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I-Maestro: Innovative forest management strategies for a resilient bioeconomy under climate change and disturbances

Patrick Vallet, Raphaël Aussenac, Nathéo Beauchamp, Matteo Cerioni, Benoît Courbaud, Gal Fidej, Ewa Grabska, Arnaud Guyennon, Martin Gutsch, Pawel Hawrylo, et al.

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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., Tymieńska L., Zudin S., Cordonnier T.

Madrid, Sept. 2022, ForestValue Final conference

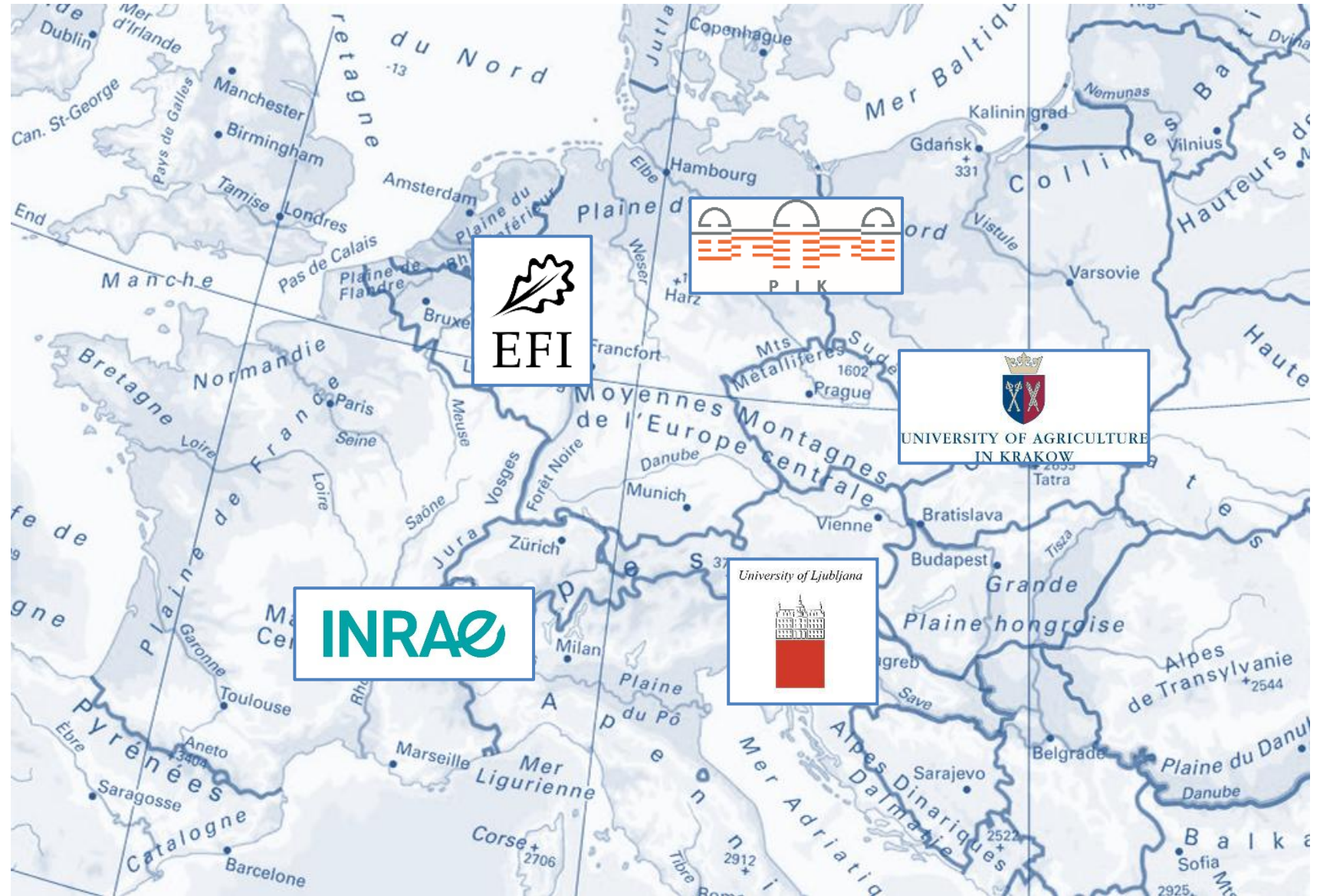


ForestValue



5 partners

May 2019 → October 2022





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

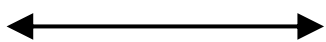
What is complexity in I-Maestro ?

Stand scale

Alpha diversity



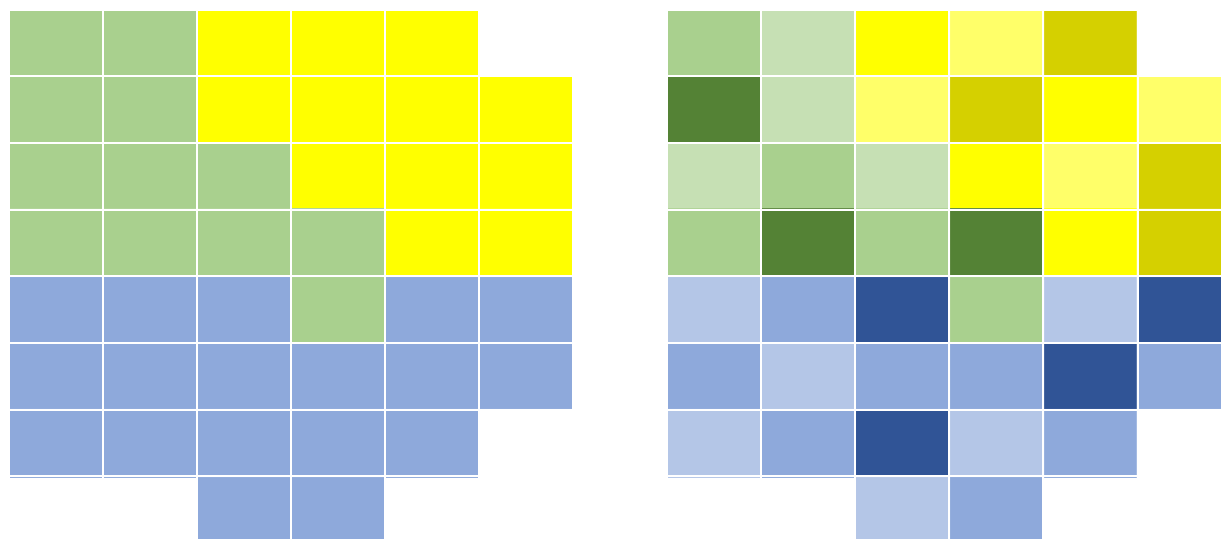
Few species
Simple diameter
structure



Many species
Complex diameter
structure

Landscape scale

Beta diversity



Low variety
of stands



High variety
of stands

In forests, time is long → modelling approach

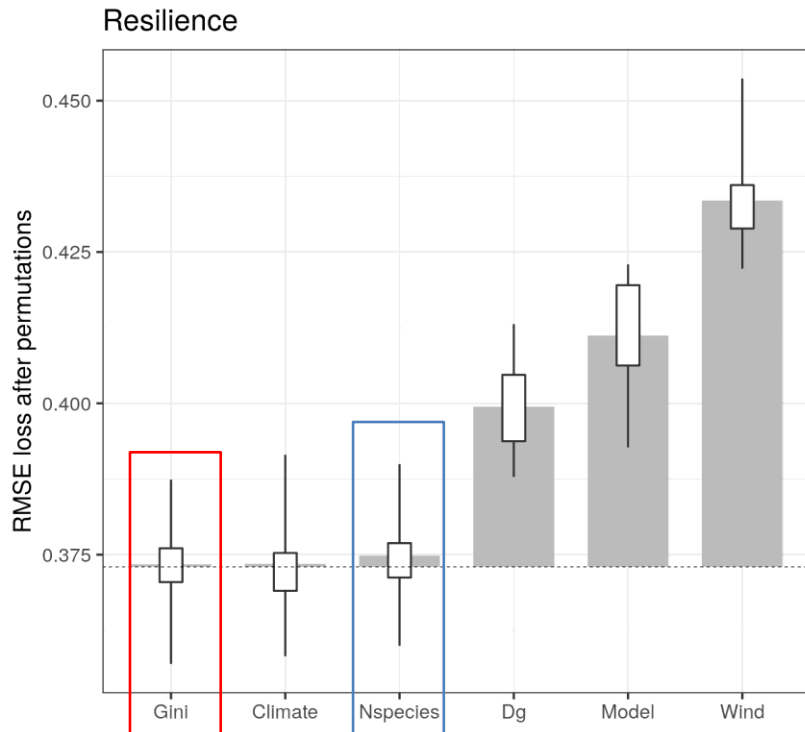
Stand scale

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 :

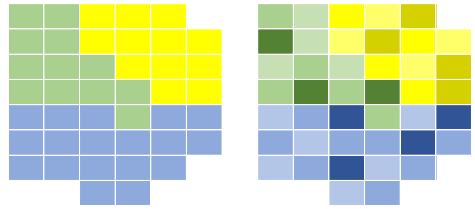
Tree size diversity (Gini) : small effect on resilience

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

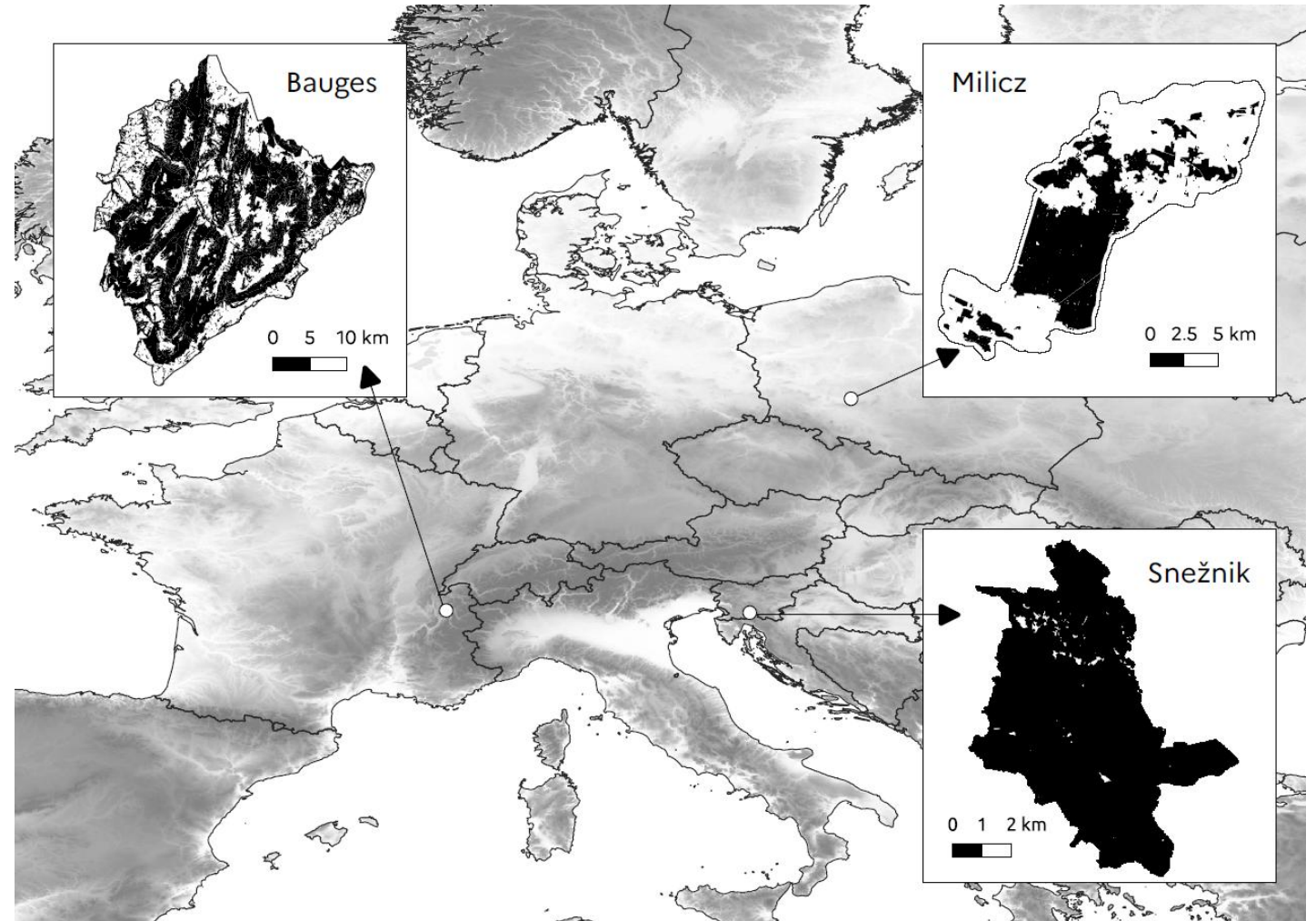
Milicz (Poland) :

~ 7 700 ha, plain forest

Sneznik (Slovenia) :

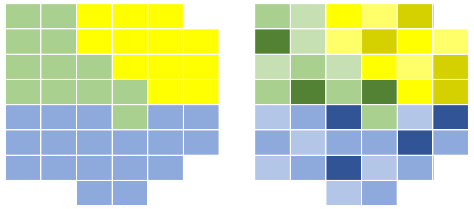
~ 4 600 ha, mountain forest

Simulation of forest dynamics on 3 case study areas

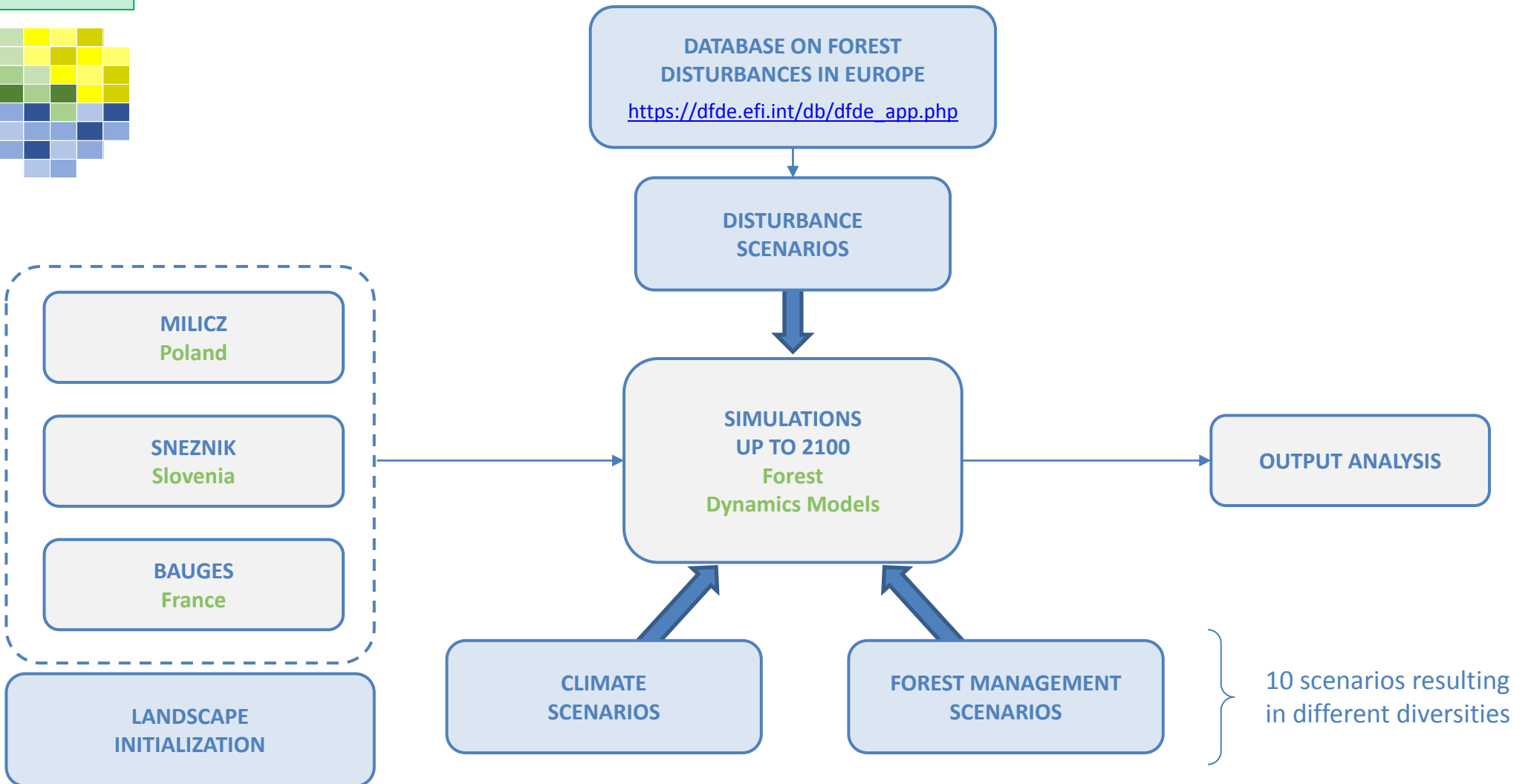


Landscape scale

Beta diversity

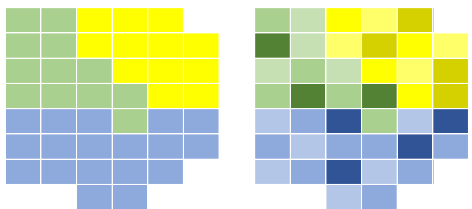


Simulation of forest dynamics on 3 case study areas



Landscape scale

Beta diversity



Contrasted situation:

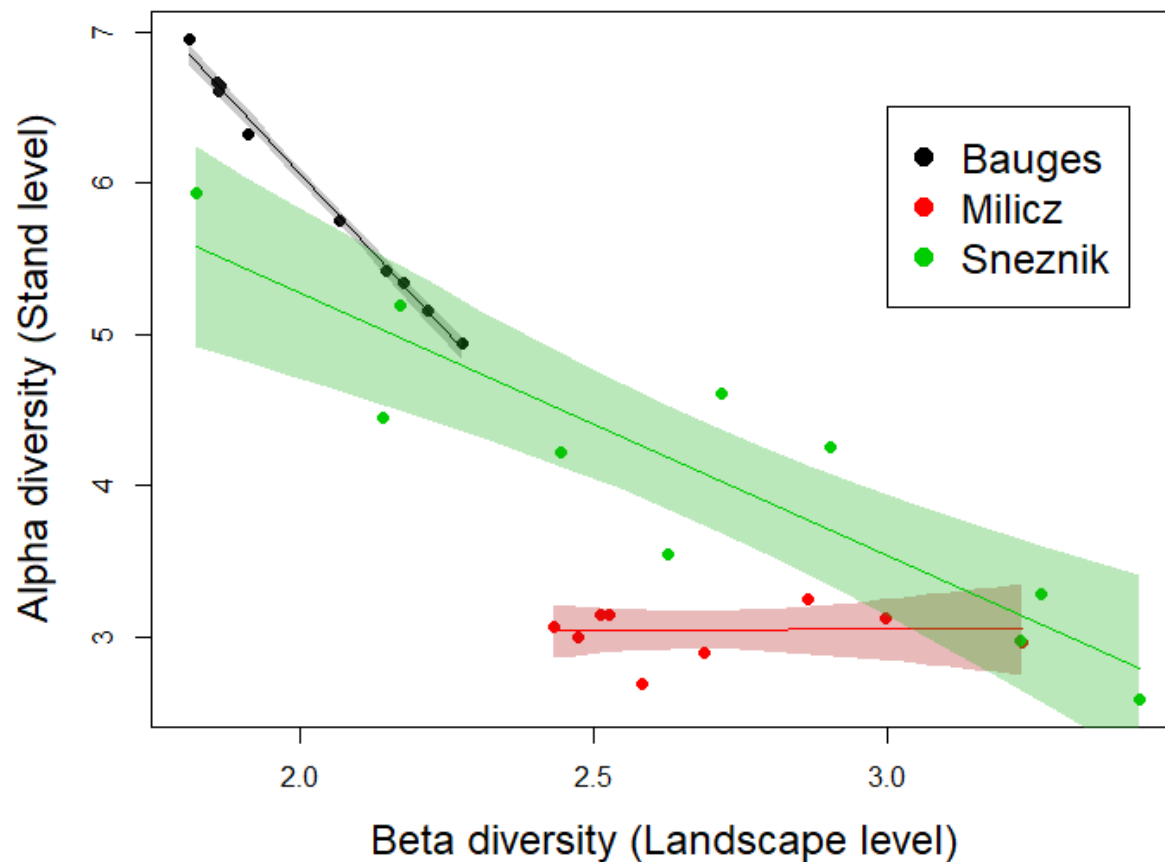
Bauges (mountain uneven-aged forest):

A homogeneous landscape
of heterogeneous stands

Milicz (plain even-aged forest) :

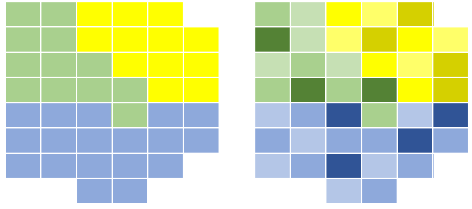
A heterogeneous landscape
of homogeneous stands

A trade-off between stand and landscape diversities

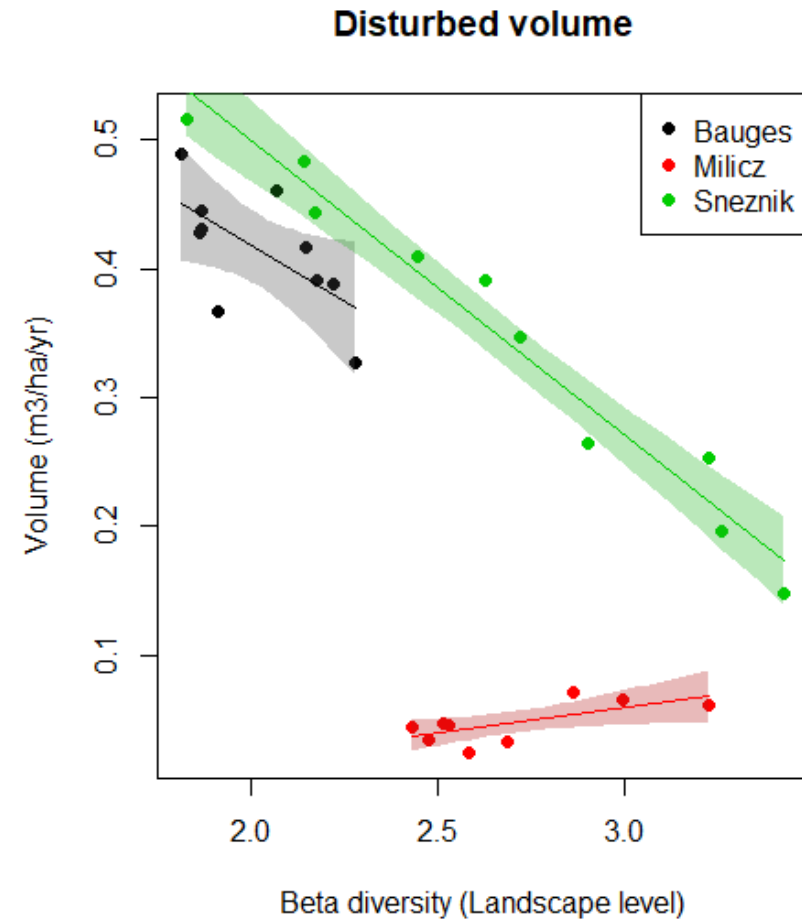
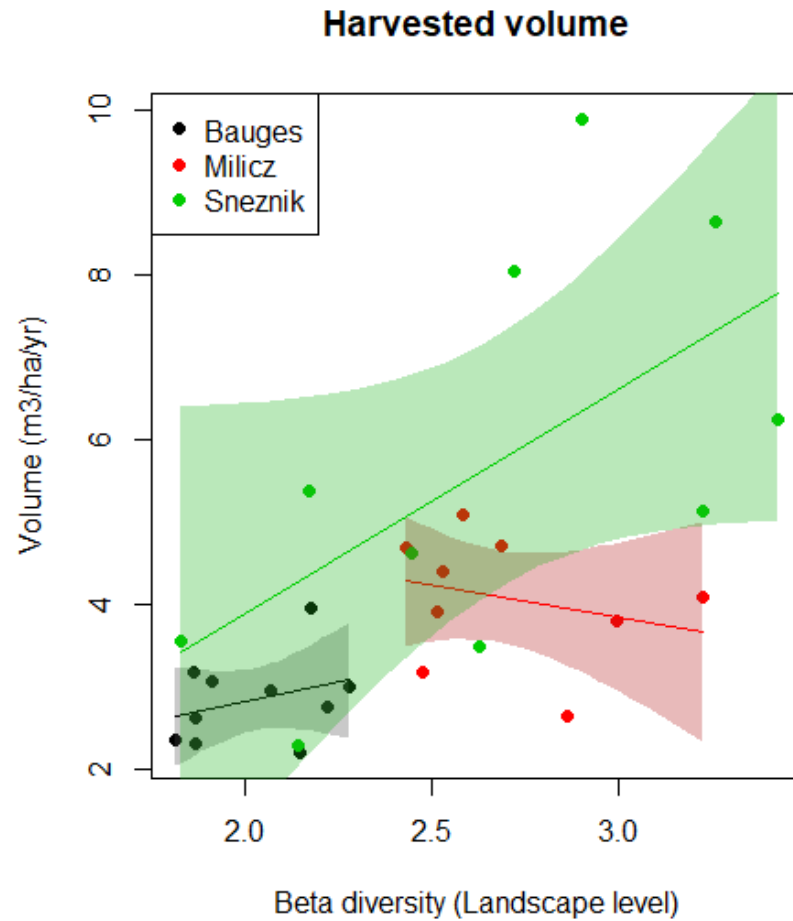


Landscape scale

Beta diversity

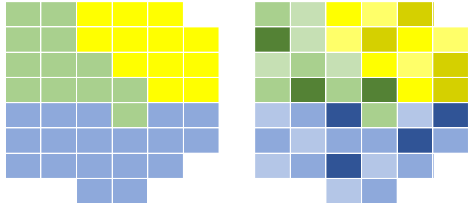


Effect of beta diversity on harvested and disturbed volumes



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/>





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

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