Emerging climate risks and vulnerability of EU forests

Alessandro Cescatti

Giovanni Forzieri, Marco Girarello, Guido Ceccherini, Ramdane Alkama, Agata Elia, Samuele Capobianco, Matteo Piccardo, Mark Pickering, Luca Caporaso

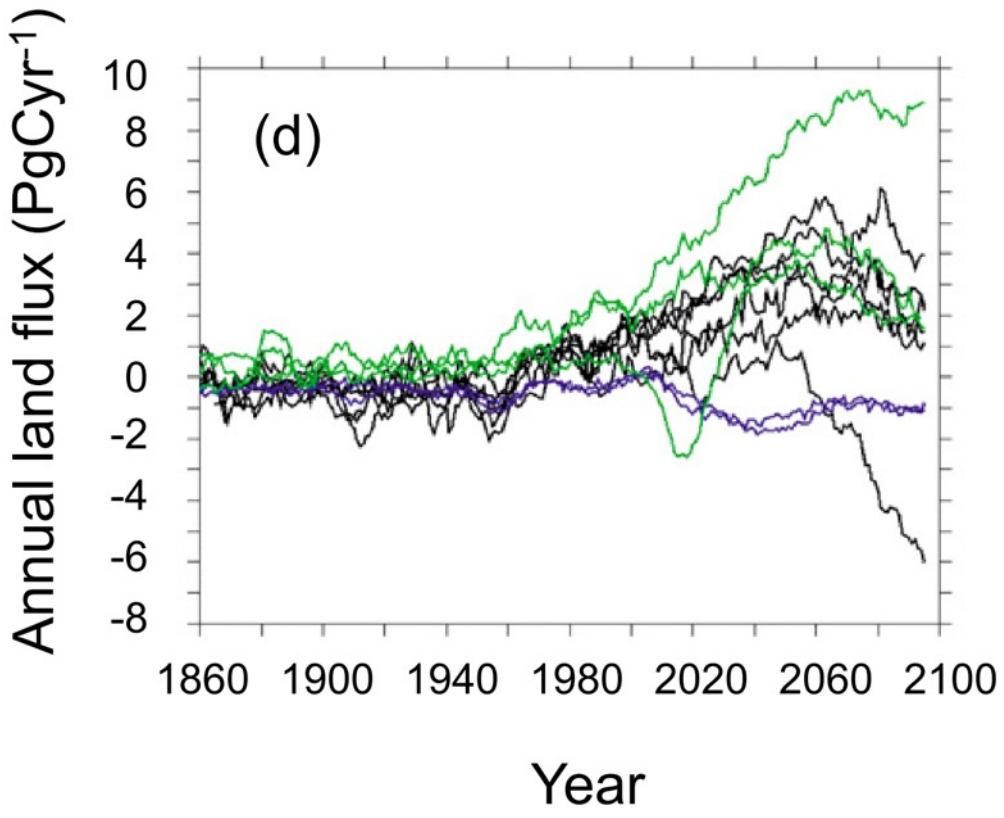
Joint Research Centre

28, June 2022

JRC Directorate D - Sustainable Resources

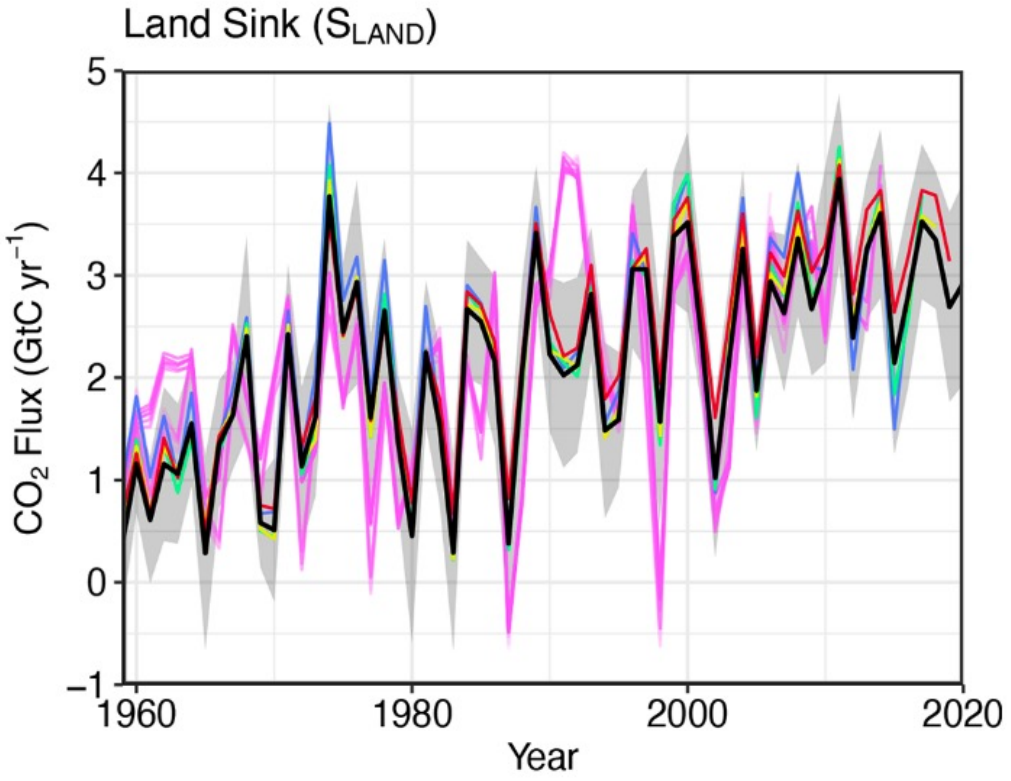
The uncertain trajectory of the terrestrial C sink

CMIP5



Friedlingstein et al., 2014

GCP 2021



Friedlingstein et al., 2022, ESSD

What is driving the saturation of the land sink?

Decline in photosynthesis related to weakening CO_2 fertilization effects?

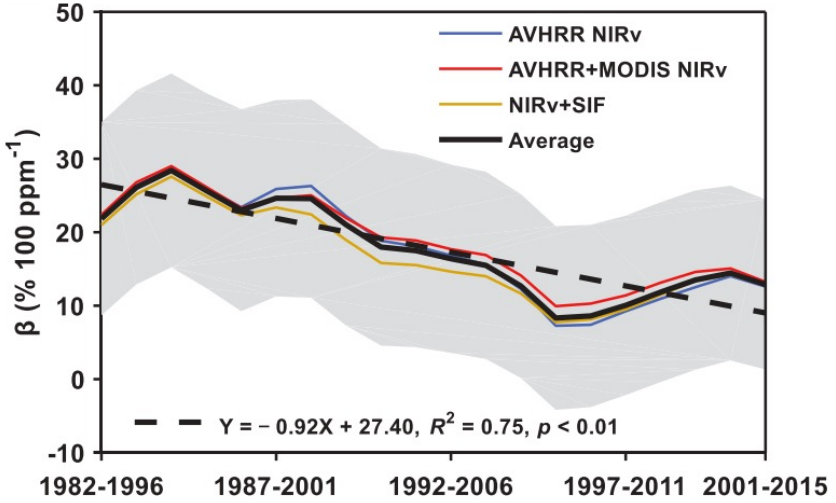
RESEARCH

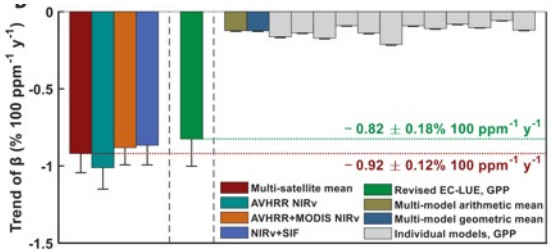
RESEARCH ARTICLE

CLIMATE CHANGE

Recent global decline of CO_2 fertilization effects on vegetation photosynthesis

Songhan Wang[1,2], Yongguang Zhang[1,2,3]*, Weimin Ju[1,2], Jing M. Chen[1,4], Philippe Ciais[5], Alessandro Cescatti[6], Jordi Sardans[7,8], Ivan A. Janssens[9], Mousong Wu[1,2], Joseph A. Berry[10],

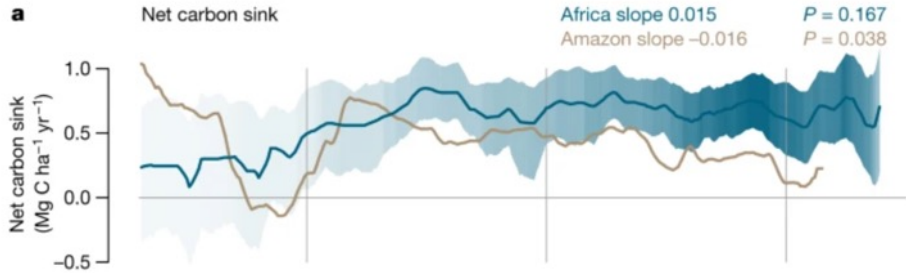




Or increasing in disturbance/mortality/respiration?

Long term decline of the C sink in amazon linked to increase in tree mortality

Fig. 1: Long-term carbon dynamics of structurally intact old-growth tropical forests in Africa and Amazonia.



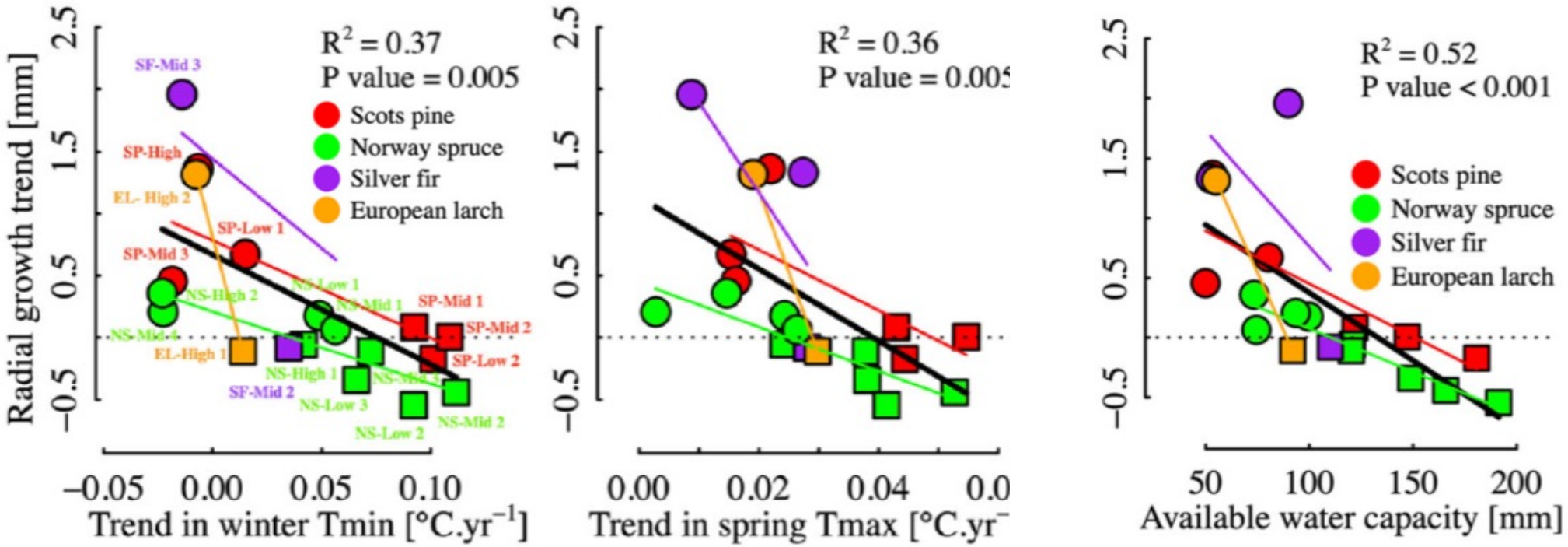
Hubau et al. 2020 Nature

Or both?

European Commission

Emerging signals from National Forest Inventories

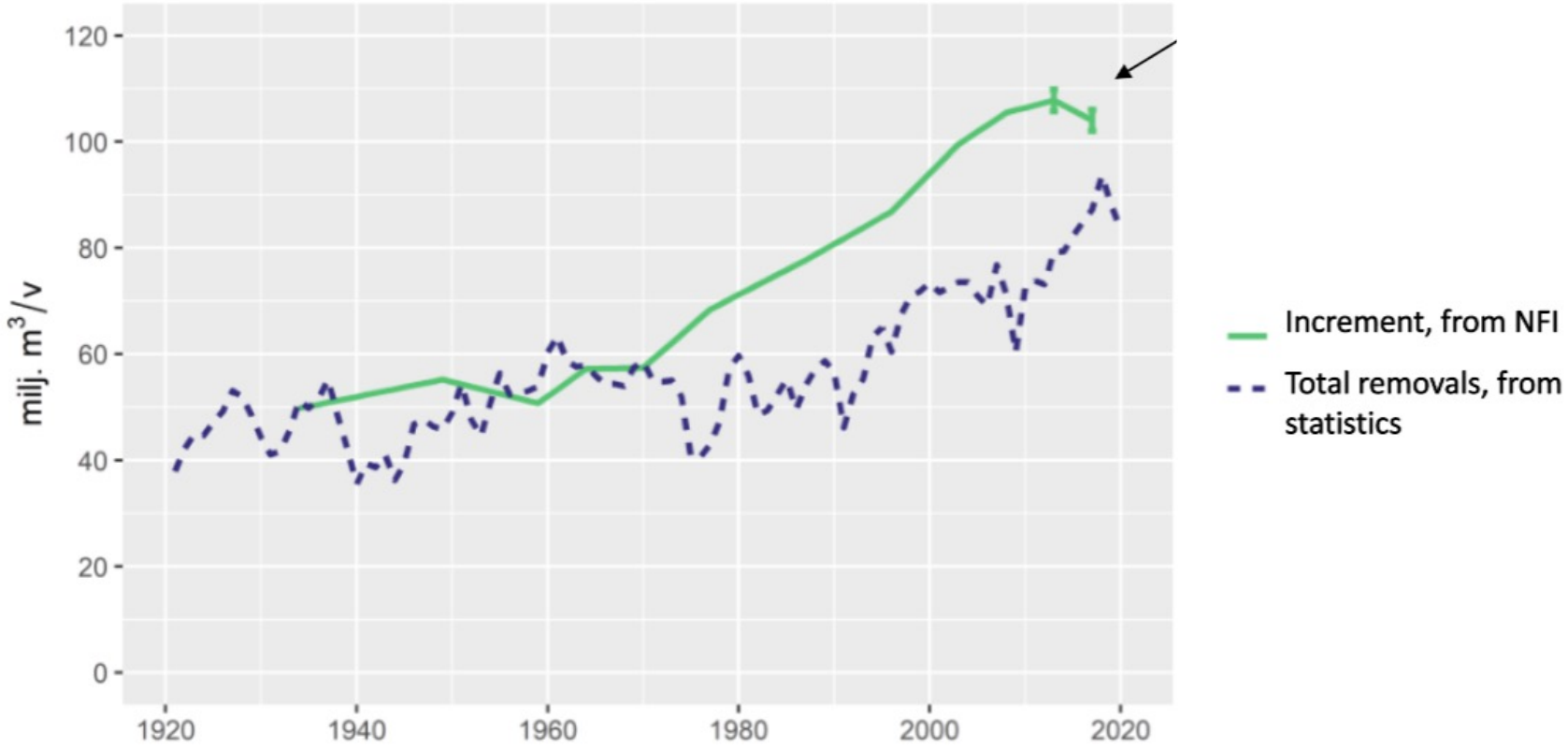
France and Austria: Negative impact of winter and spring warming on the tree growth rate



Courtesy Clémentine OLS

Emerging signals from National Forest Inventories

Finland: Recent observed decline in annual increment from NFI, in parallel to recent increase in total removals (as derived from statistics).



Courtesy Antti Asikainen, LUKE

Tree ring networks

780,000 ring width measurements
5800 trees
324 sampling sites

declining trend of beech growth rate in the last decades

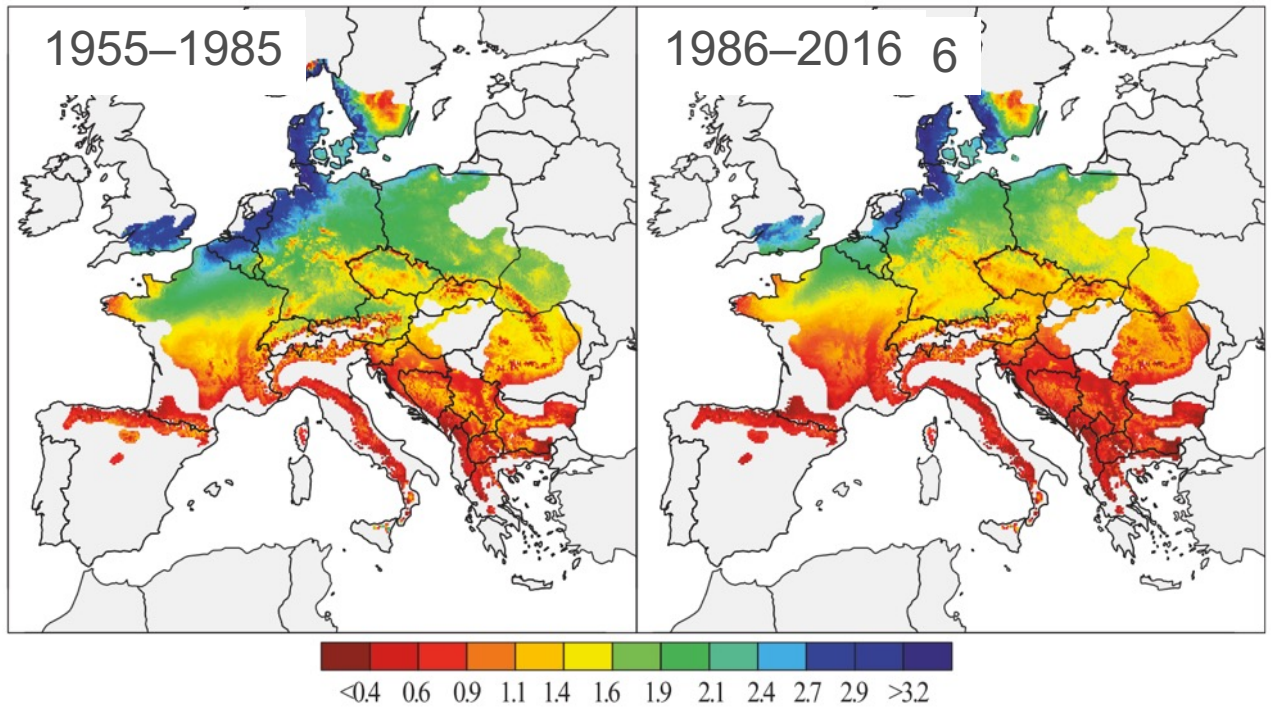
communications biology

ARTICLE

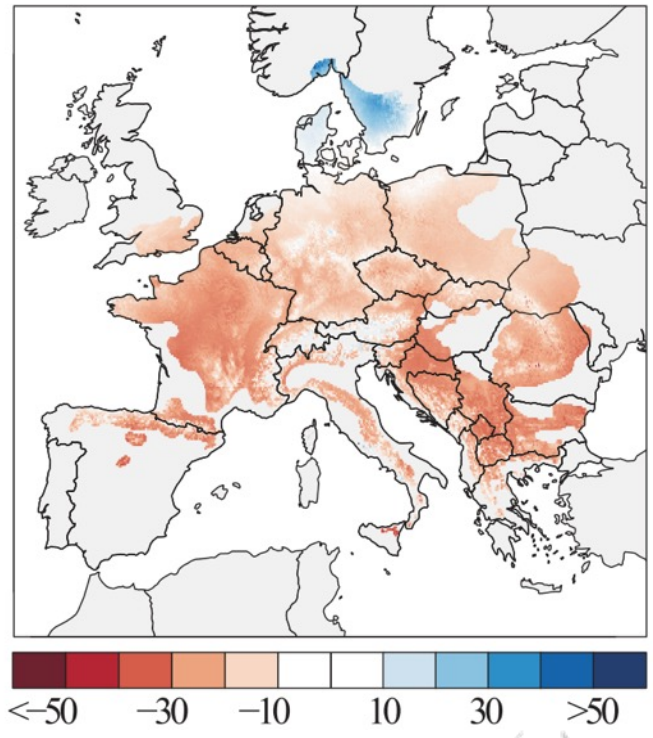
https://doi.org/10.1038/s42003-022-03107-3 OPEN

Climate-change-driven growth decline of European beech forests

Edurne Martinez del Castillo[1✉], Christian S. Zang[2], Allan Buras[3], Andrew Hacket-Pain[4], Jan Esper[1,5], Roberto Serrano-Notivoli[6], Claudia Hartl[7], Robert Weigel[8], Stefan Klesse[9], Victor Resco de Dios[10,11],



European forest beech forests: growth rate in basal area



Relative change in growth rate

Observation-driven modelling of forest vulnerability

Disturbance databases

Forest fires
EFFIS
(~15000)

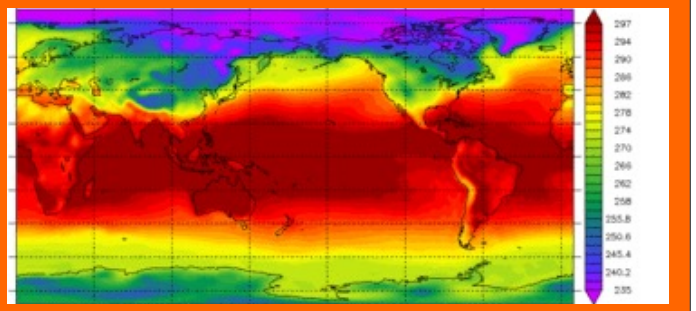
Insect outbreaks
IDS-USDA
(~42000)

Windthrows
FORWIND
(~80000)

Biomass dynamics

Vulnerability functions
Random forest regression

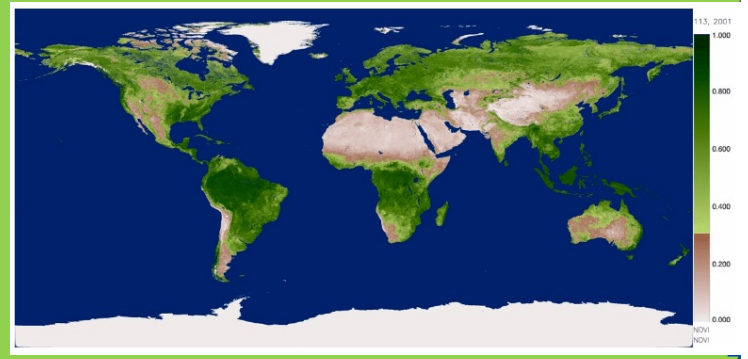
Climate indicators



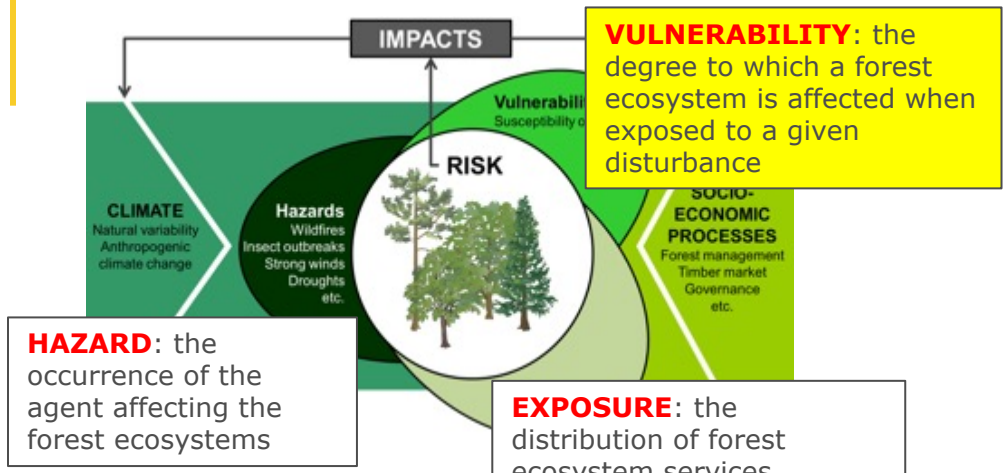
Relative biomass loss

$$BL_{rel} = V_{i,j}(C_1, \ldots, C_H, S_1, \ldots, S_K)$$

Forest and landscape indicators



Trends in climate risks for EU forests



VULNERABILITY: the degree to which a forest ecosystem is affected when exposed to a given disturbance

HAZARD: the occurrence of the agent affecting the forest ecosystems

EXPOSURE: the distribution of forest ecosystem services potentially prone to a hazard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Article | Open Access | Published: 23 February 2021

Emergent vulnerability to climate-driven disturbances in European forests

Giovanni Forzieri, Marco Girardello, Guido Ceccherini, Jonathan Spinoni, Luc Feyen, Henrik Hartmann, Pieter S. A. Beck, Gustau Camps-Valls, Gherado Chirici, Achille Mauri & Alessandro Cescatti

Nature Communications 12, Article number: 1081 (2021) | Cite this article

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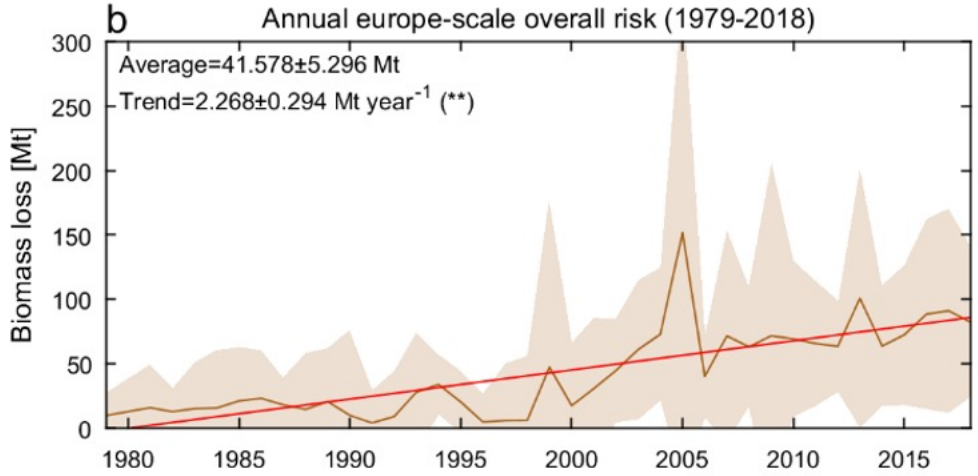
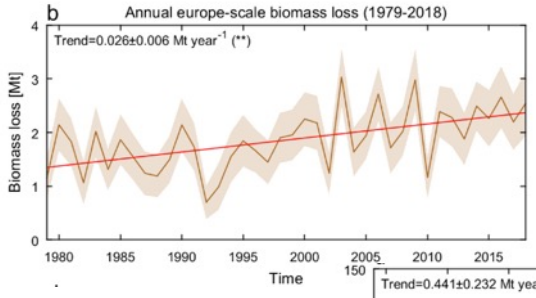
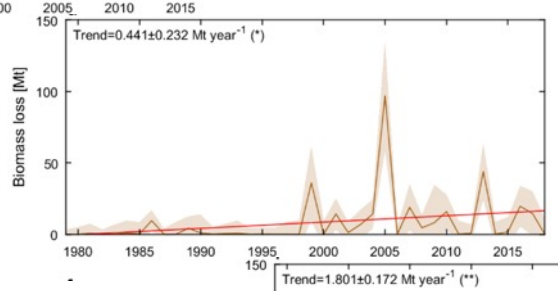


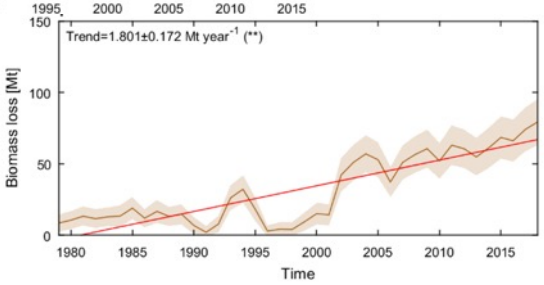
Fires



Windthrows

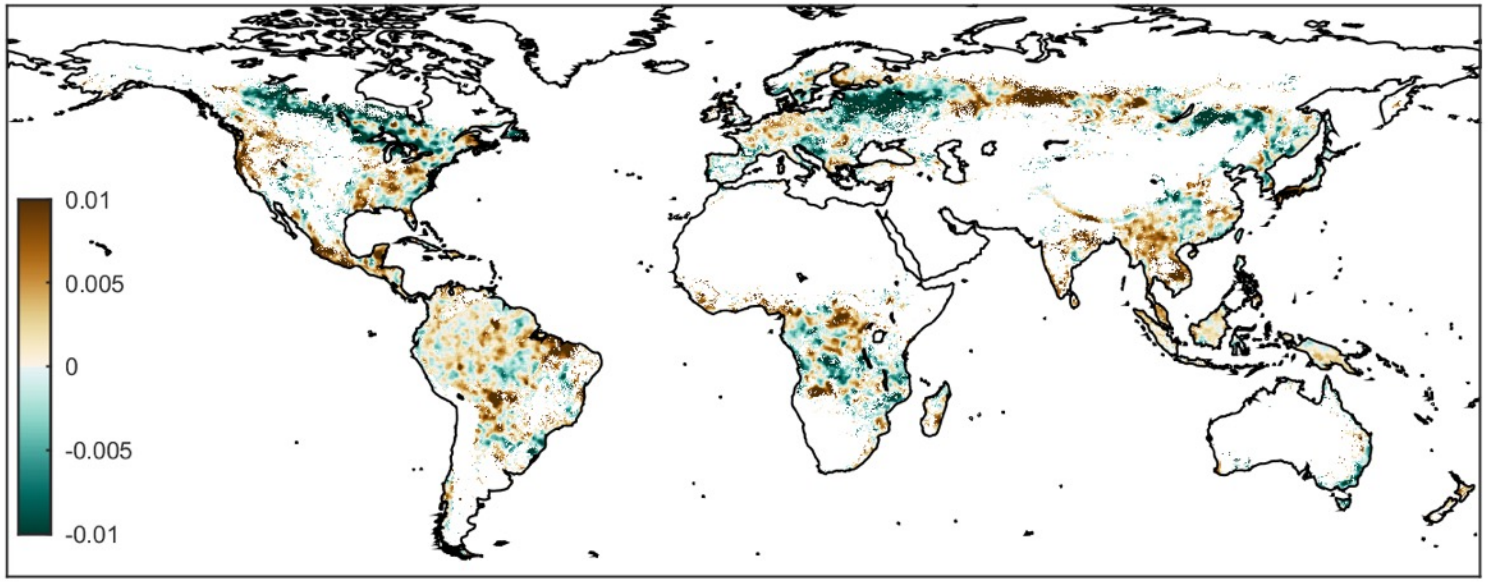


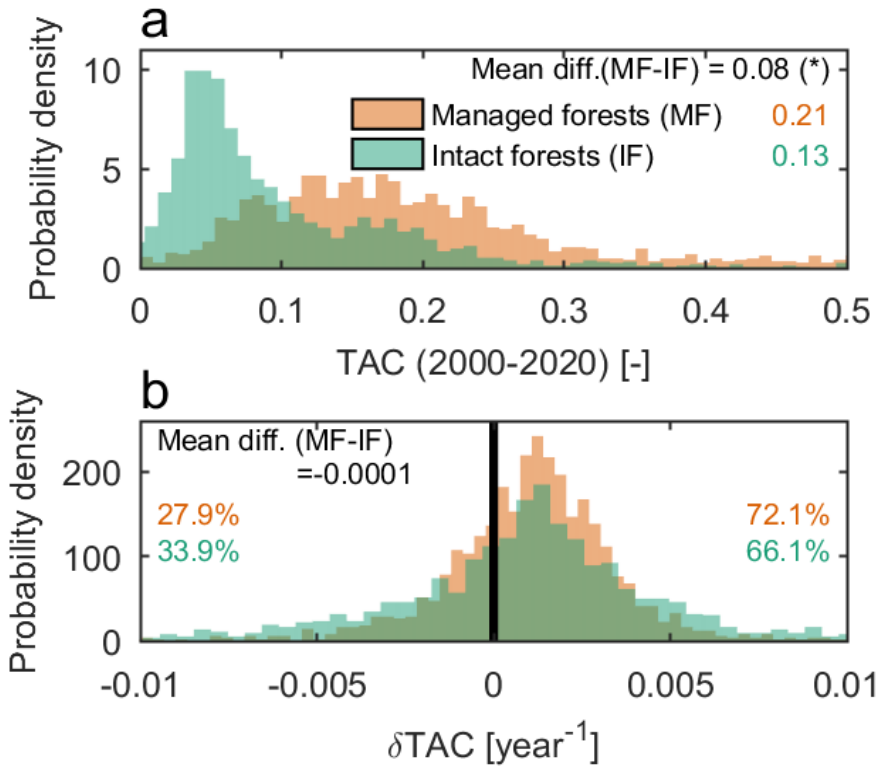
Insect outbreaks



Forzieri et al. (in review)

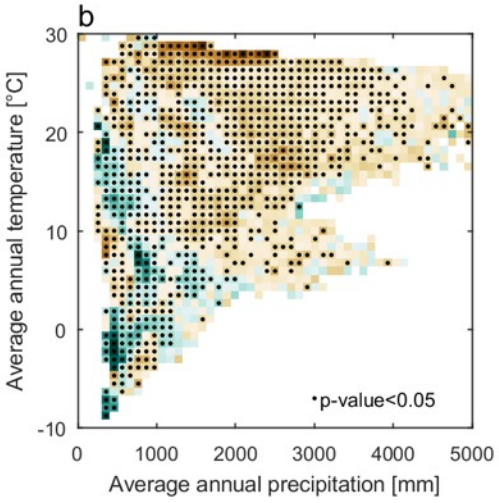
Global signals of a decline in forest resilience





Declining trends of forest resilience indicators from EO

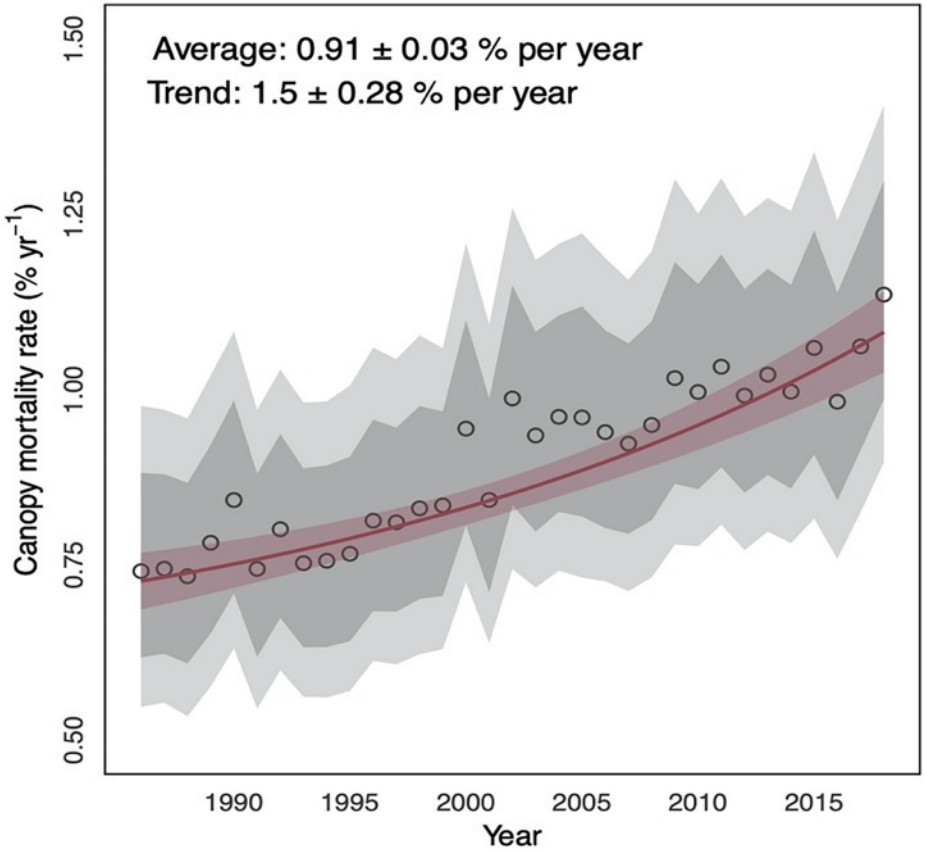
Trends are climate driven since they occur also in intact ecosystems

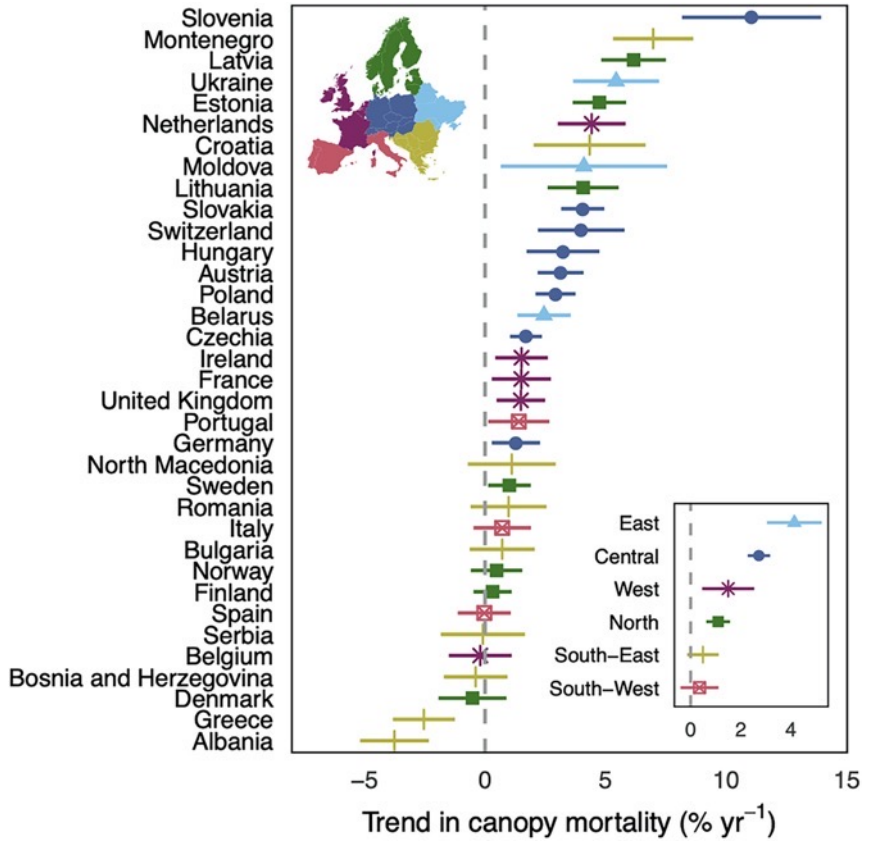


Forzieri et al. 2022 Nature

Increasing trend in EU forest canopy mortality

Sharp increasing trend in canopy mortality from 1985 to 2018 in Europe





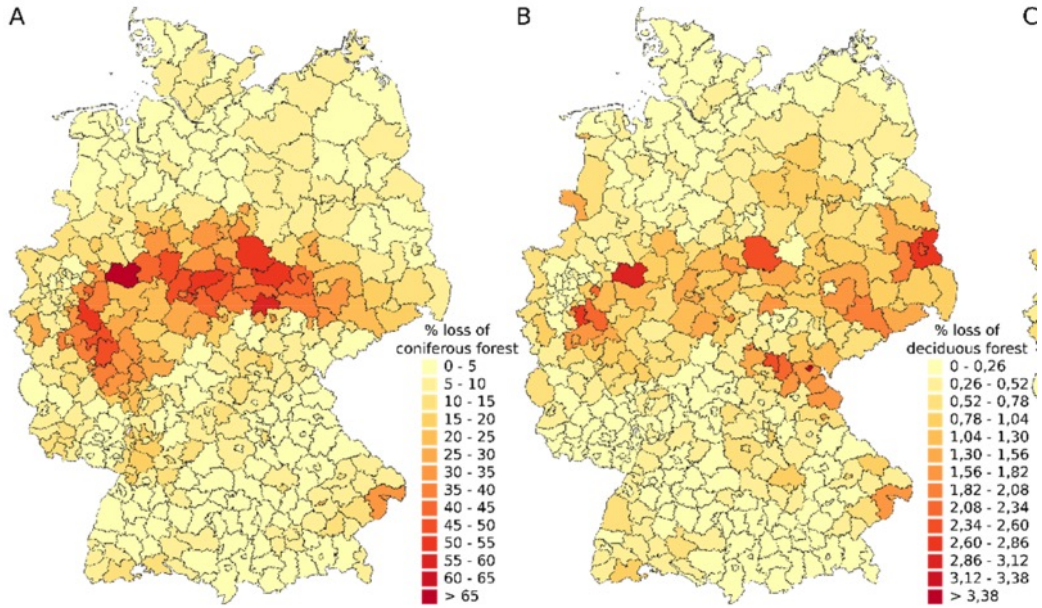
- Senf et. al. 2021 One Earth

European Commission

Bark beetle outbreaks in central EU

Tree cover loss of 501,000 ha for Germany since 2018
@check % of forest area of Germany

conifers *deciduous*



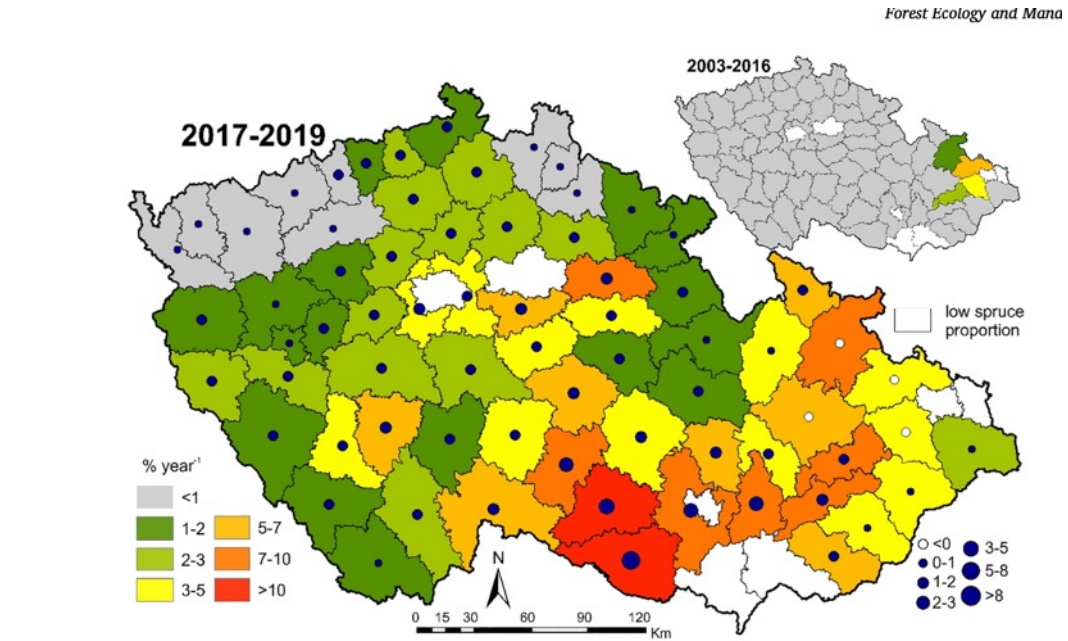
Thonfeld F. et al. 2021 Remote sensing

European Commission

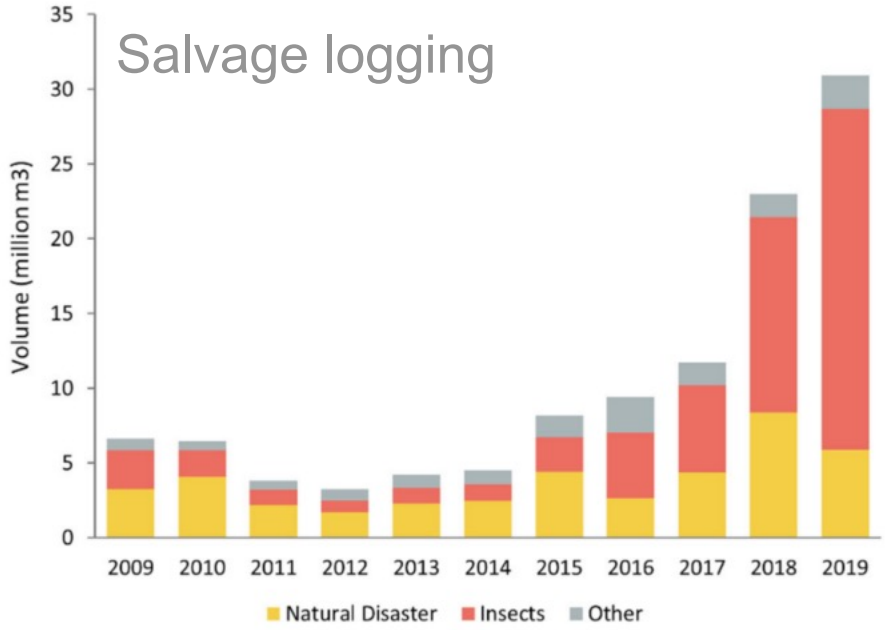
Devastating outbreak of bark beetles in the Czech Republic: Drivers, impacts, and management implications

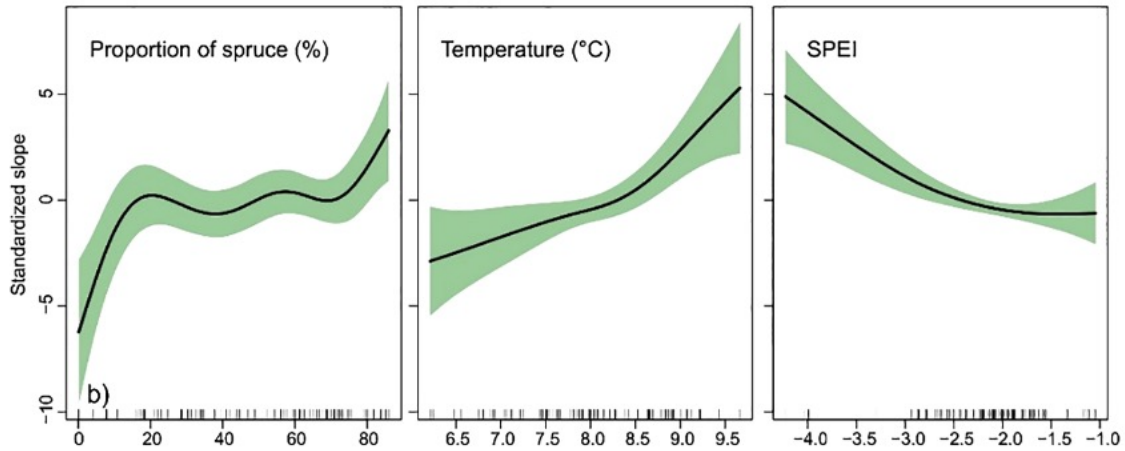
T. Hlásny [a,*], S. Zimová [a], K. Merganičová [a], P. Štěpánek [b], R. Modlinger [a], M. Turčáni [a]

[a] Czech University of Life Sciences in Prague, Faculty of Forestry and Wood Sciences, Czech Republic
[b] Global Change Research Institute, Czech Academy of Sciences, Czech Republic

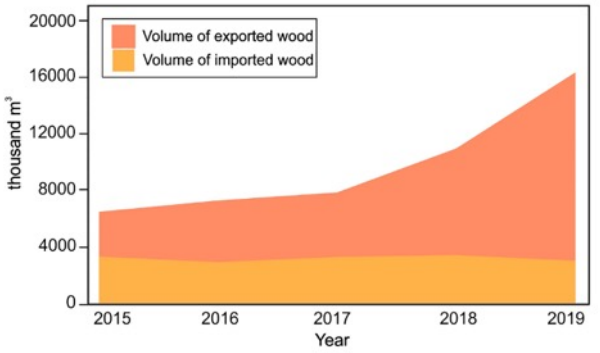


Salvage logging

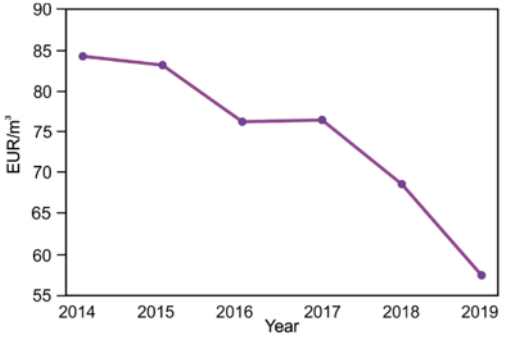




import/export



wood price



The way forward

- Advanced the monitoring of forest disturbances

EU observatory on deforestation and forest degradation

- Improve the representation of disturbance and mortality in vegetation models

foster model-data fusion for policy support

- Develop tools to support forest adaptation policies

enhance cooperation across communities

Environment

Home > Strategy > Forest strategy

New EU forest strategy for 2030

To improve the quantity and quality of EU forests

Support better availability and quality of information on forests and supply chains

- Establish an EU Observatory on Deforestation and Forest Degradation to monitor changes in the world's forest cover and give public bodies, consumers and businesses better access to data about supply chains
- Explore strengthened use of the Copernicus satellite system for forest monitoring.

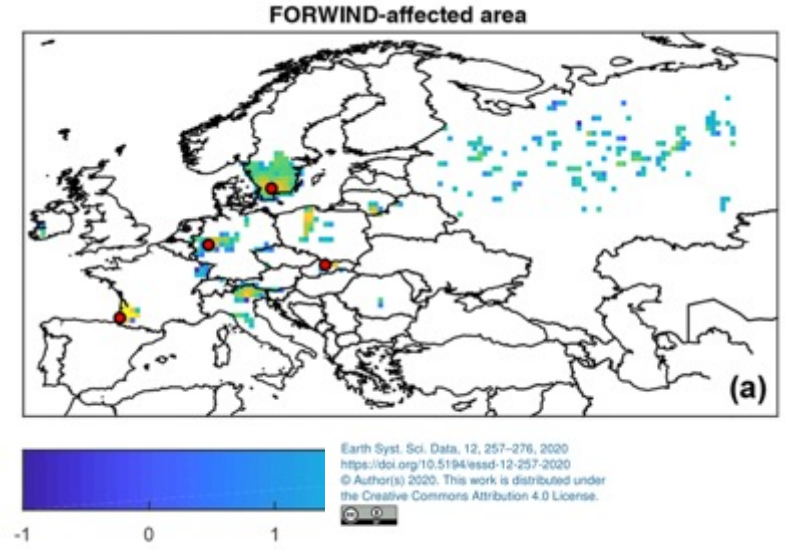
…on the basis of improved **Copernicus products**, other **remote-sensing data** and **ground-based monitoring**, strengthen the existing **monitoring of climate effects** and other **natural or human-induced disturbances** on forests…

Commission

Assessment of natural hazards on EU forests

- European Forest Fire Information System (EFFIS)

- Collection of spatial data on natural disturbances (WindFor, DEFID2)



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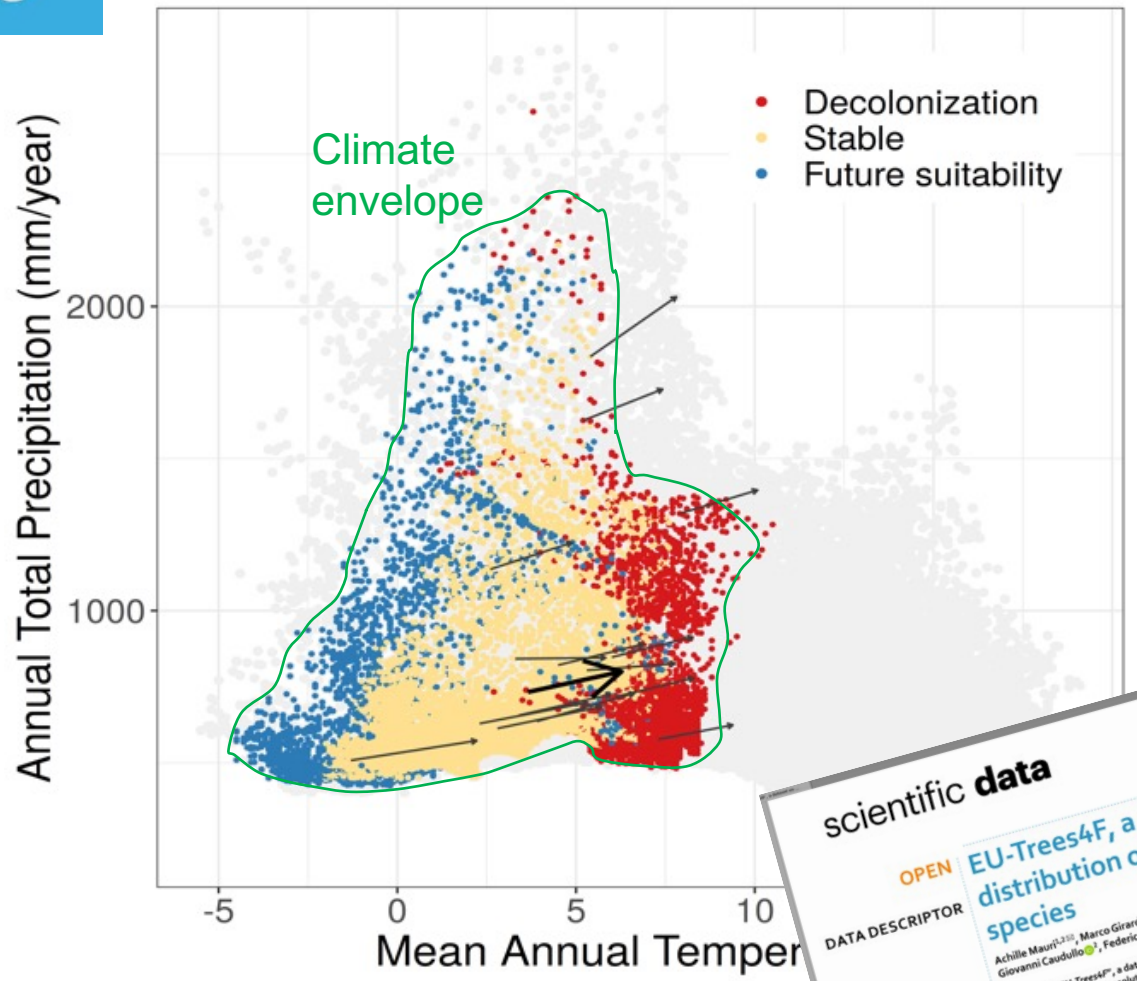
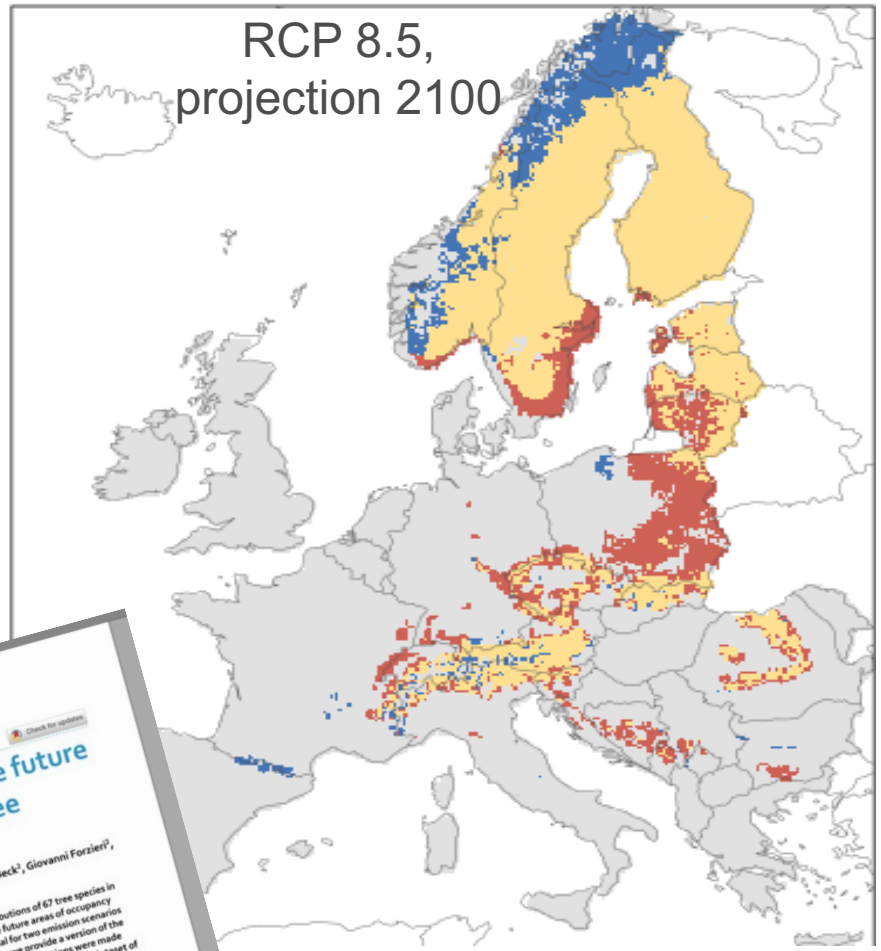
Example for *Picea abies* – Norway spruce






scientific data

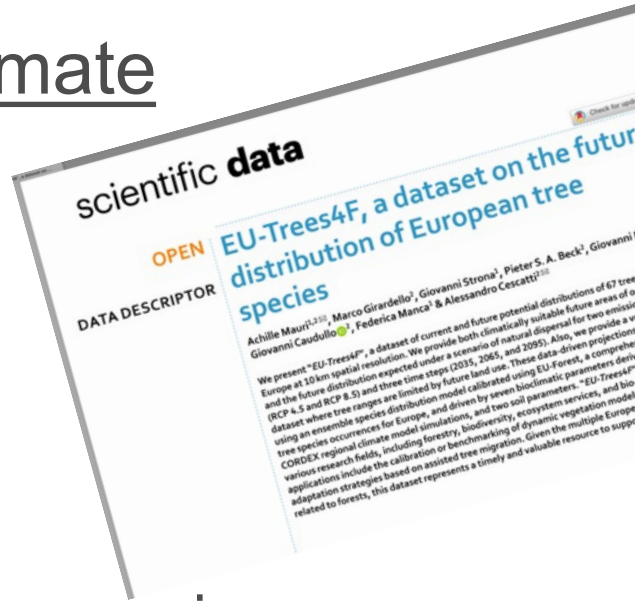
OPEN

DATA DESCRIPTOR

EU-Trees4F, a dataset on the future distribution of European tree species

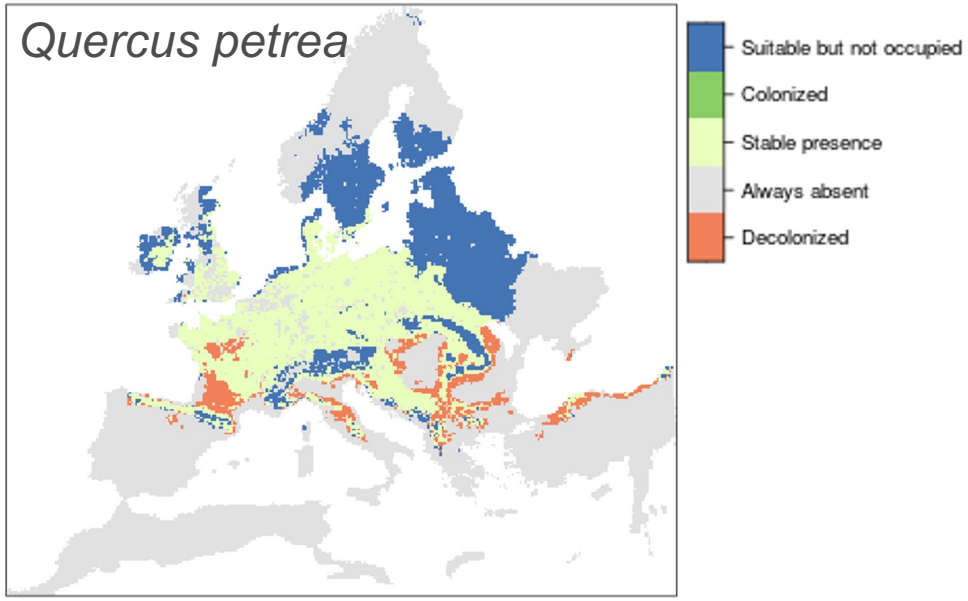
As trees have a long lifespan and low dis ...need to consider which tree species and where may thrive decades from now if we ...t to prevent/reduce the future loss of forest services

Predicting forest tree species distribution in a future climate



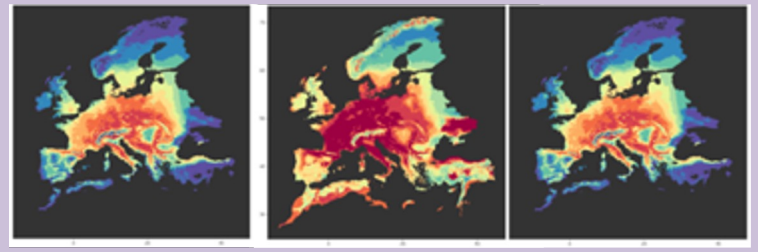
- EU-Trees4F
  Analysis of tree species distribution in the current and future climate
  - Distribution of 80 EU forest tree species
  - 2 climate scenarios (RCP 4.5 and RCP 8.5)
  - Distribution from present time to 2100

- Assessment of diversity losses and impacts on ecosystem services



Diversity metrics

Functional Diversity & Taxonomic Diversity



Mauri et al. Scientific data (2022)

European Commission

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