

Evidence of teleconnections between the Peruvian central Andes and Northeast Brazil during extreme rainfall events

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Abstract

Knowledge about changes in regional circulation and physical processes associated with extreme rainfall events in South America is limited. Here we investigate such events over the Mantaro basin (MB) located at (10S°-13°S; 73W°-76°W) in the central Peruvian Andes and Northeastern Brazil (NEB), located at (9°S–15°S; 39°W–46°W). Occasional dry and wet spells can be observed in both areas during the austral summer season. The main goal of this study is to investigate potential teleconnections between extreme rainfall events in MB and NEB during austral summer.

We define wet (dry) spells as periods that last for at least 3 (5) consecutive days with rainfall above (below) the 70 (30) percentile. To identify the dates of occurrence of these events, we used daily accumulated rainfall data from 14 climate stations located in the Mantaro basin for the period 1965 to 2002. In NEB we defined a rainfall index which is based on average daily gridded rainfall data within the region for the same period.

Dry (wet spells) in the MB are associated with positive (negative) OLR anomalies which extend over much of the tropical Andes, indicating the large-scale nature of these events. At 200 hPa anomalous easterly (westerly) zonal winds aloft accompany wet (dry) spells. Composite anomalies of dry spells in MB reveal significant contemporaneous precipitation anomalies of the opposite sign over NEB, which suggest that intraseasonal precipitation variability over the two regions may be dynamically linked. Indeed upper-tropospheric circulation anomalies over the central Andes extend across South America and appear to be tied to an adjustment in the Bolivian High-Nordeste Low system.

Dry (wet) spells in NEB are equally associated with a large-scale pattern of positive (negative) OLR anomalies; however, there are no related significant OLR anomalies over the MB during these events. Dry (wet) spells are associated with robust patterns of anomalous wind fields at both low and upper levels, caused by a changing position of the South Atlantic Convergence Zone (SACZ) toward the southwest (northeast). But, there is no coincident robust pattern of wind anomalies over the Mantaro Basin.

In conclusion, dry spells in the Mantaro basin appear to be dynamically linked to wet spells in NEB, since 62% of all dry events in MB coincide with wet spells in NEB (35% of all events). The dynamical link explaining the observed teleconnection and the resulting dipole pattern between precipitation extremes in the MB and NEB region, respectively, appears to be related to intraseasonal variability in the Bolivian High - Nordeste Low system. Only 26.53% of all wet spells, however, coincide with dry spells in NEB (12.15%

of all events). While circulation anomalies that affect precipitation extremes in the MB have the potential to also affect the precipitation characteristics in NEB, the opposite is not the case. Extreme events in NEB are primarily affected by NE-SW displacement in the SACZ, a mechanism that is of little relevance for precipitation extremes in the MB.

Keywords: Veranillos, Wet spells, Mantaro basin, Northeastern Brazil (NEB), intraseasonal variability, atmospheric circulation, teleconnection, Bolivian High-Nordeste Low System, and SACZ.