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20th century global warming favoured enhanced intensity of extreme torrential events - a proglacial sediment record in NW French Alps

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During the past few yeas, considerable climate changes have been observed at high elevation areas of the European Alps. Additionally, one of the main results of high resolution climate modelling is a trend towards both dryer summer conditions and enhanced risk of extreme floods. This should have particularly dramatic consequences in alpine areas. Indeed, the development of tourism during the 20th century in the Alps and the rise of population density resulted in an increasing potential risk from natural hazards. Among them, torrential floods are some of the most common and widespread ones. They cause both loss of human life and high damage to property and infrastructure and are particularly destructive in mountain areas. For example, in August 2005, an unusual meteorological situation resulted in a series of catastrophic floods in most regions of the European Alps and particularly in the catchment of the Vorz river, downstream of proglacial Lac Blanc (2170 m a.s.l., Belledonne range, NW French Alps).

We studied a series of sediment cores from Lac Blanc, spanning the last ca. 250 years. Through a coupled high resolution sedimentological and geochemical approach we documented about 100 flood deposits and measured their thickness. The age of each deposit has been assessed by radiochemical dating and the recognition of historically-known events – major earthquakes and historical atmospheric lead deposition. Furthermore, a detailed study of regional and local historical archives was conducted allowing us to relate the recognised flood deposits to the ones reported by local population. We hence obtained a flood calendar from 1740 to 2005 with the respective intensity of each event assessed by the thickness of the associated deposit.

The flood frequency shows an important and punctual increase at the early end of the Little Ice Age (1830 – 1860) as a response to the beginning warming period, which was emphasized by the synchronous local glacier retreat. On the other hand there is no major flood event during the following period (1860 – 1900) characterized by the retreat of the large alpine glaciers. This implies glacial activity modifies the climate-sediment transfer relationship in alpine areas. Our main result is the dramatic rise of flood deposits thickness over the last decades. Among the 100 flood-triggered layers deposited over the last 250 years, the two thickest ones occurred in 1987 and 2005 whereas the flood frequency is among the lowest. The 2005 deposit is two times thicker than any previously reported one. An enhanced intensity of recent extreme torrential events in the present-day context of global climate change seems likely.