Integration of multi-sourced and multi-scale forest monitoring data for addressing local to global challenges on forest ecosystems

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Forests and climate change (in relation to the Paris Agreement)

(Articles 4 and 5):
Reduce the growth rate of atmospheric CO2 by increasing carbon sequestration

(Article 2):
Reduce radiative imbalance at the top of the atmosphere by increasing albedo

(Article 7):
Without increasing air temperature nor decreasing precipitation
And what does recent science say?

**Focus on adaptation!**

Forest management to sustain **multiple ecosystem services** (not just C sequestration)
Sustain Multiple Forest Ecosystem Services

- Biodiversity Conservation (CBD)
- Forest Land Restoration (FLR)
- Climate change adaptation & mitigation (UNFCCC)
- Combat Desertification (UNCCD)
- Revert Land Degradation (LDN)
- Forest Ecosystem Functioning
- Provision of Ecosystem Services
- Smart Forest monitoring

Knowledge + Data Science
Data integration: multiple spatio-temporal scales

Scaling up

Global

Landscape

National / Regional

Stand

Downscaling

PRESENT

PAST

FUTURE

Days

Months

Years

Decades...

Volume, m$^3$ ha$^{-1}$

Stand age, years

Healthy P. brutia stand

Good

Medium

Poor

National/Regional
Data integration: multiple data sources

Global

GFBi

GEDi

Ecosystem Lidar

Stand

Landscape

National / Regional

Scaling up

Downscaling

Days
Months
Years
Decades...

PRESENT
FUTURE
Benefits of multi-scale & multi-source data integration

From local to global:

• Experimental data from intensive local monitoring

• Data on specific features seldom monitored in forest ecosystems at broader scales (e.g., fungal dynamics)

• Accurate information on forest dynamics & drivers operating at smaller scales

From global to local:

• New data & knowledge not available at more local level (e.g., LiDAR-based forest structure)

• Context & further insight (broader frame compared to more local forest knowledge and dynamics)

• Information on forest dynamics & drivers operating at larger scales
Example of data integration & harmonization

- Towards distributed, integrated, statistically sound and harmonised data, as well as outlooks on forest resources and their use.
- Combined with reporting, policy- and decision-making at multiple scales, it supports the development of a sustainable and circular bioeconomy while addressing the SDGs.
Global Forest Biodiversity Initiative

Central GFBI Hub
- Development of the GFBI Data Management System (GFBI DMS)
- Hosting the GFBI Data Center (GFBI DC)

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Largest individual-tree forest inventory database:
- \( \approx 1.3 \) million plots
- \( \approx 30,000 \) tree species
- From all continents and forest biomes

Positive biodiversity-productivity relationship predominant in global forests
Jingjing Liang, Thomas W. Crowther, Nicolas Picard, Susan Wiker, Mu Zhou, Giorgia Alberti, Ernst-Bettel Schulte, A. David McGarre, Fabio Bazzato, Hans Pretzsch, Sergio de Miguel, Mais Paquette, Bruno Hérault, Michael Scherer-Lorenzen,
Data integration & sharing (monitoring is not enough!)

Forest monitoring & data needs...

- Harmonization
- Standardization
- Integration
- Sharing
- Transparency
- Security
- Communication
- Etc.

Proper analytical tools:
- Big Data Technology
- Artificial Intelligence
THANK YOU

... specially to Dr. Nicolas Picard (FAO) for presenting this on my behalf.

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