



High-resolution projections for soil frost conditions in Finland with regard to timber harvesting and transport availability

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Trafficability in forest terrains is one of the most important issues in timber harvesting because multiple passes of a harvester and a loaded forwarder may cause ruts on the forest floor. The bearing capacity of soil depends on soil texture, moisture and soil frost. The most difficult forest harvesting conditions generally characterizes peat lands, which represent one third of forestry area in Finland. Already 20 cm thick layer of frozen soil or 40 cm layer of snow on the ground can carry machines used in forest harvesting that weigh 15–30 tons. Operations in poor bearing conditions cause economic losses by increasing time and fuel consumption and decreasing the efficiency of harvesting operations. Also tree roots and even stems may suffer damage. Thus, approximately 60% of logging in Finland is currently carried out while the soil is frozen. As well, forest truck roads having light foundations do not bear heavy timber trucks in wet road sections unless the soil is frozen.

During the forthcoming decades, climate is projected to become warmer. On the timber harvesting and transport conditions, this is expected to have a negative effect because reduced soil frost depth and shorter duration of soil frost period will reduce bearing capacity of soil. We studied the climate change impact on timber harvesting conditions in Finland by using a soil temperature model and data from several climate models downscaled onto an approximately 10 km × 10 km grid. The simulations were run until 2099 under representative concentration pathway (RCP) scenarios RCP4.5 and RCP8.5. The calculations were performed separately for different soil and forest types as well as for forest truck roads. In parallel an indicator for good and bad harvesting conditions in peat lands is being calculated for the EURO-CORDEX domain from 5 bias-corrected climate predictions in the same two scenarios based on snow and soil frost depths derived only from air temperature and snow depth data. Results will be available this year and a comparison should reveal the importance of taking in account soil and forest types.

By combining the soil and vegetation information with the soil frost calculations, the expected changes in timber harvesting conditions can be evaluated in a relatively small scale. However, in reality there are considerable variability in the frost conditions also within similar soil and vegetation type, e.g. due to the variations in the level of groundwater, which cannot be taken into account in this idealized approach.