Terrestrial Vegetation Monitoring

Network parks where resource is being monitored:

All GULN parks (BITH, GUIS, JELA, NATR, PAAL, PAIS, SAAN, and VICK)

Importance

Terrestrial vegetation is a key monitoring focus in all Gulf Coast Network parks. Ecologically speaking, vegetation forms the essential core and foundation for most terrestrial ecosystems, and the status and function of vegetation components are central to the function of these systems. The GULN is developing, in collaboration with the USGS, a technology-based, monitoring strategy that will address the vital signs of terrestrial vegetation within each park.

Naval Live Oaks Unit. Gulf Islands National Seashore

Monitoring Objectives

Some of the specific monitoring questions that will be addressed by this protocol include:

- What is the current status, based on physical characteristics (distribution, coverage, canopy height, and density descriptions) of selected vegetation units on sampled parks?
- How are the physical characteristics (canopy properties and in-canopy distribution) of selected vegetation units changing over time in patches on sampled parks?
- What is the current major species composition and per-species distribution in selected vegetation units in selected units or patches on sampled parks?
- How are major species composition and per-species distribution changing in selected vegetation units on sampled parks? Is relative abundance shifting? Are formerly key or dominant taxa declining, and if so, what is replacing them?
- What are the current distributions and area coverage of selected vegetation units on sampled parks?
- How are distributions and area coverage of selected vegetation units changing, in terms of area-covered and specific point and boundary locations, over time on sampled parks?

Pitcher plant bog at Big Thicket National Preserve

Basic Approach

The vegetation protocol consists of two general sampling elements: 1) technology-based sampling to detect structural change in a park's vegetation over time, and 2) a targeted ground-truth survey-based sampling to provide biological correspondence to support the technology-based monitoring. Technology-based sampling will use an airborne lidar (Light Detection And Ranging) system. Data are collected in a fly-over sampling event on a selected park at a specified season and state-of-foliation. The lidar data are geospatially explicit and link to a park's GIS layers with GPS locations. Consequently, structural vegetation metrics will be explicitly spatially linked to other biological data, such as bird and herpetofauna communities. Details on the USGS EAARL lidar sensor, lidar-based vegetation metrics, and vegetation delineation methodologies can be found at: http://ngom.usgs.gov/dsp/index.html

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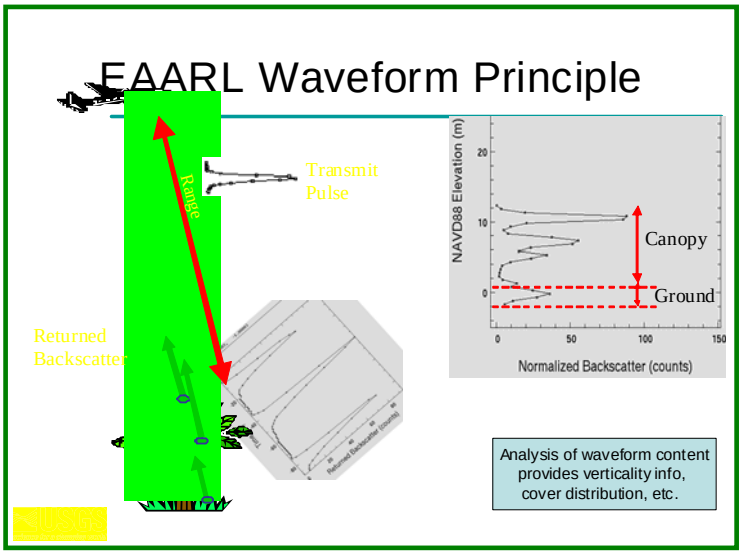
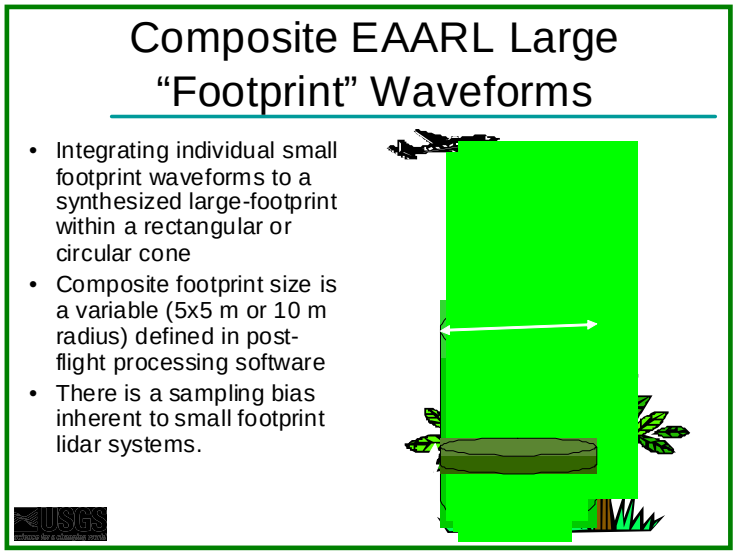
Lidar data are processed using an auto-classification modeling routine which results in a set of multi-variate, 3-dimensional structural patches that represent the sampled vegetation. Each patch belongs to one statistically-distinct class, and has a location and boundary enclosing a recognizable area on the park's landscape. Detection of structural change is via a two-level comparative analysis of lidar models acquired at different times. Level-1 analysis detects changes in the whole-park model. Level-2 analysis is based on the detailed examination of patch and within-patch changes seen at locations specified by park management. Following identification of patches that have experienced structural change, a detailed ground-truth evaluation to reveal explicit biological changes will be performed on changed patches selected for further analysis by park managers. Monitoring will consist of repeating lidar data-collection, modeling, and comparative analysis to detect changes in the size, location, dimension, and class of patches seen on a park's data set.

Ground-truth surveys identify major species composition, distribution, status, and abundance, and are based on standard plant ecological field methods. Ground-truth assessment provides (1) a biological description of patches of management interest, and 2) assessment of biological change in a patch which has shown detectable structural change in model analysis. Ground-truthing will be performed as needed to assess detected change in given patches. For example, a park may elect to assess a patch which exhibits statistically significant change to determine whether the change is of interest. Detected structural changes may indicate species-composition change, the onset of a forest pest, results of a management activity such as fire, or storm-related damage.



The EAARL system sends out a short green wavelength (532nm) laser pulse that has a 20 cm footprint when it begins to interact with the surface (or canopy). The entire time history of the outgoing laser pulse is digitized and stored. As the pulse interacts with the canopy, portions of the energy are reflected from various layers in the canopy. This time history of the reflected energy is digitized by the sensor and stored as a waveform.



At the nominal flying altitude of 300 m, a single EAARL laser pulse illuminates a small horizontal sampling area (20-cm-diameter footprint). As a result, in a forest environment, the information content of the returned laser signal includes a very small portion of the canopy. Hence, a return waveform within a forest canopy may describe the vertical distribution starting from the side of a tree crown versus the top or peak of the crown. This principle is in contrast to large-footprint lidars, where the returned waveform contains information on forest canopy and multiple forest elements rather than individual trees.

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