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Moisture sources of extreme Vb-floods in Central Europe

Amelie Krug[1], Franziska Aemisegger[2], Michael Sprenger[2], Cristina Primo[1], and Bodo Ahrens[1]
[1]Institute for Atmospheric and Environmental Sciences, Goethe Universität Frankfurt, Frankfurt am Main, Germany
[2]Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland

River floods are the most common and devastating natural hazard in Europe. In this study, we focus on a specific flood type which is associated with so-called Vb-cyclones. These extratropical cyclones are defined by their pathway from the western Mediterranean Sea north-eastward over northern Italy along the eastern fringe of the Alps towards Central Europe. Prominent examples of Vb-floods are the July 1954 and the August 2002 floods in the Elbe and Danube catchments as well as the Odra flooding during May/June 2010.

Only a few Vb-cyclones cause extreme flooding in Central Europe, even though about 2-5 follow the Vb pathway on average per year. The processes which intensify these flood triggering Vb-cyclones are only partly understood. One potential mechanism could be the soil-precipitation feedback over the continent. Moreover, the resulting latent heat release could re-enforce the atmospheric blocking conditions, e.g., over eastern Europe, that foster cyclones to follow the Vb-like pathway.

Our study aims to increase knowledge about potential feedback mechanisms by quantifying the role of specific moisture sources. We analysed the moisture uptake for selected extreme events in the 20th century based on backward trajectories in dynamically downscaled ERA-20C reanalysis. The downscaling was performed over Europe with a high-resolution and interactively coupled atmosphere-ocean model setup (COSMO-CLM+NEMO). The Mediterranean Sea contributed to rainfall in the affected river catchments often at the event start. Throughout the events, other main moisture uptake regions were the European continent pointing towards an important role of the soil-moisture precipitation feedback, but also other oceanic sources such as the North Atlantic, the North Sea, and the Baltic Sea were identified. The large variety of the identified sources highlights the complex dynamical interplay of different airmasses leading to convergence of moisture during particularly severe flood producing heavy precipitation events.