Extreme River Floods in Western Switzerland and the Lake of Constance Region in the Period Prior to Instrumental Measurements

PhD Project, part of the SNF-Project **"*Reconstruction of the Genesis, Process, and Impact of Major Pre-Instrumental Flood Events of Major Swiss Rivers Including a Peak Discharge Quantification*"**

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Goals and Research Problems

The general goal of this project is to generate knowledge about past extreme and normal river floods of major Swiss rivers north to the Alps through information provided by historical records and other man-made sources. With this information quantitative data can be reconstructed for major extreme flood events as well as smaller events between the 15th century and the onset of regular river gauge measurements in the mid to late 19th century. Detailed research objectives include:

Primary Research Objectives

P1: Setup of a long-term series of dates, intensity, reconstructed peak water levels (PWL) and peak discharges (PD) of major pre-instrumental extreme events

P2: Reconstruction of a long term series for frequency and seasonality of smaller, so called ‚normal' flood events at the research locations of Basel and Solothurn using institutional records (see below) with high temporal resolution

Secondary Research Problems (based on the analysis of the results from P1)

S1: Analysis and evaluation of the human influence on PWL and PD, with a focus on the main Swiss river corrections (Kander, Jura I + II) and local flood protection measures at the different research locations

S2: Assessment of the influence of natural phenomena such as sea Ice on the Lake of Constance (‚Seegfrörnis') on the outcome of extreme floods over time

S3: Analysis of spatio-temporal patterns of extreme events with regard to meteorological and climatological origins of the respective events

S4: Analysis of the impact on and the reception of extreme river floods by the river-based communities

S5: Comparison of organisation patterns and institutional structures of flood protection systems at the different research locations

Research Design

The methodology has been developed by Wetter et. al (2011) and successfully applied to the location of Basel. In addition, Pfister & Wetter (2011) has demonstrated the transferability of the method to other locations (Bern and Solothurn) and rivers (Aare). Accordingly, the project adopts a ***multi-step analysis*** repeated at all research locations to achieve the primary objective ***P1***:

1: Source Evaluation, Data Gathering, Qualitative Calibration

- Historical-critical method for source evaluation
- Gathering information from sources
- Calibration of information provided by the different ‚information systems' (reports, flood marks etc.)

2: Defining Flood Reference Points (FRP), Reconstructing PWL

- Defining FRPs contained in reports (e.g. features of bridges or buildings)
- Reconstruction of PWL from altitude of FRPs

3: Stability Check of FRPs Over Time

- Check of stability (of altitude) of the FRPs using historical maps, town depictions and archeological evidence
- Corrections to the PWL if necessary

4: Reconstruction of Changes to Local/ All-river Run-off conditions Over Time

- Compilation of changes to the river bed by corrections and other measures
- Detection of changes to run-off conditions
- Needed for homogenization of results to modern data series

5: Calculation of PD of Extreme Floods

- Inclusion of historical river profiles and their attribution to their respective period of flow regime
- Calculation of PD by applying the 1D hydraulic model FLUX/FLORIS2000 (based on the de-Saint Venant equations)

Research Problems *S1 – S3*

Research Locations

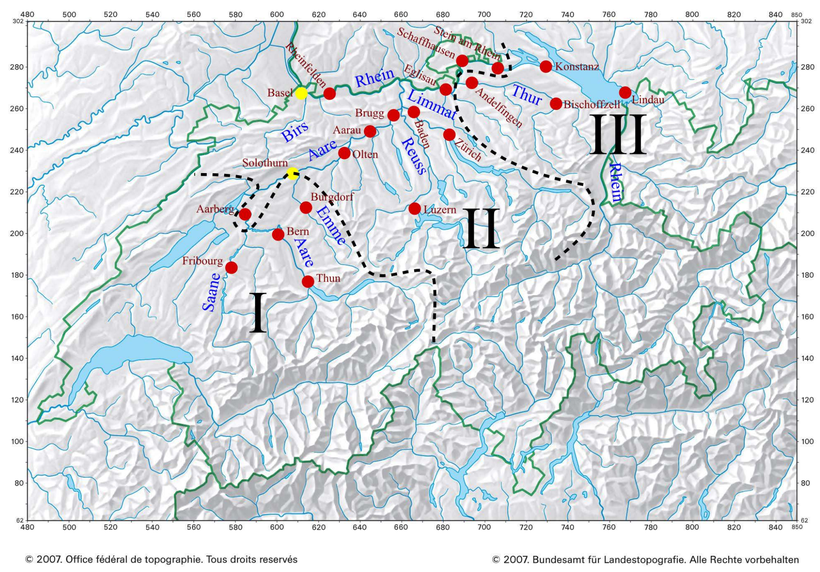

Fig. 1: Research locations of the PhD project (areas I + III) within the SNF-project. Locations have been chosen according to amount of historical sources available.

Historical Records and Sources Used

Tradition

- Chronicles
- Annals
- Newspaper Reports
- Historiography

Remains

- Sketches, Drawings and Photographs
- Historical maps and town depictions
- Flood marks
- Institutional records such as account books (in particular the ‚Wochen-Ausgabenbücher' in Basel and the ‚Seckelmeister-rechnungen' in Solothurn)
- Historical river profiles
- River gauge measurements

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