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Author: Mr. Alexander Killion
University of Michigan, Ann Arbor, United States

USING NASA'S GEDI MISSION TO MEASURE PLANT AND ANIMAL BIODIVERSITY

Abstract

For decades, remote sensing technologies have provided vital information on the two-dimensional characteristics of Earth's biodiversity and have advanced global change science and conservation. Although the three-dimensional structure of land cover strongly influences ecosystem function, rarely are these data integrated into research. This is because airborne light detection and ranging (LiDAR) data have only been available from airborne or terrestrial sensors at the resolutions necessary for ecological inference. Due to the small-extent and high cost of deploying these sensors, three-dimensional characteristics of ecosystems have been missing in ecological models. For the first time, NASA's Global Ecosystem Dynamics Investigation (GEDI), affixed upon the International Space Station, is collecting full-waveform LiDAR data and presents an unprecedented opportunity for measuring global change. However, while GEDI's extent is near-global, the coverage is not wall-to-wall. Thus, the degree that GEDI can accurately estimate three-dimensional ecosystem structure is unknown. In 2020, I used the first releases of GEDI to test its ability to quantify plant and animal diversity in a mountain system in the American West. For the first time, GEDI was used to estimate indices of morphological functional diversity and was validated with existing airborne LiDAR data. The accuracy of GEDI was largely dependent on terrain ruggedness, slope, and aspect. A scaling dependency was also present, where the grain size and density of GEDI data significantly influenced the accuracy of functional diversity indices. To test the contributions of GEDI to explain habitat-wildlife relationships, I also estimated wildlife diversity, occupancy, and abundance of over 25 wildlife species (e.g., large carnivores, small carnivores, ungulates, and small mammals). Each of these groups uses different forms of habitat structure. GEDI habitat measurements were statistically significant for some wildlife groups but were often highly correlated with other remotely sensed habitat measurements. This presents new challenges in untangling the specific contributions and effects of vegetation structure to ecosystem processes. I present how GEDI data, with appropriate methodologies, can improve our understanding of wildlife-habitat relationships, an important indicator for ecosystem-scale biodiversity functioning. I also present limitations and next steps for scaling up GEDI indices to the global scale to map biodiversity and measure new forms of global change.