G-LiHT Concept

NASA Goddard’s Lidar, Hyperspectral and Thermal (G-LiHT) is a portable airborne imaging system that simultaneously maps the composition, structure, and function of ecosystems using:

- **Lidar** to provide 3D information about the vertical and horizontal distribution of foliage and other canopy elements;
- **Imaging spectroscopy** to characterize species composition and variations in biophysical variables (e.g., photosynthetic pigments, nutrient and water content); and
- **IR Thermal camera** to detect vegetation heat and moisture stress, and edaphic conditions such as inundated and frozen soils.

G-LiHT enables **data fusion studies** by providing coincident data in time and space, and provides fine-scale (1 m) observations over large areas that are needed in many ecosystem studies.

### Instrument Specifications

![G-LiHT installed on Piper Cherokee in Alaska, USA](image)

**MEASUREMENT CHARACTERISTICS**

- **Scanning Lidar**
  - Field of view (FOV): 180° x 360°
  - Horizontal field of view (HFOV): 5°
  - Vertical field of view (VFOV): 25°
  - Return rate: 600 to 1,200 m/s
  - Pulse rate: 5 to 15 Hz

- **Imaging Spectrometer**
  - Field of view (FOV): 2° x 2°
  - Spatial resolution: 3 to 5 m
  - Spectral range: 380 to 2,500 nm
  - Sample rate: 1 Hz

- **IR Thermal Camera**
  - Field of view (FOV): 30° x 30°
  - Spatial resolution: 3 to 5 m

**Laboratory and Vicarious Calibration**

Routine boresight alignment and radiometric calibration is critical to data fusion and up-scaling to space-based sensors. A portable version of NIST’s laser-based Spectral Irradiance and Radiance responsively Calibrations using Uniform Sources (SIRCUS) is used to generate absolute radiometric response functions in 1 nm increments across portions of the VNIR spectrum, and in situ ground-based observations are used for radiance temperature.

![SIRCUS](image)

**User Friendly, Open Access Data Products**

- Lidar point clouds (classified returns and feature heights)
- Bare earth elevation and canopy height models (DTM, CHM)
- Common Lidar metrics (e.g., return height & density stats)
- Radiance spectra (400-920 nm, 4.5 nm sampling interval)
- At-Sensor reflectance using observed irradiance spectra
- Common greenness and pigment vegetation indices
- Radiant surface temperatures (°C)

### G-LiHT Acquisitions

Since 2011, G-LiHT has been used to acquire more than 2 million ha of data in Alaska, CONUS, and Mexico for a broad range of research projects and satellite missions.

![G-LiHT at-sensor reflectance draped over canopy elevation at Duke Forest, NC](image)

**2015-17 campaigns planned for coastal wetlands, mangroves and tropical forests in Florida, Bahamas, and Puerto Rico.**

### G-LiHT Science

**Forest Biomass Stocks, Growth and Disturbance**

**AMIGA-Carb: American ICESat/GLAS Assessment of Carbon**

**G-LiHT and Landsat “Space-for-Time” Forest Growth Rates**

*E.g., Parker Tract Loblolly pine plantation, NC*

**Forest Health (e.g., Emerald Ash Borer)**

![Emerald Ash Borer detections in North America (1 April 2015)](image)

**Mission Support**

**Characterization of Calibration Sites and Satellite Intercalibration**

- **Calibration sites:**
  - Railroad Valley; Ivanpah; Alkali Lake, NV
  - Red Lake & McLaws, AZ
  - Algodones Dunes, CA

- **Satellite underpasses:**
  - Landsat 7, 8
  - EO-1

For data, publications and more information, go to [http://gliht.gsfc.nasa.gov](http://gliht.gsfc.nasa.gov) or email bruce.cook@nasa.gov