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Evaluation of a Mineral Dust Simulation in the Atmospheric-Chemistry General Circulation Model-EMAC

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This study presents an evaluation of the atmospheric mineral dust cycle in the Atmospheric Chemistry General Circulation Model (AC-GCM) using new developed dust emissions scheme. The dust cycle, as an integral part of the Earth System, plays an important role in the Earth's energy balance by both direct and indirect ways. As an aerosol, it significantly impacts the absorption and scattering of radiation in the atmosphere and can modify the optical properties of clouds and snow/ice surfaces. In addition, dust contributes to a range of physical, chemical and bio-geological processes that interact with the cycles of carbon and water. While our knowledge of the dust cycle, its impacts and interactions with the other global-scale bio-geochemical cycles has greatly advanced in the last decades, large uncertainties and knowledge gaps still exist. Improving the dust simulation in global models is essential to minimize the uncertainties in the model results related to dust.
In this study, the results are based on the ECHAM5 Modular Earth Submodel System (MESSy) AC-GCM simulations using T106L31 spectral resolution (about 120km) with 31 vertical levels. The GMXe aerosol submodel is used to simulate the phase changes of the dust particles between soluble and insoluble modes. Dust emission, transport and deposition (wet and dry) are calculated on-line along with the meteorological parameters in every model time step.
The preliminary evaluation of the dust concentration and deposition are presented based on ground observations from various campaigns as well as the evaluation of the optical properties of dust using AERONET and satellite (MODIS and MISR) observations. Preliminarily results show good agreement with observations for dust deposition and optical properties. In addition, the global dust emissions, load, deposition and lifetime is in good agreement with the published results. Also, the uncertainties in the dust cycle that contribute to the overall model performance will be briefly discussed as it is a subject of future work.