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FloodAlp! – The Holocene flood history of the Central Alps reconstructed from multiple lacustrine sediment records

S.B. Wirth (1), L. Glur (2), A. Gilli (1), and F.S. Anselmetti (2)

(1) Geological Institute, ETH Zürich, Zürich, Switzerland (stefanie.wirth@erdw.ethz.ch), (2) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

Floods as a result of extreme precipitation events represent a major natural hazard in the alpine realm, causing enormous financial and social damage. Current climate models predict even an increase in heavy precipitation events in the future as a consequence of global warming. In order to assess this future flood hazard and to provide more data input for climate models, knowledge about the natural variability and the climatic forcing of heavy precipitation events is required.

The FloodAlp project aims to reconstruct the Holocene flood history of the Central Alps by combining flood-recurrence rates reconstructed from 18 lacustrine records. The investigated lakes (surface areas 0.01 to 5.2 km2) are distributed along an alpine transect from northeastern Switzerland to northern Italy covering a wide range in altitude (197 to 2065 m asl).

To verify our approach, the established flood pattern is compared to independent flood reconstructions based on historical and instrumental data covering the past 500 years. The two independent data sets are in good agreement, thus supporting the assumption that lacustrine sediments reliably record flood events, even during periods with intense human impact.

Our results reveal strong and rapid fluctuations in flood frequency during the Holocene period. In general, flood activity was lower during the early Holocene (10-4.5 kyr BP) than during the middle and late Holocene (<4.5 kyr BP). Hence, the Holocene Climatic Optimum that is considered as the warmest period of the Holocene is characterized by rather low flood activity. In addition, rapid fluctuations indicate that periods such as the Little Ice Age and the low in solar activity at $\sim$2.6 kyr BP are distinguished by high flood frequencies while the Medieval Warm Period shows little flooding. These results suggest that flood activity in the past was rather enhanced during cool periods than during warm ones. This contrasts to the current view expecting a rise in flood frequency and intensity due to global warming. Furthermore, anti-correlations between the flood patterns from the Northern and Southern Alps are only observed for restricted time periods. This indicates that variations in the NAO phase cannot solely govern the alpine flood distribution. In conclusion, we argue that solar activity and insolation play a dominant role but that complex internal forcing mechanisms such as changes in the alpine circulation patterns, as well as variations in the phase of the NAO, also contribute to the Holocene flood pattern of the Alps.