Modelling and Predicting Disturbance Damage in Swiss Forests

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MASSIMO

a **MA**nagement **S**cenario **SI**mulation **MO**del

New disturbance module!
(windthrow and bark beetles)

Management
- Felling
- Thinning
- Protection forest
- Forest reserves

Background mortality

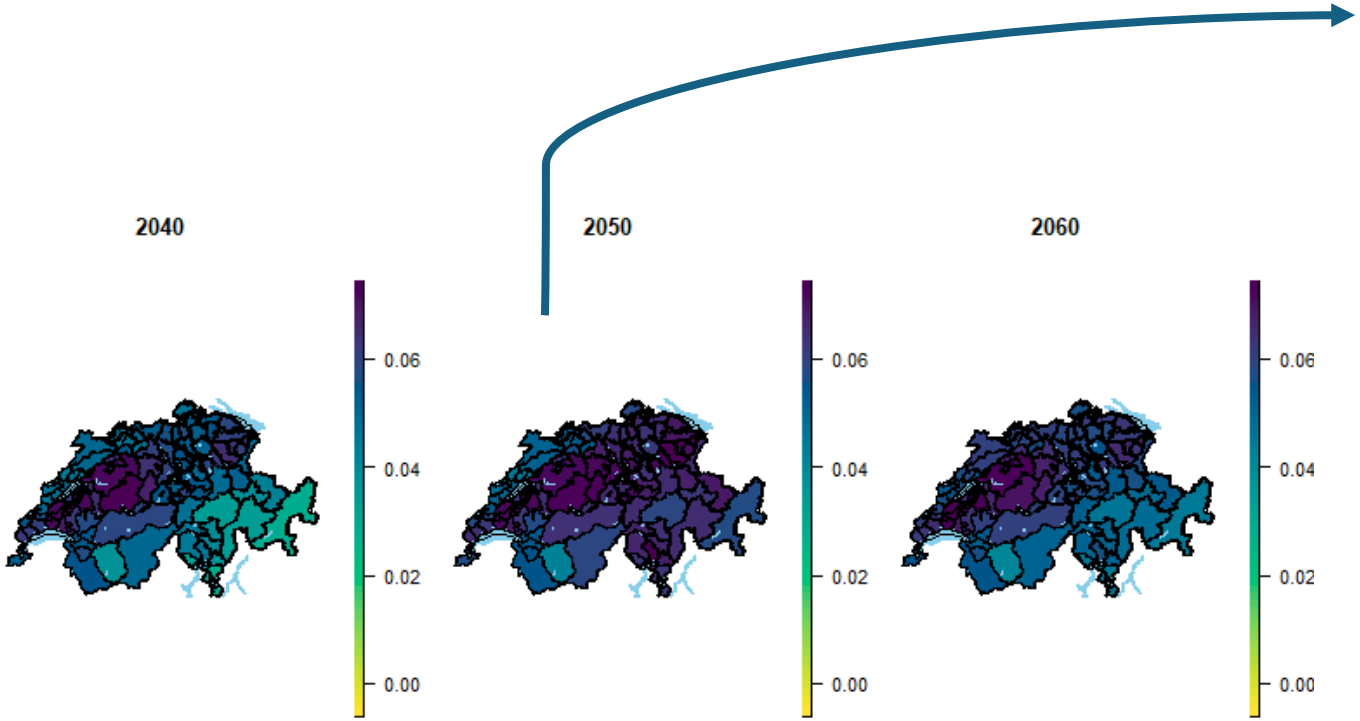
Ingrowth
- # of trees
- Species
- DBH

Growth

Stadelmann et al. 2019

Work in Progress

Disturbance module: Potential damage and actual forest stock



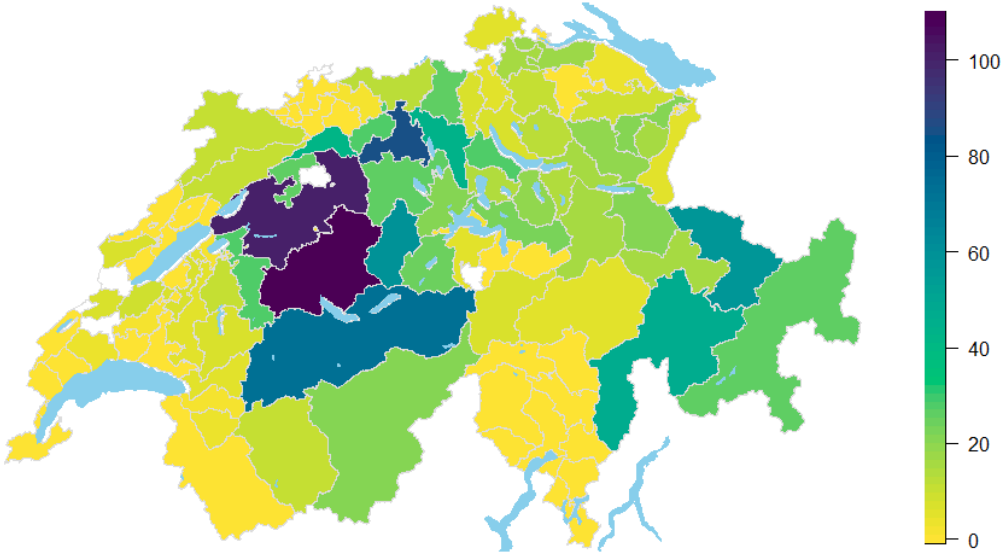
Potential damage-maps summarizing 10 years – independent of MASSIMO and future forest stock.

MASSIMO combining simulated forest with potential damage to predict forest disturbances.

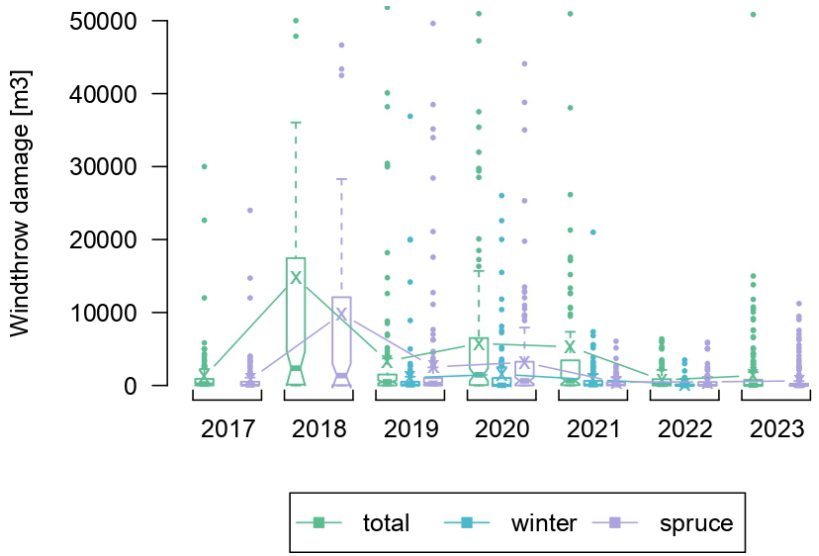
...

Damage data from Waldschutz Schweiz

- Windthrow and bark beetle damage per forest district (Forst Kreis).
- For windthrow damage it is known whether from spruce or other species – from 2019 information about winter and summer storm damage.



Spruce windthrow damage in 1'000 m^3 per forest district of the year 2018.



Time series of windthrow damage visualized with boxplots of forest districts; x depict respective mean.

- Bark beetle damage timeseries **since 1990**, including nests and remaining beetle wood.

Disturbance module: Potential damage vs. actual forest stock

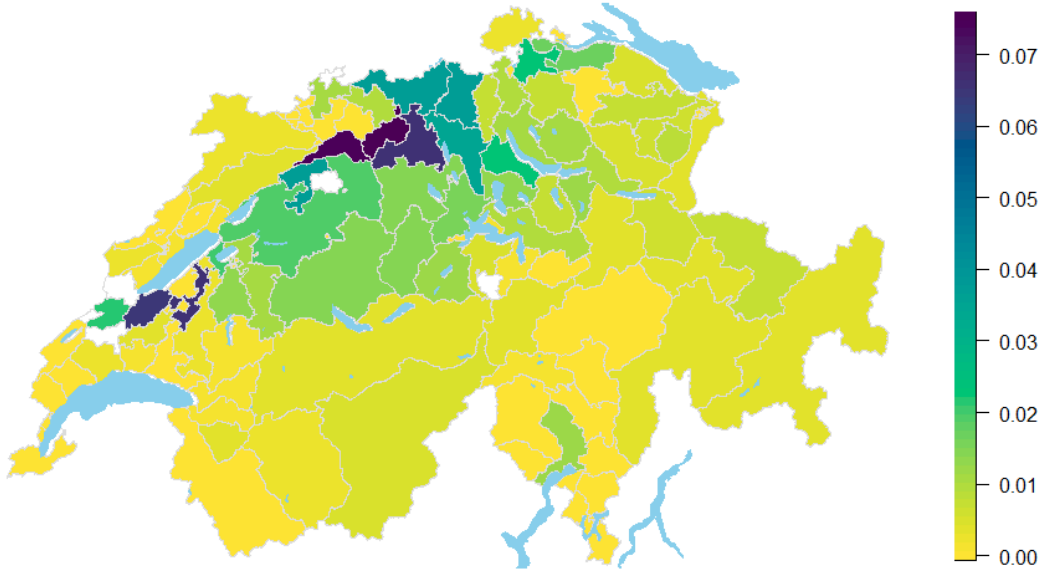
We model at forest district level

- observed damage [m^3]/total volume [m^3],
- which corresponds to the **proportion that is potentially damaged**
- * we differ between conifer/spruce and broadleaves forests

Total volume of standing trees per forest district and main tree species (spruce, etc.) is available from NFI.

We include at NFI level

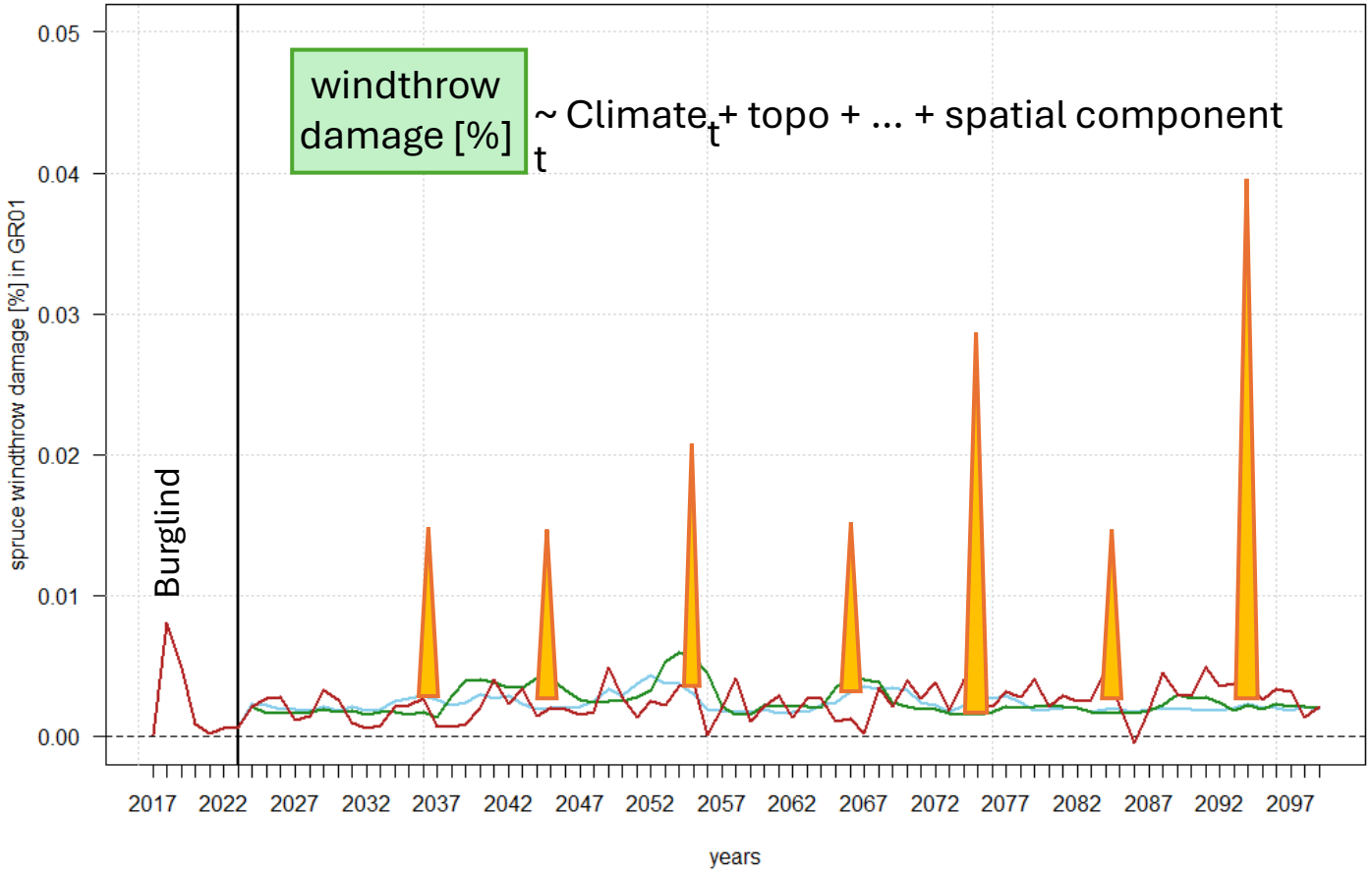
- Climate, topography, soil properties, etc.



Forest districts showing spruce windthrow damage/total spruce volume of the year 2018 (Burglind storm).

Predicted conifer windthrow damage per year – Extreme events?

Observed until 2023 for one forest district



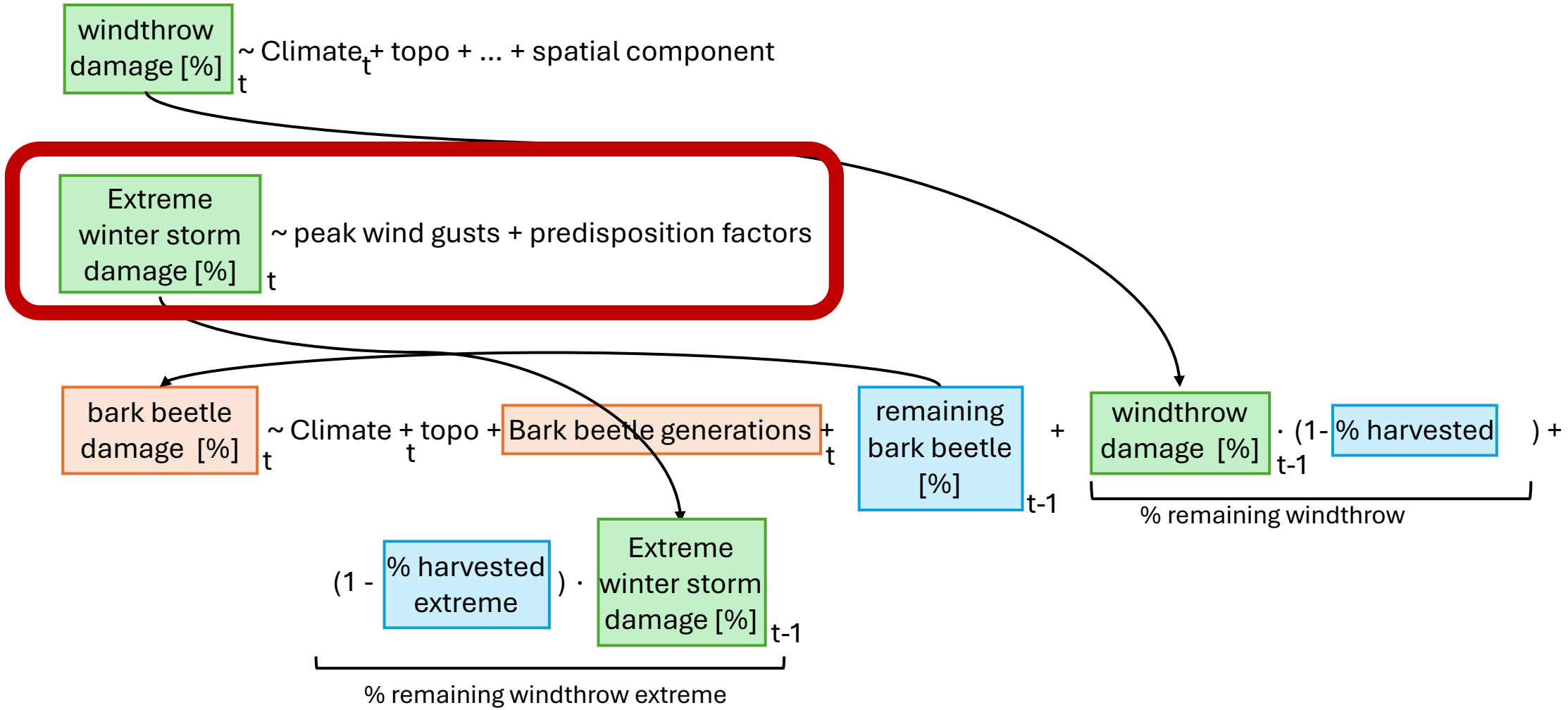
Blue: RCP-4.5 Wet

Green: RCP-4.5 Medium

Red: RCP-8.5 Dry

Disturbance modelling for spruce

Per forest district and year (t)



Modelling winter storms - Data

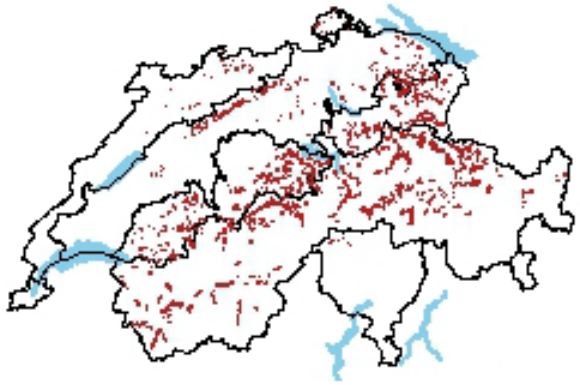
Climate scenarios

Conditions	GCM	RCM	RCP	Resolution
Dry	MOHC-HadGEM2-ES	CLMcom-CCLM4-8-17	8.5	EUR-44
Medium	ICHEC-EC-EARTH	SMHI-RCA4	4.5	EUR-44
Wet	ICHEC-EC-EARTH	DMI-HIRHAM5	4.5	EUR-11

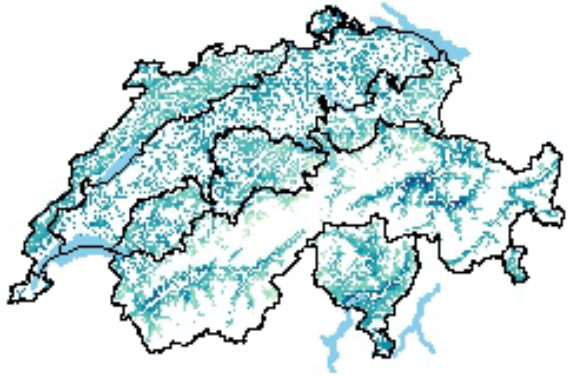
Used for MASSIMO simulations (Brunner *et al*. 2019)

NFI data

Previous winter storms (Lothar 1999 & Vivian 1990)

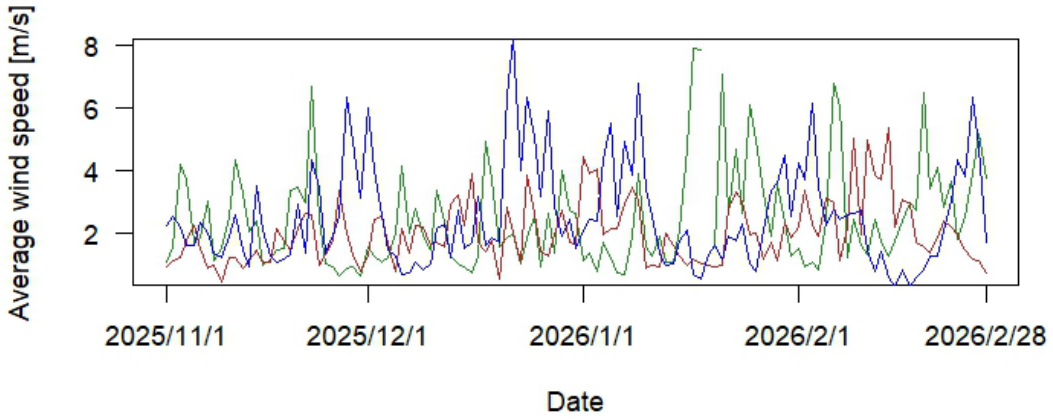


Windstorm gusts at return period of 30/50/100 years



Modelling winter storms

1. Compare climate scenarios per NFI plot



Blue: RCP-4.5 Wet

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2. Check frequency in production regions

- Assuming that winter storms are large scale events affecting many plots within production regions.

Modelling winter storms

How to decide on locations/NFI-plots?

Extreme winter storm damage [%] ~ peak wind gusts + predisposition factors

3. Train a statistical model for selected dates per production region based on

- proportion of damage on NFI plots from Vivian & Lothar
- in relation to important factors, such as

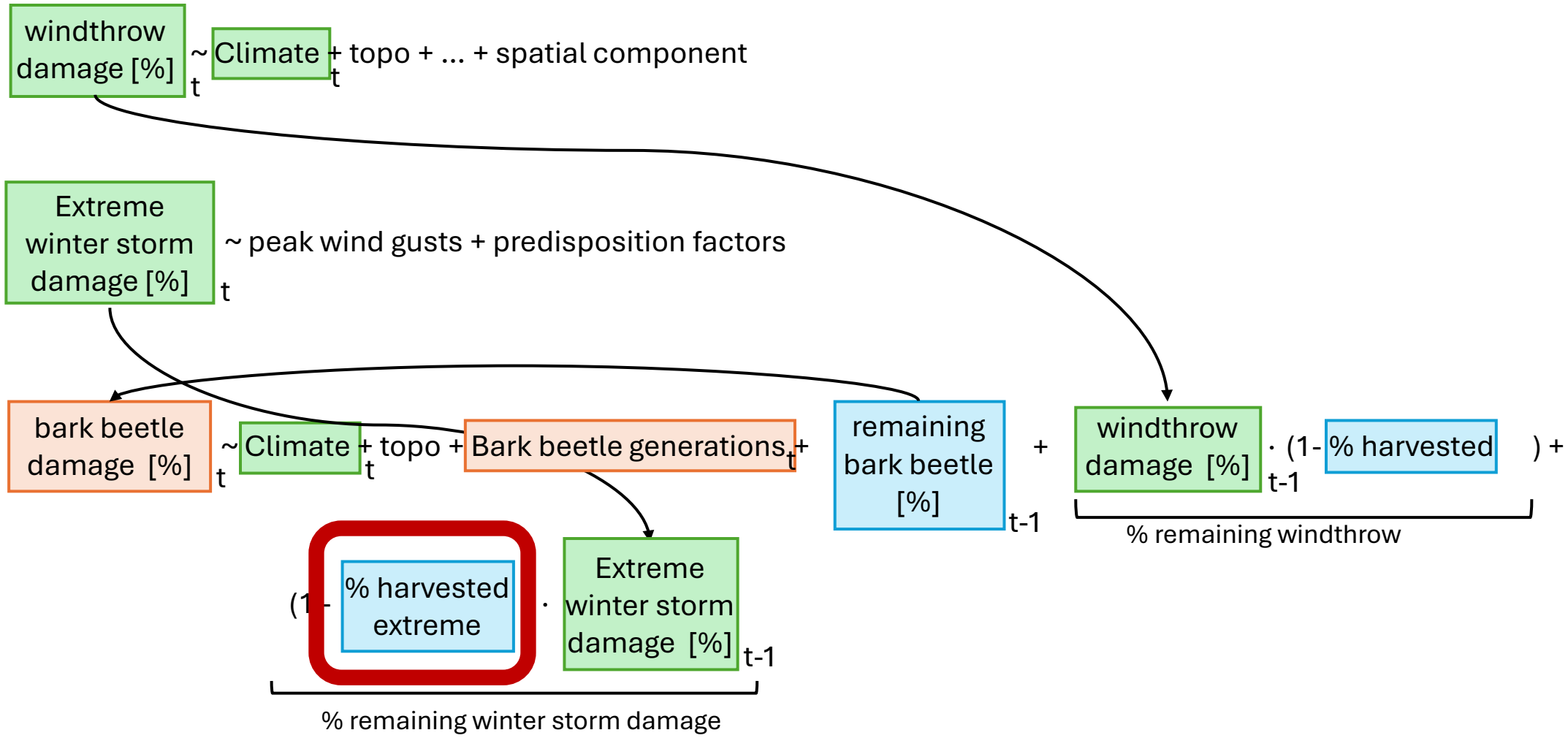
    - windthrow predisposition factors according to literature, e.g. elevation, windexposition, slope, soil depth, TWI
    - predicted return gust speeds (Meteo Schweiz)

4. Upscale potential damage to forest districts

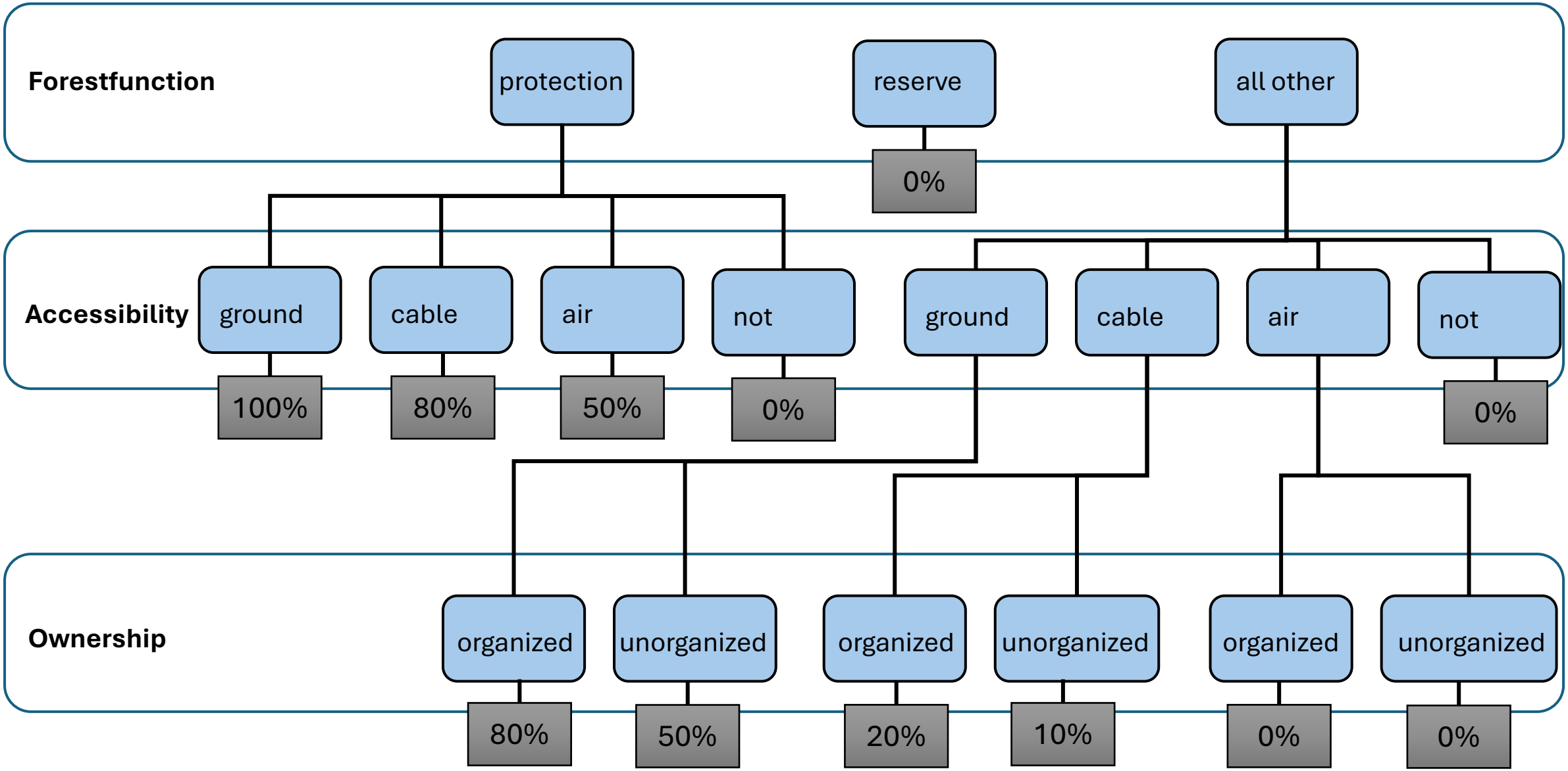
- average of representative NFI plots

Disturbance modelling for spruce

Per forest district and year (t)



Post-Windthrow Management Decision Tree



Thank you!


I ASKED AROUND AND NOBODY HEARD ANYTHING
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