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A perfect model study on the reliability of the added small-scale information in regional climate change projections

Geert Lenderink, Hylke de Vries, Erik van Meijgaard, Karin van der Wiel, and Frank Selten
KNMI, R&D Weather and Climate Models, De Bilt, Netherlands (lenderin@knmi.nl)

The issue of the added value (AV) of high resolution regional climate models is complex and still strongly debated. Here, we approach AV in a perfect model framework within a 16-member single model initial condition ensemble with the regional climate model RACMO2 embedded in the global climate model EC-Earth2.3. In addition, we also used an ensemble produced by a pseudo global warming (PGW) approach. Results for winter temperature and precipitation are investigated from two different perspectives: i) a signal-to-noise perspective analysing the systematic response to changing emission forcings versus internal climate variability, and ii) a prediction perspective aimed at predicting a 30-year future climate state. Systematic changes in winter temperature and precipitation contain fine-scale response patterns, but in particular for precipitation these patterns are small compared to internal variability. Therefore, single members of the ensemble provide only limited information on these systematic patterns. However, they can be estimated more reliably from PGW members because of the stronger constraints on internal variability. From the prediction perspective, we analysed AV of fine-scale information by comparing three prediction pairs. This analysis shows that there is AV in the fine-scale information for temperature, yet for precipitation adding fine-scale changes generally deteriorates the predictions. Using only the large-scale change (without fine scales) from a single ensemble member as a delta change on top of the present-day climate state, already provides a robust estimate of the future climate state and therefore can be used as a simple benchmark to measure added value.