Supplementary Material for "Interannual and Long–Term Precipitation Variability Along the Subtropical Mountains and Adjacent Chaco (22–29º S) in Argentina"

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Figure 1. Temporal variations in wet-season precipitation for the 34+Lomitas meteorological stations analysed. Linear trends are indicated for each record with dashed black line. Rodionov's test changes are also shown as red line. Graph below summarizes the years and frequency of positive and negative shifts (attached as Suppl.Mat. Image 1.jpeg).

Pre-treatment of precipitation-gauge data. We compiled most records available for the region. In a first selection, we discarded those series shorter than 56 years of data (1934-1990; years not arbitrarily taken, many of the stations cover this period). A second step was to reject those series with more than 5% of absent data (in order to reduce to minimum the estimation of missing values). Thirdly, we performed correlation analyses between nearby stations to finally select series with the best uniform spatial distribution, and not to have close redundant data (commonly seen in studies on mountain area), which can be influential on PCA analyses. Correlation analyses were also performed when comparing the same station but from different sources, and when updating (available series) to the year 2016. These procedures reduced the number of original precipitation records from 85 to 34.

Quality control: We performed quality control analyses of the individual instrumental series, by identifying the presence of rare or anomalous values if:

Pr-Prclim > max ([100mm, 0.1 Pranual]) y Pr-Prclim > 3 sigma y Pr> 5* Prclim

(being Pr= monhly total precipitation; Prclim= historical mean of monthly total precipitation).

In cases where a rare or anomalous data appeared, a visual control of these extreme values and a comparison with neighbouring stations within a radius of 0.5° were performed to determine if this extreme value is within regional climatic variability. If other stations have the same tendency towards one extreme, the data is saved. The PV-WAVE program was used to the quality control analyses.

Gap-filling: Missing data were estimated from a group of nearby station significantly correlated ($r > 0.7$, $p<0.05$) with the series to be completed during the common recording period (1934-1990). Based on the selected stations, the mean SD of the value to be estimated was established and that deviation was used to calculate the missing value. Thus, the estimated value weighed the monthly precipitation of each station regardless of its location in the precipitation gradient that is characteristic of NWA. The MET-DPL (Meterorological Data) program was used to estimate the missing data

Figure 2. Temporal variations in July–June PDO anomalies for the period 1900–2016. The blue dashed line represents the changes in PDO phase according to the Rodiovov's test change. Blue bars below correspond to significant positive and negative changes (above and below zero line, respectively); the length of the bars corresponds to the magnitude of the changes. Three changes are detected in the series: a slight negative change in 1948; a large positive change in 1976 and a larger negative change in 2008. The positive change in the year 1976 is in agreement with the positive change in precipitation in NW Argentina during the mid–1970s. A negative change in NW Argentina precipitation recorded in the mid–2000s, and henceforth, in agreement with the negative change in PDO series in 2008. PDO series extracted from http://research.jisao.washington.edu/pdo/

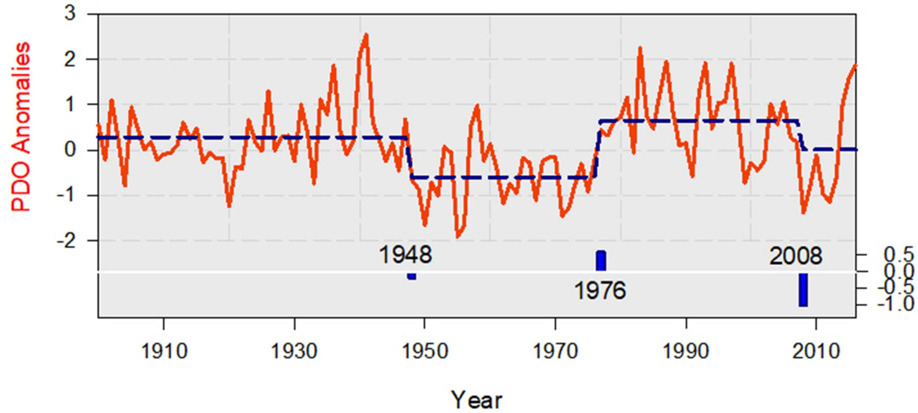

Figure 3. Comparison of temporal variations in the extended first component of wet season precipitation (*PC1.ext*) in NW Argentina and the sea surface temperature (SST) anomalies over the subtropical Atlantic Ocean (October-March; 30°E - 55°W; 20-45°S). The period analysed is 1912-2016 (105 years). The correlation coefficient ($r=0.49$) is significant for $p < 0.05$.

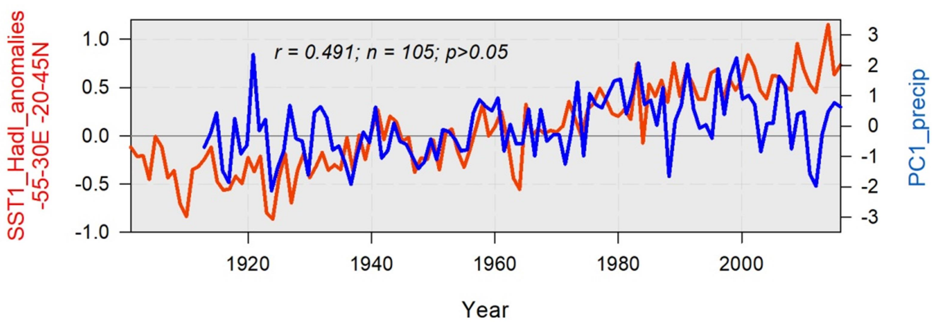

Figure 4. Temporal variations in SST anomalies for the period 1900–2016. The blue dashed line represents the jumps identified by the Rodionov's test change. Blue bars below correspond to significant positive changes; the length of the bars corresponds to the magnitude of the changes. Three positive changes are detected (years 1938, 1967 and 2010), encompassing the continuous positive trend in the SST series.