



MINISTERIO
DE ECONOMÍA Y
COMPETITIVIDAD

SECRETARÍA DE ESTADO
DE INVESTIGACIÓN
DESARROLLO E INNOVACIÓN

SECRETARÍA GENERAL
DE CIENCIA, TECNOLOGÍA
E INNOVACIÓN

DIRECCIÓN GENERAL
DE INVESTIGACIÓN
CIENTÍFICA Y TÉCNICA

SUBDIRECCIÓN GENERAL
DE RECURSOS HUMANOS
PARA LA INVESTIGACIÓN

AYUDAS JUAN DE LA CIERVA-INCORPORACIÓN
HISTORIAL CIENTÍFICO-TÉCNICO DE LOS ÚLTIMOS CINCO AÑOS DEL EQUIPO DE
INVESTIGACIÓN
(SCIENTIFIC/TECHNICAL RECORD DURING THE LAST FIVE YEARS OF THE RESEARCH TEAM)

Según el artículo 75 de la Resolución de convocatoria el equipo de investigación es el compuesto por el personal investigador que desarrolla la línea de investigación en la que se integrará el investigador candidato.

(According to what is established in article 75 of Call Resolution, the research team is defined as the one formed by the researchers developing the research line in which the candidate is to participate)

Especificar los trabajos de investigación desarrollados, publicaciones, proyectos, patentes, la capacidad formativa pre y posdoctoral y cualquier otro aspecto de interés, haciendo especial referencia a los méritos del investigador tutor del investigador candidato.

(Please specify the research work that the team has developed, publications, funded projects, patents, capacity for providing guidance and training and any other aspect that may be of interest, with a special reference to the merits of the tutor investigator of the candidate)

CUMPLIMENTAR PREFERIBLEMENTE EN INGLÉS – FILL IN BETTER IN ENGLISH

The candidate, Omar Bellprat, plans to conduct research in attribution of extreme events to climate change at the Earth Sciences department at the Barcelona Supercomputing Center - Centro Nacional de Supercomputación, and his tutor investigator is the head of the Climate Prediction Group at the Earth Sciences department, Dr. Virginie Guemas.

Note: A glossary of acronyms is given at the end of this document.

Research Center: Barcelona Supercomputing Center

The Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) is the National Supercomputing Facility of Spain. BSC-CNS's mission is to develop and manage information technology in order to facilitate scientific and technological progress. BSC-CNS hosts a range of high-performance computing (HPC) systems, including MareNostrum III, one of the most powerful supercomputers in Europe with 48,128 cores and 1.1 Pflops capacity. More than 460 researchers and students, from 44 different countries, perform research in Computer Sciences, Life Sciences, Earth Sciences and Computational Applications in Science and Engineering at BSC-CNS. This multi-disciplinary approach and the combination of world-leading researchers and HPC experts with state-of-the-art HPC resources make BSC-CNS a unique research institution.

BSC-CNS is located on a campus of the Technical University of Catalonia (Universitat Politècnica de Catalunya - UPC) and has an agreement with the UPC to use university facilities and services. Furthermore, many of the group leaders at BSC-CNS are also university professors with broad knowledge and experience in advanced research and teaching, i.e., the BSC-CNS substantially contributes to and benefits from UPC higher educational environment. The BSC-CNS is a key element of and coordinates the Spanish Supercomputing Network, which is the main framework for granting competitive HPC time to Spanish research institutions. Furthermore, BSC-CNS is one of six hosting nodes in France, Germany, Italy and Spain that form the core of the Partnership for Advanced Computing in Europe (PRACE) network. PRACE provides competitive computing time on world-class supercomputers to researchers in the 25 European member countries. BSC-CNS has been accredited as one of the first eight Severo Ochoa Centers of Excellence. This award is given by the Spanish Government as recognition for leading research centers in Spain that are internationally well known institutions in their respective areas. The candidate will carry out his project within the Earth Sciences department of the BSC-CNS.

Earth Sciences Department

The Earth Sciences department of the Barcelona Supercomputing Center (ES-BSC) conducts multi-facet research in Earth system modelling. Established in 2006, the initial core activity was focused on atmospheric composition modelling. The designation of Professor Francisco J. Doblas-Reyes as Director of the ES-BSC in 2014 initiated the merging of the Climate Forecasting Unit of the Institut Català de Ciències del Clima (IC3-CFU), which he was leading and that in a short time became a main European actor in the development of climate predictions and climate services into the ES-BSC. The newly merged department is structured around four groups with more than 55 employees, including technical and support staff. It is a highly productive scientific entity that has published more than 150 research articles in peer-reviewed journals over the last 5 years, including 9 in prestigious high-impact journals. (For a complete list of the publications of the department: <https://earth.bsc.es/wiki/doku.php?id=publications:publications>) and with a very dense international collaborative network counting at least 50 institutes worldwide. ES-BSC focuses research on atmospheric emissions, air quality, mineral dust transport, global and regional climate modelling and prediction and climate and air quality services. The ES-BSC works on the development of and conducts research with a multi-scale set of comprehensive single-component and coupled general circulation models. The ES-BSC is now composed of four distinct but highly integrated groups: 1) climate prediction group, 2) atmospheric composition group, 3) earth system services group, and 4) computational earth sciences group. The candidate will carry out his project in close collaboration with two of the four research units of the ES-BSC: the climate prediction group and the earth system services group.

The **climate prediction group** undertakes advanced research to forecast climate variations from one month to several years into the future (also known as **seasonal-to-decadal predictions**) and from regional to global scales. This objective relies on expanding our understanding of the climate processes through a deep analysis of the strengths and weaknesses of state-of-the-art climate forecast systems in comparison with the most up-to-date

observational datasets, and on exploiting these detailed analyses to refine the representation of climate processes in our climate forecast systems and their initialization. Emphasis is made on forecasting changes in **high-impact climate events** such as the persistent winds, floods, droughts and temperature extremes and attributing natural and anthropogenic causes to the events.

Many of the activities in modelling and prediction are based on research, development and predictions with the EC-Earth climate forecast system. EC-Earth is a state-of-the art coupled climate model that is being developed and used for climate predictions and projections by a European consortium of more than 20 operational and research institutions collaborating closely, including the ES-BSC. Besides contributing to the fifth phase of the Coupled Model Intercomparison Project (CMIP5), which is one of the key datasets used to produce the UN Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), global climate research activities of this group enabled the production of historical global climate reconstructions and initial conditions for the EC-Earth community. Such data is critical for the analysis of climate dynamics and initialization of seasonal-to-decadal climate predictions. This group is already active in the planning of the next phase of the coupled climate model intercomparison project, CMIP6, and is preparing to make core contributions including groundbreaking high-resolution global climate simulations with EC-Earth (with horizontal spacing of 0.25° in the ocean and 25 km in the atmosphere). Positioned at the cutting-edge of climate prediction research, the group also has access to large multi-model databases from international projects (CMIP, SPECS, NMME ...) for process analysis. Achieving the objectives rely on the combination of a large variety of expertise on climate processes within the group from the stratosphere down to the deep ocean and from tropical to polar latitudes, together with expertise on climate modeling and data assimilation, creating an optimal environment to carry out a post-doctoral project on attribution of extreme events.

The **earth system services** group aims to bridge the gap between **climate information** and **end users** in key sectors of society (energy, urban development, infrastructure, transport, health and agriculture) via **tailored services** to societal actors. Members of this group actively work in identifying user needs, which partly guide research in the ES-BSC and aim to quantify the impact of weather, climate, aerosols and gaseous pollutants upon socio-economic sectors through the development of user-oriented services that ensure the transfer of the technology developed and the adaptation to a rapidly changing environment, especially of those highly vulnerable. They develop these non-profit services in-house in collaboration with public administrations, private contracts with companies or funding agencies, and spin-off companies that could exploit operational opportunities.

Together, the climate prediction and earth system services group are currently involved in 4 EU FP7 projects (PREFACE, EUCLEIA, SPECS, EUPORIAS), 5 EU H2020 projects (APPLICATE, INTAROS, PRIMAVERA, IMPREX, ClimatEurope), 5 national projects (RESILIENCE, RESPON, DANAE, VOLCADEC, HIATUS), 2 projects from the European Space Agency (VERITAS, CMUG2), 4 Copernicus projects (SECTEUR, Clim4Energy, C3S-MAGIC, QA4Seas), 1 project funded by the French Ministry of Sciences (MORDICUS), 1 PRACE project (LSHIP) and 1 project from ERA-NET (NEWA2) and hosts two Marie Curie fellows (DPETNA, NetNPPAO). In addition, they also concluded 3 EU FP7 projects (CLIM-RUN, QWeCi, DENFREE), 2 national projects (RUCSS, PICA-ICE) as well as a 2 projects from private institutions over the course of the last five years. During that same period, they also participated in 20 Red Española de Supercomputación (RES) projects and 3 PRACE projects. A short description of the most recent and most relevant projects is given towards the end of this document. The BSC-ES international activity includes the coordination of the two World Meteorological Organisation (WMO) regional centres specialised in sand and dust warning and forecasting, as well as the participation in climate services initiatives like the Climate Services Partnership (CSP). Members of the BSC-ES participate in committees of the World Climate Research Programme (WCRP), such as the CLIVAR Scientific Steering Group for Virginie Guemas, head of the climate prediction group, or the Working Group on Seasonal to Interannual Prediction (WGSIP) for Francisco Doblas-Reyes, head of the ES-BSC.

The other two groups that the applicant will interact with but not directly work with are the the computational earth sciences group and the atmospheric composition group. The former provides help and guidance to the scientists with the technical issues relating to their work and develops a framework for the most efficient use of HPC resources. Support includes optimization of the tools developed by scientists, development of automatic tools to compile, launch, monitor and post-process climate simulations and handle the large amount of data produced, as well as installation and upgrade of a variety of software to facilitate the scientists work. The latter group aims at

further our understanding of the chemical composition of the atmosphere and its effects upon air quality, weather and climate, while improving predictions from local to global scales. This is addressed through the development and use of the NMMB/BSC Chemical Transport Model (NMMB/BSC-CTM), an online multi-scale non-hydrostatic chemical weather prediction system that can be run either globally or regionally. This group also develops and operates the CALIOPE system ("CALidad del aire Operacional Para España"), which provides high-resolution short-term air quality forecasts for Europe, with a special focus over Spain and its main urban areas using the in-house HERMES emission model.

Overall, the department counts more than 55 scientists, composed mostly of post-doctoral fellows, computer science technicians or engineers and Ph.D. students, which are spread relatively evenly amongst the four research units.

Scientific expertise and capacity for training of the supervisor – Dr. Virginie Guemas

The tutor investigator of the candidate is Dr Virginie Guemas, who is the head of the climate prediction group in which the candidate will carry out his project, in close collaboration with the Earth system services group. She is a Ramon y Cajal fellow since November 2015 and an expert on sub-seasonal to decadal climate prediction. Her 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. She is member of the WCRP (World Climate Research Program) CLIVAR (Climate and Ocean Variability, Predictability, and Change) SSG (Scientific Steering Group). She has participated in 13 national and international research projects up-to-date. Currently, she is Principal Investigator (PI) of seven European projects funded under the FP7 (PREFACE, EUCLEIA), H2020 frameworks (IMPREX, APPLICATE, INTAROS), the European Space Agency (CMUG2) or Copernicus (C3S-MAGIC), one MINECO-funded project (HIATUS), one PRACE-funded project (LSHIP) and she is WP leader in the H2020 PRIMAVERA project. A more extensive description of these projects can be found below.

She was contributing author for the IPCC (Fifth Assessment Report) Chapter 11 Near-term Climate Change: Projections and Predictability", in the UN IPCC AR5 Working Group I – The Physical Sciences Basis report. The IPCC is a United Nations scientific intergovernmental body that was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme. The IPCC is composed of the most prominent world experts in climate studies; its reports are authoritative and provide policy guidelines for governments to address climate change.

She is author of 40 articles on climate modelling and predictions in international peer-reviewed journals, among which seven in high-impact journals, such as Science, Nature Climate Change, Nature Communications and the Bulletin of the American Meteorological Society. Currently, she has a total of 761 citations, with a h-index of 14 and a i10-index of 19. A list of 10 most relevant publications from Dr Virginie Guemas is given towards the end of this document.

Dr Virginie Guemas has supervised so far three PhD students and several post-doctoral scientists. Virginie Guemas in particular, and ES-BSC in general, have been able to provide researchers with exceptional training support and conditions for their scientific growth, steering improvements in their scientific and management skills alike. The training capability of researchers is very extensive, and has been demonstrated through the successful experience in training numerous pre- and postdoctoral scientists. The ES-BSC has participated in 4 Initial Training Networks (ITN) from FP7 program and one from Horizon2020 program, and is continuously involved in the organization of numerous summer schools (e.g., European Network for Earth System modelling schools), workshops and other training events (e.g., PRACE Advanced Training Centre, PATC, courses) related to the use of HPC resources in atmospheric and climate modelling. Former postdocs and Ph.D. students hosted at the ES-BSC hold positions in several well-known scientific institutions and energy companies around the globe, such as the NASA Goddard Institute for Space Studies in USA (Dr. Carlos Pérez García-Pando), the School of Geography and Environment at the University of Oxford in UK (Dr. Karsten Haustein) and EnBW Energie Baden-Württemberg AG in Germany (Dr. Matthias Piot). A complete list of Ph.D. thesis with research conducted at EC-BSC and under Dr Virginie Guemas supervision is given at the end of this document.

Specific objectives of the candidate – Dr. Omar Bellprat

Dr. Bellprat's expertise lies in the physics of climate change and the seamless numerical prediction of weather and climate. His current research at ES-BSC focuses on attribution of extreme events to climate change using seasonal predictions. Event attribution is an emerging discipline which embraces one of the core competences of the unit. It is further an activity with high public interest and as such tightly linked to the activities of the climate services group.

The objective of the candidate are to study recent past extreme climate and weather events that have caused high socioeconomic damages. This information highly demanded by the public and private sectors which are increasingly interested in the role that climate change played in recent extreme events. His work will further involve the development of an innovative attribution system that relies on dynamical seasonal predictions. This approach has never been tested before and could become an operational standard for climate centres worldwide.

Dr Bellprat is currently PI of the European Space Agency (ESA) VERITAS-CCI (2015-2017) and Co-PI of the CMUG2 (2015-2017) and EUCLEIA (2013-2016) project. He is also scientific collaborator in QA4Seas, C3S-MAGIC, VOLCADEC and PRIMAVERA. Upon outstanding marks during his PhD he received the ETH Medal. He is author of 13 peer-reviewed or in review articles in international journals with one publication in Science as co-author and one publication in BAMS as first author, both journals having a high impact factor. He has been invited 6 times to give presentations in various workshops and institutes, one at the Basque Centre for Climate Change (BC3) summer school, and has supervised one master student.

Selection of the 10 most relevant Projects from BSC-ES

Here, we highlight the projects where the ES-BSC plays a key role and whose outcome will benefit the applicant:

1. **EUCLEIA** (EUropean CLimate and weather Events: Interpretation and Attribution) is an EU FP7 project (lasting 36 months). It aims to provide well verified assessments of the extent to which weather-related risks have changed due to human influences on climate, as well as to identify those types of weather events where the science is still too uncertain to make a robust assessment of attributable risk. It gathers experts from 11 academic, research and operational institutions across Europe to develop a system that will deliver reliable and user-relevant attribution assessment on a range of time scales from immediate aftermath of extreme events to seasonal and annual basis.
2. **VERITAS** is funded by the European Space Agency (2 years). It aims at exploiting new satellite products through an improved initialization of land surface and sea ice components which host most of the memory on seasonal timescales in a climate prediction context.
3. **CMUG2** is funded by the European Space Agency (lasting 4 years). It aims at assessing the added-value of new satellite products with ground-breaking high resolution and exploiting novel algorithms. This assessment is carried out at BSC-ES through data assimilation and climate forecast verification. This project gathers experts from 7 research centers across Europe.
4. **PRIMAVERA** (Process-based climate siMulation: AdVances in high resolution modelling and European climate Risk Assessment) is an EU H2010 project (lasting 48 months). The goal of PRIMAVERA is to deliver novel, advanced and well-evaluated high-resolution global climate models capable of simulating and predicting regional climate with unprecedented fidelity, out to 2050. Sector-specific end-users in policy and business are engaged individually, with iterative feedback, to ensure that new climate information is tailored, actionable and strengthen societal risk management decisions. This project gathers experts from 19 research centers across Europe.
5. **IMPRES** (Improving Predictions and management of hydrological EXtremes) is an EU H2020 project (lasting 48 months). The goal of IMPRES is to improve forecast skill of meteorological and hydrological extremes in Europe and their impacts by applying dynamic model ensembles, process studies, new data assimilation techniques and high resolution modeling. This project gathers experts from 23 research centers across Europe.

6. **APPLICATE** (Advanced Prediction in Polar regions and beyond: Modelling, observing system design and Linkages associated with a Changing Arctic climaTE) is an EU H2020 project (lasting 48 months). Its main objective is to improve the understanding of processes involved in polar climate variability and teleconnections with the mid-latitudes. This goal will be achieved through novel model developments, a wide variety of ambitious sensitivity experiments, the exploitation of new polar observations and improved understanding of polar climate and linkages predictability. This project gathers experts from 16 research centers across Europe.
7. **QA4Seas** is a Copernicus project lasting 38 months and which objective is to develop a framework for an automatic and objective evaluation of operational European seasonal climate forecasting systems, including visualization. Developing this framework relies on the expertise of the consortium members in bias correction and calibration, as well as in both probabilistic and deterministic evaluation.
8. **C3S-MAGIC** is a Copernicus project lasting 30 months and which objective is to develop a web interface from which a wide variety of metrics could be computed and visualized by any user to assess the trustworthiness of any climate model against any observational dataset by relying on the wide databases created within the framework of the successive Coupled Model Intercomparison Project. This web interface would also allow for plotting any climate quantity from climate projections, with a potential weighting according to user needs. This project gathers experts from 7 research centers across Europe.
9. **PREFACE** (enhancing PREdiction of tropical Atlantic Climate and its impacts) is an EU FP7 project (lasting 48 months). It involves 28 institutional partners across 18 countries in Europe and Africa. This project aims to reduce uncertainties in our knowledge of the dynamics of Tropical Atlantic climate, particularly of climate-related ocean processes and circulation, coupled ocean-atmosphere-land interactions, and internal and externally forced climate variability. Also, it plans to improve the simulation and prediction of Tropical Atlantic climate on seasonal and longer time scales, and contribute to better quantification of climate change impacts in the region.
10. **RESILIENCE** (Strengthening the European Energy Network using Climate Service) is a nationally funded MINECO project (lasting 36 months). The aim of RESILIENCE is to develop a pioneering energy climate service, tailored to the needs of network management decision makers, so that the best climate forecast information is used for appropriate, cost-effective management, planning and adaptation decision to secure the provision of energy to society.

Selection of the 10 most relevant publications from Dr Virginie Guemas since 2013

Massonnet F, Bellprat O, **Guemas V**, Doblas-Reyes F, 2016, Using climate models to estimate the quality of global observational data sets, *Science*, 354(6311):452-455

Massonnet F, **Guemas V**, Fuckar N S, Doblas-Reyes, F J, 2015, The 2015 high record of Antarctic sea ice extent [in "Explaining Extreme Events of 2014 from a Climate Perspective"]. *Bull. Amer. Meteor. Soc.*, 96 (9), S163-S167, doi:10.1175/BAMS-D-15-00093.1.

Stroeve J, Blanchard-Wrigglesworth E, **Guemas V**, Howell S, Massonnet F, Tietsche S, 2015, Improving Predictions of Arctic Sea Ice Extent. *EOS*, 96, doi:10.1029/2015EO031431.

Jung T, Doblas-Reyes FJ, Goessling H, **Guemas V**, Bitz C, Buontempo C, Caballero R, Jokobsen E, Karcher M, Koenigk T, Matei D, Overland J, Spengler T, Yang S, 2015, Polar-lower latitude linkages and their role in weather and climate prediction. *Bull. Amer. Meteor. Soc.*, 96, ES197-ES200, doi:10.1175/BAMS-D-15-00121.1.

Guemas V, Blanchard-Wrigglesworth E, Chevallier M, Day J J, Déqué M, Doblas-Reyes F J, Fučkar N, Germe A, Hawkins E, Keeley S, Koenigk T, Salas y Méliá D, Tietsche S, 2015, A review on Arctic sea ice predictability and prediction on seasonal-to-decadal timescales, *Quarterly Journal of the Royal Meteorology Society*, doi:10.1002/qj.2401.

Guemas V, Auger L, Doblas-Reyes FJ, Rust H, Ribes A, 2014, Dependencies in Statistical Hypothesis Tests for Climate Time Series. Bulletin of the American Meteorological Society, 95 (11), 1666-1667.

Guemas V., Auger L, Doblas-Reyes F., 2014, Hypothesis testing for auto-correlated short climate time series. Journal of Applied Meteorology and Climatology, 53(3), 637-651, doi:10.1175/JAMC-D-13-064.1.

Guemas V., Doblas-Reyes F., Germe A., Chevallier M., 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 [in "Explaining Extreme Events of 2012 from a Climate Perspective"], Bull. Amer. Meteor. Soc., 94 (9), S20-S22.

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.

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

Ph.D. thesis under the supervision of Dr. Virginie Guemas:

1. Danila Volpi

Title: Benefits and drawbacks of different initialization techniques in global dynamical climate predictions

Reading date: 03/2015

2. Aude Carreric

Title : ENSO diversity under climate change

Planned reading date : 2018

2. Ruben Cruz Garcia

Title : *Regional Arctic sea ice predictability and prediction on seasonal to interannual timescales*.

Planned reading date : 2019

Recent Ph.D. thesis at the UPC with research conducted at the ES-BCS (last 5 years):

1. Michele Spada

Title: Development and evaluation of an atmospheric aerosol module implemented within the NMMB/BSC Chemical Transport Model (NMMB/BSC-CTM)

Reading date: 11/2015

2. Albert Soret Miravet

Title: Air quality management: assessing the impacts of on-road transport strategies and industrial emissions in urban areas

Reading date: 12/2014

3. Marc Guevara Vilardell

Title: Development of a high-resolution emission model for air quality modelling in Spain

Reading date: 12/2014

4. Alba Badia i Moragas

Title: Implementation, development and evaluation of the gas-phase chemistry within the Global/Regional

NMMB/BSC Chemical Transport Model (NMMB/BSC-CTM)

Reading date: 12/2014

5. Ángel A. Rincón Rodríguez

Title: Sistema de pronóstico de radiación solar a corto plazo a partir de un modelo meteorológico y técnicas de post-proceso para España

Reading date: 06/2013

6. Simone Marras

Title: Variational Multiscale Stabilization of Finite and Spectral Elements for Dry and Moist Atmospheric Problems

Reading date: 12/2012

7. Karsten Haustein

Title: Development of an atmospheric modeling system for regional and global mineral dust prediction: Application to Northern Africa, Middle East and Europe

Reading date: 01/2012

8. Sara Basart Alpuente

Title: Desert dust characterization in Northern Africa, Middle East and Europe through regional dust modelling, and satellite-borne and ground-based observations

Reading date: 01/2012

Glossary

AR5 - Fifth Assessment Report

BSC-CNS - Barcelona Supercomputing Center – Centro Nacional de Supercomputación

CMIP - Coupled Model Intercomparison Project

ES-BSC - Earth Sciences department of the Barcelona Supercomputing Center

HPC - High-Performance Computing

IC3 - Institut Català de Ciències del Clima

ICREA - Catalan Institution for Research and Advanced Studies

IPCC - Intergovernmental Panel on Climate Change

PI - Principal Investigator

PRACE - Partnership for Advanced Computing in Europe

RES - Red Española de Supercomputación

UN - United Nation

UPC - Universitat Politècnica de Catalunya

WMO - World Meteorological Organization

