



Characterization of the Mid-70's Climate Shift in South America

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The temporal variability of the different components of the climate system comprises cycles from a wide range of frequencies and also abrupt or stepwise changes in the time series, called climate shifts. One example of these is the 1976/77 SST change from negative to positive anomalies that took place within one year in the tropical Pacific Ocean. This event has been associated with a phase change of the Pacific Decadal Oscillation (PDO) index and the similitude between the spatial patterns of this low-frequency mode and that of the Pacific inter-annual variability has motivated the denomination of the previous and subsequent regimes of this climate shift as "La Niña-like" and "El Niño-like", respectively. However, there is no consensus concerning the periodic nature of this phenomenon and, alternatively, it has been suggested that it could correspond to a unique event in the 20th century.

Contrasting with other regions of the world, there is not a systematic characterization of this climate shift in South America using instrumental records of different variables. This issue is tackled in this study by analyzing annual and austral-summer (DJF) air temperature and SLP instrumental time series (GHCN). Our research is complemented with reanalysis (NCEP-NCAR and ECMWF-ERA40) and gridded data: air temperature and precipitation (U. of Delaware) and SST (ERSSTv2). We have studied the change of these variables between 1961-1973 and 1978-1990 and mid-'70s significant shifts in the time series have been detected by applying Rodionov sequential Student's t-test for mean differences.

The climate shift is identified in all the analyzed variables. Moreover, we describe the spatial pattern of this phenomenon with standardized anomalies composites (baseline: 1961-1990). At annual level, we recognize the SST "El Niño-like" signal and observe an abrupt increase in surface air temperature in composites located next to the Pacific Ocean (Venezuela, Colombia, Perú and Chile) and in the La Plata Basin (Uruguay/Argentina). Although SLP instrumental records do not show an evident spatial signal, reanalysis data reveal a shift-like intensity weakening of the South Pacific Subtropical Anticyclone (that induces a decrease of cool advection from the South and of coastal upwelling at its Eastern edge and thus leads to warming in the Southwestern coast of the continent) and also the establishing of an anticyclonic circulation anomaly in the southern tip of South America. Concerning precipitation, the shift-like increase of this variable is recognized in Central Argentina and Eastern Brazil, besides the abrupt decrease to the Northeast of this latter country. Austral-summer time series (DJF) show a particularly conspicuous shift-like temperature increase in Patagonia.

We discuss the incidence of ENSO in the surface temperature shift, due to the relative higher frequency of El Niño warm events after mid-'70s, which is also interpreted as a modulation of the climatic background by the warm phase of the inter-decadal variability (PDO). The southern annular mode (SAM) would also be related to the observed SLP increase in mid latitudes. In agreement with this, we conclude that the Mid-'70s Climate Shift corresponds to a coupled response of the climate system.