PERÚ | Ministerio del Ambiente | Instituto Geofísico del Perú | Subdirección de Ciencias de la Atmósfera e Hidrósfera

# Diurnal Cycle of Precipitation and Winds Over the Huancayo Observatory (Central Peruvian Andes), using a Ka Band Cloud-profiling Radar (MIRA 35C) and Boundary Layer Tropospheric Radar (BLTR)

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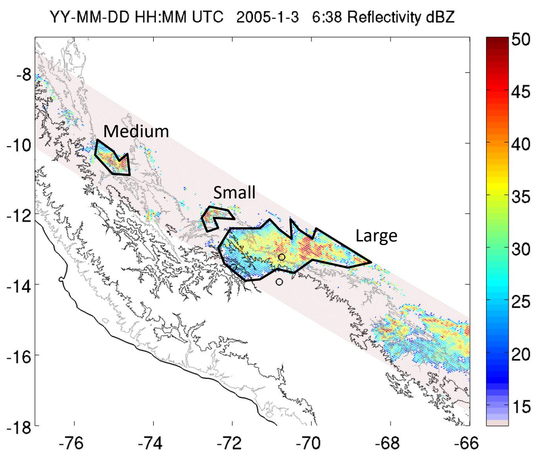
## Abstract

The Peruvian Andes has an important population above 3000masl, where the agriculture and livestock are the main economic activity. At these altitudes the adverse weather events such as frost, heavy rains, hail and droughts are quite frequent, which makes them very vulnerable. For this reason, the Atmospheric Microphysics and Radiation Laboratory (LAMAR) was implemented at the Huancayo Observatory (12° 02'18 ''S, 75° 19'22''W, 3300 m.a.s.l.), Fig. 1. The main gol of LAMAR is to understand the physical and dynamical processes of the atmosphere to explain climate change, climate variability and extreme weather events in the Peruvian Andes.

As seen by the TRMM, precipitation radar convective clouds does not become organized into larger systems, the precipitation systems that contribute the most are the small and medium size in terms of their horizontal extension. However, there are a second maximum in rainfall in early morning. Stratiform in early morning and convective in the afternoon observed from ground radars are in agreement with the rain type from TRMM PR.

The main objective of this work is to characterize the diurnal cycle of precipitation and winds during the austral summer (JFM) using the Ka-band cloud-profiling radar (MIRA 35C) and a boundary layer tropospheric radar (BLTR), which are operating in LAMAR. Data from January-March 2016 were analyzed, to identify the precipitation events using 10dB as threshold value. Preliminary results indicate that during the nights, between 00 and 09 HLT, precipitation are lighter and stratiform type; while during the afternoon and early evening there are deeper convective clouds with more intense precipitation, with the peak between 17 and 19 HLT. These results are consistent with the rain gauges measurements. Winds during the rainy season (austral summer) are predominantly easterly during the morning until 14-15 HLT, being very weak from 23 to 9 HLT near the surface until 1-1.5 km, just during the occurrence of stratiform type rainfall.

## Storm sizes




Storm sizes (PFs)

Small (S, 25–2250 km$^2$),
Medium (M, 2250–24700 km$^2$)
Large (L, >24700 km$^2$)

*Figure 2. Storm size or PFs observed by the TRMM satellite, according to previous studies* (Romatschke, 2013 ; Chavez & Takahashi, 2017)

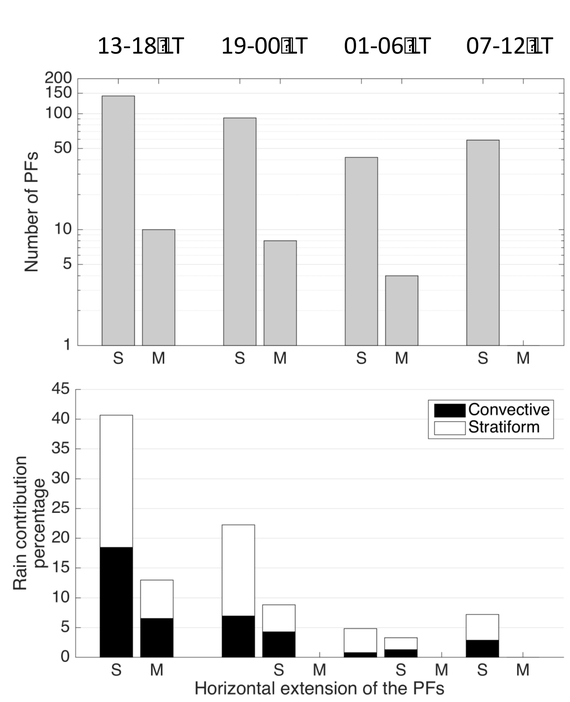



*Figure 3. Number of storms observed in the Mantaro Valley (upper image) and percentage of convective and stratiform type rainfall that contributes to total amount of daily precipitation.*

**References:**

- Chavez, S. P., and K. Takahashi (2017), Orographic rainfall hot spots in the Andes-Amazon transition according to the TRMM precipitation radar and in situ data, J. Geophys. Res. Atmos., 122, 5870–5882, doi: 10.1002/2016JD026282.
- Romatschke, U., & Houze, R. A., Jr. (2013). Characteristics of Precipitating Convective Systems Accounting for the Summer Rainfall of Tropical and Subtropical South America. *Journal of Hydrometeorology*, *14*(1), 25–46.

***Acknowledgments:***

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## Study region

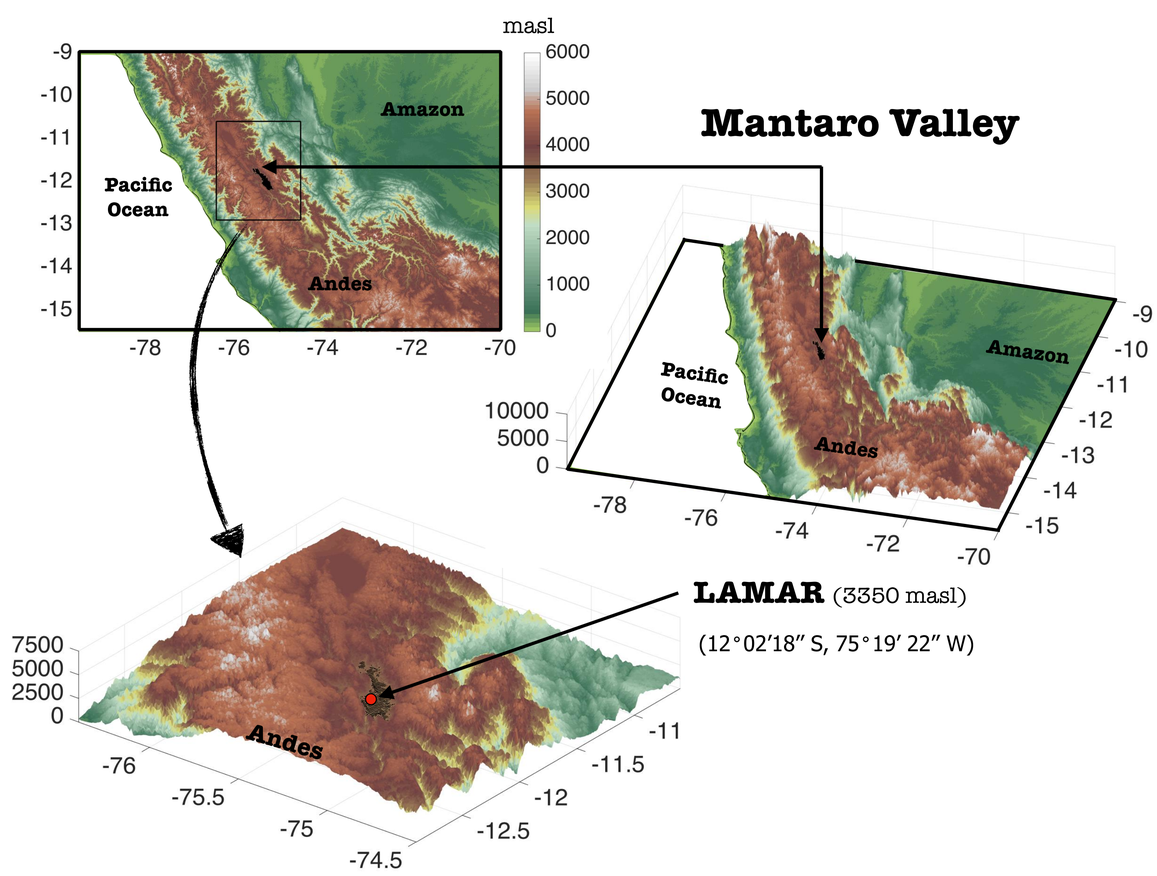


*Figure 1. Digital elevation model of the central Andes of Peru and zoom to Mantaro valley*

## Diurnal Cycle

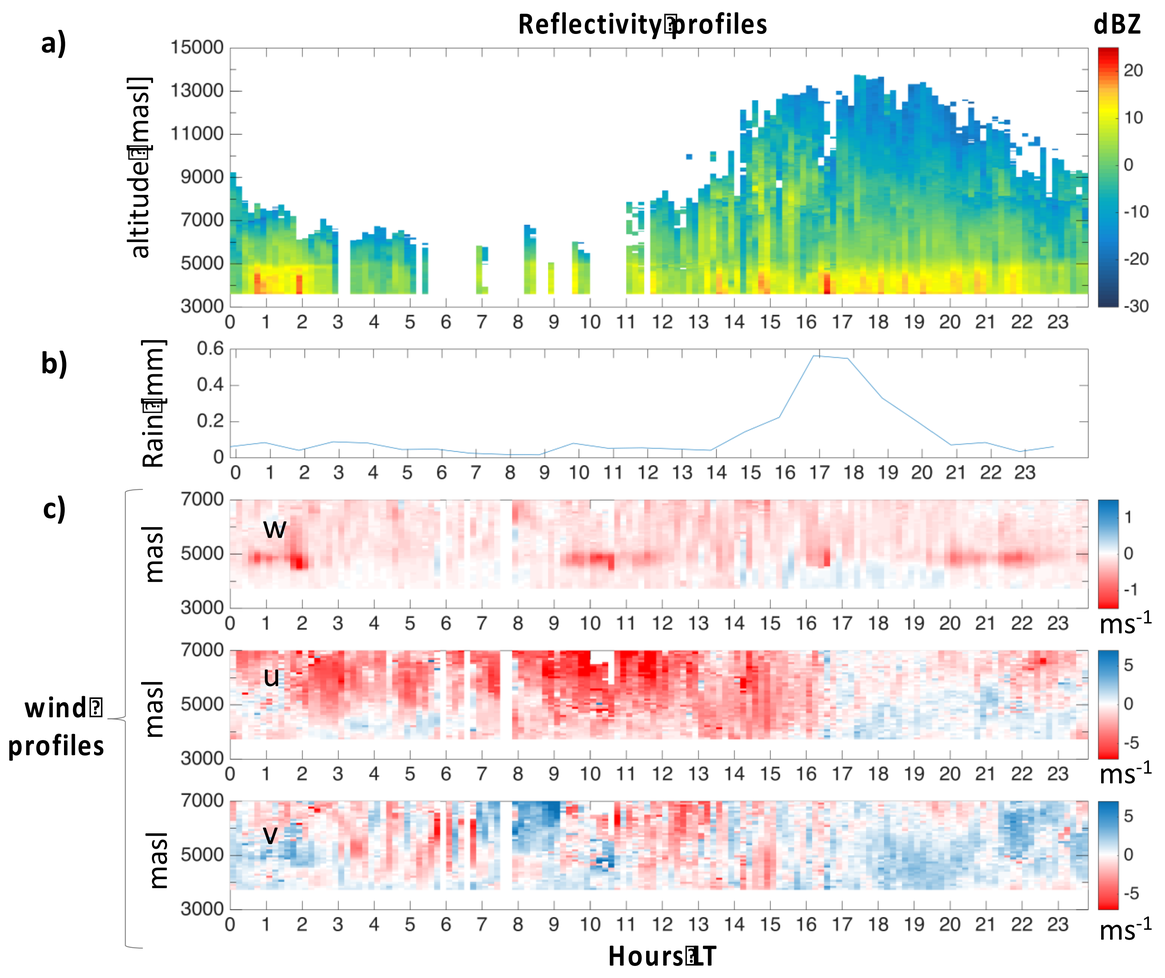


*Figure 4. Hourly average of rainfall and wind profiles for the 2016 rainy season (January - March), only rainy events were considered; a) reflectivity form MIRA 35C, b) rain gauge measurement, c) w, u and v wind component from BLTR.*

## Conclusions

- The MIRA-35C data allows to determine the vertical structure of precipitation and the spatial distribution was characterized using the TRMM radar data.
- The greatest amount of precipitation in the Mantaro valley is observed in the early afternoon until midnight (from 13 to 23 HLT), at that time the storms are mostly small size.
- The diurnal cycle shows rains of stratiform type at night (from midnight until 9 HLT), which has little vertical development (3000 to 6000 m.a.s.l) and convective rain mainly in the afternoon, with vertical development to 10000-13000 m.a.s.l.
- In general, during the rainy event in LAMAR, there are upward winds in the afternoon evidencing convection, as it sees in the case of study. Then, the winds decays and estratiform rain forms with downward winds until early morning.
- According to the diurnal cycle, in the afternoon (12 to 16 HLT) between altitudes 3500 to 7000 m.a.s.l. the winds are westerly.