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Hydrological cycles and trends in the NW Argentine Andes since 1940

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Strong spatiotemporal variability characterizes the hydrometeorological pattern in the NW Argentine Andes, draining parts of the most populated and economically important areas of South America. During the summer monsoon season (DJF), the eastern flanks of the central Andes are characterized by deep convection, exposing them to extreme hydrometeorological events. These often result in floods and landslides with disastrous effects on the local populations.

Here, we analyze river discharge to explore long-term hydrological variability in NW Argentine Andes and the linked climate controlling processes. We rely on 13 daily river discharge time series relevant to drainage basins spanning several size orders (10^2-10^4 km^2) starting in 1914 and define different hydro-climate indices both for the mean and the extreme hydrological events. We apply quantile regression to investigate long-term trends and spectral analysis associated with cross-correlation with SST-based climate indices to identify links to large-scale climate variability modes.

River discharge presents a pronounced and coherent variability signal in South America, particularly for wide drainage basins, such as the Amazon and Paraná/La Plata rivers, strongly associated to Pacific and Atlantic Oceans Sea Surface Temperature (SST) anomalies (i.e. ENSO, PDO, AMO). Our analysis evidences that in the NW Argentine Andes, mean discharge values are characterized by statistically significant, mostly positive, long-term trends since 1940, whereas the extreme events present a more non-unidirectional trend pattern. Also, coherent multi-annual to multi-decadal cycles characterizing the discharge pattern have been identified, suggesting that processes linked to SST anomaly-modes strongly control the hydrometeorology variability in the NW Argentina Andes.