The role of forest recovery from biotic and abiotic threats for risk resilient management

Prof. Dr. Anja Rammig & **Dr. Konstantin Gregor**

Technical University of Munich

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Funded by the European Union

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Aims

1. Provide strategies for sustainable forest management in a changing climate

2. Understand the dynamics of disturbances in European forests

3. Investigate and predict recovery patterns after disturbance

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Addressing constraints of sustainable forest management

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

EU Biodiversity Strategy for 2030

Bringing nature back into our lives

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

New EU Forest Strategy for 2030

REGULATION (EU) 2018/841 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 30 May 2018

on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARL

Protect 30% of EU land area
Strictly protect 10% of EU land area

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Improve multi-functionality
Promote mixed forests

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EU forests must be a sink in every country
Total EU forest sink of 310 $MtCO_2/yr$

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EU forests must be a sink in every country
Total EU forest sink of 310 $MtCO_2$/yr

→ all the while wood demand is increasing!

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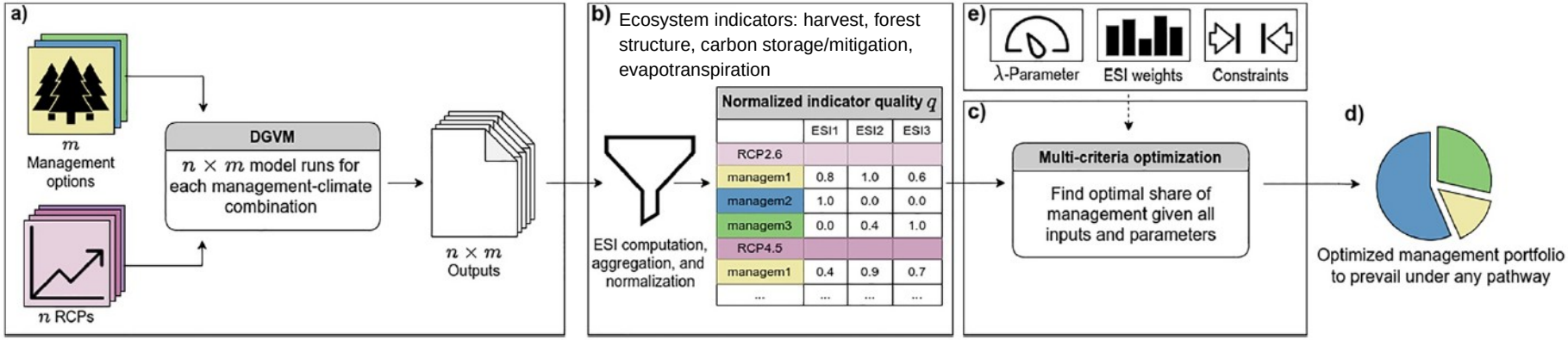
Using dynamic vegetation modelling and robust optimization



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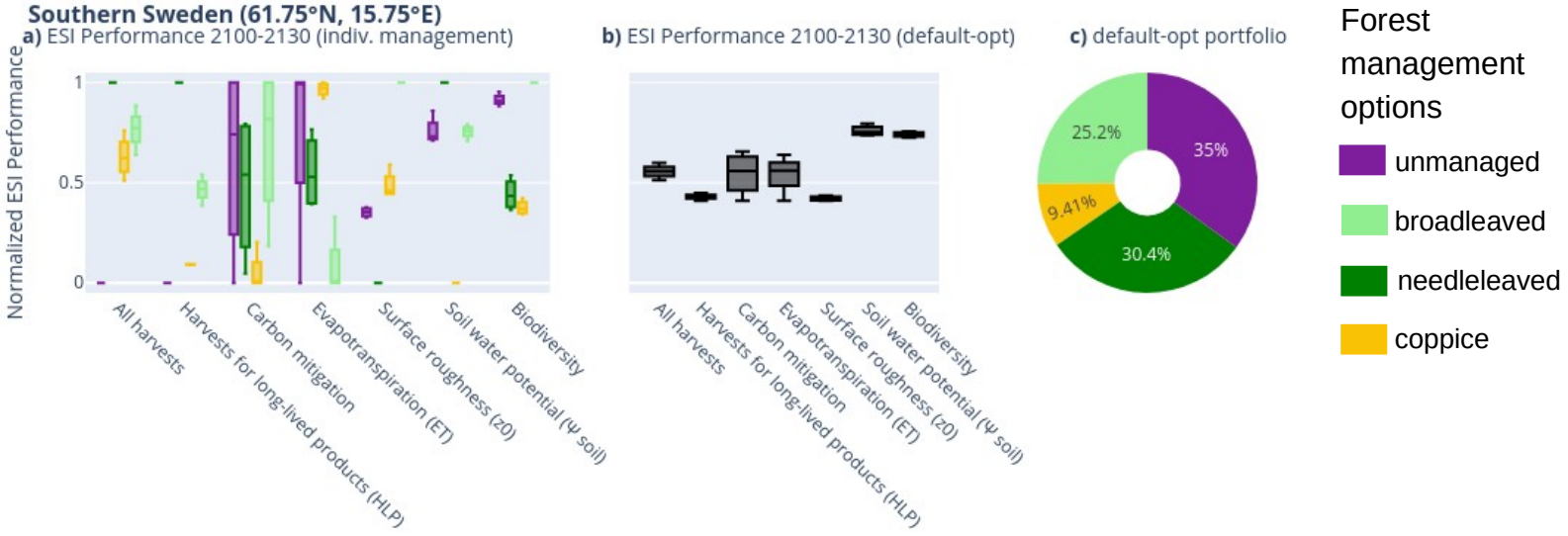

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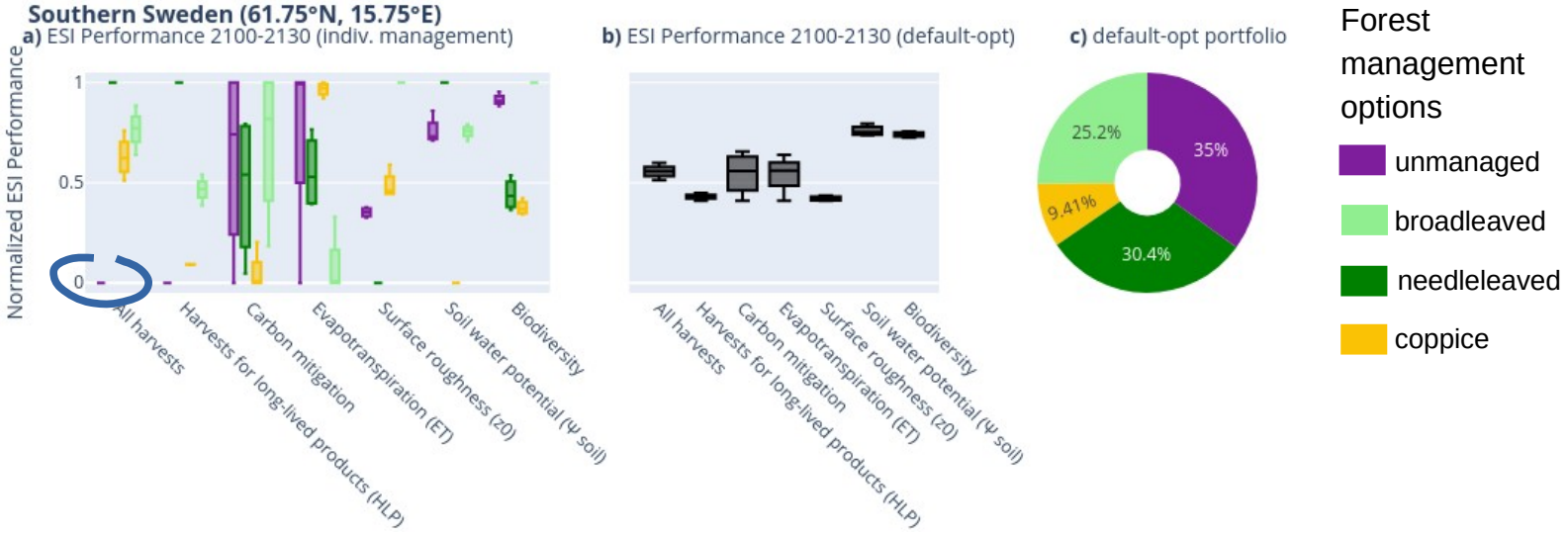

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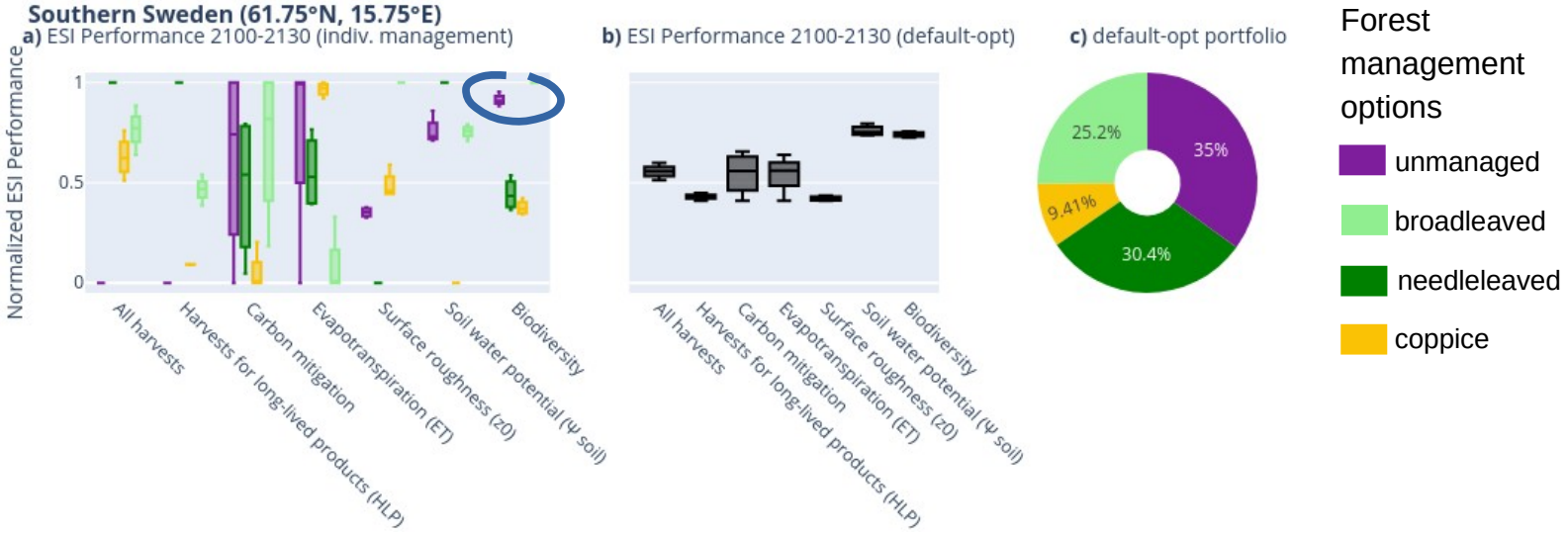

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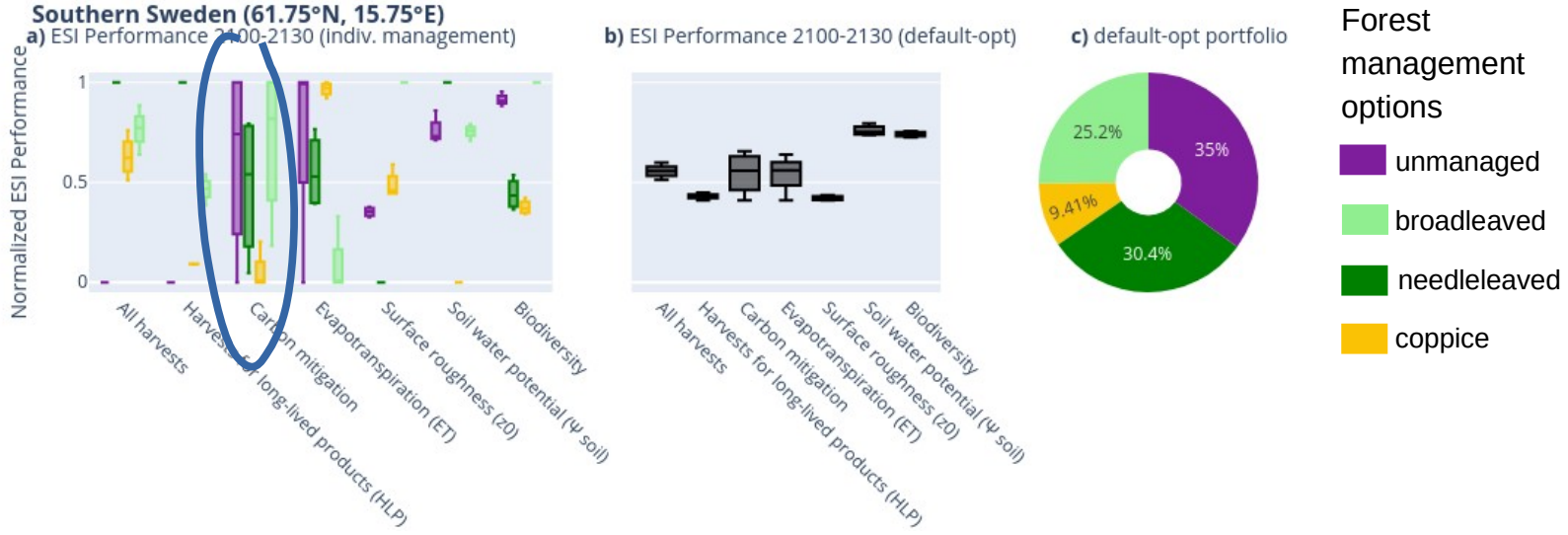

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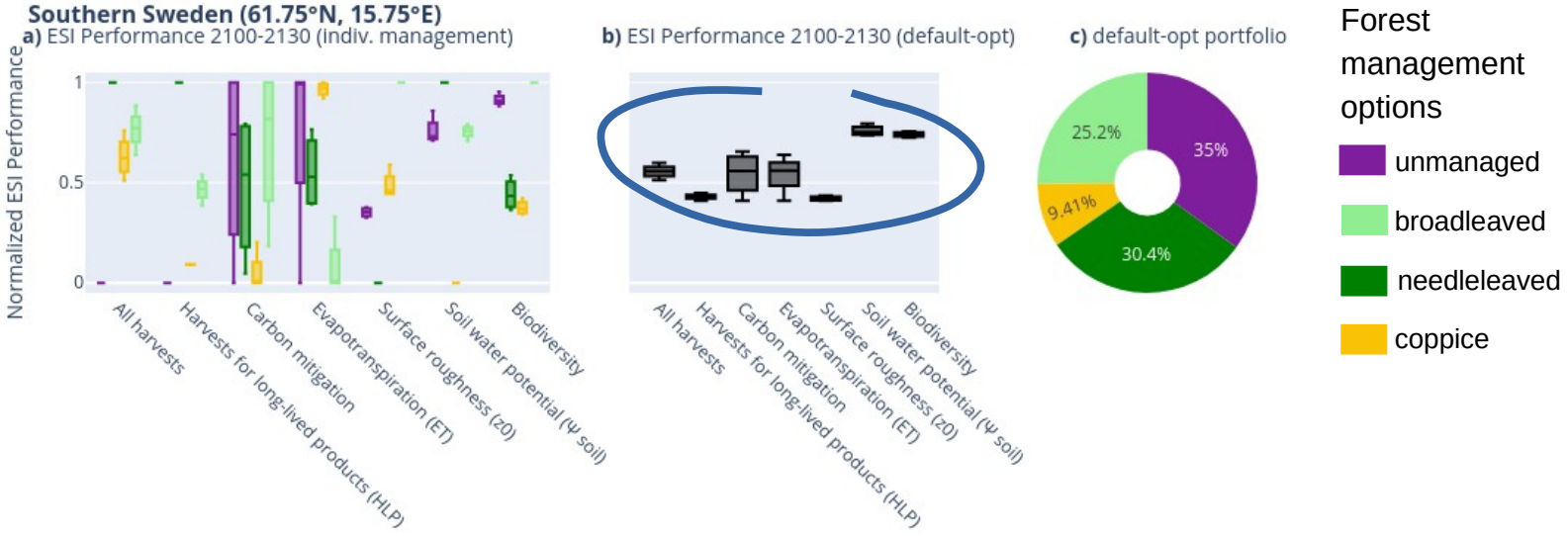

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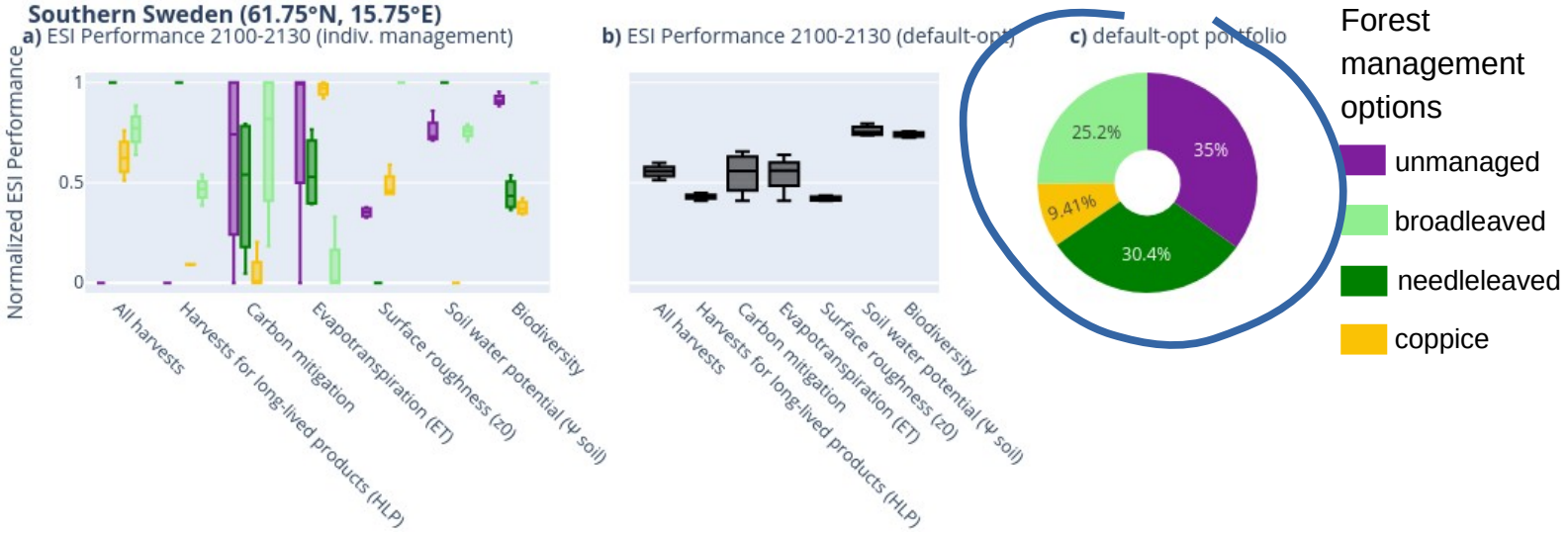

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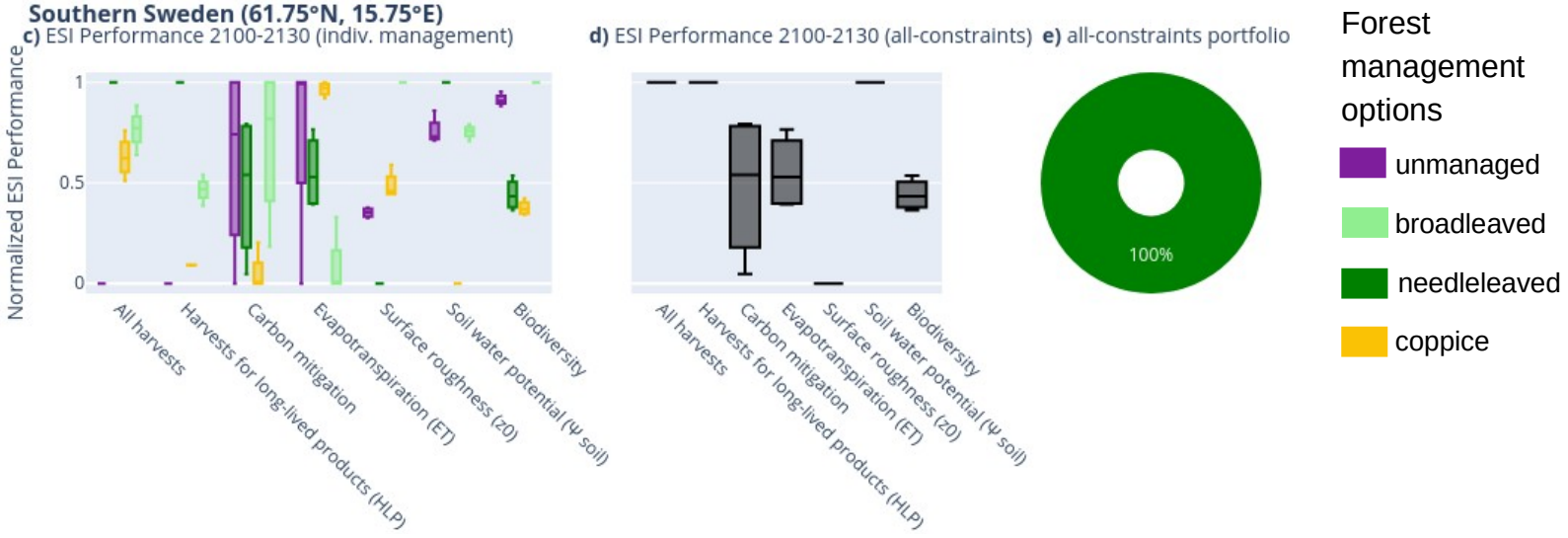
Addressing constraints of sustainable forest management

+ Add constraints

- ✓ *Enforce stable harvest levels*
- ✓ *Enforce strict protection on 10% of land area*
- ✓ *“Hard constraints”: must be met under all scenarios*



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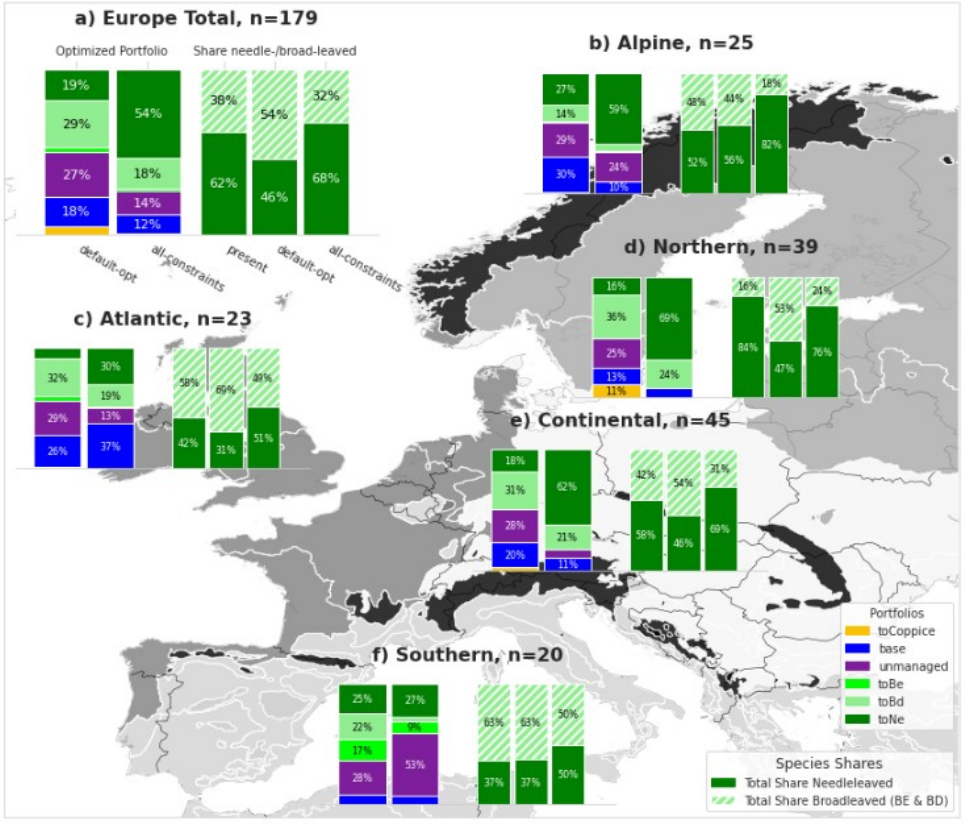

Constraints heavily restrict the balanced provision of ecosystem services

Less diversification

Gregor, K., Reyer, C. P. O., Nagel, T. A., Mäkelä, A., Krause, A., Knoke, T., & Rammig, A. (2024). Reconciling the EU forest, biodiversity, and climate strategies. Global Change Biology, 30(8), e17431.

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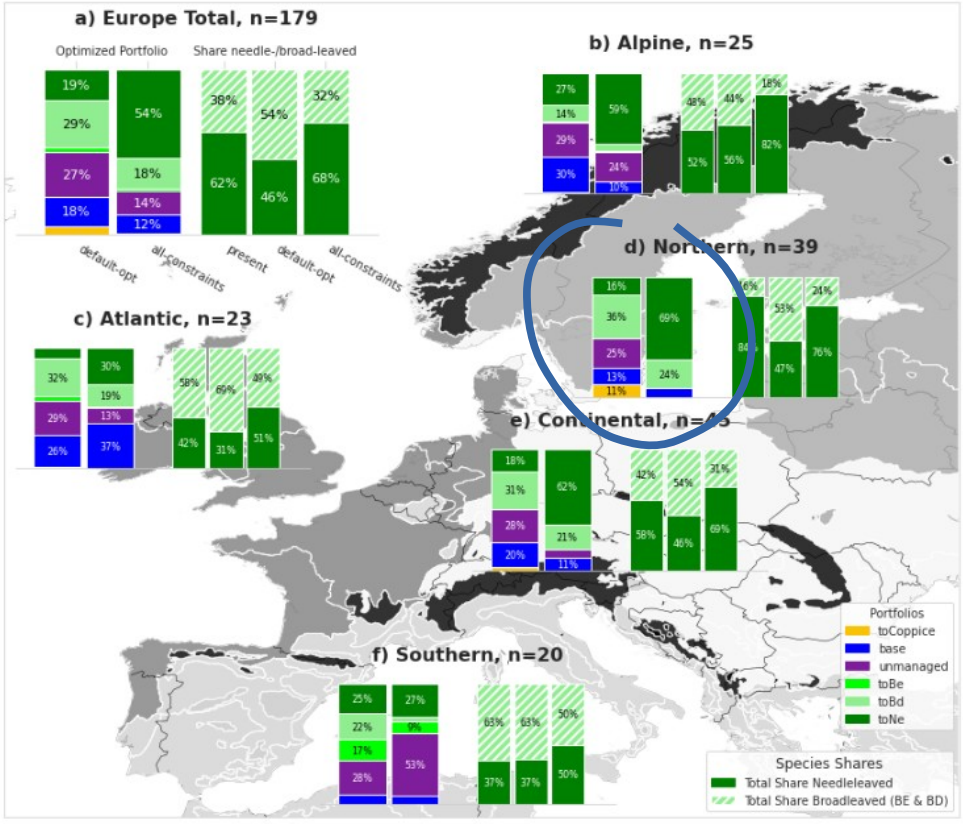

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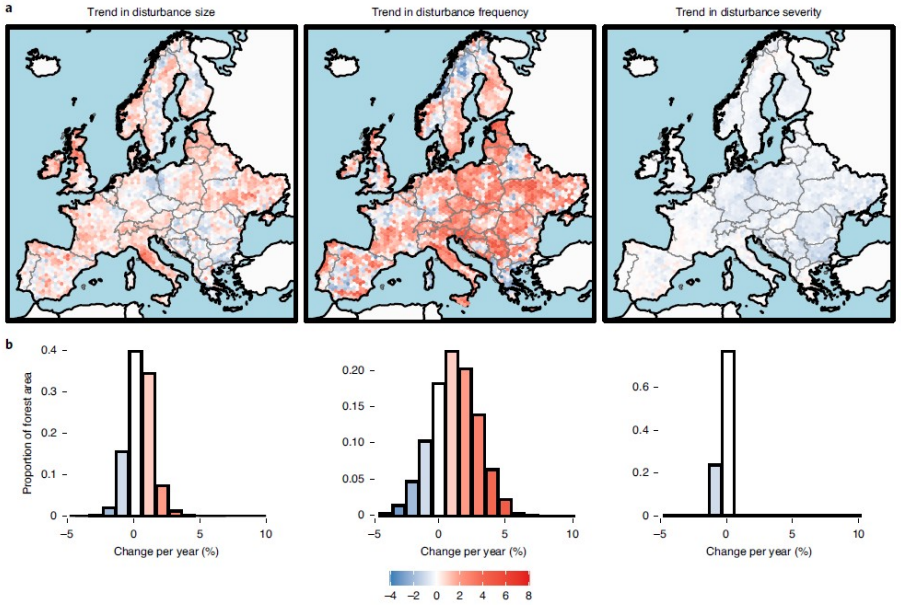
Understanding disturbance dynamics

- Disturbance size and frequency are increasing across Europe.
- Additional increase with future climate change is expected.
- Implementation in models ongoing.



From Senf & Seidl 2021

Understanding disturbance dynamics

- Bark beetles are a key disturbance agent in Europe
- Their impact is not adequately included in models
- The group at Lund University implemented a new bark beetle module into LPJ-GUESS

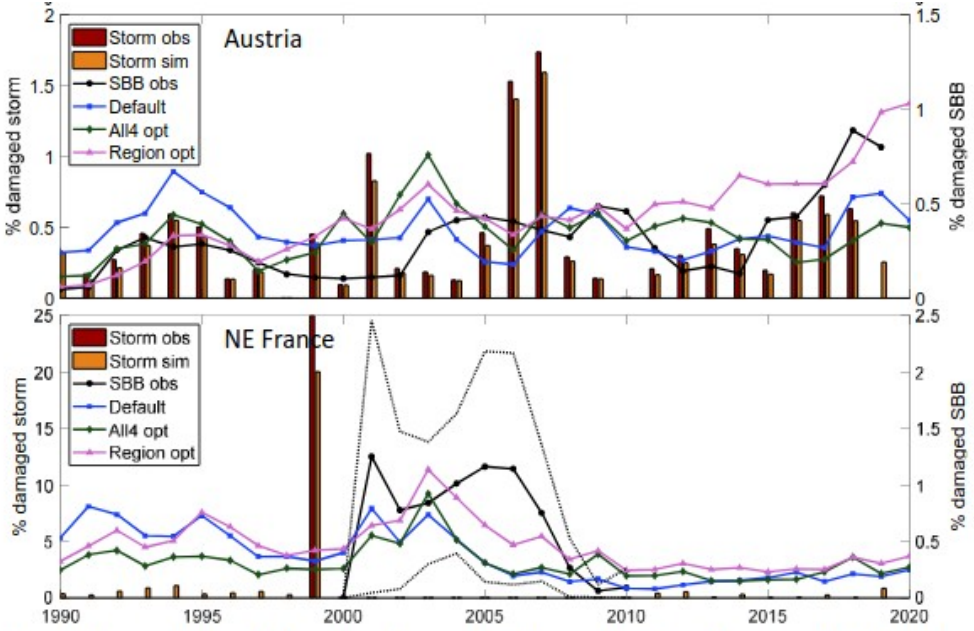


Figure 3: Observed and modelled fraction of spruce forest damaged by storm (left y-axis) and SBB (right y-axis) in four regions/countries, with modelled SBB damage from different parameter settings (Table 3) in the main base run. For Sweden (n = 10), Switzerland (n =2) and France (n = 5) +/- standard deviation between regions in observed SBB damage is shown with dotted lines.

Lagergren, F., Jönsson, A. M., Lindeskog, M., and Pugh, T. A. M.: Combining empirical and mechanistic understanding of spruce bark beetle outbreak dynamics in the LPJ-GUESS (v4.1, r13130) vegetation model (accepted), Geosci. Model Dev., https://doi.org/10.5194/gmd-2024-239

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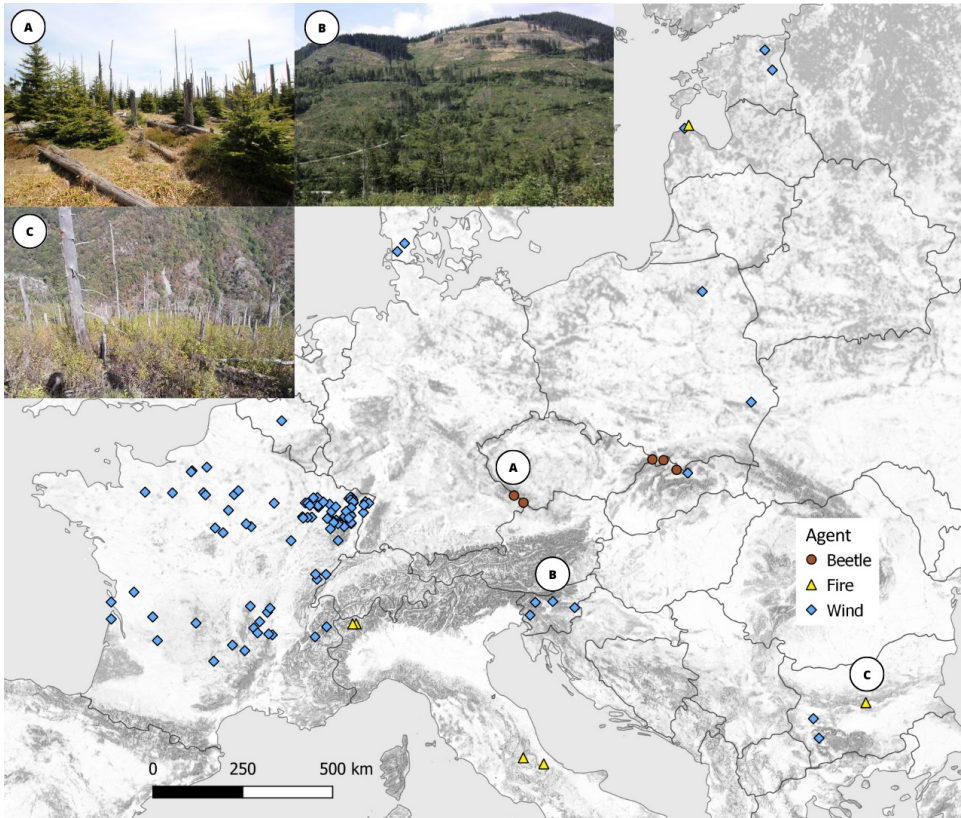
Recovery patterns after disturbance

- Reports on regeneration failure after large-scale disturbances under dry and warm conditions.
- Assessment of post-disturbance tree density, structure, and composition at 143 sites across European temperate forests.



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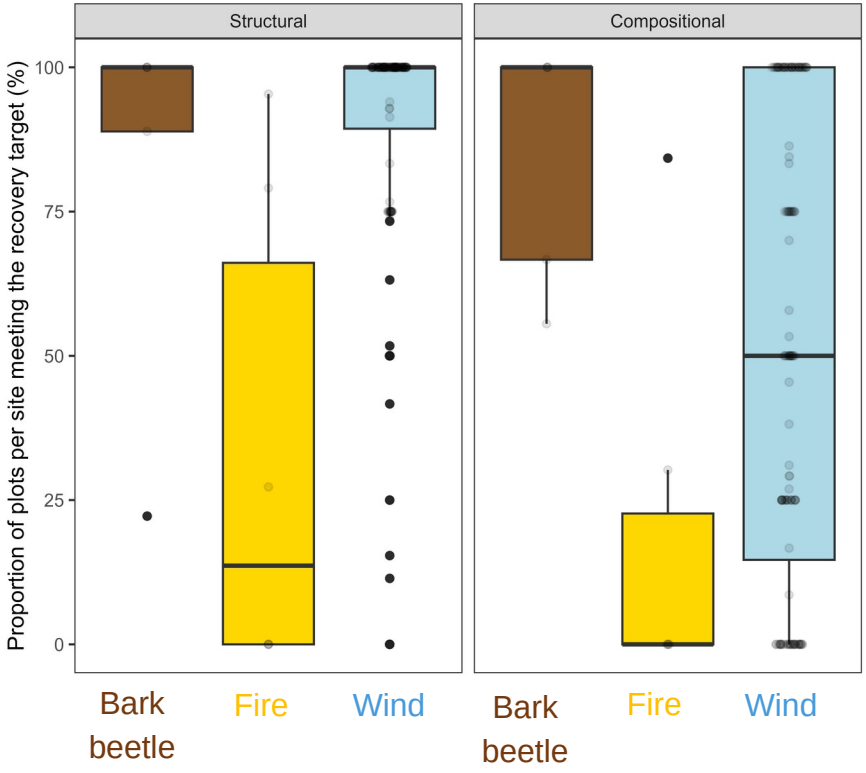
Recovery patterns after disturbance

- Reports on regeneration failure after large-scale disturbances under dry and warm conditions.
- Assessment of post-disturbance tree density, structure, and composition at 143 sites across European temperate forests.
- Generally high recovery potential ~18 years after large-severe disturbances
  - but not after fire!
- Structural recovery generally higher than compositional recovery.



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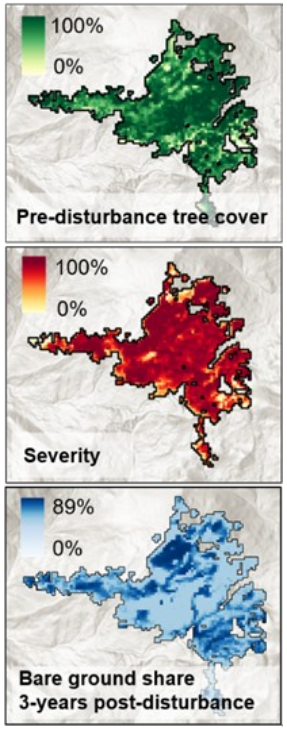
Mapping recovery from space

- Novel ecologically informed, tree-based recovery indicator from Landsat and Sentinel 2 based on spectral unmixing
- Effectively distinguishes tree regeneration from other post-disturbance vegetation (shrubs etc.).
- Considerably more realistic recovery intervals than approaches based on spectral indices.

Recovery after a storm event in Crnivec, SIovenia, 2008



Mandl et al. (2024), Unmixing-based forest recovery indicators for predicting long-term recovery success. Remote Sensing of Environment (308) 114194

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- Effectively distinguishes tree regeneration from other post-disturbance vegetation (shrubs etc.).
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- Predict the long-term forest recovery success based on short time series.
- Suitable for monitoring and forest management.

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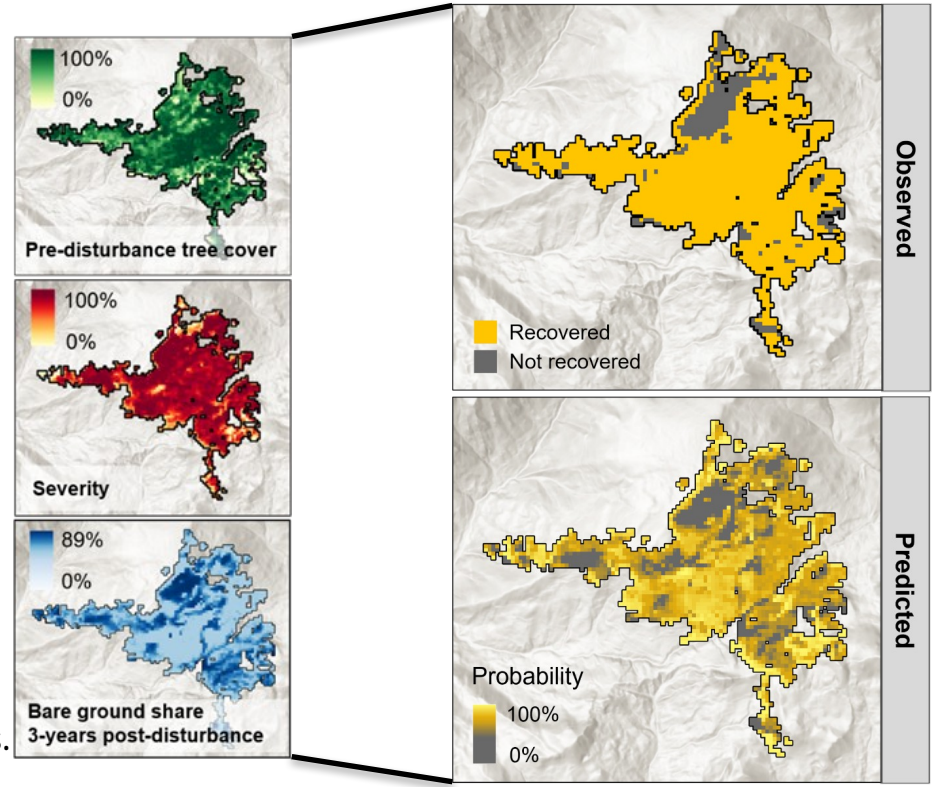

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Summary

- We provide novel tools to evaluate and monitor
  - sustainable forest management
  - forest disturbances
  - and forest recovery after disturbances.
- We are happy to share and distribute our results, please get in touch!

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Thank you!

Lisa Mandl, Cornelius Senf, Tom Nagel, Tom Pugh, Thomas Knoke, Konstantin Gregor, Joao Darela, Gal Fidej, Mats Lindeskog, Anna Maria Jönsson, Fredrik Lagergren, Karl Piltz, Annemarie Eckes-Shepard, Matteo Cerioni, …

Project partners:
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University of Ljubljana, Slowenia
Lund University, Sweden
European State Forest Association (EUSTAFOR)
FSC International
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