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Low level jets over the Sahara: Results from 'Fennec: The Saharan Climate System'

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Nocturnal Low level Jets (LLJs) are a commonplace feature of the atmosphere over West Africa including both the Sahelian and Saharan zones. Previous work has indicated LLJ activity in all seasons and within both the summertime southerly monsoon and the northerly Harmattan circulations. Notably, satellite-based analysis and the previously limited observational studies have indicated a major or even dominant role of LLJs in dust emission over the Sahara. Other work (including papers in this session) has also indicated a substantial LLJs play an important role in the heat and moisture budgets of the region. The Fennec project provides a uniquely detailed and comprehensive observational dataset to quantify LLJ processes over the vast expanse of the previously under-observed central Sahara. Here we analyse LLJ characteristics from both the vertical profile data from instruments at the Fennec supersites and the long term data (up to 2 years) from the network of automatic weather stations (AWS). In the case of the AWS data we infer LLJ occurrence from surface winds based on the out-of-phase relationship between the diurnal cycles of (nighttime) LLJ maximum and (mid-morning) surface maximum, driven by the daytime growth of the boundary layer which mixes momentum down from the LLJ to the surface. We find evidence that LLJ are a commonplace feature over the central Sahara occurring on >80% of nights in many stations. The spring (autumn) seasons experience both the highest (lowest) frequency and magnitude. Analysis of the probability density function of wind speeds indicates that LLJs are responsible for the dominant proportion of peak wind speeds greater than typical thresholds suitable for dust emission. We infer that episodic enhancement of LLJ strength through synoptic scale pressure gradients may be the dominant mechanism of dust emission events over the Sahara in all seasons with the exception of summer in the south central Sahara where Haboob features may be more important. Analysis of various model simulations indicates that at weather forecast resolution the LLJ and their synoptic scale variability is well represented.