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Extreme floods and storms in Switzerland since 1868: Case studies and hydro-meteorological patterns

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Numerical studies on the generation of extreme floods or windstorms in the Central Alps have been practicable for events which occurred since around 1950. Analyses of earlier events are restricted to increasingly sparse instrumental and documentary data, e.g., ground observations, surface synoptic charts, annals and damage reports. Despite such restrictions, it is desirable to have an extended catalog of extreme heavy precipitation or storm events in order to understand the underlying hydro-meteorological dynamics and to anticipate potential damage to forested areas, cultivated land, buildings or infrastructure.

We use a range of available sources to elect a set of historical extreme events. Among these are damage statistics by insurance companies, the EuroClimHist data base on weather and climate history, forestry reports as well as meteorological annals. Moreover, recently digitized and partly homogenized (sub-) daily measurements of precipitation and wind observations (DigiHom project by MeteoSwiss) and the Twentieth Century Reanalysis (20CR) reach back to 1868 or beyond. In addition, we integrate information from a regional version of 20CR which is downscaled by use of the Weather Research and Forecasting (WRF) Model. These datasets cover extreme events on the north and south side of the Alps and hence enable comprehensive, quantitative analyses of Swiss extreme events.

For a selection of events prior to 1950, descriptions are given of the spatial extent and intensities, antecedent hydro-climatological settings such as snowmelt as well as of the direct socio-economic impact and costs. Likewise, we assess the meteorological conditions leading to and during the extreme events, including parameters like uplift and moisture transport or propagation of the three-dimensional wind field.

We propose five subjective classes of specific flood-generating weather conditions for Switzerland from 24 investigated cases since 1868. Furthermore, we address the applicability of 20CR for analyses of the meteorological patterns leading to heavy precipitation or windstorms over Central Europe. The proposed set of weather patterns and hydro-climatologic precursors may give direction when anticipating the possibility of severe weather events as well as their damage potential in the Alpine region.