

Demonstrative Biodiversity Science from the GEDI Lidar Mission

GEDI Science Team Meeting, 17-19 Oct 2023, College Park

Scott Goetz Patrick Burns Chris Hakkenberg Patrick Jantz

+ Collaborators:

James Ball, Jed Brodie, David Coomes, Sam Cushman, Zaneta Kaszta, Rajeev Pillay







- 1. Quantify the distribution of aboveground carbon stored in vegetation
- 2. Quantify the effects of vegetation disturbance and recovery on carbon storage
- **3.** Quantify the potential for existing and new/regrowing forests to sequester carbon in the future
- 4. Quantify the spatial and temporal distribution of habitat structure and its influence on habitat quality and biodiversity





Conditions

Hansen et al. (2021). Towards monitoring forest ecosystem <u>integrity</u>... Conservation Letters





Forest integrity is strongly associated with lower risk of extinction and population decline in humid tropical vertebrates

Species tended to face lower probabilities of extinction risk and declining populations if their ranges contained greater proportions of forest cover of high structural condition and integrity

Pillay et al. (2022) **Nature Ecology & Evolution**, doi.10.1038/s41559-022-01915-8

Protected areas (PAs) aim to support habitat cover, vegetation structure, and reduce hunting



Examples of possible wildlife community outcomes in PAs or adjacent unprotected forests



High SR, FR, and PD

High SR, low FR (all mesopredators), medium PD (unique Carnivora families)

High SR, medium FR (a variety of predator sizes), and low PD (all species in the same family)



Low SR, low FR, and low PD (all small felids)



Applications of GEDI forest structure for Conservation and Policy

Protected area (PA) effectiveness depends on incorporating multiple indicators of biodiversity (habitat cover, **canopy structural integrity**, human / hunting pressure)

Brodie et al. (2023) Landscape-scale benefits of protected areas for tropical biodiversity. Nature (24 August)

Using GEDI to model cross-biome forest biodiversity across NEON sites: effects of scale, sampling density, and spatial structure





<u>Study</u>:

 Multi-scale (a) ALS census (10-50m radius) & (b) kriged GEDI samples (200-5600m radius concentric rings) to predict plant/tree diversity across 38 NEON sites (US)

 Assessed several diversity indices and lidar structural metrics

Findings:

- ALS FHD predicts 20m² plant diversity across biomes. GEDI sampling mostly nonsignificant.
- ALS and GEDI FHD predict **tree** diversity across sensors, indices and scales; esp. Simpson's D, which gives greater weight to dominant species

Conclusion:

• GEDI sampling matches the performance of ALS census for predicting **tree** diversity, but GEDI not predictive of **plant** diversity

Spatially-continuous, annual maps of forest structure metrics derived from GEDI



Completed across the GEDI domain at multiple resolutions

(300m, 1 km, 6 km, 12 km)



Being archived at the ORNL DAAC & made available via GEE

Note these are not the official GEDI L3 data products (Armston et al.)



Foliage Height Diversity mean from 2019 to 2022





Patrick.Burns@nau.edu





Example Regions 1km mean from 2019 to 2022

Number of Modes U.S. Pacific Northwest



Nearly-continuous map at 1 km



GEDI gridded structure (@6km res)







NW Mountains



NEON ALS - Yellowstone





Advancing Fusion: GEDI+CCDC



	的行动	the the
	Multi-temporal canopy height R: 2000	40 m
	G: 2009 B: 2018	3 m
		Real Providence
and the		
	ALE A	
		AND THE AND TH

ESA Annual Meeting 2023 Session

GEDI space-borne lidar for global biodiversity applications

Organized & with presentations by: Chris Hakkenberg & Pat Burns

And additional invited presentations by: Alex Killion, Yale Kerri Vierling, Univ of Idaho Zaneta Kaszta, NAU









NORTHERN ARIZONA





ENVIRONMENTAL RESEARCH ECOLOGY

More Things of Interest..

Unravelling the Role of Vegetation Structure in Ecosystem Functioning with LIDAR, Field Studies and Modelling



Guest Editors

Camille Gaillard, Northern Arizona University, USA Christopher Doughty, Northern Arizona University, USA Andrew John Abraham, Northern Arizona University, USA Alexander Shenkin, Northern Arizona University, USA Hisashi Sato, Japan Agency for Marine-Earth Science and Technology Selwyn Hoeks, Radboud University, Netherlands

Credit: Nicolle R. Fuller, Sayo-Art LLC

https://iopscience.iop.org/journal/2752-664X/page/Focus%20Issues



ENVIRONMENTAL RESEARCH

Part of the Environmental Research series from IOP Publishing

Focus on the Global Ecosystem Dynamics Investigation: Research, Applications and Policy Implications



https://tinyurl.com/spdmtkhs



Remember..

Guest Editors Ralph Dubayah, University of Maryland Scott Goetz, Northern Arizona University John Armston, University of Maryland Bryan Blair, NASA Goddard Space Flight Center Patrick Burns, Northern Arizona University Laura Duncanson, University of Maryland Lola Fatoyinbo, NASA Goddard Space Flight Center Steve Hancock, University of Edinburgh Matt Hansen, University of Maryland Sean Healy, USDA Forest Service Michelle Hofton, University of Maryland George Hurtt, University of Maryland Patrick Jantz, Northern Arizona University Jim Kellner, Brown University Scott Luthcke, NASA Goddard Space Flight Center Carlos Silva, University of Maryland Hao Tang, University of Maryland