Internal gravity waves generated by katabatic flows in a valley

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We shall present results from high-resolution large-eddy simulations of the generation of internal gravity waves by katabatic flows in a valley, as this occurs at night or in winter. The ARPS code is employed for this purpose. This work is motivated by previous experimental studies, which have reported oscillations in katabatic flows either on a simple slope or in a valley (e.g. Gryning et al., 1985; van Gorsel et al., 2004). The simulations reported in our study focus on an idealized valley with dimensions close to those of the Chamonix (France) or the Riviera (Switzerland) valleys, for which (sparse) nocturnal and/or wintertime data are available. We will present examples of internal gravity waves generated by gravity currents, as well as discuss the atmospheric stability conditions for which they may be clearly identified and characterized (for instance using Hovmoller diagrams). We shall also discuss conditions for which waves are reflected back down toward the ground surface or are damped with height because of the stratification of the upper layers. This work will be guided by numerical resolution of the ray tracing equations for the same topography, velocity and temperature fields as in the large-eddy simulations. Trapped waves between the ground surface and the layer aloft may contribute to the mixing of the stable valley atmosphere. We shall thus quantify the induced mixing and investigate the interaction of the waves with the katabatic flow. These results may help to improve parameterization of the effect of internal gravity waves on turbulence for larger-scale models.