Optimization of LiDAR Data Processing Algorithms for Wetland Graminoid Marsh and Prairie Vegetation

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"Anyone relying on LiDAR is doomed. Doomed!..."

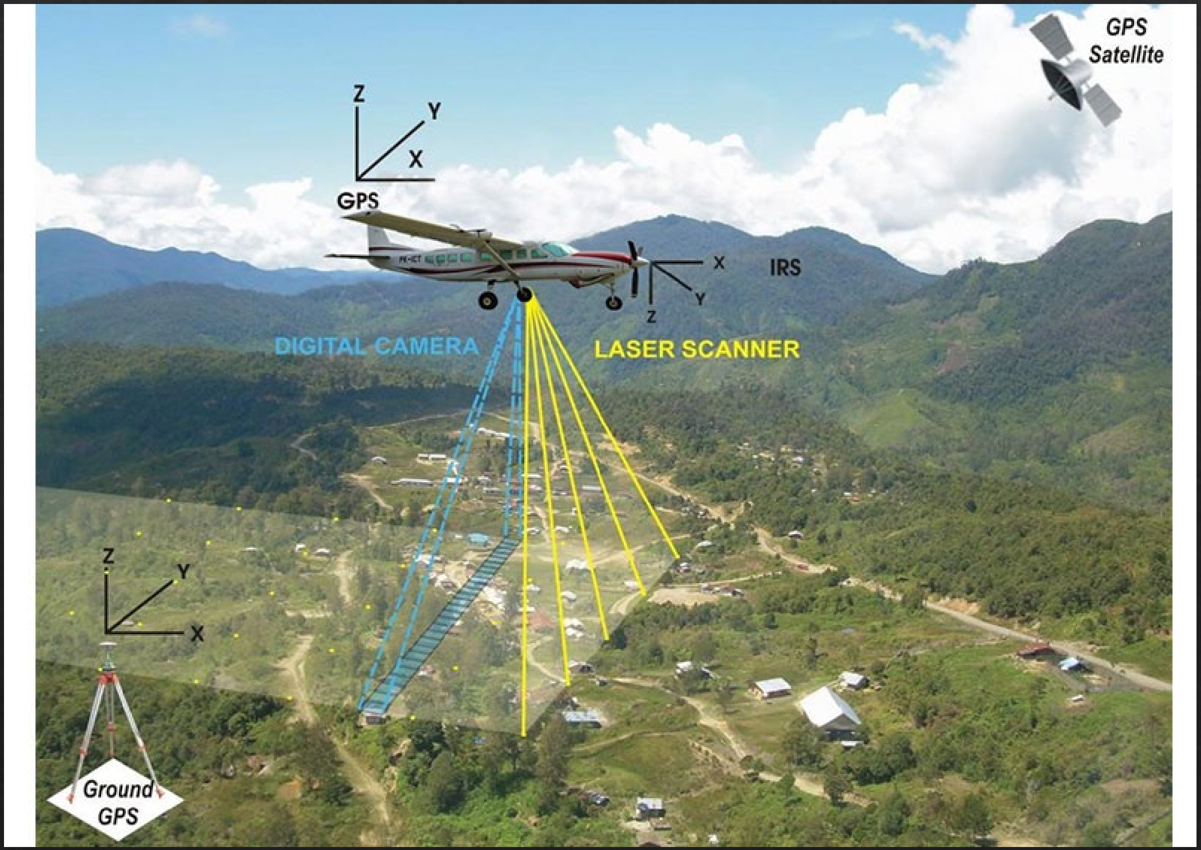
Elon Musk

https://techcrunch.com/2019/04/22/anyone-relying-on-lidar-is-doomed-elon-musk-says/

LiDAR

- LiDAR: Light Detection and Ranging
- Footprint
- Pulse rate
- Wavelength
- Scan angle (β)
- Sensor type:

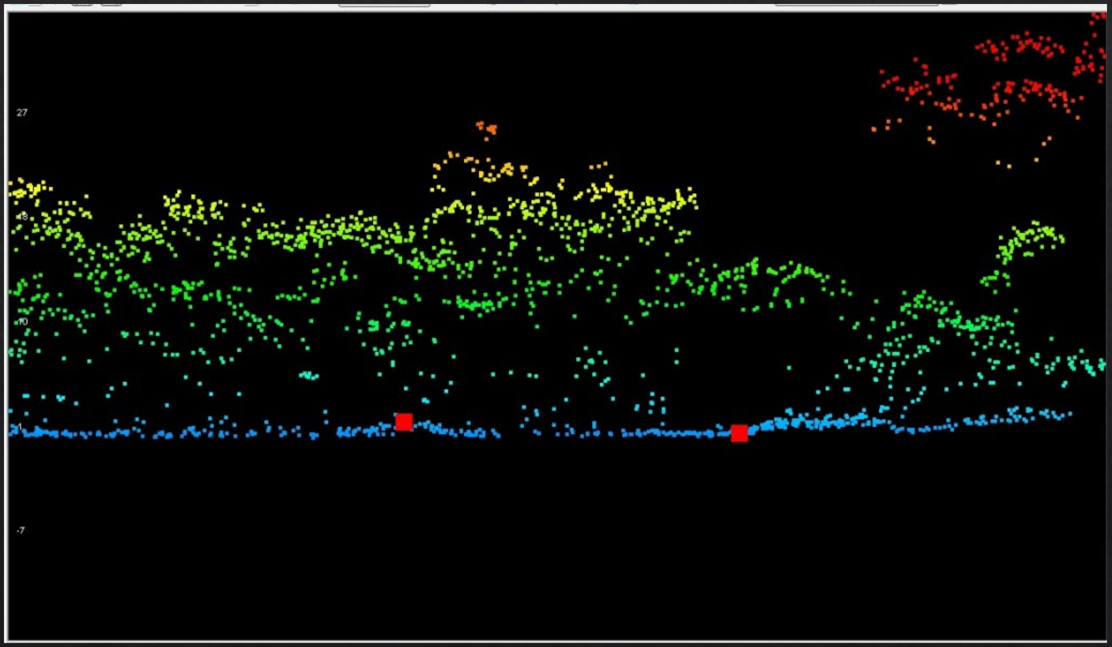
  Green/NIR



https://www.ice.org.uk/eventarchive/lidar-topographic-and-bathymetric-mapping-jakarta

Data products

- DSM: digital surface model, first return
- DTM: digital terrain model , last return
- CHM: canopy height model, = DSM-DTM



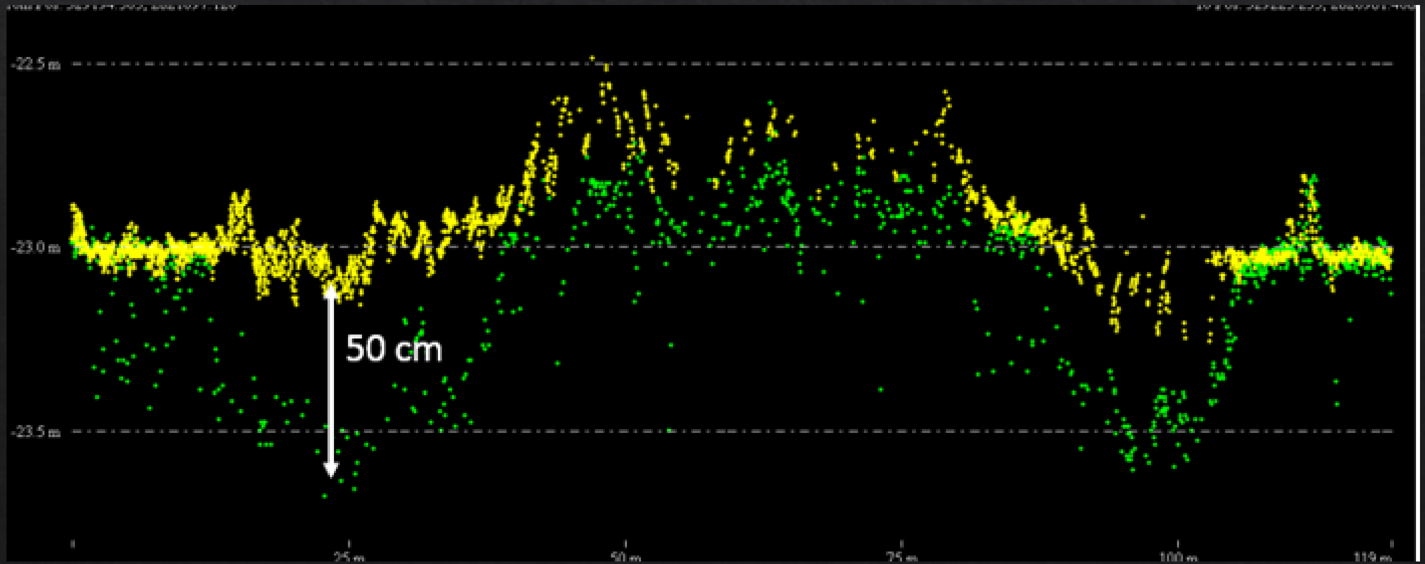
Picture from: Al Karlin, Ph.D. GISP (Al.Karlin@swfwmd.state.fl.us), Southwest Florida Water Management District

Why to collect LiDAR data?

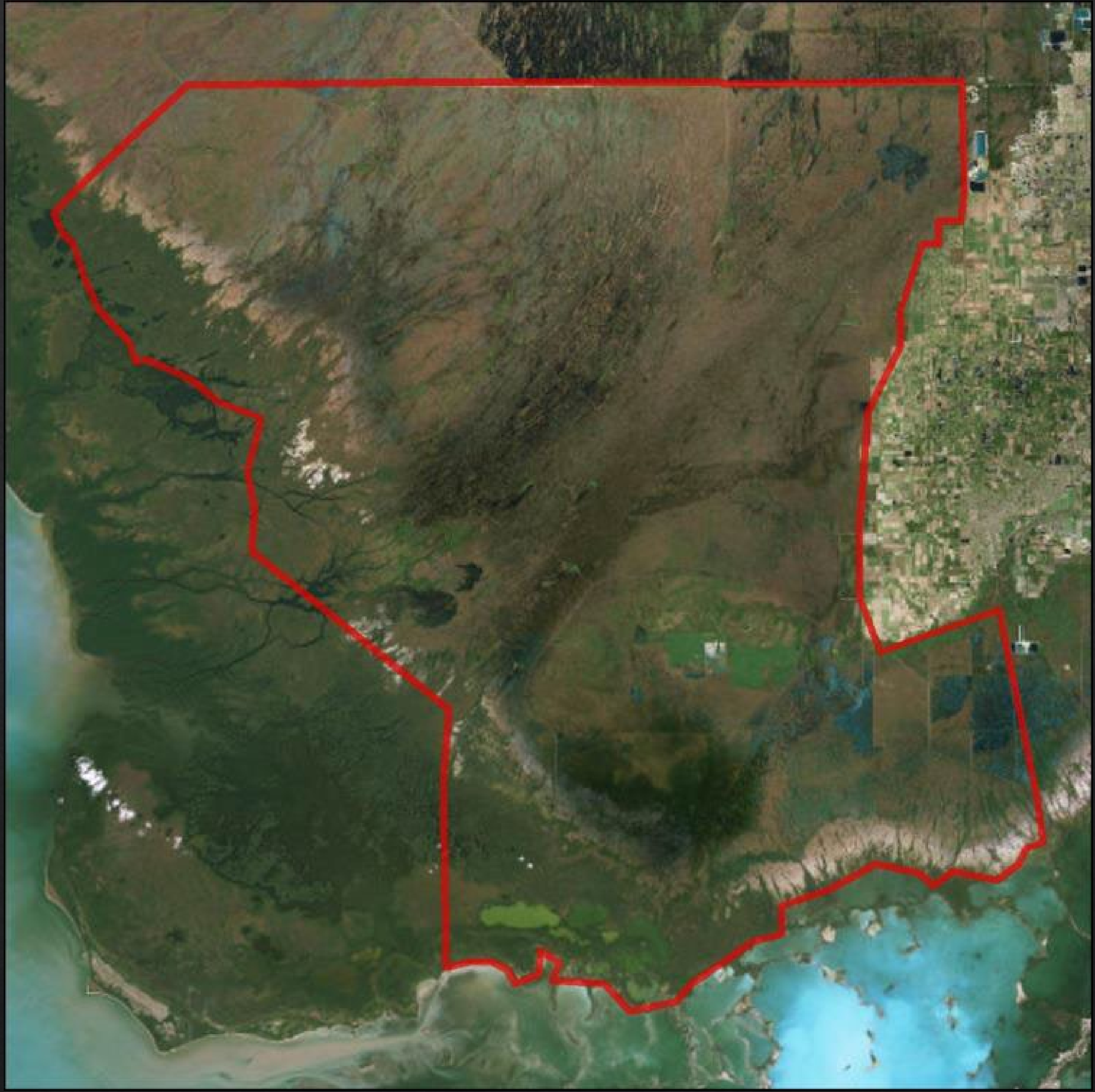
- Coastline morphology
- Coastal elevation
- Ground characteristics
- Plant community structure and biomass
- Hydrological models

LiDAR Data

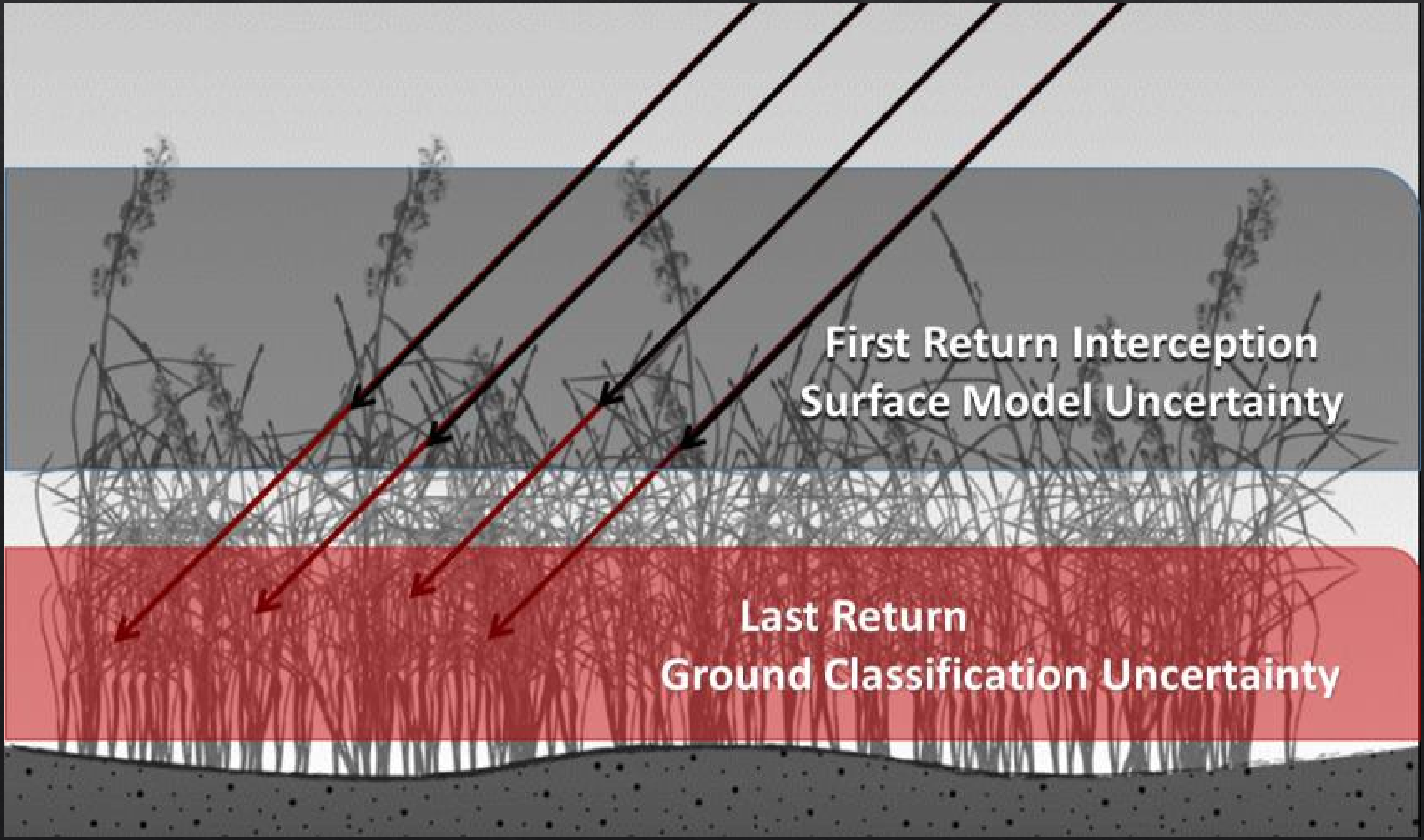
- The National Park Service (NPS), US Geological Survey (USGS)
  - Acquisition of a spatially exhaustive (continuous), elevation data set for the entire Everglades marsh and marl prairie ecosystems.
  - Data in April of 2017
  - Green and NIR



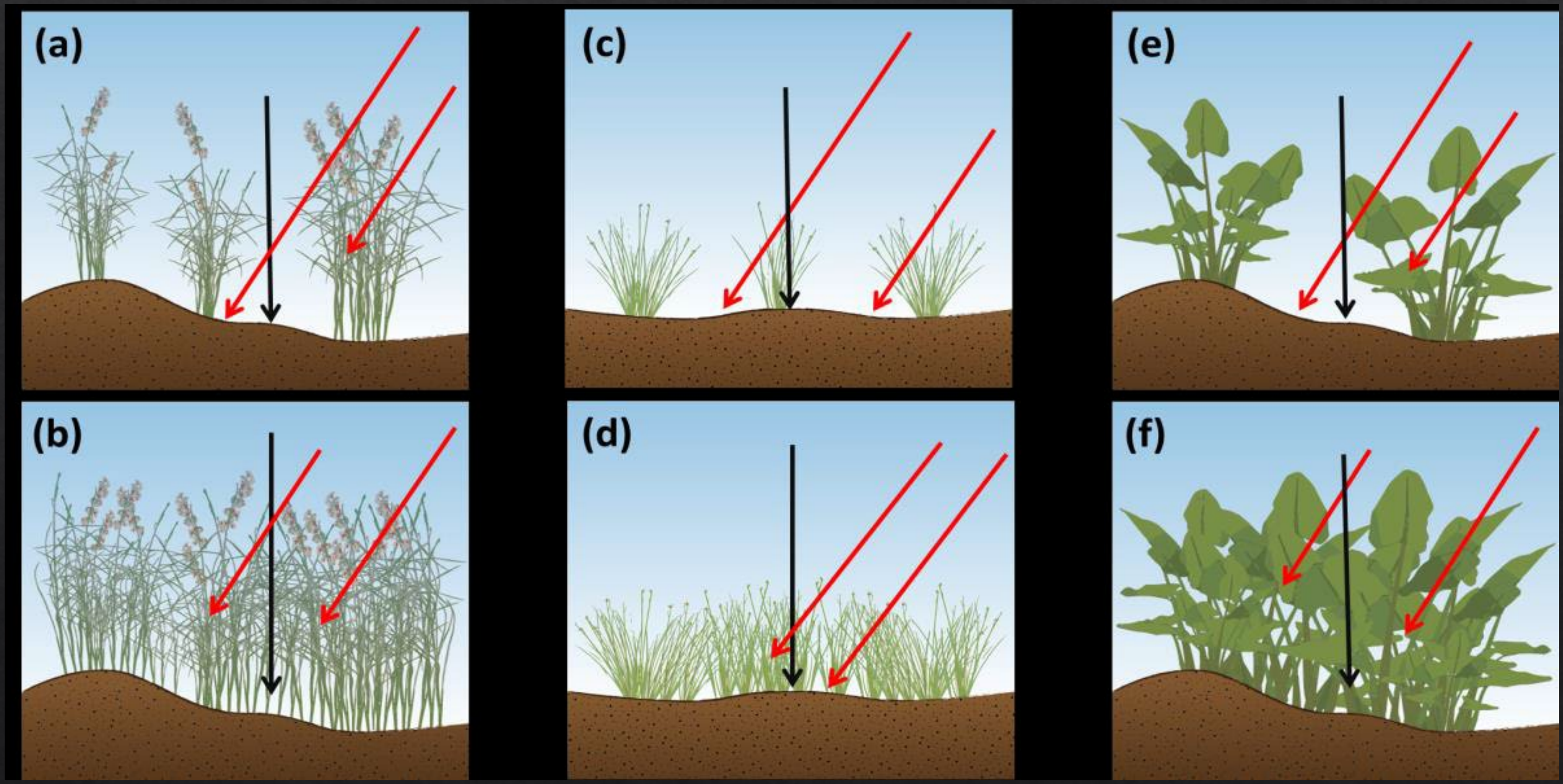
Dewberry Consultants

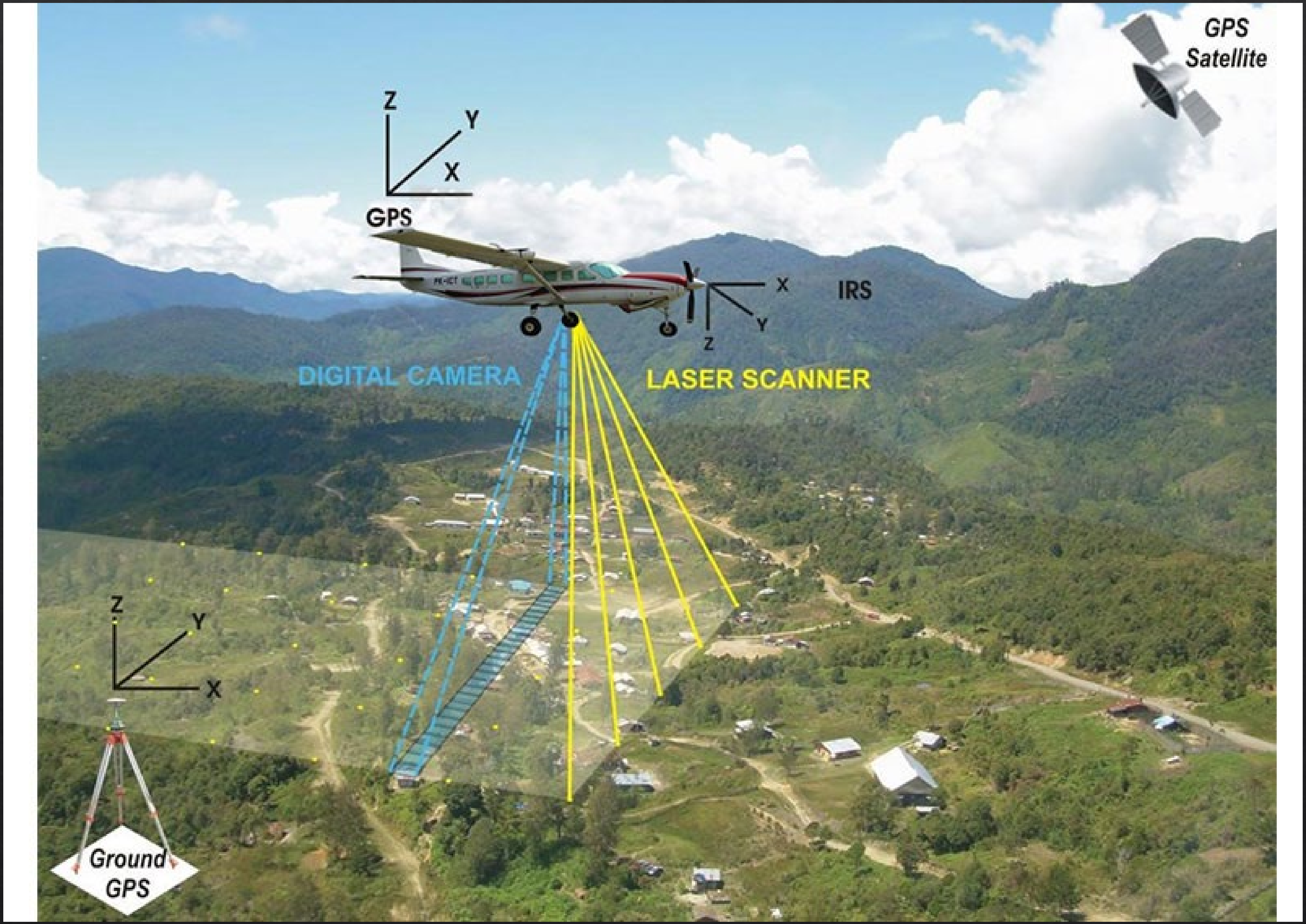


Bias and uncertainty



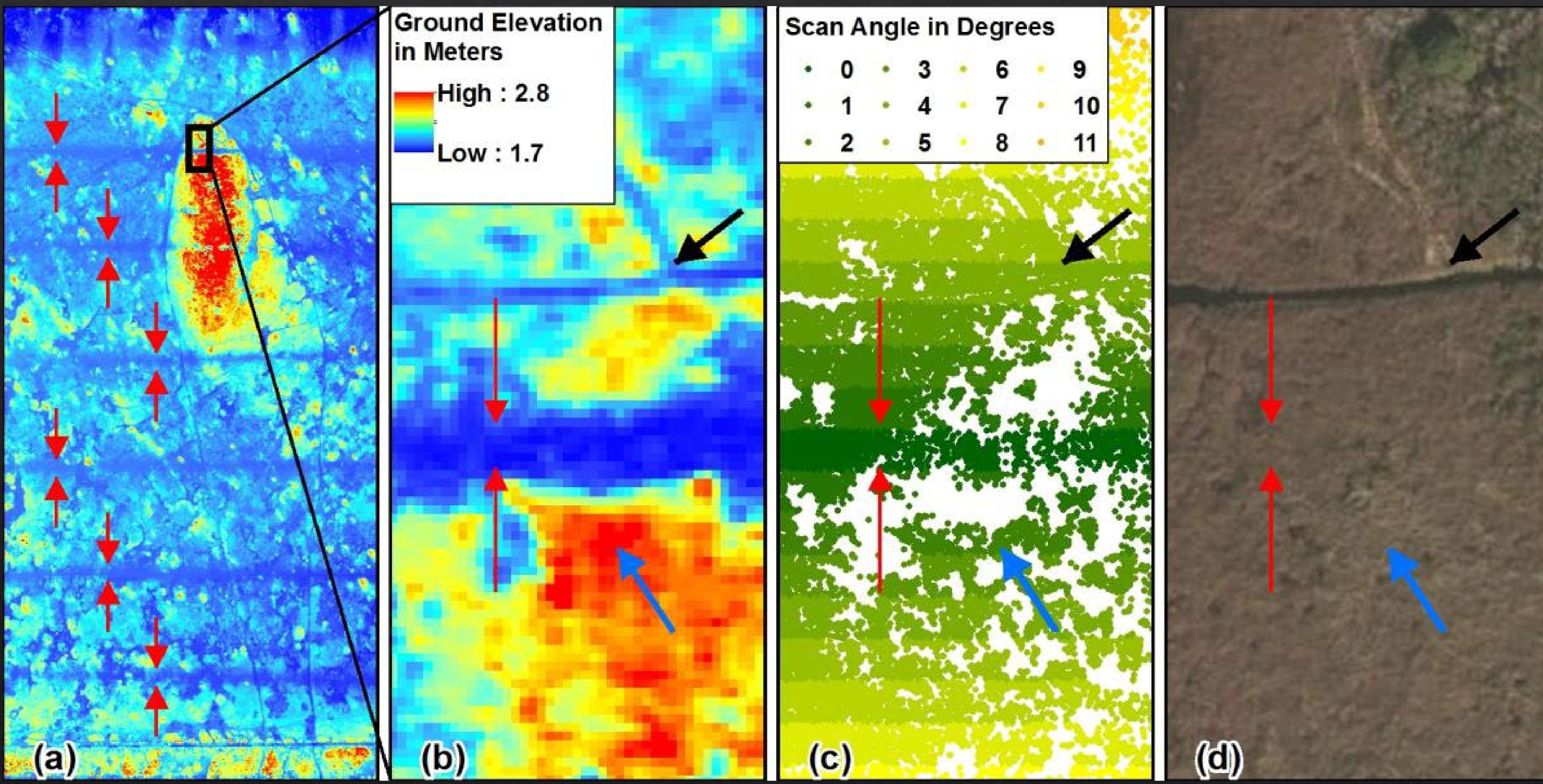
Vegetation type and density





https://www.ice.org.uk/eventarchive/lidar-topographic-and-bathymetric-mapping-jakarta

Scan angle


Ground Elevation in Meters
High : 2.8
Low : 1.7
Scan Angle in Degrees
0
1
2
3
4
5
6
7
8
9
10
11
(a)
(b)
(c)
(d)

Objective

- Develop LiDAR data processing algorithms that are optimized for wetland vegetation applications to significantly improve products derived from LiDAR data.

Question

- How are terrain elevation and surface model estimates affected by **vegetation type, vegetation density**, LiDAR scan angle, and their interactions?

The target vegetation classes are graminoid-dominated marsh and prairie communities within Everglades National Park.

Model for error correction

$\Delta LiDAR$णsष़ f (V_c, V_{hmax},V_{hmin}, β,V_d)

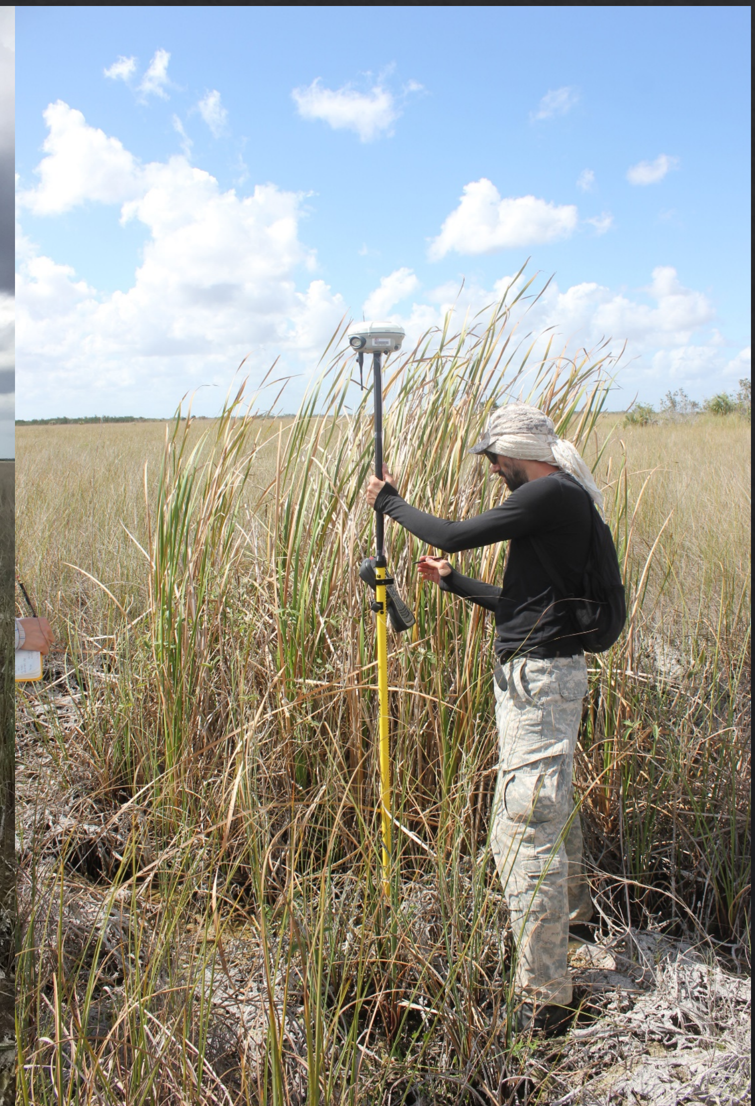
Where:

- $\Delta LiDAR$णs: is the difference between the LiDAR elevation and survey elevations estimates
- V_c: is the vegetation class
- V_{hmax}: is the maximum height intercept
- V_{hmin}: is the minimum height intercept
- β: is the LiDAR incidence angle
- V_d: is the vegetation density index define as a ratio of V_{hmax}/V_{hmin}
- V_d to be determine as a function of NDVI

Methods

- LiDAR
  - 2017 Light Detection and Ranging (LiDAR, Riegl 880G sensor)
  - Gridded digital terrain model (DTM) and digital surface model (DSM)
- Field campaigns to collect canopy structure data by vegetation class
  - RTK elevations surveys
  - Vegetation type: max and mean canopy height
  - Water level: key for floating vegetation
- Comparing data from the two data sets to determine bias by vegetation class
  - Using gridded data DTM

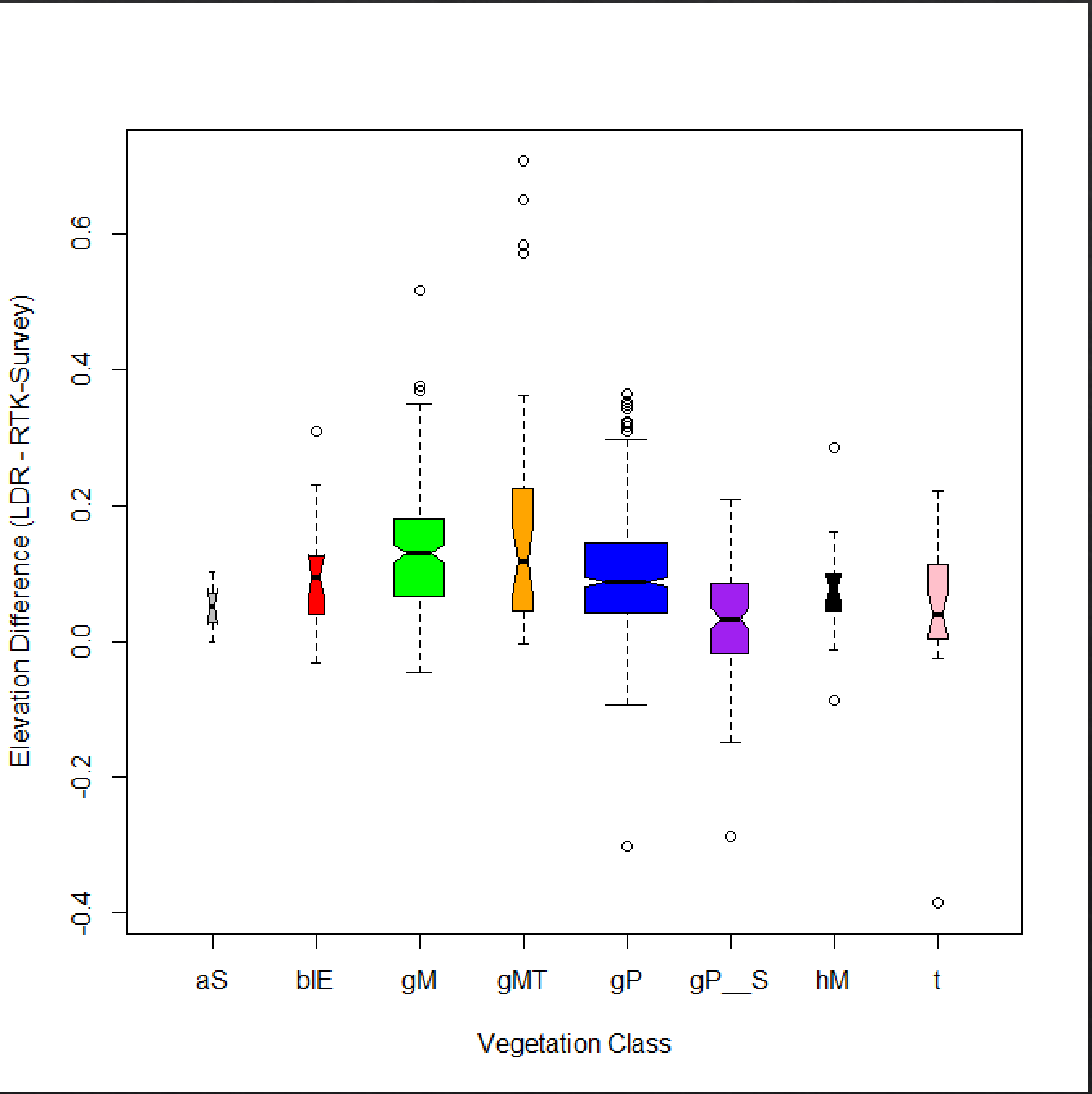
RTK Surveys



Preliminary results

We have collected over 800 ground points in mostly prairies and mash communities.

Preliminary results



Conclusions

- Preliminary data suggest that vegetation density is a key component in understanding the effect of vegetation in the estimation LiDAR bias
- We expect that ancillary such as vegetation indices that can be used as a proxy to vegetation density should provide key information for the development of correction and processing algorithms

Acknowledgment

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