Project: **1242**

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

Principal investigator: **Kerstin Schepanski**

Report period: **2025-11-01 to 2026-10-31**

The simulations conducted during 2026 focused on investigating the atmospheric dust cycle, with particular emphasis on the representation of dust emission processes, atmospheric concentrations, and the mineralogical composition of dust aerosols. The simulations were carried out within the framework of two PhD projects.

PhD project 1: Dust mineralogy

The primary objective of these simulations was to further develop the dust emission module in HAM2.3 to enable the explicit calculation of the mineralogical composition of dust aerosols based on local soil mineralogy and soil particle size distributions. A key component of this development was the implementation of a soil mineralogy database, allowing for the explicit representation of 12 individual minerals.

In 2026, the implementation of the new model developments was finalized, and a series of test simulations was successfully completed. Subsequently, multi-year simulations were conducted to evaluate the performance of the newly developed model configuration against the standard model setup and observational data. The simulations were further analysed to assess the representation of dust emission patterns, atmospheric transport pathways, regional deposition patterns, and seasonal and interannual variability. Multi-year simulations were performed using both ICON-HAM as well as ECHAM-HAM.

In 2026, the model development reached a sufficiently mature stage, allowing the model configuration to be frozen for the subsequent multi-year simulations. While further model improvements may be pursued in the future, the focus has now shifted towards production simulations and model evaluation, resulting in increased computational resource usage.

PhD project 2: Namibian dust

In early 2026, model development activities were initiated with the framework of this PhD project, focussing on improving the dust emission parameterisation in ICON-HAM-lite-LAM. Several 14-day simulations were conducted for a selected case study to evaluate different approaches representing dust source characteristics, identify potential limitations in the existing model scheme, and test improvements.