

5 years of continuous seismic monitoring of snowmelt cycles in a Pyrenean valley

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In recent years the analysis of background seismic noise variations in the proximity of river channels has revealed as a useful tool to monitor river flow, even for modest discharges. We will focus here in the application of this methodology to study the snowmelt cycle in an Pyrenean valley during the last 5 years, using data from the seismic geophysical station located inside the Canfranc Underground Laboratory (Central Pyrenees). Diaz et al. (2014) first identified in the seismic data the signature of river flow increases associated to snowmelt episodes in the catchment area of the Aragon River, based on the marked correlation between the seismic energy variations in the 2-8 Hz frequency band and the estimated variations in water resources from snowfall.

The analysis of seismic data during the snowmelt periods allows to identify a clear 24h cycle, with energy increasing from about 14:00 GMT, remaining at a relatively high level for 12 hours and then smoothly vanishing. The spectrogram reveals richer information, as clear variations in the frequency content can be detected during the time intervals in which the amplitude of the seismic signal remains constant.

The data available so far allow to compare the evolution of snowmelt in five seasons with very different hydrological behavior. The 2011 and 2012 seasons have been dry, with snow volumes 30-50 % beneath the average values, while the 2013, 2014 and in particular the 2015 seasons have been largely above the mean. Those variations are reflected in the seismic data, which allow to monitor the time occurrence of the main snowmelt stages for each season and to estimate the intensity of the different snowmelt episodes. Therefore, seismic data can be useful for long term monitoring of snowmelt in Alpine-style mountains.