Atmospheric Precursors to Floods in Switzerland

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It is important to learn more about flood triggering weather patterns in Switzerland for two reasons: (i) projections of flood frequencies in a warmer climate are strongly limited by the ability of climate models to represent the complex small-scale processes associated with typical flood triggers like heavy precipitation and snow melt. Information about flood triggering weather situations can be used in a more indirect approach to estimate changes in future flood frequencies.
(ii) Flood frequencies in Switzerland show significant decadal variability, suggesting that decadal variations in the synoptic atmospheric flow might influence flood probabilities (Schmocker-Fackel & Naef, 2010). However, links to temperature trends or large-scale climate indices are complex and ambiguous and Schmocker-Fackel & Naef expressed the need for a better understanding of the synoptic-scale atmospheric flood triggers.
We used weather types classifications to group the Swiss rivers based on their specific flood-associated synoptic situations. The classification algorithm grouped the rivers into distinct classes, each reacting to a different synoptic flow pattern. We aim to determine for each class a set of typical synoptic- and meso-scale flood ingredients by combining atmospheric reanalysis from the ECMWF with dense networks of rain gauges and river discharge measurements.
We performed a series of case study analyses that showed promising results. For the case studies four catchments have been selected, each representing a preferred hydrological flood type (e.g. shower, long lasting rain, rain on snow, pure melt). For each of these catchments many of the annual maximum floods share a common triggering weather situation and these flood triggering weather situations vary substantially between the different catchments.
An example is shown in Figure 1. On 21 December 1991 an atmospheric river brought very moist air to North-Western Europe. This atmospheric river triggered, together with other factors, a record flood in the Suze river in Switzerland.
We will use the best set of atmospheric flood precursors to build up an ingredient-based flood forecasting model. We will separate 50 years of discharge and reanalysis data into a validation and calibration period to test the skills of our flood forecasting model. In case of sufficient skill, this model will be applied to future climate projections to derive future flood probabilities for each Swiss region.

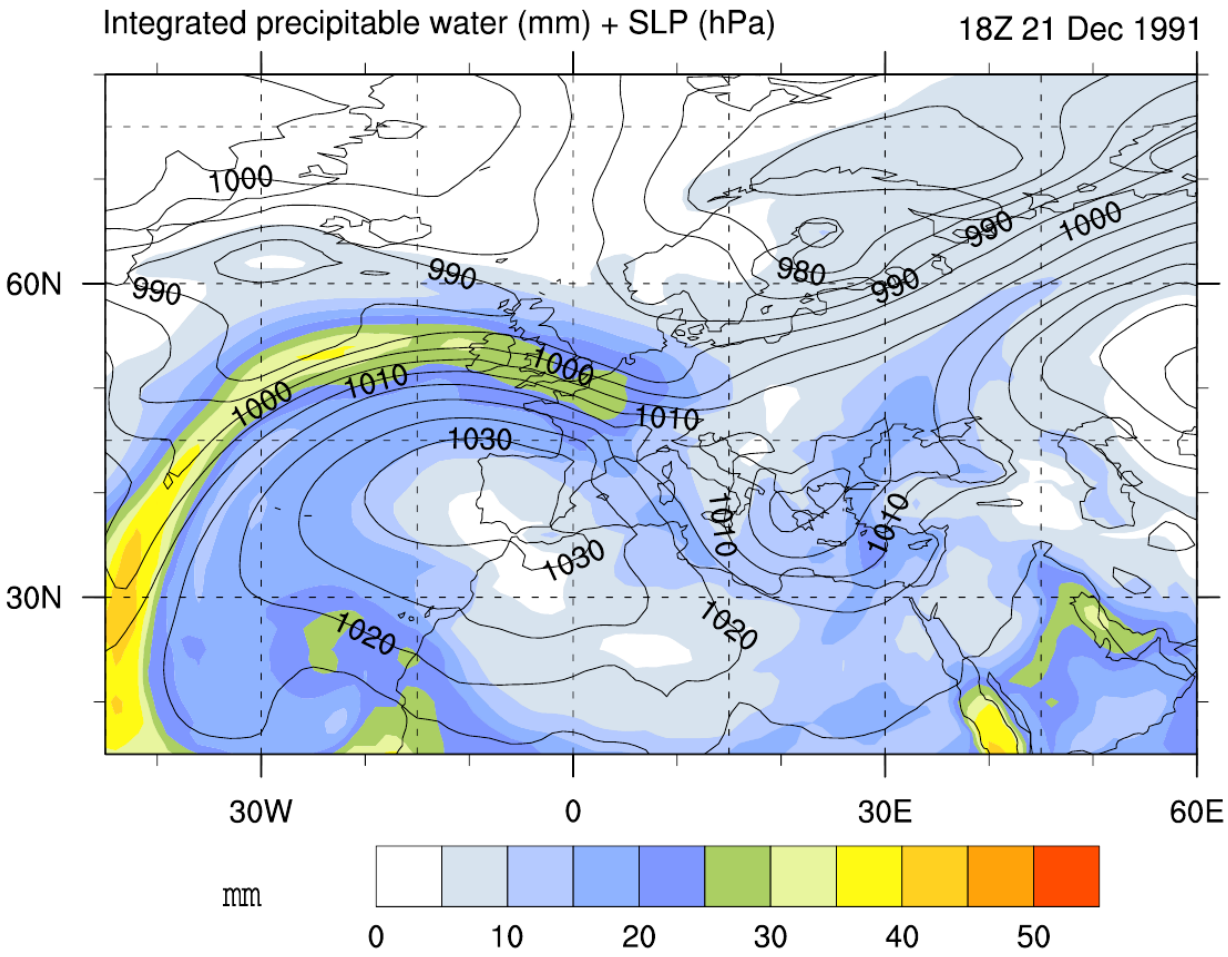

Figure 1: Precipitable water (shaded, mm) and sea level pressure (contour lines) on 18 UTC December 21 1991.

REFERENCES

Schmocker-Fackel, P. and Naef F. 2010: More frequent flooding? Changes in flood frequency in Switzerland since 1850, Journal of hydrology, 381, 1-8