Innovative forest management strategies for a resilient bioeconomy under climate change and disturbances

Vallet P., Aussenac R., Beauchamp N., Cerioni M., Courbaud B., Fidej G., Grabska E., Guyennon A., Gutsch M., Hawryło P., Keren S., Klopčič M., Labonne S., Lindner M., Mahnken M., Monnet J.-M., Nagel T., Netzel P., Nikinmaa L., Patacca M., Reineking B., Reyer C., Schelhaas M.J., Schifferdecker G., Socha J., Tymińska L., Zudin S., Cordonnier T.

Madrid, Sept. 2022, ForestValue Final conference

I-MAESTRO

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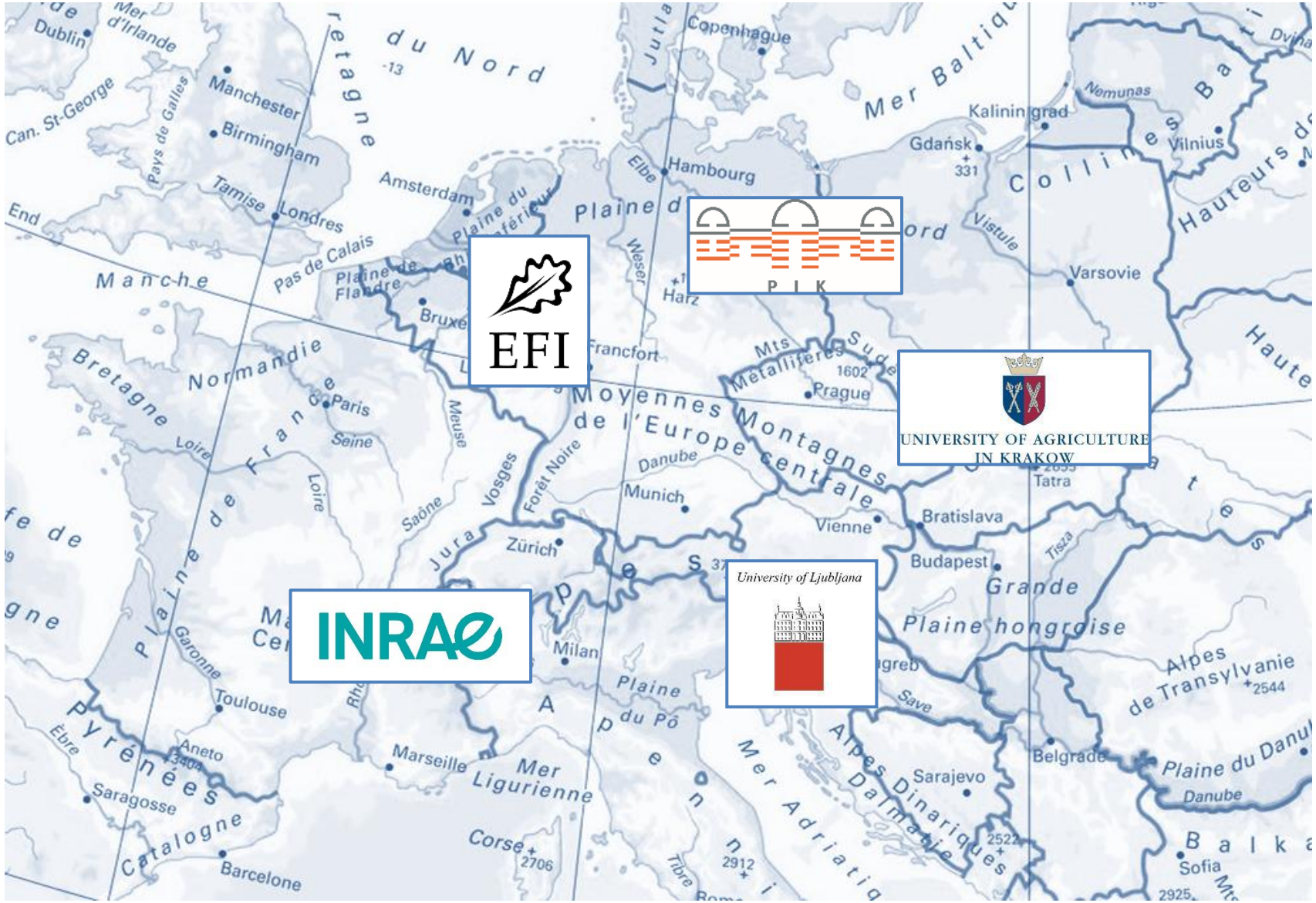
5 partners

May 2019 → October 2022



Main question of I-Maestro:
Are more complex forests more resilient to disturbances ?

What is complexity in I-Maestro ?

Stand scale

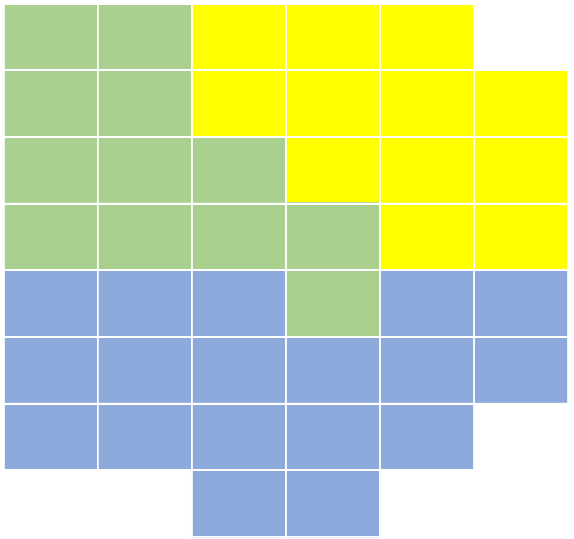
Alpha diversity

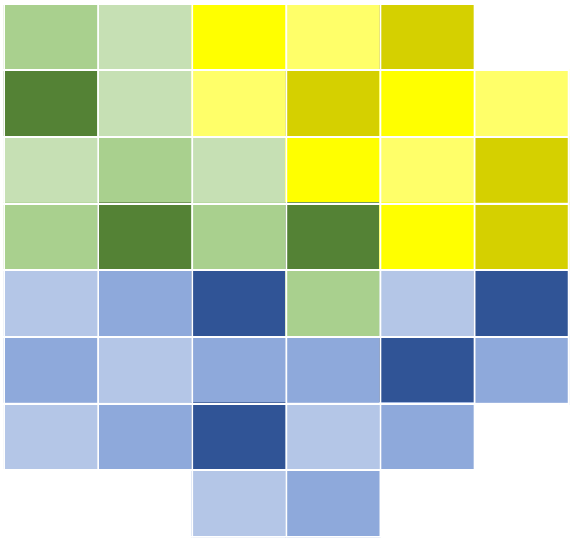
Few species
Simple diameter structure

Many species
Complex diameter structure

Landscape scale

Beta diversity





Low variety of stands

High variety of stands

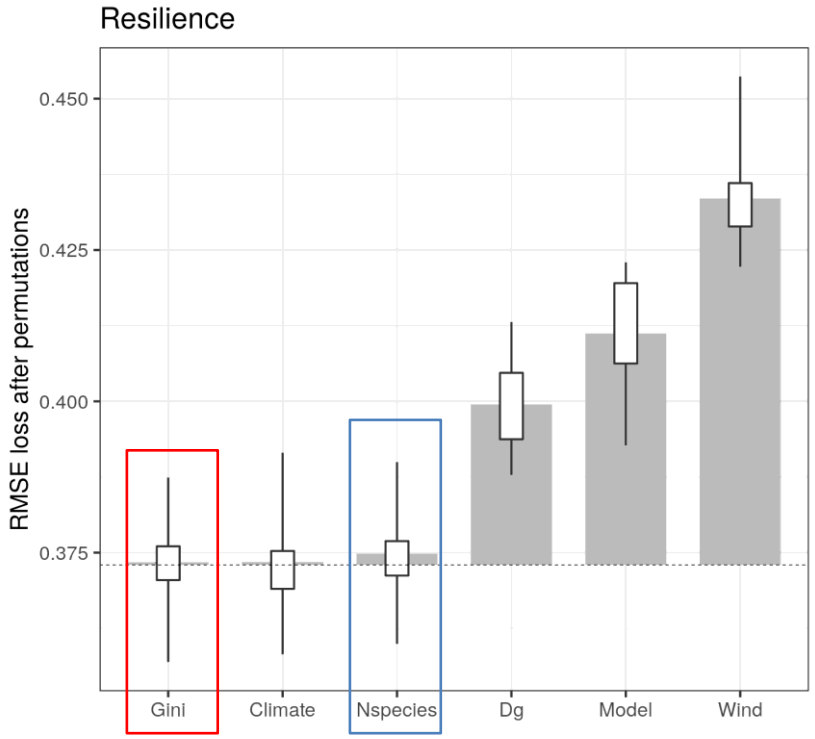
In forests, time is long → modelling approach

Stand scale

Alpha diversity

Virtual experiment

1. Generate virtual stand, with varying species diversity, and diameter structure
2. Apply 3 levels of storms
3. Simulate growth using 4 forest dynamics models
4. Analyze resistance, recovery and resilience



Key messages on Complexity – Resilience :

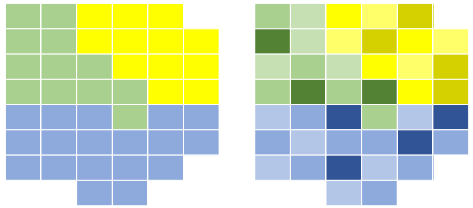
Tree size diversity (Gini) : small effect on resilience

Species richness (Nspecies) : limited effect on resilience

Main effects: the strength of the storm, the model used, and the developmental stage.

Landscape scale

Beta diversity



Bauges (France) :

~ 51 500 ha, mountain forest

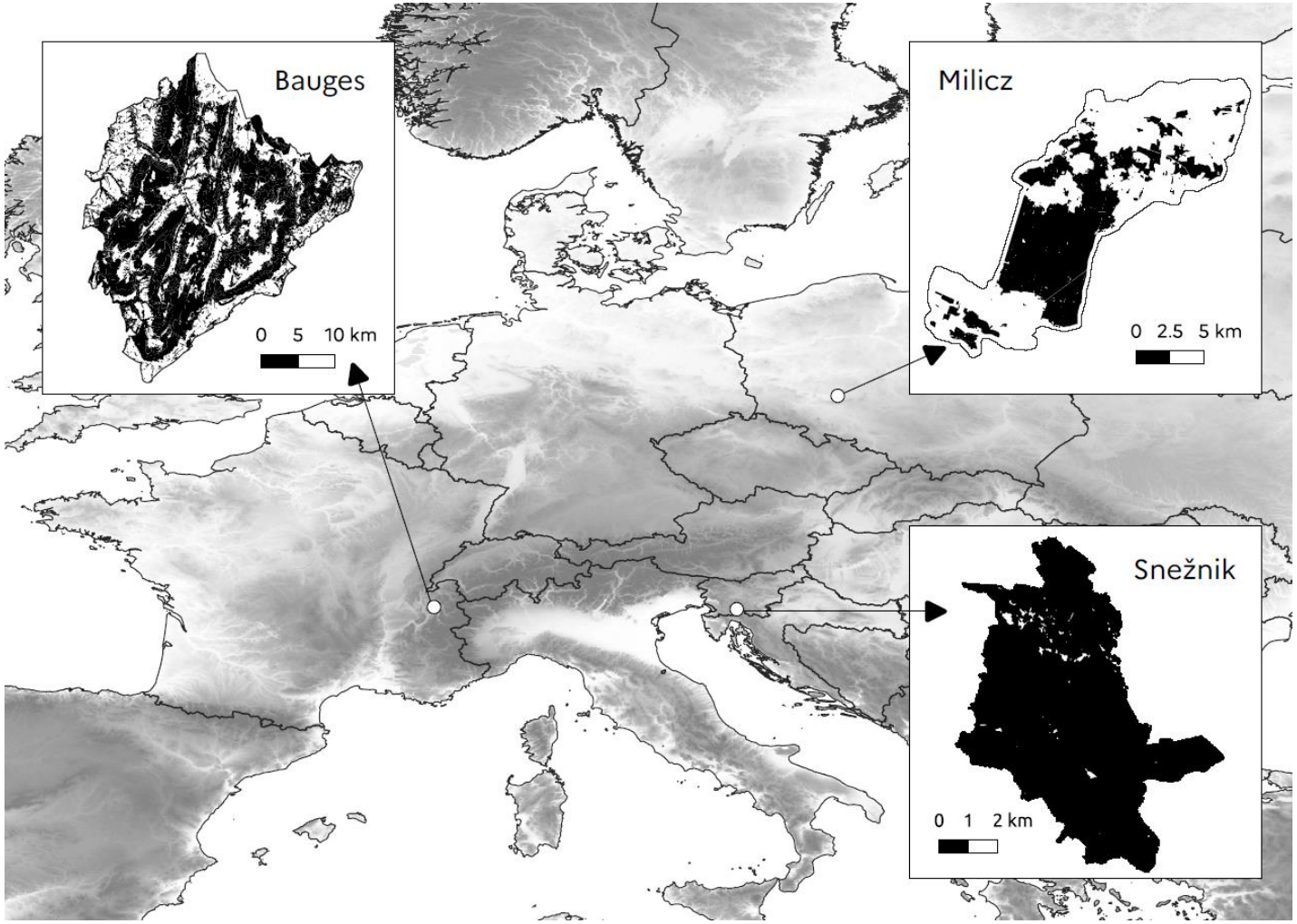
Milicz (Poland) :

~ 7 700 ha, plain forest

Sneznik (Slovenia) :

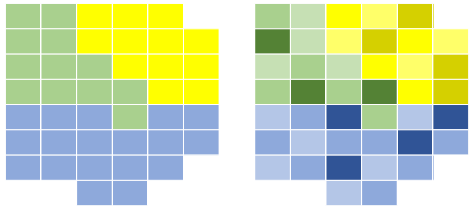
~ 4 600 ha, mountain forest

Simulation of forest dynamics on 3 case study areas



Landscape scale

Beta diversity



Simulation of forest dynamics on 3 case study areas

DATABASE ON FOREST DISTURBANCES IN EUROPE
https://dfde.efi.int/db/dfde_app.php

DISTURBANCE SCENARIOS

MILICZ
Poland

SNEZNIK
Slovenia

BAUGES
France

LANDSCAPE INITIALIZATION

SIMULATIONS UP TO 2100
Forest Dynamics Models

OUTPUT ANALYSIS

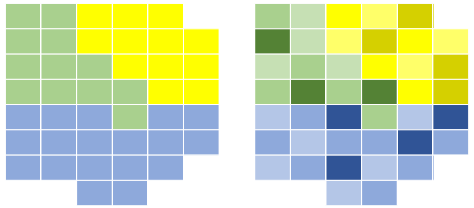
CLIMATE SCENARIOS

FOREST MANAGEMENT SCENARIOS

10 scenarios resulting in different diversities

Landscape scale

Beta diversity

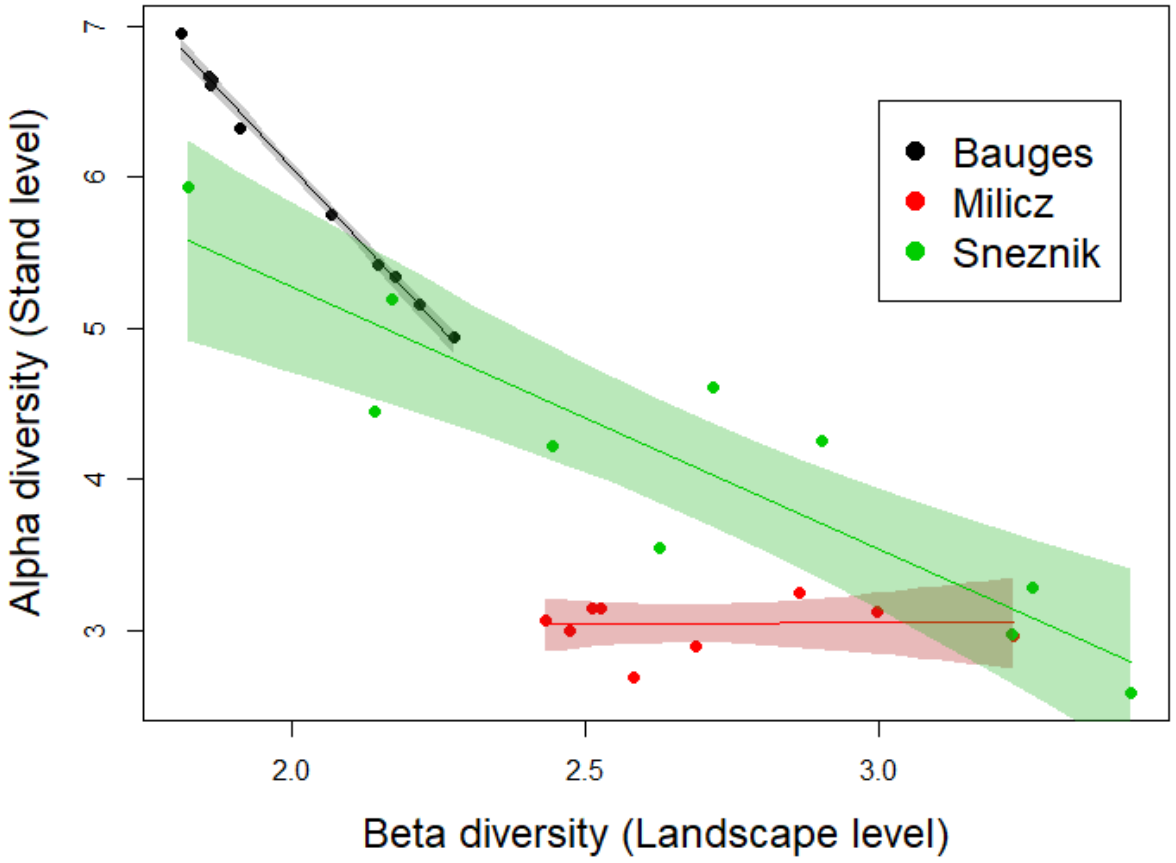


A trade-off between stand and landscape diversities

Contrasted situation:

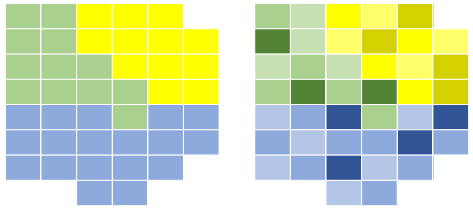
Bauges (mountain uneven-aged forest):
A homogeneous landscape
of heterogeneous stands

Milicz (plain even-aged forest) :
A heterogeneous landscape
of homogeneous stands

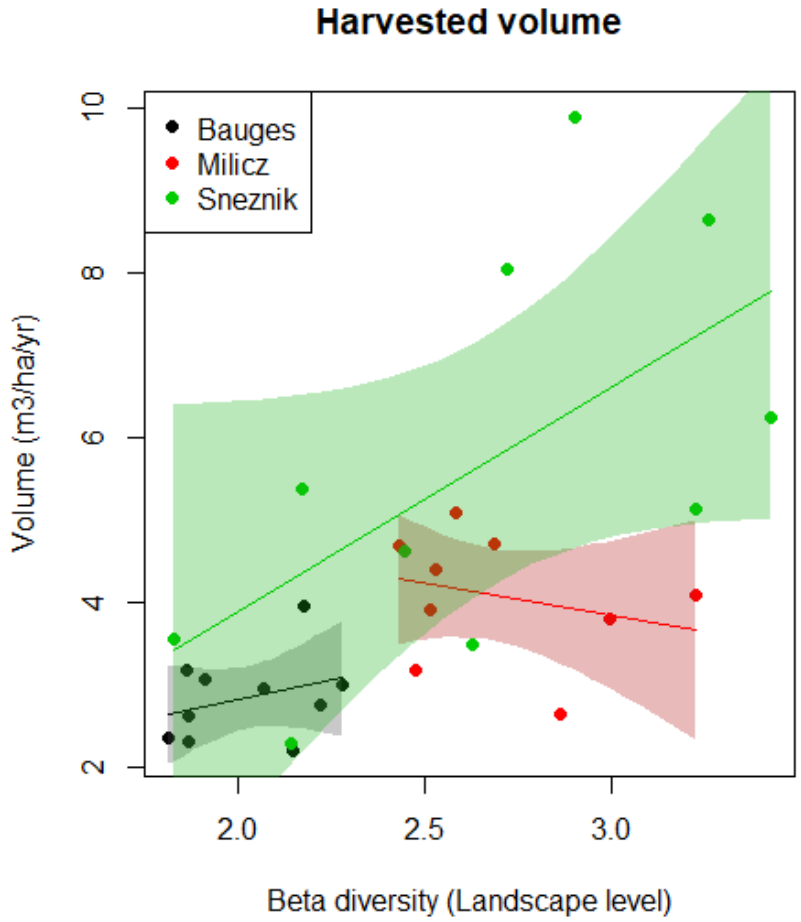


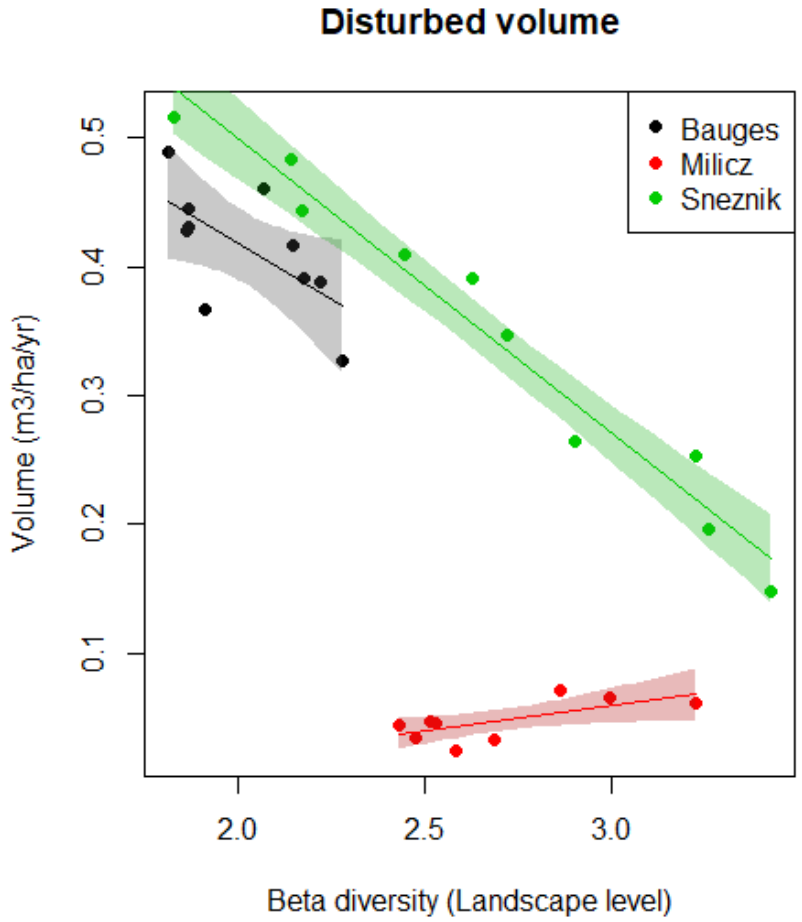
Landscape scale

Beta diversity



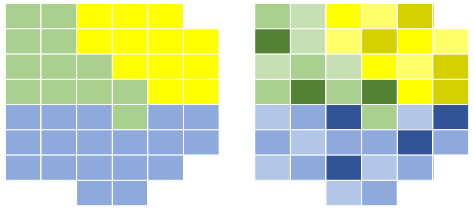
Effect of beta diversity on harvested and disturbed volumes





Landscape scale

Beta diversity



Key messages:

1. Management scenarios result in different α and β diversities
2. Trade-off between α (stand) and β (landscape) diversities
3. Low effect of β diversity on harvested volume
4. In mountain forest (high α), increasing β might reduce disturbed volume

Main outcomes of I-Maestro collaboration:

Databases:

- Database on Forest Disturbances in Europe
- Database for evaluating vegetation models and simulating climate impacts on forests
- European database on forest recovery

Methods:

- Disturbance detection methods using satellite Sentinel-2 data
- Evaluation of forest dynamics models
- Airborne Laser Scanning methods
- Construction of landscape scale dendrometry
- …

Results:

- Field studies on recovery
- Results on disturbance analyses at the European scale
- Site indices models or height growth models using Airborne Laser Scanning
- Simulation experiments at stand and landscape scales
- …

→ 19 scientific articles listed on the I-Maestro website: https://i-maestro.inrae.fr/publications/

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Thank you for your attention

I-Maestro team in the Tatra Mountains, Poland, 2022
Picture from Rosa Castañeda

Contact details:
patrick.vallet@inrae.fr