

# Howland Forest Field Measurement and LVIS data Analysis

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Lake near the Seed Orchard



# OBJECTIVES

- Conduct field measurements in Howland, Maine with team from Woods Hole to establish a forest attribute dataset suitable for study of parameter retrieval from lidar data;
- Work with LVIS team on lidar waveform data processing and analysis in Howland;
- Compile field data sets for release to wider research community.

# BACKGROUND

## Biophysical parameter estimation from Lidar

The relationship between forest carbon storage and the vertical structure from Lidar waveform is relatively unexplored. Further studies on the data properties, e.g. the effects of multiple scattering and ground slope on lidar signatures, are needed to verify and improve the retrieval algorithms.

## Study site and existing data

The mixed hardwood and softwood forest – Northern Experimental Forest, in Howland, Maine provides an ideal test site. Field forest data has been acquired since early 90s under various research projects (FED, SIRC, EOS, NEFE).

## Lidar waveform model

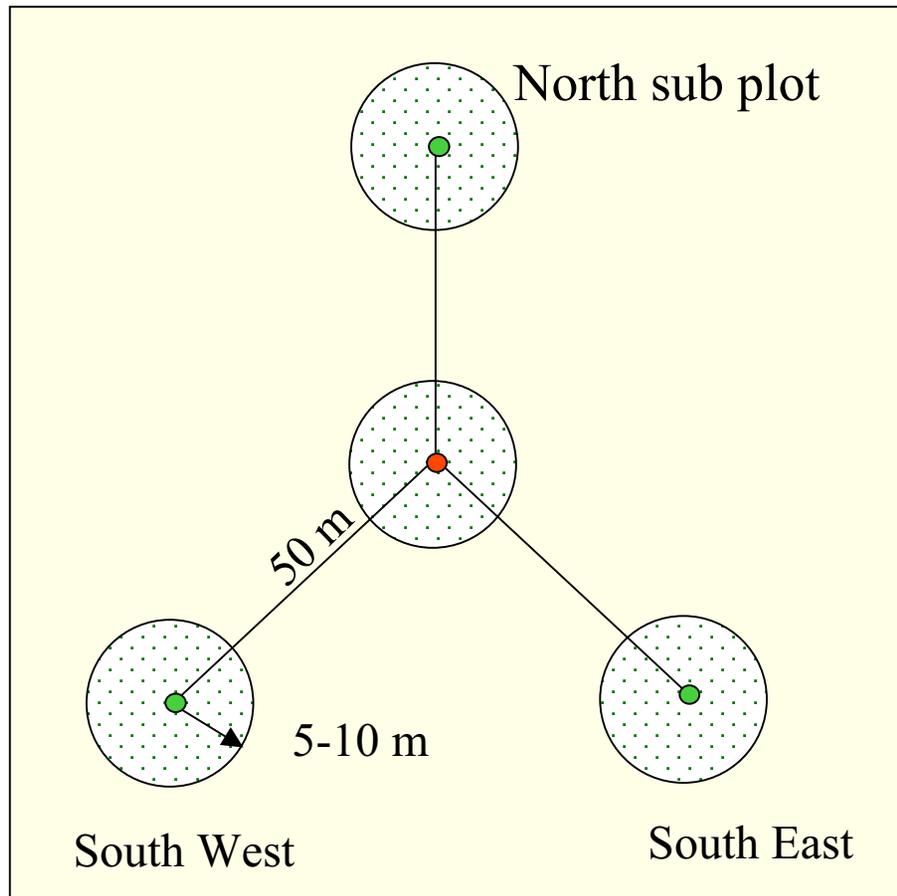
Preliminary comparisons between simulated and measured lidar waveforms show that the model captures the major characteristics of the lidar signature, and the difference in signature from deep canopy may indicate the importance of multiple scattering.

## FIELD METHODS

- Located plots using Geographic Positioning System (GPS), compass and/or tape,
- Laid out sub plots,
- Measured and recoding tree height, diameter at breast height (DBH)
- Measured and recoding distance of tree from the center of sub plot.
- Identified and recoding tree species and canopy positions.
- Measured and recoding the base of canopy distance.
- Take over one hundred hemispherical photographs to quantify canopy closure. Three to four photographs were taken at the center of each subplot. One at 0.5 m, one at 1.3m and one or two horizontally.
- Photographed additional sites near two carbon flux towers.



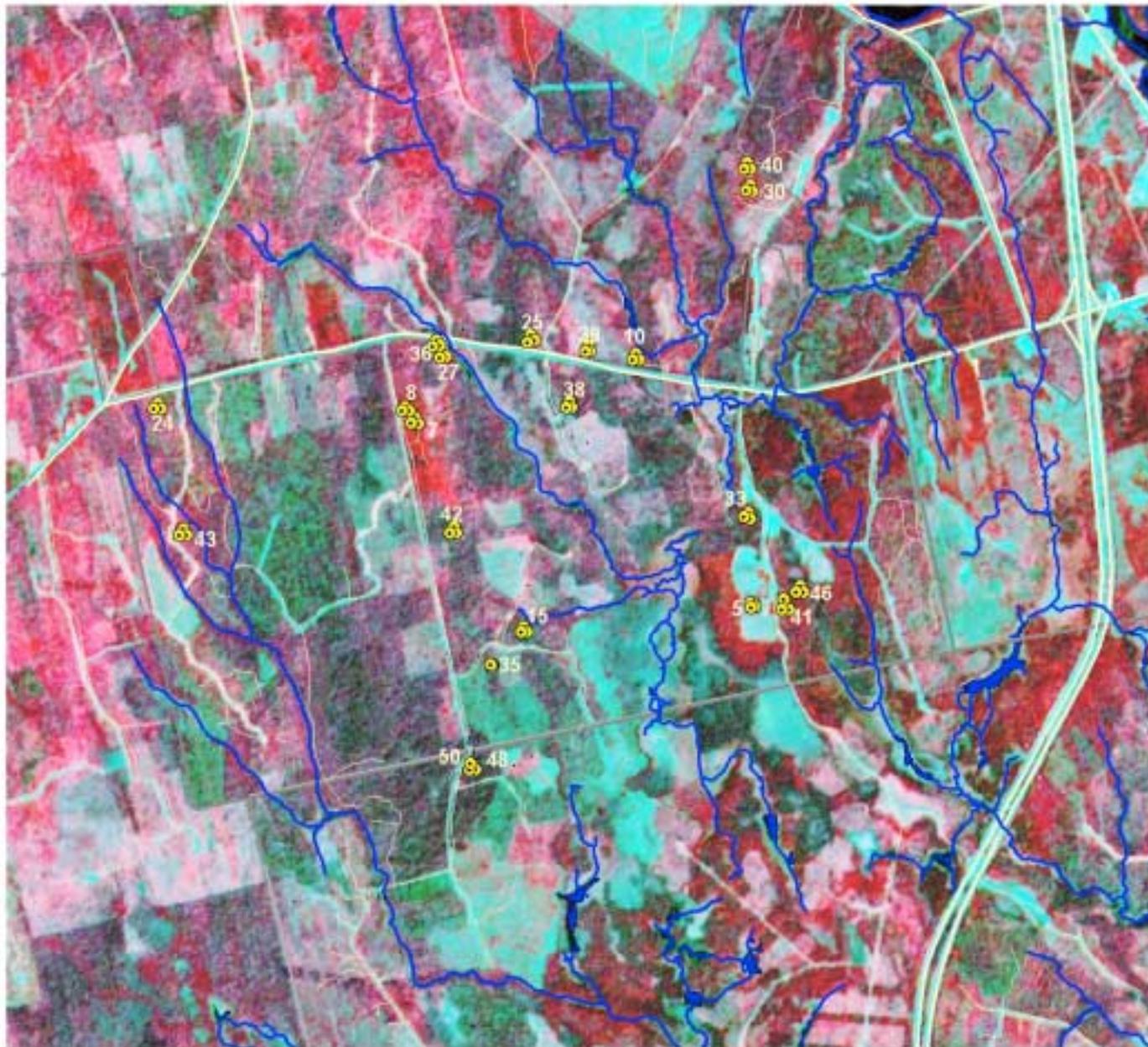
# PLOT MEASUREMENTS



Stem maps were recorded and hemispheric photographs were taken for each subplot

The location of biomass sites (surveyed in October 2003) near Howland, ME

overlaid on a false color composite ASTER image (7/22/2002)



-  Biomass\_sites 2003
-  Streams 95
-  Roads 95
-  II
-  III
-  IV
-  ORT
-  PAVE
-  polihow 95
-  poliedin 95
-  Open Water 95





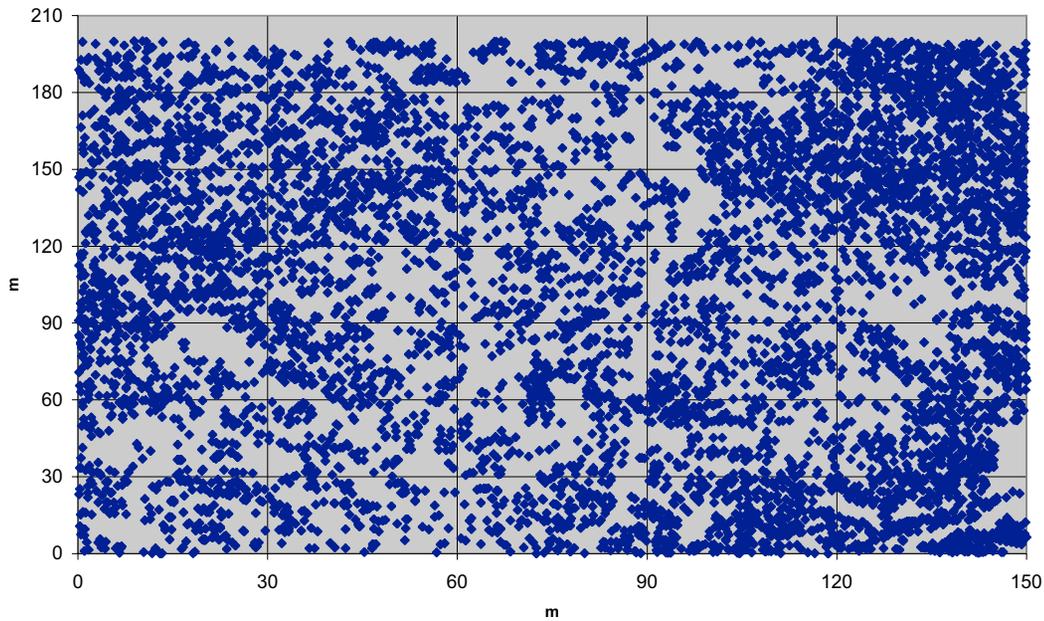




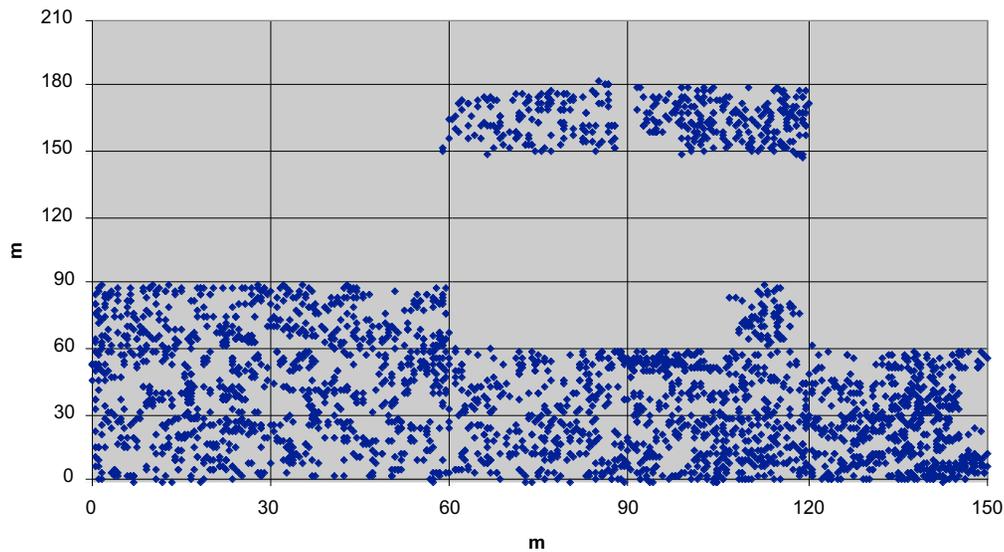
## Stem-map plot at Howland Forest.

- 200 by 150 m plot was established by NASA staff in 1988-89, and all stems were measured at that time.
- 1998-99, thirteen 30 x 30m subplots in the stem-map plot were surveyed for biomass by Woods Hole.
- 2002 the same plots were re-surveyed
- 2003, remaining subplots were measured.
- Aboveground biomass is about 80% of the total biomass.
- Biomass calculated from local allometry for stems, foliage, branches, and roots.
- Total biomass ranged from 69 to 157 Mg C/ha in the subplots

Tree locations - 1988 - Stem-map plot



Tree locations - 2002 - stem map plot

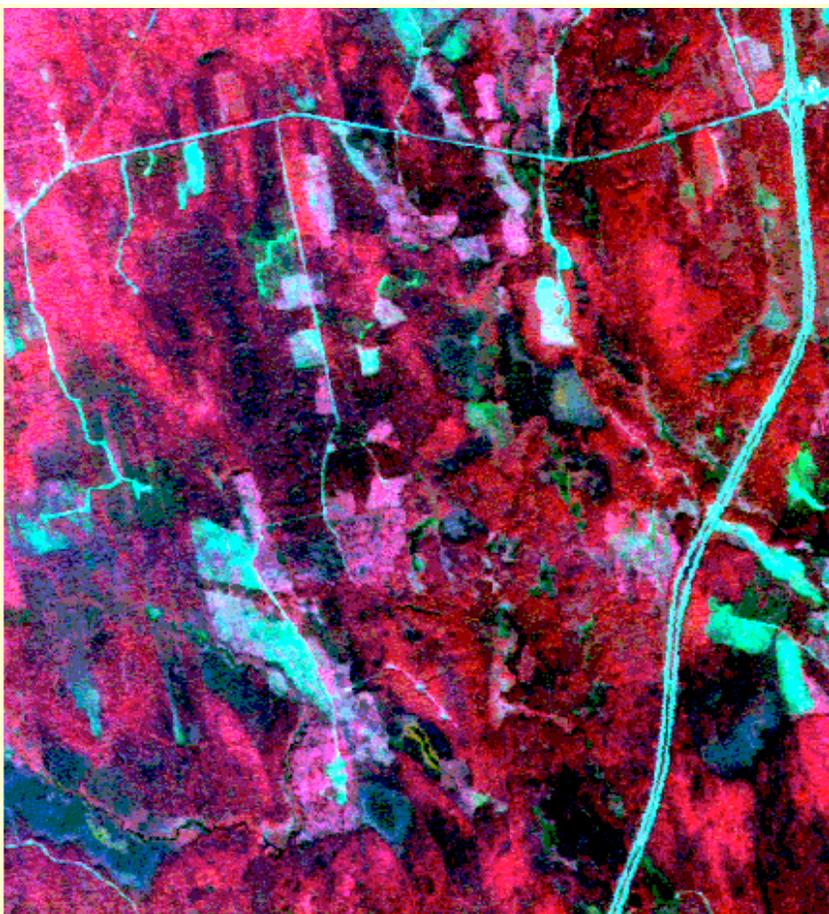


Mean biomass values for 30x30m sub-plots in the stem-map plot (200 x 150m) at Howland Forest.. Missing plots have been measured but the data not yet analyzed.

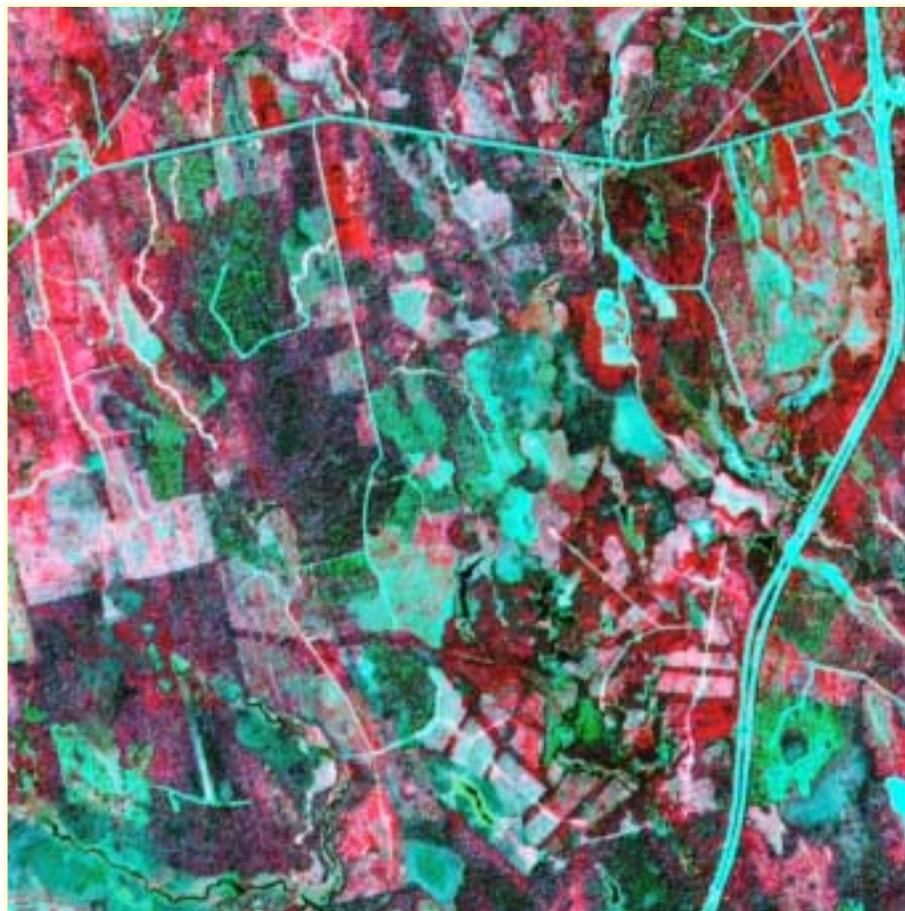
2003 2002

69	73	89	93	103
71	95	84	121	144
87	123	129	157	141
108	100	145	114	TBD
92	110	79	103	TBD
76	118	96	106	94
107	85	119	114	83

## AVIRIS (1990) and ASTER (2002) data

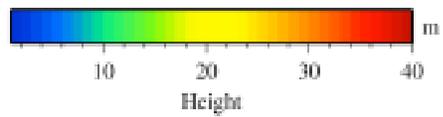
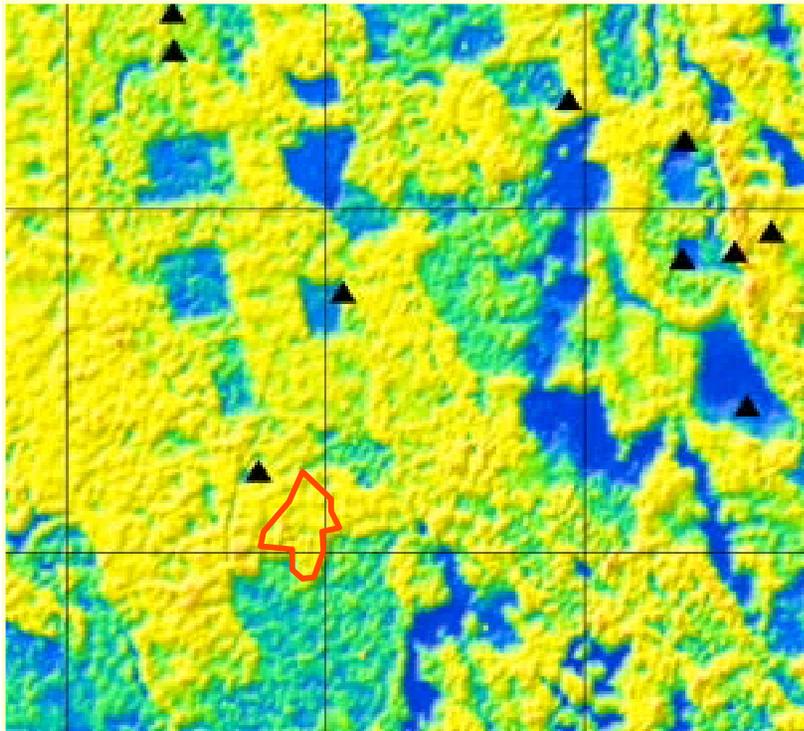


AVIRIS Image Sep 8, 1990  
R: NIR, G:Red, B:Green

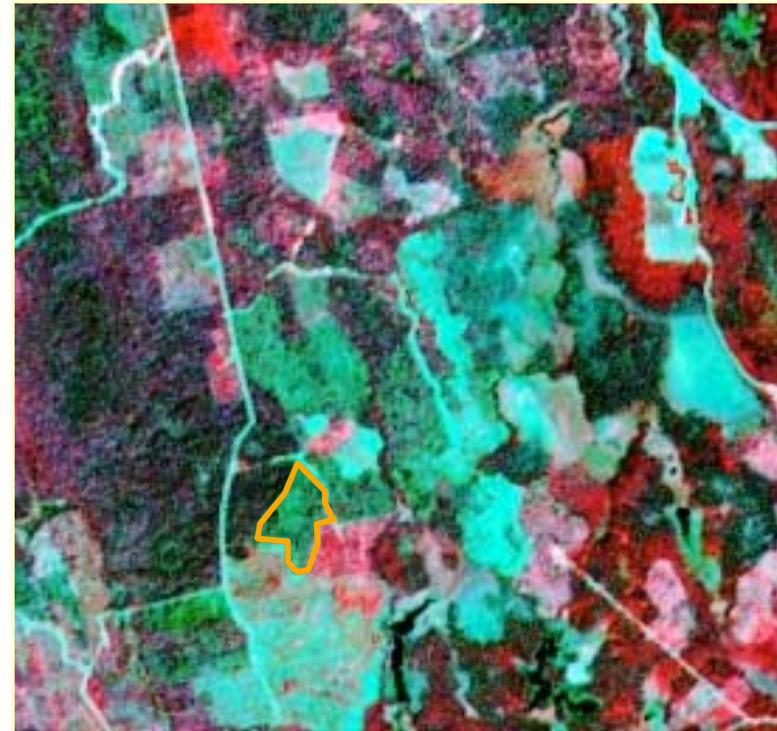


ASTER Image July, 24 2002  
R: NIR, G:Red, B:Green

# LVIS (2003) and ASTER (2002) data



LVIS 7/22/2003



ASTER 7/27/2002  
R- NIR, G-Red, B-Green

# AVIRIS (2003) and AirMISR (2003) data



AVIRIS  
08/28/2003



AirMISR  
08/28/2003

# RESULTS

Completion of stem map re-measurement

Sampling of a variety of northern forest types and development field dataset suitable for testing the algorithms for retrieving forest biomass and other parameters from lidar and radar data;

New lidar waveform model data sets to lead to possible improvement of algorithms for forest spatial structure characterization and biophysical parameter estimation from lidar data.

# Plans

- New insight on lidar waveform data and possible improvement of algorithms for forest spatial structure characterization and biophysical parameter estimation from lidar data.
- Data sets made available to LVIS project and the science community through an existing web site.
  - [fedwww.gsfc.nasa.gov](http://fedwww.gsfc.nasa.gov)
- Symposium and refereed journal publications.
- Related proposals to follow