Report for project 854 “Erdsystemmodellevaluierung”

Project: **854**
Project title: **Erdsystemmodellevaluierung**
Project leader: **Veronika Eyring**
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Aerosol-chemistry-cloud-climate interactions (ESA CMUG)

A transient simulation with the global-aerosol model EMAC (MADE3) has been performed as planned in the context of the ESA CMUG project. The simulation covers the time period 1980-2015 using a similar emission setup as the one applied for the CMIP5 historical model simulations. The EMAC (MADE3) simulation has been evaluated with the ESA-CCI aerosol products and other datasets, and compared with the CMIP5 models with interactive aerosol. The focus was on aerosol optical depth with the aim of better understanding the processes driving this quantity. The analysis revealed an overall better agreement of EMAC (MADE3) with observations than most of the CMIP5 models. This is not surprising, given the generally higher detail of representation of aerosol in EMAC (MADE3) than in most of the CMIP5 models. An example is given in Figure 1.

Further simulations were originally planned to explore the sensitivity of the results to several configuration aspects such as vertical resolution and the level of complexity of the chemistry scheme. In the course of the project, however, we decided to use a different approach and to conduct a set of shorter simulations focusing on specific processes which are expected to be important to the representation of aerosol properties with a particular focus on mineral dust. We also adopted a different evaluation strategy now looking at specific episodes on shorter time periods, taking advantage of aircraft based observations. This allows conducting a larger number of experiments at much lower computational cost, exploring more processes than originally planned. Such experiments covering the episode of the SALTRACE measurement campaign (June/July 2013) with an improved parameterization of mineral dust for comparison with aircraft data are planned for the last quarter of 2017. This parameterization replaces the previously used dust climatology in the model aiming at improving the long-range transport of mineral dust. This is considered crucial for future studies on ice formation in cirrus clouds. Another aim is a comparison of difference in dust properties between Cabo Verde (east) and Barbados (west) measured during SALTRACE.

Because the change in strategy, the resources granted for the first three quarters of 2017 were not completely used.

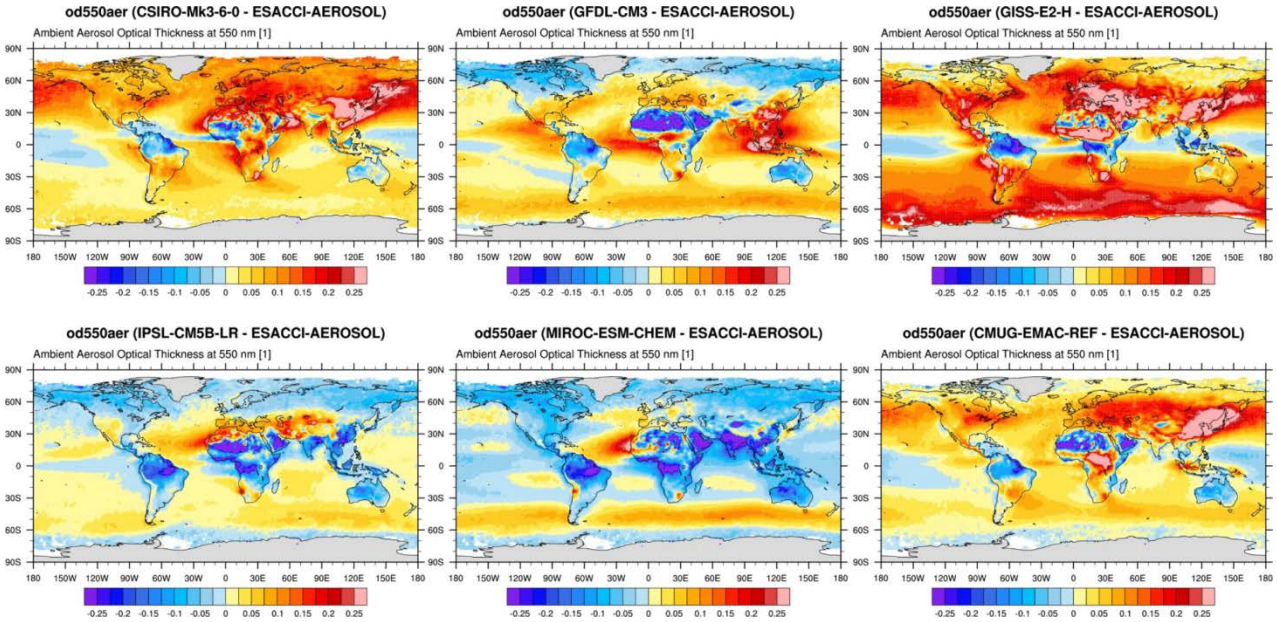

Figure 1 Bias of the multi-year mean of aerosol optical thickness at 550 nm from CMIP5 models with interactive aerosol and from EMAC (MADE3) compared with the ESA CCI Aerosol satellite dataset. The overlap period between MODIS L3 C6 and ESA CCI is analysed.

Analysis of the aircraft measurement campaign HALO ESMVal

The analysis of the background concentrations of the trace gases measured during the aircraft campaign HALO ESMVal could unexpectedly partly be done using existing model runs (Jöckel et al., 2016). The results have been published in Gottschaldt et al. (2017a,b). Figure 2 shows an example of this analysis. The originally planned sensitivity studies repeating old model experiments with an erroneous emission setup have therefore been postponed and are probably not needed any more.

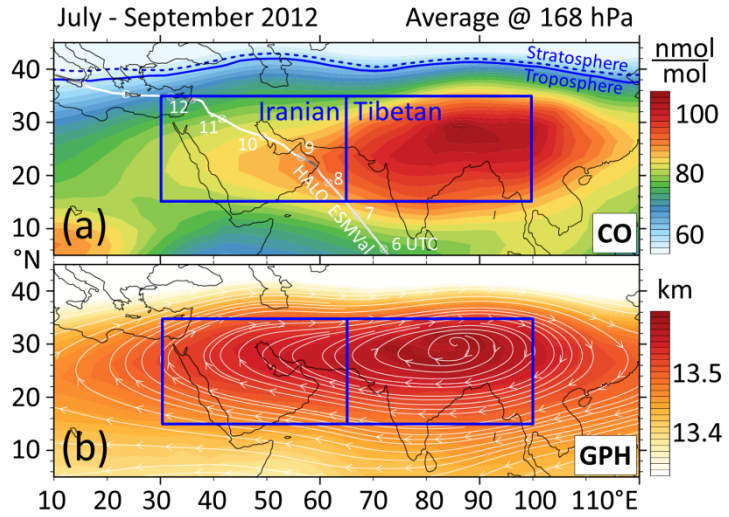

Figure 2 (from *Gottschaldt et al., 2017b): CO mixing ratios and geopotential height (GPH) as simulated by EMAC at 168 hPa, averaged for the monsoon months of 2012. Enhanced CO is considered to be a chemical characteristic of the upper tropospheric Asian summer monsoon anticyclone, and increased GPH is a dynamical proxy. The Iranian region was traversed by the HALO ESMVal campaign during a flight from Male (Maldives) to Larnaca (Cyprus) on 18 September 2012. HALO was flying in the upper troposphere where the flight track is coloured white and dived to the lower troposphere where it is gray. Beads show the HALO positions at full UTC hours. Panel (a) additionally shows the intersection between the tropopause and the 168 hPa pressure level, panel (b) additionally shows streamlines.*

Preparation of CMIP6 simulations with EMAC

In preparation for the EMAC contribution to the Aerosol Chemistry Model Intercomparison Project (AerChemMIP) endorsed by the Coupled-Model Intercomparison Project 6 (CMIP6), some first test simulations were performed. The aim of these test simulations was to adjust the model output to the repeatedly changed CMIP6 data request and to check for consistency and possible errors. These test simulations were then used as input for setting up and adjusting the ESMValTool for near real time analysis of the upcoming CMIP6 model simulations.

References

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