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The link between atmospheric blockings and Central European flood events – A case study

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Flood events are among the most devastating weather-related events in Europe and can lead to large economic losses and even fatalities. Several processes, such as heavy precipitation or snow melt, can be involved in the triggering of flood events. Here we focus on precipitation only. Important characteristics of the flood triggering precipitation events are their intensity and their duration, which in return depend on the intensity and the stationarity of the associated
weather system.

Atmospheric blockings, due to their longevity and stationarity can influence flood related precipitation event in several ways:

i) The progression of the upstream weather systems is slowed and thereby the precipitation period over a catchment can be prolonged.

ii) The cumulative effect of recurrent precipitation events occurring up- or downstream of a block can result in a flood event. The interaction between blockings and flood triggering weather events potentially works in both directions. Cloud diabatic processes can be central to the establishment and maintenance of blocking anticyclones. The precipitation responsible for the flood could hence potentially extend the lifetime and strength of a blocking anticyclone located downstream of the flooded area.

Here we illustrate the different interactions based on a flood event of a major lake in southern Switzerland in October 2000. During the flood event and in the month before blockings were present downstream, over Scandinavia as well as upstream, over the North-Atlantic. Three extreme precipitation episodes occured in southern Switzerland in September and October 2000.

The first one took place on 20 September and was associated with an atmospheric blocking over the north Atlantic. This blocking together with a downstream anticyclone led to the formation of a PV streamer over western Europe that was responsible for the heavy precipitation. The two anticyclonic systems then merged and formed a persistent blocking over the northern north Atlantic and Scandinavia. This resulted in a similar flow configuration 10 days later with an even heavier rainfall over Switzerland on 30 September. These two precipitation events were essential for the preconditioning of the catchment. After the second extreme precipitation event the lake level was already high. Ten days later the flood-triggering event took place from October 11 to 15. During this event a block was situated downstream. This block was responsible for the stalling of the precipitation triggering weather system directly over Switzerland and heavy precipitation over five days.

We also find evidence for a feedback between the heavy precipitation and the block. Backward trajectories calculated from the blocking region over Scandinavia show that some of the low PV air masses in the block passed through the heavy precipitation region over Switzerland two days early where they ascended and their PV was diabatically depleted.