FINNISH METEOROLOGICAL INSTITUTE

Impact of climate-change-induced storm risk on the optimal rotation period in Finnish forests

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Aim

- Numerically solve the forest owner's rent maximization problem in the face of endogenous wind-throw risk, in current and future climate.
- Optimized variables:
  - Rotation period
  - Number of thinnings
  - Intensity of thinnings
  - Planting density
- Combine climatological data and climate-change scenarios with economic modelling

Consequences of Asta storm in 2010

Background

Table 1. Largest wind damages in Finnish forest in the last decades

Date	Region	Timber lost million m^3
December 1975	Western Finland	1.0
September 1977	Southern Finland	0.8
November 1978, Aarno	Southern Finland	2.5
September 1982, Mauri	Northern Finland	3.0
June 1984, Jeremias	South-eastern Finland	0.4
August 1985, Sanna	South-eastern Finland	0.5
October 1985, Manta	Whole Finland	4.0
November 2001, Pyry & Janika	Central, southern Finland	7.3
July 2002, Unto	Central, southern Finland	1.0
Summer 2010, Asta, Veera, Lahja, Sylvi	Central, southern, north-eastern Finland	8.1

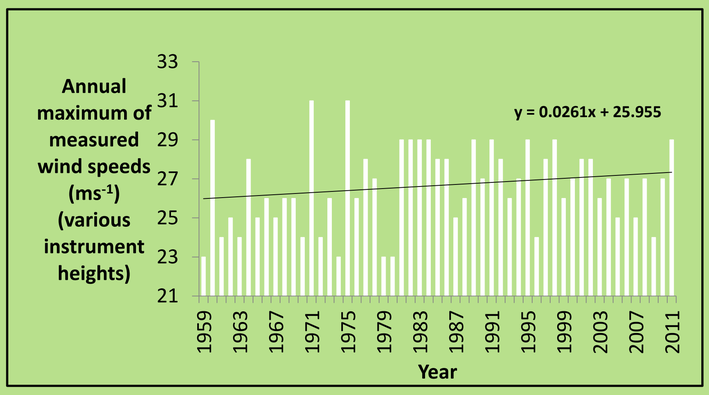

Fig. 1. Annual maximum wind speeds (ms^{-1}) at 82 stations of FMI during 1959-2011. The data set is not homogeneous. Highest wind speeds 31 ms^{-1} have occurred in 1970's. These were measured close to Vaasa coastal region.

Climate change will increase the average wind speeds. In addition, frost-free days will become more frequent. This will increase the vulnerability of especially Norway spruce to wind-throw.

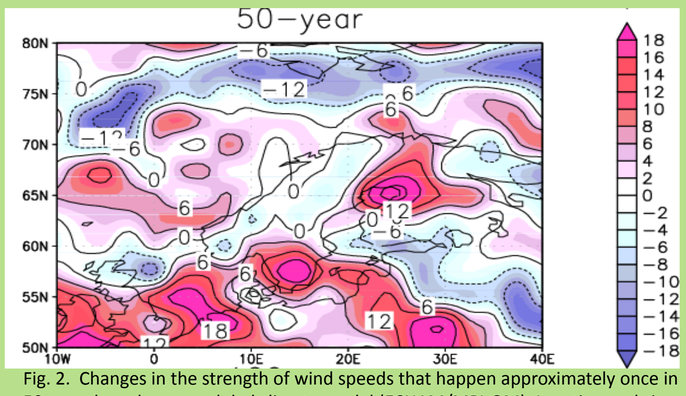

Fig. 2. Changes in the strength of wind speeds that happen approximately once in 50 years based on one global climate model (ECHAM/MPI-OM). Location and sign of change of this model is in line with results of international reasearch on projected changes in storms.

Method

- Modified Faustmann-like rotation model with stochastic, *endogenous* risk
  - the forest owner can decrease the risk of damage by optimizing silvicultural activities
- Even-aged Norway Spruce stand
  - the most vulnerable and profitable tree species in Finland
- Focus on forest edges, which are most vulnerable to wind-induced damage
- Inputs:
  - tree growth model
  - damage probability functions based on mechanistic HWIND model (Peltola et. al, 1999)
  - Frequencies for different wind speeds
  - climate-change impacts on wind speeds
  - economic data
- Numerical simulations to find the optimal set of values for the endogenous variables

Expected results

- Effect of storm risk on the current forest management
- Effect of climate change on the optimal forest management

References

Peltola, H., Kellomäki, S., Väisänen H., & Ikonen, V.-P. 1999. A mexhanistic model for assessing the risk of wind and snow damage tos ingle tres and stands of Scots pine, Norway spruce, and birch. Canadian Journal of Forest Research 29, 647-661.

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