

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 2017

Project Title: EC-Earth high resolution simulations

Computer Project Account: SPNLHAAR

Principal Investigator(s): Dr. R. J. Haarsma, Dr. Ph. Le Sager, Dr. G. van den Oord

Affiliation: Royal Netherlands Meteorological Institute (KNMI)

Name of ECMWF scientist(s) collaborating to the project (if applicable)

Start date of the project: January 1th 2017

Expected end date: January 1th 2020

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)			50,000,000	22,016,922 (44 %)
Data storage capacity	(Gbytes)				

Summary of project objectives

(10 lines max)

In this special project we will perform simulations with the high resolution versions of EC-Earth_v3.2. Targeted runs as outlined in the HighResMIP protocol will be performed with T511/ORCA025. They will add to the HighResMIP simulations done within the European H2020 PRIMAVERA project. In addition we will perform simulations at T1279/ORCA0125. At this resolution small scale atmospheric and oceanic phenomena, like tropical cyclones, air-sea interaction over SST fronts, and deepwater formation are expected to be significantly better simulated. This enables a better understanding of the physical mechanisms and will be beneficial for the quality of the climate simulations and seasonal to decadal forecasts. Analysis of the runs will be done in collaboration with the other partners of PRIMAVERA and EC-Earth.

Summary of problems encountered (if any)

(20 lines max)

The development of EC-EarthV3.2 has been delayed. Tuning for the high resolution (HighResMIP/PRIMAVERA) version is now going on and will probably be finished by the end of July 2017.

Summary of results of the current year (from January to June of current year)

The development of EC-Earth_V3.2 has been delayed. This has been caused by various issues, including delay in CMIP6 forcings, technical problems and development of new time consuming parameterisations such as Easy Aerosol.

To speed up the tuning process of the high resolution version EC-EarthV3.2 (T511/ORCA0.25) time units of SPNLHAAR have been used. The PRIMAVERA AMIP present day simulations (1950-2014) are now finished. The data is presently being CMORized and uploaded to the JASMIN server at the UK. This is where the analyses will be done. Continuation until 2050 will be done at the end of 2017 when the future CMIP6 forcings will be available.

Presently the coupled version is now being tuned. SPNLHAAR will also be used for this. The performance of the coupled model is about 3 SYPD. Long simulations (~ 500 yr) that will reach equilibrium are therefore not feasible. Instead the methodology based on “Gregory” plots will be used. This methodology assumes that there is an approximate linear relationship between the global net surface heat flux and the global SST. Using this relationship the net surface heat flux for a specific global SST can be tuned to obtain the desired global SST in equilibrium (zero surface heat flux). The tuning will be done in collaboration with CNR of Italy that is also a member of the EC-Earth consortium.

It is expected that the tuning will be completed by the end of July. The delivery date of the coupled runs (1950-2014) for PRIMAVERA is October 2017. The runs will follow the HighResMIP protocol as described in Haarsma et al. (2016).

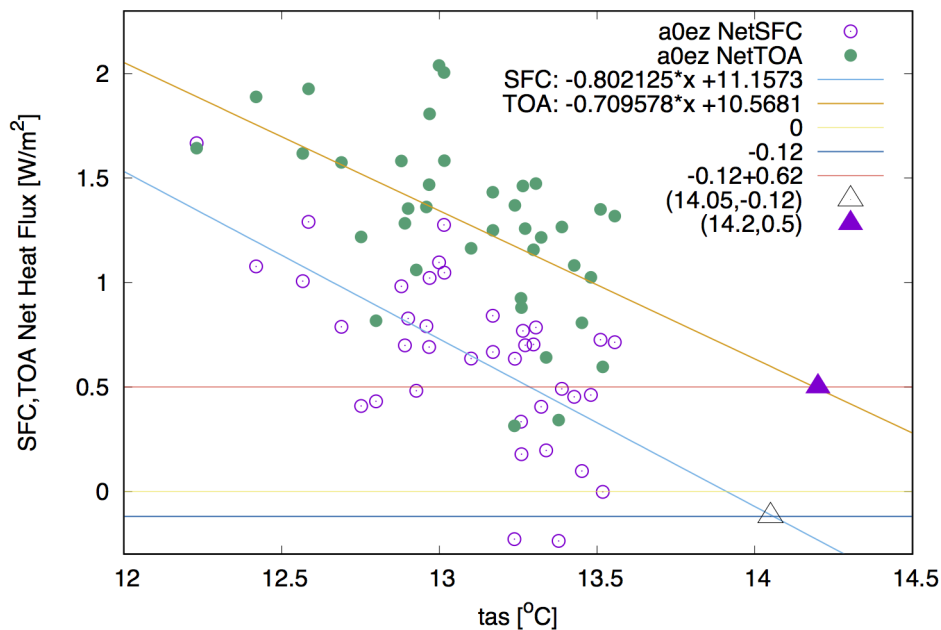


Figure 1. Gregory plot for the coupled T511/ORCA025 configuration. According to this plot the coupled simulation, which is not yet in equilibrium, will reach an equilibrium tas between 14 and 14.2 °C.

After the PRIMAVERA stream I simulations, SPNLHAAR will be used for targeted simulations as outlined in the workplan of the project. In addition we will start with simulations of the very high resolution version of T1279/ORCA0125. This will be done in collaboration with the Barcelona Super Computing center (BSC) that is a member of the EC-Earth consortium. A successful coupled simulation of about one year was presented by BSC at the EC-Earth meeting in Helsinki 29-31 May 2017. At youtube there are a few videos of these simulations:

<https://www.youtube.com/watch?v=JT4ZQAQf5yI>
<https://www.youtube.com/watch?v=kOjqWapYsVY>

This version will be the starting point for the simulations within SPNLHAAR.

Apart from the required computer resources, data storage is a serious issue at these high resolutions. Therefore we will start the software development of XIOS, to facilitate more economic data storage. This will be done in collaboration with the Netherlands eScience center and BSC.

Haarsma, R. J., Roberts, M. J., Vidale, P. L., Senior, C. A., Bellucci, A., Bao, Q., Chang, P., Corti, S., Fučkar, N. S., Guemas, V., von Hardenberg, J., Hazeleger, W., Kodama, C., Koenigk, T., Leung, L. R., Lu, J., Luo, J.-J., Mao, J., Mizielinski, M. S., Mizuta, R., Nobre, P., Satoh, M., Scoccimarro, E., Semmler, T., Small, J., and von Storch, J.-S.: High Resolution Model Intercomparison Project (HighResMIP v1.0) for CMIP6, *Geosci. Model Dev.*, 9, 4185-4208, doi:10.5194/gmd-9-4185-2016, 2016

List of publications/reports from the project with complete references

No publications or reports yet.

Summary of plans for the continuation of the project

(10 lines max)

Finalizing of the PRIMAVERA stream I (T511/ORCA025) runs before the end of 2017. Starting of targeted HighResMIP simulations: Continuation to 2100, doubling and quadrupling of CO2 forcing.

Starting of the very high resolution simulations (T1279/ORCA0125). Initial analysis will be focused but not limited to:

- *Simulation of tropical cyclones and their transition to extra-tropical storms*
- *Air-sea interaction over western boundary currents such as the Gulfstream*
- *Dynamics of the Meridional Overturning Circulation (MOC).*