



NASA, GLOBE and Trees: Looking at Tree Height from the Ground and Space

Forest – Our Lifelong Teacher Erasmus+ Project

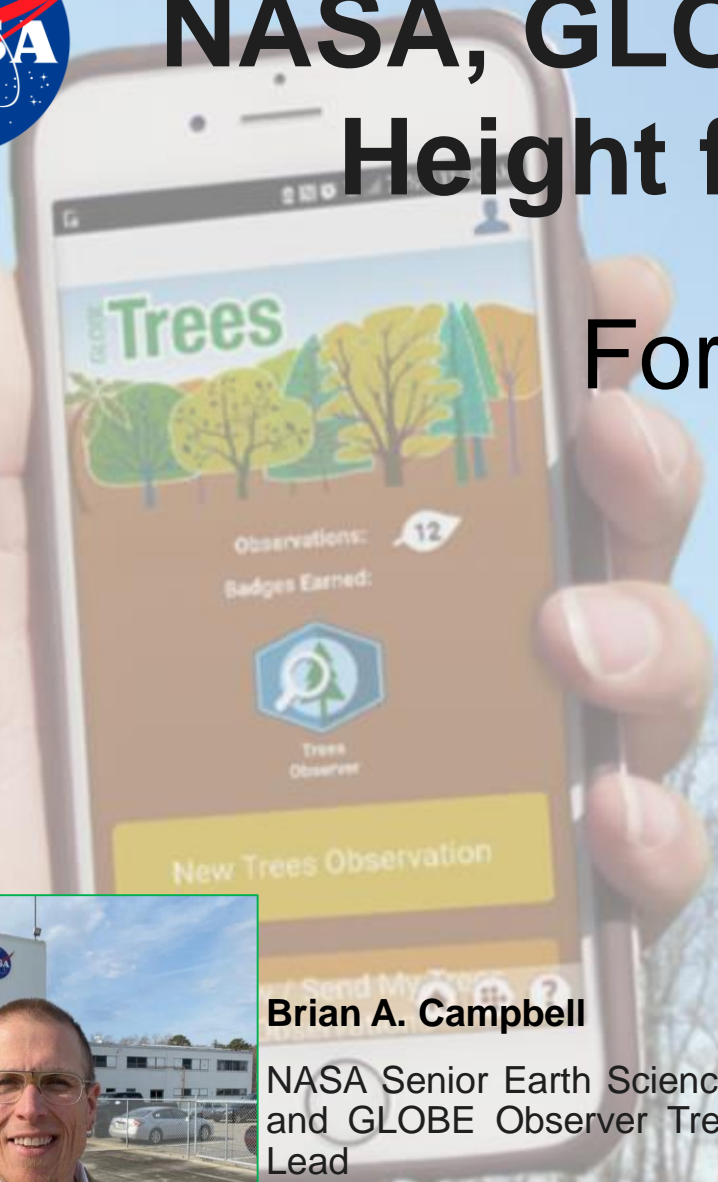
30 May 2023



Brian A. Campbell

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NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia USA





GLOBE's Vision

A worldwide community of students, teachers, scientists and citizens working together to better understand, sustain and improve Earth's environment at local, regional and global scales.

GLOBE's Mission

To increase awareness of individuals throughout the world about the global environment, contribute to increased scientific understanding of the Earth and support improved student achievement in science and mathematics.



Africa	Asia and Pacific	Europe and Eurasia	Latin America and Caribbean	Near East and North Africa	North America
27 Countries	19 Countries	45 Countries	21 Countries	13 Countries	2 Countries

www.globe.gov

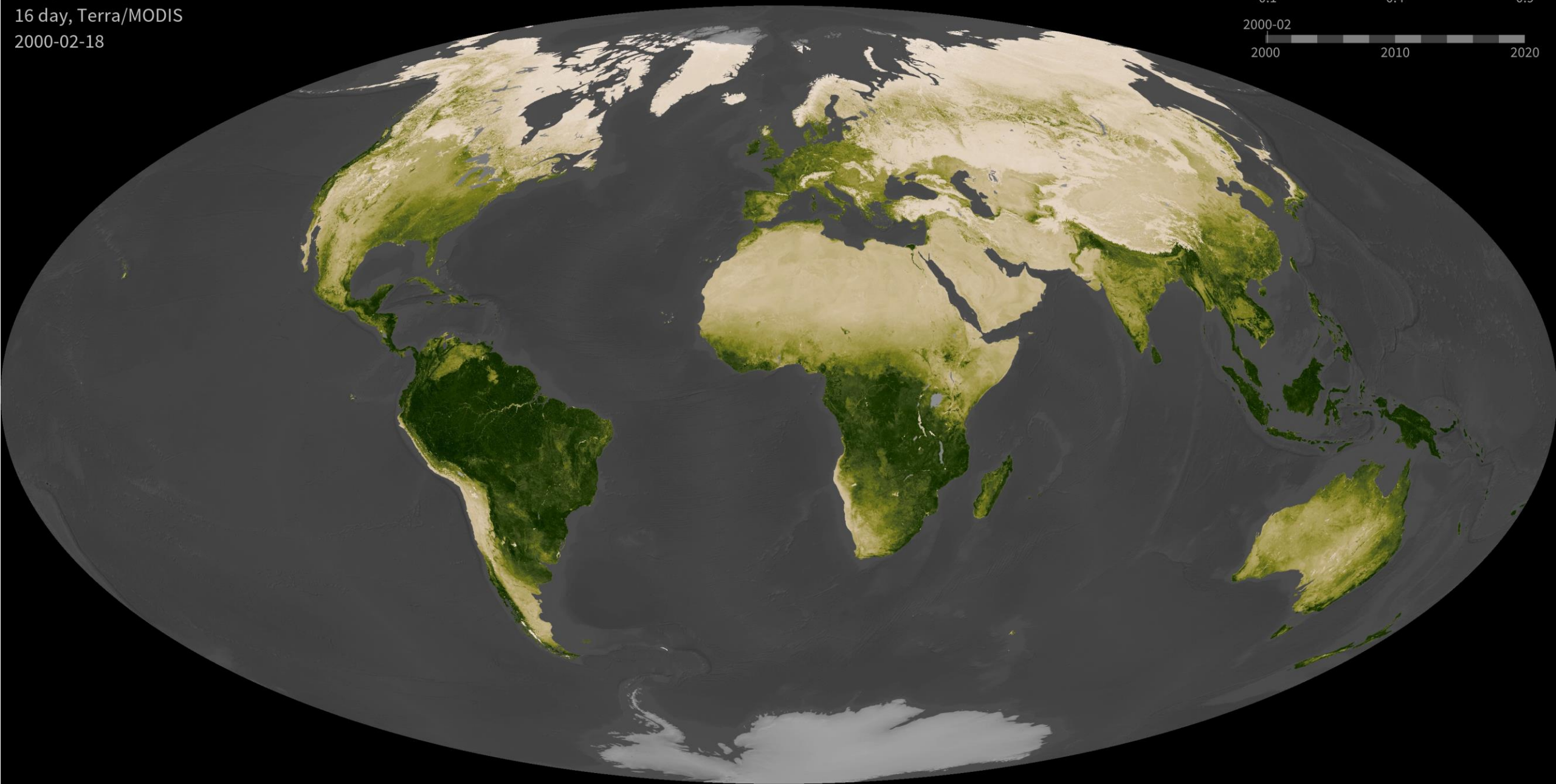
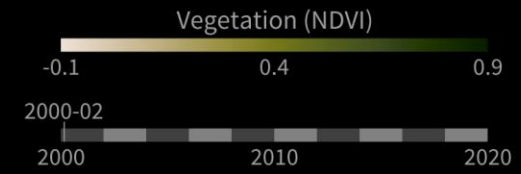
GLOBE by the Numbers

- 127** Countries
- 38,834** Schools
- 44,212** Teachers
- 248,107** GLOBE Observers
- 237,674,173** Measurements
- 734,044** Measurements this month

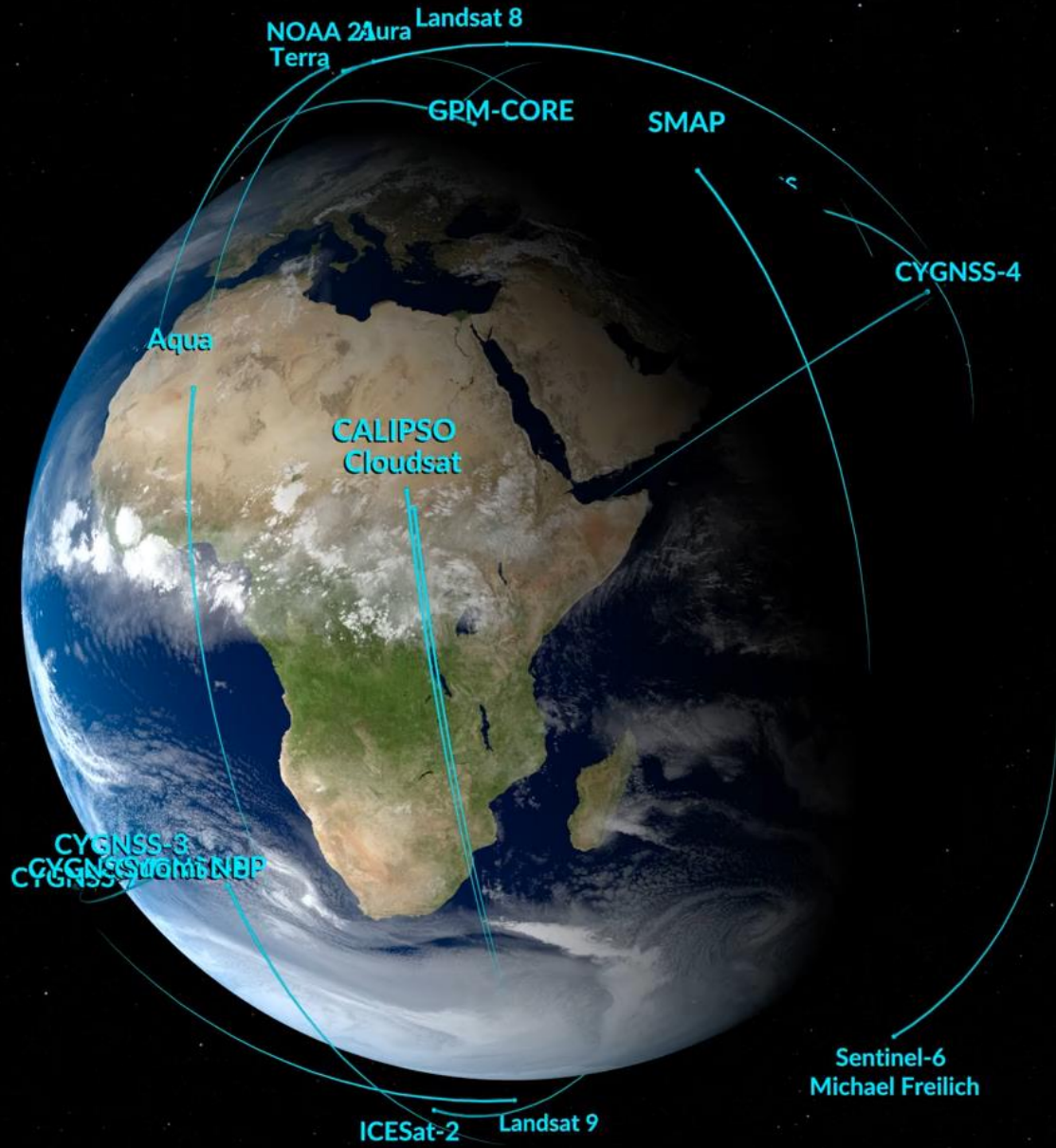
Vegetation Index

16 day, Terra/MODIS

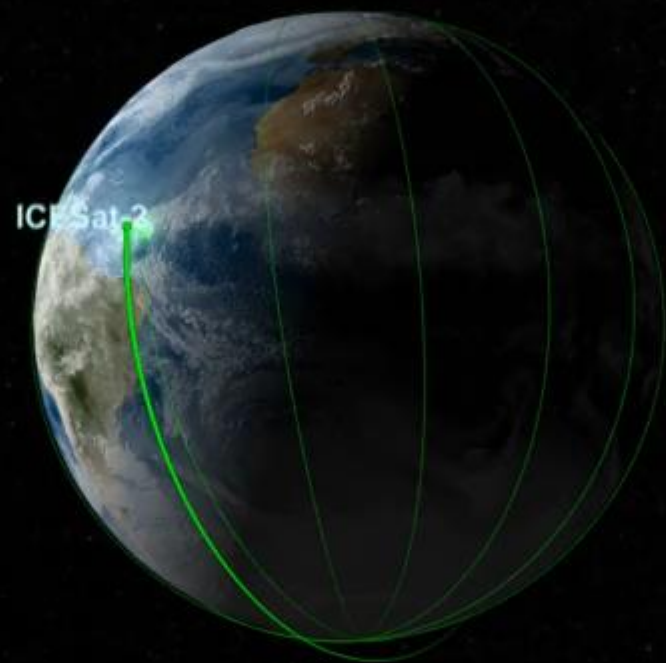
2000-02-18



GOES-14



Jan 10 2023 13:12



ICESat-2



WHY IS TREE HEIGHT SO IMPORTANT AND WHY DOES NASA CARE....and WHY SHOULD YOU?

Tree height is the most widely used indicator of an ecosystem's ability to grow trees

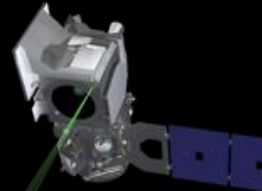
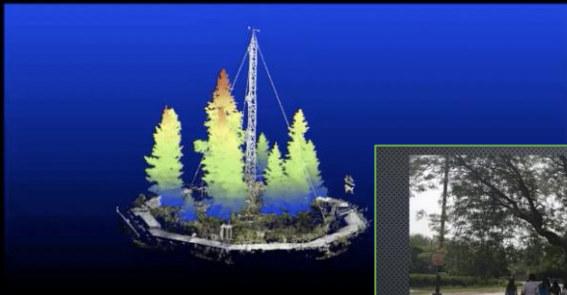
Tree height allows you to track the growth of trees over time

The GLOBE Tree height observations can help researchers understand the gain or loss of biomass which can inform calculations of the carbon that trees and forests either take in from or release into the atmosphere.

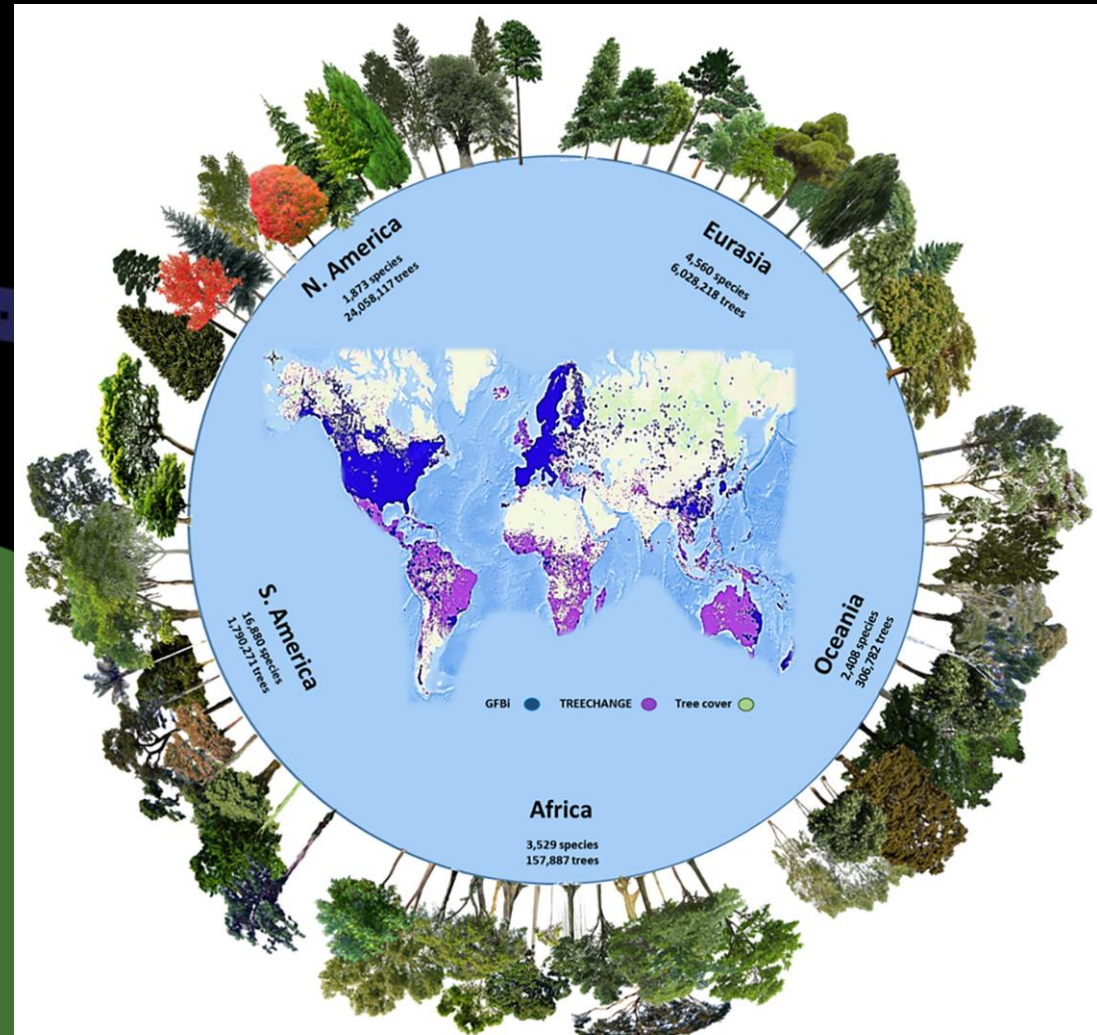
NASA missions utilize an onboard laser altimeter systems to measure the height of our planet, one photon at a time. The advanced technology of ICESat-2 can measure the height of trees and forests all around our planet.

There are 3.03 trillion trees and 78,000 tree species on Earth. Each tree is an indicator of a changing climate!

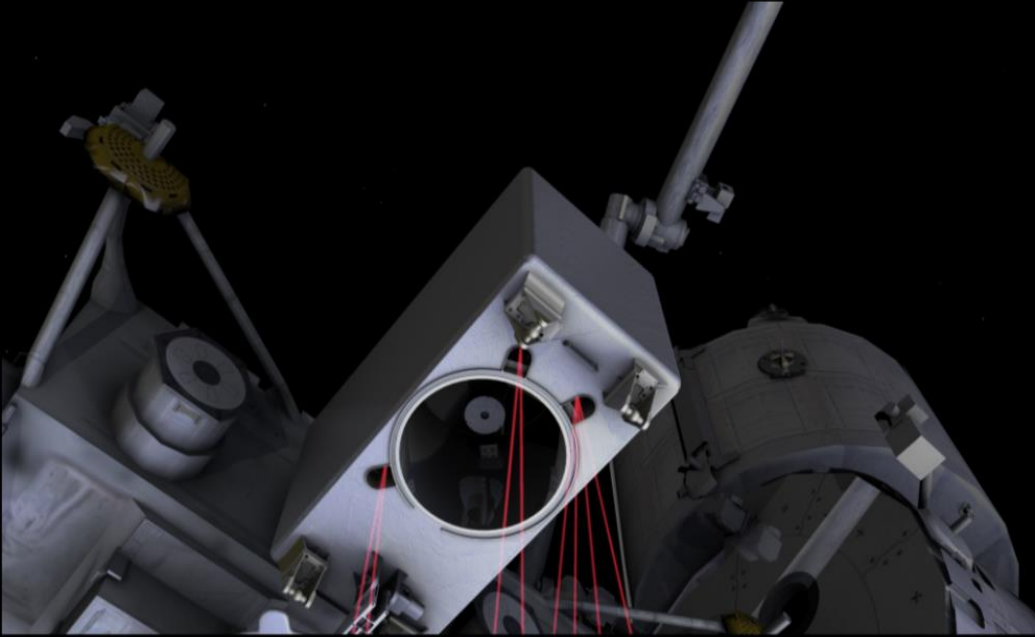
Tree height is an indicator of the environment



GLOBE Trees



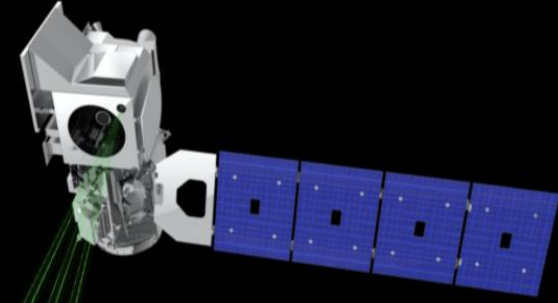
Lasers from Space



GEDI

Global Ecosystem Dynamics Investigation
on International Space Station

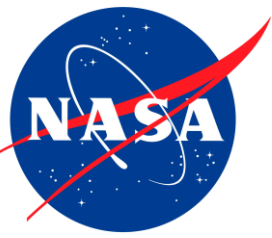
<https://gedi.umd.edu/>



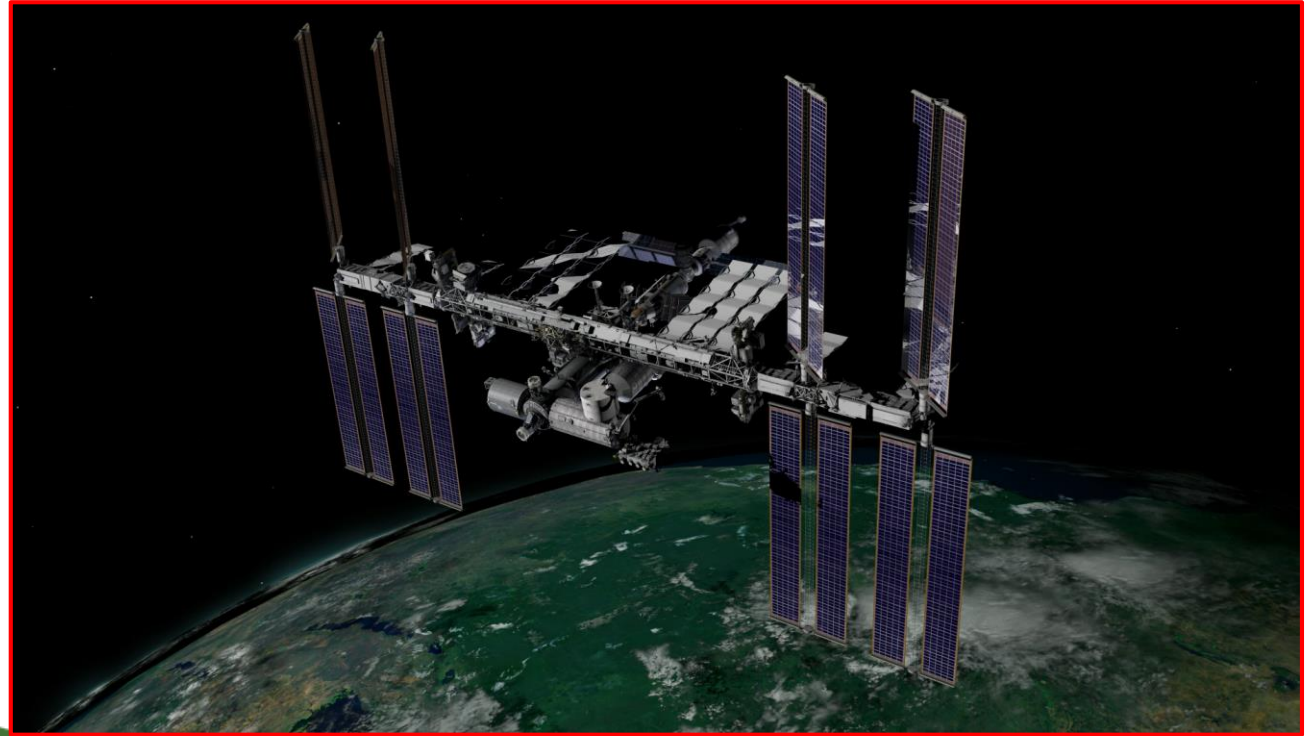
ICESat-2

Ice, Cloud, and land Elevation Satellite-2

<https://icesat-2.gsfc.nasa.gov>



Lasers from Space with the Global Ecosystem Dynamics Investigation (GEDI)



GEDI is a full-waveform lidar instrument that makes detailed measurements of the 3D structure of the Earth's surface. Lidar is an active remote sensing technology (the laser version of radar) which uses pulses of laser light to measure 3D structure.

The three lasers comprising the GEDI lidar system produce eight parallel observation tracks. Each laser fires 242 times each second and illuminates a 25-meter spot on the surface over which the surface's 3D structure is measured

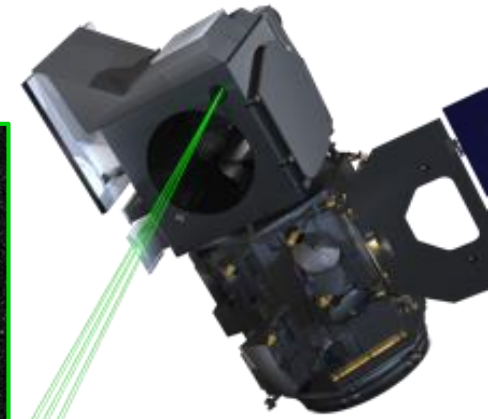
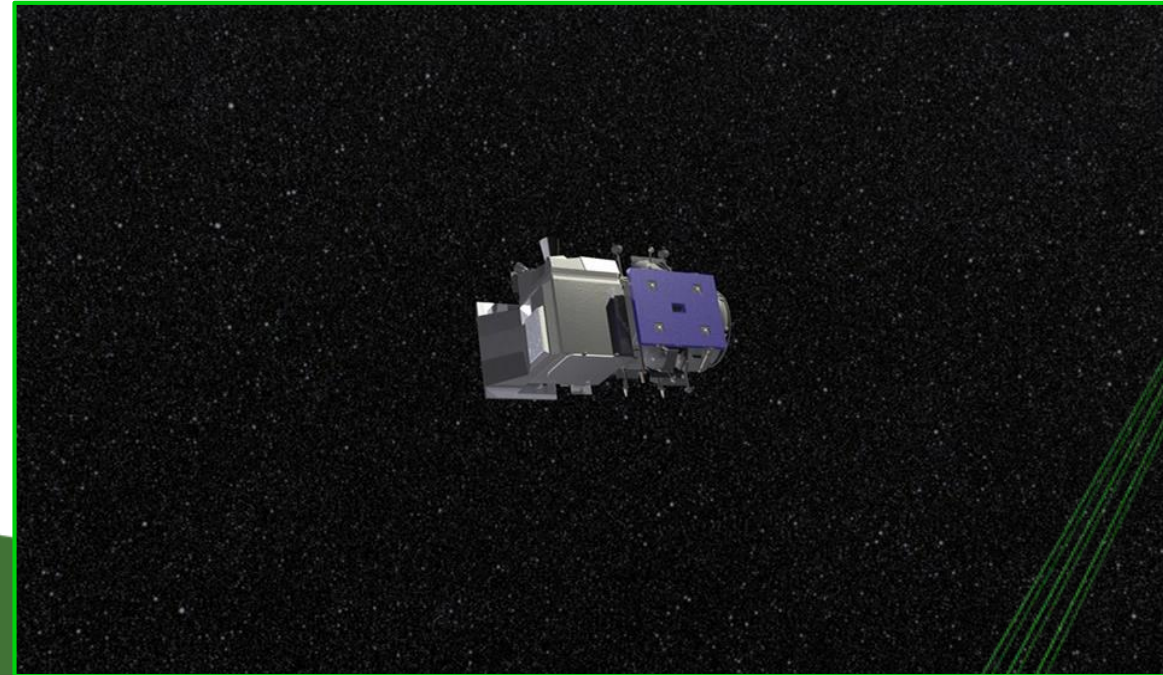
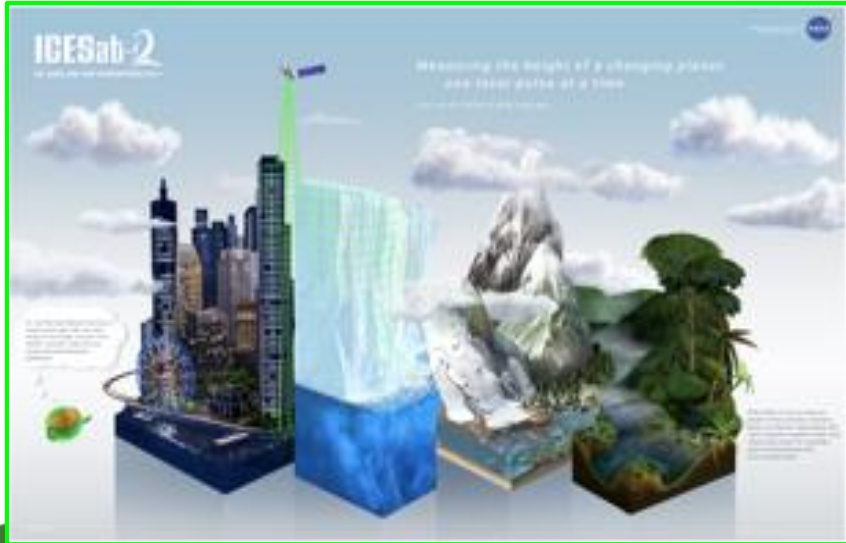
The light is reflected by the ground, vegetation and any clouds and is then collected by GEDI's telescope.

GEDI has a 25-meter diameter photon footprint on the ground.

GLOBE
Trees



Lasers from Space with the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2)



ICESat-2 uses a technology called Light Detection and Ranging or LIDAR. LIDAR is an active remote sensing technology (the laser version of radar) which uses pulses of laser light to measure the 3D structure and height of objects on Earth.

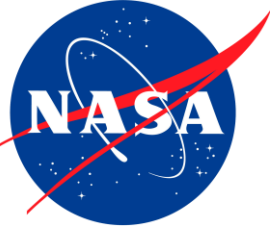
ICESat-2 measurements are made over the Earth's surface between 88° N and 88° S.

GLOBE
Trees



GLOBE Trees

Looking at Trees and Tree Height



"I think that I shall never see a poem lovely as a tree."
 --- Joyce Kilmer (Writer and Poet)

Trees Around the GLOBE Student Research Campaign

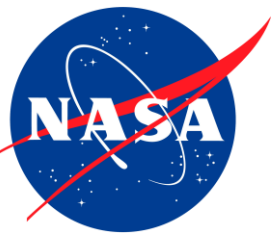
<https://www.globe.gov/web/trees-around-the-globe>



GLOBE Trees

Trees Around the GLOBE Student Research Campaign

<https://www.globe.gov/web/trees-around-the-globe>



MULTIPLE WAYS STUDENT, EDUCATORS, AND CITIZEN SCIENTISTS ARE MEASURING AND OBSERVING TREE HEIGHTS, FROM THE GROUND UP

GLOBE Hand-Held Clinometer



<https://youtu.be/Ky6KhGLw1AU>

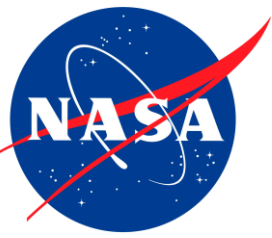
NASA GLOBE Observer Trees Tool for Citizen Science



<https://observer.globe.gov/do-globe-observer/trees>

GLOBE Trees

ONE WAY TO MAXIMIZE ACCURACY OF THE GLOBE TREE HEIGHT DATA IS TO TAKE TREE HEIGHT OBSERVATIONS WITH A HAND-HELD CLINOMETER AND THE NASA GLOBE OBSERVER TREES TOOL, THEN COMPARE THE MEASUREMENTS AND REPEAT!



The NASA GLOBE Observer Trees Tool:

<https://observer.globe.gov/do-globe-observer/trees>

The NASA GLOBE Observer Trees Tool for Citizen Science allows citizen scientists to take tree height measurements, information that can be compared with data from NASA missions.



GLOBE Trees

Optional Observation: Tree Circumference

Tree circumference is a common measurement used by ecologists. It is the measurement around the trunk of the tree, taken at Diameter Breast Height (DBH). DBH is a standard measure 1.35 m from the ground surface and used by



This information, along with the tree height, can help us estimate how much carbon dioxide has



Tree Height Measurements with a Hand-Held Clinometer

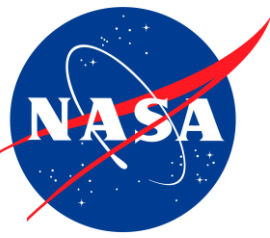


Tree Height Measurements with the NASA GLOBE Observer Trees Tool

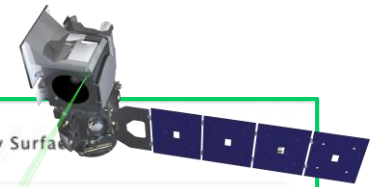
IN THE GLOBE PROGRAM DATABASE, THERE ARE 86,000+ TREE HEIGHT OBSERVATIONS FROM 28,000+ GLOBAL LOCATIONS!

GLOBE Trees

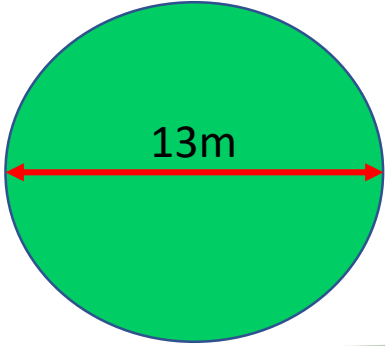
Where is all the GLOBE Tree Height Data coming from?



ICESat-2 TREE HEIGHT DATA AND COMPARE TO GLOBE TREE HEIGHT DATA



Size of ICESat-2 photon footprint on ground



ICESat-2 and NASA GLOBE Observer Data Comparisons
Tree Height and Land Cover
Salisbury, Maryland USA

Product information:
 ● ATL06
 ● ATL07
 ● ATL08
 ● ATL10
 ● ATL12
 ● ATL13

Track ID: 507
 Latitude: 38.43180465698242
 Longitude: -75.63471221923828
 Elevation: -22.14402
 SegmentID: 213251
 Time: 2019-01-30 15:20:37.543
 Beam: gt1l (strong)
 Product: ATL08
 View Photon Data

unavco.org/software/geodetic-utilities/geoid-height-calculator/geoid-height
Your Input Coordinates and GPS Height:
 Latitude: 38.431804° N = 38° 25' 54.49" N
 Longitude: 75.634° W = 75° 38' 2.4" W
 GPS ellipsoidal height: -22.144 (meters)
 Geoid height: -37.015 (meters)
 Orthometric height (height above EGM96 geoid which approximates mean sea level): **14.871 (meters)**
 (Note: orthometric height = GPS ellipsoidal height - geoid height)

NASA GO Trees Tool Data

Tree Photo

Date/Time (UTC): 03/16/2020 20:43:00
 Data Source: GLOBE Observer App
 Latitude/Longitude: 38.4315, -75.6343 (38° 25' 53.4", -75° 38' 3.48")
 Organization: Wallops Space Flight Center
 Site Name: 18SVH446538
 Height (m): 18.93
 Circumference (cm): 106.7
 Surface Conditions: Snow/Ice: No; Standing Water: No; Muddy: No; Dry Ground: No; Leaves on Trees: Yes; Raining/Snowing: No

NASA GO Land Cover Data

Date/Time (UTC): 03/16/2020 20:51:00
 Data Source: GLOBE Observer App
 Latitude/Longitude: 38.4315, -75.6345 (38° 25' 53.4", -75° 38' 4.2")
 Organization: Wallops Space Flight Center
 Site Name: 18SVH446538
 MUC Code:
 MUC Description:
 Surface Conditions: Snow/Ice: No; Standing Water: No; Muddy: No; Dry Ground: No; Leaves on Trees: Yes; Raining/Snowing: No



ICESat-2
 Latitude: 38.4318
 Longitude: -75.6347
 Canopy Height: 19.66m
 Elevation: 14.87m
 Date: 30-Jan-2019

NASA GLOBE Observer
 Latitude: 38.4315
 Longitude: -75.6343
 Tree Height: 18.93m
 Elevation: 14.93m
 Date: 16-Mar-2020

<https://openaltimetry.org/data/icesat2/>

<http://observer.globe.gov>

Brian Campbell, GST, Inc., NASA Wallops Flight Facility

GLOBE Trees

SCIENTISTS CAN USE YOUR TREE HEIGHT DATA

Coming June 2023! – Stay Tuned to the NASA GLOBE Observer Website

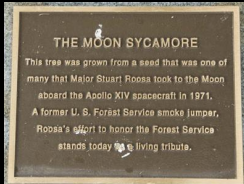
NASA Moon Tree Quest

A 2-Part Challenge:

Goal #1: Take GLOBE Observer App tree height observations of the types of trees that are moon tree species in a species-specific area within the United States.

Goal #2: Take GLOBE Observer App tree height observations of the accessible Apollo 14 Moon Trees currently growing in the United States. The App, when open, will alert the observer when they are close by an Apollo 14 Moon Tree located in the United States.

Species of Moon Tree	Region/State(s)
Douglas-fir	AZ, Northern CA, CO, ID, MT, NM, OR, SD, WA, WY, UT, NV
Loblolly Pine	Southeast (East of the Mississippi River from south of KY) and TX.
Sweetgum	Gulf Coast States
Sycamore	Great Plains and Eastern US
Giant Sequoia	OR, CA



STAY TUNED!





ASSOCIATED LINKS AND CONTACT INFORMATION

Artemis Mission:

<https://www.nasa.gov/specials/artemis/>

Apollo 14 Moon Trees:

https://nssdc.gsfc.nasa.gov/planetary/lunar/moon_tree.html

GLOBE Observer Trees Tool:

<https://observer.globe.gov/do-globe-observer/trees>

GLOBE Observer Trees Resource Library:

<https://observer.globe.gov/do-globe-observer/trees/resource-library>

GLOBE Trees Family Guide:

<https://observer.globe.gov/trees-family-guide>

ICESat-2 Mission:

<https://icesat-2.gsfc.nasa.gov/>

GEDI Mission:

<https://gedi.umd.edu/>

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