



Wind direction variability in Afternoon and Sunset Turbulence

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Understanding wind direction (WD) variability better is important for several reasons. Air pollution models need information about how variable wind direction is in different conditions (Davies and Thomson 1999). Accurate predictions of dispersion are important for human health and safety and allow for adaptation planning (Nagle et al. 2011). Other applications include horizontal diffusion, efficiency and fatigue of wind machines and air-sea interaction (Mahrt 2011).

Most studies of wind direction variability have focused on nocturnal conditions because of greater variability in light winds. Modelling WD variability in transition periods when both mean wind speed and variance of the wind components are in a state of change can, however, also be very challenging and has not been the focus of earlier studies.

The evening transitioning to the nocturnal boundary layer can play an important role in the diffusion process of pollutants and scalars emitted at surface and transported within the atmosphere. The Boundary Layer Late Afternoon and Sunset Turbulence (BLLAST) field campaign that took place in southern France in June and July 2011 focused on the decaying turbulence of the late afternoon boundary layer and related issues (Lothon et al. 2012).

We analyse field measurements from BLLAST to investigate WD variability in the evening transition period. Standard deviations of horizontal wind direction fluctuations in the lowest 60 m of the boundary layer have been examined for dependence on mean wind speed, higher order moments and averaging time. Measurement results are interpreted using measured and idealized probability density functions of horizontal wind vectors. These are also used to develop analytical functions describing how WD variability depends on wind speed, variance and other controlling factors in the atmospheric boundary layer.

References:

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