On the study of three hotspots of rainfall on the eastern Andes

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RESUMEN

Se utilizaron datos de precipitación acumulada de 3 horas de Tropical Rainfall Measuring Mission (TRMM) del período 1998-2015, con una resolución de 0.25x0.25 km y para detectar eventos de precipitación extrema en la zona este de los Andes centrales. Se analizaron tres señales intensas en la precipitación acumulada promedio. Analizando dentro de tres regiones, se obtuvieron máximos espaciales y se estudió su comportamiento. Se detectaron y analizaron eventos extremos dentro de cada una de esas regiones, definidos como el percentil 99 de su precipitación acumulada media diaria. El verano austral es el período del año que presenta eventos más frecuentes en estas tres regiones. Las estadísticas diarias muestran que tales máximos espaciales, así como sus eventos extremos, se producen durante la noche. La hipótesis de la convección nocturna en la base de una montaña se probó usando datos NCEP y simulaciones WRF. Implica el enfriamiento del aire descendente de las montañas que encuentra aire inestable en la superficie, dando lugar al desarrollo de una fuerte convección local.

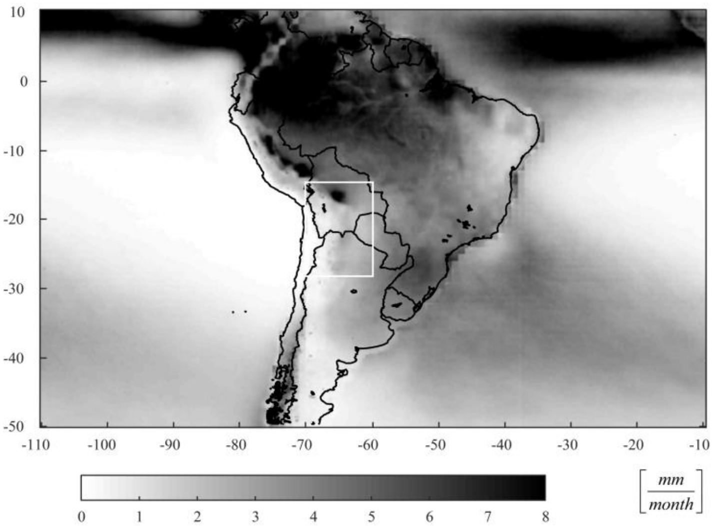
ABSTRACT

On the basis of the period 1998-2015, 3hr accumulated rainfall data from Tropical Rainfall Measuring Mission (TRMM) with 0.25x0.25 km resolution have been used to detect extreme precipitation events at the east area of central Andes. Three strong signals that appear in the mean accumulated rainfall field were analyzed. Enclosing them within three regions, spatial maxima were obtained and their behaviour studied. Extreme events within each of those regions, defined as the 99th percentile of their daily mean accumulated rainfall, were detected and analyzed. Austral summer is the period of the year presenting most frequent peaks over these three regions. Daily statistics show that such spatial maxima, as well as their extreme events, are produced during the night. The hypothesis of nocturnal convection at the base of a mountain was tested using NCEP data and WRF simulations. It implies cooling descending air from the mountains that finds unstable air at the surface, giving place to the development of strong local convection.

Palabras clave: TRMM extremes, Andes precipitation extremes, Andes precipitation variability.

1) INTRODUCTION

We focus this study on the east of the Andes, in the region enclosed between 15S -27S, 70W- 60E, where strong signals of mean accumulated rainfall have been already observed (e.g. Hierro et al., 2016). Taking the high quality TRMM verified data, the period under analysis runs from summer 1998 to winter 2015. 3-hourly (0.25x0.25 km) accumulated rainfall data (R) are obtained from the product Daily TRMM and Others Rainfall Estimate (3B42 V7 derived) Data. Using these data over an orographic region such as South America offers an important advantage, as this technique is not obstructed by topography. Figure 1 shows the mean field of R during the period 1998-2015 over the region involved in the study. Three relative strong mean R signals are observable over the base of the mountains at the lee side of the Andes (Figure 1, right).



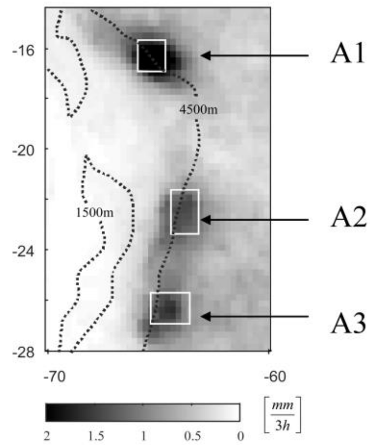


Figure 1. a) Mean R during 1998-2015 over South America and b) the same variable over the study region, showing each region under study, called A1, A2 and A3. The rectangle over Fig. a) corresponds to the area shown in Fig. b)

Each one of these three R signals was enclosed into regions, A1 (16-17S, 64.5-65.5W), A2 (22-23.5S, 63.5-64.5W) and A3 (26-27S, 63-65W) as shown in figure 1 (right). Following this spatial definition, we use daily mean of R ($\overline{R_d}$ [mm/3hr]) to define spatial maximum precipitation events over A1, A2 and A3 (hereinafter M1, M2 and M3, respectively). Temporal (days) extreme events definitions consist in taking non-zero data over A1, A2 and A3 regions and calculating the 99th percentile of $\overline{R_d}$ over each one as a cutoff value (E1, E2 and E3 respectively). The obtained cutoff values are 34 mm/day, 18 mm/day and 16 mm/day for each region respectively.

The monthly distribution of days with extreme values shows austral summer as the period of higher activity for each one. January, and December-March and January-March are the periods where the occurrence of these extreme values is most frequent. Their daily average evolution also shows peaks at night. The average daily evolution shows a similar behavior in the three cases, with increasing values of rainfall during the local night, reaching a maximum at 06Z. The idea of night convection given by descending cooling air that reaches unstable air at the base of the mountains was tested using NCEP data and WRF simulations.

References:

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