Proposal n°2013081637

General information

Type of proposal: **Project access**

Is this proposal a :

Continuation : Yes

ID of the previous proposal : 2012060992

Note: *For proposals requesting access as continuation to previous access, it is mandatory to present the final report or a progress report at the time of the closure of the Call. This report should be sent to the Peer Review Team (**peer-review@prace-ri.eu**), and will be analysed by the peer-reviewers and the Access Committee to evaluate the status of on-going access. The template document for this report is available on the PRACE website ("**Information for PRACE Awardees**"), and it must be carefully respected.*

Start date: 3rd September 2013

Project name: HiResClim: High Resolution Ensemble Climate Modeling

Research fields:

Please specify here after at least one research field along with a percentage of how much it matches your proposal. You may also provide a few additional keywords (at most six, each consisting in at most three words). This information will further be used during scientific assessment for choosing reviewers.

*Please consider your research field with care and refer to the **ERC panel descriptors**.*
The sum of the (max.) 3 fields cannot exceed 100%.

Research field :	How much fitted (%) ?
PE10_2 – Meteorology, atmospheric physics and dynamics	**20**
PE10_3 – Climatology and climate change	**60**
PE10_8 – Oceanography (physical, chemical, biological, geological)	**20**

Additional keywords :

Global Climate Modelling, High Resolution Coupled Global Climate Models, Climate Prediction, Ensemble Climate Modelling, Climate Change

Contact person for all correspondence

The project leader and the contact person will both receive all information.
Please give your professional e-mail address. E-mail addresses such as Gmail and Hotmail are not accepted.

Name: Francisco Doblas-Reyes
E-mail: francisco.doblas-reyes@ic3.cat

Project leader (personal data and contact)

For this call, proposals from academia are eligible, as long as the project leader is a senior researcher employed in a research organisation homed in a European Union country or a PRACE Association member country.

☑ **The employment contract of the project leader with the research organisation must be valid at least 3 months after the end of the allocation period.**

See other eligibility criteria on the **PRACE website**.

Gender:	Male
Title:	Dr
First name:	Francisco
Last name:	Doblas-Reyes
Initials:	
Date of birth:	07061968
Nationality:	Spanish
e-mail :	f.doblas-reyes@ic3.cat
Phone number:	+34 93 5679977
Fax number:	

Project leader (organisation and job title)

Job title:	Head of Unit
Website:	http://www.ic3.cat http://ic3cfu.wikispot.org
Organisation name:	Institut Catal de Cincies del Clima

Organisation with a Research activity : Yes

For commercial companies,

- **Is the head office of the organisation in Europe? No**
- **% of R&D activity in Europe as compared to total R&D activity : –**

Department:	Climate Forecasting Unit
Group:	
Address:	Doctor Trueta 203
Postal code:	08005
City:	Barcelona
Country:	SPAIN

Collaborators

Organisation name:	Swedish Meterological and Hydrological Institute (SMHI)	**Address:**	Folkborgsvagen 1
Department:	Research and Development	**Postal code:**	60176
Group:	Rossby Centre	**City:**	Norrkoping
		Country:	SWEDEN

Dr Jones, Colin

Job title:	Head of Climate Research
Gender:	Male
Title:	Dr
First name:	Colin
Last name:	Jones
Initials:	
Date of birth:	13101967

Nationality:	British
e-mail :	colin.jones@smhi.se
Phone number:	+46114958032
Fax number:	+46114958001

Dr Wyser, Klaus

Job title:	Researcher
Gender:	Male
Title:	Dr
First name:	Klaus
Last name:	Wyser
Initials:	
Date of birth:	03121965
Nationality:	Swiss
e-mail :	klaus.wyser@smhi.se
Phone number:	+46114958000
Fax number:	

Dr Fladrich, Uwe

Job title:	Computer Scientist
Gender:	Male
Title:	Dr
First name:	Uwe
Last name:	Fladrich
Initials:	
Date of birth:	03051968
Nationality:	German
e-mail :	uwe.fladrich@smhi.se
Phone number:	+46114958000
Fax number:	

Organisation name:	CERFACS	**Address:**	42 Avenue G Coriolis
Department:	Global Change	**Postal code:**	31057
Group:		**City:**	Toulouse
		Country:	FRANCE

Dr Terray, Laurent

Job title:	Research Director
Gender:	Male
Title:	Dr
First name:	Laurent
Last name:	Terray
Initials:	
Date of birth:	06061960
Nationality:	French
e-mail :	terray@cerfacs.fr
Phone number:	+33561193015
Fax number:	

Dr Valcke, Sophie

Job title:	Research Engineer
Gender:	Female
Title:	Dr
First name:	Sophie
Last name:	Valcke
Initials:	
Date of birth:	24021966
Nationality:	French
e-mail :	valcke@cerfacs.fr
Phone number:	+33561193074
Fax number:	

Mr Maisonnave, Eric

Job title:	Research Engineer
Gender:	Male
Title:	Mr
First name:	Eric
Last name:	Maisonnave
Initials:	
Date of birth:	24011971
Nationality:	French
e-mail :	eric.maisonnave@cerfacs.fr
Phone number:	+33561193012
Fax number:	

Organisation name:	Institut Catal de Cincies del Clima	**Address:**	Doctor Trueta 203
Department:	Climate Forecasting Unit	**Postal code:**	08005
Group:		**City:**	Barcelona
		Country:	SPAIN

Mr Asif, Muhammad

Job title:	Research Engineer
Gender:	Male
Title:	Mr
First name:	Muhammad
Last name:	Asif
Initials:	
Date of birth:	01011982
Nationality:	Pakistani
e-mail :	muhammad.asif@ic3.cat
Phone number:	+34935679976
Fax number:	

Mr Manubens, Domingo

Job title:	Research Engineer
Gender:	Male
Title:	Mr
First name:	Domingo
Last name:	Manubens
Initials:	

Date of birth:	25091982
Nationality:	Spanish
e-mail :	domingo.manubens@ic3.cat
Phone number:	+34935679976
Fax number:	

Organisation name:	Royal Netherlands Meteorological Institute (KNMI)	**Address:**	P.O.Box 201
		Postal code:	3730
Department:	Global Climate	**City:**	De Bilt
Group:		**Country:**	NETHERLANDS

Prof Hazeleger, Wilco

Job title:	Head of Division
Gender:	Male
Title:	Prof
First name:	Wilco
Last name:	Hazeleger
Initials:	
Date of birth:	08101967
Nationality:	Dutch
e-mail :	wilco.hazeleger@knmi.nl
Phone number:	+31302206718
Fax number:	

Dr Severijns, Camiel

Job title:	Computer Scientist
Gender:	Male
Title:	Dr
First name:	Camiel
Last name:	Severijns
Initials:	
Date of birth:	10111964
Nationality:	Dutch
e-mail :	camiel.severijns@knmi.nl
Phone number:	+31302206215
Fax number:	

Single machine request

- Computing time specified in core-hours for the total allocation period.
- Please justify the number of core hours you request with a detailed work plan (in the **Project Detailed Description Document**).
- See also the **Technical Guideline.**

- **MareNostrum**: 65 000 000

If less than 5Mio is required on a system, the use of the Tier-0 system has to be justified (Maximum 500 words) :

Not applicable.

If the request of a single machine exceeds 30% of the resources available in the machine for the

specific call,
please justify the large request of resources (Maximum 500 words) :

The second year of HiResClim addresses the challenge of high-resolution climate modelling using several coupled models in a seamless framework where climate simulations performed for different time scales will be used to inform climate modellers and help solving the challenge. Historical and scenario simulations will be analysed along with decadal and seasonal ensemble predictions to address fundamental questions such as the dynamical origin of the substantial climate drift that hampers progress in climate prediction. At the same time, these simulations will provide climate information to the climate adaptation and climate services communities without artificial time boundaries, as the time scales considered by climate modellers are artificial to the users, who react to climate information at a myriad of time scales. This ambitious objective pushed us to redesign the original proposal for the second year of the project to 1) increase the impact of our research while at the same time 2) reduce the computing resources required from 112 to 65 million CPU-hours. The 65 million hours requested are the minimum required to undertake with guarantees the hugely ambitious challenge of demonstrating, not only to climate modellers, but also to society, the benefits of the seamless approach in a very high-resolution multi-model context. In fact, we have estimated that the in-kind contribution the project partners will provide to HiResClim by performing the accompanying lower resolution experiments using their own HPC platforms are substantial and efforts are already under way to obtain additional resources. It will be almost impossible to achieve our objectives with a smaller request.

Summary of the project

If the project is successful this will be published on the PRACE website unless you mark it as confidential below. Please make this summary understandable to a general audience. (500 words)

HiResClim aims to make major advances in the science of estimating climate change and formulating climate predictions . This will be achieved by addressing the dual requirements of increased climate model resolution and increased number of ensemble realizations of future climate conditions over a range of time scales and for a set of plausible socio-economic development pathways. Increased model resolution aims to deliver a significant improvement in our ability to simulate key modes of climate and weather variability and, thereby, provide reliable estimates of future changes in this variability. The multi-model ensemble approach acknowledges the inherent uncertainty in estimating changes in climate over seasonal to centennial time scales, particularly in phenomena that are highly variable and, of which, changes in the occurrence of the rare but intense events are those impacting society and nature most strongly. To provide credible risk assessment in phenomena such as extra-tropical and tropical cyclones, heat waves, droughts and flood events to inform climate adaptation and climate services, the combination of high climate model resolution and a multi-model ensemble approach is unavoidable. In HiResClim we attack both of these requirements using a seamless multi-model climate modelling approach, which, as well as being the most efficient way to utilise the most advanced HPC systems of today and improve the realism of climate simulations, is also the only path to providing robust and actionable estimates of climate changes. The requirements of the project were defined considering the two state-of-the-art coupled model used, EC-Earth and ARPEGE-NEMO HR.

Recent bibliographic references that are relevant to the project

Bryan, F.O., R. Tomas, J.M. Dennis, D.B. Chelton, N.G. Loeb and J.L. McClean, 2010. Frontal scale air-sea interaction in high-resolution coupled climate models. J. Climate, 23, 6277-6291, doi: 10.1175/2010JCLI3665.1.

Caron L-P, C.G.Jones and K.Winger, 2011. Impact of resolution and downscaling technique in simulating recent Atlantic tropical cyclone activity. Climate Dyn., 37, 869-892.
Delworth, T.L., A. Rosati, W. Anderson, A.J. Adcroft, V. Balaji, R. Benson, K. Dixon, S.M. Griffies, H.-C. Lee, R.C. Pacanowski, G.A. Vecchi, A.T. Wittenberg, F. Zeng and R. Zhang, 2012. Simulated climate and climate change in the GFDL CM2.5 High-resolution coupled climate model. J. Climate, 25, 2755-2781, doi:10.1175/JCLI-D-11-00316.1.
Doblas-Reyes F.J., I. Andreu-Burillo, Y. Chikamoto, J. Garca-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 Comm., doi:10.1038/ncomms2704.
Hazeleger, W., X. Wang, C. Severijns, S. Ştefănescu, R. Bintanja, A. Sterl, K. Wyser, T. Semmler, S. Yang, B. van den Hurk, T. van Noije, E. van der Linden and K. van der Wiel, 2012. EC-Earth V2.2: description and validation of a new seamless earth system prediction model. Climate Dyn., 39, 2611-2629, doi:10.1007/s00382-011-1228-5.
Hazeleger, W., V. Guemas, B. Wouters, S. Corti, I. Andreu-Burillo, F. J. Doblas-Reyes, K. Wyser and M. Caian, 2013. Multiyear climate predictions using two initialisation strategies. Geophys. Res. Letters, doi:10.1002/grl.50355.
Johnson, C., A. Carter, I. Bethune, K. Statford, M. Alava, V. Cardoso, M. Asif, B.S.A. Schuberth, T. Weinzierl, 2013. PRACE DECI (Distributed European Computing Initiative) Minisymposium. Applied Parallel and Scientific Computing - Lecture Notes in Computer Science, 7782, 43-60, doi:10.1007/978-3-642-36803-5_3.
Jung, T., M.J. Miller, T.N. Palmer, P. Towers, N. Wedi, D. Achuthavarier, J.D. Adams, E.L. Altshuler, B.A. Cash, J.L. Kinter III, L. Marx, C. Stan and K.I. Hodges, 2012. High-resolution global climate simulations with the ECMWF model in Project Athena: Experimental design, model climate and seasonal forecast skill. J. Climate, 25, 3155-3172, doi:10.1175/JCLI-D-11-00265.1.
Kinter III, J.L. , B.A. Cash, D. Achuthavarier, J.D. Adams, E.L. Altshuler, P.A. Dirmeyer, B. Doty, B. Huang, L. Marx, J. Manganello, C. Stan, T. Wakefield, E.K. Jin, T.N. Palmer, M. Hamrud, T. Jung, M.J. Miller, P. Towers, N. Wedi, M. Satoh, H. Tomita, C. Kodama, H. Taniguchi, P. Andrews, T. Baer, M. Ezell, C. Halloy, D. John, B. Loftis, R. Mohr, K. Wong, T. Nasuno, K. Oouchi and Y. Yamada, 2013. Revolutionizing climate modeling with Project Athena: A multi-institutional, international collaboration. Bull. Amer. Meteor. Soc., 94, 231-245, doi:10.1175/BAMS-D-11-00043.1.
Maisonnave, E., L. Coquart and S. Valcke, 2011. PRACE preparatory access for high resolution ARPEGE-NEMO porting on Bullx TGCC platform. Working Note, WN/CMGC/11/77, SUC au CERFACS, URA CERFACS/CNRS No1875, France.
Moss, R.H, J.A. Edmonds, K.A. Hibbard, M.R. Manning, S.K. Rose, D.P. van Vuuren, T.R. Carter, S. Emori, M. Kainuma, T. Kram, G.A. Meehl, J.F.B. Mitchell, N. Nakicenovic, K. Riahi, S.J. Smith, R.J. Stouffer, A.M. Thomson, J.P. Weyant and T.J. Wilbanks, 2010. The next generation of scenarios for climate change research and assessment. Nature, 463, 747-756, doi:10.1038/nature08823.
Sakamoto T.T. Y. Komuro, T. Nishimura, M. Ishii, H. Tatebe, H. Shiogama, A. Hasegawa, T. Toyoda, M. Mori, T. Suzuki, Y. Imada, T. Nozawa, K. Takata, T. Mochizuki, K. Ogochi, S. Emori, H. Hasumi and M. Kimoto, 2012. A new high-resolution atmosphere-ocean coupled general circulation model. J Japan Met Soc, 90, 3, 325-359, doi:10.2151/jmsj.2012-301.
Shukla, J., R. Hagedorn, M. Miller, T.N. Palmer, B. Hoskins, J. Kinter III, J. Marotzke and J. Slingo, 2009. Strategies: Revolution in climate prediction is both necessary and possible: A declaration at the World Modeling Summit for Climate Prediction. Bull. Amer. Meteor. Soc., 90, 16-19, doi:10.1175/2008BAMS2759.1.
Taylor, K.E., R.J. Stouffer and G.A. Meehl, 2012. An overview of CMIP5 and the experiment design. Bull. Amer. Meteor. Soc., 93, 485-498, doi:10.1175/BAMS-D-11-00094.1.
Valcke, S., 2013. The OASIS3 coupler: a European climate modelling community software. Geosci. Model Dev., 6, 373-388, doi:10.5194/gmd-6-373-2013.
Vannire, B., E. Guilyardi, G. Madec, F.J. Doblas-Reyes and S. Woolnough, 2013. Using seasonal

hindcasts to understand the origin of the equatorial cold tongue bias in CGCMs and its impact on ENSO. Climate Dyn., 40, 963-981, doi:10.1007/s00382-012-1429-6.
Zhang, Y., W. Maslowski and A. J. Semtner, 1999. Impact of mesoscale ocean currents on sea ice in high-resolution Arctic ice and ocean simulations. J. Geophys. Res., 104, 18409-18429, doi:10.1029/1999JC900158.

Computer resources requested

*For all fields below, you can find information on range limits in the **Technical Guidelines***
For Multiple machine Requests, please specify the values for the Machine on which you are requesting the most resources (and in case of equal requests, please specify for the first machine selected).

Number of jobs that can run simultaneously, i.e. do not depend on each other	15
Wall clock time of a typical job execution	2 Hours

- **Are you able to write checkpoint? Yes**
- **Maximum time between 2 checkpoints (hours) :** 2

Expected job size (number of cores) and job memory (total memory usage over all cores of jobs)

	Number of cores:	Memory (GB):
Minimum:	1 024	250
Average:	1 536	275
Maximum:	2 048	300

*** Storage: Maximum amount of data needed at a time.**

Total storage (scratch) – scratch files during simulation, log files, checkpoints (GB/TB)	20 000 GB
Total storage (work) – result and large input files (GB/TB)	10 000 GB
Total storage (home) – source code and scripts (GB/TB)	500 GB
Total storage (archive) (GB/TB)	50 000 GB

*** Maximum number of files to be stored.**
**** Mio: Millions**

Number of files (scratch) (Mio)**	1
Number of files (work) (Mio)	0.5
Number of files (home) (Mio)	0.1
Number of files (archive) (Mio)	1

*** Data transfer.**

Total amount of data to be transferred to/from the production system (GB/TB)	50 000	GB

Please check recommended limits for data transfer in the Technical Guidelines (Data Transfer section).
Be aware that transfer rates above a reasonable value could be unfeasible.
Describe your strategy concerning the handling of data (pre/post processing, transfer of data to/from the production system, retrieving relevant data for long-term).In case the amount of data to be transferred is of the order of tens of TB, Justify it and explain how you plan to manage it (Maximum 500 words) :

Global climate modelling groups are familiar with the need for large data transfer and archival. This is built on over 20 years of experience in international coordinated projects under the CMIP protocols.
The transfer of initial-condition files to the production system is necessary prior to the start of the climate predictions. These files, which will be kept in the "work" file system, represent ~3 Tb for the atmosphere, land, ocean and sea-ice initial conditions. Instead of transferring all the initial conditions at a time, the transfer could be organized in successive sessions depending on the production rate as the initial conditions for a forecast already produced are not necessary any longer for performing other forecasts.
The model codes and associated configuration files represent ~100 Gb each that will be kept in the "home" file system.
In CMIP5 the distributed and federated Earth System Grid has been used for archival and distribution of simulation results. The output files will be first locally stored and then transferred back to the applicant institutions for further analysis. HiResClim simulations will all ultimately be archived in the National Supercomputing Center (NSC) in Sweden. There is a set of post-processing routines that extract and calculate the range of diagnostics required for subsequent scientific analysis. The procedure significantly thins the amount of basic data for subsequent transfer. It might be preferable to use either a smaller machine attached to the HPC or dedicated nodes for the post-processing of the model output. Once post-processed, the data is available in suitable temporal chunks that will be transfered off the MN3 system, IC3, SMHI and KNMI sharing the responsibility for retrieval and removal of the EC-Earth output. The most adequate options for transfer (for instance, gridftp) will be discussed with the local technical support.
Although there is a limit of 50 TB of data to be transferred in the guidelines, it is likely that the data to be recovered by the partners will exceed this number. At the end of the project, all data will have been transferred towards the applicant institutions and erased from the offline storage of the production platforms. More details on post-processing and data transfer are provided in the response to the mandatory questions.

*** I/O**

Please describe the I/O strategy of the code (for example usage of I/O libraries, MPI I/O, netcdf, HDF5 or other approaches).
Be aware that I/O has to be adequately managed for highly parallel applications on Tier-0 systems, especially in case of I/O intensive applications,
i.e. that need to read and/or write frequently from/to disk during a job. In general serial I/O for large amount of data is not suitable for the system :

EC-Earth produces output in NetCDF and GRIB formats. A typical experiment produces 80 Gb of atmospheric and 20 Gb of ocean output per year of simulation. The number and frequency of output variables will be significantly reduced compared to the standard CMIP5 protocol. We will mainly save only monthly variables, with a few carefully selected daily fields added. A post-processing "after-burner" will be performed that will continuously calculate averaged diagnostics from the raw output fields, allowing significant reductions in the amount and size of the final files to be transferred from MN3.
Each MPI rank writes its own restart file. Restart files for the atmosphere are raw binary files while those of the ocean model and the coupler are saved as NetCDF files. One complete set of restart files in an experiment using the T511L91/ORCA025L75 configuration results in about 20 GB of data, which is comparable to the typical output for a simulation. Typically restart files are saved at the end of a simulation chunk, which ranges in length between one and six months of simulation depending on the use of the machine, with the estimates in this proposal coming from an assumption of three-month long chunks. The size of the restart files and the possibility to adjust the checkpoint frequency is a good motivation to keep the number of checkpoints down to a minimum.

I/O data traffic (read and write) per hour for typical production job (GB) :	100
Number of files generated per hour for typical productions job :	10 000

Describe what work has already been done to develop the codes

This should include the following: describing the main algorithms, how they have been implemented and parallelized, and their main performance bottlenecks and the solutions to the performance issues you have considered. For each code that needs to be optimized, please provide the details listed below.

1. Name and version.
2. Webpage and other references.
3. Licensing model.
4. Contact information of the code developers.
5. Your relationship to the code (developer, collaborator to main developers, end user, etc.).

EC-Earth is developed from the ECMWF IFS system, with strong communication between EC-Earth and the IFS developers. SMHI has developed the latest version of EC-Earth (version 3), to be used in HiResClim, with the main developers (Wyser and Fladrich) partners in the proposal. Furthermore, KNMI developed version 2.3 of EC-Earth, the forerunner to version 3 and the code version used for CMIP5 simulations. The main developer of this code version (Severijns) are also project partners. IC3 partners are developing and testing the Autosubmit system for EC-Earth, a python software that wraps a number of independent model simulations into a single executable and manages all job control of this bundled executable during integration. IC3 is also the EC-Earth partner responsible for the initialization of the climate forecasts performed by the consortium. The IC3 developers are also part of the HiResClim team. The NEMO community ocean model developed and supported by the Paris-based NEMO system team is the ocean component of EC-Earth. The HiResClim team has developed through a range of projects extensive knowledge of the NEMO code and work closely with the NEMO team in various developmental

aspects of the NEMO performance. NEMO is the ocean model currently used in the PULSATION project, into which CERFACS participates, that has been granted 22 Mhours on Curie Thin nodes also in the 5th call.
EC-Earth has already been run and tested on tier-0 platforms such as Curie and Marenostrum III, with performance analysed out to more than 2,000 cores per single job. EC-Earth was the subject of an is-ENES-PRACE1IP collaboration to test and improve performance of a 799/ORCA025 version on PRACE systems. All of the HiResClim partners were involved in this effort, hence significant experience already exists in the team on the performance bottlenecks with both models, specific to the Curie system.
The high-resolution version of ARPEGE-NEMO is assembled by CERFACS based on the atmospheric model ARPEGE version 5.2 developed at Mto-France (at a T359 -50 km resolution and 31 vertical levels) and the ocean model NEMO 3.4 using the ORCA025 configuration (1/4 deg) and 75 vertical levels. ARPEGE-NEMO is the coupled model used in the current PRACE project SPRUCE lead by CERFACS that has been granted 27 Mhours on Curie Thin nodes in the 5th call.
It is well established that the main bottleneck for massively parallel performance of dynamical climate systems is I/O due to the need for large amounts of raw output data, from which numerous post-processed diagnostic fields are extracted. As detailed in the file with the responses to the mandatory questions attached to this proposal, the partners have developed a number of automated post-processing procedures, that continually calculate required diagnostics to be saved from the raw model output. This data thinning and reduction procedure occurs continuously in parallel with the production runs.
The second primary performance bottleneck for high-resolution climate systems is the need for frequent exchange of data and regridding through a coupler (OASIS) between component models (atmosphere, ocean, land, sea-ice). The performance of the OASIS coupling system
has recently greatly improved for large jobs, through the development of the OASIS-MCT system. OASIS-MCT will be used in the planned simulations. The developers of the OASIS-MCT at CERFACS are partners in HiResClim (Valcke and Maisonnave).
The simulations proposed here require the preparation of a complex environment on the HPC platform:
- for the model to read the initial conditions,
- the interaction between the launching and monitoring system used to perform the climate predictions, Autosubmit,
- and the time-consuming task of post-processing the model output for its transfer to the applicants institution.
Autosubmit is a tool, developed by IC3, to manage and monitor remotely climate forecasting experiments. It is designed with the following goals:
- Supercomputer independent framework to perform experiments
- Efficient utilization of available computing resources at supercomputers
- User-friendly interface to start, stop and monitor experiments
- Auto restarting the experiment or some part of experiment
- Ability to reproduce the completed experiments
The post-processing, storing and transfer scripts also need to be carefully tested to efficiently handle the large volume of files and data that will be generated. All these tasks have been undertaken in the first year of HiResClim, the tier-0 PRACE project SPRUCE and/or in the PRACE DECI7 SPIESM project.

Discuss the routes that you will use for dissemination of the project and for any appropriate knowledge transfer. This should include any resources that you will be using to support this. (500 words)

Dissemination of HiResClim will mainly follow 2 paths: (i) dissemination of the output of the simulations through archival of the data on the CMIP5 ESG nodes and making it openly available to the research community, and (ii) peer-reviewed articles, following the track record that the applicants have already

shown in the past, and participation in conferences.
The knowledge and experience gained by running the system in this particular configuration will also benefit the entire EC-Earth community, as well as other European ESM groups using components of the EC-Earth system, such as IFS (atmospheric model), OASIS (atmosphere-ocean coupler) and NEMO (ocean model).
Further to these channels, European climate researchers will be updated of progress through the ENES network, which liaises with and provides feedback to PRACE, and directly within the IS-ENES2 project and other relevant EU and national research collaborations.
Finally, the results of the project will also feature at the meetings of WCRPs Working Group on Seasonal-to-Interannual Prediction, of which the team leader is co-chair.
European policy-makers will be targeted for dissemination via suitable publications, such as the newsletters organized in the framework of the SPECS and EUPORIAS projects, and, where feasible, advances made in climate modelling will be communicated to the interested public.

Confidentiality

Is any part of the project covered by confidentiality ? **No**

If YES, specify which aspect is confidential and justify (Maximum 500 words) :

Do you have any other support for this application e.g. from your national funding council, the EC or international collaborations? Please give details of this below.

All partners have national and European Union research funding to support the science activities (i.e. mainly the scientific diagnostics) underpinning the proposed work. These include EU FP7 projects such as IS-ENES2, EMBRACE, SPECS, EUPORIAS and EUCLEIA, and national funding from the Spanish ministry as RUCSS and PICA-ICE. No direct funds are available for the implied computer costs or human resources involved in this application and the costs will be supported by the partners.
This work will substantially contribute to raise the profile of the ENES community, in particular in the field of climate prediction, both at the European and international level. Given its interest, it has received the explicit support of a number of international partners such as Meteo-France, NOAA and ECMWF.

You can nominate up to three reviewers to assess your proposal

Please note that the reviewers you nominate should not be a member of your research group or a member of a group with whom you work on a regular basis. Preferably you should nominate at least one reviewer from outside your own country. PRACE will aim to use one of these nominees to review your proposal but there is no guarantee that any of the nominees you indicate will be used.
Please give the names, affiliations and e-mail addresses of the nominated reviewers.

	Name & email		Affiliation
First nominee	**Name:**	Jim Kinter III	Director, Center for Ocean-Land-Atmosphere Studies, 4041 Powder Mill Road, Suite 302, Calverton, MD 20705 USA
	e-mail:	kinter@cola.iges.org	
Second nominee	**Name:**	Julia Slingo	Hadley Centre, UK. Meteorological Office, Exeter, UK
	e-mail:	julia.slingo@metoffice.gov.uk	

	Name & email		Affiliation
Third nominee	**Name:**	Masahide Kimoto	Atmosphere and Ocean Research Institute, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8568, Japan
	e-mail:	kimoto@aori.u-tokyo.ac.jp	

☑ ***I certify that I have read, understand, accept and comply with the terms and conditions of PRACE regular access - Call for proposals available at http://www.prace-ri.eu/Call-Announcements***

Those terms include the ones reproduced hereinafter for the sake of clarity:

The users commit to:

a. Provide to PRACE within the period established in the guide for applicants a final report, using the proper PRACE template, with the results obtained through the access to the PRACE Research Infrastructure, as well as a qualitative feedback on the use of the resources.
b. Acknowledge the role of the HPC Centre and PRACE in all publications which include the results above mentioned. Users shall use the following (or equivalent) wording in such acknowledgement in all such papers and other publications:

   « We acknowledge PRACE for awarding us access to resource [machine name] based in [country] at [site] »

c. Allow PRACE to publish the mentioned report as of one year from the termination of the allocation period.
d. Commit to collaborate with PRACE, upon its request, in the preparation of dissemination material.
e. The applicant commits to not use the project results for military purposes.