ForestSat 2024: abstract in session "Forest resilience monitoring"

Mapping the risk for wind and snow damage using NFI field plots and auxiliary remote sensing and weather data

Emanuele Papucci[a], Victor Manabe[a], Susanne Suvanto[b], Sven Adler[a], Inka Bohlin[a]

a. Department of Forest Resource Management, Swedish University of Agricultural Sciences, 901 83, Umeå, Sweden

b. Natural Resources Institute Finland (Luke), Bioeconomy and Environment, Latokartanonkaari 9, 00790 Helsinki, Finland.

There is an urgent need to adapt forest management to make boreal forests less susceptible to climate change impacts. Storm and snow are today one of the main reasons for forest damages in Sweden; based on statistic of Swedish national forest inventory (NFI) over 2,2 % of productive forest land has been affected by wind and snow damages in last 5 years. There is a fear that climate change will make forests more sensitive to storm and snow damage, especially if forest management is not adapted.

The purpose of this study was to create the first general risk model for wind and snow damage in Sweden to support decision making in forest management. This was done by testing the usability of existing remote sensing based forest data together with stand neighborhood and weather variables to predict damage risk. In the modelling, we used 2 046 damaged and 51 234 not damaged plots monitored between 2003-2022 by the Swedish NFI over the whole Sweden, including plots with a mean tree height > 5 m. Tested prediction variables included airborne laser (ALS) based structural forest and terrain information, ALS- and satellite-image based vegetation type and tree species information, stand neighborhood information, soil information and weather variables, all together over 110 variables. ALS products comes from two national campaigns (2009-2019 and 2018-2023) with point densities 0.5-1 and 1-2 points/m2, vegetation type map from 2018 and tree species maps from 2021. The mean values of weather variables were extrapolated from the 2007-2023 daily weather database. The grid-cell size of map products were 2m, 10m and 12,5m and 2,5km depending on the product. Different prediction models were tested including Generalized Linear Models (GLM) and Additive Models (GAM) and neural networks. Models were created separately for two geographical areas: the middle-south and the north, based on the snow depth data and Swedish NFI regions.

Based on our preliminary results the most important variables in the models are: tree height, snow depth, dominant species, temperature, maximum wind speed, most common wind direction, distance to closest clearcut and soil depth. The two geographic areas have differences regarding the importance of some variables. For example, in the middle-south the distance to clear cuts and wind direction have more importance than in the north, when soil depth and days with temperatures above zero have more importance in the north. Our study shows that we can successfully predict risk for wind and snow damage using combination of NFI data together with wall-to-wall remote sensing and weather data in Sweden. The results of the study will be used to create the first wall-to-wall risk maps for wind- and snow damage over the whole Sweden, which enable evaluation of abundance and distributions of the risk in stand to regional and national level. By locating potential areas with high risk for damage forest owners and other decision makers can more easily adapt their forest management for climate impacts.