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The comparison of WRF simulations using different approaches in two high-latitude fjords, Hornsund and Porsanger

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In this research we have focused on weather modeling in two Arctic fjords: Porsanger, which is located in the northern part of Norway, in the coastal waters of the Barents Sea, and Hornsund, located in the western part of the Svalbard archipelago. The atmospheric downscaling was based on The Weather Research and Forecasting Model (WRF, www.wrf-model.org) with polar stereographic projection.

We have compared the results of different settings in the model. We have tested what is the impact of the spatial resolution of the model on derived meteorological quantities. First simulations were done using parent domain (dx_1=20 km) with nested subdomains (dx_2=4 km, dx_3=0.8 km, dx_4=0.16 km) for both fjords. Note that child domains had 5 times higher resolution than parent domains. In this part, we used planetary boundary layer (PBL) scheme with simple turbulence and mixing. PBL is used to distribute surface fluxes through the boundary layer and to use vertical diffusion. This assumption begin to break down if dx $<<$ 1 km. Because for the future work we need very high-resolution meteorological data for the fjords, we decided to run model once again using large eddy simulation approach with parent (dx_1=320m) and one nested domain (dx_2=160 m). In this part 3d diffusion scheme was used and planetary boundary layer settings were turned off. We also changed other parameters in the model to adapt initial values to the fjords.

To validate the results we used meteorological data from the Norwegian Meteorological Institute. We estimated coefficients of determination (r^2), statistical errors (St) and systematic errors (Sy) between measured and modeled air temperature and wind speed at each station.

Thanks to this research, in the future we will be able to create high resolution spatially variable meteorological fields that will serve as forcing for numerical models of the fjords. We will investigate the role of different meteorological conditions like wind or precipitation on hydrographic processes in fjords.

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