COST Action CLEANFOREST, Annual Meeting, Lisbon, Portugal, 8-10 May 2024

# ICP Forests

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ICP FORESTS | 45 YEARS 1979-2024 AIR CONVENTION | Swiss Federal Research Institute WSL

# Outline

- Is the monitoring network assessing forest resilience and how?
- How could the monitoring network contribute to the Forest monitoring Law (currently at the proposal stage)?
- What is the first step that should be taken to build synergies with other monitoring initiatives?

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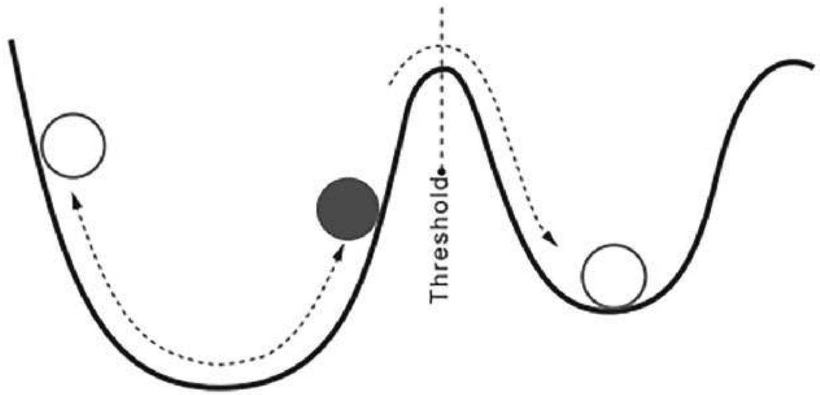
# Resilience

- >160 definitions.
  - Ability to endure stress and still be able to perform?
  - Capacity to recover after a catastrophe?
  - …
- «Any decision a forest manager will need to make is heavily affected by both the ecosystem as well as by societal demands and perceptions».
- Forest managers got frustrated: how do you implement something that you are not exactly sure of what it means?

**Ball-and-cup metaphore**

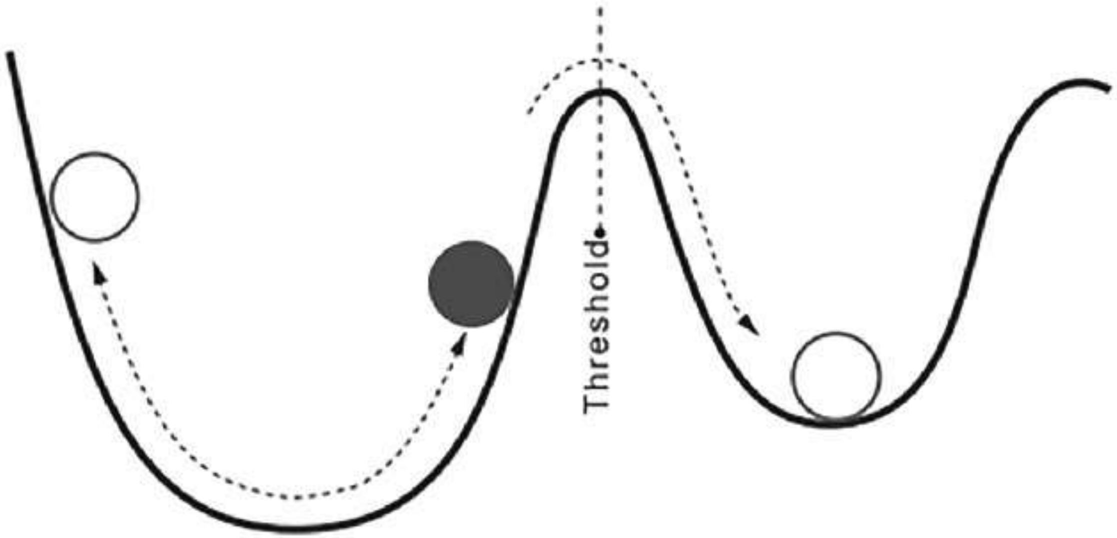



Ecological resilience concept

Holling, C. S. 1973. Annual Review of Ecology and Systematics 4:1–23.

https://efi.int/articles/how-can-we-measure-forest-resilience

# What forest monitoring can offer?

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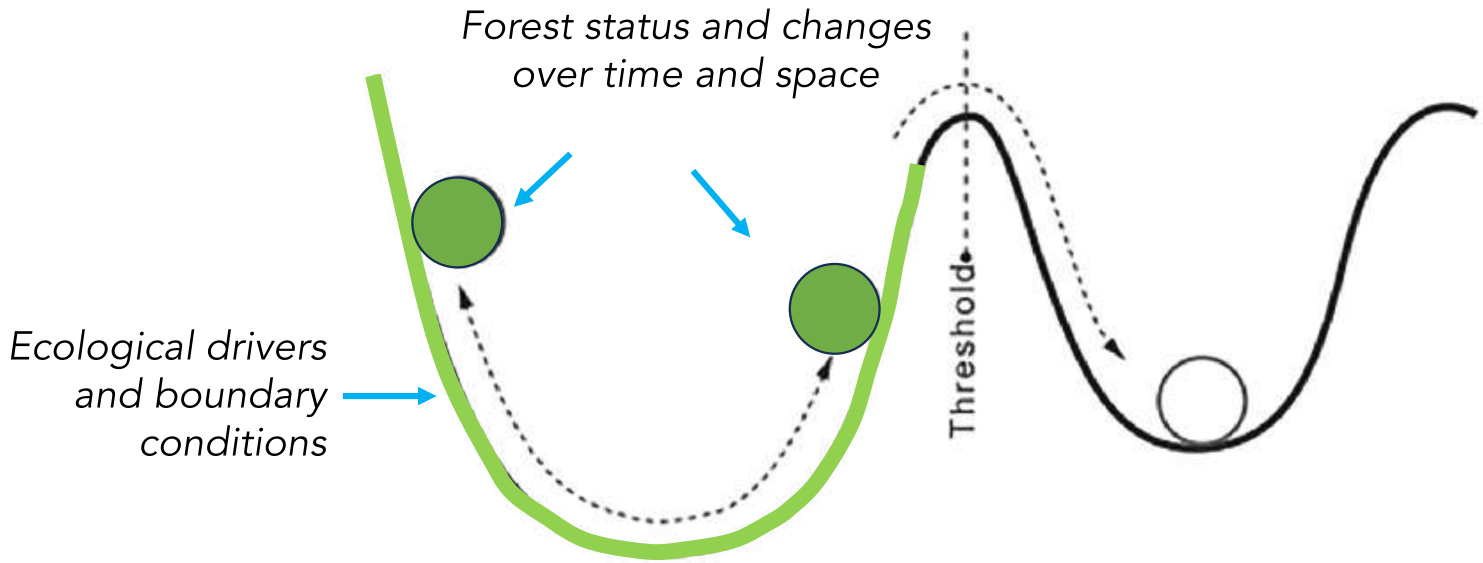
# What forest monitoring can offer?

## Measurements




Ecological resilience concept

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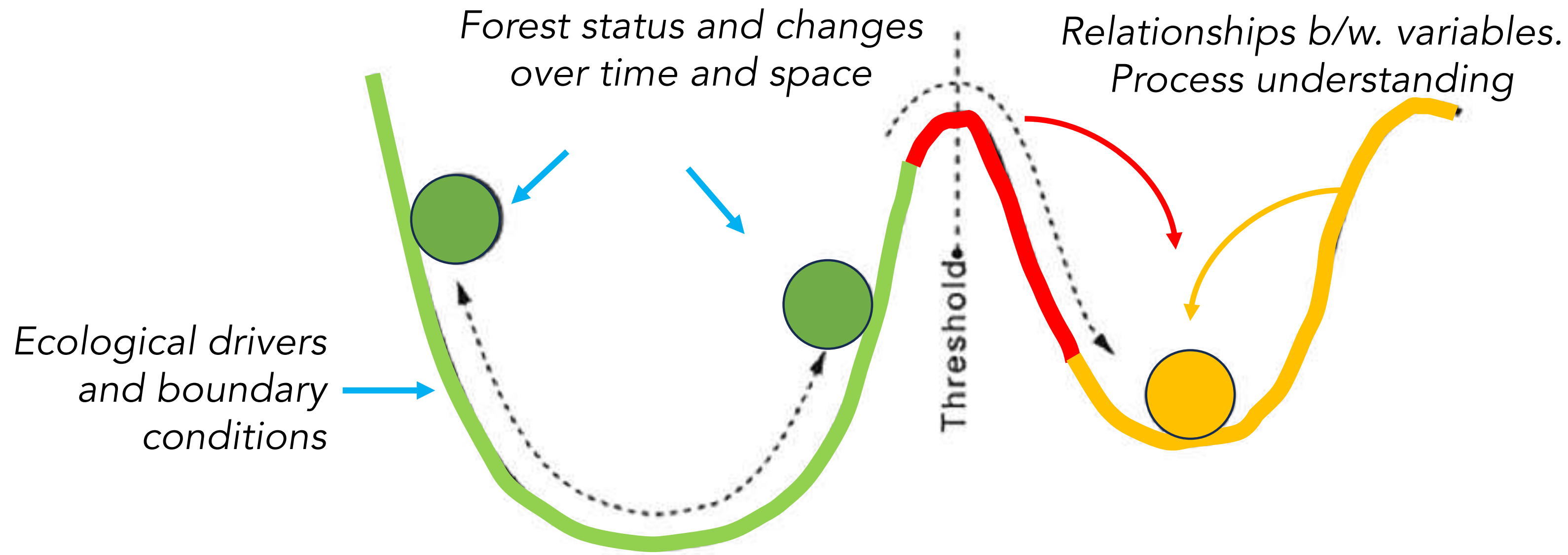
# What forest monitoring can offer?

Measurements ⟶ Understanding

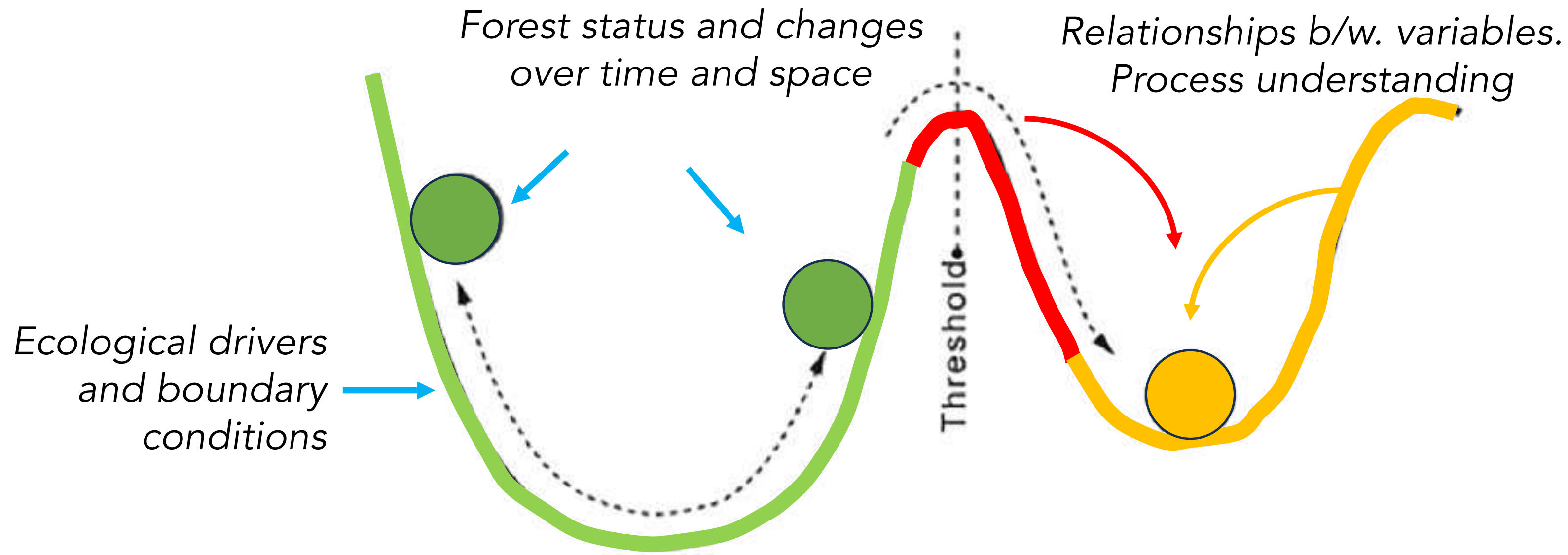



Ecological resilience concept

Holling, C. S. 1973. Annual Review of Ecology and Systematics 4:1–23.

# What forest monitoring can offer?

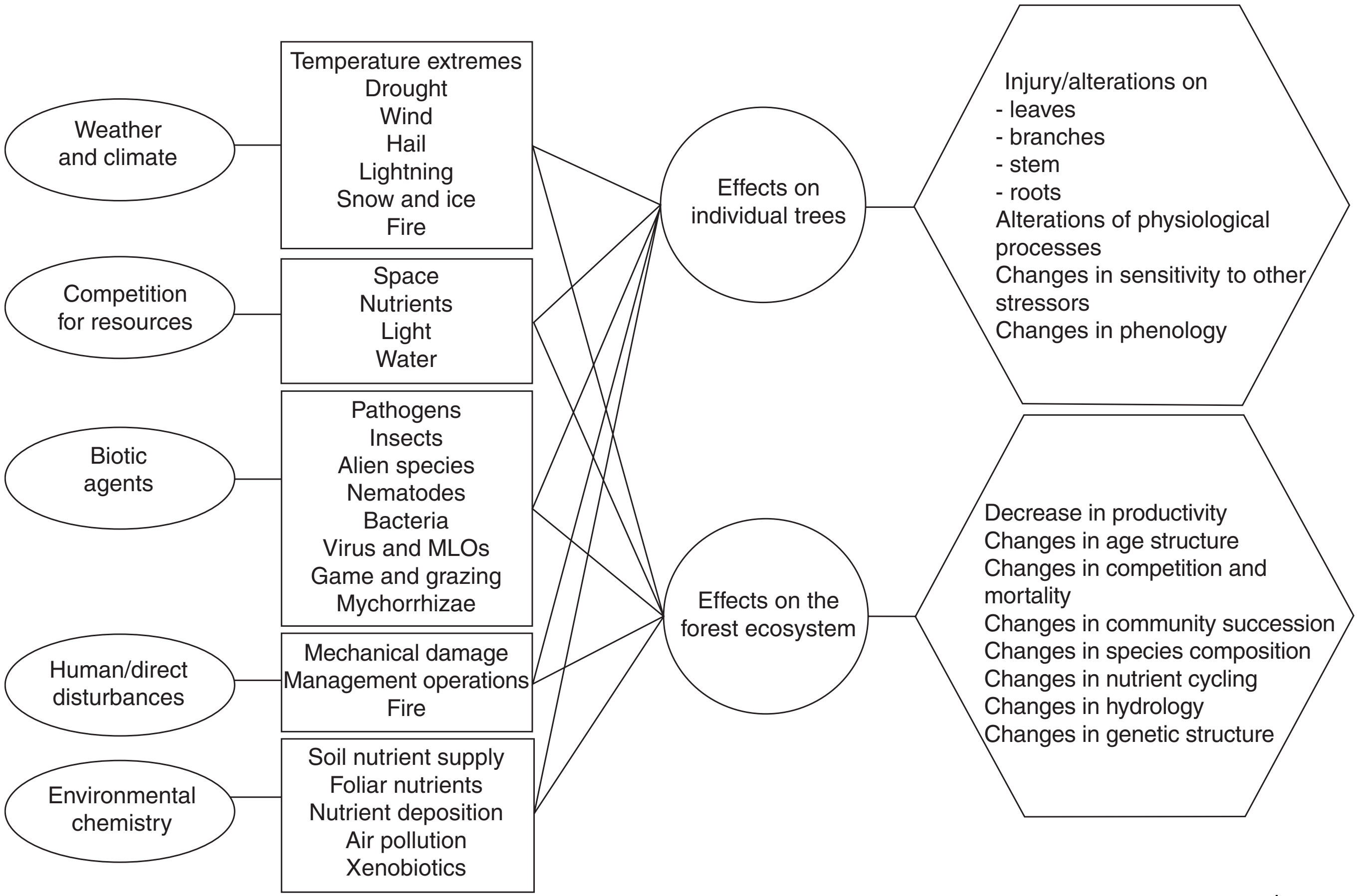
**Measurements** → *Identifying the conditions that are conducive to thresholds and/or tipping points* ← **Understanding**




Ecological resilience concept

Holling, C. S. 1973. Annual Review of Ecology and Systematics 4:1–23.

# What to measure and how?




Ferretti, 2004, in Evans, Youngquist, Burley, Encyclopedia of Forest Sciences

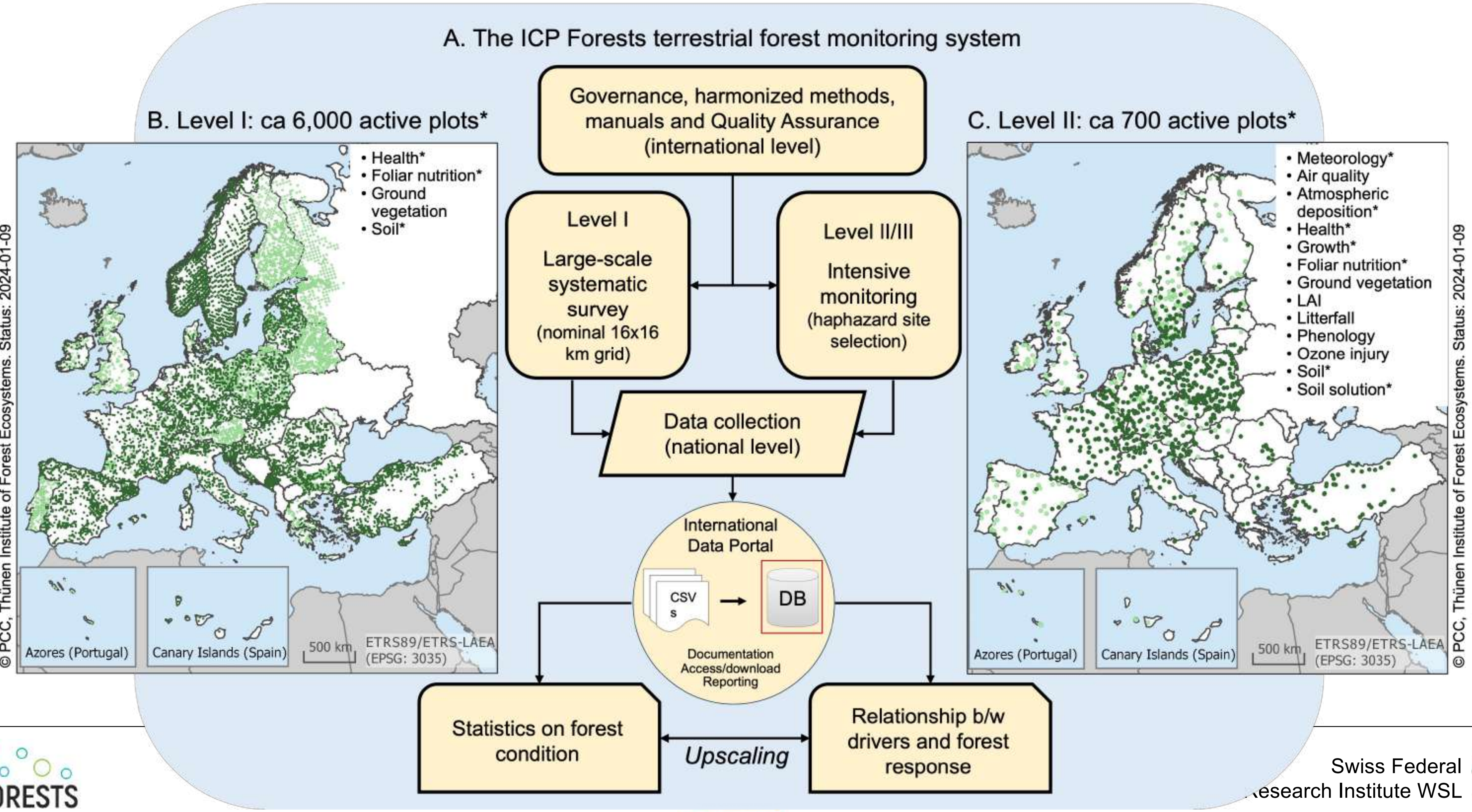
# The UNECE International Co-operative Program (ICP) on Assessment and Monitoring of Air Pollution Effects on Forests

- Collect, validate, store, process and provide data on forest health, growth, diversity, phenology, soil and foliar nutrients, climate, deposition and ozone.
- Long-term, large-scale forest condition.
- Large-scale 42 participating countries (lead: Germany).
- Drivers-response relationships.
- Standard Operating Procedures (SOPs) and Quality Assurance (QA) on a continuous basis.
- www.icp-forests.net


Credit: Michel et al., 2018.

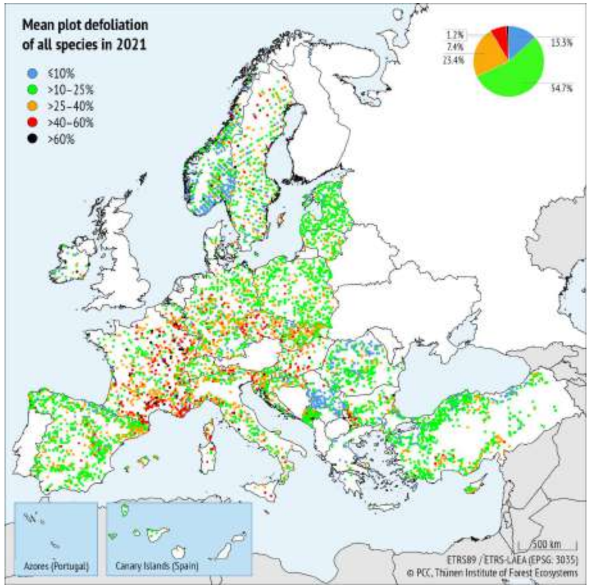
# ICP Forests in brief

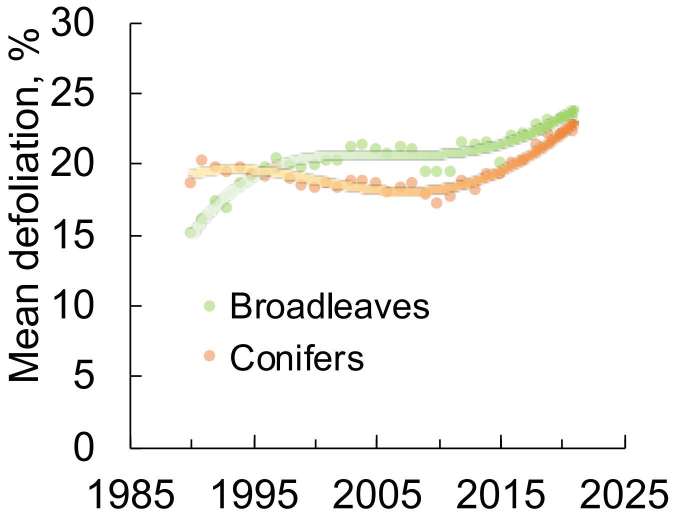
Ferretti et al., For Ecol Manage, 2024



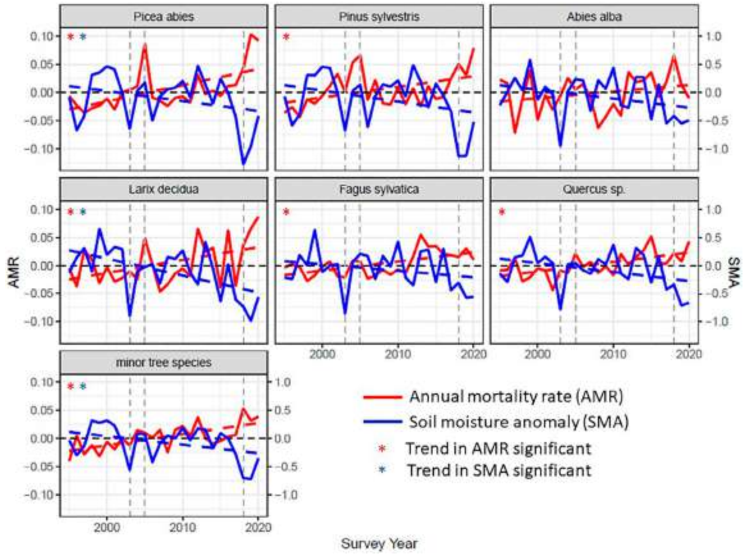
# Forest health

Mean plot defoliation



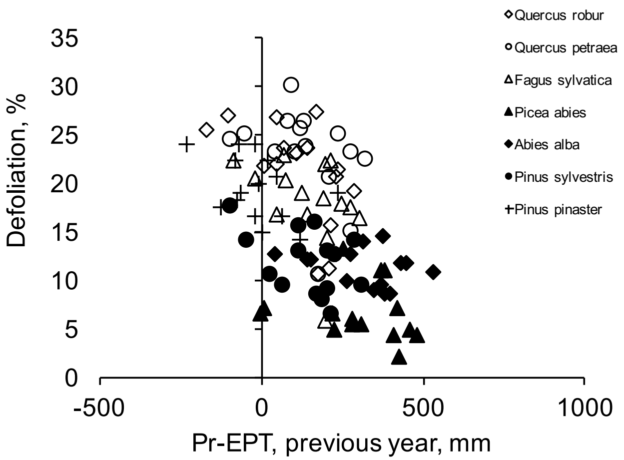

Mortality and soil moisture anomalies



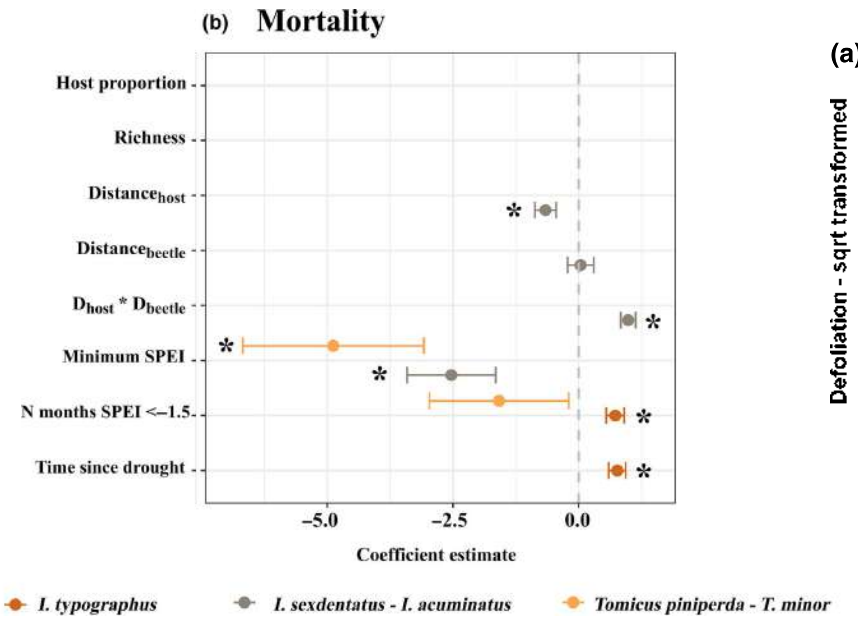

Michel *et al.*, ICP Forests TR, 2022
Potocic et al., ICP Forests Brief, 2022
George et al., Plant Biology, 2022

# Forest health

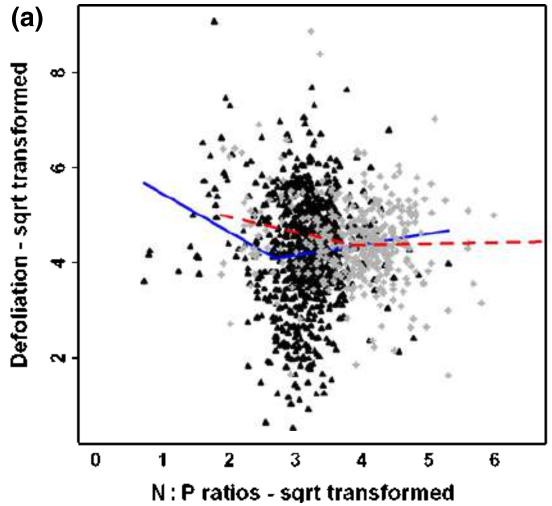
## Climate and weather




## Biotic stressors




## Nutrition




Ferretti et al., For Ecol Manage, 2013
Veresoglou et al., New Phytol, 2014
Jaime et al., Global Change Biology, 2021

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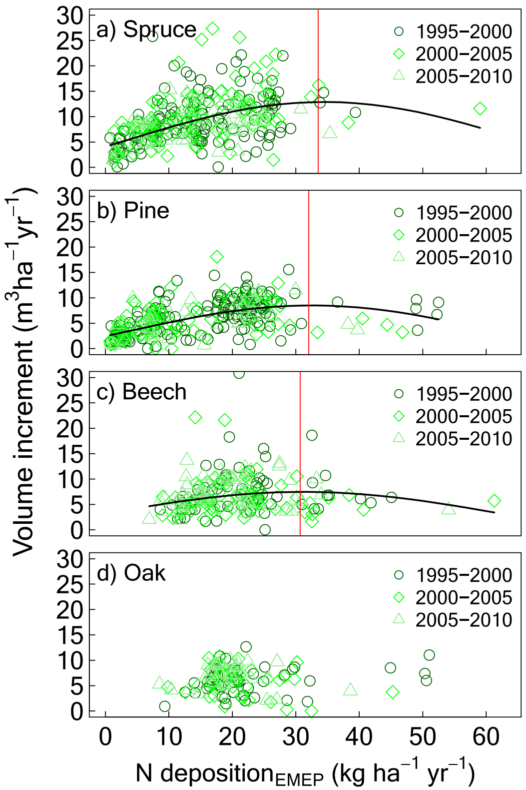
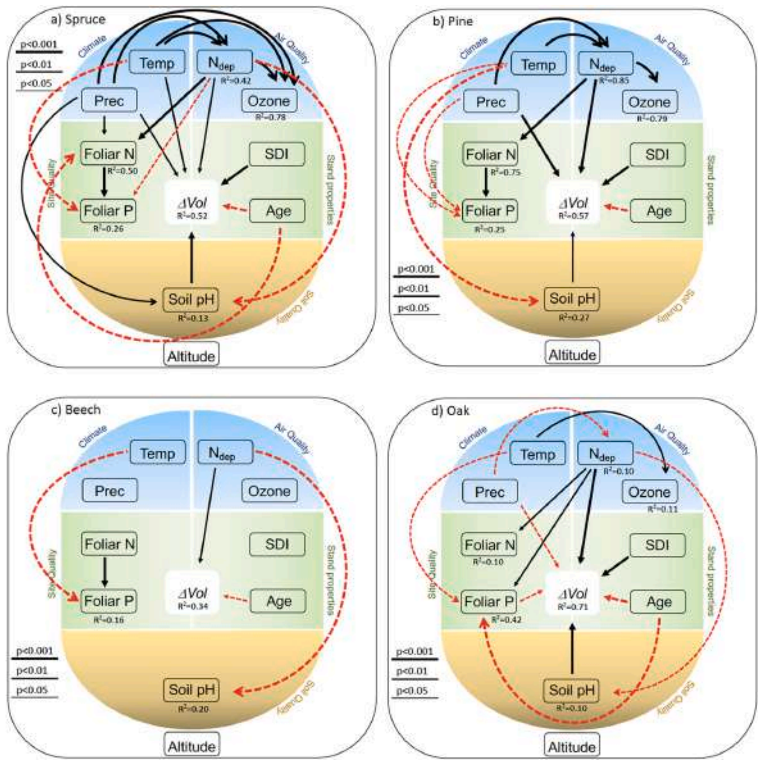
# Forest growth

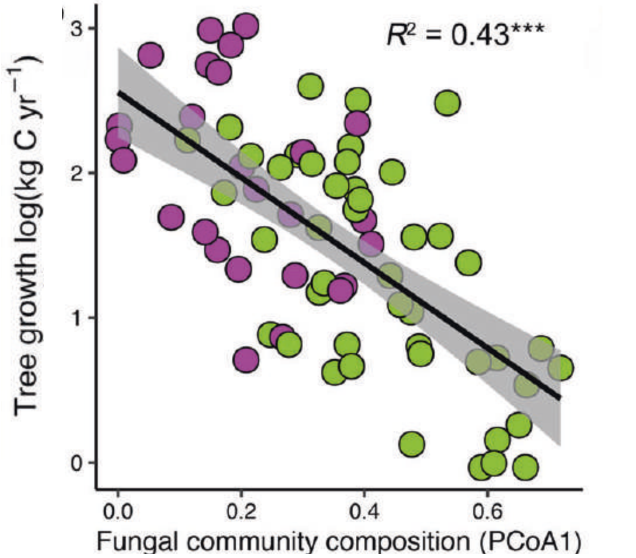
## Role of N deposition




## Role of multiple factors



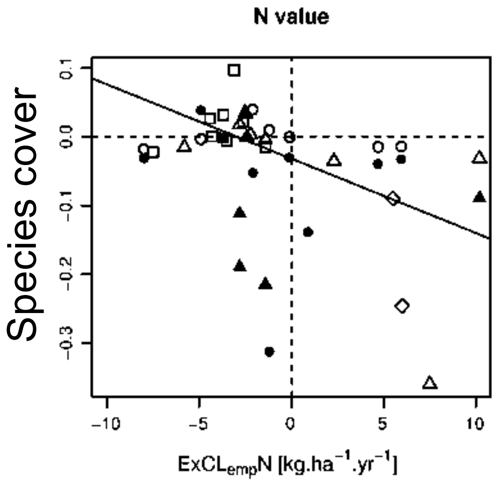

## Role of EM fungal community




Etzold *et al.* , For Ecol Manage, 2020.
Anthony et al., ISME Journal, 2022

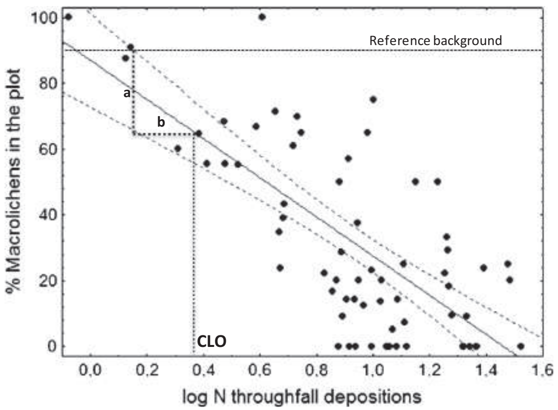
# Forest species diversity

Vascular plants



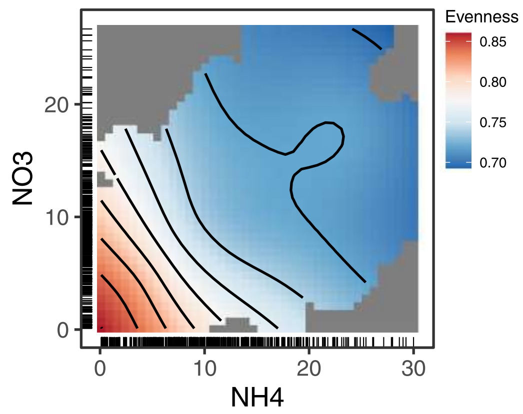

*Decrease cover of oligotrophic species (open symbols)*

Lichens



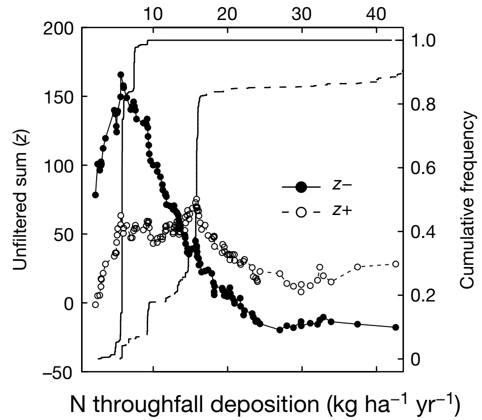

*Decrease frequency of macrolichens*

Bryophytes




*Decrease of evenness*

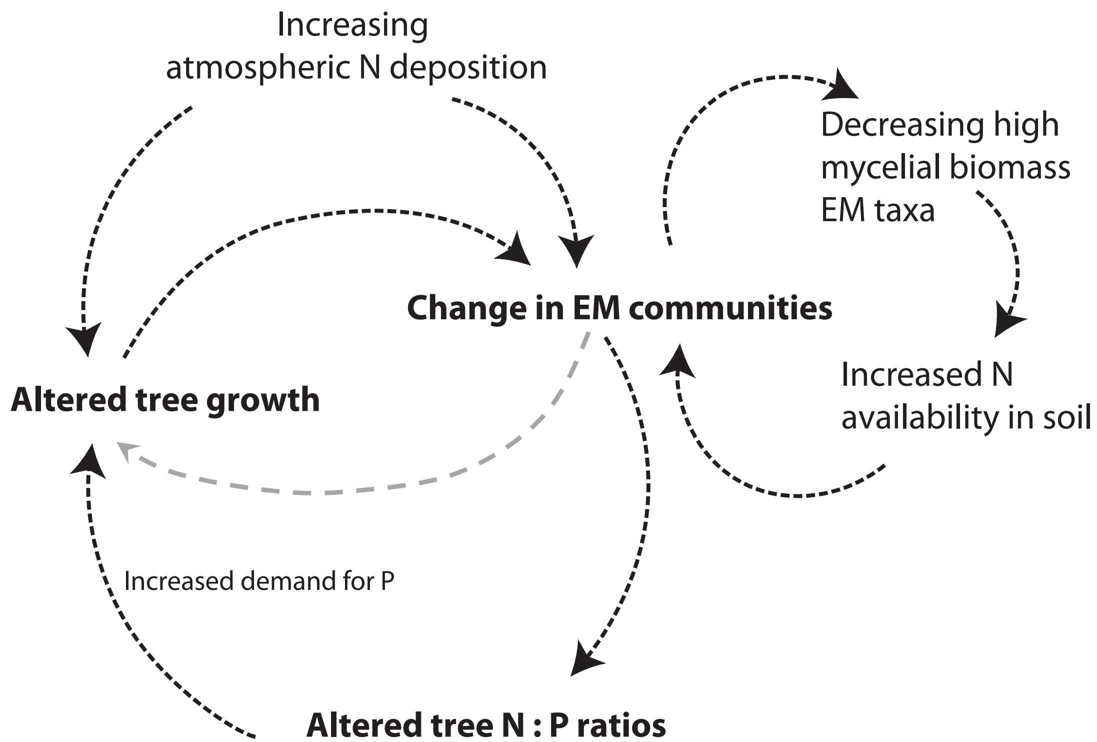
Ectomycorrhiza (EM)




*Change in EM fungal communities*

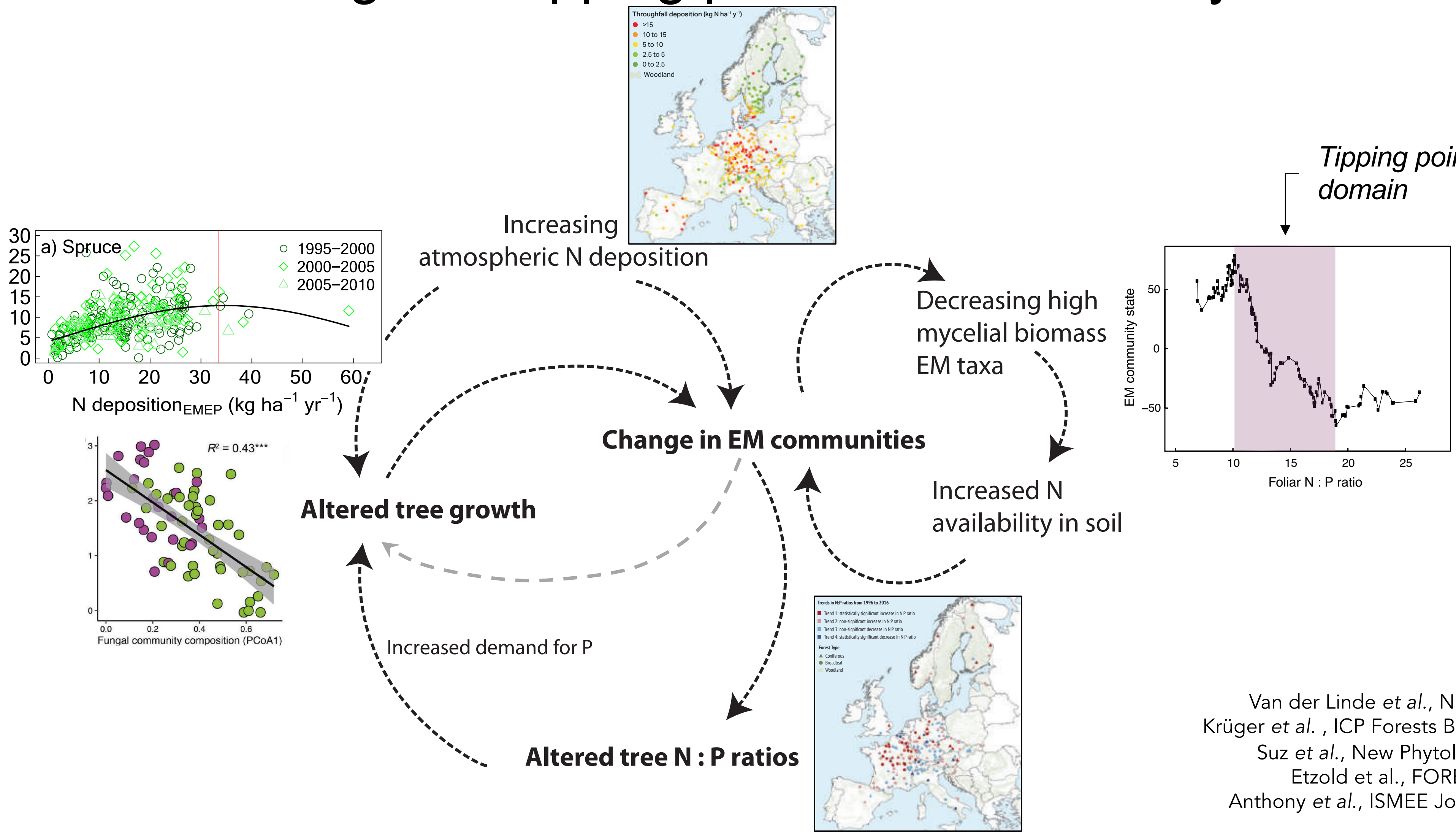
Dirnböck *et al.*, Global Change Biology, 2013; Giordani et al., For. Ecol. Manage., 2013; Welldon *et al.*, Annals of Forest Science, 2022; Van der Linde *et al.*, Nature, 2018.

# EM fungi and tipping points in forest ecosystem




Suz *et al.*, New Phytologist, 2021.

# EM fungi and tipping points in forest ecosystem




Van der Linde *et al.*, Nature, 2018.
Krüger *et al.* , ICP Forests Brief 4, 2020.
Suz *et al.*, New Phytologist, 2021.
Etzold et al., FORECO, 2021.
Anthony *et al.*, ISMEE Journal, 2022.

# Outline

- Is the monitoring network assessing forest resilience and how?
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# Information needs

**1. Detection and quantification** of status and changes of forest resources.

- "Traditional" meaning in the forest community
- Spatial coverage
- Emphasis on statistical design
- NFIs, ICP Forests Level I

**2. Identification and understanding** of drivers and processes


- "New" meaning for a broader range of scientists
- Time resolution
- Emphasis on models.
- ICP Forests Level II; ICOS;…

# Information needs

**1. Detection and quantification** of status and changes of forest resources.

**2. Identification and understanding** of drivers and processes


**3. Model future development**

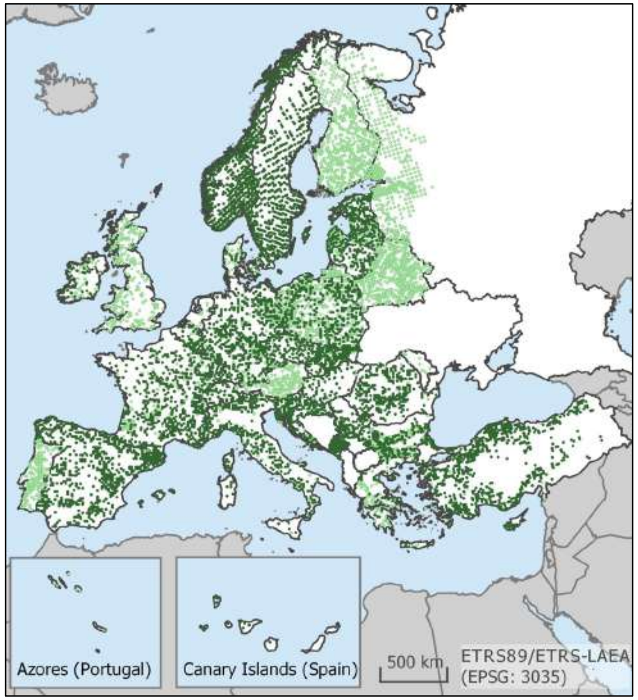
- ➢ "Traditional" meaning in the forest community
- ➢ Spatial coverage
- ➢ Emphasis on statistical design
- ➢ NFIs, ICP Forests Level I

- ➢ "New" meaning for a broader range of scientists
- ➢ Time resolution
- ➢ Emphasis on models.
- ➢ ICP Forests Level II; ICOS;…

# Three possible advantages for the new regulation

## (i) Operational

- Existing ground-based plots infrastructure with long-term data legacy:
    - covering all fields considered by the draft regulation (+ soil);
    - for the validation of data originated by the remote sensing component.
- Already harmonized methodologies.
- Already established formal QA/QC procedures.
- Model for governance and data access policy.






Ferretti et al., FORECO, 2024.

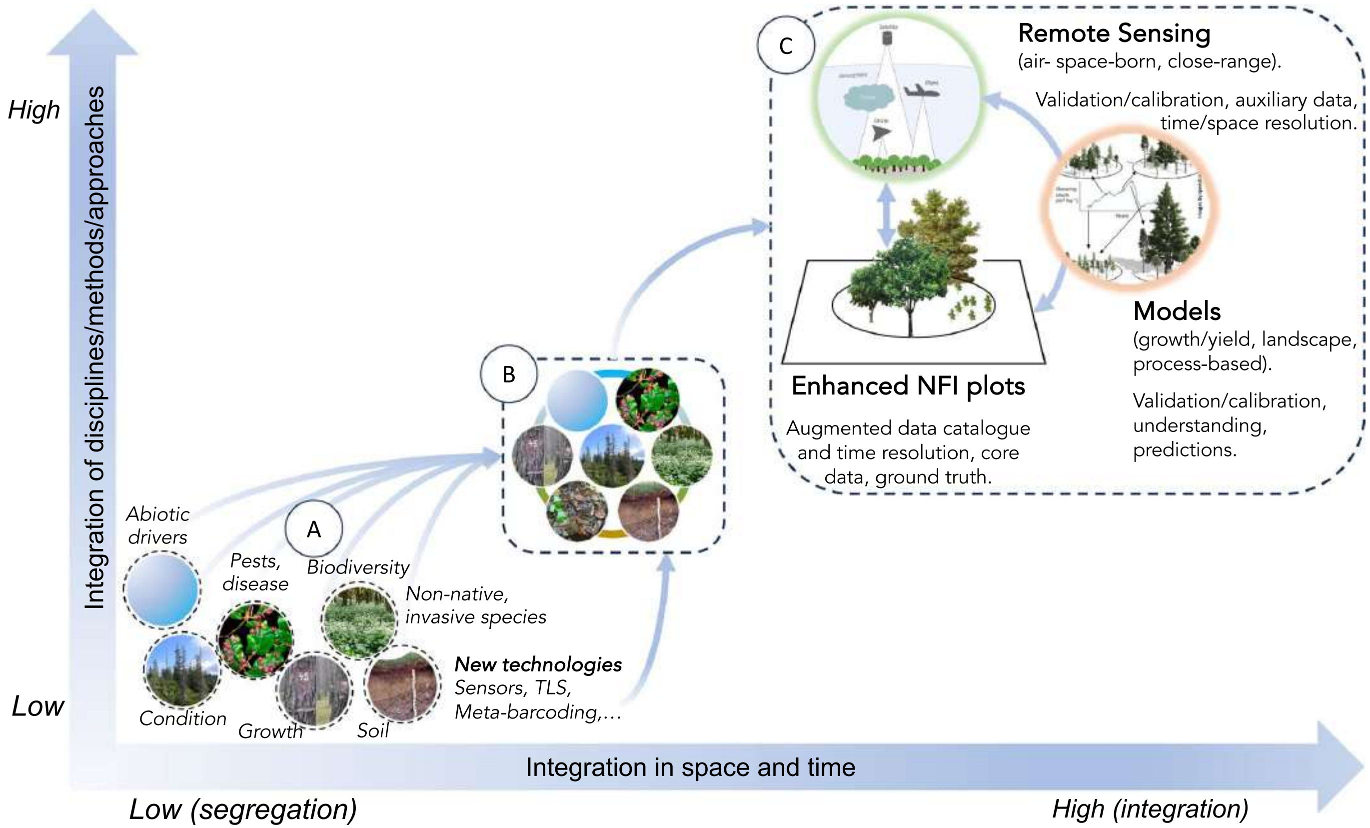
## (iii) Financial

See (i) + capitalizing the past EC investments after the EC Regulation 3528/86.

## (iii) Conceptual

- Bridging the gap between detection/quantification and understanding.

# A possible example: the SwissAIM initiative




Ferretti et al. Annals of Forest Science (2024) 81:6

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# Three main steps

**(i) Revising, further developing, and updating the suggested monitoring concept also beyond the NFIs.**

- by leveraging the existing and available internationally co-ordinated monitoring networks.

**(ii) Identifying and exploiting complementarities and synergies**

- between existing and available internationally co-ordinated monitoring networks, **filling gaps** when necessary.

**(iii) Developing an institutional framework**

- for a collaborative multi-level, multi-tier integrated ground-based and remote sensing forest monitoring system.

Forest Ecology and Management 561 (2024) 121875

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Resilient forests need joint forces for better inventorying and monitoring

Marco Ferretti [a,*], Arthur Gessler [a,b], Nathalie Cools [c], Stefan Fleck [d], Rossella Guerrieri [e], Tamara Jakovljević [f], Manuel Nicolas [g], Tiina M. Nieminen [h], Diana Pitar [i], Nenad Potočić [f], Stephan Raspe [j], Marcus Schaub [a], Kai Schwärzel [k], Volkmar Timmermann [l], Monika Vejpustková [m], Lars Vesterdal [n], Petteri Vanninen [o], Peter Waldner [a], Lothar Zimmermann [j], Tanja GM Sanders [k]

**Correspondence**

**Europe must join forces to monitor its forests**

**Marco Ferretti**

| Nature | Vol 626 | 29 February 2024

# Two important quotes: monitoring is simply essential

*"…monitoring is a crucial part of environmental science, costs very little relative to the value of the resources it protects and the policy it informs, and has added value in that basic environmental monitoring data can be used for multiple purposes."* (Lovett et al., 2007)

*"Forest science relies on the long-term data that scientists wring from forests over decades. Our chances of overcoming climate change are small, but they will diminish further if we forget the basics monitoring of our home planet" (Nature, 608, 2022).*

REVIEWS REVIEWS REVIEWS 253

**Who needs environmental monitoring?**

Gary M Lovett[1*], Douglas A Burns[2], Charles T Driscoll[3], Jennifer C Jenkins[4], Myron J Mitchell[5], Lindsey Rustad[6], James B Shanley[7], Gene E Likens[1], and Richard Haeuber[8]

Front Ecol Environ 2007; 5(5): 253–260

**In a nutshell:**

- Environmental monitoring is often criticized as being unscientific, expensive, and wasteful
- We argue that monitoring is a crucial part of environmental science, costs very little relative to the value of the resources it protects and the policy it informs, and has added value in that basic environmental monitoring data can be used for multiple purposes
- Effective monitoring programs address clear questions, use consistent and accepted methods to produce high-quality data, include provisions for management and accessibility of samples and data, and integrate monitoring into research programs that foster continual examination and use of the data
- Government agencies should commit to long-term support for valuable monitoring programs, and funders of basic ecological and environmental research should recognize that monitoring is a fundamental part of environmental science

© The Ecological Society of America

Lovett *et al.*, Front Ecol Environ, 2007

The international journal of science / 18 August 2022

**nature**

**We must get a grip on forest science — before it's too late**

**Trees are one of our biggest carbon hopes. Supporting the scientists who study them should be a high priority.**

"Forest science relies on the long-term data that scientists wring from forests over decades."

Nature | Vol 608 | 18 August 2022 | 449

*Nature, 608, 2022*

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FORECOMON and TFM 2024

Úvod ▸ FORECOMON and TFM 2024

# FORECOMON Conference and Task Force Meeting of the ICP Forests 2024

## FORECOMON 2024 – The 11th Forest Ecosystem Monitoring Conference

**Monitoring for future forests**

**Prague, Czech Republic**

**10–12 June 2024**

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MINISTRY OF AGRICULTURE OF THE CZECH REPUBLIC

Ministry of the Environment of the Czech Republic

Forestry and Game Management Research Institute

http://icp-forests.net/events/forecomon-2024-the-11th-forest-ecosystem-monitoring-conference