



Precipitation enhancement over low mountain ranges

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In Germany, most large-scale heavy precipitation events associated with local or widespread flooding are connected with substantial precipitation enhancement over low mountain ranges. Proper determination and forecast of orographic precipitation with respect to the intensities and the spatial distribution is therefore an essential issue for hydrological and risk management purposes.

The connection between flow dynamics and precipitation enhancement is investigated by analyzing measurement data over different low mountain ranges in Germany. Accordingly, the strongest enhancement is found for situations with high humidity transport (mixing ratio \times horizontal velocity) and high Froude number, where the flow goes more or less directly over the hills and gravity waves are quite suppressed. These findings were confirmed by sensitivity studies with a diagnostic precipitation model that is based on the linear theory for 3-D mountain overflow. Especially upstream the mountain, orographic precipitation was found to be very sensitive to horizontal wind speed perpendicular to the mountain, static stability, and saturation mixing ratio. However, lowest sensitivities are found directly above the mountain top, whereas locations upstream or downstream exhibit higher sensitivities.

From these studies, one may conclude, that proper determination or forecasting of the ambient conditions is essential to obtaining reliable simulations of orographic precipitation, since small changes of atmospheric parameters already may have significant impacts on the amount and distribution of precipitation.