REQUEST FOR A SPECIAL PROJECT 2010–2012

MEMBER STATE: Denmark

Principal Investigator[1]: Shuting Yang

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Project Title: Decadal climate change experiments of EC-Earth at high resolutions and with top atmosphere

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SPDKHRES**	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project. For projects started before 2009, please state 2009 as the start year.)	2009	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2010-2012: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2012.)	**2010**	**2011**	**2012**
High Performance Computing Facility (units)	200,000	400,000	
Data storage capacity (total archive volume) (gigabytes)	2,000	4,000	

*An electronic copy of this form **must be sent** via e-mail to:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): April 28, 2009

Continue overleaf

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

Principal Investigator: Shuting Yang

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Extended abstract

The aim of this project is to establish two versions of the EC-Earth system for decadal climate predictions: A high horizontal resolution version, and a high top atmosphere version. The EC-Earth system applied is an earth system model based on ECMWF's seasonal forecast system 4, i.e. IFS-OASIS3-NEMO with LIM2 as sea ice model.

Global coupled models have been used in decadal climate change predictions to provide guidance as the likelihood in extremes on the regional scale. The quality of such predictions depends not only on the our understanding of the physical processes involved in the climate system and included by the earth system model as parameterisations, but also on the model resolutions required by internal dynamics of the climate system. Many theoretical and modelling studies have indicated that small-scale phenomena such as storm tracks organized by forced large-scale flow transport heat and momentum, so that they may lead to an internal feedback upon the large-scale flow. The long-term mean planetary circulation patterns that count for the regional climate are then to a large extend an outcome of the dynamical balance caused from wave interactions of different scales. The realistic simulation of regional climate, therefore, requires a reasonable representation of small-scale waves in climate model system. Experts on climate change studies have suggested that next-generation experiments for near-term climate prediction (2005-2030), following on the scenario approach used in the IPCC third and fourth assessment reports, should apply fine resolution spatial models, e.g., atmospheric model components at resolution of 0.5° -1° latitude and longitude grid cells, as well as increased vertical resolution and domain, in order to meet the challenge of determining the regional climate changes (Hibbard et al, 2007).

In the first part of the project, the extent of the importance of enhanced horizontal resolution in decadal prediction will be studied. We will use a high horizontal resolution version of the EC-Earth system at a horizontal resolution of T319 or T399 (to be decided later according to the model efficiency and the resource allocated for the project) and 62 vertical layers for the atmosphere, and a horizontal resolution of about 1° with equatorial refinement and 31 vertical layers for the ocean.

The second part of the project will focus on understanding the stratosphere-troposphere feedback and its implication for surface climate prediction. A high-top atmosphere version of the EC-Earth system with the IFS atmospheric GCM at T159 and 91 vertical layers will be used to include the stratosphere. The top of the atmosphere in this model version is at 0.01 hPa and there are 20 layers that fall in the stratosphere.

In the first year of the project (2009), the both versions of the EC-Earth will be tuned, tested, and validated separately again present day climatology (ERA40). In the second year of the project, ensemble decadal predictions using both versions will be made for the period of 2005-2035.

References

Hibbard, K.A., G.A. Meehl, P.M. Cox, P. Friedlingstein, 2007: A strategy for climate change stabilization experiments. EOS. Vol. 88, No. 20, pages 217, 219, 221.

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