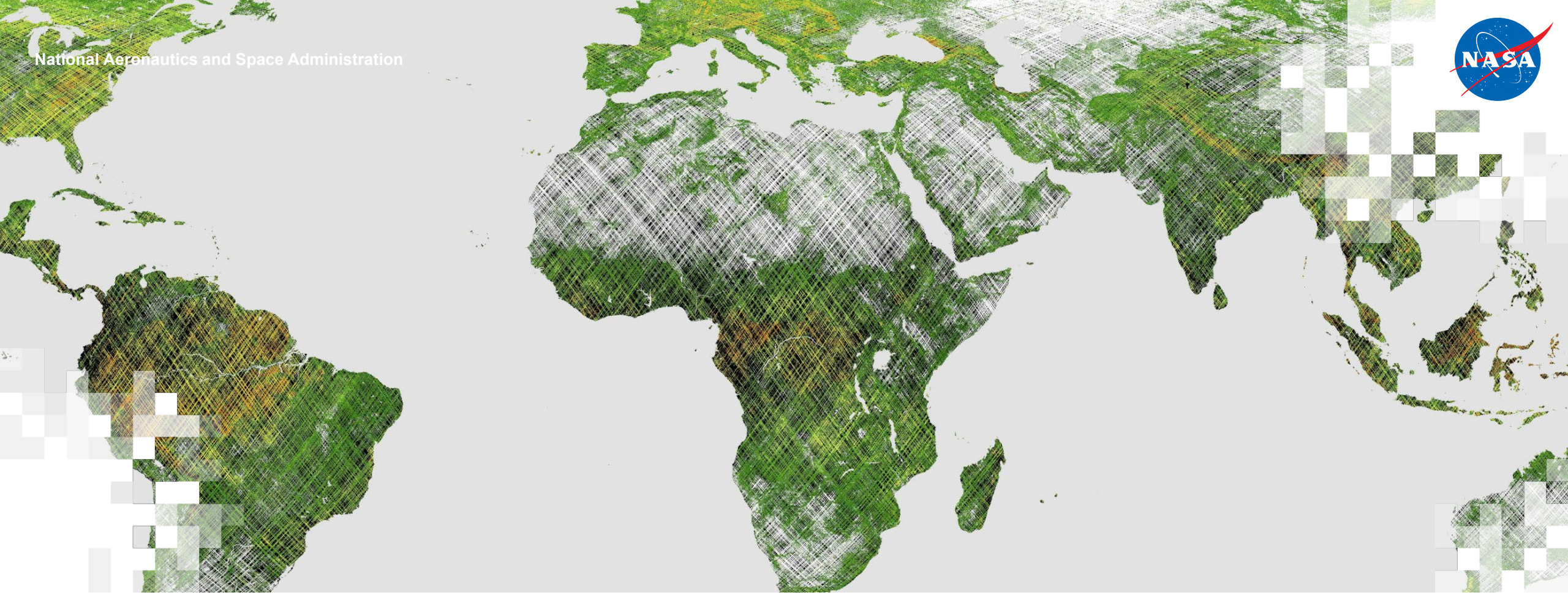


Los Fundamentos de LiDAR

Erika Podest, Ph.D., Laboratorio de Propulsión a Chorro, Instituto Tecnológico de California

16 de marzo de 2021

Agenda

- 16 de marzo - Fundamentos de *LiDAR y el Acceso y Análisis de Datos LiDAR de *ICESat-2
- 18 de marzo – Acceso y Análisis de Datos LiDAR de *GEDI
- 23 de marzo – Los Fundamentos de la Fluorescencia Inducida por el Sol (*SIF por sus siglas en inglés) y sus Aplicaciones
- 25 de marzo – Acceso y Análisis de datos de SIF para Estudios de la Vegetación

*LiDAR: Light Detection and Ranging

*ICESat: Ice, Cloud,and land Elevation Satellite

*GEDI: Global Ecosystem Dynamics Investigation

*SIF: Solar Induced Fluorescence

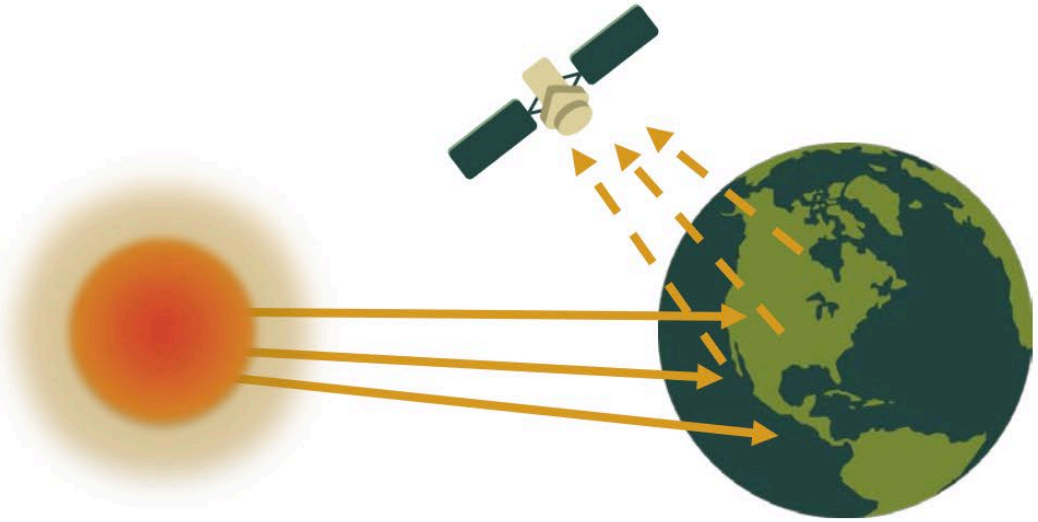
Objetivos de Aprendizaje

Al final de esta presentación, usted podrá entender:

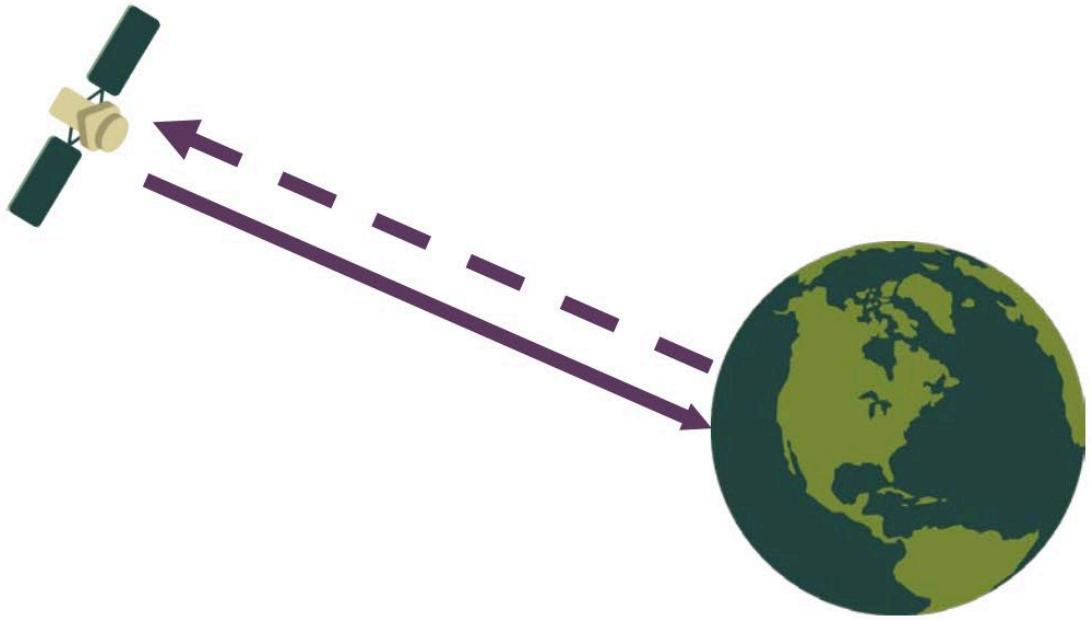
- Los conceptos fundamentales de LiDAR
- Las aplicaciones de datos de LiDAR
- Las características de los datos LiDAR de ICESat-2
- Cómo acceder y analizar datos LiDAR de IceSAT-2

Sensores Activos y Pasivos

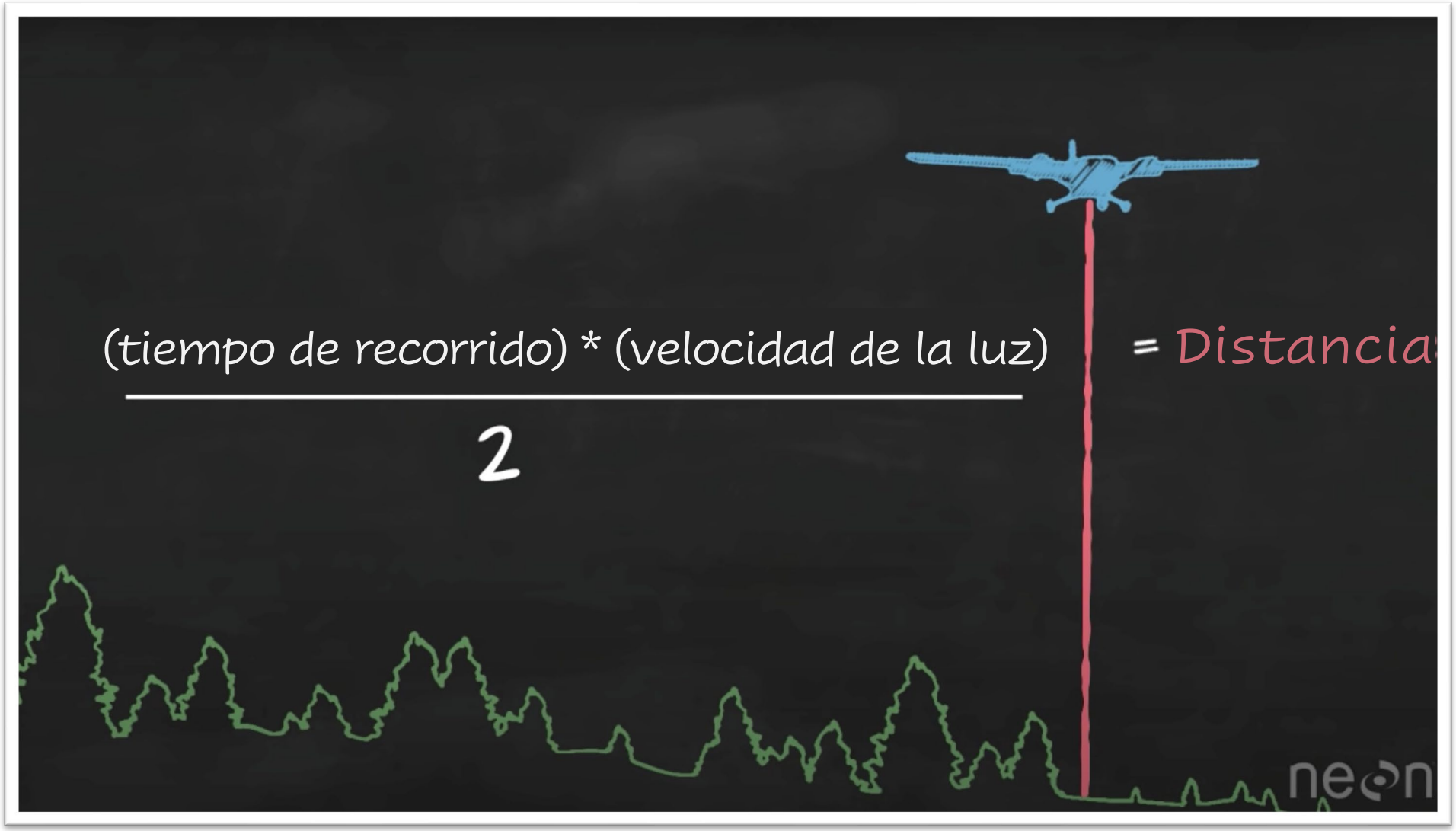
Sensores Pasivos



Sensores Activos

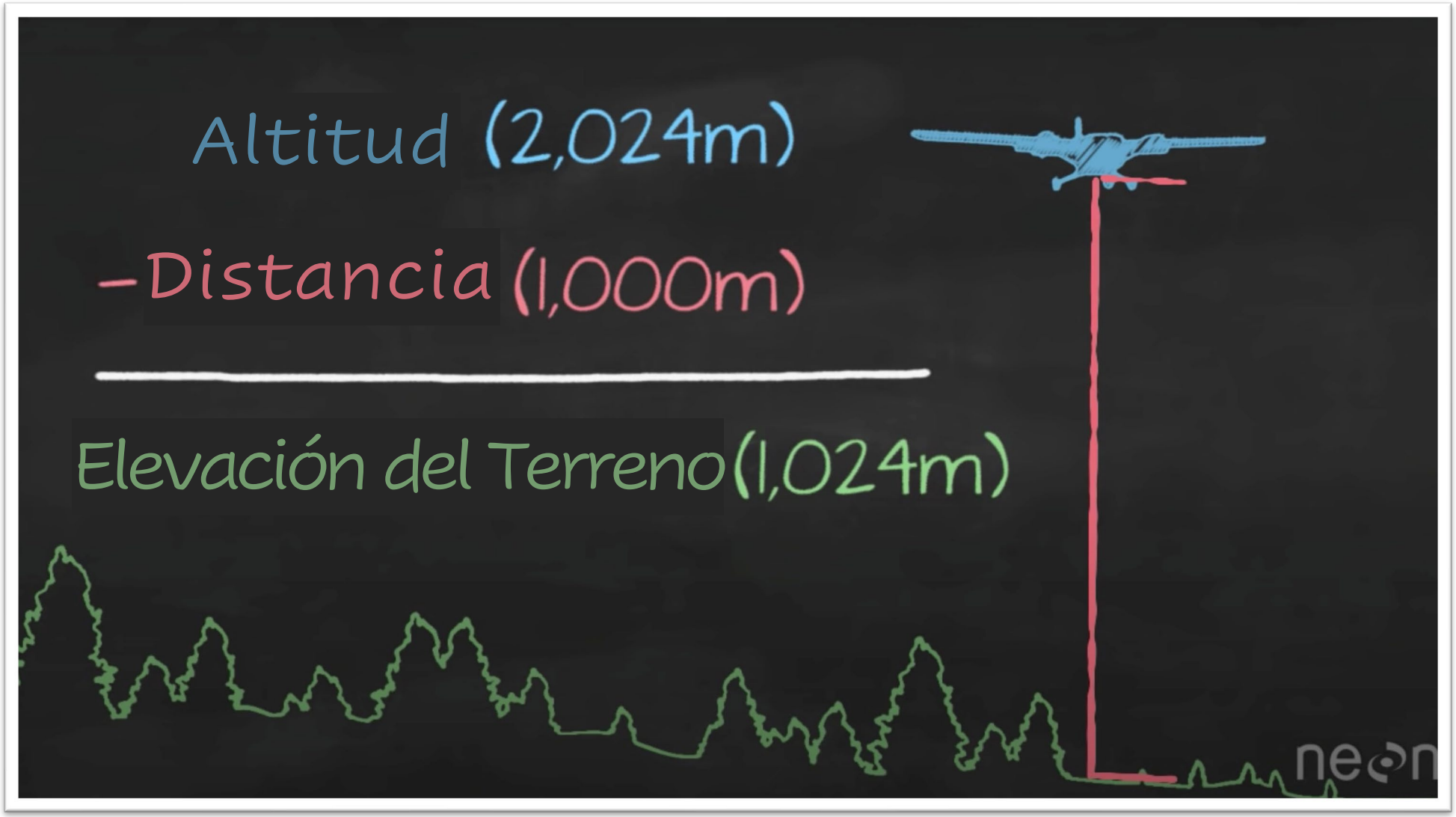


LiDAR – Determinando la Distancia



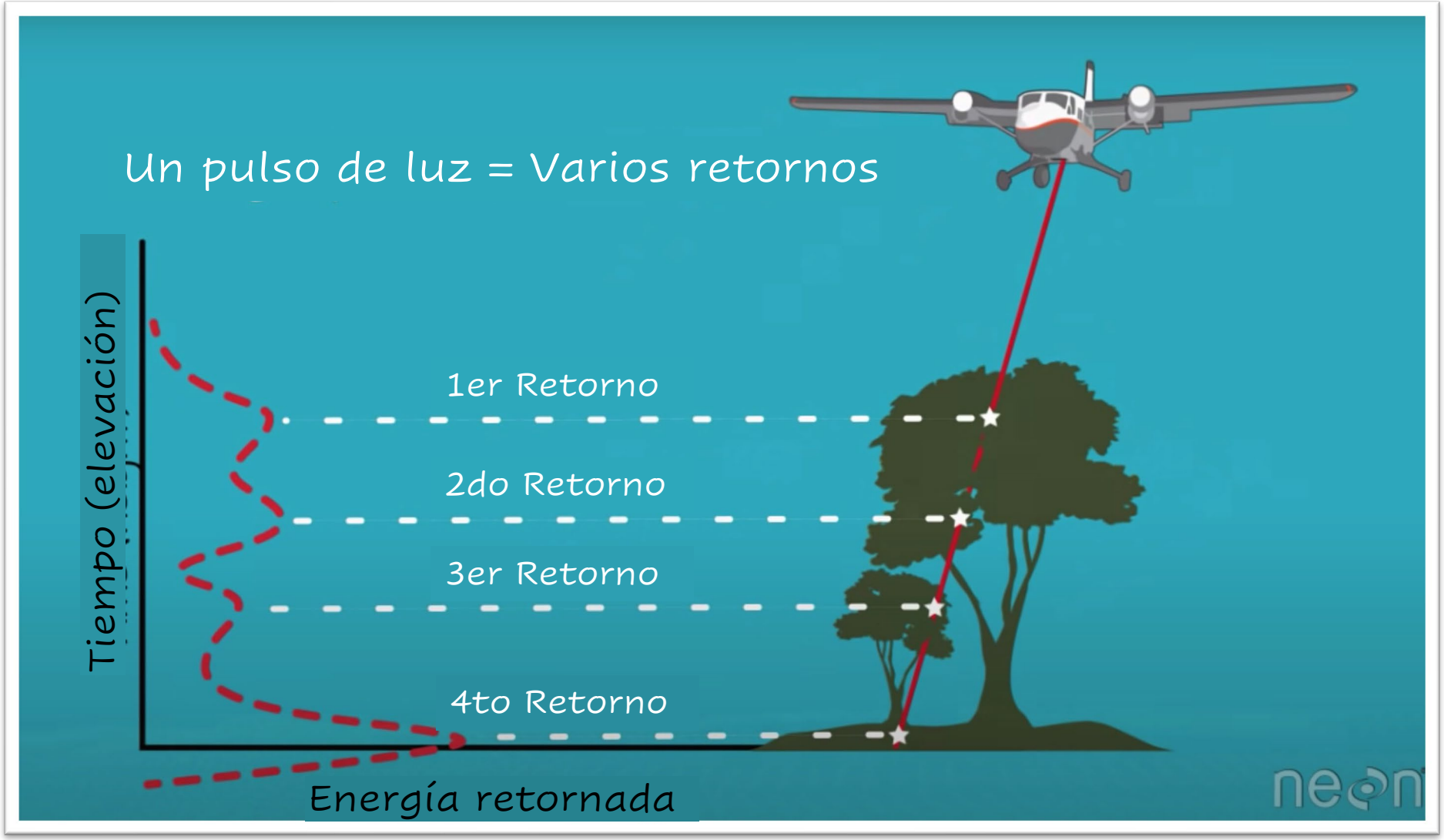
Fuente: NEON

LiDAR – Determinando la Elevación



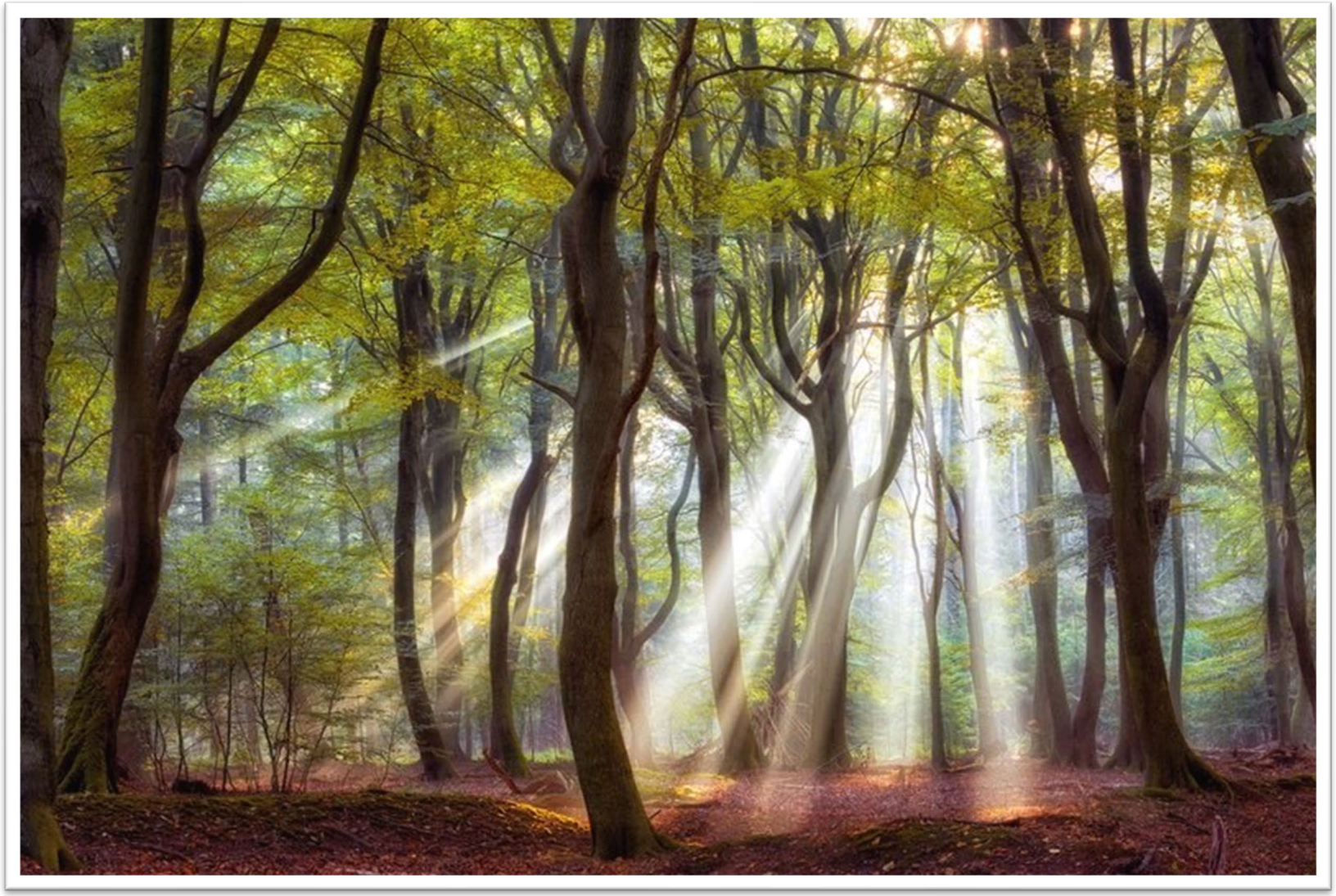
Fuente: NEON

Múltiples Ecos



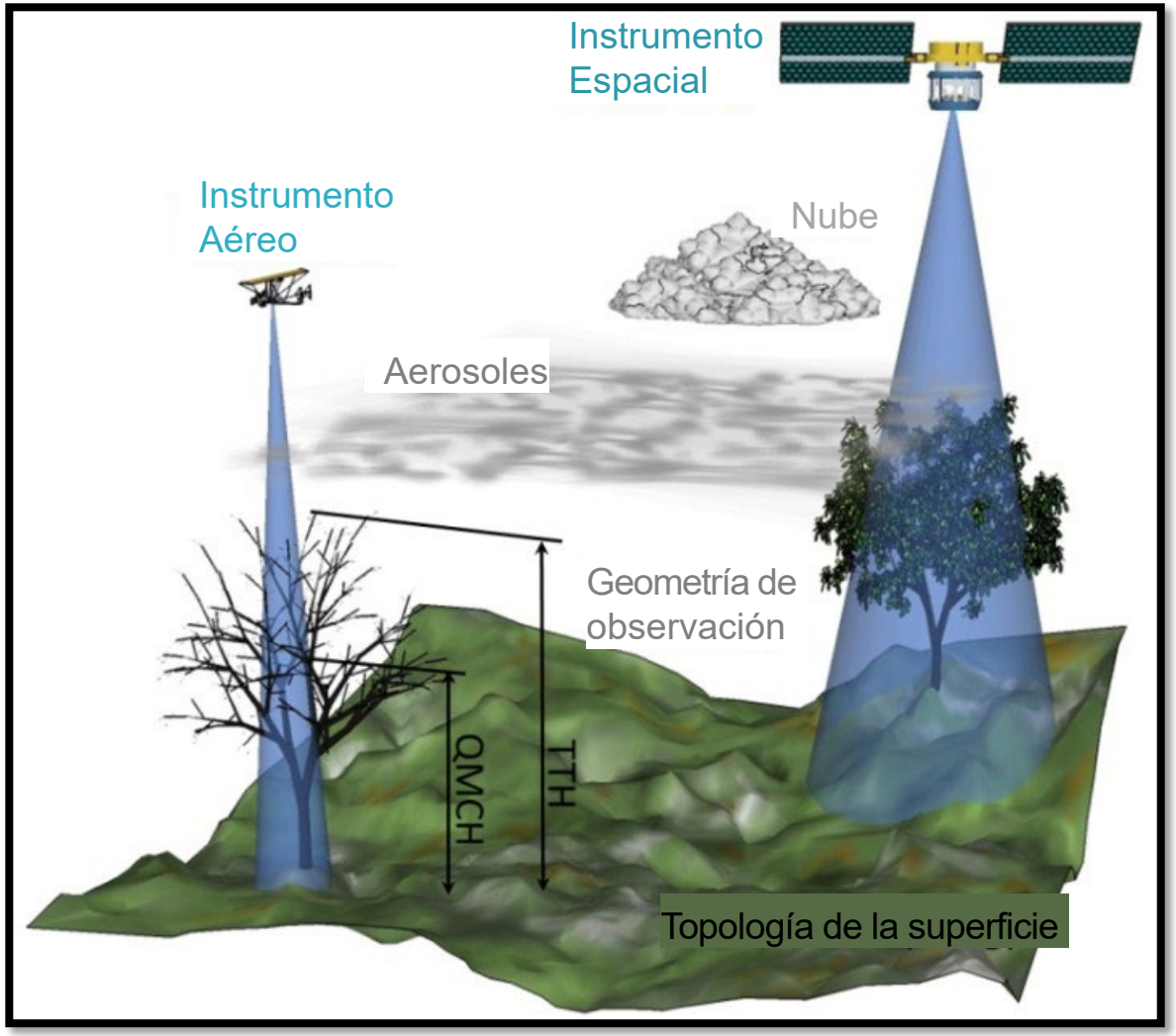
Fuente: NEON

Penetración a través de la Vegetación



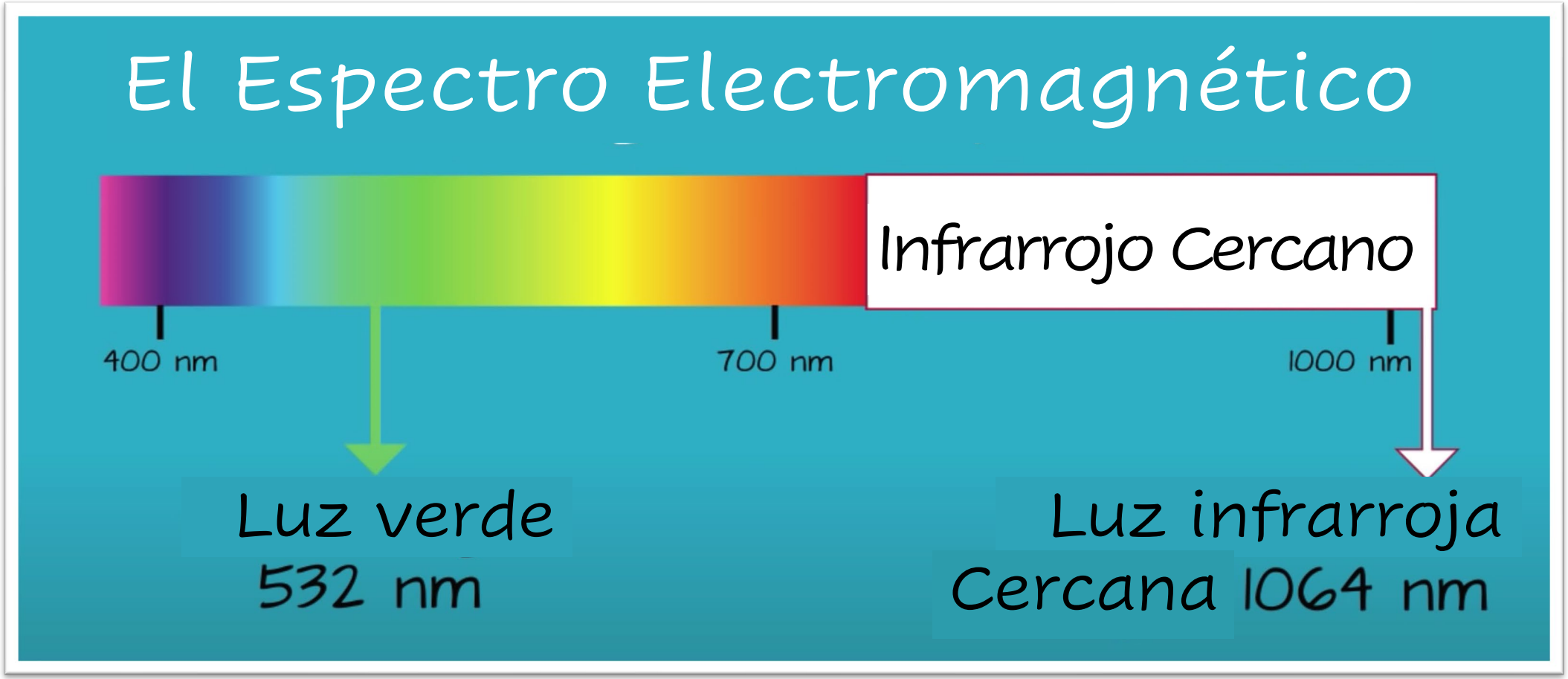
Fuente: www.awatrees.com

Plataformas de LiDAR



Fuente: Shang y Chazette, 2015

Longitud de Onda de LiDAR



Fuente: NEON

Modalidades de Detectores de LiDAR

Discretos (Discrete)

- Registran retornos individuales representando los picos en la curva de la onda.
- Un sistema discreto puede registrar de 1 a 5 retornos de cada pulso del láser. Una colección de puntos de retorno de LiDAR discretos se conoce como una nube de puntos LiDAR.

Retorno de Onda Completa (Full Waveform)

- Registra la distribución de la luz retornada.
- Los datos son más complejos para procesar pero puede que contengan más información que sensores de LiDAR discretos.

Conteo de Fotones (Photon Counting)

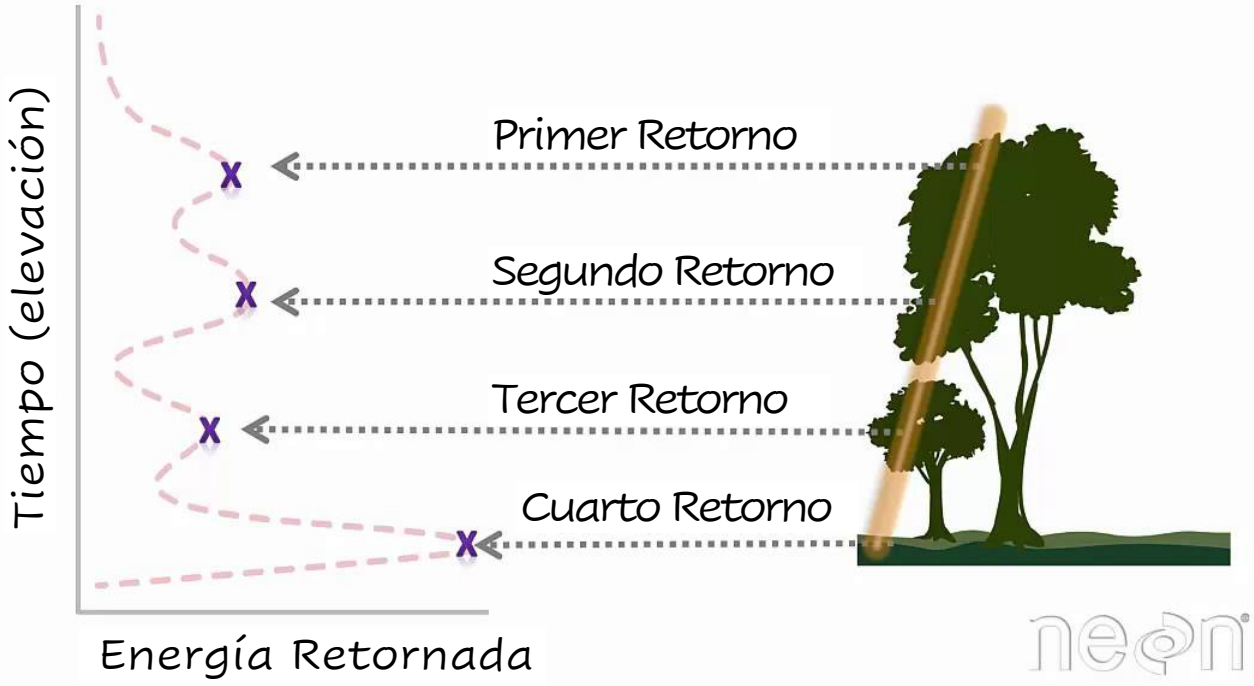
- Pulso laser de baja potencia.
- Los detectores son sensibles al nivel de un solo fotón.
- Registra el tiempo de llegada asociado con la detección de un fotón que ocurre en cualquier lugar dentro de la distribución vertical de la señal reflejada.

LiDAR Discreto

-El pulso representa picos en la energía

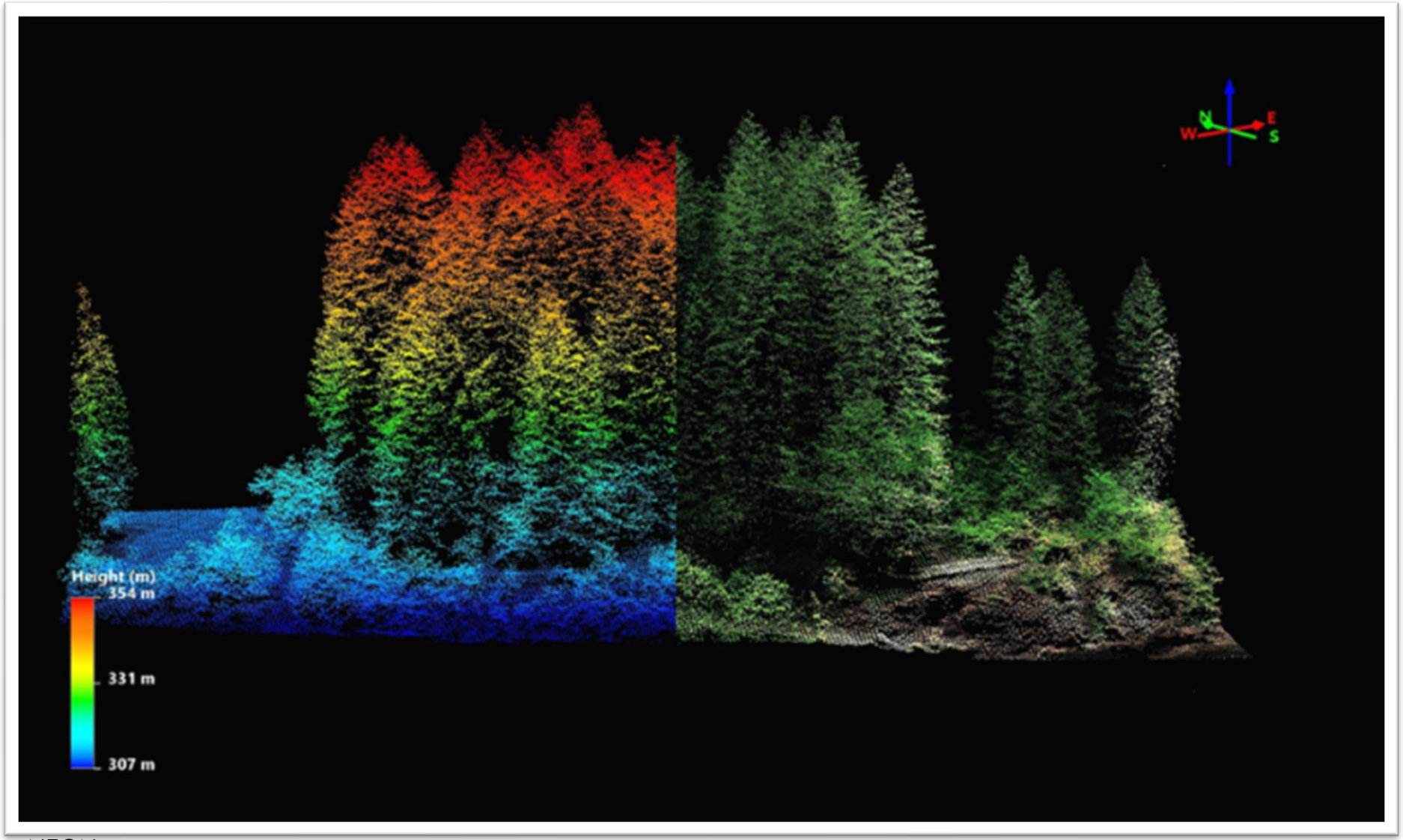
-El pulso retornado se clasifica como uno o más retornos discretos:

- Intensidad x, y, z
- Los retornos se registran cuando la intensidad sobrepasa un umbral del sistema predefinido
- Se registran varios retornos (normalmente entre 1 y 5). Los últimos son especialmente importantes para la detección del suelo.



Fuente: NEON

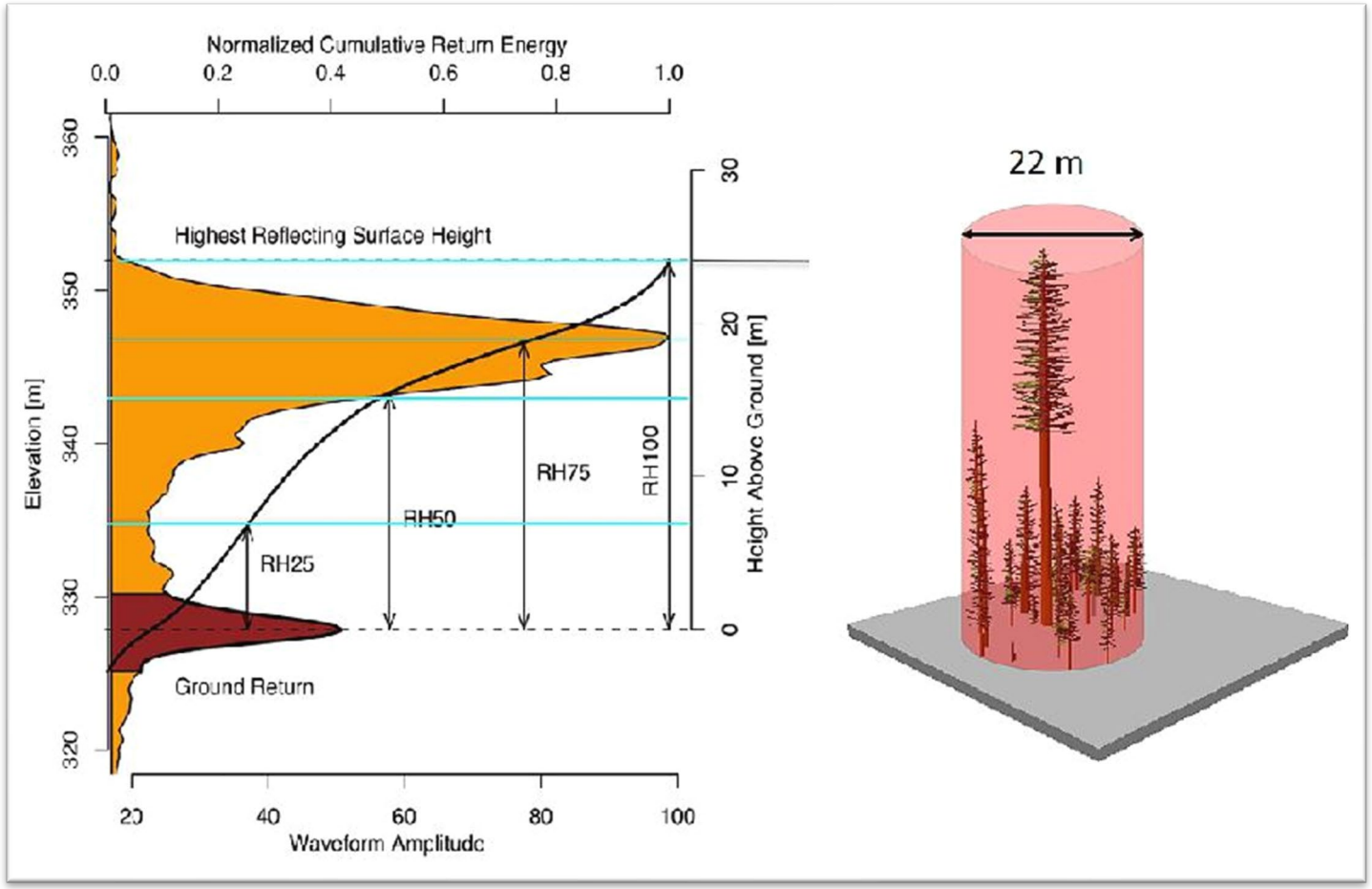
LiDAR Discreto (cont.)



Fuente: NEON

LiDAR de Retorno de Onda Completa

- La forma de onda es la distribución del retorno.
- Se puede extraer más información útil de la forma de onda entera que de retornos discretos.
- El procesamiento de datos es complejo. Hay que aplicar algoritmos para filtrar los datos y extraer información útil.

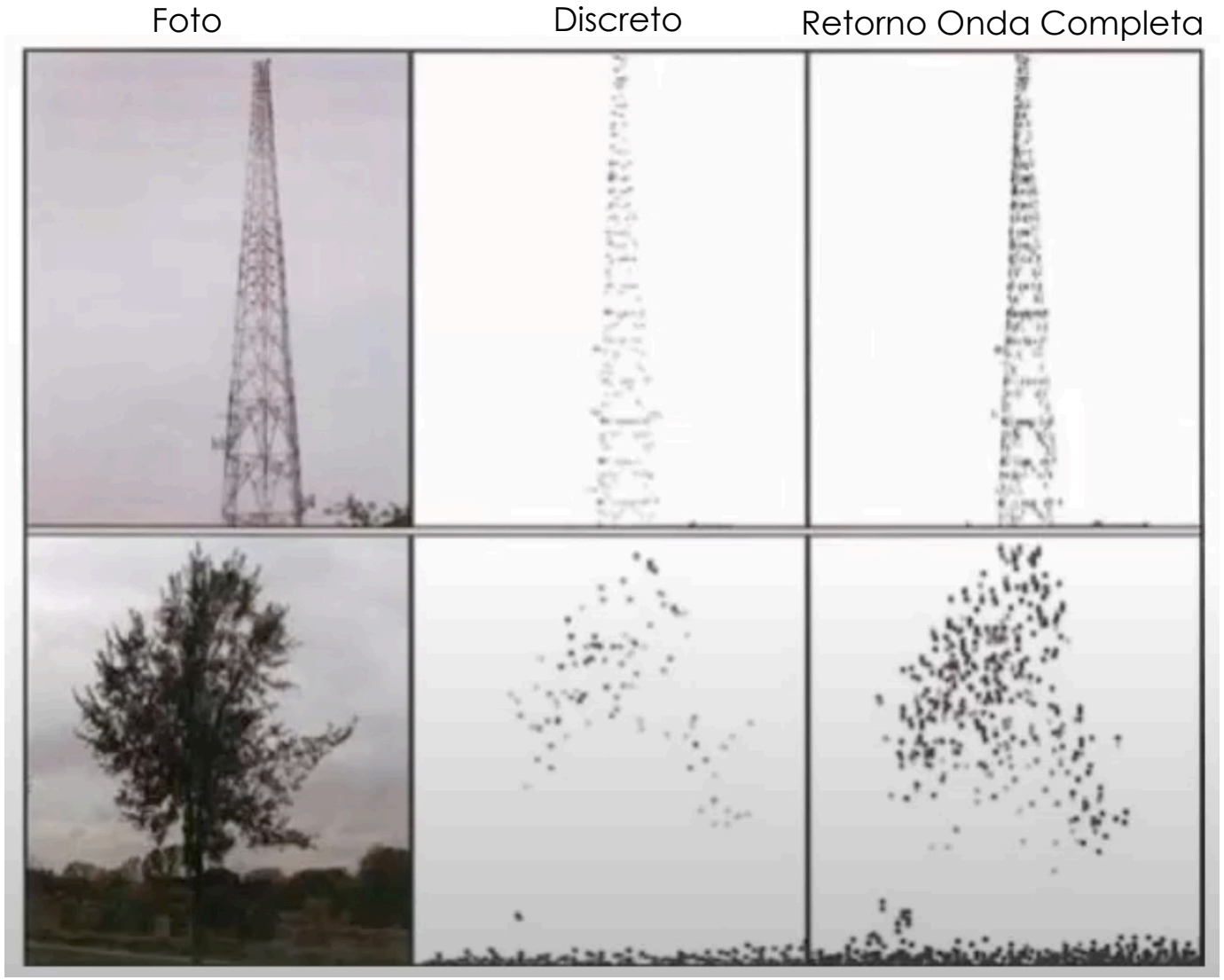


Fuente: Ralph Dubayah, Universidad de Maryland, College Park

Interacción de un Pulso Laser

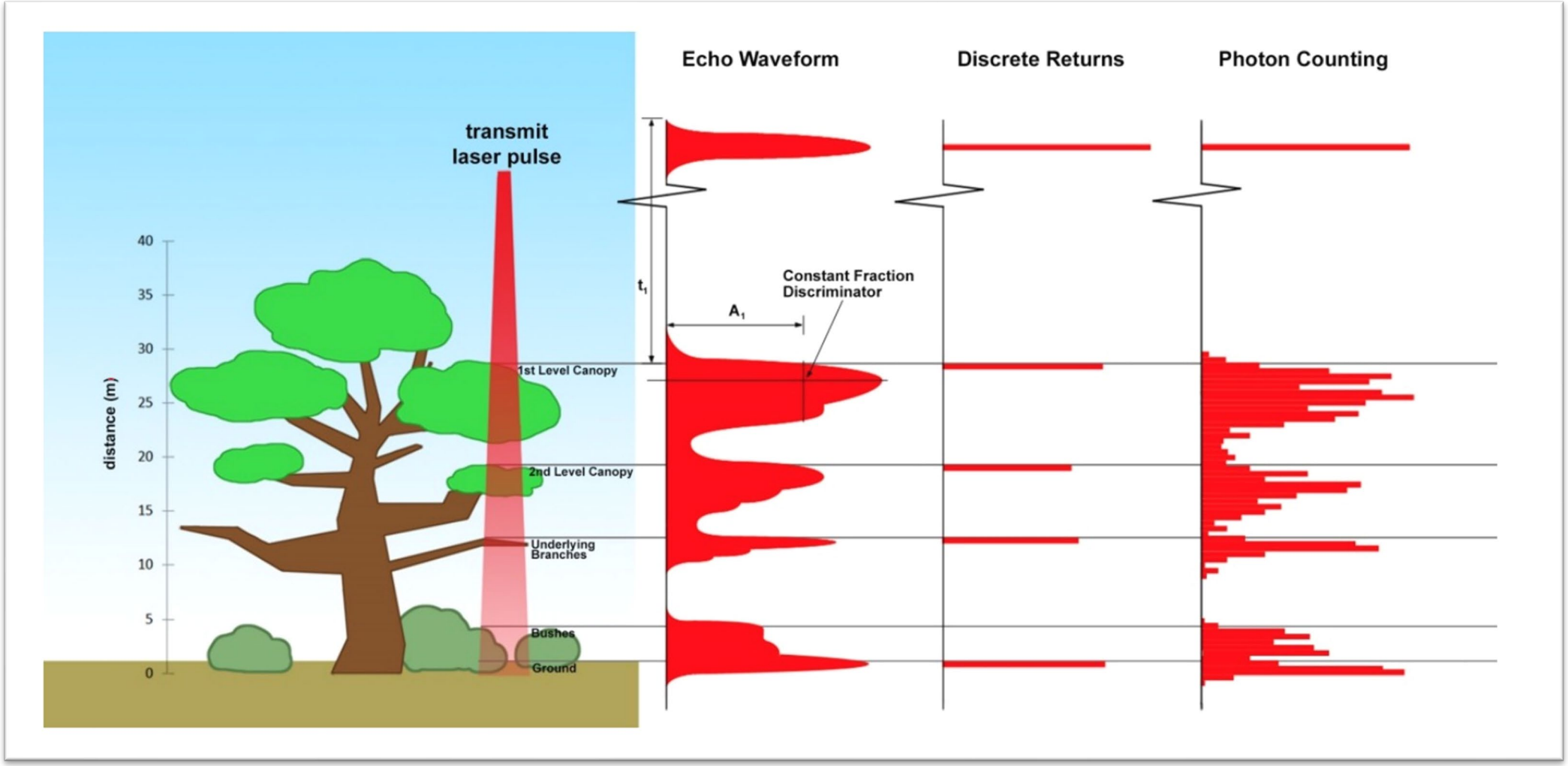
Fuente: NASA Goddard Space Flight Center

Comparación de LiDAR Discreto y de Retorno de Onda Completa



Fuente: Renslow, 2012

Contando Fotones



Fuente: ICESat-2 ATBD – adaptado de Harding, 2009

Diferencias entre LiDAR y Radar

LiDAR

-Frecuencias ópticas: IR Cercano y Verde (longitudes de onda de 532 y 1064 nm).

-Haces enfocadas de alta frecuencia permiten una resolución espacial elevada.

-Está limitado a condiciones atmosféricas despejadas. Funciona de día o de noche.

Radar

-Frecuencias de microondas: ~250,000 más largas que IR cercano.

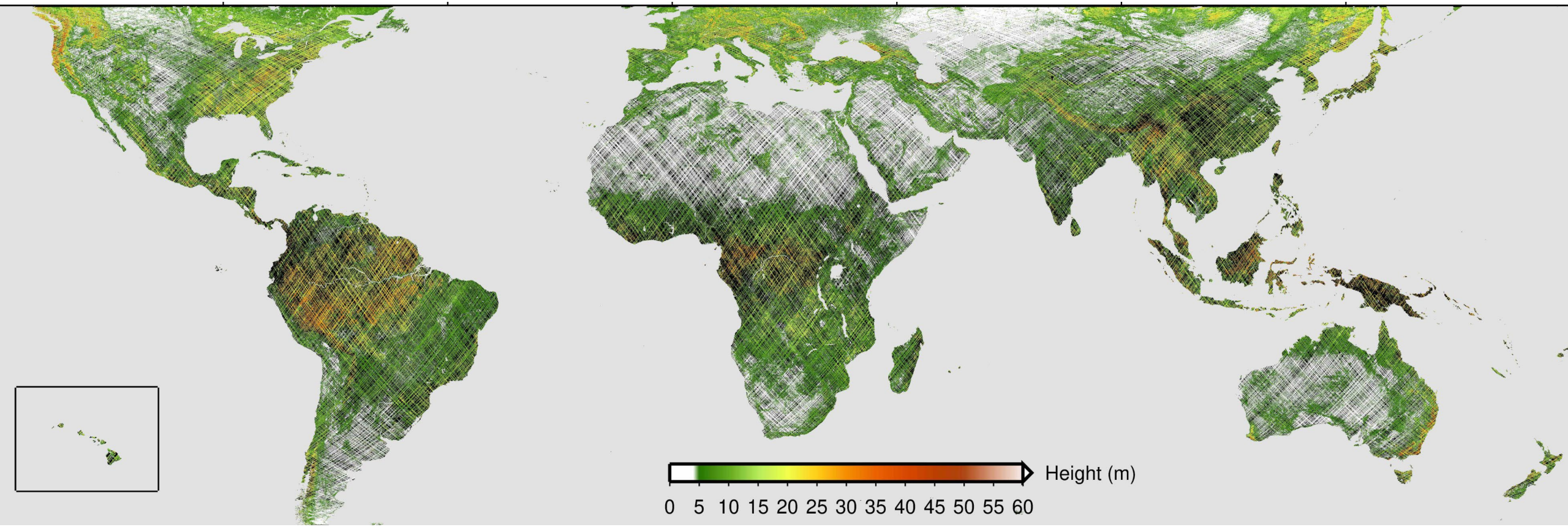
-El ancho del haz y el tamaño de la antena (aun sintetizado) limitan la resolución espacial.

-Puede operar bajo casi cualquier condición meteorológica. Funciona de día o de noche.

Aplicaciones de LiDAR

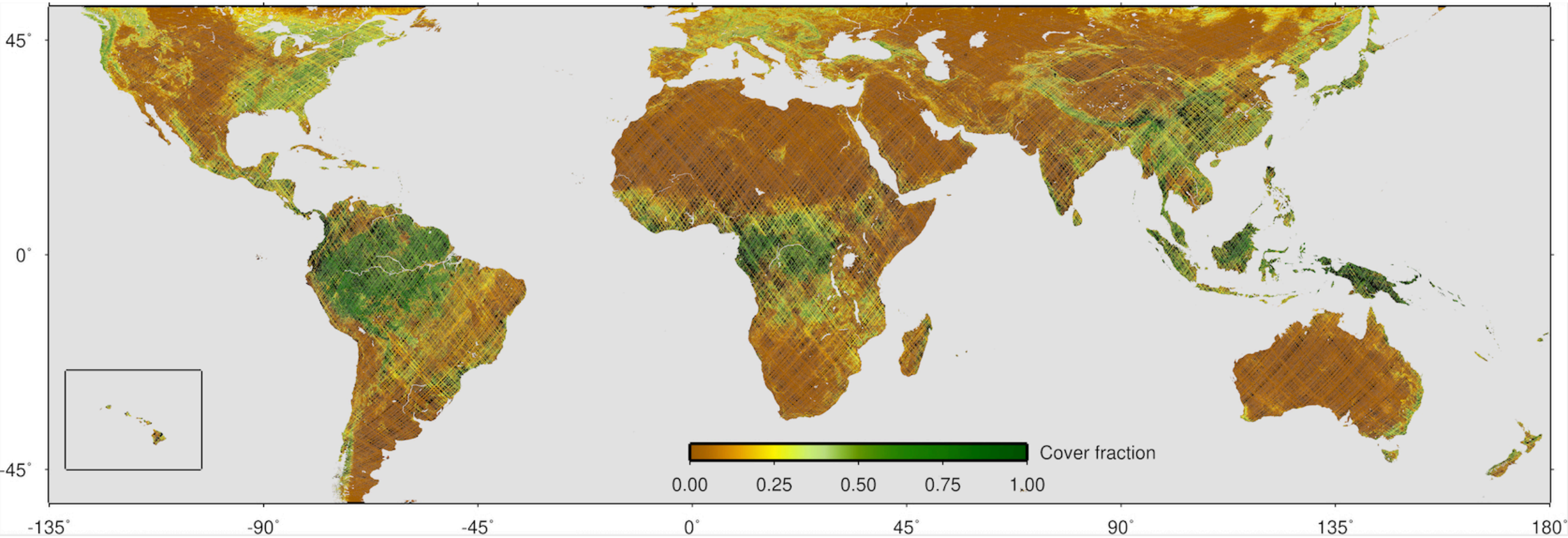
- Incendios – pérdida de vegetación
- Caracterización de hábitat (componentes estructurales y verticales)
- Secuestro de carbono
- Inventario Forestal
- Cambios en la deformación de la superficie

Altura de la Vegetación



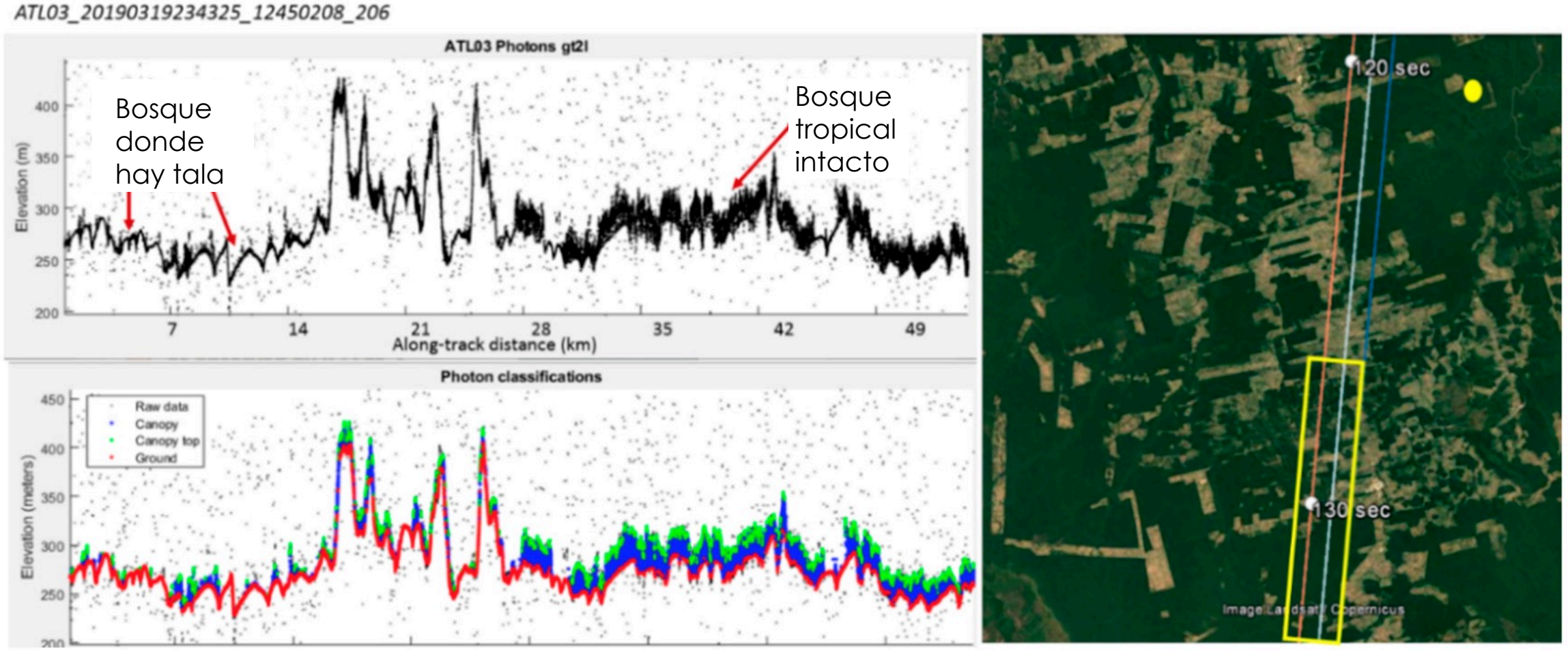
Fuente: GEDI

Fracción de la Cobertura

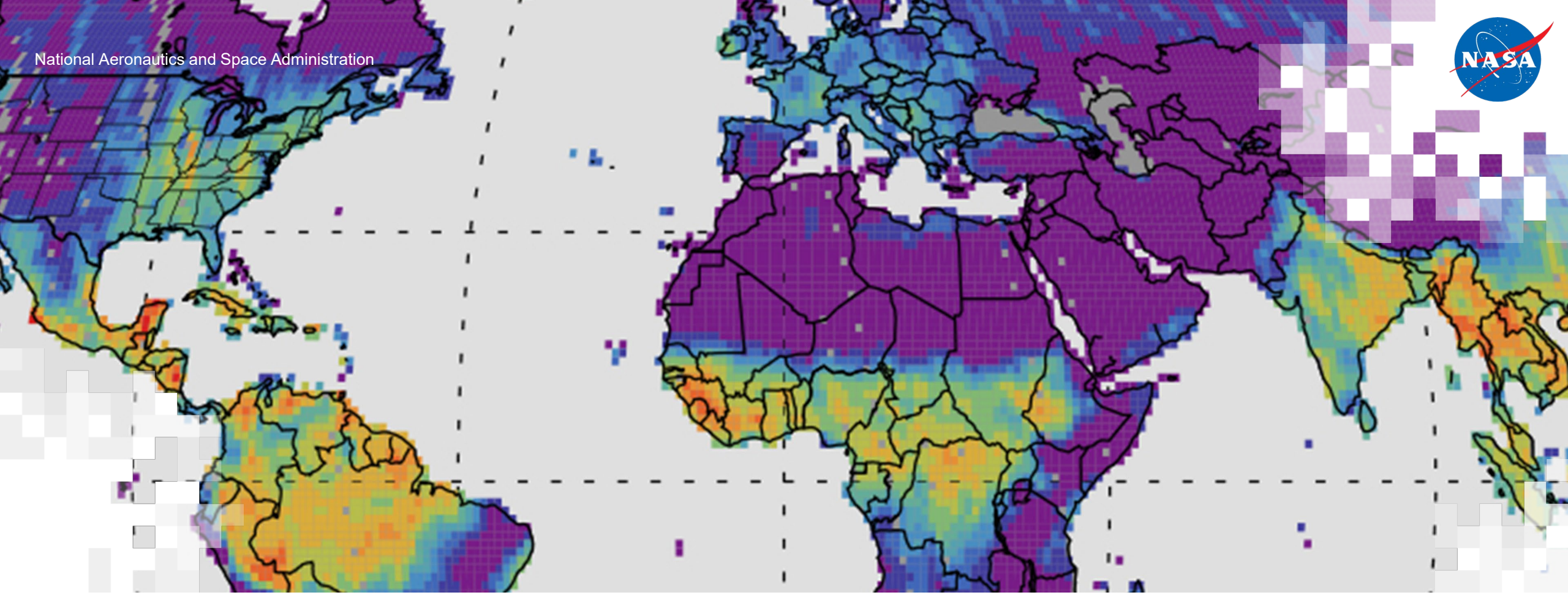


Fuente: GEDI

Caracterización de Hábitats



Fuente: Amy L. Neuenschwander y Lori A. Magruder, 2019.

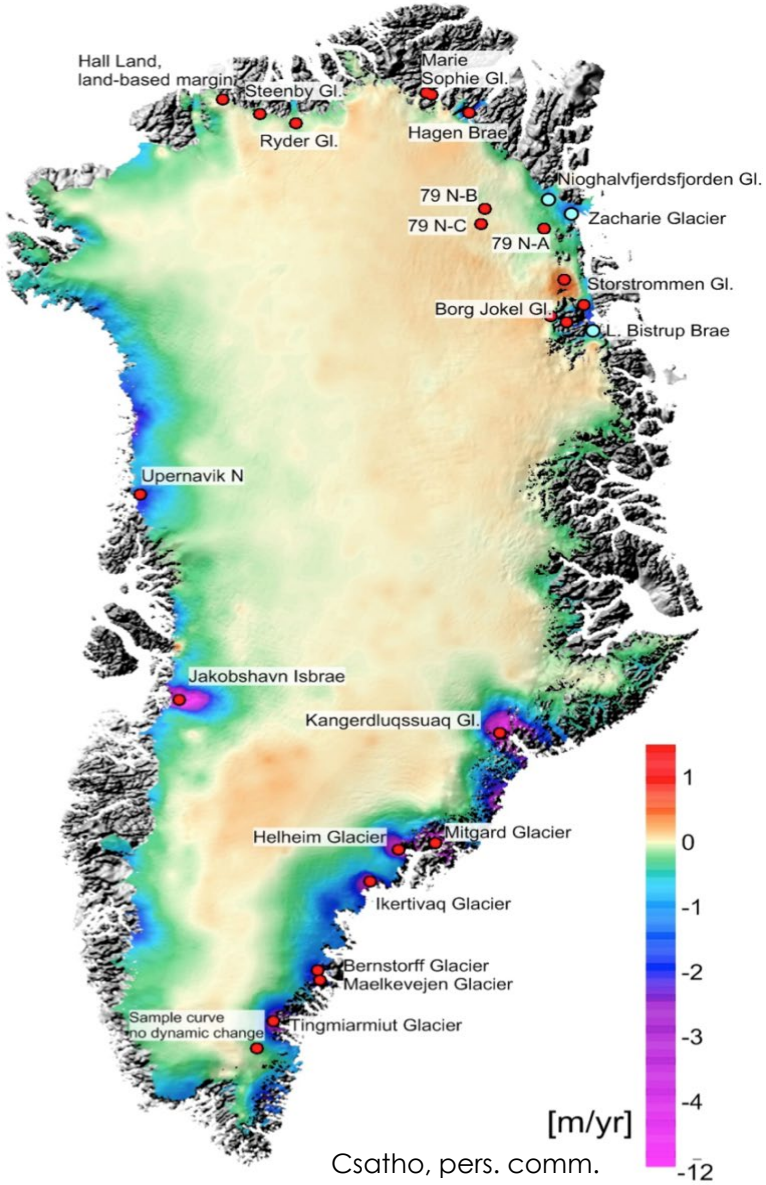


Datos de ICESat-2 y ATL08 (Tierra/Vegetación)

Amy Neuenschwander, Universidad de Texas en Austin

16 de marzo de 2021

La Misión ICESat-2



Csatho, pers. comm.

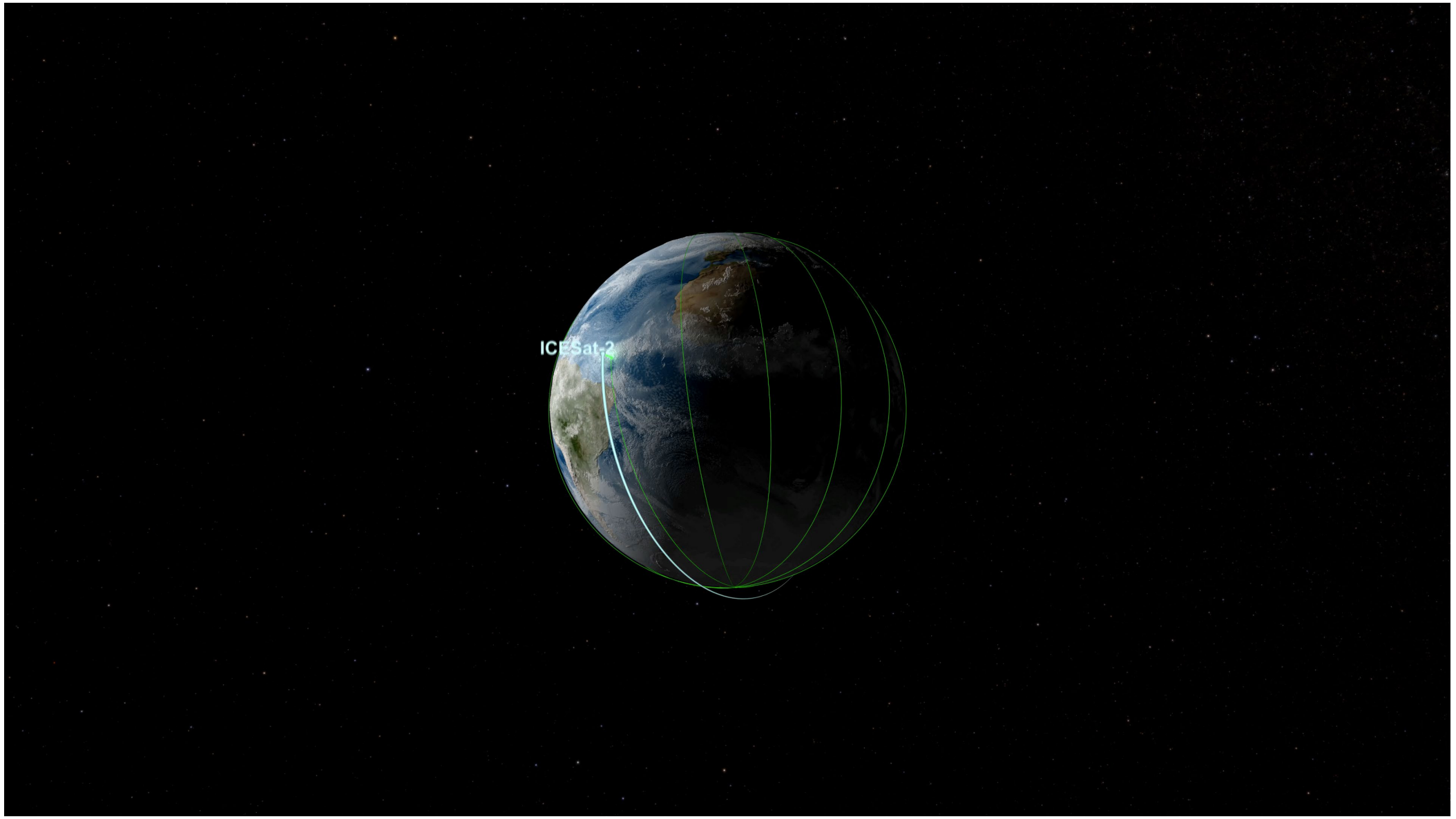
Un objetivo científico es medir elevaciones y cambios en la elevación de las capas de hielo y del hielo marino.

La Misión ICESat-2

Otro objetivo científico es medir la altura de la vegetación como base para la estimación de biomasa y cambios en la biomasa a gran escala.

ICESat-2 lanzado el 15/09/2018 de la base a

ICESat-2: Órbita y Cobertura



ICESat-2

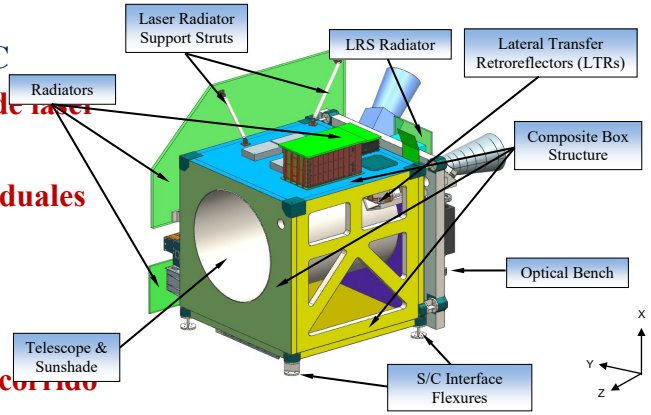

-Mide cambios en la altura
-Resolución espacial alta
-Resolución temporal baja
-NASA Goddard

ICESat-2: Resumen de la Misión

Carga útil

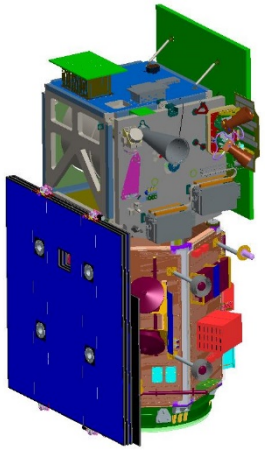
ATLAS – "Advanced Topographic Laser Altimeter System" desarrollado por GSFC

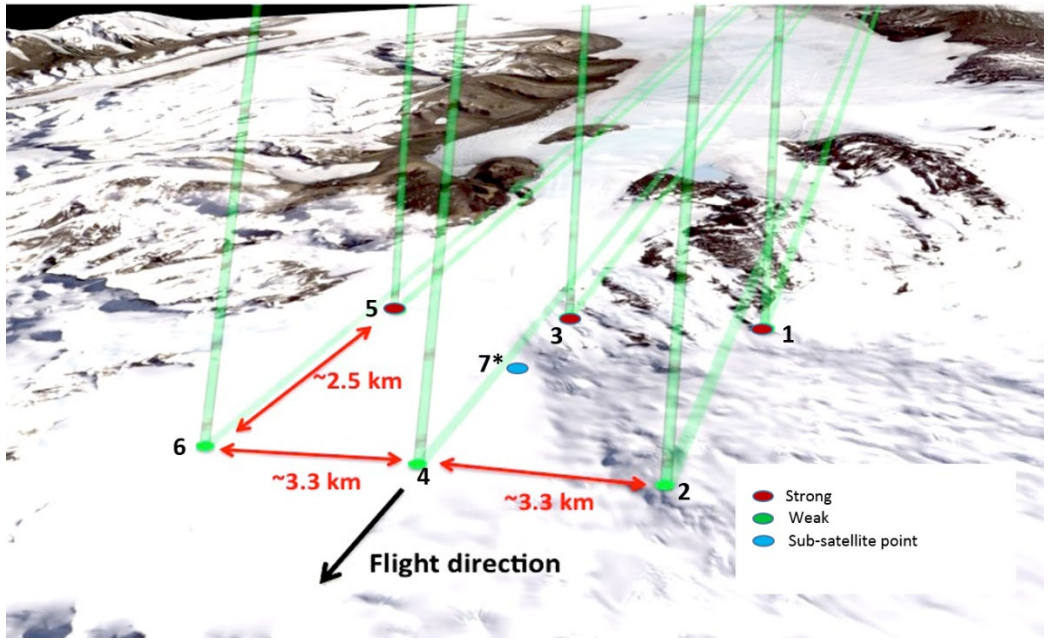
- Mide el tiempo de vuelo de pulsos de láser
- Mide la dirección de apuntar
- Detección sensitiva a fotones individuales
- 6 haces en 3 pares
- Repetición de pulsos a 10 kHz
- Huella ~12 m
- Espaciado de 0.7 m a lo largo del recorrido
- Longitud de onda de 532nm



Implementación

Fecha de lanzamiento: 15 de septiembre de 2018
Vida útil: 3 años, con productos consumibles para 5+
Órbita: 454 km, no heliosíncrona, inclinación de 92°
Repetición: Repetición exacta - 91 días, subciclo de ~30-días
Datos Científicos: 1 TB/día
Sistema de Apuntamiento: Control = 45 m (14.3 m, CBE)
Conocimiento = 6.5 m (4.0 m, CBE)



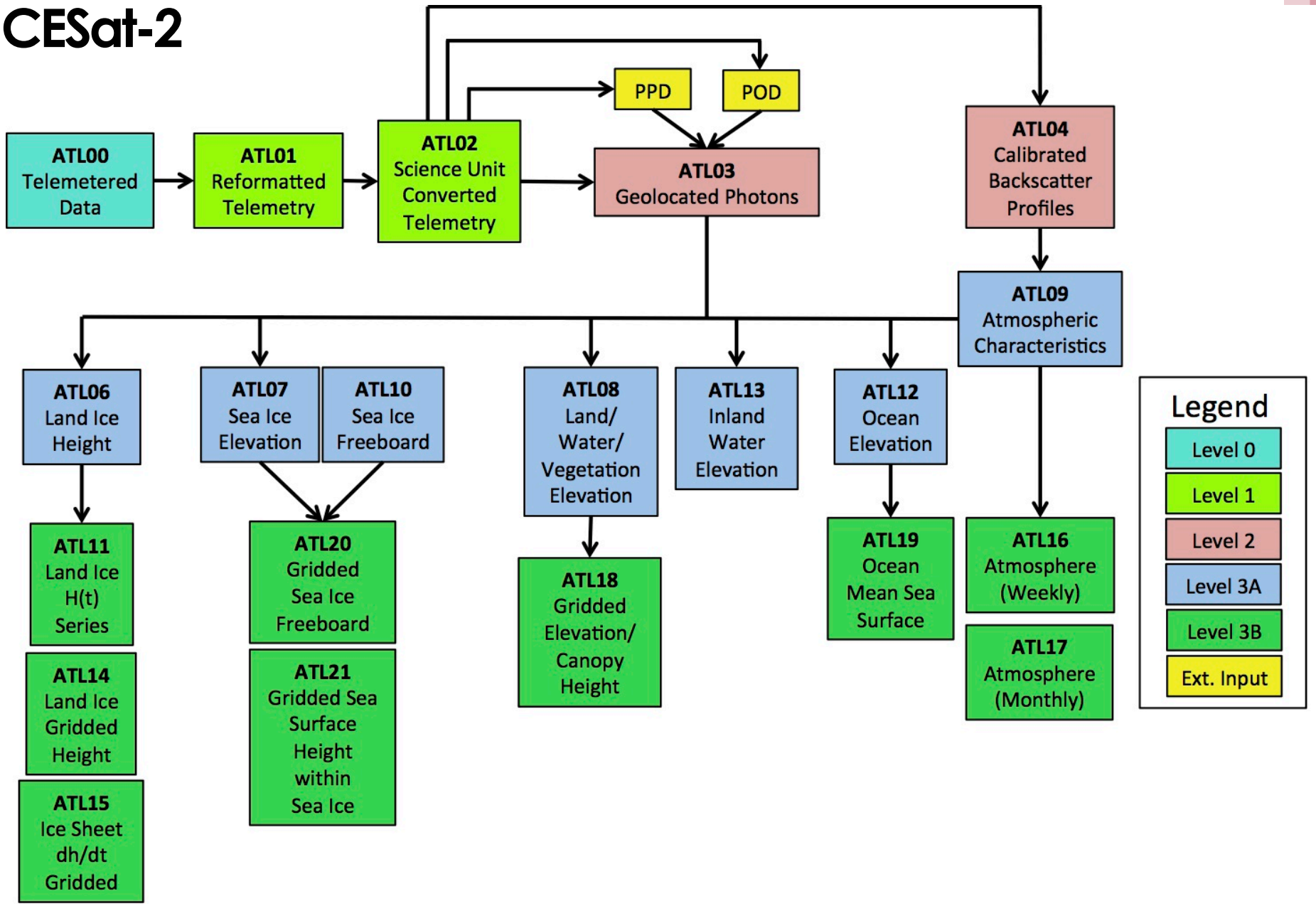


Pulso de láser singular de 532nm dividido en 6 haces.
Detección sensitiva a fotones singulares

Espaciado de ~3 km entre pares brinda una cobertura espacial
Espaciado de pares de ~90 m para ***determinación de pendiente*** (2° de guiñada)

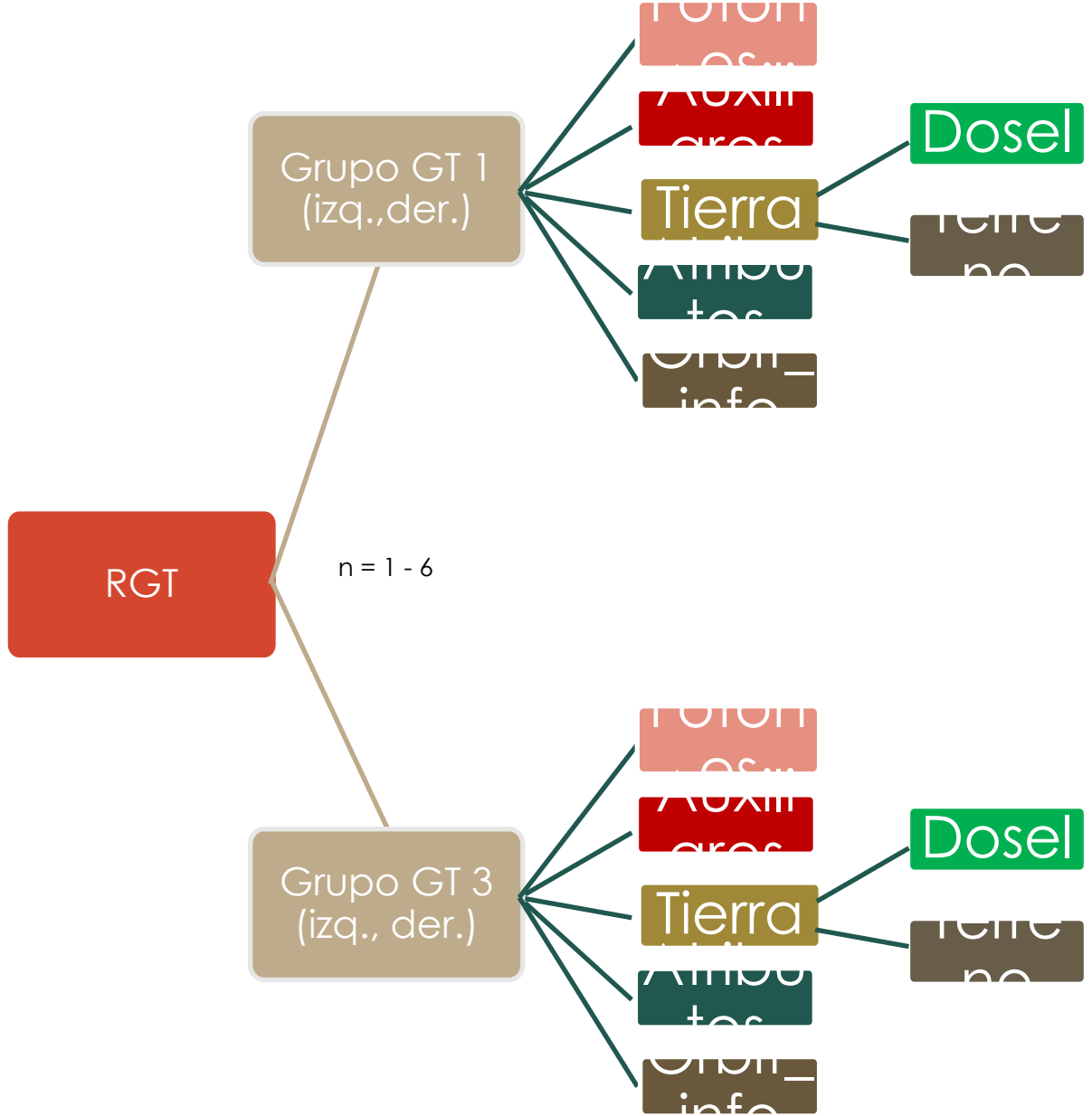
Haces de alta potencia (4x) para un mejor rendimiento sobre objetos de baja reflectividad.

Productos de ICESat-2



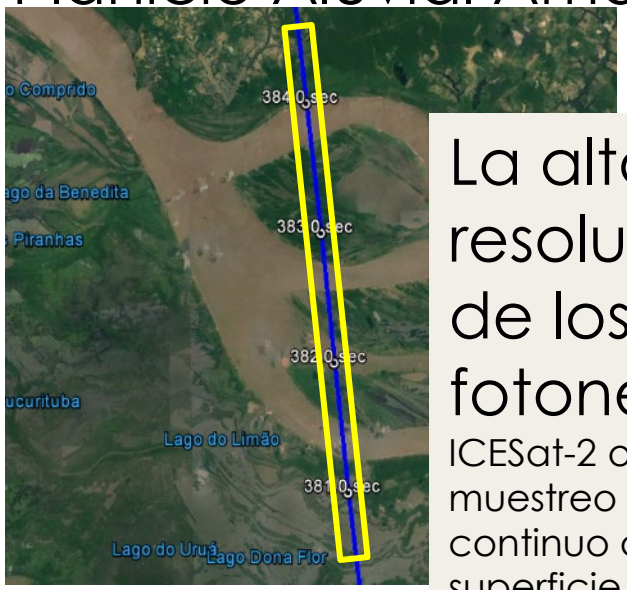
Datos ATL08

- **ATL08 - Nivel-3 (A lo largo del Recorrido)**
  - Productos computados por órbita/por haz
    - Fotones clasificados
    - Parámetros estadísticos del dosel y el terreno en base a una distancia fija de 100 m para capturar la geomorfología a alta escala
    - Segmentos de100 m de distancia
    - Índices de fotones etiquetados se mapean con referencia a ATL03



Ejemplo de ATL03 y ATL08

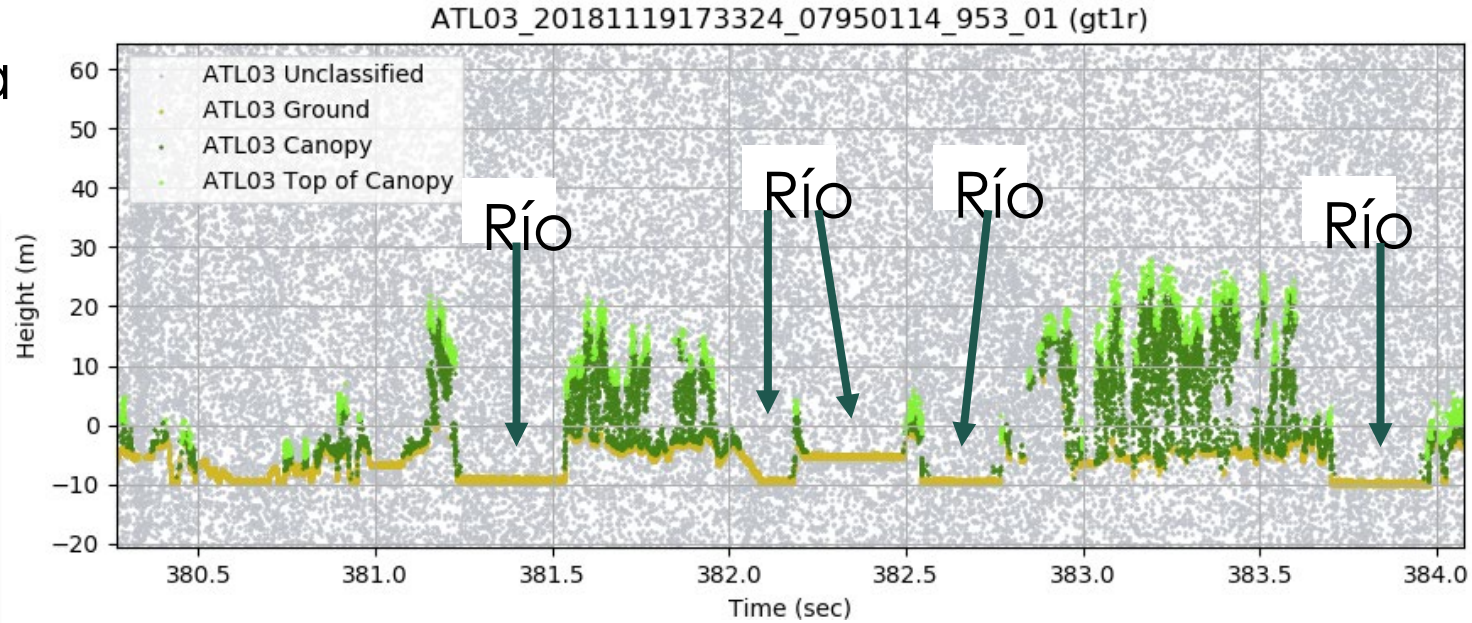
Planicie Aluvial Amazónica

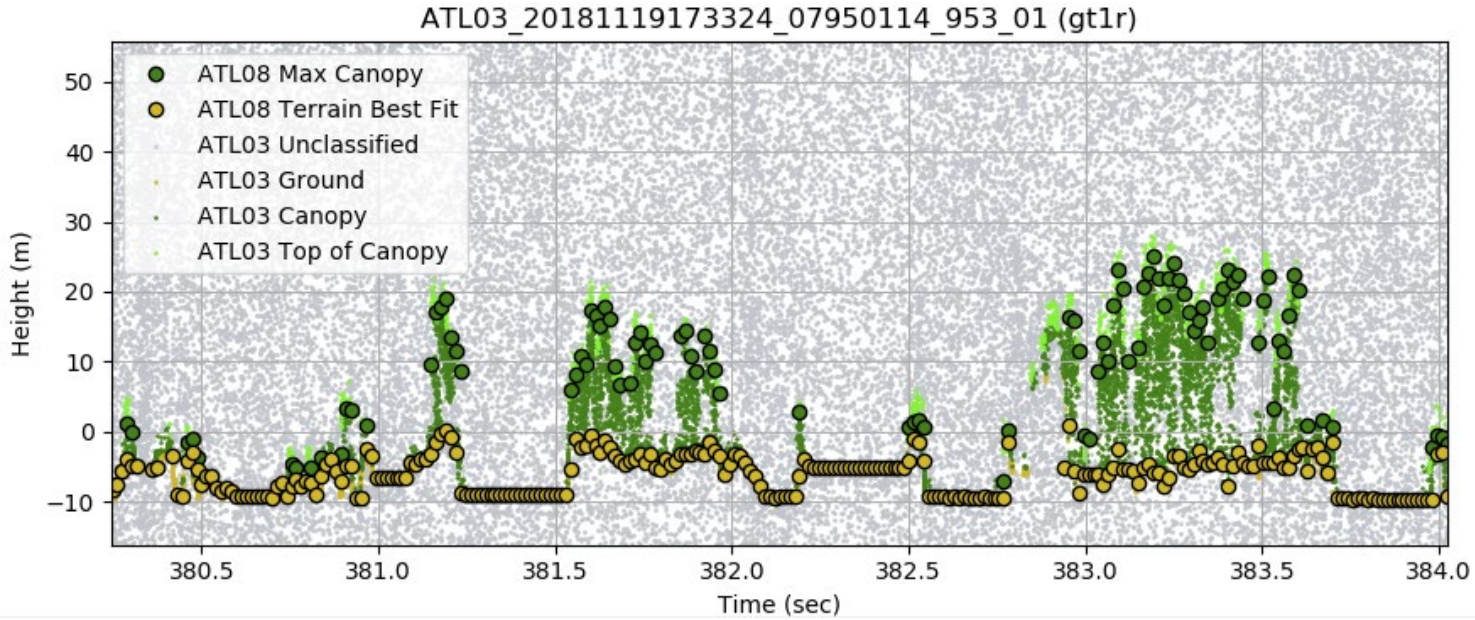


La alta resolución de los fotones de ICESat-2 ofrece un muestreo casi continuo de la superficie en la dirección de recorrido. En este ejemplo, se puede determinar los niveles de los ríos.

Los fotones de ICESat-2 son asignados un color utilizando el algoritmo de ATL08 (Tierra y Vegetación). Los datos son de una adquisición diurna.

El gráfico inferior incluye los mismos fotones que el panel





Bosque Tropical, Brasil

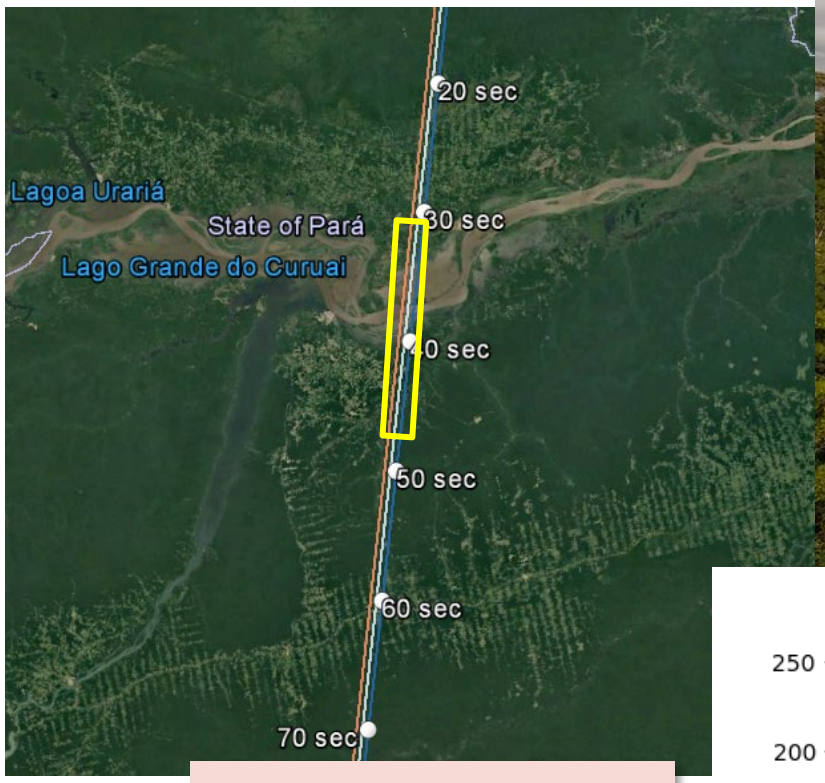
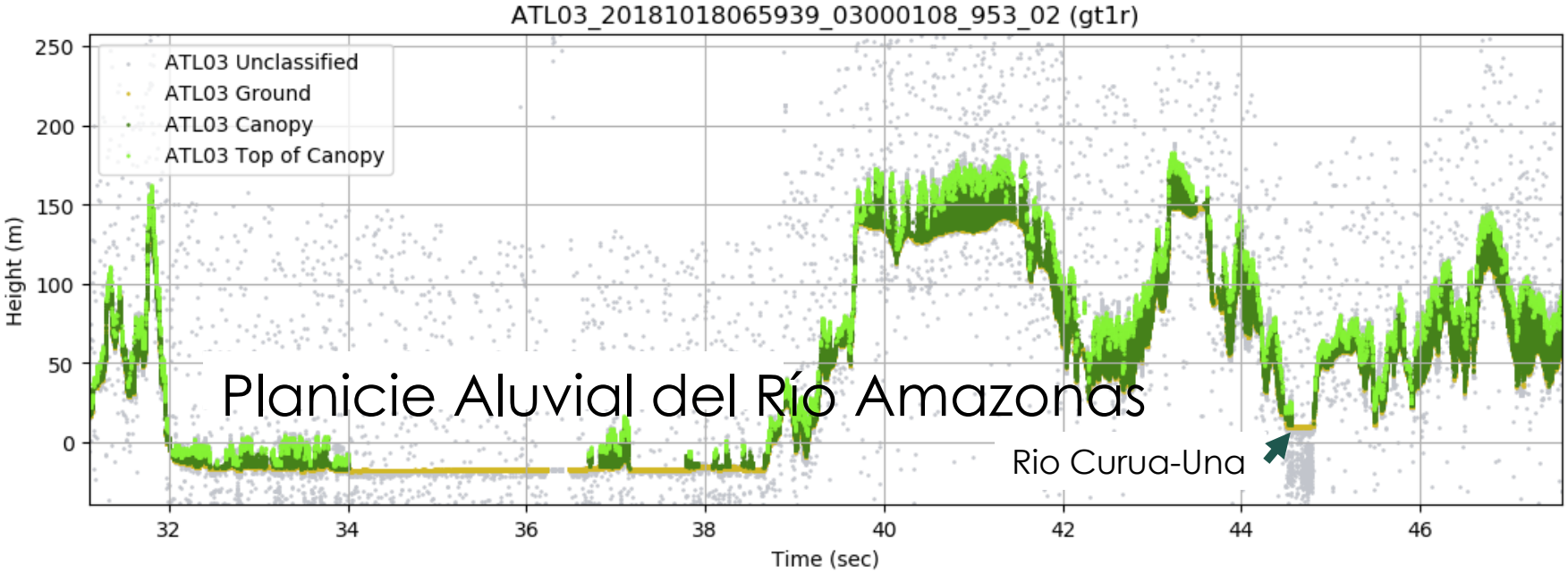


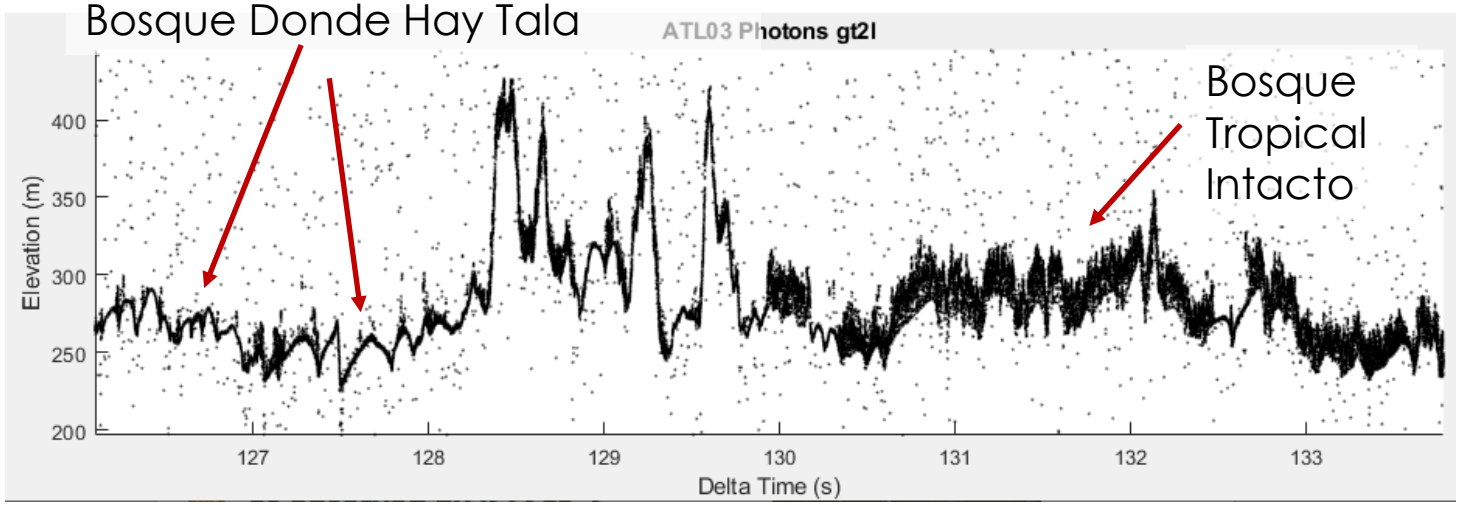
Foto del Bosque Nacional Tapajos

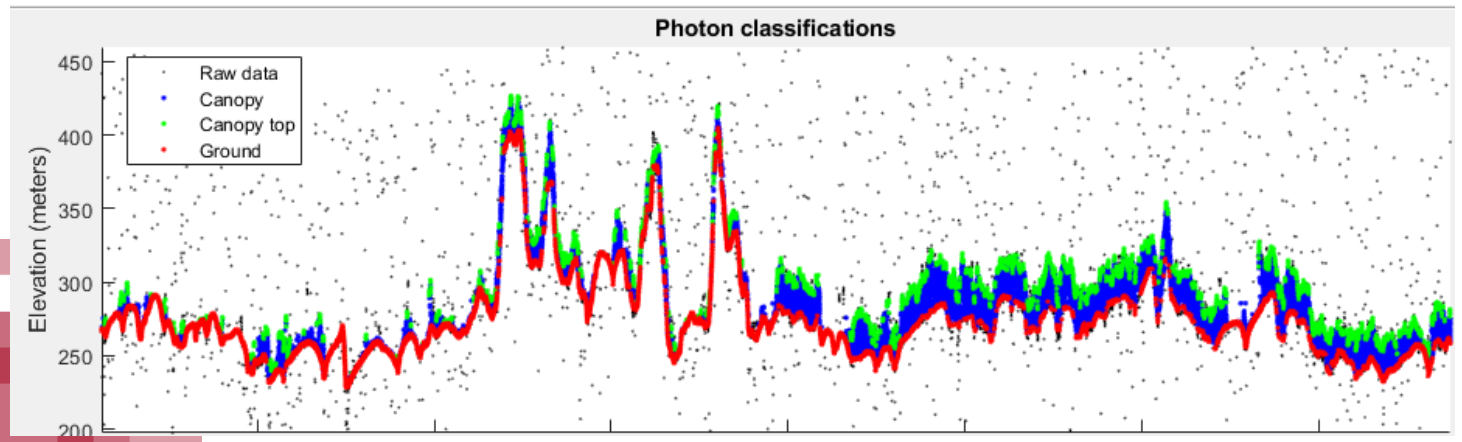
Los fotones de ICESat-2 son asignados un color utilizando el algoritmo de



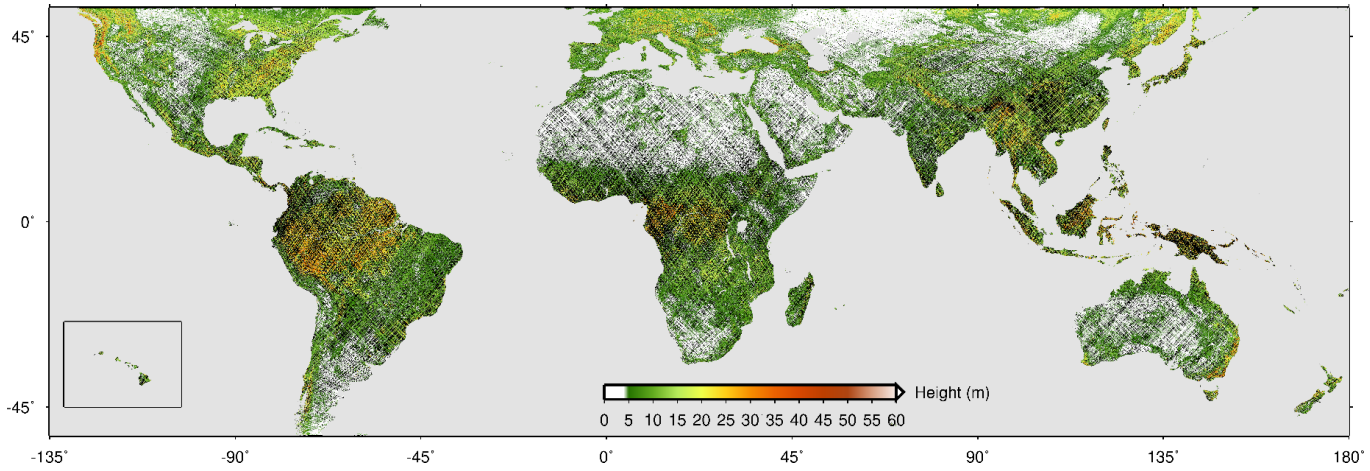
Deforestación Observada por ICESat-2

19/03/2019- adquisición nocturna de

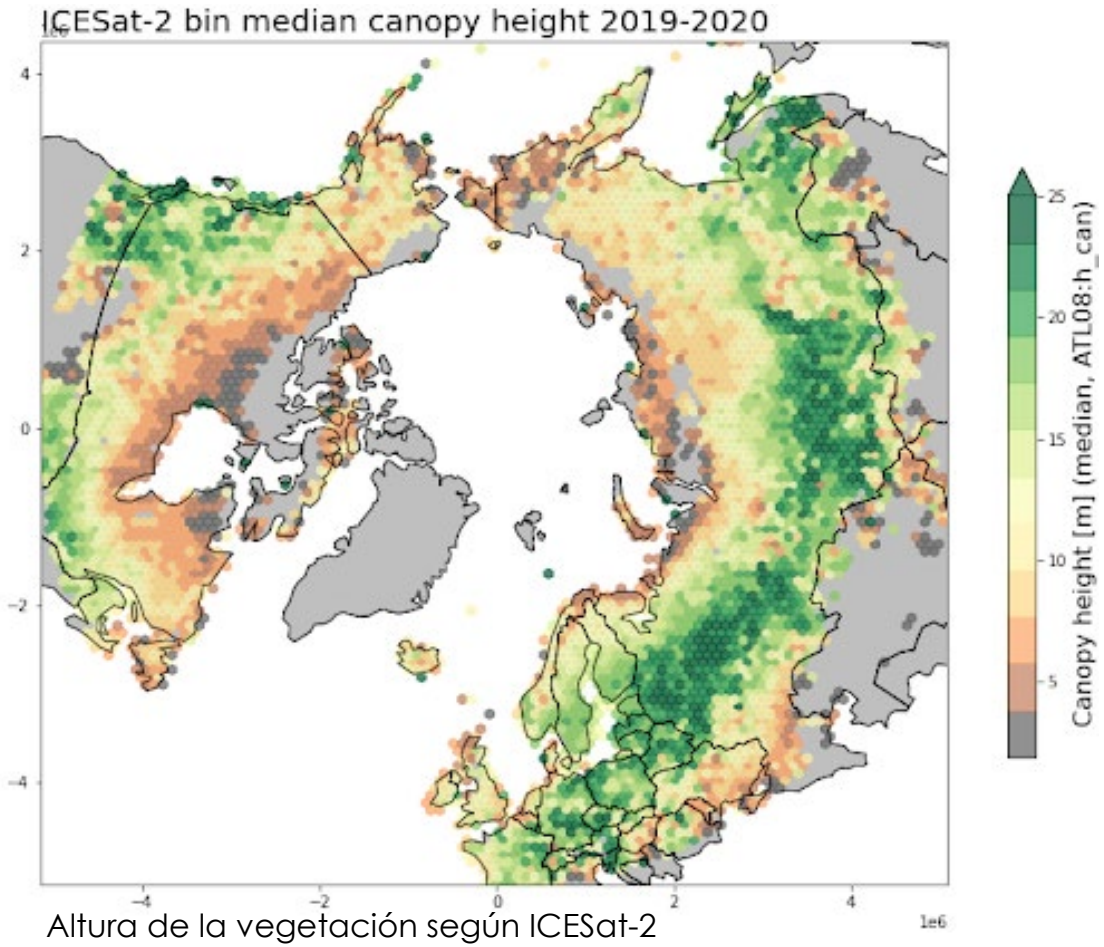




Altura de la Vegetación a Nivel Mundial por LiDAR Espacial



Altura de la vegetación según GEDI (2019)



Altura de la vegetación según ICESat-2

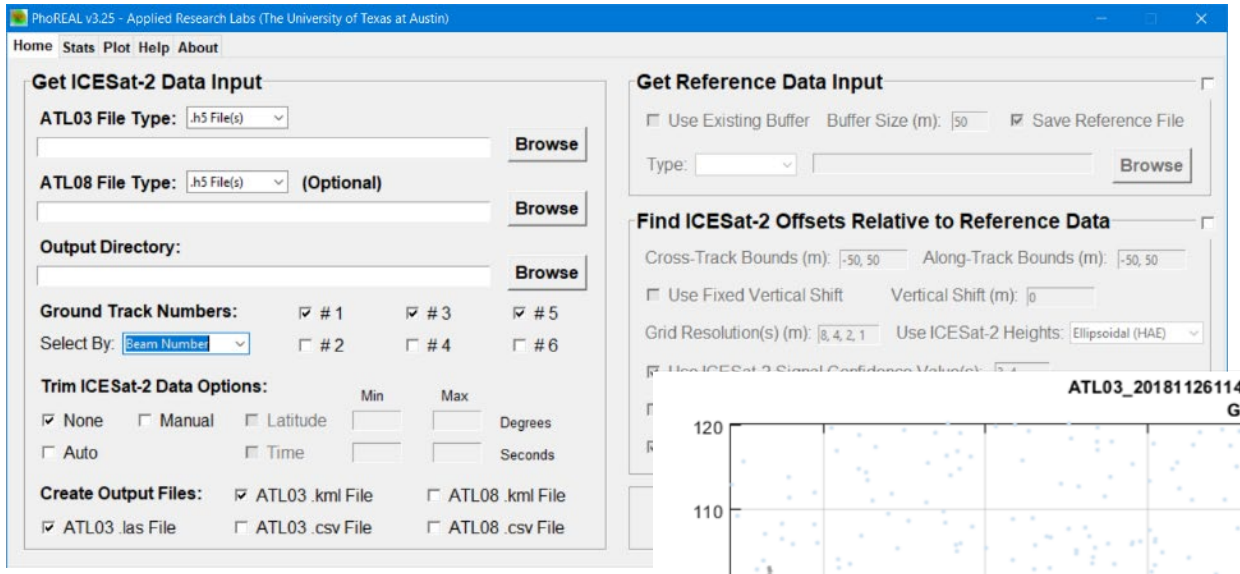
Herramientas de Python para ICESat-2 (PhoREAL)

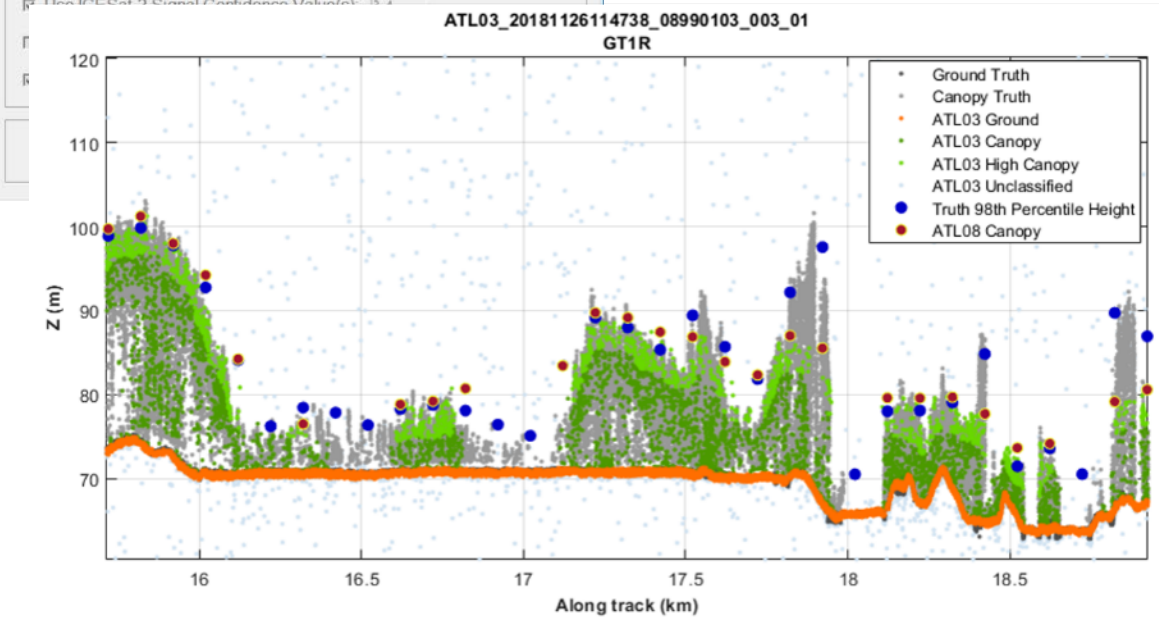
- Photon Research Exploitation and Analysis Library (PhoREAL)

Código Fue

https://github.com/icesat-2UT/PhoREA
https://utexas.box.com/v/DownloadP

Versión Windows 10 cor

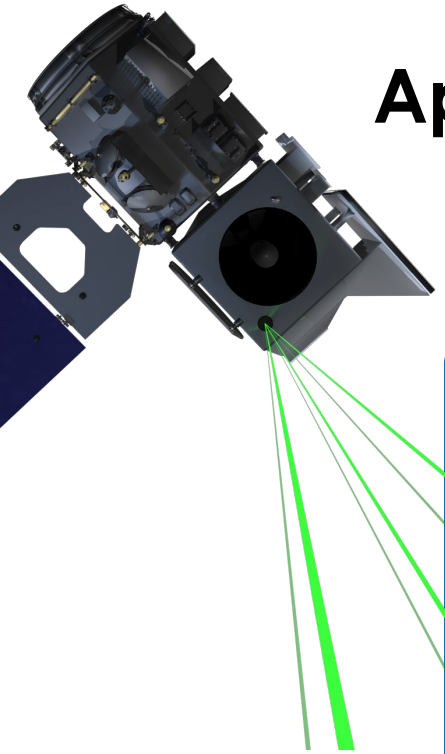




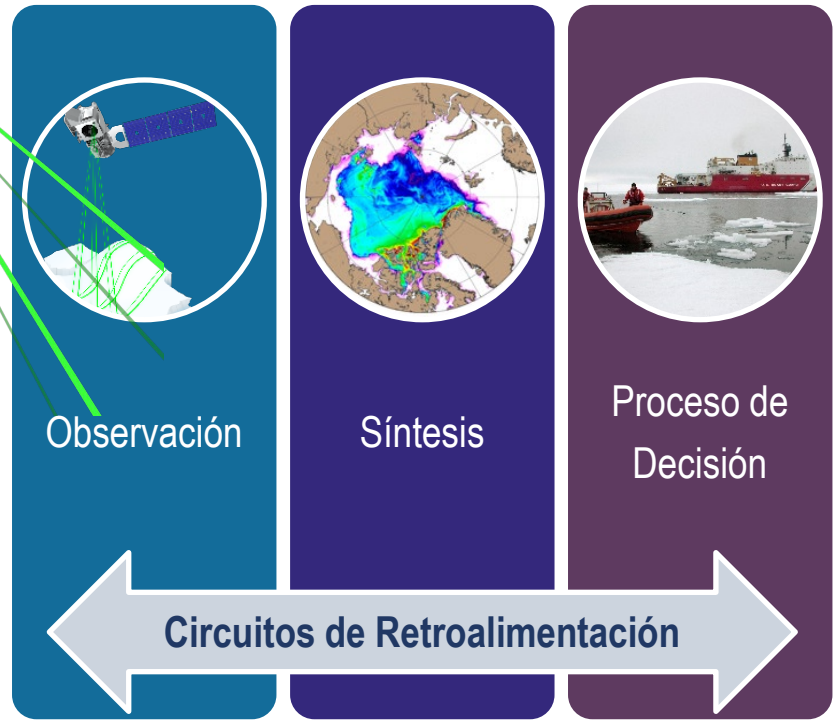
PhoREAL current capabilities

- 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

Aplicaciones de ICESat-2– ¡Involúcrese!



¿Usted cómo utiliza datos de ICESat-2?



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

Programa de Usuarios Aplicados de ICESat-2

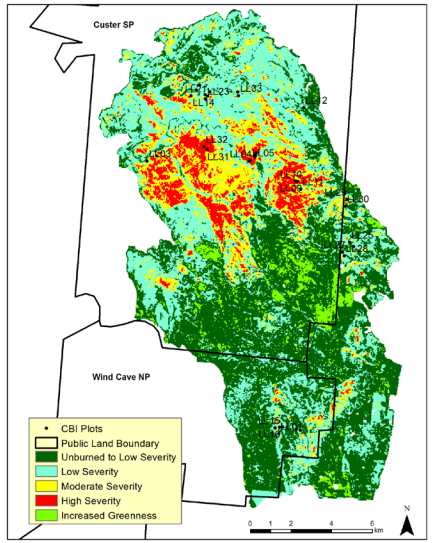
- Obtenga apoyo de un miembro del equipo Science Definition Team (SDT) o el Project Science Office (PSO)
- Participe en webinars trimestrales
- Esté al tanto sobre ICESat-2
- Obtenga acceso a datos de calibración y validación (cal/val)
- Referencie las lecciones aprendidas

Punto de Contacto: *sabrina.delgadoarias@nasa.gov*

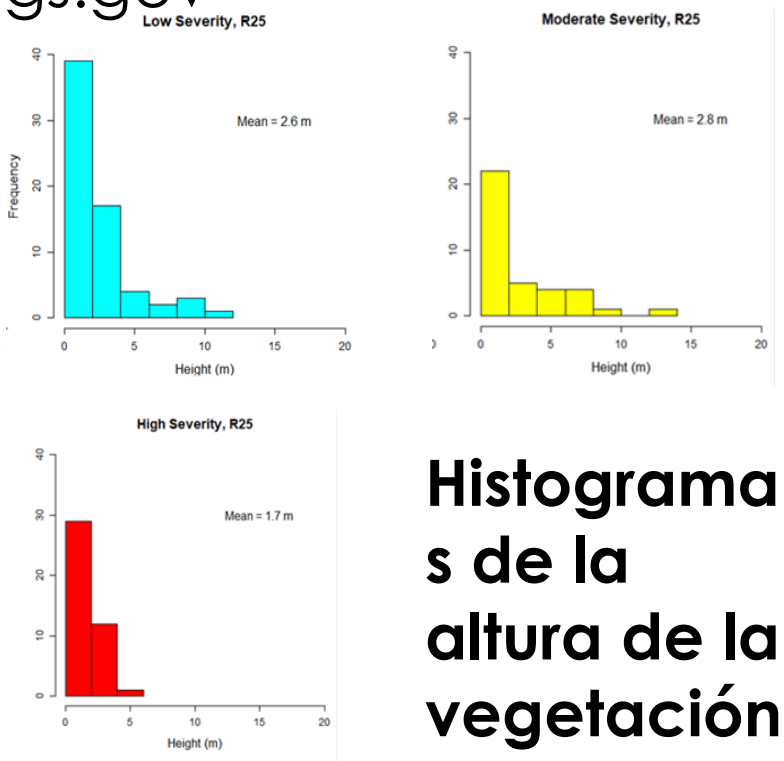
Colabore con científicos de la misión ICESat-2 mientras descubre datos de ICESat-2.

Usuario Destacado: Birgit Peterson, Earth Resources Observation Science

bpeterson@usgs.gov

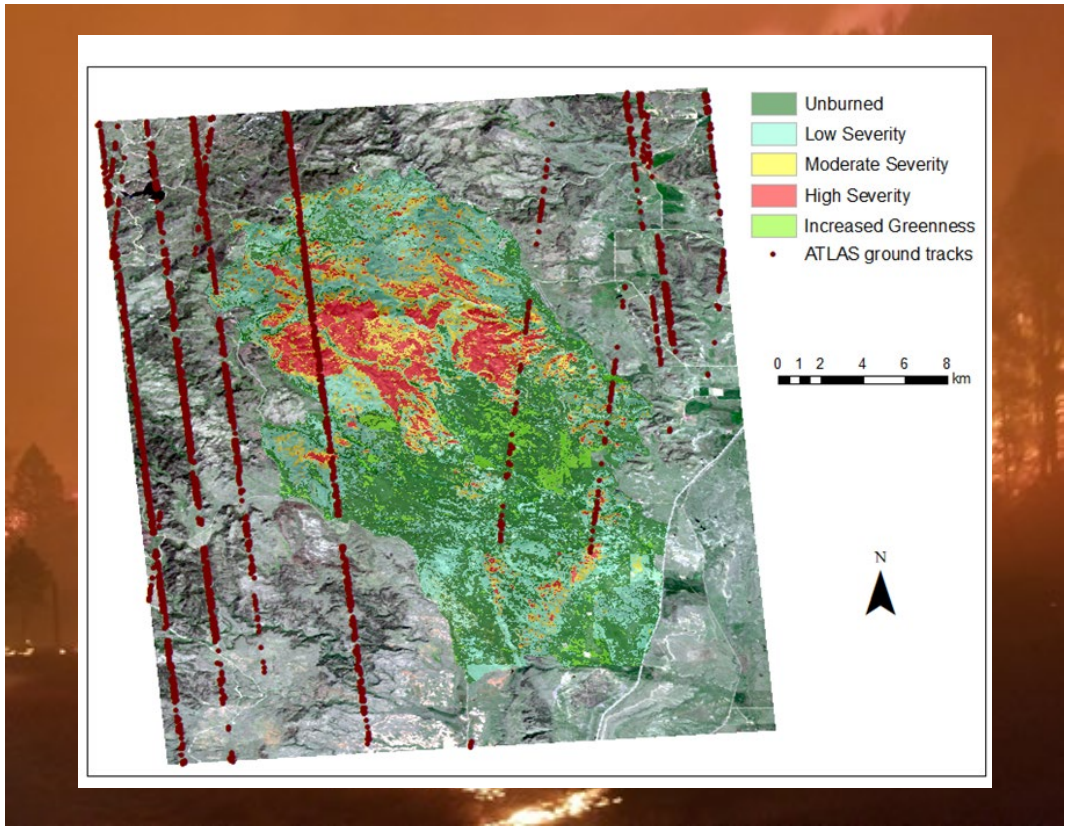


Incendio del Lago Legón, 2017 (Dakota del Sur)

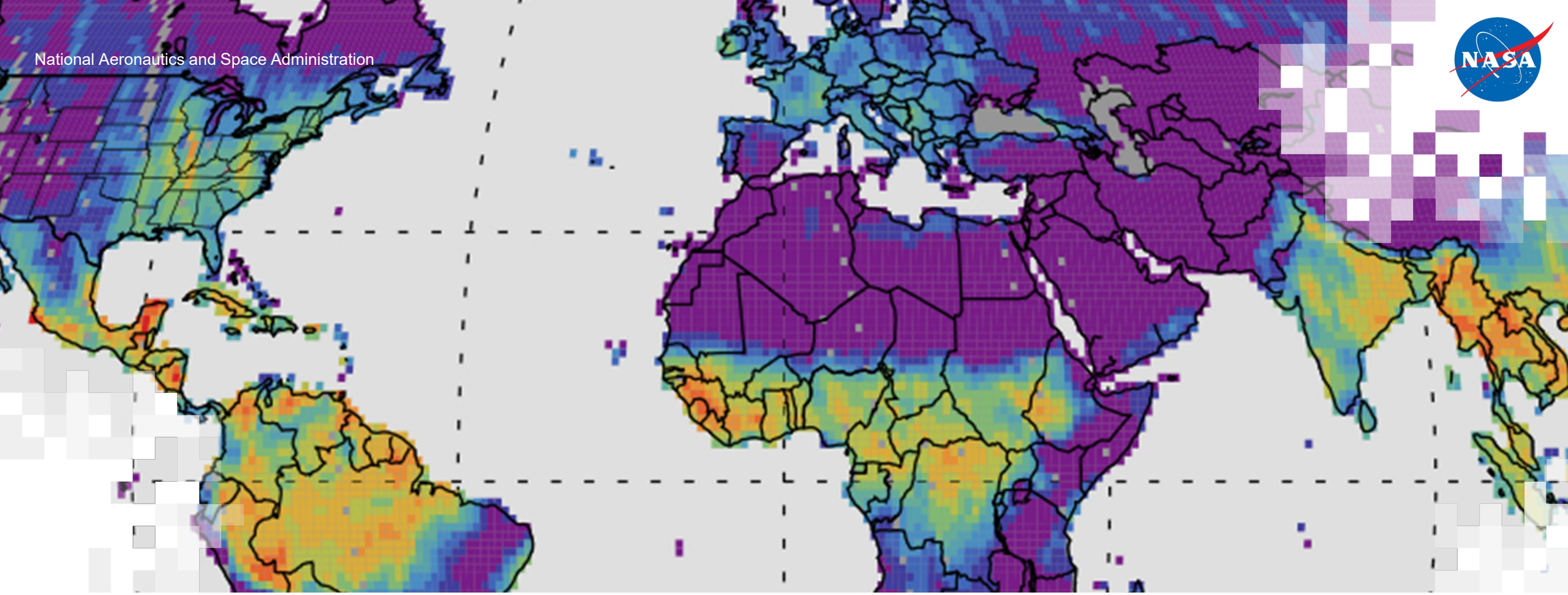


Histogramas de la altura de la vegetación derivada de ICESat-2 (altura relativa de

Mapeo de severidad de un incendio con ICESat-2



Transectos de ICESat-2 atravesando el Incendio del



ICESat-2: Servicios y Acceso a Datos

Nicholas Kotlinski,
Especialista en Soporte de Datos, Servicio al Usuario
NASA National Snow and Ice Data Center DAAC

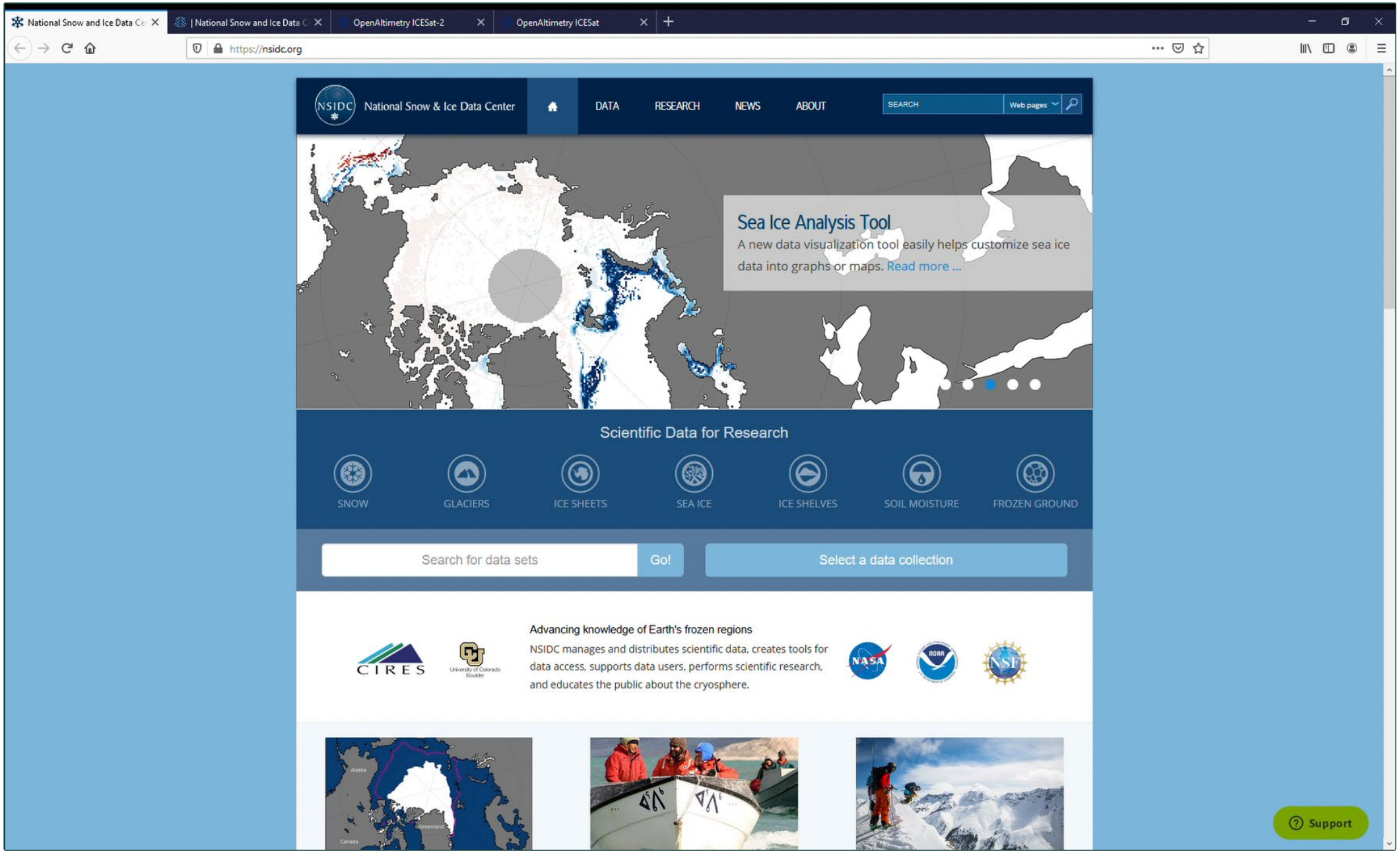
16 de Marzo 2021

Descubrimiento y Acceso a Datos

Primer Caso: Quiero visualizar los datos de elevación de ICESat-2 durante un tiempo y un área de interés muy específicos antes de descargarlos.

Segundo Caso: Quiero acceder y personalizar (subconjunto y / o reformatear) un pedido de datos masivo.

Tercer Caso: Quiero hacer todo esto con un programa, para poder acceder y analizar datos en el mismo flujo de trabajo basado en Python.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| National Snow and Ice Data C
OpenAltimetry ICESat-2
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Advancing knowledge of Earth's frozen regions
NSIDC manages and distributes scientific data, creates tools for data access, supports data users, performs scientific research, and educates the public about the cryosphere.
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Greenland
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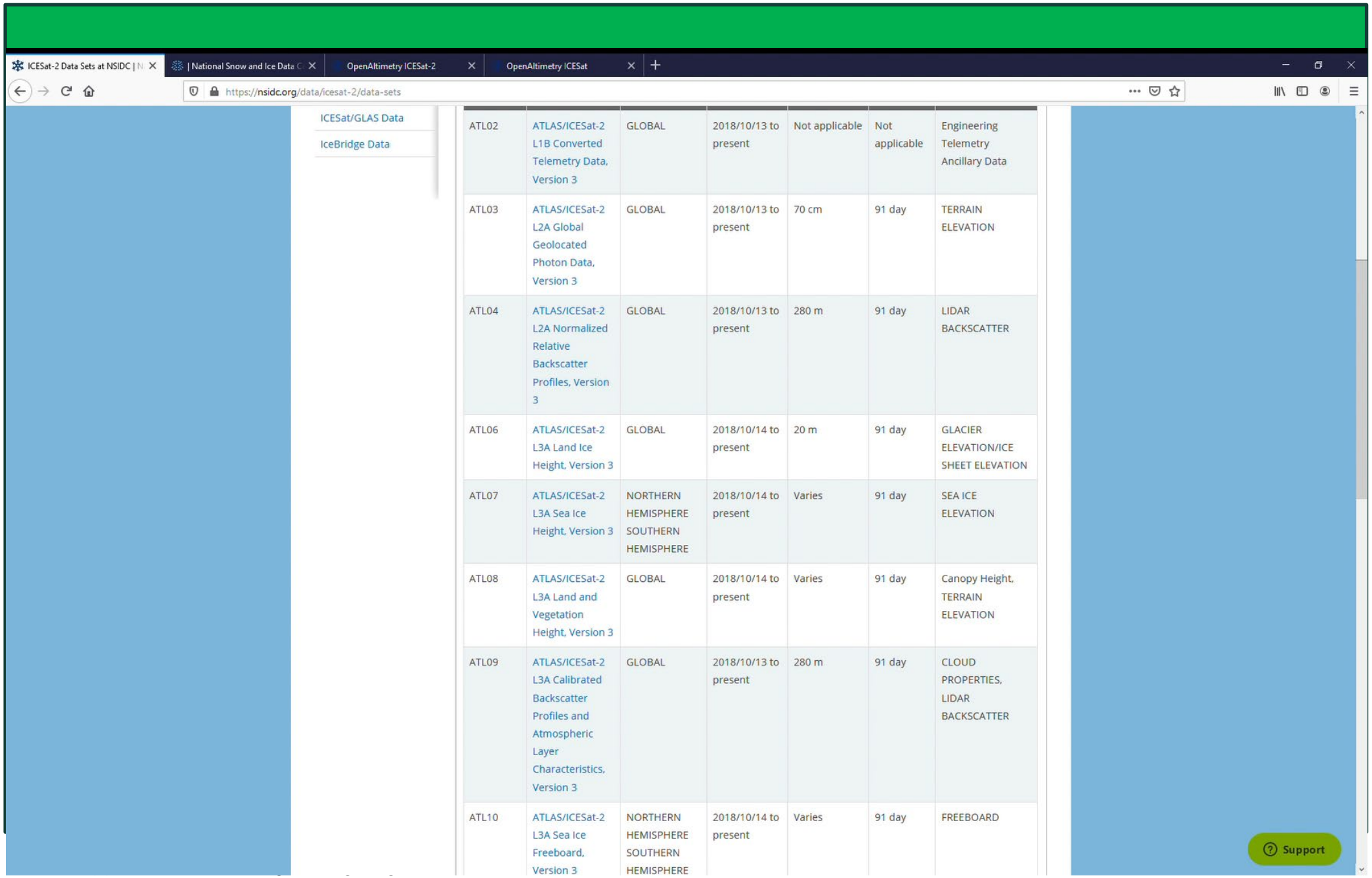
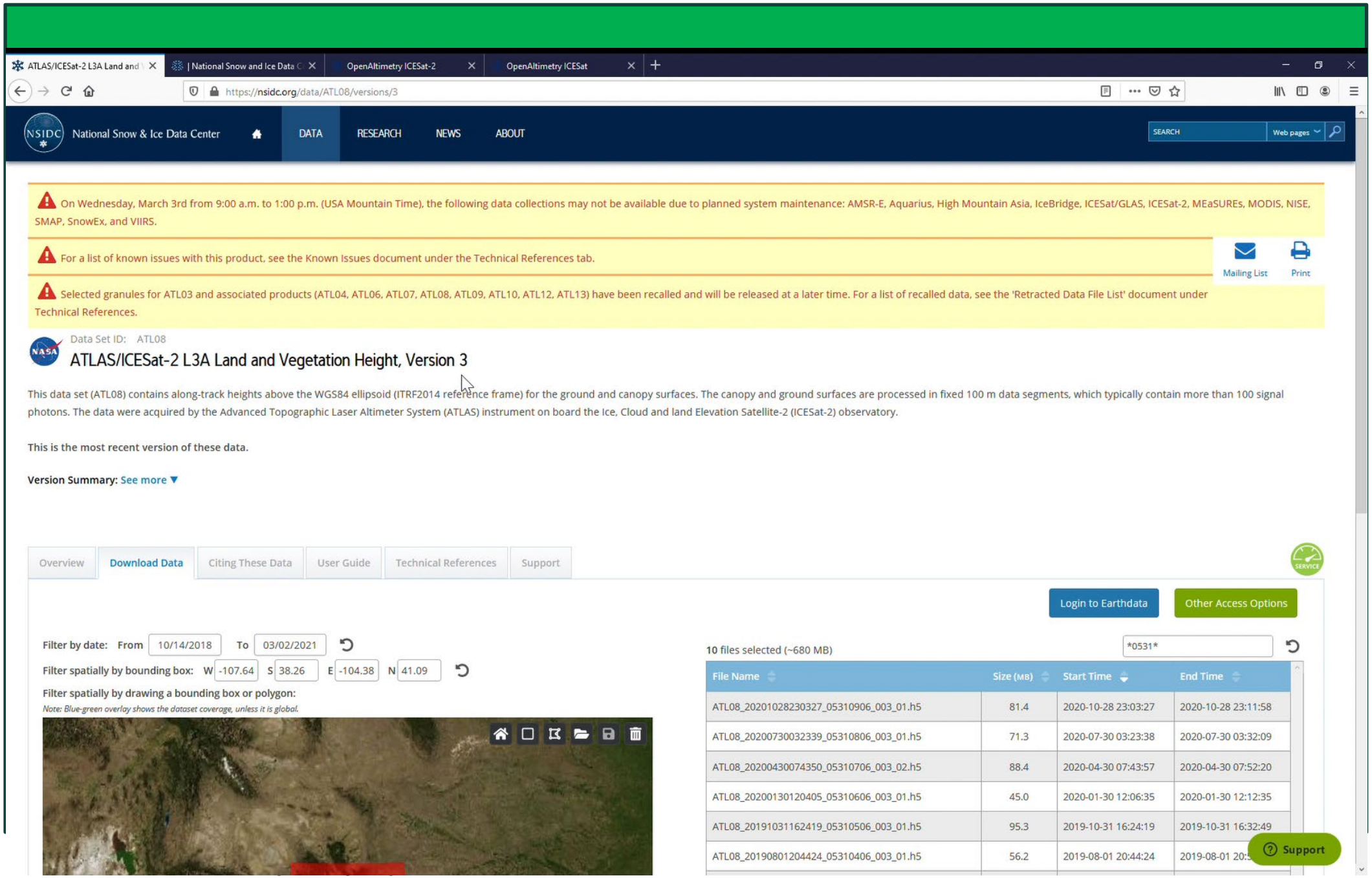


ATL02	ATLAS/ICESat-2 L1B Converted Telemetry Data, Version 3	GLOBAL	2018/10/13 to present	Not applicable	Not applicable	Engineering Telemetry Ancillary Data
ATL03	ATLAS/ICESat-2 L2A Global Geolocated Photon Data, Version 3	GLOBAL	2018/10/13 to present	70 cm	91 day	TERRAIN ELEVATION
ATL04	ATLAS/ICESat-2 L2A Normalized Relative Backscatter Profiles, Version 3	GLOBAL	2018/10/13 to present	280 m	91 day	LIDAR BACKSCATTER
ATL06	ATLAS/ICESat-2 L3A Land Ice Height, Version 3	GLOBAL	2018/10/14 to present	20 m	91 day	GLACIER ELEVATION/ICE SHEET ELEVATION
ATL07	ATLAS/ICESat-2 L3A Sea Ice Height, Version 3	NORTHERN HEMISPHERE SOUTHERN HEMISPHERE	2018/10/14 to present	Varies	91 day	SEA ICE ELEVATION
ATL08	ATLAS/ICESat-2 L3A Land and Vegetation Height, Version 3	GLOBAL	2018/10/14 to present	Varies	91 day	Canopy Height, TERRAIN ELEVATION
ATL09	ATLAS/ICESat-2 L3A Calibrated Backscatter Profiles and Atmospheric Layer Characteristics, Version 3	GLOBAL	2018/10/13 to present	280 m	91 day	CLOUD PROPERTIES, LIDAR BACKSCATTER
ATL10	ATLAS/ICESat-2 L3A Sea Ice Freeboard, Version 3	NORTHERN HEMISPHERE SOUTHERN HEMISPHERE	2018/10/14 to present	Varies	91 day	FREEBOARD


ATLAS/ICESat-2 L3A Land and
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OpenAltimetry ICESat-2
OpenAltimetry ICESat
https://nsidc.org/data/ATL08/versions/3
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On Wednesday, March 3rd from 9:00 a.m. to 1:00 p.m. (USA Mountain Time), the following data collections may not be available due to planned system maintenance: AMSR-E, Aquarius, High Mountain Asia, IceBridge, ICESat/GLAS, ICESat-2, MEaSUREs, MODIS, NISE, SMAP, SnowEx, and VIIRS.
For a list of known issues with this product, see the Known Issues document under the Technical References tab.
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Filter spatially by drawing a bounding box or polygon:
Note: Blue-green overlay shows the dataset coverage, unless it is global.
10 files selected (~680 MB)
0531
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Size (MB)
Start Time
End Time
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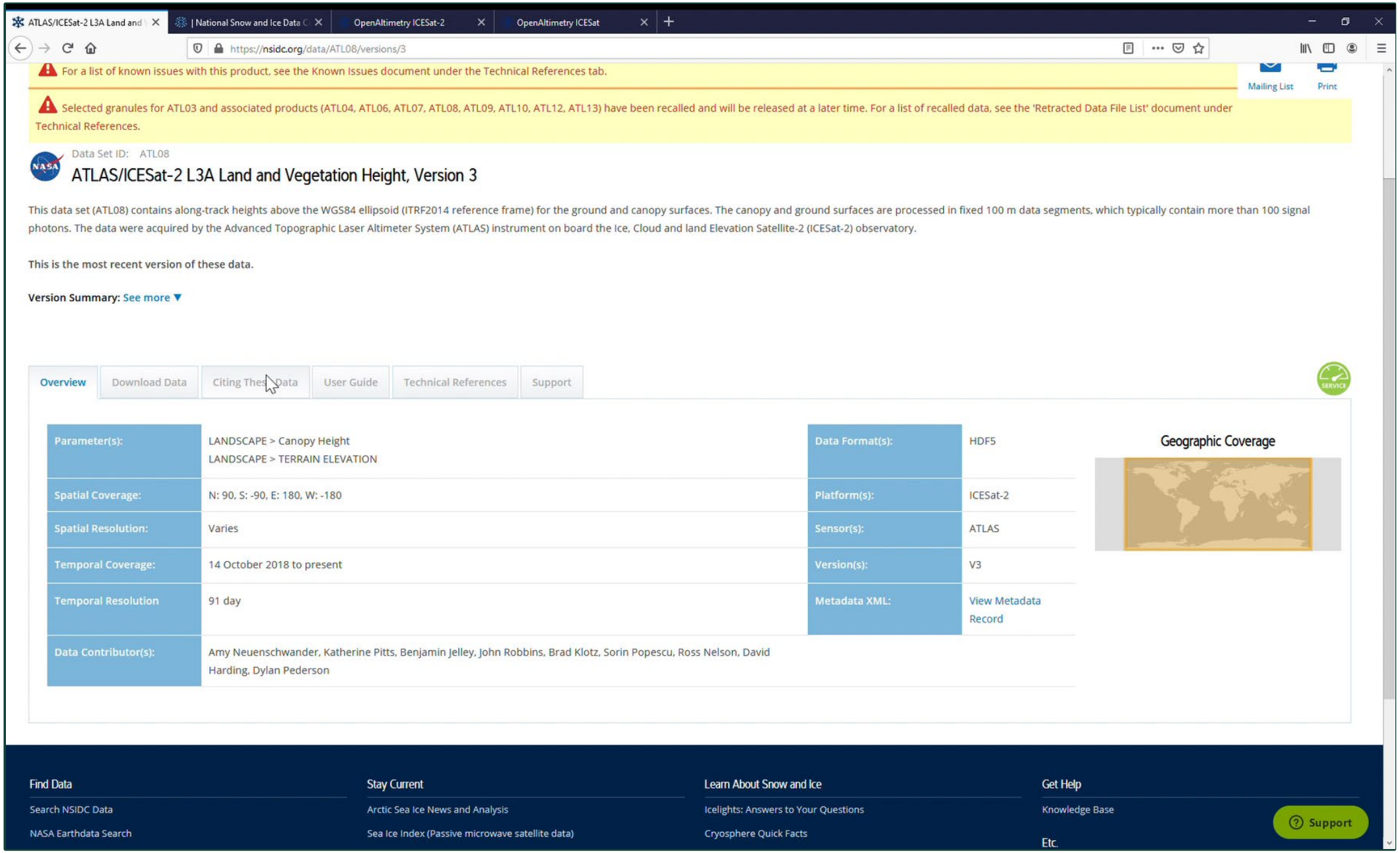
Support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OpenAltimetry ICESat
https://nsidc.org/data/ATL08/versions/3
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Parameter(s): LANDSCAPE > Canopy Height; LANDSCAPE > TERRAIN ELEVATION
Data Format(s): HDF5
Spatial Coverage: N: 90, S: -90, E: 180, W: -180
Platform(s): ICESat-2
Spatial Resolution: Varies
Sensor(s): ATLAS
Temporal Coverage: 14 October 2018 to present
Version(s): V3
Temporal Resolution: 91 day
Metadata XML: View Metadata Record
Data Contributor(s): Amy Neuenschwander, Katherine Pitts, Benjamin Jelley, John Robbins, Brad Klotz, Sorin Popescu, Ross Nelson, David Harding, Dylan Pederson
Geographic Coverage
Find Data
Search NSIDC Data
NASA Earthdata Search
Stay Current
Arctic Sea Ice News and Analysis
Sea Ice Index (Passive microwave satellite data)
Learn About Snow and Ice
Icelights: Answers to Your Questions
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Etc.
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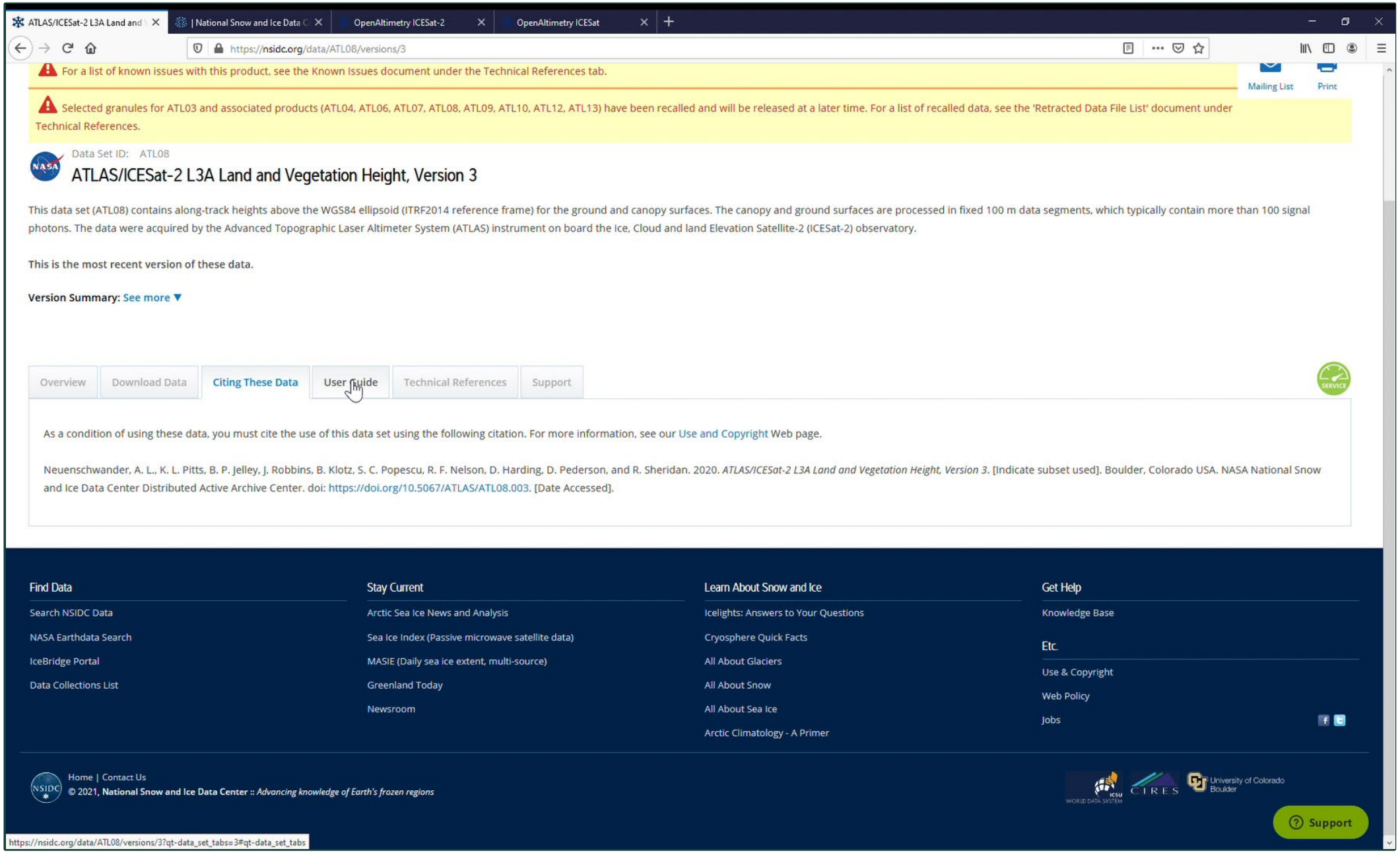
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OpenAltimetry ICESat
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Neuenschwander, A. L., K. L. Pitts, B. P. Jelley, J. Robbins, B. Klotz, S. C. Popescu, R. F. Nelson, D. Harding, D. Pederson, and R. Sheridan. 2020. ATLAS/ICESat-2 L3A Land and Vegetation Height, Version 3. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.5067/ATLAS/ATL08.003. [Date Accessed].
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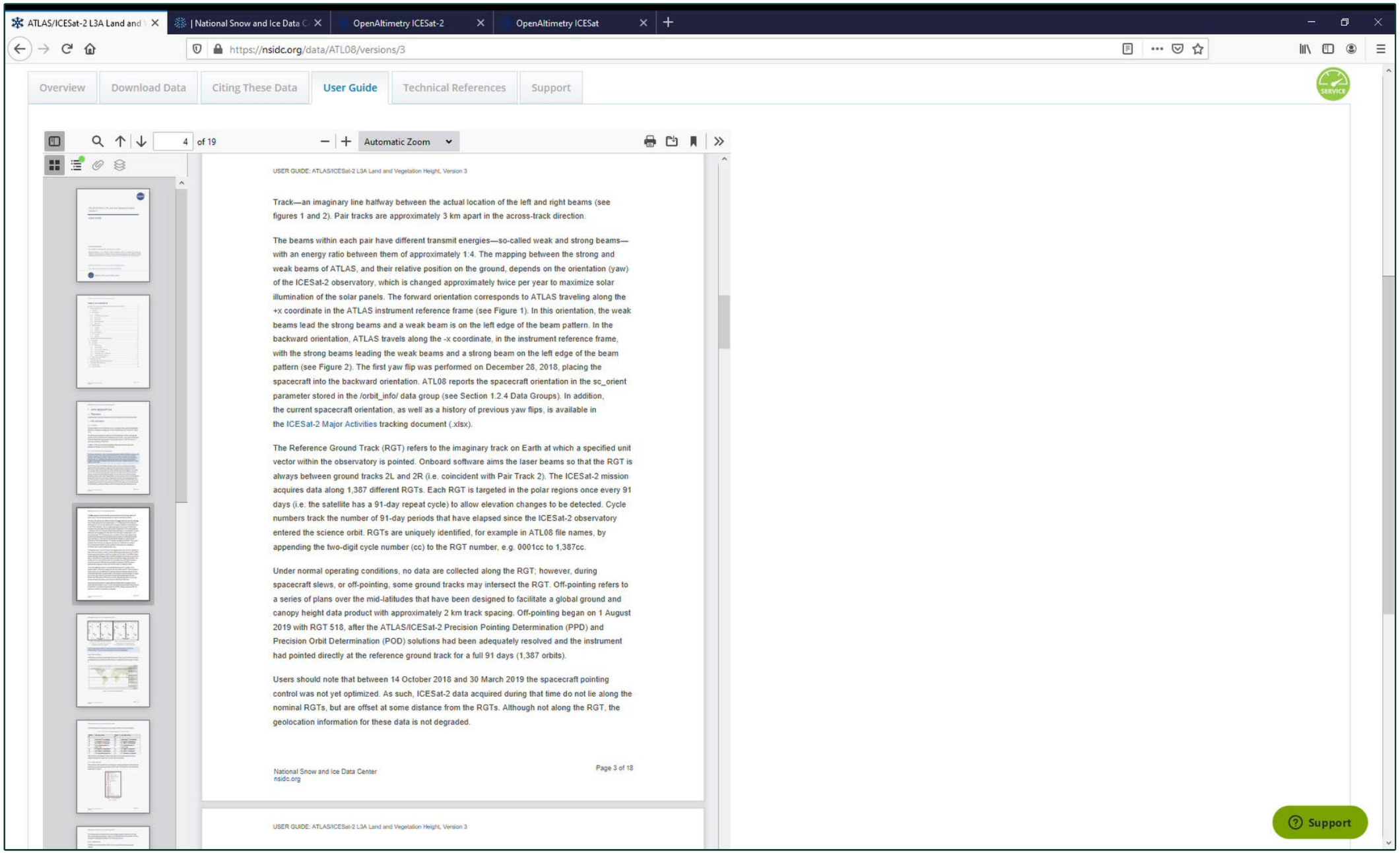
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OpenAltimetry ICESat
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Track—an imaginary line halfway between the actual location of the left and right beams (see figures 1 and 2). Pair tracks are approximately 3 km apart in the across-track direction.
The beams within each pair have different transmit energies—so-called weak and strong beams—with an energy ratio between them of approximately 1:4. The mapping between the strong and weak beams of ATLAS, and their relative position on the ground, depends on the orientation (yaw) of the ICESat-2 observatory, which is changed approximately twice per year to maximize solar illumination of the solar panels. The forward orientation corresponds to ATLAS traveling along the +x coordinate in the ATLAS instrument reference frame (see Figure 1). In this orientation, the weak beams lead the strong beams and a weak beam is on the left edge of the beam pattern. In the backward orientation, ATLAS travels along the -x coordinate, in the instrument reference frame, with the strong beams leading the weak beams and a strong beam on the left edge of the beam pattern (see Figure 2). The first yaw flip was performed on December 28, 2018, placing the spacecraft into the backward orientation. ATL08 reports the spacecraft orientation in the sc_orient parameter stored in the /orbit_info/ data group (see Section 1.2.4 Data Groups). In addition, the current spacecraft orientation, as well as a history of previous yaw flips, is available in the ICESat-2 Major Activities tracking document (.xlsx).
The Reference Ground Track (RGT) refers to the imaginary track on Earth at which a specified unit vector within the observatory is pointed. Onboard software aims the laser beams so that the RGT is always between ground tracks 2L and 2R (i.e. coincident with Pair Track 2). The ICESat-2 mission acquires data along 1,387 different RGTs. Each RGT is targeted in the polar regions once every 91 days (i.e. the satellite has a 91-day repeat cycle) to allow elevation changes to be detected. Cycle numbers track the number of 91-day periods that have elapsed since the ICESat-2 observatory entered the science orbit. RGTs are uniquely identified, for example in ATL08 file names, by appending the two-digit cycle number (cc) to the RGT number, e.g. 0001cc to 1,387cc.
Under normal operating conditions, no data are collected along the RGT; however, during spacecraft slews, or off-pointing, some ground tracks may intersect the RGT. Off-pointing refers to a series of plans over the mid-latitudes that have been designed to facilitate a global ground and canopy height data product with approximately 2 km track spacing. Off-pointing began on 1 August 2019 with RGT 518, after the ATLAS/ICESat-2 Precision Pointing Determination (PPD) and Precision Orbit Determination (POD) solutions had been adequately resolved and the instrument had pointed directly at the reference ground track for a full 91 days (1,387 orbits).
Users should note that between 14 October 2018 and 30 March 2019 the spacecraft pointing control was not yet optimized. As such, ICESat-2 data acquired during that time do not lie along the nominal RGTs, but are offset at some distance from the RGTs. Although not along the RGT, the geolocation information for these data is not degraded.
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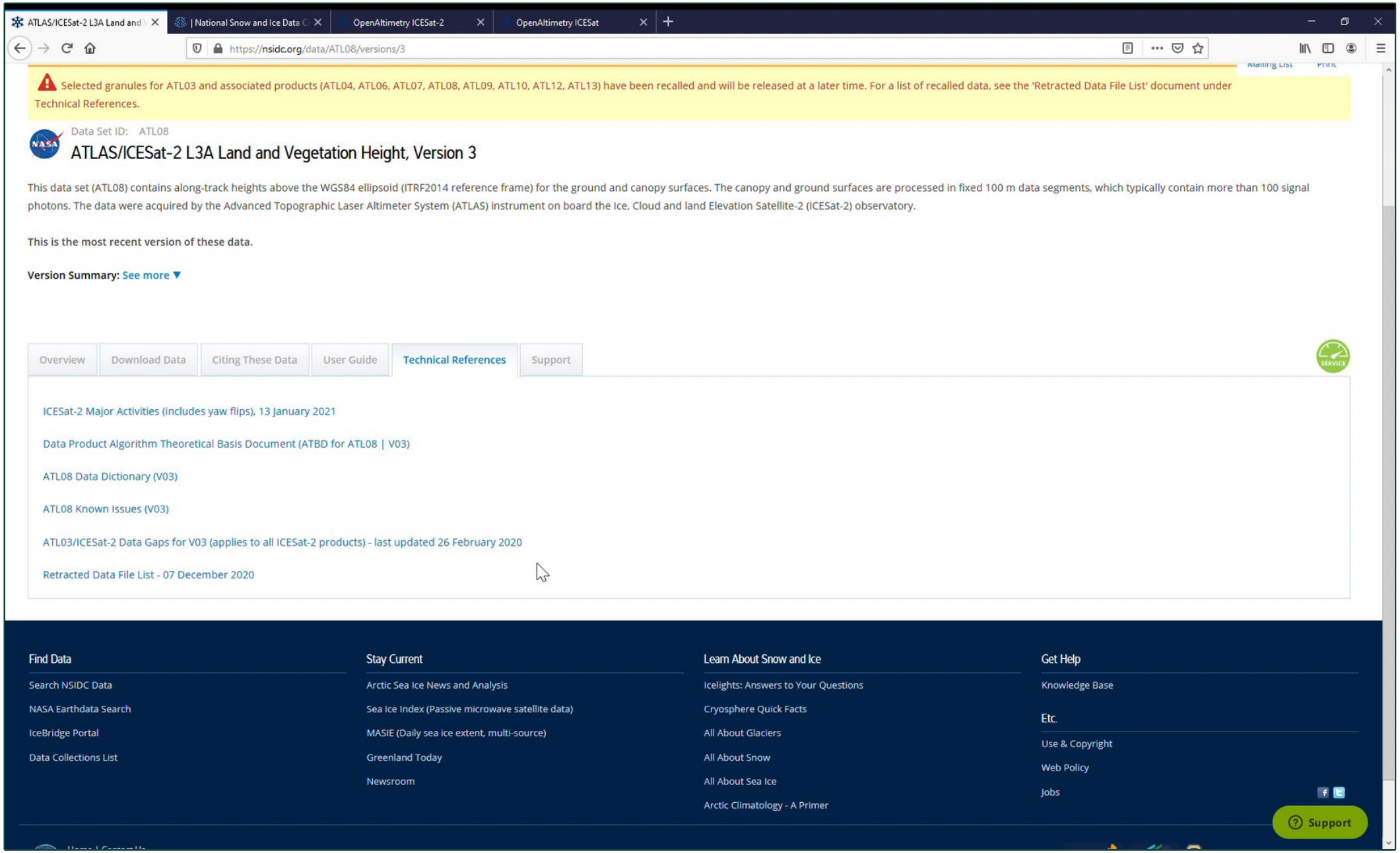
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Data Product Algorithm Theoretical Basis Document (ATBD for ATL08 | V03)
ATL08 Data Dictionary (V03)
ATL08 Known Issues (V03)
ATL03/ICESat-2 Data Gaps for V03 (applies to all ICESat-2 products) - last updated 26 February 2020
Retracted Data File List - 07 December 2020
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MASIE (Daily sea ice extent, multi-source)
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Icelights: Answers to Your Questions
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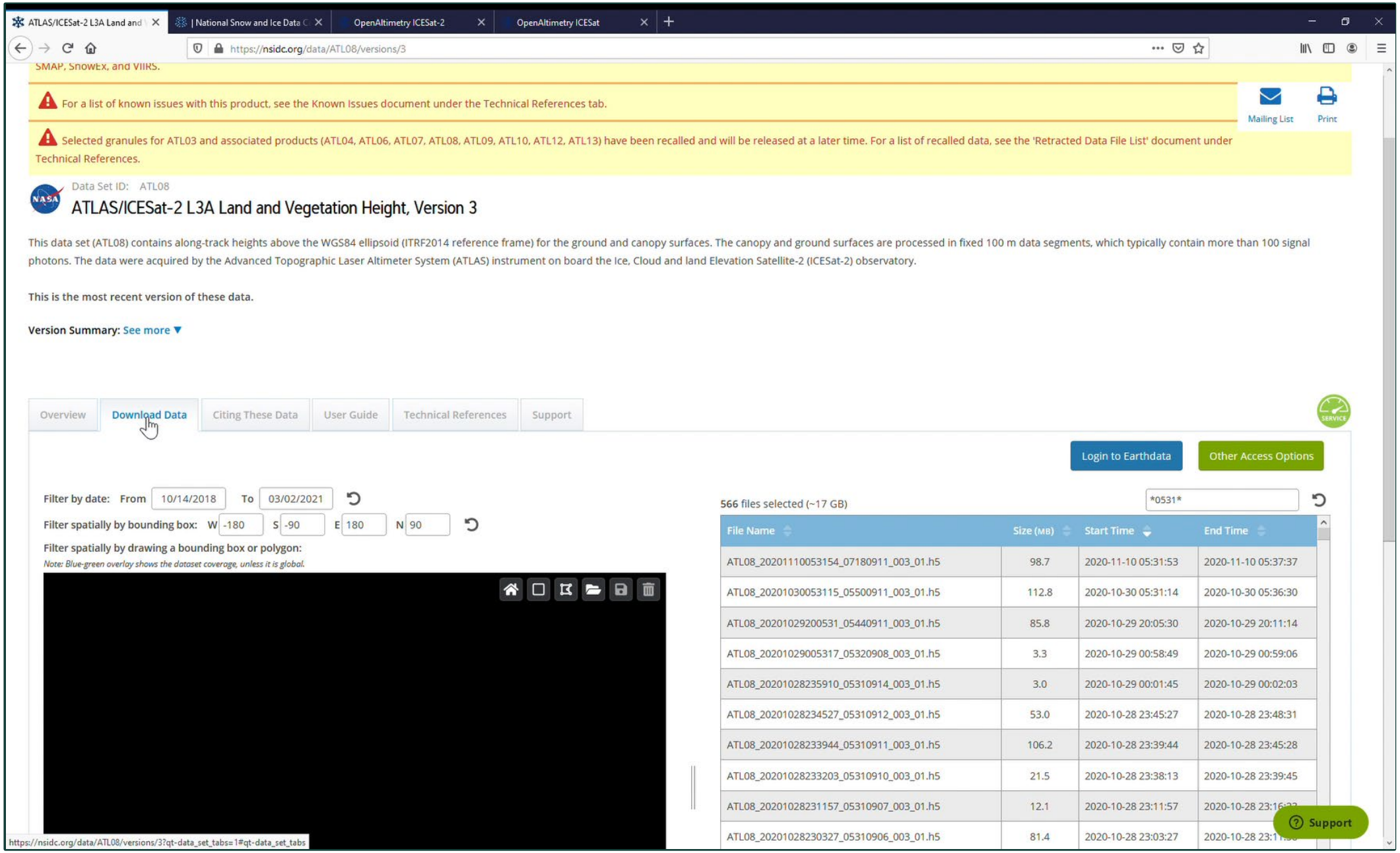
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OpenAltimetry ICESat-2
OpenAltimetry ICESat
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Size (MB)
Start Time
End Time
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ATL08_20201030053115_05500911_003_01.h5 112.8 2020-10-30 05:31:14 2020-10-30 05:36:30
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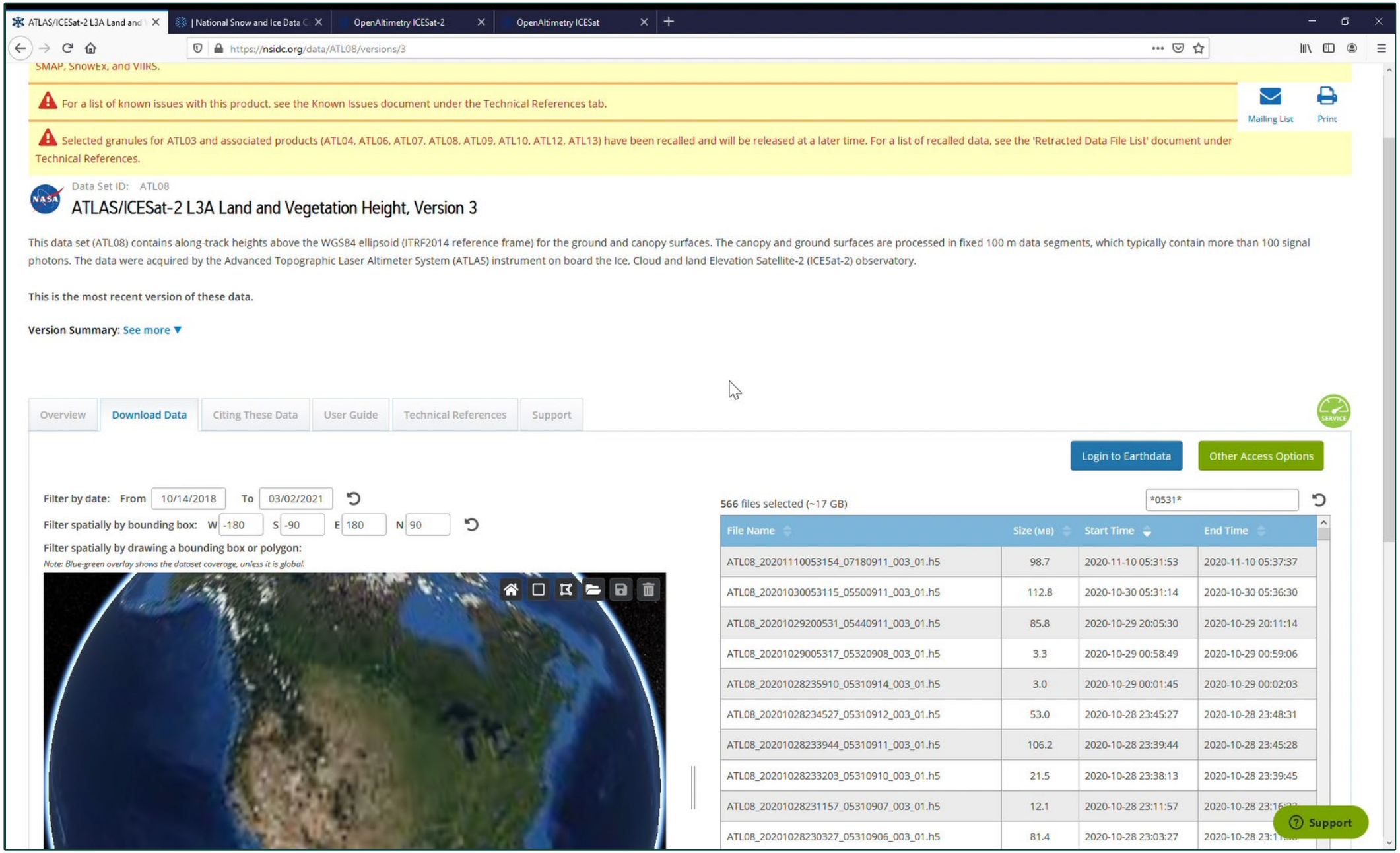
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Start Time
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ATL08_20201110053154_07180911_003_01.h5 98.7 2020-11-10 05:31:53 2020-11-10 05:37:37
ATL08_20201030053115_05500911_003_01.h5 112.8 2020-10-30 05:31:14 2020-10-30 05:36:30
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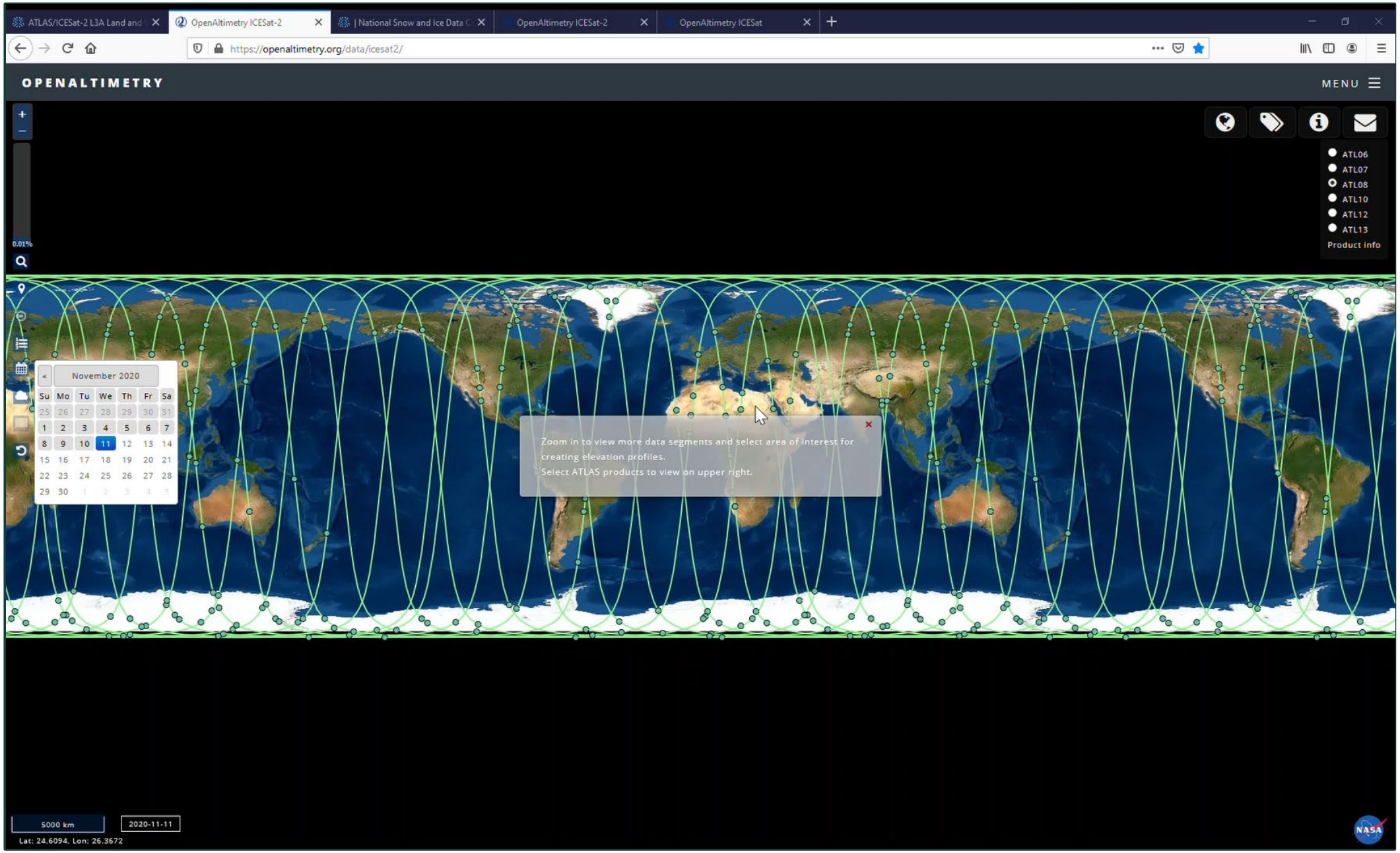
ATL08_20201028230327_05310906_003_01.h5 81.4 2020-10-28 23:03:27
Support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ATL12
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Product info
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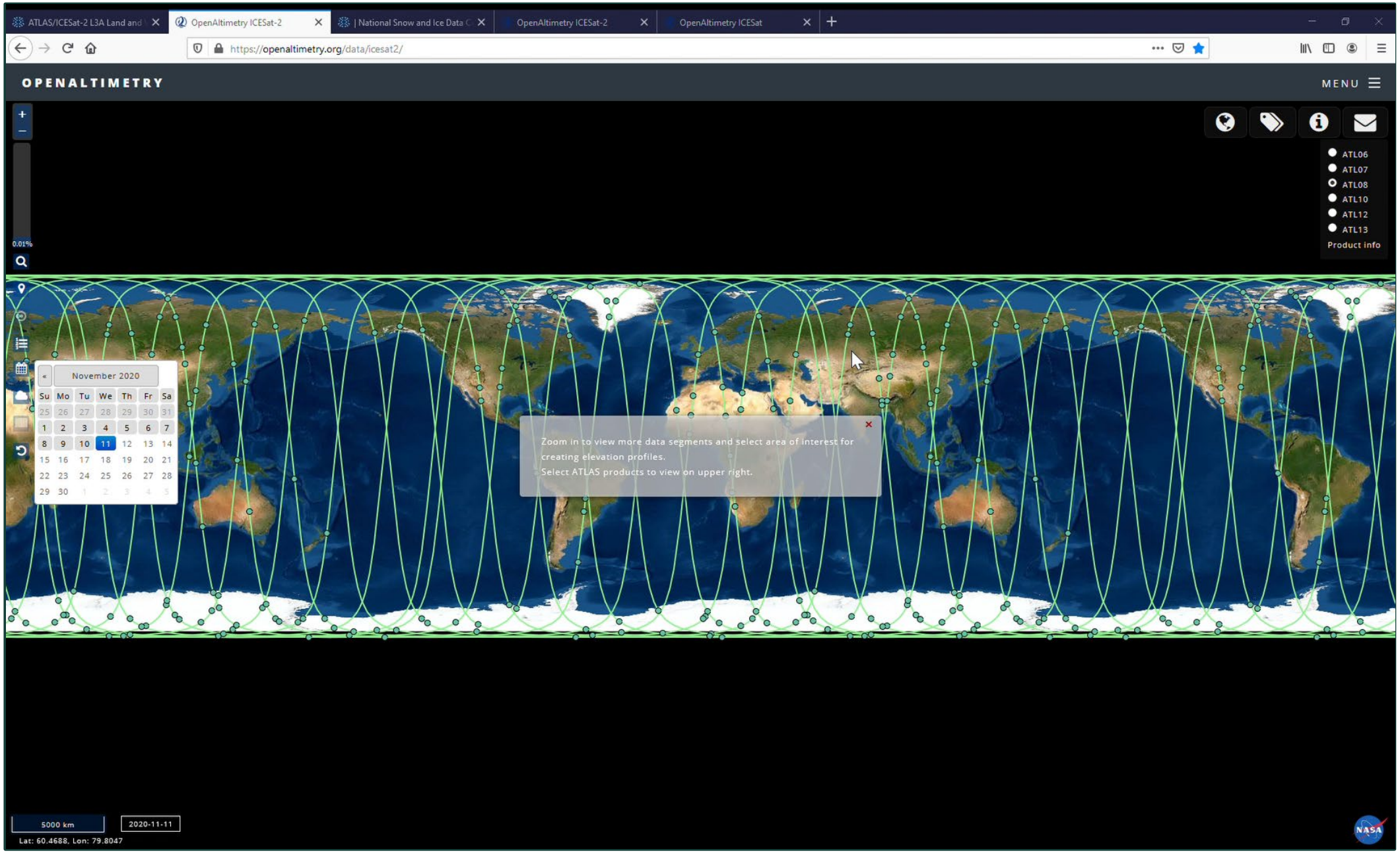
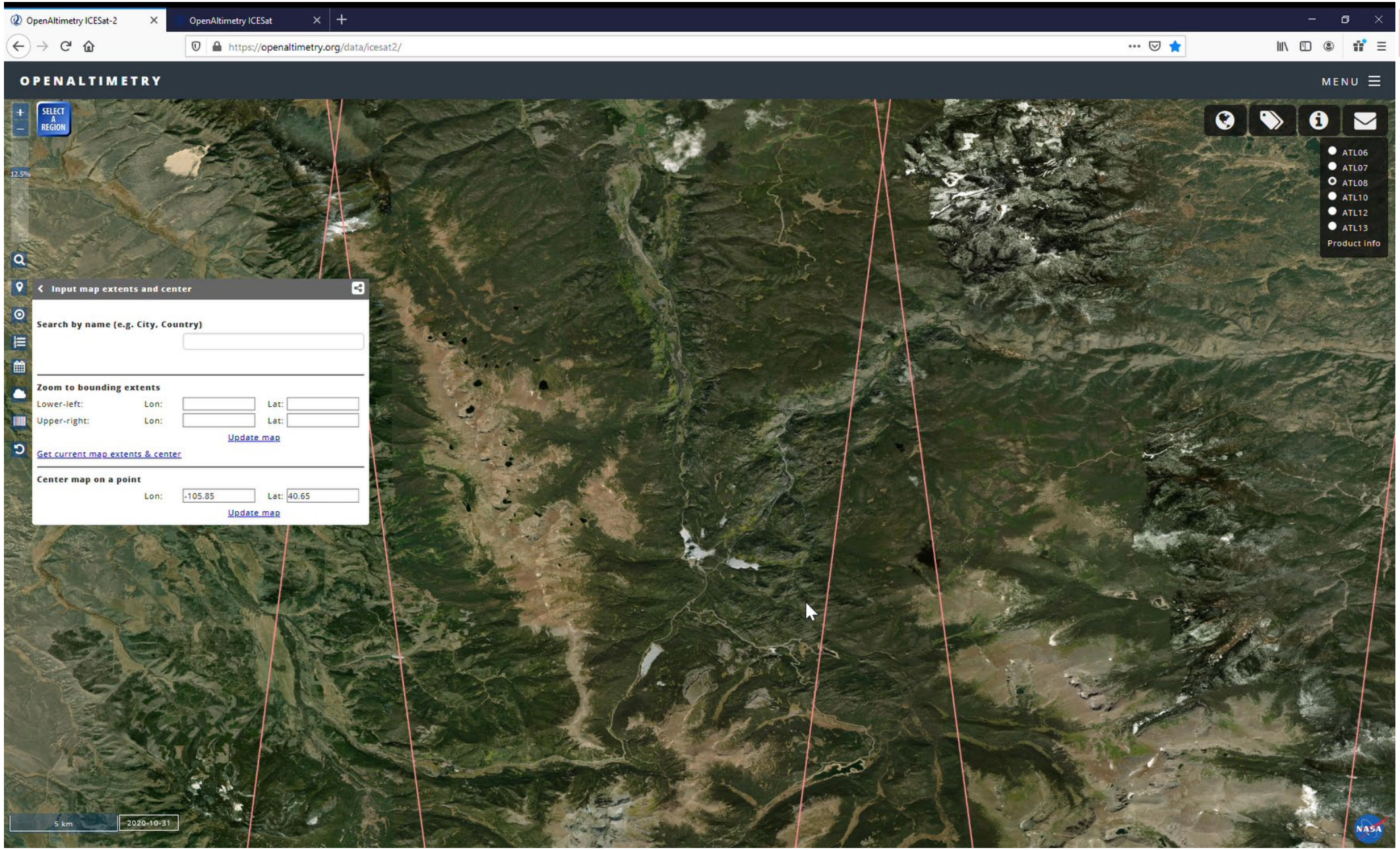
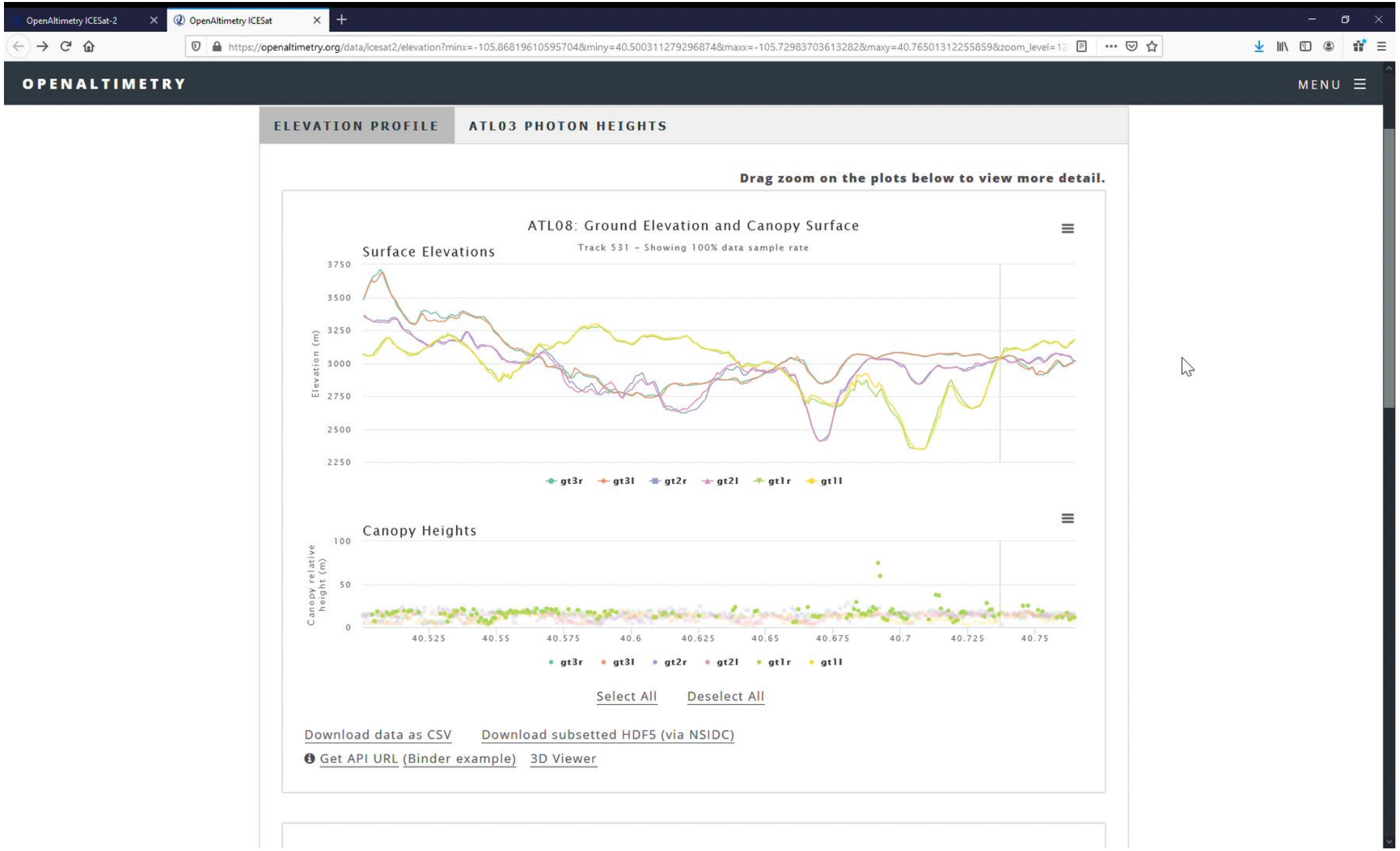
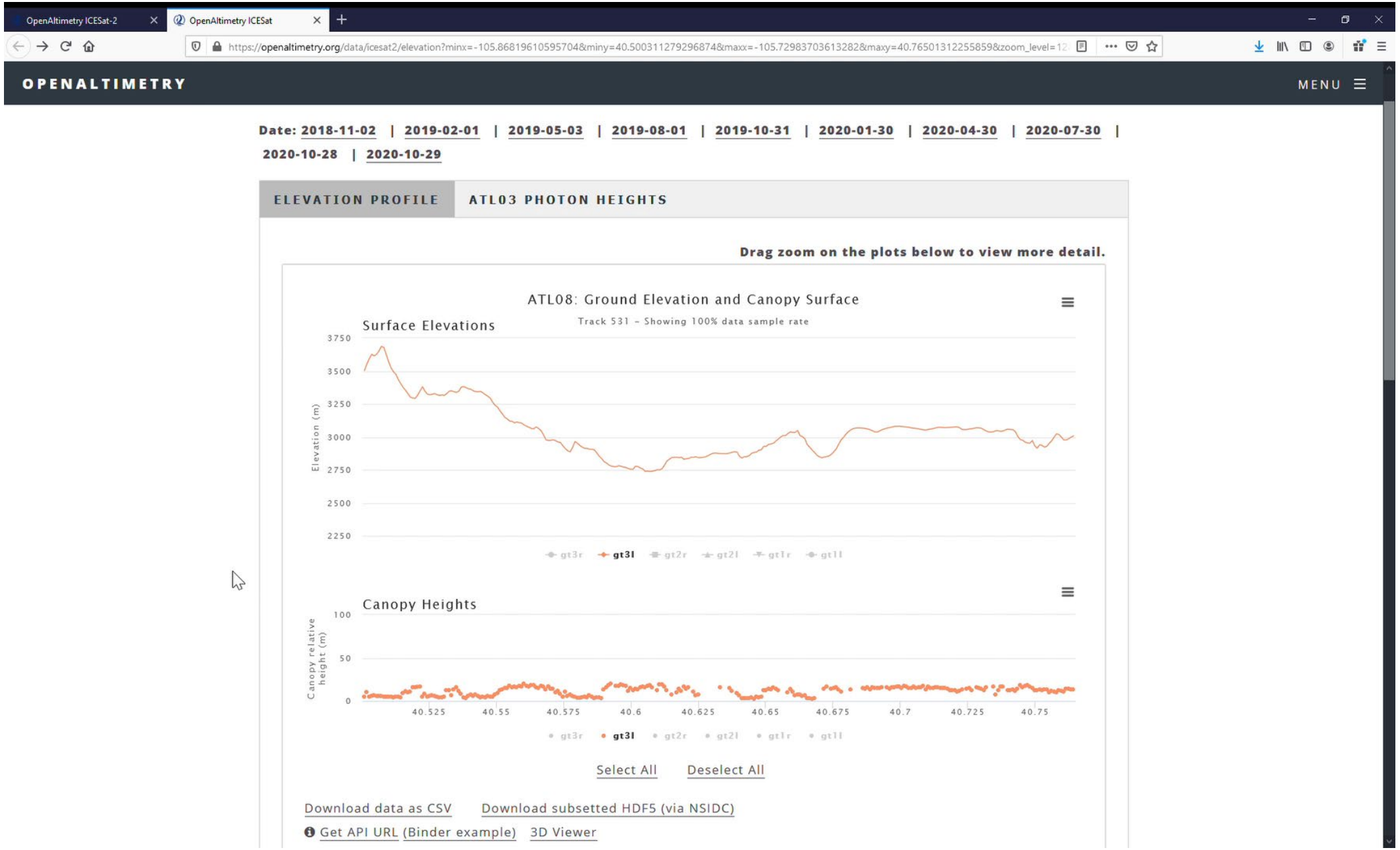
November 2020
Su Mo Tu We Th Fr Sa
Zoom in to view more data segments and select area of interest for creating elevation profiles.
Select ATLAS products to view on upper right.
5000 km
2020-11-11
Lat: 24.6094, Lon: 26.3672
NASA


ATLAS/ICESat-2 L3A Land and
OpenAltimetry ICESat-2
National Snow and Ice Data
OpenAltimetry ICESat-2
OpenAltimetry ICESat
https://openaltimetry.org/data/icesat2/
OPENALTIMETRY
MENU
ATL06
ATL07
ATL08
ATL10
ATL12
ATL13
Product info
0.01%
November 2020
Su Mo Tu We Th Fr Sa
Zoom in to view more data segments and select area of interest for creating elevation profiles.
Select ATLAS products to view on upper right.
5000 km
2020-11-11
Lat: 60.4688, Lon: 79.8047
NASA


OpenAltimetry ICESat-2
OpenAltimetry ICESat
https://openaltimetry.org/data/icesat2/
OPENALTIMETRY
MENU
SELECT A REGION
12.5%
ATL06
ATL07
ATL08
ATL10
ATL12
ATL13
Product info
Input map extents and center
Search by name (e.g. City, Country)
Zoom to bounding extents
Lower-left: Lon: Lat:
Upper-right: Lon: Lat:
Update map
Get current map extents & center
Center map on a point
Lon: -105.85 Lat: 40.65
Update map
5 km
2020-10-31
NASA


OpenAltimetry ICESat-2
OpenAltimetry ICESat
https://openaltimetry.org/data/icesat2/elevation?minx=-105.86819610595704&miny=40.500311279296874&maxx=-105.72983703613282&maxy=40.76501312255859&zoom_level=12
OPENALTIMETRY
MENU
ELEVATION PROFILE
ATL03 PHOTON HEIGHTS
Drag zoom on the plots below to view more detail.
ATL08: Ground Elevation and Canopy Surface
Surface Elevations
Track 531 - Showing 100% data sample rate
Elevation (m)
3750
3500
3250
3000
2750
2500
2250
gt3r gt3l gt2r gt2l gt1r gt1l
Canopy Heights
Canopy relative height (m)
100
50
0
40.525 40.55 40.575 40.6 40.625 40.65 40.675 40.7 40.725 40.75
gt3r gt3l gt2r gt2l gt1r gt1l
Select All
Deselect All
Download data as CSV
Download subsetted HDF5 (via NSIDC)
Get API URL (Binder example)
3D Viewer


OpenAltimetry ICESat-2
OpenAltimetry ICESat
https://openaltimetry.org/data/icesat2/elevation?minx=-105.86819610595704&miny=40.500311279296874&maxx=-105.72983703613282&maxy=40.76501312255859&zoom_level=12
OPENALTIMETRY
MENU
Date: 2018-11-02 | 2019-02-01 | 2019-05-03 | 2019-08-01 | 2019-10-31 | 2020-01-30 | 2020-04-30 | 2020-07-30 | 2020-10-28 | 2020-10-29
ELEVATION PROFILE
ATL03 PHOTON HEIGHTS
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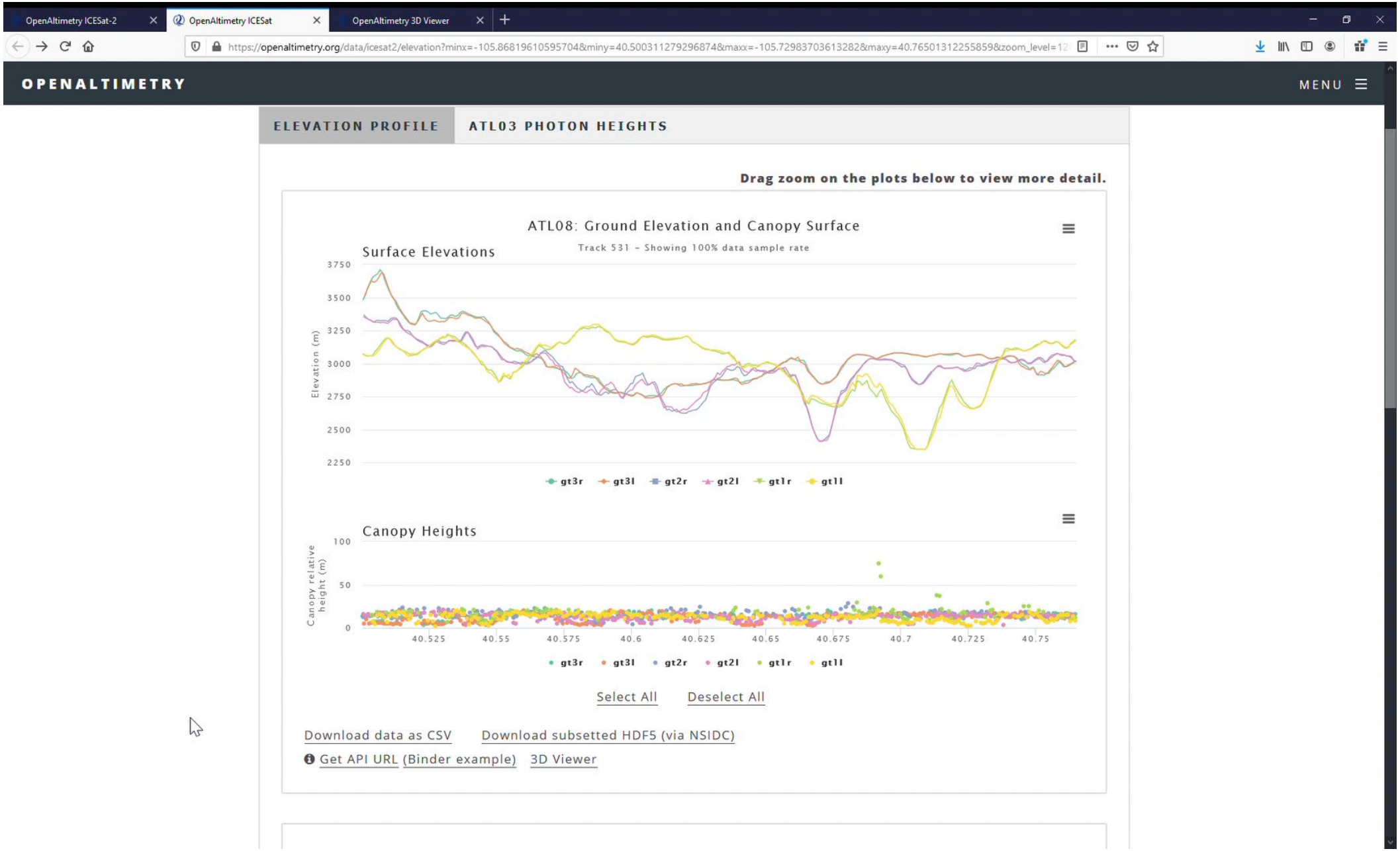
gt3r gt3l gt2r gt2l gt1r gt1l
Canopy Heights
Canopy relative height (m)
100
50
0
40.525 40.55 40.575 40.6 40.625 40.65 40.675 40.7 40.725 40.75
gt3r gt3l gt2r gt2l gt1r gt1l
Select All
Deselect All
Download data as CSV
Download subsetted HDF5 (via NSIDC)
Get API URL (Binder example)
3D Viewer


OpenAltimetry ICESat-2
OpenAltimetry ICESat
OpenAltimetry 3D Viewer
https://openaltimetry.org/data/icesat2/elevation?minx=-105.86819610595704&miny=40.500311279296874&maxx=-105.72983703613282&maxy=40.76501312255859&zoom_level=12
OPENALTIMETRY
MENU
ELEVATION PROFILE
ATL03 PHOTON HEIGHTS
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Track 531 - Showing 100% data sample rate
Elevation (m)
3750
3500
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2750
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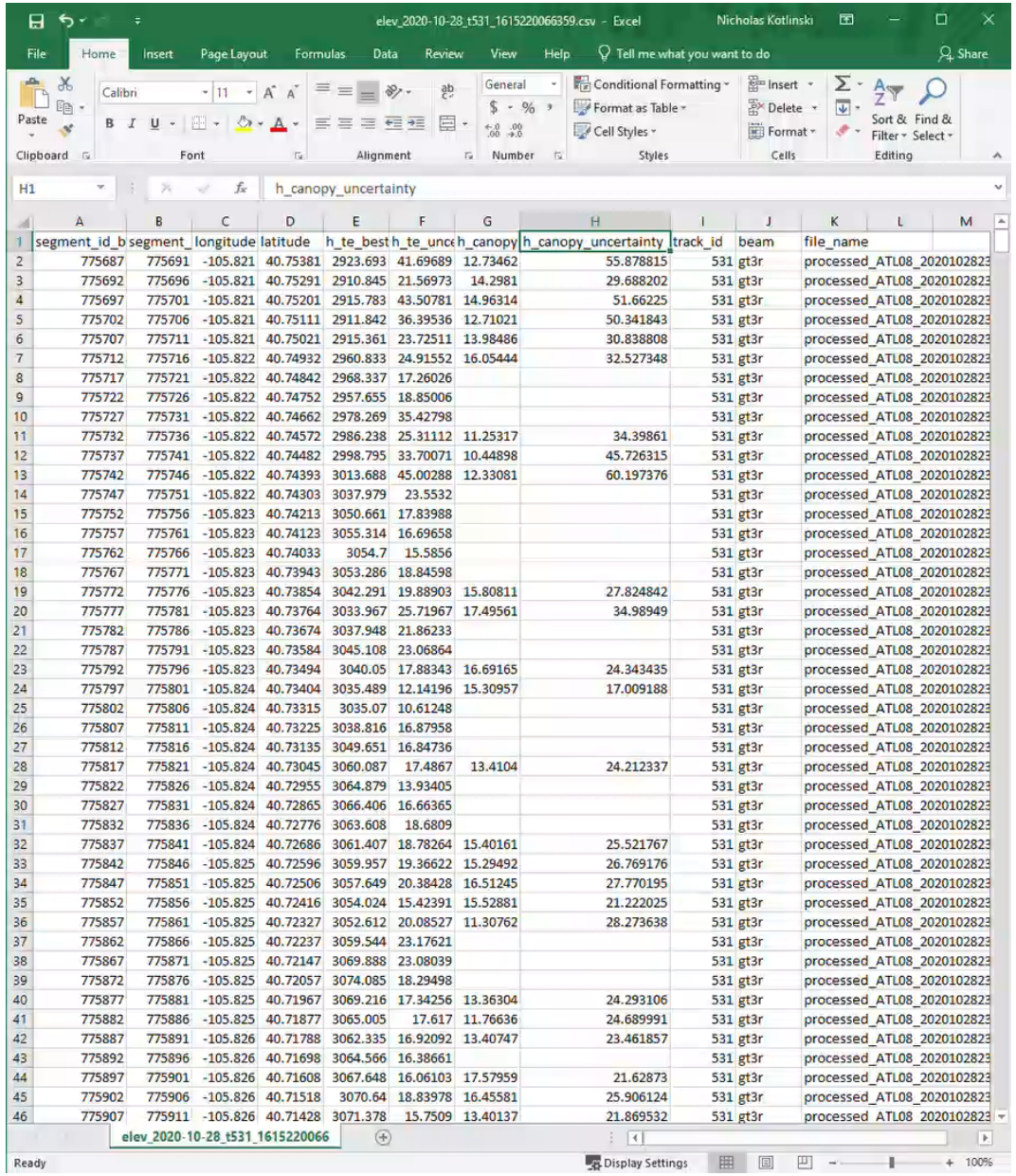
gt3r gt3l gt2r gt2l gt1r gt1l
Canopy Heights
Canopy relative height (m)
100
50
0
40.525 40.55 40.575 40.6 40.625 40.65 40.675 40.7 40.725 40.75
gt3r gt3l gt2r gt2l gt1r gt1l
Select All
Deselect All
Download data as CSV
Download subsetted HDF5 (via NSIDC)
Get API URL (Binder example)
3D Viewer


elev_2020-10-28_t531_1615220066359.csv - Excel
Nicholas Kotlinski
File Home Insert Page Layout Formulas Data Review View Help Tell me what you want to do Share
Paste Clipboard Calibri 11 Font Alignment General Number Conditional Formatting Format as Table Cell Styles Styles Insert Delete Format Cells Sort & Filter Find & Select Editing
H1
h_canopy_uncertainty
segment_id_b segment_ longitude latitude h_te_best h_te_unce h_canopy h_canopy_uncertainty track_id beam file_name
775687 775691 -105.821 40.75381 2923.693 41.69689 12.73462 55.878815 531 gt3r processed_ATL08_2020102823
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Display Settings
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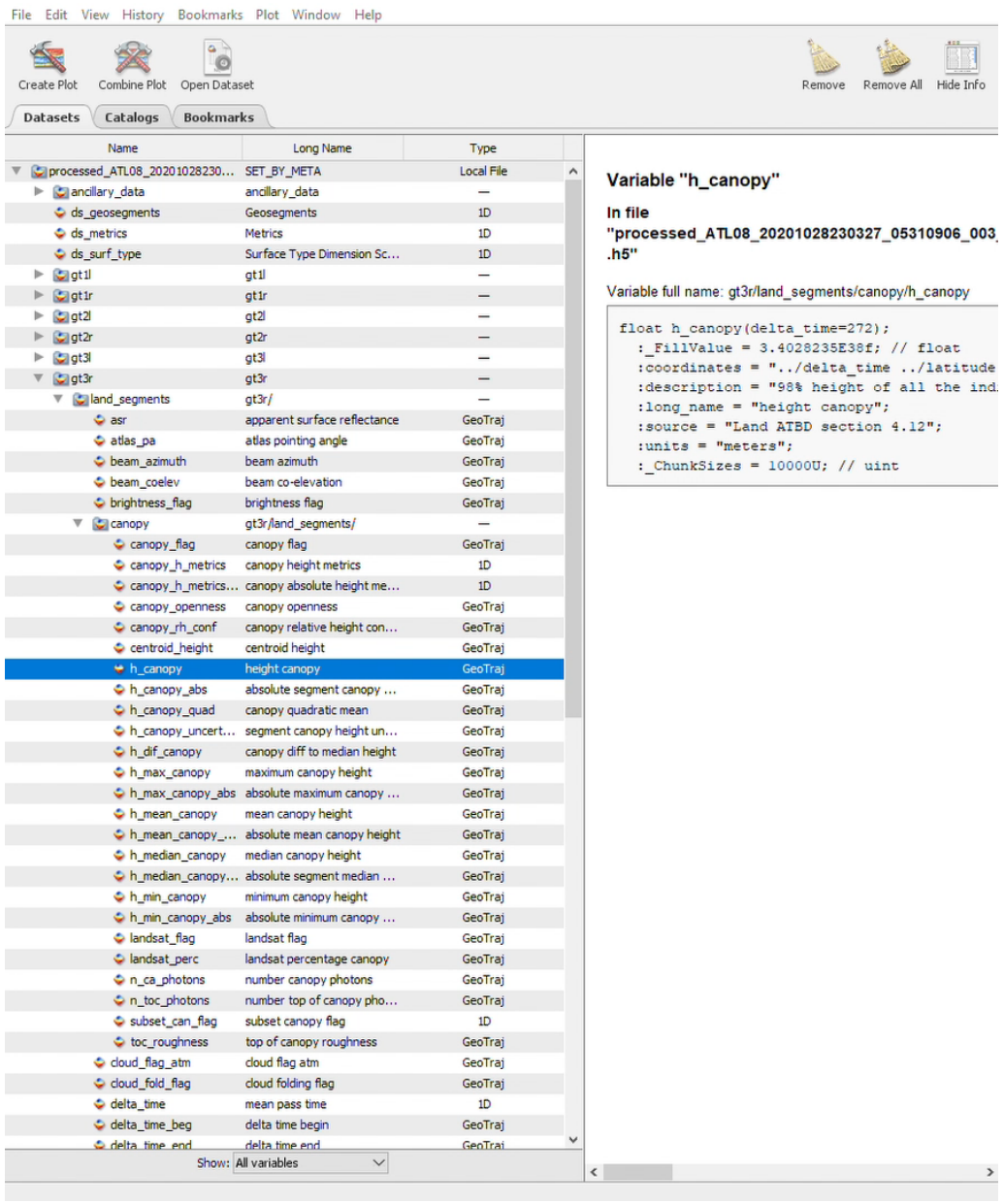

File Edit View History Bookmarks Plot Window Help
Create Plot
Combine Plot
Open Dataset
Remove
Remove All
Hide Info
Datasets
Catalogs
Bookmarks
Name
Long Name
Type
processed_ATL08_20201028230... SET_BY_META Local File
ancillary_data ancillary_data —
ds_geosegments Geosegments 1D
ds_metrics Metrics 1D
ds_surf_type Surface Type Dimension Sc... 1D
gt1l gt1l —
gt1r gt1r —
gt2l gt2l —
gt2r gt2r —
gt3l gt3l —
gt3r gt3r —
land_segments gt3r/ —
asr apparent surface reflectance GeoTraj
atlas_pa atlas pointing angle GeoTraj
beam_azimuth beam azimuth GeoTraj
beam_coelev beam co-elevation GeoTraj
brightness_flag brightness flag GeoTraj
canopy gt3r/land_segments/ —
canopy_flag canopy flag GeoTraj
canopy_h_metrics canopy height metrics 1D
canopy_h_metrics... canopy absolute height me... 1D
canopy_openness canopy openness GeoTraj
canopy_rh_conf canopy relative height con... GeoTraj
centroid_height centroid height GeoTraj
h_canopy height canopy GeoTraj
h_canopy_abs absolute segment canopy ... GeoTraj
h_canopy_quad canopy quadratic mean GeoTraj
h_canopy_uncert... segment canopy height un... GeoTraj
h_dif_canopy canopy diff to median height GeoTraj
h_max_canopy maximum canopy height GeoTraj
h_max_canopy_abs absolute maximum canopy ... GeoTraj
h_mean_canopy mean canopy height GeoTraj
h_mean_canopy_... absolute mean canopy height GeoTraj
h_median_canopy median canopy height GeoTraj
h_median_canopy... absolute segment median ... GeoTraj
h_min_canopy minimum canopy height GeoTraj
h_min_canopy_abs absolute minimum canopy ... GeoTraj
landsat_flag landsat flag GeoTraj
landsat_perc landsat percentage canopy GeoTraj
n_ca_photons number canopy photons GeoTraj
n_toc_photons number top of canopy pho... GeoTraj
subset_can_flag subset canopy flag 1D
toc_roughness top of canopy roughness GeoTraj
cloud_flag_atm cloud flag atm GeoTraj
cloud_fold_flag cloud folding flag GeoTraj
delta_time mean pass time 1D
delta_time_beg delta time begin GeoTraj
delta_time_end delta time end GeoTraj
Show: All variables
Variable "h_canopy"
In file "processed_ATL08_20201028230327_05310906_003_.h5"
Variable full name: gt3r/land_segments/canopy/h_canopy
float h_canopy(delta_time=272);
:_FillValue = 3.4028235E38f; // float
:coordinates = "../delta_time ../latitude
:description = "98% height of all the ind
:long_name = "height canopy";
:source = "Land ATBD section 4.12";
:units = "meters";
:_ChunkSizes = 10000U; // uint

Acceso a Datos: Open Altimetry

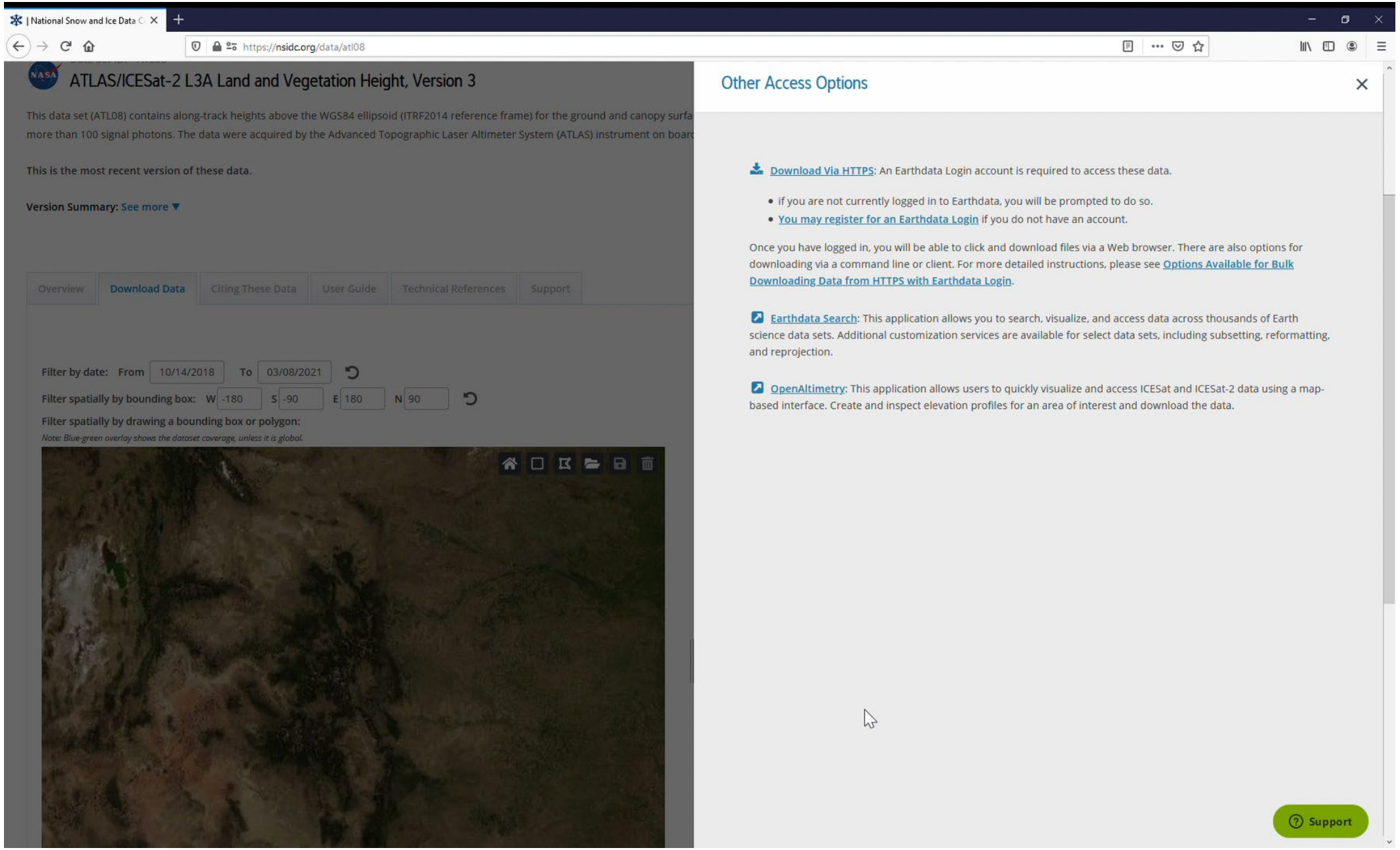
Tutoriales más Detallados de Open Altimetry:

Open Altimetry: Servicios avanzados de descubrimiento, procesamiento y visualización de datos ICESat-1 e ICESat-2

https://www.youtube.com/watch?v=ZanKXh1oQYc

Tutorial de Open Altimetry del NSIDC sobre Arboles Alrededor del Mundo - Una Campaña de Investigación Estudiantil del Programa GLOBE

https://www.youtube.com/watch?v=_kTgFeK42c8&t=1055s


National Snow and Ice Data
https://nsidc.org/data/atl08
ATLAS/ICESat-2 L3A Land and Vegetation Height, Version 3
This data set (ATL08) contains along-track heights above the WGS84 ellipsoid (ITRF2014 reference frame) for the ground and canopy surfa
more than 100 signal photons. The data were acquired by the Advanced Topographic Laser Altimeter System (ATLAS) instrument on boar
This is the most recent version of these data.
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Filter by date: From 10/14/2018 To 03/08/2021
Filter spatially by bounding box: W -180 S -90 E 180 N 90
Filter spatially by drawing a bounding box or polygon:
Note: Blue-green overlay shows the dataset coverage, unless it is global.
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Download Via HTTPS: An Earthdata Login account is required to access these data.
if you are not currently logged in to Earthdata, you will be prompted to do so.
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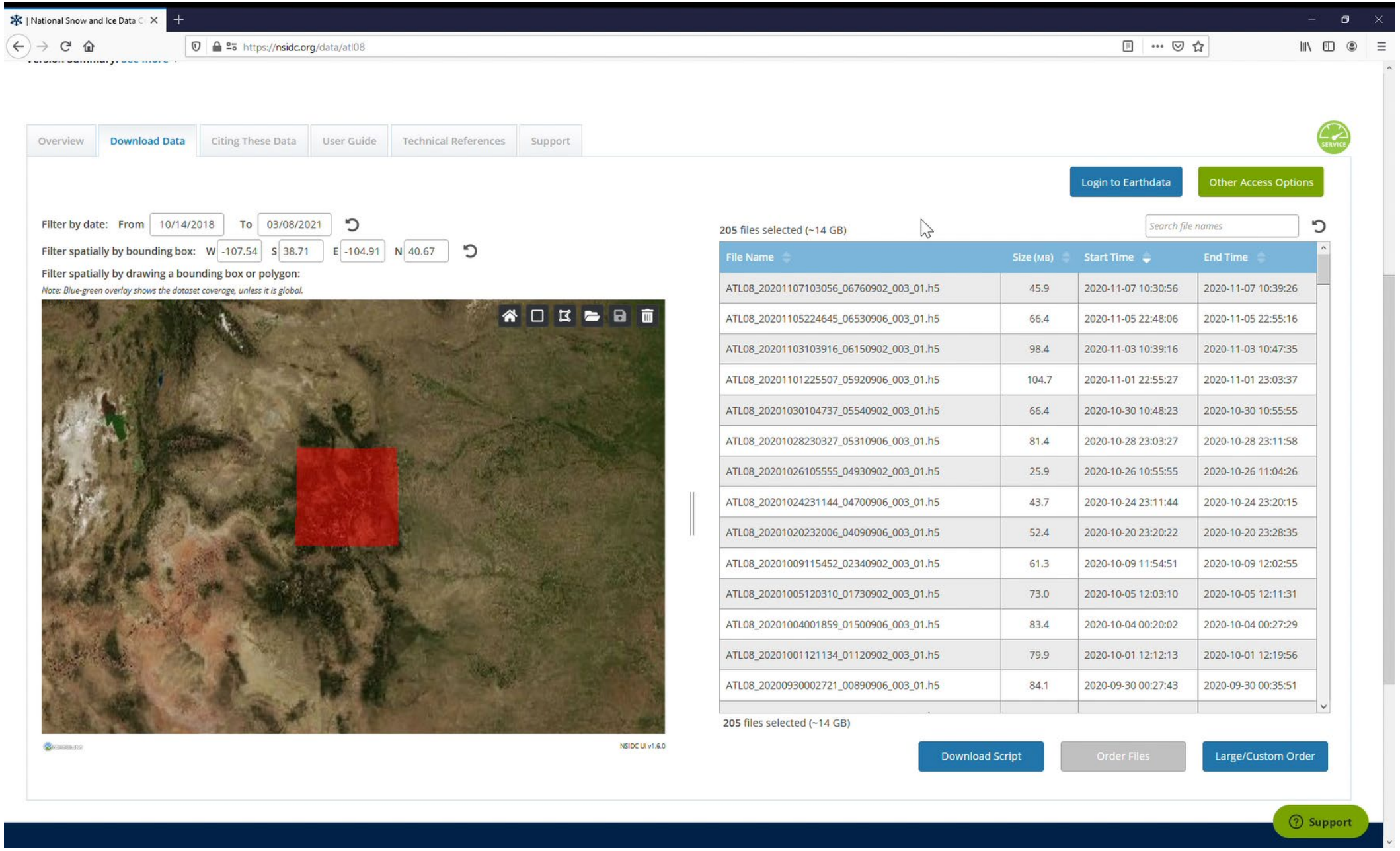
Once you have logged in, you will be able to click and download files via a Web browser. There are also options for downloading via a command line or client. For more detailed instructions, please see Options Available for Bulk Downloading Data from HTTPS with Earthdata Login.
Earthdata Search: This application allows you to search, visualize, and access data across thousands of Earth science data sets. Additional customization services are available for select data sets, including subsetting, reformatting, and reprojection.
OpenAltimetry: This application allows users to quickly visualize and access ICESat and ICESat-2 data using a map-based interface. Create and inspect elevation profiles for an area of interest and download the data.
Support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Filter spatially by bounding box: W -107.54 S 38.71 E -104.91 N 40.67
Filter spatially by drawing a bounding box or polygon:
Note: Blue-green overlay shows the dataset coverage, unless it is global.
NSIDC UI v1.6.0
205 files selected (~14 GB)
Search file names
File Name
Size (MB)
Start Time
End Time
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ATL08_20201105224645_06530906_003_01.h5 66.4 2020-11-05 22:48:06 2020-11-05 22:55:16
ATL08_20201103103916_06150902_003_01.h5 98.4 2020-11-03 10:39:16 2020-11-03 10:47:35
ATL08_20201101225507_05920906_003_01.h5 104.7 2020-11-01 22:55:27 2020-11-01 23:03:37
ATL08_20201030104737_05540902_003_01.h5 66.4 2020-10-30 10:48:23 2020-10-30 10:55:55
ATL08_20201028230327_05310906_003_01.h5 81.4 2020-10-28 23:03:27 2020-10-28 23:11:58
ATL08_20201026105555_04930902_003_01.h5 25.9 2020-10-26 10:55:55 2020-10-26 11:04:26
ATL08_20201024231144_04700906_003_01.h5 43.7 2020-10-24 23:11:44 2020-10-24 23:20:15
ATL08_20201020232006_04090906_003_01.h5 52.4 2020-10-20 23:20:22 2020-10-20 23:28:35
ATL08_20201009115452_02340902_003_01.h5 61.3 2020-10-09 11:54:51 2020-10-09 12:02:55
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ATL08_20201004001859_01500906_003_01.h5 83.4 2020-10-04 00:20:02 2020-10-04 00:27:29
ATL08_20201001121134_01120902_003_01.h5 79.9 2020-10-01 12:12:13 2020-10-01 12:19:56
ATL08_20200930002721_00890906_003_01.h5 84.1 2020-09-30 00:27:43 2020-09-30 00:35:51
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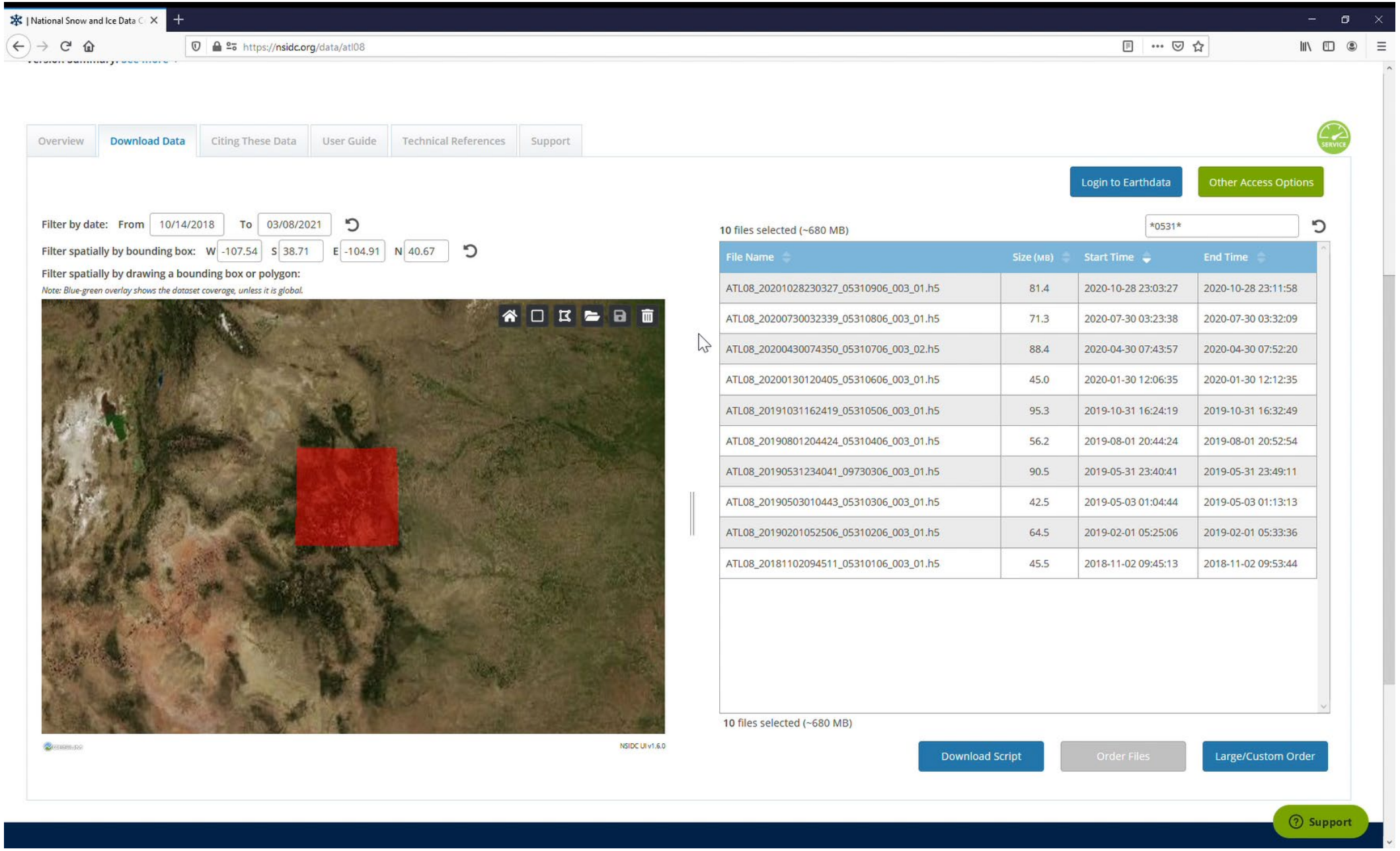
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https://nsidc.org/data/atl08
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Filter spatially by bounding box: W -107.54 S 38.71 E -104.91 N 40.67
Filter spatially by drawing a bounding box or polygon:
Note: Blue-green overlay shows the dataset coverage, unless it is global.
NSIDC UI v1.6.0
10 files selected (~680 MB)
0531
File Name
Size (MB)
Start Time
End Time
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ATL08_20200730032339_05310806_003_01.h5 71.3 2020-07-30 03:23:38 2020-07-30 03:32:09
ATL08_20200430074350_05310706_003_02.h5 88.4 2020-04-30 07:43:57 2020-04-30 07:52:20
ATL08_20200130120405_05310606_003_01.h5 45.0 2020-01-30 12:06:35 2020-01-30 12:12:35
ATL08_20191031162419_05310506_003_01.h5 95.3 2019-10-31 16:24:19 2019-10-31 16:32:49
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ATL08_20181102094511_05310106_003_01.h5 45.5 2018-11-02 09:45:13 2018-11-02 09:53:44
10 files selected (~680 MB)
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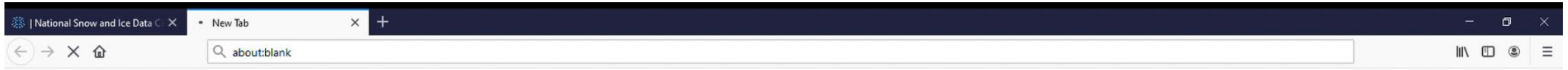
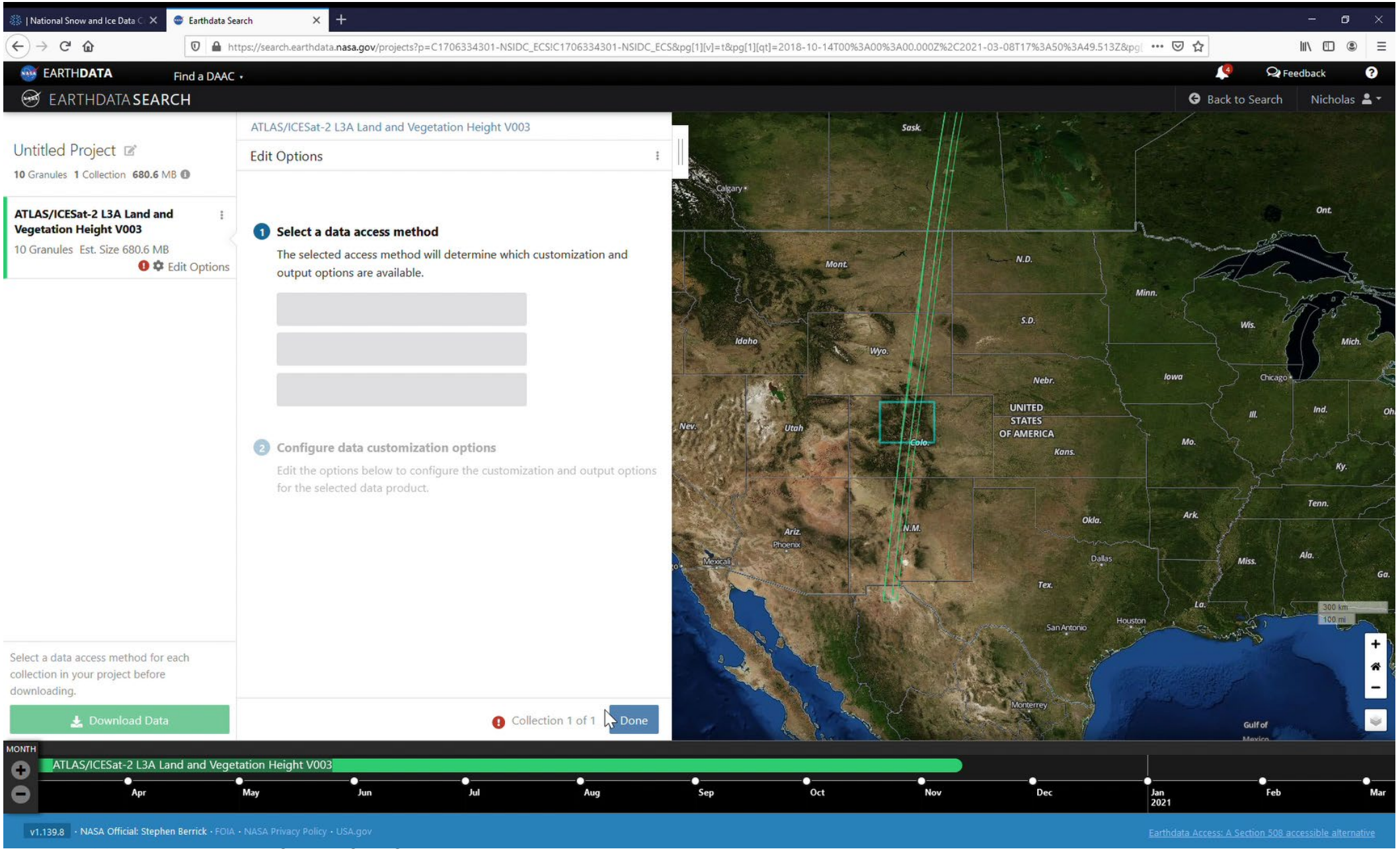
Support



search.earthdata.nasa.gov


National Snow and Ice Data C
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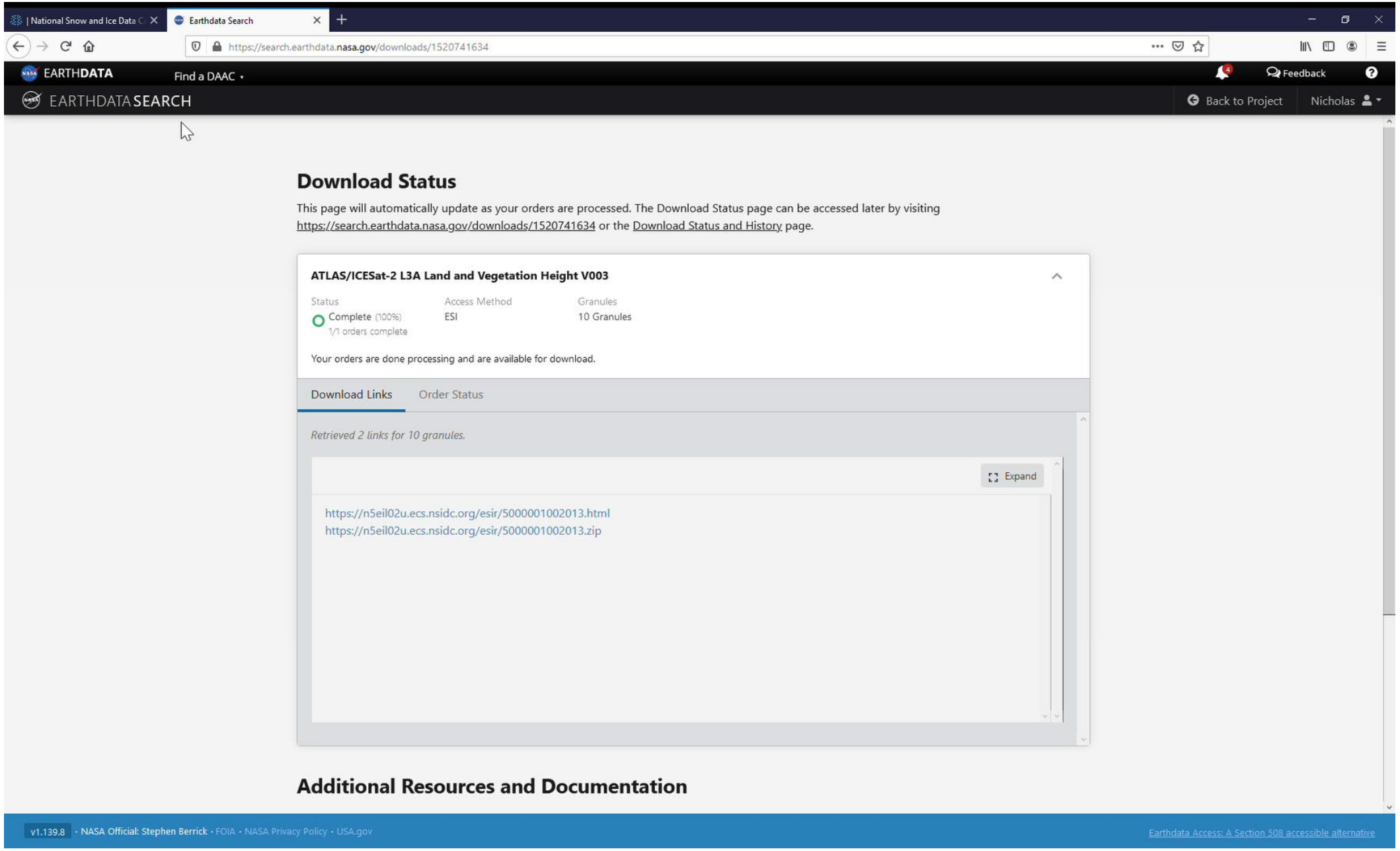
EARTHDATA
Find a DAAC
Feedback
EARTHDATA SEARCH
Back to Search
Nicholas
Untitled Project
10 Granules 1 Collection 680.6 MB
ATLAS/ICESat-2 L3A Land and Vegetation Height V003
10 Granules Est. Size 680.6 MB
Edit Options
ATLAS/ICESat-2 L3A Land and Vegetation Height V003
Edit Options
1 Select a data access method
The selected access method will determine which customization and output options are available.
2 Configure data customization options
Edit the options below to configure the customization and output options for the selected data product.
Select a data access method for each collection in your project before downloading.
Download Data
Collection 1 of 1
Done
Sask.
Calgary
Ont.
Mont.
N.D.
Minn.
S.D.
Wis.
Mich.
Idaho
Wyo.
Nebr.
Iowa
Chicago
UNITED STATES OF AMERICA
Ill.
Ind.
Nev.
Utah
Colo.
Kans.
Mo.
Ky.
Tenn.
Ariz.
Phoenix
N.M.
Okla.
Ark.
Mexicali
Dallas
Miss.
Ala.
Ga.
Tex.
La.
San Antonio
Houston
Monterrey
Gulf of Mexico
300 km
100 mi
MONTH
ATLAS/ICESat-2 L3A Land and Vegetation Height V003
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan 2021
Feb
Mar
v1.139.8 · NASA Official: Stephen Berrick · FOIA · NASA Privacy Policy · USA.gov
Earthdata Access: A Section 508 accessible alternative


| National Snow and Ice Data C
Earthdata Search
https://search.earthdata.nasa.gov/downloads/1520741634
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Download Status
This page will automatically update as your orders are processed. The Download Status page can be accessed later by visiting https://search.earthdata.nasa.gov/downloads/1520741634 or the Download Status and History page.
ATLAS/ICESat-2 L3A Land and Vegetation Height V003
Status
Complete (100%)
1/1 orders complete
Access Method
ESI
Granules
10 Granules
Your orders are done processing and are available for download.
Download Links
Order Status
Retrieved 2 links for 10 granules.
Expand
https://n5eil02u.ecs.nsidc.org/esir/5000001002013.html
https://n5eil02u.ecs.nsidc.org/esir/5000001002013.zip
Additional Resources and Documentation
v1.139.8
NASA Official: Stephen Berrick
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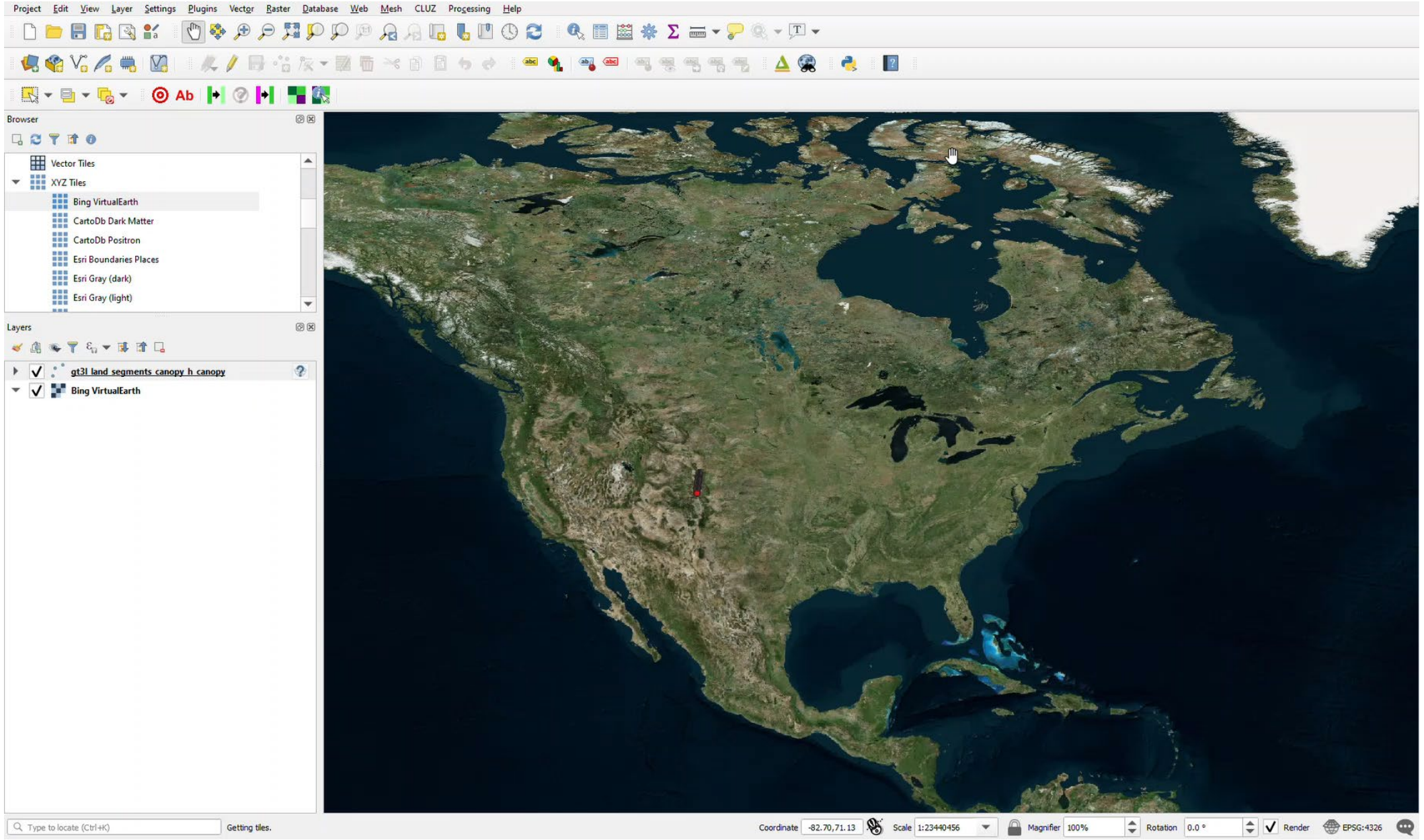
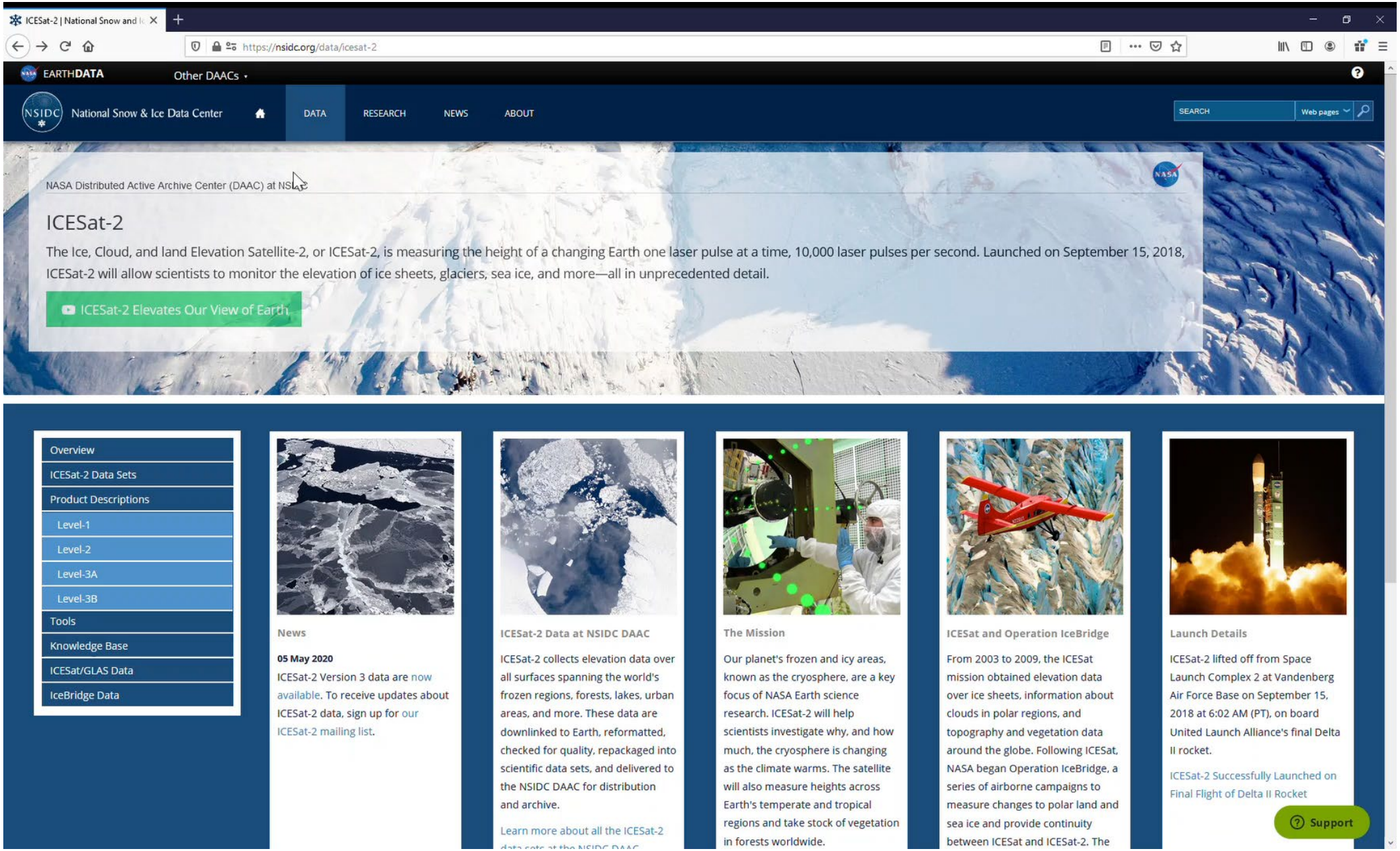
NASA Privacy Policy
USA.gov
Earthdata Access: A Section 508 accessible alternative


Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh CLUZ Processing Help
Browser
Vector Tiles
XYZ Tiles
Bing VirtualEarth
CartoDb Dark Matter
CartoDb Positron
Esri Boundaries Places
Esri Gray (dark)
Esri Gray (light)
Layers
gt3l land segments canopy h canopy
Bing VirtualEarth
Type to locate (Ctrl+K)
Getting tiles.
Coordinate -82.70,71.13
Scale 1:23440456
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326


ICESat-2 | National Snow and Ic
https://nsidc.org/data/icesat-2
EARTHDATA
Other DAACs
National Snow & Ice Data Center
DATA
RESEARCH
NEWS
ABOUT
SEARCH
Web pages
NASA Distributed Active Archive Center (DAAC) at NSIDC
ICESat-2
The Ice, Cloud, and land Elevation Satellite-2, or ICESat-2, is measuring the height of a changing Earth one laser pulse at a time, 10,000 laser pulses per second. Launched on September 15, 2018, ICESat-2 will allow scientists to monitor the elevation of ice sheets, glaciers, sea ice, and more—all in unprecedented detail.
ICESat-2 Elevates Our View of Earth
Overview
ICESat-2 Data Sets
Product Descriptions
Level-1
Level-2
Level-3A
Level-3B
Tools
Knowledge Base
ICESat/GLAS Data
IceBridge Data
News
05 May 2020
ICESat-2 Version 3 data are now available. To receive updates about ICESat-2 data, sign up for our ICESat-2 mailing list.
ICESat-2 Data at NSIDC DAAC
ICESat-2 collects elevation data over all surfaces spanning the world's frozen regions, forests, lakes, urban areas, and more. These data are downlinked to Earth, reformatted, checked for quality, repackaged into scientific data sets, and delivered to the NSIDC DAAC for distribution and archive.
Learn more about all the ICESat-2
The Mission
Our planet's frozen and icy areas, known as the cryosphere, are a key focus of NASA Earth science research. ICESat-2 will help scientists investigate why, and how much, the cryosphere is changing as the climate warms. The satellite will also measure heights across Earth's temperate and tropical regions and take stock of vegetation in forests worldwide.
ICESat and Operation IceBridge
From 2003 to 2009, the ICESat mission obtained elevation data over ice sheets, information about clouds in polar regions, and topography and vegetation data around the globe. Following ICESat, NASA began Operation IceBridge, a series of airborne campaigns to measure changes to polar land and sea ice and provide continuity between ICESat and ICESat-2. The
Launch Details
ICESat-2 lifted off from Space Launch Complex 2 at Vandenberg Air Force Base on September 15, 2018 at 6:02 AM (PT), on board United Launch Alliance's final Delta II rocket.
ICESat-2 Successfully Launched on Final Flight of Delta II Rocket
Support

Herramientas y Servicios

API and **Jupyter Notebooks**

https://nsidc.org/support/tool/icesat-2-tools-and-services

GitHub python™

.circleci	fix circleci	6 months ago
binder	testing different postBuild configurations	last month
notebooks	impriove iceflow notebook	6 days ago
.gitignore	update gitignore	last month
Dockerfile	major refactoring for valkyrie	4 months ago
LICENSE	Initial commit	11 months ago
README.md	update itslive notebook	4 months ago
docker-compose.dev.yml	Add docker-compose files and update README	5 months ago
docker-compose.yml	Add docker-compose files and update README	5 months ago

README.md

NSIDC-Data-Tutorials

launch binder

PASSED

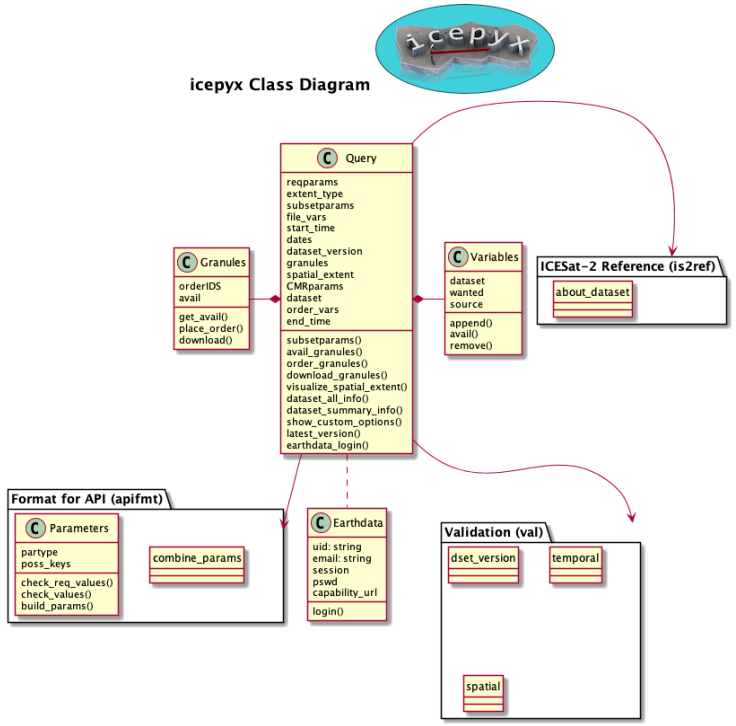
Data Access and Service API	The NSIDC DAAC's Application Programming Interface, or API, provides spatial and temporal filtering as well as customization options as a single access command, without the need to script against our data directory structure.	API	Visit the page What subsetting and reformatting services are available for ICESat-2 data? for details on subsetting and reformatting services available for each ICESat-2 data set.	NSIDC DAAC
ICESat-2 Hackweek Jupyter Notebook Tutorials	A Github repository of Jupyter Notebook tutorials presented during the ICESat-2 HackWeek at the Univeristy of Washington on June 17-21, 2019.	Downloadable tool	Python-based guidance on access, reading, plotting, and exploration of ICESat-2 cryospheric data.	ICESat-2 Hackweek, hosted by the University of Washington with support from NASA's Cryospheric Sciences Program
NSIDC DAAC Data Access Jupyter Notebook	A Jupyter notebook exploring data coverage, size, and customization service availability along with direct data download utilizing the NSIDC DAAC's access and service API.	Downloadable tool	Visit the page What subsetting and reformatting services are available for ICESat-2 data? for details on subsetting and reformatting services available for each ICESat-2 data set.	NSIDC DAAC

Herramientas y Servicios

icepyx software and community

https://nsidc.org/support/tool/icesat-2-tools-and-services

https://github.com/icesat2py/icepyx



	icepyx	A python software library for obtaining and working with ICESat-2 data. A shared library of resources - including existing resources, new code, tutorials, and use-cases/examples - that simplify the process of querying, obtaining, analyzing, and manipulating ICESat-2 datasets to enable scientific discovery. Developed and maintained by a community composed of ICESat-2 data users, developers, scientists, and students.	Downloadable tool, Python library, Jupyter Notebook	Access and reformat data through the NSIDC API	Github and documentation	

Herramientas y Servicios: Visualización de Datos

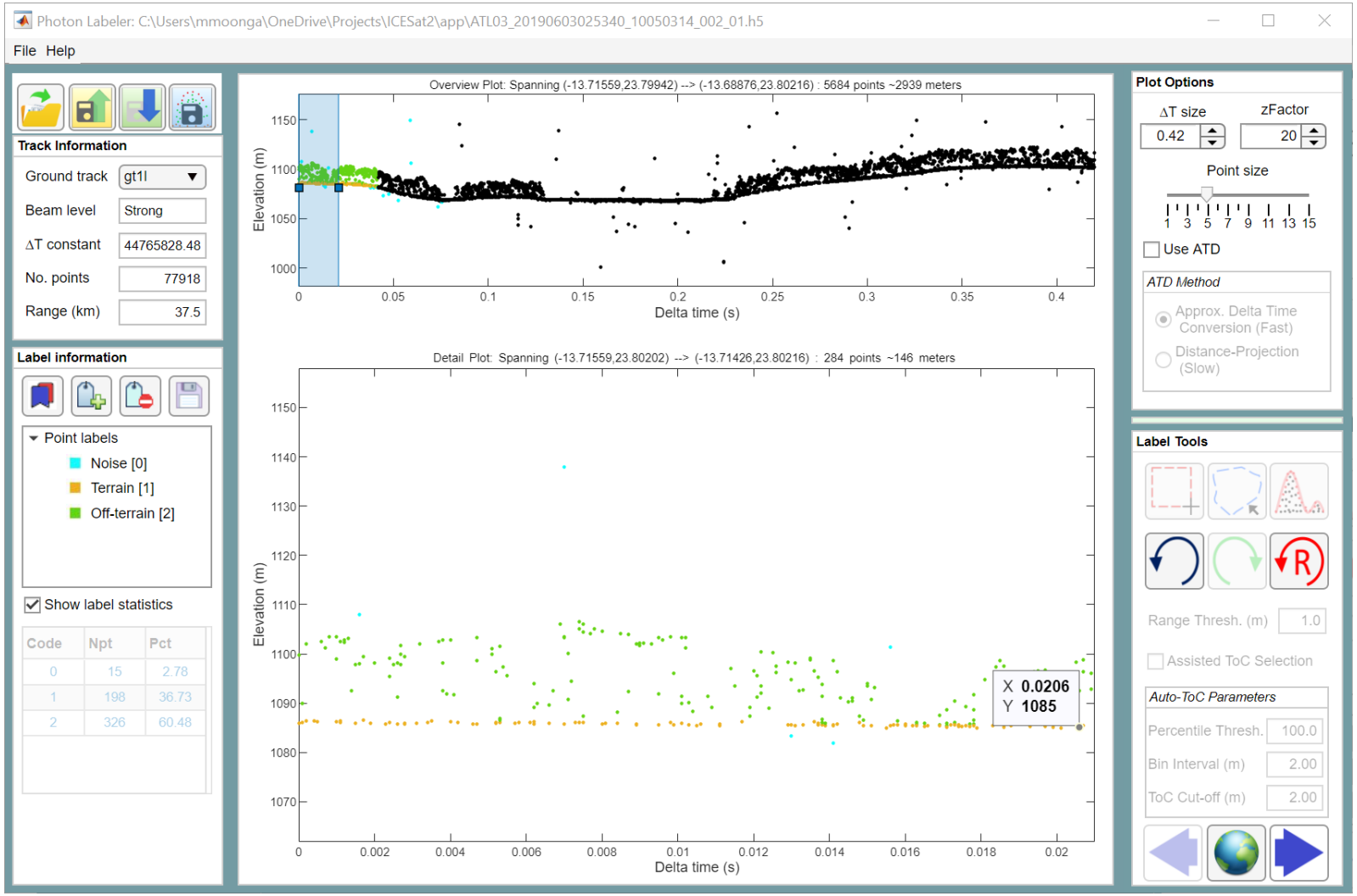
HDFView

https://www.hdfgroup.org/downloads/hdfview

Herramientas y Servicios: Visualización de Datos

PhotonLabeler

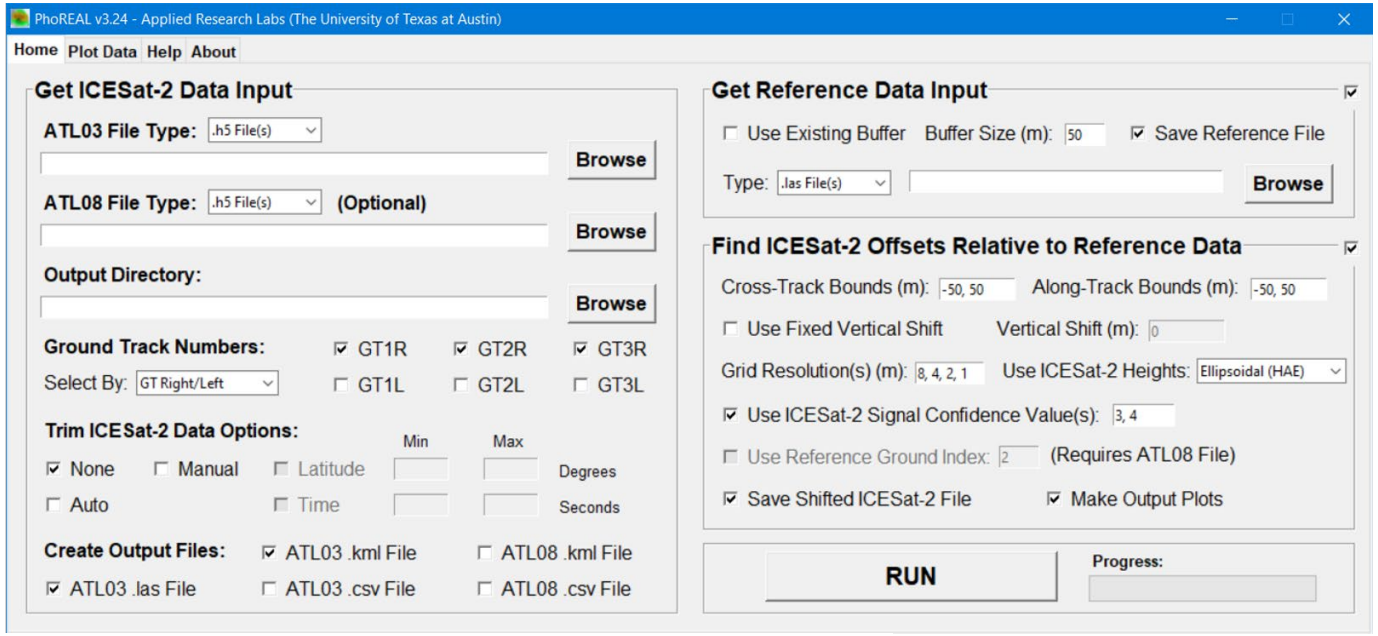
https://github.com/Oht0nger/PhoLabeler

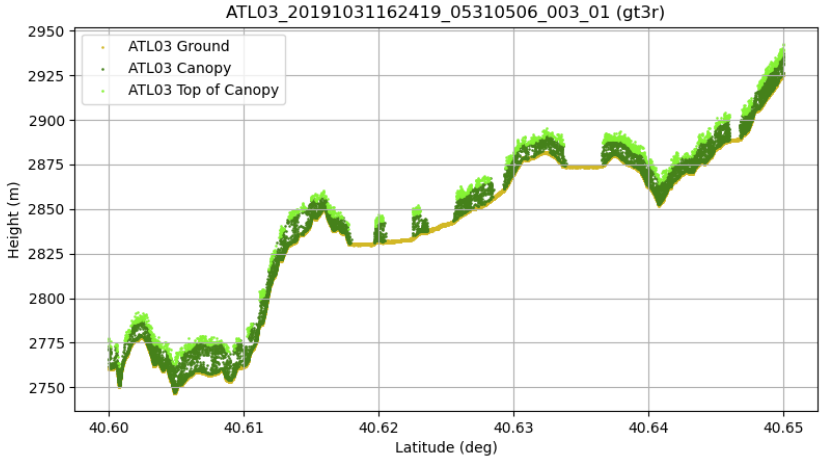


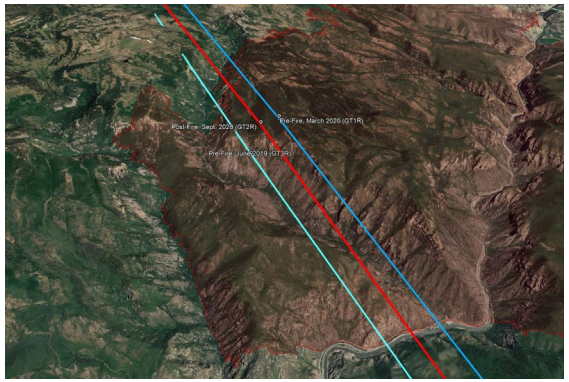
Herramientas y Servicios: Visualización de Datos

PhoREAL

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



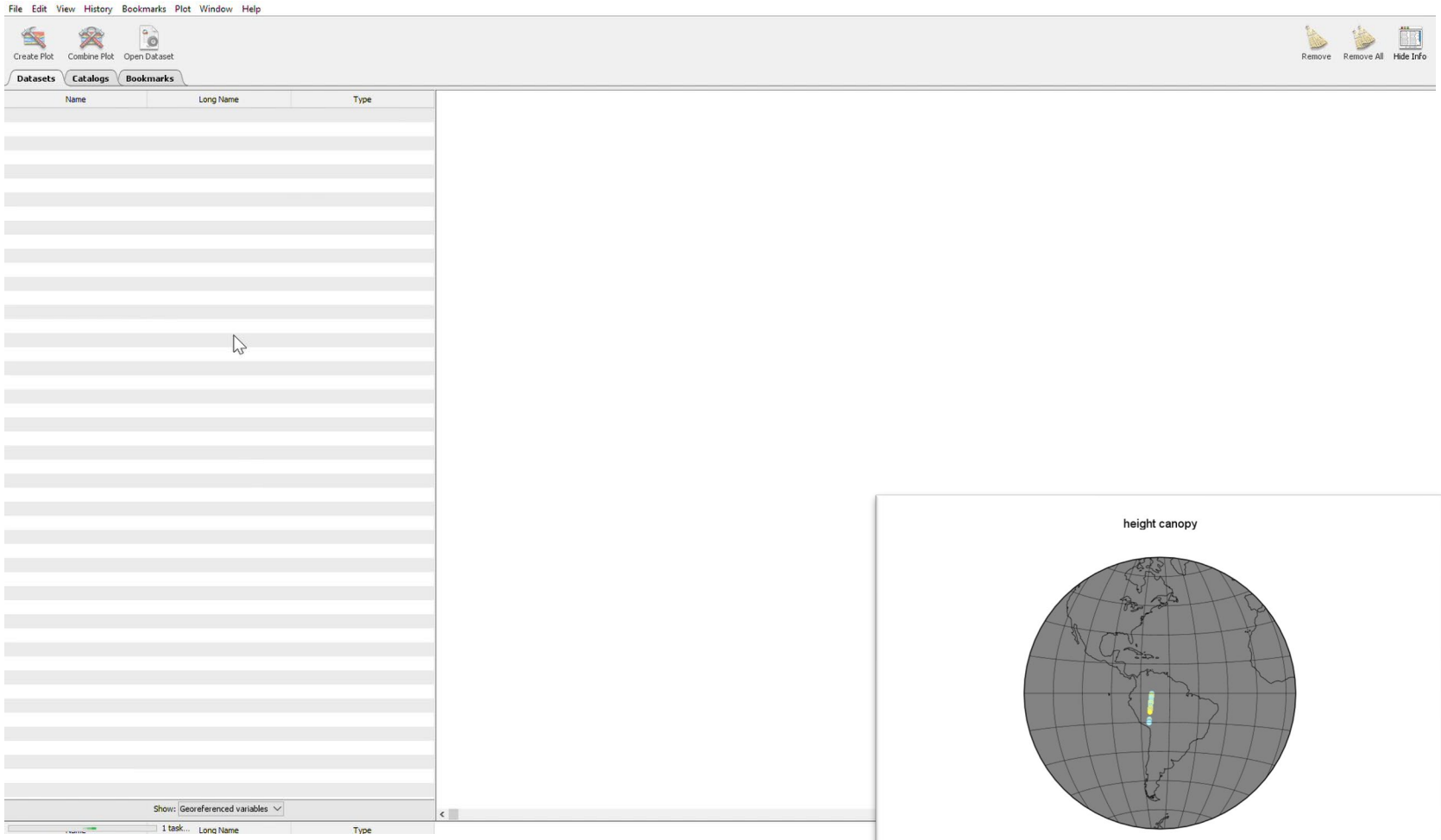




Herramientas y Servicios: Visualización de Datos

Panoply

https://www.giss.nasa.gov/tools/panoply

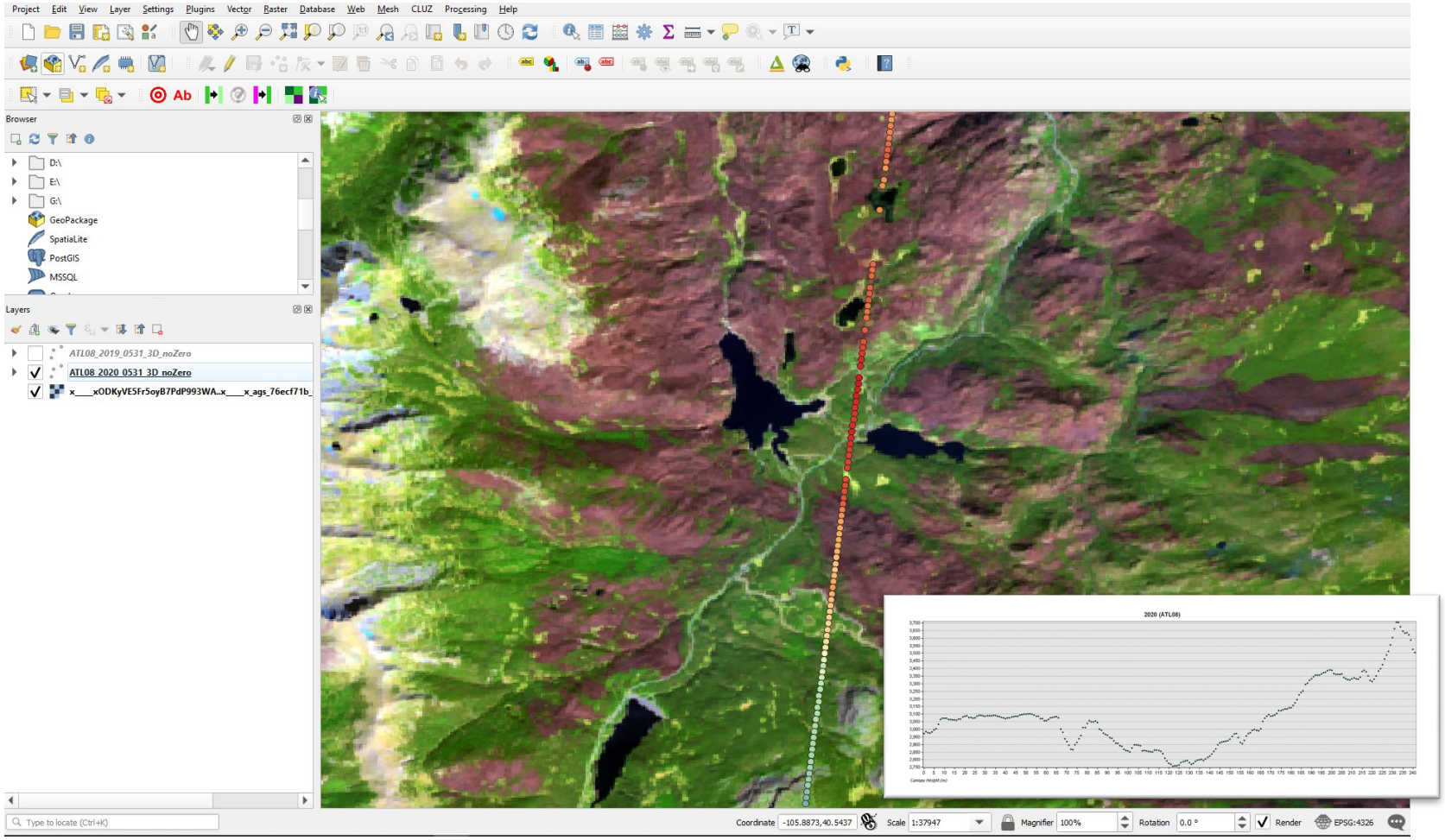


Herramientas y Servicios: Visualización de Datos

Reformateo a Shapefiles

NASA Earthdata Search

https://search.earthdata.nasa.gov/search



Visite la pagina web del **NSIDC DAAC** para acceder datos y documentación de ICESat-2

https://nsidc.org/daac

https://nsidc.org/data/**icesat-2**

Contacte los Servicios al Usuario del NSIDC **nsidc@nsidc.org**

Especificaciones Tecnicas de ICESat-2

https://icesat-2.gsfc.nasa.gov/science/specs

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- ARSET- Preguntas Generales
  - Ana Prados: aprados@umbc.edu

- ARSET- Página Web:
  - http://arset.gsfc.nasa.gov

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