ICESat-2 Mission Overview

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Lead – Land and Vegetation Data Product

(on behalf of Project Scientist Tom Neumann, NASA GSFC)

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ICESat-2 Science Objectives

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

Quantify regional signatures of ice-sheet changes to assess mechanisms driving those changes and improve predictive ice sheet models; this includes quantifying the regional evolution of ice sheet change, such as how changes at outlet glacier termini propagate inward.

Estimate sea-ice thickness to examine ice/ocean/atmosphere exchanges of energy, mass and moisture;

Measure vegetation canopy height as a basis for estimating large-scale biomass and biomass change.

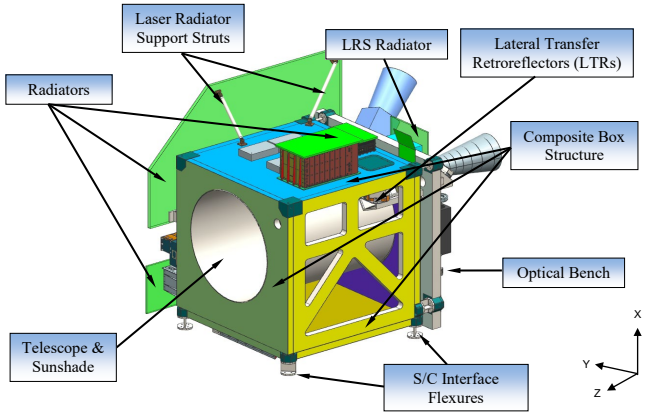
ICESat-2 Mission Overview

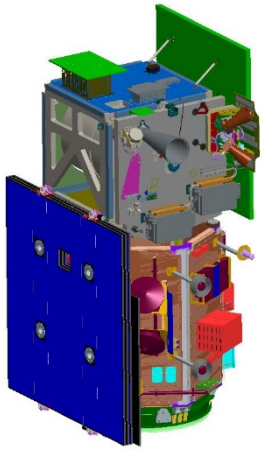
ICESat-2
ICE, CLOUD, AND LAND ELEVATION SATELLITE

Payload

ATLAS – Advanced Topographic Laser Altimeter System developed at GSFC

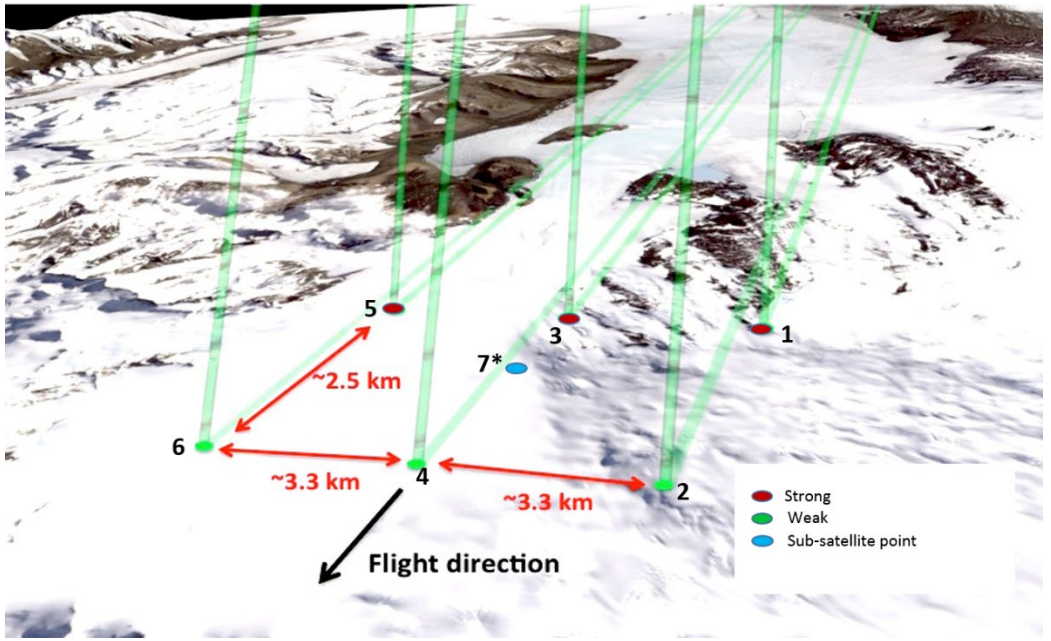
- Measures time of flight of laser pulses
- Measures pointing direction
- Single-photon sensitive detection
- 6 beams, arranged in 3 pairs
- 10 kHz pulse-rep. rate
- 14 m footprint
- spaced 0.7m along-track
- 532nm wavelength





Implementation

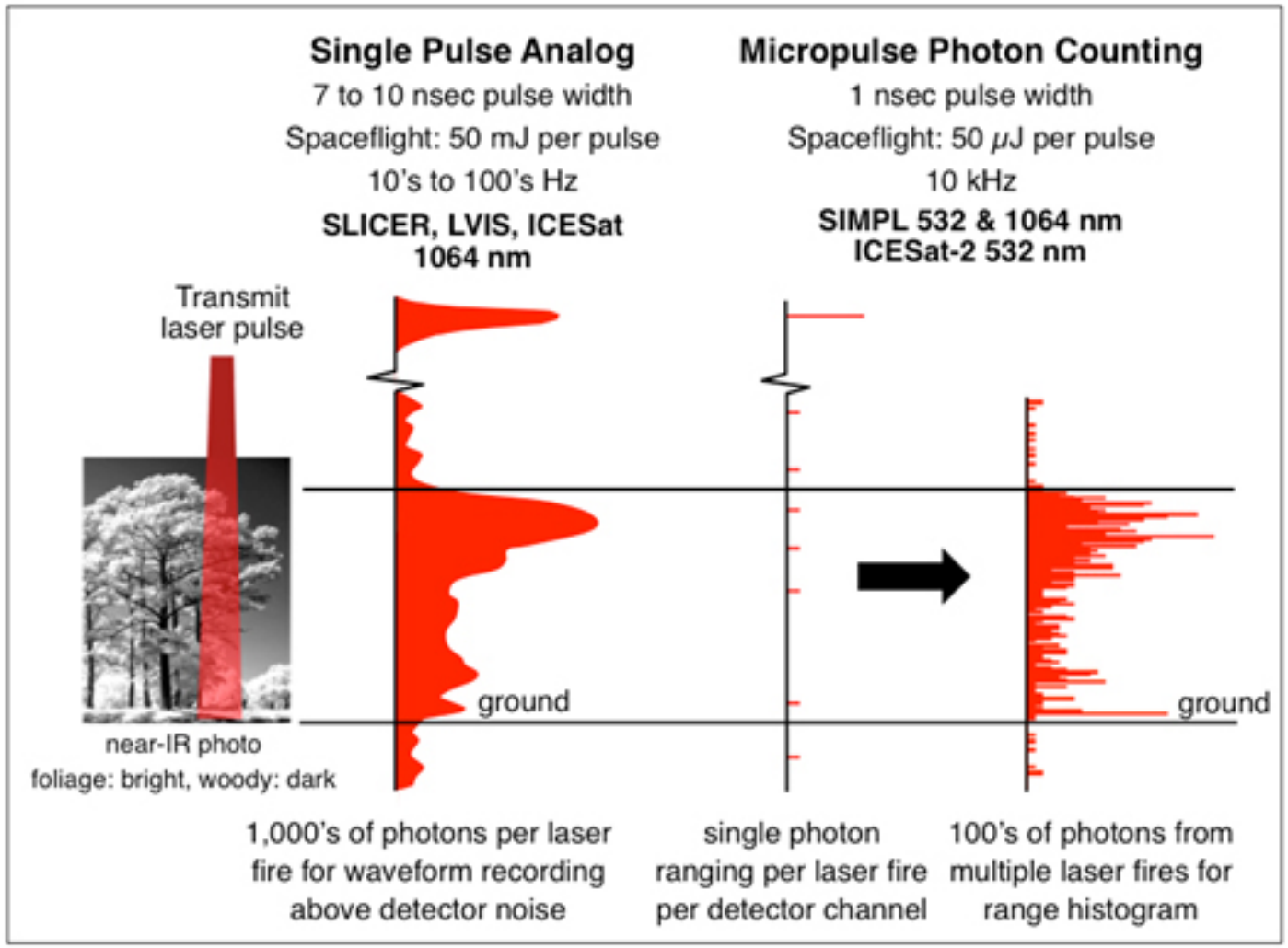
Launch Date: September 15, 2018
Lifetime: 3 years, with consumables for 5+
Orbit: 454 km, non-sun-synch, 92° inclination
Repeat: 91 day exact repeat, ~30 day sub-cycle
Science Data: 1 TB/day
System Pointing: Control = 45 m (14.3 m, CBE)
Knowledge = 6.5 m (4.0 m, CBE)

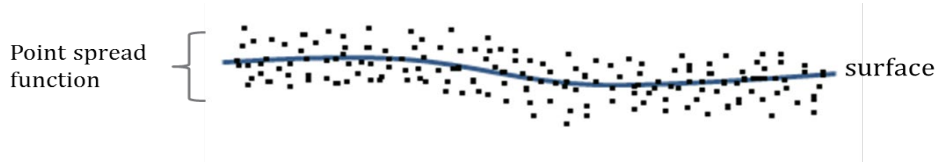


Single laser pulse at 532nm split into 6 beams.
Single-photon sensitive detection.

~3 km spacing between pairs provides spatial coverage
~90 m pair spacing for ***slope determination*** (2° yaw)
high-energy beams (4x) for better performance over low-reflectivity targets.

What is Photon Counting Lidar?





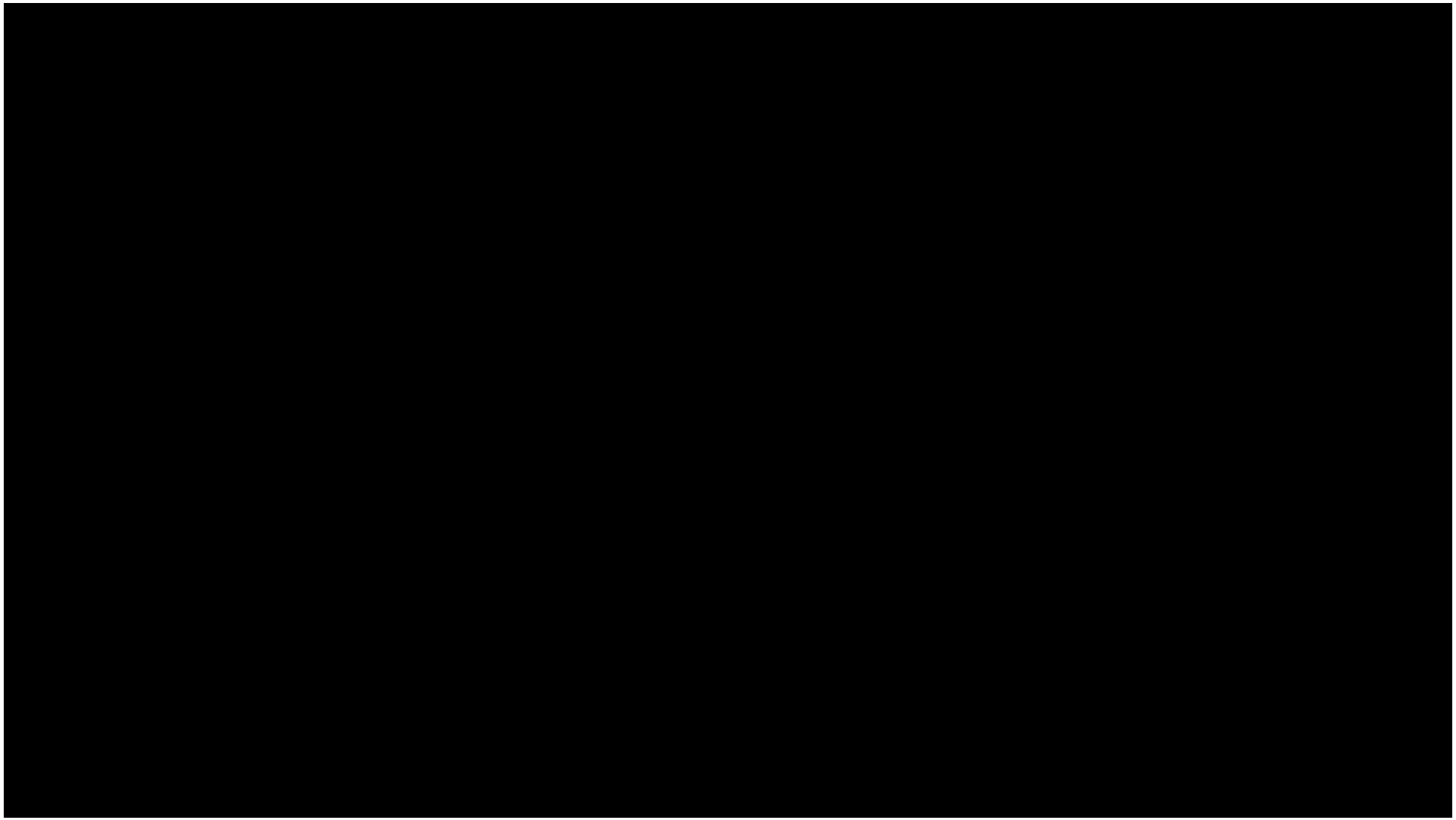
The reflectance of the surface at 532 nm drives the number of returned photons detected by ICESat-2

Land ("Vegetation and Ground") are not as bright of reflectors as snow or ice.

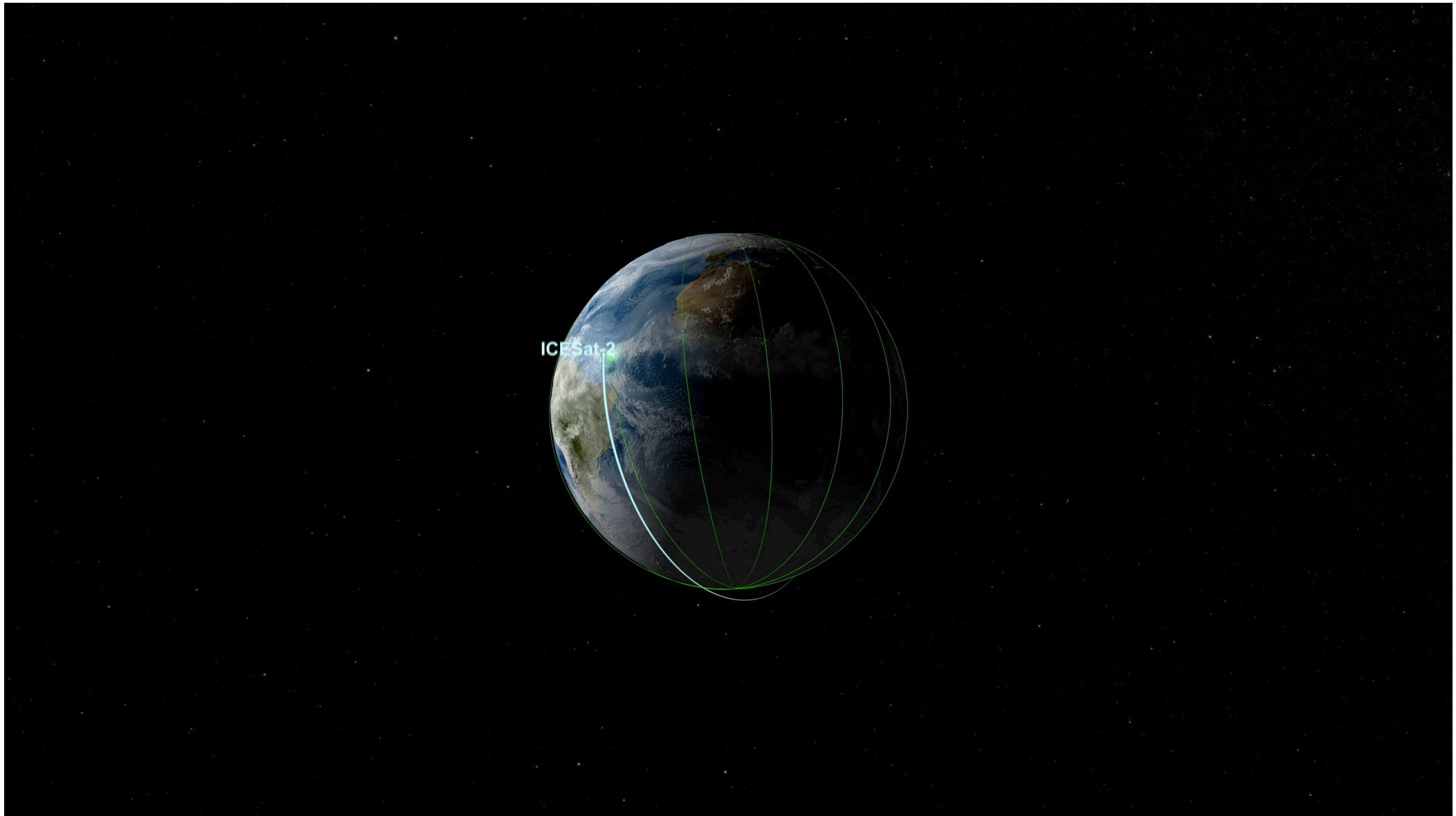
We are expecting to get a per shot average of about 1 photon from the ground and 1 photon from vegetation

1 shot every 70 cm in the along-track direction

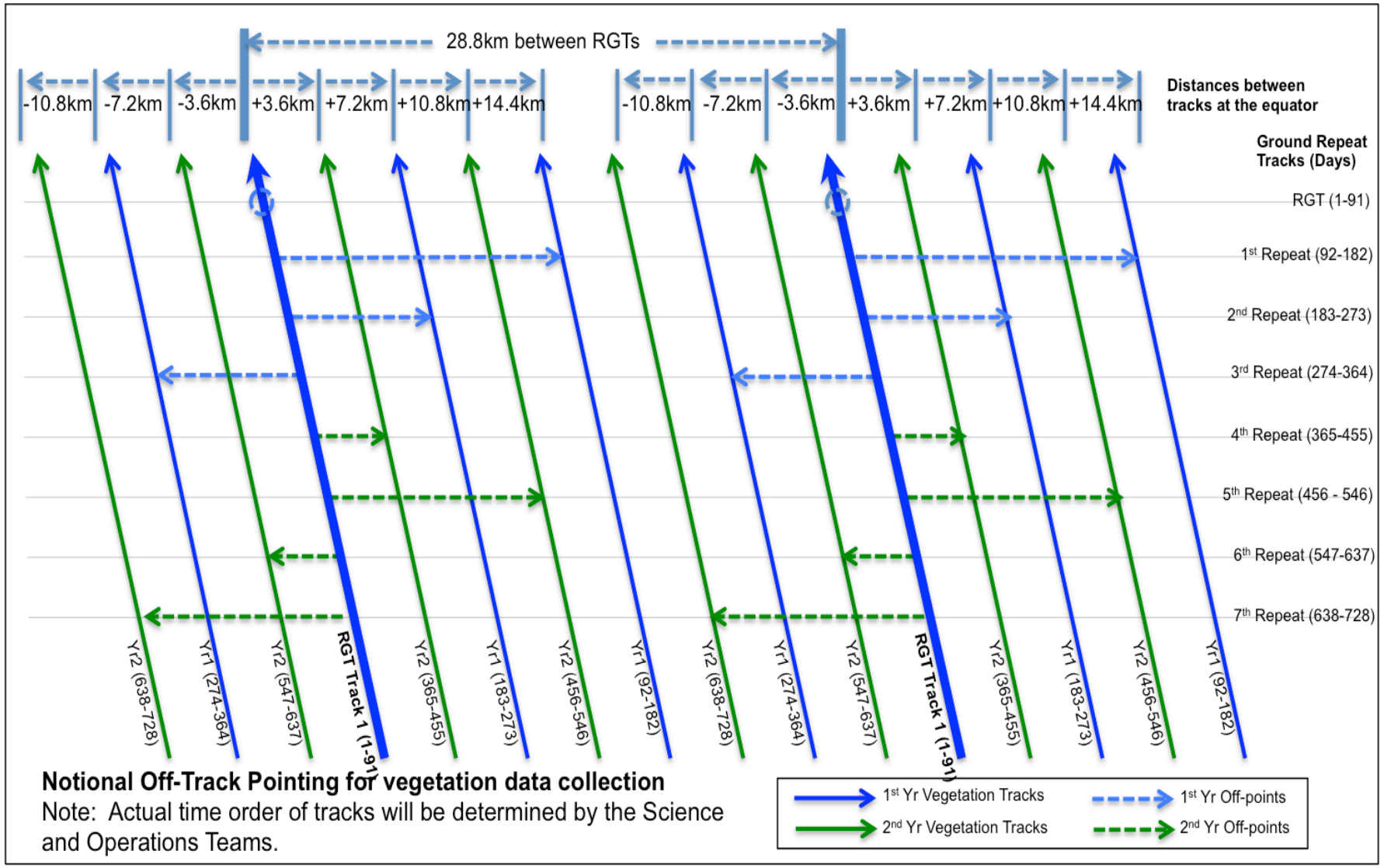
Launch and Separation



Orbit Coverage



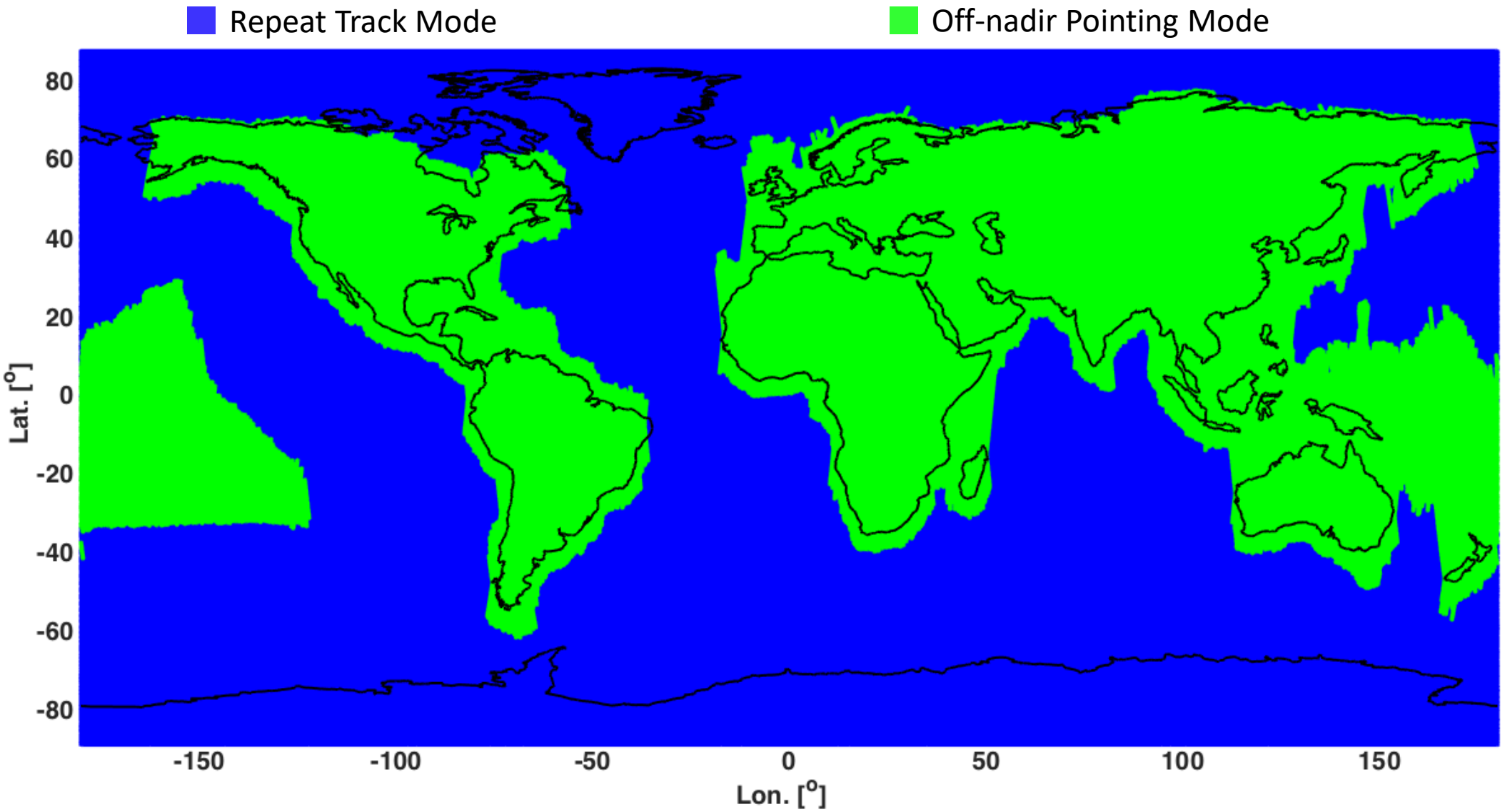
ICESat-2 Off Pointing for Land/Vegetation



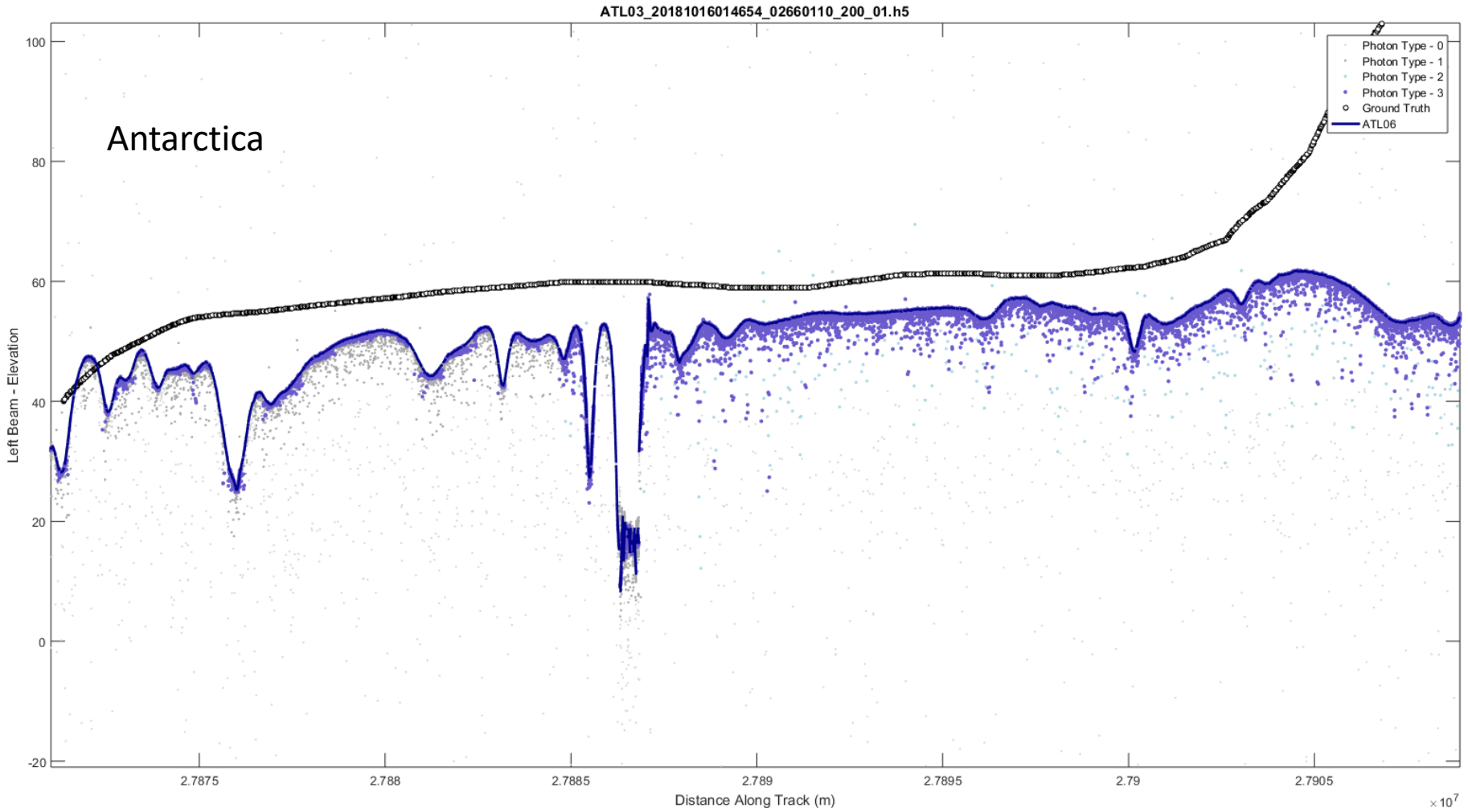
Notional Off-Track Pointing for vegetation data collection
Note: Actual time order of tracks will be determined by the Science and Operations Teams.

Over mid-latitudes, ICESat-2 will systematically off-point to increase data density

Off-Nadir Pointing over non-polar regions



What does the data look like?

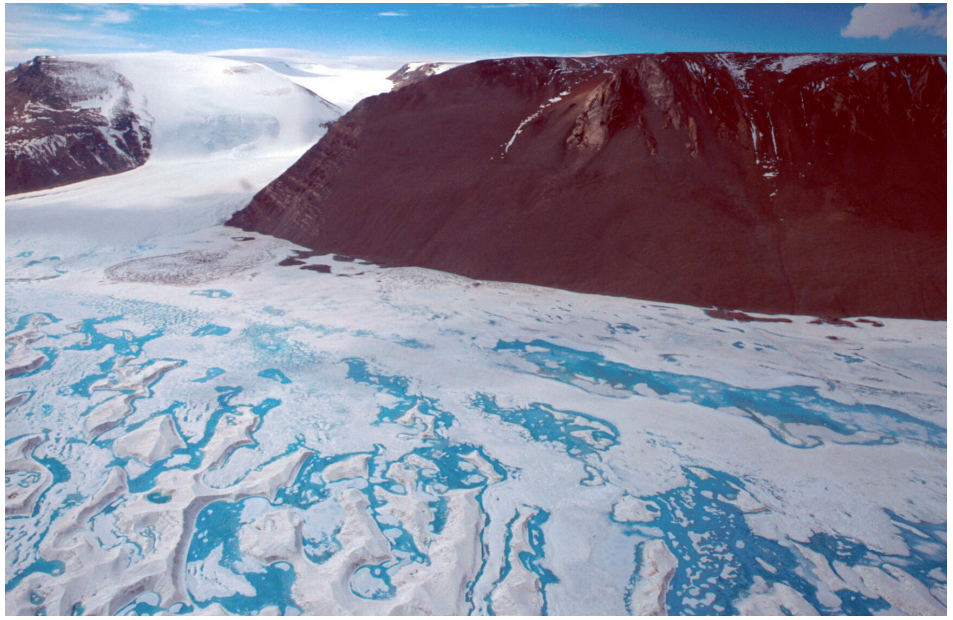


What does the data look like?

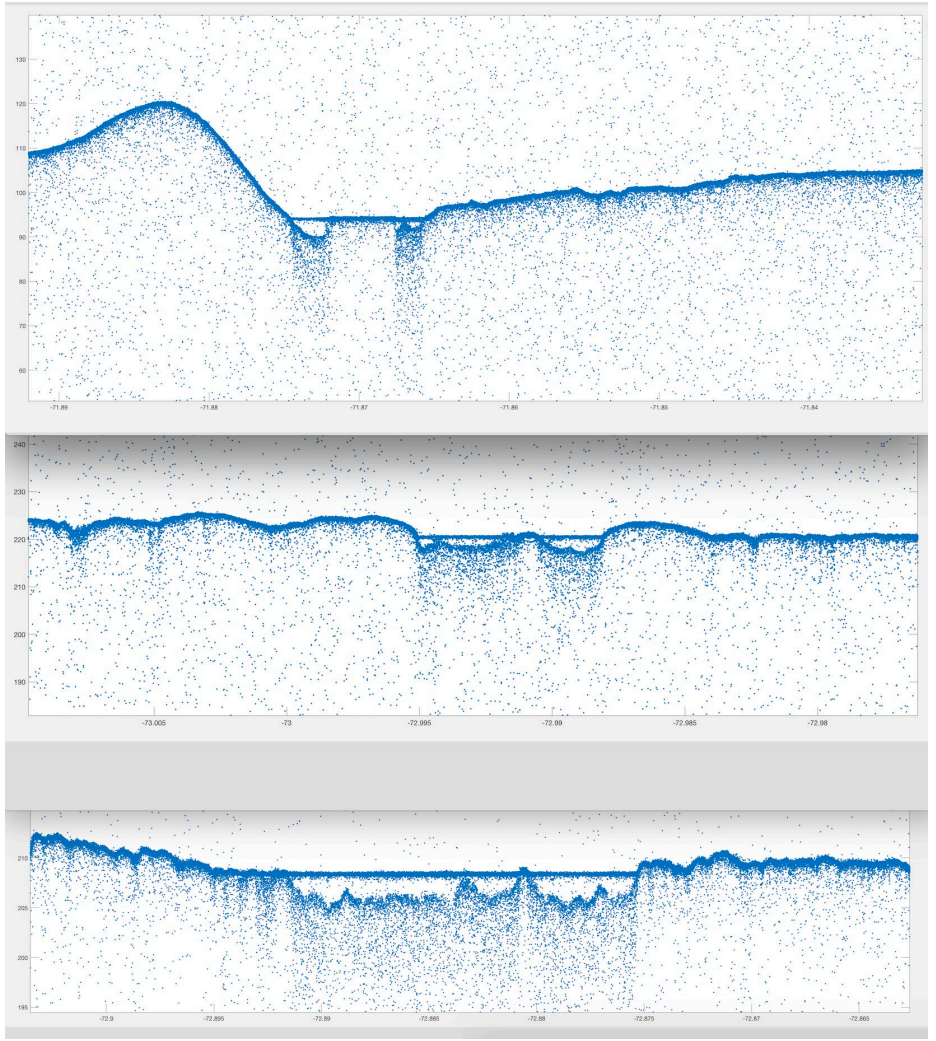
Amery Ice Shelf undergoes extensive surface melt each summer, which flows as melt streams

ICESat-2 penetrates the water and allows us to estimate the depth of melt ponds

Combined with satellite imagery, this will provide meltwater volume estimates

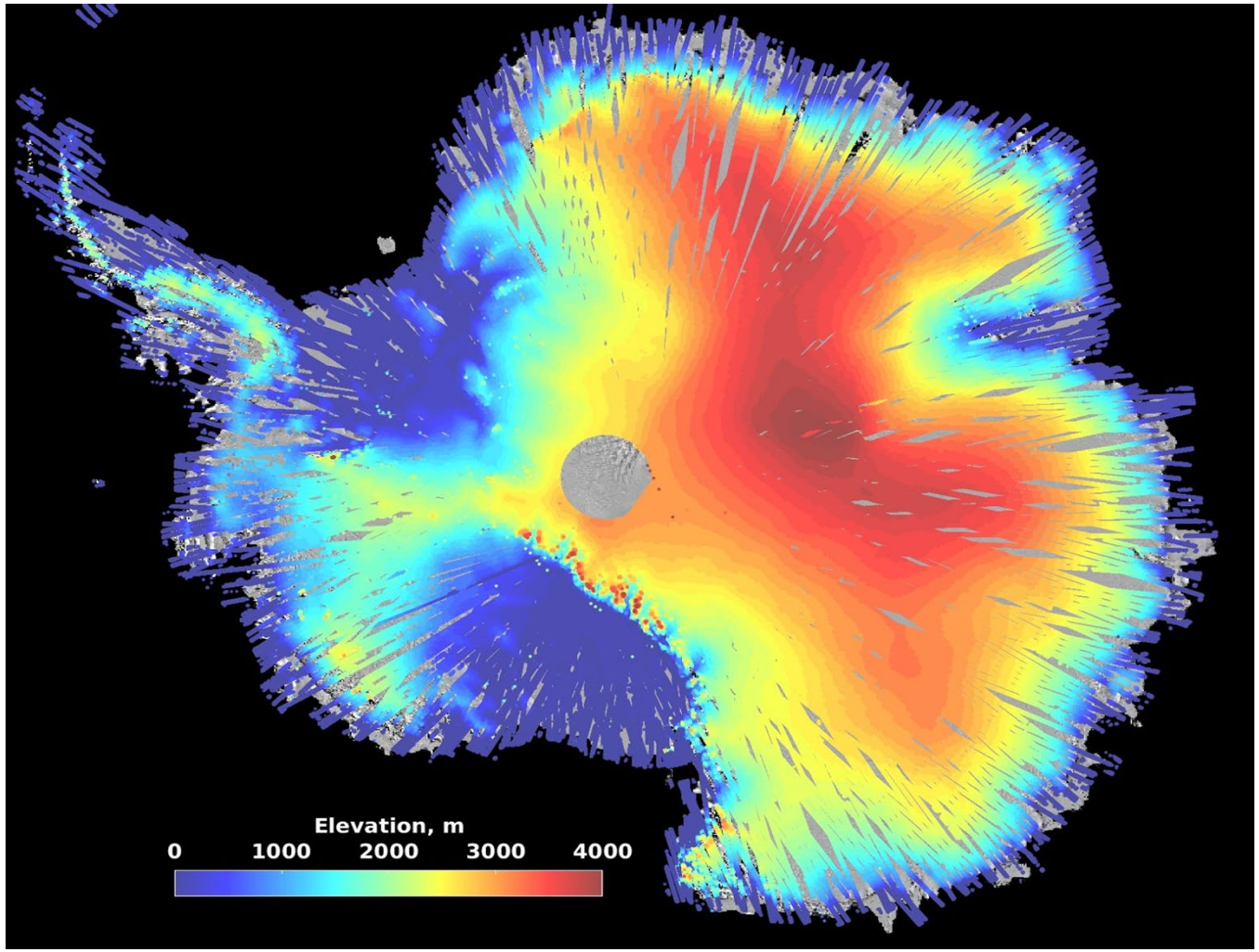


ICESat-2 ATL03 profiles



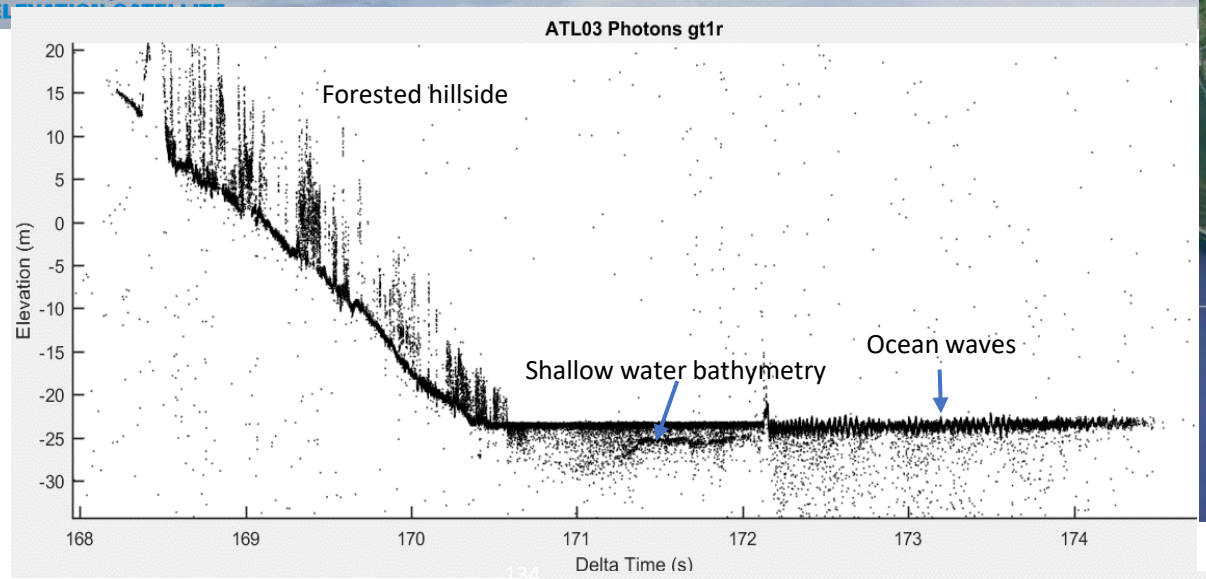
What does the data look like?

First three weeks of observations over Antarctica

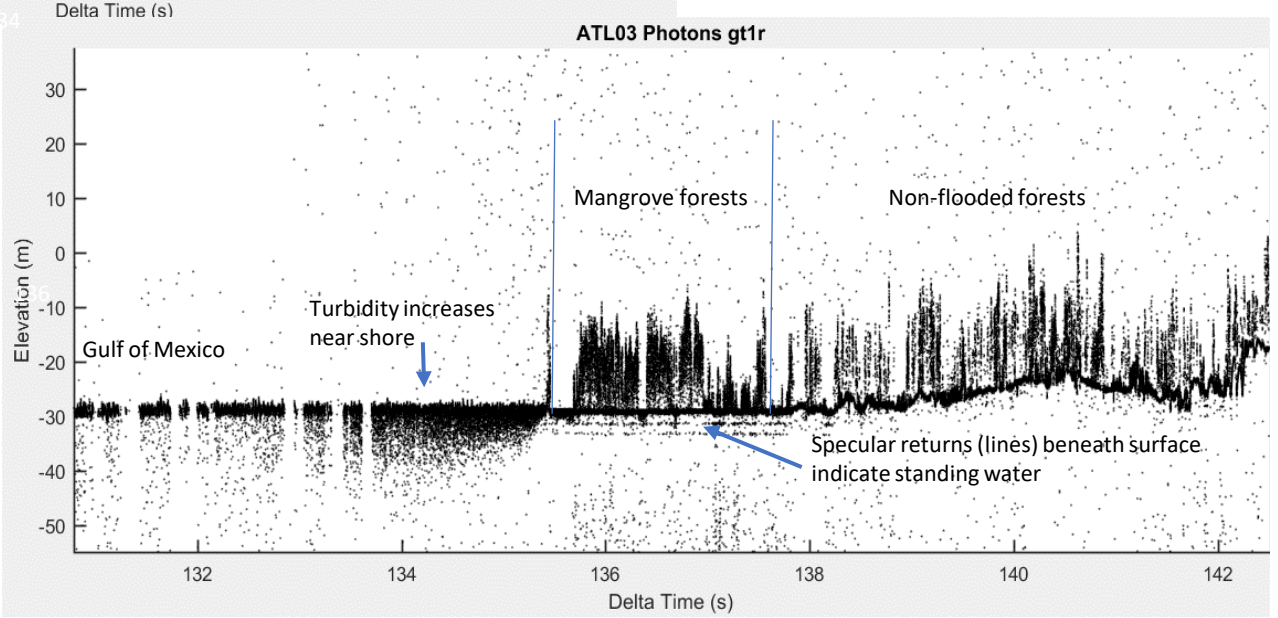


Ben Smith, University of Washington

What does the data look like?

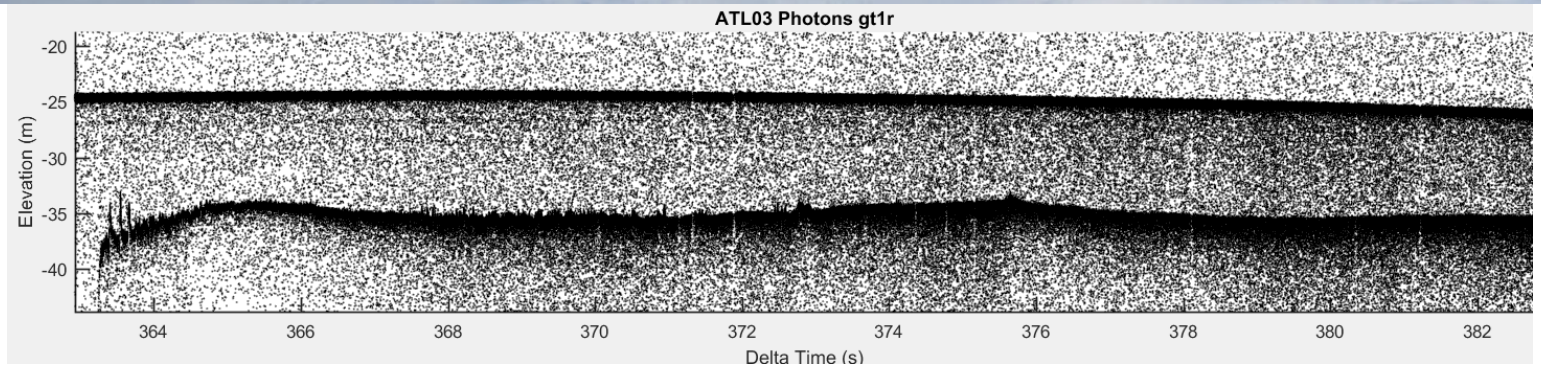


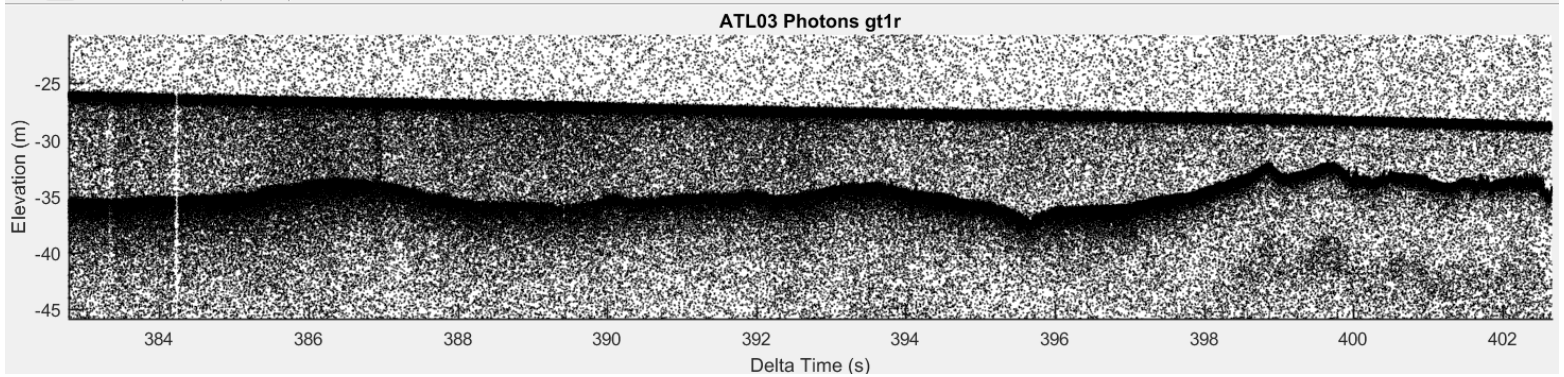
Ground track through Mexico. Mountains in interior are cloud covered, but coastal areas are cloud-free

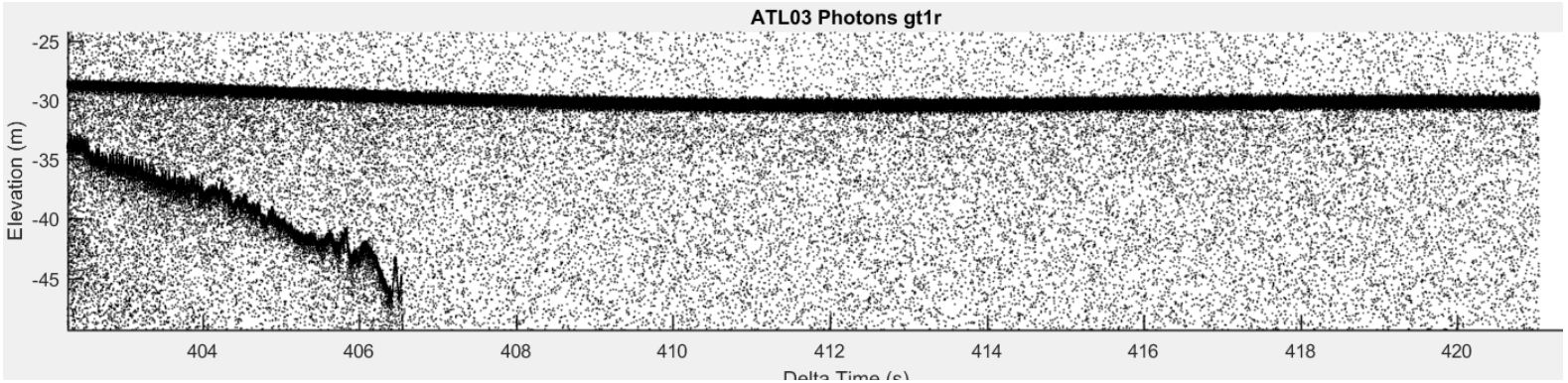


What does the data look like?

316 km of continuous bathymetry!







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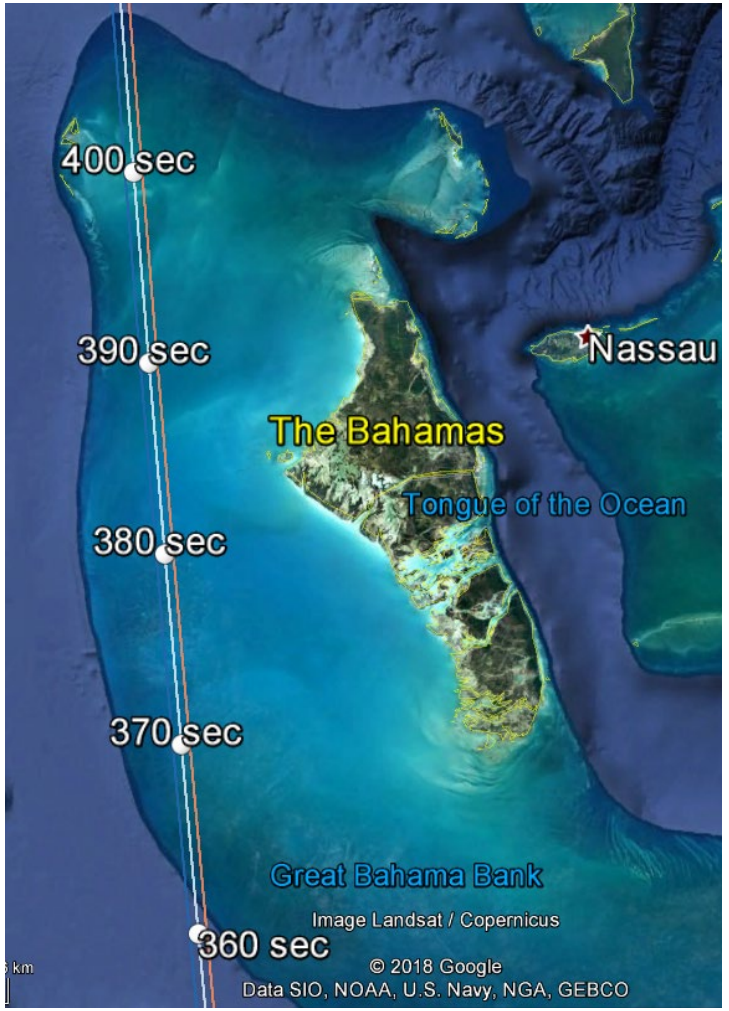


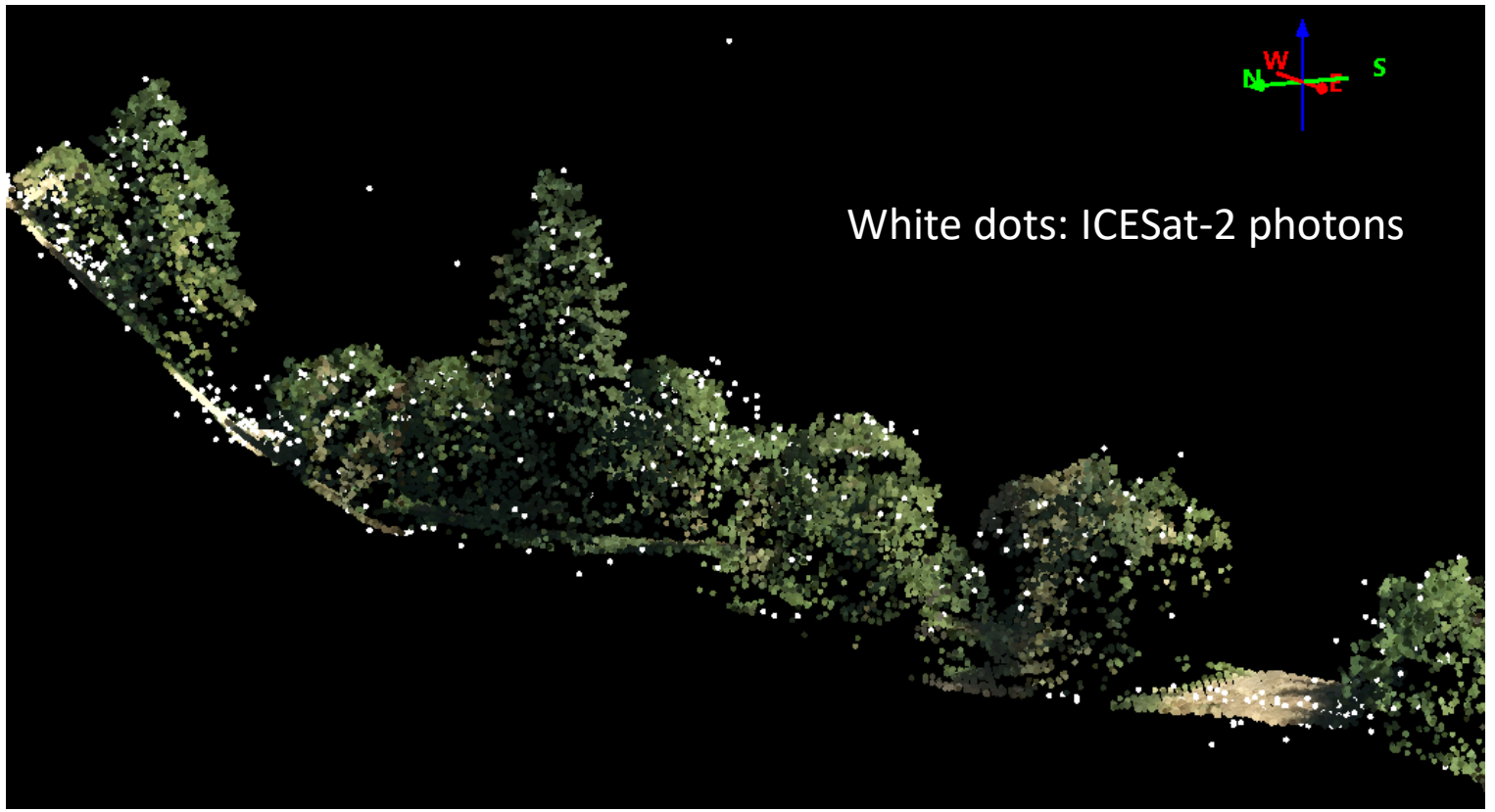
Amy Neuenschwander, U

How Accurate are the Data

Mission Requirement: < 6.5 m horizontal

Current Geolocation Accuracy (bias): <10 m horizontal, <1 m vertical

Profile View



Airborne lidar from Sonoma County

Top View