EMS Annual Meeting Abstracts
Vol. 15, EMS2018-171, 2018

10-year return levels of maximum wind speeds in current and projected future climate of Finland under frozen and unfrozen soil conditions

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Windstorms are the largest cause of abiotic forest damages in Northern Europe. The 10-year return levels of maximum wind speeds are considered to give an illustrative description of the forest wind damage risk. However, by investigating only the maximum wind speeds one cannot estimate the risks and impacts to forests in detail. The amount of damages to forests depend beside on wind speed also on forest structure (tree species, age of trees, forest stand exposure), forest management (recent thinnings, fellings, fertilization) and soil properties (soil type, water bed), and in Northern Europe especially on soil frost. Frozen soil increases anchorage of trees, therefore wind damage risk is reduced if strong winds are occurring during soil frost season. When estimating the forest wind damage risk it is thus essential to know whether the extreme wind speeds occur during the frozen or unfrozen soil conditions.

In this respect, the reliable high resolution information on spatial variation of extreme wind speeds can enhance both forest management and planning. The objective of this research is to respond to the need in the forest sector by producing spatially detailed maps of the 10-year return level of maximum wind speed by taking into account the soil frost conditions. The projected future changes in soil frost wind relationship are also of interest as climate change is expected to shorten the period of frozen soil by several weeks until the end of this century.

The 10- year return levels of maximum wind speed is estimated in this study by using the 1979-2014 ERA-Interim reanalyzed data for an area covering Finland. Downscaling from ERA-Interim coarse grid to a 20 m grid was done using the wind multiplier approach relying on high resolution digital elevation map and CORINE land use data. The estimates were calculated separately for frozen soil and unfrozen soil conditions and for three soil/forest types; spruce forest on clay/silt soil, pine forest on sandy soil and pine forest on peatlands. Projected climate change is taken into account by applying results from CMIP5 to asses changes both in windstorm and varying soil frost conditions.