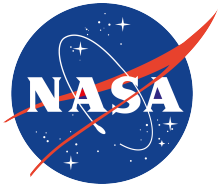
Tracking Changes in Vegetation Structure Following Fire in the Cerrado Biome using ICESat-2

American Geophysical Union Annual Meeting 2022, Chicago

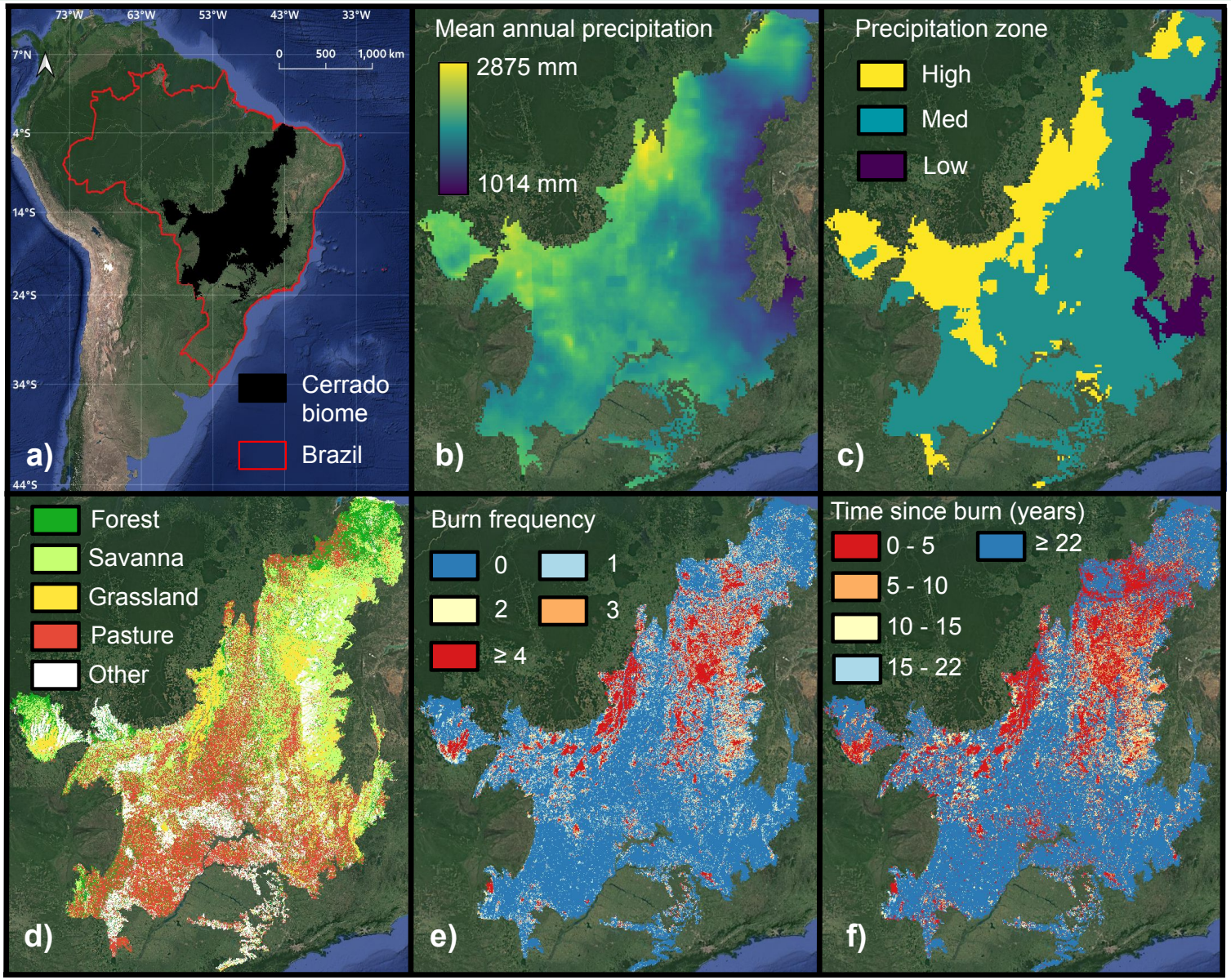
Venkata Shashank "Shashi" Konduri[1], Douglas Morton[2] and Niels Andela[3]

[1]National Ecological Observatory Network, Battelle, Boulder, CO,
[2]NASA Goddard Space Flight Center, Greenbelt, MD and [3]BeZero Carbon, London, UK

December 16, 2022



Cerrado vegetation structure is strongly affected by patterns of land use, precipitation and fire regimes



Objectives

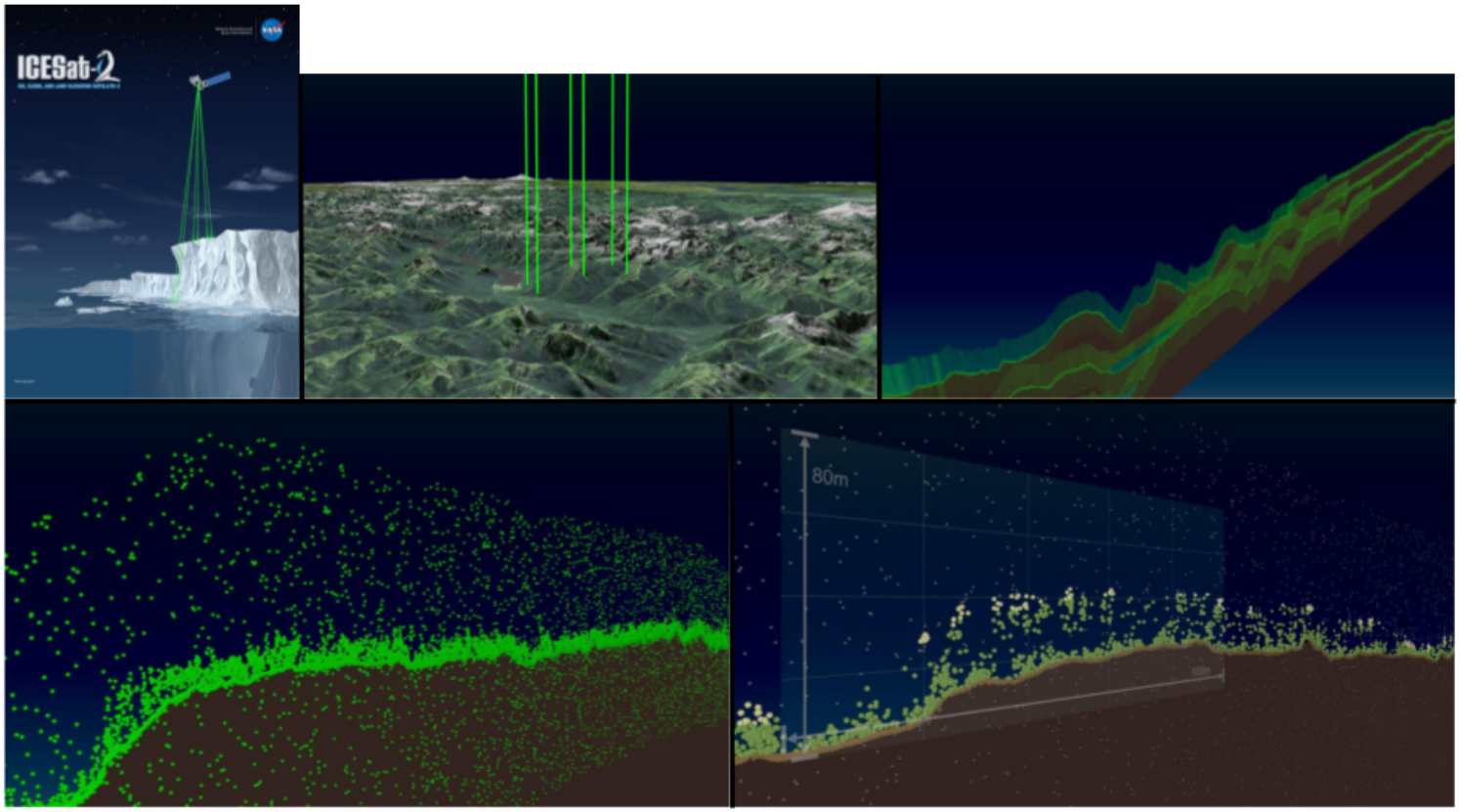
Our primary goals were to

1. quantify the influence of **burn frequency** on canopy height and canopy cover for the major Cerrado vegetation types and

2. estimate the time scales of canopy recovery as a function of **time since fire**.

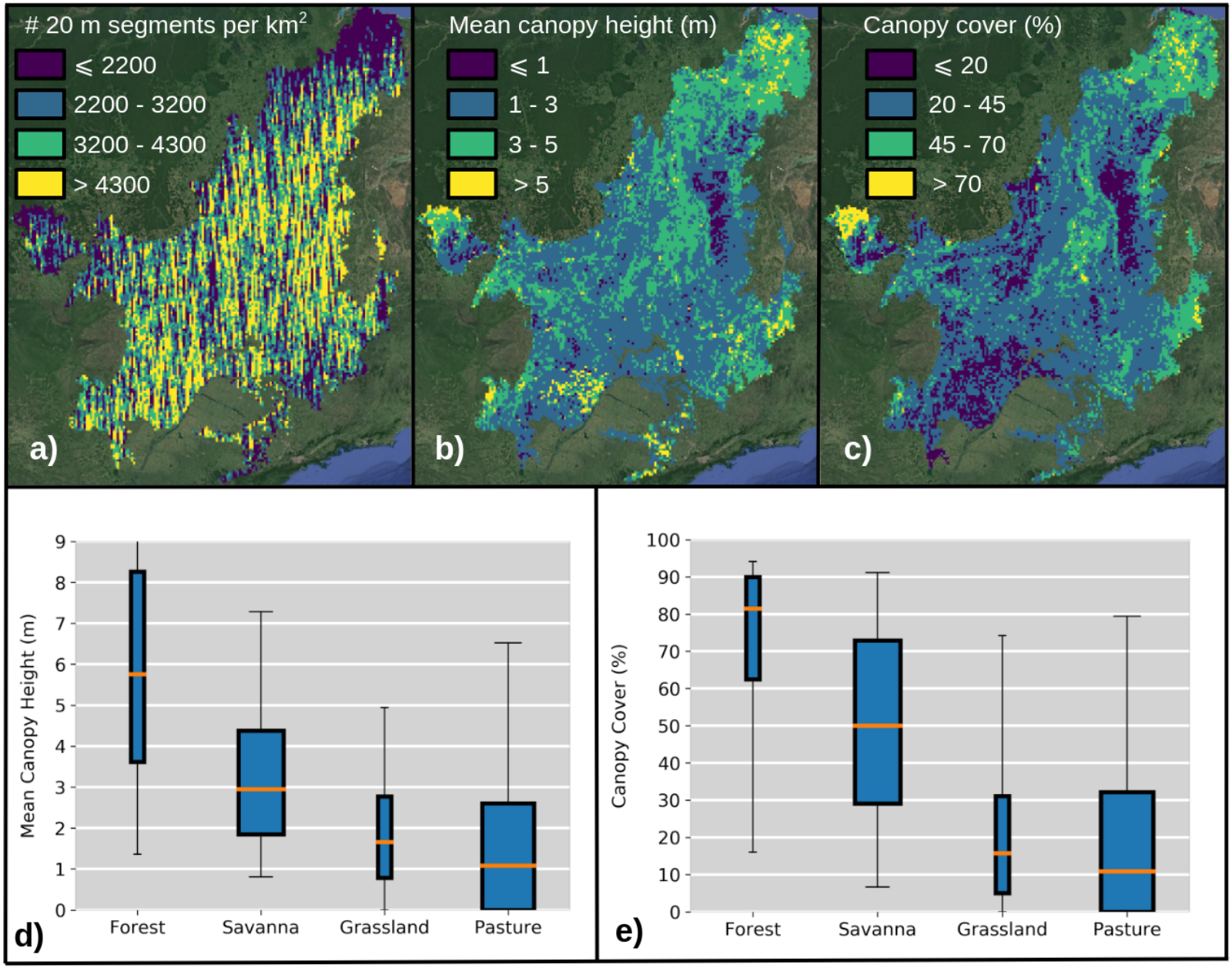
NASA's ICESat-2 mission (launched September 2018)

- Space-based photon counting laser altimeter (532 nm, 10 kHz).
- One shot every 70 cm along track; 17 m footprint.
- Photons classified as ground, canopy and top-of-canopy.



Extracted **6.2 million** ICESat-2 20m segments across Cerrado between Sep 2018 and Jun 2021 with $\sim$ **358 million** photons.

ICESat-2 derived mean canopy height and fractional cover

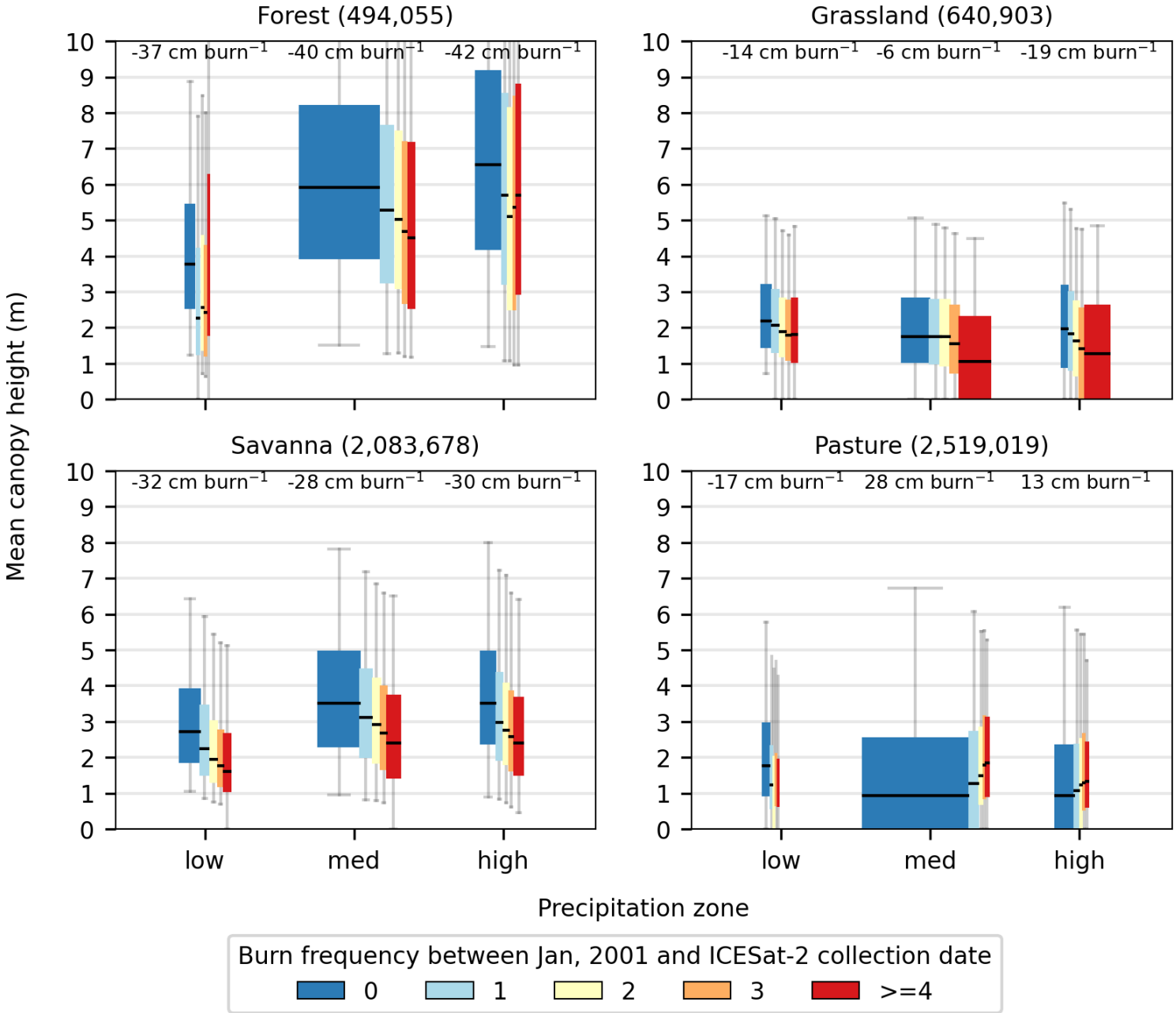


Calculating fire response and recovery rates

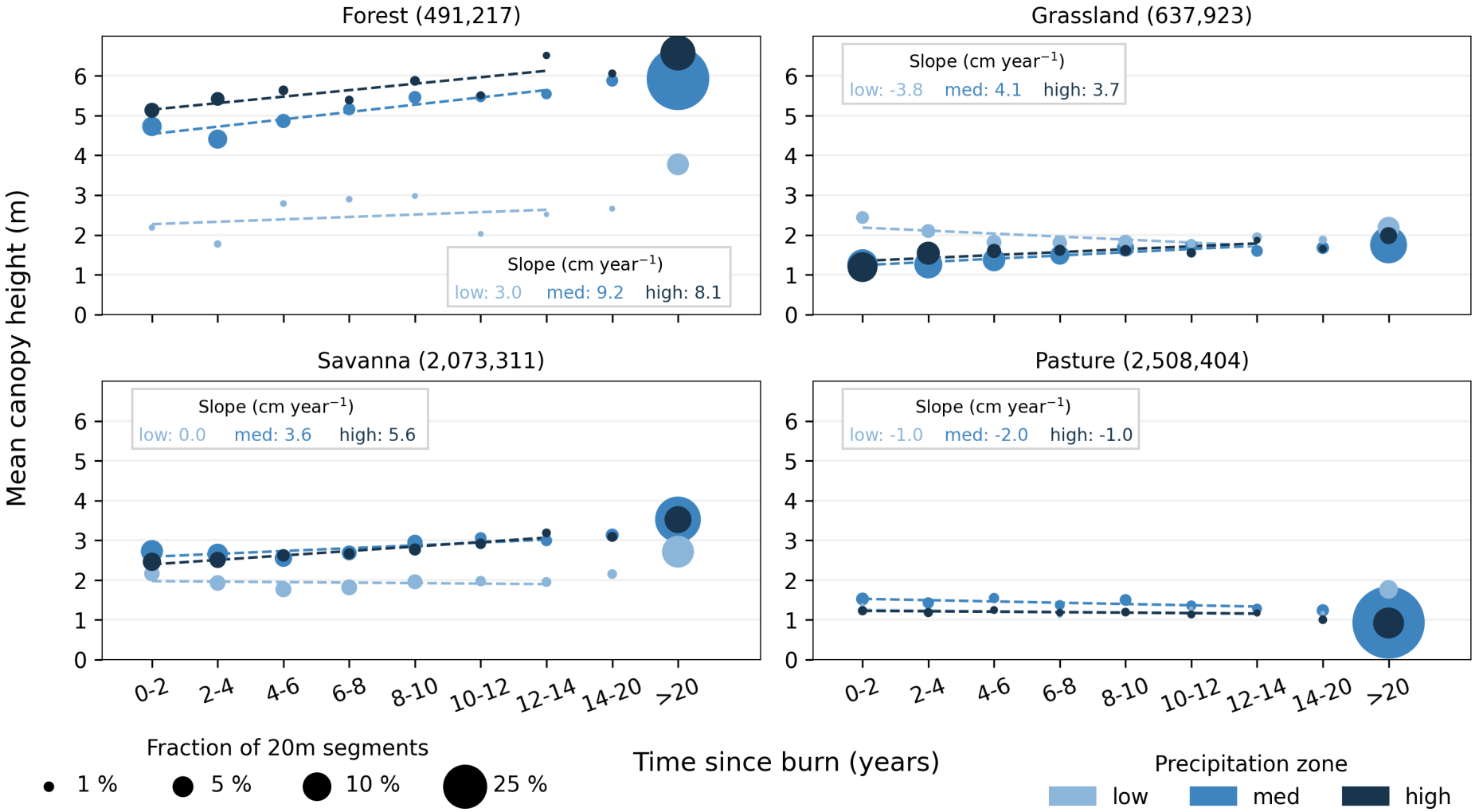
Space-for-time substitution approach

- Grouped areas that experienced similar fire activity and time since last fire.
- Compare the distribution of ICESat-2 derived canopy heights and canopy cover for those grouped areas by land cover type and precipitation zone.

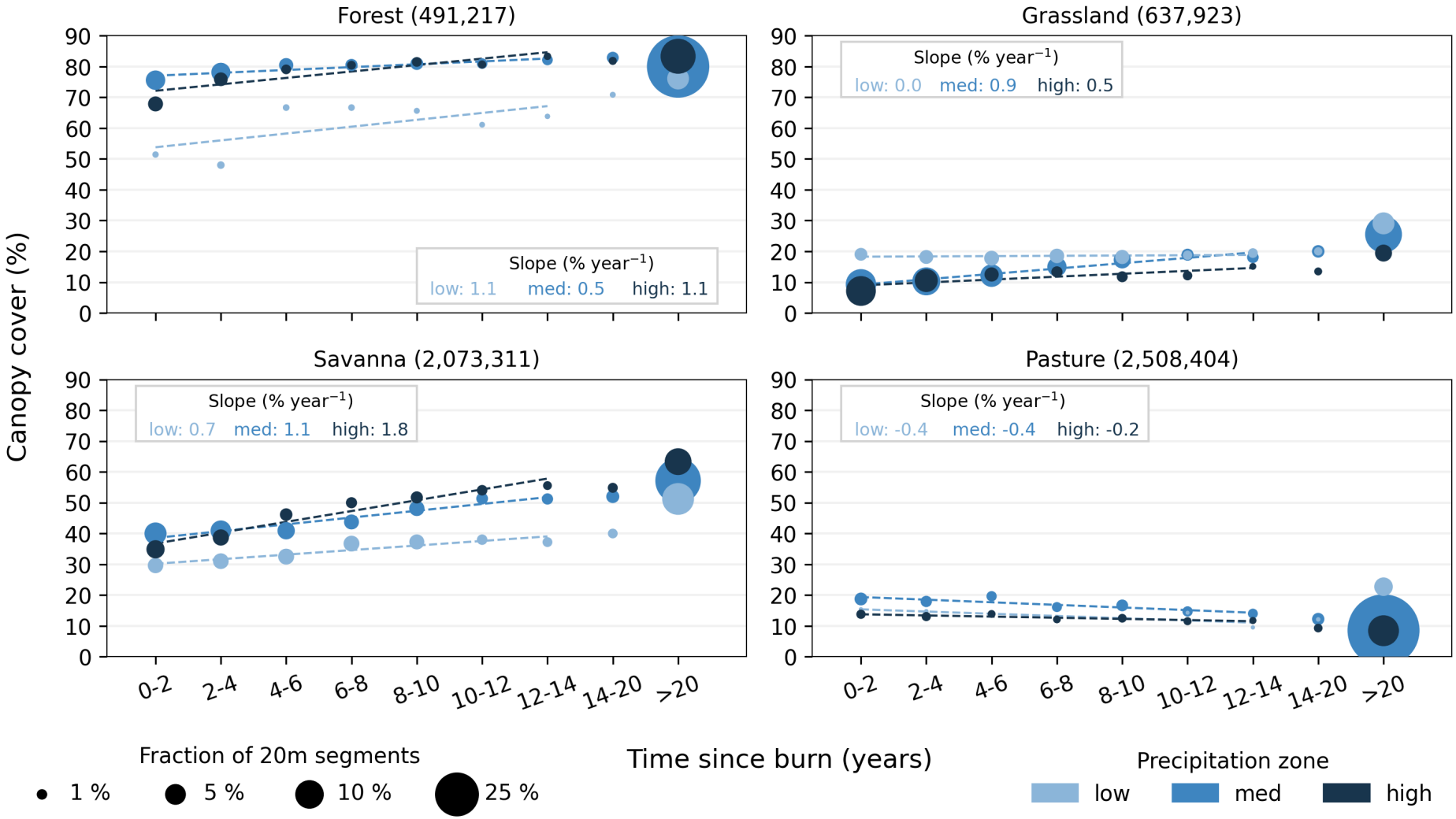
Mean canopy heights decrease with increasing burn freq.



Long time scales (> 20 years) of canopy height recovery



Recovery of canopy cover is quicker for forests (4-6 years)

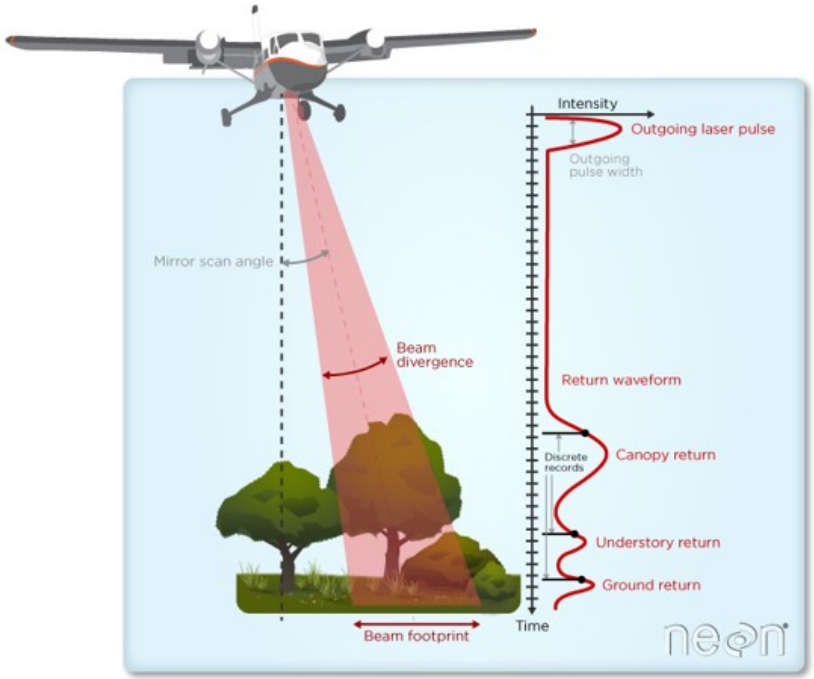


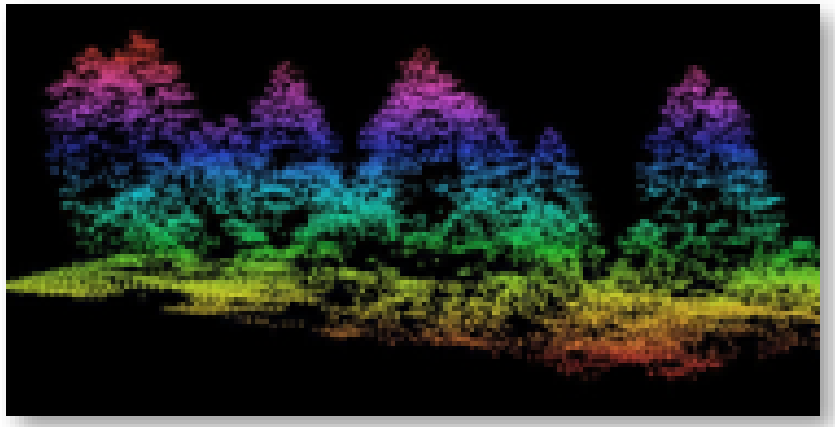
Summary

- Fire regimes differ widely in managed and unmanaged landscapes.
- Mean canopy heights and percent canopy cover derived from ICESat-2 lidar data capture differences in vegetation structure across the Cerrado.
- Mean canopy height and percent canopy cover decreased with increasing burn frequency, with the greatest decline observed for woody savannas and forests.
- While canopy heights continue to recover for > 20 years post fires, recovery of fractional cover for forests is much faster (about four to six years).

Ongoing work

Study changes in vegetation structure post fires at NEON sites in California using small-footprint airborne lidar.





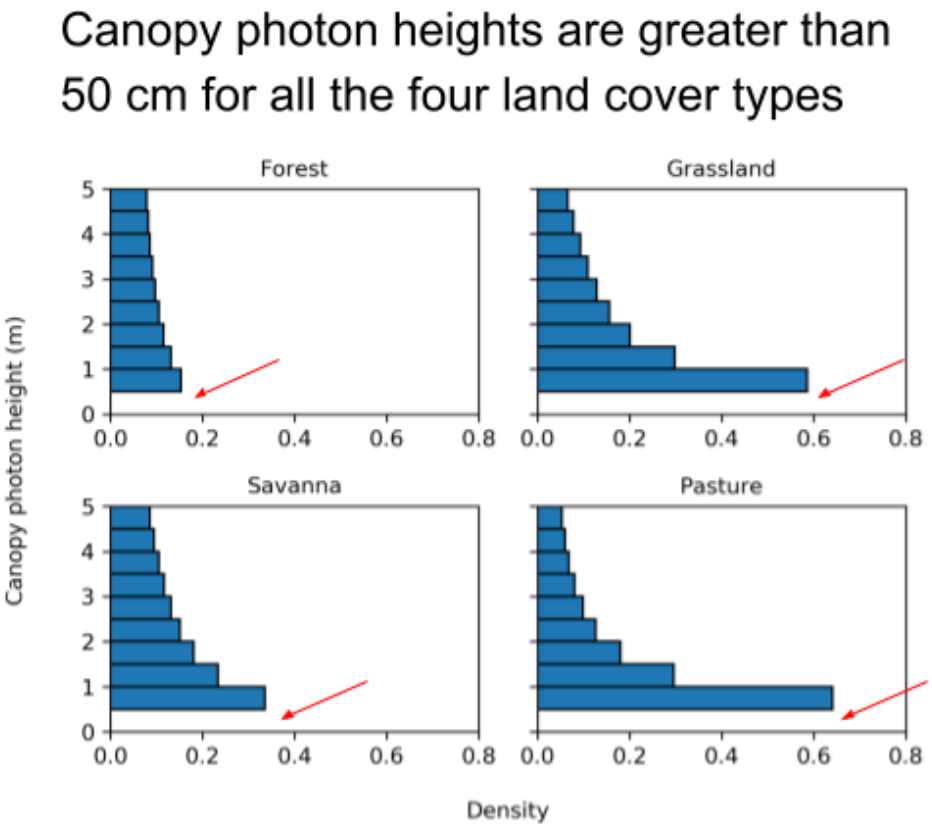
Acknowledgements

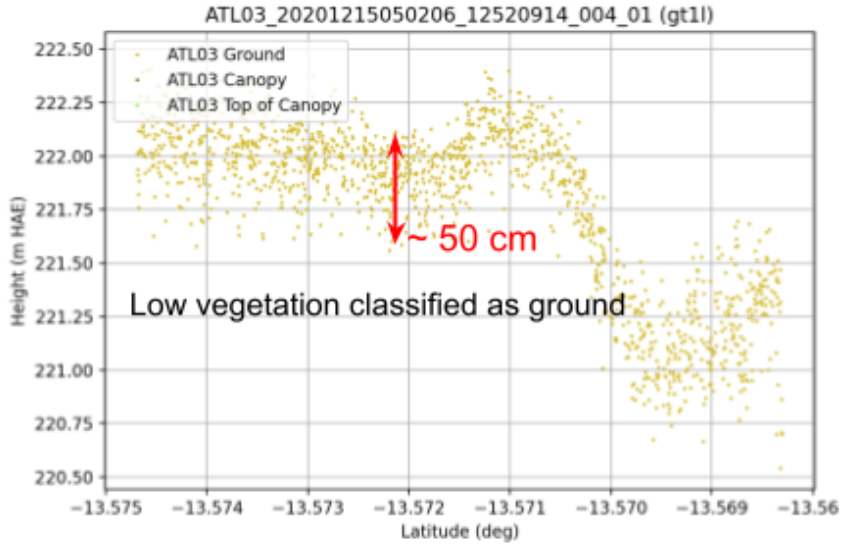
Funding for this research was provided by the NASA ICESat-2 Science Team (Grant 80NSSC20K0967). We thank the MapBiomas team for their willingness to share data on land cover and land use change in Brazil.

Citation: Venkata Shashank Konduri, Douglas Morton, Niels Andela. Tracking Changes in Vegetation Structure Following Fire in the Cerrado Biome using ICESat-2. ESS Open Archive. June 16, 2022.
DOI: 10.1002/essoar.10511641.1

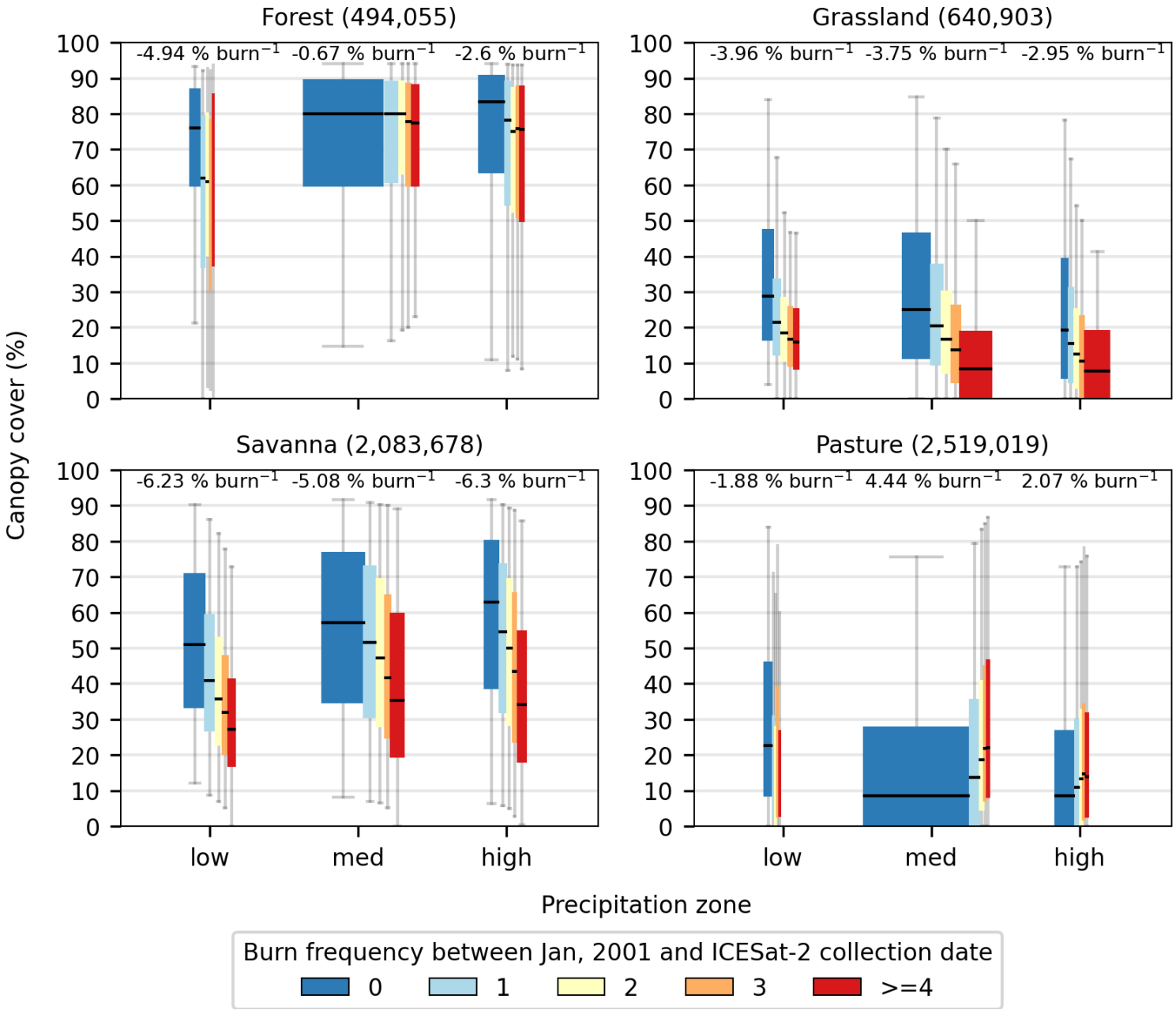
Appendix

Capturing low vegetation ($<$ 50cm) remains a challenge



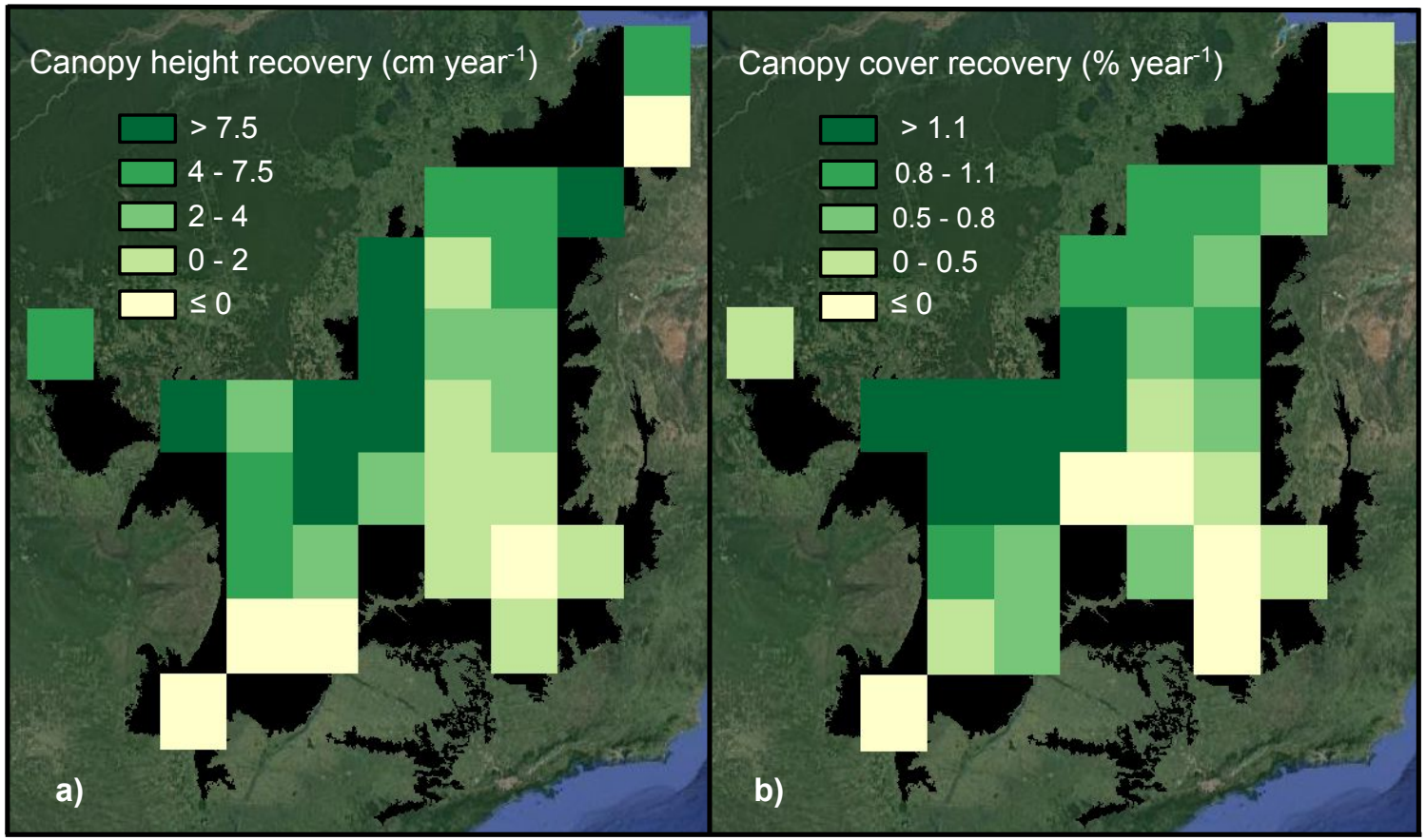


Fractional cover decreases with increasing burn freq.

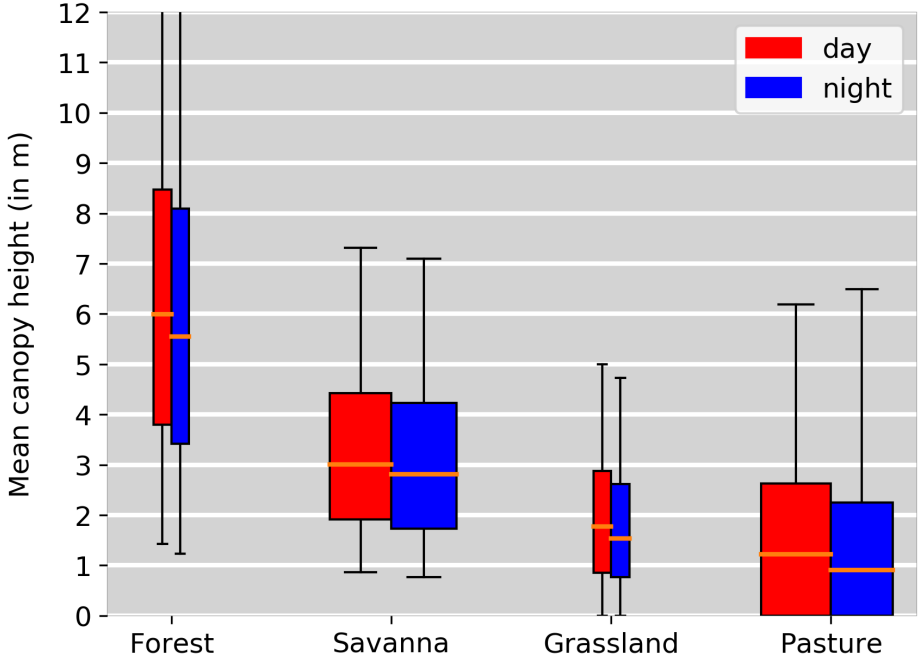


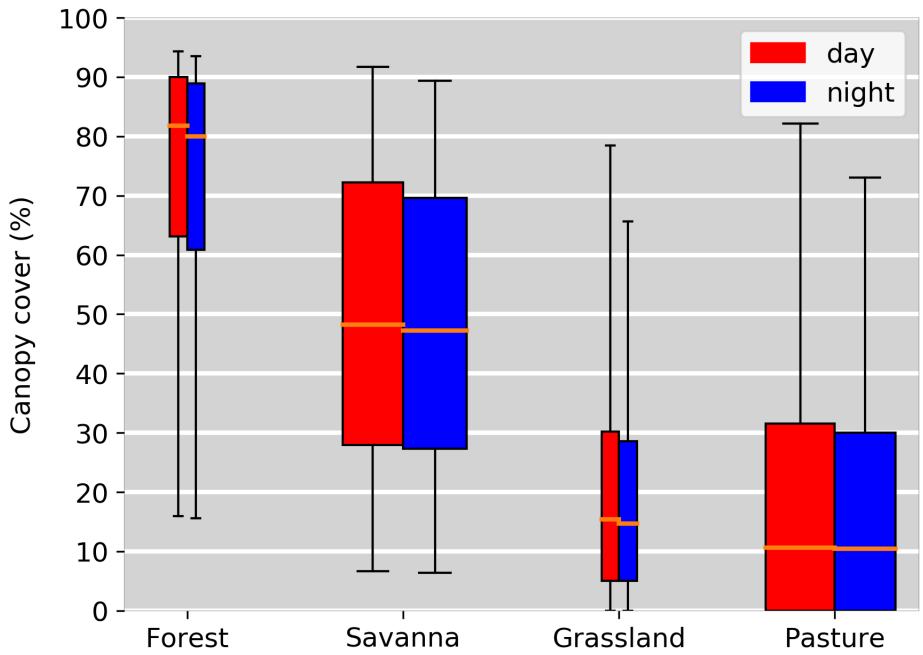
Higher recovery values in areas receiving more rainfall

Spatial maps of a) canopy height and b) canopy cover recovery for Savannas at 2^o resolution shows a clear east-west gradient.



$\sim$ 20cm bias between daytime and nighttime heights





Differences in dry and wet season fractional cover