9 projects funded by the European Commission*** under the framework of the FP7 program (ENSEMBLES, CLIMRUN, QWeCI, DENFREE, SPECS, EUPORIAS, PREFACE, EUCLEIA, IS-ENES2) and ***3 projects funded by the French Ministry of Sciences*** (CHAMPION, MISTERRE, MORDICUS). In new projects recently submitted to the European Commission under the framework of H2020, I have undertaken the role of ***PI (Principal Investigator)*** for the ***CHANCE*** project, which total budget amounts to €3.999.965 among which €242.156 for IC3 and the role of ***WP leader*** for the ***PRIMAVERA*** project, which total budget amounts to €14.261.663 among which €1.277.425 for IC3. I have also submitted a project to the ***European Space Agency*** as ***PI*** and to the French Ministry as both ***PI and WP leader (POLARIS).***

2) Leadership capability:

I am currently "***Lead researcher for polar climate prediction***" at the Institut Català de Ciències del Clima (IC3, Barcelona, Spain). Since January 2011, I was ***advisor*** of the ***PhD thesis*** of Danila Volpi submitted in December 2014. To complete my research team, two new PhD students will join the group in 2015 under my supervision. I have also been ***advising several post-doctoral scientists*** in the last few years. From 2015, I am going to undertake the ***management of the climate prediction group*** in the Earth Sciences Department from the Barcelona Supercomputing Center (BSC), as a Ramon y Cajal Fellow if my application is accepted. Regarding fund-raising, I am currently ***PI of the PICA-ICE*** (Previsión Interanual de la Cubierta de hielo marino del Ártico y su

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Impacto en el Clima de Europa) project funded by the Spanish Ministry of Economy and Competition which started in January 2013 and will last until December 2015. The allocated budget amounts to €149.760 and the reference number is CGL2012-31987. I have management responsibilities in 3 submitted European projects (2 as PI and 1 as WP leader) and one submitted to the French Ministry of Sciences (as PI and WP leader) as listed in the first most relevant contribution from my curriculum vitae above. I am also ***PI of a project submitted to the Fundació biodiversidad*** (HACE) and ***PI of a project submitted to the Fundació BBVA*** in 2014. I have also ***teaching experience*** at the university, in particular in statistics and climate physics. These elements demonstrate my capability as a group leader.

3) Article in ***Nature Climate Change (Impact factor: 15.295***): ***Guemas V.*** , Doblas-Reyes F. J., Andreu-Burillo I., Asif M, 2013, Retrospective prediction of the global warming slowdown in the past decade, Nature Climate Change, 3, 649-653, doi : 10.1038/nclimate1863.

The observed global mean temperature experienced a plateau in the last decade after a continuous increase in the previous 50 years. In parallel, the anthropogenic greenhouse gas level sustained its build-up. These observations triggered a debate in the scientific community about the potential causes for such apparent inconsistency. Some authors suggested a key role of the deep prolonged solar minimum, of the stratospheric water vapour, of the stratospheric or tropospheric aerosols, of a potential increased heat uptake by the deep ocean. However, ascertaining the reasons behind such global warming slowdown had remained a challenging issue. A series of retrospective climate predictions were performed at IC3 using the EC-Earth2.3 european global climate model. These predictions were initialized from the best possible estimate of the observed climate state every 1st November, each extended 10 years into the future and each repeated 5 times by perturbing slightly the initial conditions to account for the observational uncertainty and assess the resulting uncertainty during the climate prediction. The average of these 5 repetitions is shown in red in Figure 1 after a smoothing through a 1-year running mean while the observations are shown in black. The prediction initialized in 1999 (which appears from 2000 on the figure because of the smoothing) tracks very closely the observed anomalies with a sharp warming during the first year followed by a sudden flattening. The predictions initialized earlier also capture the warming slowdown but to a too cold state. The predictions initialized later during the warming slowdown tend not to show any warming and even a cooling for some of them (the ones initialized in 2002, 2003, and 2004). The ability of these retrospective climate predictions to capture the global warming slowdown stood as a crucial opportunity to investigate its causes. I compared our predictions with an historical simulation started in 1850 from a preindustrial control simulation, i.e. a simulation in which the model has no information about the observed variability, but in which the external radiative forcings (solar activity, stratospheric and tropospheric aerosols, greenhouse gas concentration) are exactly the same as in our climate predictions. Three repetitions were performed by using three different initial states in 1850 and their average is shown in blue in Figure 1 after a smoothing. Although the temperature is cooler than the observations in 1998 and 2001, it tends to be about 0.05-0.1◦C too warm afterwards and it tends to warm up after 2001 whereas it tends to cool down in the predictions initialized after 2001. The observed net input energy at the top of the atmosphere ([0.5-1 W.m-2]) was captured in both experiments. A deeper investigation of our climate predictions highlighted that most of this excess energy was absorbed in the top 700 m of the ocean at the onset of the warming pause, 65% of it in the tropical Pacific and Atlantic oceans. These results hence pointed at the key role of the ocean heat uptake in the recent warming slowdown. ***I had many interviews concerning this publication, including on live, and according to IC3's communication team report, there has been more than 8000 articles in the international (New York Times, ABC Sciences, Le Figaro …), national (La Vanguardia, El Periodico …) and local media, as registered of June 2013.***

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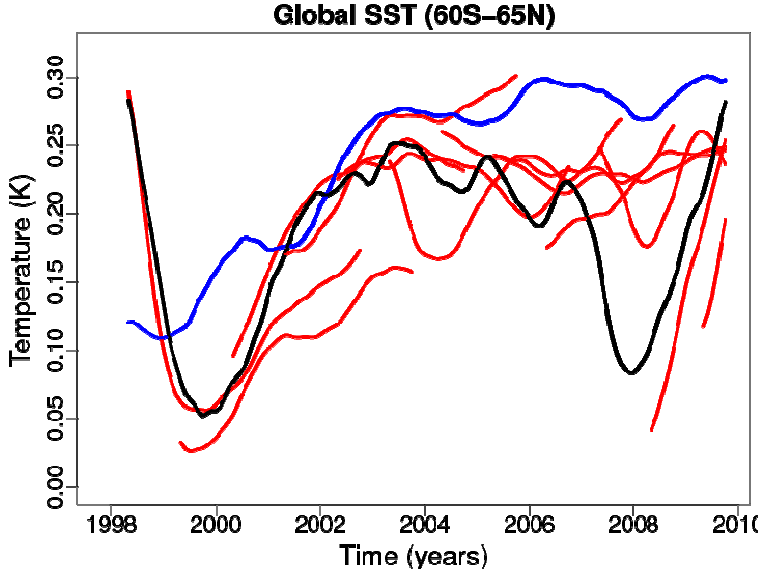

Figure 1: Ability to capture the warming slowdown. Climate predictions (red), Historical simulations (blue) ensemble-mean and observed (black) global sea surface temperature (60°S-65°N) anomalies smoothed out with a 1-year running mean. Note that due to the smoothing, the first six months of each forecast do not appear on the figure. Figure from Guemas et al (2013), Nature Climate Change.

4) Article in ***Bulletin of the American Meteorology Society (Impact Factor: 11.574): Guemas, V.,*** Doblas-Reyes F.J., Germe A., Chevallier M. and Salas y Mélia D., 2013, September 2012 Arctic sea ice minimum: Discriminating between sea ice memory, the August 2012 extreme storm and prevailing warm conditions, Bulletin of the American Meteorological Society, 94, S20-S22, in "Explaining Extreme Events of 2012 from a Climate Perspective":

On 18 September 2012, the Arctic sea ice extent hit a new record low of 3.41 million km2 as reported by the National Snow and Ice Data Center (NSIDC), i.e., about half of the 1979–2000 September mean. From 6 August to 8 August 2012, an extreme storm also transited over the Arctic. Such an intense storm had the potential to accelerate the sea ice loss through increased ice breaking and transport toward warmer regions and through increased ocean mixing. None of the forecast systems participating in the Study of Environmental ARctic CHange (SEARCH) program were able to predict the extreme 2012 summer sea ice melting at lead times greater than one month. This article aimed at estimating the contributions from three different factors to the observed 2 million km^2 excess sea ice loss during summer 2012 as compared to the average of summers 2000-2011 (in black in Figure 2): (i) the extreme August summer storm that transited over the Arctic, (ii) the preconditioning by the history of the sea ice cover prior to the beginning of the melt season (among which the sea ice thinning related to the long-term warming); and (iii) the warmer-than-usual surface atmospheric conditions (also partly related to the long-term warming). A control experiment (CTRL in light blue in Figure 2) was performed using an ocean-sea ice coupled model forced by observed atmospheric data which captures relatively well the observed sea ice loss. The sensitivity experiments to the storm (brown), to the preconditioning (green), to the warm atmospheric conditions (purple) and to the combination of the last two factors (dark blue) indicated that the exceptional 2012 sea ice loss was primarily due to the sea ice memory and to the positive feedback of the warm atmospheric conditions, both contributing approximately equally. These results also pointed at a negligible contribution of the extreme 2012 summer storm.

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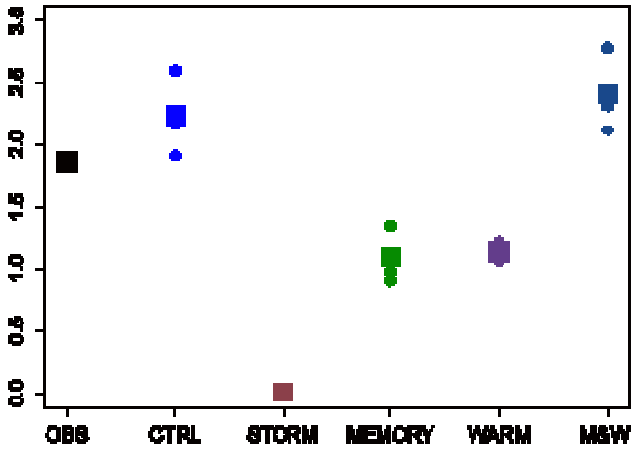

Figure 2: Contribution to the 2012 extreme Arctic sea ice loss. The observed Arctic sea ice loss is estimated as the difference between the observed 2012 September minimum sea ice extent and the average of the Arctic September sea ice minima over the 2000-2011 period. CTRL, STORM, MEMORY, WARM, M&W are respectively the control experiment and the sensitivity experiments to the extreme August summer storm, the memory of initial conditions, the warm atmospheric temperature during the summer and the joint effects of the memory and warm atmospheric conditions. Figure from Guemas et al (2013), BAMS.

5) Article in ***Nature Communications (Impact factor: 10.742):*** Doblas-Reyes F.J., Andreu-Burillo I., Chikamoto Y., García-Serrano J., ***Guemas V.,*** Kimoto M., Mochizuki T., Rodrigues L.R. and van Oldenborgh G.J., 2013, Initialized near-term regional climate change prediction, Nature Communications, 4, 1715, doi:10.1038/ncomms2704.

This article provided an overview of the state-of-the-art capability in predicting climate a few years into the future based on all the coupled model predictions produced within the framework of the Fifth Phase of the Coupled Model Intercomparision Project (CMIP5) in preparation of the Fifth Assessment Report (AR5) from the Intergovernmental Panel on Climate Change (IPCC). Figure 3 illustrates, for example, the skill in predicting near surface air temperature (top row) 2 to 5 years into the future (left) and 6 to 9 years into the future (right) obtained when initializing global climate models from the best possible estimate of the observed climate state (top) together with the added-value of such climate predictions relative to historical simulations in which the models have no information about the observed variability but only information about the external radiative forcings such as the solar activity, the aerosols and the greenhouse gas concentrations (bottom row). This article formed the base for ***Chapter 11 "Near-term climate change: projections and predictability" of the IPCC AR5*** - Working Group I - for which I was ***contributing author***.

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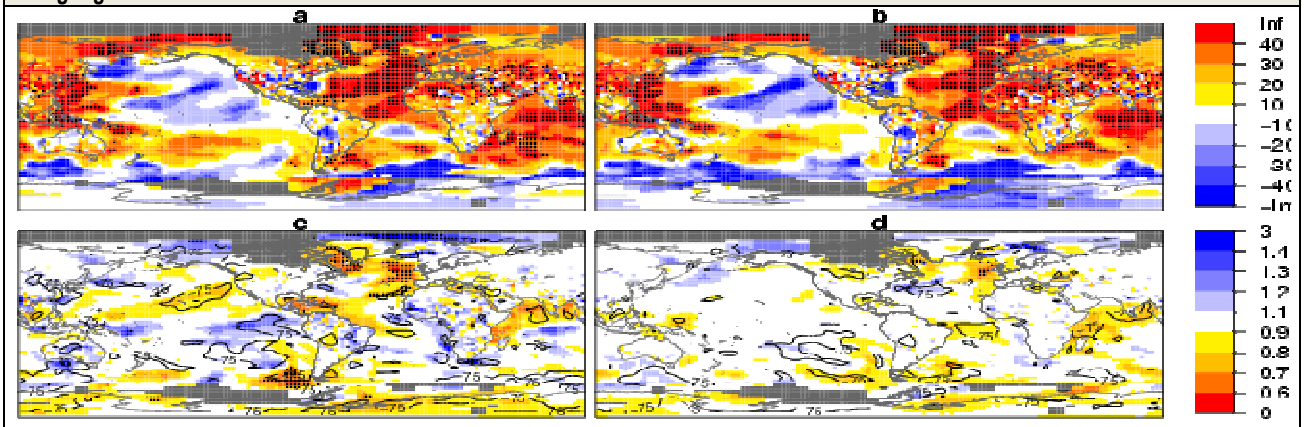

Figure 3: Near-surface air temperature forecast quality. (a,b) Root Mean Square Skill Store (RMSSS, multiplied by 100) of the multi-model ensemble of climate predictions performed within the framework of CMIP5 averaged over forecast years (a) 2-5, (b) 6-9. Black dots indicate regions where the RMSSS is significant to the 95% level. (c,d) Ratio of the Root Mean Square Errors of the CMIP5 multi-model ensemble of climate predictions over the counterpart CMIP5 multi-model ensemble of historical simulations, in which the models have no information about the observed variability, but in which the external radiative forcings are exactly the same as in the CMIP5 climate predictions. Contours are used for areas where the ratio of at least 75% of the individual forecast systems agrees with the ratio of the mean of the multi-model ensemble. Dots indicate regions where the ratio is significantly above or below 1 at the 90% level. Regions of poor observational sampling are masked in grey. Figure from Doblas-Reyes et al (2013) Nature Communications.

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Extended detail of the research career of the candidate and the main research line that he/she has carried out.

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For being ***valedictorian***, i.e. the highest ranked of my graduating class at the University, I obtained an "***Excellence scholarship for Master students***" in 2005 which is a renowned award delivered each year by Paul Sabatier University (Toulouse, France) to its best students in exchange of a commitment to carry out a PhD thesis after completing their master. My master thesis focused on the mechanisms driving the interannual to decadal variability of the deep ocean circulation, in particular in the Atlantic Ocean and its coupling to the Arctic Ocean, as well as on its expected evolution during the next century in relation with climate change. This six-month internship led to ***2 publications*** as first author in international peer-reviewed journals (Guemas and Salas-Melia, 2008a,b, Climate Dynamics, impact factor: 4.619) and allowed me to acquire a good knowledge of the processes by which climate predictability can arise from the deep ocean on interannual to decadal timescales. I graduated in June 2006, still valedictorian.

Thanks to ***a highly competitive PhD grant from the Commissariat à l'Energie Atomique*** (CEA, France), I started in September 2006 my PhD at Météo-France (Toulouse, France) in collaboration with the Laboratoire des Sciences du Climat et de l'Environnement (Paris, France), entitled: "Role of the marine surface on the summer intraseasonal atmospheric circulation variability in the North Atlantic European region". This PhD aimed at determining whether the coupling of the atmosphere with the upper ocean plays a key role on the intraseasonal variability of the large-scale atmospheric circulation and if the sea surface can be a potential source of predictability for the atmosphere at these time scales. A second objective was to investigate the impact of the representation of physical processes in the upper ocean, in particular the ocean diurnal variations, on the representation of sea surface temperatures (SST) and atmospheric circulation at longer time scales. This PhD thesis contributed to the national ***CHAMPION*** and ***LEFFE-MISTERRE*** projects. To carry out this work, I developed the CNRMOM1D simplified ocean model which represents realistically the thermodynamic variability of the ocean mixed layer (the upper ocean layer) at diurnal to intraseasonal timescales and longer-term trends are prescribed. Its main interest is its low cost in computing time which made it possible to produce climate simulations with high vertical resolution. The high vertical resolution is essential to represent the ocean diurnal cycle which has been one of the main issues addressed in this PhD. The most important result of this PhD was to illustrate the potential improvements of the atmosphere and ocean mean states and intraseasonal variability that could stem from hourly coupling between the atmosphere and ocean components and the use of a high ocean vertical resolution in coupled general circulation models. I was ***invited*** in December 2008 by Rowan Sutton for a ***one-week stay at the National Center of Atmospheric Sciences*** (NCAS, Reading, UK). I defended my PhD in December 2009 and I obtained, in 2010, the ***Adrien Gaussail PhD Prize*** awarded every two years by the Académie des Sciences Inscriptions et Belles-Lettres to a scientific PhD. The wide topics considered for this award and the low-frequency of its delivery make it a very competitive PhD prize. My PhD thesis allowed me to gain a deep understanding of the oceanic sources of predictability for the European climate on sub-seasonal to interannual timescales and it resulted in ***6 publications*** among which 4 as first author (Guemas et al 2009, Geophysical Research Letters, impact factor: 4.456; Guemas et al, 2010, Climate Dynamics: 4.619; Guemas et al, 2011, Journal of Climate: 4.904; Guemas et al, 2013, Dynamics of Atmospheres and Oceans: 2.358; Menegoz et al 2010, Journal of Geophysical Research: 3.44; Salas-Melia et al 2007). During my PhD, I was in charge of two ***courses to first-year students at the University***: one on ***statistics (10 hours/year)*** and another on ***mechanics and thermodynamics (20 hours/year).***

In November 2009, I was hired as a post-doctoral research assistant at the Laboratoire de Météorologie Dynamique (LMD, Paris, France) to work on the impact of the horizontal resolution on the atmospheric dynamics of the in-home model, in particular on the mid-latitude winter jet position, within the framework of the ***EU-funded FP7 ENSEMBLE project***. This stay provided me with a strong expertise on the storm development and the storm track which substantially affect the European climate on sub-seasonal to decadal timescales and it resulted in ***2 publications*** in peer-reviewed international journals (Guemas and Codron 2011, Journal of Climate, impact

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factor: 4.904; Hourdin et al, 2013, Climate Dynamics: 4.619).

Exploiting my expertise on the ocean and sea ice sources of predictability for the European climate on sub-seasonal to multi-decadal timescales, I headed toward the climate prediction field in December 2010 when I joined the Institut Català de Ciències del Clima (IC3, Barcelona, Spain) where I am currently ***leading the polar climate prediction research line***. As soon as I arrived, I undertook the challenging objective of generating of in-home sea ice reconstructions to initialize climate predictions and later also the adaptation of ocean reanalyses from other institutes to the initialization of the climate forecast system used at IC3, EC-Earth. I started contributing to the ***EU-funded FP7 QWECI, DENFREE, CLIM-RUN, and IS-ENES2 projects*** in parallel, to achieve the objectives my team had committed to. I started ***supervising the PhD*** of Danila Volpi in January 2011 on the comparison between various initialization techniques for climate prediction who submitted her PhD in December 2014. My first key scientific results based on the analysis of state-of-the-art climate predictions were the attribution of the worst performance worldwide obtained in the North Pacific Ocean to the too strong ocean turbulent mixing in climate models (Guemas et al 2012, Journal of Geophysical Research, impact factor: 3.44) on one hand, and of the best performance obtained in the Indian Ocean to the dominating impact of the external radiative forcing on the prediction skill (Guemas et al 2013, Journal of Climate: 4.904) on the other hand. I was ***invited*** for a ***one-week stay at the Max-Plank Institute for Meteorology*** (Hamburg, Germany) by Daniela Matei and Wolfgang Mueller in December 2011 and for a ***3-day stay at the European Center for Medium Range Weather Forecasts*** (ECMWF, Reading, UK) by Susanna Corti and Magdalena Balmaseda in January 2012 to present these results. I was awarded the ***2012 Young Scientist Award*** by the European Meteorological Society (EMS, http://www.emetsoc.org/awards/travel-awards-ystas). My most famous study, described in more details as the third most relevant contributions of my curriculum vitae, highlighted the ocean heat uptake as the dominant cause for the recent global warming slowdown and was published in ***a prestigious high-impact journal*** (Guemas et al 2013, Nature Climate Change, impact factor: 15.295) and cited 46 times until today. Following this publication, I was ***invited*** for a ***3-day stay at the Laboratoire de Physique des Oceans*** (LPO, Brest, France) by Guillaume Maze in September 2013. I was also involved in an analysis of the state-of-the-art performance of climate predictions published in another ***prestigious high-impact journal*** (Doblas-Reyes et al, 2013, Nature Communications, impact factor: 10.742), described in more details as the fifth most relevant contribution of my curriculum vitae, and cited 32 times until today. This study formed the base for Chapter 11 "Near-term climate change: projections and predictability" of the ***IPCC AR5*** - Working Group I - for which I was ***contributing author***. I led afterwards a deeper analysis of the state-of-the art prediction performance focused on the Mediterranean region with an investigation of the associated sources of skill (Guemas et al 2014, Quaterly Journal of the Royal Meteorological Society: 5.131). During my stay at IC3, I also contributed to 6 more articles (Smith et al 2013, Climate Dynamics:4.619; Hazeleger et al, 2013, Geophysical Research Letters: 4.456; Volpi et al, 2013, Geophysical Research Letters; Du et al, 2012, Climate Dynamics; Garcia-Serrano et al, 2014, Climate Dynamics; Carrassi et al, Non Linear Processes in Geophysics: 1.692; Carrassi et al, 2015, Climate Dynamics) that I will not describe here. I was ***invited*** to give a presentation on the initialization of the EC-Earth climate forecast system at the ***National Workshop on Data Assimilation*** in Toulouse on 1-3 December 2014.

The ***3-year PICA-ICE project*** (CGL2012-31987) funded by the MINECO with a budget of 149.760 euros (Previsión Interanual de la Cubierta de hielo marino del Ártico y su Impacto en el Clima de Europa) and for which I am ***Principal Investigator (PI)*** started in 2013. The rapid Arctic sea ice decline in the last decades, particularly in summer and fall, accompanied with a rapid thinning, has been considered as an early indicator of climate change. This decline could favor an increase in autumn/winter snowfall, snow cover, a polar stratospheric cooling, a weakening of the midlatitude jet and an increase in the frequency of blockings and cold winter events in the northern hemisphere. The reduced observational sampling of the Arctic sea ice cover stands as an obstacle for Arctic climate studies which was overcome, as part of **the first objective** of PICA-ICE, by the production and validation of sea ice reanalyses, covering the 1958-present period - they constitute a physical

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extrapolation of the sparse available observations (Guemas et al, 2014, Climate Dynamics: 4.619). The **second objective** of PICA-ICE was to investigate the mechanisms driving the sea ice cover variability and its impact on the Northern Hemisphere climate by applying an original statistical method to the available observational datasets and PICA-ICE sea ice reanalyses. This methodology based on clustering methods aim at gathering sea ice states into classes with a minimization of the variance intra-classes and a maximization of the variance inter-classes. These classes correspond to the main sea ice modes of variability and their indices of occurrences can be exploited to composite other fields to extract variability mechanisms (Fuckar et al, 2015, Climate Dynamics: 4.619). PICA-ICE sea ice reanalyses also provided optimal estimates of the observed sea ice cover as initial conditions for interannual climate predictions that were produced with EC-Earth. With these predictions, the ability of the EC-Earth climate model to predict the Arctic sea ice cover modes of variability is currently assessed and the added value of refining the sea ice cover prediction on the forecast quality of the Northern Hemisphere seasonal-to-interannual climate predictions is estimated as part of the **third objective** of PICA-ICE. Finally, since one major public concern is the overall climate impact of an Arctic sea ice shrinking, the **fourth objective** of PICA-ICE is, through extreme sensitivity experiments, to assess the timescale for a recovery of the Arctic sea ice cover after an ice-free summer and to assess the sensitivity of the Northern Hemisphere climate to such a massive sea-ice loss as an upper-bound to its sensitivity to interannual sea ice cover changes. As part of the second objective of PICA-ICE, I performed an attribution study of the September 2012 record minimum in Arctic sea ice extent, as described in more details as the fourth most relevant contribution of my curriculum vitae above, which was published in a ***prestigious high-impact journal*** (Guemas et al, 2013 BAMS: 11.574) and cited 41 times until today. I also developed a more advanced and more robust methodology to correct for the dependency between the data the statistical inference tests classically used in meteorology and climate sciences, which was also accepted and is currently in press for a ***prestigious high-impact journal*** (Guemas et al, 2014, BAMS: 11.574). So far, within the framework of the PICA-ICE project, ***9 publications*** have been accepted in peer-reviewed international journals (the ones listed in this above in this paragraph + Guemas et al 2014, Journal of Applied Meteorology and Climatology: 2.099; Wouters et al 2013, Geophysical Research Letters: 4.456; Fuckar et al 2014, Geophysical Research Letters; Tietsche et al, 2014, Geophysical Research Letters; Guemas et al, 2014, Quarterly Journal of the Royal Meteorological Society: 5.131; Stroeve et al, 2015, EOS). Related to the sea ice activities within PICA-ICE, I was ***invited*** to the ECMWF ***WWRP/THORPEX workshop on Polar Prediction*** in June 2013 and to the joint ***Year of Polar Prediction (YOPP) Planning Meeting*** organized by the ***WWRP/THORPEX Polar Prediction Project (PPP*)**, as explained in more details as the first most relevant contribution to my curriculum vitae above. I was also ***invited*** to attend the ***sea ice prediction workshop*** in Boulder (USA) on 1-2 April 2014 organized by ARCUS and to give an ***invited talk at the AGU Fall Meeting*** in San Francisco (USA) on 18 December at the "Polar Climate: Processes and Predictability" session which I had both to decline for personal reasons. I was nominated nonetheless in 2014 as a member of the ***SIO Action Team*** as described in more details in the first most relevant contribution to my curriculum vitae above. I was member of the ***local organizing committee for the "International workshop on polar-lower latitude linkages and their role in weather and climate prediction"*** (http://www.polarprediction.net/linkages.html) that took place in Barcelona on the 10-12 December 2014; I have ***chaired a session*** at the EC-Earth meeting in Lisbon in April 2013; and I am ***co-convener of the Polar Climate Predictability and Prediction session*** of the 2015 EGU General Assembly.

The other projects which started while I was already an IC3 member and for which I contributed to the elaboration are: the ***EU-funded FP7 SPECS, EUPORIAS, EUCLEIA and PREFACE projects*** and the ***MORDICUS project*** funded by the French Ministry. I have therefore participated in ***13 national and international projects*** until now. To date, I have co-authored a total of ***32 articles*** in peer-reviewed journals (16 as first author), ***28*** of them ***in the first SCI quartile, 4*** of them ***in prestigious high-impact journals*** (3 as first author). I have a ***H-index of 10***, with a total of 269 citations until December 2014, among which ***132 citations in***

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2014 and 76 citations in 2013. I am a ***reviewer for 6 peer-reviewed journals*** (Journal of Climate, Climate Dynamics, Geophysical Research Letters, Journal of Geophysical Research, Quarterly Journal of the Royal Meteorological Society; Journal of Atmospheric and Oceanic Technology) and ***project reviewer for the NERC*** (Natural Environmental Research Council, UK) ***and the ANR*** (Agence Nationale de la Recherche, France). I am ***collaborating*** in my day-to-day activities ***with 17 research institutes***: SMHI (Torben Koenigk, Sweden), KNMI (Geert Jan Van Oldenborgh, Holland), Météo-France (Matthieu Chevallier, France), LOCEAN (Juliette Mignot, France), Univ. Reading (Ed Hawkins, UK), Univ. Exeter (David Stephenson, UK), ECMWF (Magdalena Balmaseda, UK), MPI (Daniela Matei, Germany), AWI (Thomas Jung, Germany), NOAA (Annarita Mariotti, USA), Univ Washington (Cecilia Bitz, USA), NSIDC (Julienne Stroeve, USA), CMCC (Giovanni Aloisi, Italy), CERFACS (Laurent Terray, France), MetOffice (Doug Smith, UK), ISAC (Susanna Corti, Italy), UCL (Thierry Fichefet, Belgium). Up to date, I have been ***invited to a total of 10 different events***: conferences, workshops or visits to other institutes and I have given ***about 100 presentations*** in conferences, scientific events or institutes (that I have not listed exhaustively in my Curriculum Vitae Normalizado for the sake of readability). In 2014, I was appointed as a member of the ***CLIVAR SSG*** until at least December 2017, which is an honour bestowed for the first time ever to a member of a Spanish Research Institute. I was therefore ***invited*** to participate in the ***21st planning meeting of the CLIVAR SSG*** in Moscow on 10-12 November 2014.

As a scientist, I see public engagement and information about climate change as of utmost priority. Toward this objective, I have given in September 2012 a seminar at the Poblenou library intended to a large public on the melting Arctic sea ice cover and the historical record minimum of that same year. I have also given close-to ***30 interviews*** intended to the general public, mainly for the written press from a large variety of countries (USA, Sweden, France …) ***and a few on-live for the radio or television*** (in Catalan or Spanish which are not my mother tongues). My latest and the one with probably the largest audience was on-live on 31 October 2014 in '8 al dia' (http://www.8tv.cat/8aldia/videos/per-que-fa-calor-per-la-castanyada/). Furthermore, my research is of public utility, not only for its informative aspects, but also from an economic point-of-view. Indeed, the development of climate predictions which is my main objective feeds the ***climate services*** group at IC3, which exploits these predictions to try and extract the information suitable to the needs of private or public companies for applications: EDF (Electricité De France), MAPFRE…

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