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Tropical-extratropical teleconnections and impacts between the sea surface temperature of the Southern hemisphere and the daily intensity of extreme rainfall over Argentina

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During the past few decades there has been considerable effort devoted to obtaining a better understanding of natural climate variability on interannual to interdecadal timescales. To determine the mechanisms governing these climatic variations, it is essential to characterize the large-scale interactions between the ocean and the overlying atmosphere. The impact of climate variability on the environment and the economic activities mainly depends on changes in the frequency of occurrence of extreme events. Relatively few studies on regional variability of climatic extremes are found in the literature compared to the number of studies on changes in climatic means. Small changes in the mean could produce substantial changes in the frequency of extreme events. In this work we analyzed the relation between the extreme daily rainfall in Argentina and the sea surface temperature (SST) of the Southern Hemisphere. The general analysis was performed in the period 1962-2005, using two data sets: 1) Monthly SST from the Kaplan SST V2 from the NCEP/NCAR. The region of analysis comprises the Southern Oceans, from 17,5º N to 90º S, and for all the longitudes and 2) high quality daily rainfall for 35 observation stations from the National Weather Service of Argentina distributed throughout the country. Although there are more raingauges in this region only 35 stations were deemed appropriate for the analysis with long records; less than 10% of missing data; and continuity of records.

In this work, we consider extreme daily precipitation when rainfall it is greater than 75th daily percentile for the period 1961-2000. The monthly mean of daily intensity of extreme rainfall index (hereafter DIER index) is the quotient between monthly accumulated extreme rainfall and the number of days with extreme precipitation per month. For SST and DIER, all monthly time series span from December 1962 to november 2005. For both data set, the monthly anomalies are first computed by subtracting the 44-year monthly means from the original data, and seasonal anomalies are further obtained as the 3-month averages DJF (summer), MAM (fall), JJA (winter), and SON (spring). In order to remove non-stationary effects, the analysis was carried out with the anomalies of the climatic series (DIER and SST) regarding the linear trend. Singular Value Decomposition (SVD) analyses are performed jointly on the DIER in Argentina and the SST over the ocean of the Southern Hemisphere, in order to explore the co-variability between the two fields and provide insight into the possible mechanisms that may relate the extreme precipitation events with the ocean temperatures. The wavelet transform was applied to the SVD time series of the SST in order to analyze the dominant cycles and their period of occurrence/influence.

We have explored the first five patterns of a joint SVD analysis between DIER in Argentina and the South hemisphere SST for each season. During spring, the large percentage of the covariance explained by the first SVD mode suggests a fair degree of predictability of the DIER and SST. The SST patterns look like to the ENSO phenomena with an enhanced DIER in the central and east of Argentina. In the second SVD mode of spring, summer and autumn, the tropical and subtropical Atlantic presents significant correlation with the rainfall in the center of Argentina. This mode shows a significant decadal variability, with two sub period: 8 years and 12 years. The second mode of spring, not only show a strong relation with the Atlantic Ocean, also present a strong correlation with the SST close to Indonesia.