Project: **1143**
Project title: **FORCES**
Principal investigator: **Johannes Quaas**
Report period: **2021-11-01 to 2022-09-30**
Text: maximum of two pages including figures.

An overarching issue with the resource utilization in the reporting period was the move from mistral to levante. The familiarization with the new HLRE environment by all staff, including the efficient utilization of the model codes, took a fairly long time. Meanwhile, the codes run and simulation activity takes up again. Nevertheless, some successes can be reported about.

In the reporting period, we were interested in two aspects.
(1) Hemispheric contrast of clouds. This aims at identifying, i.e. detecting and attributing, the impact of the hemispheric difference in anthropogenic aerosol emissions on clouds and radiation. The setup of the simulations is illustrated in Fig. 1: emissions in the southern hemisphere are scaled such that the pattern remains the same but the overall amount is as strong in the southern hemisphere as for the control case in the northern hemisphere, and vice versa. The counterfactual idea is that the bulk of anthropogenic activities in this hypothetical world would be in the southern, rather than northern hemisphere. Some results are shown in Fig. 2. For aerosol, cloud drop number, but also radiation, it is evident that in most cases the factual simulation is closer to the observations than the counterfactual one, so an attribution is possible. A paper on these results is being prepared by Henkes et al.

(2) Decadal trends in aerosols and subsequently in clouds. This is aiming at corroborating the observations and CMIP6-derived results presented by Cherian and Quaas (2020) and Quaas et al. (2022). We conducted the planned simulations with the new ICON-HAM model system (Salzmann et al., 2022). Early results are contributing to an international study. Fig. 3 shows as an example the comparison of top-of-atmosphere fluxes to another model and to satellite retrievals. Our model reproduces trend and interannual variability well. More detailed analysis and further studies follow.

References

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Figures

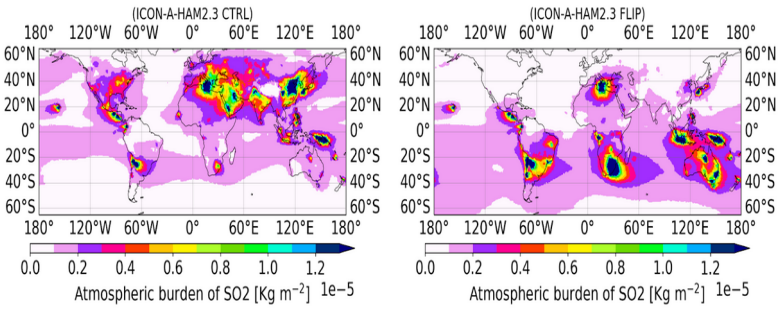

Figure 1. Simulation with control emissions of sulfur dioxide (a), and with emissions scaled so that the emissions are flipped (total emissions in the southern hemisphere as in the northern hemisphere in the control case, and vice versa).

Fig. 2. Simulated aerosol, cloud, and radiation quantities from satellite observations (gray), from the control simulation (green) and the “flipped” simulation (blue) for extra-tropics in the northern hemisphere (ETR-NH) and the southern hemisphere (ETR-SH), tropics in both hemispheres (TR-NH and TR-SH, repectively), and marine-stratocumulus-regions in both hemispheres (SC-NH and SC-SH, respectively).

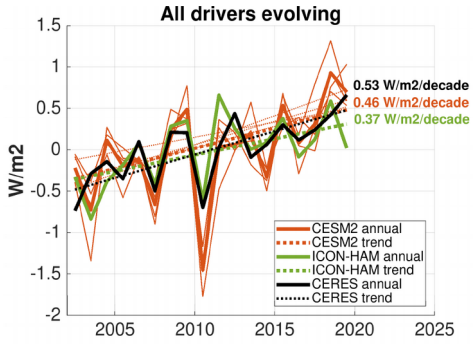

Fig. 3. Decadal trends in top-of-atmosphere radiation in ICON-HAM (green) in comparison to CESM2 (orange) and observations from the CERES EBAF satellite product (black).