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On the detectability of a regional-scale anthropogenic climate change in Northern Europe

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We investigate the detection and attribution of a potential anthropogenic effect on regional-scale temperature and precipitation changes in Northern Europe. The generally decreasing signal-to-noise ratio with decreasing area of aggregation as well as the shortcomings of present-day climate models in simulating regional climate limit successful detection and attribution at the regional scale. However, the effect of both the decreasing signal-to-noise ratio and potential model errors can be analyzed in a perfect model framework.

We compare the observed pattern of change to the response patterns due to anthropogenic and natural forcing factors using single and two-factor detection analysis. The response patterns are derived from the WCRP CMIP3 multi-model dataset. We find that changes in both screen temperatures and precipitation in Northern Europe since 1950 are different from what we expect due to internal variability alone. In the case of temperature, the observed change can be attributed to anthropogenic forcing. The positive detection and attribution result is further substantiated by corresponding results when individual model simulations are used as pseudo-observations in the detection analysis. In contrast, the observed change in precipitation can be attributed to natural forcing factors. Using individual model simulations as pseudo-observations, we conclude that the anthropogenic effect on precipitation in Northern Europe becomes detectable no sooner than 2020. Furthermore, the attribution results in the perfect model framework indicate, that there is considerable spread in the response to natural forcing across different models, and thus attribution results for precipitation should be taken with caution.