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Gradual transition from temperature to precipitation controlled regime in Rhone River discharges

Carla Taricco¹, Sara Rubineti², Enrico Arnone¹, Davide Zanchettin², Angelo Rubino², and Ilaria Bizzarri¹

¹Università di Torino, Dipartimento di Fisica, Torino, Italy (carla.taricco@unito.it)

²Università Cà Foscari, Dipartimento di Scienze Ambientali, Informatica e Statistica, Venezia, Italy

River discharge series provide large-scale hydrological information over a broad range of timescales. Despite discharge records consist of punctual measurements, they integrate variations in snowmelting, precipitation and runoff processes over the catchment till the discharge measurement site.

Discharges of the Rhone River, one of the largest rivers in Europe, have been monitored accurately during the last century at different sites. Long discharge records from seven stations along the course reveal the spatial and temporal behaviour of discharges from the source of the river to its mouth. An accurate spectral analysis of the records, performed using advanced spectral analysis methods, allow us to extract significant periodic variations in the records at different temporal scales. Then, we analyse the sensitivity of such periodic variations to evolving hydroclimate conditions, in particular focusing on the relationship between discharge and temperature and precipitation.

The strong annual oscillation recorded at stations close to the source is almost entirely due to snow melting on alpine glaciers, closely resembling the temperature annual cycle. This remarkable agreement allows to consider the upstream discharges as a thermometer on the glacier region during the melting season. On the contrary, the decrease of the annual cycle going towards the mouth of the river and the contemporary growth of interannual components demonstrates the transition from a temperature to a precipitation controlled discharge regime.

We will finally discuss the impact of large-scale variability patterns on the detected discharge variations and associated implications for their near-term predictability.