An exploratory assessment of the past-decade changes in above-ground biomass (ΔAGB) from four multi-temporal global products

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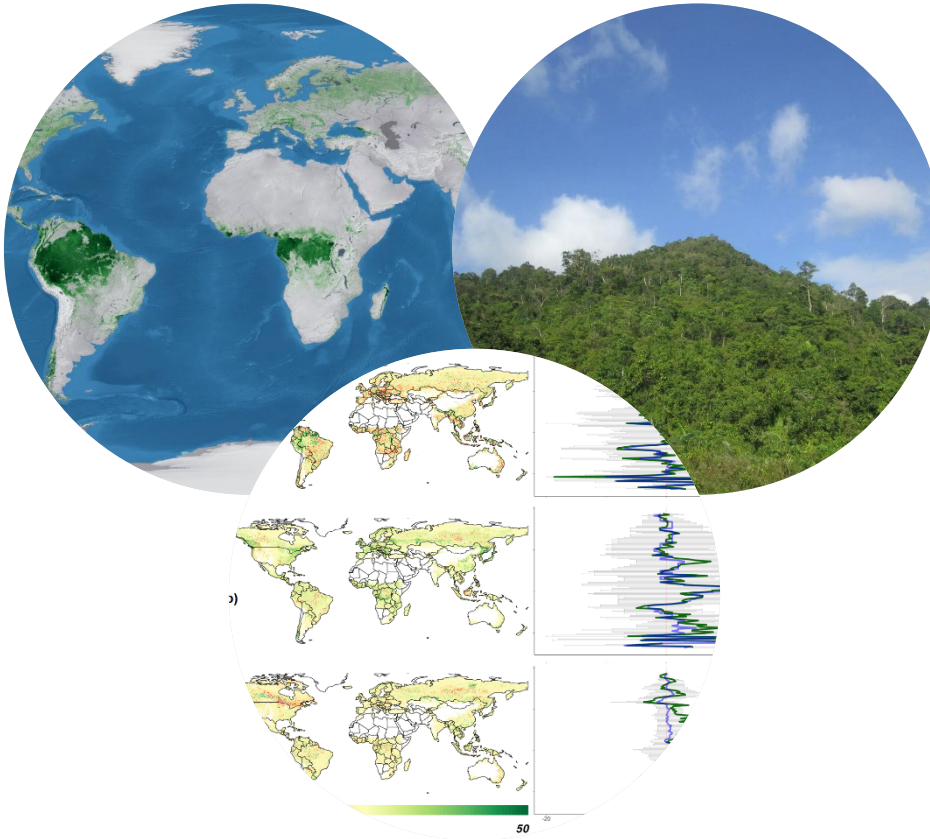

May 26, 2022

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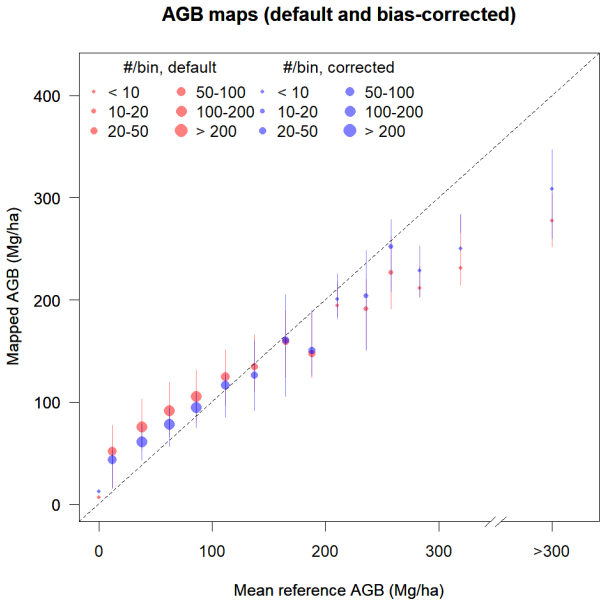
Progress on AGB map accuracy analysis

- Map accuracy assessments using independent reference data are necessary (CEOS, users)
- Model-based uncertainty framework for single map epochs have been developed
    - *Plot2Map* tool in R / CEOS MAAP platform https://github.com/arnanaraza/PlotToMap
- Options for the reduction of map systematic differences (bias) in high biomass regions (tropics)



Araza, A., de Bruin, S., Herold, M., Quegan, S., Labriere, N., Rodriguez-Veiga, P., ... & Lucas, R. (2022). A comprehensive framework for assessing the accuracy and uncertainty of global above-ground biomass maps. *Remote Sensing of Environment*, *272*, 112917.

Current multidate / change global AGB maps

Different approaches are being used:

- Multi-date, annual AGB (e.g., 2010, 2018) = ALOS PALSAR-based (100 m)
- Annual time series AGB = MODIS / L-VOD (10-25 km)
- AGB/carbon fluxes = Baseline AGB & loss-gain data

Table 1: List of large scale map products of ΔAGB and their key details.

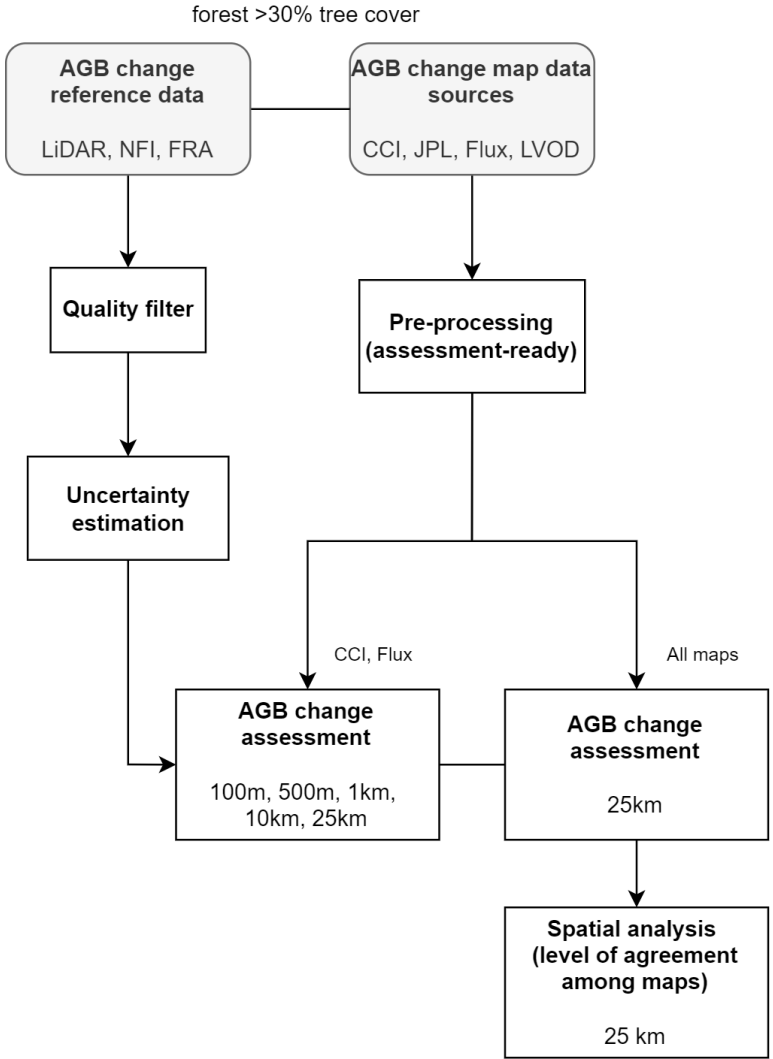
Maps	Spatial scale	Forest mask data	Pixel size	Temporal resolution	RS and in situ data	Open access (OA)	Open Uncertainty layer	Reference	Access
CCI Biomass	global	-	100 m	2010,2017,2018, 2020	ALOS2-PALSAR2, Sentinel 1	Yes	Yes	Santoro and Cartus (2019)	https://catalogue.ceda.a
WRI Flux model	global	>30% tree cover from Global Forest Change	30 m	2000-2020	Baccini 30-m AGB, GFC data and IPCC activity data	Yes	No	Harris et al. (2021)	https://data.globalfores
Saatchi TS	global	>30% tree cover from Global Forest Change	10 km	2010-2019	MODIS, ICESat, ALOS-PALSAR	Yes	No	Xu et al. (2021)	https://zenodo.org/reco
VOD TS	global	-	25 km	1988-2008	VOD	No	Yes	Liu et al. (2012)	-
Baccini TS	pantropical	woody live vegetation	250 m	2003-2014	MODIS, ICESat	No	No	Baccini et al. (2017)	-
L-VOD SMOS	global	-	25 km	2010-2019	L-band VOD from SMOS, GlobBiomass 2010	No	No	?	kayrros.com

Objectives

(1) Compile several ΔAGB reference data sources and assess their suitability in assessing the map products;

(2) Investigate the effect of spatial aggregation to the map assessments; and

(3) Spatially assess whether map products agree or disagree on ΔAGB.



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Pre-processing and comparisons of map and ref data

- **CCI-Biomass:** map differencing
- **WRI Flux model**: 2010 variables modified; AGC component only
  https://github.com/arnanaraza/carbon-budget
- **JPL:** average of 2009-2011 and 2018-2020
- **LVOD** already an improvement of previous LVOD; re-projected into WGS 84

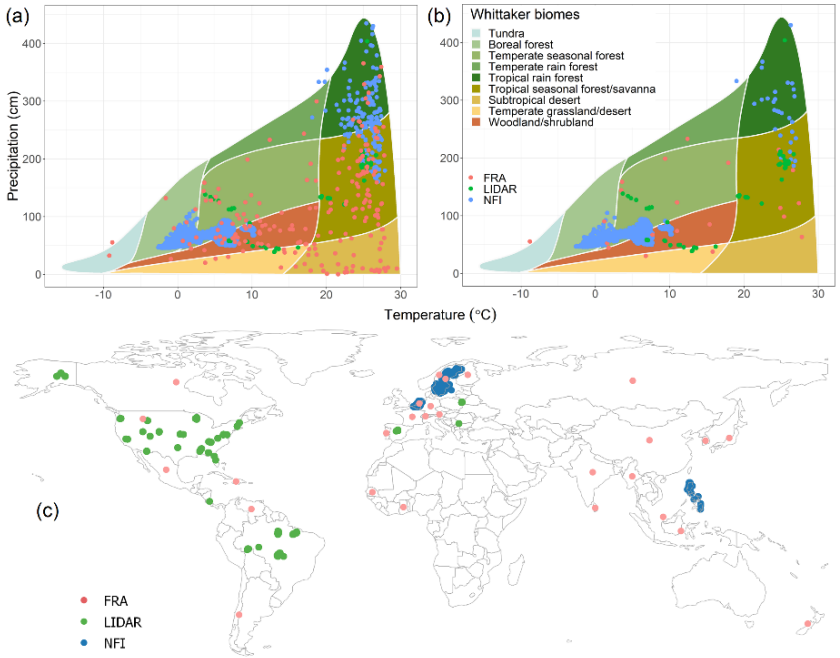
- **Remeasured NFI** plots - removed old plots and those deforested after the 2nd epoch;
- **Multi-date LiDAR** removed missing values epoch and forest edge pixels;
- **FAO FRA country data -** selected countries with repeated NFIs and with very good RS capacity & forest area changes

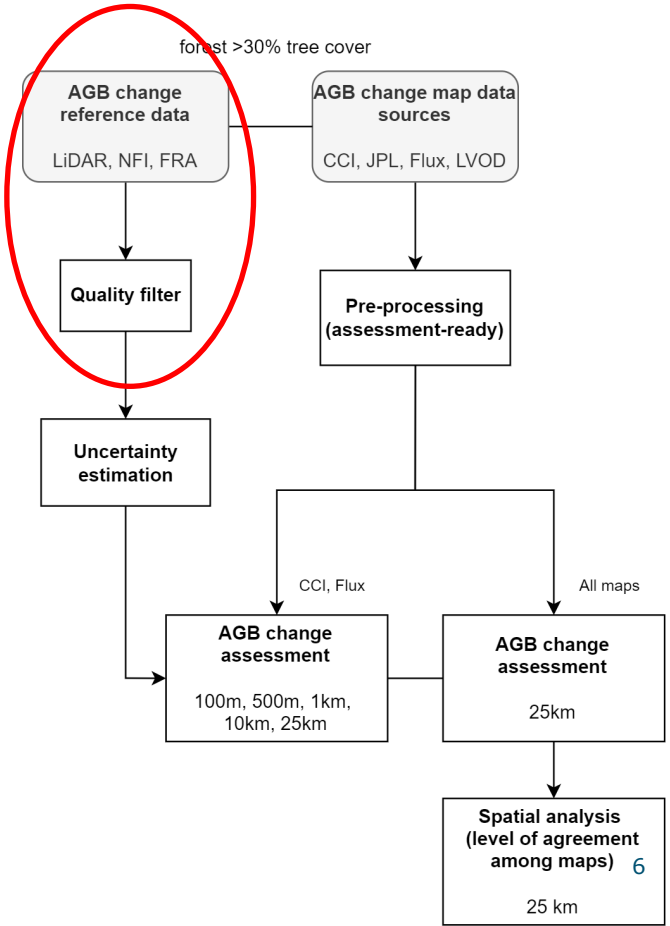
- Aggregation: mean

weighted mean (except FRA)

Availability and characteristics of reference data

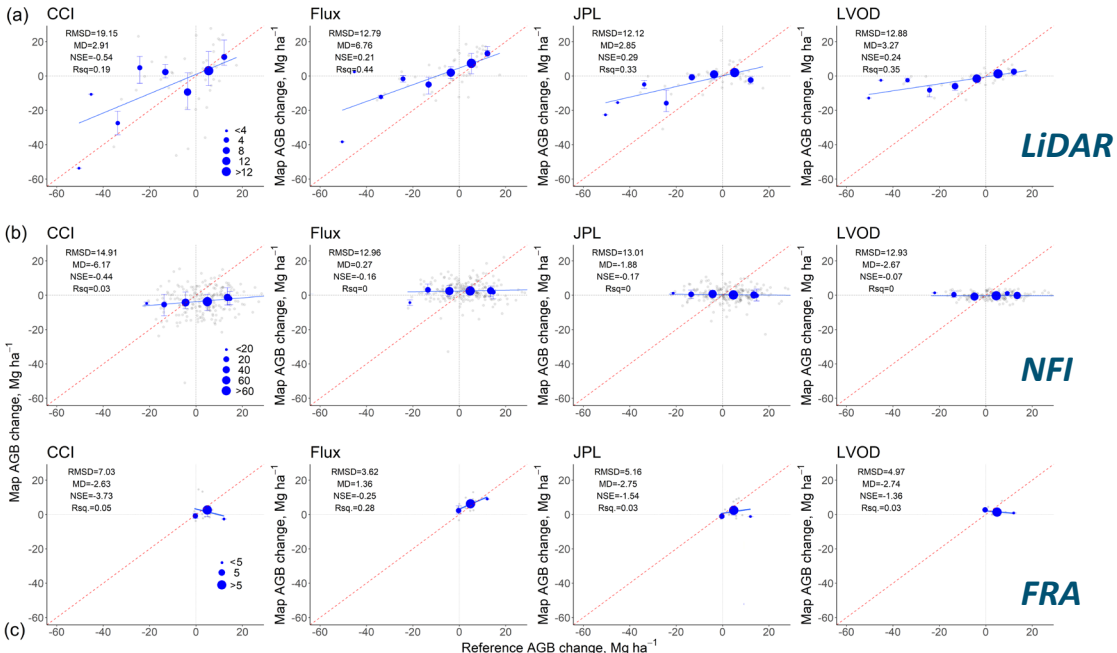
- European and PH NFIs; (2) SLB, NEON, EU LiDAR maps; (3) FRA (high-capacity)
- Spatially clustered sample

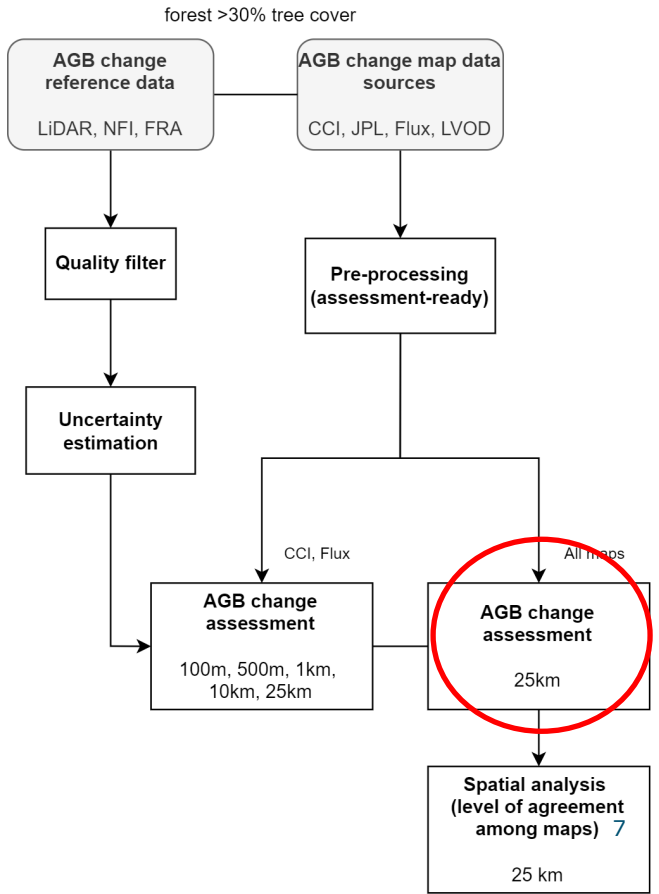




Key results (2019-2010 net ΔAGB)

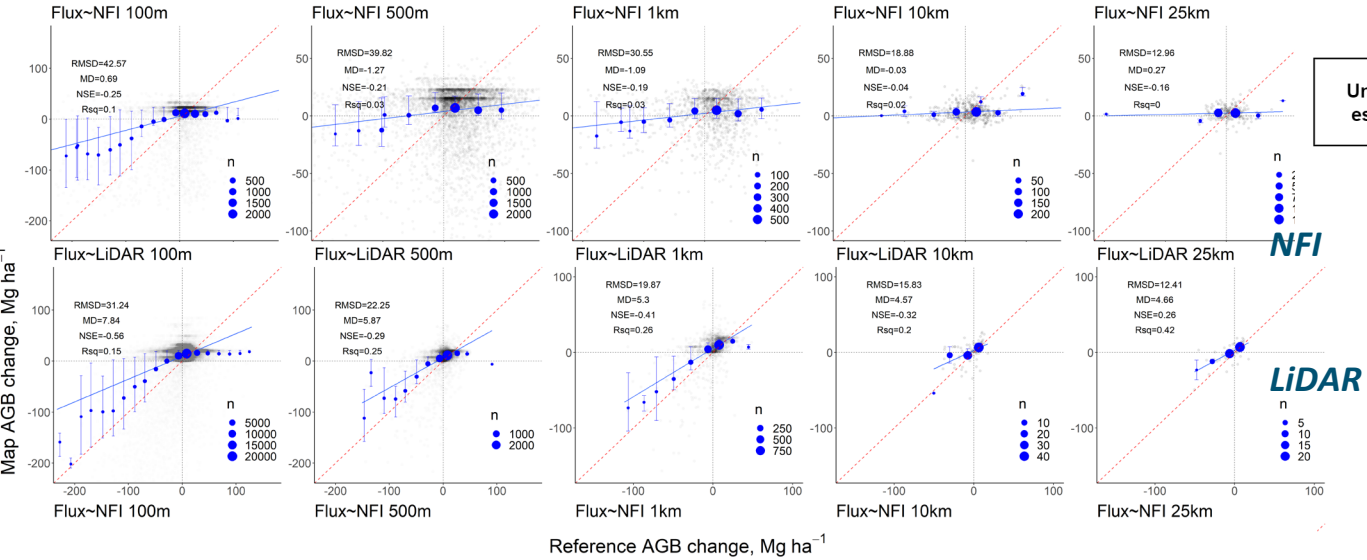
- 25 km comparisons for all maps
- Map agreement with LiDAR being both spatially explicit

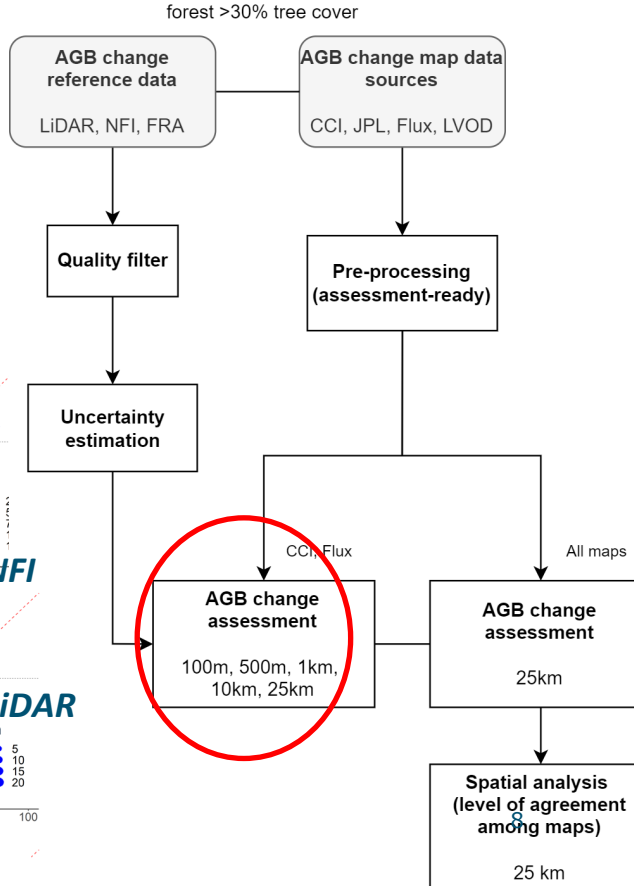




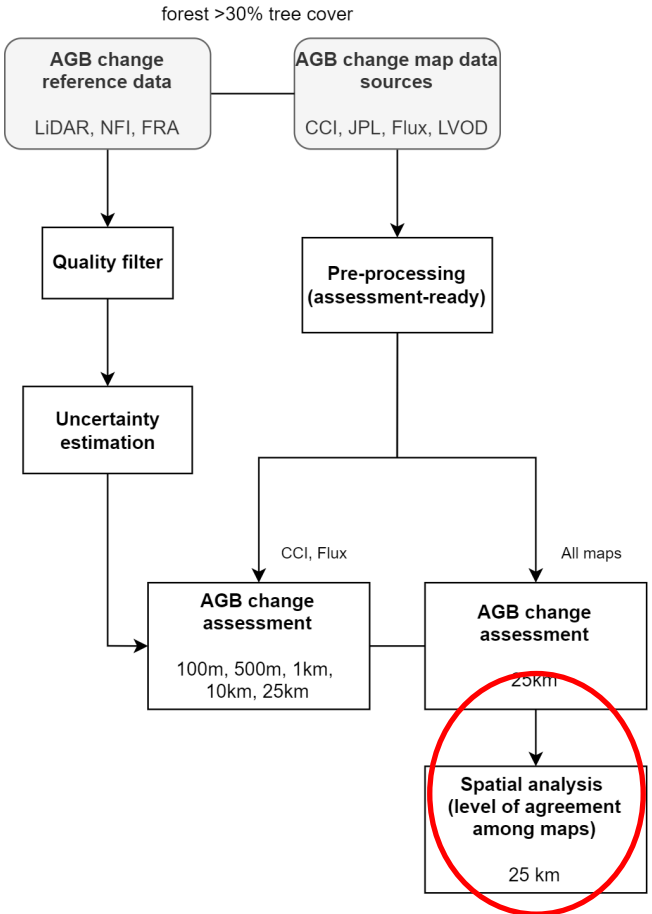
Key results (2019-2010 net ΔAGB)

- 100m, 500m, 1km, 10km, 25km comparisons
- Scatter decrease with aggregation
- Map systematic differences persist





Key results



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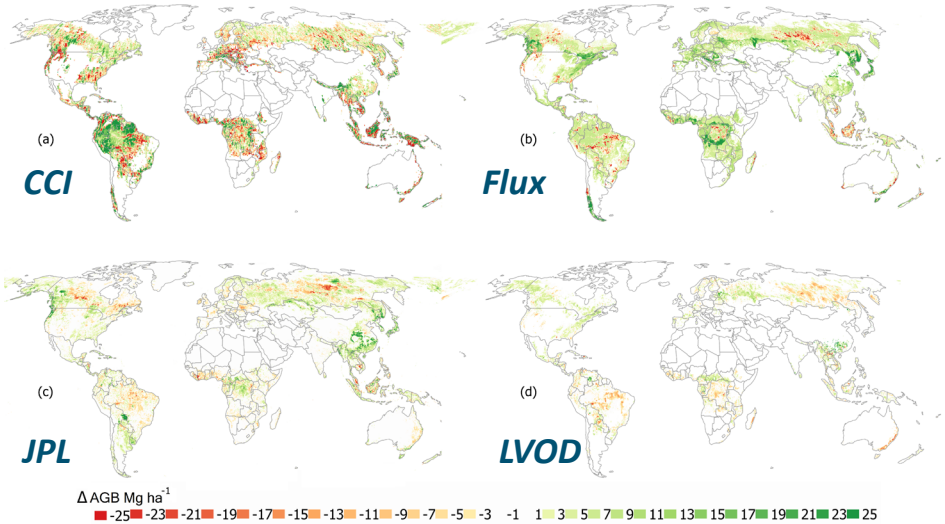
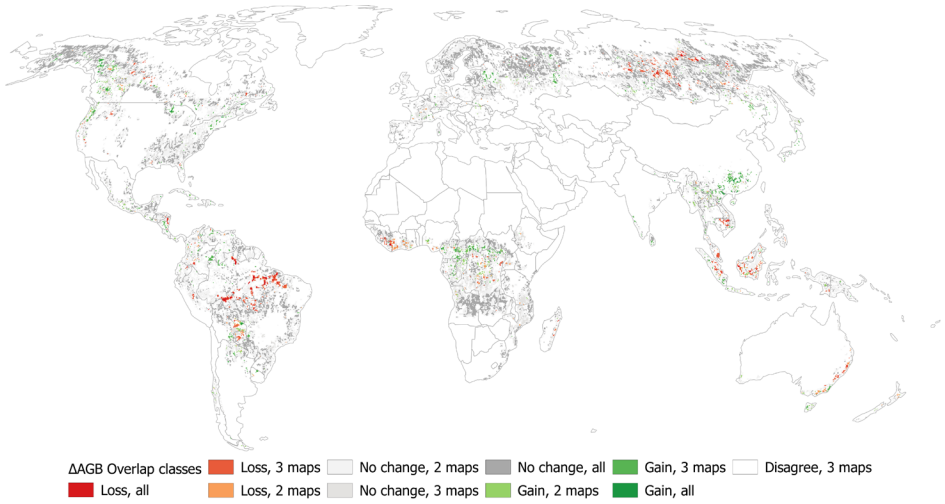




Remarks

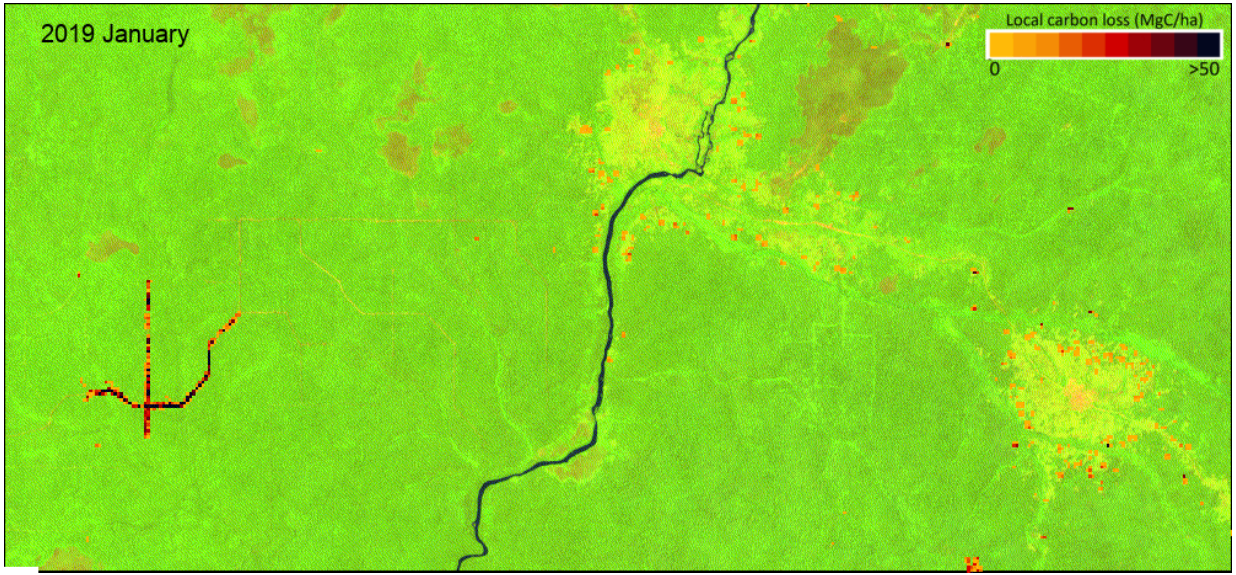
- Progress in assessing global AGB maps using independent reference data
- Exploratory assessment of global ΔAGB using different reference data sources
- Comparisons at 25 km resolution: map-LiDAR agreement
- Aggregation effect: scatter decrease, inc. large changes, bias persist
- ΔAGB maps show some similar AGB loss/gain hotspots

Moving forward / Outlook

- Increasing ΔAGB maps ~ Increasing ΔAGB reference data(?)
- Combining different ΔAGB estimates from maps and reference to improve estimation for certain user needs
- Future options for spatially explicit carbon sources and sink estimation
- Global and national applications

Combining forest disturbance alerts and AGB estimates

- Carbon accounting (UN-SEEA framework)
- Local MRV of carbon



Csillik, O., Reiche, J., De Sy, V., Araza, A., & Herold, M. (2022). Rapid remote monitoring reveals spatial and temporal hotspots of carbon loss in Africa's rainforests. Nature *Communications Earth & Environment*, *3*(1), 1-8.

Thank you for your attention!

Maraming salamat sa pakikinig!

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