21ST CENTURY CHANGES IN THE NORDIC CLIMATE: UNCERTAINTIES DERIVED FROM AN ENSEMBLE OF REGIONAL CLIMATE MODEL SIMULATIONS

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The Rossby Centre ensemble
Seasonal mean temperature, precipitation and wind speed over the Nordic region are analysed in an ensemble of 16 regional climate model (RCM) simulations for 1961-2100. To construct the ensemble we have used the Rossby Centre RCM with boundary conditions from seven global climate models (GCMs) under four emission scenarios. Most of the simulations were downsampling experiments of GCMs forced by the emission scenario SRES A1B (Nakicenovic and Swart, 2000). One of the GCMs was run three times under A1B differing only in initial conditions. The Rossby Centre ensemble and the more large-scale European climate change signal has earlier been documented by Kjellström et al. (2010).

Changing precipitation
Figure 1. Change in annual mean precipitation versus change in Tmp relative to 1961-1990. The letters indicate which driving GCM that has been used. The number of which time period the change is calculated: (1) 2011-2040, (2) 2041-2070 and (3) 2071-2100. Colours indicate emission scenarios (A2-red, A1B-black, B2-blue, B1-green). The grey line is a least-square fit to the data.

A wetter climate?
Figure 2. Change of P-E versus change in Tmp relative to 1961-1990 for the Nordic mainland: The letters indicate which driving GCM that has been used. The number of which time period the change is calculated: (1) 2011-2040, (2) 2041-2070 and (3) 2071-2100. Colours indicate emission scenarios (A2-red, A1B-black, B2-blue, B1-green). The grey line is a least-square fit to the data.

A changing wind climate?
Figure 3. Change in annual mean wind speed versus change in Tmp relative to 1961-1990. The letters indicate which driving GCM that has been used. The number of which time period the change is calculated: (1) 2011-2040, (2) 2041-2070 and (3) 2071-2100. Colours indicate emission scenarios (A2-red, A1B-black, B2-blue, B1-green). The grey line is a least-square fit to the data.

Gradual changes with 6 different AOGCMs under A1B
Winter (DJF) Summer (JJA)

Biases in the control period
Winter (DJF) Summer (JJA)

Summary
The ensemble is used to; i) evaluate the simulated Nordic climate against observed climatologies for 1961-1990, ii) assess future climate change and iii) illustrate uncertainties in future climate change related to natural variability, boundary conditions and emissions.

> Biases in temperature and precipitation in the 1961-1990 period are strongly related to errors in the large-scale circulation in the GCMs (Fig. 5).
> Statistically significant increases in temperature are seen for all of the Nordic region already in the next decades (Fig. 4).
> Precipitation increases in northern Europe and most so in winter (Figs. 1 & 4).
> Generally wetter conditions in the future (Fig. 2).
> Wind speed changes are generally small. Increase in wind speed are found in parts of the northern seas and decreases in many other areas (Figs. 3 & 4).
> Uncertainty largely depends on choice of GCM. This strong dependency is related to their representation of changes in the large-scale circulation.
> The uncertainty related to forcing (i.e. emission scenario) is most important by the end of the century while natural variability sometimes dominates the uncertainty on local to regional scales in the near few decades.

References

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