

Plans for the U.S. National Ecological Observatory Network (NEON):

The Contribution of Remote Sensing

Susan L. Ustin

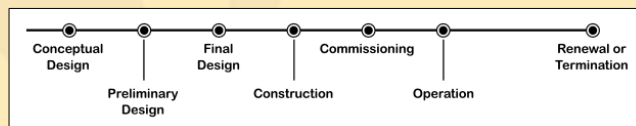
Center for Spatial Technologies and Remote Sensing
University of California Davis



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NEON Goal: Transform Ecological Sciences

- From site-based focus to Continental/Global Science
- 30 year plan to monitor environments to address “8 Grand Research Challenges”
 - NSF Major Research Equipment Facilities Center (MREFC; Infrastructure Program); expected start 2007



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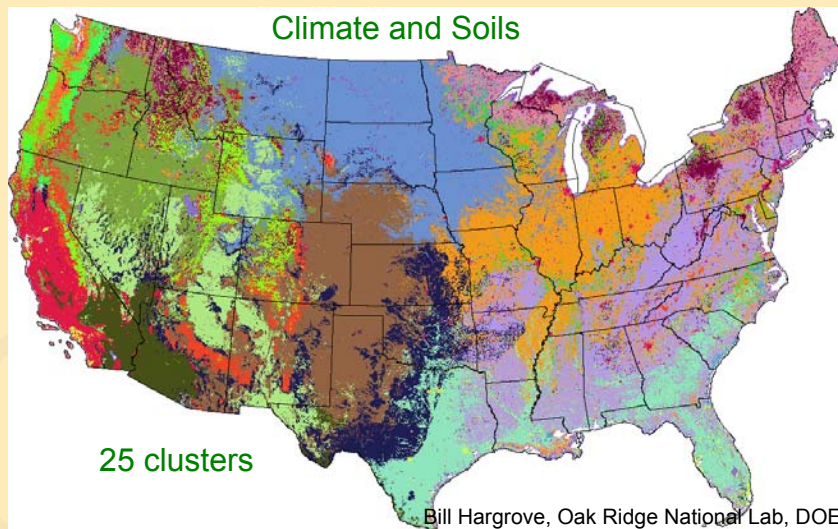
Fundamental NEON Science Challenges

- How will ecosystems and their components respond to changes in natural- and human-induced forcings such as climate, land use, and invasive species?
 - Across a range of spatial and temporal scales?
 - What is the pace and pattern of the responses?
- How do internal responses and feedbacks to biogeochemistry, biodiversity, hydroecology and biotic structure and function interact with changes in climate, land use, and invasive species?
 - How do feedbacks vary with ecological context and spatial and temporal scales?



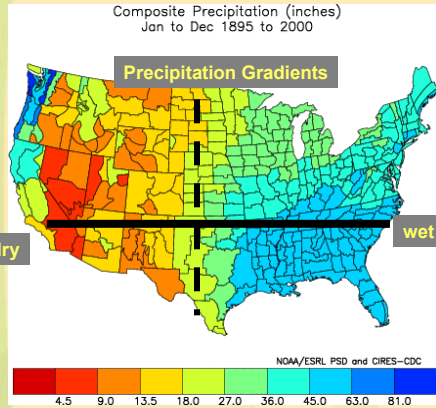
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Site Selection: Evaluation of Environmental Variables

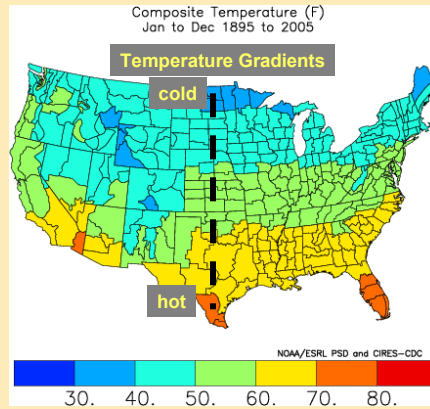


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Continental Gradients: Climate Example



Precipitation amount from dry to wet;
constant mean annual temperature



Mean annual temperature cold to hot;
constant precipitation amount/yr



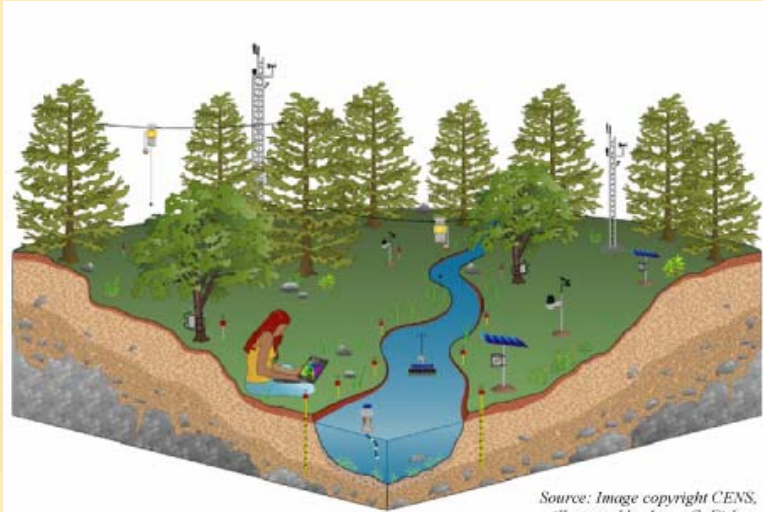
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National Network: 20 NEON Domains: Nested Network of Sites

- 1 Northeast
- 2 Mid Atlantic
- 3 Southeast
- 4 Atlantic Neotropical
- 5 Great Lakes
- 6 Prairie Peninsula
- 7 Appalachians / Cumberland Plateau
- 8 Ozarks Complex
- 9 Northern Plains
- 10 Central Plains
- 11 Southern Plains
- 12 Northern Rockies
- 13 Southern Rockies / Colorado Plateau
- 14 Desert Southwest
- 15 Great Basin
- 16 Pacific Northwest
- 17 Pacific Southwest
- 18 Tundra
- 19 Taiga
- 20 Pacific



Concept of Fundamental Instrument Unit within a NEON Domain

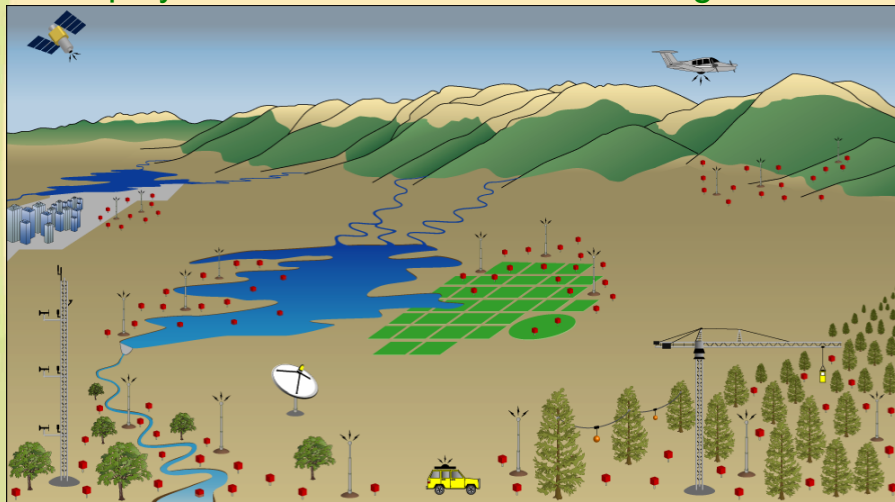


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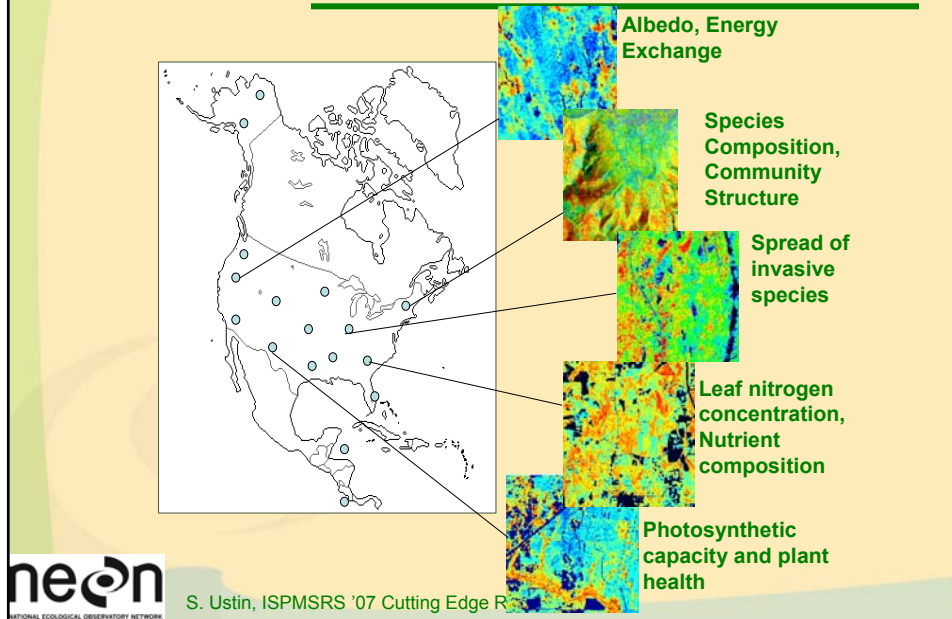
Sensor arrays (canopy microclimate, soil, aquatic), BioMesoNet towers, and other embedded or robotically-controlled sensors are depicted.

Nationally Distributed Observatory Network Deployed across wildlands and urban gradients



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Environmental Monitoring From Airborne Data Systems



NEON Airborne Observatory

Partnerships for Satellite Data Access

- Landsat (now operational), NPOESS, etc.
- possible hyperspectral and/or Lidar satellite imagers

NEON Airborne Plan: Flexible Responses

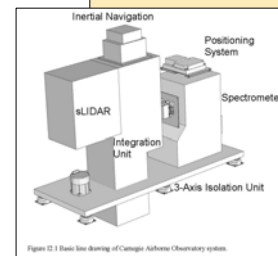
- 2 Continental “Large” packages (reconfigurable components)

Hyperspectral Imager and Full Waveform Lidar

- Annual/biannual mapping
- Supports continental scaling
- Satellite calibration
- Deployable to extreme events like hurricanes, wildfires, pest outbreaks

- 5 Regional “Smaller” packages
 - supports gradients & multi-domain efforts
 - provides dedicated multitemporal data

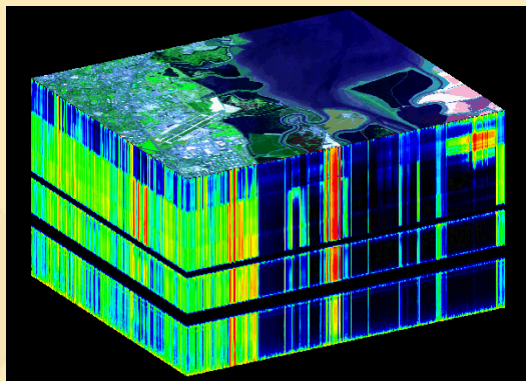
Prototype
Continental
Package



Airborne Observation Platform

Airborne Hyperspectral Data

- Coupling Observations from Site Studies to Satellites
- Monitoring Climate Change Impacts



High Fidelity Imaging Spectrometers with 100s of Narrow Spectral Bands UV to Thermal Wavebands

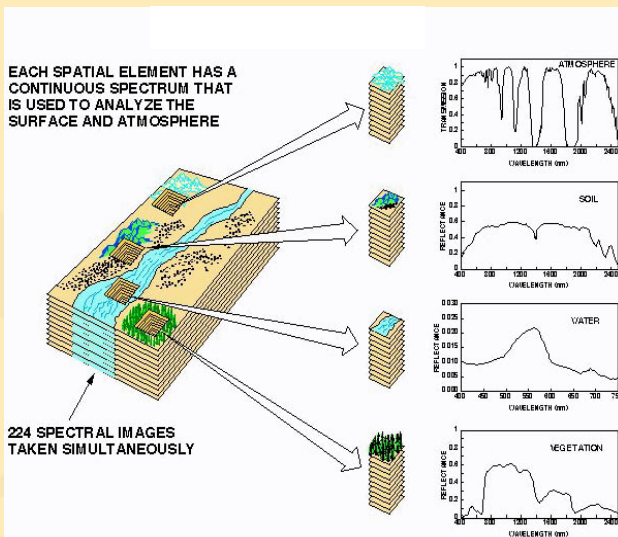


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High-Fidelity Imaging Spectroscopy

Standard NEON Products:

- Vegetation indexes
- Leaf Area Index
- Canopy moisture
- Canopy chemistry (terrestrial and aquatic)
- Canopy pigments (terrestrial and aquatic)
- Spectral unmixing of landscape components
- % cover, NPV, etc.
- Ecological/ Biological diversity maps

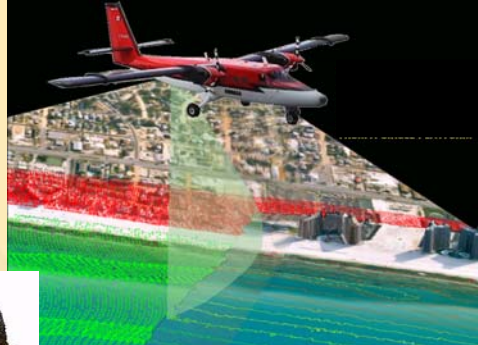


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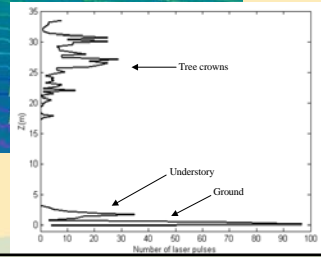
Airborne Observation Platform

Full Wave-form LiDAR

- Vegetation height & distribution of structural elements
- Canopy top topography
- Biomass
- Life form diversity

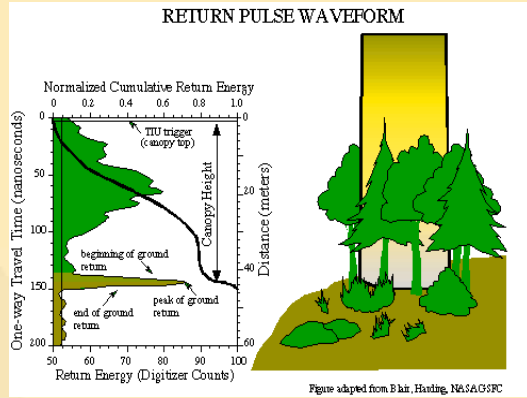
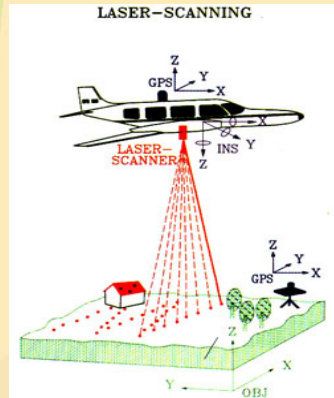


- Ground Topography & Bathymetry



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Imaging LiDAR



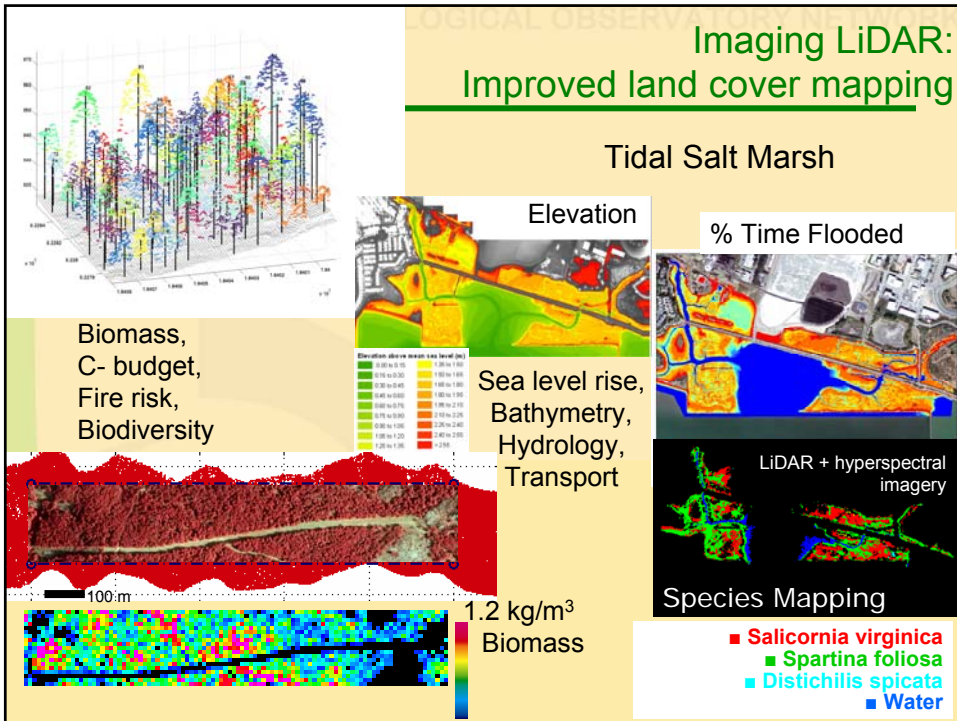
Differential Absorption LiDAR (multiple wavelengths)
Imaging Full Waveform



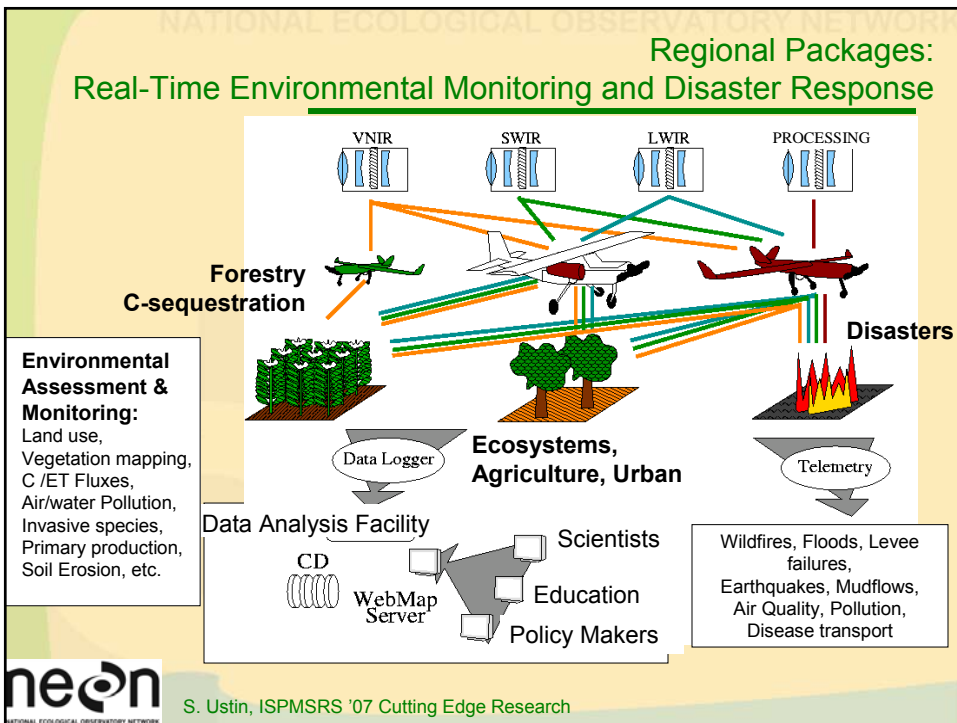
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Imaging LiDAR: Improved land cover mapping

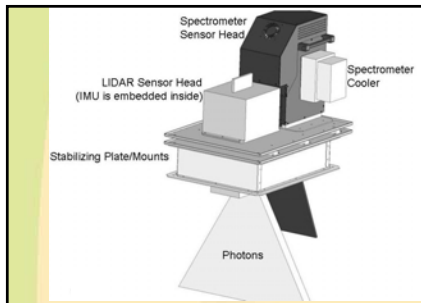
Tidal Salt Marsh



Regional Packages: Real-Time Environmental Monitoring and Disaster Response



NEON Prototype: CAO Aircraft Instrument System



Imaging Spectrometer:

- 400-1050 nm
- 2.3 nm FWHM
- 1500 pixel cross-track
- < 2.0 m GIFOV

LIDAR:

- 100 khz
- Full waveform digitization
- < 0.5 m spot spacing

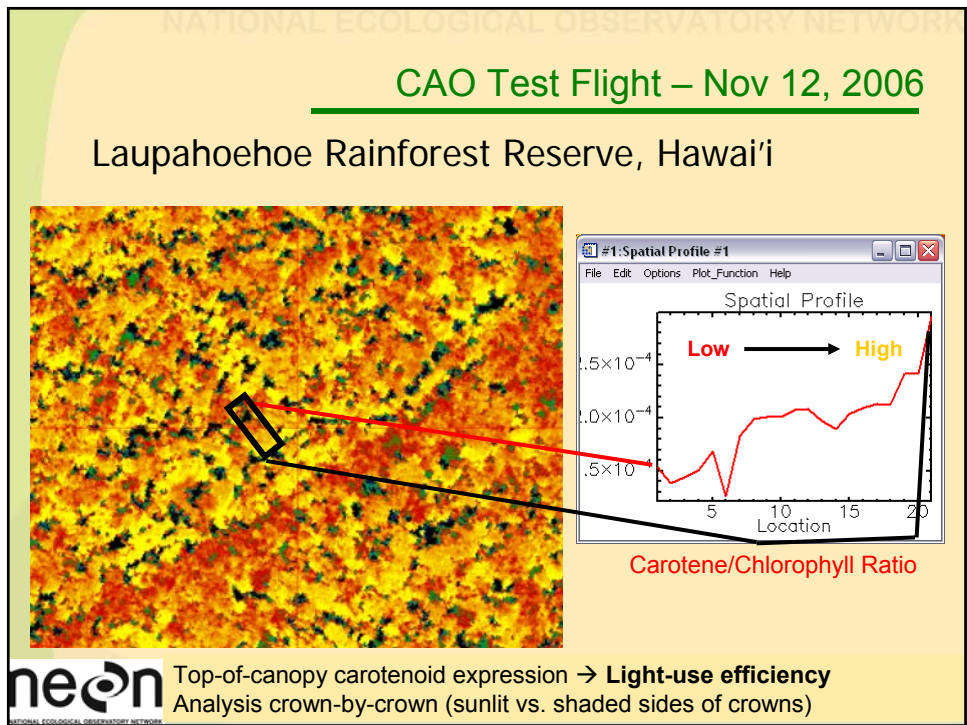
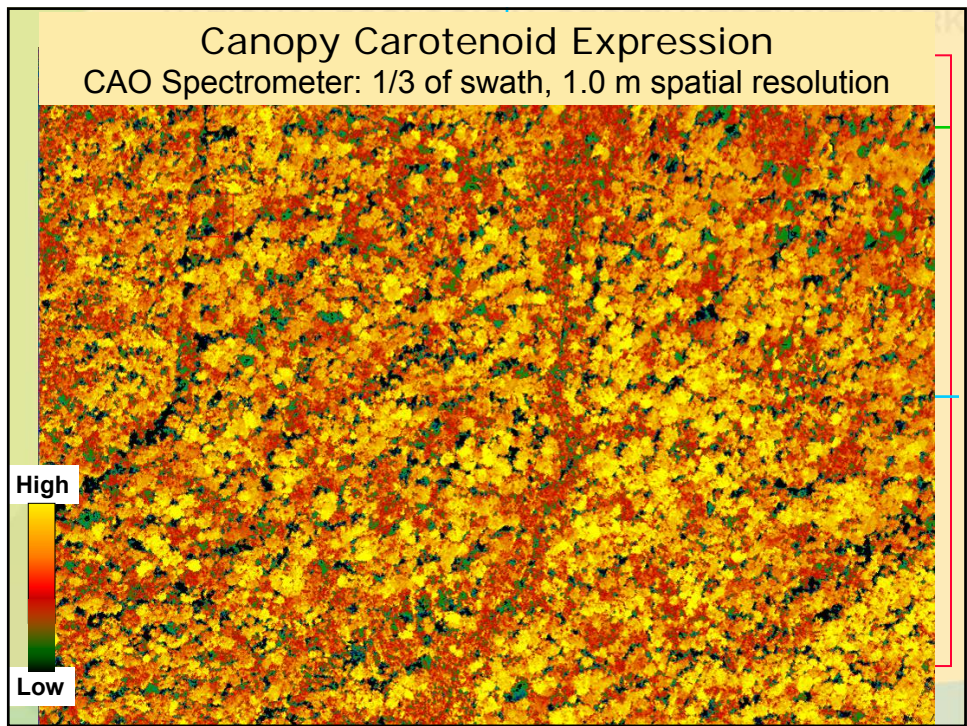
Integration:

- Real-time ortho-georectification
- In-flight atmospheric correction



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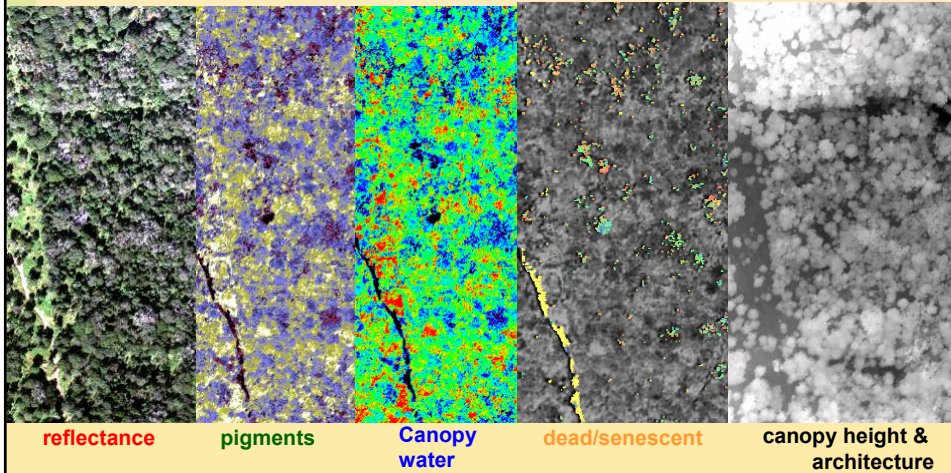


CAO Rapid Data Products

CAO Analysis Products

- Calibrated reflectance spectra
- Canopy pigments
- Canopy water
- Dead/senescent vegetation
- Canopy height and architecture
- Surface topography

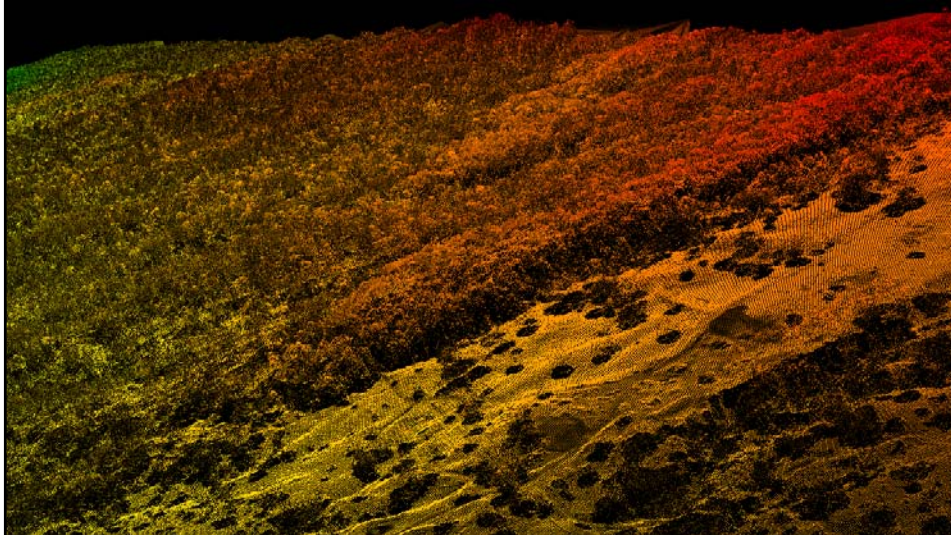
- Aboveground carbon storage
- Net primary production
- Evapotranspiration
- Species dominance
- Species richness
- Invasive species



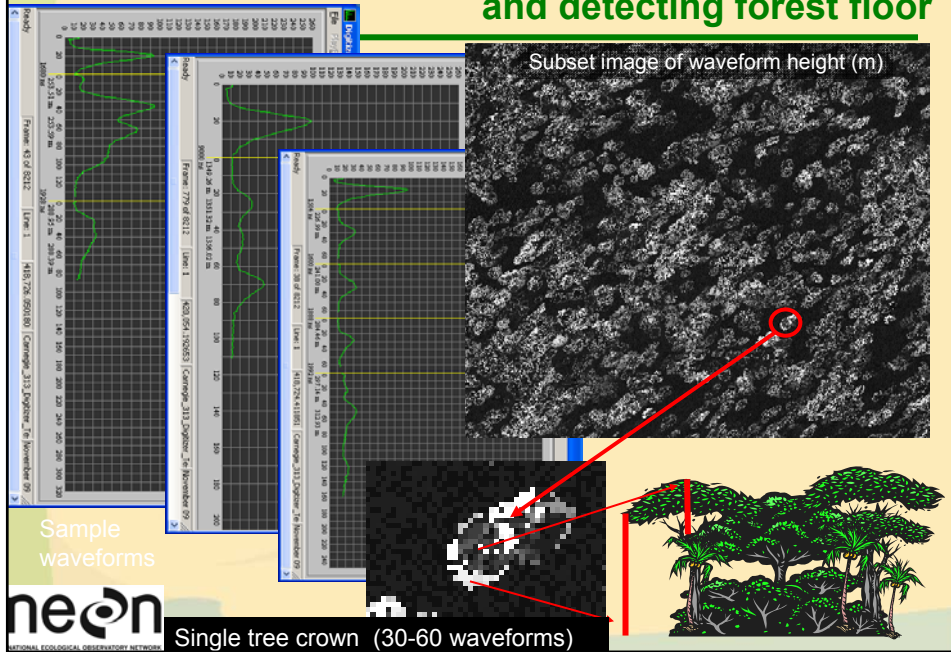
3-D Forest & Topographic Imaging –Rainforest & Pasture

Laupahoehoe Forest Reserve, Hawaii

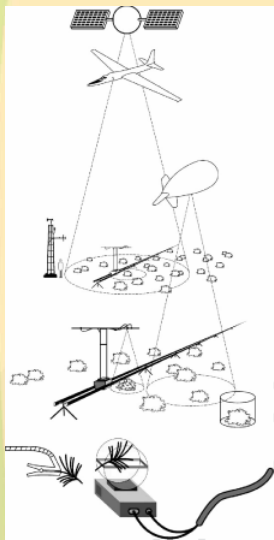
1.0 m spatial resolution, 100,000 htz



CAO LiDAR waveforms for profiling forest canopy and detecting forest floor



Ground Measurements & Validation Data



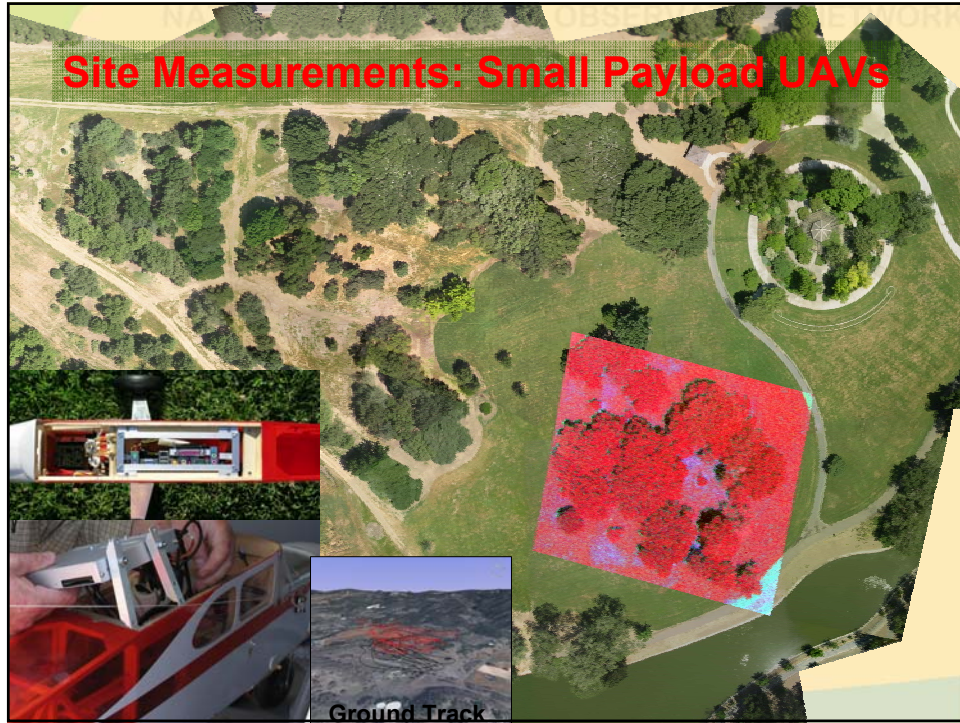
NEON Design:
Hierarchical Sampling

Plans are not finalized,
Options for Site Studies:

- endmember (spectral library) measurements
- continuous or periodic sampling from towers or cables (e.g., SpecNet)
- local airborne sampling



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NATIONAL ECOLOGICAL OBSERVATORY NETWORK
~8 kg Payload, electric motor, pointing
& GPS



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Computer



Sensors: IRGA



C-NIR Imagers

Miniaturized Imaging Spectrometers



Imaging Spectrometers
350-2500 nm range

Silicon 128, 256, 512 elements
InGaAs 256 elements
Extended InGaAs 256 elements

Dimensions with standard detector

Length 55 mm
Width 24 mm
Height 48 mm
Weight ~1 lb.



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Thank You!



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