CyVerse-NEON AOP Workshop
November 2020

Bridget Hass
Remote Sensing Scientist
Airborne Observation Platform (AOP)

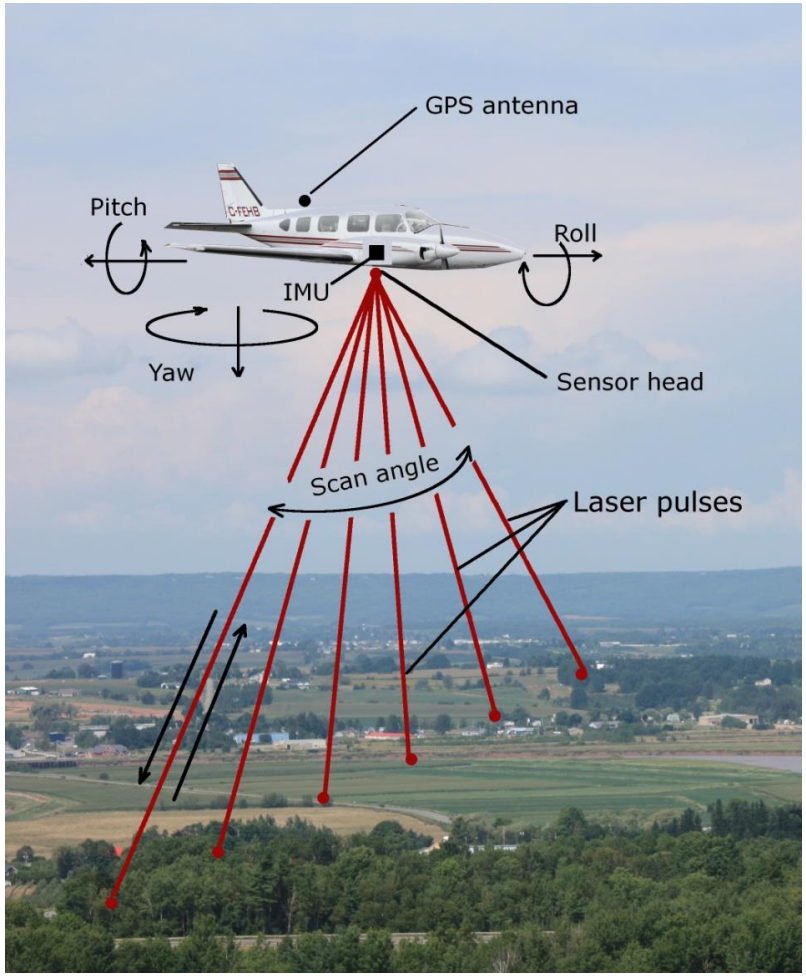
Introduction to LiDAR

National Ecological Observatory Network

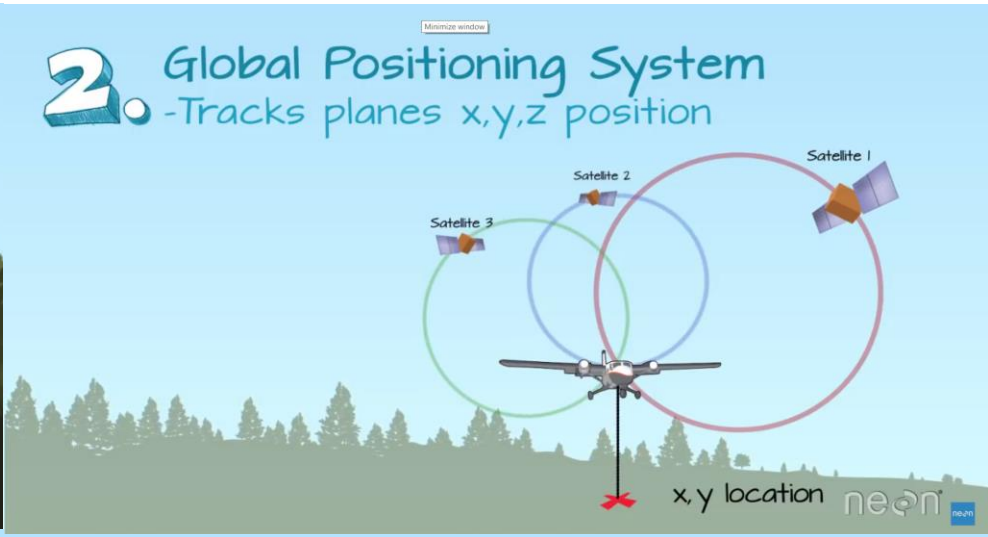
A project sponsored by the National Science Foundation and proudly operated by Battelle

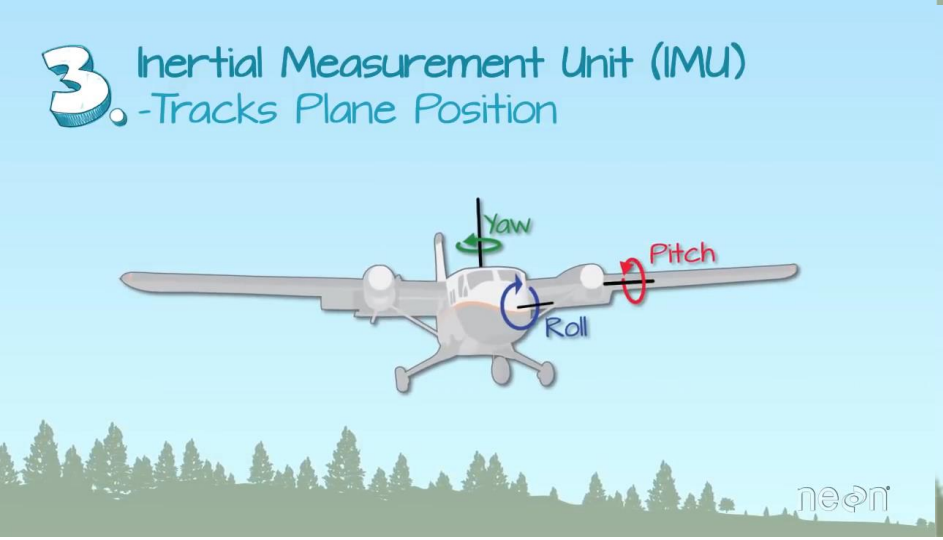
LiDAR

- LiDAR (Light Detection and Ranging)
  - Active vs. passive
- Produces 3D ground coordinate
- Direct geo-referencing
  - GPS
  - IMU
  - Laser Scanner
  - Laser Ranger (500 kHz)
- Accurate and dense raw point spacing allows for a high spatial resolution DEM
- Enables accurate creation of DEMs at the meter level

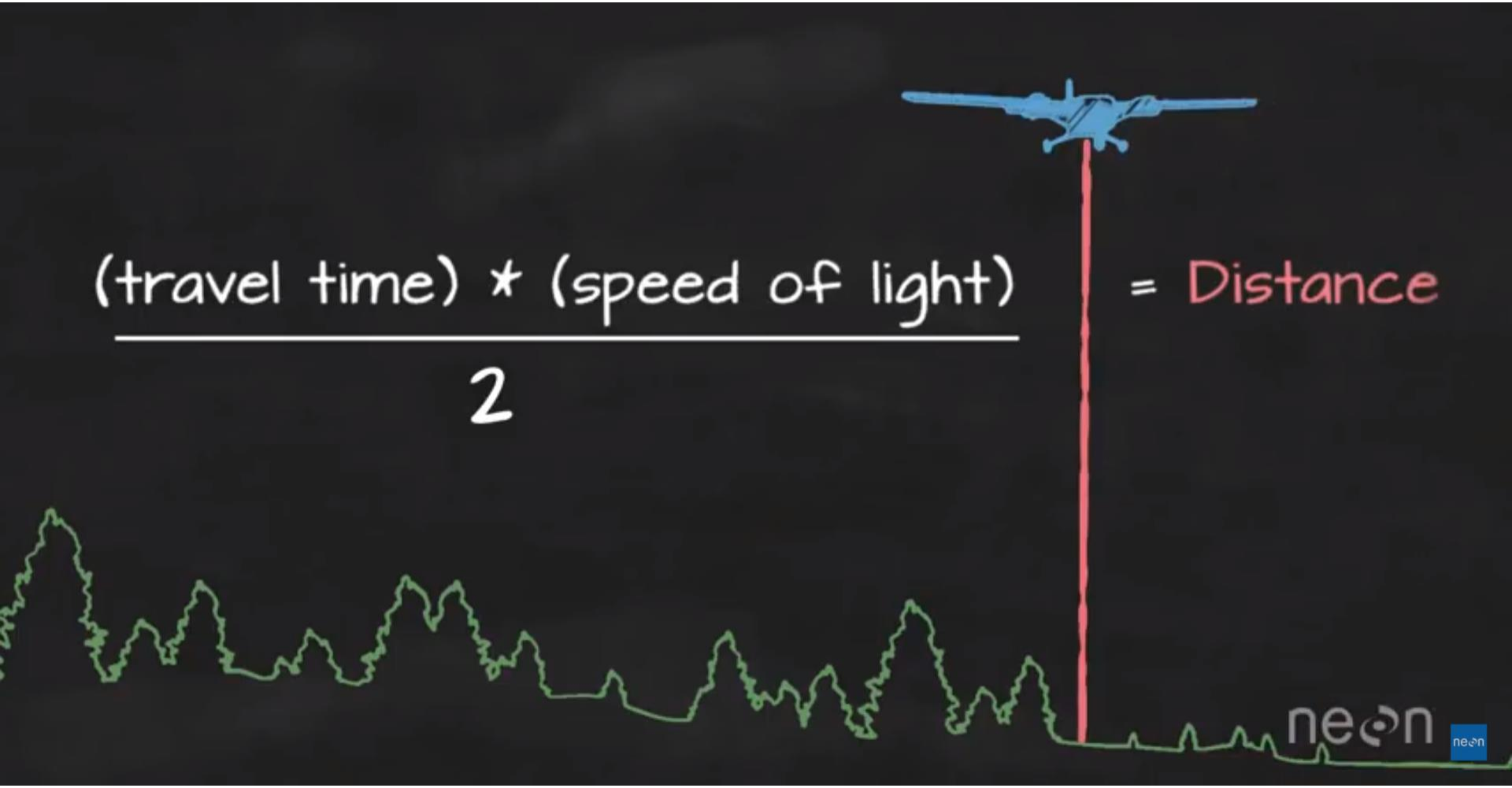


4 main components

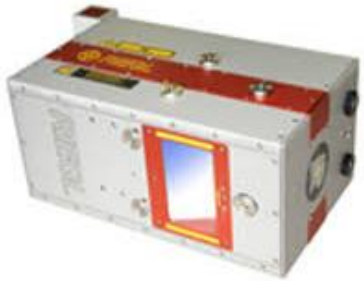




Range Calculation



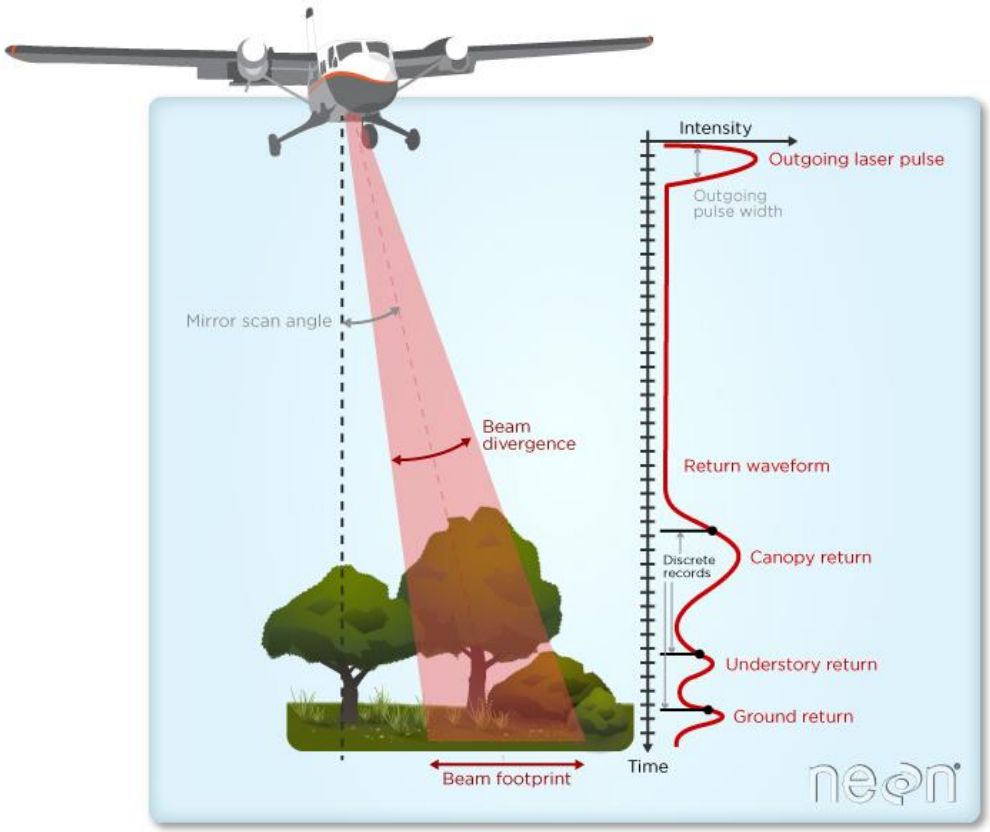
NEON LiDAR Sensors



	Optech Gemini (P1 & P2)	Riegl Q780 (P3)	Optech Galaxy Prime (P1 2021+)
Years Flown	2012 +	2018 +	2021 +
Laser Pulse Length (ns)	10	3	3
Beam Divergence (mRad)	0.8	0.25	0.25
Nominal PRF (kHz)	33-100	300-400	150-900
Pulse Density (pulses/m^2)	2-4	4-10+	up to 30

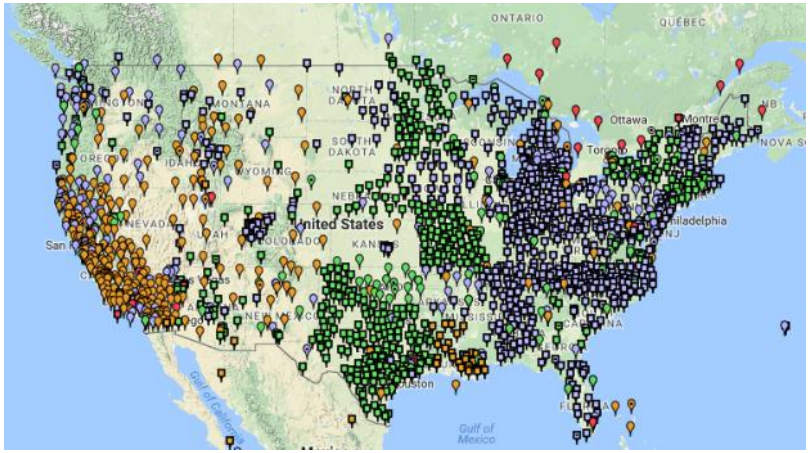
Discrete vs full waveform

- Optech Gemini/Galaxy return signal is split
  - Discrete receiving electronics
  - Waveform digitizer
- Riegl – discrete is derived from full waveform
- Discrete returns saves only point locations of returns
- Waveform saves the full return energy signature
- Tradeoff between data size / processing time vs. enhanced information



Trajectory Processing

- NEON base stations set up at FBO (airport) and site
- Use CORS network
- 1 basestation within 20 km of aircraft on site, or 4 basestations all within 70 km that encompass flight
- Aiming for errors in x, y, and z to be < 0.05 cm and 0.08 m
- Aiming for errors in roll, pitch, and yaw to be below 0.005º and 0.008º
- PDOP (position dilution of precision) can be high depending satellite configurations



Trajectory Processing Results

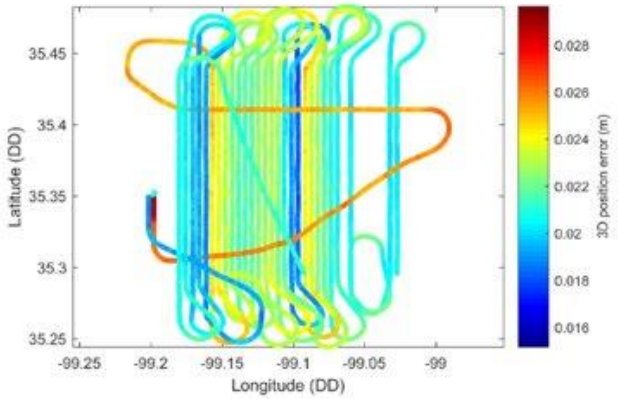


Figure 3: D11 OAES R1 P1 v2 fltlines Trajectory Error

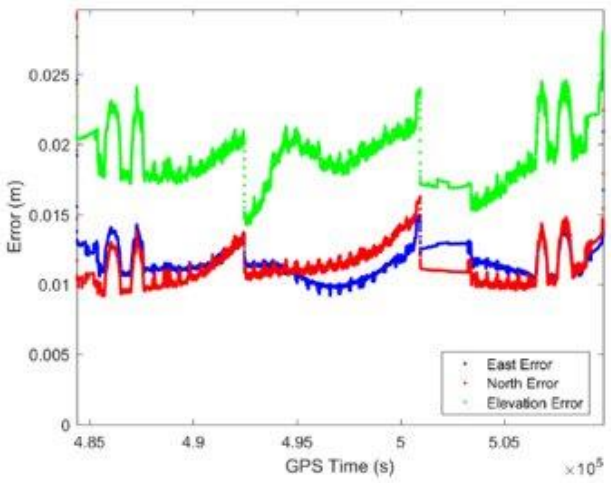
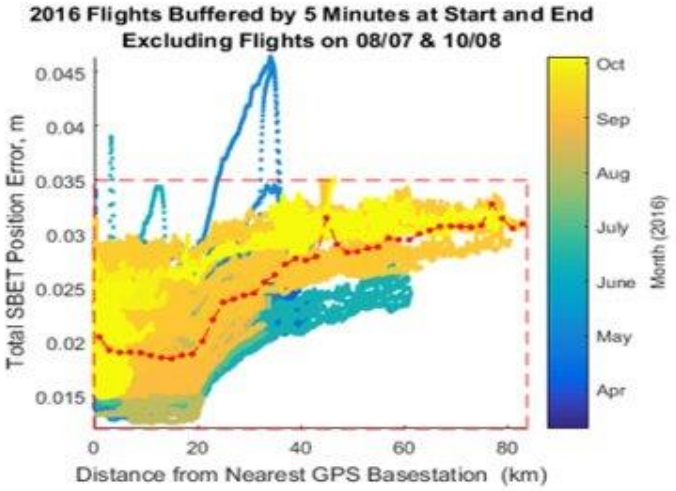
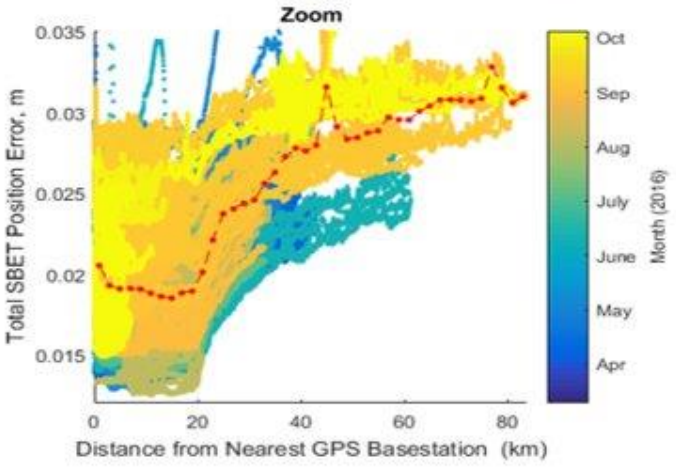


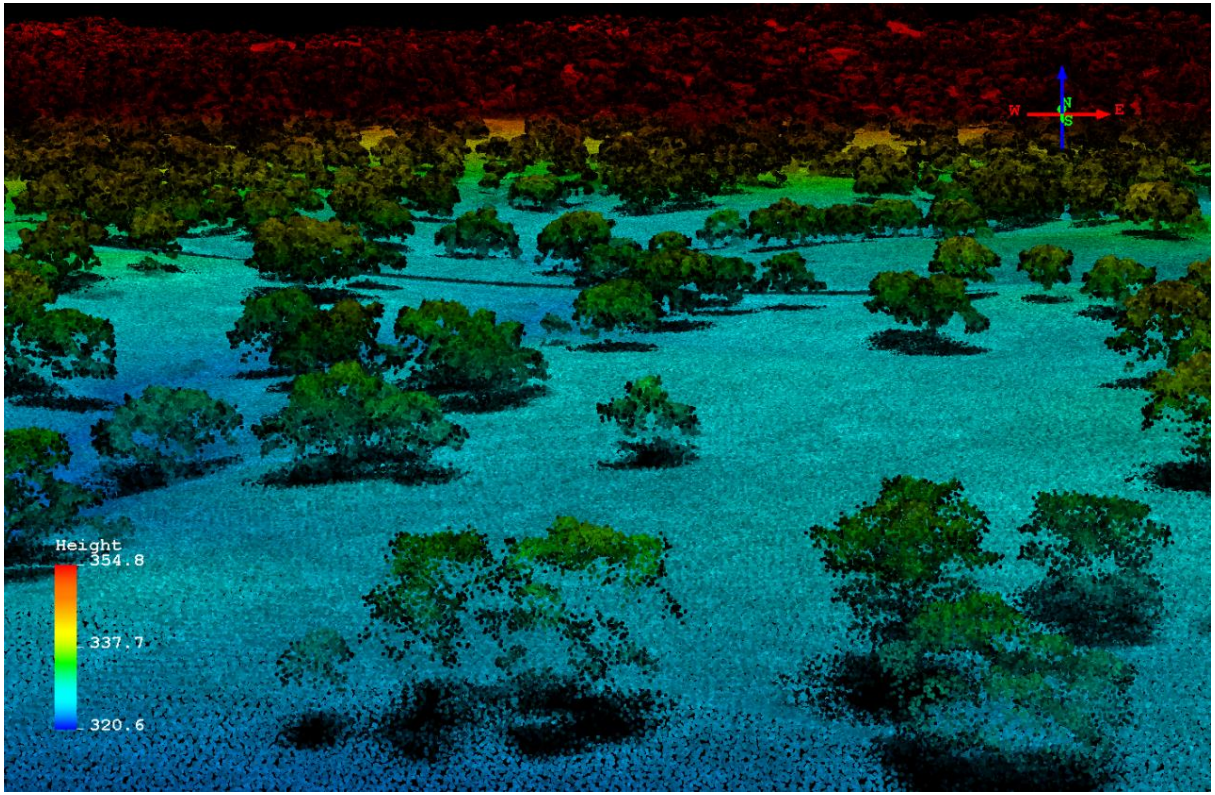
Figure 5: 2017050514 P1C1 Position Error





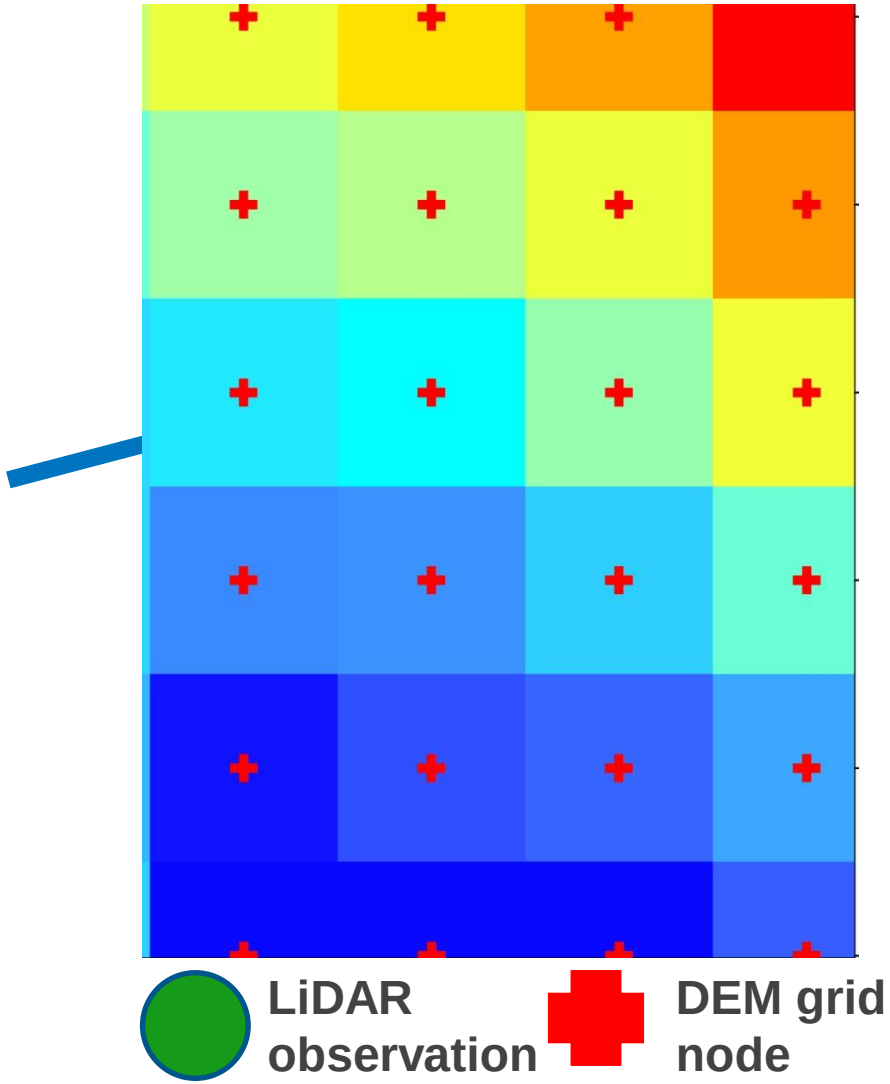
LiDAR point cloud

- A selection of LiDAR points acquired in the survey.
- Fully three-dimensional coordinates



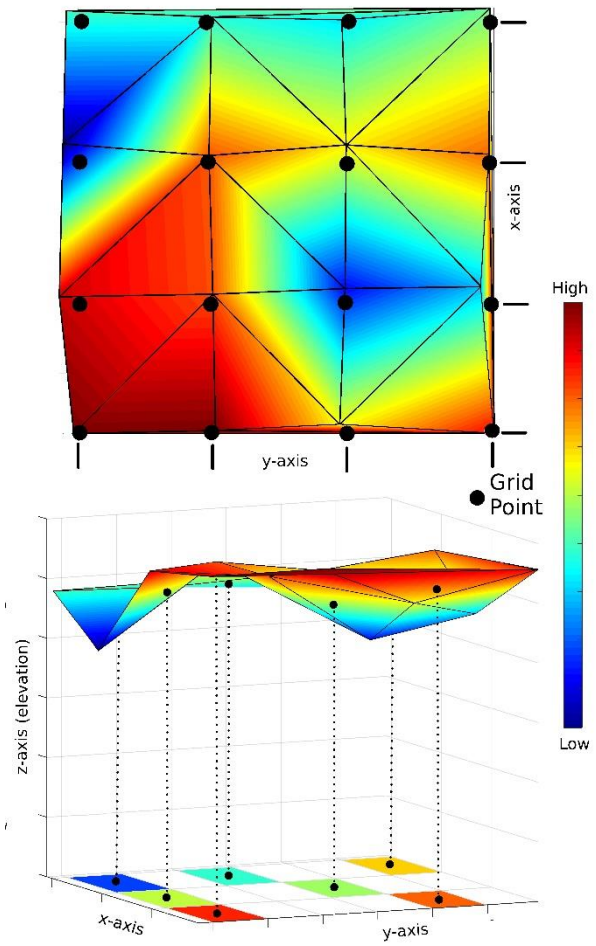
Cloud to grid

- Turn LiDAR point cloud into raster product
- Requires interpolation method
- Many available
- Triangular Irregular Network (TIN) used at NEON



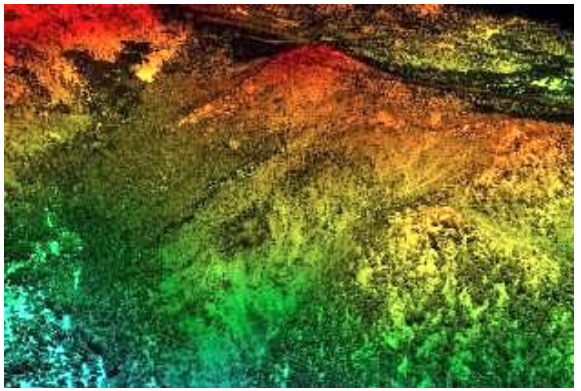
Triangular Irregular Network (TIN)

- Computationally efficient
- Honors location of original LiDAR points
- Does not exploit redundancy in the LIDAR data to reduce noise through averaging
- 4 pts / m^2, with only 1 m pixels



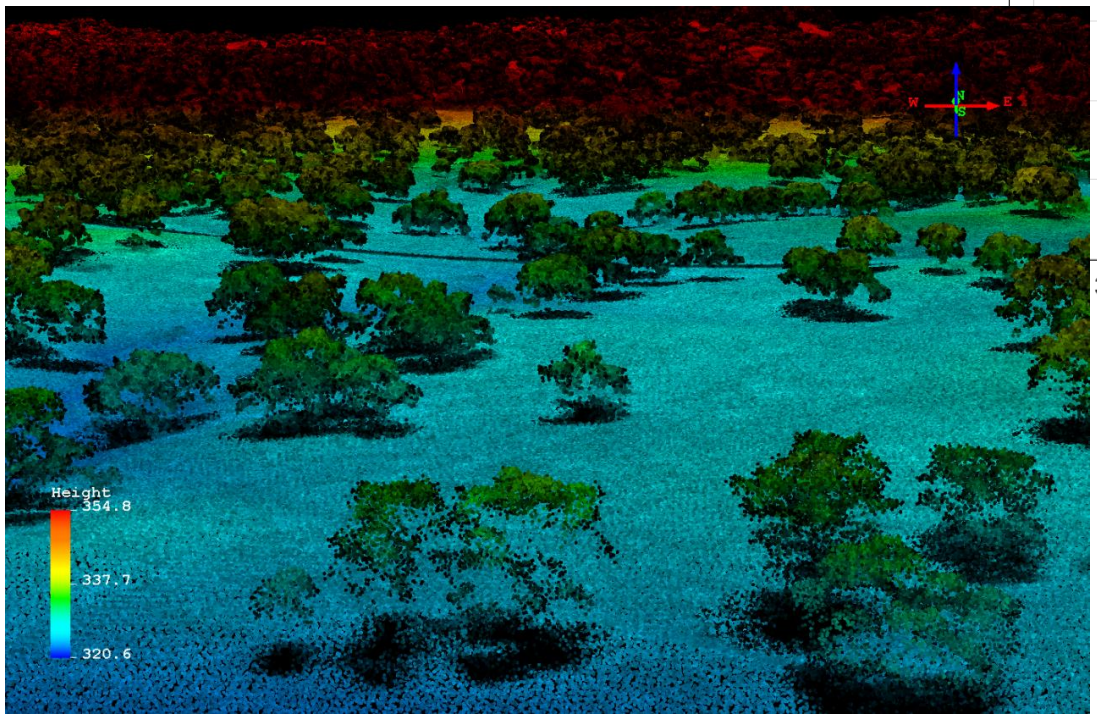
NEON AOP Lidar Products

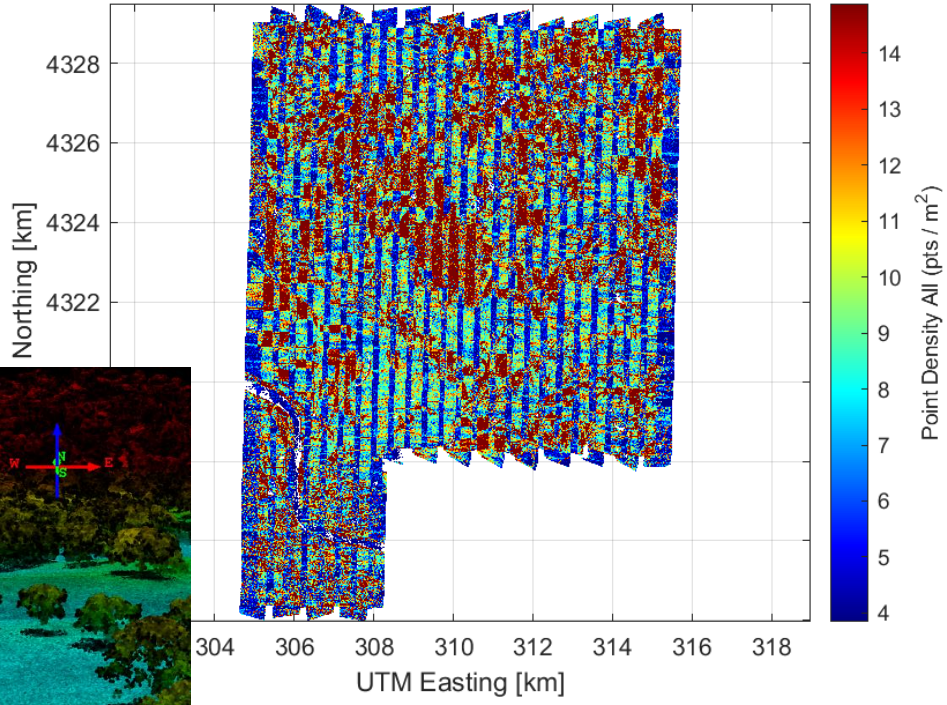
- **Lidar**
  - Unclassified point cloud (.las v1.3)
  - Classified point cloud (.laz v1.3)
  - DTM / DSM (1m, .tif)
  - Slope / Aspect (1m, .tif)
  - Canopy height model (1m, .tif)
  - Slant range waveform (.plz,.wvz 0.3)



NEON discrete LiDAR Data – Point Cloud

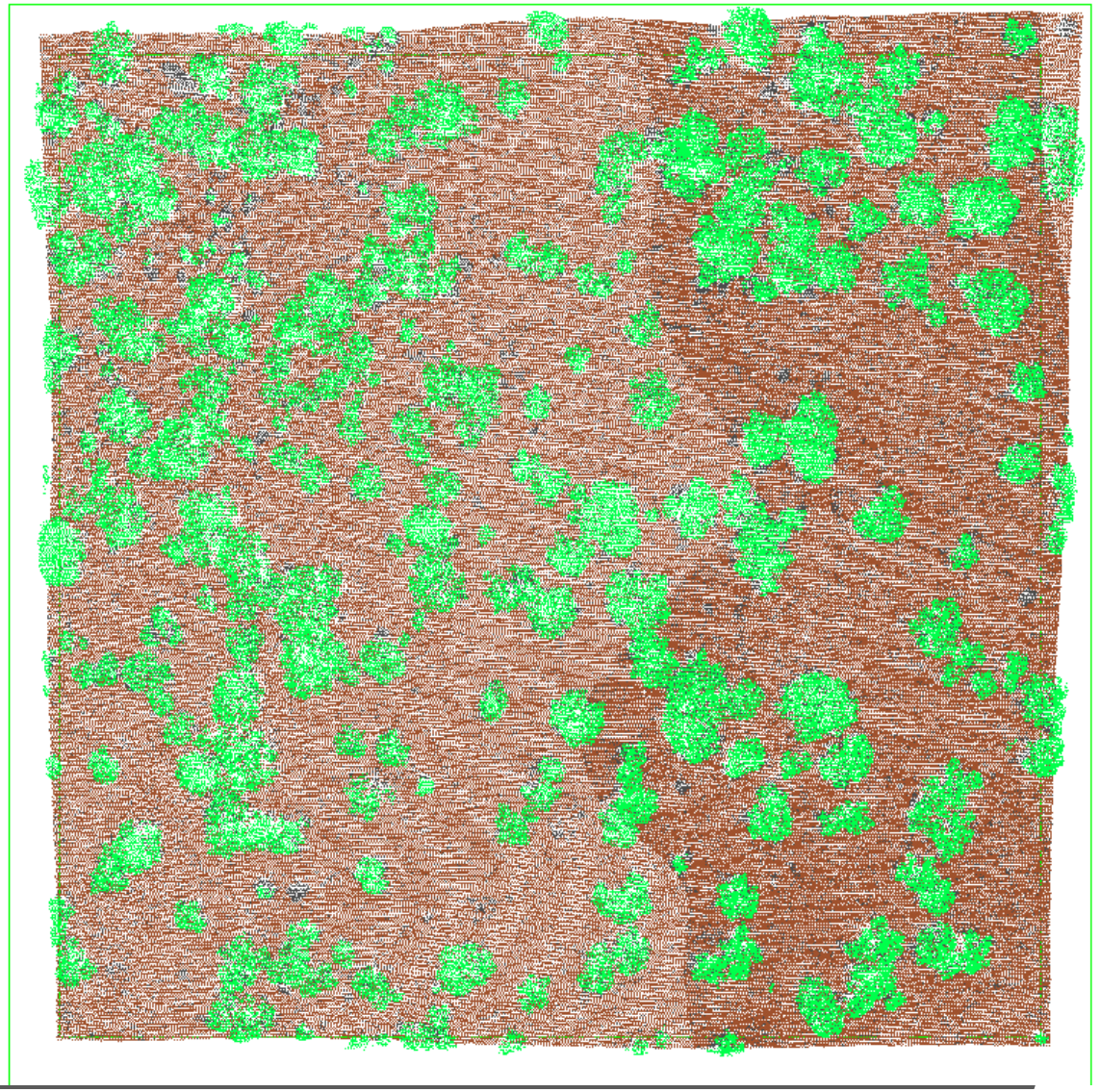
- L1 product derived from LiDAR
- LAS 1.3 format
- Available by flight line, 4-10+ points/m^2



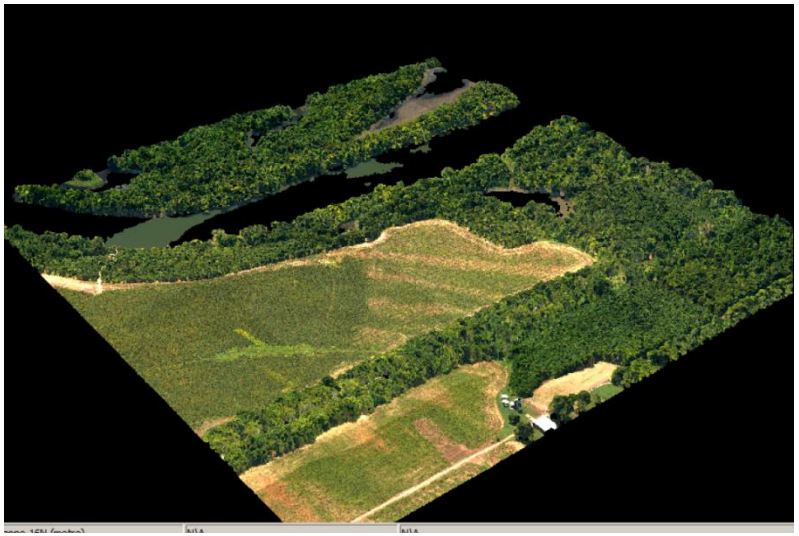


NEON discrete LiDAR Data – Classified Point Cloud

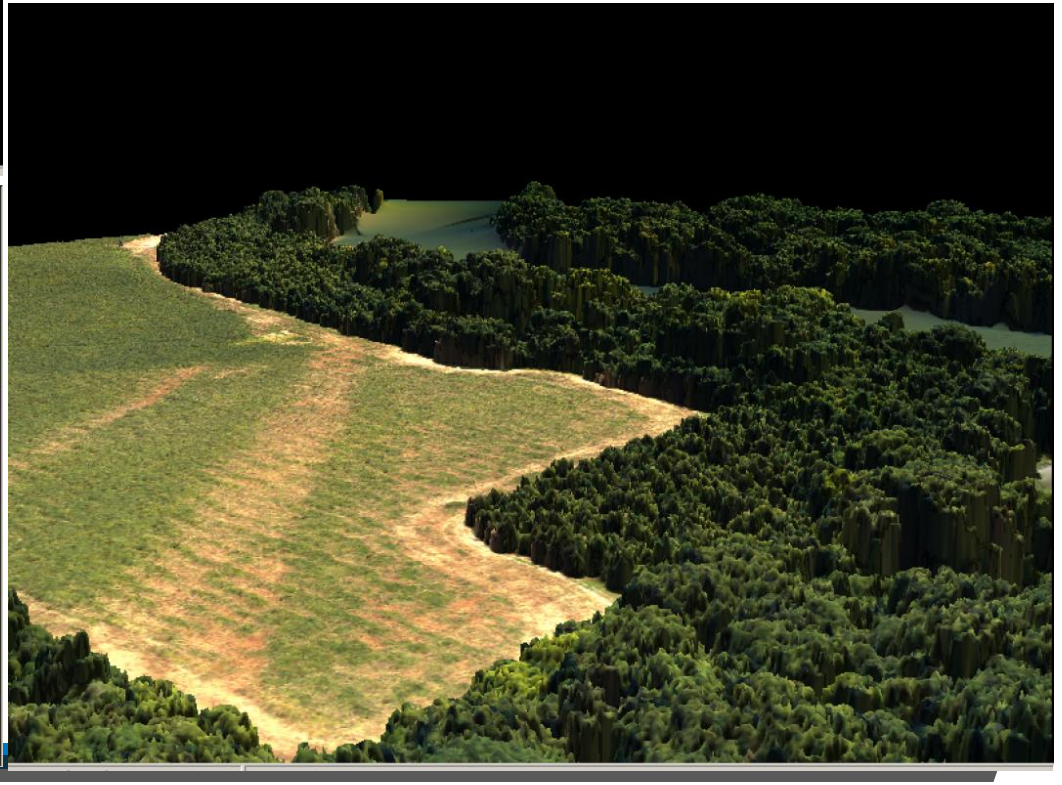
- Classification performed with LAStools (http://rapidlasso.com)
- Classifications based on ASPRS LAS standard classification scheme
- Classes include
  - Ground
  - Vegetation
  - Building
  - Noise
  - Unclassified
- Provided in 1 km by 1 km tiles (LAZ format)



Colorized point cloud



- Color from high resolution RGB imagery, added to classified tiles according to LAS 1.3 specification



NEON Science Resources

Videos and Tutorials:

http://www.neonscience.org/lidar-basics

http://www.neonscience.org/resources

http://www.neonscience.org/resources/science-videos

YouTube Channel:

https://www.youtube.com/channel/UCNodgIxpGyEjhV3XXMxFO5g

https://www.youtube.com/watch?v=EYbhNSUnIdU&feature=youtu.be

National Ecological Observatory Network

BATTELLE

It can be done

720.746.4844 | neonscience@battelleecology.org | www.neonscience.org