**Field and Aircraft Observations in Support of DESDynI**


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**Background**

**DESDynI** (Deforestation, Ecosystem Structure and Dynamics of Ice) is a NASA satellite mission that will provide global estimates of aboveground biomass and ecosystem structure using LiDAR (Light Detection and Ranging) and L-band radar. LiDAR waveforms and radar backscatter coefficients at different wave polarizations are sensitive to forest height, structure, and composition, and can be used to make quantitative estimates of standing biomass/carbon stocks and ecosystem structure for biodiversity and habitat assessment.

Field and aircraft observations in support of DESDynI for terrestrial ecosystem science have been collected at the La Selva Biological Research Station in Costa Rica, in the Sierra Nevada and New England regions of the USA. DESDynI Airborne simulators include the Laser Vegetation Imaging Sensor (LVIS) and Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), which provide full waveform LiDAR returns and quad polarization L-band radar data, respectively. Ground-based data include forest inventories; leaf reflectance spectrum; and vertical/horizontal distribution of canopy elements by visual observation, hemispheric photography, and ground-based LiDAR.

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**Regional Field Campaigns and PIs**

- **New England, 2009**
  - Jon Ranson, Penobscot
  - Sassan Saatchi, Harvard
  - Ralph Dubayah, Bartlett and Hubbard Brook
- **Sierra Nevada, 2008**
  - Ralph Dubayah
  - Paul Siqueira, Harvard
  - Sierrana dvark@sierrana.edu
- **La Selva, Costa Rica 2005/2010**
  - David Clark
dclark@birch.uts.ac.cn

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**Field Data**

- **Extensive Forest Inventory**
  - 2 ha field plot
  - GPS used to establish center transect
  - Compass and tape used to form subplot boundaries
  - Species, live/dead status, and DBH recorded for all trees >10cm
  - Small stems (<10 cm) sub-sampled within 1m of plot centerline
  - Height of 5 tallest trees measured in each subplot

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**Intensive Measurements of Vegetation Structure**

- **ECHIDNA** (ground-based LiDAR)
  - 3D Stem/Canopy metrics
  - Derived wood volumes
  - Alan Strahler (PI)
  - alan@bu.edu
  - http://www.modis.bu.edu/lidar/introduce.html
- **LVIS** (full waveform LiDAR)
  - 25m footprint
  - Wall-to-wall scanning
  - Areal coverage ~43,000 ha site
  - Bryan Blair (PI)
  - James.b.blair@nasa.gov
- **UAVSAR** (quad-pol, L-band radar)
  - 10m pixel
  - Areal coverage ~150,000 to 250,000 ha site
  - Marc Simard (PI)
  - marc.simard@nasa.gov

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**Summary Statistics and Ongoing Analysis**

**Site Totals**

<table>
<thead>
<tr>
<th>Study Sites</th>
<th>Area sampled (ha)</th>
<th>Trees measured (k)</th>
<th>Largest DBH (m)</th>
<th>Tallest tree (m)</th>
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</thead>
<tbody>
<tr>
<td>Bartlett</td>
<td>3.56</td>
<td>6,444</td>
<td>312.6</td>
<td>42.71</td>
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<tr>
<td>Harvard</td>
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<td>10,088</td>
<td>136.9</td>
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<td>Howland</td>
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<td>7,818</td>
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<tr>
<td>Hubbard Bk.</td>
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<td>5,972</td>
<td>92.0</td>
<td>39.50</td>
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<tr>
<td>Penobscot</td>
<td>11.97</td>
<td>8,972</td>
<td>88.8</td>
<td>36.70</td>
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<tr>
<td>Sierra Nevada</td>
<td>8.00</td>
<td>2,545</td>
<td>546.0</td>
<td>90.00</td>
</tr>
</tbody>
</table>

**Figure 1 (right)**

Distributions of biomass estimates derived from field measurements during the 2008/09 campaigns.

Biomass density is shown at the subplot level for stems <10 cm DBH.

The NASA/NACP database contains plot coordinates; data for individual trees; biomass calculated from general equations of Jenkins et al. (2004); and subplot summary statistics.

**Figure 2 (right)**

Stems <10 cm diameter in New England forests contributed up to 50% of the total biomass, and binned averages were up to 30 to 40 Mg ha⁻¹ in low-density subplots.

**Figure 3 (below)**

Data are being used to develop algorithms for deriving forest biomass from LiDAR, radar, and LiDAR/radar fusion.

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**Data Links and Availability**

- North American Carbon Program
  - http://www.nacarbon.org
  - Peter Griffith (NACP Coordinator)
peter.s.griffith@nasa.gov