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TRENDS AND INTERDECADAL VARIABILITY OF RAINFALL IN CHILE

Juan Quintana[1*] and Patricio Aceituno[2]
[1]Dirección Meteorológica de Chile
[2]Departamento de Geofísica. Universidad de Chile

1 . INTRODUCTION

Rainfall regime along the extratropical West coast of South America is characterized by a strong annual cycle with the wet season concentrated during the austral semester (Apr-Sep). Annual rainfall increases southward from around 100 mm at 30°S to nearly 2,000 mm at 40°S. The Andes cordillera isolates this region from the influence of continental air masses. Results from recent investigations about slow changes in the rainfall regime in this region are presented here, including the assessment of trends, interdecadal variability and associated changes in regional and large-scale circulation. This investigation builds upon results from previous studies documenting a generally negative trend in annual rainfall in central Chile and its relationship with the Pacific SST at the interdecadal time-scale (Montecinos et al., 2000).

2. DATA AND METHODOLOGY

Monthly rainfall series corresponding to 34 chilean stations located betwen 30°S and 53°S were considered for analysis after a careful data quality control. To assess changes in the frequency and intensity of precipitation, daily rainfall values were analyzed for 7 stations in south-central Chile. Changes in the strength of the SE Pacific subtropical anticyclone was determined with monthly pressure data from 6 coastal stations plus Eastern Island (27.1°S, 109.3°W) and Juan Fernandez island (33°S, 80°W).

3. RESULTS

Linear trends for the 30-year period 1970-2000 are presented in Fig. 1. In northern central Chile (30°S - 34°S) annual rainfall does not exhibit a significant trend during this period, while in the southern part of the country a marked negative trend is apparent, particularly in the band 40°S - 44°S. From the analysis of daily rainfall records it was concluded that this negative trend derives from a decrease both in the frequency of rainy days and in precipitation intensity.

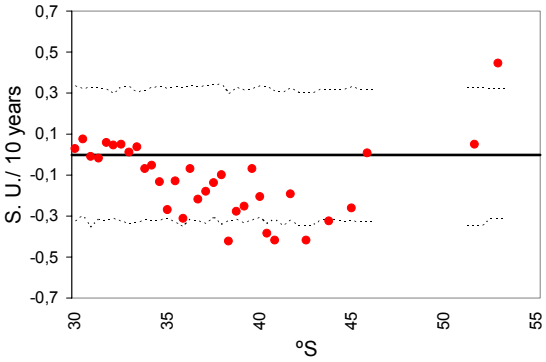

Figure 1: Linear trend in annual rainfall at individual chilean stations (30°S - 53°S) during the period 1970-2000. Values are expressed as change in standardized units every 10 years. Dots indicate boundaries for 95% significance levels.

Interdecadal variability of annual rainfall is presented in Fig. 2 as changes in the linear trend when sliding 30-year periods are considered from 1930 to 2000. In the subtropical domain (30ºS - 37°S) a negative trend prevailed up to the mid-1970's followed by a positive trend that reached maximum intensity for the period 1956-1985 approxi-mately. During most recent 30-year periods annual rainfall regime has remained more or less stationary in the band 30ºS – 34ºS (see also Fig. 1). The evolution of annual rainfall was broadly opposite in the band 33°S - 45°S where the positive trend prevailing up to the mid 1980's was followed by mostly negative trends.

This well defined interdecadal variability in the rainfall regime along the extratropical West coast of South America seems linked to slow changes in the intensity of the SE Pacific subtropical anticyclone (Fig. 3). Thus, the change of the trend in annual rainfall, from negative to positive in the subtropical domain coincides with a significant weakening of the anticyclone which reached minimum intensity during the decade starting in 1980.

* *Corresponding author address: Juan Quintana*. Dirección Meteorológica de Chile, Casilla 717, Santiago, Chile; e-mail: juaquin@meteochile.cl

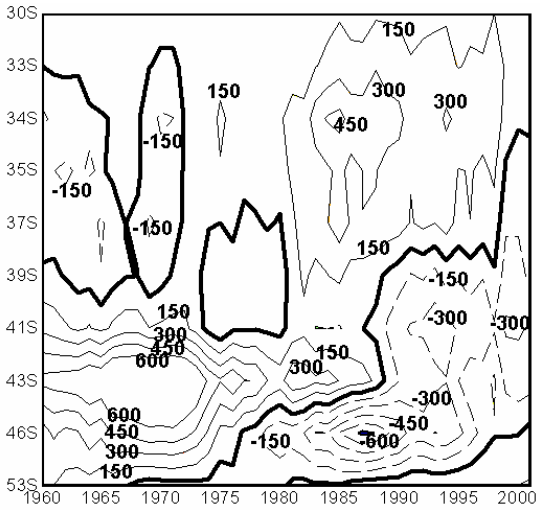

Figure 2: Linear trend in annual rainfall (mm/30 years) calculated for latitudinal rainfall indices in Chile, considering sliding 30-year periods during 1930 – 2000. Note that the latitude scale is not regular.

The marked strengthening of the anticyclone in most recent years (Fig. 3) is consistent with the concomitant weakening of the positive trend in rainfall along the subtropical domain (Fig. 2). Furthermore, the N-S dipolar structure in the rainfall trend pattern could be explained by latitudinal changes in the storm track over the SE Pacific associated with changes in the intensity of the subtropical anticyclone.

Interdecadal variability of the SE Pacific subtropical anticyclone shown in Fig. 3 seems related to large scale changes in the Pacific basin described by the Pacific Decadal Oscillation (Power et al., 1999). Thus, the notorious change in the phase of this oscillation in the mid-1970's, also revealed in the functioning of the Southern Oscillation, is at the origin of the weakening of the subtropical anticyclone during the 1980's and early 1990's. Regarding the evolution of rainfall in southern Chile the changes in the functioning of high latitude phenomena such as the Southern Hemisphere annular mode are also relevant as described in Quintana (2003).

4.- CONCLUDING REMARKS

The interdecadal rainfall variability along the extratropical West coast of South America is related to regional and large scale changes in the atmospheric circulation, including changes in the intensity of the SE Pacific subtropical anticyclone and the Pacific Decadal Oscillation. The annular mode at high latitudes in the Southern Hemisphere may also play a role, but this aspect needs further investigation. The significant decrease in rainfall in south-central Chile during recent decades is a matter of concern considering that most projections from global and regional climate models indicate a drying trend for this region during the XXI century.

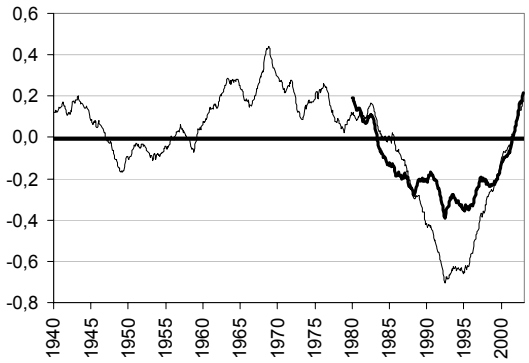

Figure 3: 10-year moving average of the intensity of the SE Pacific subtropical anticyclone calculated from monthly pressure at 8 stations in northern and central Chile plus Eastern Island (27.1°S, 109.3°W) and Juan Fernandez island (33°S, 80°W) during 1970-2002 (thick line) and from monthly pressure at Santiago (33.5°S, 70.7°W) during 1930-2002 (thin line).

5. ACKNOWLEDGMENTS

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6. REFERENCES

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