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Characterization of the morning transition from downslope to upslope winds and its connection with the nocturnal inversion breakup at the foot of a gentle slope.

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Thermally driven winds observed in complex terrain are characterized by a daily cycle dominated by two main phases: a diurnal phase in which winds blow upslope (anabatic), and a nocturnal one in which they revert their direction and blow downslope (katabatic). This alternating pattern also implies two transition phases, following sunrise and sunset respectively.

Here we study the upslope component of the slope wind with a focus on the morning transition from the katabatic to the anabatic flow based on data from the MATERHORN experiment, performed in Salt Lake Desert (Utah) between Fall 2012 and Spring 2013 (Fernando et al, 2015).

First of all, a criterion for the selection of purely thermally driven slope wind days is proposed and adopted to select five case studies, taken from both the spring and the autumn periods. Then, the analysis allowed the investigation of the driving mechanisms through the connection with the patterns of erosion of the nocturnal inversion in the valley bed at the foot of the slope under analysis. Three main patterns of erosion of the inversion in the particular topography of a gentle and isolated slope are identified: a) erosion due to upward growth of a convective boundary layer, b) erosion due to descent of the inversion top, and c) erosion due to a mix of the two previous mechanisms. The three patterns are then linked to the initiation of the transition by two different and competing mechanisms: mixing from above (top-down dilution) and surface heating from below. Finally, an analytical model for the description of slope circulation (Zardi and Serafin, 2015) has been used to diagnose the time of the transition.

Zardi, D. and S. Serafin, 2015: An analytic solution for daily-periodic thermally-driven slope flow. Quart. J. Roy. Meteor. Soc., 141, 1968–1974.

Fernando, H. J. S., Pardyjak, E. R., Di Sabatino, S., Chow, F. K., De Wekker, S. F. J., Hoch, S. W, Zsedrovits, T., 2015, The MATERHORN: Unraveling the intricacies of mountain weather. *Bulletin Of The American Meteorological Society*, 96, 1945-1967.