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An overview of the June 2011 Fennec surface-based observations in the central Sahara: New insights into dust uplift and transport

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The scarcity of data from the central Sahara has for many years impeded the understanding of dust uplift and transport. The Fennec project aims to provide a definitive dataset for the central Sahara and in June 2011 two supersites in the Sahara were instrumented as part of the Fennec Intensive Observation Period (IOP). The first, at Bordj Bardji Mokhtar (BBM, Algeria), is close to the centre of the summertime Saharan Heat Low and the climatological location of maximum summertime dust aerosol optical depths (AODs). At BBM, for the Fennec IOP, the Algerian l'Office National de la Météorologie deployed three-hourly radiosondes, a lidar, a sodar, a cimel sun photomter, broad-band radiometers, an instrumented 15-m flux tower (with sonic anemometers for calculating sensible fluxes by eddy correlation) a nephelometer and a dust sampler. The second Fennec supersite was in Zouerat in Mauritania. Here, we provide an overview of the data from the primary site at BBM, with an emphasis on the new insights the data give into dust uplift and transport processes.

The data provide unique observations of the diurnal cycle of the approximately 5-km deep Saharan boundary layer and demonstrate the occasional persistence of a near-neutral residual layer over the Saharan convective boundary layer over many days. These boundary-layer structures provide a strong control on dust transport, with the dust affecting the mixing in the boundary-layer by modulating the sensible heating from the land surface. During the IOP, the influence of the West African Monsoon at BBM increased, with overnight arrivals of cool moist air and associated cold pool outflows from deep convection. Overall, the cold pool outflows dominated the local dust uplift and provided the largest AODs. The next largest contribution is from the daily mixing of momentum from the nocturnal low-level jet to the surface. The data therefore support the hypothesis that cold pools are likely to make a substantial contribution to the annual cycle of dust uplift in the Sahara. Cold-pool winds are known to be very poorly captured in global models and this is expected to significantly limit the accuracy of the dust uplift in such models.