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Regional Climate Projections for Greenland 1980 – 2099 using the HIRHAM5 Model

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Ice sheet models are commonly used to quantify the response of the Greenland Ice Sheet to climate change and the subsequent impact on global sea level; these are driven by a mass balance forcing derived from a climate model. The HIRHAM5 regional climate model (RCM) has an interactive surface scheme that includes an internal surface mass balance (SMB) calculation making it suitable for direct coupling to an ice sheet model. We present new results from three climate simulations run for the period 1980 to 2099 downscaling output from two different General Circulation Models (ECHAM5 and HadCM3) forced with the SRES A1B scenario, and an additional run downscaling the E1 scenario from ECHAM5. We compare these runs with a reference simulation for the period 1989 – 2010 using ERA-Interim forcing at the boundaries that is validated with observational data from the GC-Net and DMI operated weather stations around Greenland.
This analysis shows that the HadCM3 model produces significantly warmer temperatures over the ice sheet than the ECHAM5 model, which is closer to the reference run values. Output from both models produces less precipitation over the ice sheet than is seen in the reference run. All simulations indicate that the SMB of the ice sheet will become progressively more negative over the course of this century. Validation of the reference run with field observations shows a warm bias over the ice sheet in winter but close to observed monthly mean temperatures in summer. Although precipitation is much more difficult to validate, comparison with some shallow ice cores suggests that the HIRHAM5 reference run captures accumulation adequately.
These HIRHAM5 runs provide a source of climate forcing available to other modellers, including ice sheet models, and helps to delineate some of the uncertainties in future climate simulations.