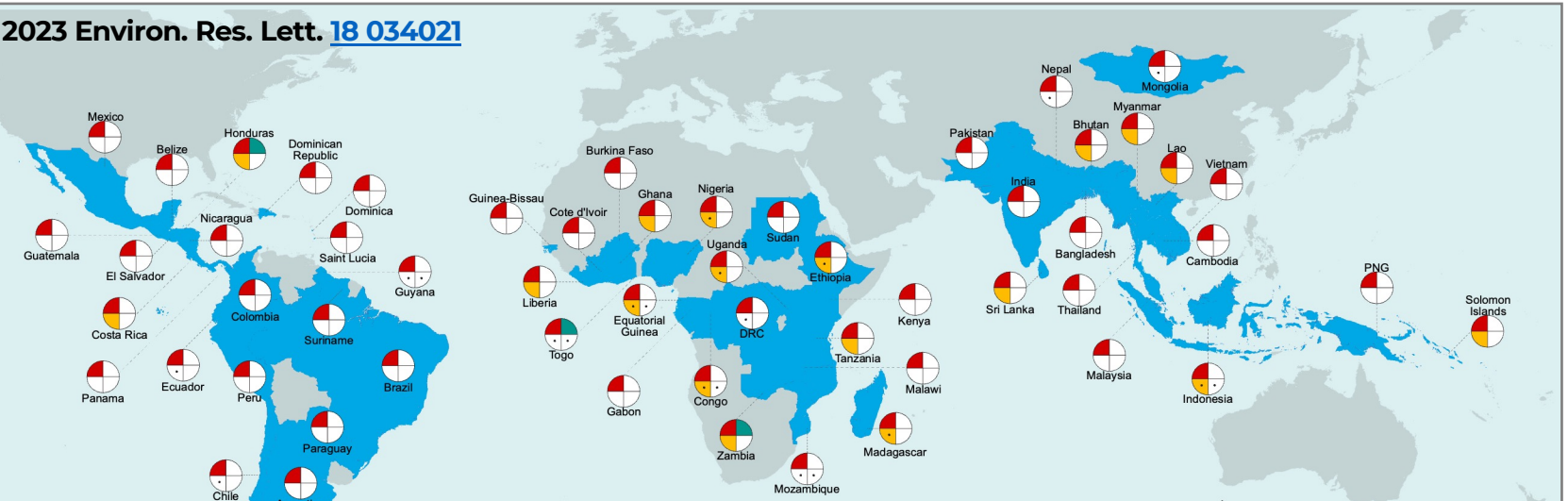
Biomass Harmonization

(GEDI estimates of IPCC Tier 1 aboveground biomass)

Neha Hunka, University of Maryland

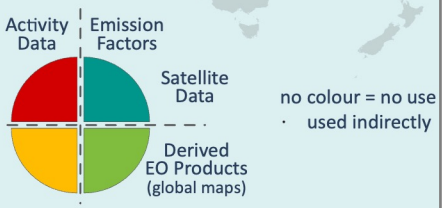
Carbon estimation from space: Do we need to 'Biomass Harmonize'?

Melo et al 2023 Environ. Res. Lett. 18 034021



Use of satellite-based global maps?

Global product	AD	EF	Indirectly
Global forest change (GFC)	16	-	14
MODIS Fire (BA, AF)	2	-	1
Saatchi et al (2011)	-	-	3
Baccini et al (2012)	-	-	2



no colour = no use
· used indirectly

Satellite-based global maps are rarely used in forest reference levels submitted to the UNFCCC

Joana Melo[4,1], Timothy Baker[1], Dirk Nemitz[2], Shaun Quegan[3] and Guy Ziv[1]

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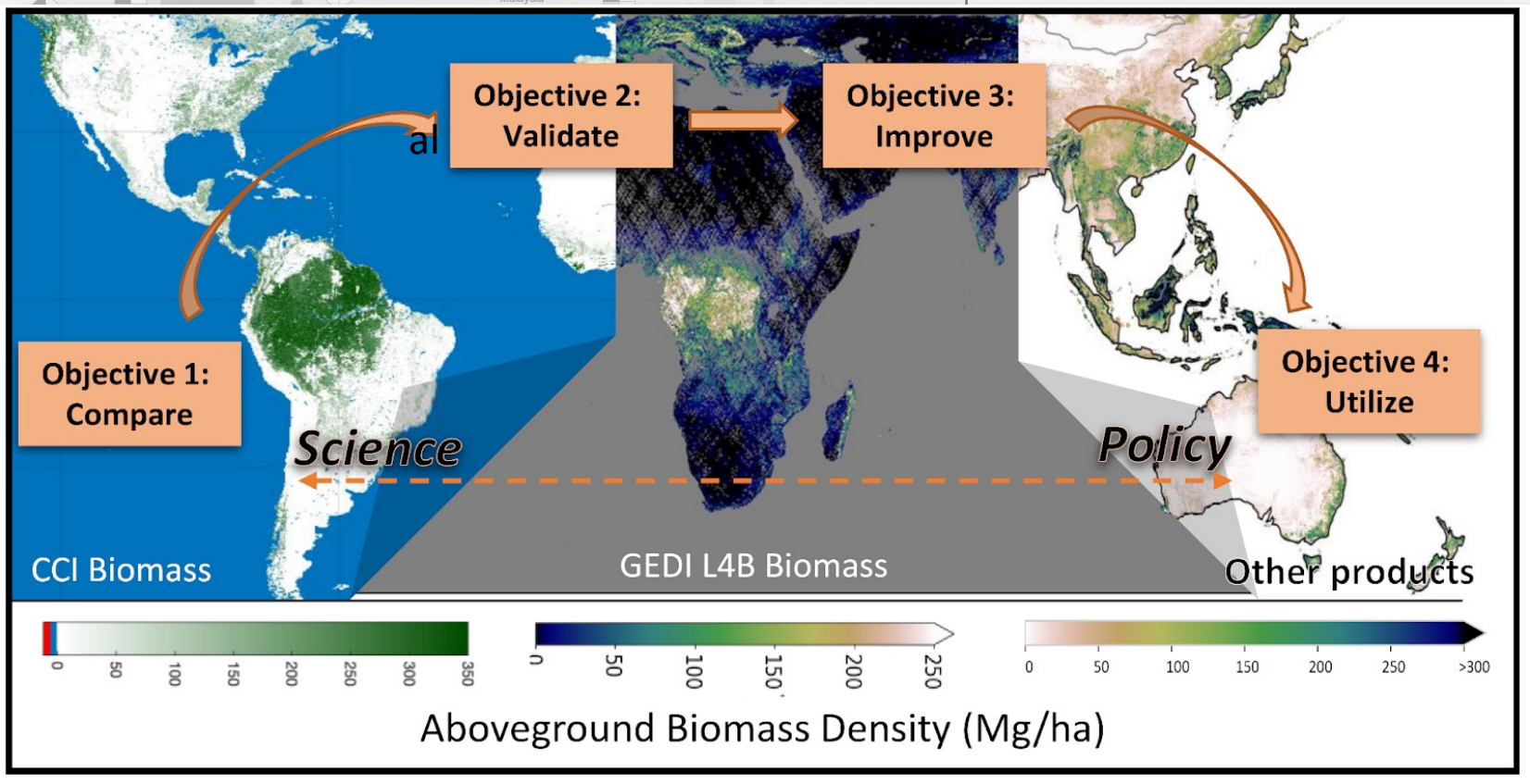
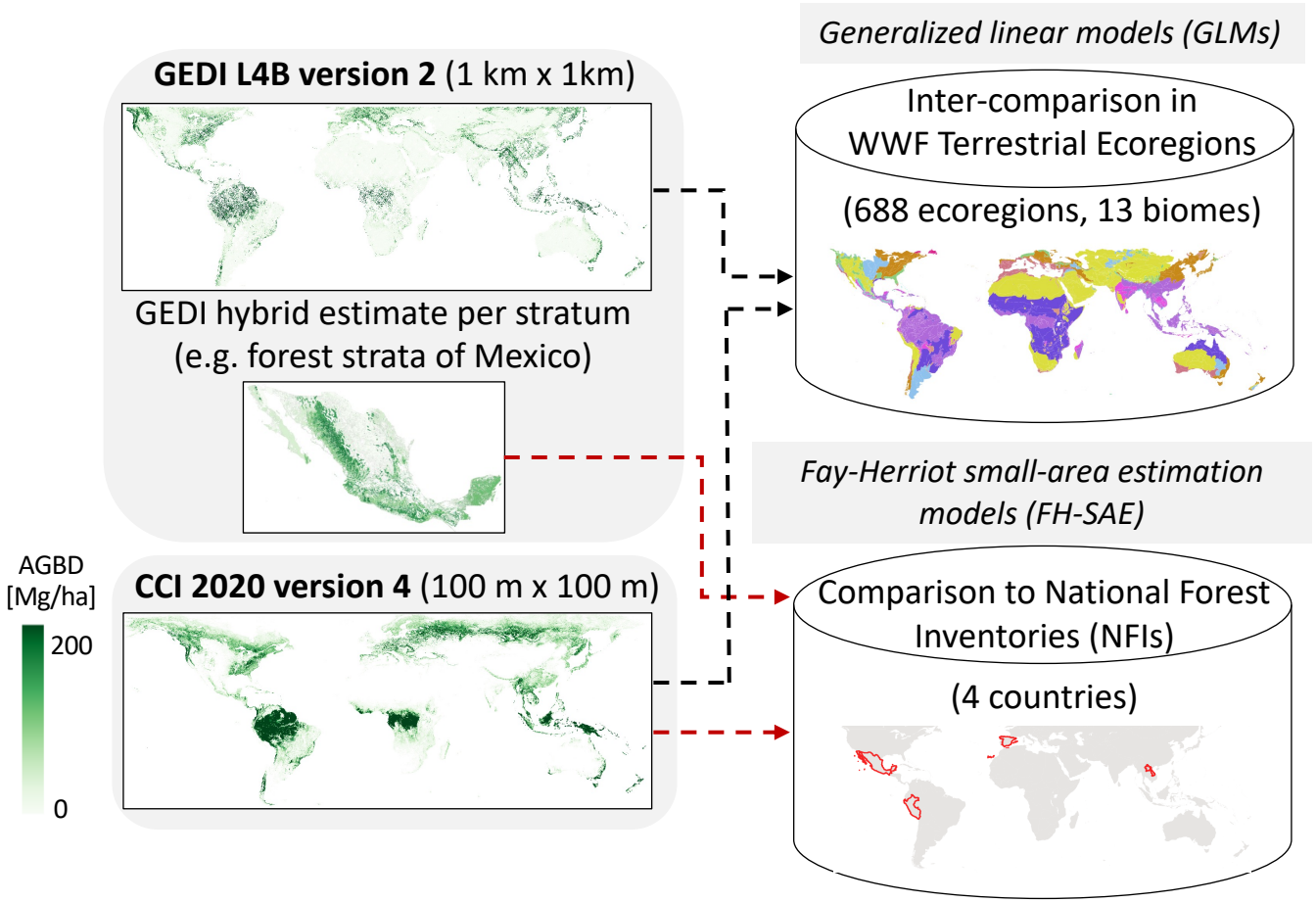
Harmonizing Biomass Maps With Policy Needs:

Development of National Prototypes for the Global Stocktake



Intercomparing EO-derived AGB map products

Approach



Hunka et al., (in review)

Intercomparing EO-derived AGB map products

Product inter-comparison

Approach

GEDI L4B version 2 (1 km x 1km)

GEDI hybrid estimate per stratum
(e.g. forest strata of Mexico)

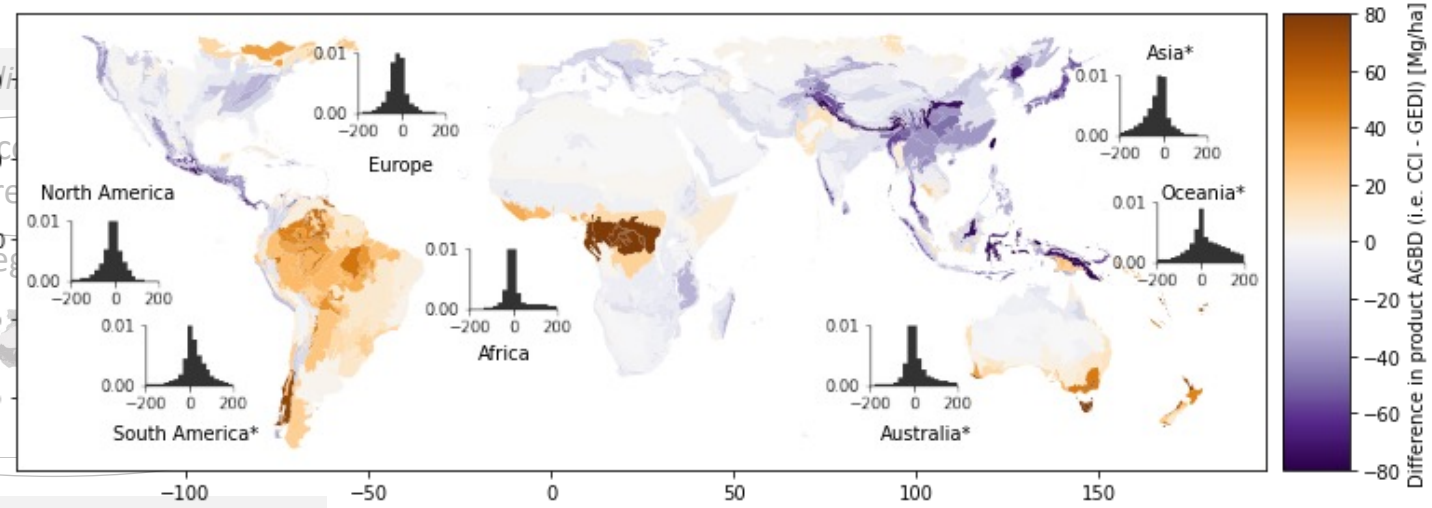
AGBD [Mg/ha]

200

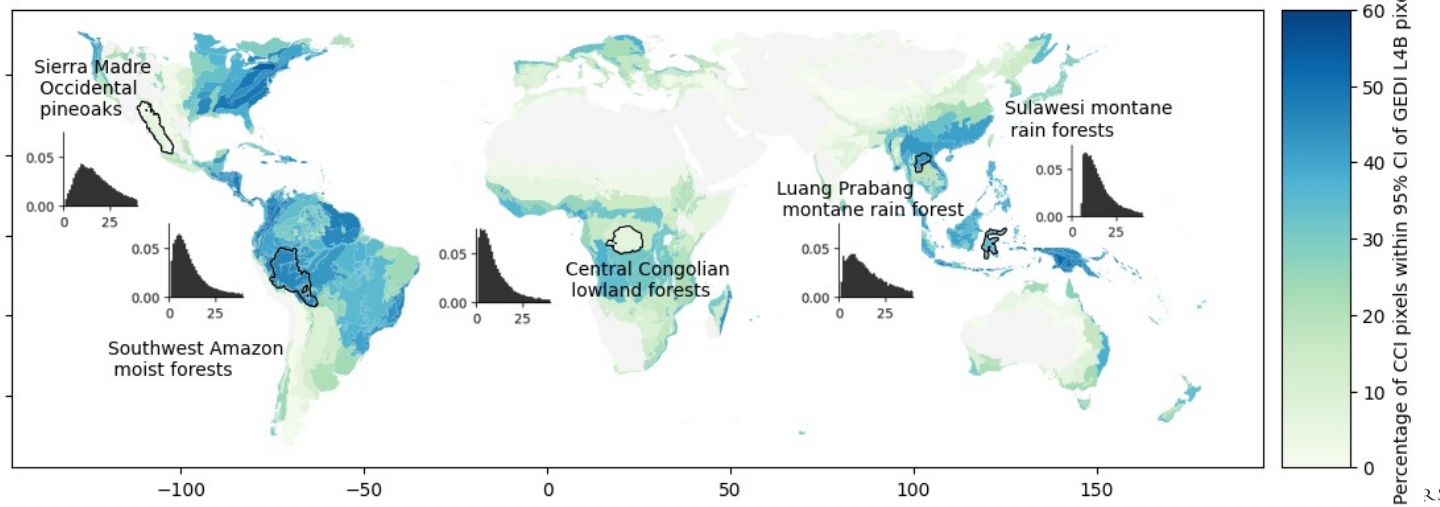
0

CCI 2020 version 4 (100 m x 100 m)

CCI 2020 v4 – GEDI AGBD v2



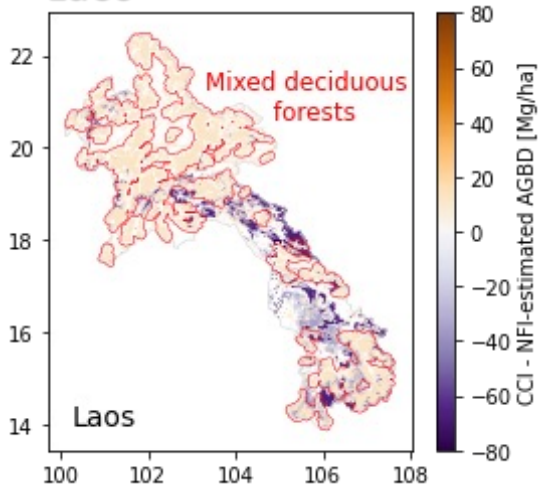
Extent of 95% CI overlap

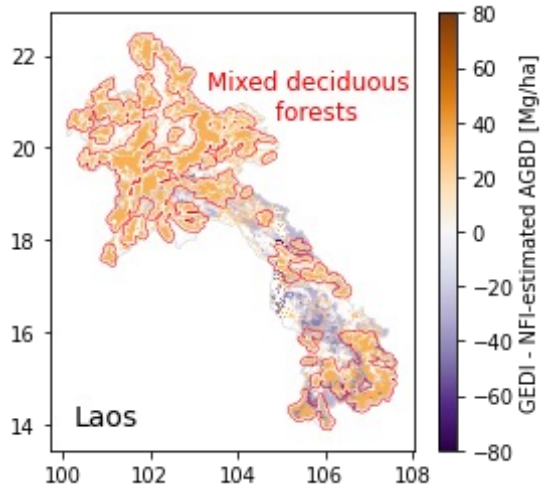


Hunka et al., (in review)

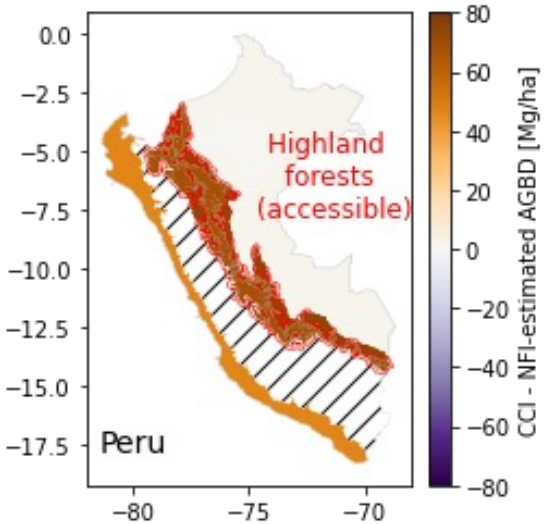
Comparing EO-derived AGB map products to National Forest Inventory estimates

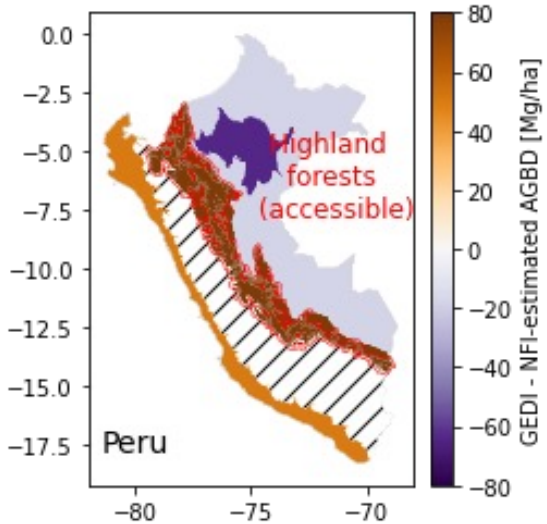
Laos





Peru





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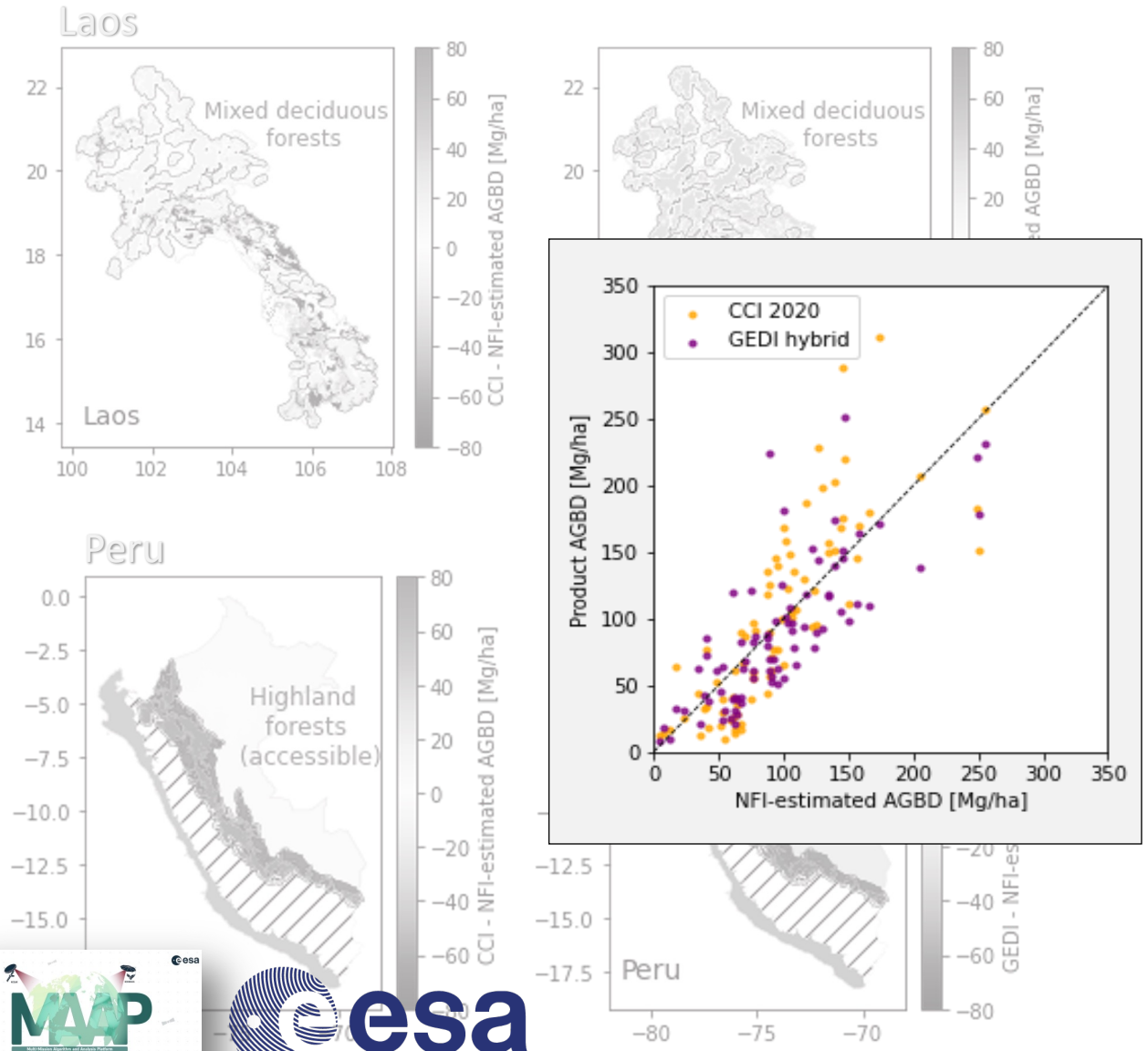

The optimistic outlook

- Large differences in AGB between the two products are restricted to a few regions of the globe.
- Systematic error, compared to NFI data, in the four countries examined is non-existent.
- Few weaknesses are being worked on and provide realistic opportunities for improvements in AGB estimates in future iterations.

Hunka et al., (in review)

Aligning for uptake in the UNFCCC Global Stocktake

The "we're working on it" outlook

- **Align uncertainty assessment frameworks**: Consistent and common analytical approach to defining and reporting information on the precision of AGBD estimates.

- **Provide source-code for large area assessments**: Transparent, well-documented and open-source code to estimate mean and total biomass stocks with associated uncertainties.

- **Provide guidance on enhancing NFIs with AGB maps**: Guidance on methods and open-source codes to enhance national-level biomass stock estimates.

- **Make documentation and usability practical for non-experts**:

- Can map-based AGBD estimates be used in the equations recommended in IPCC Generic Methodologies to estimate carbon stock changes (Chapter 2 in IPCC 2019 Refinement Guidelines)

- How the map-product estimates compare to the IPCC default tables for Tier 1 estimates (i.e. Tables 4.7 to 4.10 in Chapter 4, IPCC 2019 Refinement Guidelines)

Hunka et al., (in review)

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Hunka et al., (in review)

GEDI estimates of IPCC Tier 1 aboveground biomass

2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Chapter 4: Table 4.7

(https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch04_Forest%20Land.pdf)

TABLE 4.7 (UPDATED)
ABOVE-GROUND BIOMASS IN NATURAL FORESTS (TONNES D.M. HA^{-1})

Domain	Ecological zone [1]	Continent	Status/condition[2]	Above-ground biomass [tonnes d.m. ha^{-1}]	Uncertainty	Uncertainty type	References
Tropical	Tropical rainforest	Africa	Primary	404.2	120.4	SD	1-12
			Secondary >20 years	212.9	143.1	SD	5-7, 11, 13-16
			Secondary ≤20 years	52.8	35.6	SD	9-11, 14, 15, 17
		North and South America	Primary	307.1	104.9	SD	3, 4, 9, 10, 18-21
			Secondary >20 years	206.4	80.4	SD	9, 10, 22-28
			Secondary ≤20 years	75.7	34.5	SD	9, 10, 14, 22, 23, 28-32
		Asia	Primary	413.1	128.5	SD	3, 4, 9, 10, 33-35
			Secondary >20 years	131.6	20.7	SD	9, 10, 36, 37
			Secondary ≤20 years	45.6	20.6	SD	9, 10, 37-39
	Tropical moist deciduous forest	Africa	Primary	236.6	104.7	SD	1, 2, 16
			Secondary >20 years	72.8	36.4	SD	9, 10, 16, 40-47
			Secondary ≤20 years				
		North and South America	Primary	187.3	94.0	SD	3, 4, 9, 10, 18-21
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		Asia	Primary	67.7	93.4	SD	9, 10, 35, 48-50
			Secondary >20 years				
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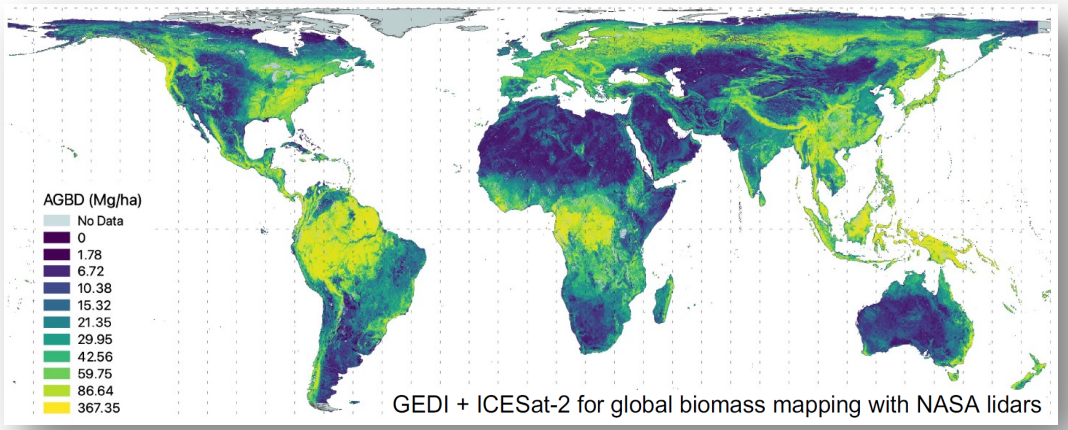
- Countries with no other forest data use IPCC Tier 1 defaults in national/sub-national reports
- Some combinations of climate domain, ecological zones, continents, forest types, age classes etc. lack credible numbers (e.g. handful of references, default values for all forest ages)
- Can we aid UNFCCC processes by providing a 'replica' of IPCC Tier 1 with GEDI (& ICESat-2 + Sentinel2 for boreal) estimates?



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[2] Some categories include sub-strata for primary forests, which are defined as old-growth forests that are intact or with no active human intervention, and secondary forests which include all other forests. The table considers a forest definition of at least 10% tree canopy cover (74).

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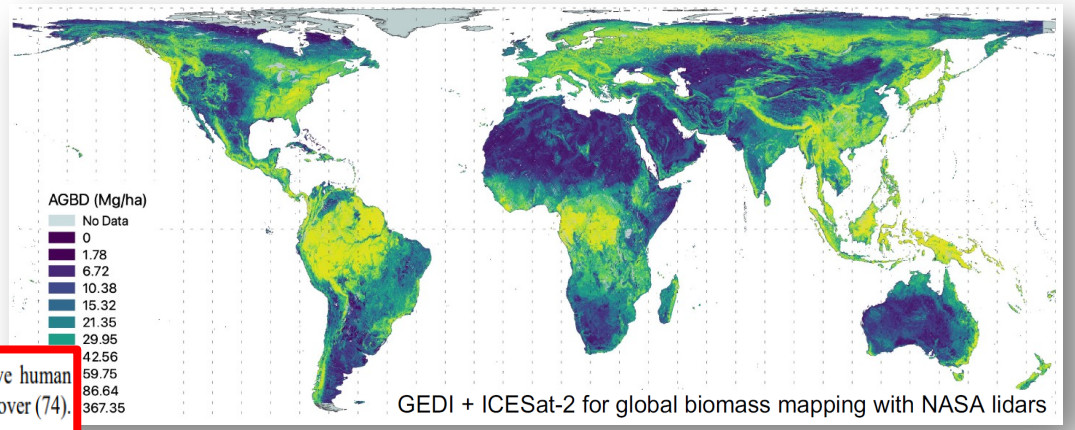

GEDI + ICESat-2 for global biomass mapping with NASA lidars

GEDI estimates of IPCC Tier 1 aboveground biomass

CONTINENT + ECOZONE + FOREST AGE

- Global Ecological Zones (GEZ) layer (FAO map catalogue)
- Global continents layer
- Forest heights 2000
- Forest heights 2020
- Forest gain
- Forest loss

Global Land Analysis & Discovery

Forest Height 2019 Dataset Reference
P. Potapov et al. (2020) Mapping and monitoring global forest canopy height through integration of GEDI and Landsat data. Remote Sensing of Environment, 112165. https://doi.org/10.1016/j.rse.2020.112165

- Forest Cover 2000/2020
- Forest loss year (2000-2020)

Hansen, M. C et al. (2013) High-Resolution Global Maps of 21st-Century Forest Cover Change. Science 342 (15 November): 850-53. Data available on-line from: https://glad.earthengine.app/view/global-forest-change.

- Plantations

WORLD RESOURCES INSTITUTE **Spatial Database of Planted Trees (SDPT Version 1.0)**

- ABoVE Boreal stand age

Feng, M et al. (2022) ABoVE: Tree Canopy Cover and Stand Age from Landsat, Boreal Forest Biome, 1984-2020. ORNL DAAC, USA.

- Intact forest landscapes

Intact Forest Landscapes

Potapov, P. et al.(2017) The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013. Science Advances, 2017; 3:e1600821

- Primary forests Asia
- Primary forests S America
- Primary forests Africa
- **…and more!**

Primary Humid Tropical Forests Reference
Turubanova S., Potapov P., Tyukavina, A., and Hansen M. (2018) Ongoing primary forest loss in Brazil, Democratic Republic of the Congo, and Indonesia. Environmental Research Letters https://doi.org/10.1088/1748-9326/aacd1c

Global Land Analysis & Discovery

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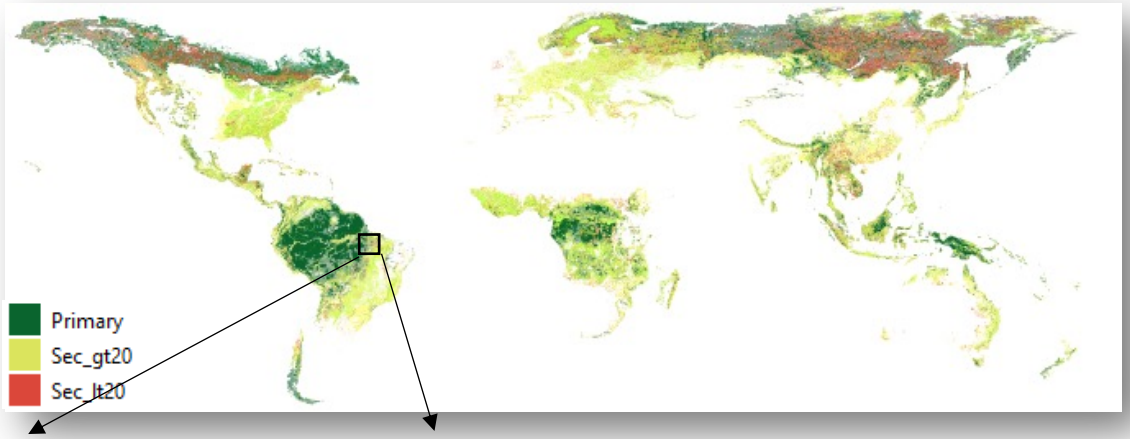

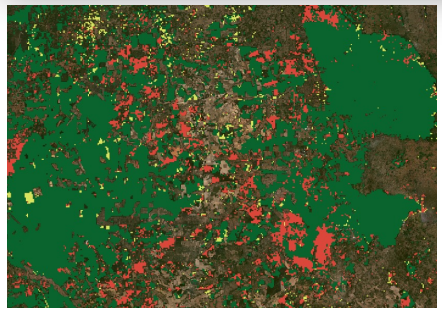

South America + Tropical Rainforest + Primary, Old and Young Secondary

Thoughts, suggestions, tips on how to validate this map?

CEOS

Thanks!

esa JAXA

NASA

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