



International Max Planck Research School on Earth System Modelling

Detection of an anthropogenic influence on the
observed changes in nearsurface temperature
and precipitation in Northern Europe

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Abstract

Extensive evidence of a large-scale anthropogenic climate change has been collected during the last decades. In contrast, regional-scale climate change is less well understood. Thus, this study aims at contributing to the discussion of an observable human influence on changes in near-surface temperature and precipitation in the Baltic Sea catchment.

The spatial resolution of present-day global general circulation models (GCMs) is inappropriate for the simulation of climate over heterogeneous terrain and in regions with complex land-sea distribution. Therefore, we compare the spatial pattern of the change with regional climate model simulations. In contrast, the change in area-average temperature and precipitation is compared with GCM simulations, as dynamical downscaling with regional climate models is shown to have a minor influence on area-average quantities.

We compare the most recent trends in observed precipitation and temperature in the Baltic Sea catchment with estimates of the response to anthropogenic forcing from regional climate models. The observed change in temperature is consistent with regional climate change projections. In contrast, the model projections generally underestimate the magnitude of the recent change in precipitation. The recent change in the North Atlantic Oscillation does not fully account for the mismatch in simulated and observed precipitation changes.

In a formal detection and attribution analysis we assess the relative importance of anthropogenic and natural forcing and the role of internal variability in explaining the observed change in area-average temperature and precipitation using GCM simulations. The observed change in area-average temperature in the Baltic Sea catchment is very likely not caused by internal variability alone. Although anthropogenic forcing is the dominant forcing, we are not able to separate the anthropogenic and natural influence on the observed change in a two-signal attribution analysis. The results for precipitation are strongly dependent on the details of the analysis. We detect an external influence, but neither anthropogenic nor natural forcing alone provide plausible explanations for the observed change. Model simulated changes in precipitation are generally

much weaker than the observed changes, which corroborates the findings based on regional climate models. The detection results for precipitation should be treated with caution, as present-day GCMs have severe limitations in simulating regional-scale precipitation.