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Turbulence characteristics in katabatic flows: some results from MATERHORN-1

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Turbulence characteristics of katabatic flows are analysed using measurements collected during the fall experimental campaign of the Mountain Terrain Atmospheric Modeling and Observations (MATERHORN) Program. The first of the two campaigns was conducted at the Granite Mountain Atmospheric Science Testbed (GMAST) of the US Army Dugway Proving Ground, Utah, in September-October 2012 as part of the US Multidisciplinary University Research Initiative (MURI) that was devoted to improve weather predictions in mountainous terrain. Using data from sonic anemometers and additional slow sensors mounted at up to seven levels on four towers positioned along a gentle slope with an angle alpha between 2-4 degrees, it is shown that katabatic flows are rather intermittent. This is due to interactions with valley flows occurring at various times during the night. The flow appears to be free from those interactions only soon after sunset when its duration is at most about two-three hours. Both flow velocity and temperature depict characteristic oscillations consistent with wave motion of different frequencies and therefore associated to different mechanisms. During the "pure" regime, the analysis suggests the presence of K-H instabilities capping a lower region of long standing waves. This region appears to be located in proximity of the nose of katabatic flow, where data give indication of upward transport of heat. This observation together with mixing enhancement in this region are interpreted as the signature of breaking internal waves. A conceptual model is here presented which is able to describe salient features of turbulence associated to katabatic flows. Results may be useful for guiding improvements of sub-grid turbulence schemes within mesoscale models.