Internal variability in Arctic regional climate simulations: A case study for the SHEBA year

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The sensitivity of a regional climate model (HIRHAM) to the lateral boundary forcing and to the initial conditions is evaluated for a pan-Arctic domain. The study focuses on seasonal simulations over the period of the Surface Heat Budget of the Arctic Ocean project from October 1997 to September 1998. Small perturbations in the initial and/or lateral boundary conditions can make the model diverge from the driving large-scale fields, and the extent to which this occurs depends on the control of the model by the lateral boundary forcing, not on the origin of the perturbation. The model response to a perturbation does not depend on the kind of the perturbation, it is largely independent of the magnitude as well as of the source of the perturbation. Temperature perturbations, either of smaller or larger amplitude, have similar consequences for the monthly mean atmospheric patterns and the root mean square difference. However, the model response depends on the season. Two regimes in the internal variability are found: a regime of large variability in autumn/winter and a regime of smaller variability in summer. The pronounced magnitude of the internal variability has to be taken into account discussing the significance of climate change and climate sensitivity signals in Arctic regional climate models.