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Validation of a Lagrangian dust transport model with data from the Fennec/LADUNEX field campaign

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Mineral dust aerosol is a key player in the Earth system. Strong winds over the world's major deserts mobilise and subsequently lift mineral dust high into the atmosphere. Due to the harshness and inaccessibility of desert regions, the exact processes of mobilisation and lifting, and layer formation are still unclear. One major unknown in the dust cycle is the dust source or emission strength. Despite better quantification being key for global models, the assessment of impacts on clouds, radiation and biogeochemical cycles, estimates in the literature from global and regional models span a wide range. Here, we validate the state-of-the-art Lagrangian particle dispersion model FLEXPART, which has been made capable of simulating dust mobilisation and settling, with airborne and ground-based mineral aerosol and turbulence measurements from the Fennec/LADUNEX field campaign, which was carried out over the western Sahara during June 2011. For a selected case study we compare in-situ and remote-sensing data from an aircraft and the CALIOP LIDAR observations with FLEXPART dust transport simulations. The reliability of ECMWF analysis data in the vicinity of a convectively-generated dust plume is assessed using a set of model simulations, in which dust emissions are prescribed manually from SEVIRI satellite images. Dust emission associated with deep moist convection has been recently identified as a key problem. Overall, this research underlines the potential of jointly using measurements and observations from many data sources with models to better understand dust emission processes in the Sahara desert, and to limit model uncertainty.