

BioSpace25 - Biodiversity insight from Space
10 - 14 February 2025 | ESA-ESRIN | Frascati - Italy

Biodiversity From Space

Understanding Large-Scale Patterns of Ecosystem Structure and Diversity with Remote Sensing

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Humans are causing pervasive declines in biodiversity.

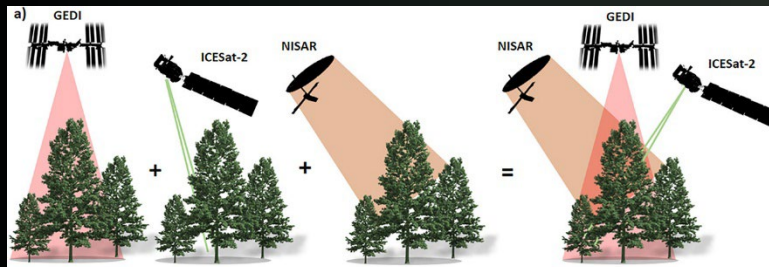
“Identify the most severe risks on a global scale over the next 10 years”

■ Economic ■ Environmental ■ Geopolitical ■ Societal

- 1st **Climate action failure**
- 2nd **Extreme weather**
- 3rd **Biodiversity loss**
- 4th **Social cohesion erosion**
- 5th **Livelihood crises**

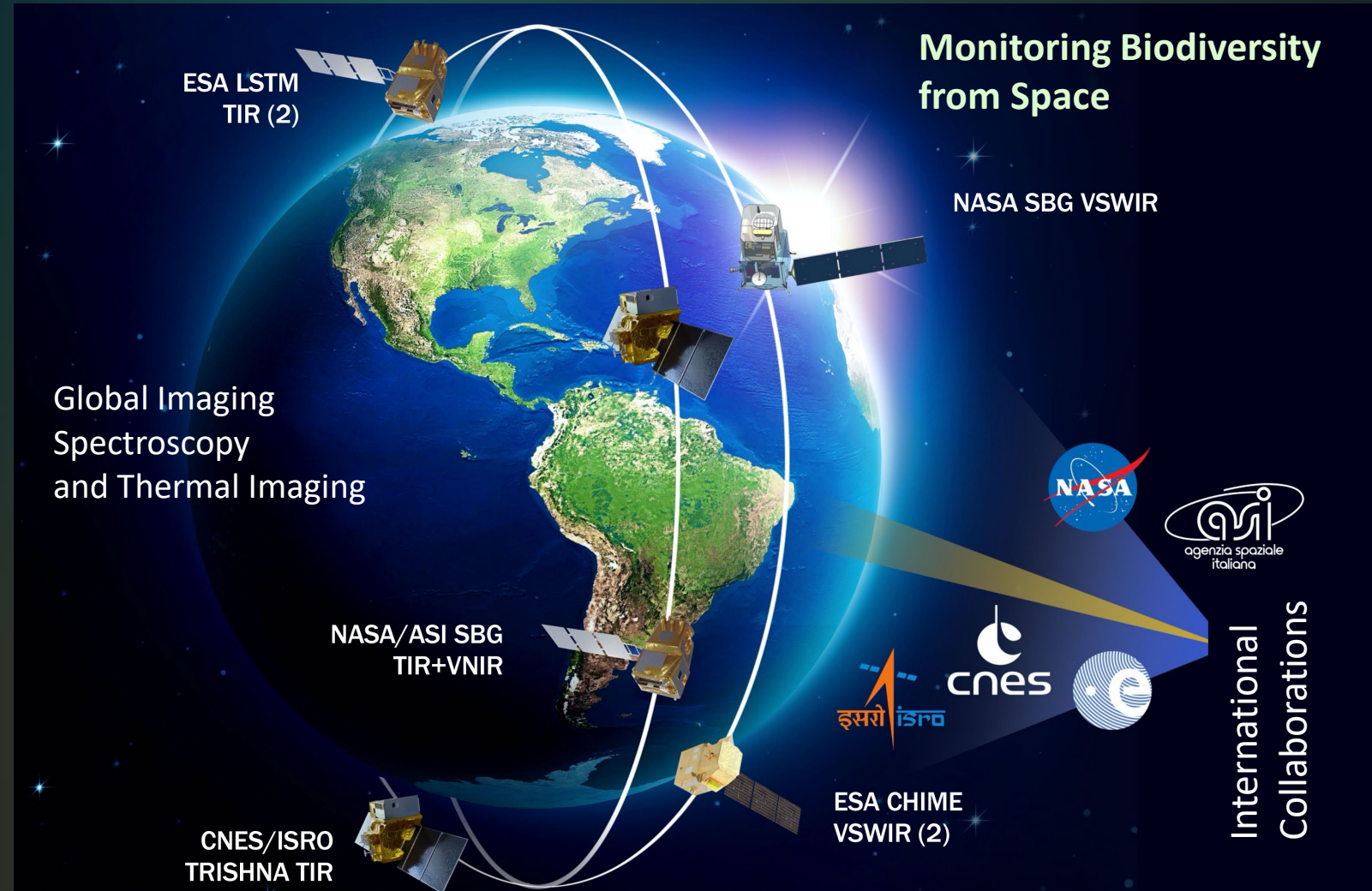
Source: World Economic Forum Global Risks Perception Survey 2021-2022

Global LiDAR & RADAR



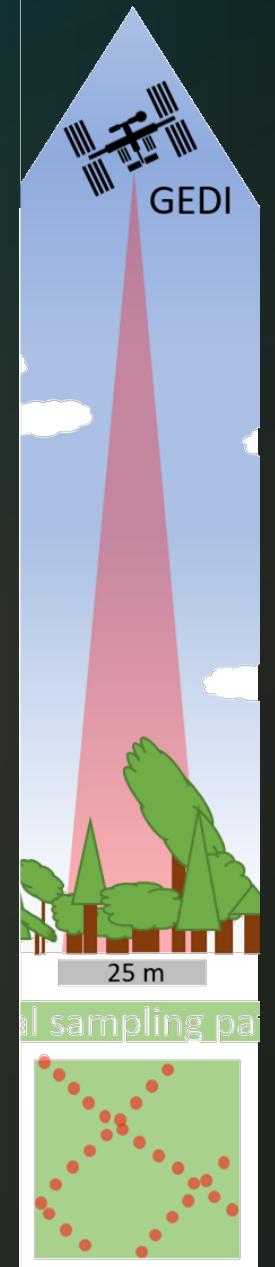
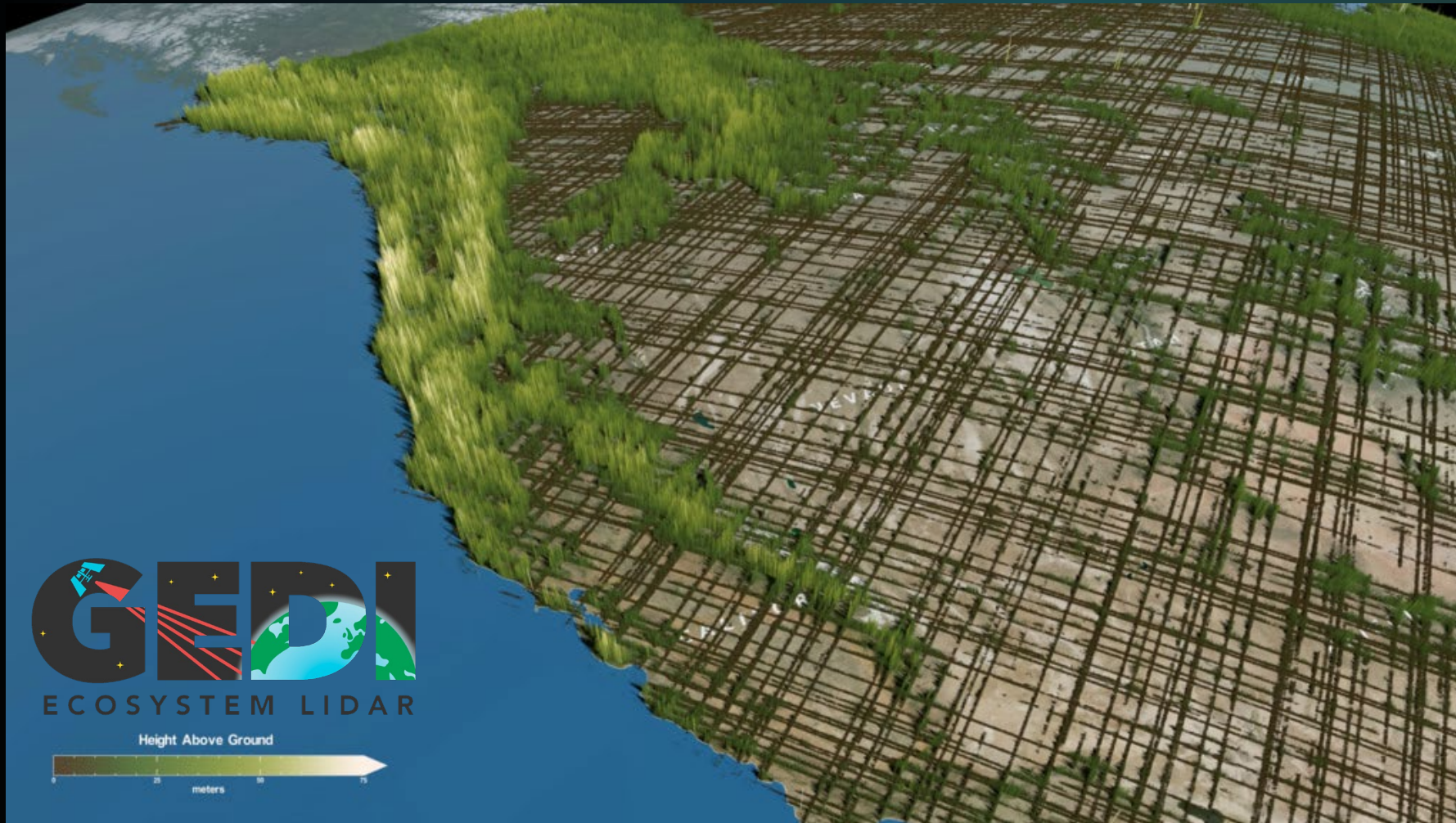
Silva et al. (2021) RSE

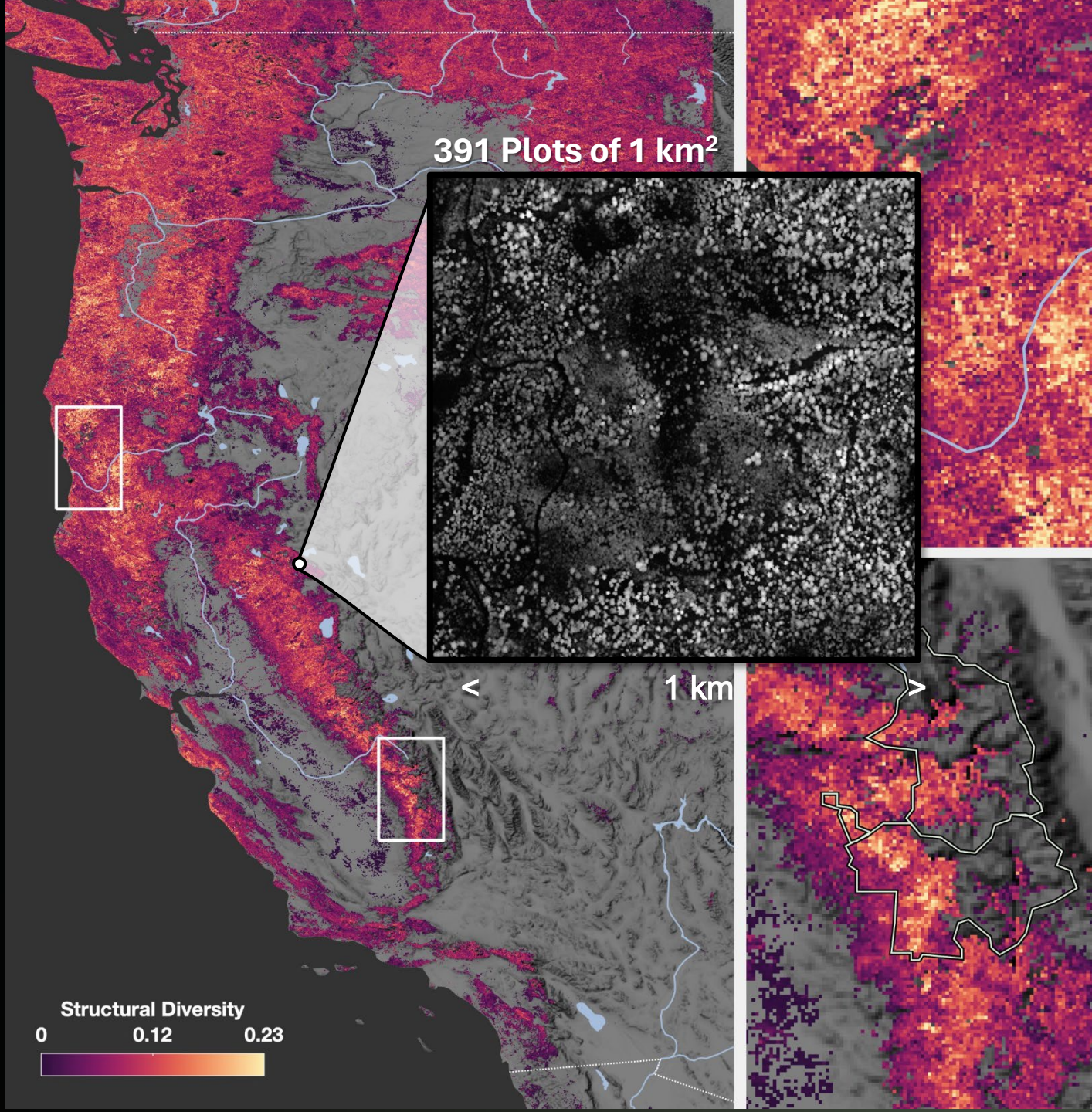
We need monitoring to understand and act on biodiversity change



Monitoring Structural Diversity from Space

Characterizing the diversity of forest canopy structure using LiDAR



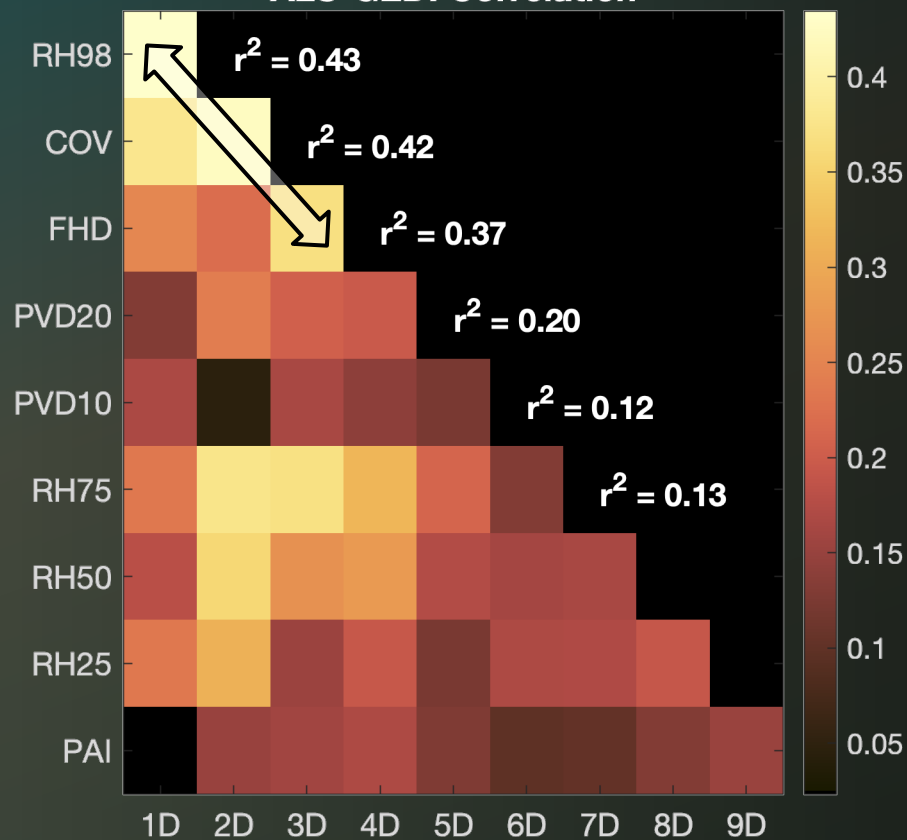


Structural Diversity

derived from GEDI

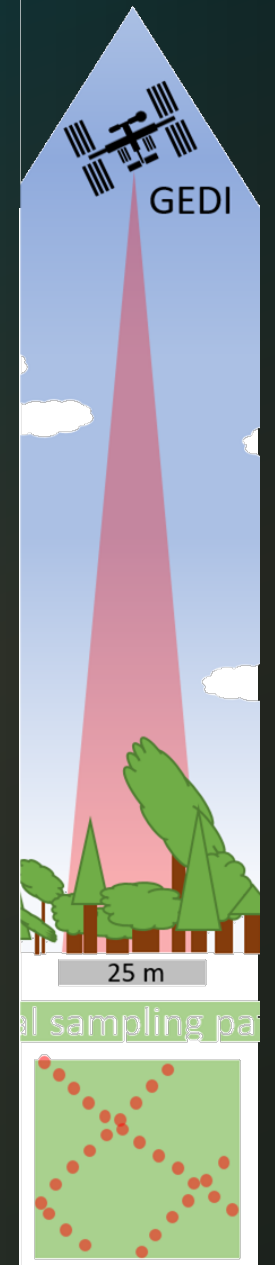
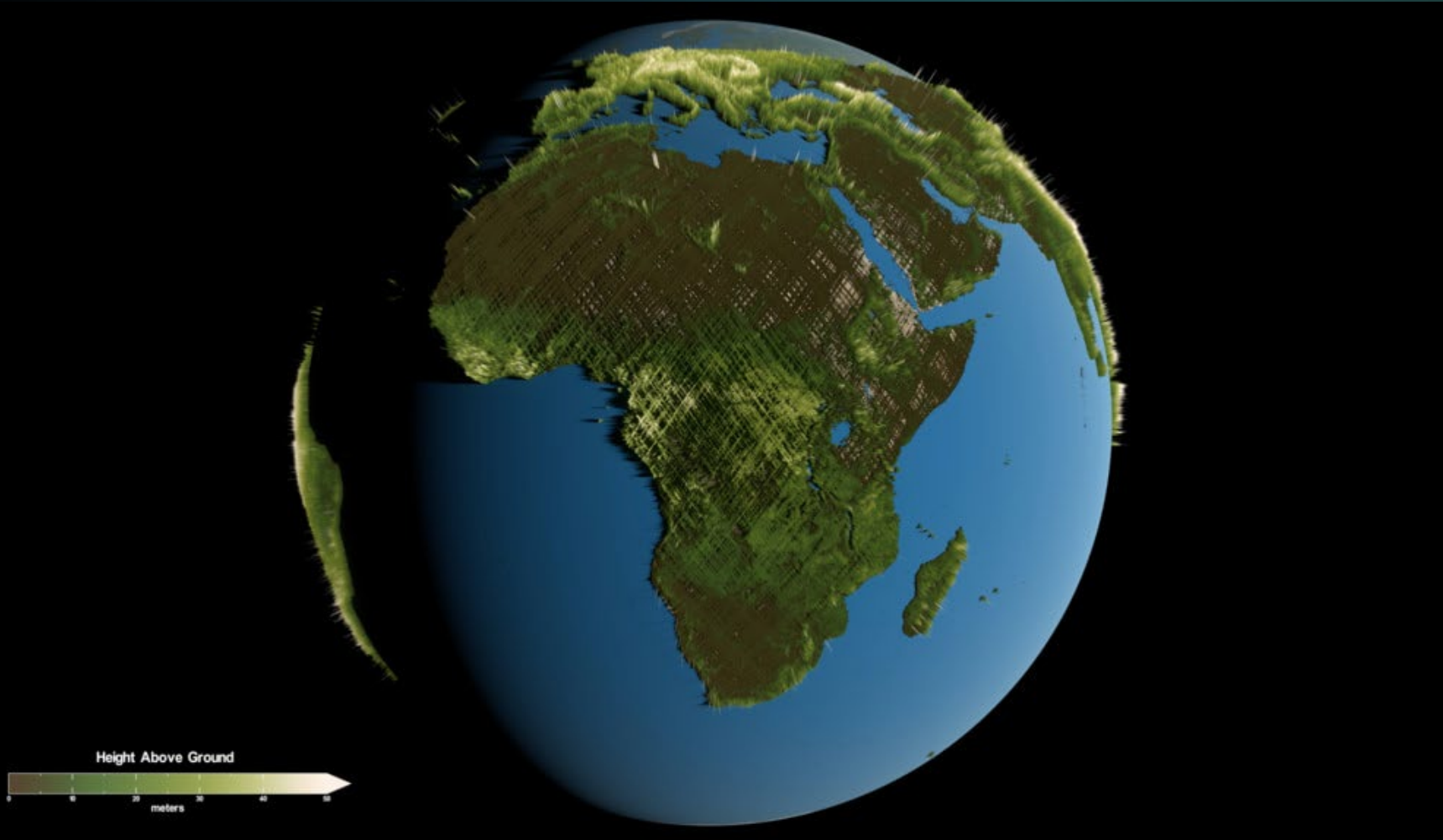
- Canopy Height (RH98)
- Vegetation Cover (COV)
- Foliage Height Diversity (FHD)

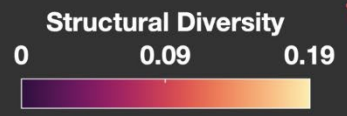
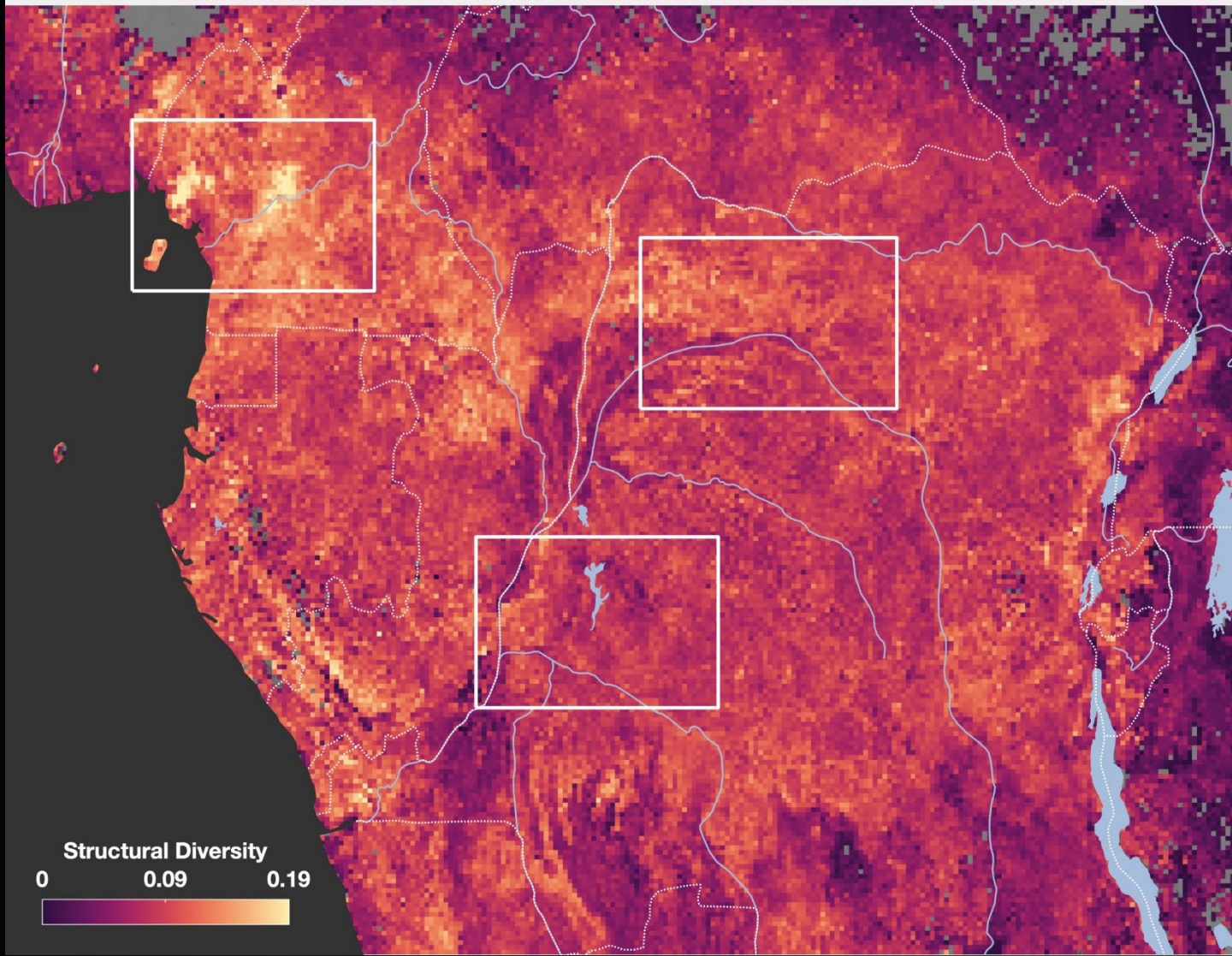
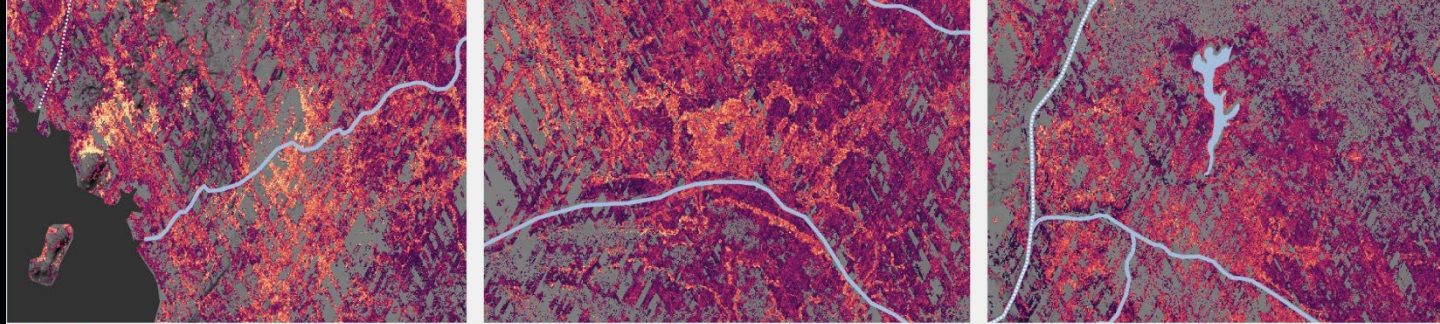
ALS-GEDI Correlation



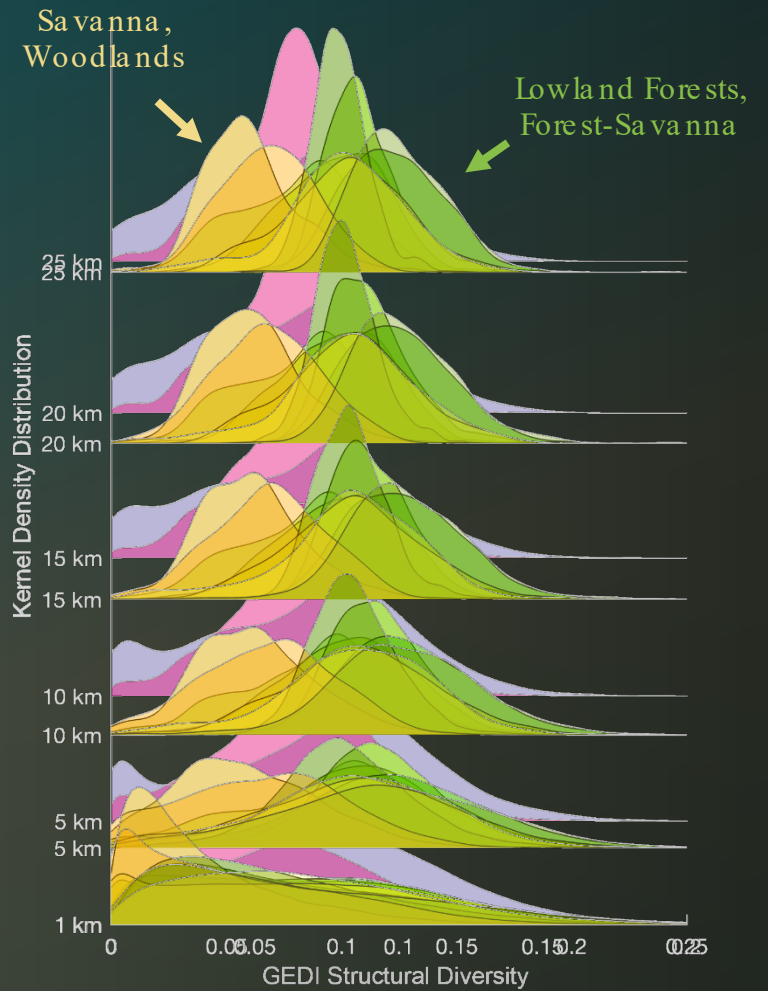
Monitoring Structural Diversity from Space

Characterizing the diversity of forest canopy structure using LiDAR





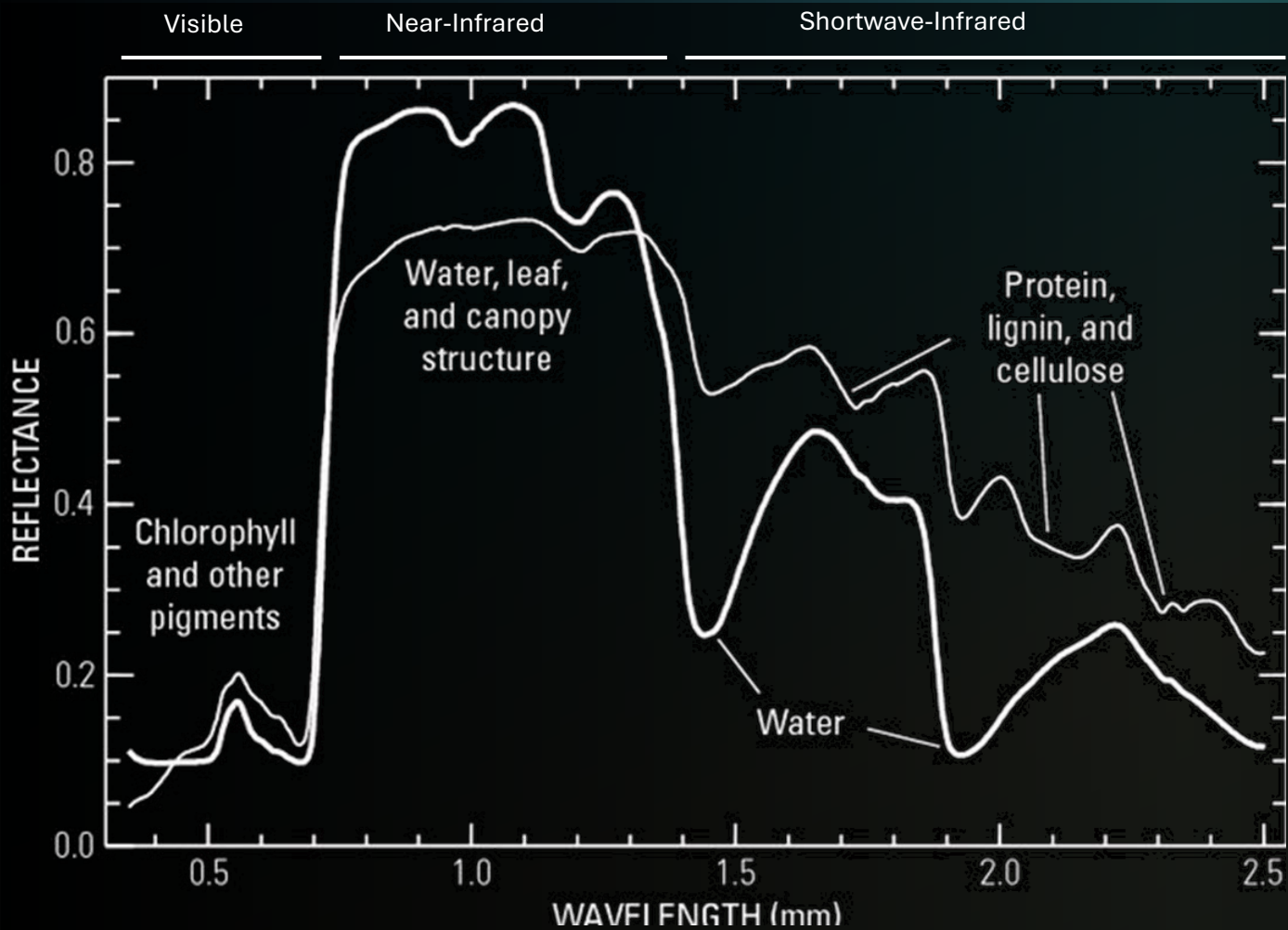
Structural Diversity derived from GEDI



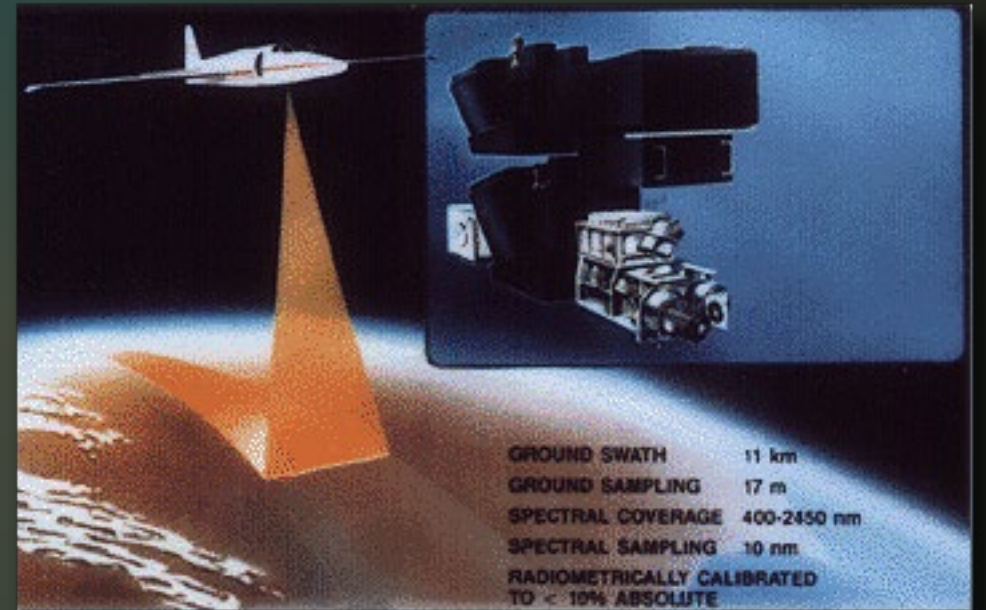
- Northern Congolian Forest-Savanna
- West African Forest-Savanna
- East Sudanian savanna
- Southern Congolian forest-savanna
- Central Congolian lowland forests
- Western Congolian forest-savanna
- Northeast Congolian lowland forests
- Central Zambesian wet miombo woodlands
- Northwest Congolian lowland forests
- Congolian coastal forests
- Guinean forest-savanna

Monitoring Functional Diversity from Space

Characterizing the diversity of plant foliar traits using imaging spectroscopy

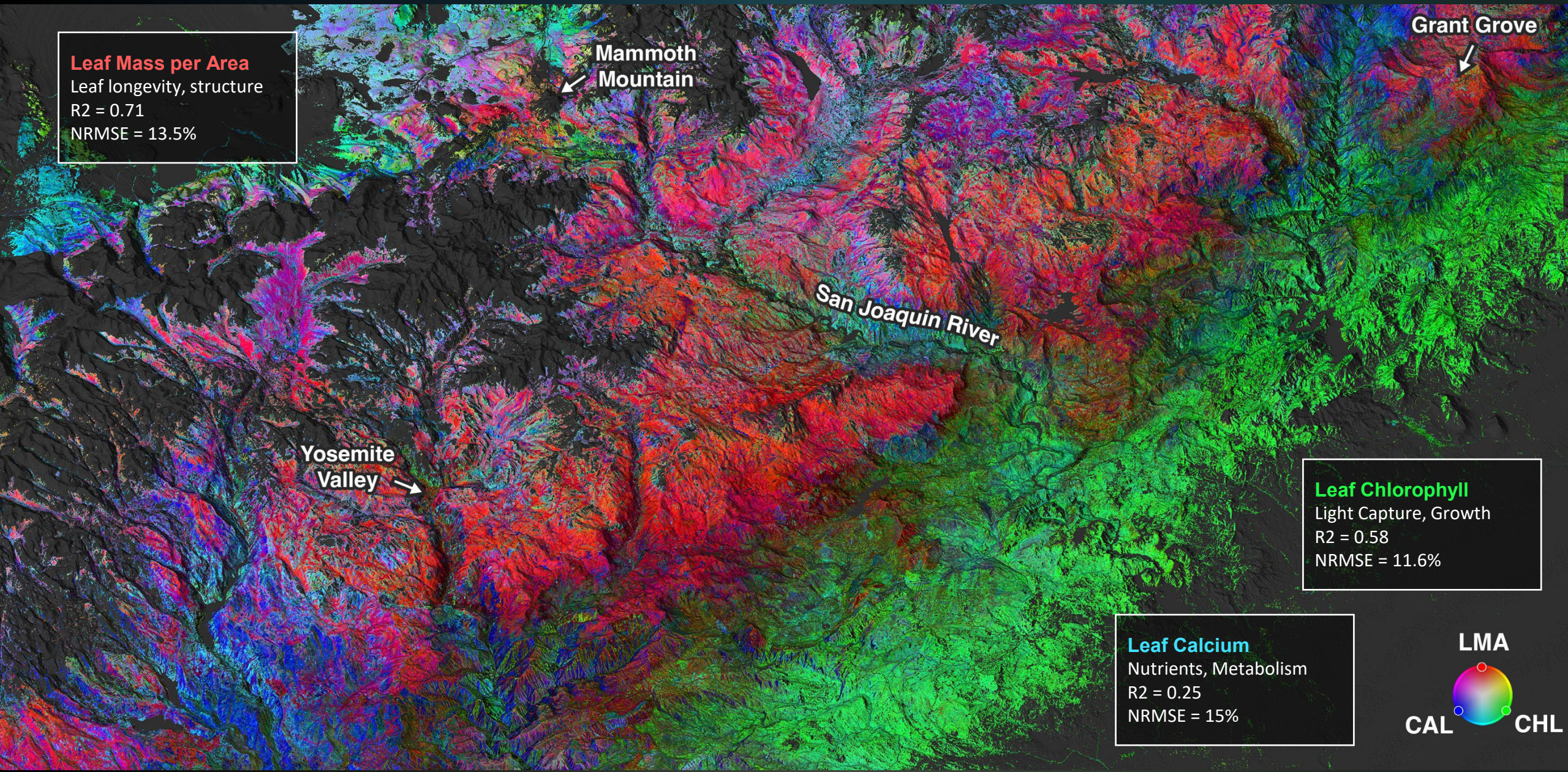


AVIRIS
Airborne Visible / Infrared
Imaging Spectrometer



Monitoring Functional Diversity from Space

Zheng et al. (in preparation);
Schneider et al. (in preparation)



Leaf Mass per Area
Leaf longevity, structure
R2 = 0.71
NRMSE = 13.5%

Mammoth Mountain

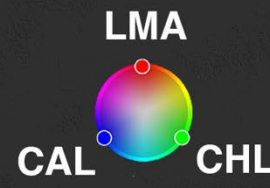
Grant Grove

San Joaquin River

Yosemite Valley

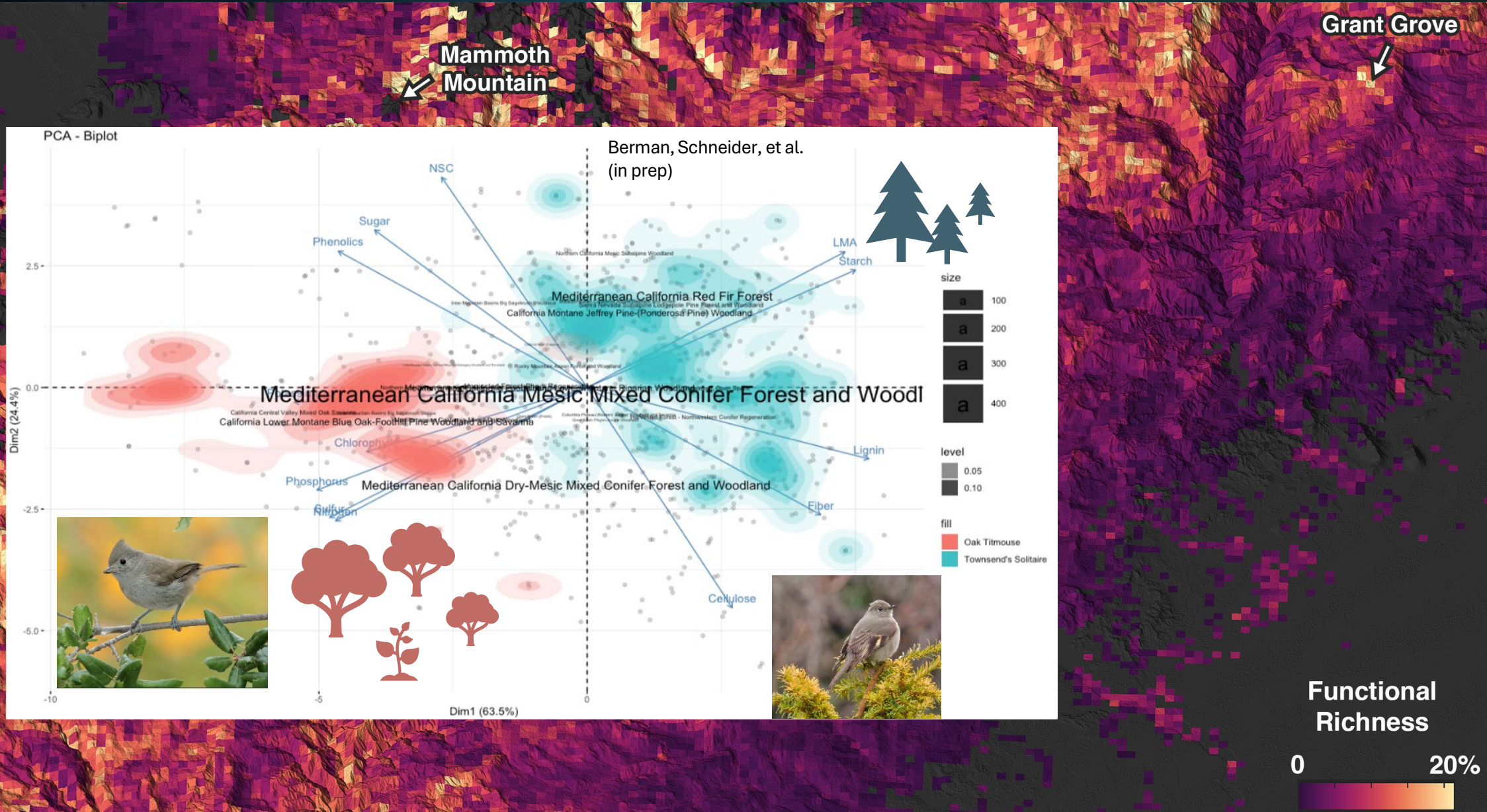
Leaf Chlorophyll
Light Capture, Growth
R2 = 0.58
NRMSE = 11.6%

Leaf Calcium
Nutrients, Metabolism
R2 = 0.25
NRMSE = 15%



Monitoring Functional Diversity from Space

Schneider et al. (in preparation)



RECOMMENDATIONS



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Future work and priorities:

- Scaling analyses: scalable approaches in space and time to better understand dynamic changes from local to global scales
- Integration of multiple sensors and data streams to monitor ecosystem structure, diversity and function
- Extend to more complex trophic interactions and indicators of ecosystem complexity



THANK YOU



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We are hiring:

- Postdoc: Multispectral Imaging and Imaging Spectroscopy of Ecosystem Spectral Diversity and Fragmentation [<https://lnkd.in/dRyayhBQ>]
- PhD: Quantifying Ecosystem Structural Diversity and Fragmentation using LiDAR, RADAR, Structure from Motion or Deep Learning [Announcement in March 2025]



AARHUS
UNIVERSITY

Functional Stability and Turnover with Disturbance

What is the impact of wildfires and drought on plant functional traits and diversity?

