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Atmos. Chem. Phys., 5, 215-226, 2005
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Simulating orographic rainfall with a limited-area, non-hydrostatic atmospheric model under idealized forcing

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Abstract. A modified version of an operational 3-dimensional, non-hydrostatic, limited-area atmospheric model (MM5) was used to perform high-resolution, idealized simulations of the interaction of an infinitely long single ridge with a steady, lateral large-scale wind field. The effect of different mountain ridge dimensions, wind speeds and patterns and moisture profiles on the quantity and distribution of orographic rainfall was investigated. The simulations demonstrated a number of commonly observed mountain flow features like formation of cap clouds, foehn wall, convective break-out associated with mountain topography, interaction of downslope winds with sea breeze, and different stages of cumulus development. It was found that the rainfall maxima associated with the mountain always occur upstream of the ridge peak. Changing mountain dimensions, wind speeds and patterns and moisture profile had clear effects on amount and pattern of accumulated rainfall. Low wind speeds resulted the maximum accumulated rainfall to occur considerable distance upstream of ridge peak. Reversal of wind directions in upper atmosphere caused rainfall to be largely restricted to the wind-side of the peak. The observed rainfall patterns are explained by the different flow patterns observed in the model output.

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