

# The GEO-TREES Initiative

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Space agencies have made enormous investments in Earth Observation missions to map forest biomass across continents in support of climate science and carbon markets.

ESA will launch the BIOMASS Earth Explorer and supports the global mapping of forest biomass through various projects, such as the CCI Biomass.

Several other Space Agencies are engaged in comparable initiatives. NASA launched the GEDI mission in 2018 and together with ISRO is preparing for the launch of the NISAR mission in 2024. JAXA launched the most recent mission ALOS-4 mission in March 2023

The Committee for Earth Observation Satellites (CEOS, [URL-1]) defines Calibration as “the process of quantitatively defining a system’s responses to known, controlled signal inputs”.

Validation is “the process of assessing, by independent means, the quality [uncertainty] of the data products derived from those system outputs”.

Validation is a core component of a satellite mission (and should be planned for accordingly) starting at the moment satellite instrument data begin to flow until the end of the mission.

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The suite of independent ground measurements that provide the maximum Return on Investment for a satellite mission by delivering, to users, the required confidence in data products, in the form of independent validation results and satellite measurement uncertainty estimation, over the entire end-to-end duration of a satellite mission



“We propose the creation of a **CEOS Forest Biomass Reference System** as an equitable and sustainably-funded system of recurrent site-based measurements that will serve as a lasting interface between the Earth Observation agencies and ground-based tree-by-tree measurement initiatives.

This infrastructure is designed to become a **common good for the entire EO community.**”

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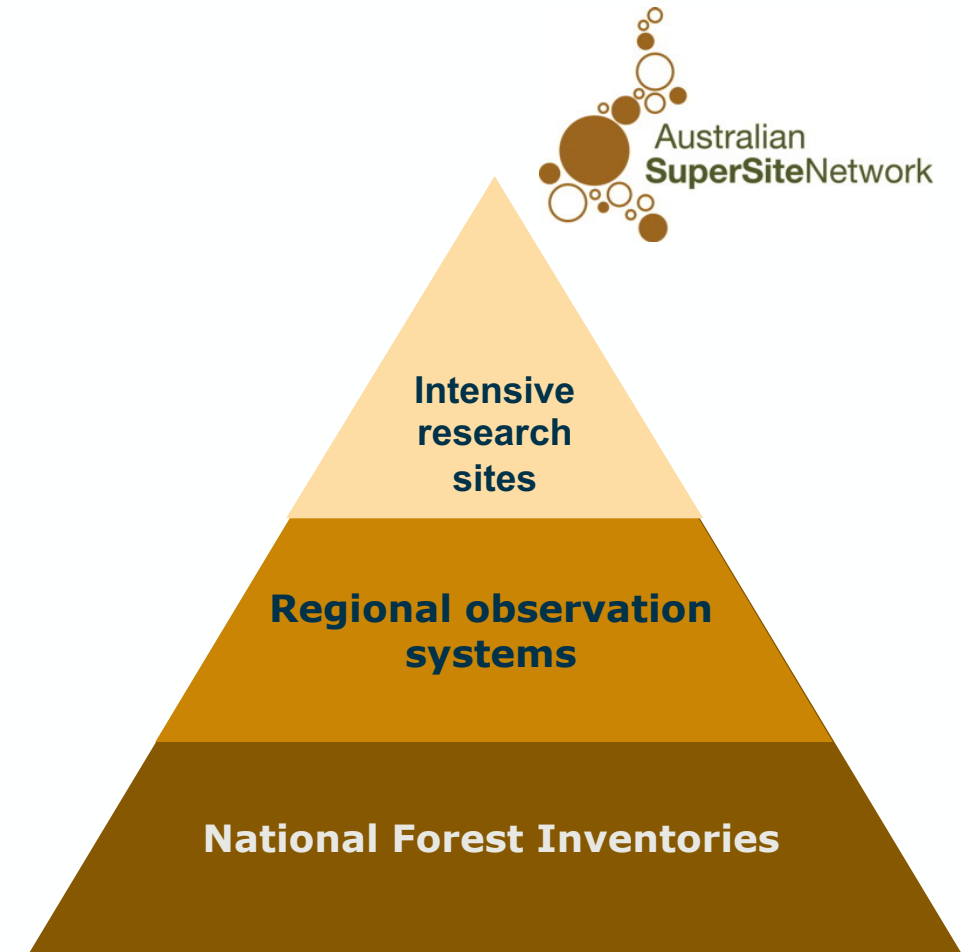
## Biomass Production Validation (2021)



The cover of the report features a grid of logos at the top, including NASA, CNES, ESA, JRC, CSIRO, and others. Below the logos, the text reads: "Committee on Earth Observation Satellites", "CEOS Working Group on Calibration and Validation Land Product Validation Subgroup", "Aboveground Woody Biomass Product Validation", "Good Practices Protocol", "Version 1.0 – 2021", and "Editors: Laura Duncanson, Mat Disney, John Armston, David Minor, Fernando Camacho, Jaime Nickeson". At the bottom, there is another row of logos from various universities and research institutions like Liège University, UNSW, and ETH Zürich.



- Forest Biomass Reference System is implemented at a limited number of well-studied, long term research sites
- Research tree inventories should be precisely geolocated
- Sites should be attached to a local institution
- Local Principal Investigators should be actively involved in the data acquisition strategy
- The engagement strategy should rely on long-term agreements: GEO-TREES must build upon existing plot networks
- Wherever possible, ground activities should actively involve national remote sensing agencies
- GEO-TREES complements national activities (National Forest Inventories) and efforts by GFOI







## Classical forest census (10x 1ha)



Delivrables

Create high-quality **geolocated** AGB estimates at 0.25 ha scale **using allometric model**

## Airborne lidar (1000 ha)



Upscale local plot information over landscapes **using locally calibrated AGB-height model**

## Terrestrial/UAV lidar



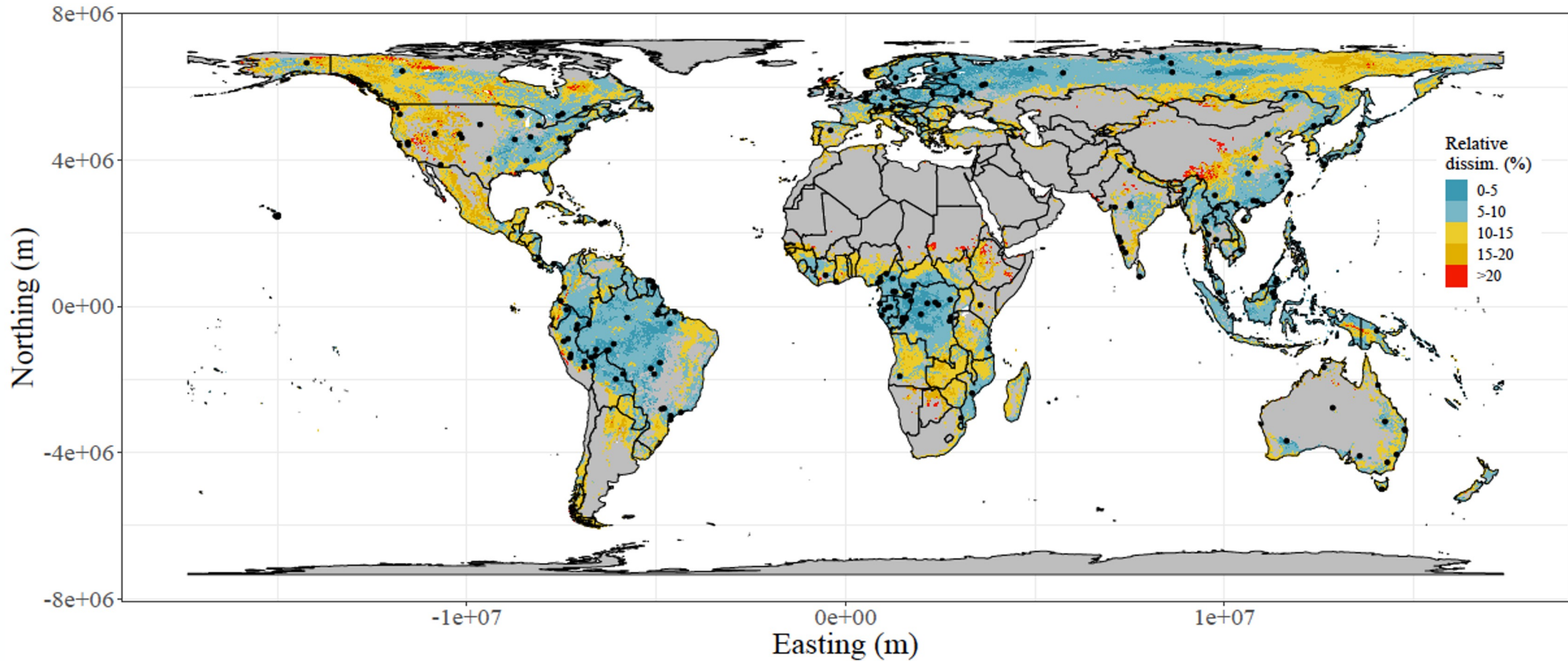
Validate generic or locally fitted models

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To cover all major forest types and environments we need ca. 50-100 sites



Labrière et al. Glob. Change Biol (2023)

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## One-entry data portal

georeferenced 0.25-ha AGB and height values as inferred from (1) plot data (ca 40 points/site); (2) ALS data (landscape-scale map)

Dmitry Schepaschenko (poster #22)



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# Standing on the shoulders of giants

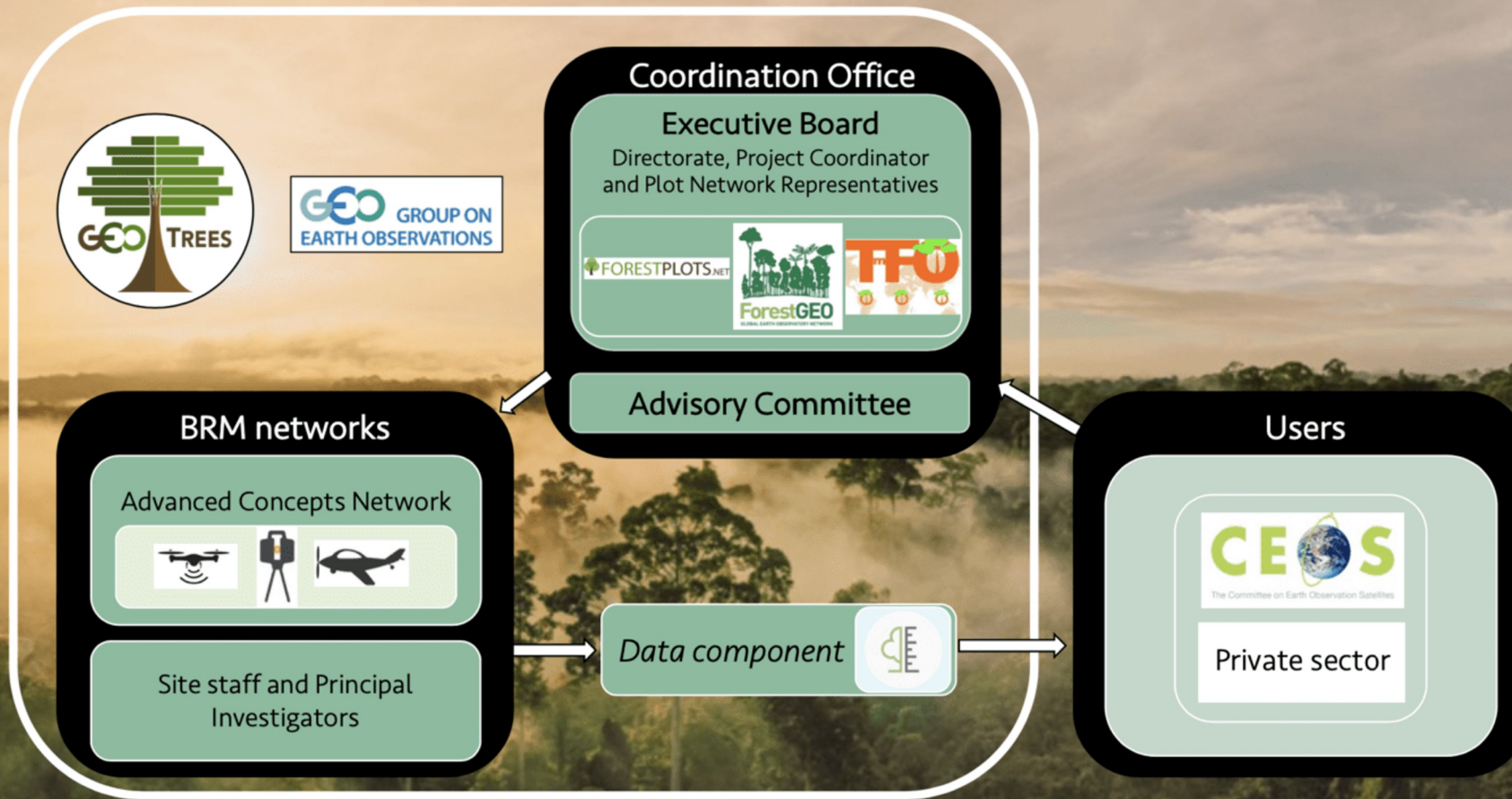
- GEO-TREES builds upon three long-term forest networks: **ForestPlots, ForestGEO, TmFO**
- They have built-in data standards, database management structures, verification systems.
- Even more importantly, they have built a trusted community within scientific research and have managed reputational risks
- GEO-TREES addresses a single very important science question (forest carbon): it is no substitute for these networks. However it brings visibility to the EO community and credibility to a range of potential funders
- GEO-TREES is a win-win: sites partners benefit from funding and increased visibility; existing networks benefit from continuity in funding streams, the EO community benefits from free-access biomass data



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## GEO-TREES Structure





# Core institutions and networks



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→ THE EUROPEAN SPACE AGENCY

The bulk of the costs is onsite data acquisition

First case studies suggest an effective cost around 250 k€/site per campaign only for **data acquisition** (including salaries, insurance, travel to site, botany)

In addition to field costs, **data processing & coordination** costs must be included

Minimal estimate of GEO-TREES for a 10-yr cycle ranges between 50 and 100 M€ (or MUSD)

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# Milestones and road ahead

- 2016-2020: Concept development
- Since 2018: GEDI Science Team Validation Plan
- March 2021: GEO-TREES is endorsed as a GEO activity
- 2021-2023: Phase 0 – Implementation at three test sites: French Guiana, Gabon and Malaysia (Sabah)
- 2023: Phase 1 – engagement and deployment plan at 30 tropical sites over three years
- 2023: Phase 1 – Engagement of EO agencies
- 2024/5: NISAR/BIOMASS launch





THANK YOU



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