

Austral summer rainfall in Peru and its dependence on ENSO flavor and interactions with ITCZ and SPCZ

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The El Niño/Southern Oscillation (ENSO) is a coupled ocean-atmosphere phenomenon originating in the tropical Pacific with global impacts. Currently, there are few studies about the change of large-scale weather anomalies associated with the ENSO flavor events around the globe through atmospheric and oceanic teleconnections, with significant impacts on society and natural system. For example, El Niño in the East and Central Pacific have different impacts on the rainfall of Peru and the atmospheric pathways through the SPCZ and Pacific ITCZ are poorly understood yet. Therefore, the goal of this study is describe the impact of ENSO flavors, ITCZ and SPCZ on the interannual variability of Peruvian rainfall during austral summer.

To address this, we performed linear regression of sea surface temperature (SST) E (eastern Pacific) and C (central Pacific) indices, as well as precipitation indices for SPCZ and ITCZ, with gridded precipitation and ERA Interim reanalysis data sets during the austral summer (December-January-February) for the 1980-2016 period.

The results show clearly that many aspects of the ENSO impacts over South America associated with E and C are similar, but there are also significant differences. Positive C induces dry anomalies along tropical Andes (Ecuador, Peru and Bolivia) and northern South America (SA), while wet anomalies prevail over southeastern South America (SESA). Moreover, they produce wet (dry) conditions in northwestern (central and southern) Peruvian Amazon. In contrast, E enhances wet conditions along the coast of Ecuador and northern Peru associated with the southward displacement of the eastern Pacific ITCZ and dry only in the Peruvian Altiplano. Both E and C are associated with upper-level westerly wind anomalies over Peru, but it is more restricted to the central Andes with E. Both the zonal position of the SPCZ and its northward displacement suppresses rainfall over the Peruvian Andes; but the latter also inhibits rainfall over the Bolivian Altiplano. Both are linked to upper-level westerly wind anomalies over all of Peru, but these anomalies do not extend as far south in the former. The southward displacement of the eastern Pacific ITCZ also induces wet anomalies in SESA while induces dry anomalies over northeastern Brazil (NEB) and Altiplano region. In contrast, the southward displacement of the central Pacific ITCZ induces dry anomalies in NEB and along the northern coast of Peru; while wet anomalies occur in eastern Brazil, Paraguay and the Bolivian Altiplano.

Keywords: Rainfall of Peru, atmospheric teleconnections, El Niño-Southern Oscillation (ENSO), South Pacific Convergence Zone (SPCZ), Intertropical Convergence Zone (ITCZ), South America

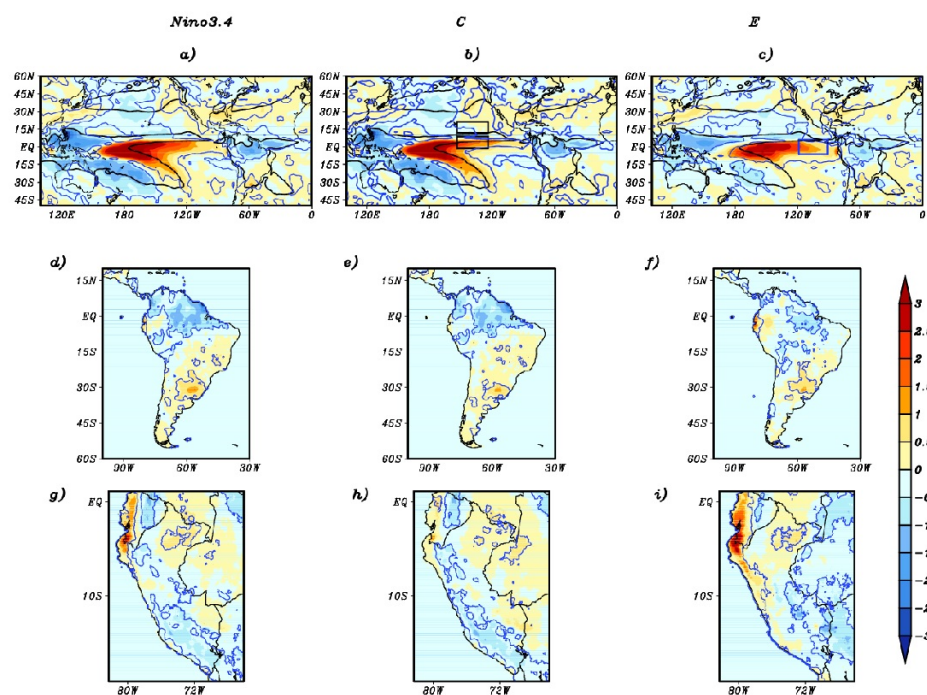


Figure 1. One standard deviation of ENSO indices (Niño 3.4, E and C) regressed upon DJF GPCP precipitation: (a, b and c), Delaware precipitation (d, e and f) and PISCO precipitation (g, h and i). Black contours represent significant correlation at the 95% confidence level. Black boxes are associated with ITCZC index, while the blue box is linked to ITCZE index. Analysis based on the period 1980-2016.