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A multi-observational Characterisation of Dust Emission from Sources within complex Terrain

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Recent studies using satellite observations show that numerous dust sources are located in the foothills of the Saharan mountains. Generally, dust emission is closely related to sediment supply and surface wind. Thus, dust emission can be inhibited by either lack of high wind speeds or by unsuitable surface characteristics. Significant rainfall and flash flood events have been proposed to lead to changes in pluvial sediment supplies in mountain drainage systems. These sediments are suitable for dust uplift and assumed to have a main contribution to the dust emission fluxes over these areas. This mechanism could help to explain the observed marked interannual variability of some dust sources, which is currently not well understood.

This study uses a novel combination of airborne and space-borne measurements to explore dust sources within complex terrain. It consists of two main parts: First, dust emission forced by the break-down of nocturnal low-level jets is investigated by analysing data from the RAIN4DUST/FENNEC-France aircraft campaign in June 2011 based at Fuerteventura, Spain. Local dust emission over North Mauritania is observed using a combination of different measurement systems flying aboard the French Falcon FA20, such as high resolution aerial ground camera, high-resolution lidar instrument and drop-sondes. The orientation of the flight legs allows for the characterisation of the evolution of a developing dust plume in time and space combining information on ground surface structure and vertical dust distribution. Supplementary analysis of model simulations and satellite remote sensing products provide additional information on the location of dust sources and dust transport paths. Second, the role of pluvial sediment supply for dust emission in desert valleys is investigated. For a selected area over West Africa ENVISAT SAR (synthetic aperture radar) measurements from 2003-2010 are analysed to identify changes in surface sediments through loss of coherence between two consecutive images. Results from this study highlight the contribution of flash floods for dust sources located within complex terrain.

Together the two approaches provide a detailed picture of dust emission from sources within complex terrain revealing controls on dust emission from both atmospheric factors and sediment supply.