

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

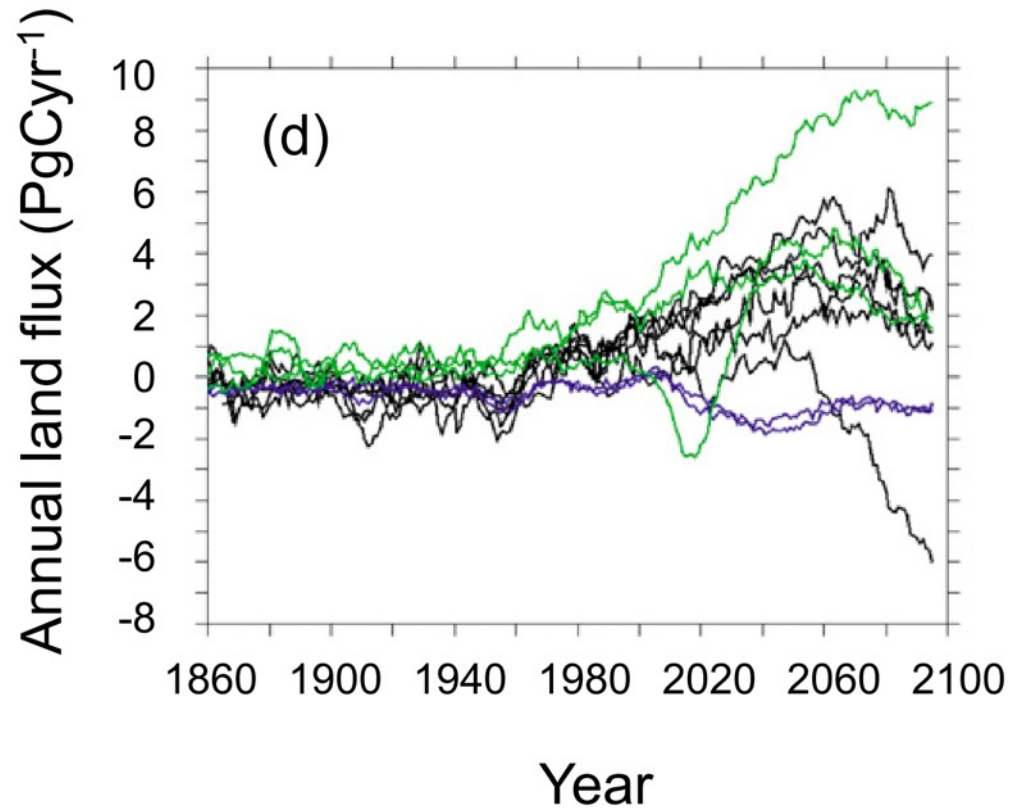
Joint Research Centre

28, June 2022



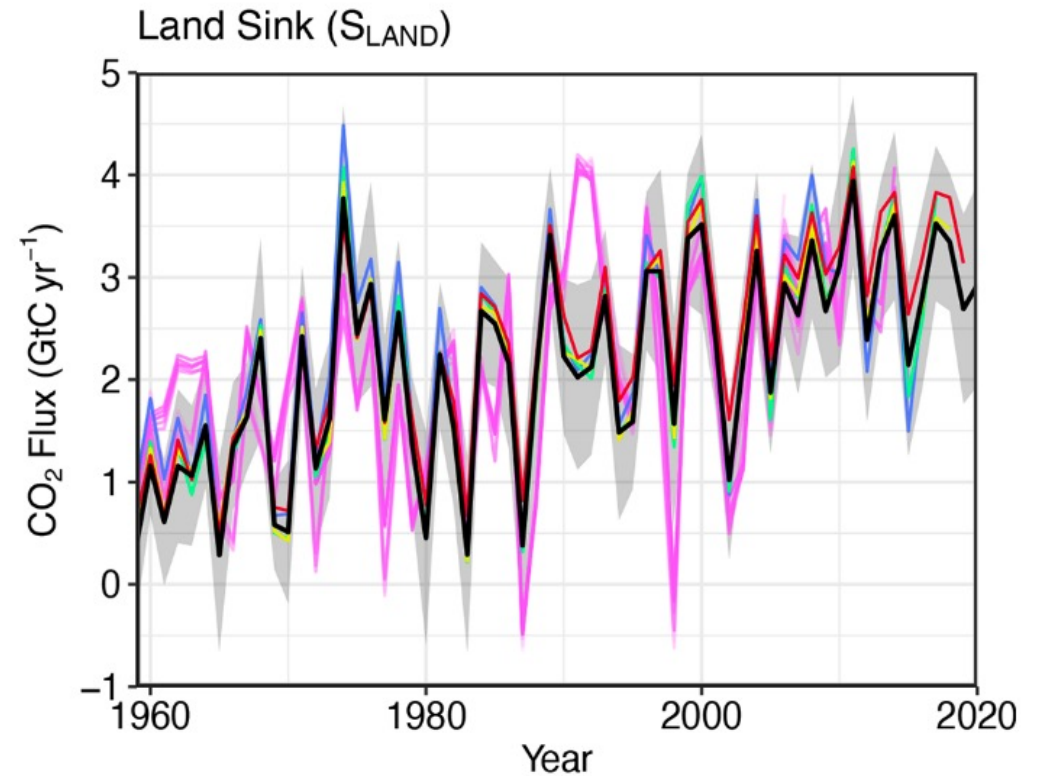
The uncertain trajectory of the terrestrial C sink

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 CO₂ fertilization effects?

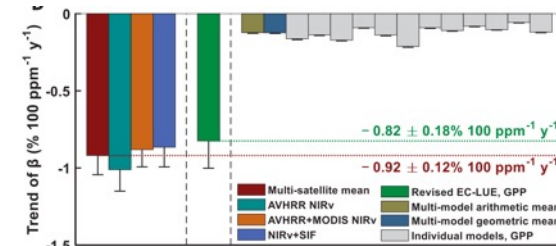
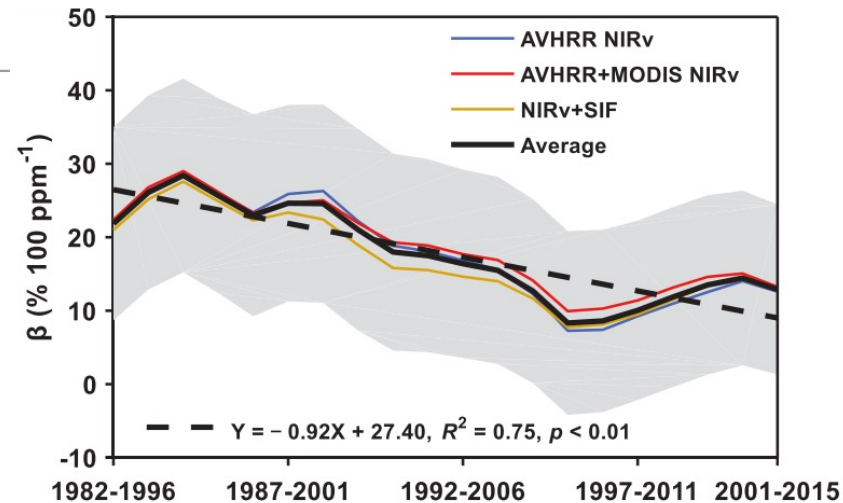
RESEARCH

RESEARCH ARTICLE

CLIMATE CHANGE

Recent global decline of CO₂ fertilization effects on vegetation photosynthesis

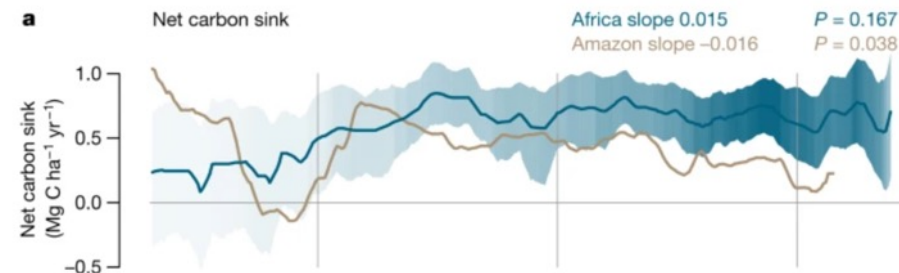
Songhan Wang^{1,2}, Yongguang Zhang^{1,2,3*}, Weimin Ju^{1,2}, Jing M. Chen^{1,4}, Philippe Ciais⁵, Alessandro Cescatti⁶, Jordi Sardans^{7,8}, Ivan A. Janssens⁹, Mousong Wu^{1,2}, Joseph A. Berry¹⁰,



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.



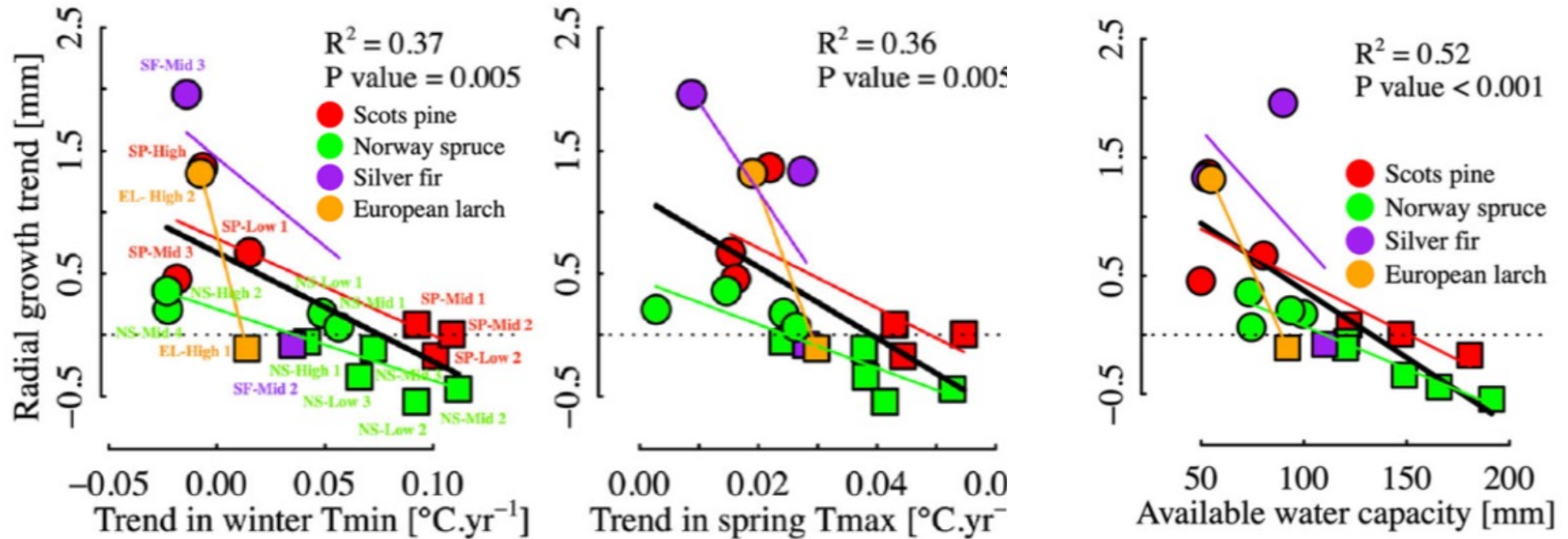
Hubau et al. 2020 Nature



Or both?

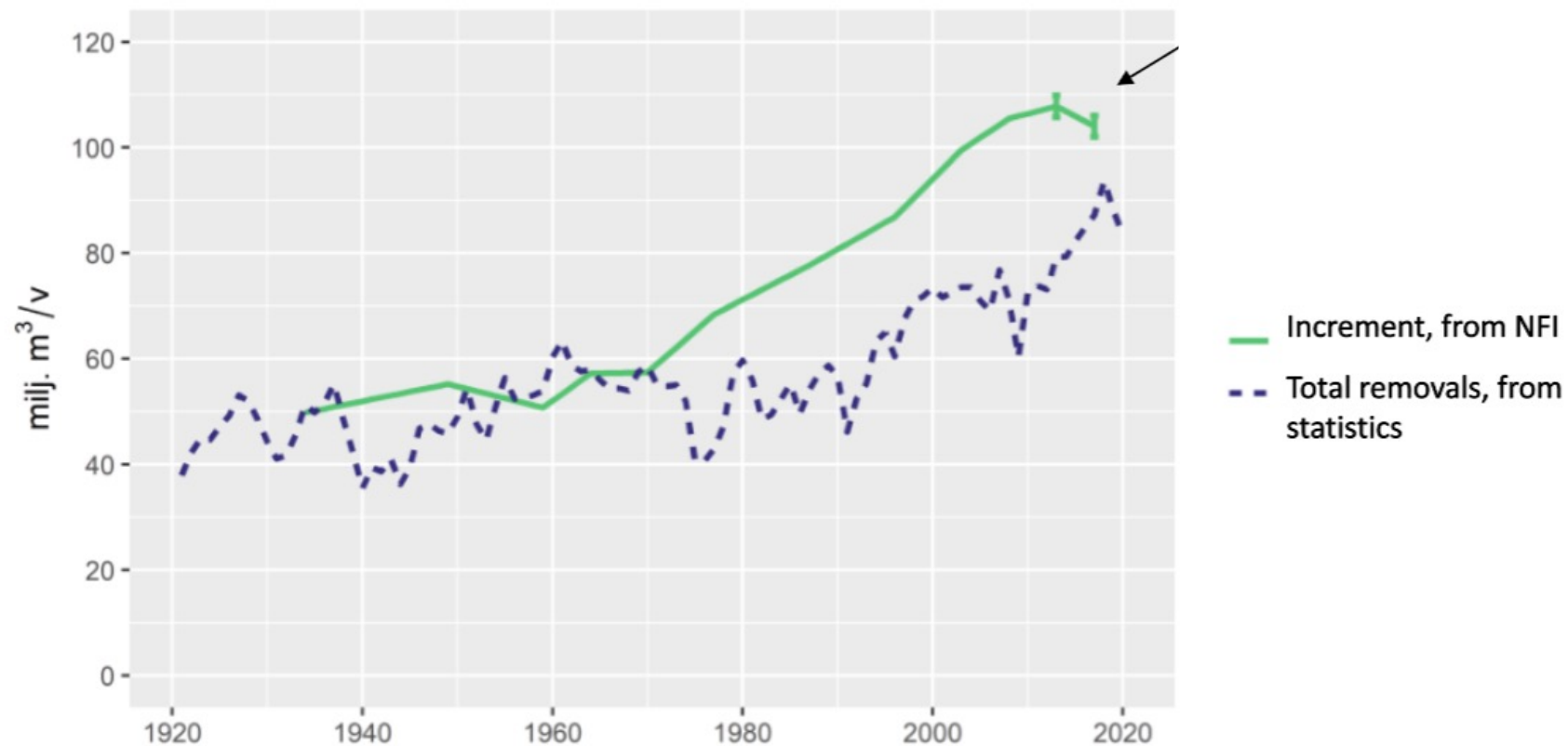
Emerging signals from National Forest Inventories

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



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

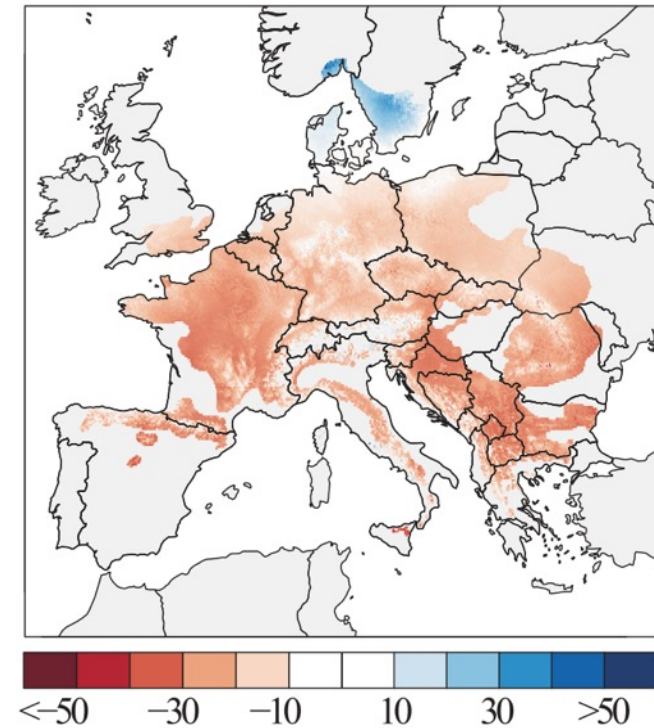
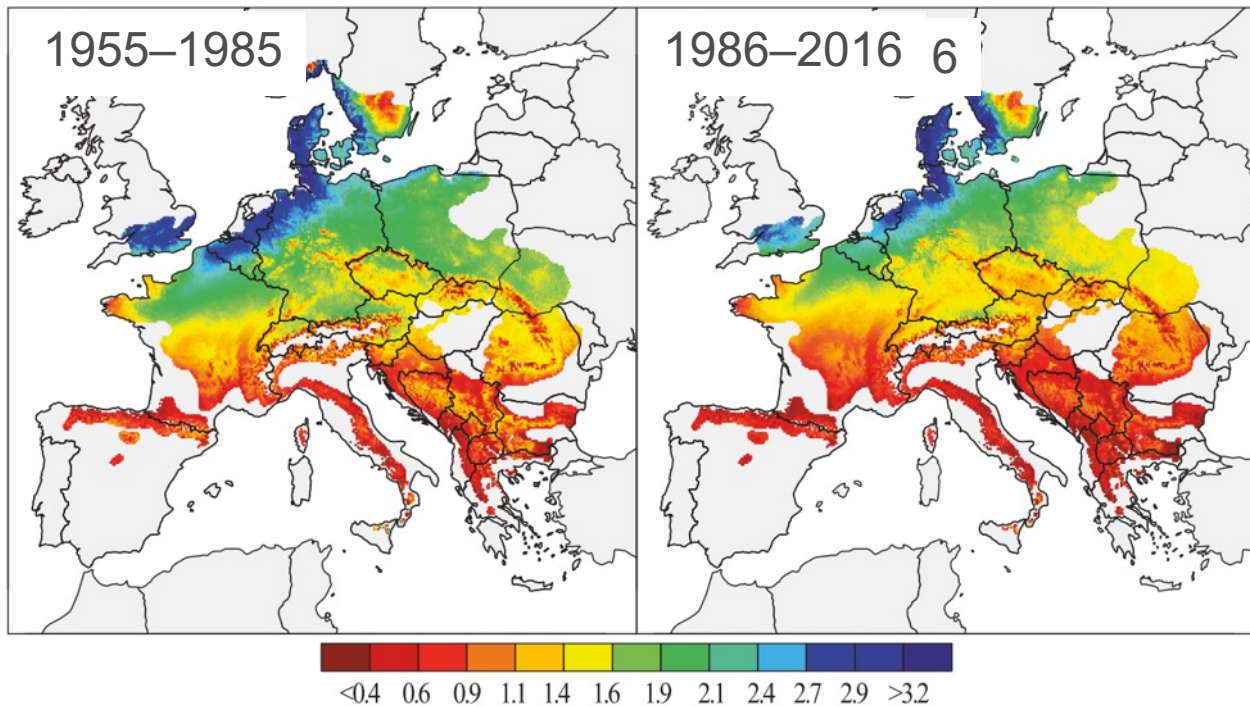
ARTICLE

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

Climate-change-driven growth decline of European beech forests

Edurne Martinez del Castillo¹, Christian S. Zang², Allan Buras³, Andrew Hacket-Pain⁴, Jan Esper^{1,5}, Roberto Serrano-Notivol⁶, Claudia Hartl⁷, Robert Weigel⁸, Stefan Klesse⁹, Victor Resco de Dios^{10,11}

Check for updates



European forest beech forests: growth rate in basal area

Relative change in growth rate European Commission

Observation-driven modelling of forest vulnerability

Disturbance databases

Forest fires
EFFIS
(~15000)



Insect outbreaks
IDS-USDA
(~42000)



Windthrows
FORWIND
(~80000)

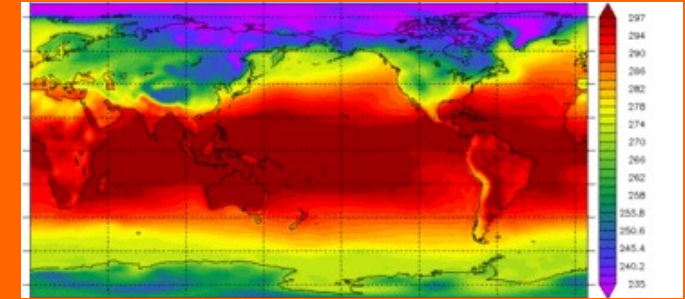


Biomass dynamics



Vulnerability functions
Random forest regression

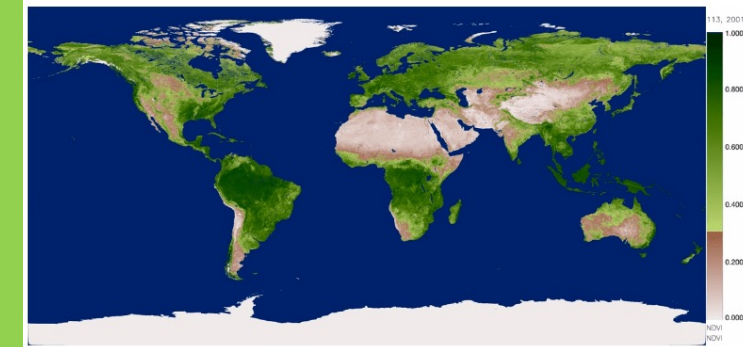
Climate indicators



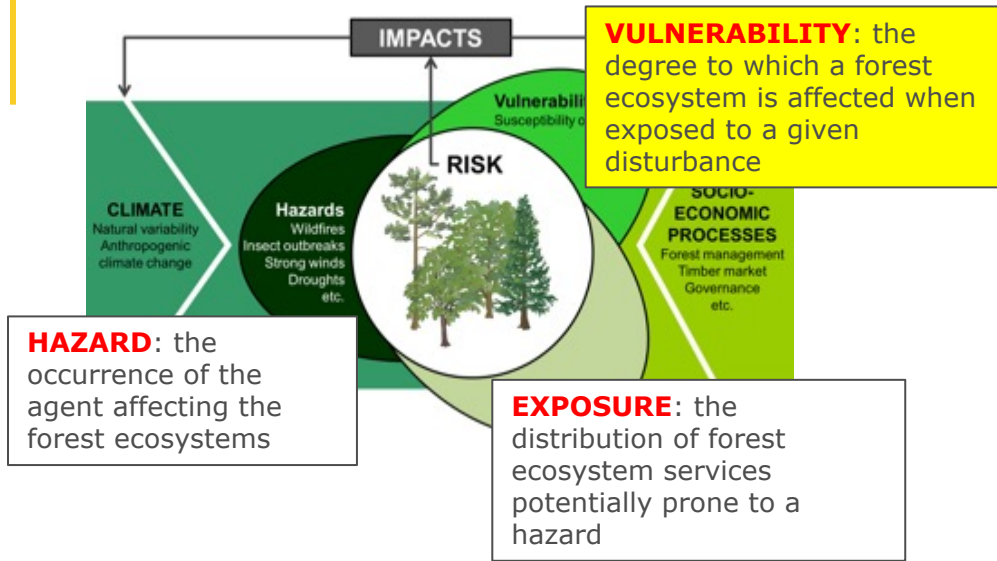
Relative
biomass loss

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

Forest and landscape indicators



Trends in climate risks for EU forests



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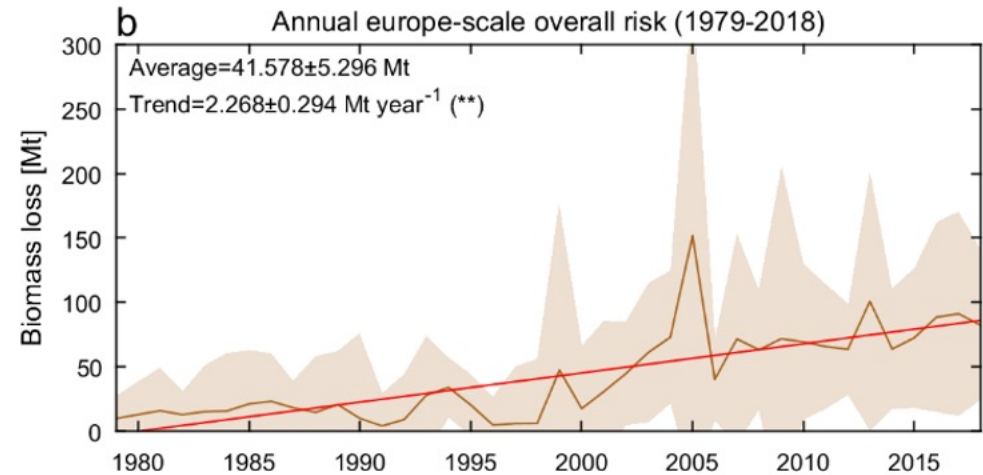
Article | [Open Access](#) | Published: 23 February 2021

Emergent vulnerability to climate-driven disturbances in European forests

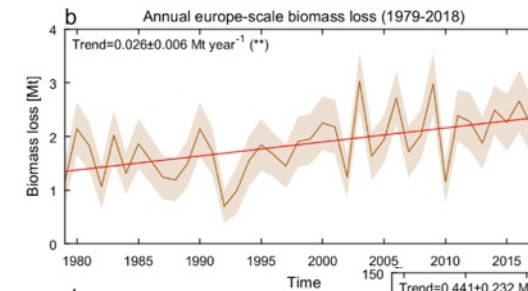
Giovanni Forzieri , Marco Girardello, Guido Ceccherini, Jonathan Spinoni, Luc Feyen, Henrik Hartmann, Pieter S. A. Beck, Gustau Camps-Valls, Gherardo Chirici, Achille Mauri & Alessandro Cescatti

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

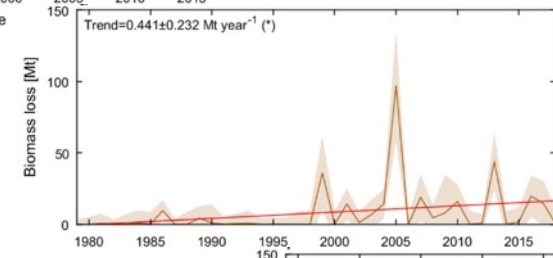
12k Accesses | 19 Citations | 248 Altmetric | [Metrics](#)



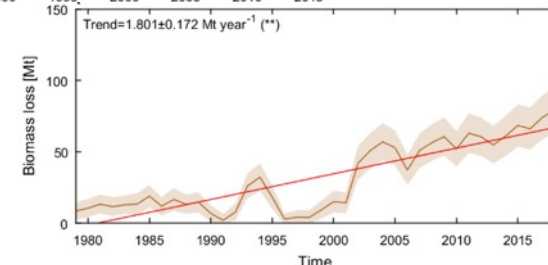
Fires



Windthrows

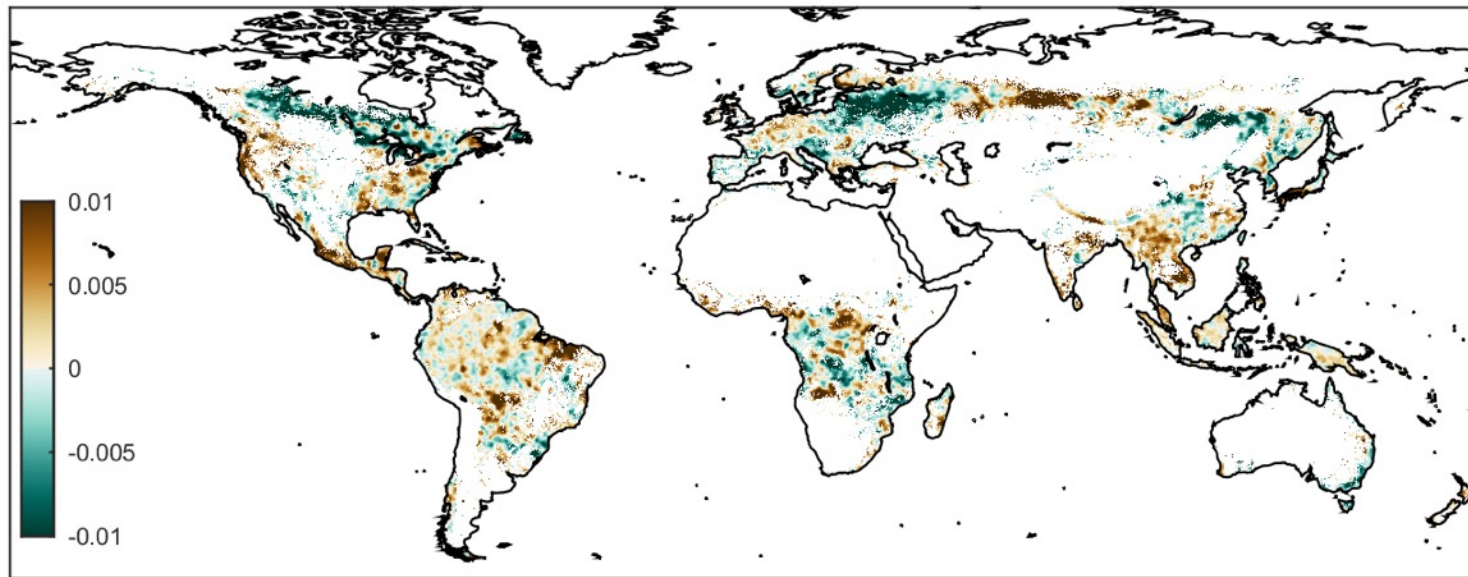


Insect outbreaks



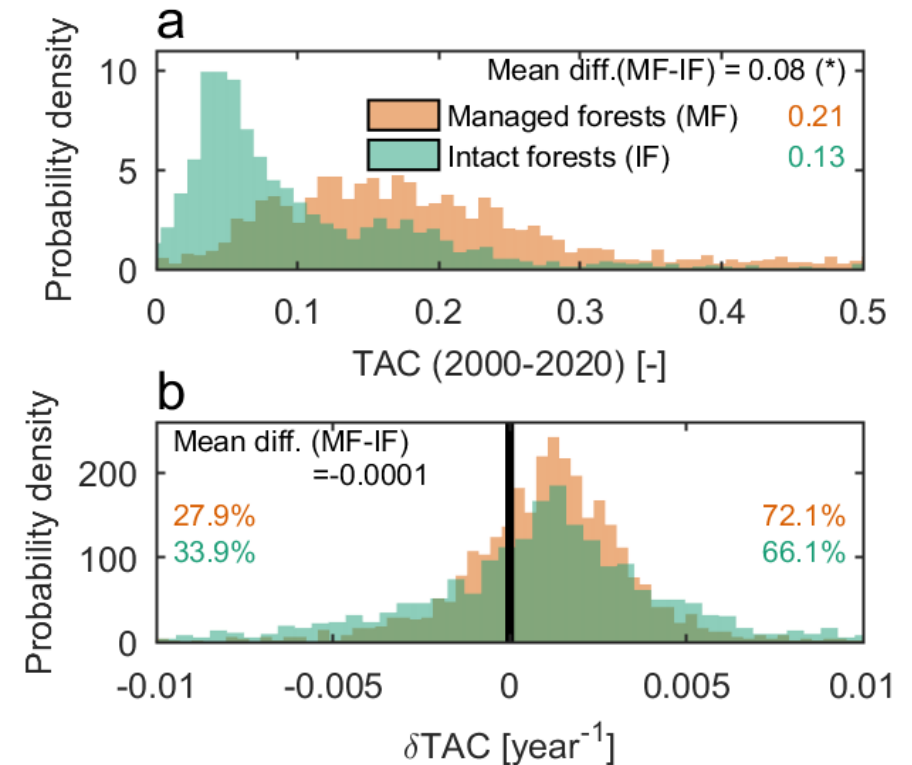
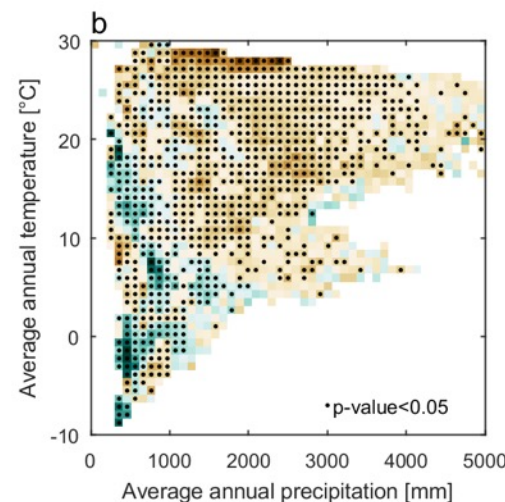
Forzieri et al. (in review)

Global signals of a decline in forest resilience



Declining trends of forest resilience indicators from EO

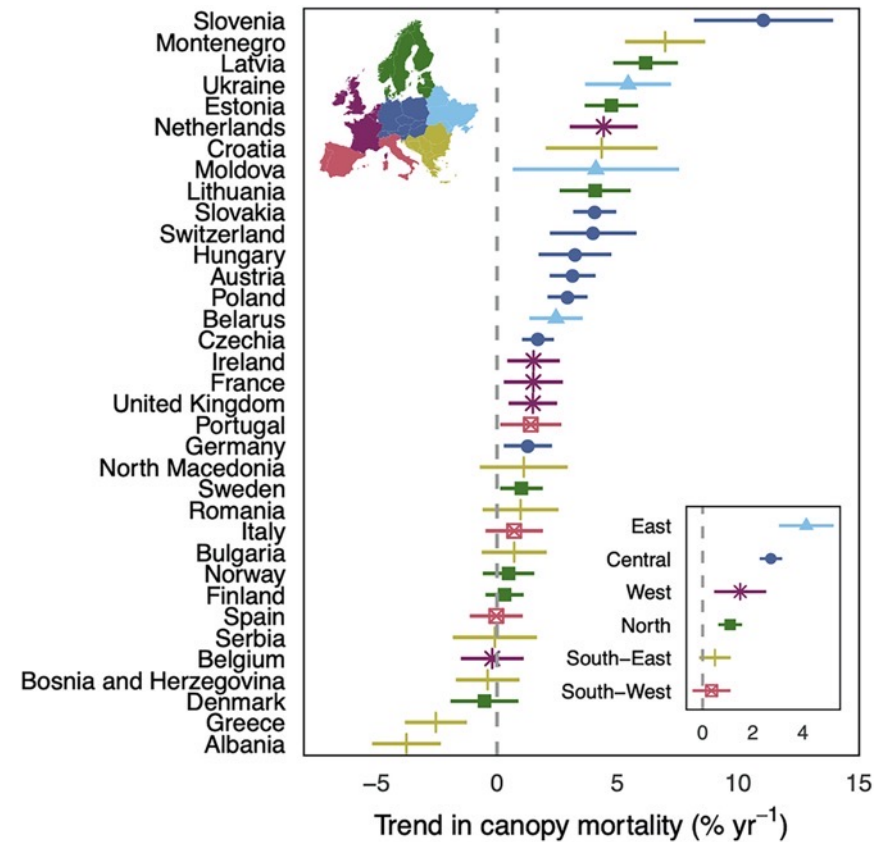
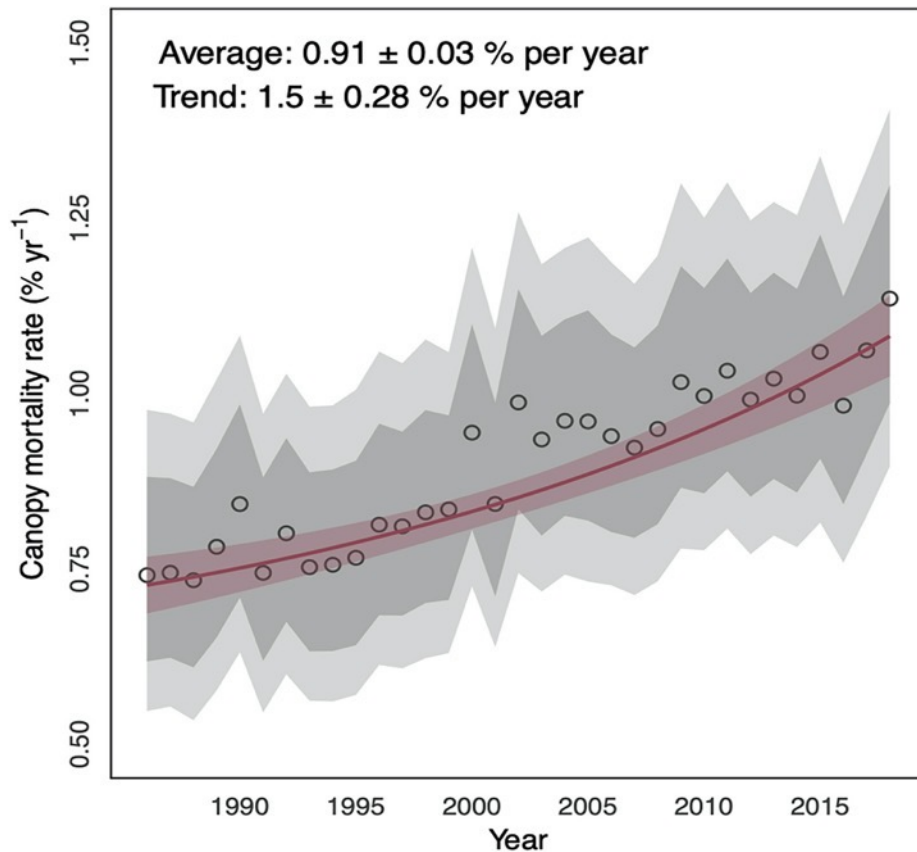
Trends are climate driven since they occur also in intact ecosystems



Forzieri et al. 2022 Nature

Increasing trend in EU forest canopy mortality

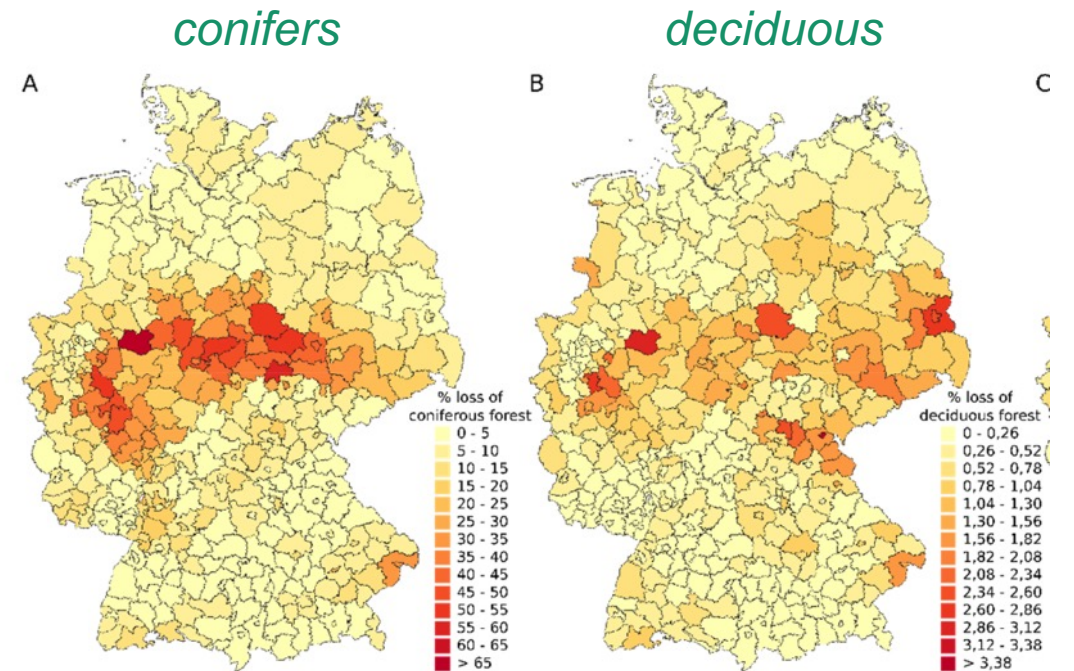
Sharp increasing trend in canopy mortality from 1985 to 2018 in Europe



Bark beetle outbreaks in central EU



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



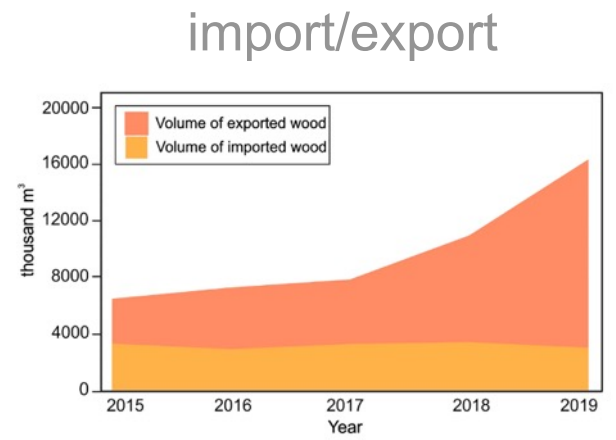
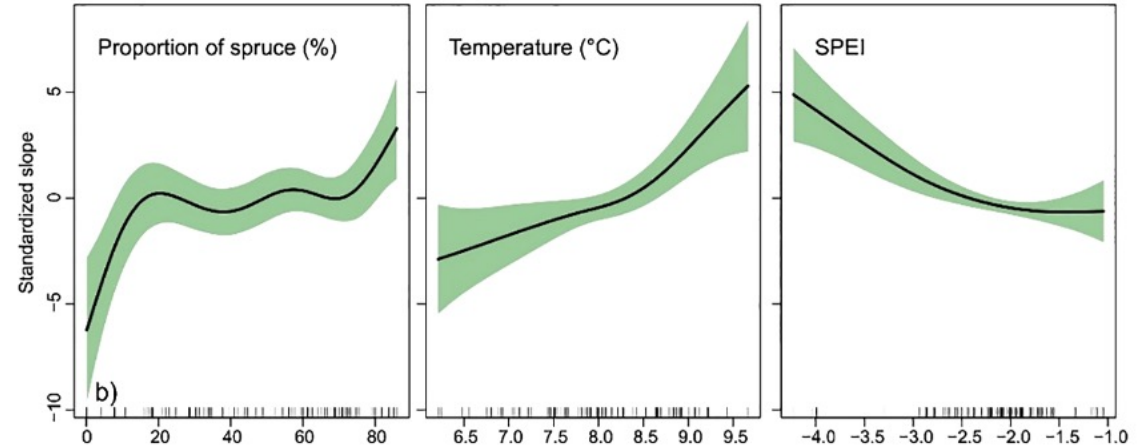
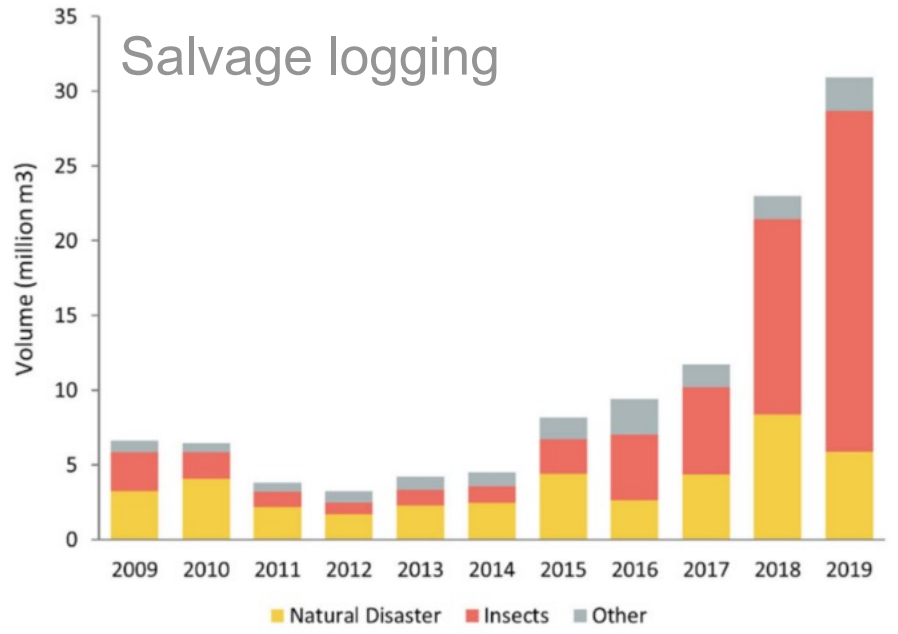
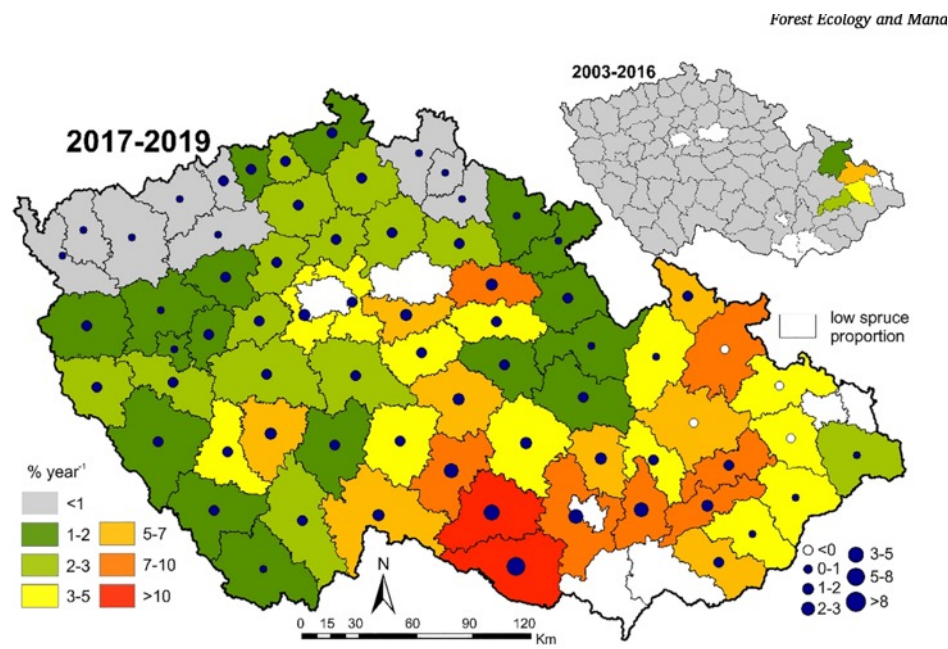
Thonfeld F. et al. 2021 Remote sensing

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



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

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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...

Assessment of natural hazards on EU forests

- European Forest Fire Information System (EFFIS)
- Collection of spatial data on natural disturbances (WindFor, DEFID2)



FOREST INFORMATION SYSTEM FOR EUROPE

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News / News / New initiative from the JRC to develop the Database of European Forest Insect & Disease Disturbances (DEFID2)

New initiative from the JRC to develop the Database of European Forest Insect & Disease Disturbances (DEFID2)

Researchers, forest services, and forest owners from across Europe engaged in mapping such forest disturbances are invited to contribute and share their observations into DEFID2, which will be harmonized and curated by the JRC. DEFID2 will be open-access, with the aim to improve our capacity to observe, understand, and predict biotic forest disturbances and quantify their impact on forest ecosystems. Results of the data collection will be published in a high-profile scientific journal and coauthorship will be offered to all data providers.

In case you are willing to share your data with us, please contact JRC-DEFID2@ec.europa.eu. More details will be provided to interested data providers.

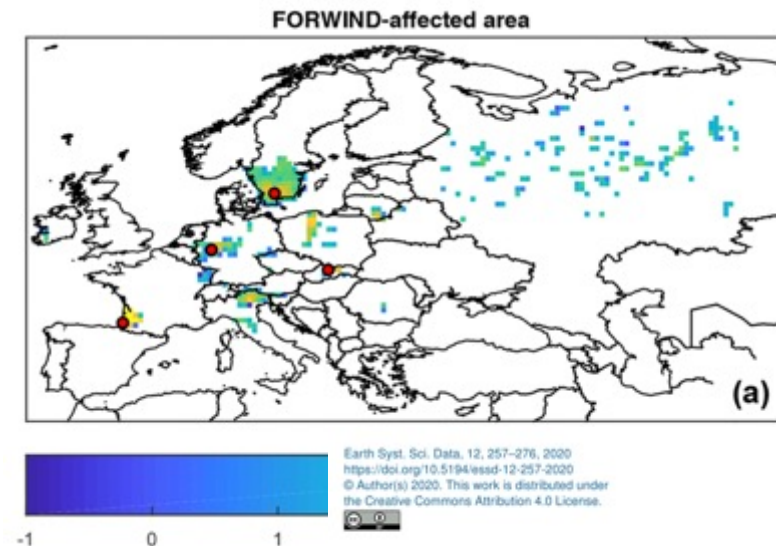


Welcome to EFFIS

The European Forest Fire Information System (EFFIS) supports the services in charge of the protection of forests against fires in the EU and neighbor countries and provides the European Commission services and the European Parliament with updated and reliable information on wildland fires in Europe. Since 1998, EFFIS is supported by a network of experts from the countries in what is called the

New feature

Make your specific requests of data by the new [Data Request Form](#)



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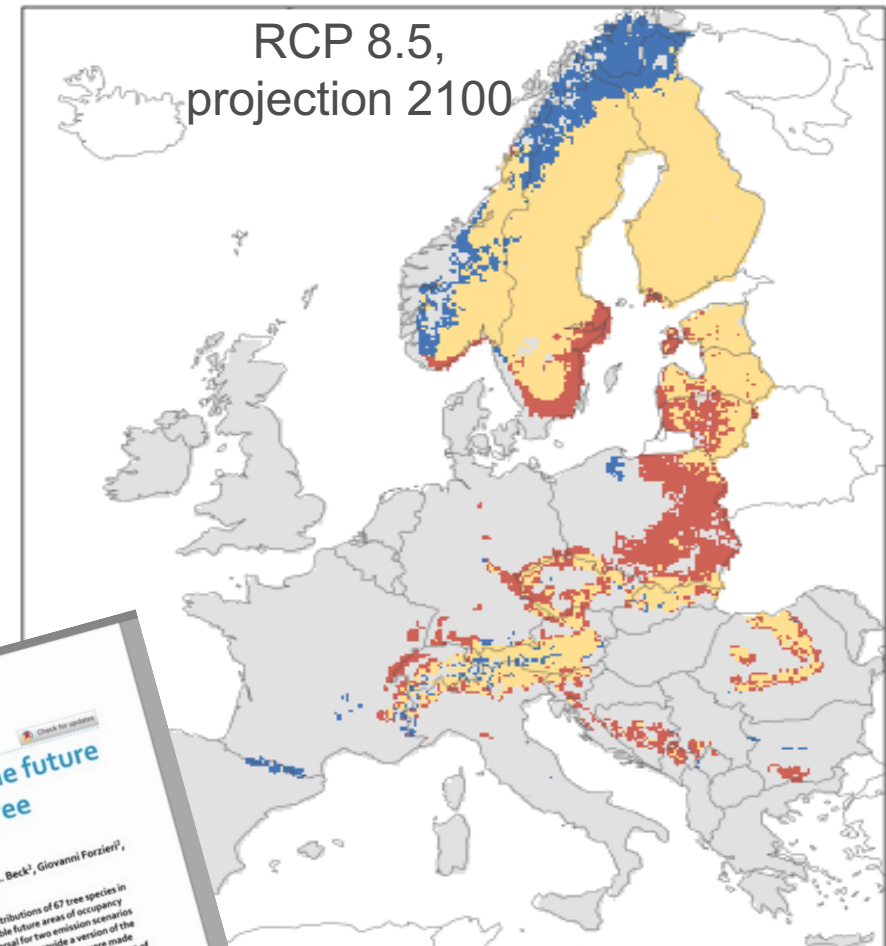
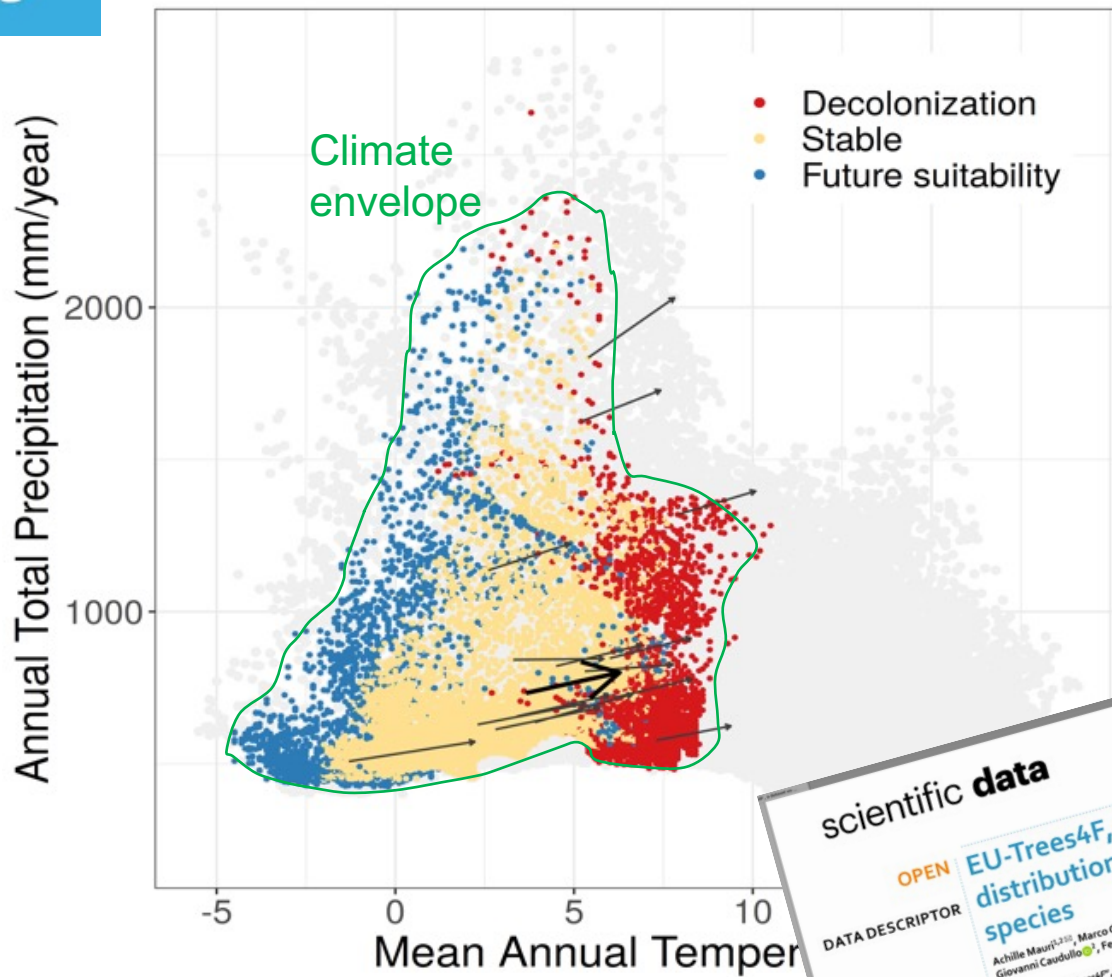
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Example for *Picea abies* – Norway spruce



scientific data

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

DATA DESCRIPTOR

Achille Mauri^{1,2,3*}, Marco Girardello¹, Giovanni Strona¹, Pieter S. A. Beck¹, Giovanni Forzieri¹, Giovanni Caudullo^{4,5}, FedERICA Manca⁶ & Alessandro Cescatti^{2,3,6}

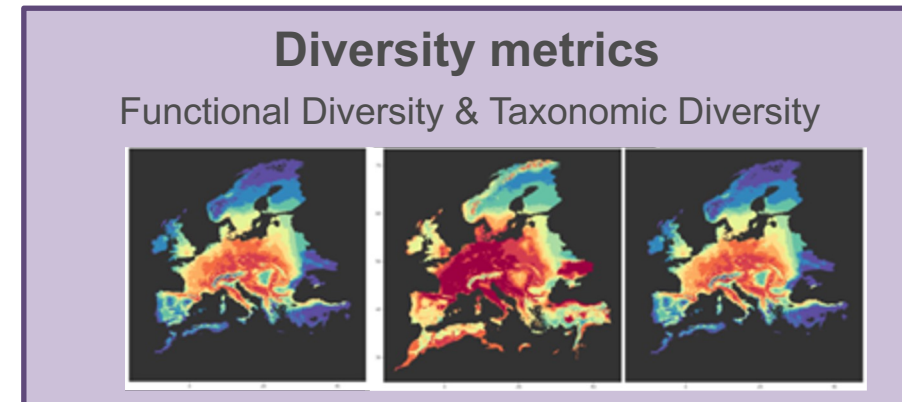
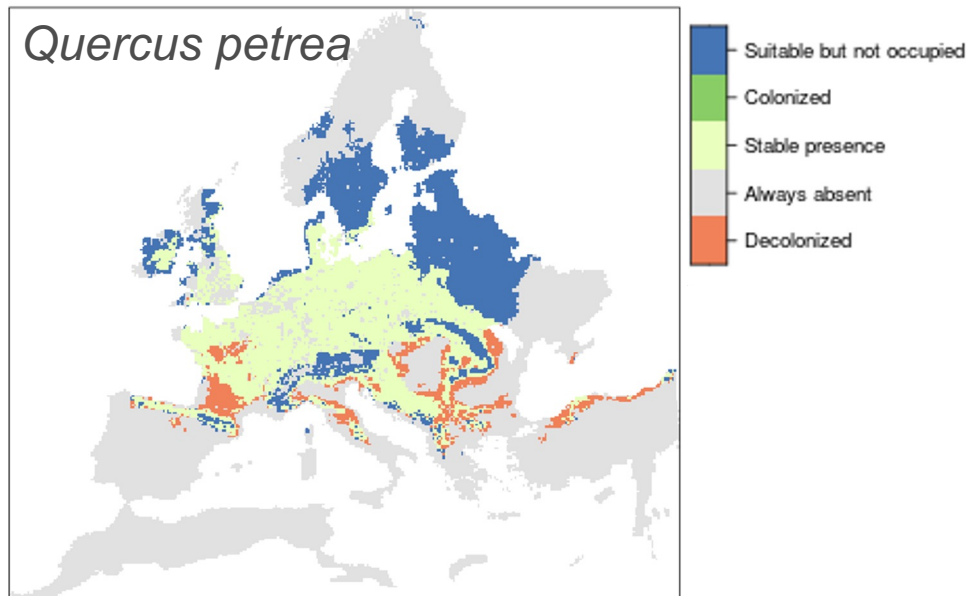
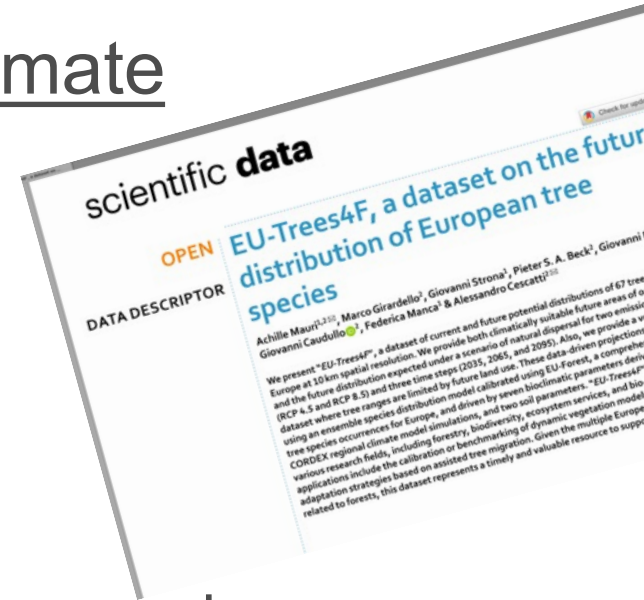
We present "EU-Trees4F", a dataset of current and future potential distributions of 67 tree species in Europe at 10 km spatial resolution. We provide both climatically suitable future areas of occupancy and the future distribution expected under a scenario of natural dispersal for two emission scenarios (RCP 4.5 and RCP 8.5) and three time steps (2035, 2065, and 2095). Also, we provide a version of the dataset where tree ranges are limited by future land use. These data-driven projections were made using an ensemble species distribution model calibrated using EU-Forest, a comprehensive dataset of tree species occurrences for Europe, and driven by seven bioclimatic parameters derived from EURO-CORDEX regional climate model simulations, and two soil parameters. "EU-Trees4F" can benefit various research fields, including forestry, biodiversity, ecosystem services, and bio-economy. Possible applications include the calibration of benchmarking of dynamic vegetation models, or informing forest adaptation strategies based on assisted tree migration. Given the multiple European policy initiatives related to forests, this dataset represents a timely and valuable resource to support policymaking.

[Check for updates](#)

As trees have a long lifespan and low dispersal ability, we need to consider which tree species and where they may thrive decades from now if we want 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



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