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

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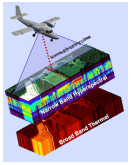
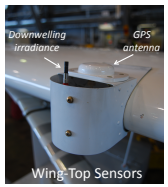
G-LiHT Concept



***G-LiHT** is a portable airborne system that simultaneously maps the composition, structure and function of terrestrial ecosystems.*

Relevance to NASA Earth Science

1) Fusion of 3D LiDAR data and 2D hyperspectral/thermal imagery provides a new, **synergistic method for studying ecosystem structure and function**.
   - ✓ *LiDAR* provides information on **vegetation structure**.
   - ✓ *Hyperspectral and thermal imagery* provides information on **ecosystem composition and health**.
2) "Data fusion" often requires coincident data in time and space; thus, "instrument fusion" can be viewed as a **prerequisite to data fusion**.
3) Data fusion can enhance the science objectives of planned decadal survey missions, including **ICESat-2 and HyspIRI**.



G-LiHT was designed to…

- ✓ acquire fine-scale (<1 m), co-registered LiDAR/optical/thermal data for ecosystem studies
- ✓ simplify worldwide deployment
- ✓ minimize collection costs

…and features:

- ✓ eye safe lasers
- ✓ portability (compact, lightweight)
- ✓ single solution GPS-INS
- ✓ up/downwelling spectrometers
- ✓ ease of installation on common, civilian-use aircraft
- ✓ non-ITAR (Int'l Traffic in Arms Regulation) instruments

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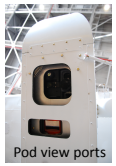
Technical Specifications

Compatible with Various Airborne Platforms

1) "Low-and-slow" aircraft (e.g., Cessna, Piper, Twin Otter)
2) Two installation options:
   - ✓ Wing-mounted pod (mounts to any Cessna 206)
   - ✓ Standard camera port inside cabin



Integrated "Off-the-Shelf" Instrumentation*

① **Scanning LiDAR** (Riegl VQ-480)
50-300 kHz; 1550 nm; onboard waveform processing

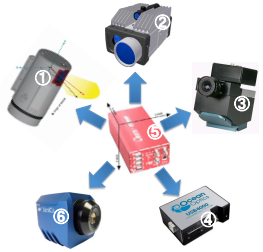
② **Profiling LiDAR** (Riegl LD321-A40)
10 kHz; 905 nm; up to 5 returns per laser shot

③ **VNIR imaging spectrometer** (Headwall Hyperspec)
50 Hz; 0.4 to 1 µm, 1.5 nm resolution; pushbroom array

④ **VNIR irradiance spectrometer** (Ocean Optics USB4000)
1 Hz; cosine diffuser mounted above wing

⑤ **Thermal imager** (Xenics Gobi-384)
25 Hz; non-cooled microbolometer, 8 to 14 µm

⑥ **GPS-INS** (Oxford RT-4041 with OmniStar HP)
250 Hz; 10 cm position, 0.1° yaw, 0.03° roll/pitch accuracy



Overall Physical Specifications

Size (W×H×L): 30 × 30 × 60 cm
Weight: 37 kg (G-LiHT); 10 kg (pod)
Power: 210 W (7.5 A, 28 VDC)

** Specific trade names are for informational purposes only and do not constitute an endorsement by NASA.*

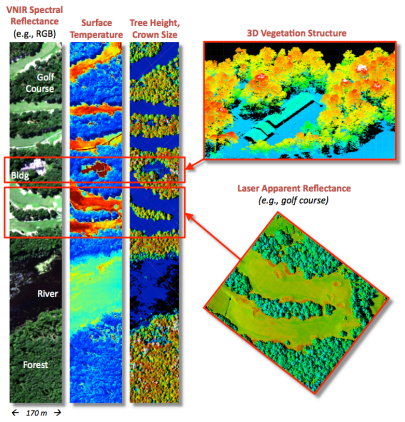
Demonstration Project

Acquisition Details

Date: June 2011
Altitude: 335 m AGL
Swath: ~170 m
Resolution: ≤1 m
Data acquisition rate: ~50 MB/s (1 TB per day)

Ecosystem, Stand, and Tree-Level Observations

The complementary nature of LiDAR, optical and thermal data is immediately apparent in a single flight line over contrasting cover types and within seemingly similar forest stands.



*Support for G-LiHT I&T and this demonstration project were provided by **NASA-GSFC Internal Research and Development (IRAD)**, in partnership with **NASA-LaRC Research Services Directorate (RSD).***

CC&E Support

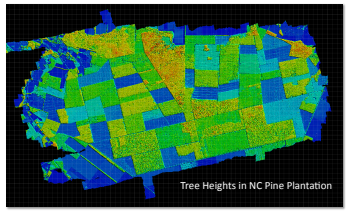
G-LiHT currently supports two of NASA's CC&E projects:

American ICESat/GLAS Assessment of Carbon

Nelson *et al.*, 2011-13, NASA Carbon Cycle Science

NASA's Carbon Monitor System (CMS)

Tucker *et al.*, 2011-12, NASA CMS Biomass Pilot Project



Open-Access Data

Standard data/products

- ✓ Classified point cloud data (LAS format)
- ✓ Ground elevation, canopy height, return metrics (Geotiffs)
- ✓ Vegetation indices and spectral bio-indicators (e.g., NDVI, EVI, PRI, red-edge)
- ✓ Reflectance spectra
- ✓ Surface temperature
- ✓ Derived ecosystem products (e.g., biomass, LAI, GPP, ANPP)
- ✓ Associated ground data (where available)

G-LiHT Website *(coming soon!)*

http://forest.gsfc.nasa.gov

For additional information, please contact Bruce Cook at **bruce.cook@nasa.gov**