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Radiative Effects and Feedbacks of Saharan Dust and Biomass Burning Aerosol over West Africa and the Northern Tropical Atlantic

Bernd Heinold (1), Ina Tegen (1), Stefan Bauer (2), and Manfred Wendisch (2)

(1) Leibniz Institute for Tropospheric Research (IfT), Leipzig, Germany (heinold@tropos.de), (2) Leipzig Institute for Meteorology (LIM), University of Leipzig, Germany

Soil dust aerosol from the world's arid and semi-arid regions and land fire smoke represent major components of the atmospheric aerosol load. They influence the climate system by changing the atmospheric radiation balance through direct and indirect effects and play an important role in the biogeochemical and hydrological cycle. However, in particular the magnitude and sign of the radiative effects are highly uncertain due to still existing uncertainties in their optical properties and the variability and complexity of the spatio-temporal distribution. The dust and biomass burning aerosol from Africa is of particular interest since the continent harbours the largest and most active sources of both aerosol types. The Saharan and Sahel regions contribute at least 50% to the global dust emissions and a considerable amount of smoke originates from active biomass burning areas in west and central Africa. Within continuous aerosol outbreaks, the Saharan dust and land fire smoke are transported towards the West African Monsoon region and across the tropical Atlantic Ocean. In boreal winter, when the most land fires are active, the Saharan dust layer merges with the West African smoke plumes resulting in a complex aerosol layering.

Here, the results of a regional model study on direct radiative forcing and dynamic atmospheric response due to dust and biomass burning aerosol will be presented. Particular focus will be on radiative impacts on regional circulation patterns and implications for the aerosol transport. For simulations of the complex spatial distribution of the West African aerosol and estimates of direct radiative effects and feedbacks, the regional model system COSMO-MUSCAT is used. The model allows online interaction of the computed dust and biomass burning aerosol load with the solar and thermal radiation and with the model dynamics. The simulations are performed for the second field campaign of the SAharan Mineral dUst experiMent (SAMUM) that was conducted in January and February 2008 in the Cape Verde region and aimed at quantifying the radiative effects of the mixed plume of Saharan dust and smoke aerosols as it leaves the source region. In addition, modeled irradiances and airborne radiation measurements obtained within SAMUM will be shown which have been compared in order to quantify the solar radiative impact of pure or modified Sahara dust transported over the North Atlantic.