

G-LiHT: Goddard's LiDAR, Hyperspectral and Thermal Airborne Imager

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Abstract

Scientists at NASA's Goddard Space Flight Center have developed an ultra-portable, low-cost, multi-sensor remote sensing system for studying the form and function of terrestrial ecosystems. G-LiHT integrates two LIDARs, a 905 nm single beam profiler and 1550 nm scanner, with a narrowband (1.5 nm) VNIR imaging spectrometer and a broadband (8-14 μm) thermal imager. The small footprint ($\sim 12\text{cm}$) LIDAR data and $\sim 1\text{ m}$ ground resolution imagery are advantageous for high resolution applications such as the delineation of canopy crowns, characterization of canopy gaps, and the identification of sparse, low-stature vegetation, which is difficult to detect from space-based instruments and large-footprint LiDAR. The hyperspectral and thermal imagery can be used to characterize species composition, variations in biophysical variables (e.g., photosynthetic pigments), surface temperature, and responses to environmental stressors (e.g., heat, moisture loss). Additionally, the combination of LIDAR, optical, and thermal data from G-LiHT is being used to assess forest health by sensing differences in foliage density, photosynthetic pigments, and transpiration. Low operating costs ($\sim \$1\text{ ha}$) have allowed us to evaluate seasonal differences in LiDAR, passive optical and thermal data, which provides insight into year-round observations from space. Canopy characteristics and tree allometry (e.g., crown height:width, canopy:ground reflectance) derived from G-LiHT data are being used to generate realistic scenes for radiative transfer models, which in turn are being used to improve instrument design and ensure continuity between LiDAR instruments. G-LiHT has been installed and tested in aircraft with fuselage viewports and in a custom wing-mounted pod that allows G-LiHT to be flown on any Cessna 206, a common aircraft in use throughout the world. G-LiHT is currently being used for forest biomass and growth estimation in the CONUS and Mexico in support of NASA's Carbon Monitoring System (CMS) and AMIGA-Carb (AMERICAN Icesat GLAS Assessment of Carbon). For NASA's CMS, wall-to-wall G-LiHT data have been acquired over intensive study sites with historic LiDAR datasets, dense inventory data, stem maps and flux tower observations. For AMIGA-Carb, G-LiHT transects have been acquired over ICESat tracks and USDA-FS inventory plots throughout the CONUS, and similar data will be acquired in Mexico during 2013. This talk will highlight recent science results from continental-scale transects landscape-scale deployments of G-LiHT, as well as seasonal forest dynamics from repeat pass G-LiHT acquisitions.