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Observations and analysis of slope-valley flow interactions in MATERHORN-1

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In this paper, observations of flow interactions in complex terrain under low synoptic forcing are presented using a unique dataset collected at the Granite Mountain Atmospheric Science Testbed (GMAST), U.S. Army Dugway Proving Grounds (DPG), Utah, in fall 2012 as part of the Mountain Terrain Atmospheric Modeling and Observations Program (MATERHORN). Due to the complexity of the multi-scale interactions between thermally-driven meso-scale down valley and downslope flows, a vast suite of instrumentation was required to fully capture the process. Data analyses showed that even in presence of an isolated mountain, flow does not simply drain into the valley. To this respect, in addition to data from ultra-sonic anemometers, LiDAR measurements were particularly useful in identifying the interactions of the downslope flow with the valley flow. LiDAR scans clearly illustrate the formation of intense turbulent regions, intrusions and instabilities at the interface of the colliding flows. A detailed analysis of measurements showed that each collision consists of primary and secondary collisions in which the valley flow undercuts the slope flow. Such a combination of primary and secondary collisions repeats itself during the night in a cycle. An analysis of the type of collisions and relevant time scales including the decay of the collision is presented with a description of the relevant dynamics.