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Modelling Slope Flows and Dispersion in Complex Terrain with Weak Geostrophic Winds

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With very weak geostrophic winds or within well sheltered valleys there are broadly three categories of flows driven up and down slopes by diurnally varying buoyancy forces caused by surface heating and cooling with different characteristic dynamics and streamline patterns. These flow categories also depend on the steepness of the slope, denoted here as high, medium and low. The geometries of the height contours determine whether the downslope flows lie in open or closed drainage regions. In these situations flows can be calculated locally along streamlines passing through the area of interest, such as a pollution source or wind energy site. The streamlines are approximately parallel to the surface lines of maximum gradient of surface elevation, except in the 'low' slope regions where the flow direction is determined by the average flow field on the adjacent slopes of 'medium' steepness. On 'higher' slopes the dynamics are locally quasi-steady ($c.f.$ Princevac, M., J.C.R. Hunt and H.J.S. Fernando: Quasy-Steady Katabatic Winds on Slopes in Wide Valleys: Hydraulic Theory and Observations, *J. Atmos. Sci.*, 2007; Manins, P.C., and B.L. Sawford: A Model of Katabatic Winds, *J. Atmos. Sci.*, 1979; Hunt, J.C.R., H.J.S. Fernando, and M. Princevac: Unsteady Thermally Driven Flows on Gentle Slopes, *J. Atmos. Sci.*, 2003), but on the 'medium' and low slopes the down or up slope flows are dominated by shallow unsteady gravity currents or long wave currents extending up to the mixing height. It the evening hours the transition from up to down slope flow on gentle slopes occurs over a period of several hours. In this stage the air is cooling as it rises up the slope gradually losing its buoyancy as well as inertia and eventually stops forming a mo-

mentary stagnation at a location within a few meters above the surface. The resulting stagnant air phenomenon is known as the "*transition*" front and it is followed by local overturning. Coriolis effects are important on open mountain slopes, but negligible in valleys whose width is less than the Rossby deformation radius based on the mountain height. Algorithms suitable for fast PC based methods are being developed, which can be combined with those already in use for synoptically driven flows.