Project: **1242**

Project title: **Simulating the atmospheric dust cycle**

Principal investigator: **Kerstin Schepanski**

Report period: **2022-11-01 to 2023-10-31**

The simulations performed were carried out to study the atmospheric dust cycle with particular focus on the representation of atmospheric dust concentrations. Overall, the objectives of the simulations were to improve the dust emission module in HAM2.3 and thus to improve the representation of the atmospheric dust concentrations and its variability. Finally, we used the atmospheric general circulation model ICON coupled to the aerosol model HAM2.3 (Salzmann et al., 2022; Tegen et al., 2019):

During the reporting period, we continued our work on implementing a scheme accounting for the mobilization of mineral dust during vegetation fire such as agricultural fires or wildfires. The work on the high-latitude dust sources was slowed down due to a change in personnel. Our work on the 'fire-dust emission' parameterization is based on the conceptual approach discussed in Wagner et al. (2021) and in the ICON-HAM model framework additionally introduces links to soil and vegetation characteristics. The implementation into HAM has been started during an earlier reporting period. During this report period, we have started to test this scheme thoroughly in ICON-HAM and hence in an atmosphere-aerosol model environment. The experiment set-up enables us to explicitly calculate the fraction of fire-driven dust emission flux and atmospheric dust concentration. During the testing, the 'fire-dust' emission parameterization required some further adjustments.

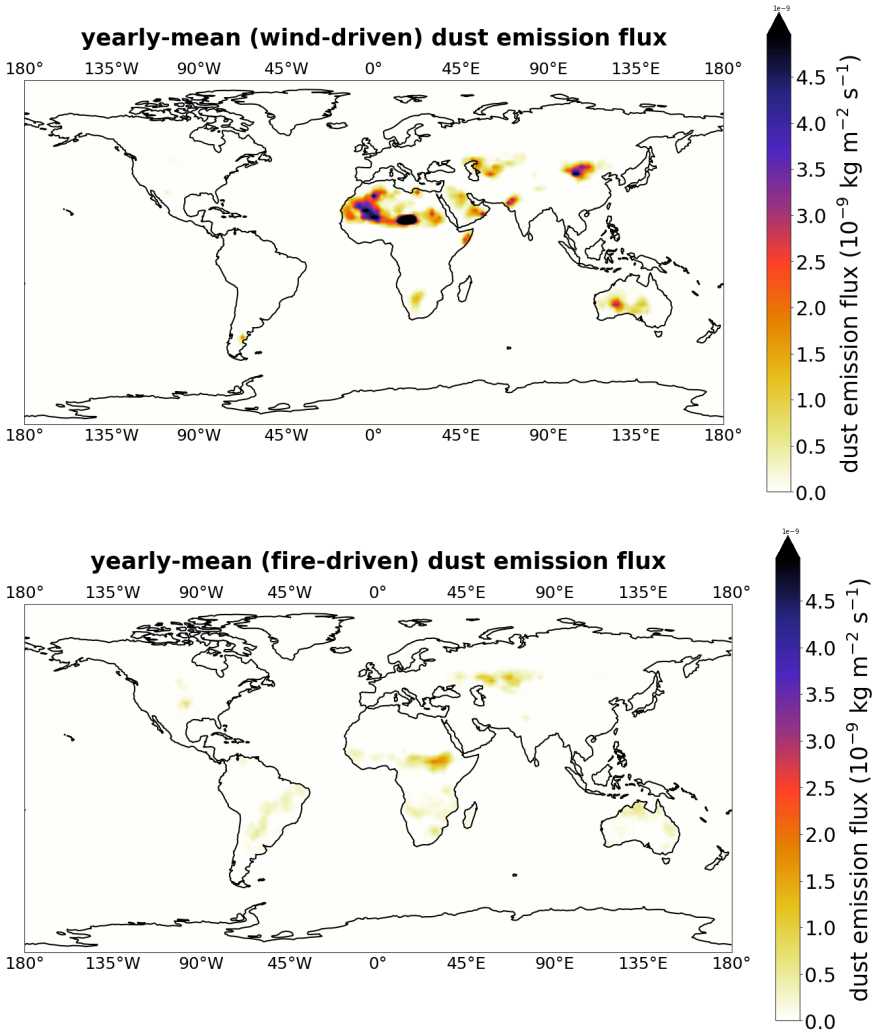

Figure 1: ICON-HAM dust simulations for 2003-2014. Spatial resolution of 160x160 km^2 with a model time step of 10 min. The results are preliminary.

First results illustrate that ICON-HAM reasonably represents the expected, predominant dust emission regions (Figure 1). However, their emissions are at the lower level compared to similar aerosol model. Fire-driven dust emissions occur in regions susceptible to fires, but highest fire-driven dust emission fluxes do not match the regions that are well known for their extensive wildfires. Overall, the fraction of fire-driven dust is small with respect to the entire year, but can be significant locally during a wildfire event.

Salzmann, M., S. Ferrachat, C. Tully, S. Münch, D. Watson-Parris, D. Neubauer, et al. (2022), The global atmosphere-aerosol model ICON-A-HAM-2.3 - Initial model evaluation and effects of radiation balance tuning on aerosol optical thickness, JAMES, 14, e2021MS002699, https://doi.org/10.1029/2021MS002699.

Tegen, I., Neubauer, D., Ferrachat, S., Siegenthaler-Le Drian, C., Bey, I., and co-authors: The global aerosol–climate model ECHAM6.3–HAM2.3 – Part 1: Aerosol evaluation, Geosci. Model Dev., 12, 1643–1677, https://doi.org/10.5194/gmd-12-1643-2019, 2019.

Wagner, R., K. Schepanski, M. Klose (2021), The Dust Emission Potential of Agricultural-Like Fires – Theoretical Estimates From Two Conceptually Different Dust Emission Parameterizations, J. Geophys. Res., doi:10.1029/2020JD034355.