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Thermal stability effects on the turbulent boundary-layer flow over a steep 2-D hill: Near-wake structure WEI ZHANG, University of Minnesota, FERNANDO PORTE-AGEL, EPFL — Thermally stratified boundary-layer flows over complex topography are of great interest to the atmospheric science and wind engineering communities. Neutral boundary-layer flows over topography have been extensively studied by wind-tunnel experiments and numerical simulation techniques such as Large-Eddy Simulation (LES). Thermal stability effect, however, is seldom considered due to difficulty of physical simulation in wind tunnels. Experimental studies of thermal stability (neutral, stable and convective) effects on the flow over a steep 2-D hill were conducted in an atmospheric boundary-layer wind tunnel. The 2-D model hill had a steepest slope of 0.73 and its shape followed a cosine shape with height of 7 cm and length of 14.5 cm. High-resolution PIV was employed to characterize the onset of separation, the recirculation zone and flow reattachment location. Results show that thermal stability significantly affects the turbulent flow downwind of the hill, with an elongated recirculation zone and delay of the reattachment in the stable case, and a shorter recirculation zone and early attachment in the convective case. The present study leads to better understanding of thermal stability effects on the boundary-layer flow over a steep 2-D hill, and provides a reliable database for validation and improvement of LES models.

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