Project: **882**

Project title: **CESM1 (Community Earth System Model) as a new MESSy basemodel: Evaluation and further development**

Project lead: **Andreas Baumgärtner**

Report period: **2016-01-01 to 2016-12-31**

Summary:

The CESM1/MESSy model was further developed and successfully tested (WP1), and scaling tests were performed (WP2). Simulations equivalent to the MESSy ESCiMo Setup are currently running (WP3).

Detailed progress report

In the past, the Modular Earth Submodel System (MESSy) system was equipped with the spectral element dynamical core of the CESM1 model (NCAR/USA). Basic tests and a middle atmosphere version with full atmospheric chemistry were published in Baumgaertner et al. (2016). The progress in the three work packages (see request for 2016) is detailed below.

WP1: Debugging

Further developments, for example in making the ECHAM boundary layer scheme more compatible with CESM1/MESSy, were performed and tested. Comparisons with EMAC(ECHAM/MESSy) simulations are now very promising. Figure 1 shows the soil moisture stress function from a CESM1/MESSy simulation (left) and EMAC (right) for January 1998 with good agreement.

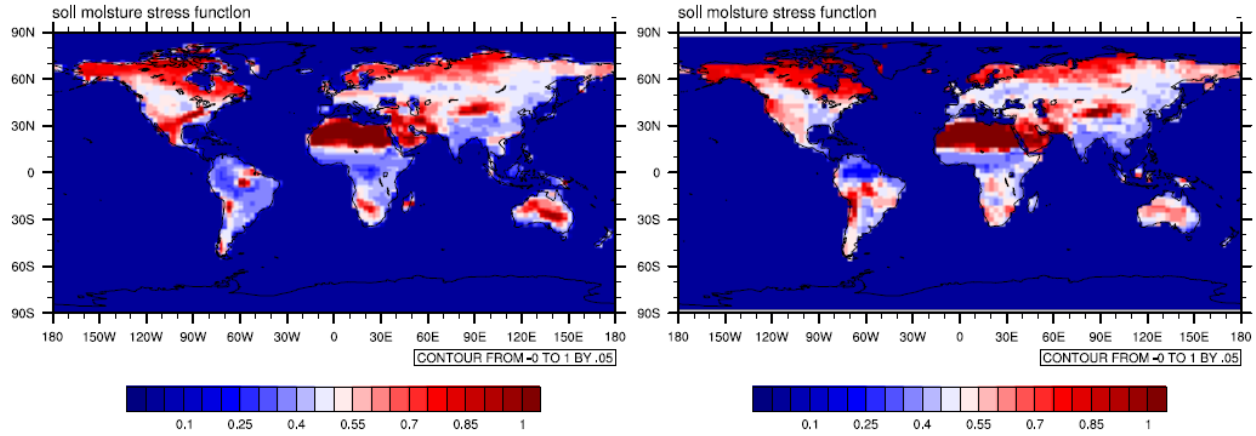

Figure 1: Soil moisture stress function from a CESM1/MESSy simulation (left) and EMAC (right) for January 1998.

WP 2: Scaling tests

Scaling tests were performed up to 32 nodes. Due to the cut in resources in the third quarter of 2016, and the priority for WP 3, scaling tests with a higher number of nodes and with higher model resolution were not tested. Figure 2 shows the results for the 2x2 degree model resolution scaling tests for 2 to 32 nodes on the Broadwell nodes compute2 (36 cores) for 2 setups: no chemistry, lower atmosphere version with 26 levels (only MESSy submodels AEROPT, CLOUD, CONVECT, ORBIT, RAD, TROPOP, VERTDIFF), and the middle atmosphere ESCiMo Setup with full atmospheric chemistry

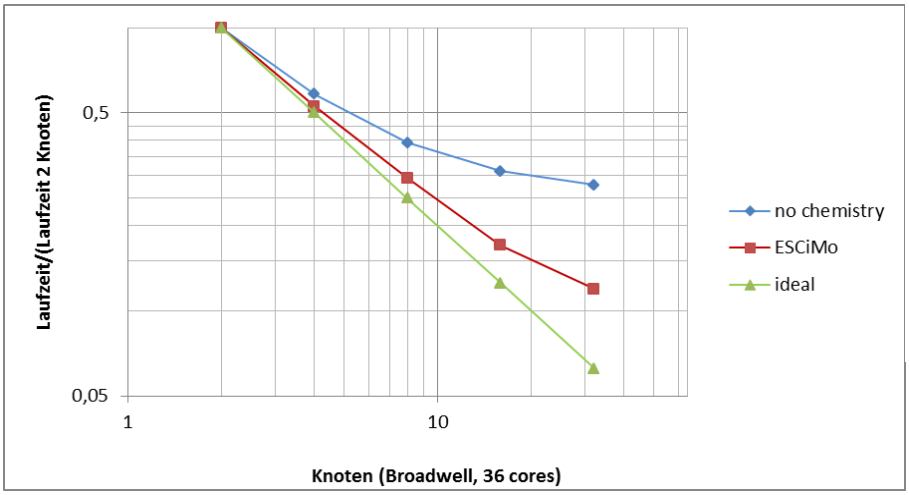

Figure 2: Scaling tests for CESM1/MESSy on mistral for 2 setups with horizontal resolution ne26 (2x2 Grad) for 2 to 32 nodes.

WP3: Escimo-Setup

The ESCiMo Setup as published by Jöckel et al. 2016 (consortium activity at DKRZ) was adapted for CESM1/MESSy and, due to limited computing resources, will be simulated for 1998-2010. The simulations are still running. Figure 3 shows the CESM1/MESSy (left) results for 1998 for the NOx tracer family as a function of time for latitude 60N in comparison to EMAC (right), showing good agreement.
A full analysis is planned for 2017.

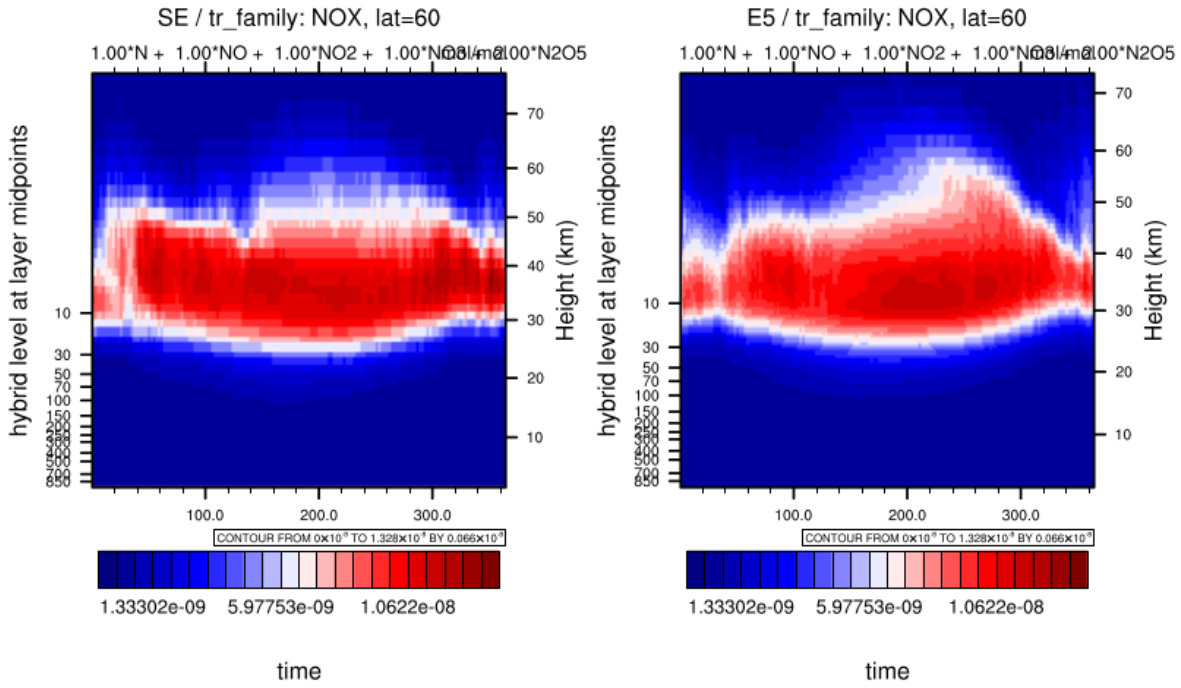

Figure 3: NOx tracer family as a function of time (day of year) for latitude 60N for CESM1/MESSy (left) and EMAC (right).

Publications:

Baumgaertner, A. J. G., Jöckel, P., Kerkweg, A., Sander, R., and Tost, H.: Implementation of the Community Earth System Model (CESM) version 1.2.1 as a new base model into version 2.50 of the MESSy framework, Geosci. Model Dev., 9, 125-135, doi:10.5194/gmd-9-125-2016, 2016