Project: **1004**

Project title: **Development and evaluation of aerosol processes in ECHAM-HAMMOZ**

Project lead: **Bernd Heinold**

Report period: **2016-07-01 to 2017-06-30**

The aim of this project is the on-going evaluation and coordination of further developments of the aerosol model HAM (Versions 2.2, 2.3) in close collaboration with scientists from the HAMMOZ consortium. The well-established global aerosol-chemistry-climate model ECHAM6-HAMMOZ is jointly developed by partners from several European universities and research institutes. The model code is hosted at the ETH Zurich where it is made accessible to the research community; partners include scientists at the Universities of Oxford, Helsinki and Munich, as well as at the German research institutes MPI Hamburg, FZ Jülich, TROPOS and GEOMAR. It simulates the lifecycles of the climate-relevant aerosol species including microphysical transformation processes, and their climate impact. The model system includes the global atmospheric climate model ECHAM, the aerosol-microphysics model HAM, and the atmospheric chemistry model MOZART. The role of TROPOS in this project is to bring together the different aspects of the model development and to test the subsequent modifications in the aerosol distribution resulting from the changes of the aerosol parameterisation

During the period 07/2016 to 04/2017, a series of tests of different emission schemes of aerosols and aerosol precursor species as well as and bug-fixes of the model were carried out. This work was to a large part performed in support of the new release of the model version ECHAM6.3-HAM2.3-MOZ1.0 in February 2017. Several manuscripts describing the changes and performance of the new and considerably updated model version model are currently in preparation by the international HAMMOZ consortium.

A main focus of the TROPOS project was in the improvement of the emission scheme for primary marine aerosols. A new state-of the art emission scheme for sea salt particles (Long et al., 2011) was implemented and thoroughly evaluated. The new emission scheme includes a temperature dependence for the sea salt emissions (Sofiev et al., 2011), which considerably improved the agreement with observations of both the simulated near-surface concentration of sea salt particles as well as of aerosol optical thickness over remote ocean regions. In particular the significant reduction of sea salt particles in high latitudes improves the model performance considerably. In these regions, the agreement with observations is dramatically improved. In addition, also the size-dependent organic fraction of primary marine aerosol can be simulated (Figure 1).

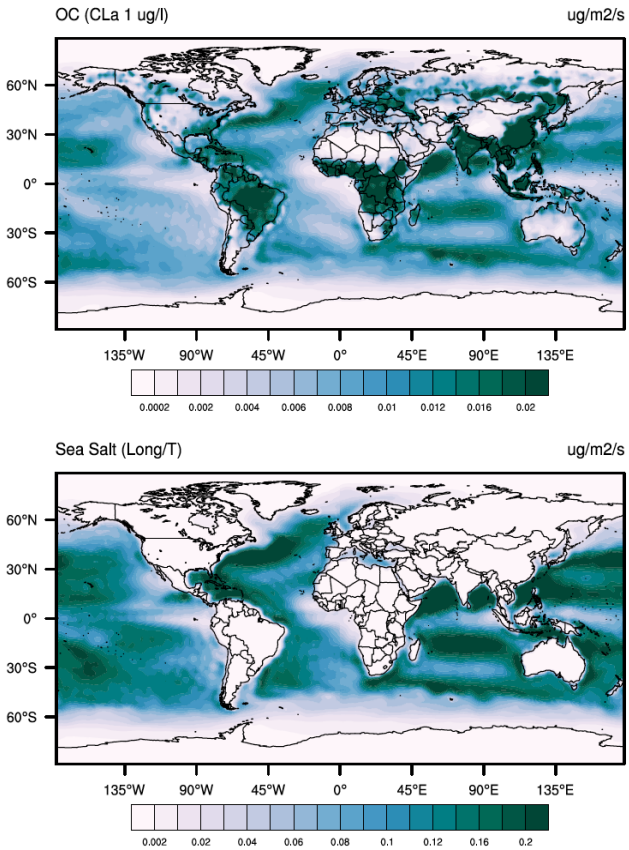

***Figure 1**: Simulated marine primary aerosol emission fluxes averaged for the year 2011. Top: Organic carbon (total annual emissions 45 Tg), bottom: Sea salt (total annual emissions 1200 Tg).*

The parameterization reduces sea salt mass emissions by about a factor 3 compared to the original parameterization. However, it also shifts the marine aerosol distribution towards smaller particle sizes, which in effect increases CCN concentrations over pristine remote ocean regions (Figure 2).

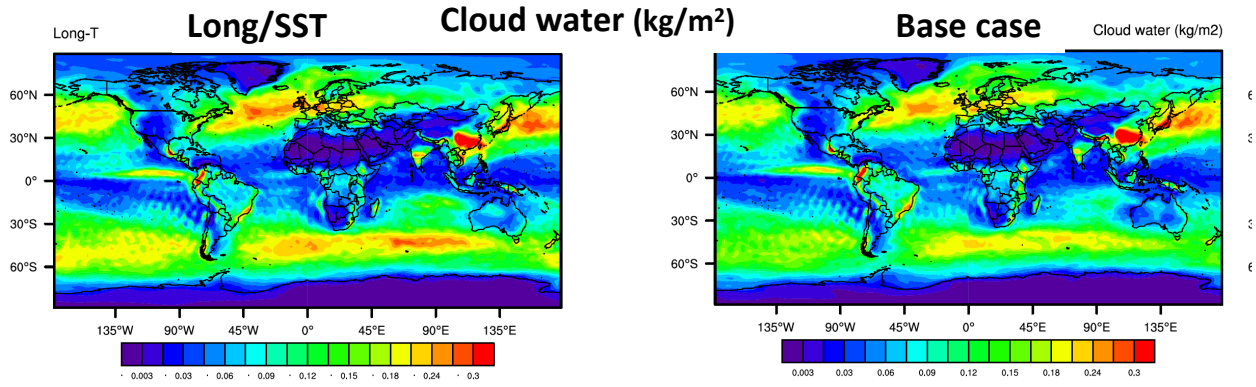

***Figure 2**: Simulated cloud water averaged for year 2010 using the new primary marine aerosol emission scheme (left) and the original parameterization (right).*

References:

Long, M. S., Keene, W. C., Kieber, D. J., Erickson, D. J., and Maring, H. (2011), A sea-state based source function for size- and composition-resolved marine aerosol production, Atmos. Chem. Phys., 11, 1203-1216, doi:10.5194/acp-11-1203-2011.

Sofiev, M., J. Soares, M. Prank, G. de Leeuw, and J. Kukkonen (2011), A regional-to-global model of emission and transport of sea salt particles in the atmosphere, J. Geophys. Res., 116, D21302, doi:10.1029/2010JD014713.