Project: **1242**

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

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The simulations performed were carried out to study the atmospheric dust cycle. 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 two different atmospheric general circulation models (ICON-A and ECHAM6) coupled to the aerosol model HAM2.3 (Salzmann et al., 2022; Tegen et al., 2019):

(a) We started implementing a scheme accounting for the mobilization of mineral dust during vegetation fire such as agricultural fires or wildfires. The approach eventually added to the dust emission module of HAM, but with links to soil and vegetation characteristics as well, has been conceptually described by Wagner et al. (2012). During this report period in particular, this scheme was implemented in HAM and is now for the first time tested in an atmosphere-aerosol model environment (Figure 1). Please note the results are preliminary and the newly implemented scheme yet does not fully account for all variables controlling dust emission.

(b) The simulation of mineral dust emission from high-latitude dust sources is challenging due to the specific characteristics of this source type. In 2022, we performed simulations that shall ultimately enable us improve the representation of high-latitude dust sources in the ECHAM-HAM model system. As the standard set up does not represent dust emission events as observed during the field campaign in 2021, we elaborated the variability in the wind speed distribution in more depth, along with a revisit of the soil characteristics. This is work is still ongoing.

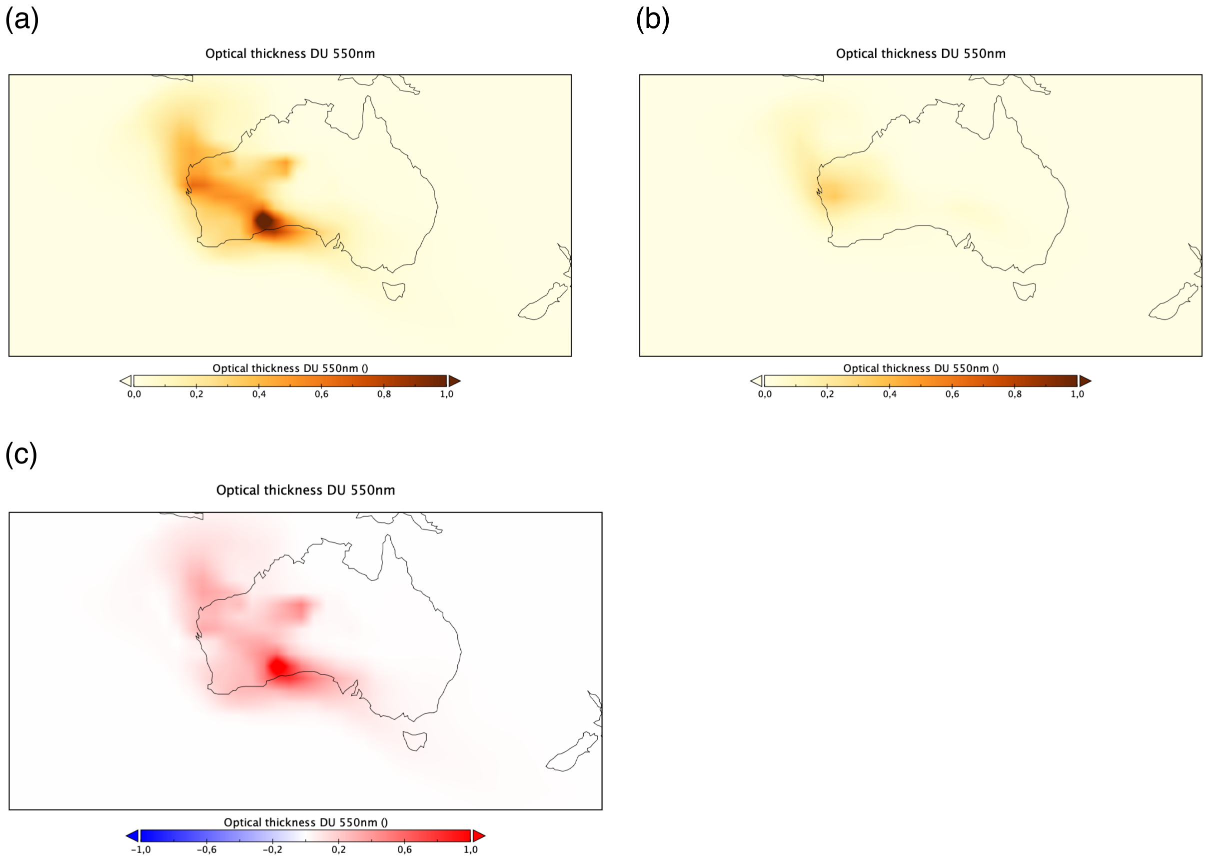

Figure 1: The panel provides first insights into the ability of the new ICON-A-HAM setup to simulate atmospheric dust concentrations for both, wind-driven ("standard") dust emission and fire-driven dust emission. The simulation was performed on the R2B4 grid (approx. 150 km grid spacing) and with 6-hourly output. Shown is the average for the period 03 -10 Jan 2012. (a) shows the aerosol optical depth at 550 nm resulting from both dust emission processes, (b) shows the aerosol optical thickness resulting from fire-driven dust emission only, and (c) shows the difference between (a) and (b). Please note, these are very preliminary results, not all dependencies controlling dust emission are currently regarded and thus absolute values supposedly will change in due course.

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.