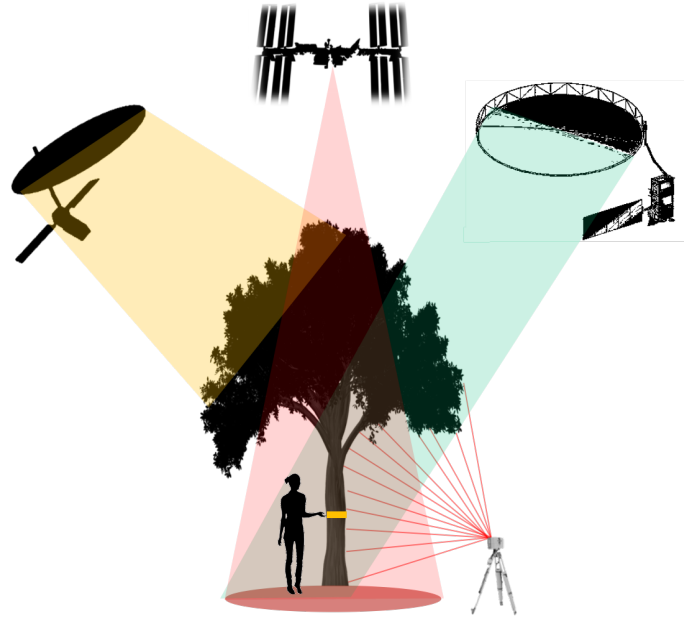
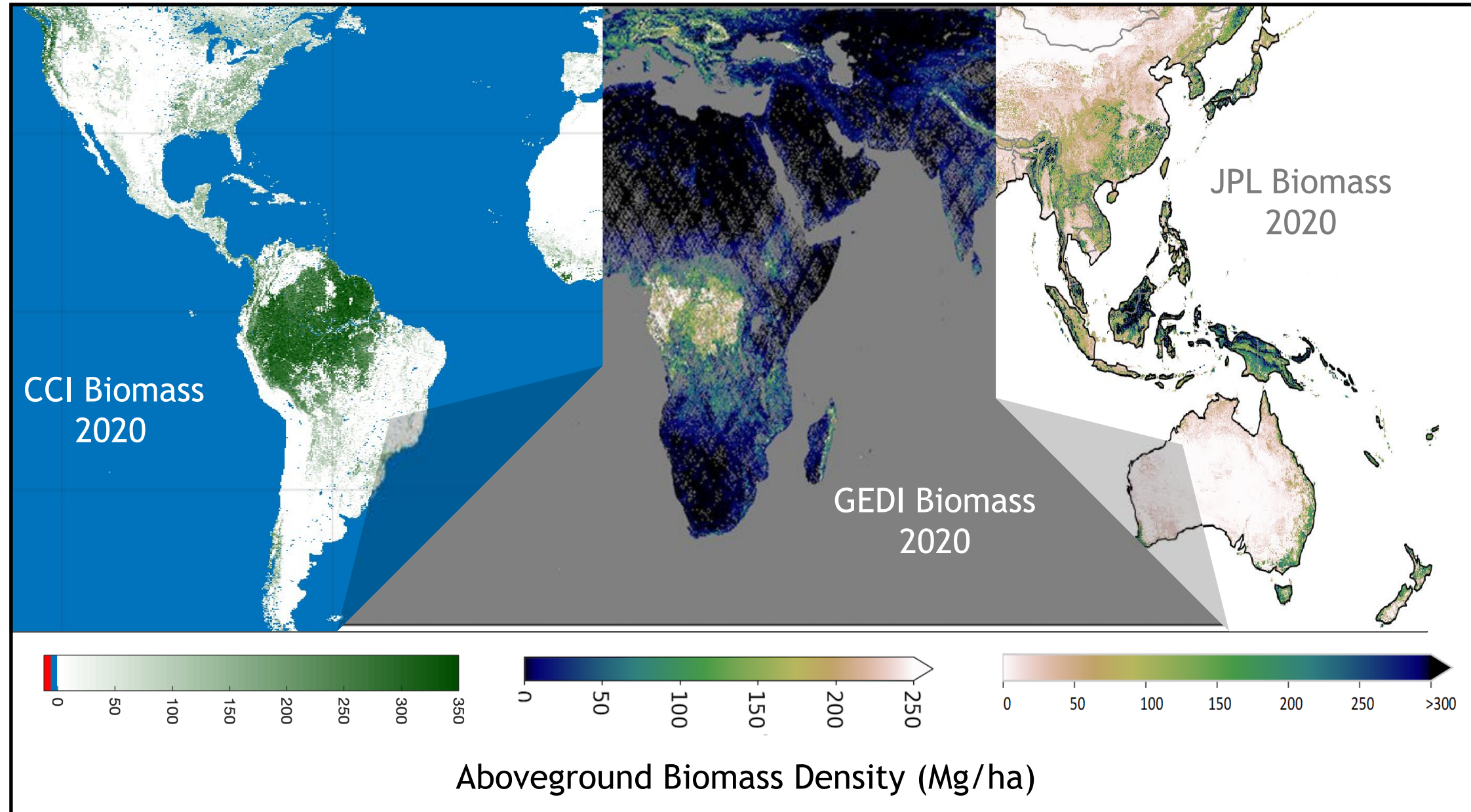


Toward Global Harmonization of 2020 Satellite-based Forest Aboveground Biomass Maps



Laura Duncanson, Clement Albinet, Arnan Araza, John Armston, Aimee Barciauskas, Ralph Dubayah, Gerald Guala, Masato Hayashi, Sean Healey, Martin Herold, Neha Joshi Hunka, Heather Kay, Veronika Leitold, Richard Lucas, Ron McRoberts, Joana Melo, David Minor, Erik Næsset, Osamu Ochiai, Shaun Quegan, Sassan Saatchi, Klaus Scipal, Frank Martin Seifert, Pedro Rodriguez Veiga, Ake Rosenqvist, Takeo Tadono, Sylvia Wilson

Biomass Product Harmonization Activity for the UNFCCC GST

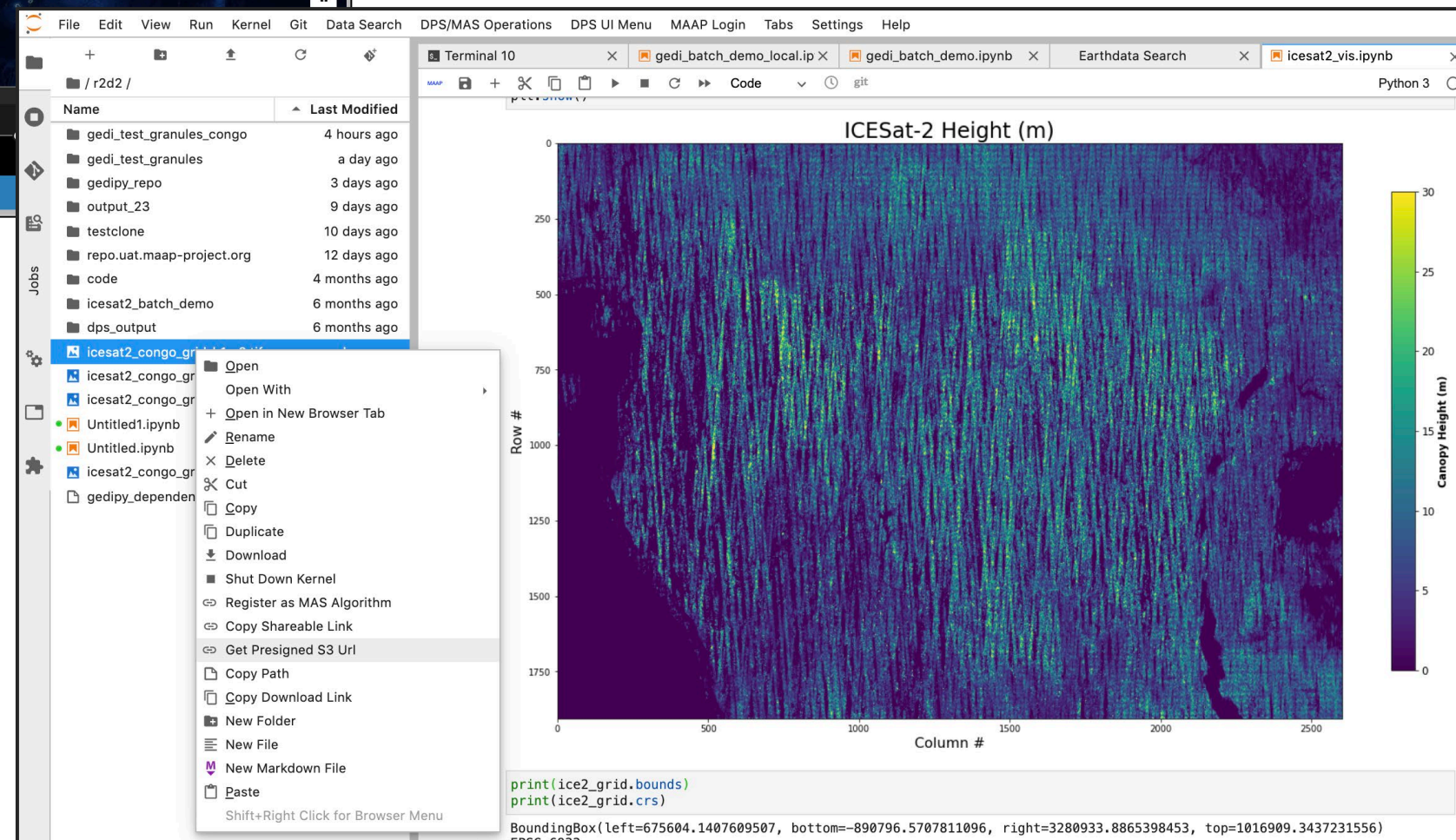
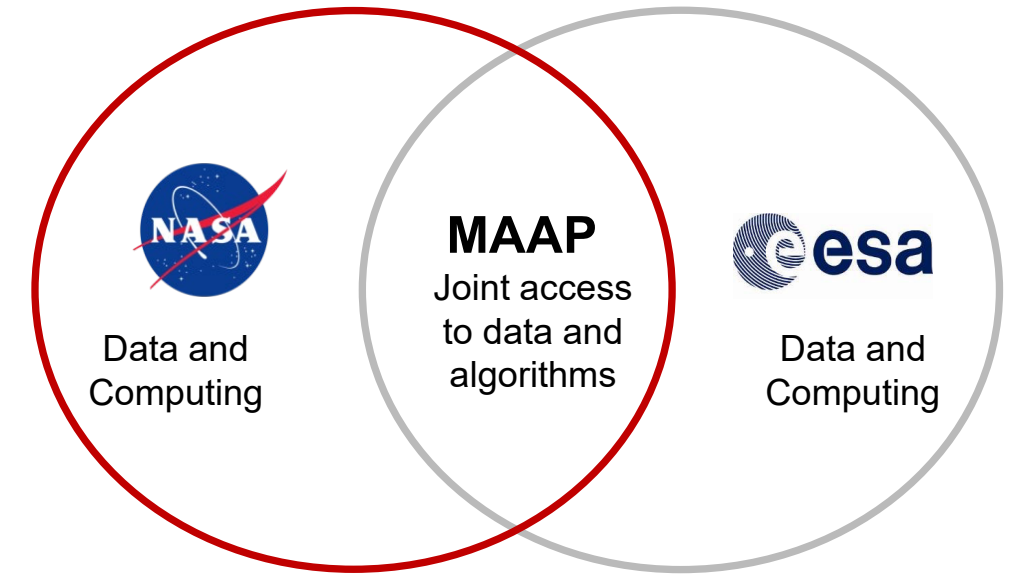
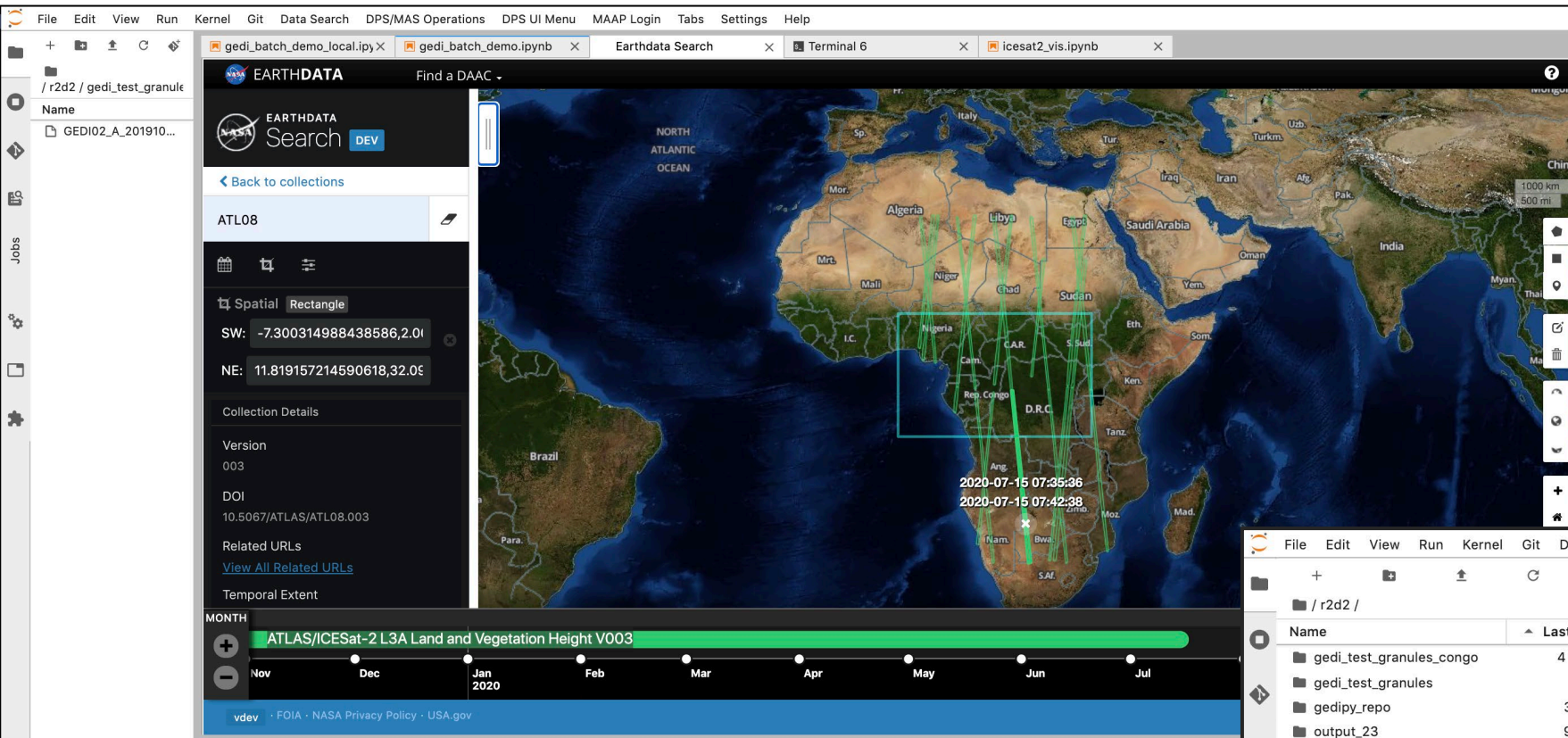


As new biomass products come online, we need to understand which products are most accurate, where, and why? This needs to be transparent to data users.

Comparing and Validating New Biomass Products

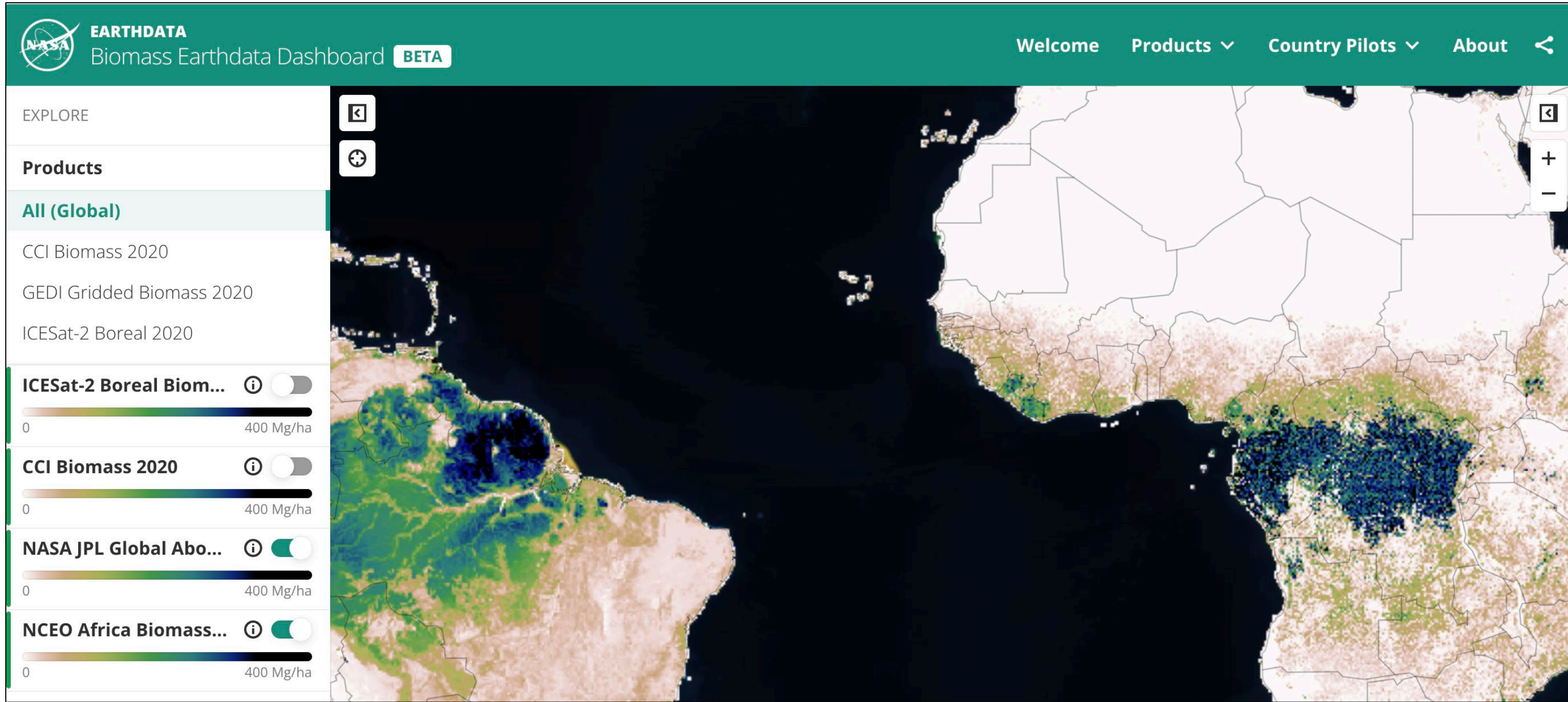
Product	Data Type	Missions	Years represented	Spatial Resolution	Spatial Domain
GLOBIOMASS	SAR, lidar	ALOS, ENVISAT, ICESat GLAS	2010	100-m	Global
GEOCARBON	Fusion of other products	Inputs to other products (lidar, SAR, Optical)	2010	0.01°	Global
NASA JPL	Lidar, SAR	GLAS, ALOS	2015	10-km	Global
CCI Biomass	SAR and Optical	ALOS, Sentinel-1	2017, 2018	100-m	Global
NASA JPL	Lidar, SAR	GLAS, ALOS-2	2020	100-m	Global
NCEO Africa	Lidar, SAR, Optical	GEDI, ALOS-2, Landsat	2017	100-m	Africa
CCI Biomass	Lidar, SAR and Optical	ALOS, Sentinel-1, GEDI, ICESat-2	2020	100-m	Global
NASA GEDI mission Product	Lidar	GEDI	2019-2021	1-km	+/- ~51.6° latitude
NASA ICESat-2 boreal product	Lidar	ICESat-2, Landsat	2019-2021	30-m	Boreal (50-75° N)

Open science platform - the Multi-Mission Algorithm and Analysis Platform (MAAP)



- Bilateral platform between ESA and NASA
- Designed for collaborative **open science**, algorithm and product development
- Pilot focuses on forest biomass mapping
- Cloud compute (AWS, Orange)
- Hosts lidar (GEDI, ICESat-2) and future SAR (NISAR, BIOMASS) + reference data
- Used for the biomass harmonization activity

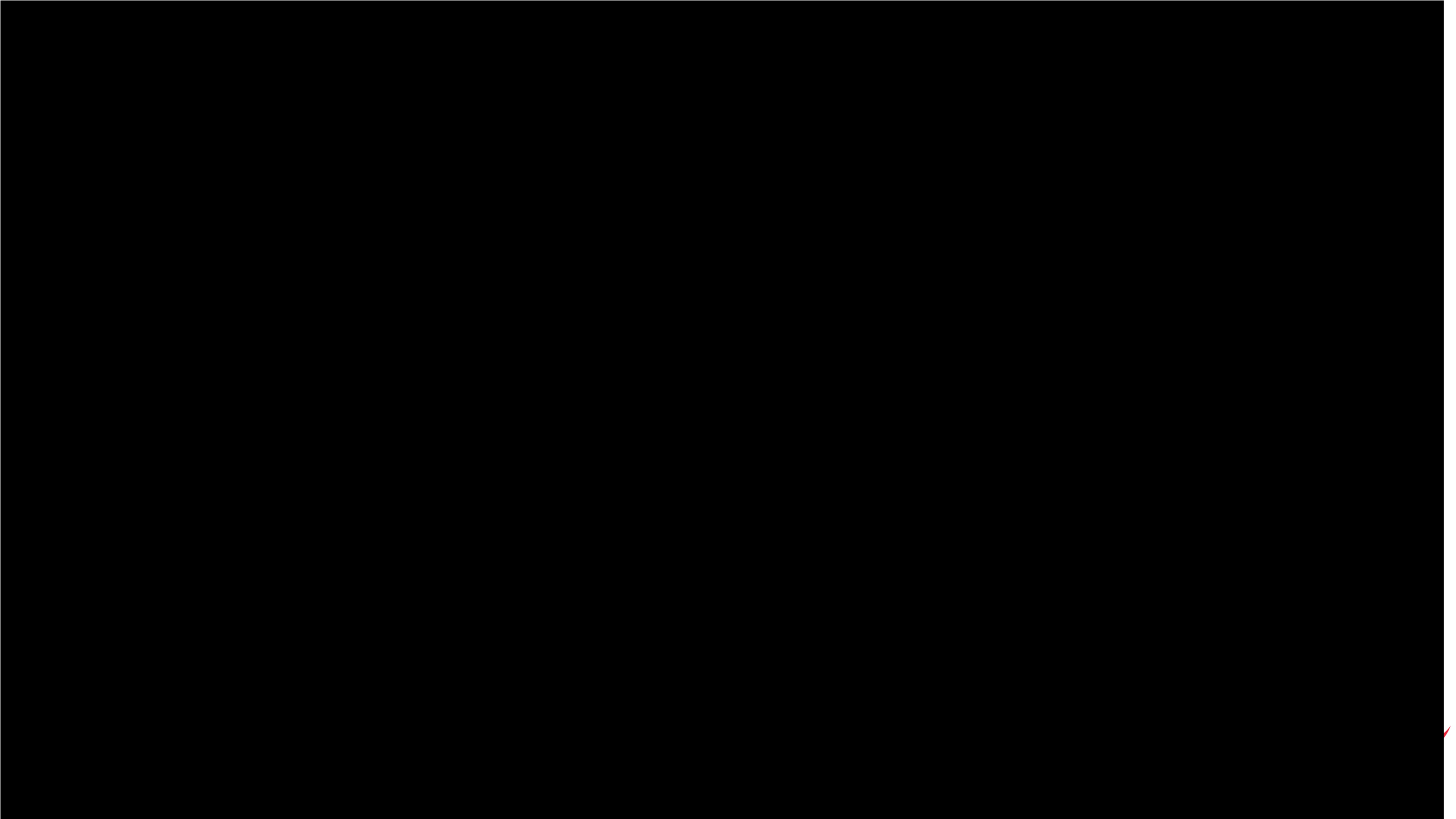
Dashboard for COP26 - Explore 2020 Biomass Products!



<https://earthdata.nasa.gov/maap-biomass>

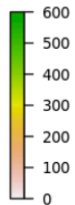
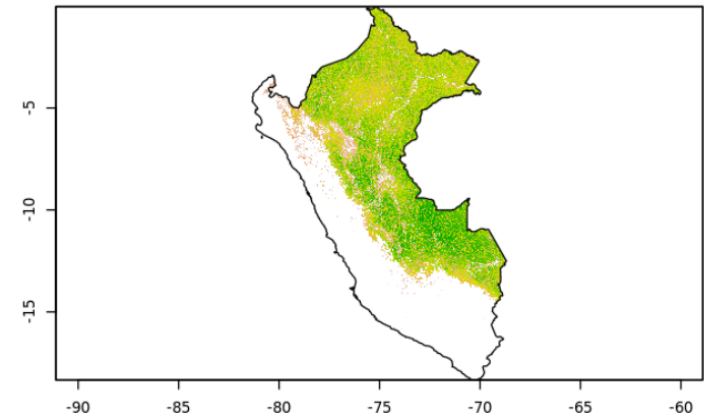
Biomass Harmonization Activities

- Products are being assessed **following the WGCV biomass protocol** using **available reference data** in pilot USGS Silvacarbon & SERVIR countries
- New biomass products available on platform: <https://earthdata.nasa.gov/maap-biomass>
- **Map producers asked to provide sufficient information for estimating uncertainty:**
 - Model uncertainty (training data, or models with variance-covariance matrices) + per-pixel variance
 - Challenging for machine learning and semi-empirical approaches; likely require big compute Monte Carlo approach
 - Everybody still ignoring uncertainty in field estimates (allometry, tree measurements)
- **Harmonization framework still in discussion**
 - Harmonized estimates planned at jurisdictional level
- **Country-level summaries Created with user-friendly notebooks**
 - Toward pilot jurisdictional estimates

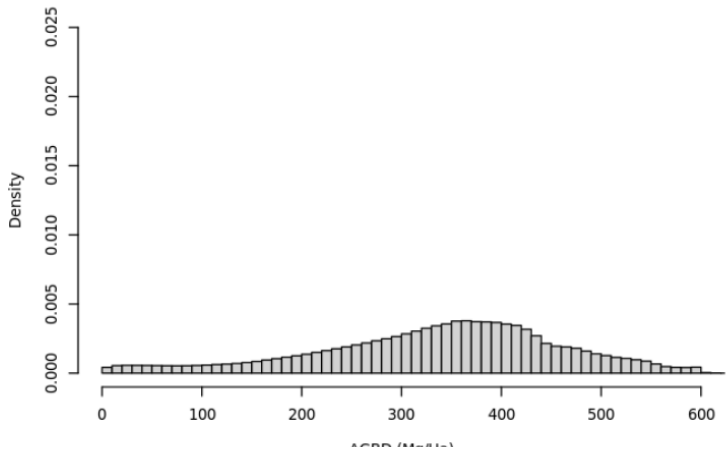


National Map Comparisons

CCI AGBD 2020 (cover>30%)



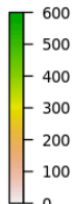
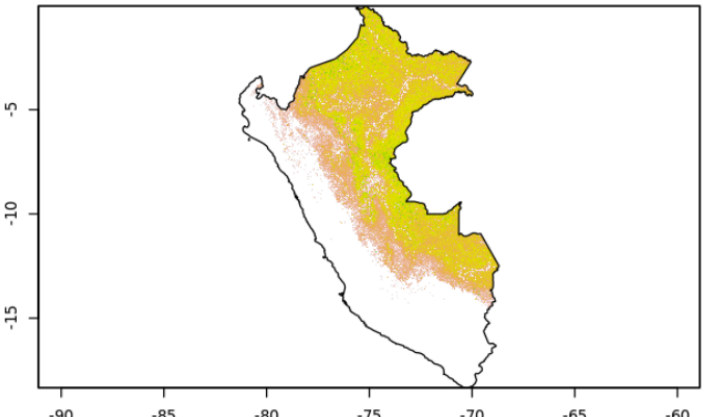
CCI AGBD 2020



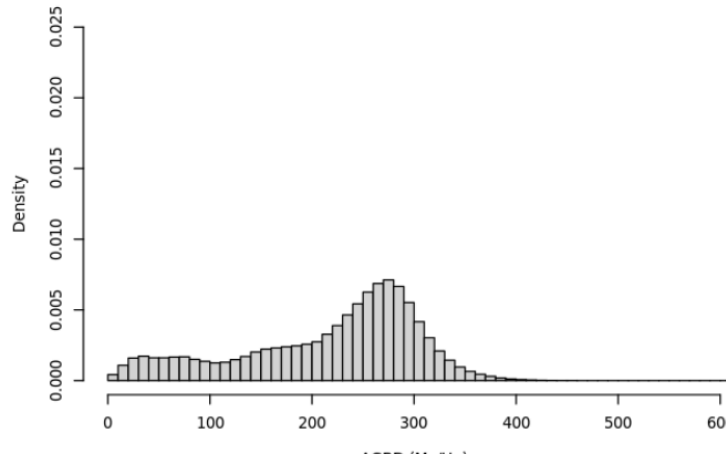
Mean: 274.04 Mg/ha
Total: 26.07 Pg

GEDI means are lower due to mapping non-forest

JPL AGBD 2020 (cover>30%)



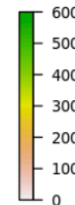
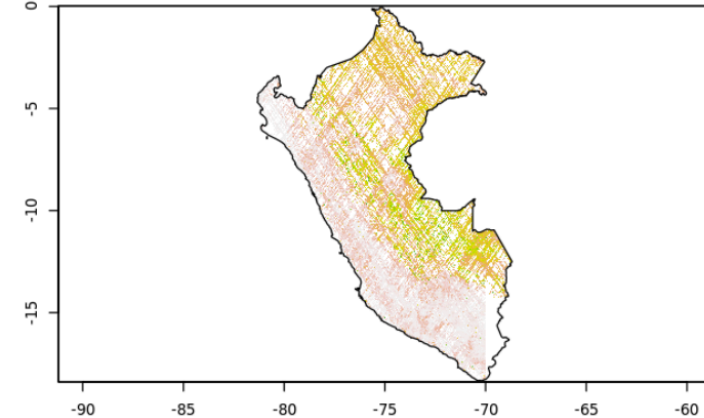
JPL AGBD 2020



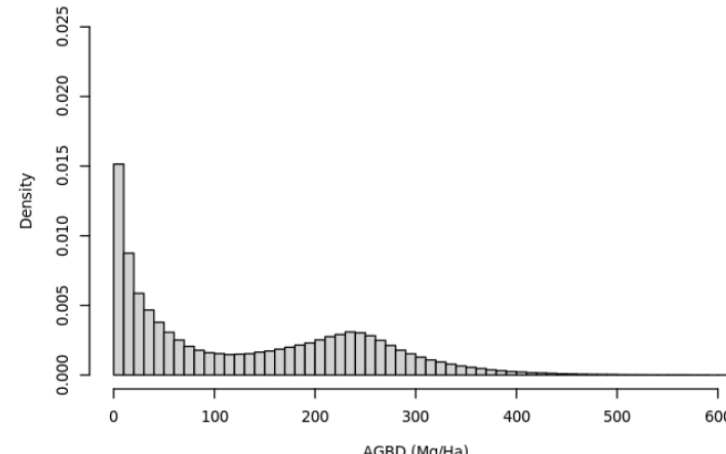
Mean: 174.45 Mg/ha
Total: 16.52 Pg

GEDI totals are more comparable to other maps

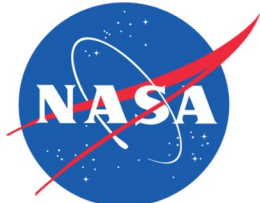
GEDI L4B AGBD 2020 (cover>30%)



GEDI L4B AGBD 2020

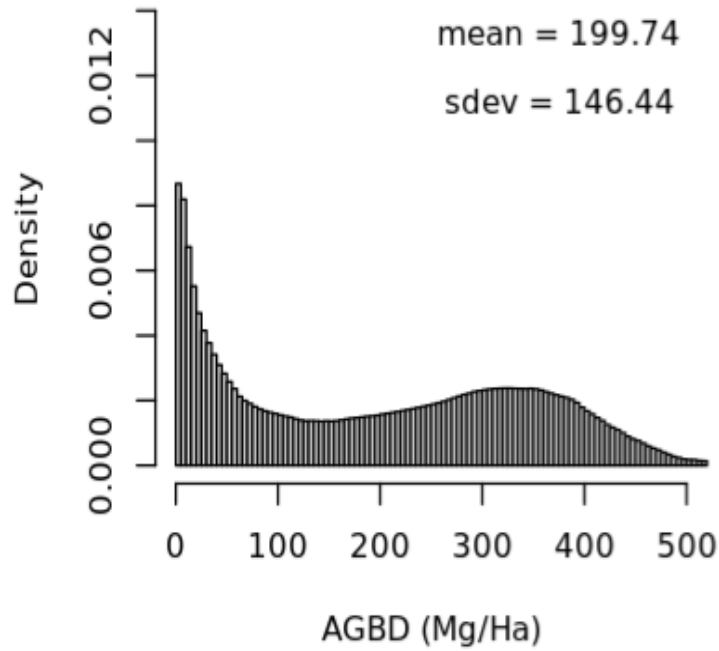


Mean: 145.8 Mg/ha
Total: 18.82 Pg

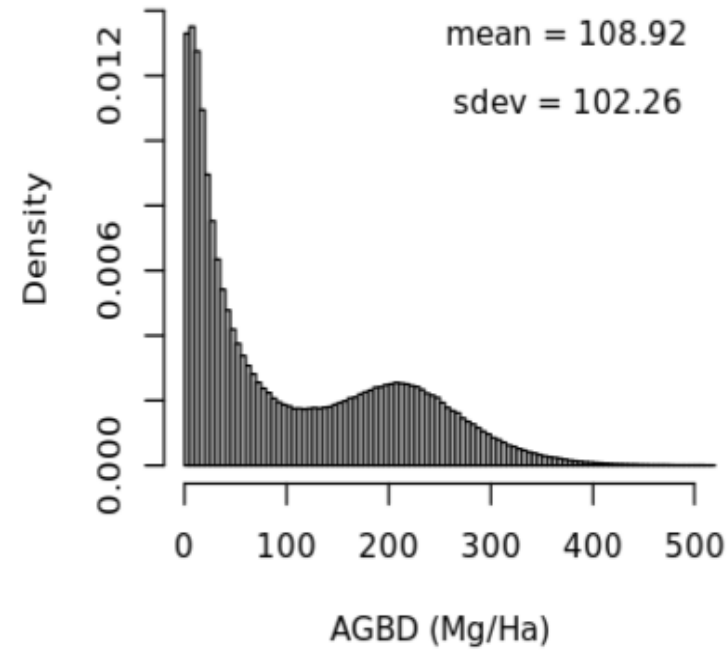


Tropical Subtropical Moist Broadleaf Forests Africa

CCI AGBD 2020



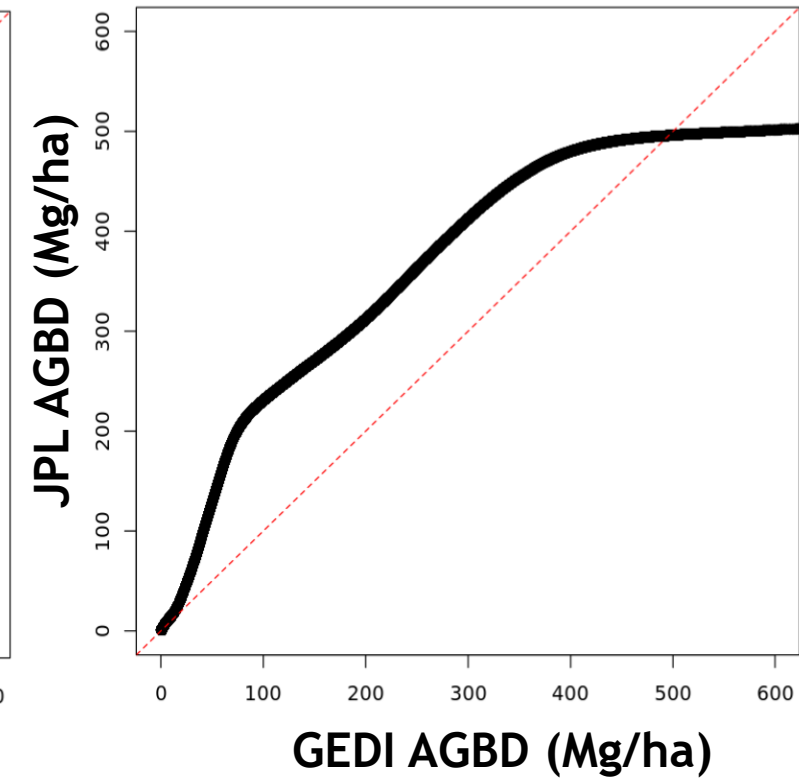
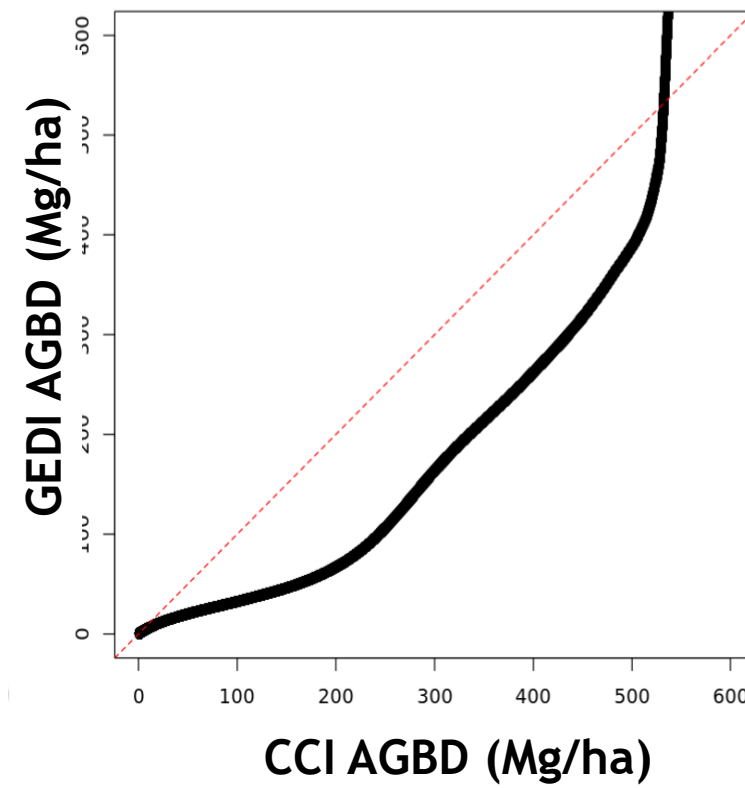
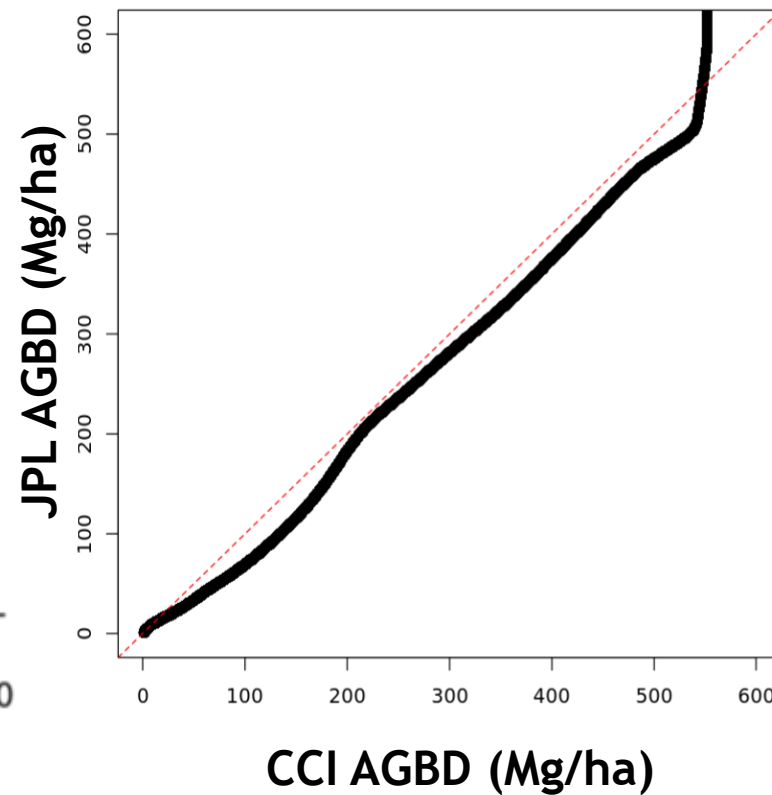
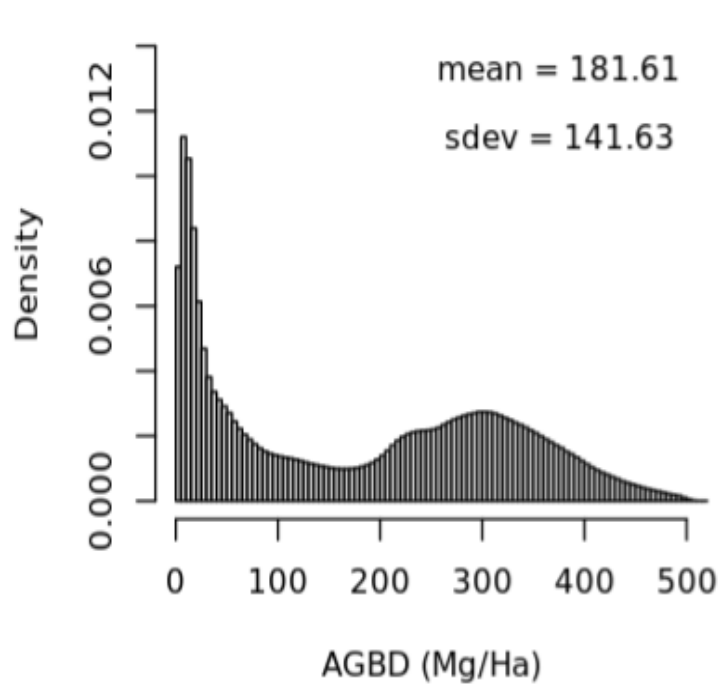
GEDI AGBD 2020



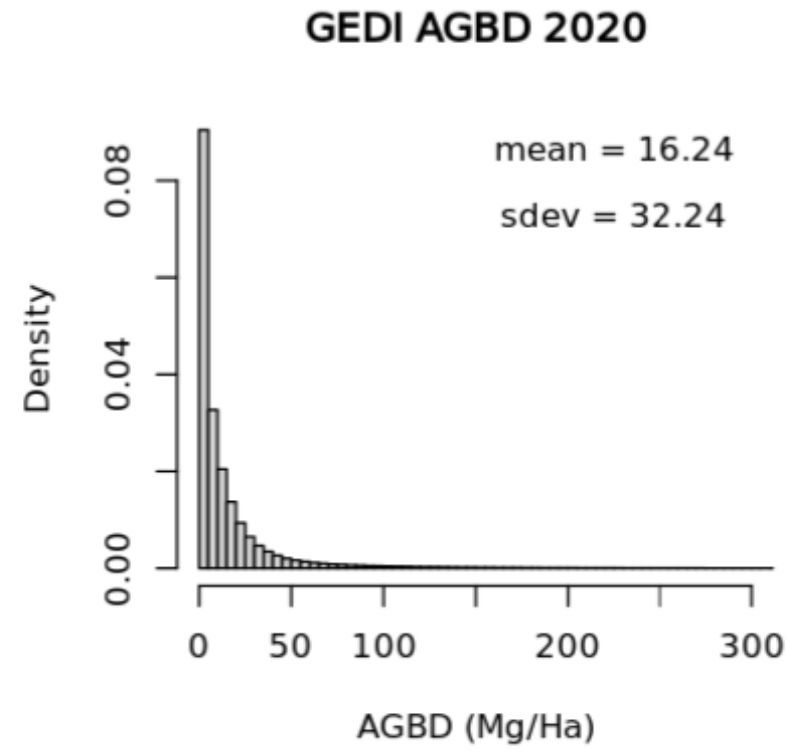
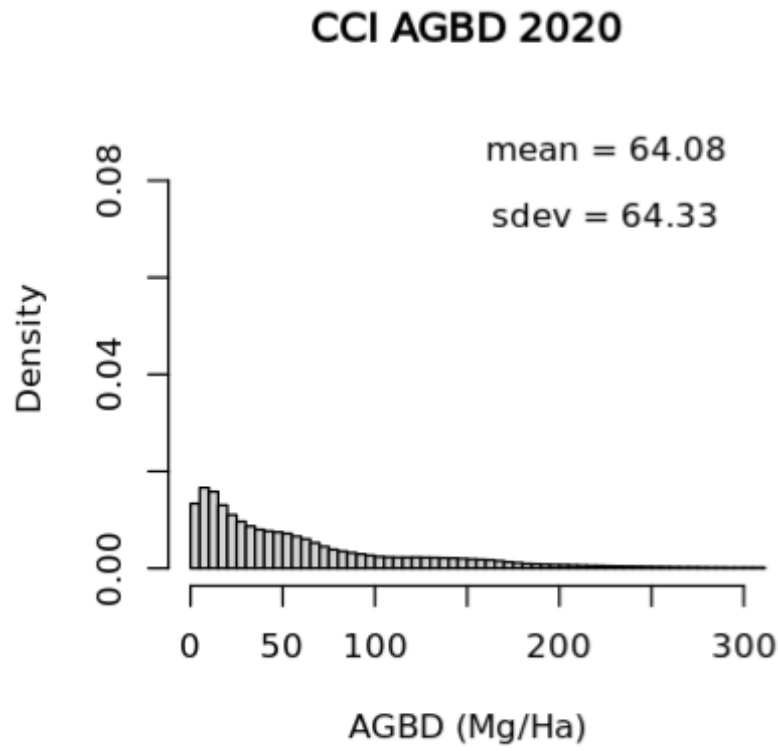
JPL and CCI match closely,
GEDI lower in low biomass,
higher in highest biomass



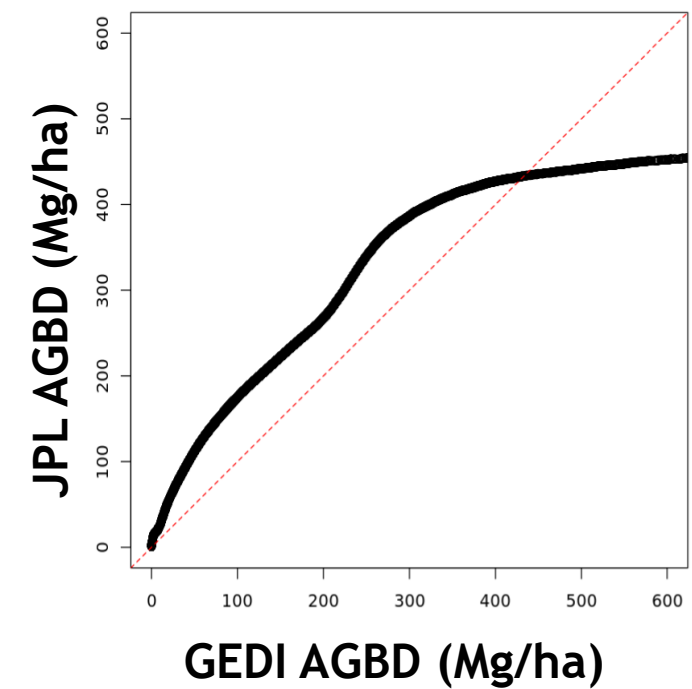
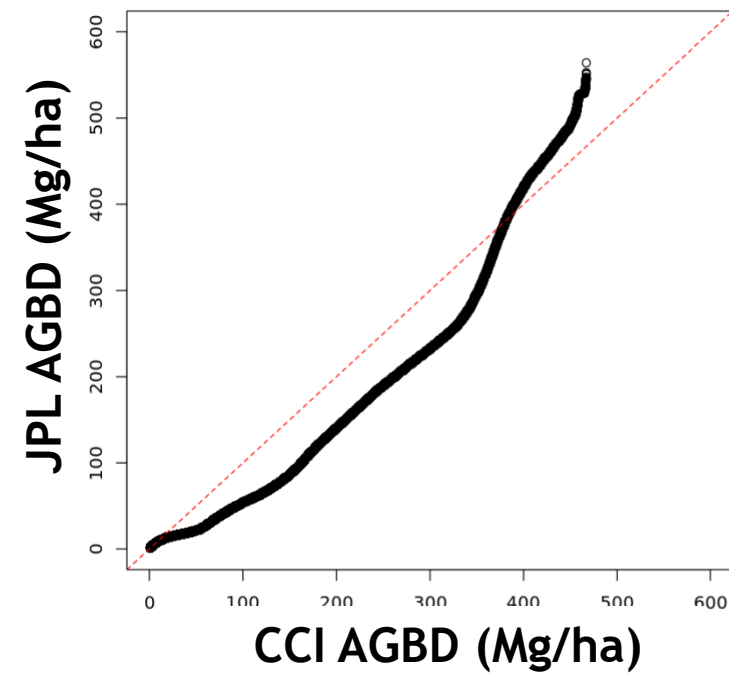
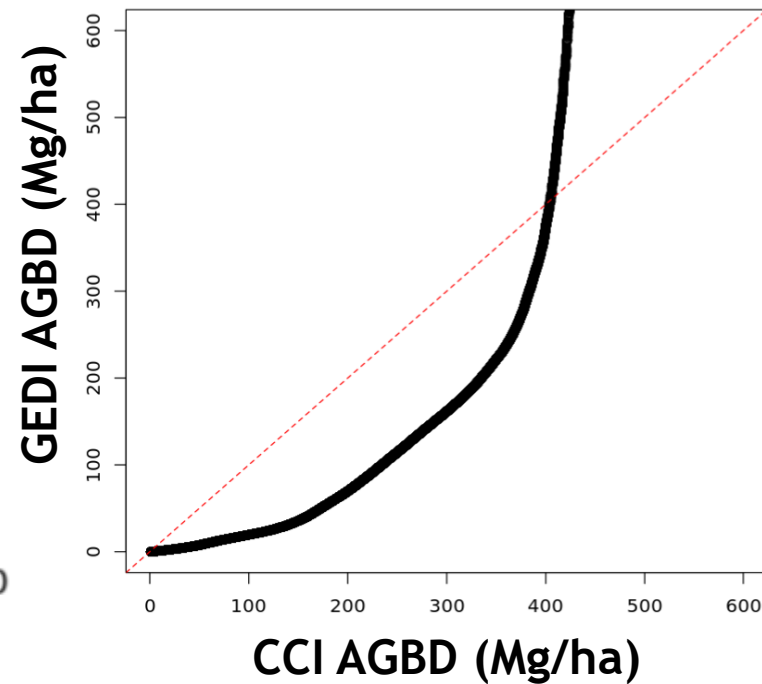
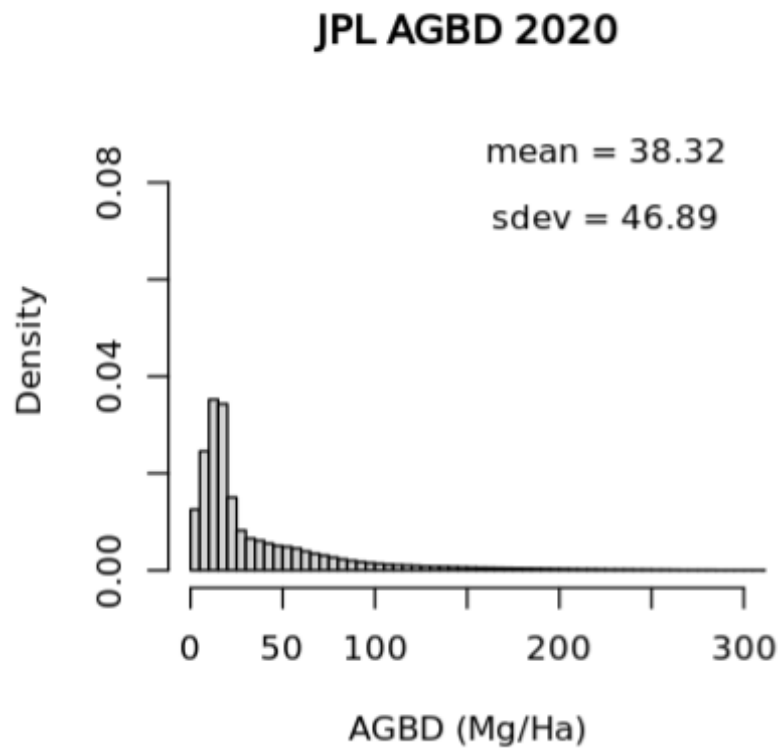
JPL AGBD 2020



Tropical Subtropical Grasslands Savannas Shrublands South America

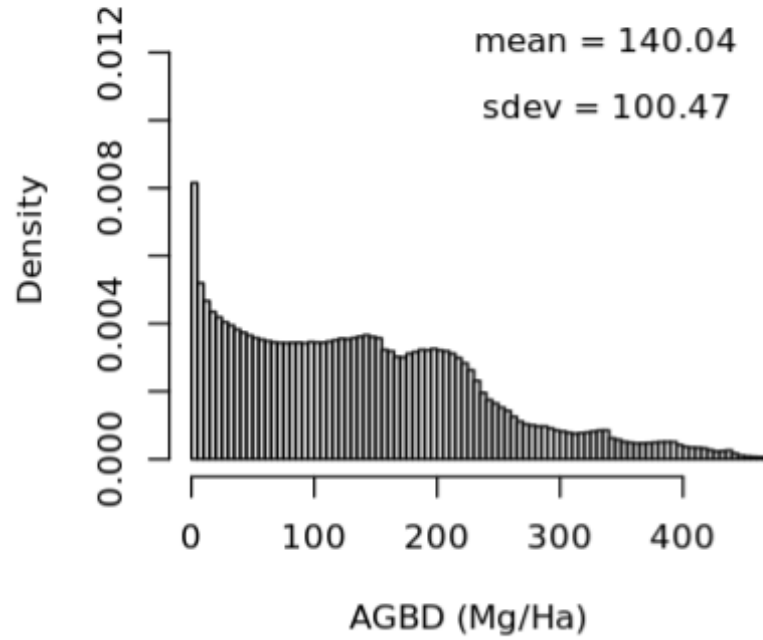


JPL and CCI match closely,
GEDI lower in low biomass,
higher in highest biomass

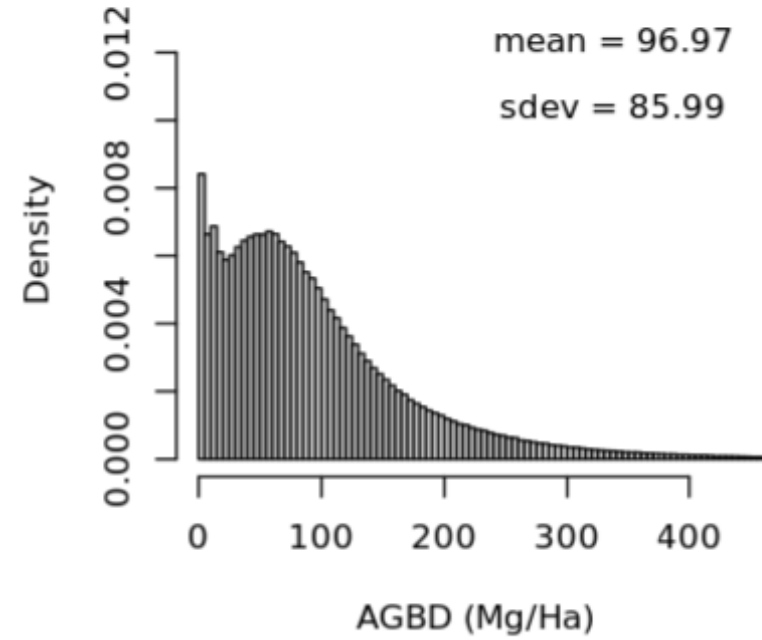


Temperate Conifer Forests North America

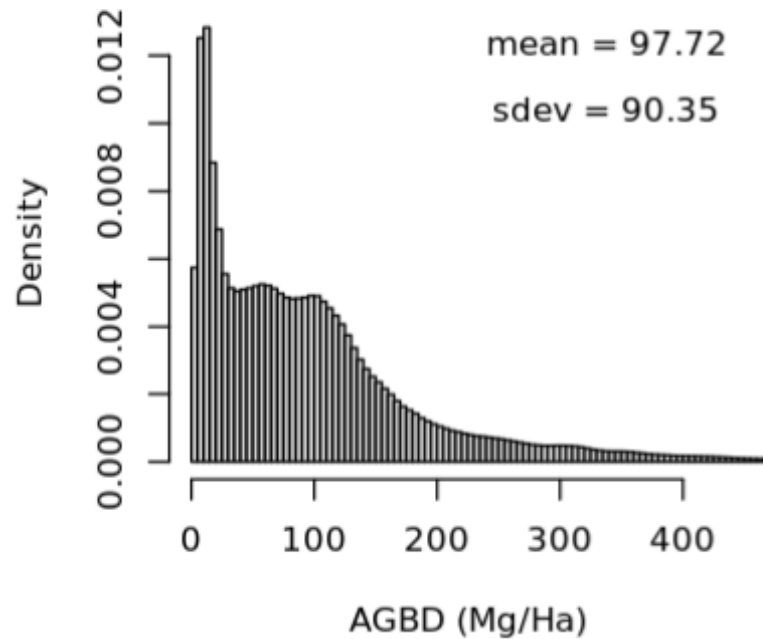
CCI AGBD 2020



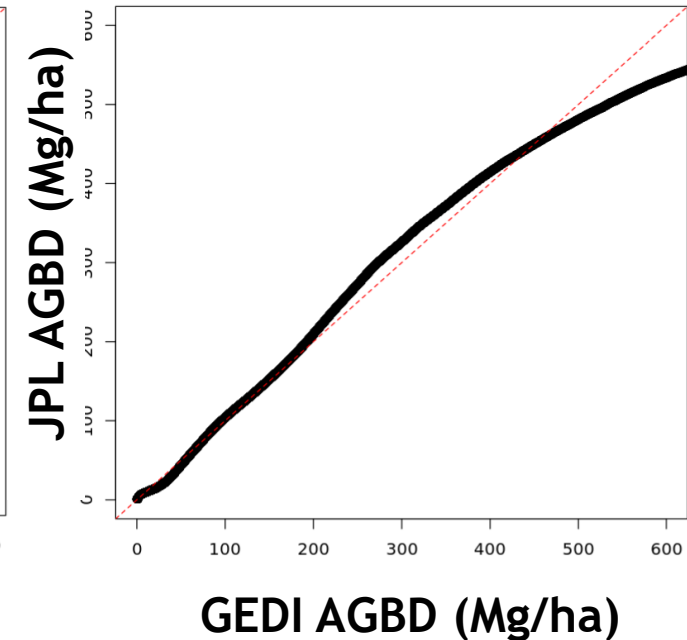
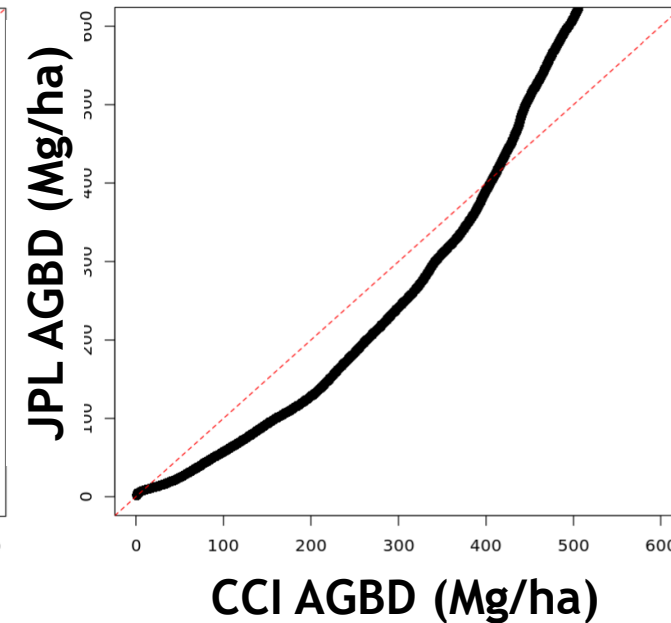
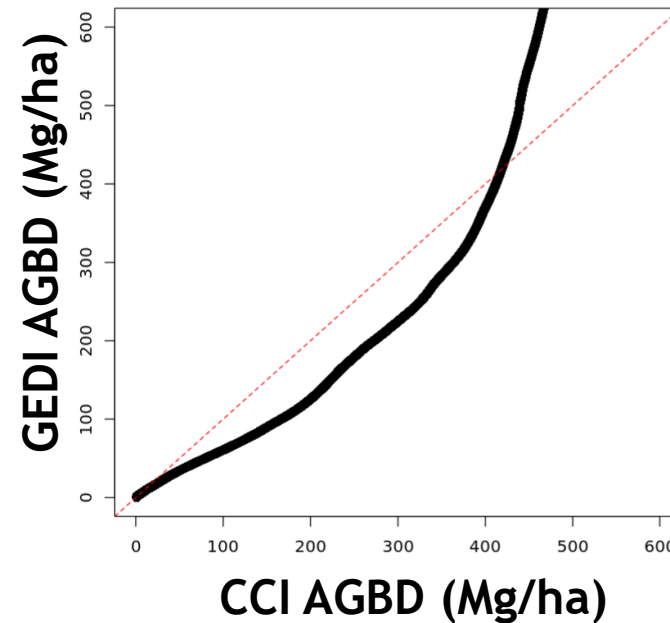
GEDI AGBD 2020



JPL AGBD 2020



JPL and GEDI match closely,
CCI higher in low biomass,
GEDI higher in highest
biomass



Validation with plot network data (eg NFI) with ESA's PlotToMap

3.4_dps.ipynb

Remote Sensing of Environment 272 (2022) 112917

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journal homepage: www.elsevier.com/locate/rse

A comprehensive framework for assessing the accuracy and uncertainty of global above-ground biomass maps

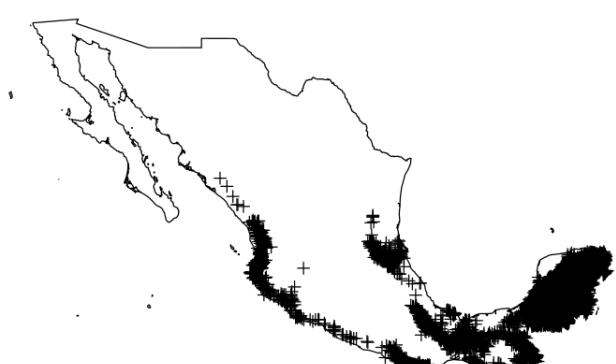
Arnan Araza^{a,b,*}, Sytze de Bruin^a, Martin Herold^{a,c}, Shaun Quegan^d, Nicolas Labriere^{e,f}, Pedro Rodriguez-Veiga^{g,h}, Valerio Avitabileⁱ, Maurizio Santoro^j, Edward T.A. Mitchard^k, Casey M. Ryan^k, Oliver L. Phillips^l, Simon Willcock^{m,n}, Hans Verbeeck^o, Joao Carreiras^d, Lars Hein^b, Mart-Jan Schelhaas^p, Ana Maria Pacheco-Pascagaza^{g,q}, Polyanna da Conceição Bispo^q, Gaia Vaglio Laurin^r, Ghislain Vieilledent^s, Ferry Slik^t, Arief Wijaya^u, Simon L. Lewis^{v,w}, Alexandra Morel^x, Jingjing Liang^y, Hansrajie Sukhdeo^z, Dmitry Schepaschenko^{aa,ab,ac}, Jura Cavlovic^{ad}, Hammad Gilani^{ae}, Richard Lucas^{af}

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^{af} Department of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, Ceredigion SY23 3DB, UK

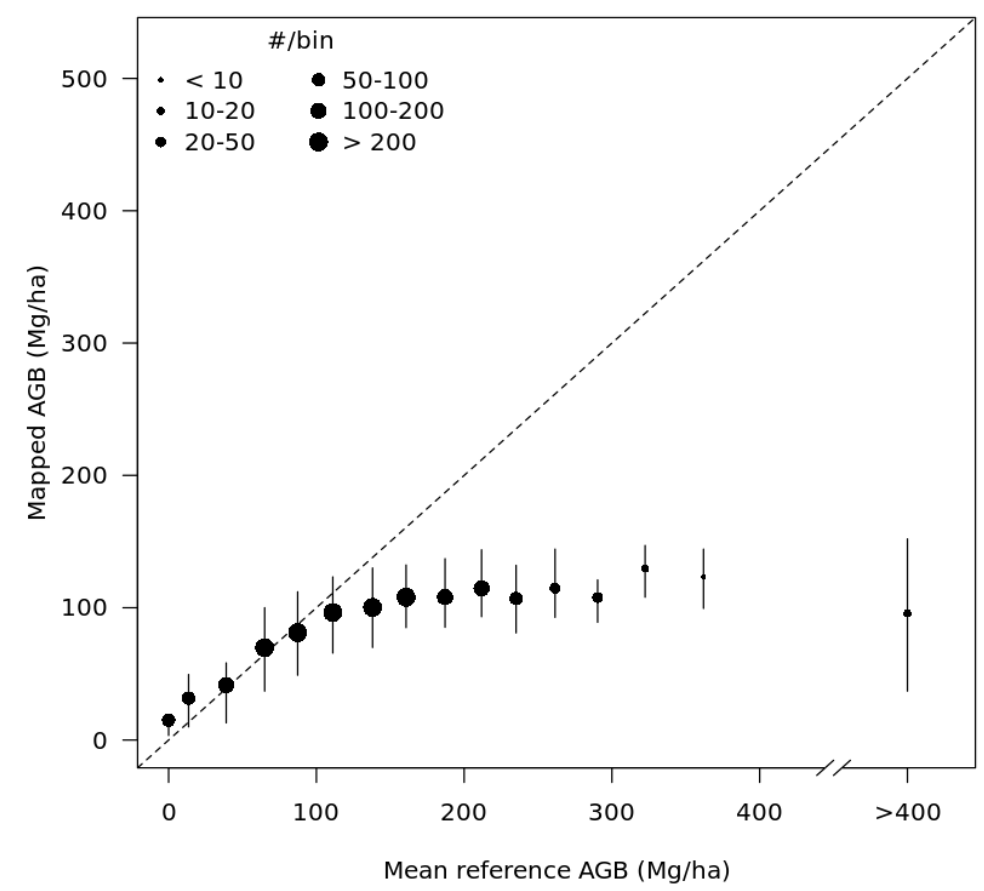
ARTICLE INFO ABSTRACT

Editor: Marie Weiss

Over the past decade, several global maps of above-ground biomass (AGB) have been produced, but they exhibit significant differences that reduce their value for climate and carbon cycle modelling, and also for national



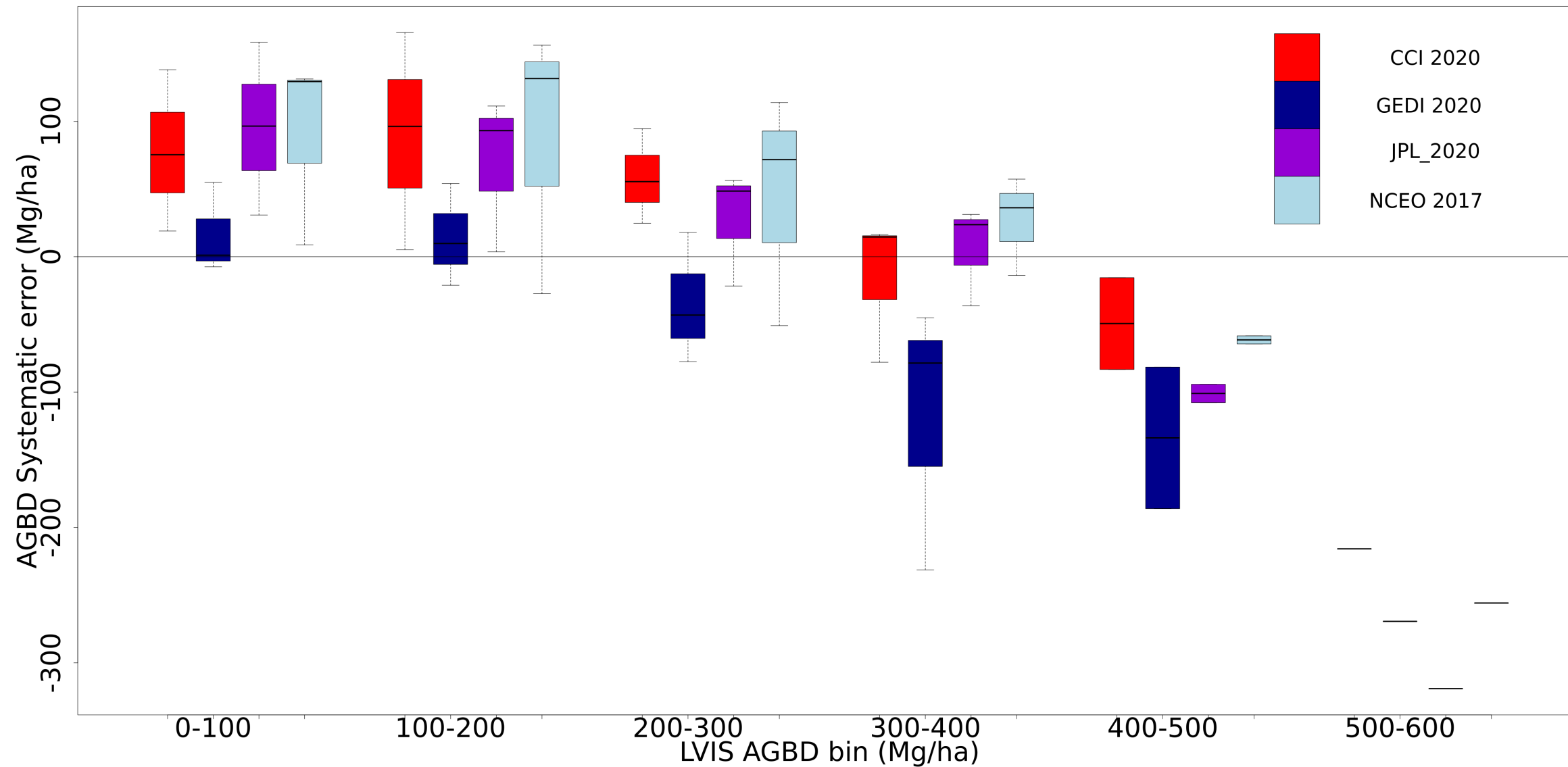
MEX plot2map



Arnan Araza et al., RSE, 2022

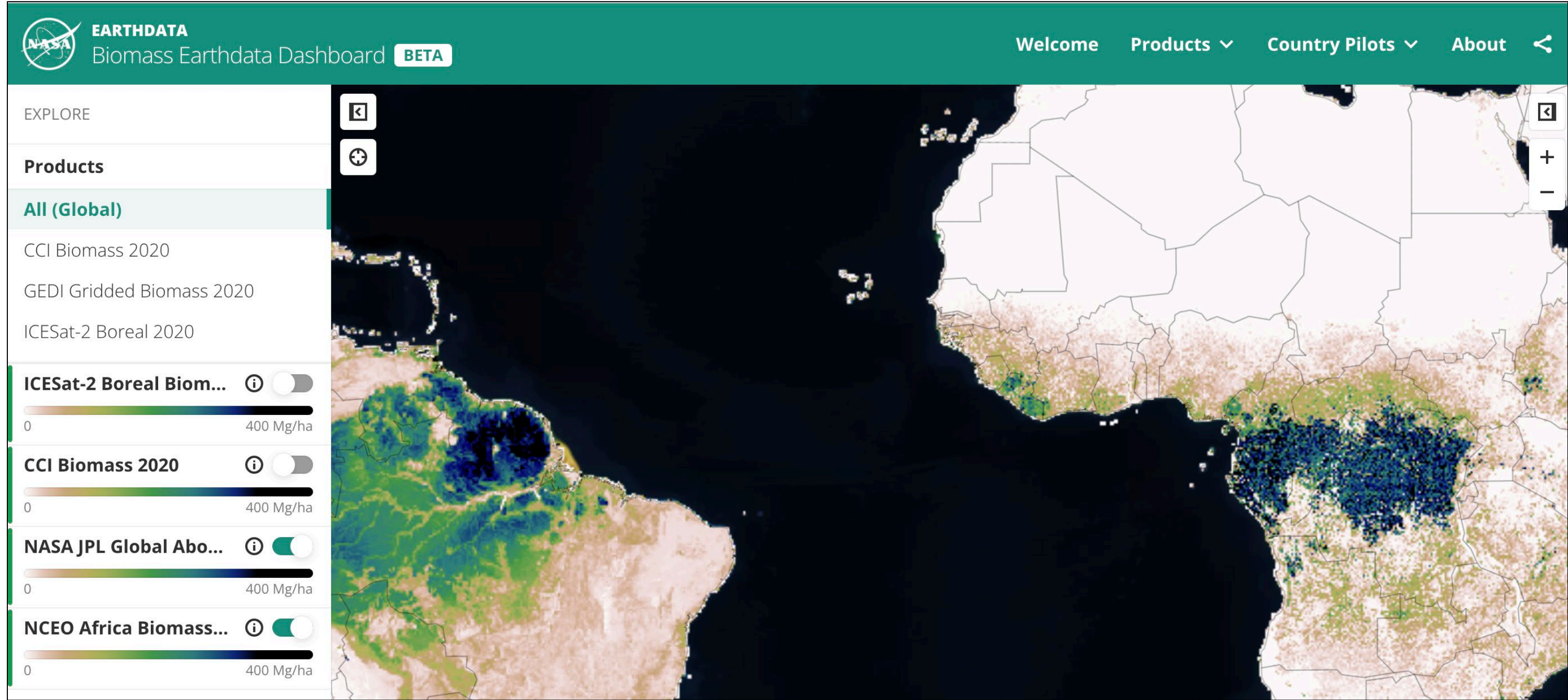
Bias is revealed i.e. map underestimation > 120 Mg/ha

Validation with Airborne Lidar Biomass Maps in Gabon

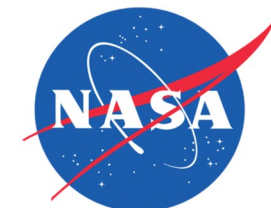


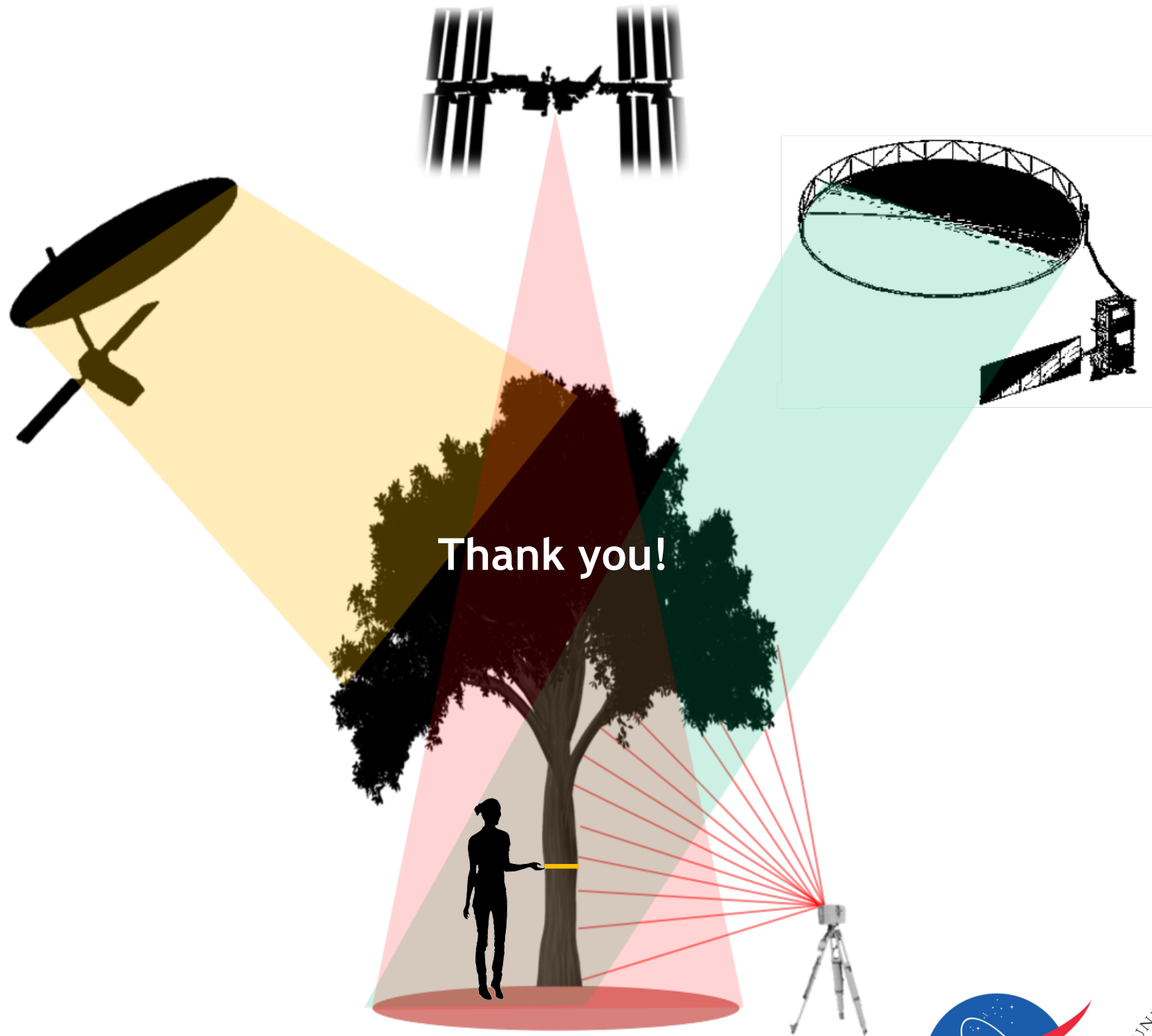
Approach follows CEOS biomass protocol recommendations

Products will be updated on the platform as we learn



<https://earthdata.nasa.gov/maap-biomass>





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