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Forest carbon, deadwood and harvests in German forests under future climate, nature protection and disturbance scenarios

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Introduction

- Climate change affects the growing conditions for trees and disturbance dynamics.
- Societal demands are changing: increasing focus on biodiversity protection but also on climate change mitigation.
- These shifts in management focus either on carbon storage in the forest or on the provisioning of wood products that substitute carbon-intensive materials while maintaining a forest carbon sink.
- This implies trade-offs between different ecosystem services in different nature protection strategies.
- We study the effect of different nature protection aims on forest stemwood carbon, deadwood and harvests.

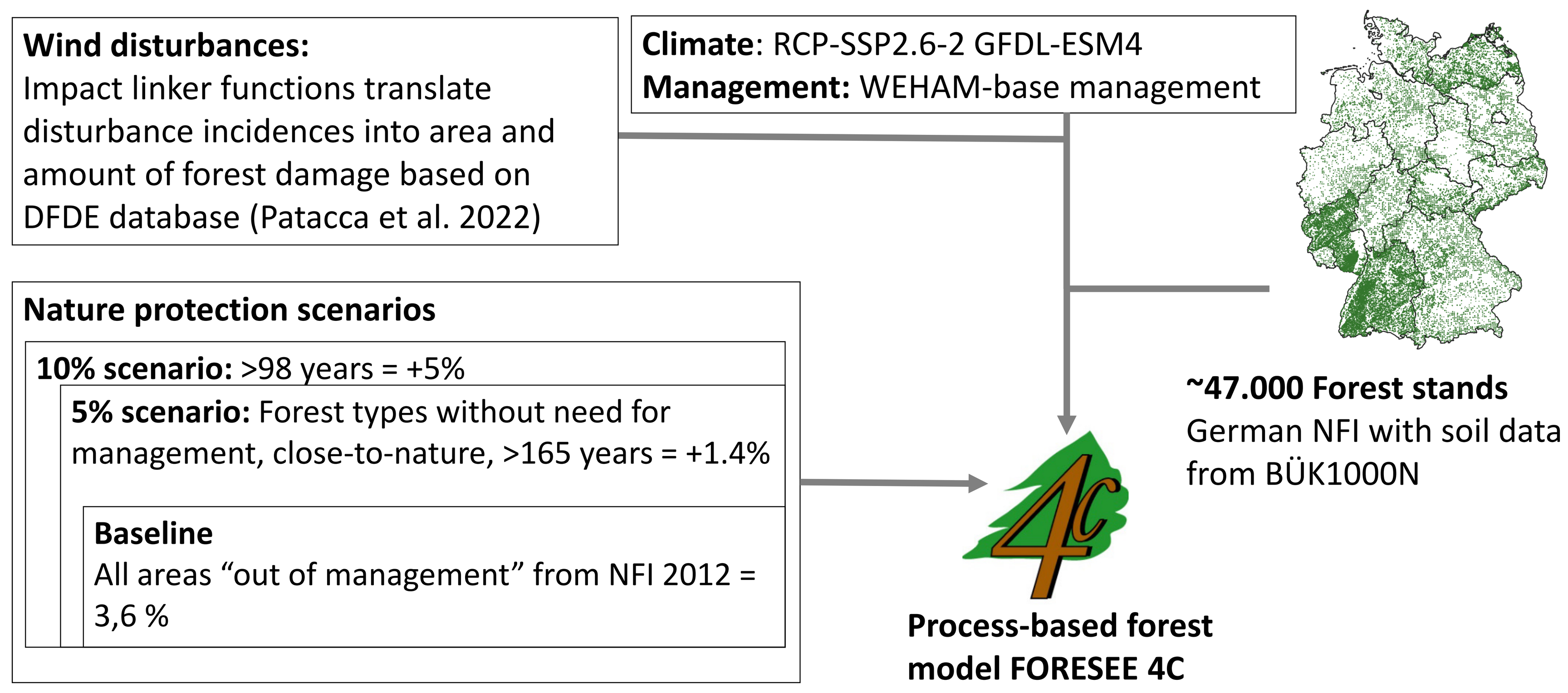

Fig. 1 *Overview of methods, data and simulation set-up.*

Simulation design and model evaluation

- Simulate growth and dynamics of German forests until 2050 under future climate, wind, management and nature protection scenarios (Fig.1).
- Simulation design to test for effects of disturbances (on/off), forest management (on/off) combined with different degrees of forest protection (baseline, 5% and 10% of forest area protected).
- Simulations overestimate disturbance damage compared to the observed 2000-2021 average (Fig. 2).
- Simulated stem biomass stock decreases after initialisation for some 20 years which is likely due to an overestimation of mortality in 4C (Fig. 2).

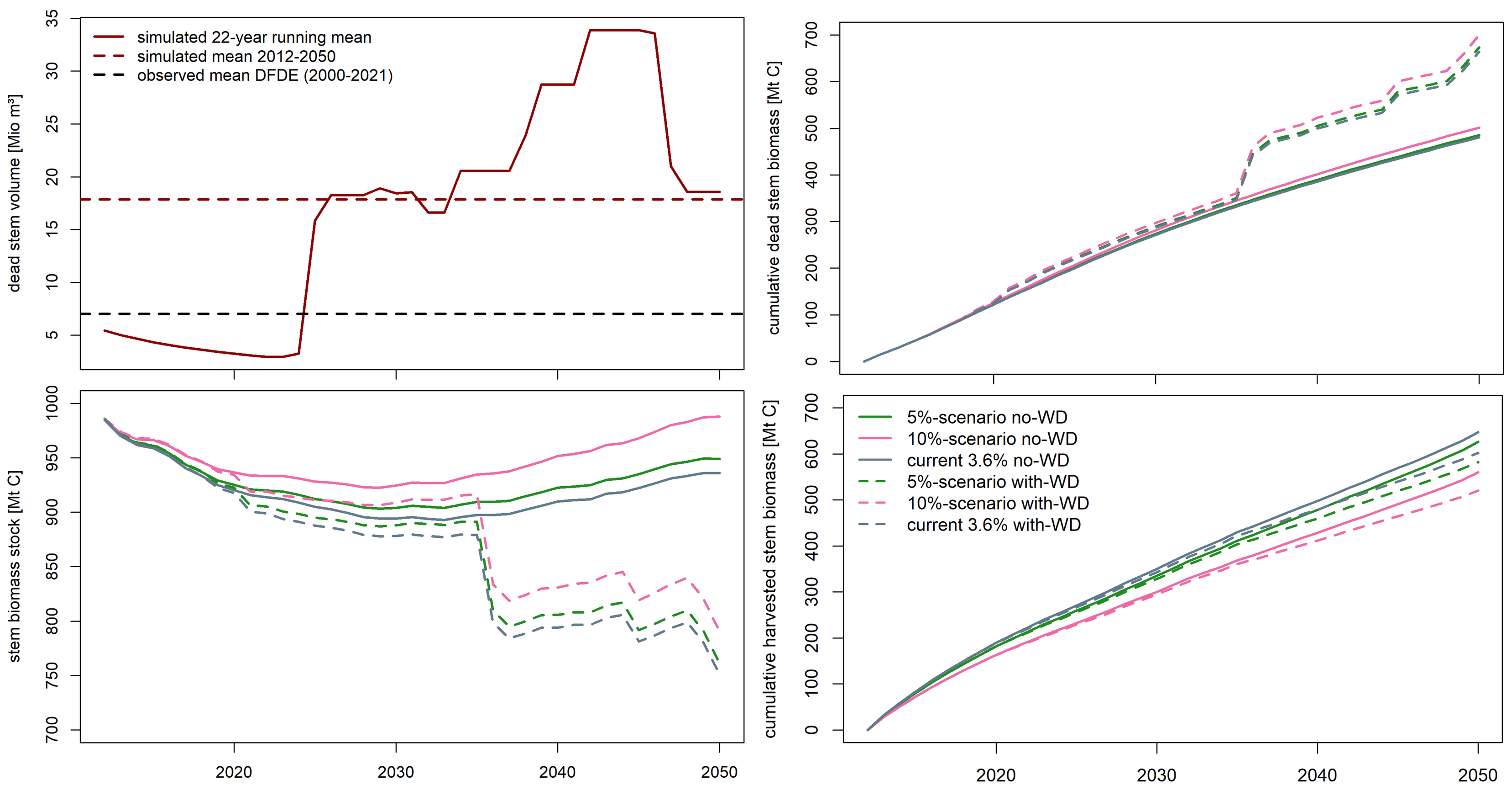

Fig. 2 *Simulated and observed deadwood due to storms (upper left) and time series of the simulated cumulative dead stem biomass (deadwood, upper right), stem biomass stock (standing stock, lower left) and cumulative harvested stem biomass (harvests, lower right).*

Results

- Simulations including wind disturbances result in lower standing stem biomass as well as cumulative harvests (in 4C damaged wood is not harvested) while cumulative deadwood is higher (Fig. 2 & 3)
- Deadwood dynamics are strongly influenced by wind disturbances and much less by the nature protection scenario (Fig. 2 & 3).
- For harvests and stem biomass stock the effects of disturbances and nature protection strategy are similar in magnitude (Fig. 2 & 3).
- There is no clear spatial pattern, central and southern Germany are hotspots (Figure 4).

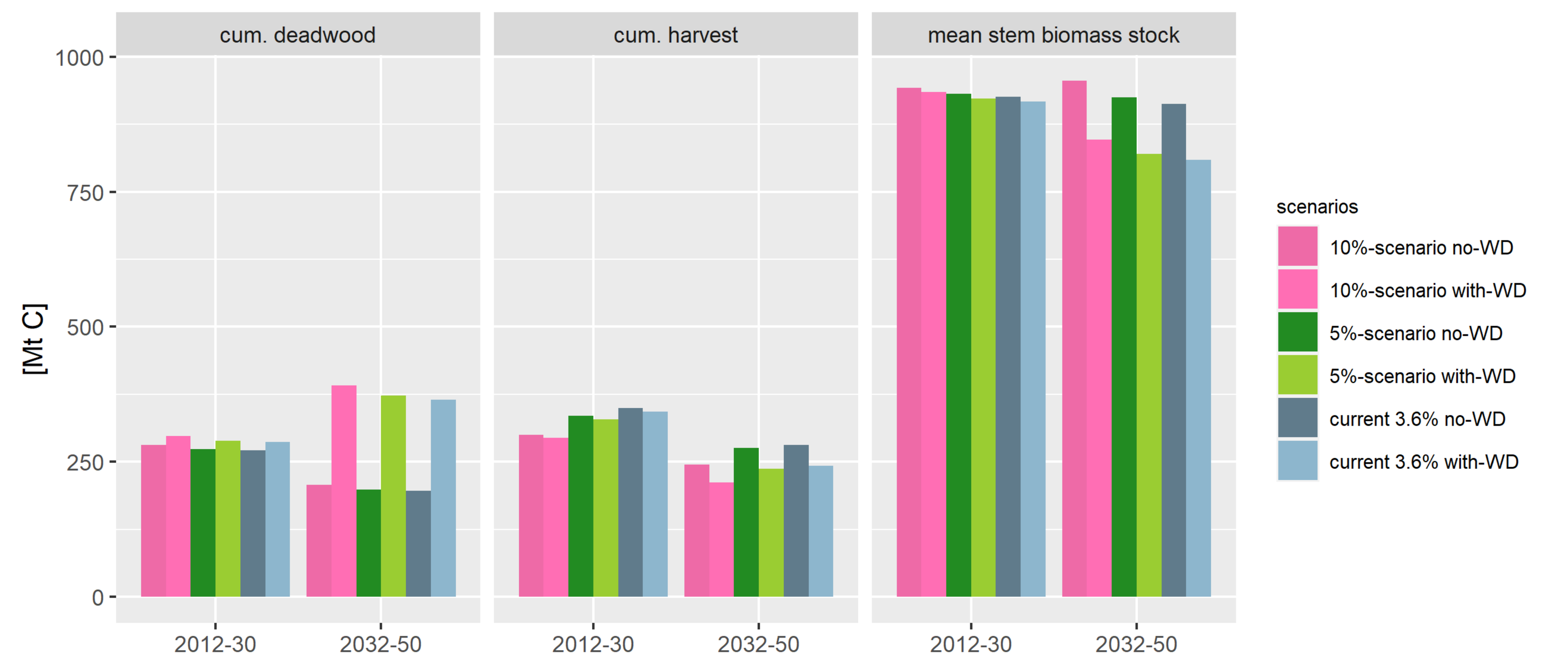

Fig. 3 *Cumulative deadwood, cumulative harvests and mean stem biomass stock for the period 2012-2030 and the period 2032-2050 for Germany under different nature protection scenarios (10%, 5% and current 3.6%) and including or excluding wind damage (WD).*

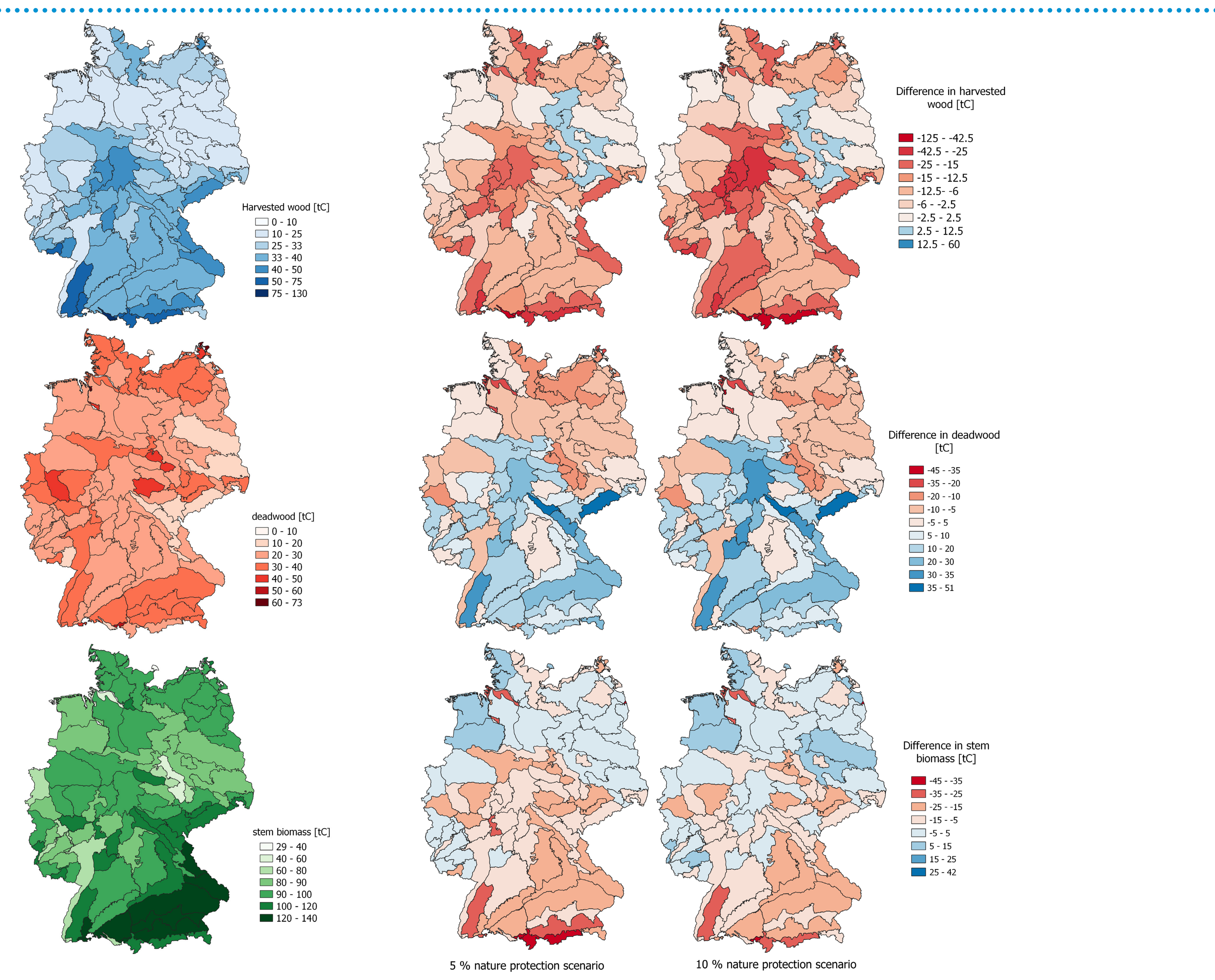

Fig. 4 *Cumulative deadwood, cumulative harvests and stem biomass stock for the period 2012-2030 under the current nature protection scheme (left column) and the difference for the 5% and 10% scenario for 2032-2050 for Germany including wind damage (middle, right column).*

Discussion & Next steps

- More realistic evaluation with actual storm damage time series.
- Improving simulated wind damage by calibrating the number of NFI plots affected and adjusting the linker function.
- Interaction of storm occurrence and management to be improved.
- Inclusion of more climate (ISIMIP) and management (deviations from WEHAM Baseline) and disturbances (I-Maestro) scenarios as well as a wider range of ecosystem services.

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Literature:
Patacca et al. (2022) submitted DFDE paper.
BÜK1000N V2.31, (C) BGR, Hannover, 2013.

I-MAESTRO

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