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Characterization of dust emission from alluvial sources using aircraft observations and high-resolution modeling

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We investigate mineral dust emission from alluvial sediments within the upland region in northern Mauritania in the vicinity of a decaying nocturnal low-level jet (LLJ). For the first time, the impact of valleys that are embedded in a rather homogeneous surrounding is investigated with regard to their role as dust source. Measures for local atmospheric dust burden were retrieved from airborne observations, satellite observations, and model simulations and analyzed in order to provide complementary information at different horizontal scales.

Observations by the LNG backscatter lidar system flying aboard the SAFIRE Falcon 20 aircraft were taken along five parallel flight legs perpendicular to the orientation of the main valley system dominating the topography of the study area. Results from a comparison of lidar-derived extinction coefficients with topography and aerial photographs confirm the relevance of (1) alluvial sediments at the valley bottoms as a dust source, and (2) the break-down of the nocturnal LLJ as a trigger for dust emission in this region.

An evaluation of the AROME regional model, forecasting dust at high resolution (5 km grid), points towards an underrepresentation of alluvial dust sources in this region. This is also evident from simulations by the MesoNH research model. Although MesoNH simulations show higher dust loadings than AROME which are more comparable to the observations, both models understimate the dust concentrations within the boundary layer compared to lidar observations. A sensitivity study on the impact of horizontal grid spacing (5 km versus 1 km) highlights the importance of spatial resolution on simulated dust loadings.