AMERICAN METEOROLOGICAL SO

19B.6 Near the Surface Air Temperature Dynamics from Distributed Temperature Sensing

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The evolution of cold-air layers near the surface and their interaction with turbulent mixing events were investigated. The presence of cold-air layers can significantly influence the nocturnal hydro-climatological dynamics, and in turn change local environmental conditions relevant for vegetation. The nocturnal case can be dominated by strong temperature stratification and weak turbulent atmospheric conditions near the surface, leading to large variability in environmental conditions. This variability, both in space and time, is not easily captured by current methods relying on observations in few points to measure flow and scalars such as temperature.

Novel to this study was the use of a dense, quasi three-dimensional network of air temperature observations. We present a first analysis of observations of air temperature measured using high-resolution fibre-optic based distributed temperature sensing (DTS). The observations included 276 vertical profiles in a quasi three-dimensional geometry of (LxWxH) 42x13x5m oriented along a shallow depression in the landscape. Our experimental design translated into 8359 co-located points, for which air temperature was recorded simultaneously with a 1.3 s sampling interval during 47 days in late summer.

The resulting high-resolution time-series was used to investigate spatio-temporal patterns in air temperature near the surface at night, for cases representing different turbulence regimes during the measurement campaign. In addition, we evaluated the capability of the employed DTS technique to resolve patterns in the spatial structure of the flow. We discuss cold-air layer development in relationship with weak turbulent atmospheric conditions, strong temperature stratification and interaction with intermittent turbulent mixing events. We also show how motion can be inferred from the three-dimensional temperature scalar field, and how this complements traditional wind vector point-measurements from ultrasonic anemometers.

The study demonstrates the value of dense spatial observations to investigate the transitions between turbulent and non-turbulent flow near the surface.

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