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Modelling economic losses of historic and present-day high-impact winter storms in Switzerland

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Windstorms can cause significant financial damage and they rank among the most hazardous meteorological hazards in Switzerland. Risk associated with windstorms involves the combination of hazardous weather conditions, such as high wind gust speeds, and socio-economic factors, such as the distribution of assets as well as their susceptibilities to damage. A sophisticated risk assessment is important in a wide range of areas and has benefits for e.g. the insurance industry. However, a sophisticated risk assessment needs a large sample of storm events for which high-resolution, quantitative meteorological and/or loss data are available. Latter is typically an aggravating factor.

For present-day windstorms in Switzerland, the data basis is generally sufficient to describe the meteorological development and wind forces as well as the associated impacts. In contrast, historic windstorms are usually described by graphical depictions of the event and/or by weather and loss reports. The information on historic weather events is overall sparse and the available historic weather and loss reports mostly do not provide quantitative information. It has primarily been the field of activity of environmental historians to study historic weather extremes and their impacts.

Furthermore, the scarce availability of atmospheric datasets reaching back sufficiently in time has so far limited the analysis of historic weather events. The Twentieth Century Reanalysis (20CR) ensemble dataset, a global atmospheric reanalysis currently spanning 1871 to 2012, offers potentially a very valuable resource for the analysis of historic weather events. However, the $2^\circ \times 2^\circ$ latitude-longitude grid of the 20CR is too coarse to realistically represent the complex orography of Switzerland, which has considerable ramifications for the representation of smaller-scale features of the surface wind field influenced by the local orography.

Using the 20CR as a starting point, this study illustrates a method to simulate the wind field and related economic impact of both historic and present-day high-impact winter storms in Switzerland since end of the 19th century. Our technique involves the dynamical downscaling of the 20CR to 3 km horizontal resolution using the numerical Weather Research and Forecasting model and the subsequent loss simulation using an open-source impact model. This impact model estimates, for modern economic and social conditions, storm-related economic losses at municipality level, and thus allows a numerical simulation of the impact from both historic and present-day severe winter storms in Switzerland on a relatively fine spatial scale.

In this study, we apply the modelling chain to a storm sample of almost 90 high-impact winter storms in Switzerland since 1871, and we are thus able to make a statement of the typical wind and loss patterns of hazardous windstorms in Switzerland. To evaluate our modelling chain, we compare simulated storm losses with insurance loss data for the present-day windstorms “Lothar” and “Joachim” in December 1999 and December 2011, respectively. Our study further includes a range of sensitivity experiments and a discussion of the main sources of uncertainty.