National Aeronautics and Space Administration

Vegetation structure estimation over California

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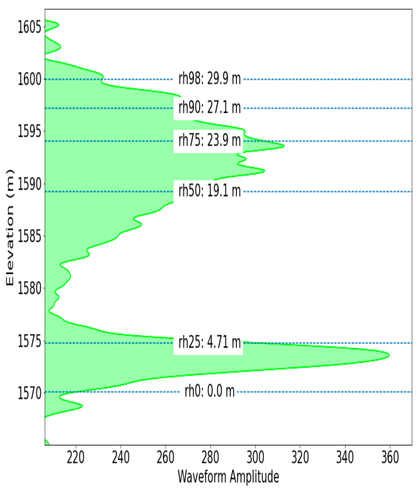
Context

- Environmental pressure on forests in California (CA)
- CA forests 13M ha , >800 Tg Carbon stored, world highest trees (>100 m)
- Need to assess forest fuel loads, and also improve carbon stocks estimates
- Relies on forest structure mapping: Canopy top height, vegetation vertical profile

Wildfire at Lick Creek, Umatilla National Forest, Oregon, United States

Goal: Create a **wall-to-wall map** of **vegetation structure** metric from **GEDI** data using ancillary **satellite datasets**.

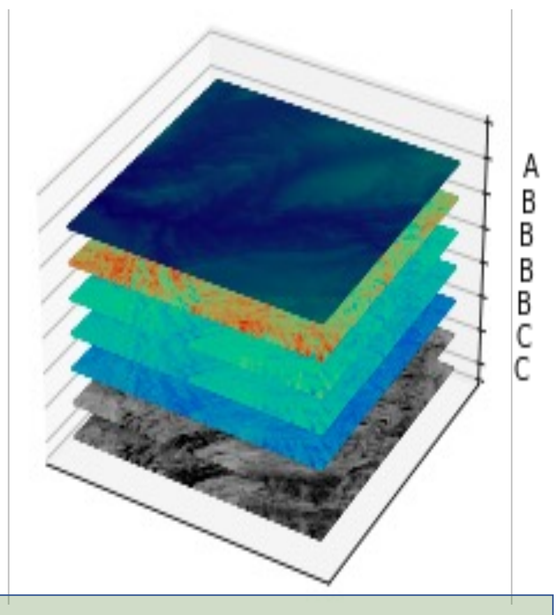
Global Ecosystem Dynamics Investigation (GEDI) [1]



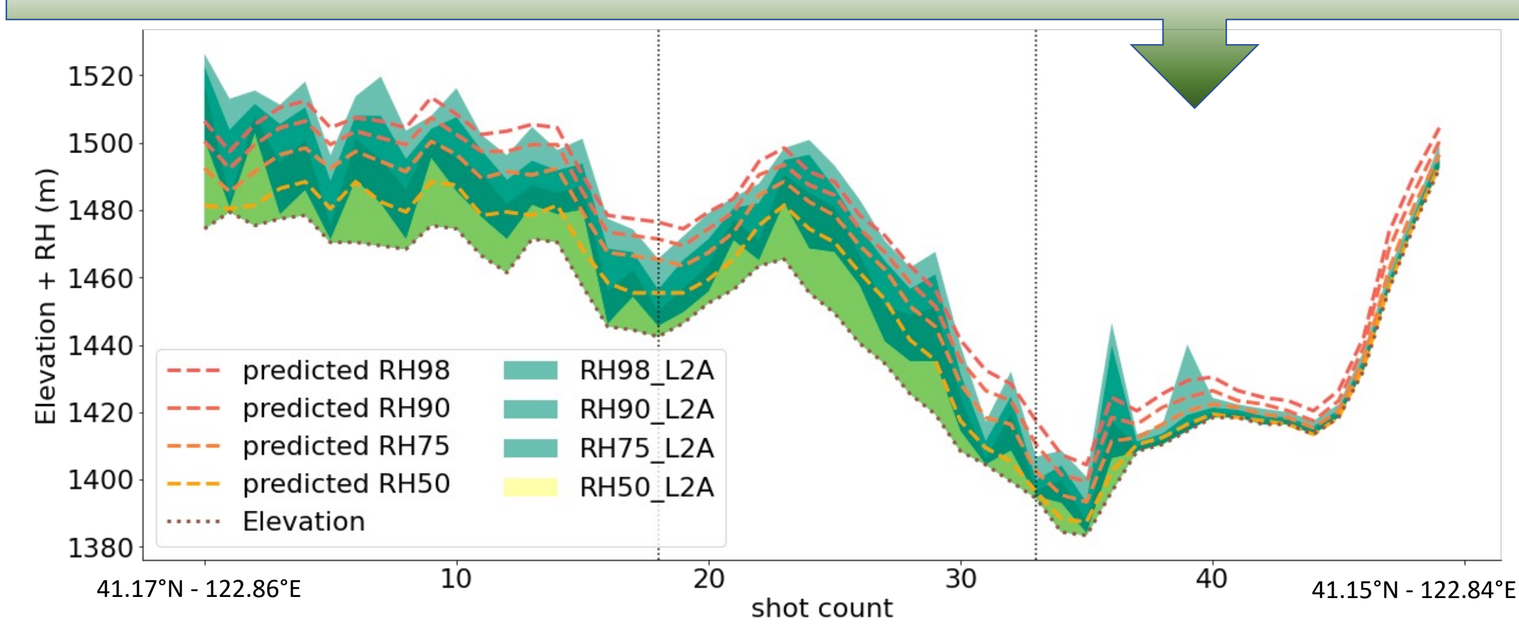
- Full Waveform LiDAR, ~25m footprint
- Onboard the ISS since 2019
- L2A processing: multiple relative heights metrics represent the fraction of energy returned below a certain height: 98% of Waveform energy below RH98 (associated with canopy top height)
- Low sampling every 60 m, 600 m apart: globally ~3% coverage

Satellite data sources

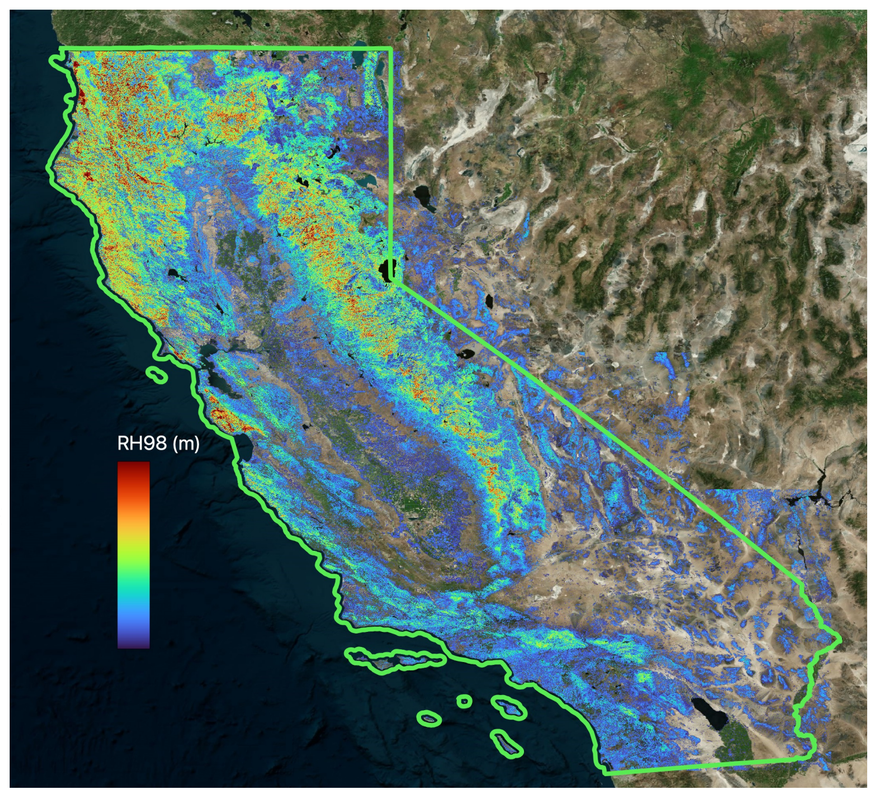
A) Digital elevation model (Copernicus, 30 m)
B) Landsat8 (Red, SWIR, IR1, IR2)
C) ALOS PALSAR 2 (HH, HV), 25m resolution



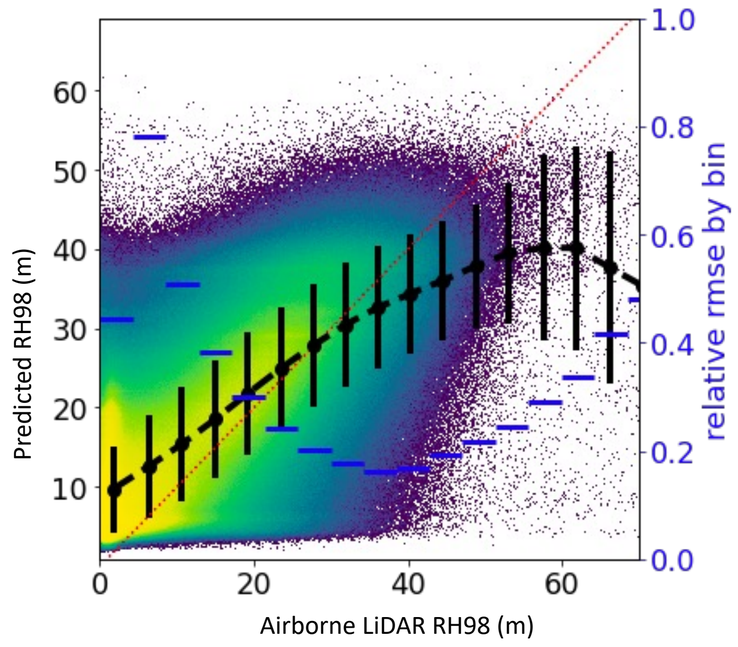
Model : CNN U-net-like (3 levels deep) + post-processing steps (inland water bodies, urban and non-forest removal)
60K 128x128 tiles, 100 epochs



A transect of a sample of GEDI L2A metrics (RH50, 75, 90, 98) in green shades, overlayed with predicted heights by the model (orange dashed lines).



Predicted map over California of RH98 from 0 to 50 m



Scatter plot of the predicted RH98 against the canopy top height over the Sierra Nevada (-119.5°E 37.7°N /-118.3°E 36.5°N) from an airborne LiDAR campaign.

Results:

- Root mean squared error on the validation data <6 m for RH98
- Californian map provided to be used as input to fuel load or carbon stock estimation models

Improvements

- Correcting discrepancies between airborne LiDAR and GEDI training data
- Improving the underestimation of very high canopies
- Extension to a global scale (with reduced spatial resolution)

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References:

1. Dubayah, R., M. Hofton, J. Blair, J. Armston, H. Tang, S. Luthcke. GEDI L2A Elevation and Height Metrics Data Global Footprint Level V002. 2021, distributed by NASA EOSDIS Land Processes DAAC, https://doi.org/10.5067/GEDI/GEDI02_A.002. Accessed 2022-10-06.

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