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# Very high resolution regional climate simulations on the 4 km scale as a basis for carbon balance assessments in northeast European Russia

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Simulations with global circulation models (GCMs) clearly indicate that major climate changes in polar regions can be expected during the 21st century. Model studies have shown that the area of the Northern Hemisphere underlain by permafrost could be reduced substantially in a warmer climate. However, thawing of permafrost, in particular if it is ice-rich, is subject to a time lag due to the large latent heat of fusion. State-of-the-art GCMs are unable to adequately model these processes because (a) even the most advanced subsurface schemes rarely treat depths below 5 m explicitly, and (b) soil thawing and freezing processes cannot be dealt with directly due to the coarse resolution of present GCMs. Any attempt to model subsurface processes needs information about soil properties, vegetation and snow cover, which are hardly realistic on a typical GCM grid. Furthermore, simulated GCM precipitation is often underestimated and the proportion of rain and snow is incorrect. One possibility to overcome resolution-related problems is to use regional climate models (RCMs). Such an RCM, HIRHAM, has until now been the only one used for the entire circumpolar domain, and its most recent version, HIRHAM5, has also been used in the high resolution study described here. Instead of the traditional approach via a degree-day based frost index from observations or model data, we use the regional model to create boundary conditions for an advanced permafrost model. This approach offers the advantage that the permafrost model can be run on the grid of the regional model, i.e. in a considerably higher resolution than in previous approaches. We here present results from a new time-slice integration with an unprecedented horizontal resolution of only 4 km, covering northeast European Russia. This model simulation has served as basis for an assessment of the carbon balance for a region in northeast European Russia within the EU-funded Carbo-North project.