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The Impact of a Warmer Mediterranean Sea on Central European Summer Flooding

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Central European climate is influenced by the Mediterranean Sea, which experienced a strong increase in sea surface temperature (SST) during the last four decades. One example of extreme weather events are cyclones following the "Vb" pathway. These cyclones are generated over the Mediterranean Sea and travel northeastwards around the Alps and then hit countries like Poland and Germany. The cyclones carry large amounts of moisture and cause extreme precipitation, and subsequently flooding, particularly in summer. These floods, such as the Elbe flood in 2002, have devastating societal impacts and also influence ecosystems.
To analyse the potential impact of increased Mediterranean SST on extreme precipitation in Europe, a series of simulations with the atmospheric general circulation model (AGCM) ECHAM5 has been carried out. ECHAM5 was run at high horizontal resolution (T159) and integrated for 40 years in each experiment. The control run is forced by SST and sea ice concentration (SIC) climatology derived from 1970-1999. A warmer climate is simulated by using global climatological SST and SIC from 2000-2012. To disentangle the impact of the Mediterranean Sea, an additional simulation was performed with the same global SST and SIC as in the control run, but with the warmer 2000-2012 SST climatology restricted to the Mediterranean and Black Seas. 20-season return levels were derived as a measure of extreme precipitation for daily as well as five day precipitation in JJA (June, July, August). These return levels are estimated as quantiles of a stationary generalised extreme value (GEV) distribution.
Although the increase in the number of Vb cyclones is only modest, precipitation return levels in JJA show an increase along the Vb cyclone track, for daily (up to approximately 63 %) as well as for five day (up to approximately 76 %) precipitation extremes. This increase can be attributed to the warmer Mediterranean Sea, as it is observed in both the globally warmer and warmer Mediterranean Sea experiments. The strongest increase in both daily and five day precipitation extremes is located in western Hungary, in the catchment area of the Danube River. This finding suggests further increases in European summer flooding, should Mediterranean SST continue to increase.