Predicting biomass over large areas from GEDI lidar footprints

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Science Question

NASA's GEDI (Global Ecosystem Dynamics Investigation) Mission uses lidar to sample the Earth's surface at 25-m footprints (see figure). GEDI needs a method for making statistically viable biomass estimates for larger areas, accounting for uncertainty due to GEDI's sample and the fact that biomass is modeled, not measured, at each GEDI footprint.

Analysis

Using airborne lidar collected under a preceding CMS project (Cohen, 2012), we simulated GEDI waveforms and tested an approach to biomass inference called hybrid model-based estimation.

Results

Hybrid estimates of mean biomass are unbiased in the GEDI context, and estimates of the variance around those means are asymptotically unbiased (slightly low when only two or three overpasses are available).

Significance

Hybrid inference appropriately accounts for two important sources of uncertainty: how accurately GEDI predicts biomass at the footprint level; and how much of the target area is actually measured. Like all remote sensing-based approaches, hybrid inference is limited by a lack of field data in some areas.
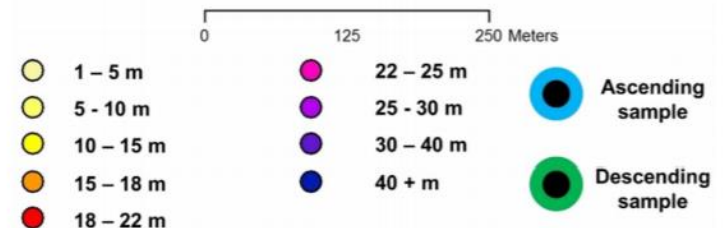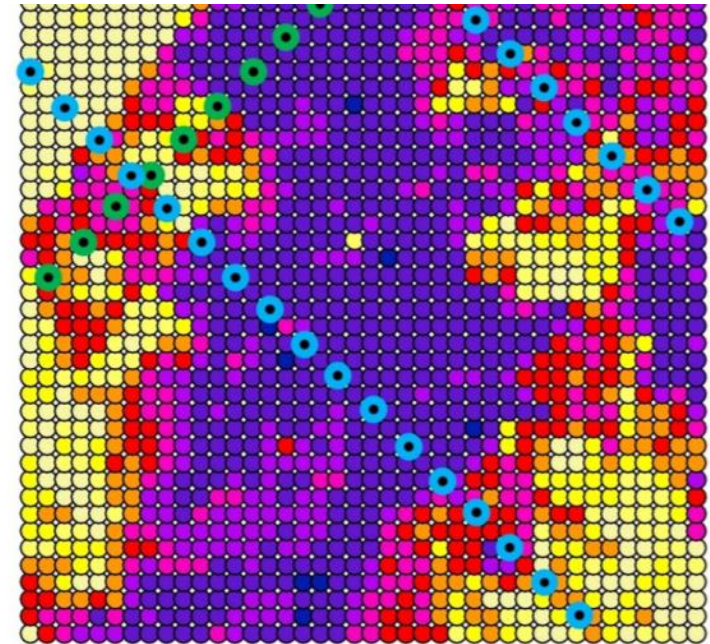
GEDI's lidar based system will provide 25-m measurements of canopy height in a lattice pattern around the world. Our work shows that hybrid inference is an appropriate way to use those measurements to infer biomass in larger areas.