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Use wavelet transform to analyze the hydrological response of an alpine glaciated catchment

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Glaciers in the European Alps have retreated substantially over the past 50 yr. Strongest melting periods occur during summer heat waves, and recent studies have shown a clear tendency of increase in magnitude and frequency. Due to the periodicity of the snow and ice-melt signal in stream discharge, wavelet analysis has been shown a powerful technique to analyze characteristic timescales and the correlations between discharge and climatic factors.

In this contribution we analyze, trough discrete and continuous wavelets transform, the time series of discharge, temperature and precipitation of the upper Saldur basin. This basin (60 km^2) lies in the Eastern Italian Alps (elevation range between 1700 and 3700 m a.s.l.) and presents a glacier whose extension is about 5 km^2. Since 2009, in the framework of the projects “Klimwandel”, “Emerge” and “HydroAlp”, 3 stream gauges and 17 monitoring stations were installed, to measure standard micrometeorological variables, snow depth and soil moisture.

Wavelet transform allows for separating three characteristic time scales in the discharge signal, related respectively to diurnal, synoptic scale (7 – 15 days), and seasonal temperature fluctuations. Results suggest that most of the signal energy is related to anomalous high summer pressure periods, responsible for most of the ice melt during the season. Moreover, the analysis provided useful information for parameterizing a distributed hydrological model for the catchment and implementing a simple, but effective, conceptual ice melt model, to be used in climatic scenarios analyses.