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Reorganization of the flood-prone atmospheric patterns at the onset of the 20th century?

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Frequency and intensity of heavy rainfalls, triggering floods and causing human and large economic losses, are expected to increase in the context of the global warming, due to the larger water carrying capacity of warmer air masses. However, the relationship between such events and climatic changes remains still poorly understood. In particular, the stability of the flood-prone atmospheric circulations under future climate changes is a key question for projections of extreme precipitation. This study aims at exploring this issue using flood reconstructions from the NW Mediterranean domain. We compiled existing historical records from the Southern Massif Central and lake-sediment records from the Eastern Pyrenees and the Southern French Alps. We completed this West-East transect by studying new lake sequences in the SE French Alps and the Western Italian Alps.

For both of the new lake sediment sequences (Lake Foréant, Queyras massif, France and Lago Inferiore di Laurès, Aosta valley, Italy), several short cores were retrieved to understand the sedimentary processes. In the laboratory, high-resolution pictures, bulk density, geochemistry and grain size were measured. Dating was undertaken by short-lived radionuclides (EAWAG, Zürich) and radiocarbon (University of Bern) measurements. Lago Inferiore sequence covers the last 250 years and Lake Foréant sequence the last millennium. 232 turbidites were identified; 11 of which seem to be related to mass movements, whereas the other 221 were triggered by flood events. The reconstructed flood regimes were then compared to local flood activity based on historical data. The good agreement between the datasets supports the quality and sensitivity of flood reconstructions.

In the NW Mediterranean domain, floods and related heavy rainfalls are mostly triggered by autumn humid air masses coming from the Mediterranean Sea. In detail, distinct atmospheric pathways transport these air masses and trigger floods in the different studied regions. Comparing all the flood reconstructions over the last 250 years aims at tracking these atmospheric pathways and their possible changes over time. Strong similarities in flood frequency are observed from 1750 to 1900 for the western part (Cévennes, Southern French Alps), while no convincing correlation appears between the other records. Around 1900, a drastic change appears with strong similarities between records of the eastern part (Southern Alps, SE French Alps and NW Italian Alps). In particular, the flood frequency largely increased in the Cévennes during the first part of the 20th century, while this period is one of the most ‘quiet’ in all other records. Hence, these results suggest a reorganization of the flood-prone atmospheric patterns at the onset of the 20th century.