



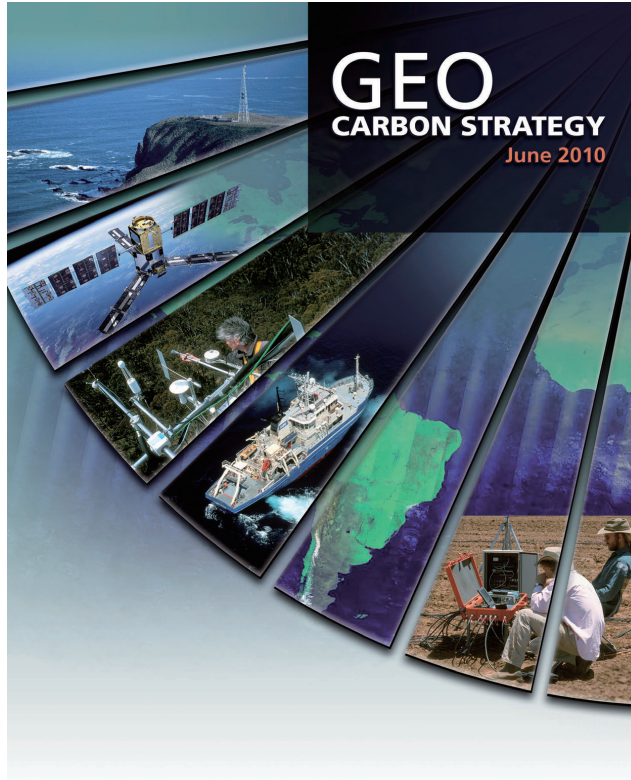
# CEOS's Land Product Validation Focus Area on Biomass

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Laura Duncanson, John Armston,  
Mat Disney, Jaime Nickeson, Miguel Roman



# Priorities for Earth Observation



 GROUP ON  
EARTH OBSERVATIONS

" A key reason for our lack of understanding of the global carbon cycle is the dearth of global observations. An increased, improved and coordinated observing system for observing the carbon cycle is a prerequisite to gaining that understanding. "

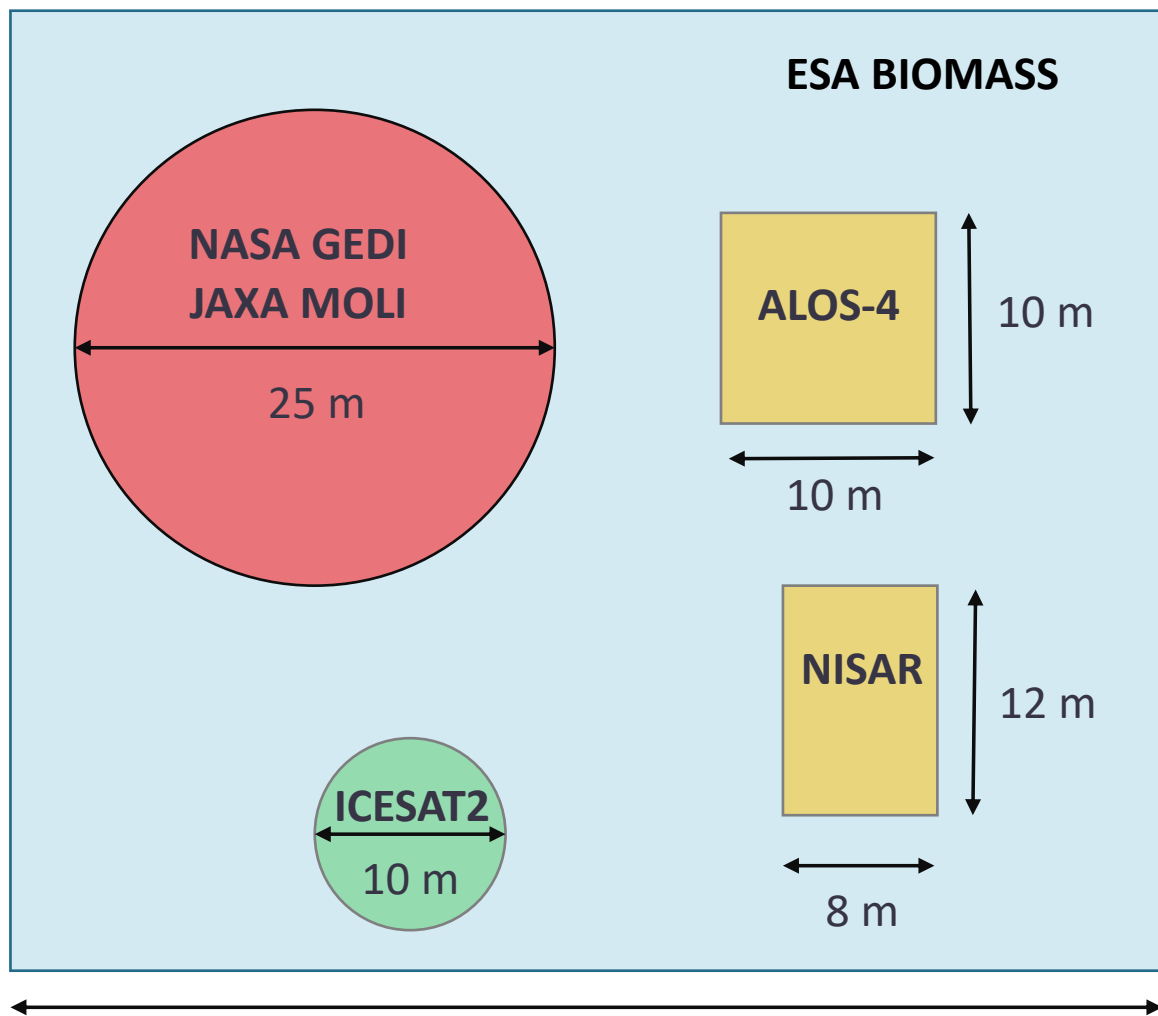


# Formation in Response to a CEOS Carbon Action

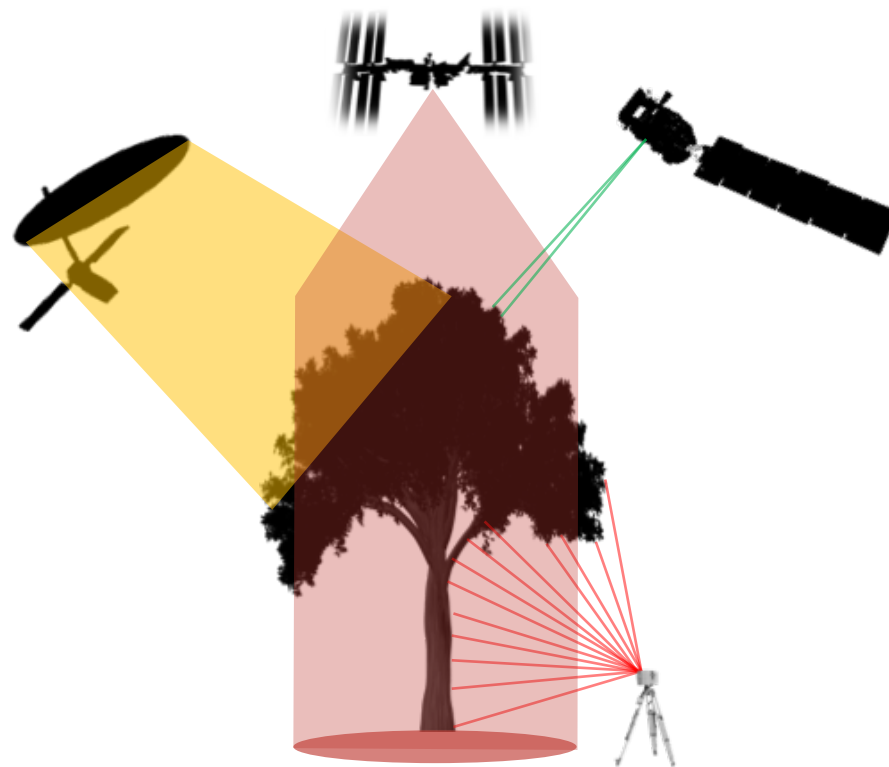
## 3.2 Progress implementation of the CEOS Strategy for Carbon Observations from Space

CARB-16: Cal/val and production of biomass products from CEOS missions	Q4 2019	Development of a coordinated cal/val strategy across NASA and ESA biomass missions that rationalizes protocols, data sharing, and the establishment of ground-based carbon super-sites.	NASA and ESA
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# Many Upcoming Missions Will Provide Data That Will Be Used to Map Biomass

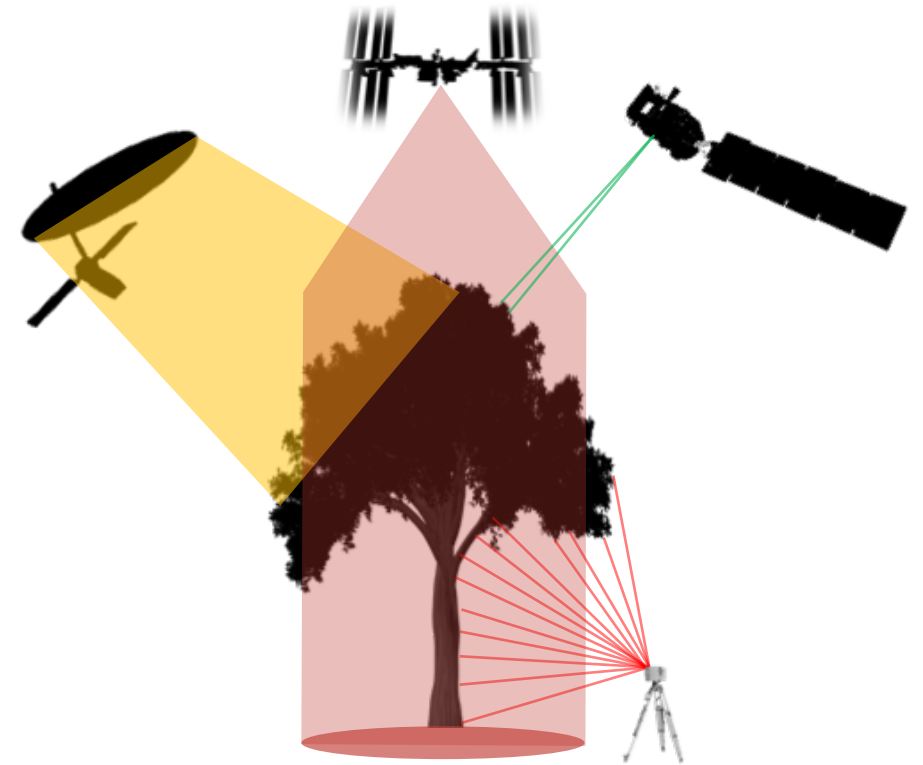
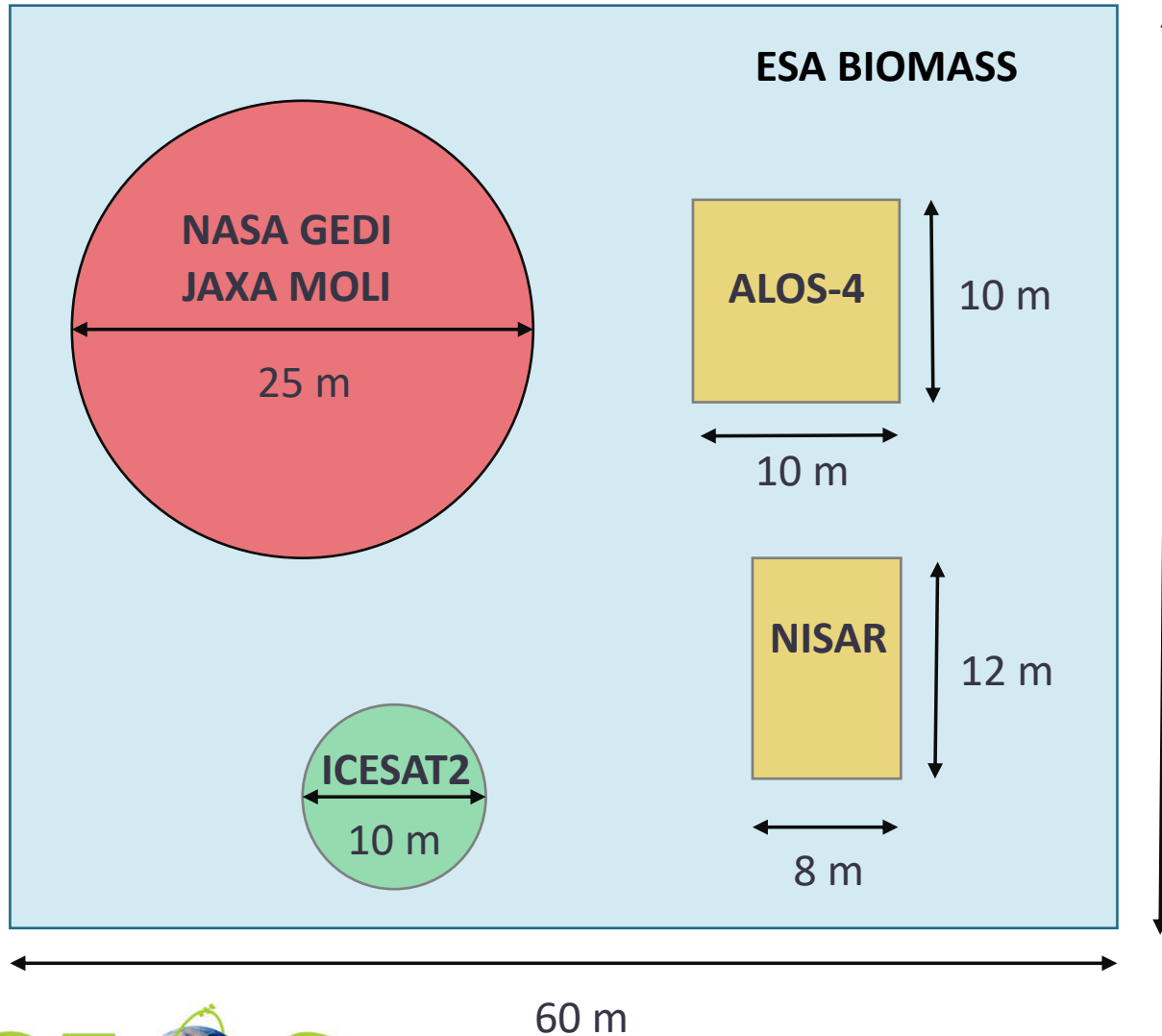


~50 m  
(6 looks)

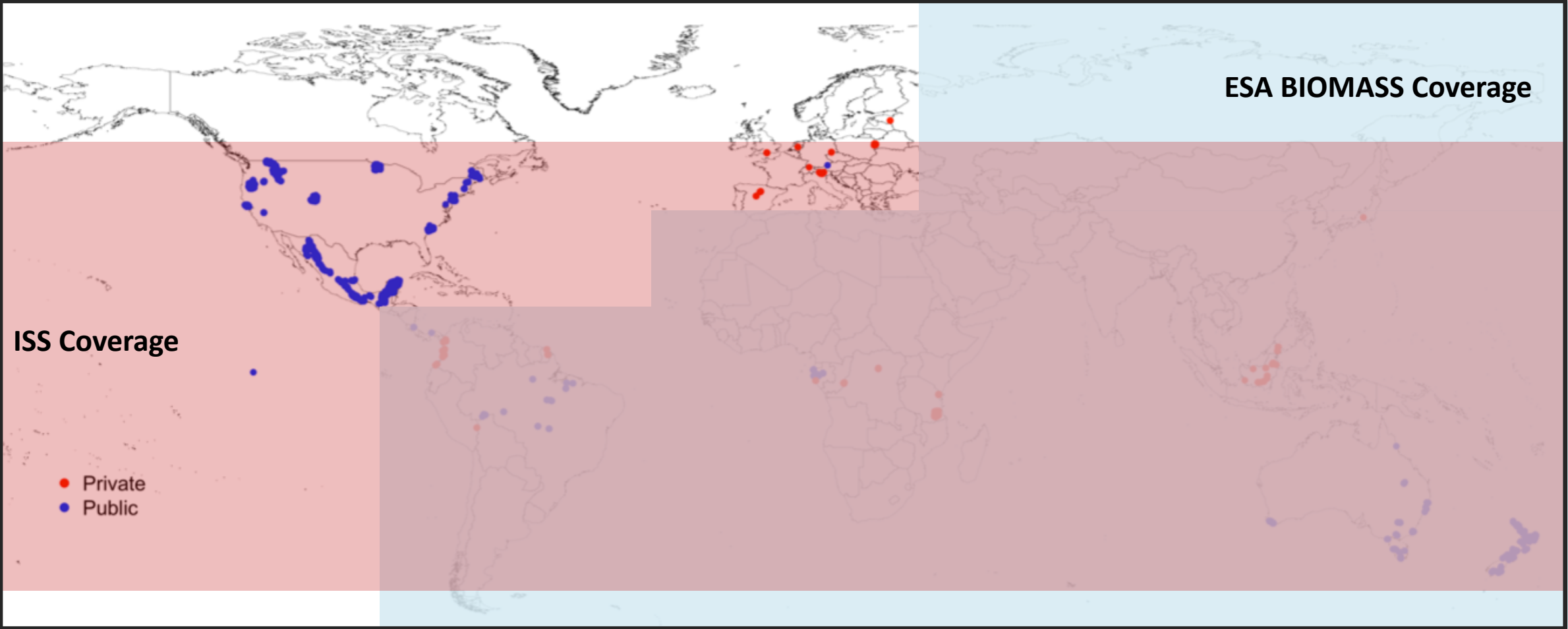




# How will scientists make sense of many the data products? How will policy makers?



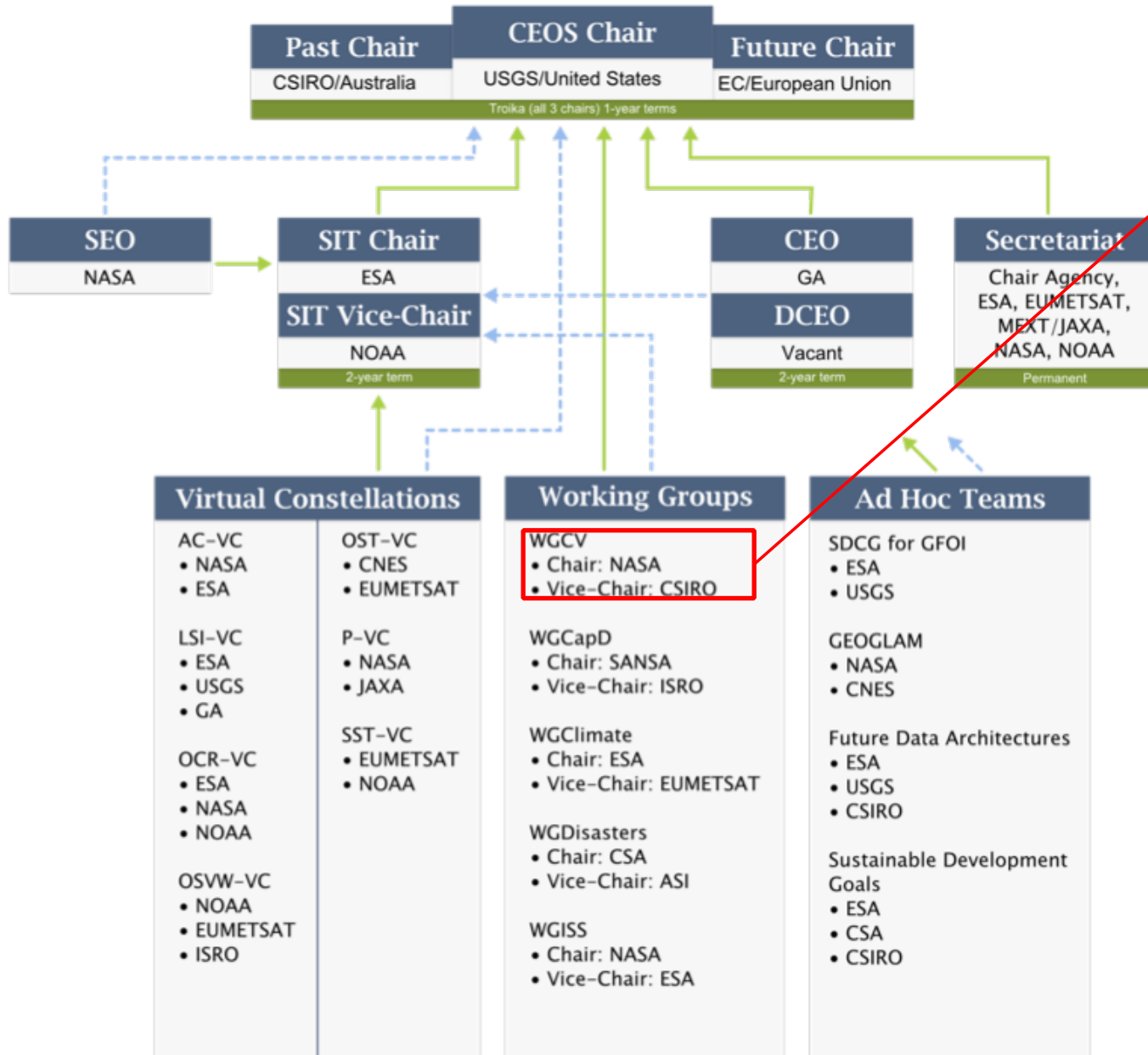
# Spatial Distribution of Upcoming Spaceborne Datasets



NISAR, ICESAT2 have global coverage, GEDI (and MOLI) covers ~51 N/S, BIOMASS global minus US and Europe

For accurate, global biomass mapping fusion of missions datasets will be necessary

# CEOS Organization



## Working Group on Cal/Val:

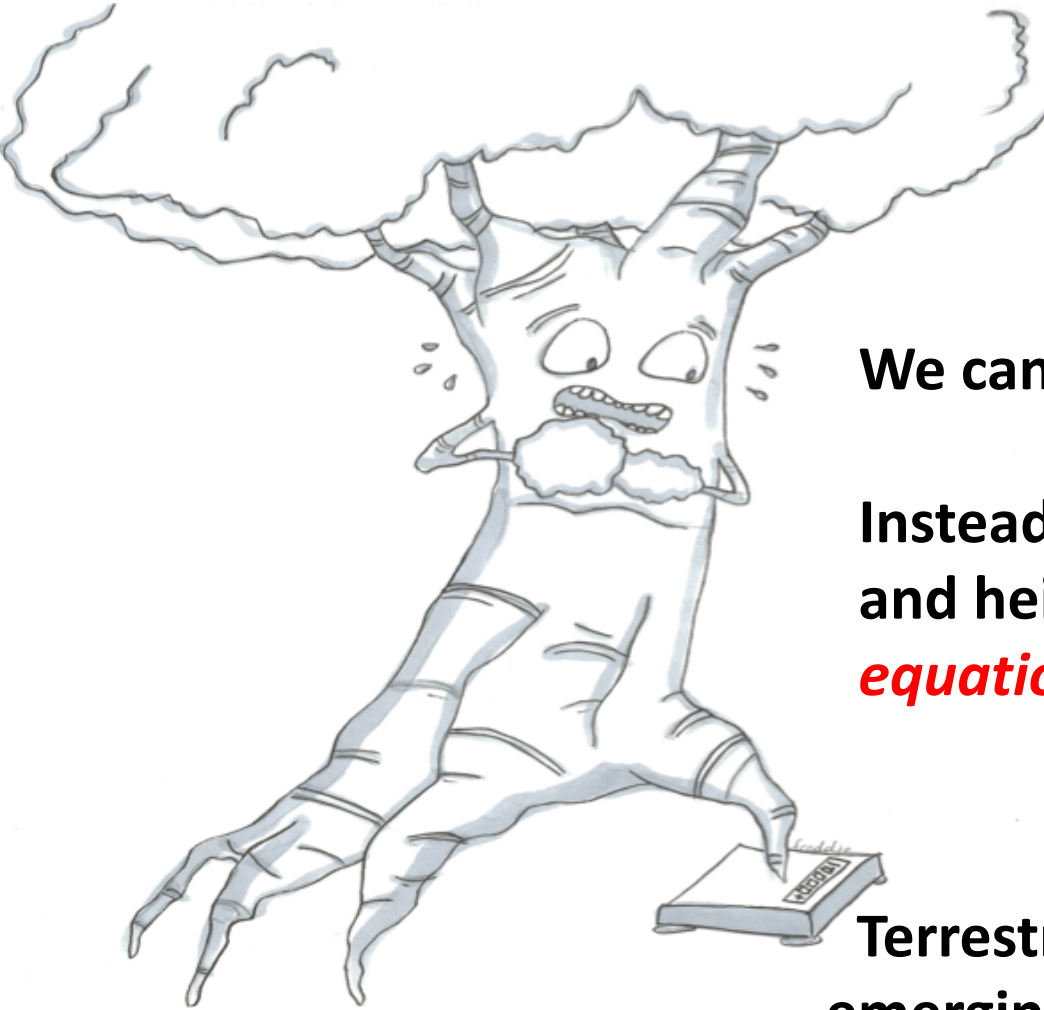
- Atmospheric Composition
- Synthetic Aperture Radar
- Microwave Sensors
- Terrain Mapping
- Infrared & Visible Optical Sensors
- **Land Product Validation**

- Land Cover
- Fire
- LAI
- FAPAR
- Albedo
- Land Surface Temperature
- Soil Moisture
- Phenology
- Snow Cover
- **BIOMASS**

**New CEOS LPV for Biomass led by:  
John Armston, Mat Disney & Laura Duncanson**

**Biomass, for the purposes of CEOS LPV, is defined as the above ground standing dry mass of live or dead matter from tree or shrub (woody plant) life forms, expressed as a mass or mass per unit area.**

# Field Estimation of Above Ground Biomass



We cannot weigh trees in forest plots

Instead, we measure stem diameters and heights, and apply *allometric equations* to estimate biomass

Terrestrial Laser Scanning (TLS) is an emerging technique for more accurate estimates of in situ biomass





# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Good practices for biomass estimation in the field**
  - Allometric Error
  - Field Measurement Error
  - Terrestrial Laser Scanning
- **Linking remote sensing observations to field estimates**
  - Geolocation & Spatial Scale
  - Temporal differences between field, airborne & spaceborne data
  - Using airborne data to scale from field to spaceborne data
- **Error Propagation**
  - Sources of Uncertainty
  - Extrapolating models to global maps
- **Independent Validation and Reporting**
  - Reporting requirements for each stage
  - Scope/scale of products
  - Error reporting by strata
  - Inter-comparison of maps
  - Requirements for online portal
- **Utility of Protocol for Other Communities**
  - Modeling community
  - Policy communities
  - Non-forest communities
- **Knowledge Gaps**
  - Experiments that will advance the field
  - Airborne / Field data gaps
  - Cross mission cal/val plans

# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Good practices for biomass estimation in the field (Leads Jerome Chave, Keryn Paul, Kim Calders)**
  - Allometric Error (Jim Kellner, Tommaso Jucker, Keryn Paul)
  - Field Measurement Error (Grant Domke, Jean-Francois Bastin, Tommaso Jucker, Jim Kellner)
  - Terrestrial Laser Scanning (Atticus Stovall, Harm Bartholomeus, Nicolas Barbier, John Armston)

# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Linking remote sensing observations to field estimates (Leads Maxime Réjou-Méchain and Nicholas Barbier)**
  - Geolocation & Spatial Scale (Ed Mitchard, Valerio Avitabile, Danae Rozendaal)
  - Temporal differences between field, airborne & spaceborne data (TBD)
  - Using airborne data to scale from field to spaceborne data (Nicolas Barbier, Jean-Francois Bastin)

# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Error Propagation (Leads Ron McRoberts and Steven Roxburgh)**

- Sources of Uncertainty
- Extrapolating models to global maps
  
- **Volunteers: David Coomes, Maxime Réjou-Méchain, Hans Anderson, Stephen Roxburgh, Marcos Longo, Jean-Francois Bastin, Eric Næsset**



# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Independent Validation and Reporting (Leads Laura, Mat & John)**
  - Reporting requirements for each stage
  - Scope/scale of products (Martin Herold, Martin De Kauwe)
  - Error reporting by strata
  - Inter-comparison of maps (Valerio Avitabile)
  - Requirements for online portal (Richard Lucas)



# Components of CEOS LPV Biomass Protocol

*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Utility of Protocol for Other Communities**

- Modeling community (George Hurtt, Andreas Huth, Natasha MacBean, Martin De Kauwe)
- Policy communities (Martin Herold, Jean-Francois Bastin)
- Non-forest communities (Natasha MacBean, Lola Fatoyinbo)



# Components of CEOS LPV Biomass Protocol

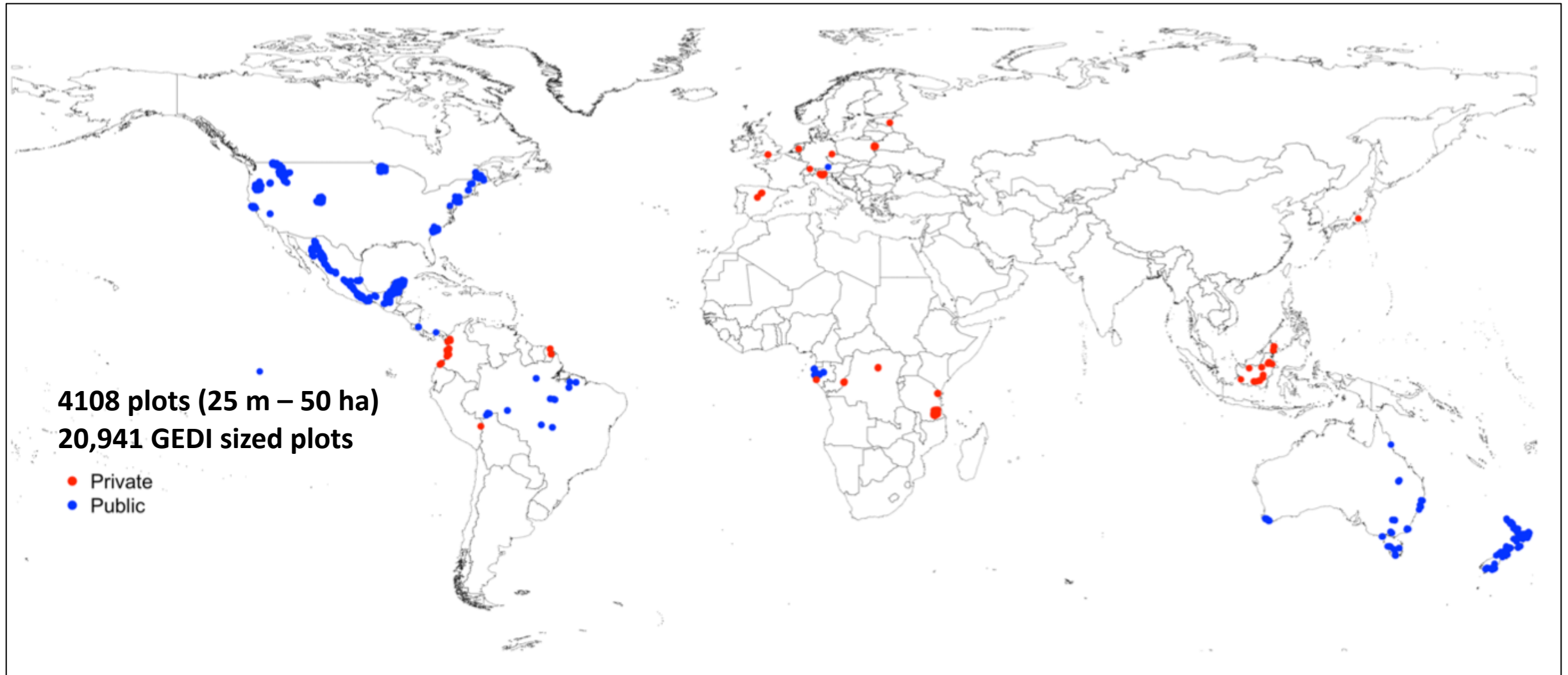
*The protocol will be a good practices guide to biomass model calibration and product validation at a global (or near global) scale*

- **Knowledge Gaps (Leads Laura, Mat and John)**
  - Experiments that will advance the field
  - Airborne / Field data gaps
  - Cross mission cal/val plans (reps from each active structure mission to coordinate flights?)
- **Volunteers: David Coomes, Jim Kellner, Danae Rozendaal**

# Timeline

Timeline	Activities
Fall 2017	<ul style="list-style-type: none"><li>• Identify contributors</li><li>• Develop draft protocol skeleton</li><li>• Meet with writing groups</li></ul>
Winter 2017	<ul style="list-style-type: none"><li>• Finalize skeleton, writing groups / leads</li></ul>
January – June 2018	<ul style="list-style-type: none"><li>• Section drafts complete by June 2018</li></ul>
June – August 2018	<ul style="list-style-type: none"><li>• Collation of section drafts</li><li>• LPV co-leads draft introduction, conclusion</li><li>• Synthesis for data gaps section</li></ul>
Fall 2018	<ul style="list-style-type: none"><li>• Internal review</li></ul>
Winter 2018 - Summer 2019	<ul style="list-style-type: none"><li>• External review</li><li>• Draft / submit peer reviewed papers</li></ul>
2019	<ul style="list-style-type: none"><li>• Collation of reference datasets</li><li>• Adoption by ICESAT2 &amp; GEDI biomass products</li></ul>

# GEDI's Field and Lidar Calibration Database

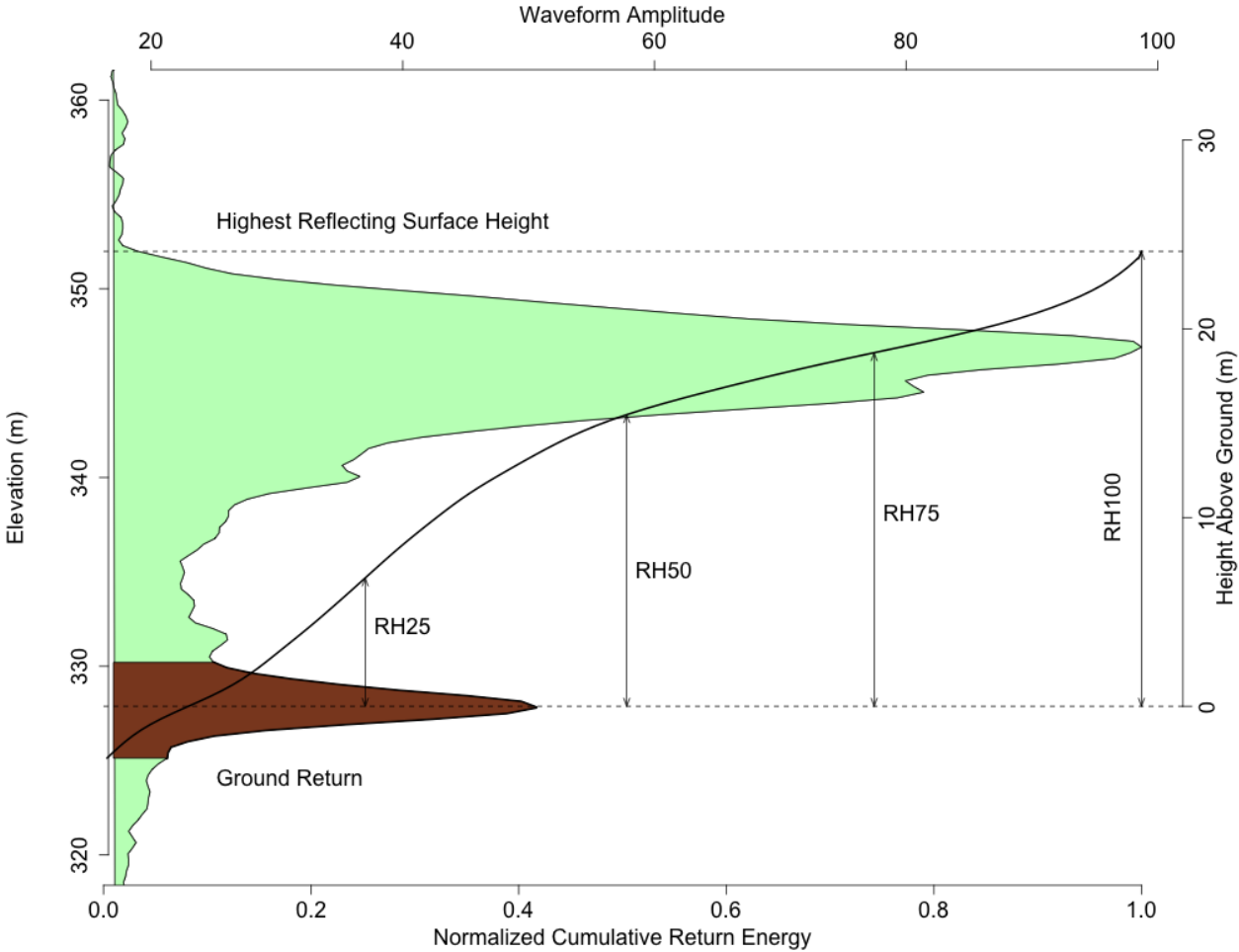
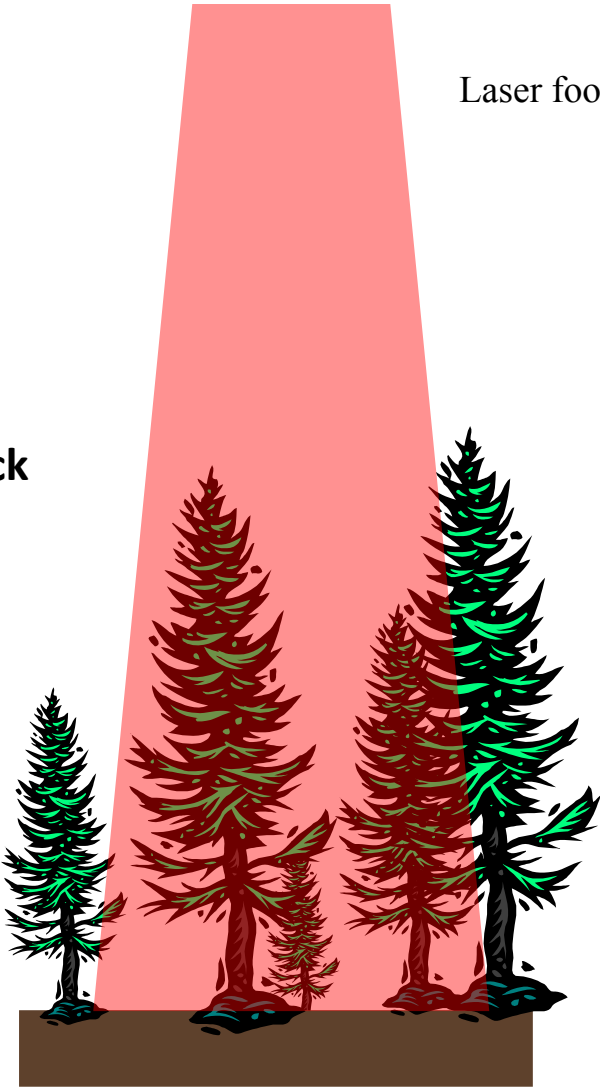


*Data are crowd-sourced from international collaborators*

# Simulating GEDI with Airborne Lidar

Laser footprint

Slide by  
Steve Hancock



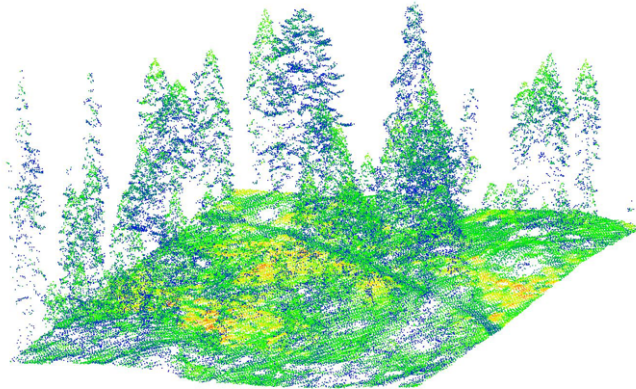
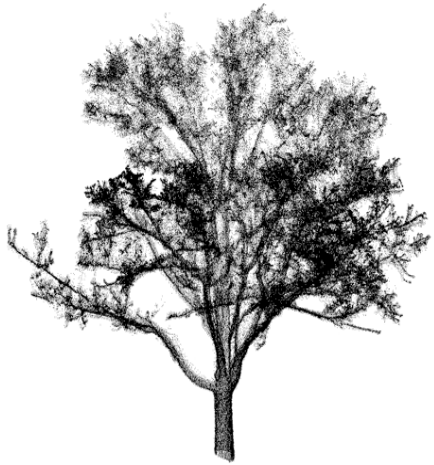


# General Biomass Validation Concept

## Error Propagation

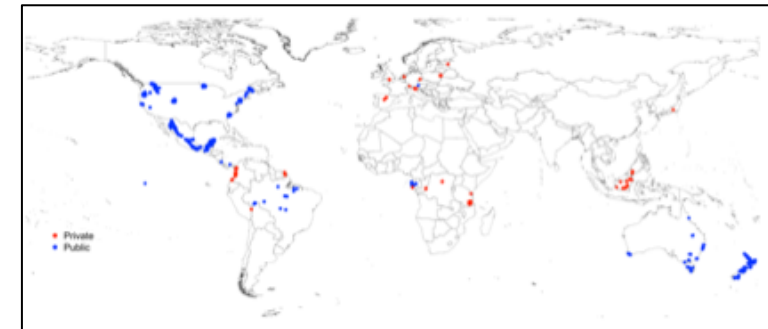
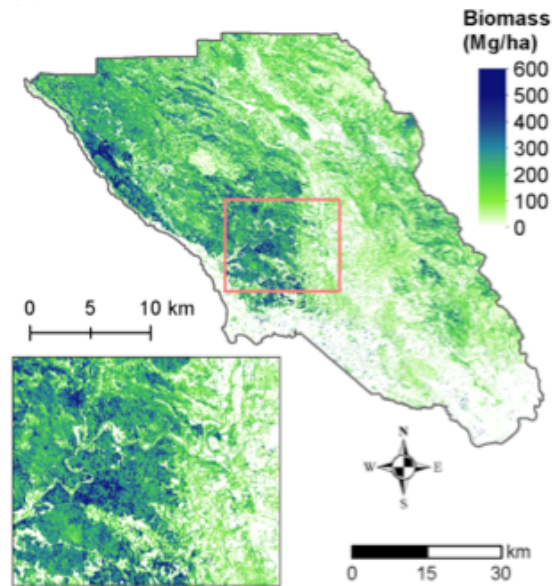


1. TLS + Field Data for plot biomass estimates



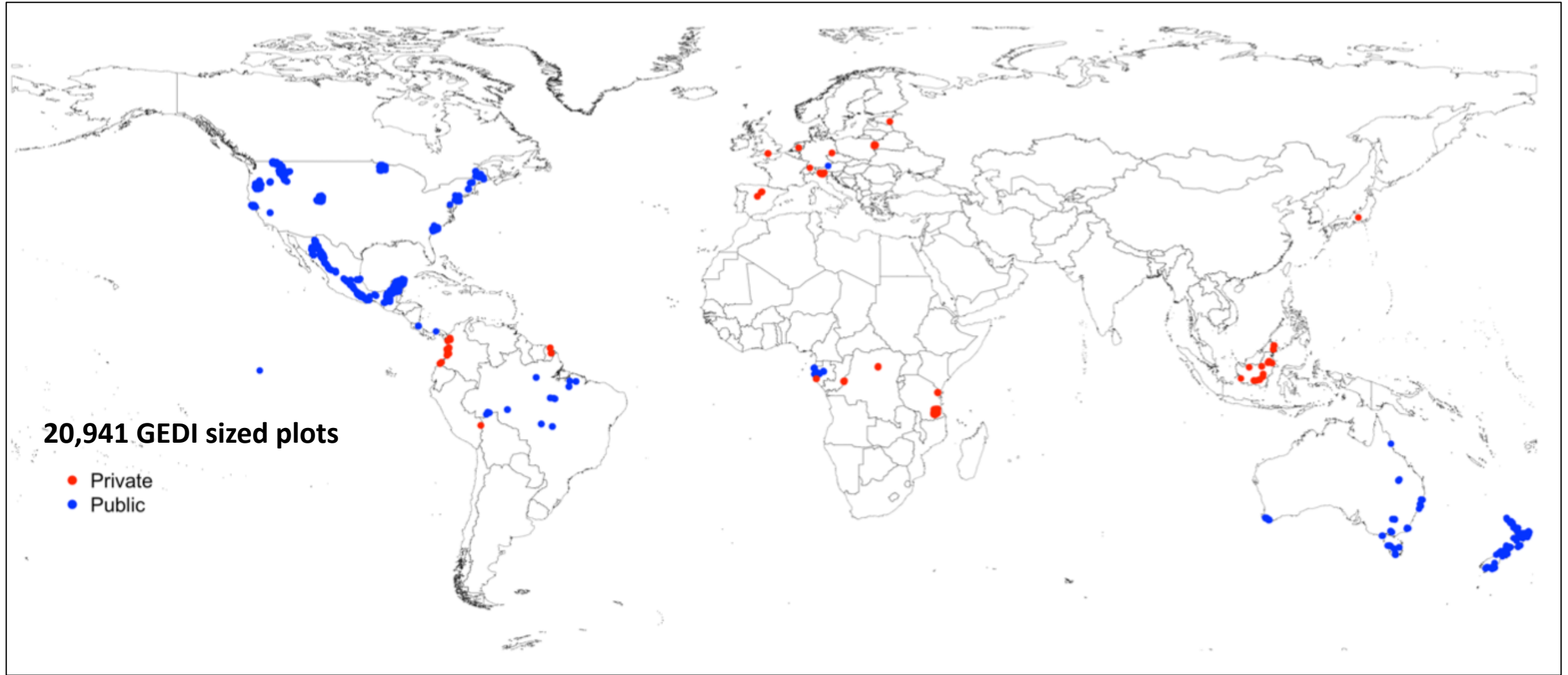
2. Calibrate Airborne lidar with local TLS plots

3. Generate local:regional biomass maps at desired resolution



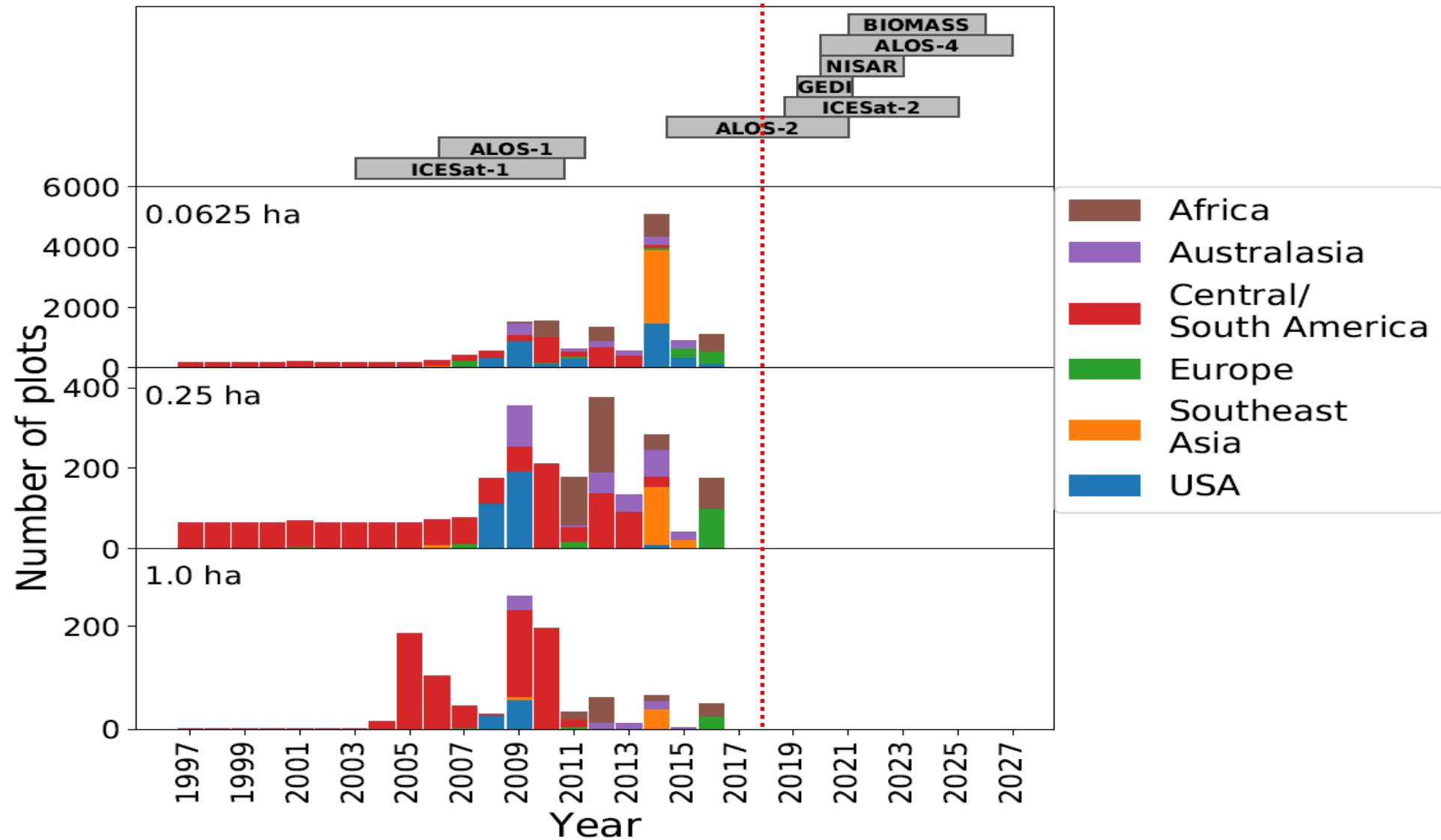
4. Report accuracy over geographic domain of interest

# GEDI's Field and Lidar Calibration Database

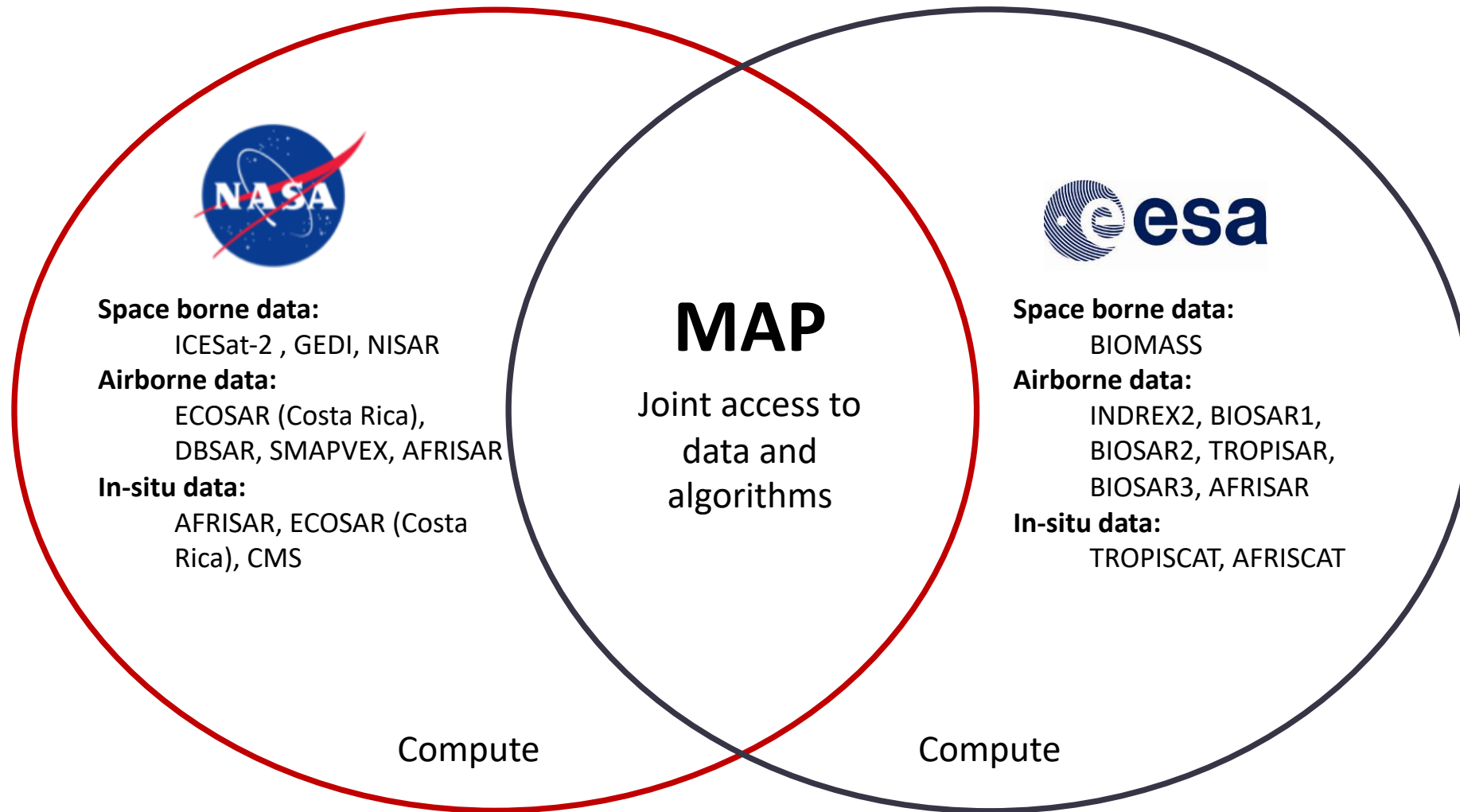


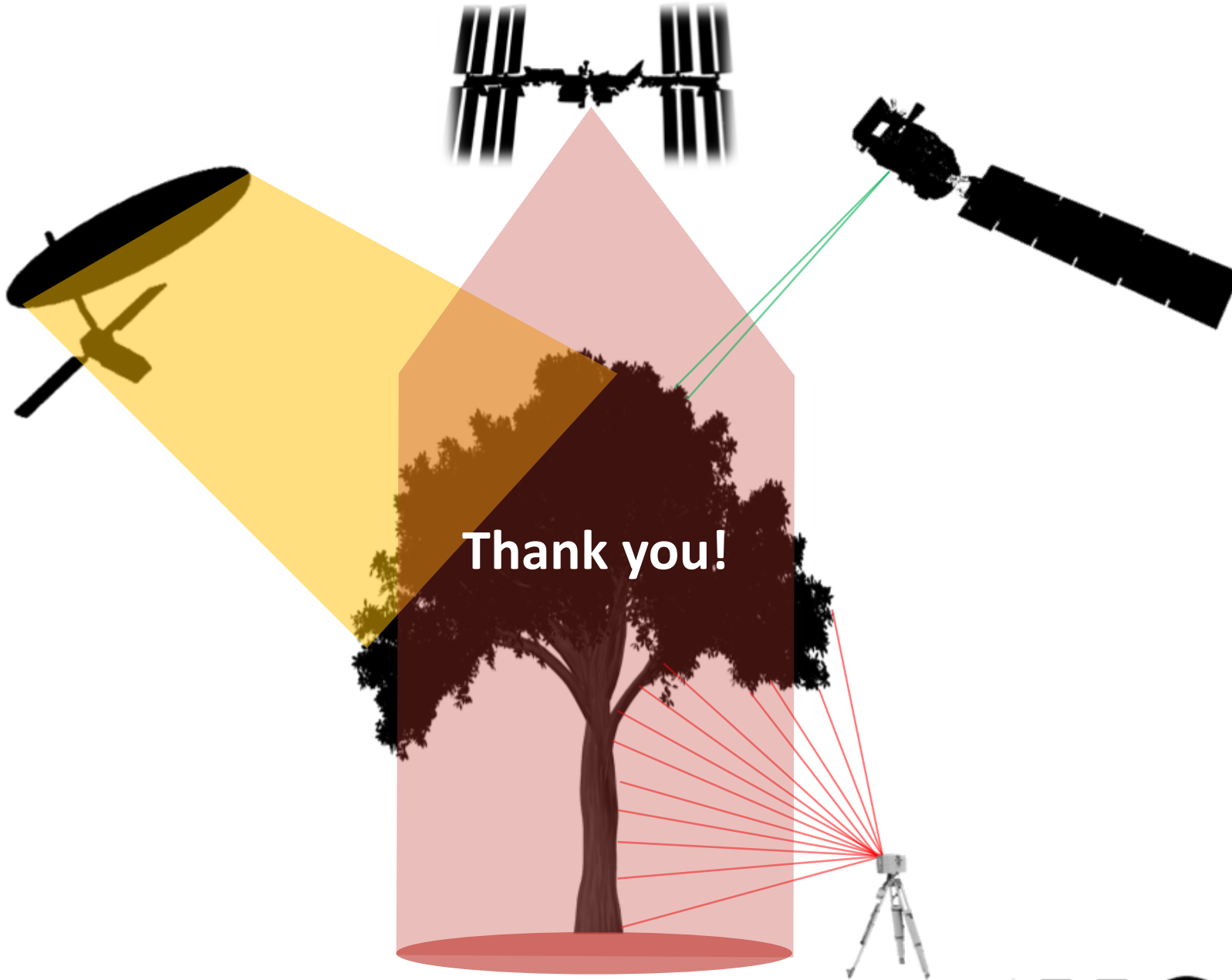
*Data are crowd-sourced from international collaborators*

# GEDI Forest Structure and Biomass Database



# Potential Validation Portal: Multi-mission Analysis Platform





Thank you!