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Preparing for a coupled climate-hydrological model: The influence of domain characteristics on the HIRHAM regional climate model

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The study is a part of the HYACINTS project (http://hyacints.dk/index.shtml). As a part of the part the project a fully coupled climate-hydrological model will be developed for the entire Denmark consisting of the HIRHAM regional climate model (Danish Meteorological Institute) and the MIKE SHE hydrological model (DHI / Geological Survey of Denmark and Greenland). The coupled model is anticipated to provide improved hydrological predictions of the impact of climate change. In this study the impact of domain characteristics is analyzed by forcing the HIRHAM regional climate model by ERA-Interim reanalysis data. The results of eight different model runs are presented for varying domain size, domain location and grid resolution. The analysis was carried out as there are no strict guidelines in the choice of optimal domain characteristics.
Due to the hydrological focus of the project the model runs were mainly analyzed with respect to precipitation and temperature and validated against both point and spatial observations in the period 2008-2009. For spatial precipitation observations, both bias-corrected and uncorrected measurements were used since the current bias-correction method is considered to over-correct in the winter months. The actual observed winter precipitation must therefore be considered to be between the corrected and the uncorrected.
For precipitation there is a tendency for the HIRHAM model simulations to slightly overestimate in the winter period (DEC-FEB - 0-1mm/day) to slightly underestimate in summer and fall periods (JUN-AUG and SEP-NOV – both 0-1mm/day) and to be near the observations in the spring period (MAR-APR – overestimation app. 0-0.25mm/day) when validating against uncorrected observations. When validating against the corrected results overestimations prevail, strongest in the summer and fall periods (up to 1.5mm/day) and weakest in the spring (up to 0.75mm/day). For temperature, the fall and winter periods generally show slightly underestimated simulations, whereas the spring and summer periods are closer to the observed. The visual inspection of the error maps is somewhat subjective but in general the larger domains tend to predict the precipitation better than the smaller domains and for temperature the case is the same, except for the winter period. Comparing domains with the same extent there is no improvement in decreasing the grid size to 5.5km compared to 11km. Increasing domain size, but keeping the same resolution, does not show apparent differences in a spatial context whereas the point validation favors the smaller of the two domains. Altering the target area placement (Denmark) within the model domain keeping all other factors constant show slightly smaller errors for the domain having the biggest stretch to west.