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VALLEY-MOUNTAIN CIRCULATION ASSOCIATED WITH PRECIPITATION FORMATION IN THE TROPICAL ANDES (RIO SANTA BASIN)

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ABSTRACT

During the austral summer season, the precipitation in the Rio Santa basin, localized in the Tropical Andes, is strongly influenced by the interaction between large-scale circulation with local processes. However, this interaction has not been fully explored in the region. Therefore, the identification of the circulation patterns, and how occurs the interaction with local and regional-scale mechanisms influences the rainfall development is the main objective of this work. The analysis used fine resolution Weather Research and Forecasting (WRF) simulations nested in ERA5 reanalysis data. Different combinations of parameterizations were evaluated with a horizontal grid size of 5 km, in order to find the most suitable configuration for simulating the observed diurnal cycle of precipitation. Once identified the configuration, longer nested simulations (December 2012 until March 2013) with horizontal grid size of 6 km and 2 km were performed. Estimated (TRMM, CMORPH, PISCO, CHIRPS) and local observations were used to validate the simulations. The chosen WRF configuration consists mainly of the Goddard microphysics and the Betts-Miller-Janjic cumulus parametrization. This configuration is able to simulate the main features of the observed diurnal cycle of precipitation, according to the in-situ data. However, the model still overestimates precipitation. In assessing the circulation associated with the precipitation diurnal cycle it was identified as a westerly flow during the daytime, which is perpendicular to the Andes and enters through the north of the basin. This near surface flow is vital for the development of rainfall over the western slopes-highlands of the basin from noon to mid-afternoon. At same time, in eastern side of basin the coastal moisture transport converges with Amazon easterly flow over the mountains causing precipitation. On the other hand, between the late afternoon and early night, the rainfall predominates on the eastern slope associated with the upslope valley winds persisting in this period. These results contrast with most of studies that have indicated the Amazon basin as an exclusive source of moisture for the formation of precipitation over the Andes.

Keywords: Large-scale circulation, local processes, WRF, parameterizations

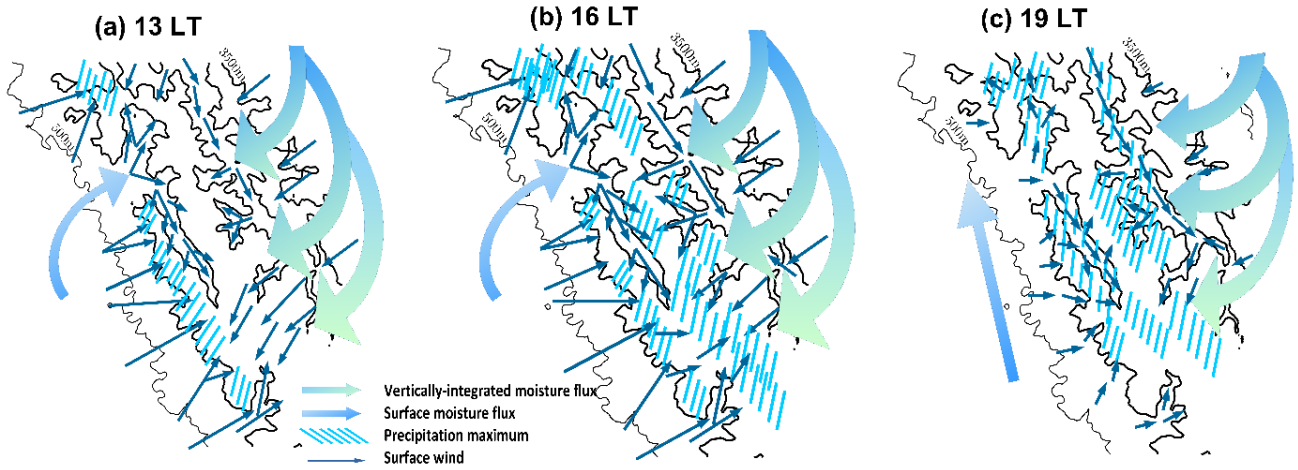

Figure 1. Schematic diagram of the main circulation from model outputs at (a) 13, (b) 16, and (c) 19 LT. Blue dashed zones correspond to precipitation maxima. Light blue-green arrows indicate vertically-integrated moisture flux, thin light blue arrows are surface moisture flux and thin dark blue arrows are surface winds.