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Numerical experiments on sensitivity of local meteorology vs. land-cover changes in the Arctic through seamless Enviro-HIRLAM modelling

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In the recent decade, the Arctic as a whole is subject to amplified warming and well documented changes in the Arctic ecosystems, and especially, these changes are becoming more and more pronounced over territories of the Russian Arctic.

In this research, to study atmosphere-land-sea surfaces interactions, and in particular, heat-moisture exchange/ regime between these surfaces and for better understanding and forecasting of local meteorology in the Arctic, the seamless modelling approach was tested and applied. The Enviro-HIRLAM (Environment High Resolution Limited Area Model) is an online integrated meteorology – atmospheric composition multi-scales and -processes modeling system. This model was adapted for a region of interest located in the Russian Arctic covering the inland, seashore and adjacent seas territories with the Yamal Peninsula in the center of the domain. Two short-term periods during summer (in July) and winter (in January) were chosen.

The performed model runs include changes in vegetation and land-cover as well as taking into account direct and indirect aerosol effects (for summer), which is needed to estimate interactions and feedbacks between meteorology – atmospheric composition – land cover changes. In this study, the model was run in a downscaling chain with 5 and 1+ km horizontal resolutions. The meteorological and aerosols/ gases initial and boundary conditions required were extracted from ECMWF. The model output includes both 3D meteorology and atmospheric composition (with focus on aerosols in this study) in the surface, boundary layer and free troposphere.

The analysis of variabilities on a diurnal cycle (for key selected meteorological parameters such as air temperature, relative humidity, wind characteristics, boundary layer height, latent and sensible heat fluxes) due to changes in vegetation and land-cover was performed for selected warm and cold periods and will be presented.