Sentinel-1 for Science Amazonas

Estimating AGB, AGB gains/losses and associated uncertainties – some considerations and challenges

Erik Næsset

Norwegian University of Life Sciences

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What guidelines and standards should we follow for national, regional or global estimation of biomass/carbon stocks, gains and losses?

IPCC Good Practice Guidelines (2003, 2006)

What roles can/must earth observation data take in this process?

Critically needed – (1) lack of field surveys, (2) improve precision

How realistic is it to obtain estimates that fullfill the standards and which are sensitive to changes over short time periods (<10 yrs) ?

An example will illustrate (how difficult that is…)

IPCC Good Practice Guidance (2003, 2006):

"Defines inventories consistent with good practice as those which contain **neither over- nor underestimates so far as can be judged, and in which uncertainties are reduced as far as is practicable**"

Implications:

1. We should use **unbiased** estimators
2. We should be capable of estimating and documenting the **precision** (variance) of the estimates and produce a confidence interval

NOTE: Precision is also required to assess if changes are significant

An example will illustrate some points

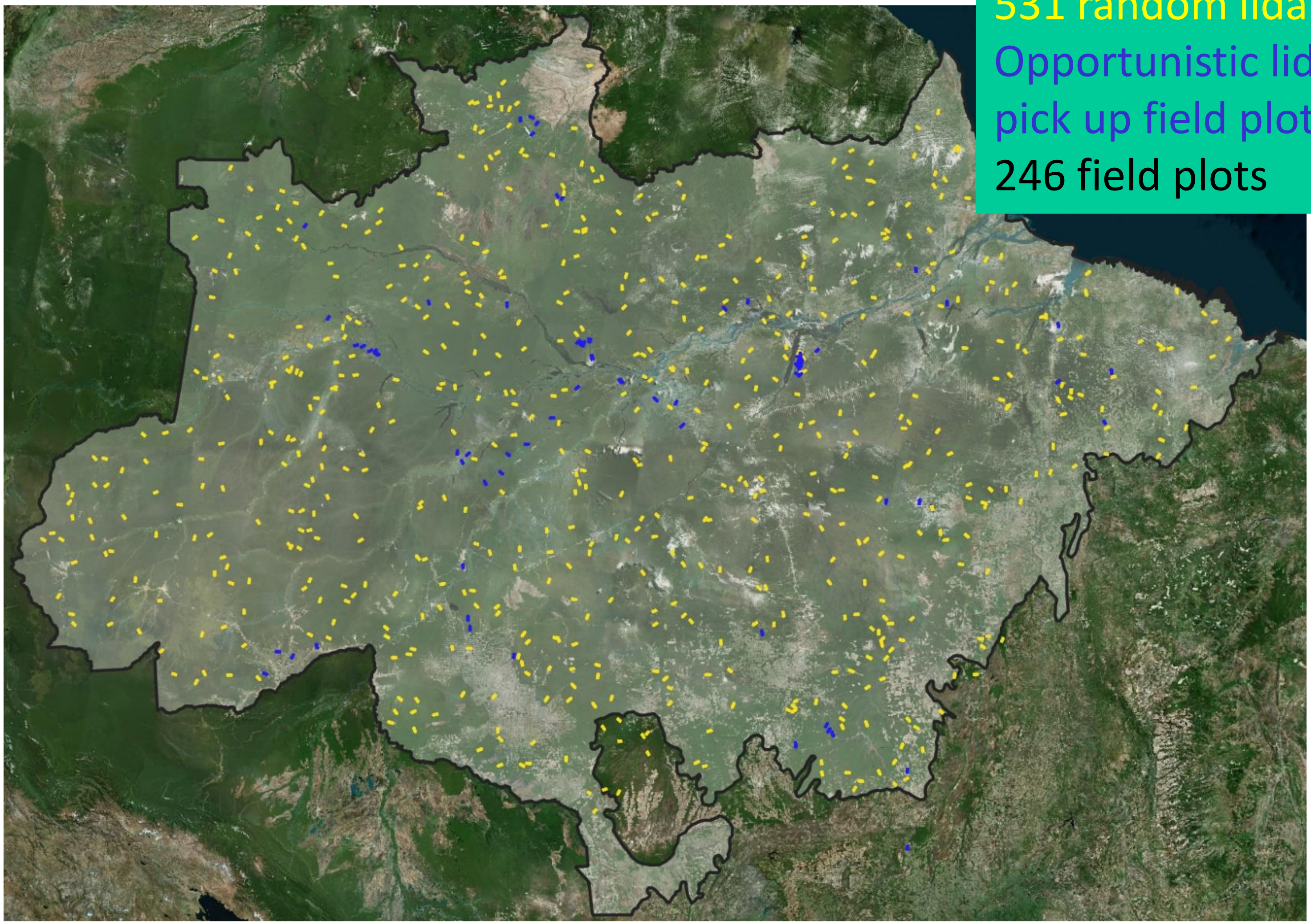
Overview

1. Estimation based on INPE data from field and airborne lidar sample survey

2. Estimation based on global maps:
   a) ESA CCI-Biomass 2017/2020 AGB map
   b) NASA/JPL 2015/2020 AGB map

3. Estimation based on NASA GEDI space laser

Field and lidar (INPE - EBA)



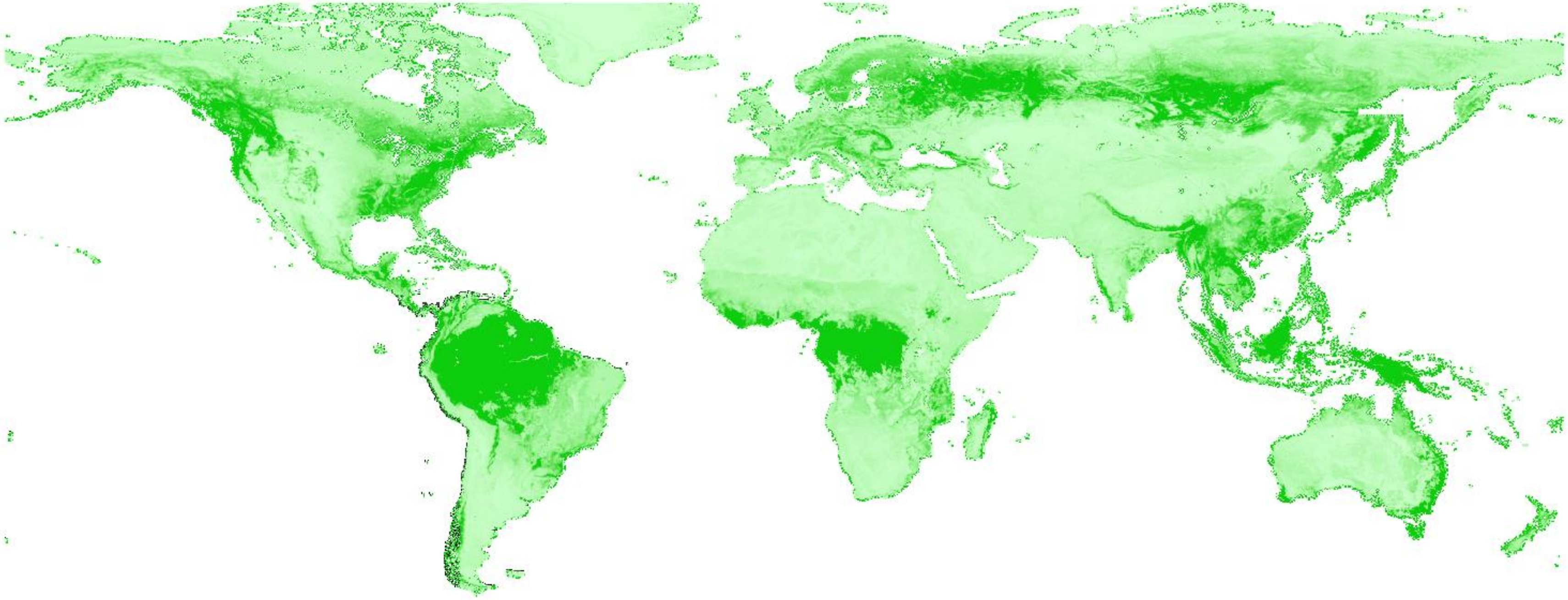
531 random lidar transects, 12km
Opportunistic lidar transects to pick up field plots
246 field plots

Estimation in lidar sample survey

- A single linking AGB model field-to-lidar

  AGB=f(ALS-metrics)
- Variance estimation – two components:
  - Lidar sampling variability
  - Model uncertainty (parameters)

Estimation of CCI and JPL biomass



Estimation: Estimate by «pixel counting»

Variance: No rigorous inference possible due to lack of meta data

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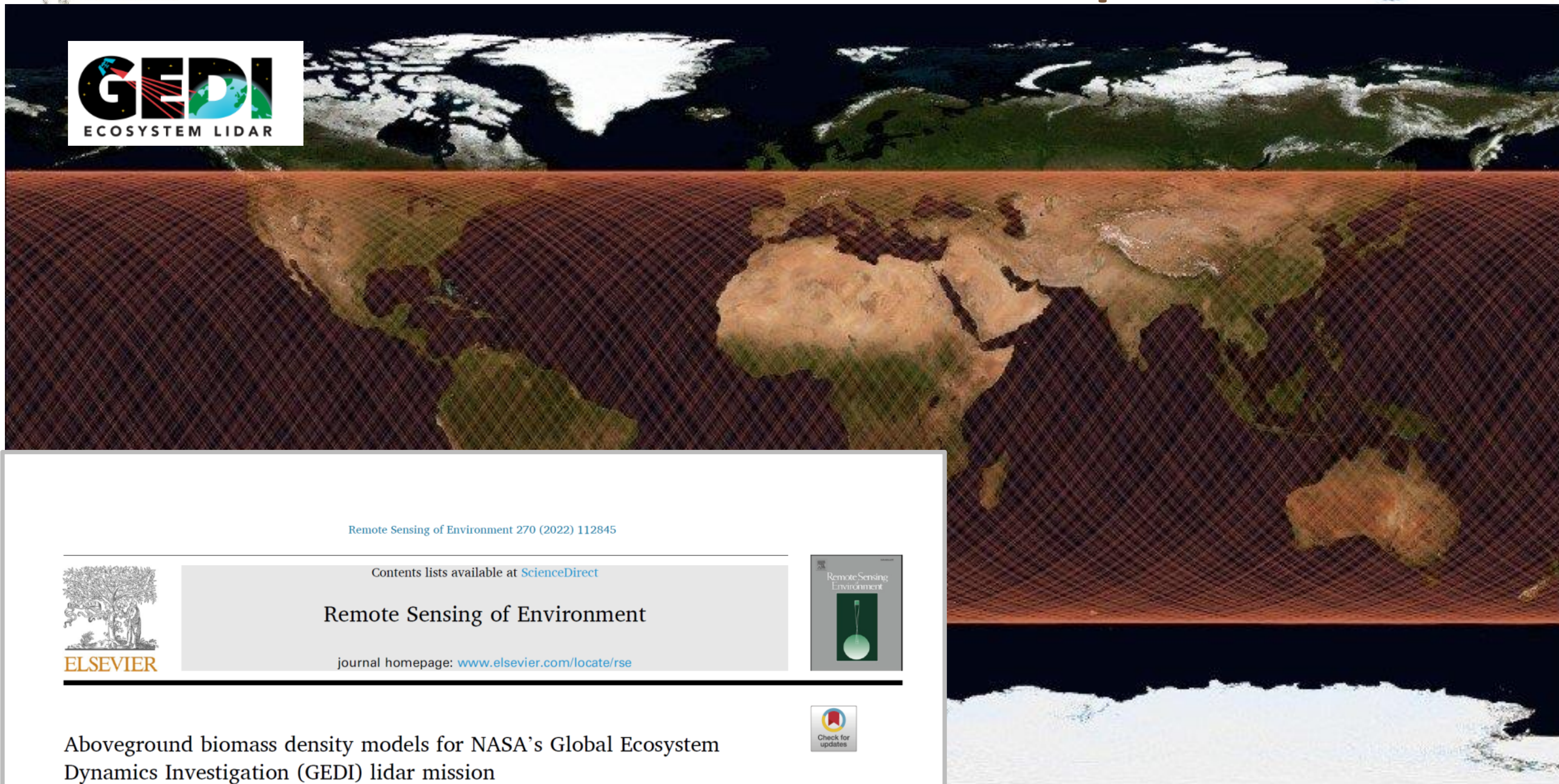
Estimation based on GEDI L4A product

esa



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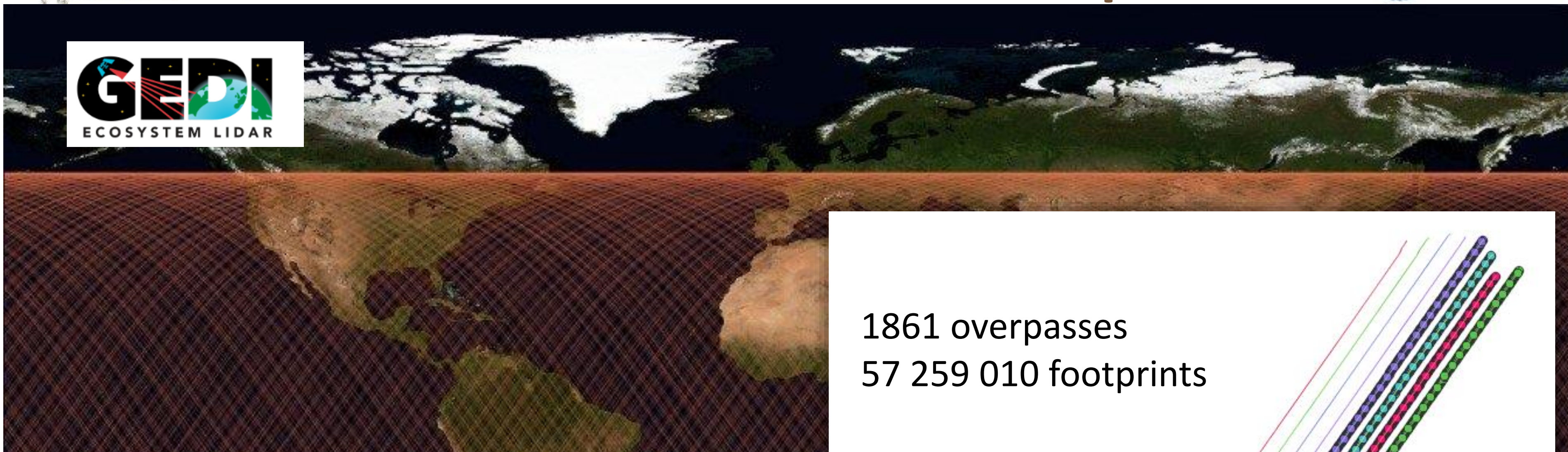
Aboveground biomass density models for NASA's Global Ecosystem Dynamics Investigation (GEDI) lidar mission

Duncanson et al. 2022

Estimation based on GEDI L4A product



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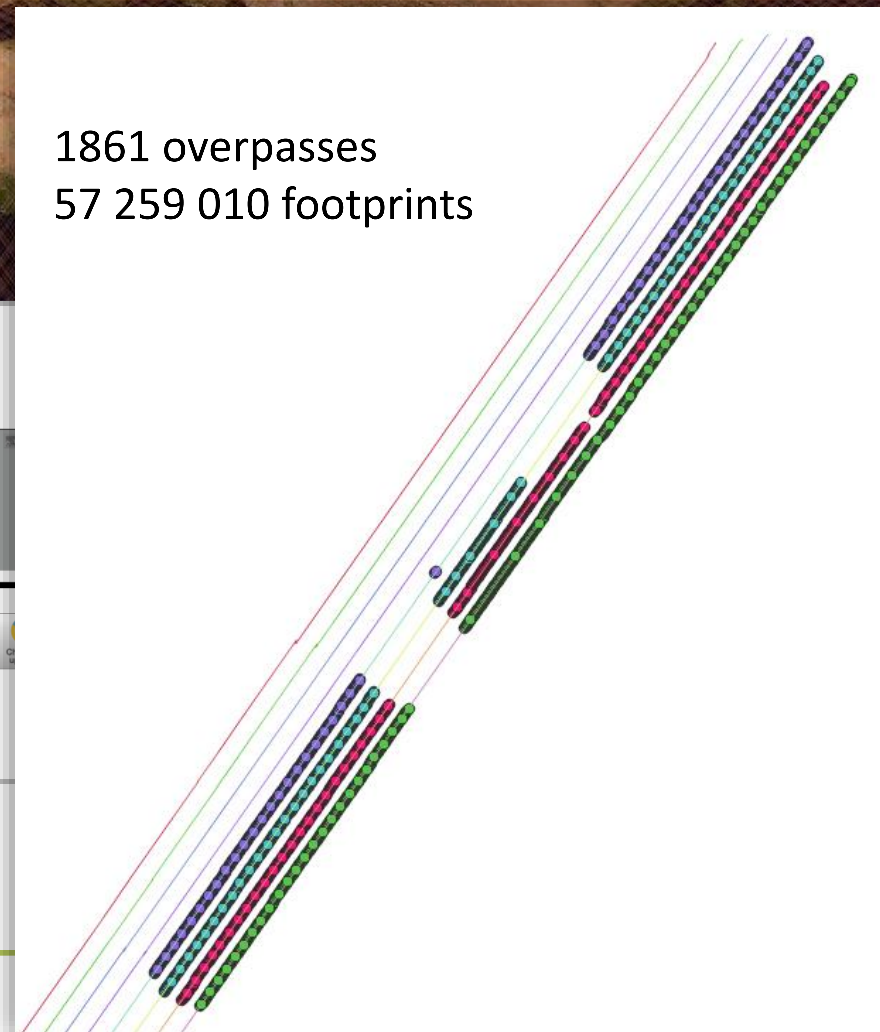


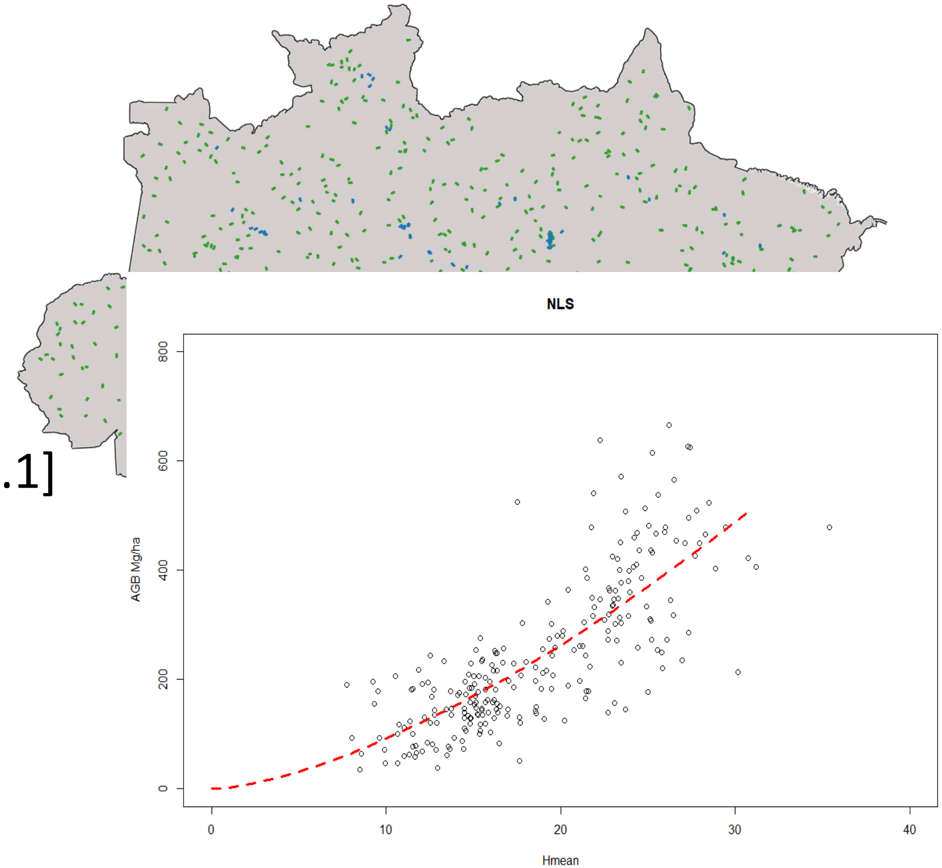
Result – airborne lidar (2016-2018)

Mean AGB/ha: 249.8 Mg/ha

Confidence interval (95%): [237.4, 262.1]

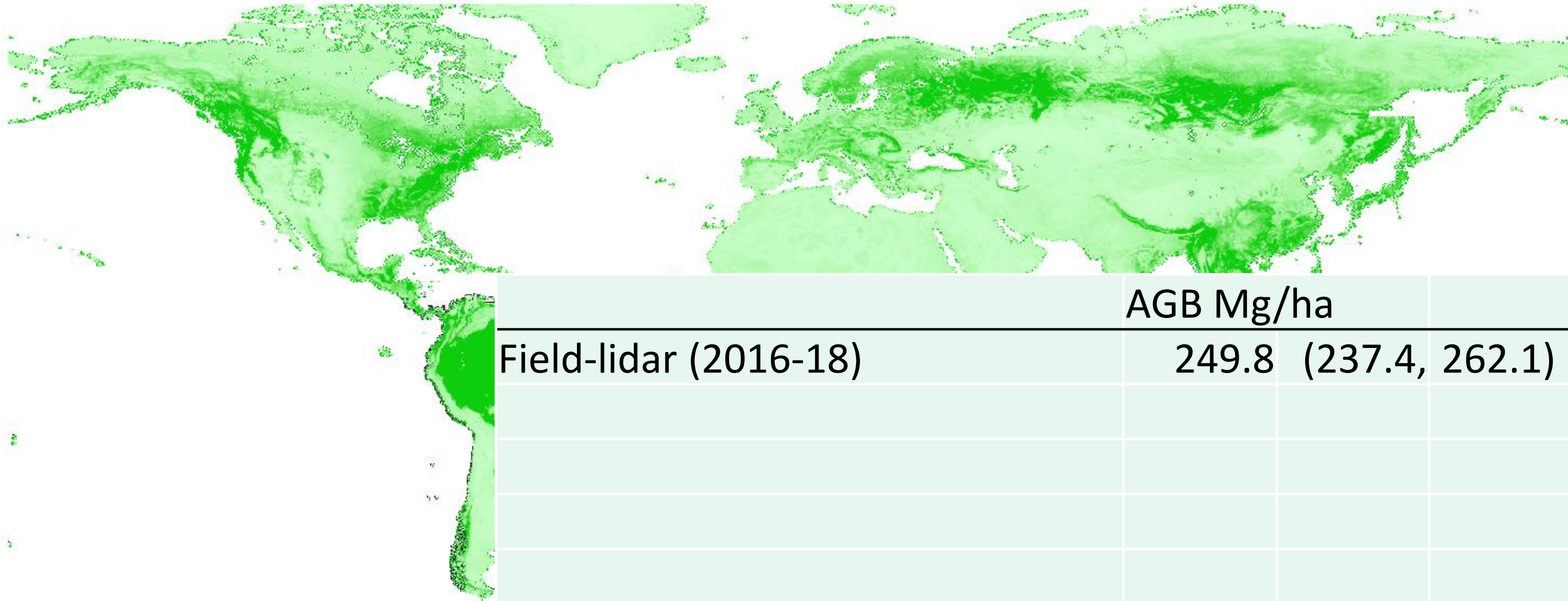
Proportion of variance:

Lidar sampling:	27%
Model:	73%



Result

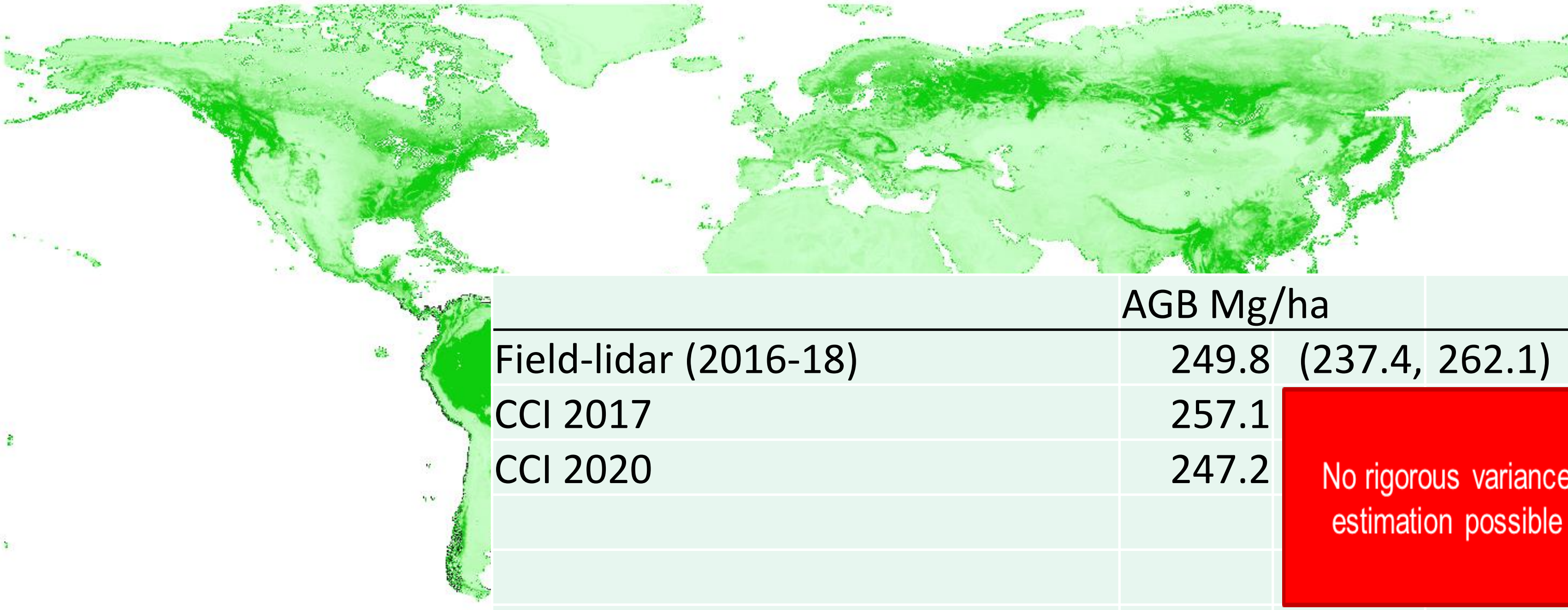
Comparison to global biomass maps



	AGB Mg/ha		
Field-lidar (2016-18)	249.8	(237.4,	262.1)

Result

Comparison to global biomass maps

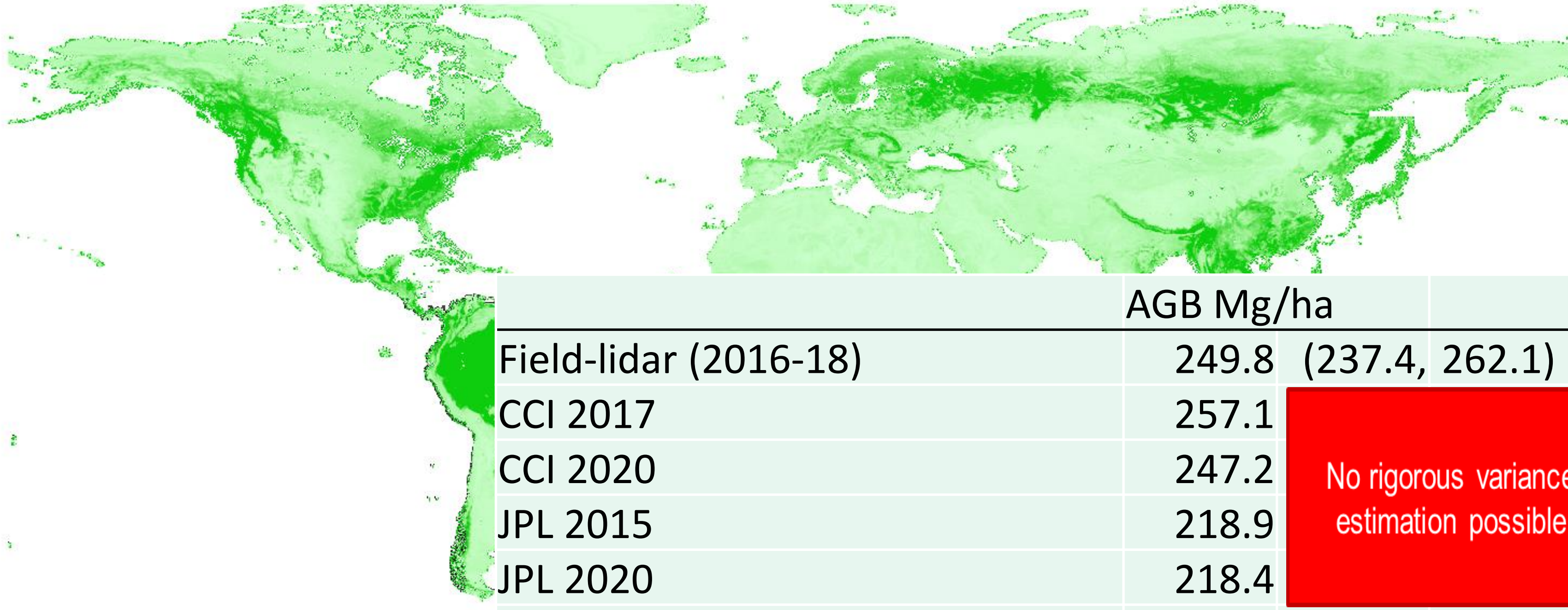


	AGB Mg/ha		
Field-lidar (2016-18)	249.8	(237.4,	262.1)
CCI 2017	257.1		
CCI 2020	247.2		

No rigorous variance estimation possible

Result

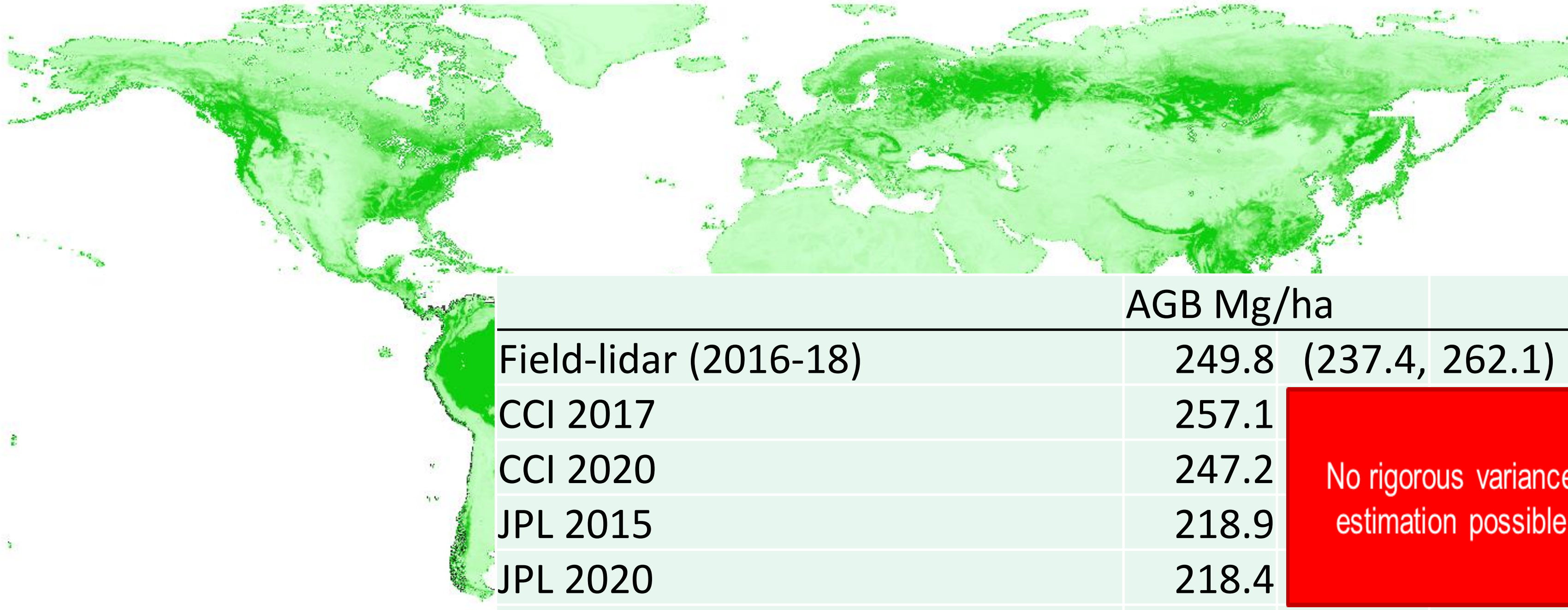
Comparison to global biomass maps



	AGB Mg/ha	
Field-lidar (2016-18)	249.8	(237.4, 262.1)
CCI 2017	257.1	No rigorous variance estimation possible
CCI 2020	247.2	
JPL 2015	218.9	
JPL 2020	218.4	

Result

Comparison to global biomass maps



	AGB Mg/ha		
Field-lidar (2016-18)	249.8	(237.4,	262.1)
CCI 2017	257.1		
CCI 2020	247.2		
JPL 2015	218.9		
JPL 2020	218.4		
GEDI L4A	159.6	(157.0,	162.1)

No rigorous variance estimation possible

Some observations and concluding remarks:

- Different products produce very different estimates
    - They all rely on models – which model is more correct?

- Change estimation requires consistent products across time

- RS products must come with necessary information for variance estimation

- Is it realistic to expect that change estimates over short time periods (<10 yrs) ever can be claimed to be statistically significant?