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HISTORICAL FLOODS IN SWITZERLAND Prerequisites, new trends in research



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- Switzerland as the "water castle of Europe"
 - Catchment areas
 - Seasonal precipitation
- New trends in flood and drought research
 - Starting point: the state of the art 10 years ago
 - Worst-case scenarios: the extreme drought of 1540
 - Discovering the regional scale
 - New historical sources for the reconstruction of pre-modern and modern floods
 - New interdisciplinary studies related to anniversaries
 - 1868
 - 1947
 - New approaches from unusual perspectives
 - Historical floods and droughts related to nuclear power plants

Switzerland as the "water castle of Europe"

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- Numerous river systems in Central Europe with headwaters in Switzerland
 - Rhine (1232 km, of which 375 km in Switzerland)
 - Rhone (812 km, of which 264 km in Switzerland)
 - Inn (517/520 km, of which 104 km in Switzerland)
 - Ticino (248 km, of which 91 km in Switzerland)
- Rain and snowmelt
 - Heaviest rainfall in the summer months
 - Snowmelt mainly from April to July
- Extreme weather conditions
 - Humid, and rather mild winters (risk of avalanches)
 - (Late) spring rain and meltwater (floods)
 - Summer low-pressure systems from the northern Mediterranean
 - Thunderstorm activity on the edge of the Alps (Moleson, Pilatus, Säntis, etc.)

Switzerland as the "water castle of Europe" Physical-topographical map of Switzerland

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Switzerland as the "water castle of Europe" Catchment area of the major Swiss rivers



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Switzerland as the "water castle of Europe" Catchment area of the Rhine River and its tributaries



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Source: University of Bern, Institute of Geography, Hydrology Unit / swisstopo

Switzerland as the "water castle of Europe" Average precipitation, 1951-1980



Source: Hydrologischer Atlas der Schweiz

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Switzerland as the "water castle of Europe" Precipitation in the Alps by season, 1971-1990 Spring (March to May)

Mittlere Niederschlagshöhen im Frühling (März-Mai) Hauteurs moyennes des précipitations en printemps (mars-mai)



Flächentreue Azimutalprojektion, Kartengrundlage: PK 1000, © Bundesamt für Landestopographie Projection azimutale équivalente, base de la carte: PK 1000, © Office fédéral de topographie

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Source: Hydrologischer Atlas der Schweiz

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Switzerland as the "water castle of Europe" Precipitation in the Alps by season, 1971-1990 Summer (June to August)

Mittlere Niederschlagshöhen im Sommer (Juni-August) Hauteurs moyennes des précipitations en été (juin-août)



Source: Hydrologischer Atlas der Schweiz

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Switzerland as the "water castle of Europe" Precipitation in the Alps by season, 1971-1990 Autumn (September to November)



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Mittlere Niederschlagshöhen im Herbst (September-November) Hauteurs moyennes des précipitations en automne (septembre-novembre)



Source: Hydrologischer Atlas der Schweiz

HYDROLOGISCHER ATLAS DER SCHWEIZ

Switzerland as the "water castle of Europe" Precipitation in the Alps by season, 1971-1990 Winter (December to February)

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Mittlere Niederschlagshöhen im Winter (Dezember-Februar) Hauteurs moyennes des précipitations en hiver (décembre-février)



Quelle: Hydrologischer Atlas der Schweiz

Flood frequency and flood risk in Switzerland

- First major river rectifications and deviations from the 18th century onwards
 - Kander breakthrough (1711-1714)
 - Linth canal (1800s)
 - Jura lakes melioration project (1868-1891)
- Intensity of floods decreases noticeably due to corrections
- Floods of 1868 as "worst-case scenario"
 - Trigger for a change to federal flood management legislation
 - Predominating technical flood protection
- "Disaster gap" (Christian Pfister) between 1910 and 1987
 - Hypothesis only applicable on a large-scale level
- New series of floods since 1987
 - Implementation of an integral flood protection since the 1980s
 - Large number of studies on flooding after the events of 2005 and 2007

New research trends State of the art 10 years ago



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- Large number of studies on flooding after the events of 2005 and 2007
- Approaches
 - Reist et al. 2002; Weingartner, Reist 2004
 Hydrological reconstruction of regional events, e.g. the flash flood of the Emme river in 1837 according to Jeremias Gotthelf's report
 - Schmocker-Fackel, Naef 2010
 Flood frequencies for Switzerland during the last 500 years
 - Wetter et al. 2011
 Flood frequency of the Rhine river in Basel since 1268
 - Summermatter 2012/2017
 Political activities for the prevention of floods in Switzerland (1868-1987)

Frequency of floods in the city of Basel

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New research trends Worst-case scenarios: the extreme drought of 1540

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- Wetter et al. 2014: "The Year-Long Unprecedented European Heat and Drought of 1540 – a Worst Case"
 - Large international study on the millennium summer of 1540
 - More than 300 contemporary sources from human archives used
- Reception
 - Büntgen et al. 2015
 Critique by the dendrochronology community: no remarkable signal in tree-ring data
 - Response by Pfister et al. 2015: "Tree-Rings and People Different Views on the 1540 Megadrought. Reply to Büntgen et al. 2015" Resolution of anthropogenic sources higher than any natural archive
 - Reference study for the understanding of the hot and dry summers from 2003 onwards

New research trends Discovering the regional scale

- Challenge of Christian Pfister's concept of a "disaster gap"
 - Not applicable on a regional and local level (?)
- Salvisberg 2017
 - Flood protection along the Gürbe river (canton of Bern)
 - "The most expensive torrent of Switzerland"
 - High-resolution reconstruction of regional flood regimes
 - Definitely no "disaster gap" there
- Heinzmann 2019
 - Flood protection and management along the lower Emme river

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Melanie Salvisberg



Der Hochwasserschutz an der Gürbe

Eine Herausforderung für Generationen (1855–2010)



Schwabe

New research trends New historical sources for the reconstruction of premodern and modern floods

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- Various studies at the Institute of History, University of Bern
 - Partly related to the SNSF project "Reconstruction of the genesis, process and impact of major pre-instrumental flood events of major Swiss rivers including a peak discharge quantification"
- Sources
 - Urban account books with weekly expenditures on
 - Repairs for bridges
 - Maintenance of protective buildings
 - Pictorial evidence for flood reconstruction
- Publications
 - Rohr 2014: Serial iconography to evaluate early disaster photography
 - Berner Studien zur Geschichte open access series
 - Longoni 2019: Fribourg, 14th to 16th centuries
 - Spycher 2022: Basel, 1600-1650
 - Ineichen 2024 (forthcoming): Soluthurn, 15th century

New research trends

New interdisciplinary studies related to anniversaries

- 150th anniversary of this "centennial flood" in 2018
- Contributing disciplines
 - Climatology
 - Hydrology
 - Forestry studies
 - Geology
 - Environmental and climate history
 - Political science
- Publication for a wider audience (Geographica Bernensia series)
 - Print and open access
 - German, English, French, and Italian version





1868 – the flood that changed Switzerland: Causes, consequences and lessons for the future

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New research trends New interdisciplinary studies related to anniversaries

- 75th anniversary of the extremely dry summer of 1947
 - Recent hot summers as additional trigger
- Various contributing disciplines
- Publication for a wider audience (Geographica Bernensia series)
 - Print and open access
 - German, English, and French version





Hot and dry summers in Switzerland

Causes and impacts of the record summers

1947, 2003, and 2018

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Thank you for your attention!

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