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Constraints on European temperature and rainfall changes from attributed changes

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Quantifying and reducing the uncertainty of climate projections will benefit both mitigation and adaptation decisions. Observed climate change provides evaluation of climate model simulated change, but the contribution by different external forcing factors needs to be reliably separated in order to use observational constraints. We revisit this ASK (for Allen et al., 2000; Stott and Kettleborough, 2002) approach to use attributed responses to greenhouse gas forcing to constrain future predictions.

We derive constraints on the projected near-surface summer temperature change over Europe as well as over three European subregions. The temperature responses to different external forcings (natural and greenhouse-gas (GHG) or combined anthropogenic) are estimated as the multi-model means of historical simulations from the Coupled Model Intercomparison Project 5 and incoming CMIP6, and the range of factors by which they can be scaled and still be consistent with observations since 1950 (E-OBS) given internal variability is calculated and applied to future RCP8.5 simulations.

Results show that both the response to GHG-only and to the combined anthropogenic (including aerosols etc.) forcing are detectable in the observed temperature change over Europe, and that the response over the Mediterranean region might be underestimated. Observed precipitation changes over Europe are also detected over some regions, although the confounding effects of the North Atlantic Oscillation need to be considered carefully. The results demonstrate the successful application of the ASK method for constraining projections of regional change over Europe.