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Characterization of alluvial dust sources and their temporal development - a multi-sensor approach for the Aïr Massif, Niger

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One of the world's largest sources of atmospheric dust is the Sahara. It is said that 55% of the total global dust emission can be linked to the desert in northern Africa. Thus, understanding the Saharan dust sources is of great importance to estimate the total global dust load and its variability. Especially one type of dust sources has gained attention in dust research in recent years: The emission of dust from sediments formed by hydrologic processes, so called alluvial dust sources. These sediments were either formed in the past under the influences of a more humid paleoclimate or are deposited recently, e.g. during strong precipitation events when surficial runoff leads to the activation of wadi systems or to the occurrence of flash floods. Especially the latter phenomenon is able to deliver a huge amount of potentially erodible sediments.
The research presented here focuses on the characterization of these alluvial dust sources with special attention on their temporal variability in relation to wet and dry phases. A study area covering the Aïr Massif in Niger is analysed over a four years time span from January 2013 to December 2016. The whole cycle from sediment formation to dust emission is illustrated by using data of various satellite sensors that are able to capture the processes taking place at the land surface as well as in the atmosphere:
(1) The rainfall distribution for the study area is shown by time series of the TRMM precipitation estimates. A catchment analysis of the area helps to estimate the amount of surficial runoff and to detect areas of potential sediment accumulation. (2) Changes in the sediment structure of the land surface are analysed using atmospherically corrected time series of NASA's Landsat-8 OLI satellite. A land cover classification shows the distribution of alluvial sediments over the area; fresh layers of alluvial deposits are detected. Furthermore, the evolution of the vegetation cover, which inhibits dust emission, is analysed by calculating NDVI time series from the Landsat data. (3) The MSG Dust Product is used to determine the frequency of dust emission from the investigation area. Furthermore, the product allows the precise localization of the sources. Therefore the alluvial sediments can directly be connected to dust emission.
By combining the findings of these different satellite sensors, a profound analysis of alluvial dust sources on different levels is possible. The connection between the amount of precipitation and the supply of potentially erodible sediments is shown, which leads to a better understanding of the temporal evolution and importance of this source type.