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Simulating the Hydrological Cycle of Northernmost Europe using Different Model Approaches

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The Arctic is likely to experience the largest changes in climate in the coming century. Within the arctic terrestrial environment, hydrological processes play a crucial role and have the potential to feed back on the regional climate (e.g. by changes in the snow cover dynamics) as well as the Arctic Ocean (by means of the discharge of freshwater). However, due to a lack of reliable observations of - particularly - precipitation and evaporation, the water balance of high-latitude areas is still highly uncertain. Within the European project BALANCE (Global Change Vulnerabilities in the Barents Region: Linking Arctic Natural Resources, Climate Change and Economies) we have been looking into the sensitivity of the freshwater runoff into the Barents Sea to future changes in climate. To assess the uncertainties and discrepancies between the various modeling approaches, we compared the simulation of the water balance in the different models used within the project: the regional climate model REMO, an advanced land surface scheme (JULES), a conceptual water balance model (BarentsFLOW), and a dynamic vegetation model (LPJ-GUESS), whereby the latter three models were driven by the meteorological output of the climate model. Although the models were applied to the same region and used the same climate forcing, significant differences and deviations from the observations were sometimes found. These four models therefore represent fundamentally different views of the same hydrological cycle in Northernmost Europe. Off-line coupling of such different models should therefore be done with great care, in order to avoid inconsistencies.