Optimising Multi-functional Forest Management on the Individual-Tree Level

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Background

STATUS

European forests are expected to provide biodiversity and multiple ecosystem services (BES) [1]:

Biodiversity Timber Recreation

There are trade-offs between different ecosystem services.

Climate change increases the risk of natural disturbances in forests [2]:

Forest fires Pests Drought

Natural disturbances threaten the ability to provide BES [3].

Advances in Earth sensing & AI enable the large-scale collection of individual-tree data [4]:

Earth sensing Individual-tree data

However, forest management rarely uses this data.

CHALLENGE

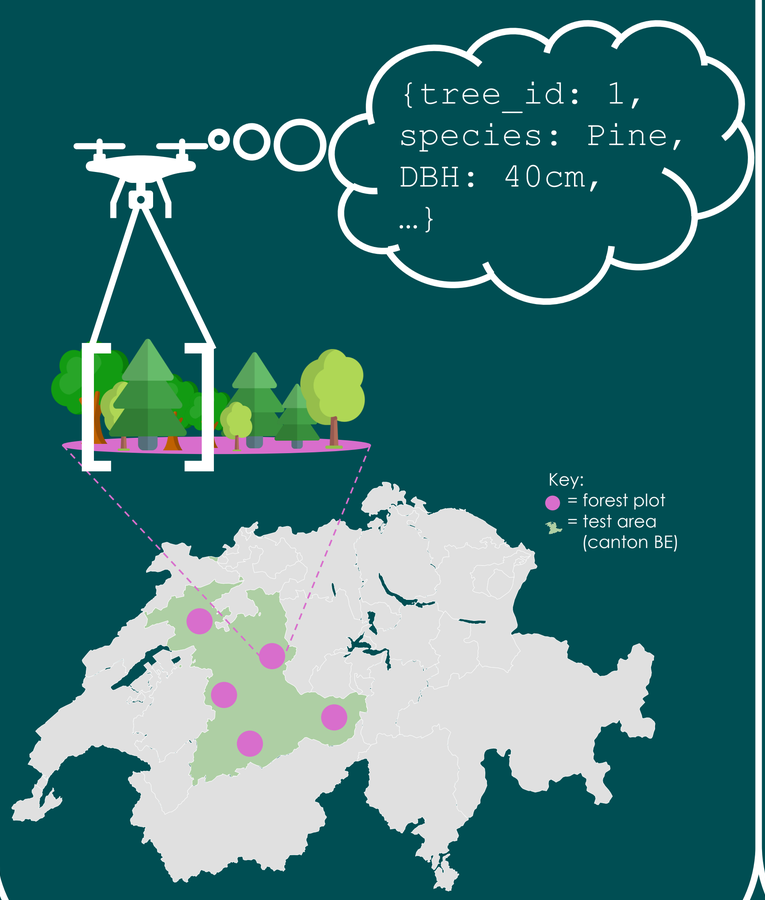
Objective and Hypothesis

We design an optimisation routine for individual-tree management decisions - addressing multifunctional management objectives while fostering resilience to natural disturbances - and compare this against current forest management.

Hypothesis: optimised individual-tree management improves ecosystem service provision and forest resilience.

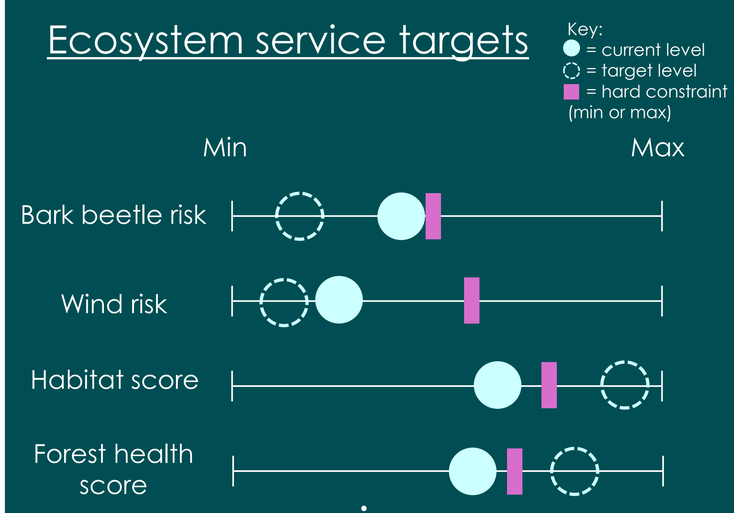
Methodology

Data: collect single-tree data with Earth sensing technology and extract features with AI.



Objectives and constraints: specify management, local BES targets and constraints.

Ecosystem service targets



Additional constraints

Do not harvest habitat trees

Conform to local forest management regulations

Optimisation: solve for the optimal forest management plan with mixed integer programming and evaluate the solution against the status quo.

Optimal solution

vs

Existing strategy

Habitat score increases by X%

Beetle risk increases by Y%

Outlook

- Does optimised individual-tree management improve biodiversity, ecosystem service provision and forest resilience?
- Our results will inform multifunctional forest management in a changing climate.

References

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