Project: 839 Project title: Quantifying Aerosol-Cloud-Climate Effects by Regime (QUAERERE) Project lead: Johannes Quaas Report period: 1.1.2018 – 31.12.2018

The goal of the ERC-funded QUAERERE project is a better assessment of the effective radiative forcing by aerosol-cloud interactions mainly from satellite data, with support from modelling.

In the reporting period, we requested computing time to be able to contribute to the highly visible and influential Precipitation Driver and Response Model Intercomparison Project (PDRMIP, Myhre et al., 2017). PDRMIP is widely used in the climate forcing and -feedback research community and is a cornerstone for the draft of the upcoming 6th assessment report of the Intergovernmental Panel on Climate Change; it was thus of very large importance for our team to be able to contribute to this important project.

A first publication on the basis of the multi-model ensemble, to which this time also the ECHAM5-HAM2 model contributed, just has been accepted (Smith et al., 2018). A key result from that study is shown in Fig. 1. It describes the instantaneous radiative forcing, the effective radiative forcing, and the rapid adjustments (e.g., Sherwood et al., 2015) as diagnosed from the multimodel ensemble for five different forcing agents (Myhre et al., 2017): carbon dioxide (CO2, the perturbation is a doubling of the atmospheric concentration), methane (CH4, the perturbation is a tripling of the atmospheric concentration), solar constant (the perturbation is a reduction by 2%), black carbon (BC, the perturbation is a tenfold increase in the emissions), and sulfate (Sul, perturbation is a five-fold increase in the emissions).

The past reporting period contributed four of these, as simulated with the ECHAM-HAM system – only the BC perturbation was simulated before by another team (Univ. Oxford). A key result is the relative smallness of the sulfate rapid adjustment, and the differences in sign of the rapid adjustments – opposite to the instantaneous forcing for solar constant and BC, same sign otherwise.

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Fig. 1: Instantaneous radiative forcing, effective radiative forcing, and rapid adjustments for five different climate change drivers. Each bar represents a multi-model mean and each model is given equal weight with up to 6 different methods of calculating each adjustment for each model (from Smith et al., 2018).