SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2013 …….

Project Title: Last Glacial Maximum and Mid-Holocene Climate in EC-Earth ……..……

Computer Project Account: SPDKYANG ……..……

Principal Investigator(s): Shuting Yang ……..……

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Affiliation: Danish Meteorological Institute ……..……

Name of ECMWF scientist(s) collaborating to the project (if applicable) N/A……..……

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Start date of the project: Jan. 2013 ……..……

Expected end date: Dec. 2014 ……..……

Computer resources allocated/used for the current year and the previous one (if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	N/A		495,000	0
Data storage capacity	(Gbytes)	N/A		5,000	0

Summary of project objectives
(10 lines max)

Climate models are mostly validated by evaluations of their ability to reproduce the present-day climate. However, applications of climate models to the palaeoclimate conditions, for which the external forcings are large and relatively well known, can test the performance and reliability of state-of-the-art climate models, and thereby assess the ability of these models to simulate radically different climates. Such assessments may help us understand the climate sensitivity and identify the uncertainty in future climate projections. In this project, the EC-EARTH model simulations for the periods of the Last Glacial Maximum (LGM) and the Mid-Holocene (MH) will be carried out following the experiment protocols established by the Palaeoclimate Modelling Intercomparison Project phase 2 (PMIP2). The simulations will be evaluated against the palaeo-observations and other PMIP2 models. The responses of the climate system will also be investigated.

Summary of problems encountered (if any)
(20 lines max)

As the forcing and boundary conditions for the periods of LGM and MH are very different from the preindustrial-/present-day to which the current version of the EC-EARTH model has been adjusted, a considerably long spin-up of the model system is required so that the model climate is able to adjust to the forcings accordingly. We will monitor the model climate as the simulations proceed, and estimate the length of spin-up is needed for the model to reach the quasi-equilibrium with the forcing conditions. According to our test on the current HPC (c2a), by using 128 CPUs, an 1-year integration of the EC-EARTH model at T159L62 and 1 x 1 degree ocean resolution costs 2200 billing units. The allocated 495,000 units for each project year (i.e., 2013 and 2014, respectively) are thus only sufficient for not more than 500 year simulation all together. It is very likely that more HPC facility will be needed for accomplish the desired experiments. We will follow the evolution of our simulations closely and report back our needs.

Summary of results of the current year (from July of previous year to June of current year)
This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

The project started formally from year 2013. However, some preparation works already began in 2012. These works were mostly on porting the DMI's configuration of the EC-EARTH model to the new ECMWF IBM Power 7. This porting includes

i) Compiling and linking the executables and the necessary libraries;
ii) Setting up the run-environment in terms of input data and scripts to configure, execute and restart the experiments;
iii) Setting up the post-processing as part of the run-restart cycle. The post-processing is performed on the ecgate server at the end of a run cycle (ie., one year), once the simulation for the cycle (that is performed on the c2a HPC machine) is completed. It is a necessary step to use the HPC efficiently and to reduce the data storage.

A benchmark test following the EC-EARTH benchmarking protocol was then carried out on the IBM Power 7. The outputs were evaluated. The results compared well with those of the other groups participating in the benchmark on various computer platforms.

According to the project plan, the main work in the first phase of the project is to extend the EC-EARTH model for applications of the palaeo-conditions, which includes:

- Implementation of a module that allows the solar insolation changes driven by the orbital changes;
- Implementation of the concentrations of greenhouse gases and aerosols, and the conditions of vegetation and ice sheets, i.e., the forcing and boundary conditions that are appropriate for the periods of LGM and MH, respectively, as specified by the PMIP2 experiment protocol.

A student has started these implementations and the work is in progress following the project plan.

List of publications/reports from the project with complete references

Peter L. Langen, 2012: Porting the DMI configuration of the EC-Earth v. 2.3 GCM to the new ECMWF IBM Power 7. *Danish Climate Centre Report 12-05.*
http://www.dmi.dk/fileadmin/Rapporter/DKC/dkc12-05.pdf

Summary of plans for the continuation of the project

(10 lines max)

Work plan for the rest of 2013 and 2014:

- July-Sept, 2013: Continuation of adaptation of EC-EARTH to the LGM conditions; Short test runs at local DMI's HPC. Simulation with the LGM condition starts at the ECMWF's HPC.
- Oct.-Dec., 2013: LGM simulation continues and extends to at least 300 years (ideally to 500 years providing enough resource).
- First half year, 2014: Analysis of the LGM simulation; Testing of EC-EARTH for MH conditions at DMI; Perform the MH simulation at the ECMWF's HPC.