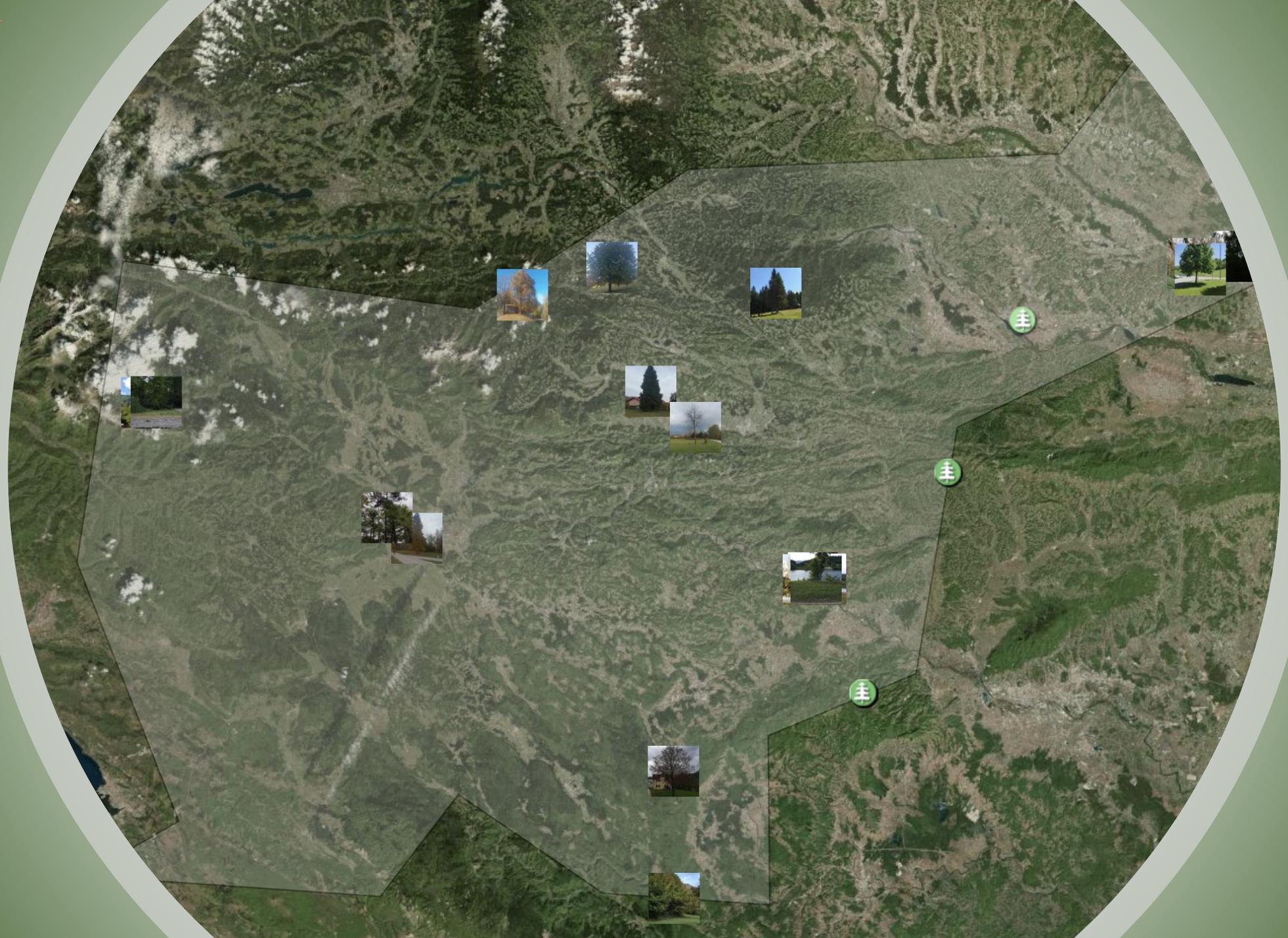
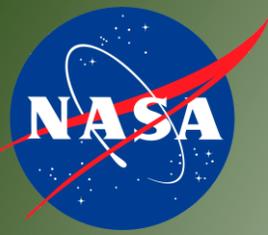


Let's Talk NASA GLOBE Tree Height: Trees Around the GLOBE Student Research Campaign and the NASA GLOBE Trees Challenge 2022: Trees in a Changing Climate

GLOBE Slovenia 24 October 2022



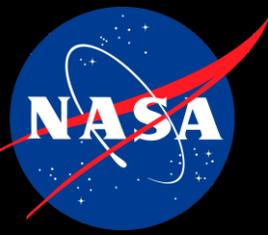
Brian A Campbell – NASA Senior Earth Science Specialist
Lead - ICESat-2 Mission Education
Lead - NASA GLOBE Observer Trees Science
Lead – Trees Around the GLOBE Student Research Campaign
Lead – NASA Wallops Earth Science STEM Engagement





GLOBE Trees

Looking at Trees and Tree Height



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

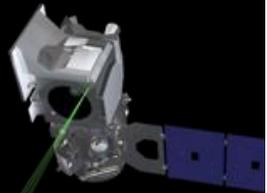
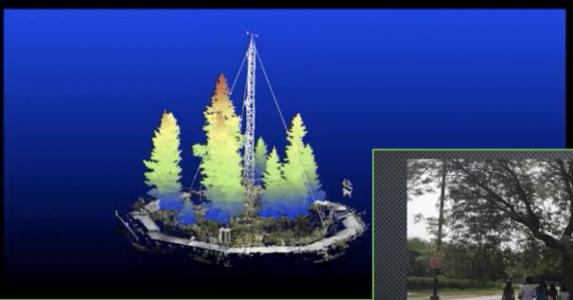
Tree height allows you to track the growth of trees over time

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.

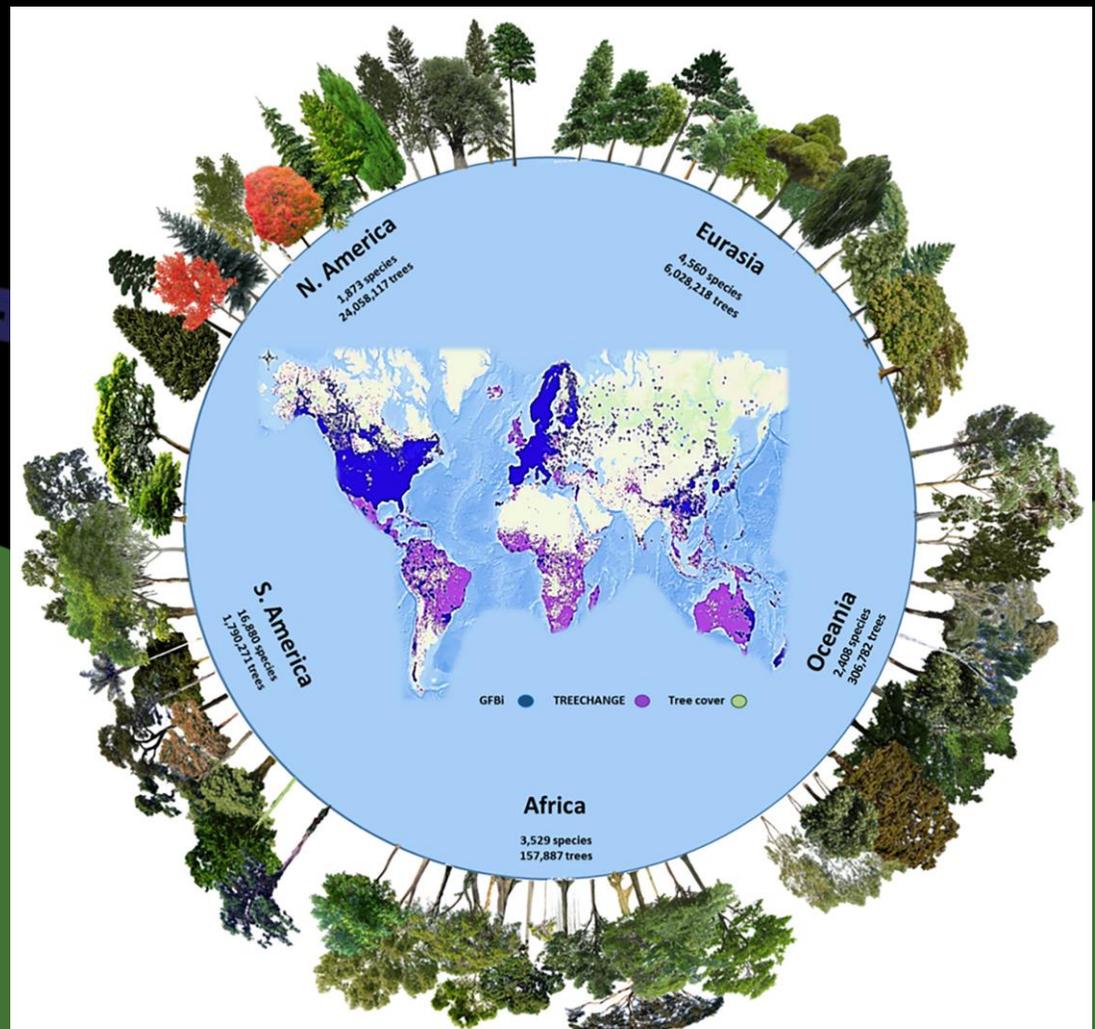
NASA missions utilize an onboard laser altimeter systems to measure the height of our planet, one photon at a time. The advanced technology of ICESat-2 can measure the height of trees and forests all around our planet.

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



"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>



 THE GLOBE PROGRAM

**Year 5: 1 October 2022 - 30 September
2023**

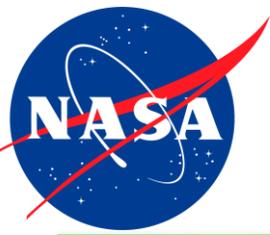
Looking at Change Over Time and Organizing
Student Research

Our goal is to help teachers guide students with their student research projects focusing on tree height, land cover, greenings (green-up/green-down), and carbon cycle, by showcasing how to use new and archived GLOBE data, online data tools and maps, and bringing together GLOBE schools for project collaboration for IVSS 2023. This year, the campaign will focus deep on getting students really focused on the trees and land cover in their local regions by taking a detailed look at the characteristics in every land cover and tree height photo they take.

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

GLOBE
Trees

The Trees Around the GLOBE
Student Research Campaign



Brian Campbell
Campaign Lead
NASA Wallops/GST
Virginia USA



Peder Nelson
*GLOBE Partner &
Online Tool and
Data Expert*
Oregon State
University
Oregon USA



Peter Falcon
*Cross-Country
Coordination Lead*
NASA JPL
California USA



Dorian Janney
*Emeritus
Cross-Campaigns Lead*
NASA Goddard/ADNET
Maryland USA



Christopher Shuman
*Emeritus
Campaign Subject
Matter Expert and Trees
in the News Lead*
NASA Goddard/UMBC
Maryland USA

GLOBE **Trees**

Core Campaign Team

Cross-Campaigns Collaborations

Trees Around the GLOBE Student Research Campaign

Tree Height, Land Cover, Greenings

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



European Phenology Campaign

Greenings (Green-up, Green-down, Carbon Cycle)

<https://www.globe.gov/web/european-phenology-campaign>

The GLOBE Program



GLOBE Mission Mosquito

Mosquitoes, Tree Holes

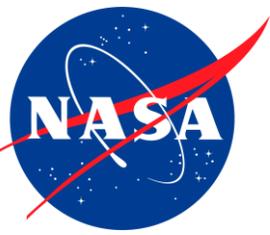
<https://www.globe.gov/web/mission-mosquito/overview>



Urban Heat Island Effect – Surface Temperature Field Campaign

Land Surface Temperature – Shaded and Non-shaded tree areas





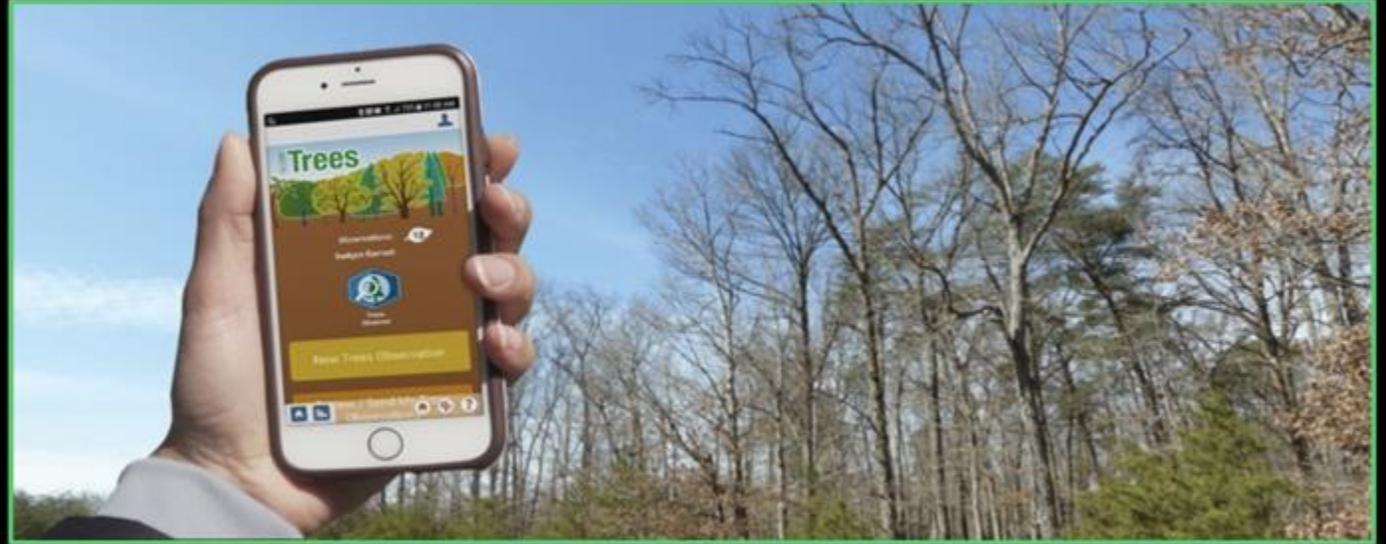
MULTIPLE WAYS STUDENT, EDUCATORS, AND CITIZEN SCIENTISTS ARE MEASURING AND OBSERVING TREE HEIGHTS, FROM THE GROUND UP

GLOBE Hand-Held Clinometer



<https://youtu.be/Ky6KhGLw1AU>

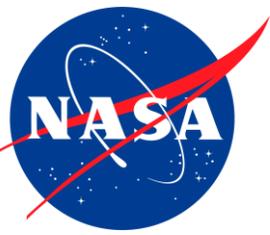
NASA GLOBE Observer Trees Tool for Citizen Science



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

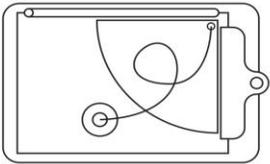
GLOBE Trees

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 Hand-Held Clinometer for Measuring Tree Height

Build a Clinometer



1. Pull a knotted string through the circle in the upper right corner.
2. Attach a weight to the bottom of the string.
3. Tape your straw to the top of the page.
4. Clip to a clipboard or hold against a hard surface.

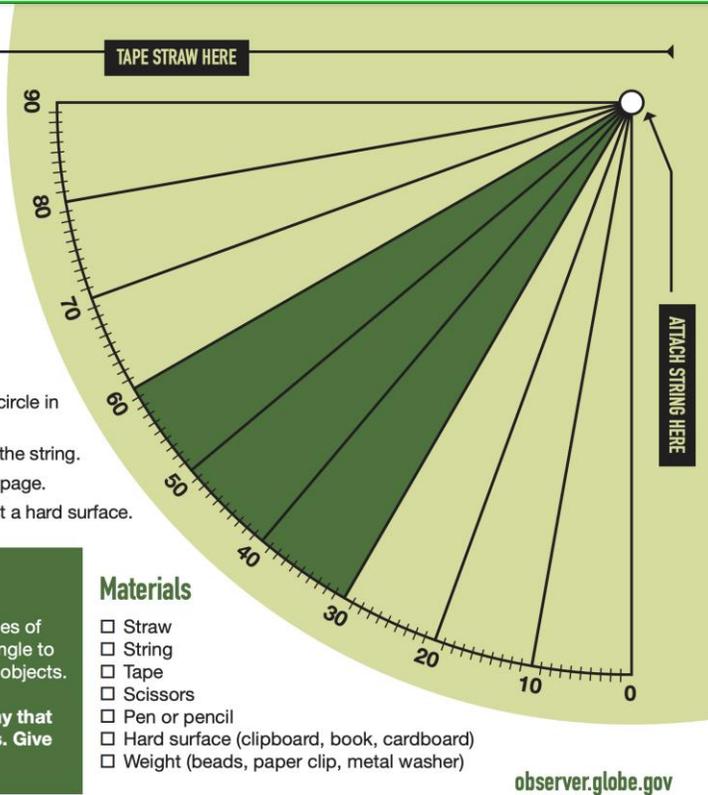
What is a clinometer?

A clinometer is tool for measuring angles of slope or elevation. You will need this angle to calculate the height of trees and other objects.

Measuring tree height is just one way that scientists study the health of forests. Give it a try using this paper clinometer.

Materials

- Straw
- String
- Tape
- Scissors
- Pen or pencil
- Hard surface (clipboard, book, cardboard)
- Weight (beads, paper clip, metal washer)



Calculate the Height of a Tree

1. Find a tree on level ground that is at least 15 ft (5 m) tall. Stand where you can clearly see the base and the top.
2. Look at the top of the tree through the drinking straw.
3. Use the clinometer to measure the angle at which you are looking at the tree. It helps to have a friend tell you where the string crosses the arc.
4. Measure the distance to the tree using a tape measure or your pace length.



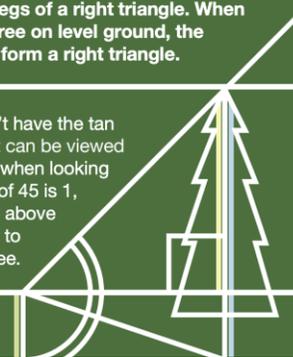
You can also measure trees with the GLOBE Observer app - no tape measure or clinometer required!



What is a tangent?

The tangent (tan) of an angle is a trigonometric function used to calculate the legs of a right triangle. When measuring a straight tree on level ground, the tree trunk and ground form a right triangle.

If your calculator doesn't have the tan function, find a tree that can be viewed from a 45 degree angle when looking at the top. The tangent of 45 is 1, so the height of the tree above your eye height is equal to the distance from the tree.



Which measurement system do you prefer?

Imperial (Feet and Inches) or Metric (Meters and Centimeters)

Circle or highlight the units you plan on using. Remember, you can use either system, but it's important to only use one.

Your Height in. cm - 4 in. = in. cm = Eye Height in. cm

This is an estimate. You can also measure your eye height with the tape measure.

Distance from Tree in. cm x tan Clinometer Angle = Vertical Leg in. cm

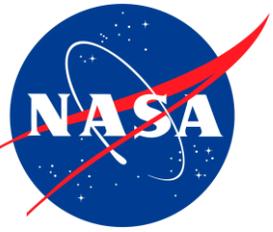
Vertical Leg in. cm + Eye Height in. cm = Tree Height in. cm

Tree Height in. cm ÷ 12 = Tree Height ft. m

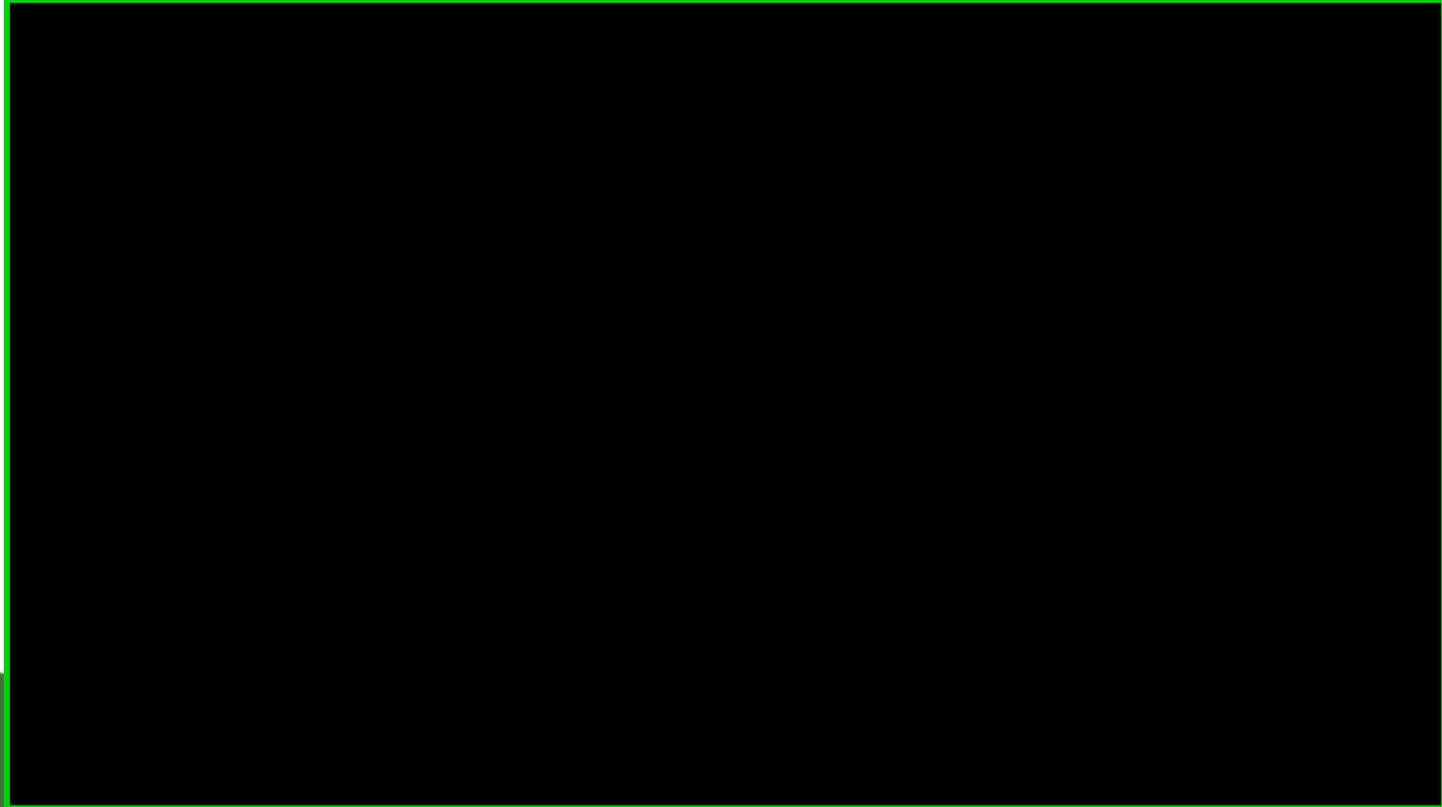
You can use the same process to measure anything taller than you on level ground.

GLOBE Trees

Clinometer: an instrument used for measuring the angle of elevation of slopes. A clinometer can be used to measure the heights of trees, poles, towers, and buildings.

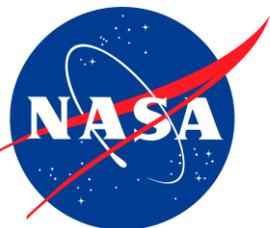


The NASA GLOBE Observer Trees Tool for Citizen Science allows citizen scientists to take tree height measurements, information that can be compared with data from NASA missions.



GLOBE
Trees

The NASA GLOBE Observer Trees Tool:
<https://observer.globe.gov/do-globe-observer/trees>

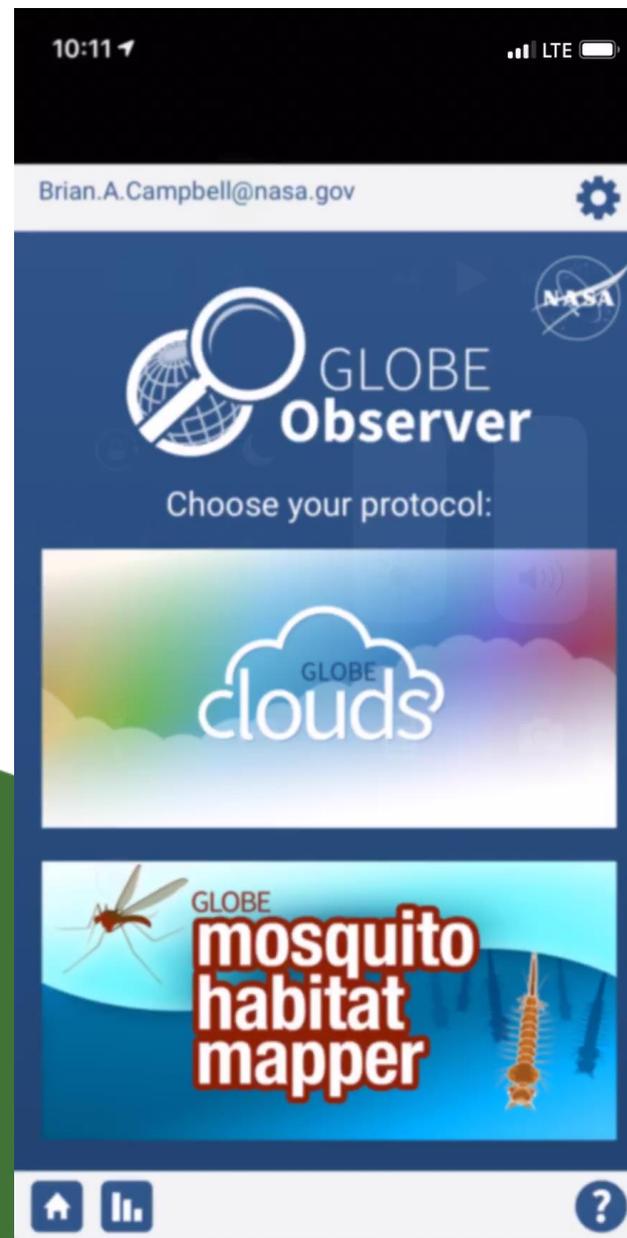


An Example Observation of the NASA GLOBE Observer Trees Tool

The 4 most important things to remember:

- Only take NASA GO observations if it is safe and legal to do so.
- When choosing a tree, make sure you can see the base and top of the tree and be able to walk to its base in a straight line with no obstacles.
- Always keep your cell phone's camera at eye level when measuring the angles to the base of the tree and the top of the tree.
- Always make sure you have the correct height for the current observer taking the tree height observation - you can check this in the Trees Tool Introduction section.

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 researchers, foresters and ecologists.

This information, along with the tree height, can help us estimate how much carbon dioxide has been pulled in by a tree over its lifetime.



Tree Height Measurements with a Hand-Held Clinometer

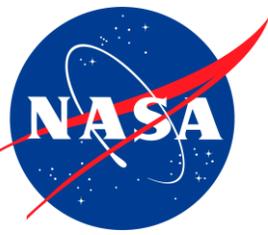


Tree Height Measurements with the NASA GLOBE Observer Trees Tool

GLOBE Trees

Where is all the GLOBE Tree Height Data coming from?

IN THE GLOBE PROGRAM DATABASE, THERE ARE 73,000+ TREE HEIGHT OBSERVATIONS FROM 23,500+ GLOBAL LOCATIONS!



THE ONLINE OPEN ALTIMETRY TOOL TO VISUALIZE
ICESAT-2 TREE HEIGHT DATA AND COMPARE TO GLOBE TREE HEIGHT DATA
Looking at groups of trees and ICESat-2

SCIENTISTS CAN USE YOUR
TREE HEIGHT DATA

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

Legend:
● ATL06
● ATL07
● ATL08
● ATL10
● ATL12
● ATL13
Product Information

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

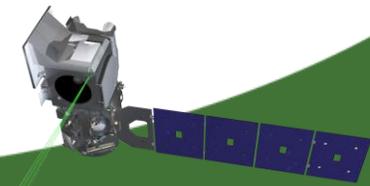
NASA GO Land Cover Data
Date/Time (UTC): 03/16/2020 20:51:00
Data Source: GLOBE Observer App
Latitude/Longitude: 38.4315, -75.6345 (38° 25' 53.4", -75° 38' 4.2")
Organization: Wallops Space Flight Center
Site Name: 18SVH446538
MUC Code:
MUC Description:
Surface Conditions: Snow/Ice: No; Standing Water: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

ATL08: Ground Elevation and Canopy Surface
Track 507 - Scale 1:1000
Surface Elevations
Elevation (m)
Canopy Height
Beam: gt1l
Latitude: 38.43180465698242
Canopy Heights: 19.667034 m

ICESat-2
Latitude: 38.4318
Longitude: -75.6347
Canopy Height: 19.66m
Elevation: 14.87m
Date: 30-Jan-2019
<https://openaltimetry.org/data/icesat2/>

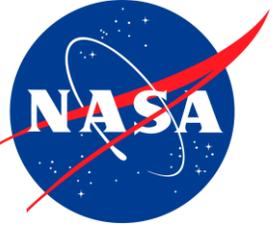
NASA GLOBE Observer
Latitude: 38.4315
Longitude: -75.6343
Tree Height: 18.93m
Elevation: 14.93m
Date: 16-Mar-2020
<http://observer.globe.gov>

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



GLOBE
Trees

Comparing NASA GLOBE Observer Tree Height Data to NASA Satellite Data on Open Altimetry
<http://openaltimetry.org>

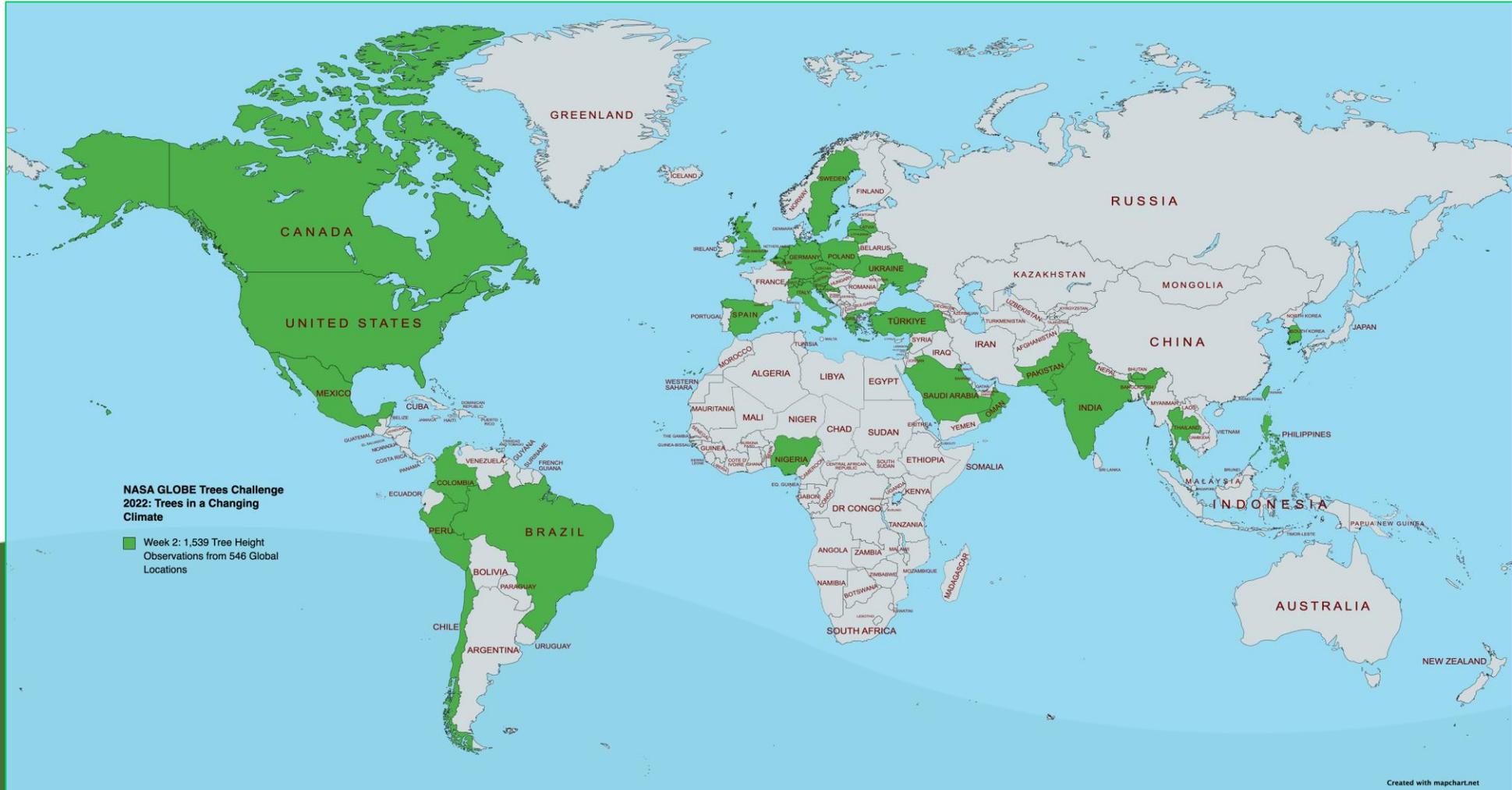
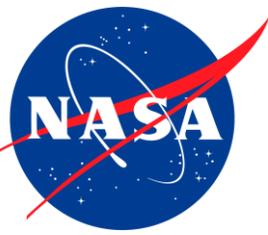


NASA GLOBE Trees Challenge 2022: Trees in a Changing Climate

With the 3.03 trillion trees and 78,000 tree species on Earth, we are constantly striving to build and sustain the global inventory of tree height observations and to collect as many tree circumference measurements as possible. Scientists especially need data from multiple trees in areas that contain many trees. This data density is a way for scientists to build a more robust dataset of the tree heights from the ground and space.

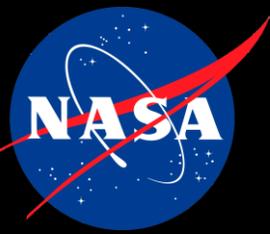
GLOBE
Trees

<https://observer.globe.gov/trees-2022>



GLOBE Trees

The Challenge numbers so far!
1,539 Tree Height Observations from 546 Global Locations



ASSOCIATED LINKS AND CONTACT INFORMATION

THE GLOBE Program:

<http://www.globe.gov>

NASA GLOBE Observer Trees Tool:

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

NASA GLOBE Trees Challenge 2022: Trees in a Changing Climate

<https://observer.globe.gov/trees-2022>

NASA GLOBE Observer Land Cover Tool:

<https://observer.globe.gov/do-globe-observer/land-cover>

GLOBE Trees Family Guide:

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

ICESat-2 on Open Altimetry:

<http://openaltimetry.org>

ICESat-2 Mission Website:

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

Contact Information: brian.a.campbell@nasa.gov



GLOBE
Trees