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Dust emission from the Bodélé Depression, Northern Chad: Results from BoDEx 2005

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Mineral dust in the atmosphere is an important component of the climate system but is poorly quantified. The Bodélé depression of Northern Chad stands out as the world's greatest single source region of mineral dust into the atmosphere. Frequent dust plumes are generated by strong low level winds, from an outcrop of diatomite sediment approximately 11,000km2 in area. This dust is transported over West Africa, the tropical Atlantic as far as South America. Here, we summarise the findings of the Bodélé Dust Experiment (BoDEx 2005), the first geophysical field project to the region. During the Bodélé Dust Experiment (BoDEx) in 2005 instrumentation was deployed to measure dust properties and boundary layer meteorology. The primary results are as follows: (1) The first observational evidence of the Bodélé low level jet feature shows a pronounced diurnal cycle with maxima (minima) during the day (night). (2) The diurnal cycle of surface winds is out of phase with that of the LLJ. (3) Synoptic scale variability in the strength of the Libyan high (often associated with explosive anti-cyclogenesis) modulates the strength of the LLJ, which controls dust emission events. (4) Dust emission events are triggered when near surface wind speeds exceed 10.0ms-1 (5) Physical and optical properties of the diatomite dust are broadly similar to other Saharan dust sources (6) The local radiative impact of high dust loadings results in a reduction in surface temperature of around 7°C in the Bodélé region. (7) We estimate the total dust flux emitted from the Bodélé to be 1.18ś0.45Tg per day during a substantial dust event (assuming a uniform emission rate across the diatomite region). Observations from BoDEx 2005 have supported model experiments by various groups. High resolution regional climate model experiments indicate that when suitably configured RCMs can well simulate the LLJ but underestimate surface wind speeds. This is a critical issue for dust models.