Spaceborne lidar missions

NASA LITE: 1994

- Technology demonstrator

NASA ICESat/GLAS: 2003-2009

- Ice elevation and volume

NASA Calipso/CALIOP: 2006-2023

- Cloud profiles

NASA CATS: 2015-2017

- Cloud profiles

ESA Aeolus/ALADIN: 2018-2023

- 3D wind speed

NASA ICESat-2/ATLAS: 2018-

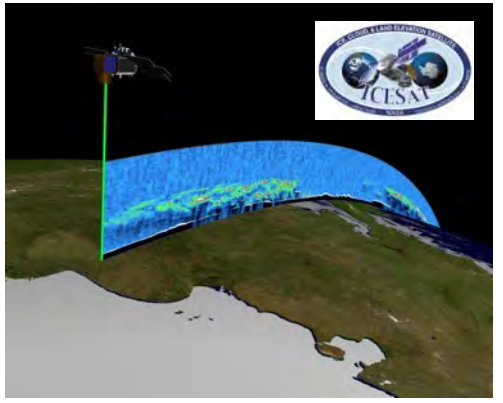
- Ice elevation and volume

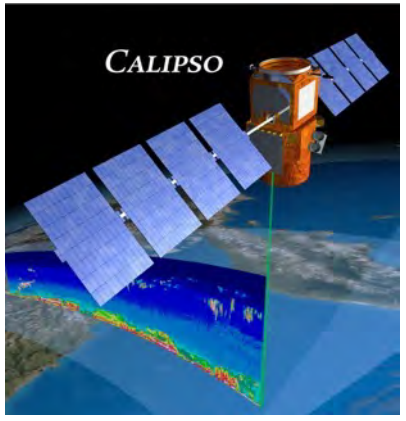
NASA GEDI: 2018-2023

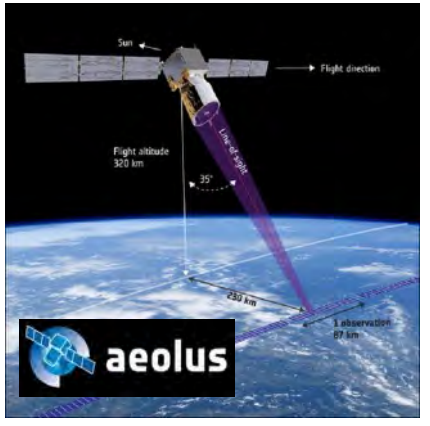
- Forest biomass and structure

CNSA TECIS: 2022- (?)

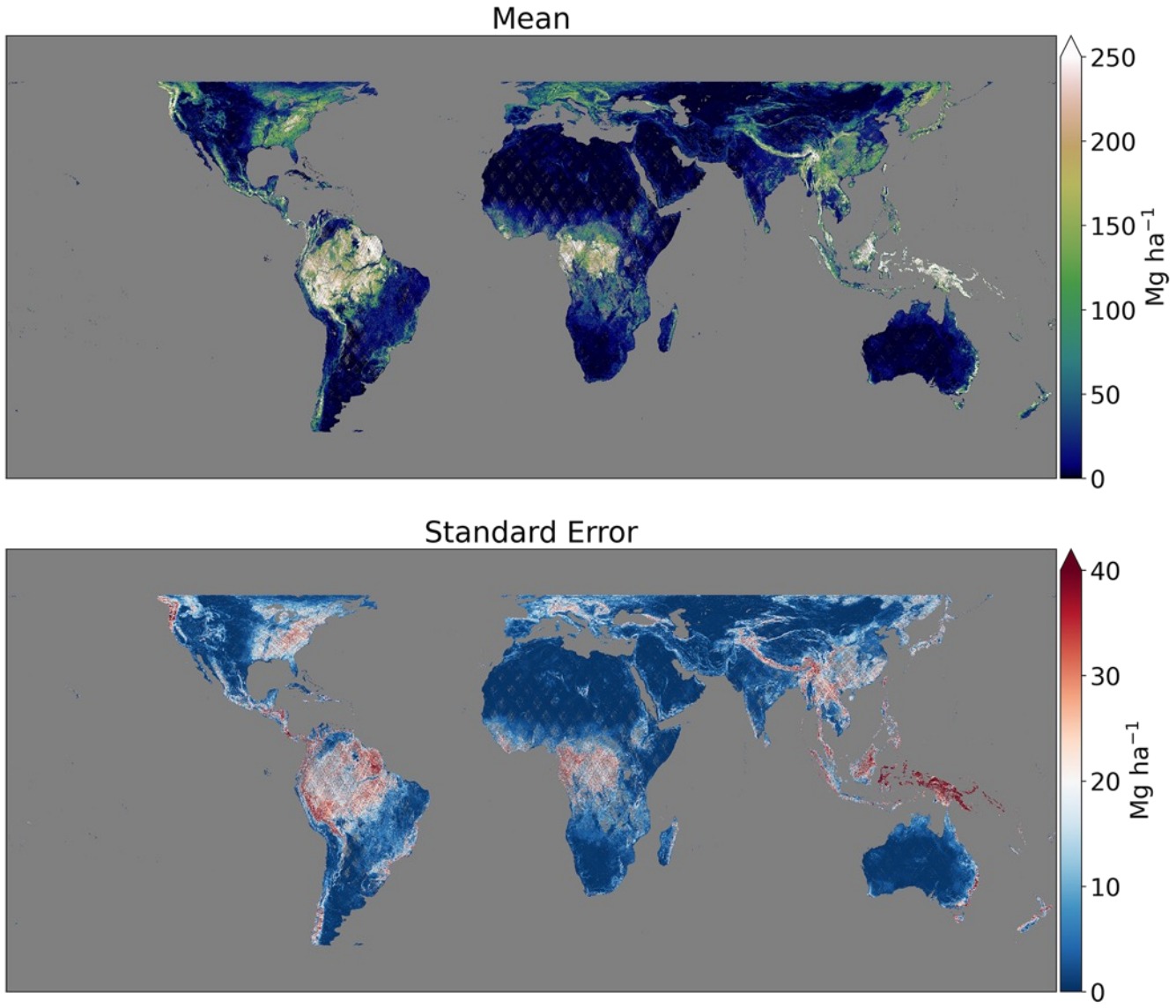
- Dual wavelength







Lidar coverage



Sparse coverage limits applications

- Coarse resolution inference (forests, ice mass)

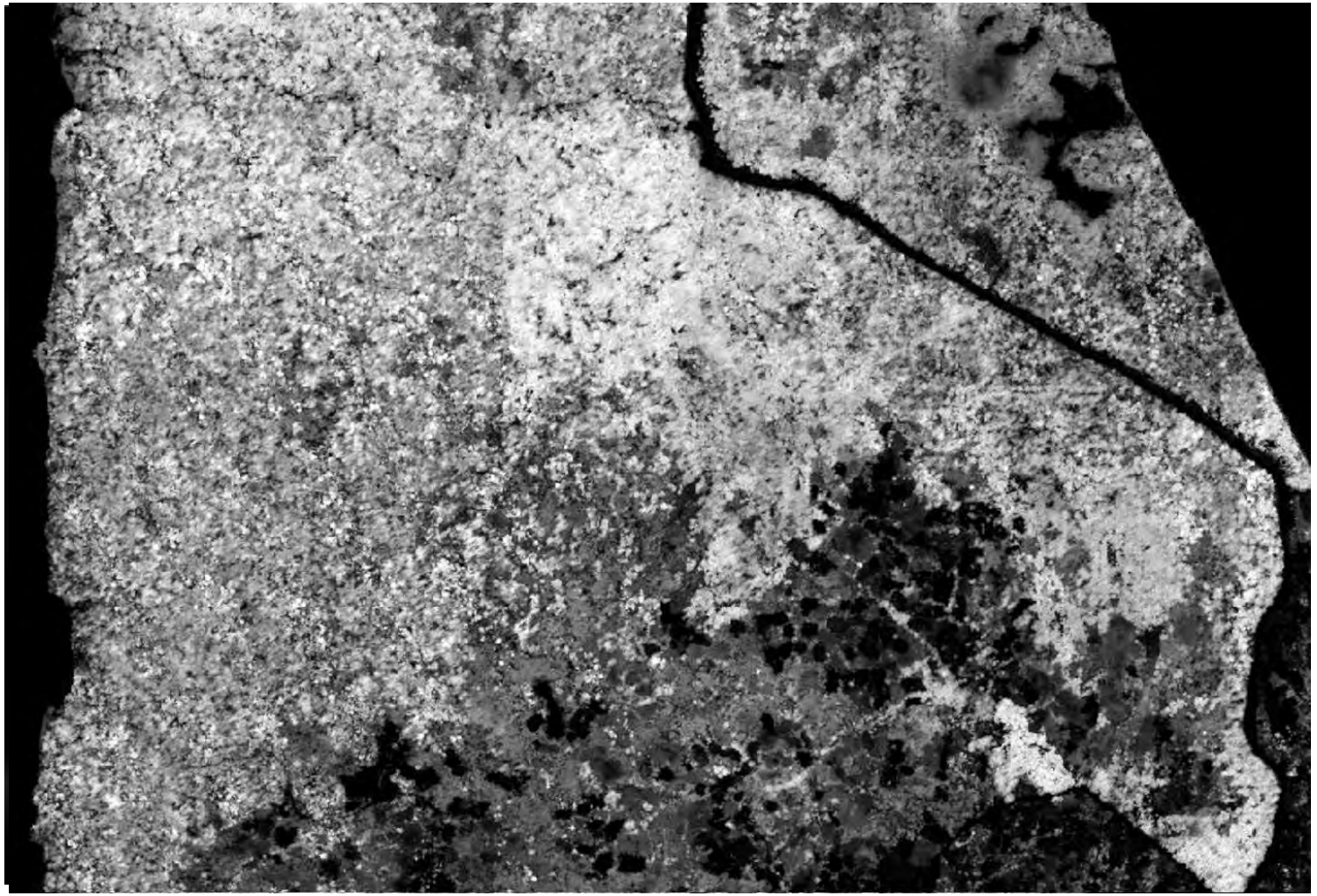
Too coarse to allow

- Continuous mapping
- Flood modelling
- Anything in urban areas
- Train line monitoring
- Commercial forestry

Sparse sampling leads to uncertainty

- Complicates robust change detection
  - Satellite carbon change products not yet reliable

Bringing the world into focus

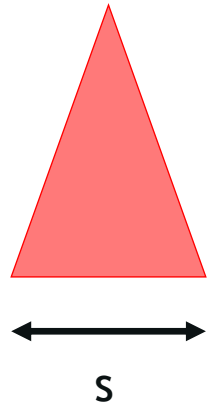


Continuous coverage satellite lidar would be…

- An incremental technology improvement
- A step change in data applications

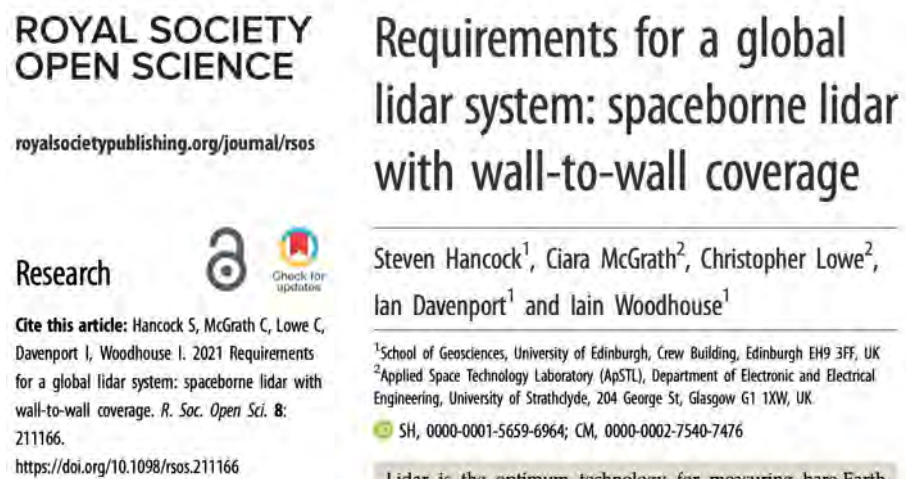
Increasing lidar coverage

$$s = \frac{P_{pay} L_e}{E_{det}} \frac{A}{\pi h^2} Q \rho \tau^2 \frac{r^2 (R+h)^{\frac{3}{2}}}{R\sqrt{GM}}$$



Which parts could we adjust to maximise coverage per unit cost?

- **Instrument**: Laser and detector efficiencies improved with new photonics?
- **Platform**: Maximise payload power and telescope area per unit cost?
- **Processing**: Reduce energy requirements with signal processing?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Research

Cite this article: Hancock S, McGrath C, Lowe C, Davenport I, Woodhouse I. 2021 Requirements for a global lidar system: spaceborne lidar with wall-to-wall coverage. *R. Soc. Open Sci.* **8**: 211166.
https://doi.org/10.1098/rsos.211166

Requirements for a global lidar system: spaceborne lidar with wall-to-wall coverage

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