

THE INFLUENCE OF ENSO ON THE FLOWS OF THE CARONÍ RIVER IN VENEZUELA OVER THE PAST 50 YEARS

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The global connection *El Niño-Southern Oscillation* (ENSO) originate climatic anomalies in other places of the world. In the case of Venezuela the effects are the cold winters that affect the flows and the hydro electrical energy production. Being Caroní basin the source of 64 % of the energy consumed by the whole country, it is important to investigate the relationship between the onset of ENSO episodes and their effect over the flows of Caroní River. The Caroní basin is located in the South-East of Venezuela between 3° 40' and 8° 40' N and 60° 50' and 64° 10' W; it has an area of 96.000 km² (10% of the country). Caroní River extends from Brazil- border to the confluence with the Orinoco River near the city of Puerto Ordaz. Orinoco River pours the waters into the Atlantic Ocean. Caroní basin is divided in two sections: the Upper Caroní Basin formed by the so called "Great Sabana" and the Lower Caroní basin until its outlet in the Orinoco River. The mean annual values of the meteorological parameters over the basin are: precipitation 2.800 mm; temperature 27°C; evaporation 2.000 mm; relative humidity 76 % (Guevara, 2005).

This paper deals with the study of the relationship between ENSO Indices and the flow anomalies of Caroní River, using the time series of monthly mean flows observed at Guri Gauging Station during the period of 1950-2003.

Flow anomalies were correlated with 12 ENSO- Indices. The best correlation was obtained using the Index ENSO 3/4. This index is a composite one that includes the moving average of the last three months of both, the SOI Index, and the SST Index in the region El Niño3/4. The fact that the best correlations are obtained with the use of composite indices (ENSO) means that the join occurrence of atmospheric and oceanic events (tele-connections) exercise the biggest influence in the occurrence of flow anomalies in the Caroní river (Cardenas, 2000, 2002; Marin and Guevara, 2004).

To evaluate the influence of ENSO on the flows of Caroní river a variance analysis was applied to the flow anomalies dividing the historical data according to the percentile distribution of the indices capable to define the phenomena in samples corresponding to ENSO event years. The results of variance analysis are given in Figure 1, where bigger (and positive) values belong to A-ENSO events, being the highest for the dry period of the year. For ENSO events the tendency is similar but the values are negative and smaller than for A-ENSO. This results clearly show the effect of tele-connections on the flow anomalies of Caroní River. The inclusion of the strenght of the phenomena improves the significance levels as the intensity of the meteorological event increases for all analyzed cases (See Figure 2). Here the A-ENOS is responsible for the occurrence of the highest positive flow anomalies, especially during the dry period of the year. In other words, there is a direct relationship between the intensity of the phenomena and the magnitude of the flow anomalies.

The conclusion is that during the cold El Niño period in the Pacific (La Niña or A-ENSO) the flows in Caroní river diminish affecting the storage and the level of operation of the reservoir and the production of hydro electrical energy. From the 14 El Niño years that happened in the period 1950-2003, 12 correspond to years with flow values in Caroní River smaller than the historical mean. Knowledge of this fact can help authorities to make better decisions on the operation of the National Interconnected Electrical System when an episode La Niña (A-ENSO) is foreseen.

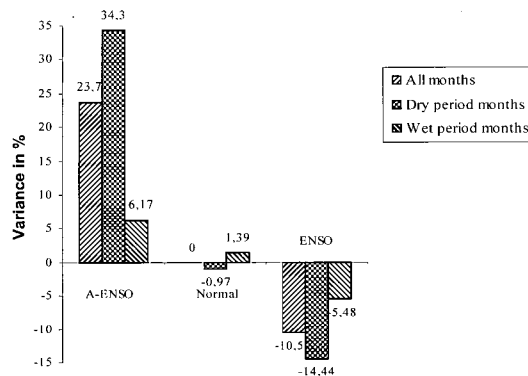


Fig. 1 Results of the variance analysis in % for the flow anomalies of Caroní river using the Índice ENSO 3/4 (best correlation) for ENSO and A-ENSO (La Niña) events.

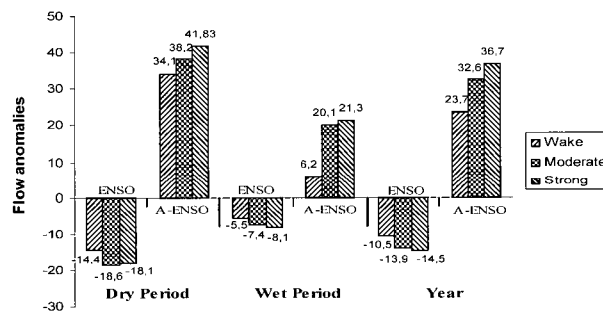


Fig. 2 Flow anomalies of Caroní river at Gurí Gauging Station in % during ENSO and A-ENSO (La Niña) events for different periods of the year

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