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Meteorological processes forcing Saharan dust emissions inferred from MSG-SEVIRI observations of sub-daily dust source activation

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Mineral dust aerosol from arid and semi-arid regions plays an important role in the climate system by directly and indirectly affecting radiation fluxes and nutrient cycles. A prerequisite for estimates of the influence of dust aerosol on the climate system is the knowledge of the location of its source areas. So far, locations of dust sources are mostly implied from daily satellite retrievals, or alternatively from reports of dust storm frequencies. Determining dust source areas by such indirect methods is impeded by low temporal resolution and ambiguities of the retrieval. Here, Meteosat Second Generation (MSG) infra-red (IR) difference dust index images are used to identify dust source areas. For every 15-minute scan the dust index is computed basing on the difference of the brightness temperatures measured by the Spinning enhanced Visible and Infra-Red Imager (SEVIRI) at the wavelengths centred at 8.7 μm, 10.8 μm and 12.0 μm. Because of its behaviour at IR wavelength, airborne mineral dust is well identifiable using this index, especially over semi-arid and arid land surfaces. Emission and subsequent transport of individual dust events can be very well observed and followed in these IR composite picture. The observations of dust source activation (DSA) frequencies are compiled in a 1° x 1° map for the Sahara and Sahel, including information about time at 3-hourly resolution. We use this dataset to identify the most active dust source areas and the time-of-day when dust source activation occurs most frequently. In the Sahara Desert 65% of DSA (2006/03-2007/02) occur during 06-09 UTC, pointing towards an important role of the break-down of the nocturnal

low-level jet (LLJ) for dust mobilisation. Other meteorological mechanisms like density currents, haboobs that occur preferentially in the afternoon hours, and cyclonic activities may lead to atmospheric conditions suitable for dust mobilisation. The role of the nocturnal LLJ for dust mobilisation in the Sahara is corroborated by regional model studies using the dust emission and transport model system LM-MUSCAT, and analysis of synoptic data from Saharan weather observation stations.