Tools for Risk Assessment

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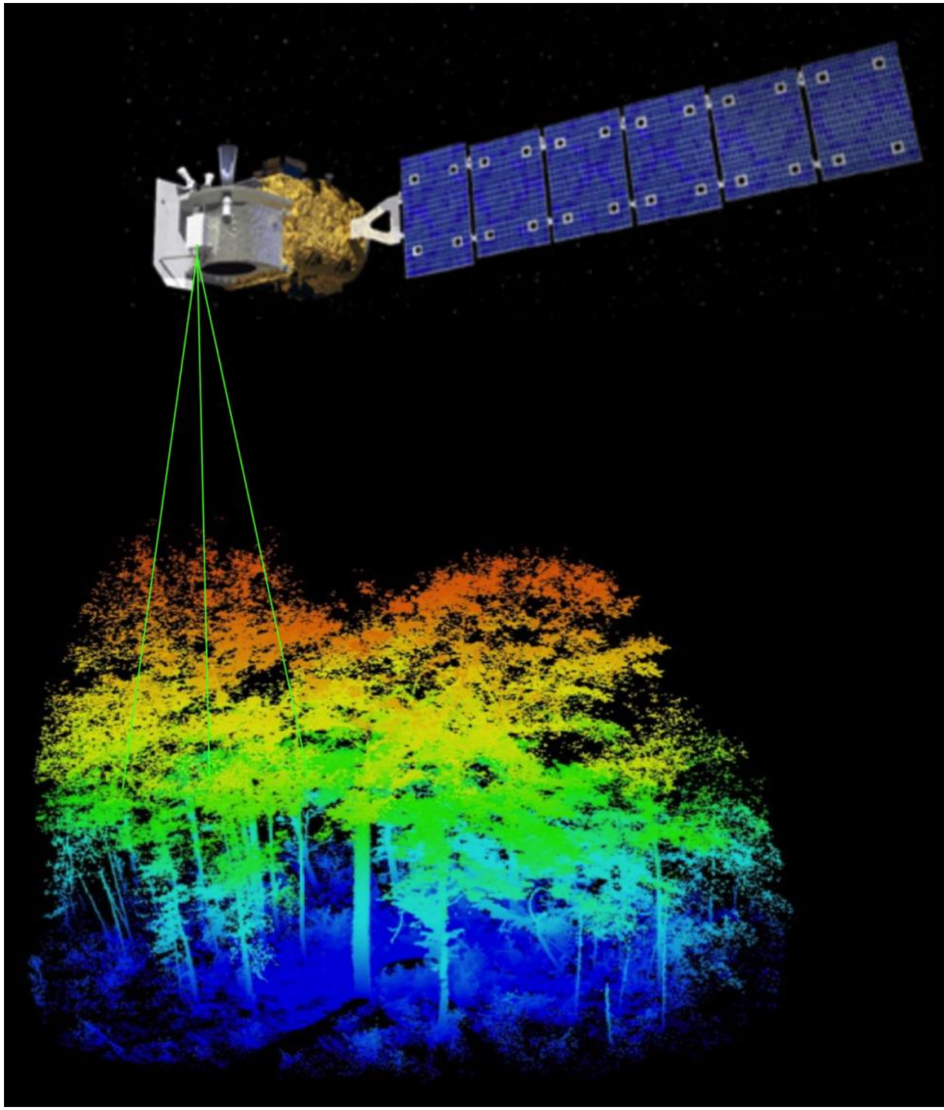
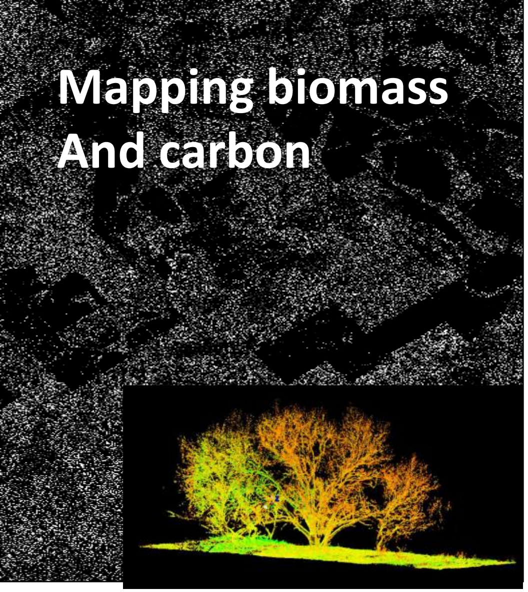
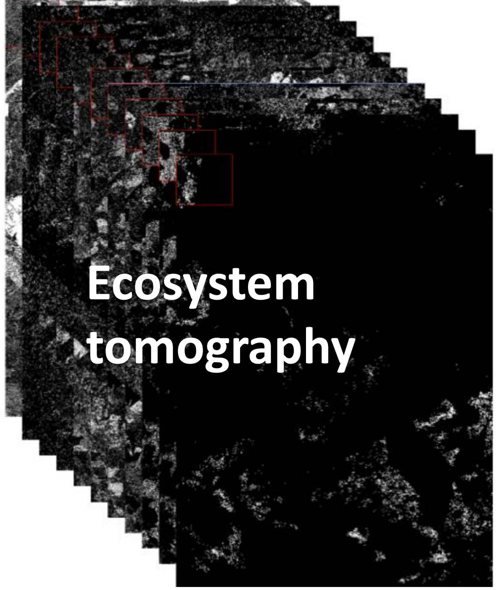
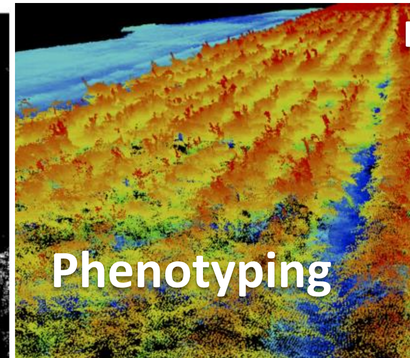
Department of Ecosystem Science and Management
Texas A&M University

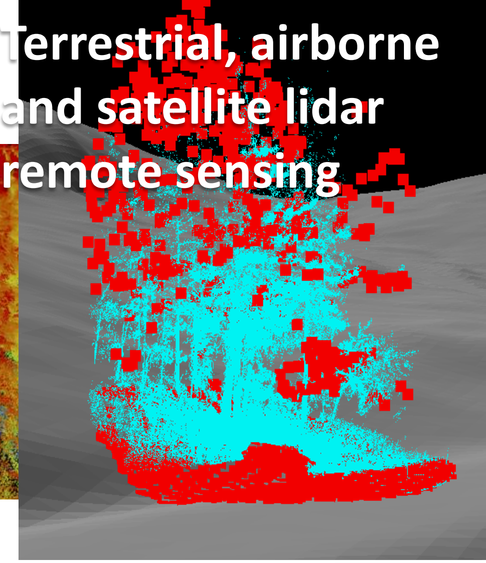
LASERS LAB
Lidar Applications for the Study of Ecosystems with Remote Sensing





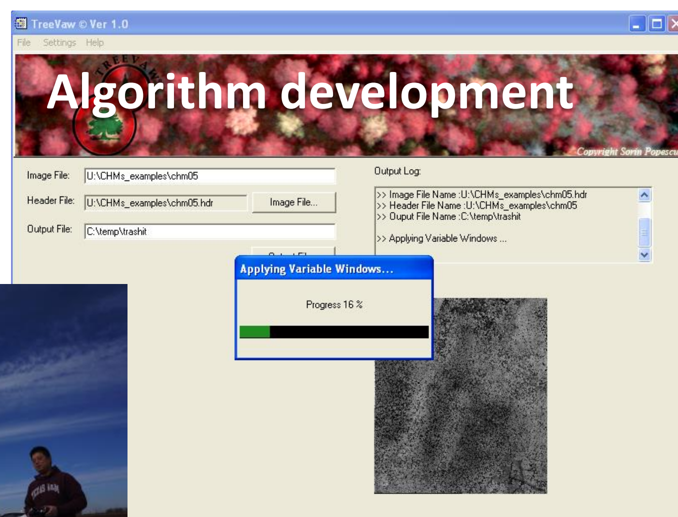


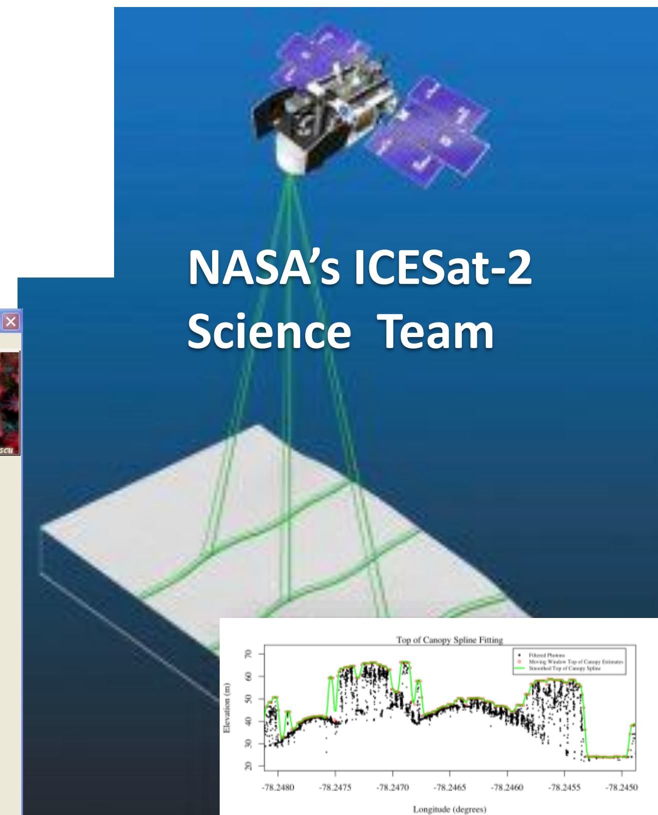




Remote Sensing projects
LASERS Lab, PI Sorin Popescu

(Lidar Applications for the Study of
Ecosystems with Remote Sensing)





Risk assessment “burning” issues

1. Fuel
2. Fuel
3. Fuel

Assess biomass resource availability

Tools

1. **Technology: Remote sensing lidar platforms**
2. **Methodology for assessing biomass or scaling up, including allometrics and models**

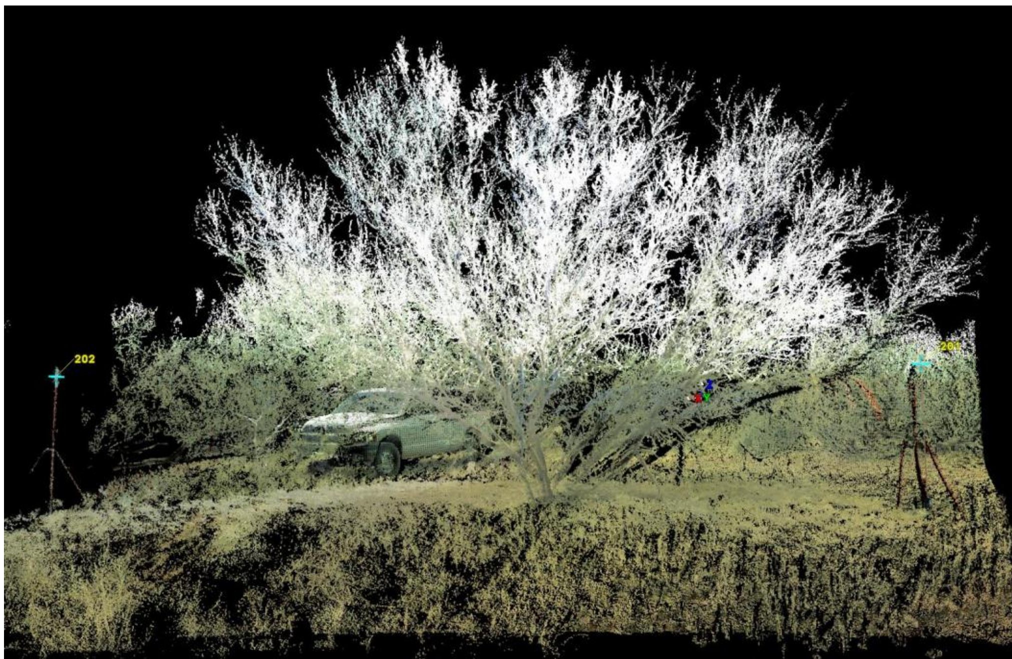
Spaceborne

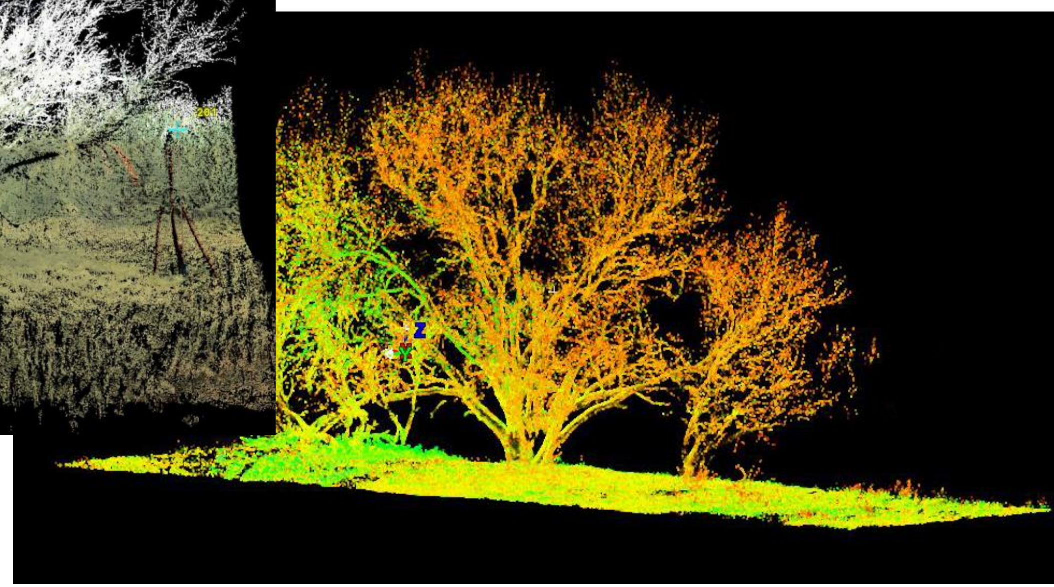
Airborne & UAV

Terrestrial

Scale

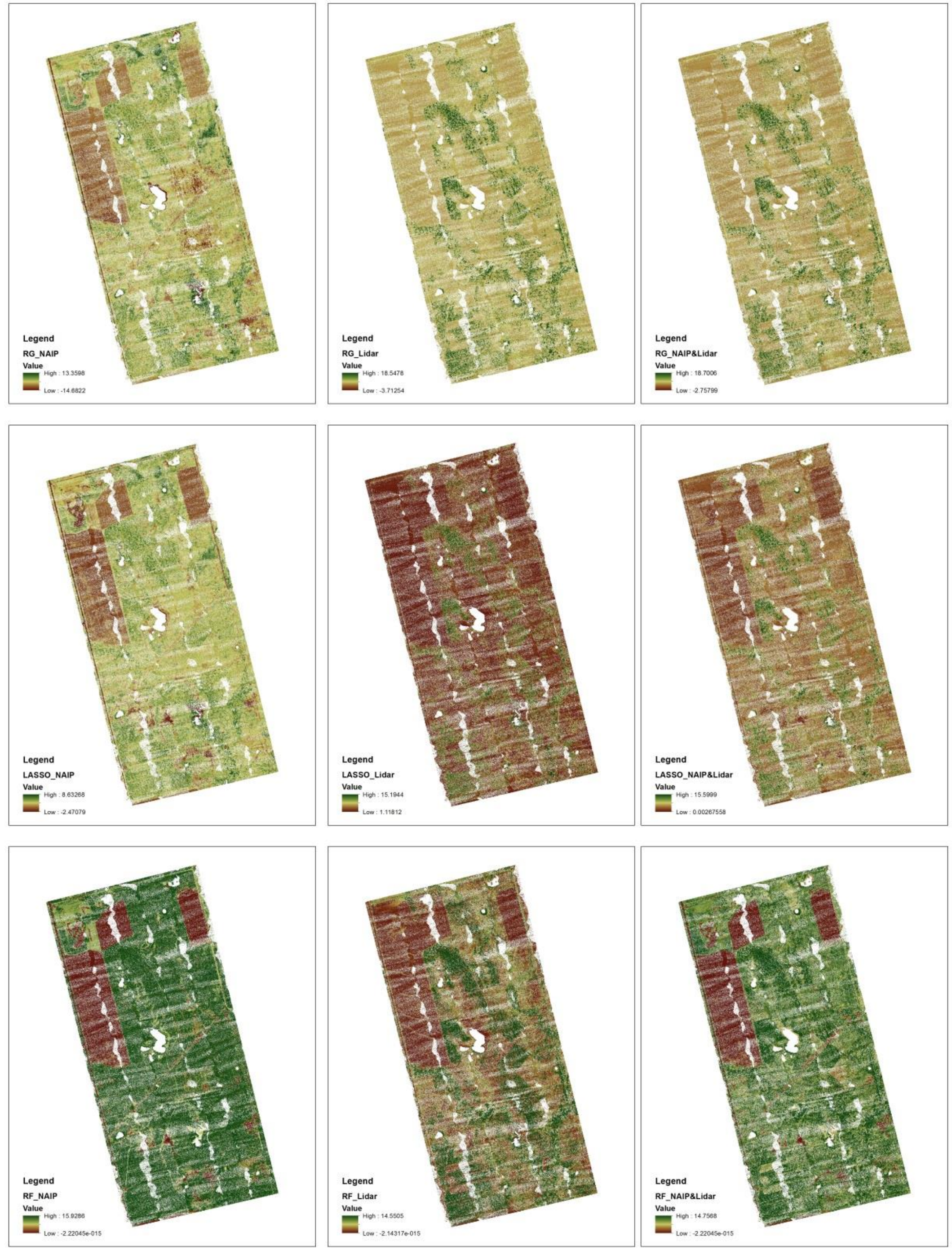
Range biomass estimation in Texas, for bioenergy production resource assessment



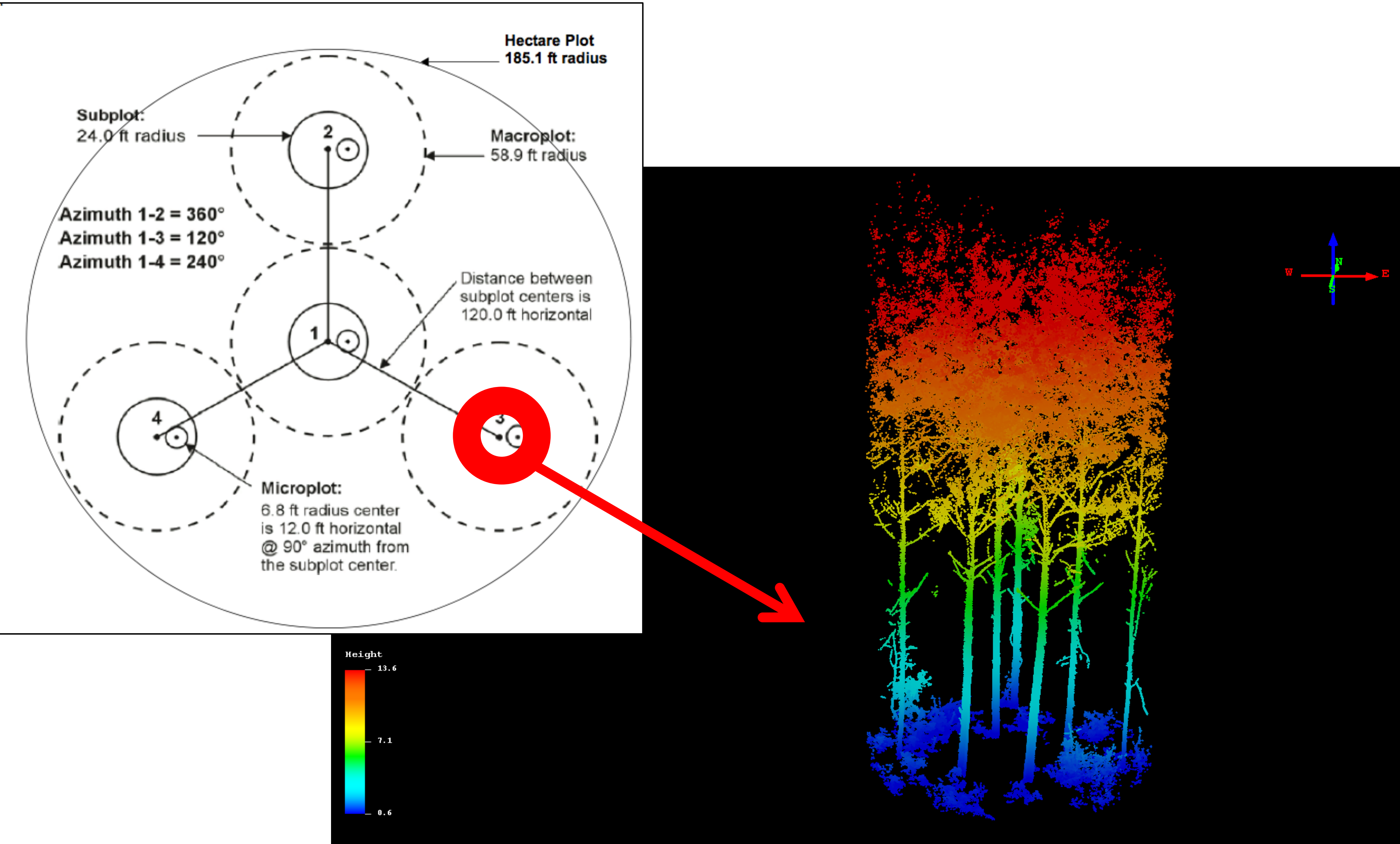


Local scale vegetation biomass maps with stepwise regression, LASSO, and Random Forests methods

- Top: stepwise regression biomass maps with multispectral variables, lidar metrics, and the combination of multispectral variables and lidar metrics (Left to right).
- Middle: LASSO biomass maps with multispectral variables, lidar metrics, and the combination of multispectral variables and lidar metrics(Left to right).
- Bottom: Random Forests biomass maps with multispectral variables, lidar metrics, and the combination of multispectral variables and lidar metrics (Left to right).



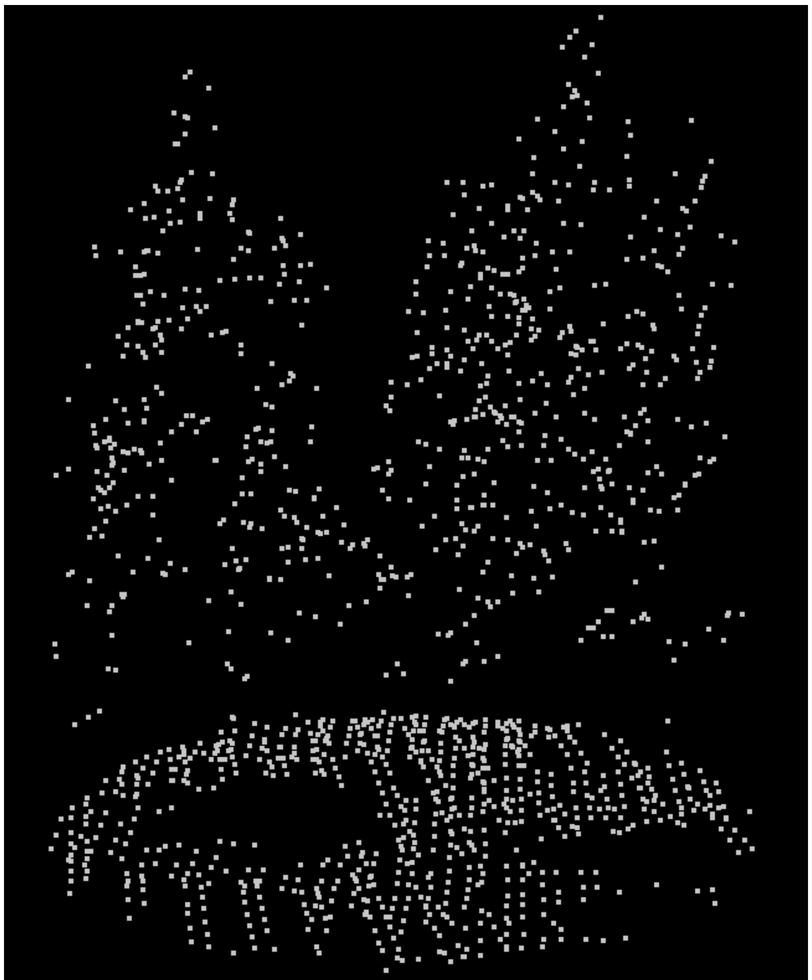
USDA Forest Service Forest Inventory and Analysis plot structure and TLS



USDA Forest Service FIA plot

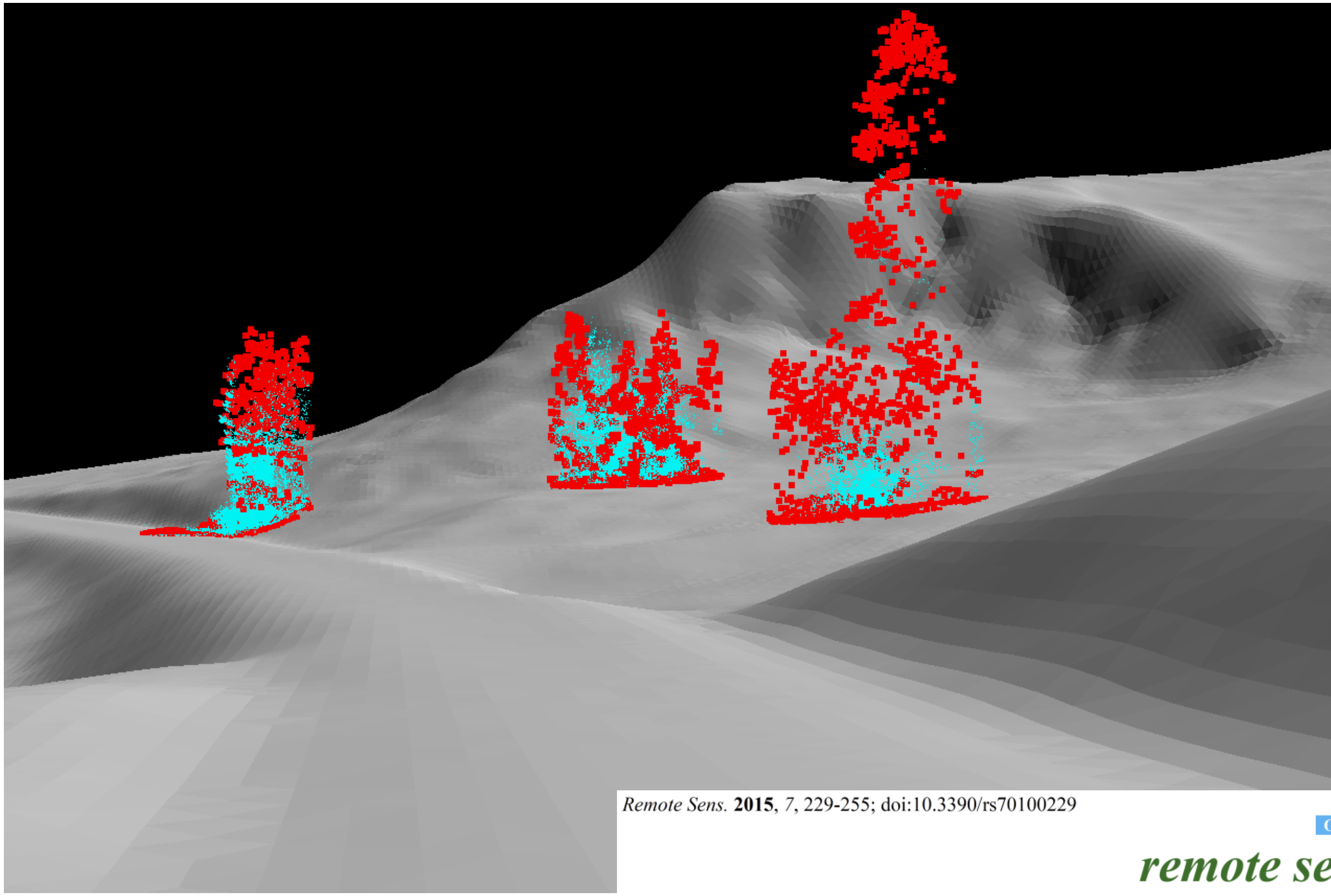
(Forest Inventory and Analysis project in Oregon)

Airborne



TLS

Airborne vs. terrestrial lidar



Remote Sens. **2015**, *7*, 229-255; doi:10.3390/rs70100229

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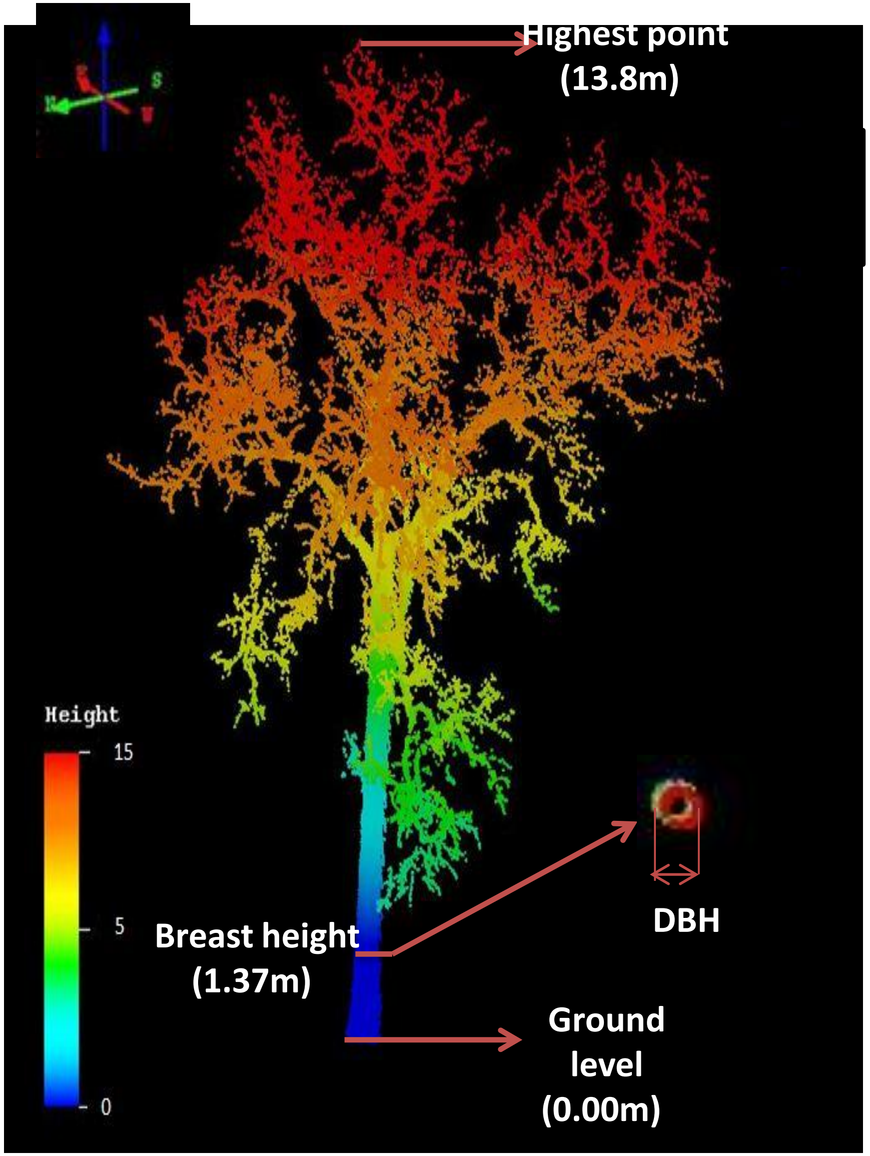
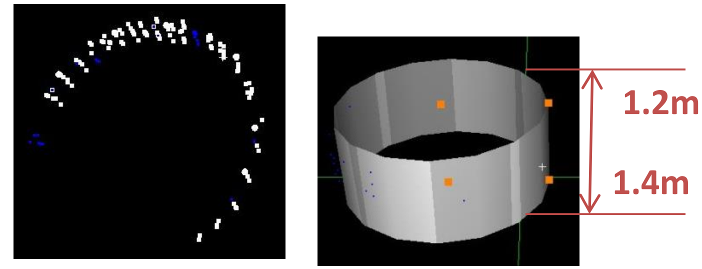
Article

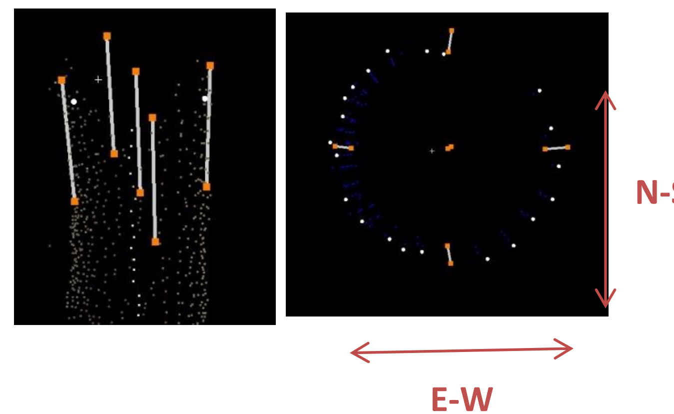
Modeling Forest Aboveground Biomass and Volume Using Airborne LiDAR Metrics and Forest Inventory and Analysis Data in the Pacific Northwest

Ryan D. Sheridan [1,*], Sorin C. Popescu [1], Demetrios Gatziolis [2], Cristine L. S. Morgan [3] and Nian-Wei Ku [1]



Current project: multi-temporal TLS data sets, at multiple dates to assess growth





Remote Sens. **2015**, *7*, 1877-1896; doi:10.3390/rs70201877

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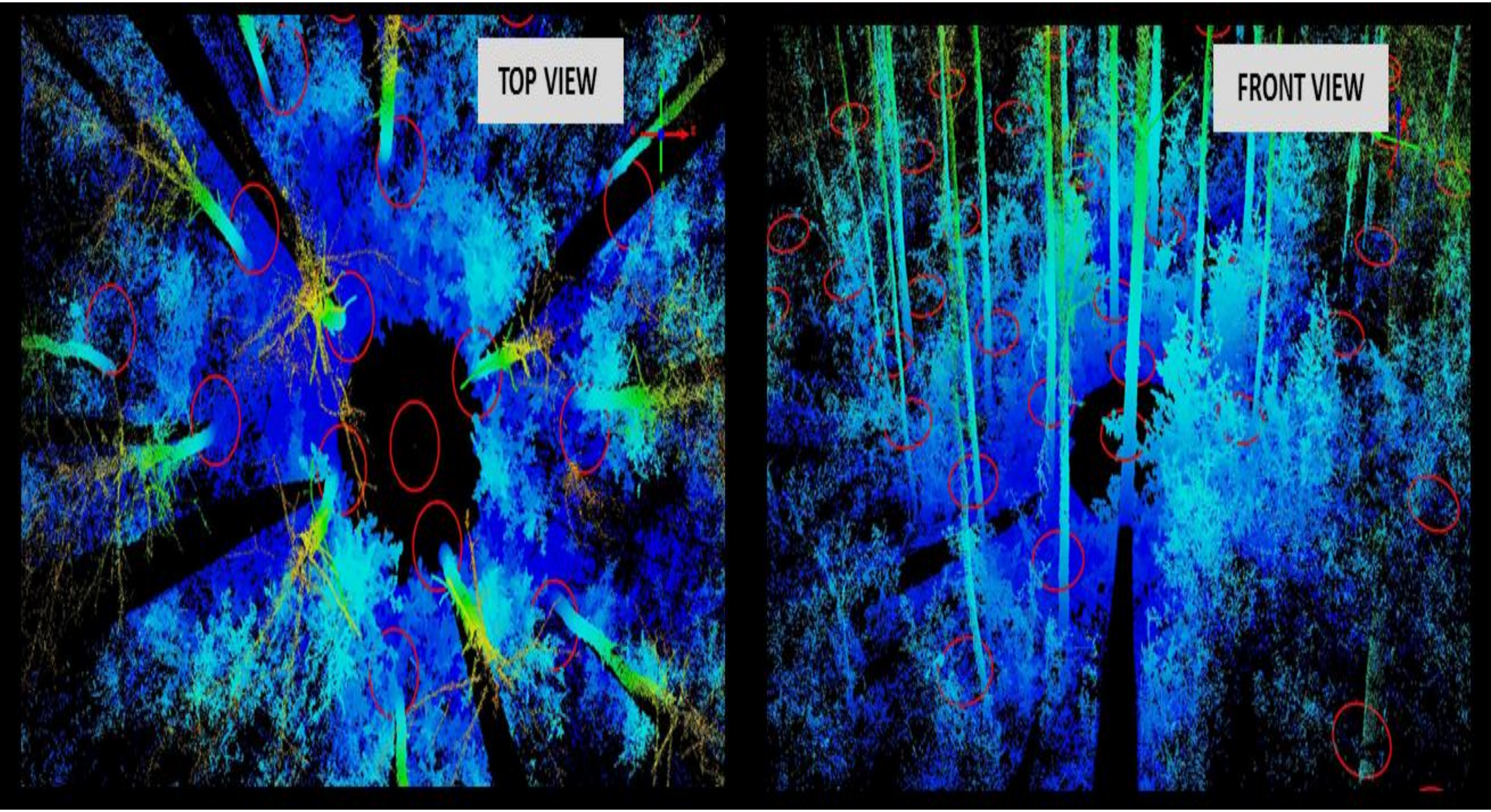
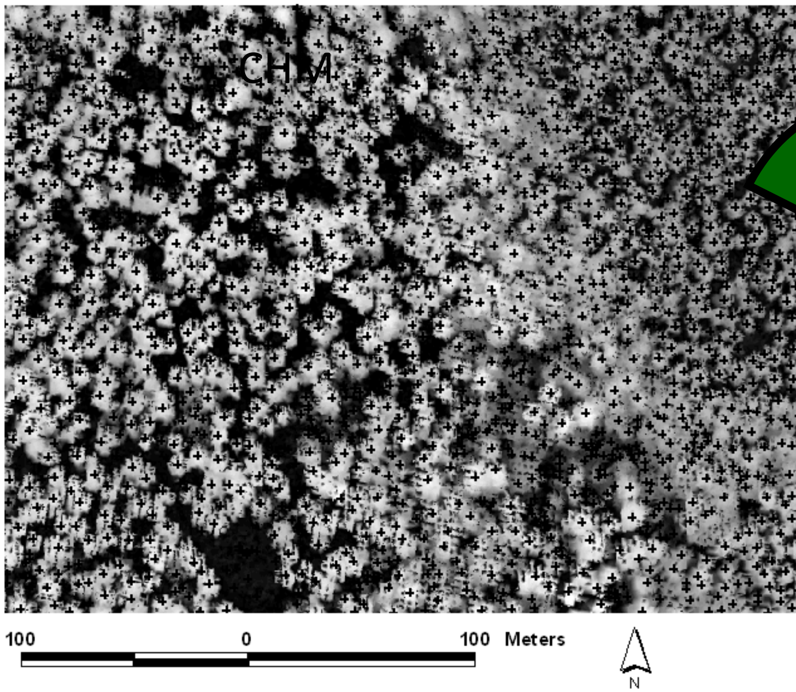
Article

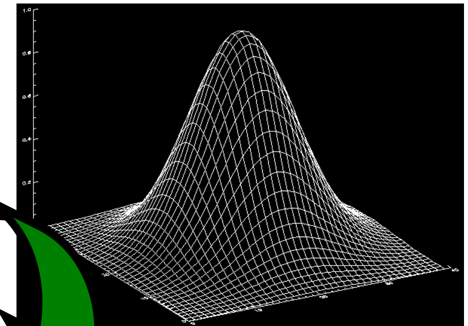
Terrestrial Laser Scanning as an Effective Tool to Retrieve Tree Level Height, Crown Width, and Stem Diameter

Shruthi Srinivasan *, Sorin C. Popescu, Marian Eriksson, Ryan D. Sheridan and Nian-Wei Ku

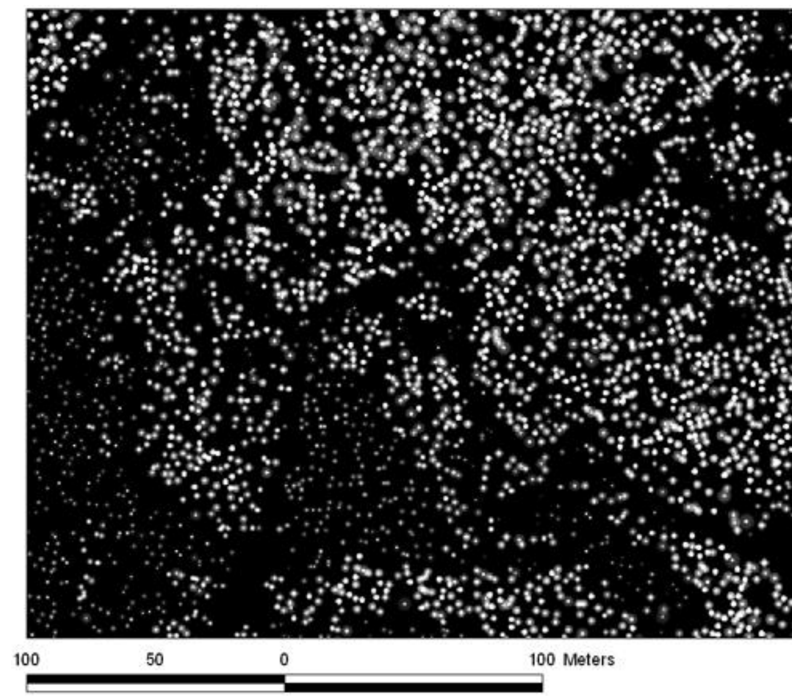

TOP VIEW
FRONT VIEW

From individual tree measurements to mapping biomass





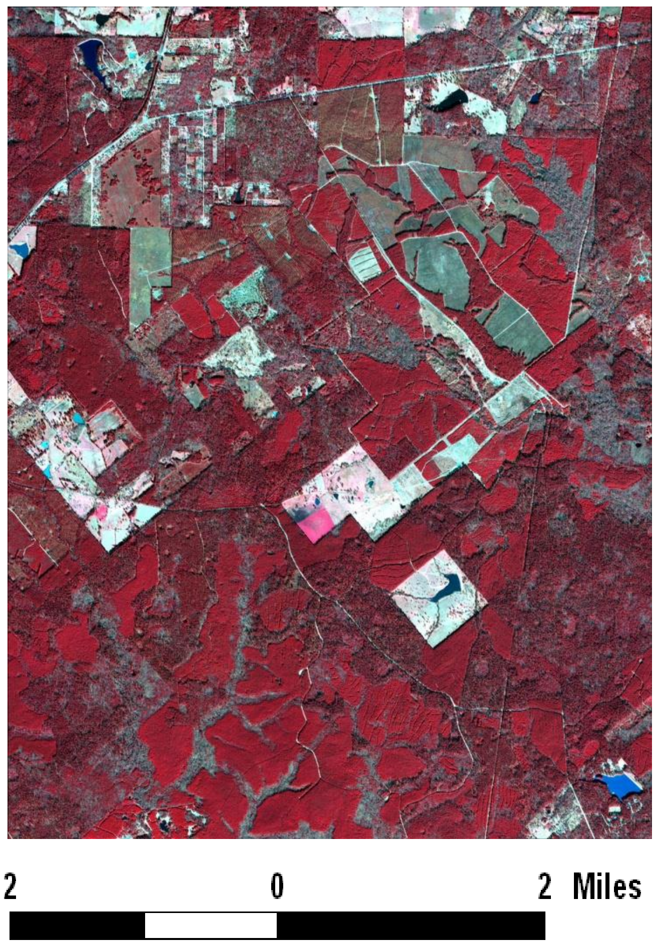
Biomass

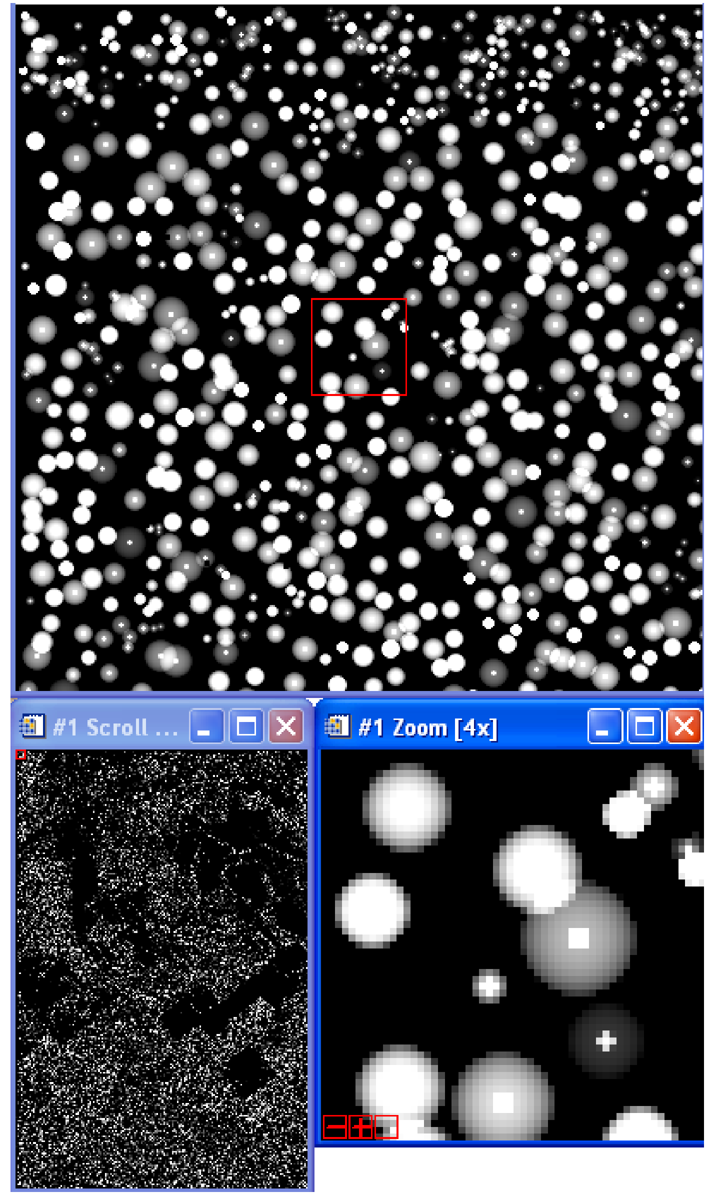


$$Biomass(kg) = Exp(\beta_0 + \beta_1 \ln dbh)$$

Biomass calculated from generalized biomass equation for US tree species (Jenkins et al., 2003)

Local scale aboveground biomass map

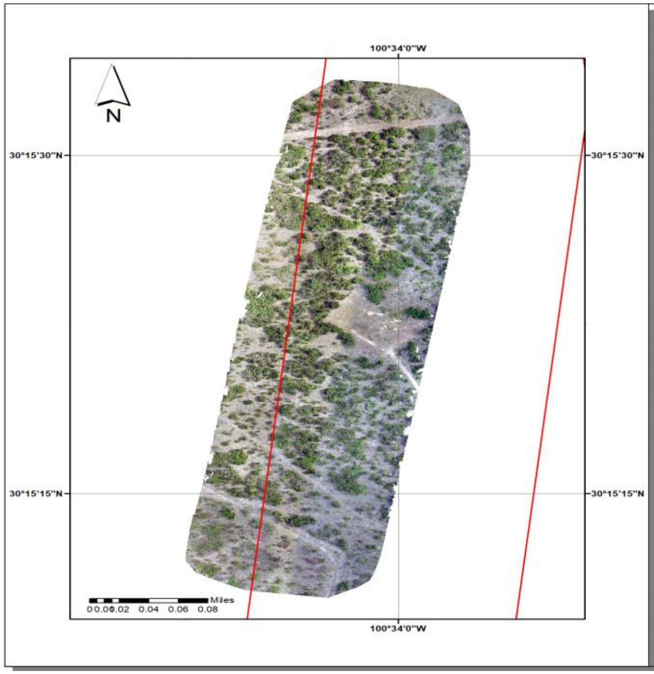




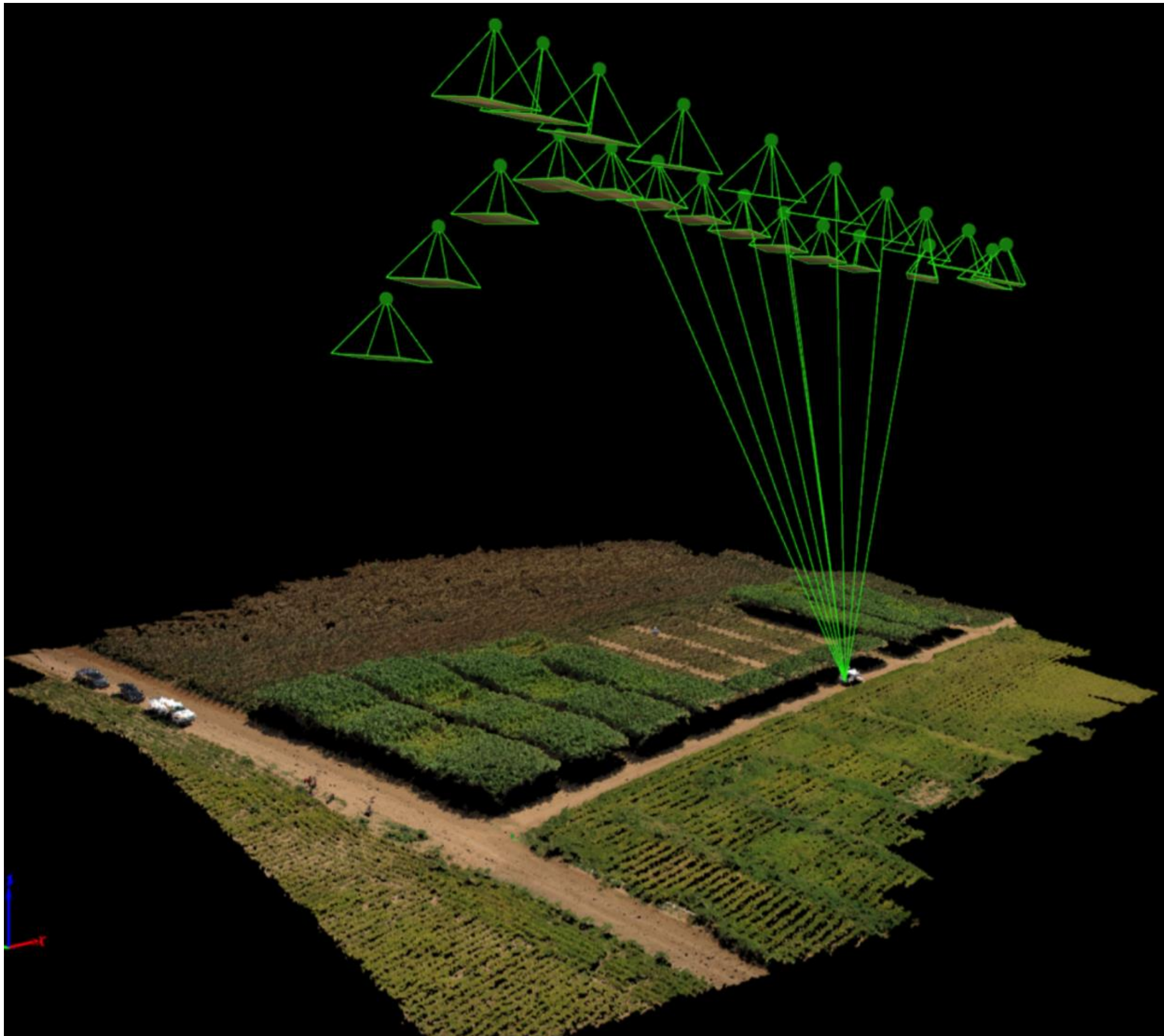
Zhao, K., **S. C. Popescu**, & R.F. Nelson, 2009. Lidar remote sensing of forest biomass: A scale-invariant estimation approach using airborne lasers. *Remote Sensing of Environment* 113(1): 182-196.

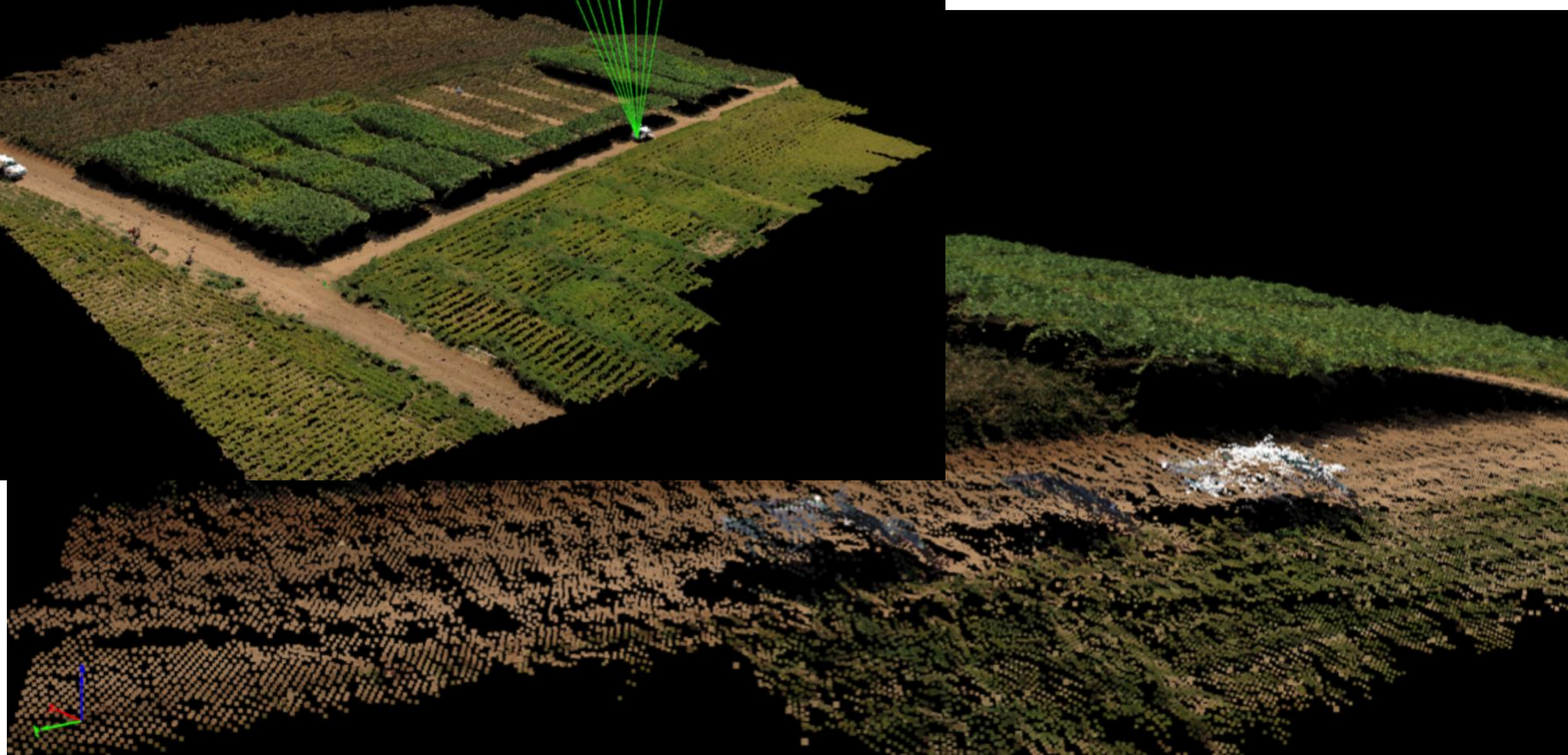
UAS 3D point clouds

- Photogrammetric 3D point clouds
- UAS lidar (Velodyne HDL32)

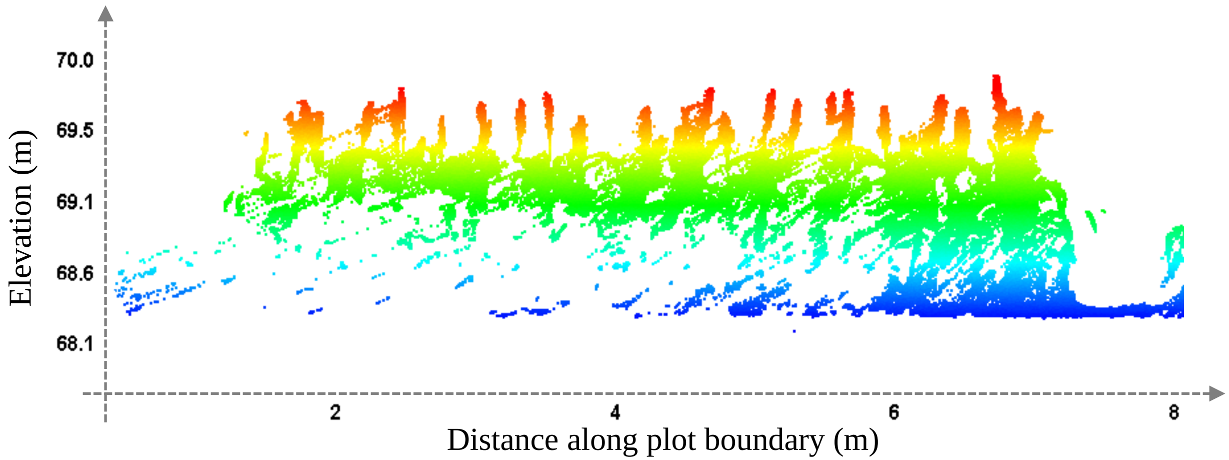


Mapping of sorghum heights for biomass assessment

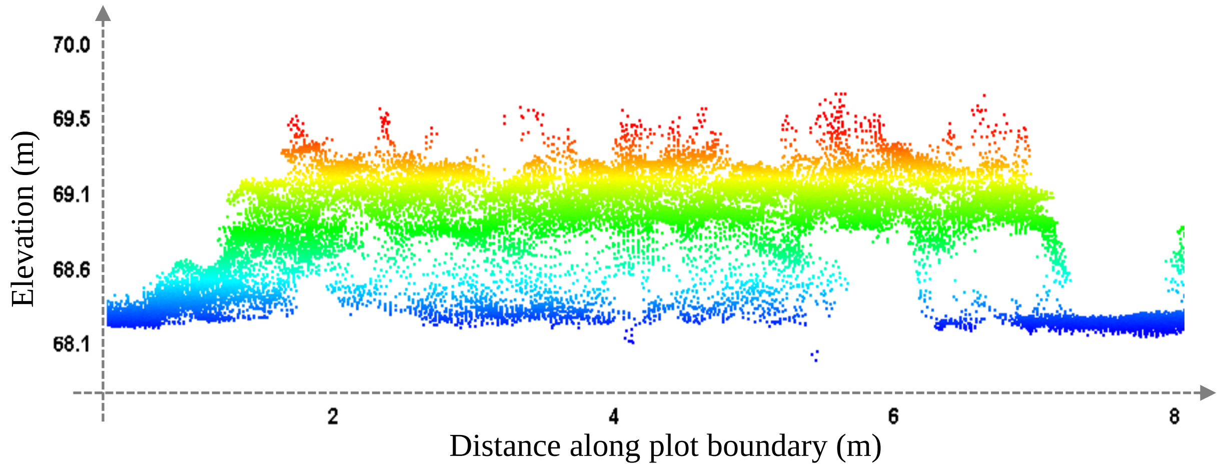




LiDAR/SfM 3D point clouds differences



LiDAR view



b) SfM view

3D longitudinal views

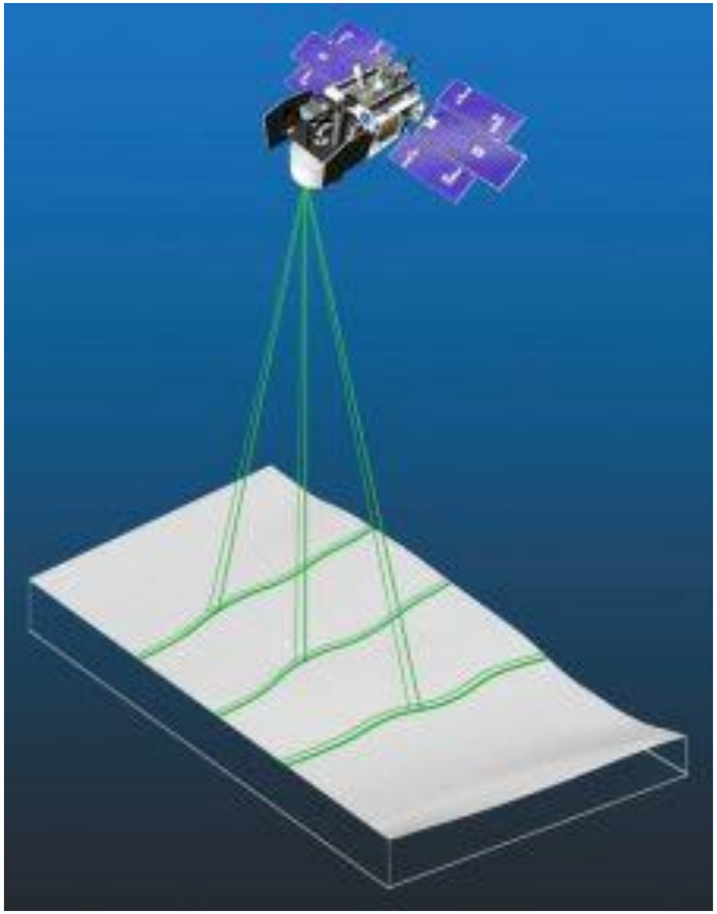
ICESat 2 – launched September 15, 2018, data publicly available end of May, 2019

http://icesat.gsfc.nasa.gov/icesat2/

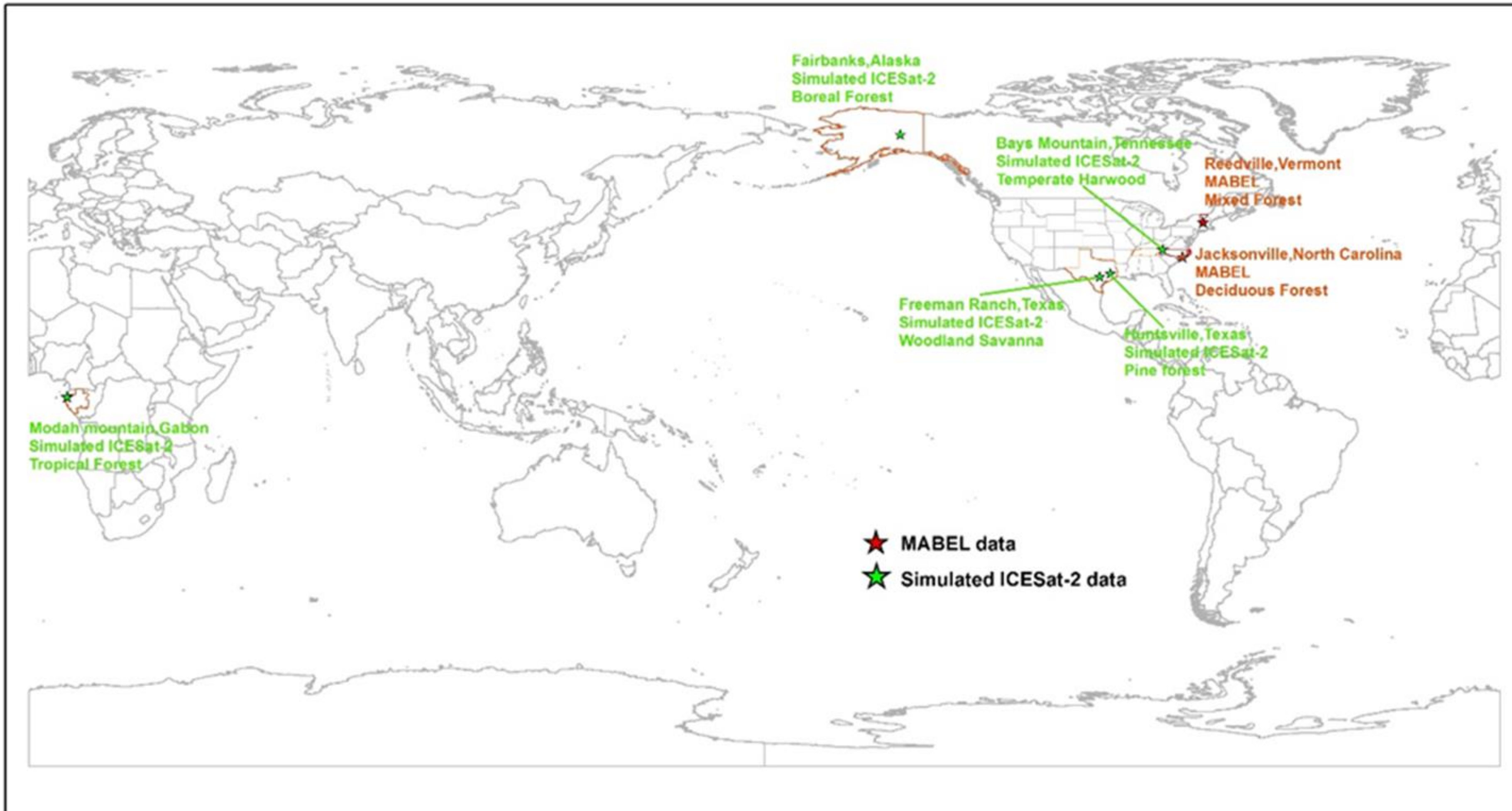
Main Science Objectives:

•Quantifying polar ice-sheet contributions to current and recent sea-level change and the linkages to climate conditions.

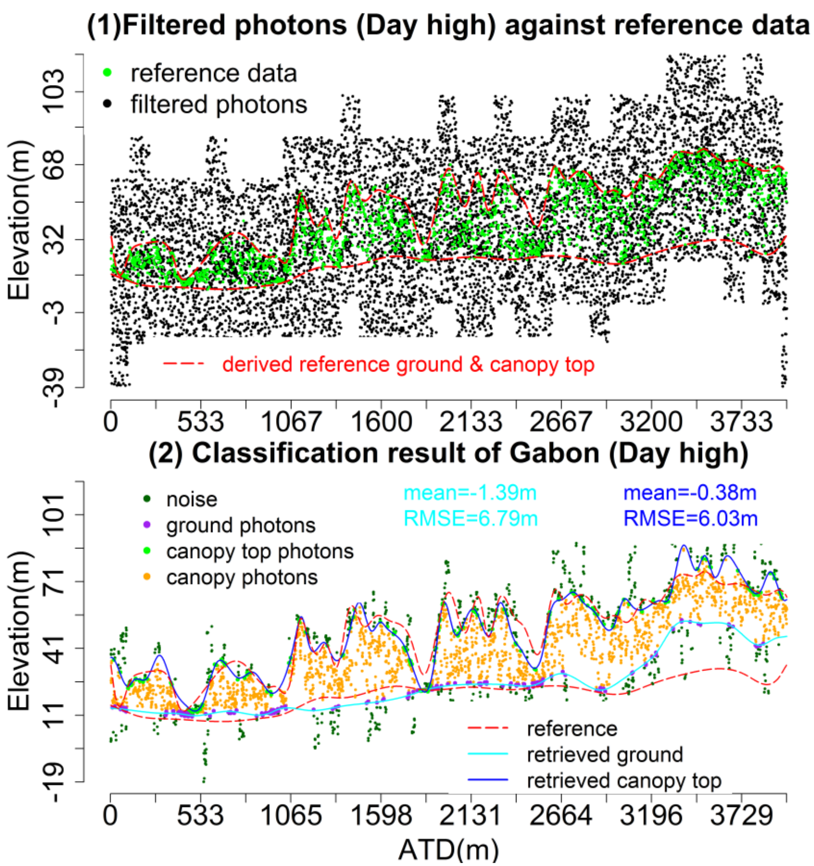
•**Measuring vegetation canopy height as a basis for estimating large-scale biomass and biomass change.**

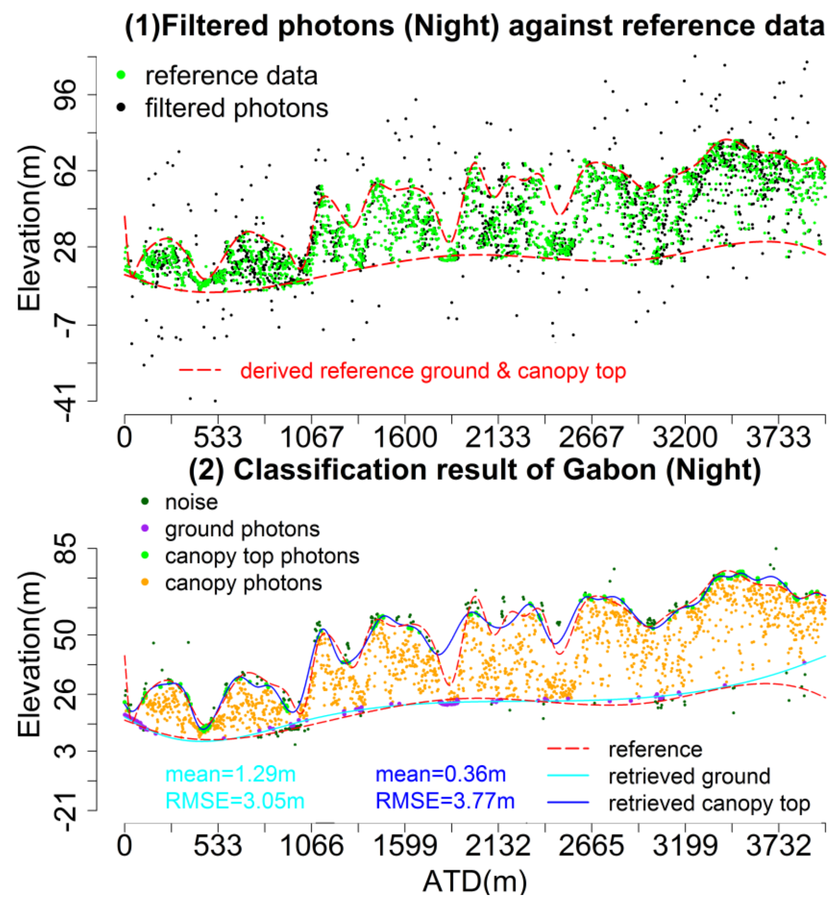


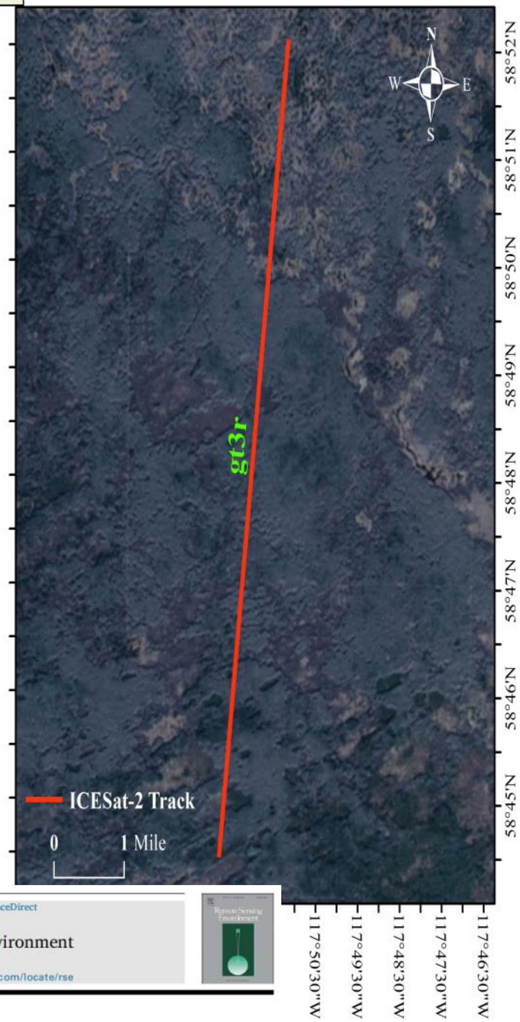
Study sites (51 locations)

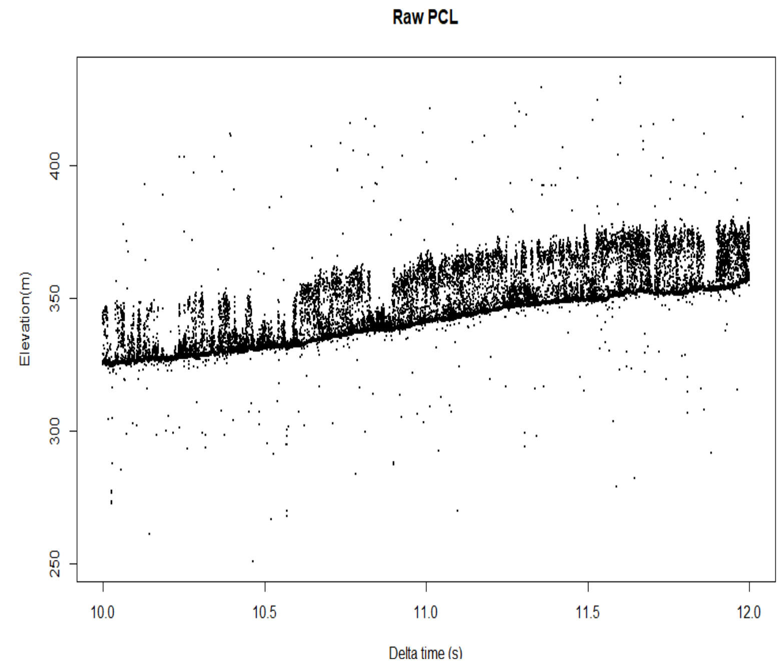


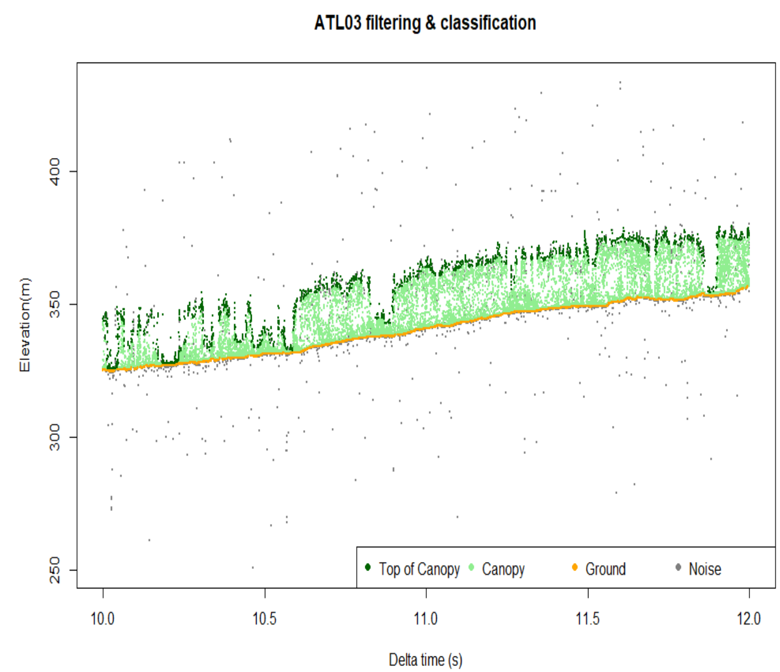
Photon classification and height estimates











Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Photon counting LiDAR: An adaptive ground and canopy height retrieval algorithm for ICESat-2 data

S.C. Popescu[a], T. Zhou[a,*], R. Nelson[b], A. Neuenschwander[c], R. Sheridan[a], L. Narine[a], K.M. Walsh[d]

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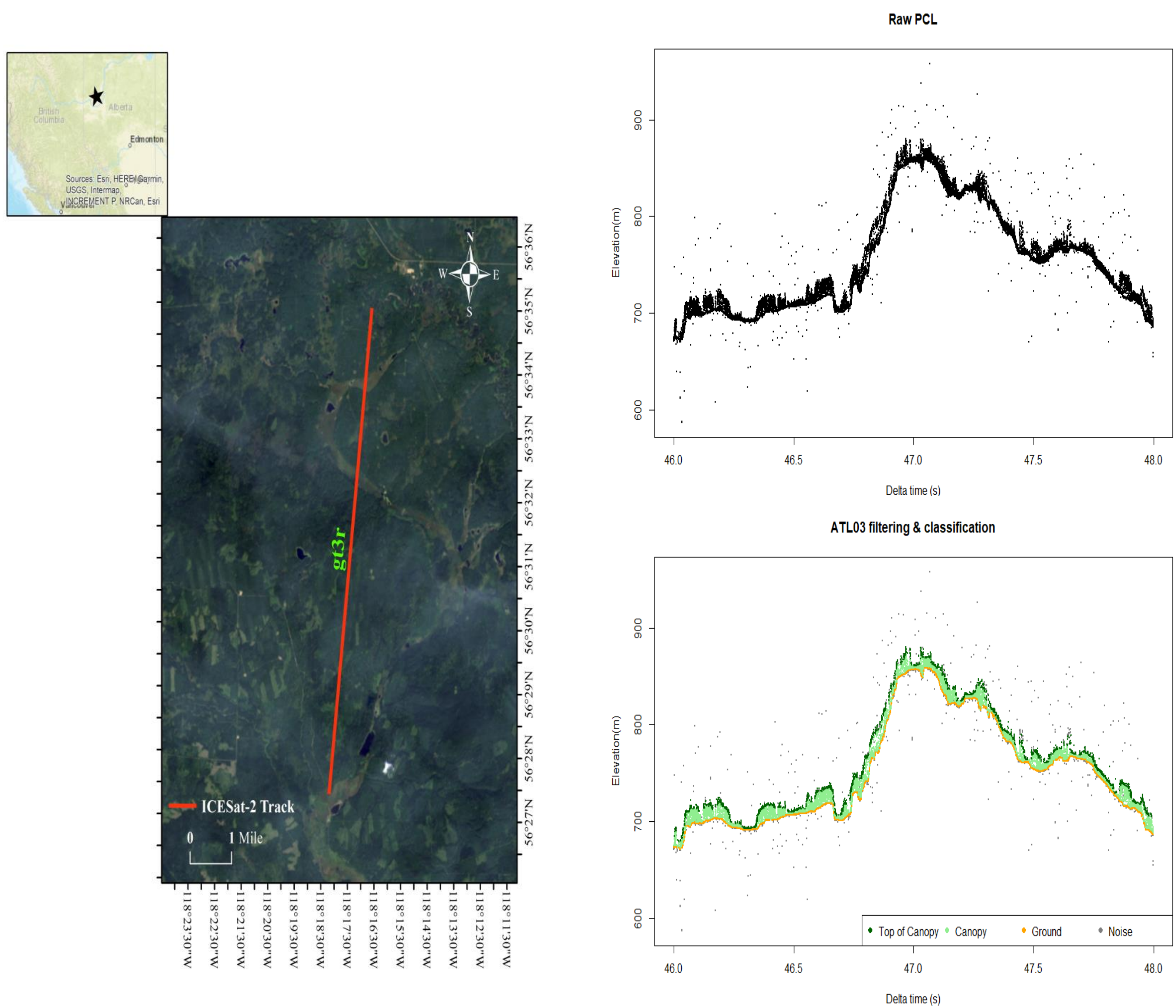
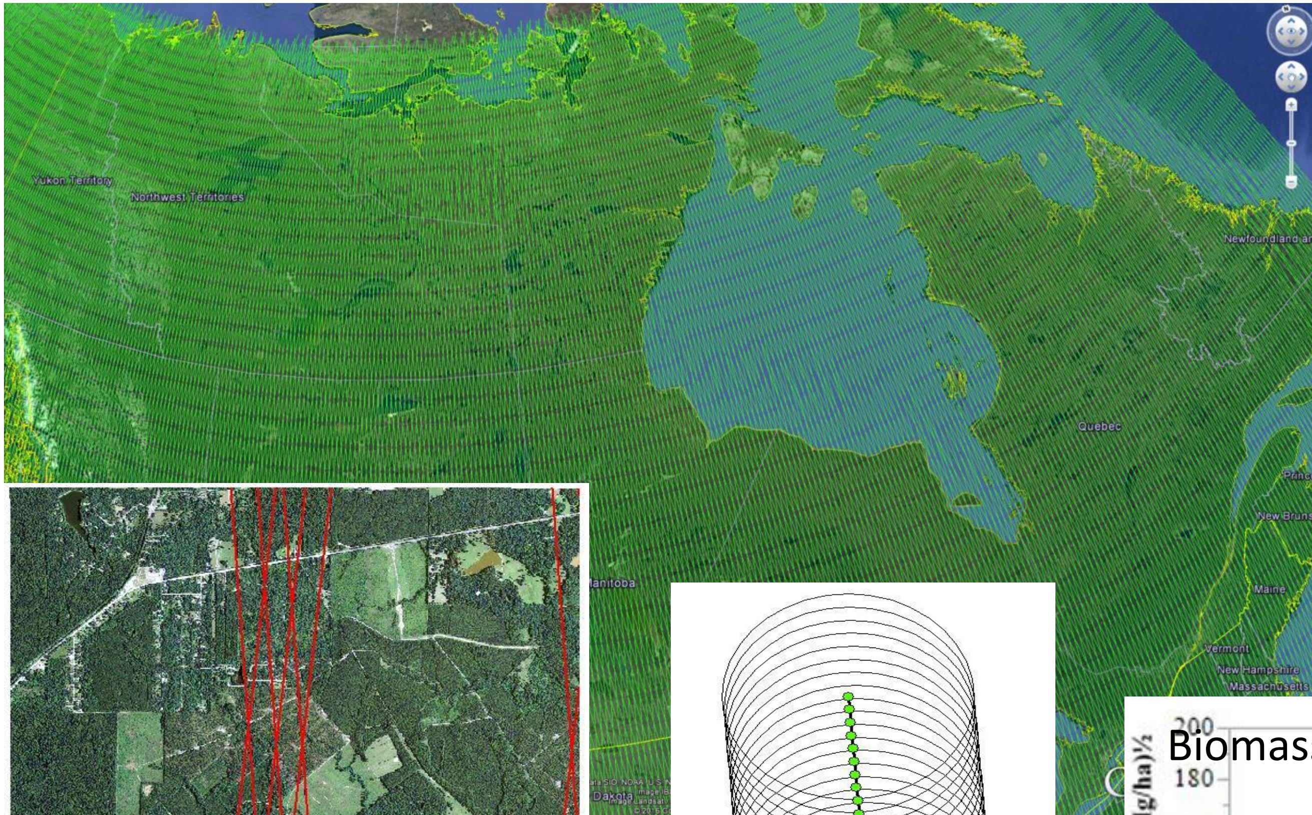
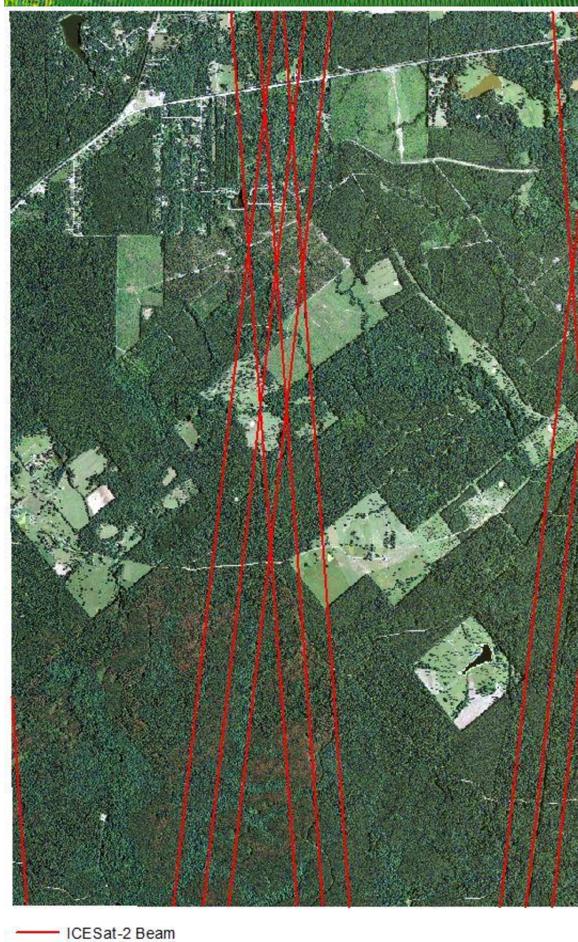
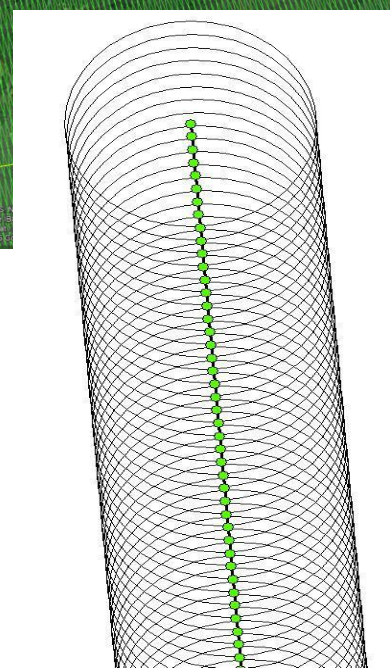
[b] Biospheric Sciences Lab, Code 618, NASA-GSFC, Greenbelt, MD 20771, USA
[c] Geospatial Laser Applications and Measurements, Applied Research Laboratories, University of Texas at Austin, 10000 Burnet Rd, Austin, TX 78758, USA
[d] NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA



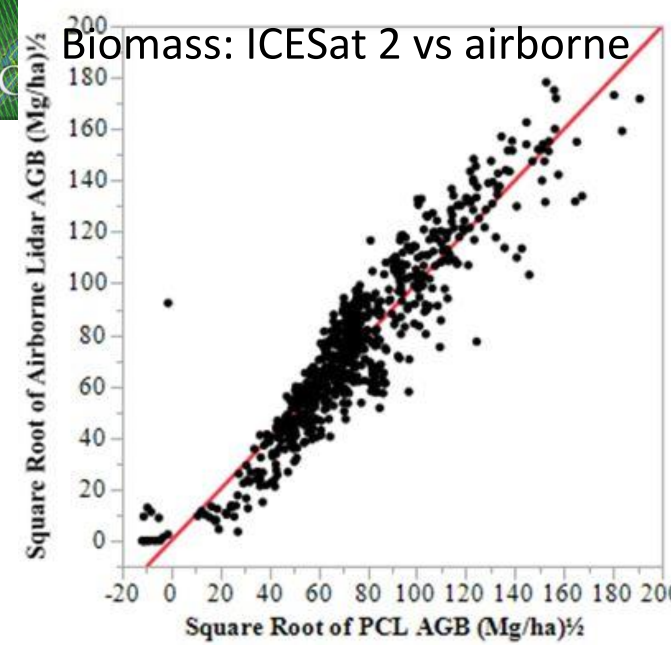
British Columbia
Alberta
Edmonton
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri
N
S
W
E
gt3r
ICESat-2 Track
0
1 Mile
56°36'N
56°35'N
56°34'N
56°33'N
56°32'N
56°31'N
56°30'N
56°29'N
56°28'N
56°27'N
118°23'30"W
118°22'30"W
118°21'30"W
118°20'30"W
118°19'30"W
118°18'30"W
118°17'30"W
118°16'30"W
118°15'30"W
118°14'30"W
118°13'30"W
118°12'30"W
118°11'30"W
Raw PCL
Elevation(m)
600
700
800
900
46.0
46.5
47.0
47.5
48.0
Delta time (s)
ATL03 filtering & classification
Elevation(m)
600
700
800
900
46.0
46.5
47.0
47.5
48.0
Delta time (s)
Top of Canopy
Canopy
Ground
Noise







Biomass: ICESat 2 vs airborne

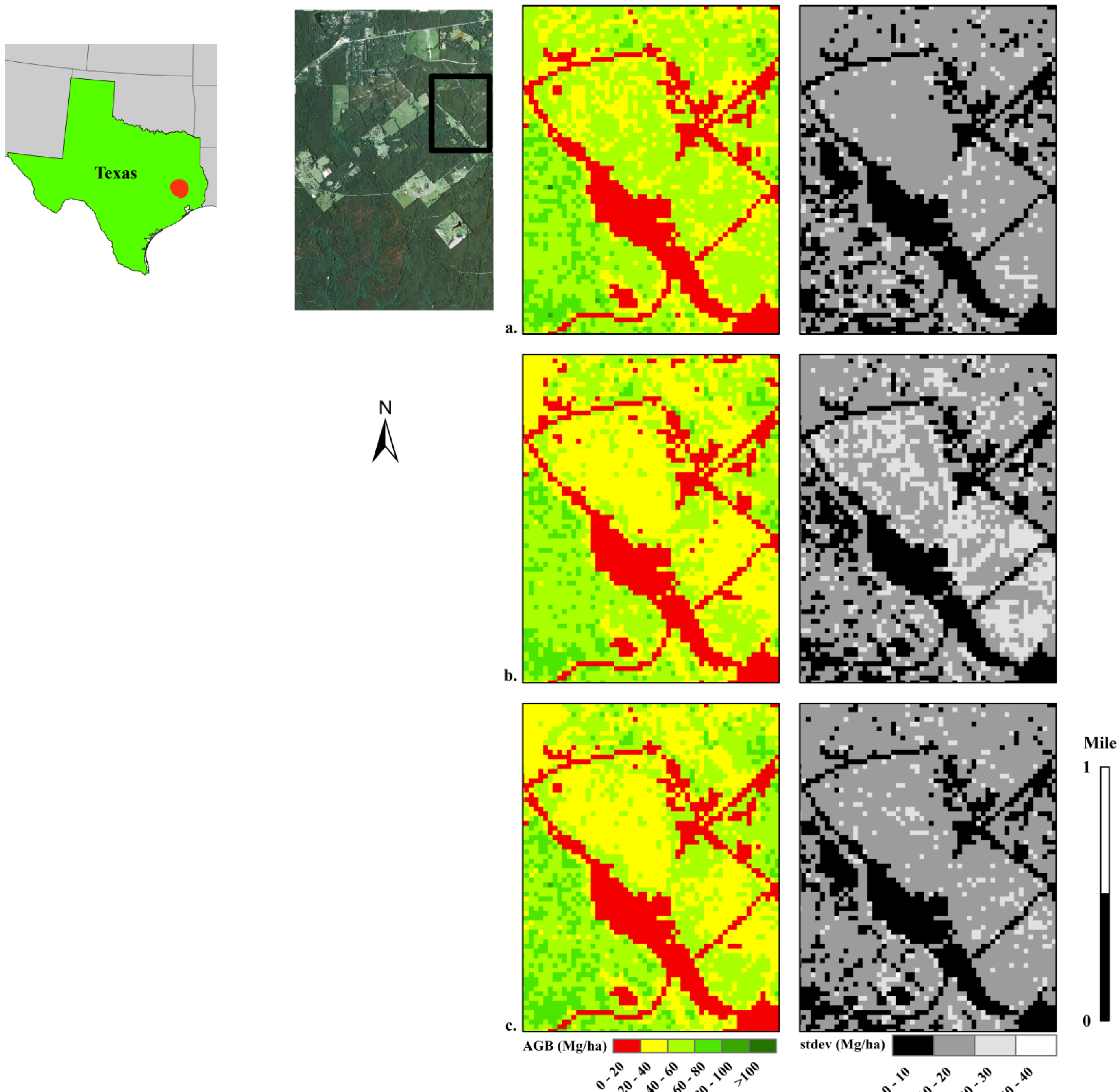


ICESAT 2 tracks in Texas

Methodology for scaling up Random Forest and Deep Neural Networks

Comparison of RF predicted AGB with AGB predicted from DNN models under three scenarios; no noise, daytime and nighttime scenarios

Scenario	RF Model		DNN Model		
	R^2	RMSE	Network Structure	R^2	RMSE
Daytime	0.42	19.69 Mg/ha	6-300-160-1	0.42	19.55 Mg/ha
Nighttime	0.49	19.30 Mg/ha	6-600-400-1	0.49	19.35 Mg/ha
No Noise	0.51	19.72 Mg/ha	6-500-300-60-1	0.50	19.82 Mg/ha



No Noise

Daytime

Nighttime

Conclusion – risk assessment tools

- State of **technology** and **methodology**
  - **Trend towards automation and reduced human/field effort**
  - **3D structural information availability**
  - **Already changing inventory and management paradigms**
- Assess costs
- Assess impacts – socio-economic and environmental
  - **Reduced uncertainty**

"Billy The Kid?! Only name folks gonna remember from here on is Jimmy The Risk Averse, buddy..."

Thank you