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Enhanced Central European summer precipitation in the late 19th century: A link to the Tropics

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In Central Europe, an unusual large number of floods were recorded in the late 19th century, causing important damages. Different factors contributing to the occurrence of these floods have been discussed in the literature, including the unusually high precipitation anomalies recorded at the time. Based on the frequency and spatial pattern of these floods, previous studies suggest that changes in the large scale circulation played a relevant role. Here, we use an atmospheric General Circulation Model forced with observed SSTs to test this hypothesis and identify causes for the associated change in atmospheric circulation.

We find that in our simulations, SST variability is the primary driver for these high summer/autumn precipitation anomalies. Using a series of numerical experiments, we specifically show that SST variability in the central and eastern tropical Pacific ocean (associated to the El Nino Southern Oscillation region) was the primary driver for these precipitation anomalies. In addition, we show that SST variability in the Indian ocean, as well as increased anthropogenic aerosols substantially enhanced these precipitation anomalies.

Finally, we show that between 1875 and 1890, SST variability in the central and eastern tropical Pacific enhances the summer/autumn central European precipitation via its impacts on the summer/autumn atmospheric circulation: These include a Pacific North American (PNA)-like pattern over North America and a substantially weakened mid-troposphere westerly flow over Europe and the North Atlantic, as well as increased pressure over Greenland and reduced pressure over Europe, resembling the negative phase of the Summer North Atlantic Oscillation (NAO). Note however that whereas the simulated atmospheric patterns resemble the patterns usually associated with ENSO in winter, no deterministic link could be established between individual ENSO events and the wet years in Central Europe during this time period. In addition, the reason for the seasonality difference between ENSO events (winter) and Central European wet years (summer/autumn) is still unexplained.

Ref. Bichet et al. (2012), QJRMS (in revision)