GC31A-12: Impacts of the Precipitation and Evaporation Patterns over the La Plata Basin Streamflow

João Gerd Zell de Mattos, Luis Goncalves, Dirceu L Herdies
Group on Data Assimilation Development
CPTEC, INPE, Cachoeira Paulista, São Paulo, Brazil.

ABSTRACT

The La Plata Basin constitutes sub-basins of the Paraná, Paraguay and Uruguay rivers, with an area covering the countries of Brazil, Bolivia, Paraguay, Argentina and Uruguay where it was built the multi-national Itaipu hydroelectric, the largest in operation in the world. Efforts have been made to understand how the climate patterns influence the streamflow from this Basin. There are many factors that may cause the streamflow changes, and evapotranspiration and precipitation play an important role. However, the relationship between the climatological precipitation and evapotranspiration patterns over a watershed and its hydrological response, through the streamflow, may have different degrees of complexity according to their physical features. In general, the behavior of the streamflow is more easily identified than directly observe changes in climate variables. The goal of this study is to evaluate, using Empirical Orthogonal Functions and Singular Value Decomposition techniques, the influence of the distribution of precipitation and evaporation in the streamflow of the major rivers of the La Plata Basin. The NASA's Modern Era Retrospective-analysis for Research and Applications (MERRA) and the South American Land Data Assimilation System (SALDAS) forcind datasets were used. The MERRA data sets were used for the period from January-1979 to December-2006 and SALDAS from January-2000 to December-2004. The streamflow data was obtained from the Brazilian National Water Agency (Agência Nacional da Águas, ANA). The anomalies of precipitation and evaporation that occurred during the austral summer had more emphasis, despite the hydrometeorological regime of the Basin Region not presenting a clear seasonal pattern, although during this period most of the water availability occured. The patterns of anomalies of streamflow, and also the description of the changes in precipitation patterns and evapotranspiration during the period analyzed was evaluated. The spatial patterns vary slowly with respect to time, reflecting the spatial and temporal scales controled by the climatic variables.

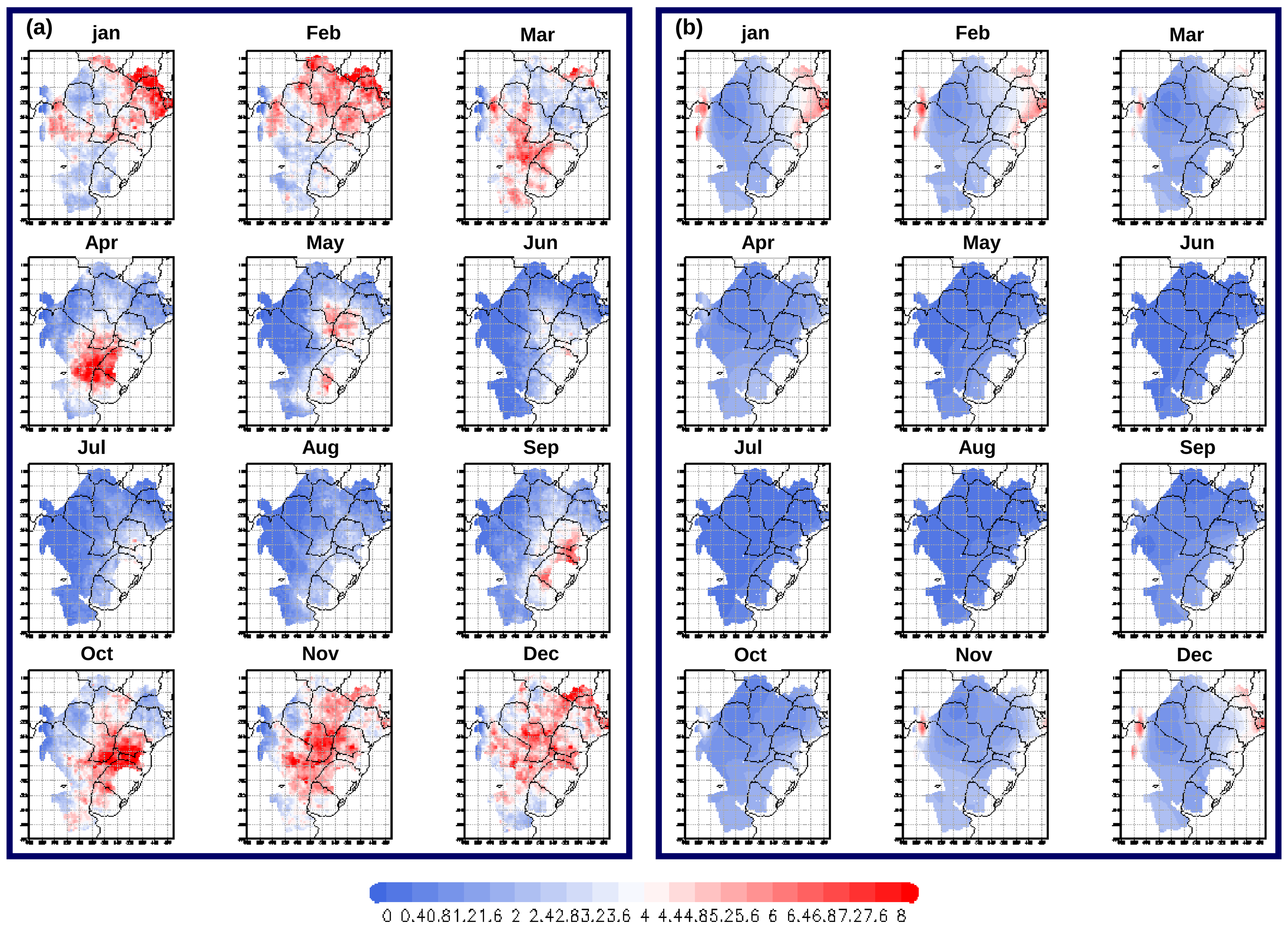

Figure 1: Mean Precipitation (mm/day) over La Plata Basin for two data sets: (a) SALDAS 2000 – 2004 and; (b) MERRA 1979 – 2006. The MERRA and SALDAS data sets have maximum precipitation over the months of October to March, however the MERRA accumulated precipitation in each month is lower.

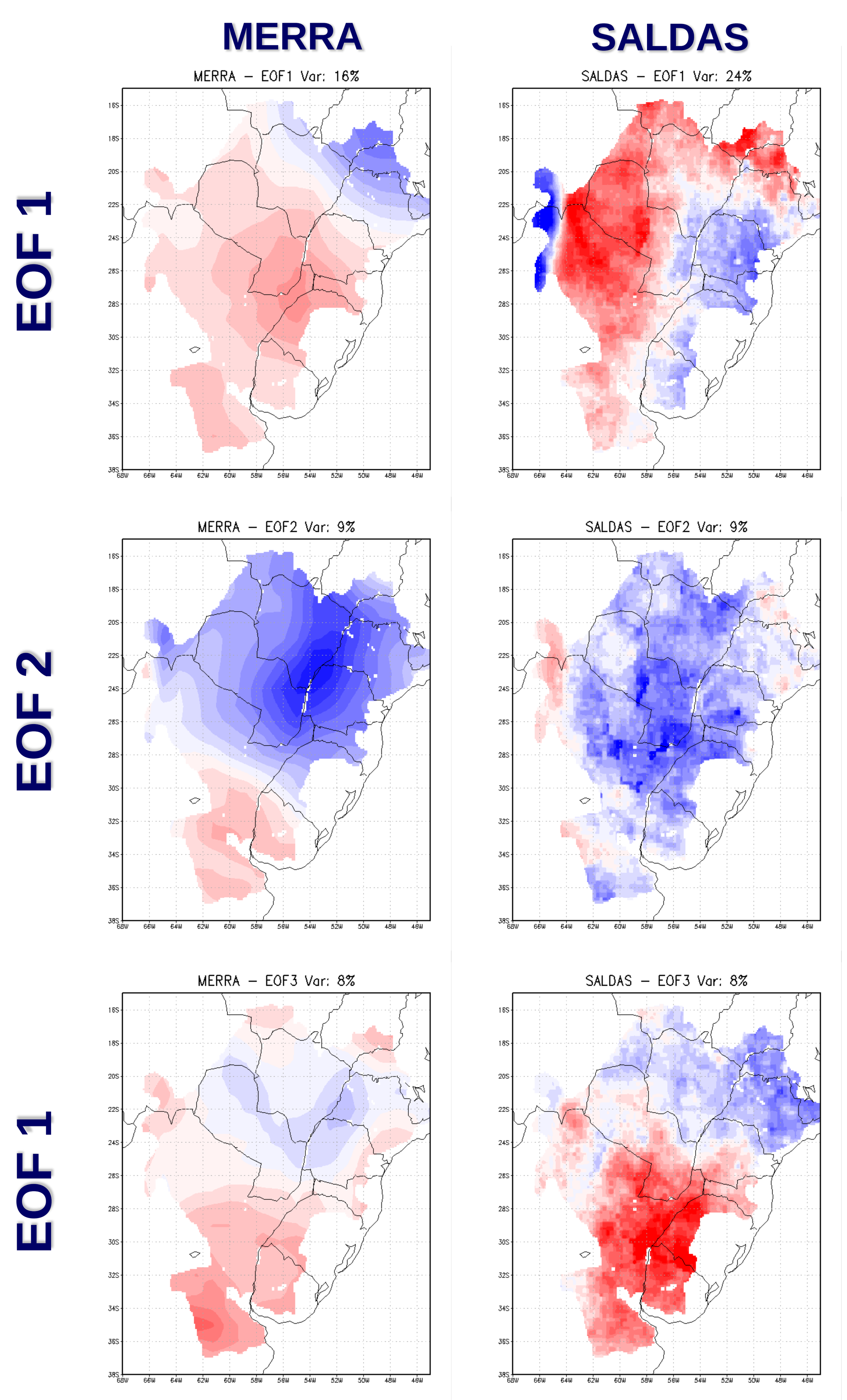

Figure 3: EOF's for the two atmospheric data sets. Spatial pattern in EOF1 is very different between the two data sets. While SALDAS present an east-west dipole, MERRA has a north-south dipole.

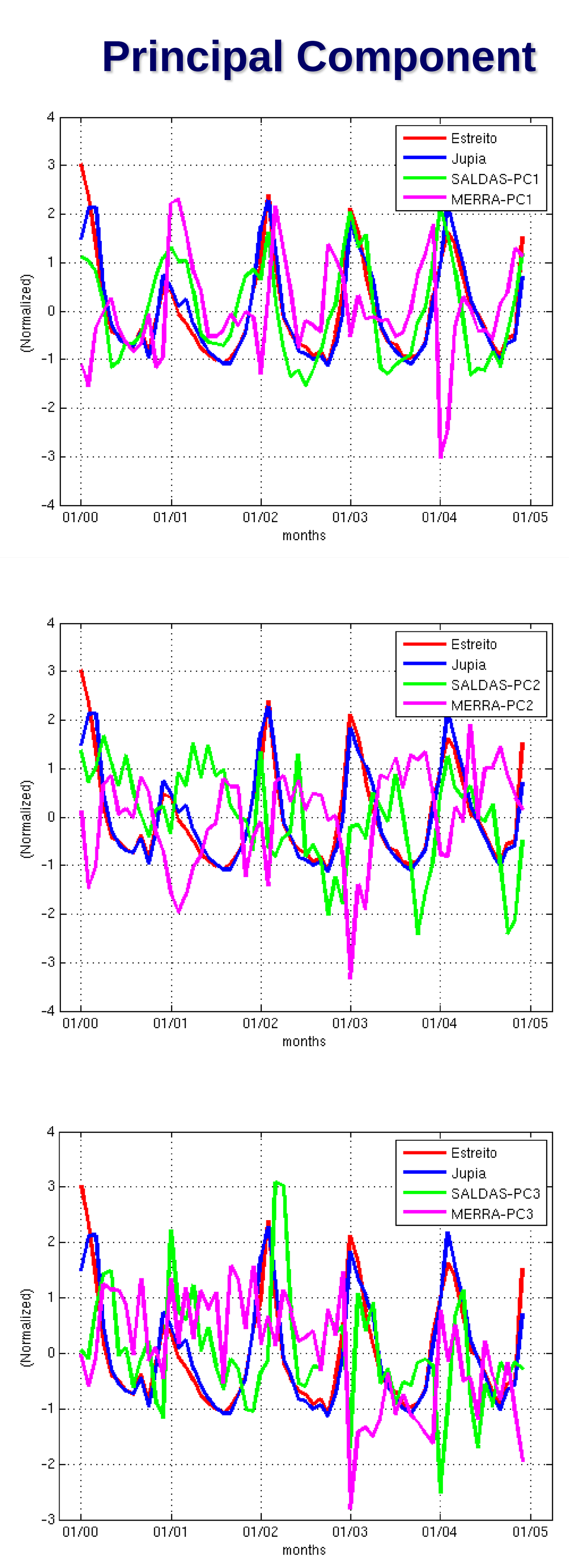

Figure 4: Principal Components versus Stremflow data.

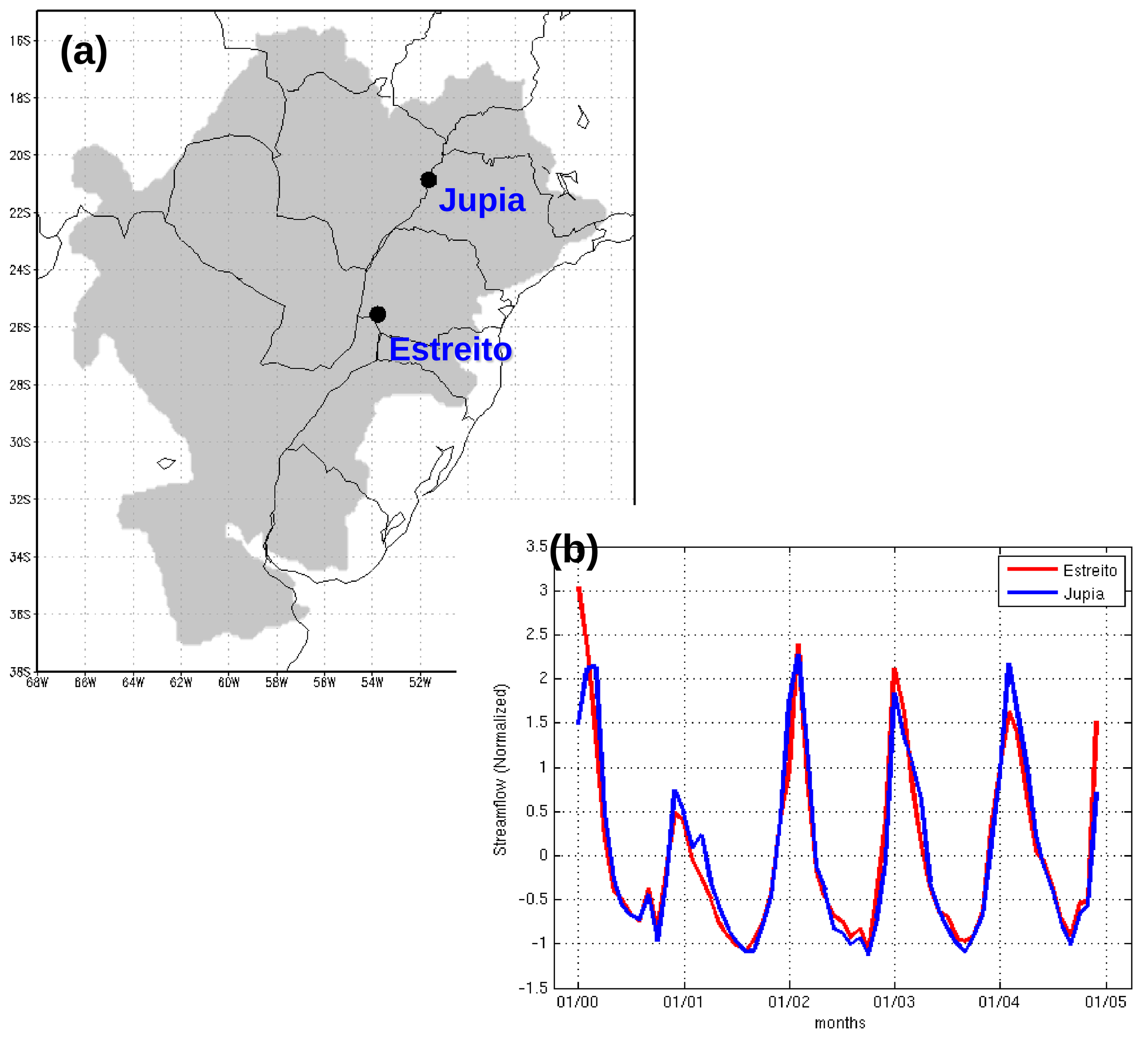

Figure 2: (a) location of the observed streamflow stations; (b) Streamflow data at Jupia station (blue line) and at Estreito station (red line). The streamflow in both stations present a maximum value during the summer and minimum during the winter.

Precipitation X Streaflow

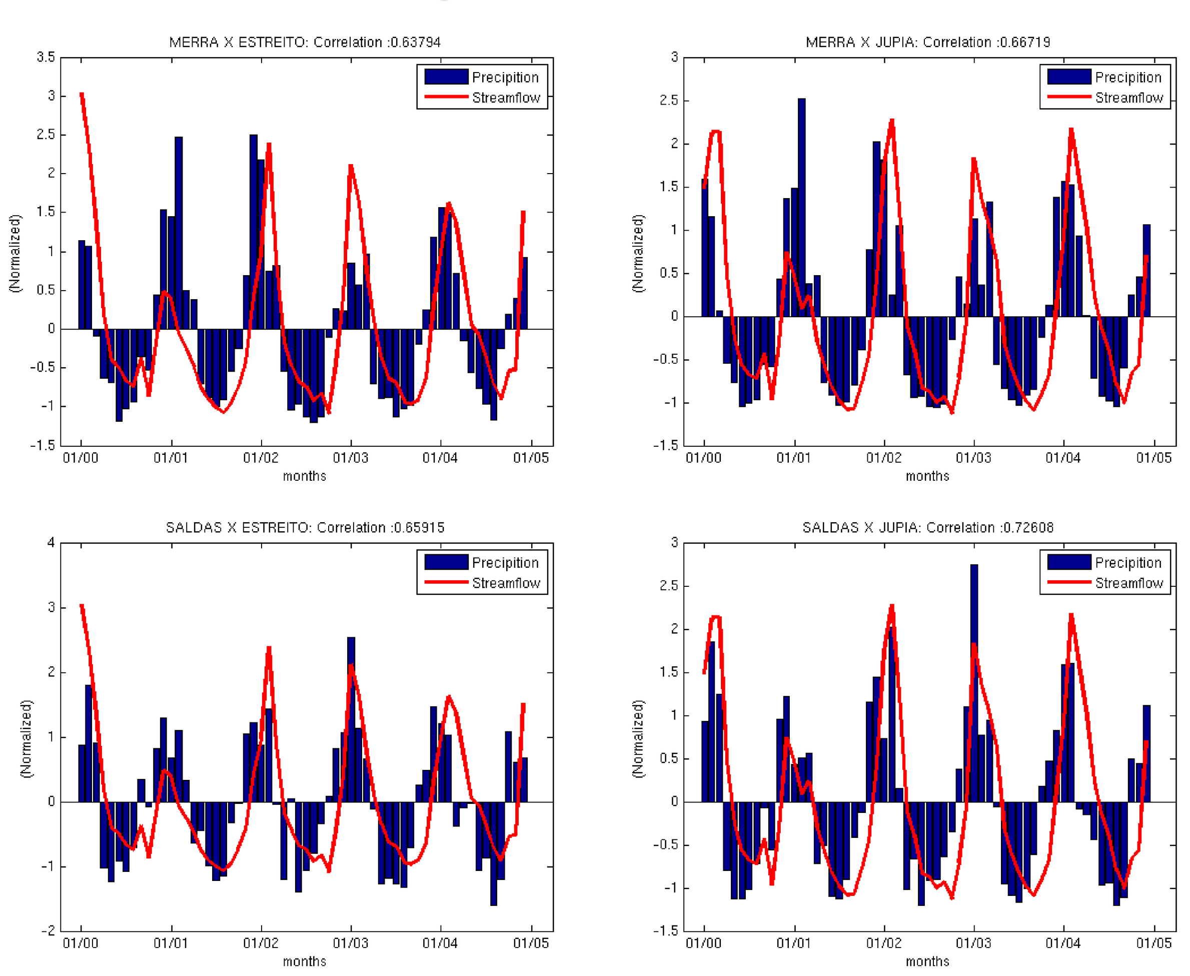

Figure 5: Total monthly precipitation over each sub-basin and corresponding observed streamflow (normalized time series). Total monthly precipitation series shows a good agreement with streamflow data, with a clear sazonal pattern. The maximum values of precipitation occour in January and the miminum is found during the winter, with a lag of approximately 1 month between rainfall and streamflow data sets.

	SALDAS X ESTREITO			
	0	1	2	3
PC1	0.730	0.712	0.437	0.118
PC2	0.186	-0.110	-0.453	-0.500
PC3	0.041	-0.144	-0.198	-0.258

	SALDAS X JUPIA			
	0	1	2	3
PC1	0.721	0.812	0.601	0.254
PC2	0.264	0.006	-0.336	-0.501
PC3	0.114	-0.127	-0.196	-0.290

	MERRA X ESTREITO			
	0	1	2	3
PC1	-0.184	-0.138	-0.001	0.027
PC2	-0.529	-0.396	-0.057	0.171
PC3	-0.205	-0.162	-0.076	-0.037

	MERRA X JUPIA			
	0	1	2	3
PC1	-0.179	-0.208	-0.030	0.018
PC2	-0.564	-0.510	-0.203	0.096
PC3	-0.158	-0.101	-0.090	-0.055

Table 1: Lagged correlation between streamflow data and the principal components. Both stations have a high correlation with the first principal component of SALDAS until lag three whereas the best correlation with MERRA is found in the second principal component.

ACKNOWLEDGMENT:

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