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Katabatic flow observations over a steep alpine slope

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Katabatic flows, or downslope drainage flows, are thermally driven winds generated over sloping terrain when the surface is colder than the adjacent air and synoptic forcing is weak. This near-surface temperature inversion generates a buoyancy field such that denser, cooler air near the surface tends to sink down the slope and form the katabatic flow. Often these flows can be exploited for wind energy, and they are important in predicting pollution transport in mountainous regions and the formation of large cold air pools in valleys and basins. Mean characteristics of katabatic flows over gentle slopes are well documented. However, small-scale observations of turbulence inside the katabatic jet are less common, especially over very steep slopes in highly complex topography. Summertime measurements over a steep slope (36.5°) in a narrow alpine valley (Val Ferret, Switzerland) were taken with the aim of better understanding the near-surface turbulent fluxes that govern the local slope flows. Here, a weak katabatic jet with a height less than 1 m characterizes the mean flow. High-resolution, near-surface temperature measurements suggest a shallow internal boundary layer within the katabatic layer. Additionally, the turbulent heat flux varies significantly over the 6 m measurement layer. Hence, Monin-Obukhov Similarity theory (MOST) may be invalid for steep slopes. Turbulent statistics such as velocity and temperature variances, fluxes of momentum and heat, turbulence kinetic energy (TKE), and turbulent Prandtl number are compared to those obtained in large eddy simulations (LES) of idealized steep sloping terrain.