GEO-TREES

Terms of Reference

Version 1.0

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This is an evolving document and we are happy to discuss this with partners.

1. THE NEED

Forests take-up huge amounts of carbon and store it as biomass. They can release carbon too, especially when damaged or destroyed. How much carbon forests store directly impacts future climate warming. With no credible path to keeping heating within 1.5 degrees without healthy forests, humanity needs to know exactly where this biomass carbon is, if forests' vital functions are changing, and what their future holds.

This need for verifiable and consistent measurement of forest carbon stocks and fluxes is rapidly growing, to support nature-based solutions that can help tackle climate change and for communities to quantify the ecosystem services of their lands.

Space agencies have made enormous investments in Earth Observation missions to map forest biomass across continents to support climate science and carbon markets. Yet, satellites do not measure biomass directly, use a variety of techniques, lack ground control and rarely last more than a few years. They measure proxies for biomass, like tree height. Consequently, the resulting biomass maps are often inconsistent. This undermines confidence in space-based carbon estimates.

To unlock the value of these investments requires careful, globally consistent ground-based measurements to calibrate satellites and ensure accurate estimates of forest carbon. In short, to ensure that forest biomass maps can be used by everyone with confidence, we need eyes on the ground to help those in the sky.

International forest plot networks have been established by the scientific community (ForestGEO, ForestPlots.net, TmFO). They provide long-term, high-quality observational data. Yet, these networks, and the sites they include are typically funded on a case-by-case basis, and they depend critically on short-term funding cycles.

GEO-TREES is filling this critical gap by building the world's first ground-based, open-access, equitably developed and funded reference system to ensure that satellite observations accurately represent forest carbon stocks on the ground.

2. GEO-TREES CONCEPT

The GEO-TREES concept was established by a coalition of world-wide specialists, representing international networks of permanent forest inventories, space agencies, and leading science institutions with important and diverse input from others to support the efforts of forest carbon mapping by Earth Observation technologies.

The GEO-TREES initiative funds high quality ground data from a global network of long-term forest inventories and makes these data openly available at the website www.data.geo-trees.org.

GEO-TREES aims to be the standard reference system for the calibration and validation of satellite-based above ground biomass (AGB) products. It is a vital contribution to the Earth Observation mission to map and monitor forest carbon and AGB at a global scale.

Standing at the nexus of ecology and remote-sensing, GEO-TREES is an ambitious world-wide network of forest biomass reference sites building on four integrated principles:

1. Partnerships & Engagement: To generate high-quality ground measurements, GEO-TREES partners with ecological and botanical specialists around the world. Partners are fully engaged and involved in every step of the project. Only with strong representation of partners, particularly from the Global South, and only with fair compensation for the work especially of Global South partners and investment in their institutions and skills, can science capacity be advanced. This is essential for the long-term sustainability of the GEO-TREES system.

2. Innovative technologies: GEO-TREES aims to build on preexisting forest research sites benefiting from the field experience of the teams on site and forming part on a long-term research effort. At least 100 forest biomass reference sites will be supported that will represent the various environmental and anthropogenic dimensions over which forests occur globally. Ground measurements involve four integrated sets of measurements: forest inventory plots with high-quality botanical identification, airborne laser scanning, terrestrial laser scanning, and climate monitoring. Many additional sites will be needed to fill gaps, using well-identified and carefully measured forest plots. GEO-TREES then uses the established recommendations of the Committee on Earth Observation Satellites for validating satellite derived AGB products (https://lpvs.gsfc.nasa.gov/AGB/AGB_home.html).

3. Long-term commitment: Forest carbon and biomass are hugely dynamic through space and time. Maintaining current and accurate estimates of carbon and biomass stocks requires continued long-term measurements. Long-term measurements also ensure the continued engagement and participation of partners throughout the system.

4. Open-access data: GEO-TREES is committed to equitably produced, fully funded and openly shared global forest biomass reference measurements. High-quality, high-resolution maps of the world's forests developed through the Earth Observation missions in partnership with GEO-TREES will be made open to all.

GOVERNANCE

3.1. Executive Board

The **Executive Board** is the core scientific team in charge of implementing the GEO-TREES science objectives.

3.1.1. Composition

The **Executive Board** composition shall reflect the full expertise required for the implementation of GEO-TREES. It is composed of:

- up to two project chairs (Directors). The project chairs (Directors) shall be impartial towards the interests of each international forest plot network involved in the GEO-TREES initiative.

- up to two representatives (one network and one site representative) of each of the three founding partner networks: ForestGEO, ForestPlots.net, and TmFO.

Executive Board members are listed in Appendix A to this document.

The **Executive Board** is supported by a Project Coordinator. The Project Coordinator oversees organizing all meetings of GEO-TREES (preparation, minutes of meetings). The Project Coordinator does not have a vote.

3.1.2. Nomination

- The **Executive Board** shall not exceed eight members.
- GEO-TREES is a scientific project. The **Executive Board** is equivalent to the role of a Principal Investigator (PI) and as such, members are not nominated by a third party.
- If a member resigns, s/he informs the **Executive Board** at least a month in advance. A new member will be nominated for an equivalent role.
- The duration of the **Executive Board** term is 4 years, starting 1st January 2024.
- **Executive Board** members are implicitly reappointed, until they resign.

3.1.3. Role and responsibility

The **Executive Board** has the following roles:

- Define the long-term strategy.
- Define an annual work plan, including which sites will be supported each year.
- Decide on financial matters (GEO-TREES funds can be managed by different, individual entities, but decisions on how these funds are spent will be taken by the **Executive Board**).
- Decide on protocols for data-sharing, data use, and intellectual property related to data produced as part of the project.
- Implement the work plan, including field inventories, aerial surveys, training, data-management and so on.
- Communicate with any third party, in particular: Invite, negotiate and involve any relevant organisation (donors, plot networks, scientific institutions).

- Report to the other structures, Donors and the GEO-TREES community.

3.1.4 Organisation

The **Executive Board** shall meet in a formal meeting twice per year and in ad-hoc meetings.

Biannual meetings. These are formal **Executive Board** meetings. At these meetings attendance is requested. The agenda of these meetings shall include (i) a report of the Project coordinator on the progress with respect to the annual workplan; and (ii) All important decisions. The meeting is chaired by the Directors. For these meetings, written minutes shall be taken and shared with the GEO-TREES Community.

Ad hoc meetings. These **Executive Board** meetings shall be called as needed, roughly monthly. The meetings are chaired by the Directors. Minutes are taken for internal reference and published in the private Teams shared documents of GEO-TREES.

Decisions are taken unanimously. If unanimity cannot be reached, a vote with a majority of 2/3 decides.

3.2. Scientific Advisory Board

The **Scientific Advisory Board** represents the scientific GEO-TREES community and provides advice and insight on the overall GEO-TREES strategy.

3.2.1. Composition

Members of the **Scientific Advisory Board** shall represent the various communities involved in GEO-TREES such as site PIs, Earth Observation experts, scientists, technical experts.

The leaders of the Technical Implementation Groups are part of the **Scientific Advisory Board**.

The **Scientific Advisory Board** members are listed in Appendix A of this document.

3.2.2. Nomination

Scientific Advisory Board members are nominated intuitu personae by the Executive Board. Potential candidates may be suggested by standing Scientific Advisory Board members.

The term of the **Scientific Advisory Board** is 4 years, starting from 1st January 2024.

3.2.3. Role and responsibility

The **Scientific Advisory Board** has following tasks and responsibilities:

- Provide advice on specific aspects of the annual work plan.
- Give recommendations, support and advice on the plan and actions from a scientific, technical and applications perspective.
- Support the implementation of certain actions.

3.2.4. Organisation

The **Scientific Advisory Board** shall meet every 6 months preceding the Executive Board biannual meeting. The meeting is chaired by the GEO-TREES Directors and Executive Board members are invited.

Recommendations are taken unanimously, and in case of disagreement, the minority view shall be reported in written.

3.3. Strategic Advisory Committee

The **Strategic Advisory Committee** represents key strategic partners of GEO-TREES. It supports GEO-TREES to achieve its long-term strategic goals on financial, institutional, and programmatic aspects.

3.3.1. Composition

The **Strategic Advisory Committee** is composed of the five founding institutions of GEO-TREES: CIRAD, CNRS, the European Space Agency, the Smithsonian Tropical Research Institution, and University of Leeds.

The **Strategic Advisory Committee** members are listed in Appendix A to this document.

3.3.2. Nomination

Strategic Advisory Committee members are invited by the Executive Board. The term of the **Strategic Advisory Committee** is 4 years from 1st January 2024.

3.3.3. Role and responsibility

The **Strategic Advisory Committee** provides high-level advice on financial, institutional, and programmatic aspects. The role could evolve when new major actors are involved.

3.3.4. Organisation

The **Strategic Advisory Committee** shall meet once a year. The meeting is chaired by the GEO-TREES Directors. The Executive Board participates in the meetings of the **Strategic Advisory Committee**.

3.4. Technical Implementation Group

The **Technical Implementation Group** oversees the implementation of the data acquisition, quality assessment and quality control (QA/QC), for the tree inventories, for airborne laser scanning, and for terrestrial laser scanning.

3.4.1. Composition

The **Technical Implementation Group** is composed of three sub-groups: Tree inventories; Airborne laser scanning (ALS) and Terrestrial laser scanning (TLS). Each sub-group is composed of two leaders and of non-permanent members. The members

are nominated based on their scientific expertise to implement the GEO-TREES technical programs.

The **Technical Implementation Group** members are listed in Appendix A to this document.

3.4.2 Nomination

The leads of each subgroup of the **Technical Implementation Group** are nominated intuitu personae by the Executive Board.

The non-permanent members of each sub-group are nominated by the **Technical Implementation Group** leaders or by the Executive Board. The term of the non-permanent member depends on the mission for which they work.

3.4.3. Role and responsibility

The **Technical Implementation Group** discusses technical issues. It provides input to protocols, guidance on methods.

3.4.4 Organisation

Each sub-group of the **Technical Implementation Group** shall meet on a regular basis. Meetings are called and chaired by the two subgroup leads.

Appendix

Appendix A: Composition of the GEO-TREES governance

Executive Board

- **Directors:**
  - Jerome Chave (CNRS, France)
  - Klaus Scipal (ESA, Italy)
- **Partner representatives:**
  - Stuart Davies (STRI, USA; ForestGEO)
  - Alvaro Duque (Universidad Nacional de Colombia, Colombia)
  - Beatriz Marimon (UNEMAT, Brazil; ForestPlots.net)
  - Oliver Phillips (University of Leeds, UK; ForestPlots.net)
  - Camille Piponiot Laroche (CIRAD, France; TmFO)
  - Irié Casimir Zo-Bi (INP-HB, Côte d'Ivoire; TmFO)

Scientific Advisory Board:

- Luiz Aragao (INPE, Brazil)
- *Mathias Disney (University College London, UK)
- **Laura Duncanson (University of Maryland, USA)
- Martin Herold (GFZ Potsdam, Germany)
- *** Euridice Honorio (University of Saint Andrews, UK)
- **Tommaso Jucker (University of Bristol, UK)
- *Helene Muller-Landau (STRI, USA)
- Sassan Saatchi (NASA, Jet Propulsion Laboratory, USA)
- Dmitry Schepaschenko (IIASA, Austria)
- Bonaventure Sonké (University of Yaounde I, Cameroon)
- *** Genoveva Gatti (National Scientific and Technical Research Council, Argentina)

*: The two Technical Implementation subgroup leaders for TLS
**: The two Technical Implementation subgroup leaders for ALS

***: The two Technical Implementation subgroup leaders for Forest Plots

Strategic Advisory Committee:

- **Representative of each of the fie founding institutions:**
  - Guy Ziv (University of Leeds)
  - Stéphane Blanc (CNRS)
  - Inge Jonckheere (ESA)
  - Plinio Sist (CIRAD)
  - Joshua Tewksbury (STRI)