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The influence of small scale terrain features on the nocturnal boundary layer and grid-averaged fluxes

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Much of the Earth's surface is covered by low amplitude small-scale terrain features such as shallow valleys and low hills on the horizontal scale of a kilometre or less. These features are unresolved in most numerical models. Although their impact on the boundary layer has been studied much less than that for more dramatic terrain features, small terrain features becomes important with stable stratification and weak large-scale flow.

This study examines marginal cold pools and cold air drainage forming in a shallow valley, instrumented with 21 surface stations that include sonic anemometers and a 20 m tower on the valley floor. The analysis indicates that the traditional concept of a cold pool must be generalized to include cold pool intermittency, relationship of the cold pool to tributary gullies, complex variation of temperature on the adjacent slopes and a diffuse cold pool top. Different types of cold pools are classified in terms of the stratification and gradient of potential temperature along the slope. The cold pool strength is limited by weak downvalley drainage of cold air. The vertical distribution of the fluxes in the presence of near surface wind maxima of the cold air drainage are examined along with attendant parameterization problems.

The network domain is then viewed as a grid area in a numerical model. Strategies for parameterizing the influence of the small scale unresolved terrain are examined in terms of the grid-averaged fluxes.