Geophysical Research Abstracts
Vol. 20, EGU2018-2061-1, 2018
EGU General Assembly 2018

Integration of multi-archive datasets and paleoclimate modelling of past flood extremes in the Swiss Alps

Lothar Schulte (1), Juan Carlos Peña (2), Oliver Wetter (3), Bruno Wilhelm (4), Benjamin Amann (5), Stefanie B. Wirth (6), Lukas Glur (7), and Filipe Carvalho (1)

(1) Fluvalps-PaleoRisk Research Group, Department of Geography, University of Barcelona, Spain, (2) Meteorological Service of Catalonia, Barcelona, Spain, (3) Section of Economic-, Social- and Environmental History & Oeschger Centre for Climate Change Research, University of Bern, Switzerland, (4) University Grenoble Alpes, CNRS, IRD, Institute of Geosciences and Environment, F-38000 Grenoble, France, (5) Department of Geography and Planning, Queen's University, Kingston, Canada, (6) Centre for Hydrogeology and Geothermics (CHYN) University of Neuchâtel, Switzerland, (7) Helvetia - Swiss Insurance Company, Switzerland

Paleoflood research is a rapidly developing approach through which insight from multiple disciplines (hydrologists, geomorphologists, climatologists, historians, paleolimnologists) has implications for contemporary global livelihoods because the ultimate goal is to better understand and quantify flood risk. During the last decade, the knowledge of flood frequency and magnitude has been improved through paleodata. However, despite advances in applicable dating methods, new proxies and increasingly sophisticated statistical analyses and efforts to identify atmospheric drivers, a number of fundamental questions remain unsatisfactorily resolved. The integration of "field data" and interpretation of flood series is a complex exercise because catchments, landscapes and flood drivers are globally heterogeneous.

The goal of the case study of catchments in the alpine Aare basin is to (i) develop an innovative approach integrating flood data from flood plain and lake sediments, historical sources and bioindicators, (ii) model paleoclimate for flood-rich periods, and (iii) understand the time-space flood variability and forcing in a densely populated mountain area.

During the first phase of the PAGES Floods Working Group Pilot project, the following targets were completed. (i) Paleoflood series from different archives of the Hasli Aare, Lütschine and Kander catchments and lakes Grimsel, Oeschinen, Iffig and Thun were collected and new flood series were achieved and processed. (ii) Thresholds and filtering/smoothing of flood data were explored to homogenize flood proxies. (iii) Natural archives, historical flood damages (since 1499) and peak discharges (since 1908) were compared to a) detect sensitivity of archives due to different erosion thresholds between catchments to rainfall/flood events, b) validate or reject pairs of events considering factors such as dating uncertainties, connectivity of sedimentary-hydrological subsystems, catchment topography and physiographic characteristics, influence of different physical processes, false events and exposure/vulnerability of local communities.

Based on the methodological progress and outcome of phase 1, the ongoing second project phase focuses on the following targets. i) Definition of periods of synchronous flood activity (1320-1350, 1430-1490, 1680-1720, 1800-1860, around 1920 AD) and asynchronous flood response among sites (16th to 17th c.). ii) Exploration of factors such as precipitation type, duration and intensities (reconstructed from historical sources and instrumental data) and spatial distribution (including the records of all archives). iii) PCA is performed for integration of paleoflood proxies and identification of data series, which reveal different patterns.

To explore the flood variability, atmospheric circulation modes and external forcing, paleoclimate modelling of the sea level pressure anomalies were performed over the last 700 years. Summer North Atlantic Oscillation (SNAO) in negative phase prevailed during the cold flood-rich periods (1430-1490, 1550-1620, around 1650 and 1800-1860) and SNAO in positive phase during warm flood-rich periods (1320-1350, around 1560 and 1977 to present).

A further outcome of the research is the generation of thematic maps, which integrate the topography of the catchments, the location of the flood archives, and the magnitude of the flood event according to the type of archives. These maps show the historical spatial and altitudinal locations of flooding and improve the understanding of alpine floods and the regional flood risk assessment.