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Satellite observations of the seasonal cycles of absorbing aerosols in Africa related to monsoon rainfall, 1995 – 2008

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The link between the African Monsoon systems and aerosol loading in Africa is studied using multi-year satellite observations of UV-absorbing aerosols and rain gauge measurements.

The main aerosol types occurring over Africa are desert dust and biomass burning aerosols, which are UV-absorbing. The abundance of these aerosols over Africa can be characterised using residues and Absorbing Aerosol Index (AAI) data from Global Ozone Monitoring Experiment (GOME) on board ERS–2 and SCanning Imaging Absorption SpectroMeter for Atmospheric ChartograpHY (SCIAMACHY) on board Envisat. High residues can be associated with high atmospheric aerosol loading.

Time series of regionally averaged residues from 1995 – 2008 show the seasonal variations of aerosol distributions in Africa, which are clearly linked to the seasonal cycle of the monsoonal wet and dry periods in both studied areas. Zonally averaged daily residues over Africa are related to monthly mean precipitation data and shows monsoon-controlled atmospheric aerosol loadings. The distinction between the West African Monsoon and the East African Monsoon, which have different dynamics due to the asymmetric distribution of land masses around the equator in the west, mainly, is also apparent in the different aerosol distribution in both areas.

The residue distribution over Africa shows two distinct modes, one associated with dry periods and one with wet periods. During dry periods the residue can become very high, due to aerosol emissions from deserts and biomass burning events. During wet periods the residue depends linearly on the amount of precipitation, with a reduction of one residue unit for every 160 mm monthly averaged precipitation. This is most clear over east Africa, where the sources and sinks of atmospheric aerosols are controlled directly by the local climate, i.e. monsoonal precipitation. The reduction of the residue, and aerosol load, during precipitation events are due to scavenging of aerosols and the prevention of aerosol emissions from the wet surface. Shielding effects due to cloud cover may also play a role in the reduction of the residue.

A possible influence of aerosols on the monsoon, via aerosol direct and indirect effects, is plausible, but cannot directly be deduced from these data.