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Idealised large-eddy-simulation of thermally driven flows over an isolated mountain range with multiple ridges

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Two dimensional idealised large-eddy-simulations are performed using the WRF model to investigate thermally driven flows during the daytime over complex terrain. Both the upslope flows and the temporal evolution of the boundary layer structure are studied with a constant surface heat flux forcing of 150 W m^{-2}. In order to distinguish between different heating processes the flow is Reynold decomposed into its mean and turbulent part. The heating processes associated with the mean flow are a cooling through cold-air advection along the slopes and subsidence warming within the valleys. The turbulent component causes bottom-up heating near the ground leading to a convective boundary layer (CBL) inside the valleys. Overshooting potentially colder thermals cool the stably stratified valley atmosphere above the CBL. Compared to recent investigations (Schmidli 2013, J. Atmos. Sci., Vol. 70, No. 12: pp. 4041-4066; Wagner et al. 2014, manuscript submitted to Mon. Wea. Rev.), which used an idealised topography with two parallel mountain crests separated by a straight valley, this project focuses on multiple, periodic ridges and valleys within an isolated mountain range. The impact of different numbers of ridges on the flow structure is compared with the sinusoidal envelope-topography. The present simulations show an interaction between the smaller-scale upslope winds within the different valleys and the large-scale flow of the superimposed mountain-plain wind circulation. Despite a smaller boundary layer air volume in the envelope case compared to the multiple ridges case the volume averaged heating rates are comparable. The reason is a stronger advection-induced cooling along the slopes and a weaker warming through subsidence at the envelope-topography compared to the mountain range with multiple ridges.