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Katabatic flows and their role in the formation of convective clouds

Katja Trachte and Joerg Bendix
University of Marburg, Laboratory for Climatology and Remote Sensing, Marburg, Germany (trachtek@staff.uni-marburg.de)

At the eastern Andes of South Ecuador in the Rio San Francisco valley precipitation measurements revealed an unexpected early morning rainfall peak. This precipitation event is related to the occurrence of nocturnal mesoscale convective systems in the Peruvian Amazon basin south-east of South Ecuador at the Andean foothills. It was hypothesised that the formation of these cloud cluster is an interaction of nocturnal cold drainage of air and the warm-moist Amazonian air. The special terrain configuration with a concave geometry in the cloud formation area forming an extensive drainage system contributes to a confluence of katabatic flows from the Andean slopes and valleys. With a sufficient increase in the pressure field due to the topographical configuration vertical motion is initiated, which develops to convective activities during sufficient moisture in the atmosphere. In addition, a frequently occurring nocturnal low-level jet at the eastern flanks of the Andes increases the low-level convergence, and thus, lifting of air.
In order to verify the hypothesis stated above the numerical model Advanced Regional Prediction System (ARPS) was used. Based on the very steep slopes and valleys of the Andean mountains a simplification of the main features of the terrain was made to reduce the high slope angles. This are slopes, valleys, a concave ridgeline and finally an irregular drainage system. At first the development of a thermally-driven flow along a simple slope is demonstrated. Afterwards its modification by the configuration of the terrain regarding its confluence is shown. This follows the presentation of the formation of a convective cloud cluster due to the concave geometry of the terrain.