Project: **1054**

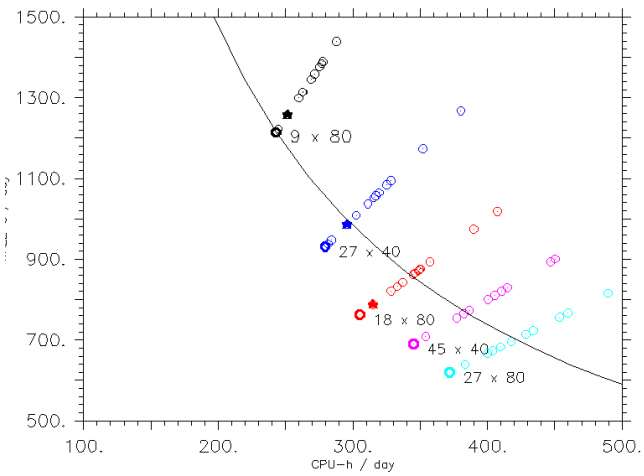
Project title: **CESM1 (Community Earth System Model) as a new MESSy basemodel: Evaluation based on ESCiMo simulations with ECHAM5/MESSy**

Principal investigator: **Astrid Kerkweg**

Report period: **2017-07-01 to 2018-06-30**

In the application for the allocation period 07/2017-06/2018, five simulations were planned in order to evaluate CESM1/MESSy. During the preparation of these simulations, this number was reduced to three simulations for technical reasons:

Acronym	Model	horizonal resol.	vertical resolution	Period	current status (April 2018)
CMne16L90	CESM1/MESSy	ne16	L90MA	1950 – 2011	1950 – 2003
CMne30L90	CESM1/MESSy	ne30	L90MA	1990 – 2010	1990 – 2007
EMACT106L90	EMAC	T106	L90MA	1990 – 2010	finished



For EMAC at T106L90MA resolution a scaling test was performed. The figure on the left side shows results for 20 (black), 30 (blue), 40 (red), 50 (pink), and 60 (cyan) compute2-nodes (i.e., with 36 cores each), for different domain decompositions. EMACT106L90MA scales very well up to 40 nodes, but the speed up on 50 or 60 nodes is also still satisfying. Therefore the EMAC simulations have been performed on 40 or 50 nodes.

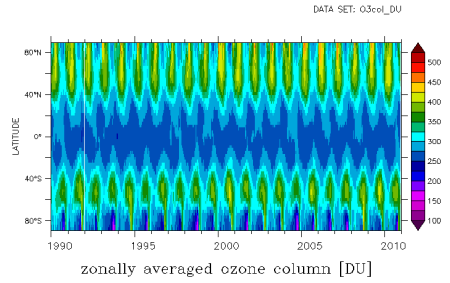
The scaling of CESM1/MESSy is less good, due to the tracer transport implementation in CESM1. Therefore, the CESM1/MESSy simulations are still ongoing, but will be finished by the end of the application period.

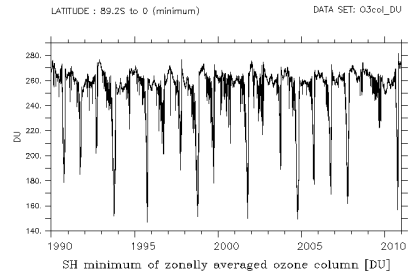
As CESM1/MESSy works on an unstructured grid, the output of CESM1/MESSy needs to be post-processed to a regular grid for further analyses. This produces an enormous overhead on data storage requirements. Unfortunately, we underestimated the required space on the /work and /arch data storage systems. Therefore we had to temporarily use more than the granted space on both systems. After finishing the simulations, the memory consumption on /work will be reduced to the amount granted. For the archiving we decided that it would be good to store the original unstructured output, until we can be sure that the post-processing worked correctly. Unfortunately, we did not take this into account for the application. This is why we used 200% of the granted archive space. As we currently have a shortage in manpower for the data analyses, this storage space will still be required for the coming allocation period. Nevertheless, at the end the data archive space required will be reduced to the originally allocated one.

The second figure shows the time series of the zonally averaged total ozone column and southern hemispheric minimum of the zonally averaged ozone column for (A) EMAC T42L90MA (ESCiMo simulation), (B) EMAC T106L90MA, (C) CESM1/MESSy ne16L90MA and (D) CESM1/MESSy ne30L90MA. For most latitudes, especially in the tropics and at the South Pole EMAC T42L90MA produces lower zonally averaged ozone columns compared to the other three

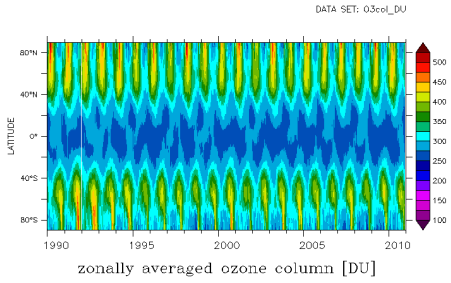
model configurations. Particularly, it produces by far the most events with less than 200 DU. Here, both “finer resolved” model configurations (for EMAC and CESM1/MESSy, respectively) produce no such event. CESM1/MESSy shows larger SH minimum zonally averaged ozone columns compared to EMAC (270 DU vs 265 DU).

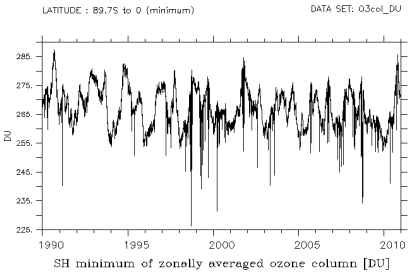
(A) EMAC T42L90



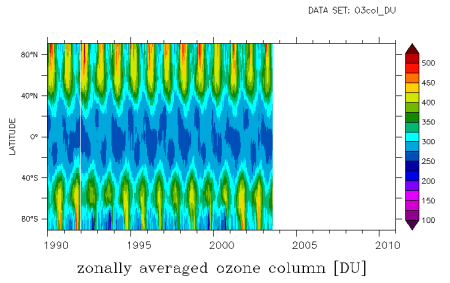


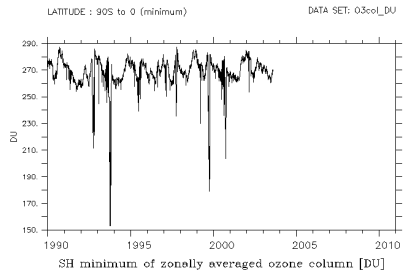
(B) EMAC T106L90





(C) CESM1/MESSy ne16L90





(D) CESM1/MESSy ne30L90