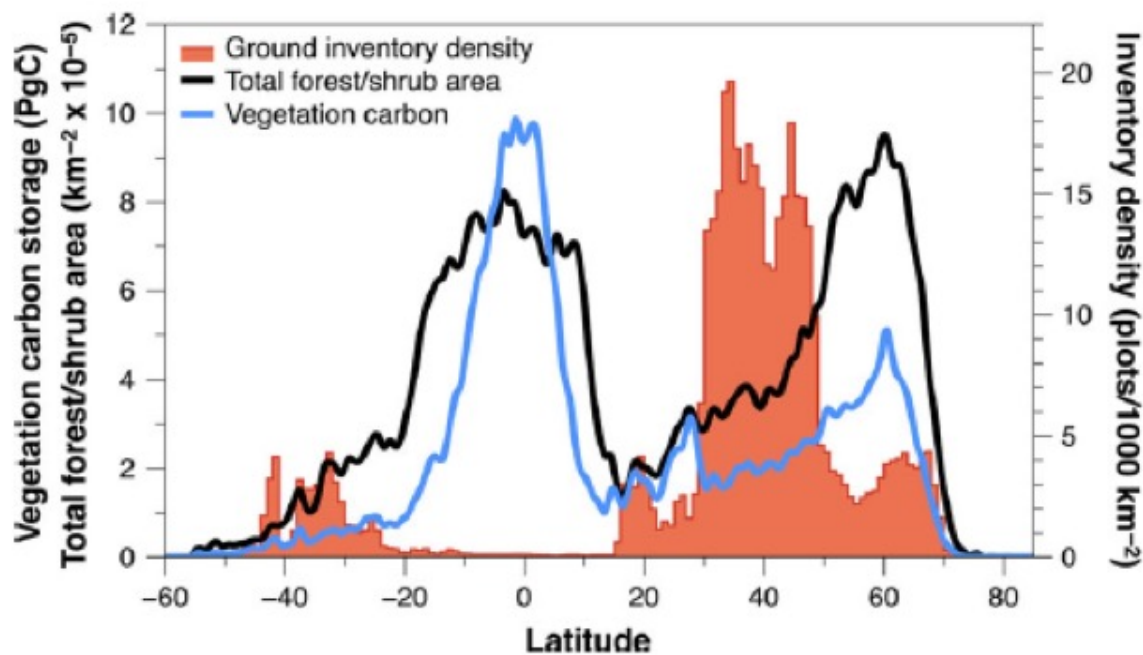# GEO-TREES

Phase 1: Building a Global Forest Biomass Reference System

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The need for a Global Forest Biomass Reference System – the importance of tropical forests

a 4th mission?

Schimel et al. 2015

Alliance for Tropical Forest Science (ATFS)
11 Tropical Forest Plot Networks

RESOURCES	2ndFOR	AfriTRON	ATDN	DryFlor	ForestGEO	GEM	RAINFOR	RBA	SEOSAW	TmFO	TreeCO
Map color in Figure 2											
Countries (No.)	17	15	9	20	21	13	8	6	12	11	3
Plots (No.)	2,413	498	1,894	1,602	37	112	360	356	1,902	639	1,843
Year Started	2015	2009	2001	2012	1990	2008	2000	2012	2016	2012	2014
Partners (No.)	85	>100	>200	>80	>200	>100	>100	>30	>30	>50	>30
Main regional focus	Neotropic	Africa	Amazon	Neotropic	Pantropic	Pantropic	Amazon	Andes	Sth. Africa	Pantropic	Atlantic
Forest type - elevation	lowland	lowland	lowland	lowland	mixed	mixed	lowland	montane	lowland	lowland	lowland
Forest type - moisture	mixed	wet	wet	dry	mixed	wet	wet	wet	dry	wet	wet
Forest type - disturbance	secondary	primary	primary	primary	primary	primary	primary	mixed	mixed	logged	primary
Typical plot area (ha)	<1	1	1	<1	25-50	1	1	1	<1	1	1
Permanent plots	yes	yes	no	no	yes	yes	yes	yes	mixed	yes	mixed
Number of trees (million)	0.22	0.19	1.10	0.20	6.50	n/a	0.28	0.09	0.27	0.35	2.00
Species (No.)	4,300	1,800	5,075	7442	12,000	n/a	5,500	2,340	613	n/a	3,952
Minimum DBH (cm)	5	10	10	n/a	1	10	10	10	5-10	10-20	10
Field protocol development	no	yes	no	no	yes	yes	yes	no	yes	no	no
Building Capacity	yes	yes	yes	no	yes	yes	yes	no	no	yes	no
Database management	central	central	central	central	central	central	central	local	central	local	central

2ndFOR

Alliance for Tropical Forest Science (ATFS)
A global multi-network initiative for science and training
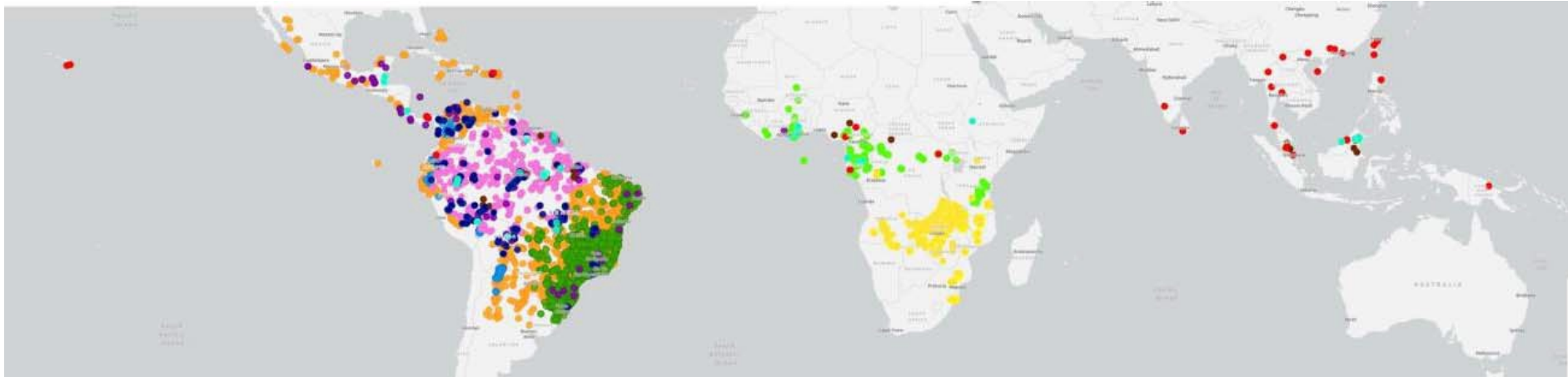
11,656 plots in 56 countries

Include more than 50% of the world's tree species

Complementary ecosystem and land-use coverage

Extensive additional data collection (incl. traits, soils, physiology, meteorology, etc.)

International partnerships and collaborations

Training & capacity-strengthening programs

**Needs/Opportunities for multi-network collaboration:**

1. Research to improve understanding of tropical forest biomass stocks and fluxes and to predict how they will respond to and drive future changes in the Earth System will be greatly accelerated by increased multi-network collaboration

2. None of the networks is sufficiently extensive nor intensive to provide global coverage for tropical forests

3. Many tropical regions urgently need additional capacity-strengthening to help address the challenges forests face

4. Sustaining ground observations in the future will benefit from greater coordination and collaboration

5. And, critically, a multi-network collaboration could form the basis of a global reference system for tropical forest biomass – GEO-TREES
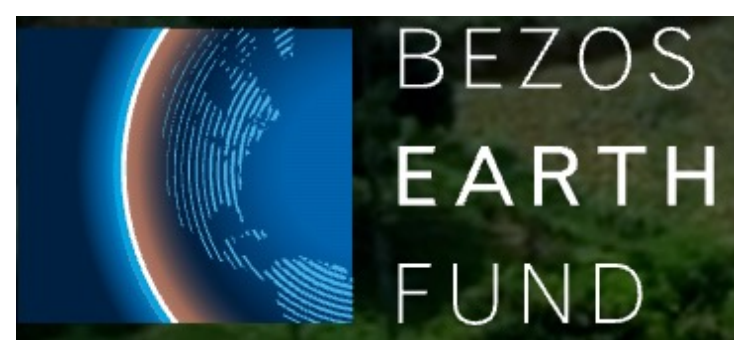
GEO-TREES: A Global Forest Biomass Reference System

100 core sites (60 Tropical and 40 Temperate)
200 supplementary, lower-cost sites

Designed to represent the main environmental and anthropogenic dimensions over which forests occur globally, with the highest sampling intensity in the critical carbon-rich tropics

GEO-TREES Sites
- Temperate
- Tropics

Carbon Density (MgC Ha⁻¹)
0 — >120
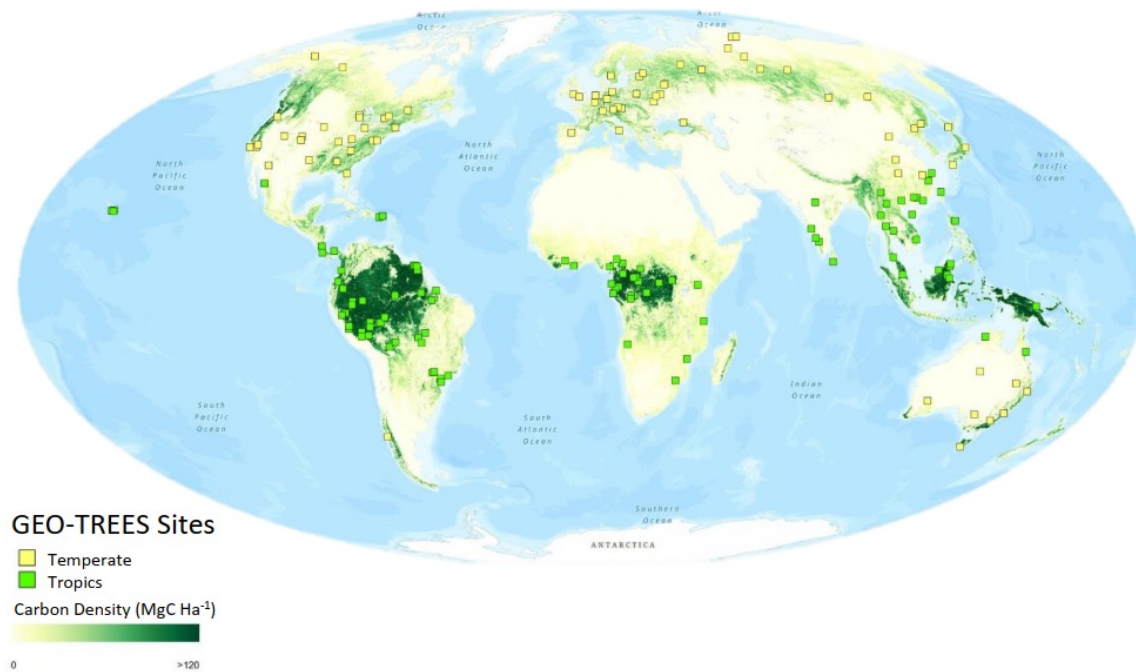
Existing partner networks will allow us to layer most of the GEO-TREES sites onto existing forest monitoring plots, providing historical baselines and benefitting from existing partnerships, and sharing capacity and skills

GEO-TREES will be the world's first ground-based, open-access, equitably developed, forest biomass reference system.

Phase 1 – BEF Support	Phase 2	Phase 3
$12M (2023-2028)	$22M (2024-2031)	$22M (2026-2033)
Tropics 1	*Tropics 2*	*Temperate*
100 Core Sites Selected	Leverage BEF Funds / Fund Collab.	Resource Mobilization
Training and Science Workshops	Training and Science Workshops	Training and Science Workshops
Data Portal Development	Tropical Portal Launch	Temperate Portal Addition
30 Core Tropical Sites Established	30 Core Tropical Sites Established	40 Core Temperate Sites Established
Fellowship Program Implemented	200 Supplementary Sites Selected	

Phase 1 will also be supported by a total of $21.3M in existing co-funding from the Smithsonian and many network partners.

Core Elements of the BEF support for GEO-TREES:

1. **Innovative Technologies:** Ground measurement will involve three integrated sets of measurements: forest inventory plots, terrestrial laser scanning, and airborne laser scanning following established CEOS recommendations.

2. **Partnerships, Engagement, and Training:** GEO-TREES will rely on existing partner networks—with strong representation of all stakeholders, capacity exchange, fellowships, and fair funding for all partners.

3. **Broad Environmental Sampling:** Current, accurate estimates of carbon and biomass stocks in mature, degraded, and secondary forests representing the main environmental and anthropogenic dimensions over which tropical forests occur.
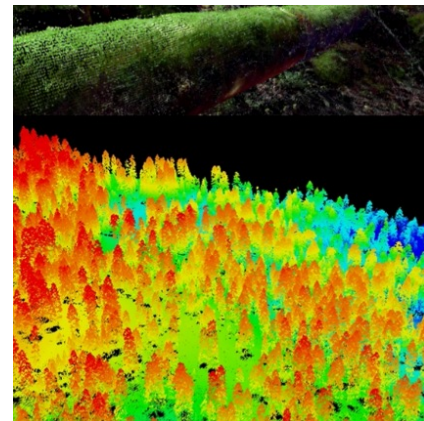
Core Elements of the BEF support for GEO-TREES:

4. Long-Term Commitment: Long-term measurements to ensure accurate assessment of forest carbon stocks & fluxes, and to ensure the continued engagement and participation of partners throughout the system.

5. Open-Access Data: Commitment to equitably produced and openly shared global forest biomass reference measurements. High-quality, dynamic, high-resolution forest carbon data will be made open to all in as near to real-time as possible.
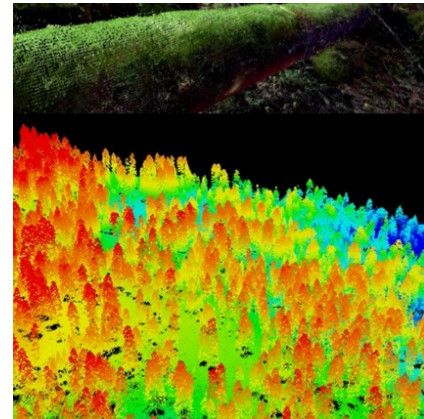
BEF-supported Phase 1 activities:

    Implementation of 30 GEO-TREES sites
    Annual in-person workshops
    Annual virtual meetings & public webinars
   Postdoctoral fellowships
    International exchange fellowships & internships
    Training for early-career scientists

Current GEO-TREES activities:

- selection of 30 sites for Phase 1 (5 years)
- building partnerships across ground, TLS and ALS researchers & networks
- planning workshops & training initiatives
- strengthening governance structure and stakeholder representation

Labrière et al. 2023 Global Change Biology
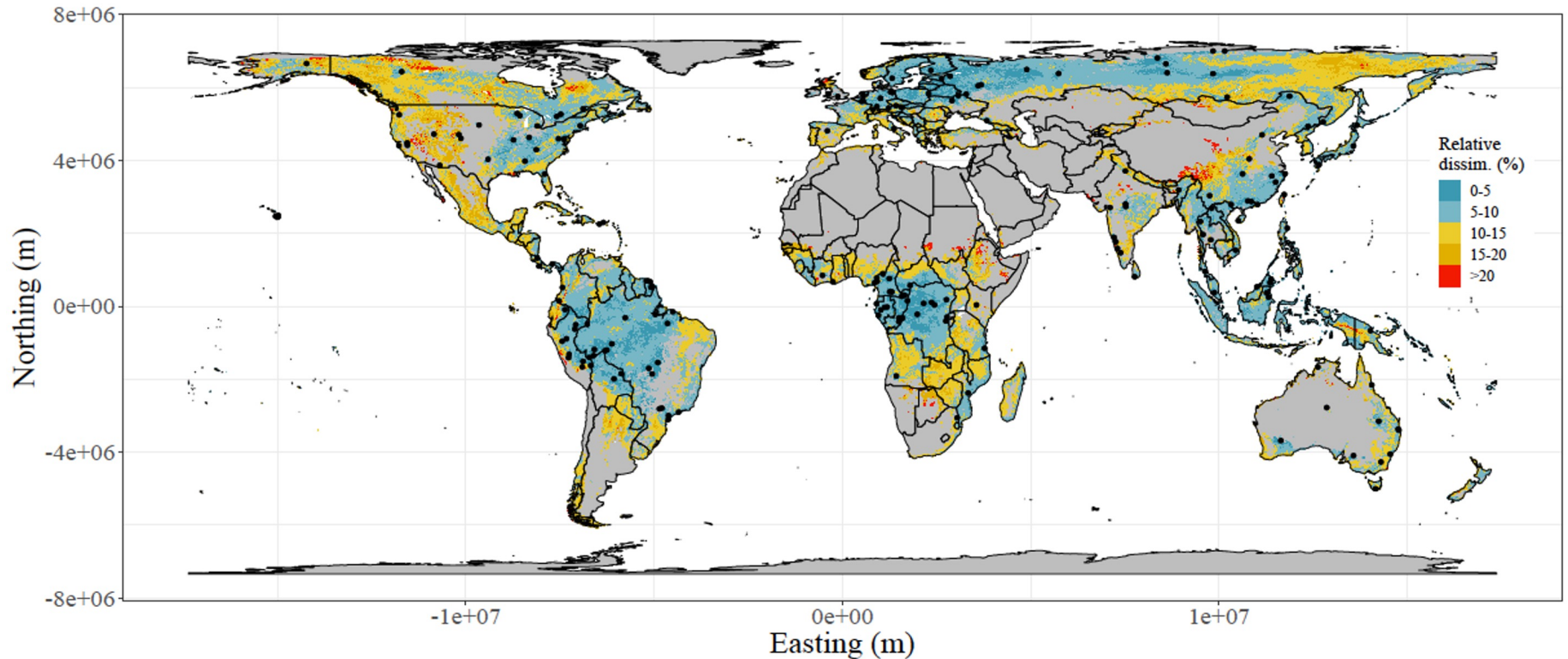
GEO-TREES: Looking forward

1. Secure resources to reach the vision of 100 core / 200 supplementary sites

2. Build links across other disciplines and applications for forest biomass/carbon assessment (e.g., modeling community, local and jurisdictional carbon/biomass assessments, carbon market activities, etc.)

3. Explore partnerships with EO community focused on biodiversity assessment and monitoring (e.g., new hyperspectral missions, etc.)

GEO-TREES: a collaboration of many partners and networks