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Global forcing of Holocene paleohydrological variability over NW Alps: long-term trend and secular variability

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Among the global expressions of climatic changes over the Holocene period, changes in hydrological patterns have been particularly important. Indeed, reconstructed changes of past lake levels, flood/droughts frequency or glacier position revealed high magnitude variability at various timescales. In this paper we present a synthesis of such reconstructions in NW French Alps from various natural archives (lake and river sediment sequences, glacier position evidences), all of them being located in a restricted geographic area.
All of the studied sequences yield a common history at a secular to millennial timescale. In particular the Late Holocene was marked in the studied region by wet periods around 5.6, 4.2, 3.2, 2.7-2.4; 1.5-1.3; 6.5-0.5 ka cal. BP interrupted by relatively dryer periods.
At a millennial to pluri-millennial timescale, we show that the Early Holocene was a period of reduced hydrological activity. The first important wet period occurred around 5.6 ka cal. BP, and a threshold seems to have been reached around 2.7 ka cal. BP. Since then, the alpine glaciers occupied a Little Ice Age-like position more than 50 % of time, whereas the inverse situation prevailed in the Early to Mid-Holocene times. This climatic change also resulted in a dramatic rise of flood frequency and a reorganisation of river Rhône geomorphology.
In terms of climate forcing our results tend to demonstrate a complex interplay, at different time-scales, between long-term orbital-forced changes in insolation and the - still not yet well-understood – effect of solar activity. Indeed, the long-term trend toward more frequent and intense wet periods along the Holocene seems to be forced by the northward shift of westerlies winds in response to precession forcing, whereas the secular to pluri-secular periods of enhanced hydrological activity are synchronous to solar minima. Regarding those conclusions, the present-day warm and dry climate situation over NW Alps seems anomalous compared to the natural climate evolution and is thus likely caused by human-triggered greenhouse gases emissions.