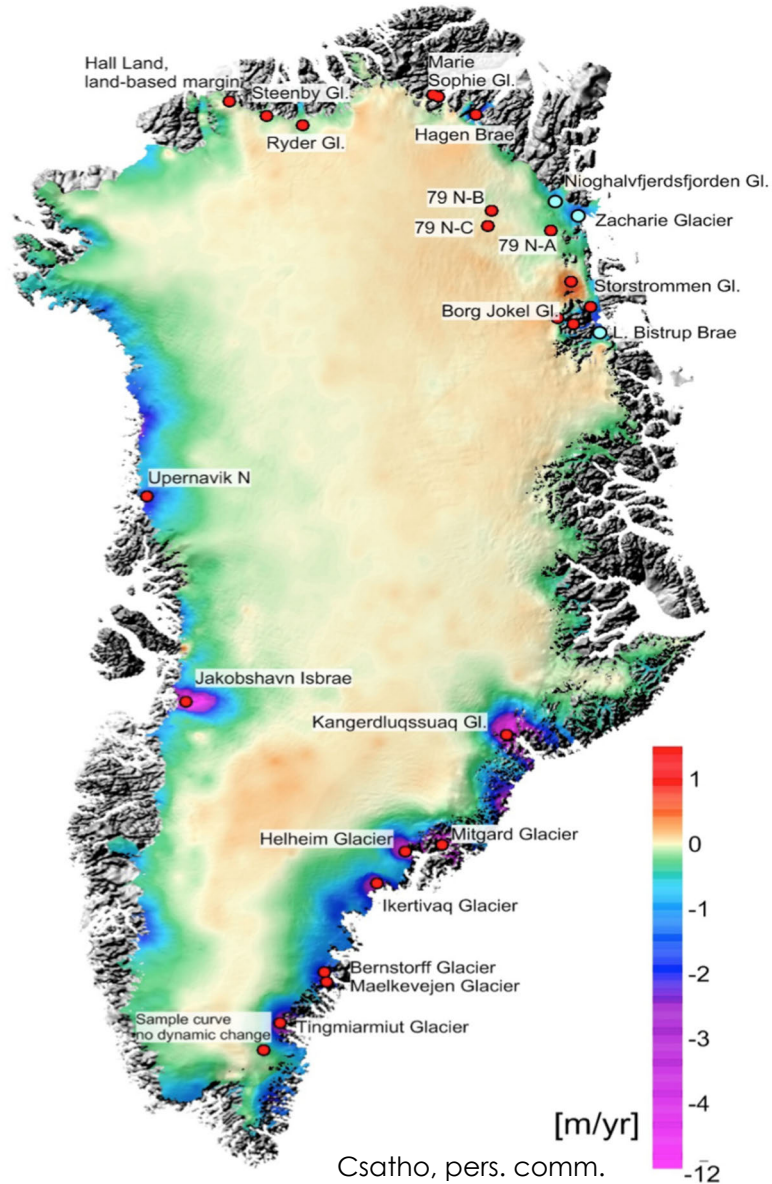National Aeronautics and Space Administration

ICESat-2 and ATL08 (Land/Vegetation) Data

Amy Neuenschwander, University of Texas at Austin

March 16, 2021

The ICESat-2 Mission

Hall Land, land-based margin
Steenby Gl.
Ryder Gl.
Marie Sophie Gl.
Hagen Brae
Nioghalvfjerdsfjorden Gl.
79 N-B
79 N-C
79 N-A
Zacharie Glacier
Storstrommen Gl.
Borg Jokel Gl.
L. Bistrup Brae
Upernavik N
Jakobshavn Isbrae
Kangerdluqssuaq Gl.
Helheim Glacier
Mitgard Glacier
Ikertivaq Glacier
Bernstorff Glacier
Maelkevejen Glacier
Sample curve no dynamic change
Tingmiarmiut Glacier

[m/yr]

Csatho, pers. comm.

A primary science objective is to measure elevations and elevation change in the ice sheets and sea ice.

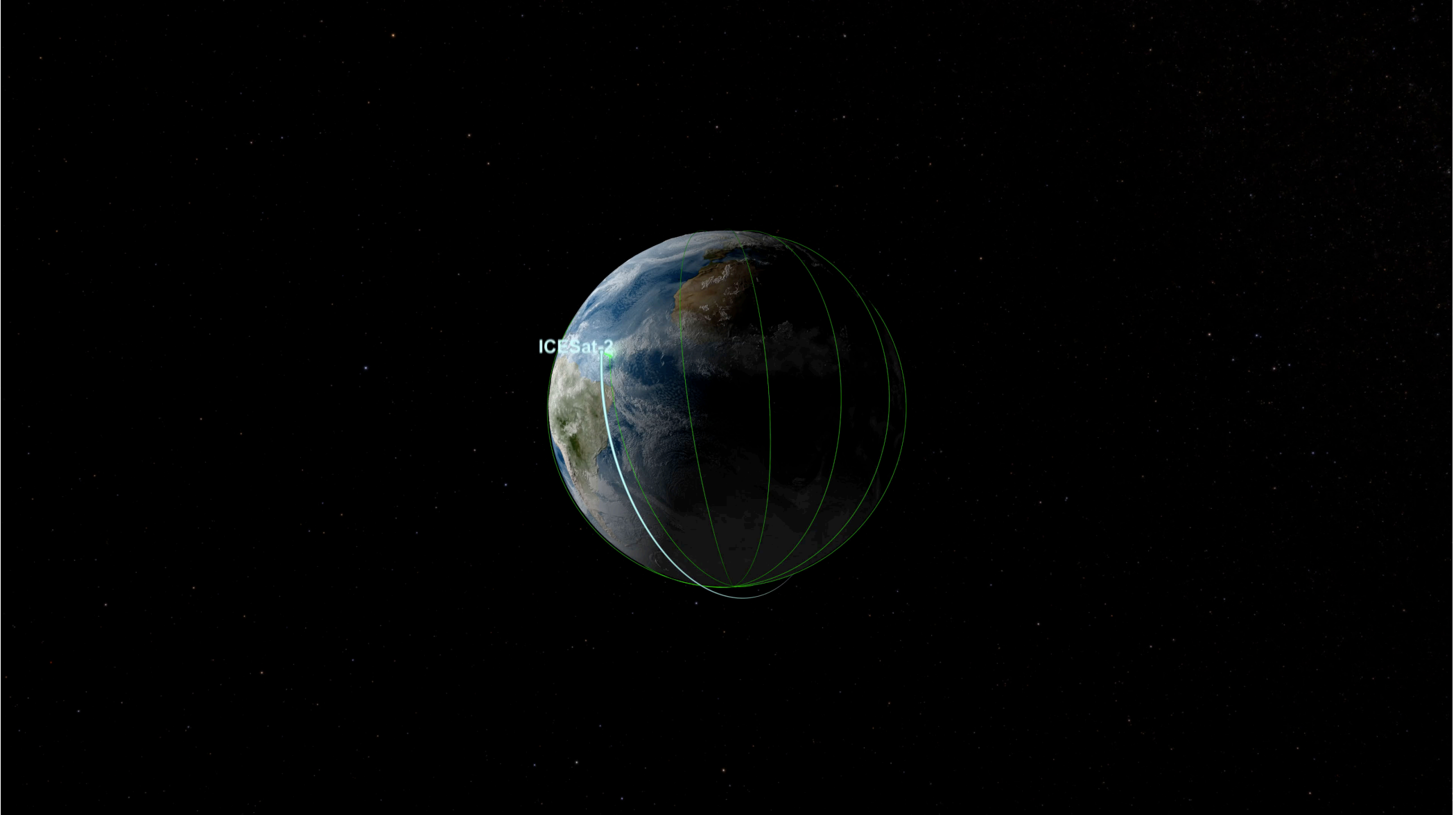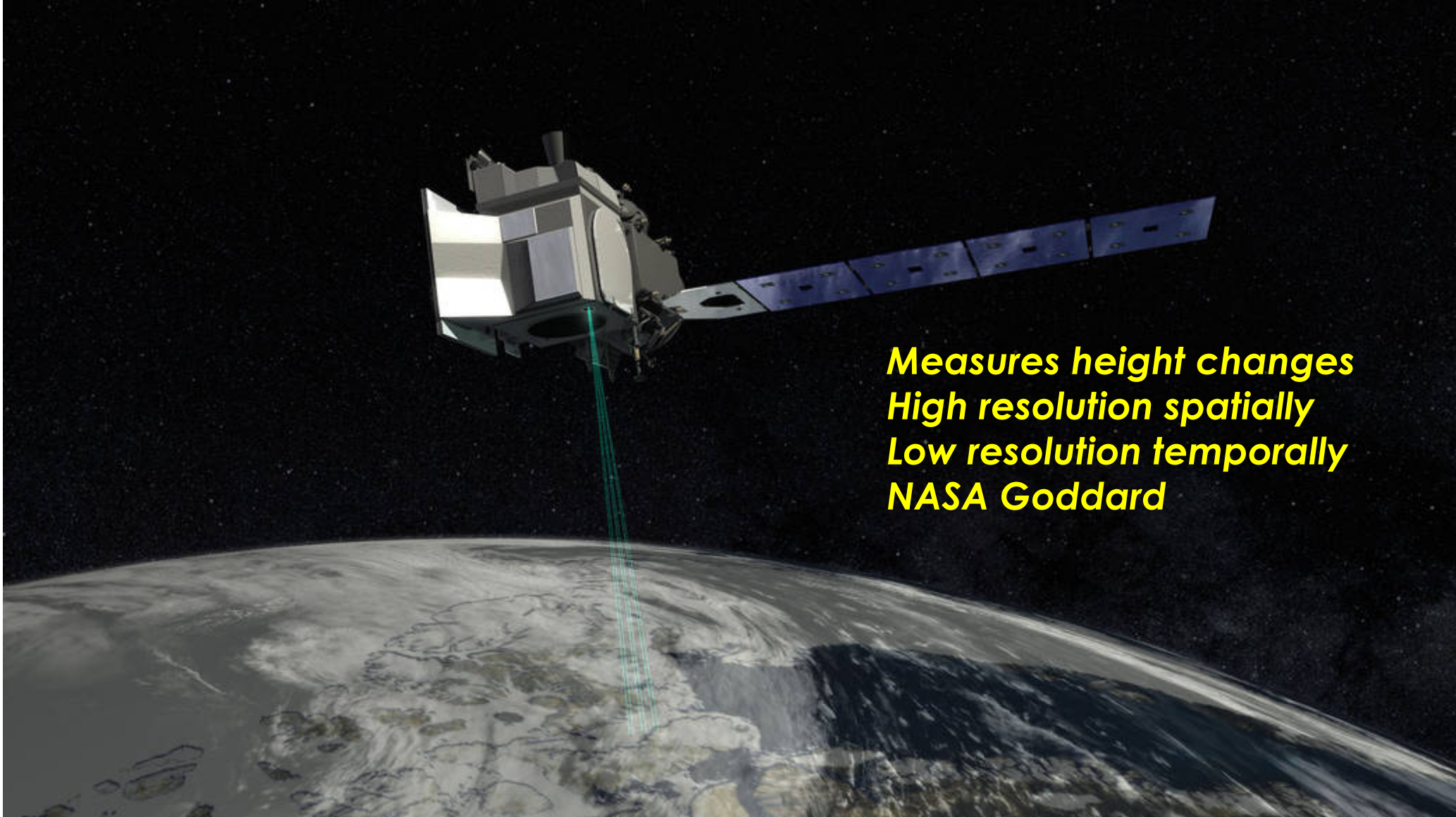ICESat-2 Launched September 15, 2018 from Vandenburg AFB, CA.

The ICESat-2 Mission

An additional science objective is to measure vegetation canopy height as a basis for estimating large scale biomass and biomass-change.

ICESat-2 Launched September 15, 2018 from Vandenburg AFB, CA.

ICESat-2 Orbit and Coverage

ICESat-2

Measures height changes
High resolution spatially
Low resolution temporally
NASA Goddard

ICESat-2 Mission Overview

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

~12 m footprint

Spaced 0.7 m along-track

532nm wavelength
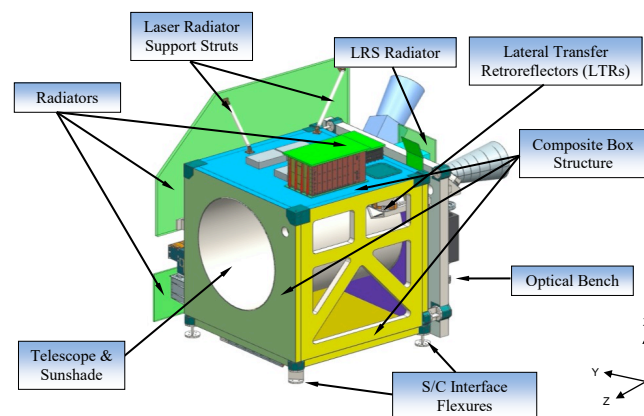
Implementation

Launch Date: September 15, 2018
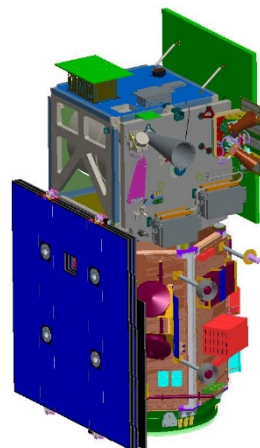
Lifetime: 3 years, with consumables for 5+

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)
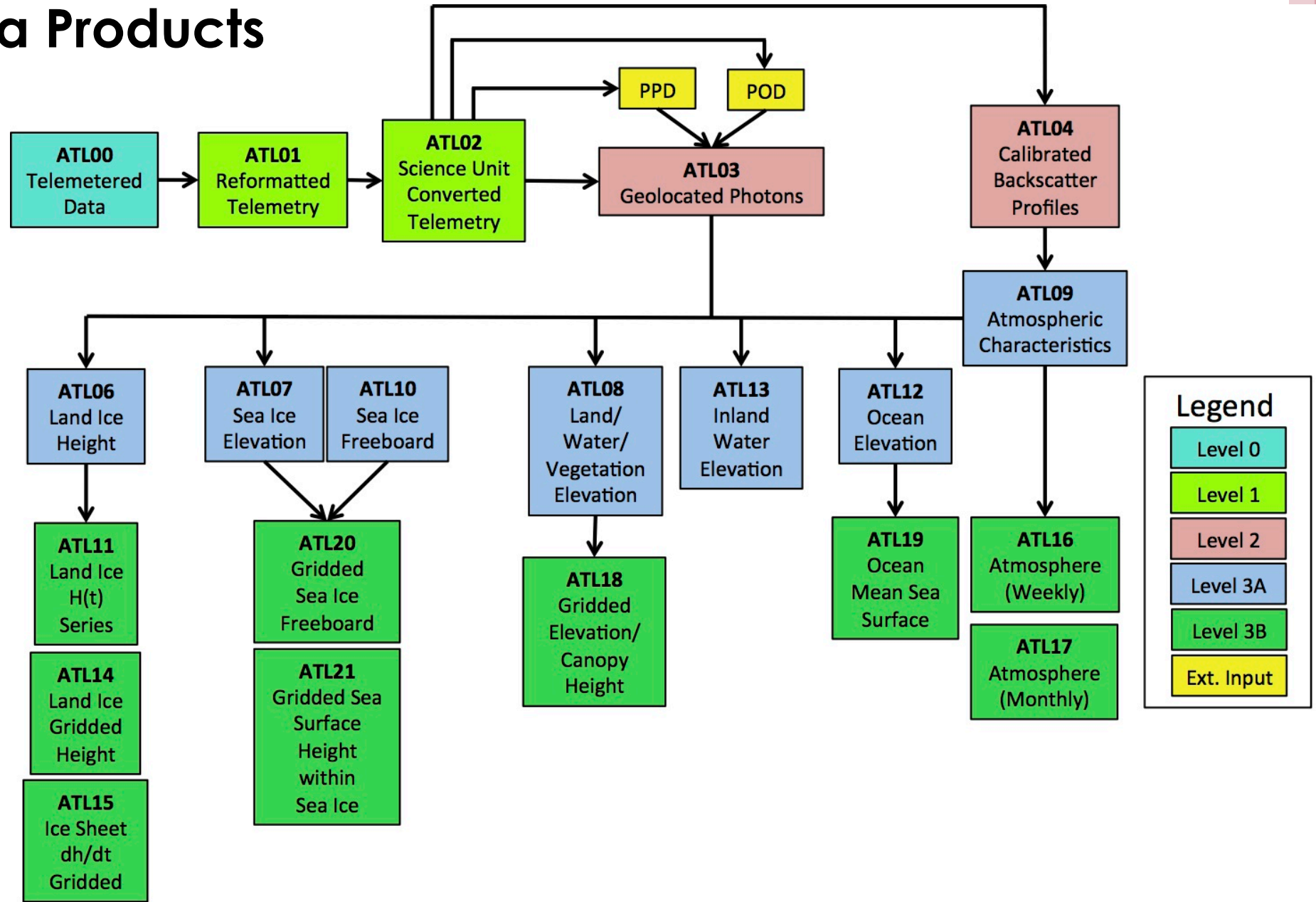
Knowledge = 6.5 m (4.0 m, CBE)
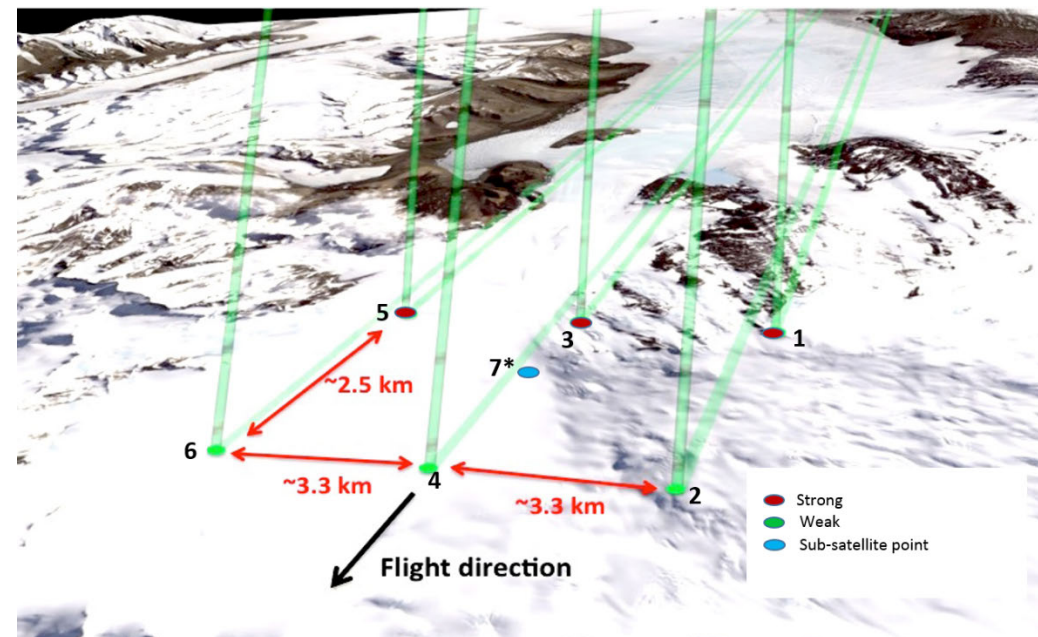
Single laser pulse at 532nm split into 6 beams.
Single-photon sensitive detection.

~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.
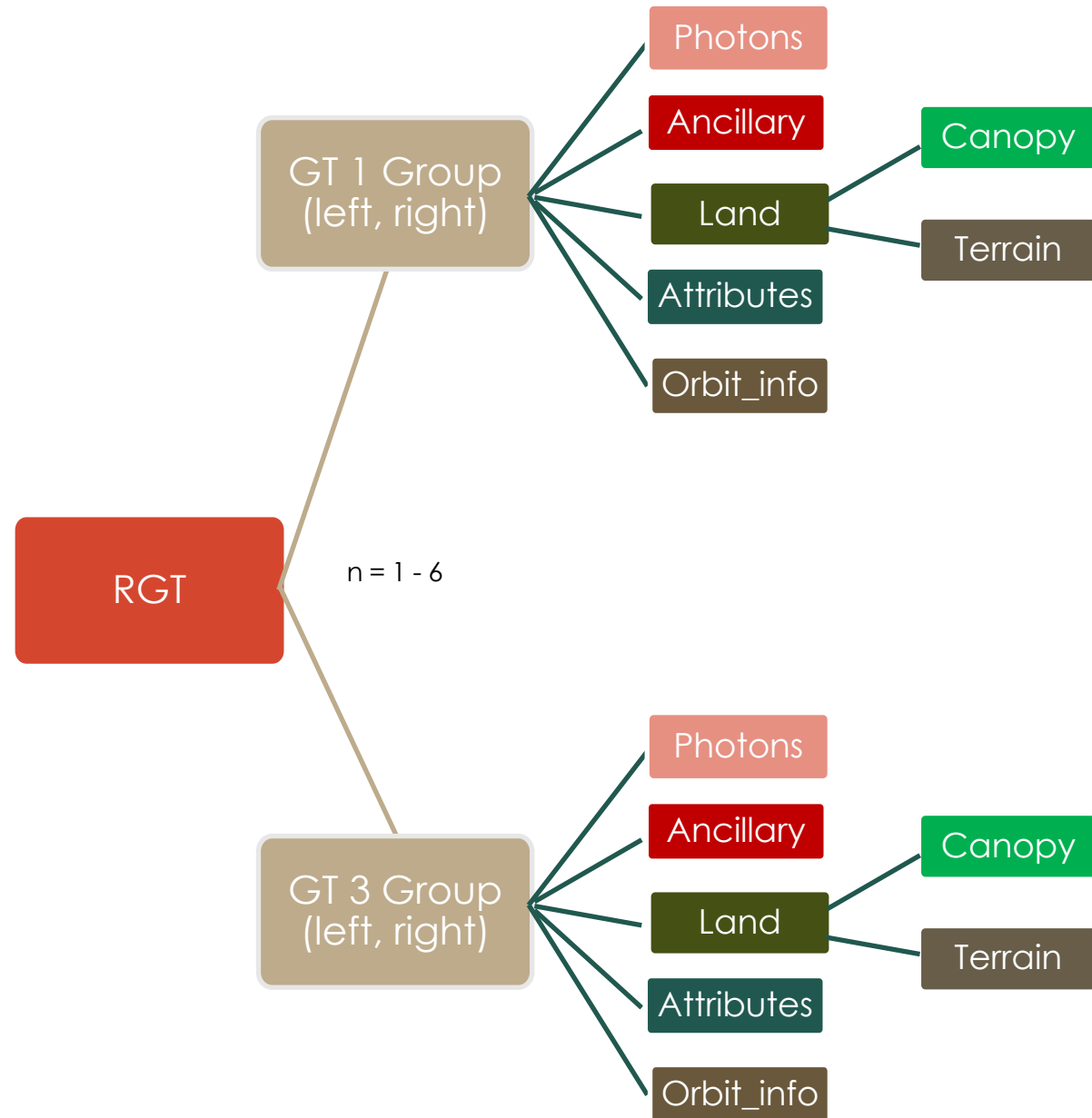
# ICESat-2 Data Products

ATL08 Data Product

- **ATL08 - Level-3 (Along-Track)**

  – Products computed on a per-orbit/per-beam basis

    - Classified Photons
    - Statistical parameters of canopy and terrain based on fixed 100 m distance to capture fine-scale geomorphology
    - Segments output in 100 m step size
    - Indices of labeled photons map back to ATL03

Example of ATL03 and ATL08

Amazon Floodplain
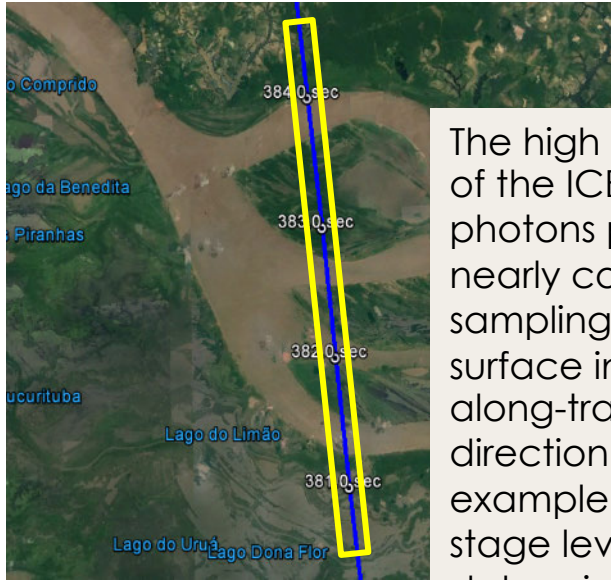
The high resolution of the ICESat-2 photons provide a nearly continuous sampling of the surface in the along-track direction. In this example, river stage levels can be determined.
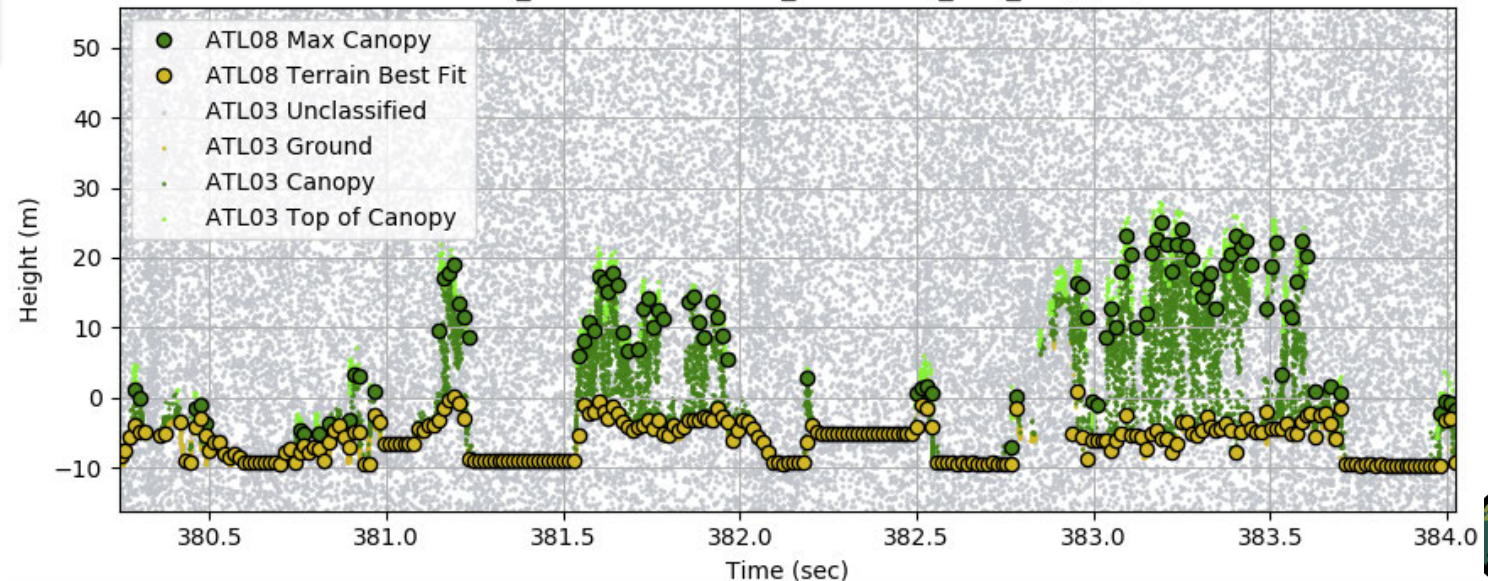
Photons from ICESat-2 are color-coded by the ATL08 (Land and Vegetation) algorithm. Data are from a day acquisition.

Bottom plot includes the same photons as the top panel, but the ATL08 100 m canopy height and terrain heights are superimposed.
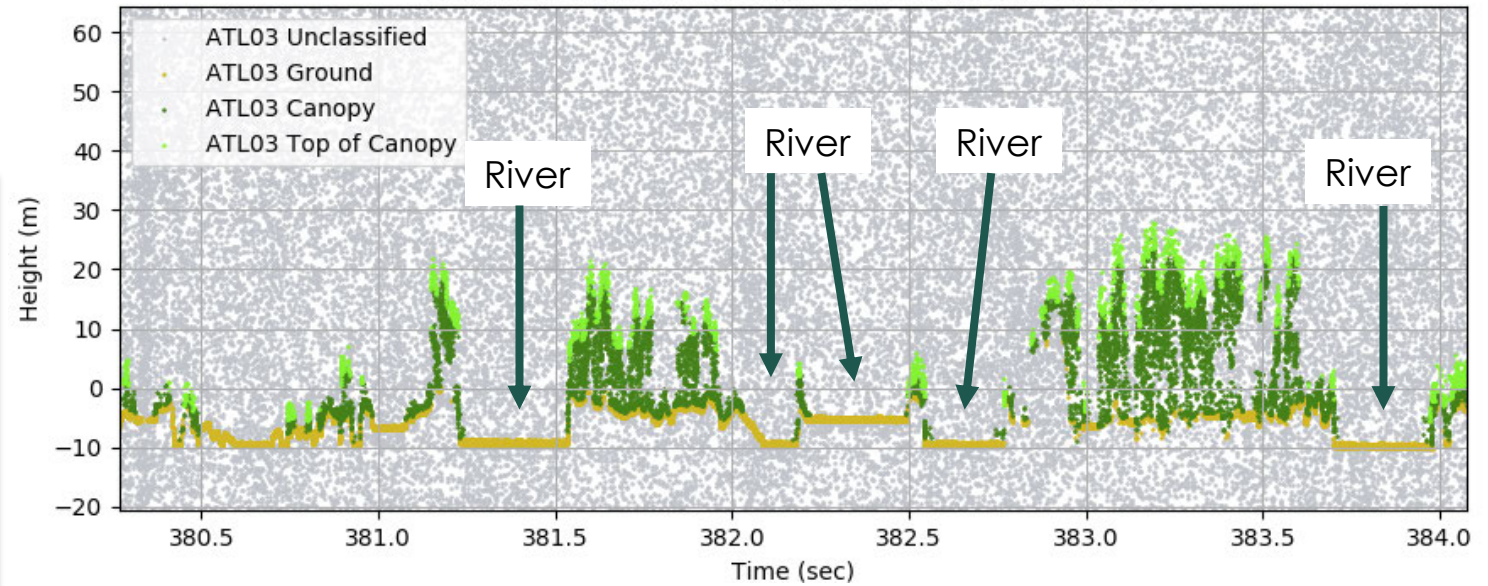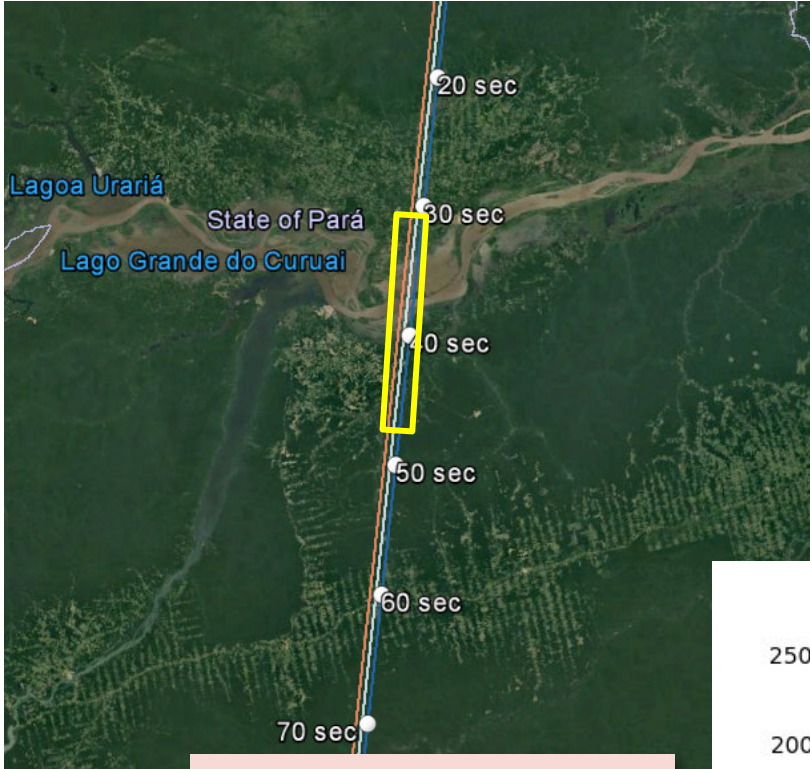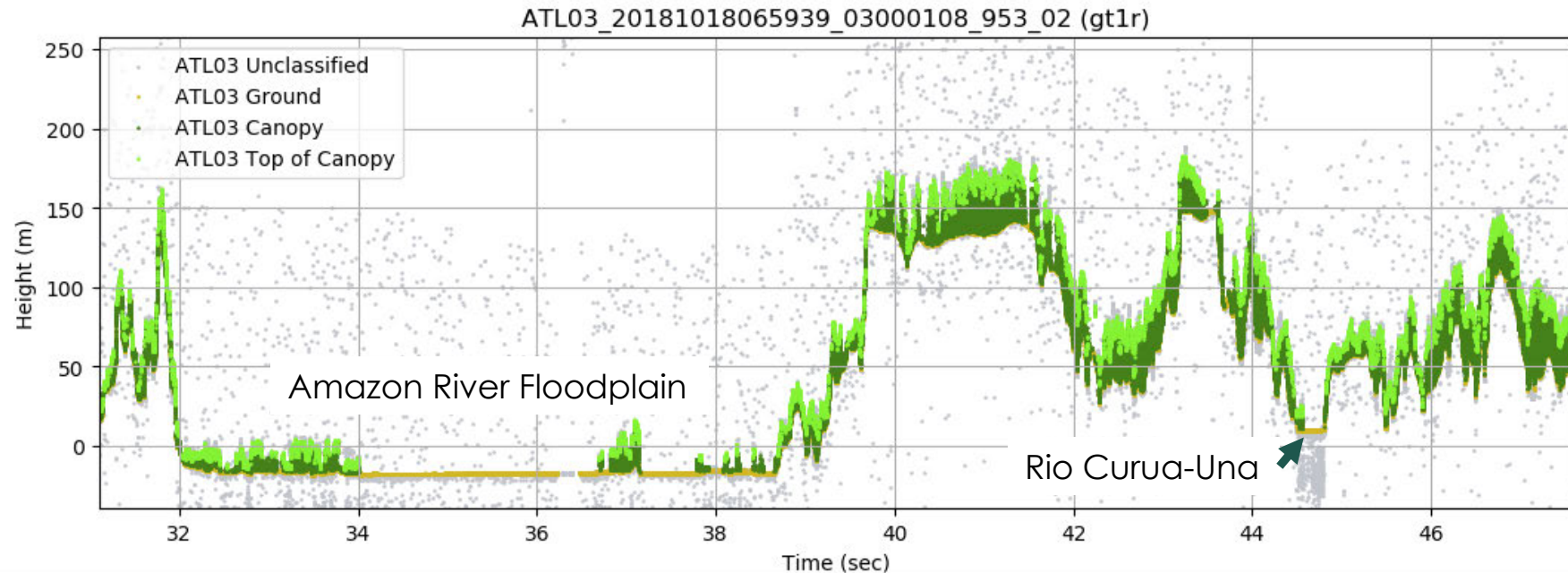
Tropical Forest, Brazil

Picture from Tapajos National Forest

Photons from ICESat-2 are color-coded by the ATL08 (Land and Vegetation) algorithm. Data are from a night acquisition.
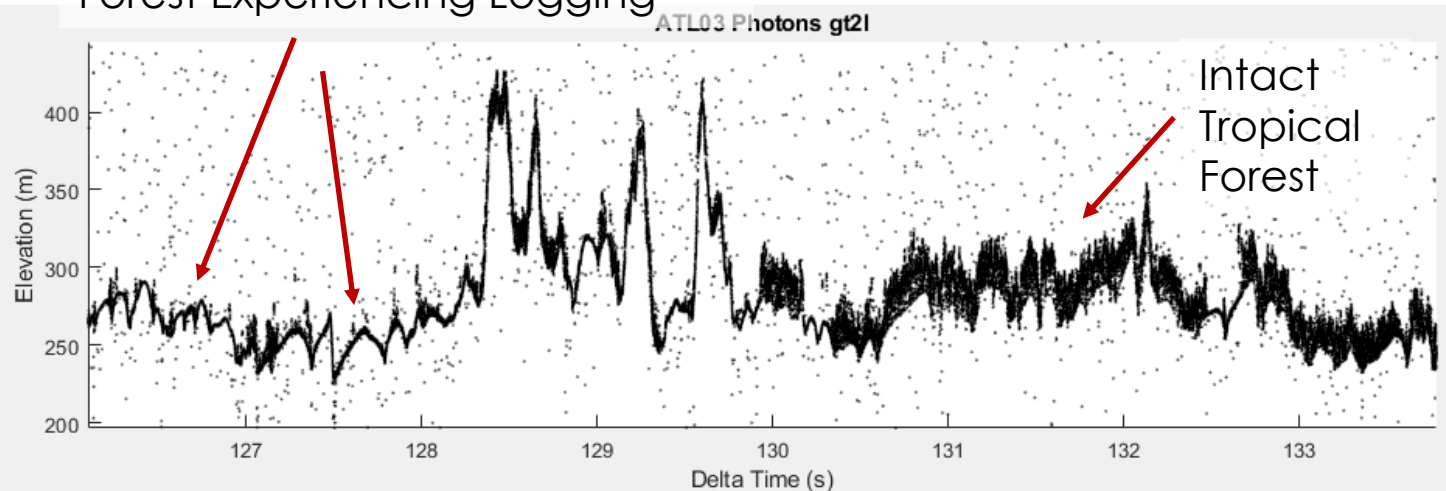
ATL03_20181018065939_03000108_953_02 (gt1r)

- ATL03 Unclassified
- ATL03 Ground
- ATL03 Canopy
- ATL03 Top of Canopy

Amazon River Floodplain
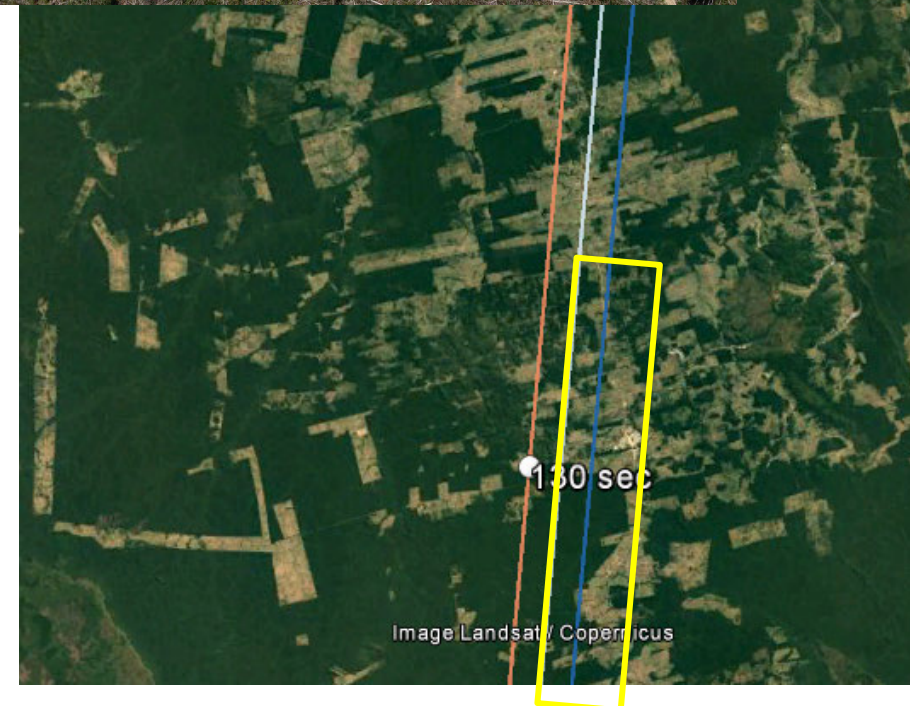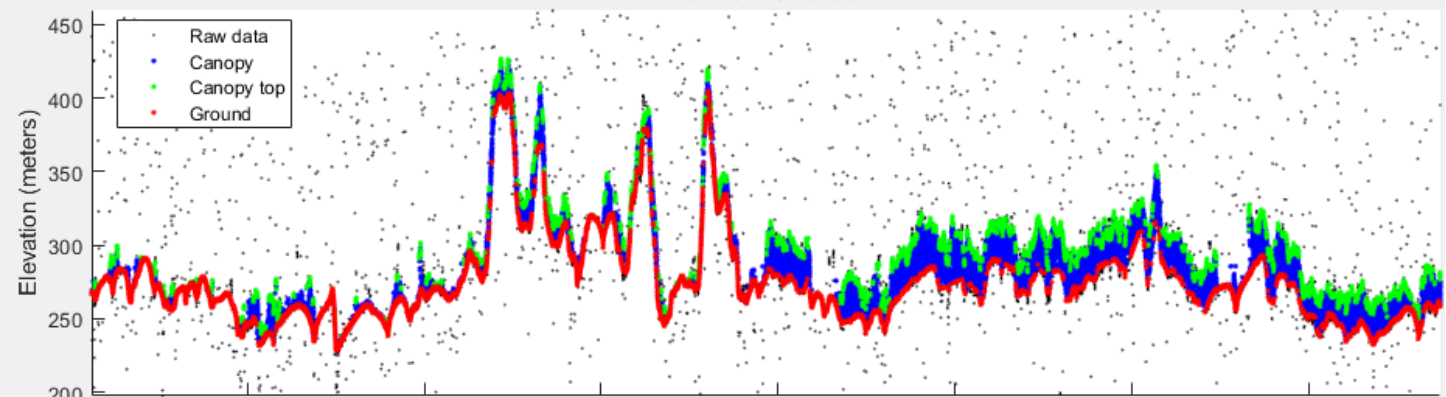
Rio Curua-Una

Deforestation as Observed by ICESat-2

March 19, 2019 night acquisition of ICESat-2 over Brazil's tropical forest

Forest Experiencing Logging

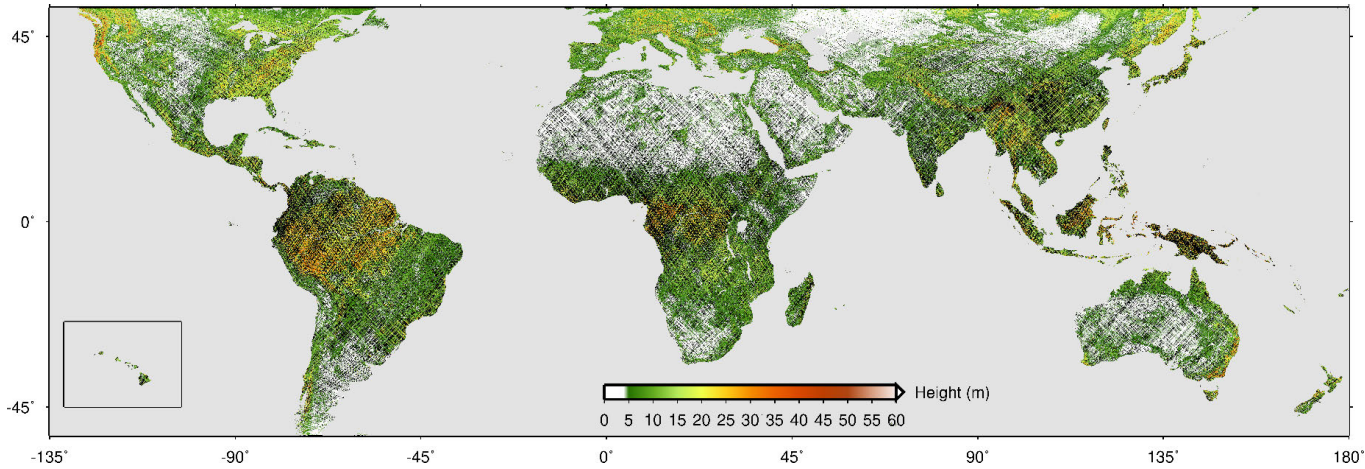Intact Tropical Forest

Global Canopy Heights for Space-Based LiDAR

GEDI Canopy Heights (2019)

ICESat-2 bin median canopy height 2019-2020
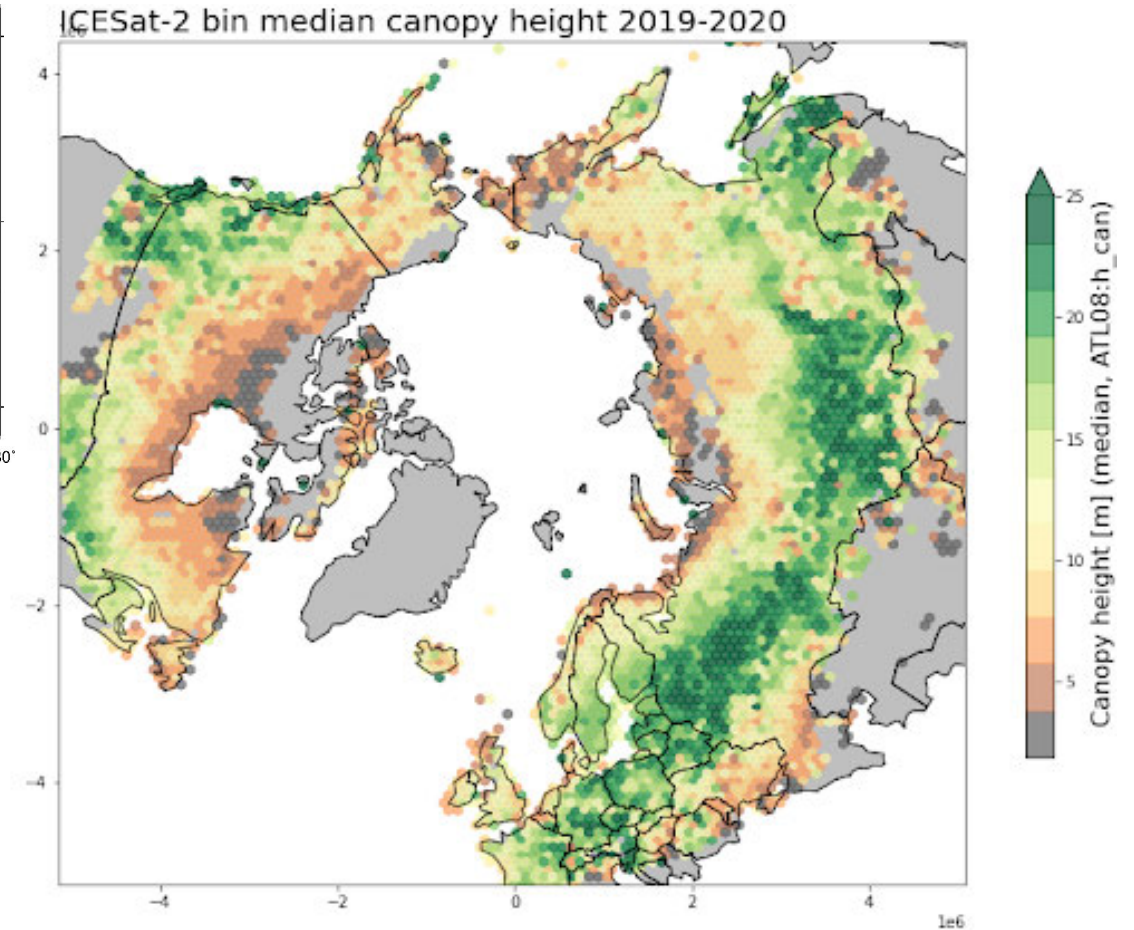
ICESat-2 Python Tools (PhoREAL)

- Photon Research Exploitation and Analysis Library

Source Code

https://github.com/icesat-2UT/PhoREAL

https://utexas.box.com/v/DownloadPhoREALGUI
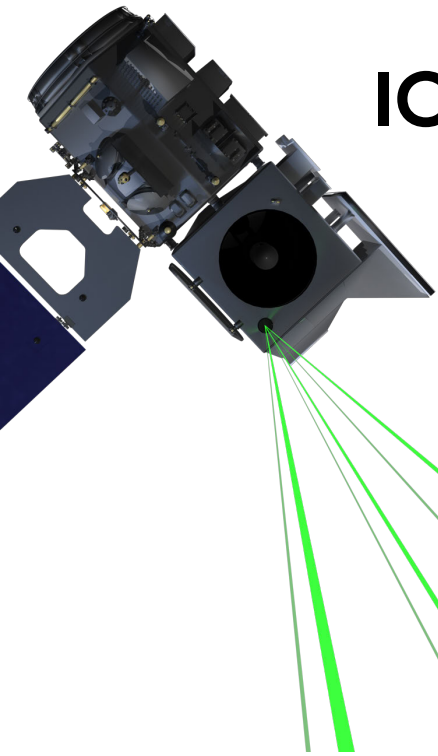
Windows 10 version with GUI
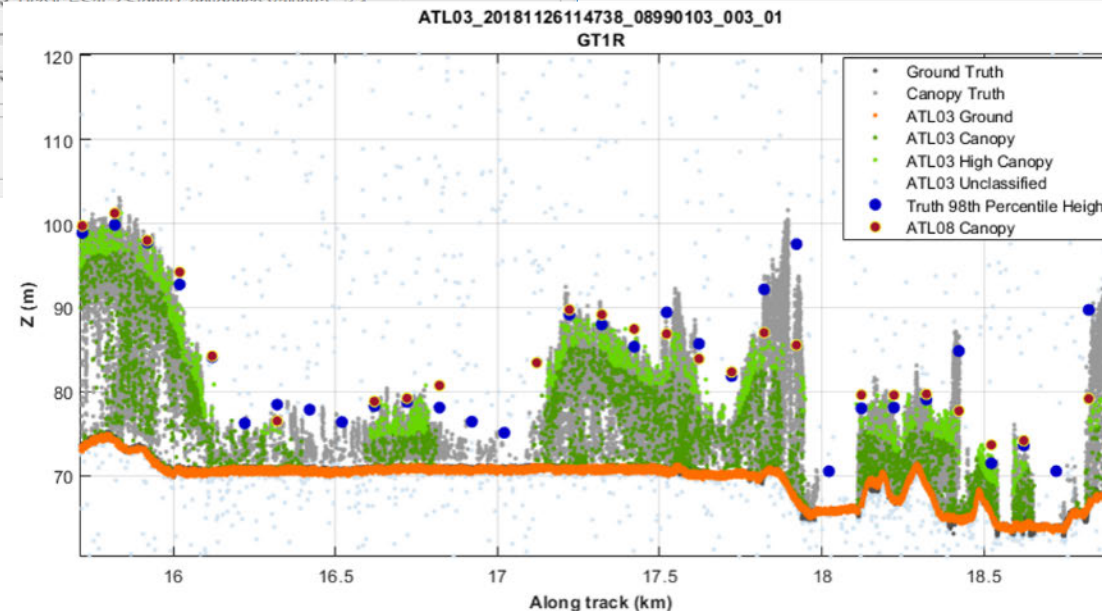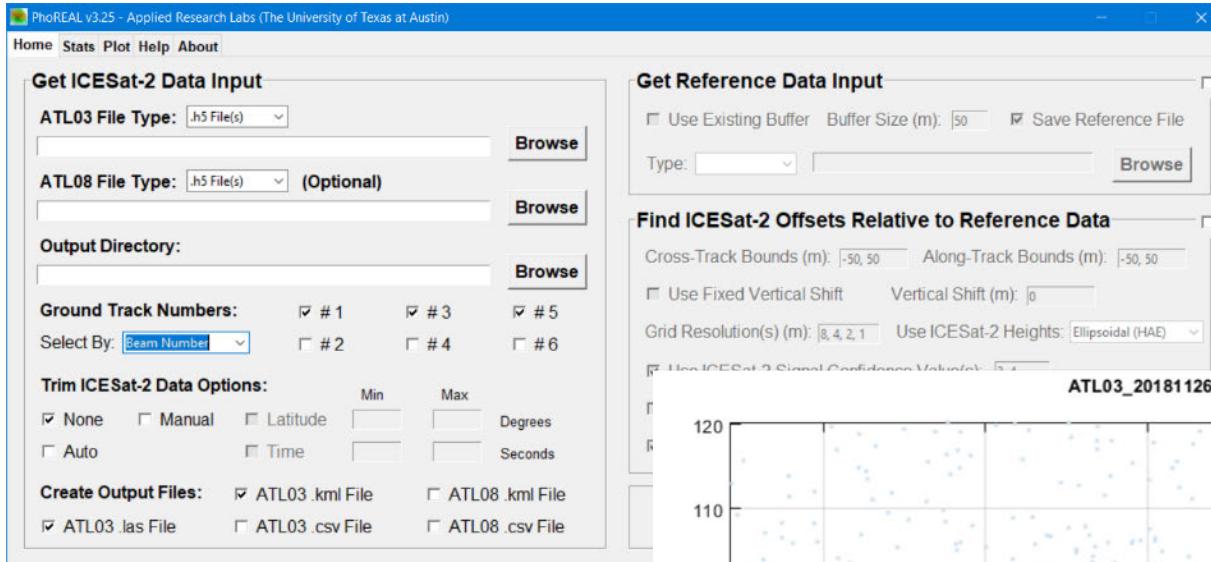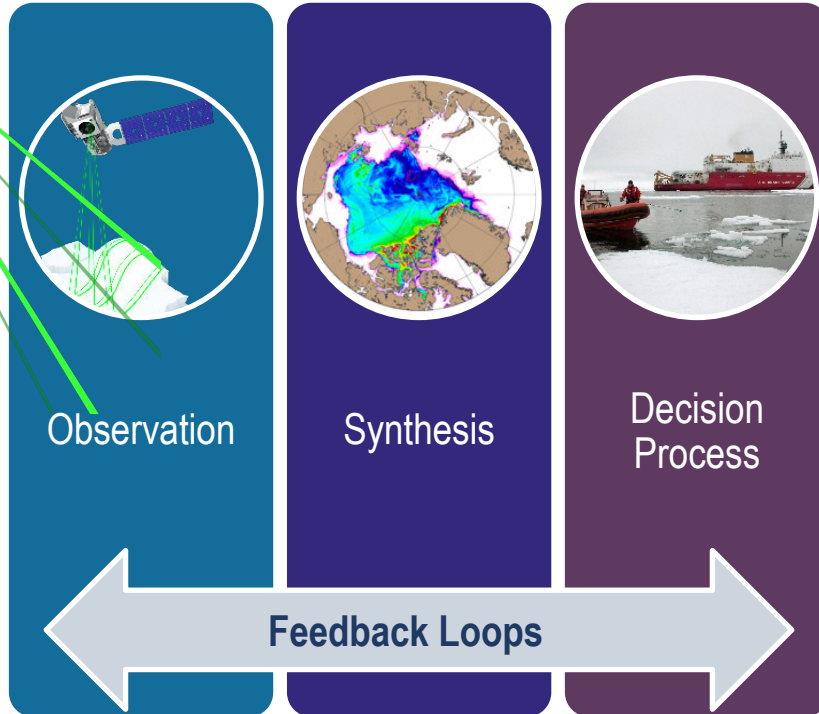

PhoREAL current capabilities

- Calculate geolocation offsets
- Subset ATL03/ATL08 data
- Reproject ATL03/ATL08 data to different coordinate system
- Map classification values to ATL03 photon cloud
- Calculate terrain and canopy height statistics at photon rate based on distance/time
- Calculate height residuals against reference airborne lidar data at any spatial resolution
- Calculate height residuals against reference DEMs at any spatial resolution

ICESat-2 Applications – Get Involved!

How are you using ICESat-2 data?

Observation   Synthesis   Decision Process

Feedback Loops

https://icesat-2.gsfc.nasa.gov/applications

ICESat-2 Applied Users Program

- Get support from a Science Definition Team (SDT) or Project Science Office (PSO) member
- Participate in quarterly webinars
- Be in the know about ICESat-2
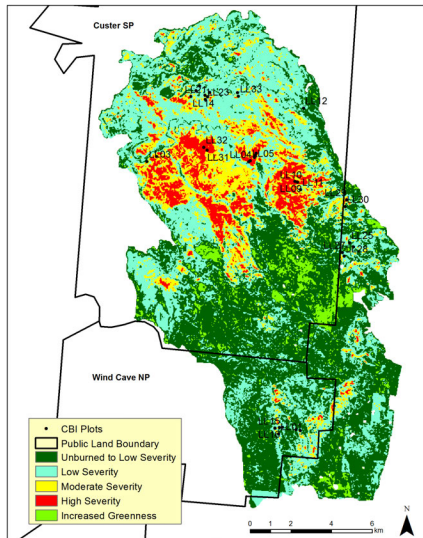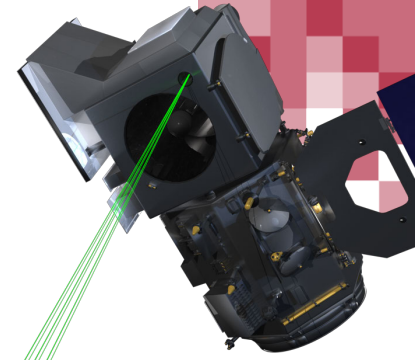- Get access to calibration and validation (cal/val) data
- Reference lessons learned

POC: sabrina.delgadoarias@nasa.gov

Partner with ICESat-2 mission scientists in your discovery of ICESat-2 data.
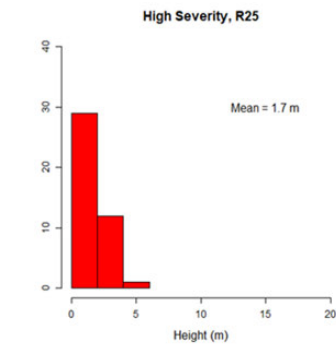
Early Adopter Spotlight: Birgit Peterson, Earth Resources Observation Science

bpeterson@usgs.gov

Burn severity mapping with ICESat-2

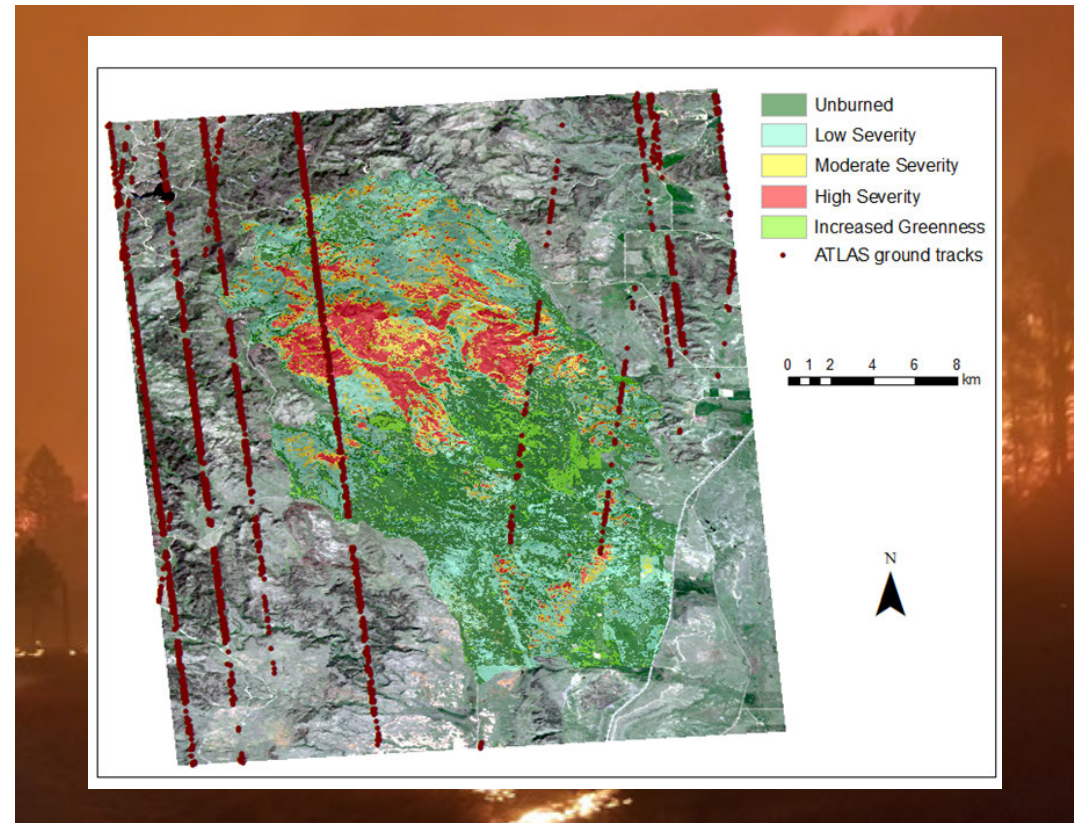

Legion Lake Fire, 2017 (South Dakota)
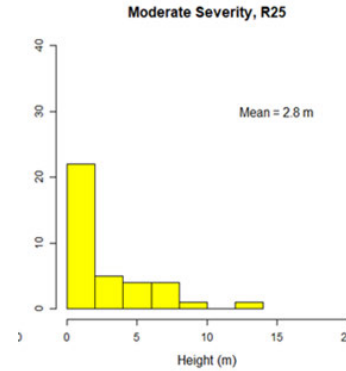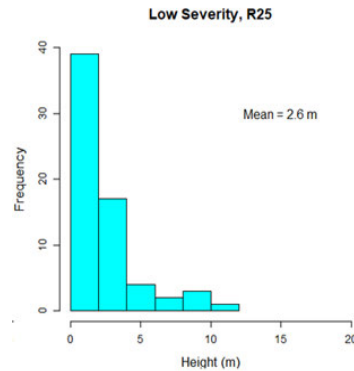
Histograms of ICESat-2-derived canopy heights (relative height from ATL08, 25th percentile)

ICESat-2 transects intersecting Legion Lake Fire

Thank You!