Understanding the Global 3D Signature of Tree Biodiversity

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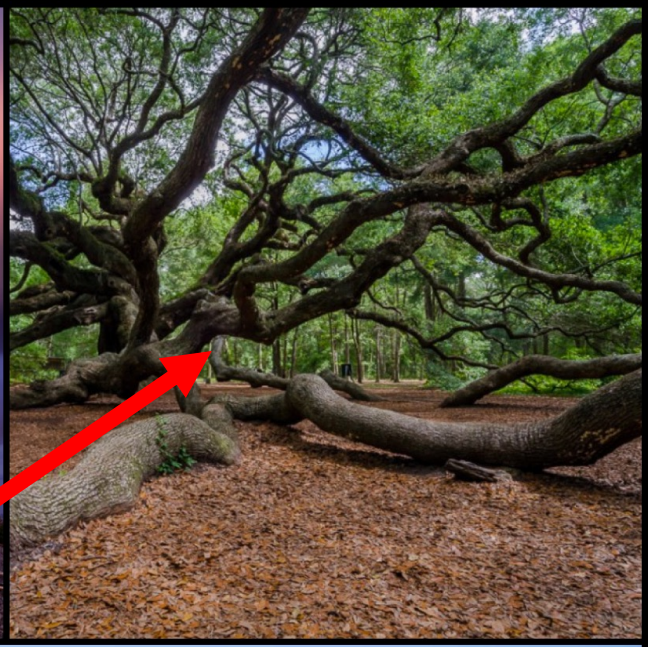
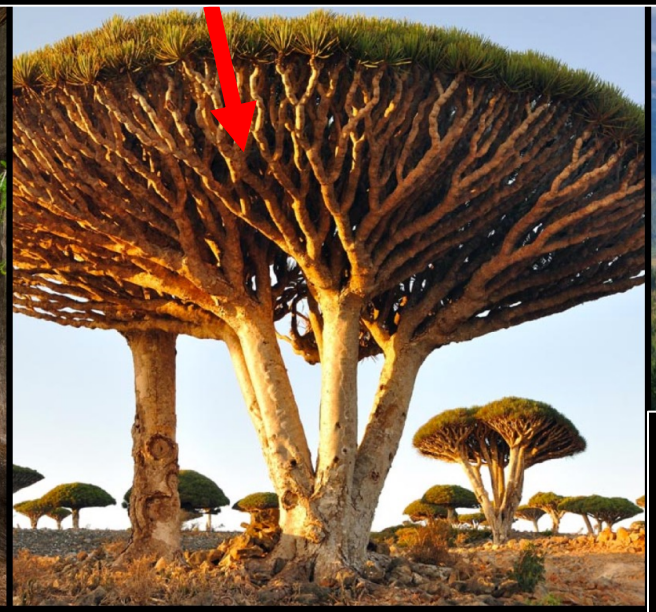
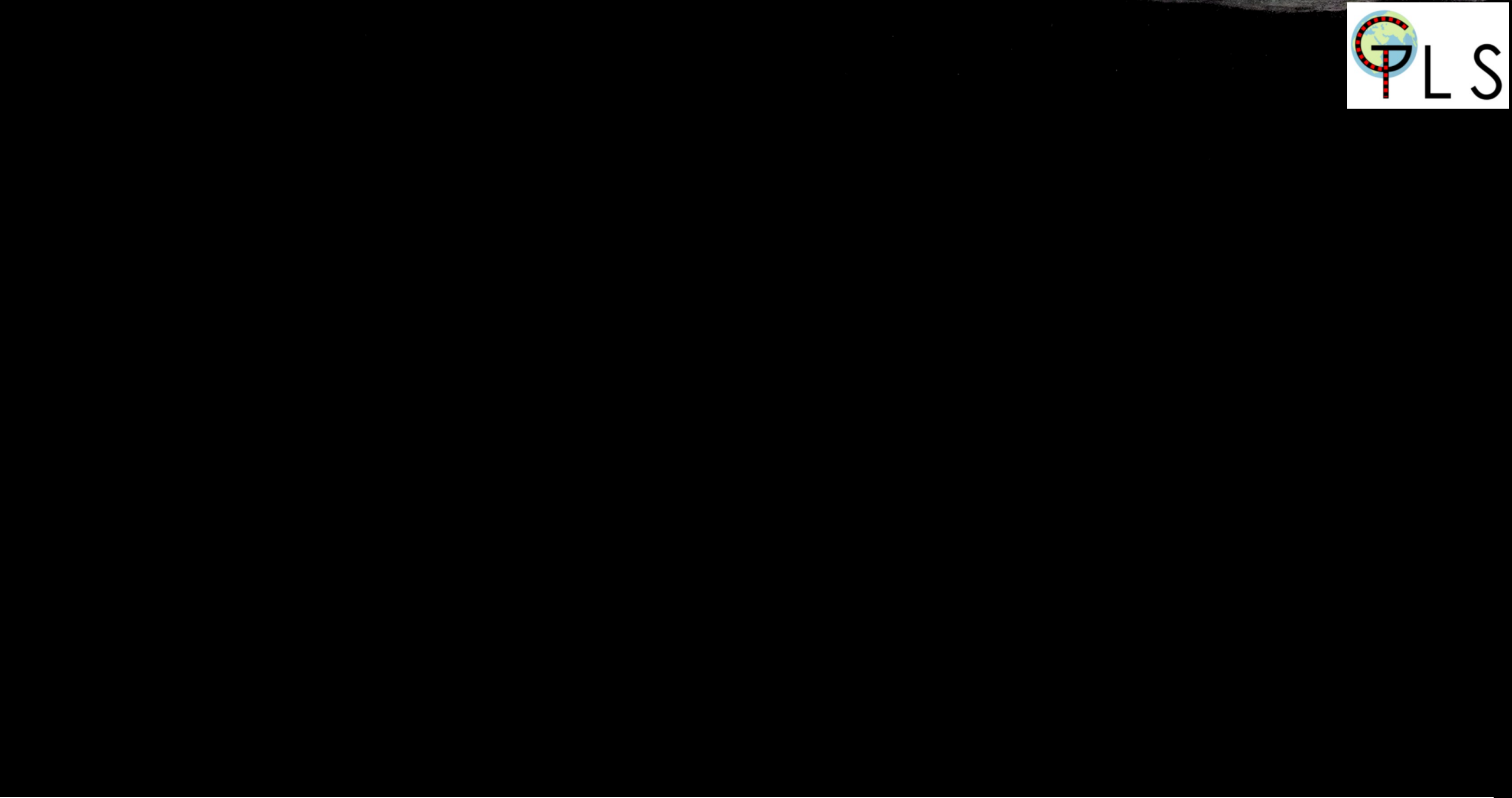


Tree structure is extremely diverse



How do we quantify the structural traits of biodiversity?



Terrestrial laser scanning brings 3D to biodiversity traits

Atticus Stovall | Lola Fatoyinbo | John Armston | Shukhrat Shokirov | Lisa Bentley | Kim Calders | Mat Disney







Goal: Better understand ***structural and functional scaling relationships of trees***

How?: Quantifying ***drivers of tree-level traits*** *for improved characterization of* ***biodiversity****.*

1) Develop **global TLS database** and **extract 3D traits.**
2) Validate and test **allometry** and **scaling theories.**
3) Link **scaling relationships** to **environmental conditions.**

We have assembled a **global** dataset

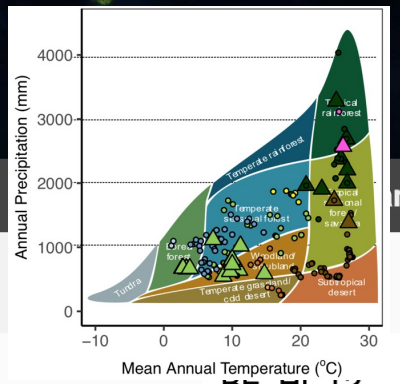
global-tls.net

- GTLS grew by **592 TLS plots to 1594!**
- 57 members (47 with TLS data) and 40 institutions have joined
- TLS database manuscript near submission – more to come!

TLS Network

- NASA CMS 3D Change
- TERN / JRSRP
- Ghent University
- University College London
- University of Virginia
- Wageningen University
- University of Helsinki
- University of Maryland
- National University of Comahue

Campaign Planning



University								
Ghent University	BE_HI_T3	2018-07-	RIEGL					

Search:

We must fill spatial gaps!

TLS

TLS Network

- [x] NASA CMS 3D Change
- [x] TERN / JRSRP
- [x] Ghent University
- [x] University College London
- [x] University of Virginia
- [x] Wageningen University
- [x] University of Helsinki
- [x] University of Maryland
- [x] National University of Comahue

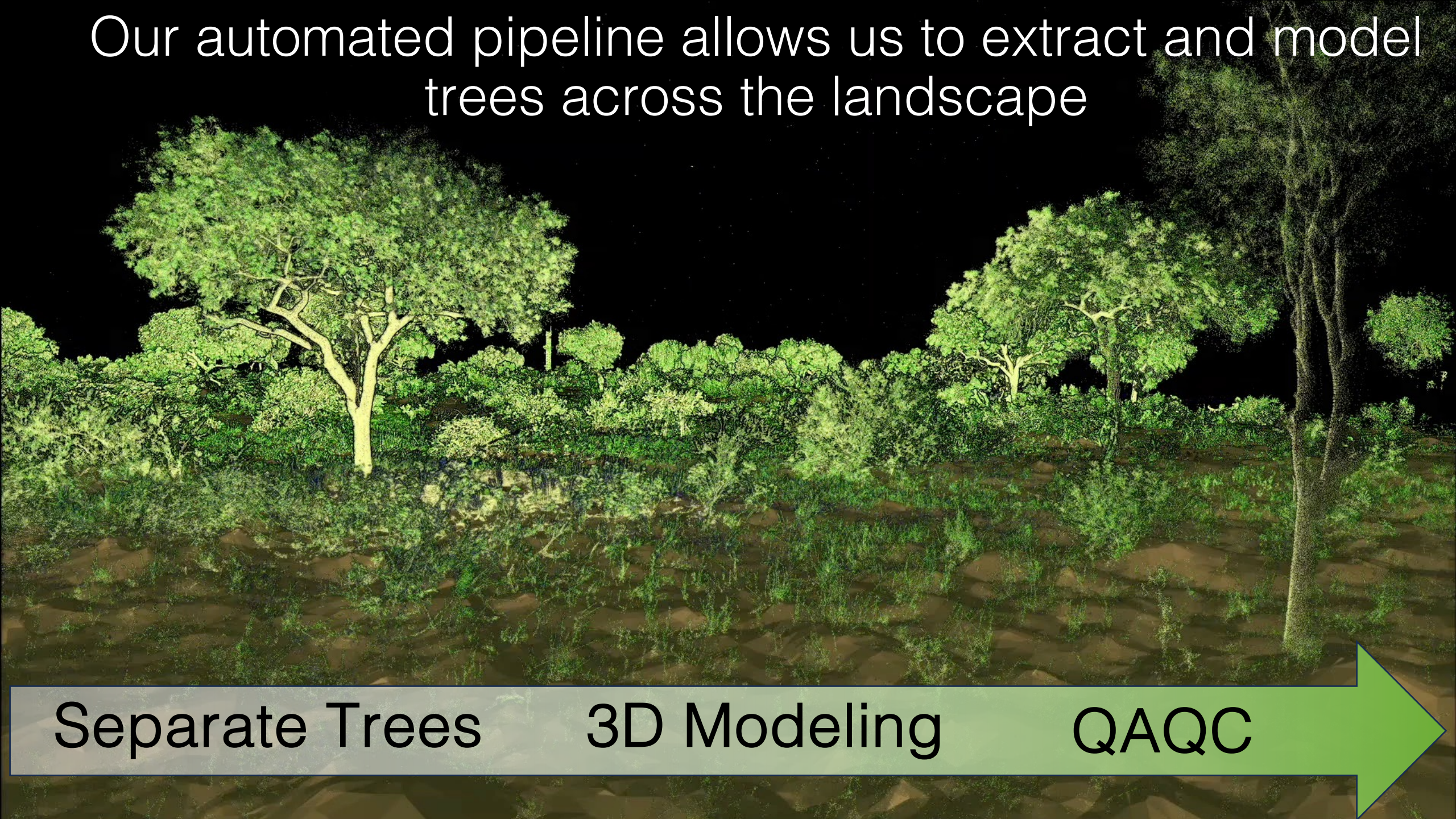
Campaign Planning

S. Africa field campaign in Kruger NP last Oct and Nov

University of Maryland | Leaflet | © Mapbox

Group	Name	Datetime	Instrument	Protocol	Area	QSM	Open
Ghent University	BE_HI_T1	2018-07-04T00:00:00	RIEGL VZ400	edge_core_transect_100m_5scans	0.00	No	contact:kim.calders@ugent.be;Pieter.D
Ghent University	BE_HI_T2	2018-07-04T00:00:00	RIEGL VZ400	edge_core_transect_100m_5scans	0.00	No	contact:kim.calders@ugent.be;Pieter.D
Ghent University	BE_HI_T3	2018-07-04T00:00:00	RIEGL VZ400	edge_core_transect_100m_5scans	0.00	No	contact:kim.calders@ugent.be;Pieter.D
Ghent		2018-07-	RIEGL				

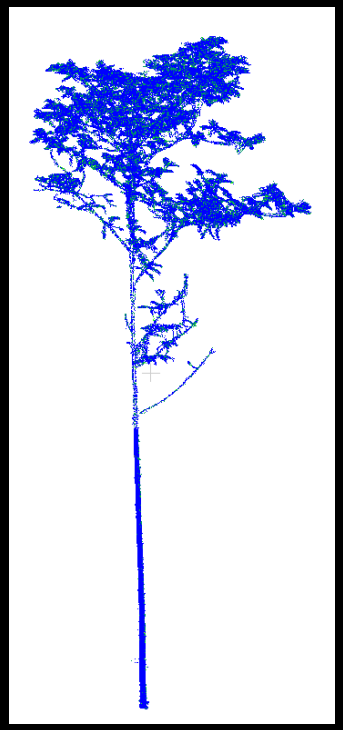
Our automated pipeline allows us to extract and model trees across the landscape

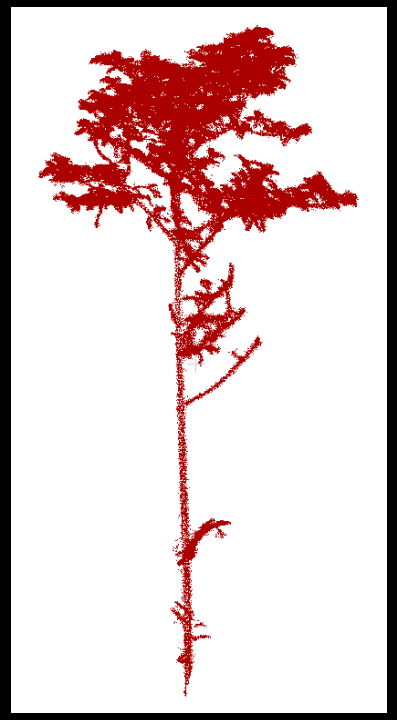


Manual

Raycloudtools

Overlap

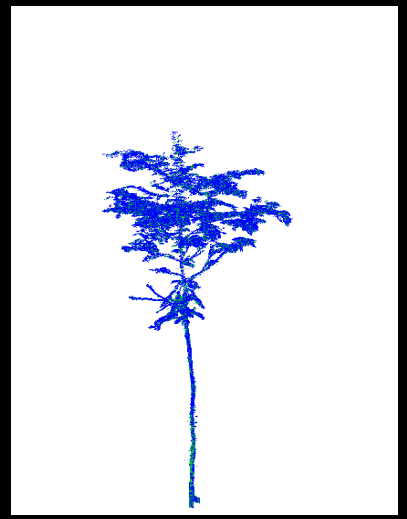


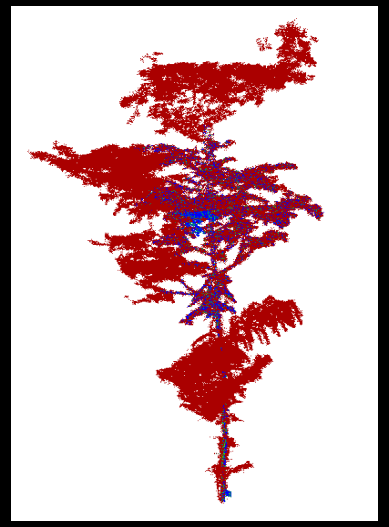


Finalizing tree segmentation and parameters

TP: 99.87%
FN: 0.12%
FP: 7.08%

GOOD Segmentation



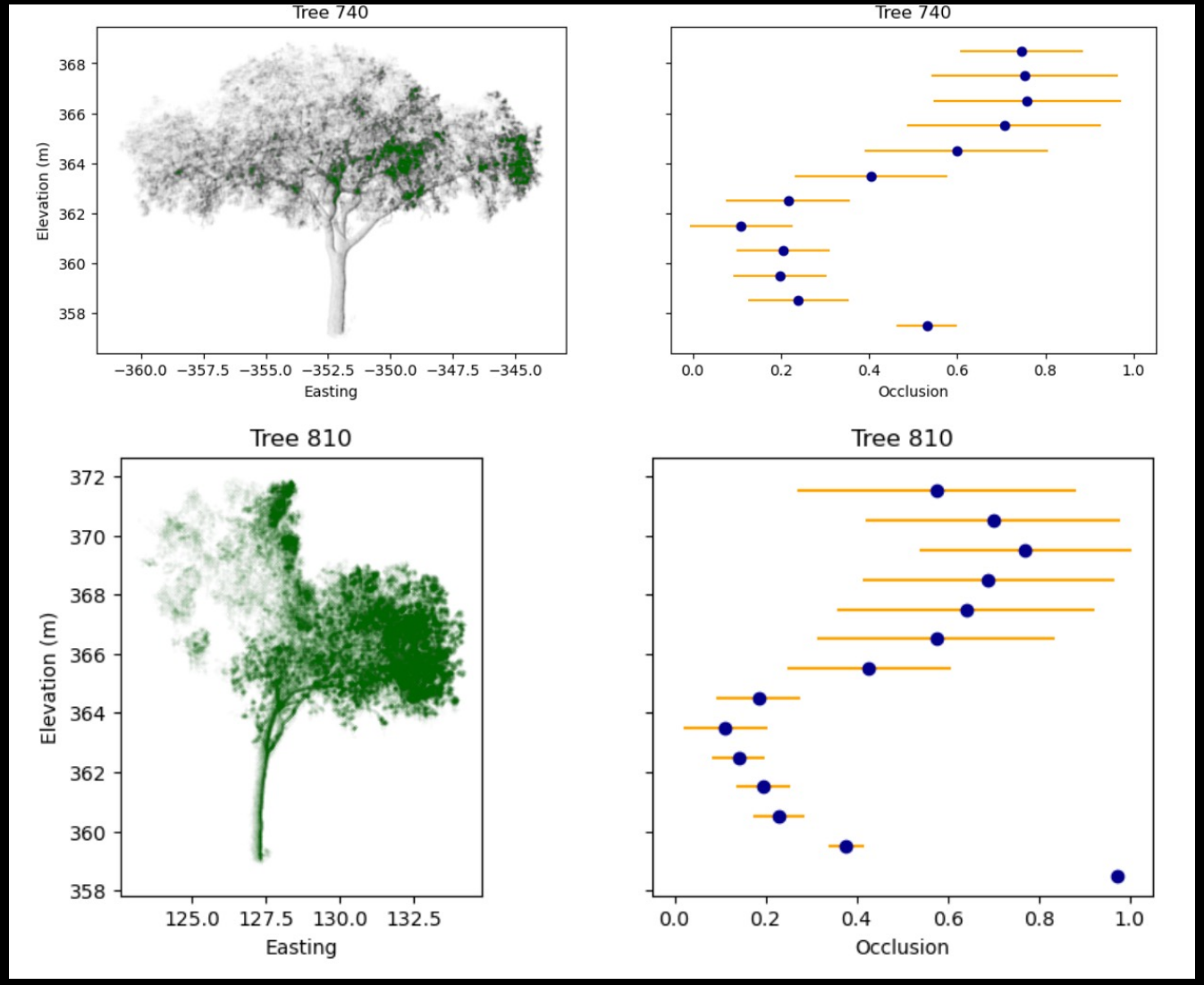


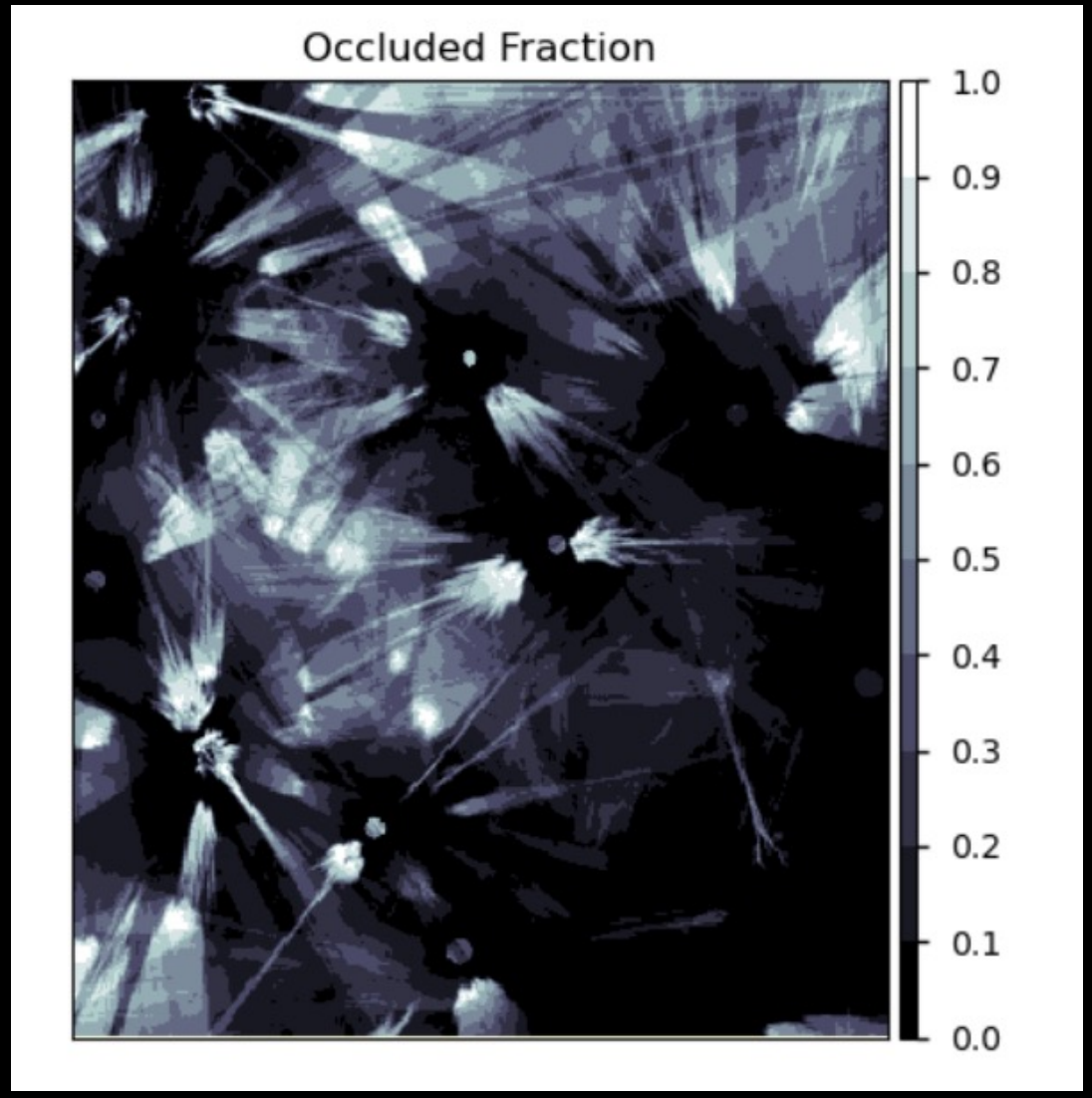
TP: 99.74%
FN: 0.26%
FP: 63.1%

POOR Segmentation

New **occlusion** metric for **automatic** QAQC

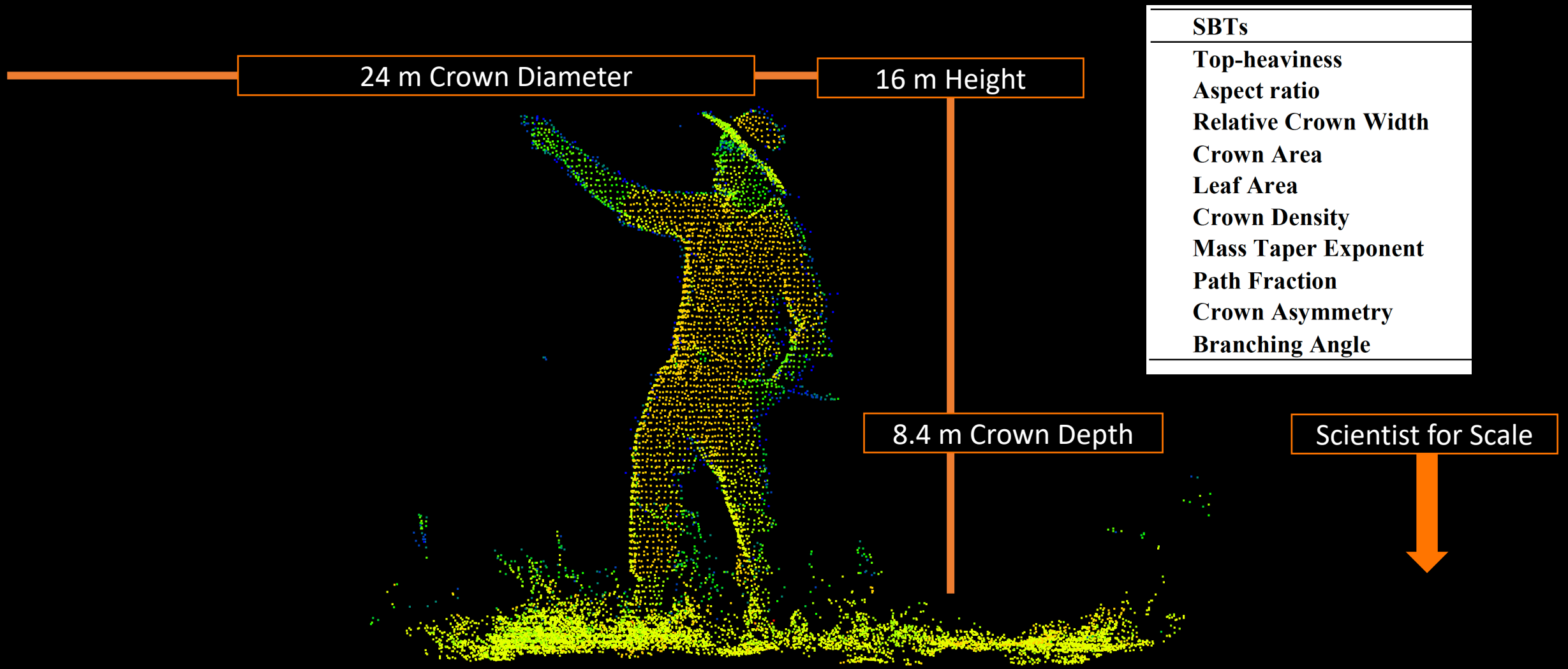
New occlusion metric for automatic QAQC





Automatic QAQC will rapidly increase GTLS datasets

South Africa's Southern-most Baobab



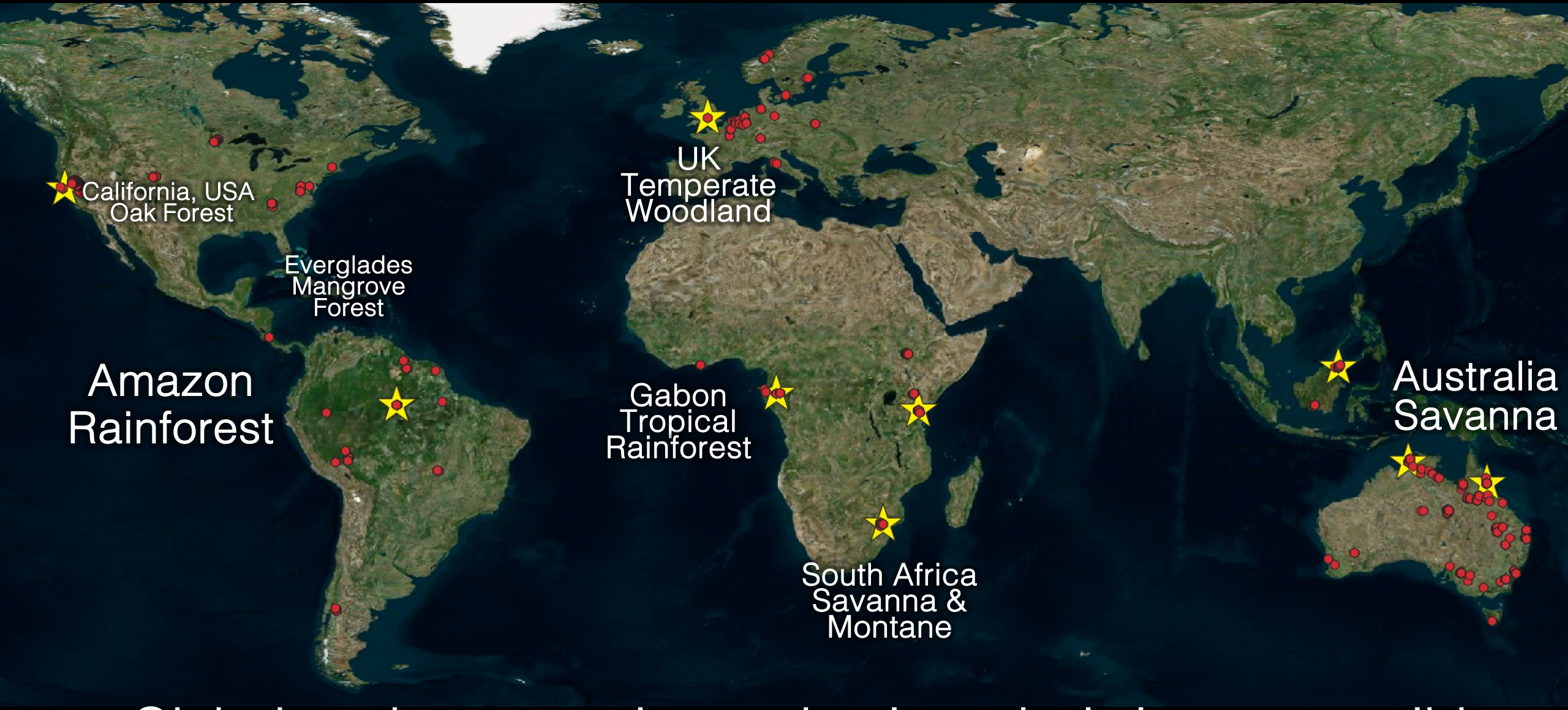
SBTs
Top-heaviness
Aspect ratio
Relative Crown Width
Crown Area
Leaf Area
Crown Density
Mass Taper Exponent
Path Fraction
Crown Asymmetry
Branching Angle

All trees in the database undergo 3D structure extraction

Traits calculated directly on the 3D structure

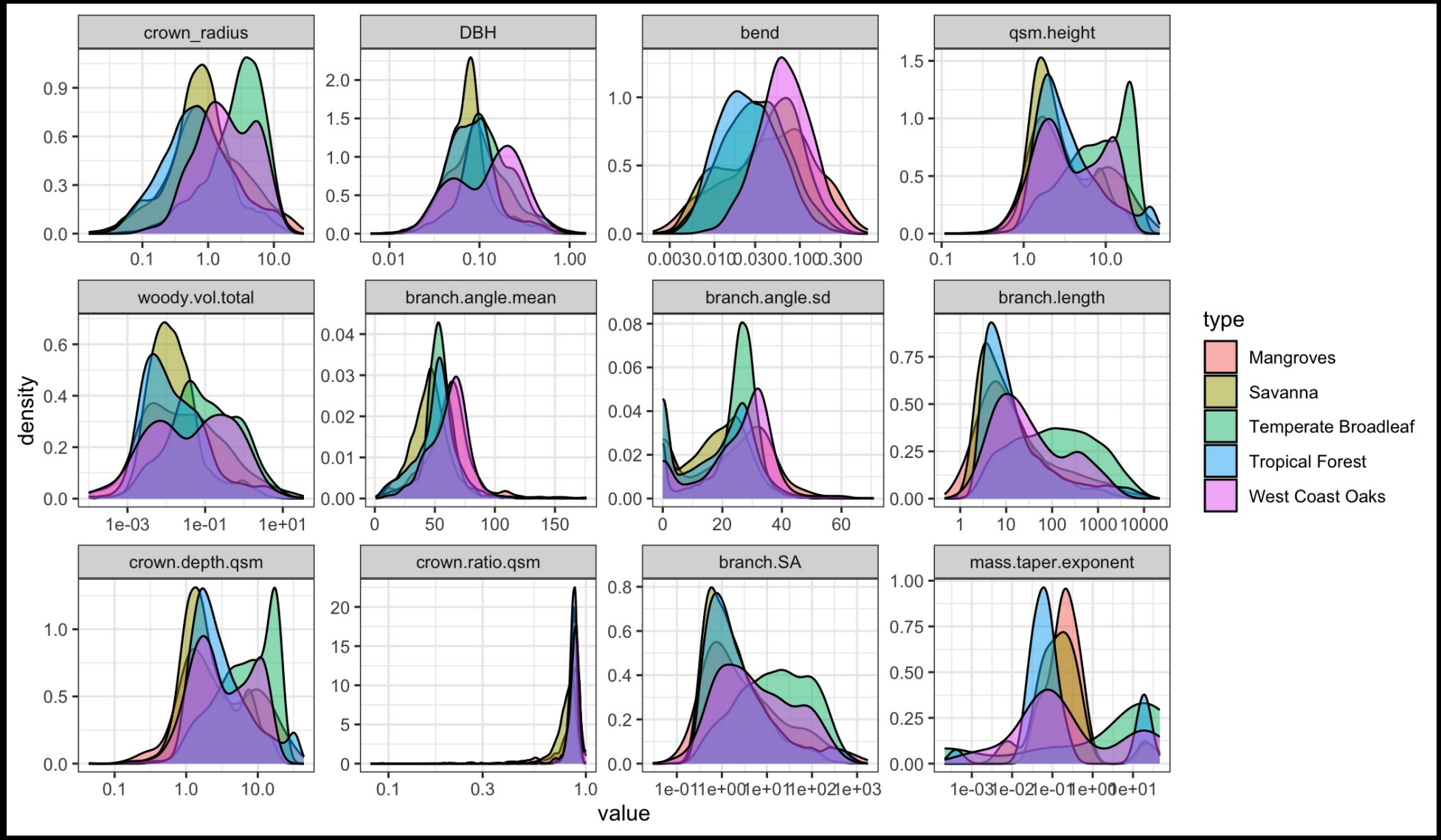
Open source GTLS standardized 3D trait extraction method shared with all Co-Is, Collaborators, and GTLS members

20 Representative Focal plots for Finalizing Automated Processing



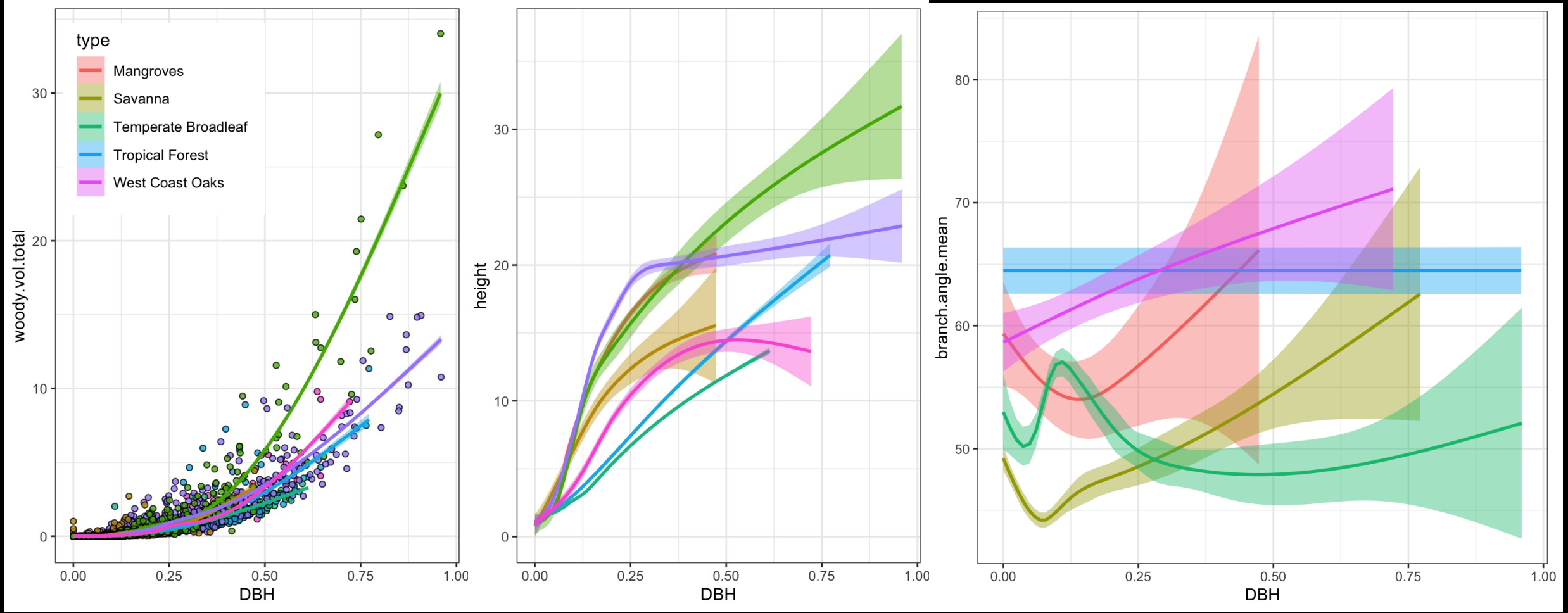
Global-scale processing and trait analysis is now possible

3D Trait Distributions for >11,000 trees in 5 Biomes

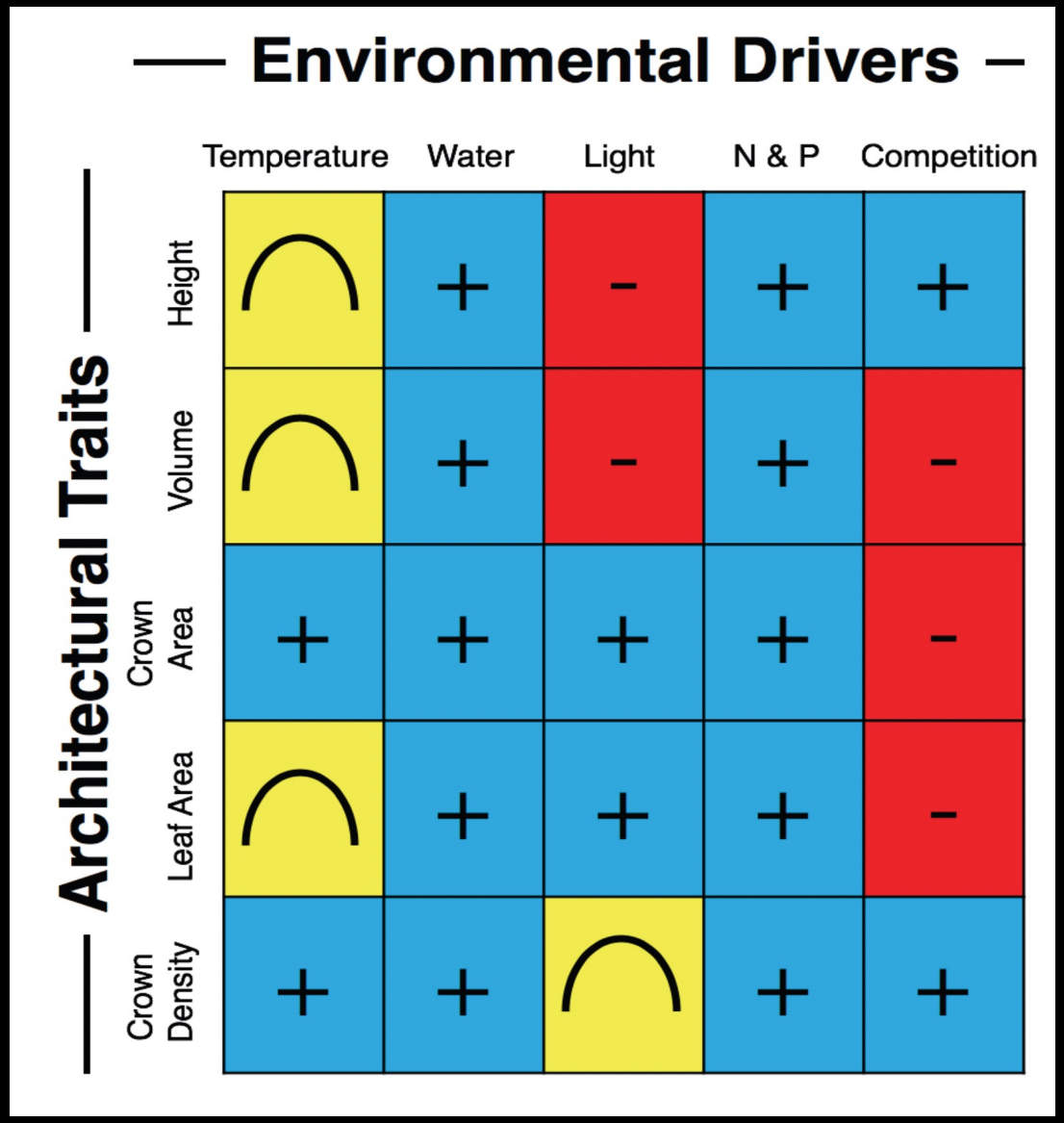


Traits in these broadleaf systems have a diverse range at a global scale

Convergent and Divergent Traits Across the World's Forests



How might 3D traits connect to the growing conditions of trees?


Environmental Drivers
Temperature
Water
Light
N & P
Competition
Architectural Traits
Height
Volume
Crown Area
Leaf Area
Crown Density
+
-
+
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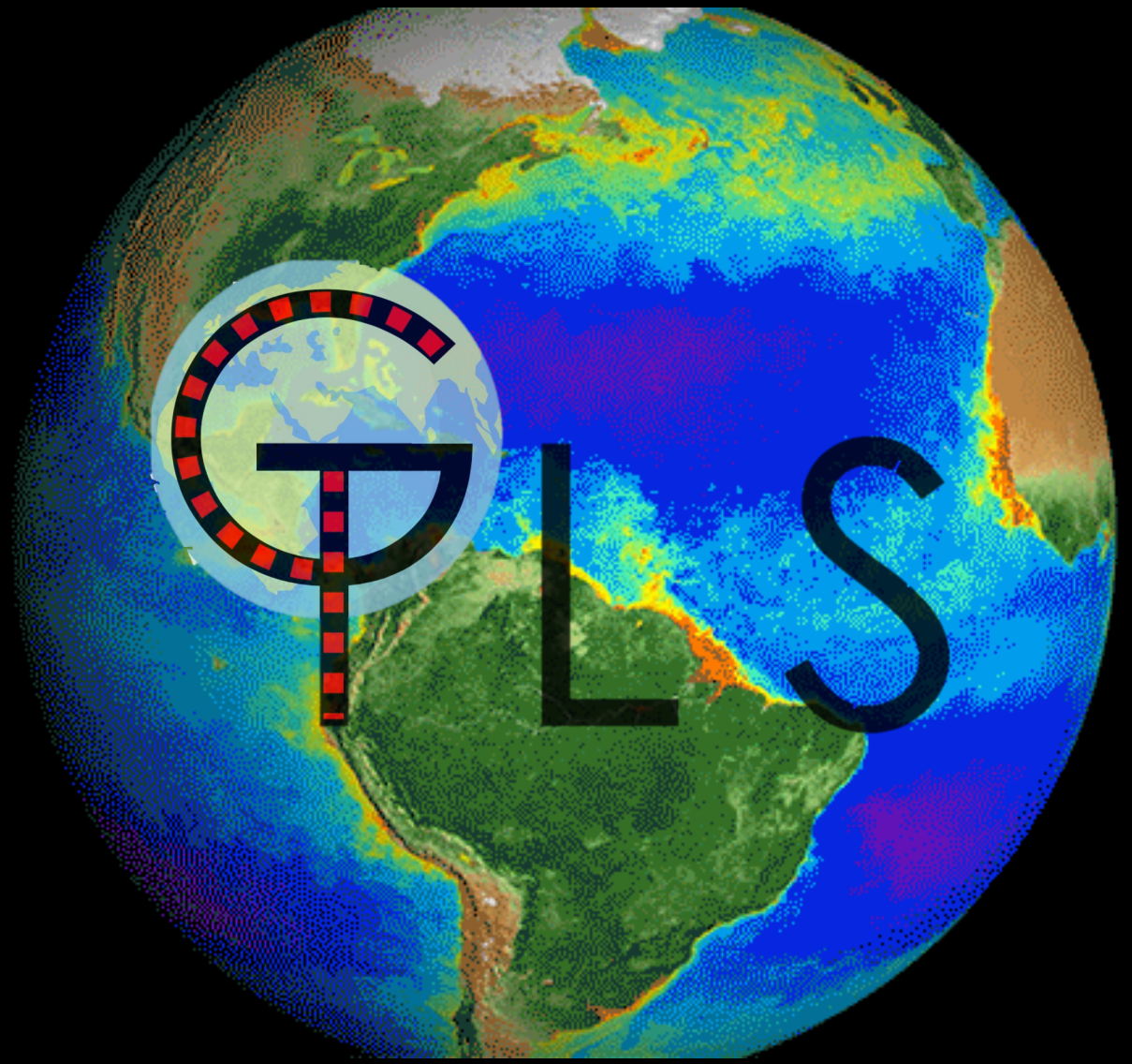

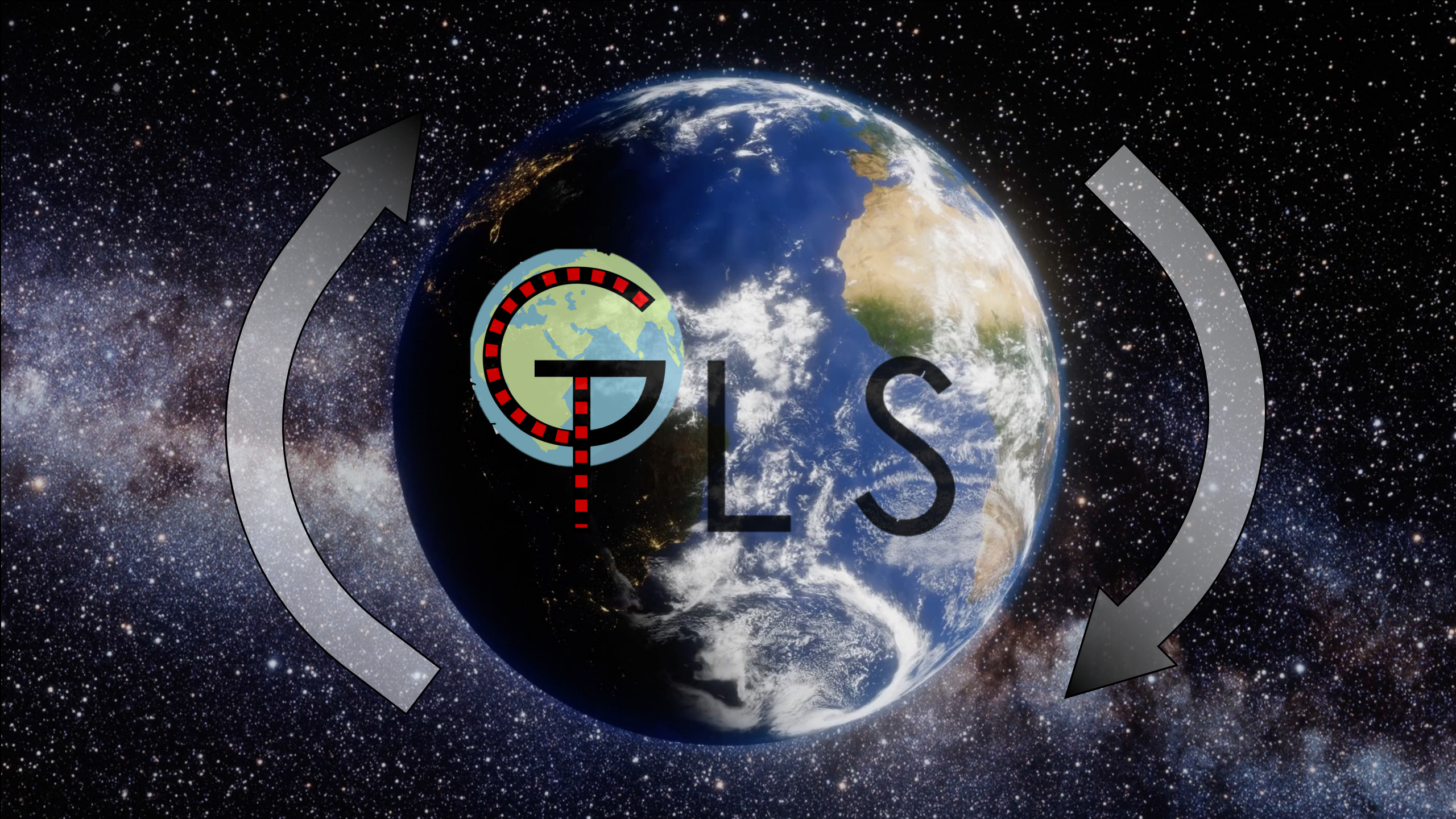
GLS

Past Year Progress:

- ***Massively successful*** *field campaign in* ***South Africa***
- ***MAJOR advances*** *in* ***processing*** *and* ***data assessment*** *that lay the groundwork for* ***larger-scale future processing of TLS data****.*
- ***>10,000 trees*** *processed in 5 biomes, paving the way for global-scale analysis of scaling relationships.*

Next Steps:

- Link **scaling relationships** to **environmental conditions.**
- Current project focuses on **long-term environmental drivers**. We need to consider **dynamics** and **disturbance** in *future work*!

Thanks to all current contributors:

NASA GSFC
Terrestrial Ecosystem Research Network
University College London
University of Virginia
University of Nevada Reno
Wageningen University

We look forward to more!

For more information, contact:
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Sign up!

GTLS Map

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SONOMA STATE UNIVERSITY LUX MENTIS · LUX ORBIS · 1960

GEDI ECOSYSTEM LIDAR

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