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A dust outbreak over West Africa and its impact on the state of the atmosphere: A model study with LM-ART

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Mineral dust is involved in many important processes in the Earth's climate system. The particles directly affect the atmospheric radiation budget through absorption and scattering of incoming solar radiation, and absorption and re-emission of outgoing longwave radiation. While the scattering of solar radiation and the indirect aerosol effect tend to cool the atmosphere, the absorption of radiation by aerosols leads to a warming of the atmosphere and to a reduction of cloud formation (semi-direct effect) (e.g., IPCC, 2001; Johnson et al., 2004; Helmert et al., 2006).

In this study the dust outbreaks of March 2004 and March 2006 are simulated with the regional model system LM-ART. LM-ART is a recently developed model system which describes the emission, transport and deposition of aerosols and gases and their feedback with the state of the atmosphere. It consists of the LM (Lokal Modell), the operational weather forecast model of the German Weather Service (DWD), and the aerosol model ART. The dust emission scheme was developed by Vogel et al. (2006). It combines the parameterisation of the threshold friction velocity following Lu and Shao (1999) and the parameterisation of the saltation process of Alfaro and Gomes (2001). The emission scheme is coupled online with the LM-ART model.

We show a comparison between the modelled optical thickness and the measurements by AERONET stations. For analysing the impact of the mineral dust on the radiation and the state of the atmosphere two model runs were carried out. One with feedback between online calculated dust concentration and the radiation field and one run without feedback. The results show large changes in the shortwave and longwave radiation on the surface through the direct aerosol effect. They implicate also interesting changes in the cloud cover through the semi-direct effect.