GLOBE clouds

Citizen Science Guide for Libraries

January 2019 – Review Copy

This guide is a working document intended to help library staff implement GLOBE Observer Clouds citizen science in their programming. Please send your feedback to theresa_schwerin@strategies.org.

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Introduction

Clouds play an important role in our Earth system. They affect incoming energy, in the form of sunlight as well as outgoing energy, as heat emitted from Earth's surface back to space. Thus, they help regulate Earth's temperature. NASA and other space agencies have a number of satellites orbiting Earth and collecting data about clouds and Earth's energy. Combining this global view from above with ground observations of clouds and sky conditions from below helps scientists get a more complete picture of clouds in our atmosphere.

Because clouds can change rapidly, frequent observations are needed from citizen scientists. *Citizen science* engages volunteers in the collection and analysis of science data relating to the natural world, typically as part of a collaborative project with professional scientists. Through the GLOBE Observer app, citizen scientists of all ages can learn more about clouds and participate in NASA science. Formal training in science is not required to participate, just a curiosity about our planet.

Whether you're planning for a special event or an ongoing program, there are many ways to bring citizen science into your library programs. Programming ideas include arts activities, hands-on investigations, story hour, book clubs and more.

Materials

- Smartphone or tablet with GLOBE Observer app downloaded
  - Download from App Store or Google Play
  - Create a login using code: Library
  - Using a smart tablet is good when working with groups - easier to show the screen
- Access to outside
- GLOBE Cloud Chart (optional)
- GLOBE Observer card (optional)
- Additional resources can be found under programming resources (p. 12)

Audiences

GLOBE Observer can be used in library programming for elementary aged (5-11), tweens (11 to 13), teens (13- 18), adults, family groups, and seniors. When working with elementary-aged children, it's recommended to use printable resources for making sky observations, with an adult entering data into the app.

Planning Timeline

NASA needs cloud observations from citizen scientists throughout the year; both ongoing observation programs or organizing observations around one or more events throughout the year are valuable.

Two Months+

Plan your event

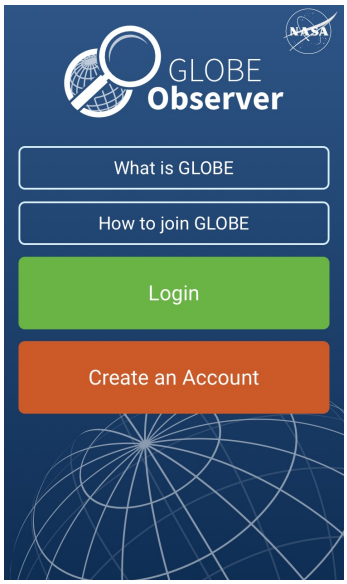
- Goals and target audience
- List of tasks and who is responsible for each
- Select date(s)
- Develop promotional strategy and begin promoting (see Appendix ___ for promotional resources)

One Week Before

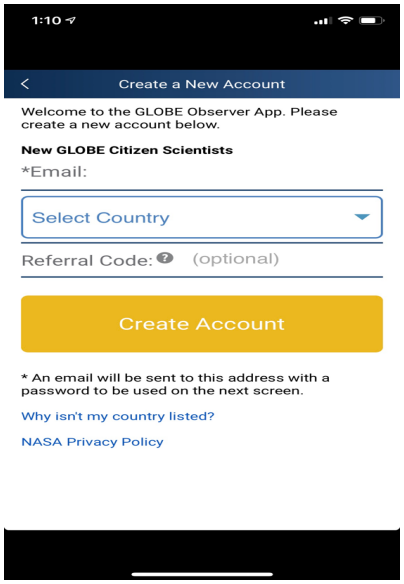
- **Download the app**: https://observer.globe.gov/about/get-the-app.
- **Create a login and register:**

1. When you first open the app, you will need to create a login by entering an email address.
2. The app and use are completely free. You can set-up referral codes to identify and create maps of observations from GLOBE Observers in your programs (coming soon).
3. ***An email is sent immediately with a password.*** Login with the password and you're ready to start observing.

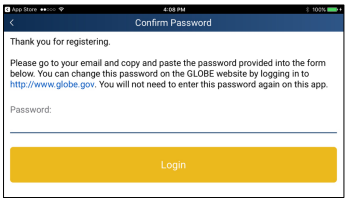
Below A-C: *Screenshots showing the registration process.*



A. Open app on smart phone or tablet and select Login/Create an Account.



B. Enter email and referral code (if provided), click Create Account.



C. Login using the emailed password.

Planning Timeline (Cont)

One Week Before

- Consider whether participants will have or need Internet access to download the app during your program or event. Observations can be made offline and uploaded later.
- Practice making observations using the app. Explore features in the app to help with cloud identification, such as satellite overpass times, cloud type key and help screens. There are also useful resources to sharpen skills and practice estimating cloud cover (http://bit.ly/cloudcoverpractice) and identifying cloud type (http://bit.ly/cloudtypepractice).
- Select a site outside for making observations and plan your logistics. *(How will you get patrons there? Will you start outside at this location? Or begin inside the library?)*
- Determine when the satellite will overpass your location in case you want to be outside taking observations at that time. It is not necessary to be taking observations when satellites are passing overhead, but this will allow your observations to be matched with the satellite overpass.
- Send out announcements to local media and through the library's social media accounts. See page 21 for promotional materials and social media shareables that can be customized.
- If possible, send out directions to registered participants or post on your event or program page so they can download the GLOBE Observer app, register, and are ready to go!
- Display promotional materials for your program (e.g., book displays and flyers).

Day before the program

- Make sure your GLOBE Observer app is up-to-date and that you can login easily (logging in to the app will automatically install any updates).
- Send final reminders to participants if registration is required for your program.
- Print out and copy any handouts needed.
- Do a dry run of your planned program with library staff and volunteers.

Morning of the program

- Charge your smart phone or tablet
- Test out the app to be sure everything is working.
- Check the weather; if needed, consider a rainy day back up plan (e.g., take sky observations from a library window).

Safety Notes

- Review safety procedures with participants.
- In particularly remind people to **Never look directly at the Sun.**
- Select a safe location for making sky observations (e.g., without traffic). Patrons will be looking up at the sky and may not be aware of their surroundings. It is not suggested to use the library parking lot unless you are able to block off a section from traffic.

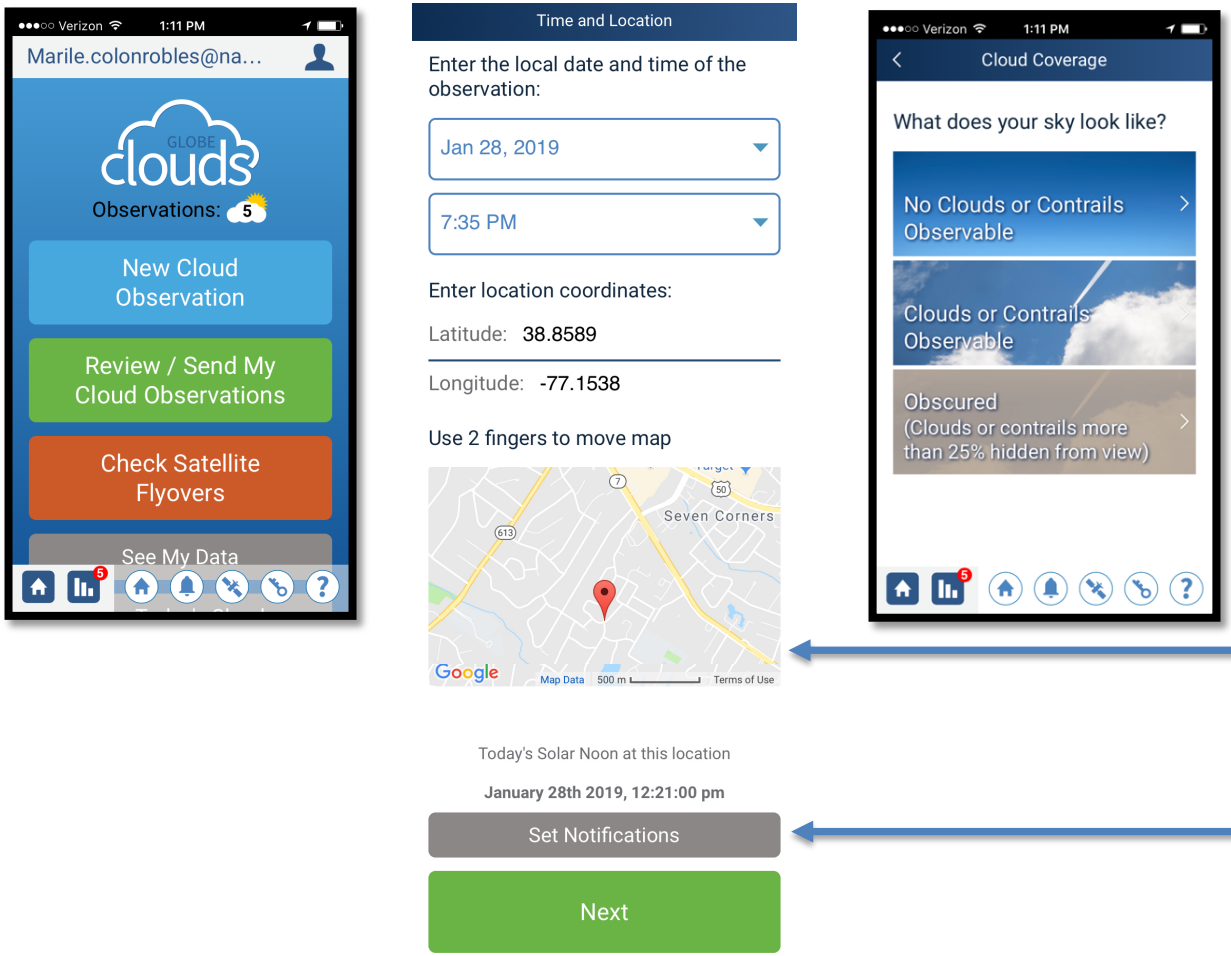
NOTE: the screenshots shown on pages 4-11 were current as of January 2019. The GLOBE Observer app is updated with improvements from time-to-time and some screens may be slightly different from what's shown in this guide. Always login before a program to make sure your app is updated and recommended to do make observation to see if anything has changed.

GLOBE Observer: Step-by-Step Sky Observing

Download and Register

The GLOBE Observer app walks through the steps for taking and submitting cloud observations. Download the app, register, and open the Clouds tool. While observations are useful at any time, your reports can help verify satellite measurements if taken during a satellite overpass. Select ***Check Satellite Flyovers*** from the home screen (below left) to determine these times and to set notifications reminding you 15 minutes before the satellite passes over and to customize your notifications (e.g., days of the week, time, and satellites).

Start by selecting ***New Cloud Observation*** (left). The app fills in ***date, time, and your location*** information based on information already on your phone (center). It then walks you through reporting. First, ***Cloud Coverage*** – What does your sky look like? Are clouds visible? (right)



Pro tips

Demonstrating the app to a group? For small groups demonstrate with a smart tablet (instead of a smart phone). For larger groups, project the PowerPoint slides with the screen shots shown in this section.

Open the app in different languages: Login, then click on your name at the top of any screen, and select, "Change language."

The app includes English, Spanish, French, German, Portuguese, Arabic, and more.

Location shown not correct? The app uses the GPS in your phone. The map is interactive, If your location shown is not correct, move the map to your location using 2 fingers.

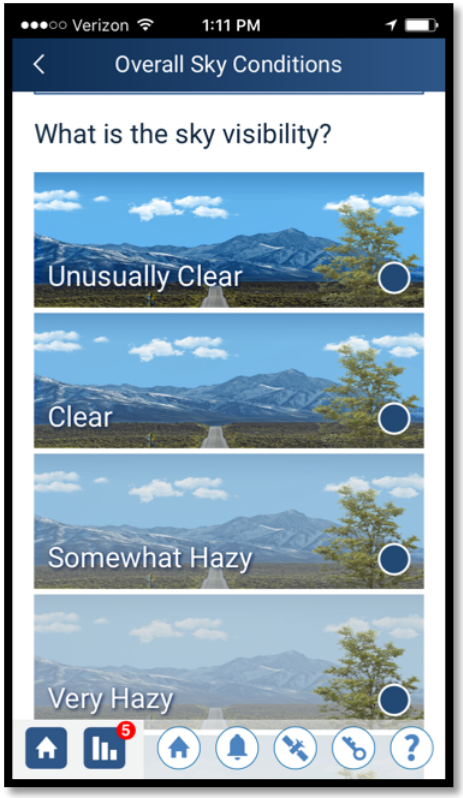
Set Notifications to receive alerts when a satellite is overhead

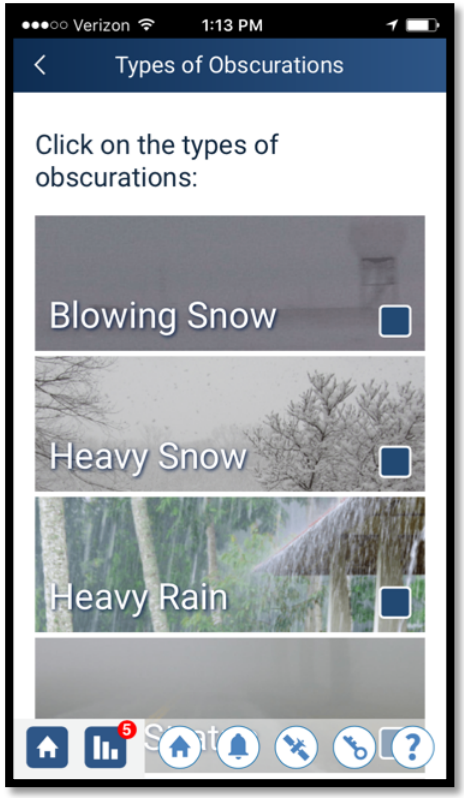
No Clouds or Contrails Observable

If no clouds or contrails are visible, the app will then step you through questions about ***Overall Sky Conditions*** including ***sky color***, which is a measure of the amount of aerosols present *and* ***sky visibility*** (How clear is the sky?). See screenshots below (left and middle). It will then ask you about **Surface Conditions** (see p. 7)

Obscured

Clouds or contrails are more than 25% hidden from view. This is not asking if there is a building blocking your view of the sky, but if there is a natural occurrence that is making it difficult to observe the sky, such as blowing snow, heavy rain, dust, fog, etc. See screenshot below (right).



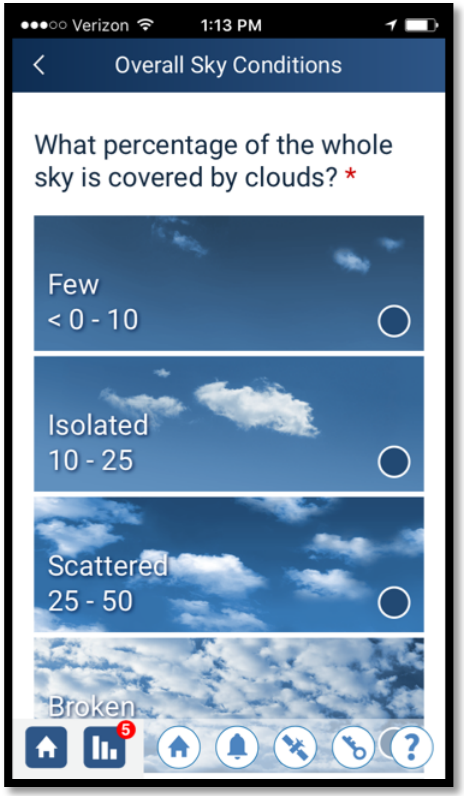


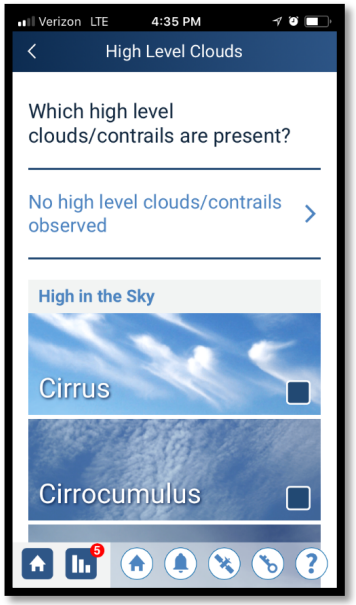
Clouds are Visible

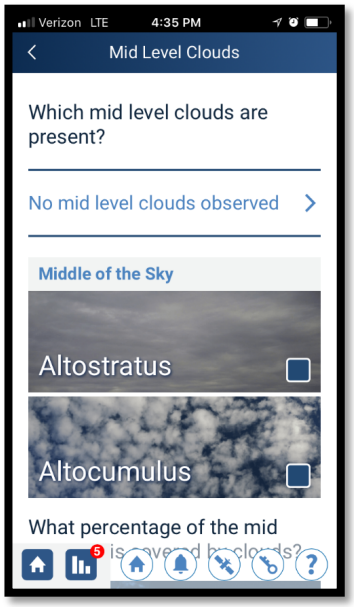
If clouds are observed, the app walks through identifying how much of the entire sky is covered with clouds by altitude: ***percentage covered by high-, medium-, and low-level clouds***. Pictures of cloud types and percentages guide you along with visual cues. After entering information on the clouds that are visible, the app then goes to the screens shown on page 5 for ***sky color*** and ***sky visibility***.

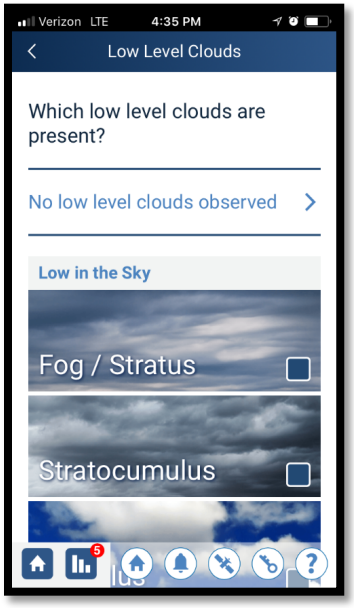
Pro tips: Determining the percentage of the entire sky covered by clouds cloud cover can be tricky, with many people overestimating this amount. Following are tips and activities to practice cloud cover estimating skills.

- Use the **average of several independent estimates** from individuals in a group or family.
- **Create simple cloud models** using colored paper (below)
- Use the online **cloud estimation interactive** at http://bit.ly/cloudcoverpractice





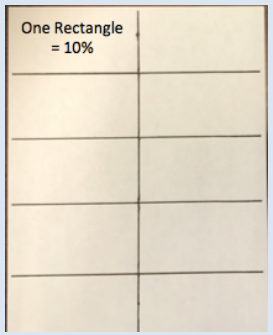


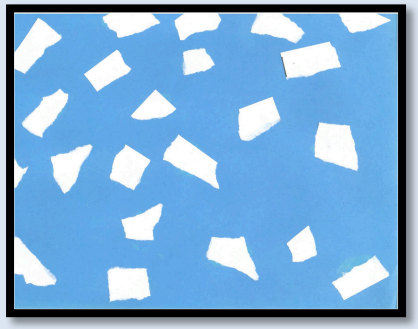


Right: Simple Cloud Cover Model *to practice estimating %*

- Divide a piece of white paper into equal blocks. In this example, one block = 10%.
- Cut or tear up different numbers of blocks into "clouds" and glue them onto your "sky" - a blue piece of paper (right).
- Have several people do this, as clouds come in different sizes and shapes. For example, 50% cloud cover could mean half the sky is clear; or it could mean lots of little cumulus clouds.

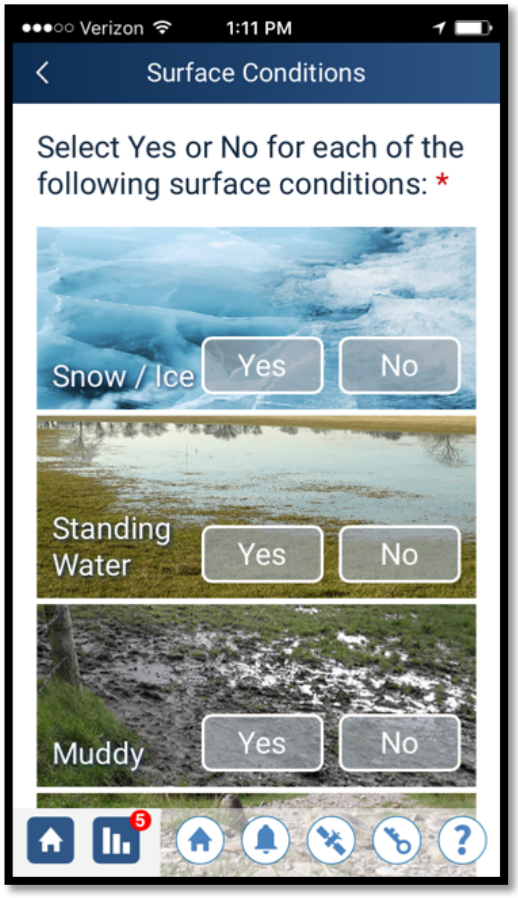
What percentage of the blue "sky" page to the right is covered by "clouds"?
(Answer: 2 rectangles or 20%)

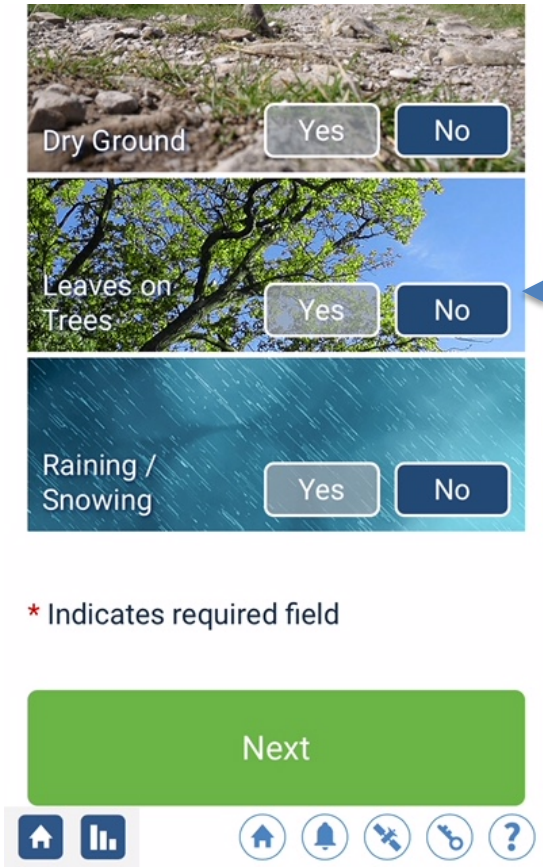




Surface Conditions

Surface conditions (snow/ice, standing water, muddy, dry ground, leaves on trees, and raining/snowing) are helpful for improving identification of features in satellite images, e.g., snow, ice, clouds look similar looking down from space satellites, your observations provide ground verification.



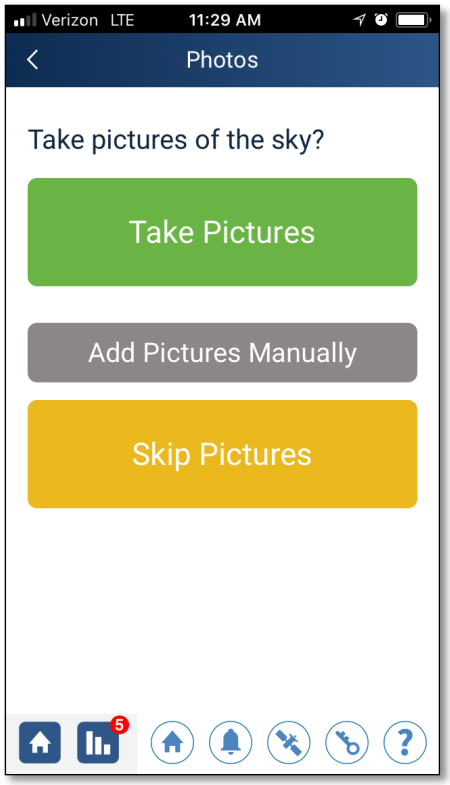


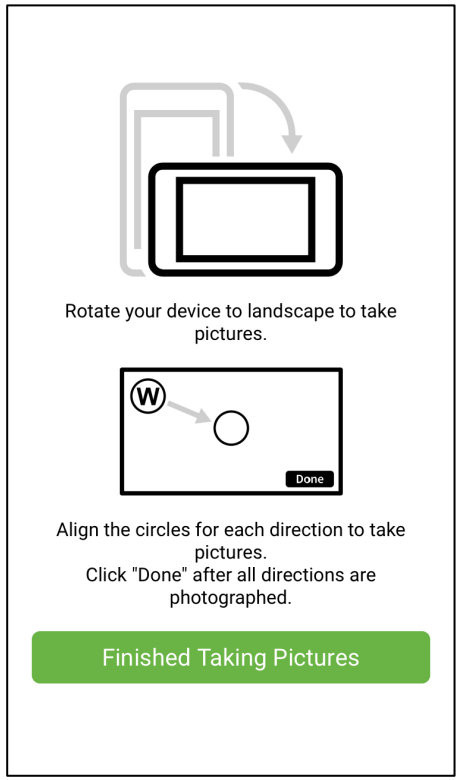
Pro tips:

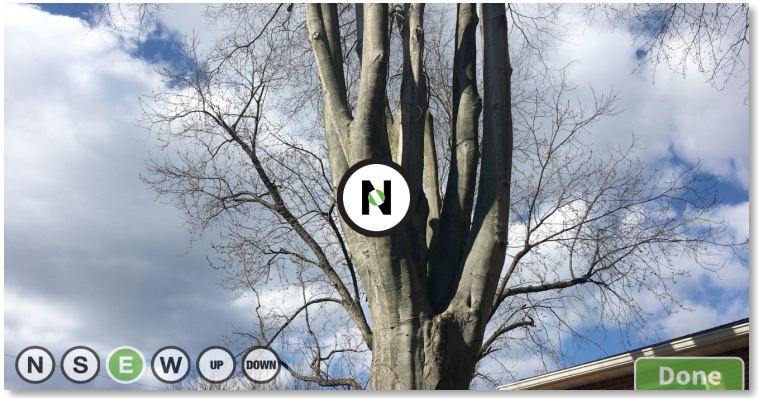
Leaves on Trees: What do you do if some of the deciduous trees (shed their leaves in the fall) have leaves, but others don't, or if a tree has some of its leaves? If more than half of the leaves remain on the tree or trees, select "Yes," but if the tree has lost more than half its leaves, select "No."

Photograph the Sky (Optional)

You will be able to take and submit photos with your sky observations. Be sure to take the photos outside. Rotate your device to landscape and move the phone/tablet until the letter is in the circle. Line up your view with the ***direction guide (N, S, E, W, Up, and Down)*** and the app will automatically take the photo, when your smart phone of tablet is pointed in the correct direction (below right).







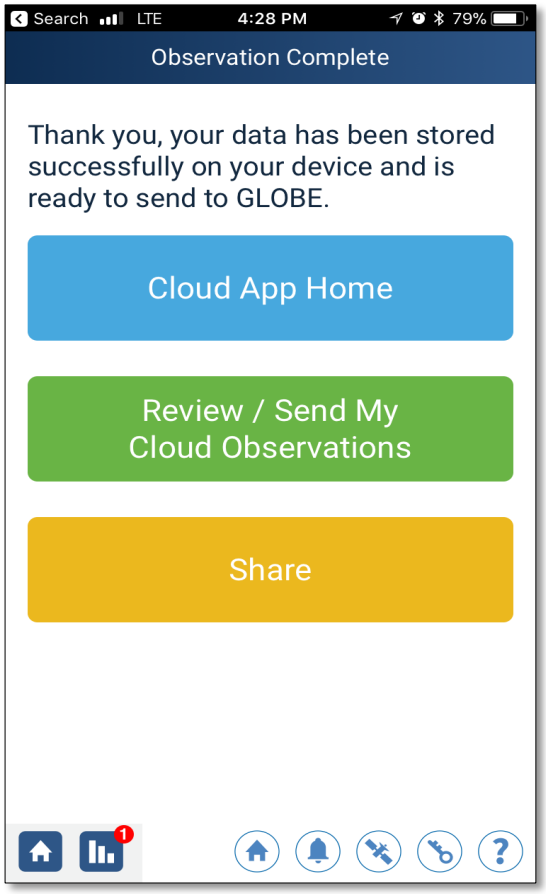
Above: Image uploaded via GLOBE Observer of clouds observed in Redmond, WA

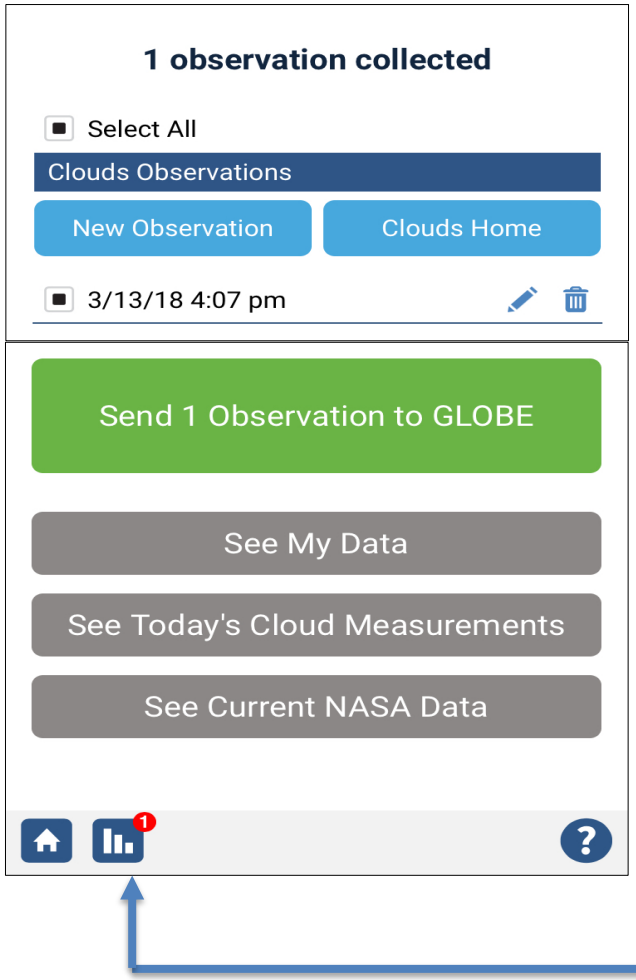
Pro tip

Screen doesn't rotate to landscape? Make sure screen lock is turned off.

Submit Your Observations

After completing your observations, your data and photos are stored in the GLOBE Observer app on your phone until you review and send these to GLOBE, by selecting ***Review / Send my Cloud Observations*** (see screenshot below, left). This is particularly useful if you don't have wifi or phone connection while outside. You can submit one or more observations, then select ***Send Observation to GLOBE*** (below right). Click See My Data to access all observations submitted.





Pro tips

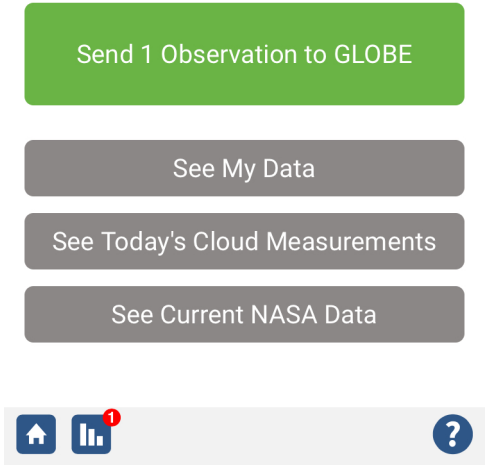
Need to **check or edit an observation before submitting** to GLOBE? Or delete practice or demo observations? Use the icons to the right of the observation date (pencil – edit, trash can – delete).

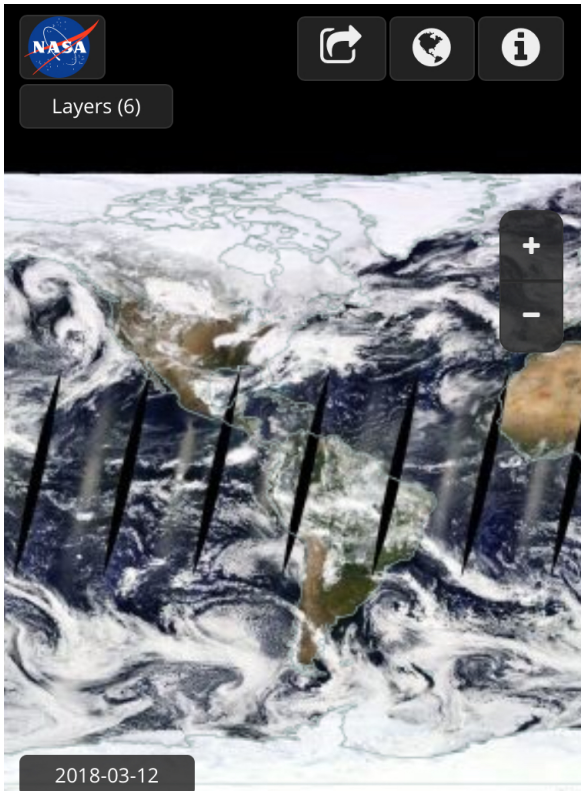
Unsubmitted Observations?
A quick way to see if you have unsubmitted observations – when logged in, at the bottom of any screen an icon of a graph – if there's a red circle with a number it indicates the number of saved observations that have not yet been submitted to GLOBE.

Clicking that icon takes you to this observation submission screen

Explore Cloud Observations by GLOBE Observers and Current NASA Data from Satellites

If you are connected to the Internet, you will be able to use the app to see daily ***cloud observations from all GLOBE Observers (middle image)*** and the ***current NASA cloud observations*** from the Terra satellite ***(right image)***. The satellite image is from NASA Worldview, which provides images typically within 3 hours of observation.

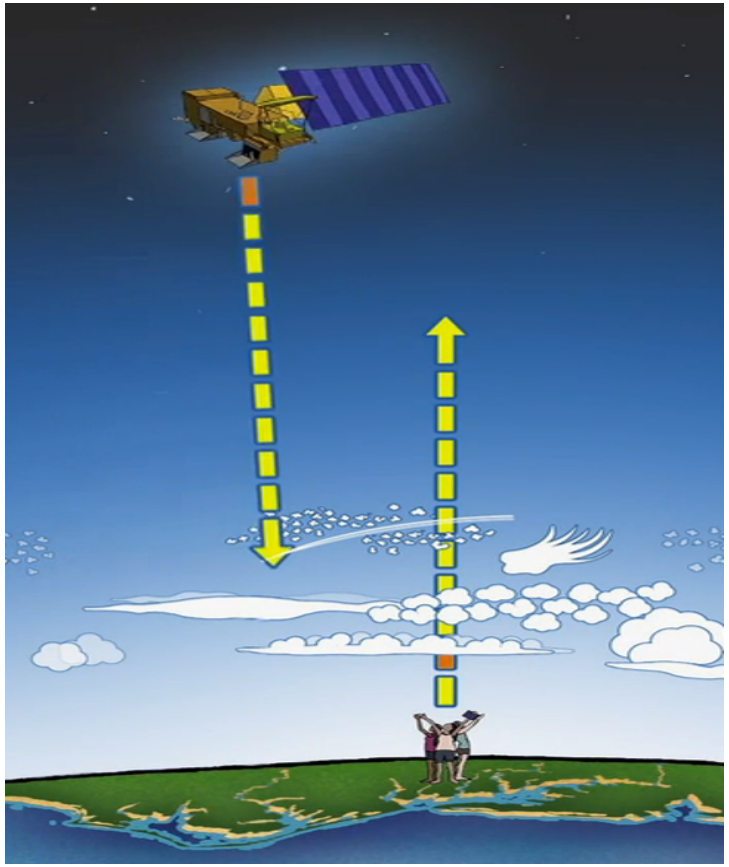


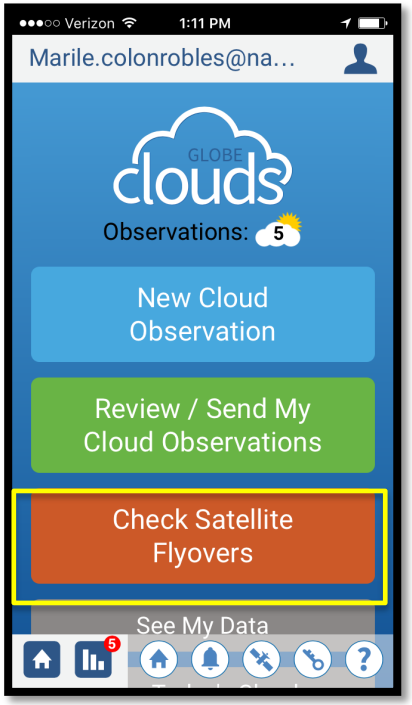


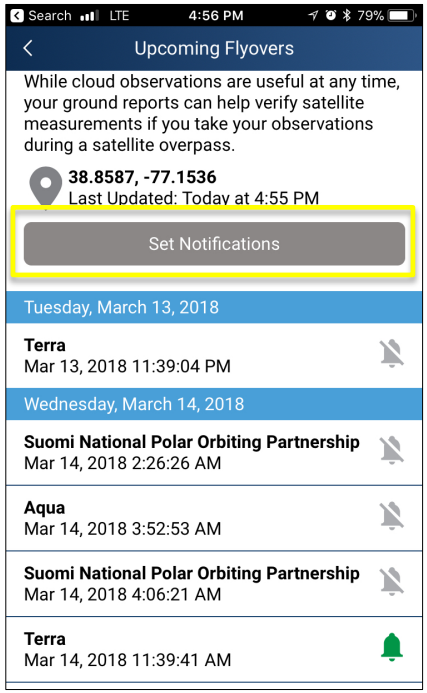
NASA GLOBE Observer Clouds with Satellite Matching

The GLOBE Clouds Team at NASA Langley Research Center has been collecting citizen scientist observations of clouds for twenty years. These observations help researchers understand the data being collected by satellites observing our atmosphere, and, in particular clouds. Certain cloud types, like thin wispy cirrus, are sometimes hard to detect by certain satellites. Also, certain conditions like clouds in a snow-filled area make it hard for satellites to distinguish what is a cloud and what is snow. Our eyes are great detectors and can give researchers some very important information.

GLOBE Observer cloud observations submitted are matched with satellites overhead of the observer taking measurements at about the same time. While observations are useful at any time, your reports can help verify satellite measurements if taken during a satellite overpass. Select ***Check Satellite Flyovers*** from the home screen ***(left image)*** to determine these times and to ***set notifications (middle image)*** reminding you 15 minutes before the satellite passes over and to ***customize your notifications, e.g., days of the week, time, and satellites (right images)***.



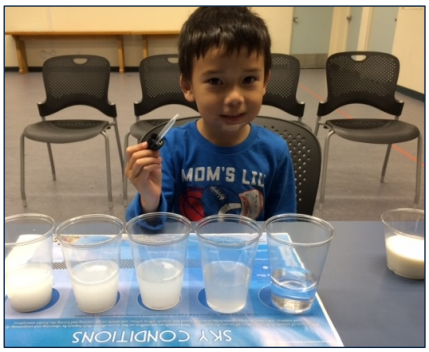




Pro tips: Find a schedule of upcoming satellite flyovers for several days in advance under Check Satellite Flyovers.

Set notifications to select when you do (and don't want) to be notified (e.g., skip days of the week or only receive notifications during certain times of the day).

Programming Resources



Above left: Children estimate cloud cover through this hands-on activity using construction paper: *Estimating Cloud Cover: A Simulation* (Credit: The GLOBE Program). **Above right:** Earth Day 2017 activities at the San Francisco Public Library included GLOBE Observer and the STEM activity: *Sky Conditions*. (Credit: San Francisco Public Library).

Tales from the Field: Citizen Science in Library Settings

For Earth Day 2017 and 2018, the GLOBE Observer team partnered with the STAR net library network (starnetlibraries.org) to engage libraries across the United States to offer programming around NASA resources related to weather and clouds. While the resources provided to participating libraries focused on clouds and citizen science using the GLOBE Observer mobile app, libraries adapted their programs to a variety of different themes beyond science and clouds, including

Agriculture
Arts and Crafts
Citizen science
Conservation/environmental stewardship
Community or local sustainability
Ecology
Environmental awareness or nature appreciation
Gardening, planting, or community gardens
Local/library cleanup
Nature Walk
Photography Club
Recycling
Sky and Atmosphere
Weather and Weather Hazards
Water cycle

Following are brief examples from library staff of programming conducted using GLOBE Observer Clouds.

Local/place-based concern or community benefit:

- *Use GLOBE Clouds resources to teach children and parents in the community about weather safety, including what the different clouds look like, what to look for, and how.*
- *Partner with a local organization (e.g., science museum or university), agency, or expert (e.g., meteorologist at local TV, radio, or newspaper) to come and speak as part of the program (see section on finding local experts and collaborators).*

Integrating NASA/citizen science into existing interests or community groups:

- *As part of a monthly garden club event at the library, members were introduced to the app, and given samples of resources (e.g., cloud ID charts).*
- *A weekly photography club that meets regularly at the library, used the app to photograph clouds, with a talk by local professional photographer on how to photograph clouds.*

Leveraging community-wide Earth Day, environmental events, and organizations

- *Libraries worked with local schools to promote the program, as well as through the local parks and recreation department. Other local groups included local conservation groups, science museum, and local youth groups (e.g., YMCA, scouts, and 4H).*

Using GLOBE Observer as a "gateway" to other citizen science opportunities

- *In addition to the GLOBE Observer cloud observation activity, programming included offering a presentation, aimed at adults and teens, describing the role of citizen science in research, and giving them information about other citizen science opportunities in the community.*
- *One library featured information about a different citizen science project each week in April, with book lists related to the projects.*
- *A weekly storytelling session for children and families was used to introduce clouds and learn how to identify different kinds of clouds by how they look. Each family received a cloud chart to bring home with the challenge to watch the sky for a week. A follow-up activity could include coming back the following Saturday to share their family's cloud observations over the week.*

Following are additional ideas using resources starting on page 14:
Are there additional ideas, or expanded versions of these that the pilot test libraries suggest?

- From **Book to Action** club, or **Trivia Night** launching a community challenge or cloud-a-thon. Provide book suggestions to kick-off with themed discussion groups – see book suggestions starting on p. 17;
- One-hour **science stories with make-and-take activities**;
- 90-minute **family science/drop-in-science** (stations w/hands-on activities and demos and staff circulating);
- One-hour **Science Café Series** (partner with local university) w/take-away on GO Clouds;
- **After school club program** – See example from GLOBE Clouds Team - What clues do you use to identify clouds? Tips and activity sheet at http://bit.ly/CloudsClues.

The matrix on the following pages includes a range of programming resources for developing your program around the *GLOBE Observer Clouds App.*

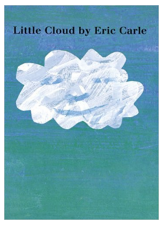
Resource	Brief Description	STEM Activity	Art-Based	Book	Promo	Print-ables	Time	Adaptations for library setting
GLOBE Observer: Cloud App https://observer.globe.gov	This app for smart phones and tablets (iOS and Android) guides you through taking and submitting observations that complement NASA satellite observations. Citizen scientist cloud observations include photographing clouds, recording sky observations, and comparing your observations with NASA satellite images.	X					10-20 min.	Integrate NASA's GLOBE Observer citizen science into existing interests or groups that are part of the library's community, e.g., afterschool teen science club, garden club or photography club. Tap into local science expertise with a talk by the local newspaper, radio, or television station's weathercaster/meteorologist to talk about clouds, weather, and local meteorology. Spanish language: The app language can easily be changed. After logging in, click on your name (at the top of any screen within the app), then click change language.
GLOBE Observer Clouds: Why Observe? https://observer.globe	In this short video, NASA scientist Jessica Taylor explains the role of clouds in Earth's climate, how NASA is studying clouds from space, and the importance of cloud observations from citizen scientists to complement NASA science.				X		Under 5 min.	Show this short video (<3 minutes) to introduce your program and why GLOBE Observer cloud observations are needed. Post or link to the video on your program page and use to promote your program.
GLOBE Cloud ID Chart and Sky Observations Add URLs for English & Spanish	The GLOBE Program Cloud Identification Chart combines photos of various cloud types with tips on observation basics. English and Spanish versions are available. Use this field guide to learn about the different cloud types and sky observations that citizen scientists can contribute through the GLOBE Observer citizen science project.	X				X	20-40 min.	The chart works as a "field guide" and can also be sent home with patrons to encourage using the GLOBE Observer app. Working with children or groups without phones or smart tablets? Walk through the chart and print out the paper form (see related links) for entering data as a proxy for entering data in the app, then the facilitator or parent enters the data into the app.

Cloud Teller http://www.starnetlibraries.org/wp-content/uploads/2018/03/GLOBE-Cloud-Teller.pdf	Based on the popular fortune-telling game, this printable interactive craft and game familiarizes learners with cloud vocabulary and varying degrees of cloud cover. This activity can be used to prepare young citizen scientists to make cloud observations with GLOBE Observer.	X	X			X	10-20 min.	Use this make-and-take activity as an introduction to clouds and cloud observations using GLOBE Observer app.
GLOBE Observer Postcard/ Bookmark (add URL)	Provide patrons with this oversized bookmark/postcard postcard with the URL to download the GLOBE Observer app. One side is in English, the other in Spanish.				X	X	N/A	Use as a takeaway to your citizen science program - includes the URL for downloading the app.
Elementary GLOBE: Do You Know That Clouds Have Names https://www.globe.gov/web/elementary-globe/overview/clouds	In this storybook for children ages 6-10, descriptions of cloud types are combined with analogies related to cloud shapes and are acted out by the GLOBE Kids. Activities give learners the opportunity to describe the shape and appearance of cumulus clouds and learn the types of weather that are associated with cumulus clouds.They identify cloud types using cloud classification names and explore the three types of contrails.	X		X			10-20 min. (book)	Use Elementary GLOBE books for children's story hour followed by arts and craft activities related to clouds and sky observing using GLOBE Observer app and activities like: Cloud Teller and Estimating Cloud Cover activity. Each Elementary GLOBE book is part of a module that includes hands-on learning activities. The activities include adaptations for older and younger learners.
Elementary GLOBE: What's Up in the Atmosphere? Exploring Colors in the Sky	In this storybook for ages 6-9, the GLOBE Kids investigate colors in the sky and learn how air pollution affects sky color and our health. Activities engage learners in describing sky color and conditions in the atmosphere, creating a model to learn how sky color and visibility are affected by	X		X			10-20 min. (book)	Use Elementary GLOBE books for children's story hour followed by arts and craft activities related to clouds and sky observing using GLOBE Observer app and activities. An activity related the Elementary GLOBE book on Exploring Colors in the Sky, is Sky Conditions. Each Elementary GLOBE book is part of a module that includes learning activities. The activities

https://www.globe.gov/web/elementary-globe/overview/air-quality	aerosols, using prisms to explore properties of light and colors, and collecting aerosol samples.							include adaptations for older and younger learners.
Estimating Cloud Cover: A Simulation https://www.globe.gov/documents/348614/d58984c8-381c-4783-ad30-221fc381d619	Working in pairs or small groups, learners use their estimation and math skills to simulate a clear, isolated, scattered, broken, or overcast sky using blue construction paper and torn white paper shapes. Participants try to accurately guess the percentage of cloud cover for each other's simulations. This activity was written for the classroom but can be adapted for out-of-school settings. It builds estimation skills needed for GLOBE Observer citizen science cloud observations.	X	X				40-60 min.	Learners need to be familiar with fractions and percentages. Citizen scientists tend to overestimate the amount of sky that is covered by clouds. This activity could be used to practice and build estimating skills before going outside to make GLOBE Observer sky observations of the amount of cloud cover.
Cloud Cover Estimation: Online Interactive http://bit.ly/cloudcoverpractice	This interactive web-based tool allows you to calibrate your eye by practicing cloud cover estimation using images on the computer. Learners can use this interactive to practice and build cloud estimating skills for the GLOBE Observer Clouds citizen science program.	X					10-20 min.	Citizen scientists tend to overestimate the amount of sky that is covered by clouds. This activity could be used to practice and build estimating skills before going outside to make GLOBE Observer sky observations of the amount of cloud cover.
Cloud in a Bottle http://www.nisenet.org/catalog/exploring-earth-investigating-clouds	In this hands-on activity visitors create a cloud in a bottle and explore it with laser light. Includes facilitators guide, worksheet and short training videos on how to do the activity. The activity is connected to current and ongoing NASA mission research. Includes English and Spanish versions.	X				X	Under 10 min.	This short activity is part of a toolkit for informal science centers and can be done in a library setting as a demo or station activity. Table signs can be downloaded from the URL provided and printed to set up activity stations.

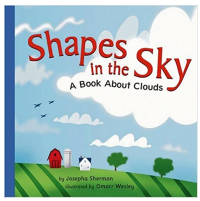
Books About Clouds

Followed is a selected list of books and further reading related to clouds and weather. Several of the books are likely to be included in a school or public library collection.

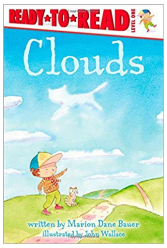


Little Cloud board book by Eric Carle (1998)
Toddlers
Little Cloud drifts away from his wispy friends and entertains himself by changing into a variety of forms - a lamb, an airplane, a shark, a clown - before joining the others to form one big cloud that rains.

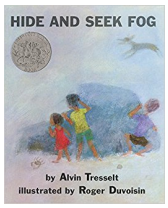
It Looked Like Spilt Milk by Charles G. Shaw (1947)
Toddlers to age 6
Children's picture book about clouds: "Although it looked like spilt milk, or a bird, or an ice cream cone or an angel, it was none of those things. What was it?"



Shapes in the Sky: A Book About Clouds (2003)
By Josepha Sherman and Omarr Wesley
Ages 4-8
Following a descriptive introduction, short chapters contain one scientific concept per spread.

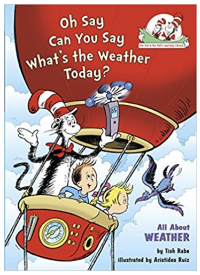


Clouds, by Marion Dane Bauer (2004)
Ages 4-6
This book is part of the ready-to-read weather series, this book focuses on three cloud types (cirrus, stratus and cumulus), how they form, and what they do for humans (e.g., provide shade, send water back to us, etc.)

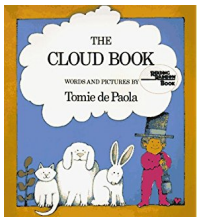


Hide and Seek Fog, by Alvin Tresselt (1965)
Ages 4-8
In a Cape Cod seaside village, the worst fog in 20 years rolls in for 3 days and affects fisherman and vacationers. The children play throughout a heavy fog with strange and mysterious effects.

Cloudette, by Tom Lichtenheld (2011)
Ages 4-7
A petite cloud believes that she is not big enough to accomplish what the big clouds can: provide enough rain to water crops or replenish a flowing waterfall or river. She is inspired by the accomplishments and "good-natured" acts of her larger kin. *School Library Journal*

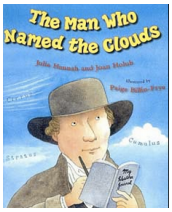


Oh Say Can You Say What's the Weather Today?
All About Weather by Tish Rabe
Ages 6-9
The Cat in the Hat and friends take a hot air balloon ride and experience various types of weather. Readers learn about different methods for measuring weather, plus humidity, cloud types and more.



The Cloud Book by Tomie dePaola (1975)
Ages 6-8
This book presents the ten most common clouds along with related myths and popular weather sayings.

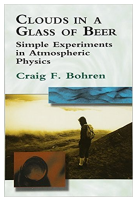
Next Time You See a Cloud by Emily Morgan **(2016)**
Ages 6-10
This book is part of the NSTA Kids series, “Next Time you See” that are designed for children to experience everyday phenomena in nature.



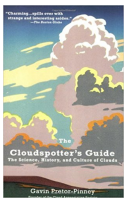
The Man Who Named the Clouds by Julie Hanna and Joan Holub
Ages 9-11
Readers will learn about cloud classification from this picture-book biography of 18th-century English meteorologist Luke Howard. Historical portraits and reproductions of his original painted cloud studies are mixed in with Billin-Frye's attractive ink-and-watercolor cartoons. *School Library Journal*

For Teens and Adults

Clouds in a Glass of Beer: Simple Experiments in Atmospheric Physics
by Craig Bohren



In a captivating, conversational tone, this book explores meteorological topics, including rainbows, coronas, color of sky and sea, visibility, cloud physics, and basic physics relevant to the atmosphere. It includes over 25 experiments to observe and reproduce natural phenomena with simple materials.



The Cloudspotter's Guide: The Science, History, and Culture of Clouds by Gavin Pretor-Pinney
Journalist and sky watcher Gavin Pretor-Pinney (founder of the Cloud Appreciation Society) reveals everything there is to know about clouds, from history and science to art and pop culture.

From Book to Movie

Severe weather plays a critical role in these true stories, which were made into movies:

The Finest Hours: The True Story of a Heroic Sea Rescue by Michael J. Tougias and Casey Sherman (Young Adult Version available)

The Perfect Storm by Sebastian Junger (1997)

Following are online NASA articles where you can read about the latest NASA science related to clouds.

A Celebration of Clouds from Space, Earth Has an Elegant Atmosphere (Dec. 20, 2016)
https://earthobservatory.nasa.gov/Features/CloudsGallery/

How Cloud Data is Improving Weather Forecasts (March 7, 2018)
https://www.nasa.gov/feature/langley/how-cloud-data-is-improving-weather-forecasts

Signs of Ships in the Clouds (January 21, 2018)
https://earthobservatory.nasa.gov/IOTD/view.php?id=91608

FAQs and Insider Tips

Do I need special equipment to participate in GLOBE Observer Clouds?

The only equipment needed is a smart phone or tablet (iOS or Android). Download the GLOBE Observer app at https://observer.globe.gov/about/get-the-app. The app tutorial provides the information you need to make a cloud observation. This guide provides additional resources that you can use to frame library programming.

Why does NASA need these observations?

Researchers use, and value, citizen science cloud data because it helps to validate data from Earth-observing instruments. Scientists at NASA Langley Research Center (LaRC) work with a suite of six instruments known as the Clouds and the Earth's Radiant Energy System (CERES).

Even though CERES' instruments use advanced technology, it is not always easy for researchers to positively identify all types of clouds in their images. For example, it can be difficult to differentiate thin, wispy cirrus clouds from snow since both are cold and bright; even more so when cirrus clouds are above a surface with patchy snow or snow cover. One solution to this problem is to look at satellite images from a particular area and compare them to data submitted by citizen scientists on the ground. NASA LaRC matches the GLOBE Observer citizen observations with satellite observations taken around the time of the satellite overpass.

How often are cloud observations needed? Can I do a one-time event? Or a continuing program?

The GLOBE Observer app and resources are evergreen – they can be used any time of the year, and for one event or many. While there is extra value getting a large number of people observing clouds on one day, it is important for citizen scientists to observe regularly. We are also identifying libraries that are interested in establishing an ongoing citizen science programs. If you are interested, please contact Theresa_schwerin@strategies.org

Where can I learn more about GLOBE Observer and stay connected?

Visit the GLOBE Observer website (http://observer.globe.gov) where you can find additional resources, including training materials, information about NASA scientists and citizen scientists, and toolkits for educators.Be sure to also follow GLOBE Observer on Facebook @nasa.globeobserver or Twitter @NASAGO.

Are there other measurements that GLOBE Observers can contribute, in addition to clouds?

Yes! GLOBE Observers can also contribute observations using GLOBE Observer Mosquito Habitat Mapper and Land Cover/Adopt-a-Pixel, which are described below. Learn more at: http://observer.globe.gov.

> **Mosquito Habitat Mapper** Citizen scientists locate, identify, and photograph mosquito breeding sites in their community; sample and determine whether the larvae they find could potentially mature into vectors of mosquito borne disease; and reduce the risk of disease by dumping water containers and monitoring the environment. Note: this investigation focuses on an immature developmental

stage (larva) of mosquitoes that lives in water, doesn't bite, and doesn't pose a health hazard to humans.

Most of the Mosquito Habitat Mapper observations can be done with just a smart phone or tablet, and the citizen scientist can elect to just take those observations. Optional steps include taking a sample and identifying the larva genus, which require some inexpensive equipment and supplies (e.g., a clip-on lens that magnifies the image 60x - 100x, turkey baster, pipette, plastic bag, and white paper plate).

Why? NASA scientists can't see mosquitoes from space, but they can observe environmental conditions and develop models predicting where outbreaks of mosquito-borne disease will occur. Ground observations of mosquito breeding sites will help refine and validate these models. This data is also useful for public health officials.

Land Cover/Adopt a Pixel: Citizen scientists photograph the land and identify what is there (forests, city, crops, etc.). They also compare what they see to a satellite land cover map to report changes or differences.

Why: Land cover—what is on the surface of the land—plays a role in our water quality, temperature and weather patterns, and in the carbon cycle. It is the source of our food and our home, and yet, we don't have detailed and complete land cover maps. By classifying land cover, citizen scientists are helping scientists verify satellite observations of land cover, fill in details that satellites don't record well, and update places where land cover has changed.

Are there special events coming up or suggestions that I could use as a theme for programming?

Throughout the year here are intensive observing periods that you might use to garner interest in cloud observing and citizen science. For example, the GLOBE Clouds team organizes data challenges to collect a large number of observations over a period of time (see the Spring 2018 cloud data challenge at bit.ly/GOcloudsDataChallengeSring2018). You can keep up with upcoming campaigns and events at observer.globe.gov.

There are also annual and seasonal events you might leverage – e.g., Citizen Science Day and Earth Day are both in April; Earth Science Week is in the fall – the months when seasons change could lead to some pretty fascinating cloud activity in the sky; summer library reading and learning programs are also opportunities.

But the wonderful thing about sky observations is **the sky is available 365 days a year and NASA needs citizen science sky observations any time of the year.**

My library wants to go further and establish an ongoing citizen science program. What can we do?

Consider becoming a GLOBE trained science educator and becoming a GLOBE site or partnering with a local GLOBE school. Learn more about the GLOBE Community at https://www.globe.gov/globe-community and find a potential collaborator at: https://www.globe.gov/globe-community/find-a-collaboration-partner.

To become a GLOBE trained science educator or citizen scientist: Attend a training workshop or take part in virtual eTraining to receive certification.

- Create a GLOBE Teacher Account to get started.
- Find Training Opportunities in Your Area at https://www.globe.gov/get-trained/workshops
    - Face-to-Face Training Workshops: a school to fully participate in the GLOBE Program, at least one educator must be trained in GLOBE science measurement protocols and education activities.
    - Online E Training, start or expand your protocol knowledge by completing protocol modules and assessment tests online at http://www.globe.gov/get-trained/protocol-etraining

Making Observations

What tips do you have for identifying whether a cloud is low, mid, or high-level in the sky?

Following are tips are adapted from *Lin's Tips for Cloud Observers*, by NASA scientist, Dr. Lin Chambers, and available at https://scool.larc.nasa.gov/GLOBE/lintips.html and blog post by Marile Colon Robles https://www.globe.gov/web/marile.colonrobles/home/blog/-/blogs/36852844

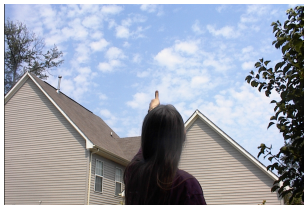
Unless you live next to a tall skyscraper or a mountain, it is not possible to figure out the height of a cloud just by looking. This is because there are no points of reference in the sky. That's why our determination of height relies on identifying the cloud type.

The most important thing a sky observer can do is to pick a cloud type at the right level. This will be most useful for NASA, because the satellite instruments cannot distinguish cumulus from stratus from stratocumulus. All of these will be identified as low-level water clouds.

Hints for identifying cumulus-type clouds:

Low-level cumulus cloud cells (the individual puffs of cloud) are about the size of your fist or larger, when you hold up your hand at arms' length. (see to photo, right)
When cumulus clouds are just forming or evaporating, they can look considerably different from those that are fully-formed. Do not be fooled! Sometimes you can tell that the clouds are forming or evaporating if there is strong wind and both new and fully-formed clouds are moving along in the same layer. Other times you may have to look for other clues.

Mid-level cumulus cloud cells (altocumulus) are about the size of your thumbnail when you hold your hand at arm's length. (Note that in this picture the clouds look larger than a thumb. This is because the photo was taken from behind, considerably more than an arm's length the thumb. (see middle photo, right)



High-level cumulus cloud cells (cirrocumulus) are about the size of the nail on your littlest finger - again, at arm's length. (see bottom photo, right)

Stratus Clouds Without the size clues provided by individual cumulus clouds, determining the height of stratus-type clouds can be a challenge. Some hints for stratus-type clouds:

- If it rained recently or is about to rain, you are most likely dealing with a low-level stratus cloud. While it is possible for rain to fall from mid-level clouds, it is quite rare.
- If it is raining during your observation, you have nimbostratus (or cumulonimbus - a thunderstorm). The terms nimbo/nimbus are from the Latin word for rain.
- If a stratus cloud is so thick and opaque that you can't even figure out where the sun is, most likely it is a low-level stratus.
- If you can see the sun but it looks diffused and translucent (like looking through a glass bottle), most likely you have altostratus.
- High-level cirrostratus will generally be thin and transparent enough that the sun is still quite distinct. If the cirrostratus is not between you and the sun, you may be able to distinguish cirrostratus as being so thin that parts of the cloud appear bluish (that is, you are seeing through to blue sky).

What are tips to estimate the percentage of the sky covered by clouds?

Determining the percentage of the entire sky covered by clouds cloud cover can be tricky, with many people overestimating this amount. Following are tips and activities to practice cloud cover estimating skills.

1. Use the **average of several independent estimates** from individuals in a group or family.
2. **Create simple cloud models** using colored paper (below)
3. Use the online **cloud estimation interactive** to practice at http://bit.ly/cloudcoverpractice

What are tips to estimate sky color and visibility?

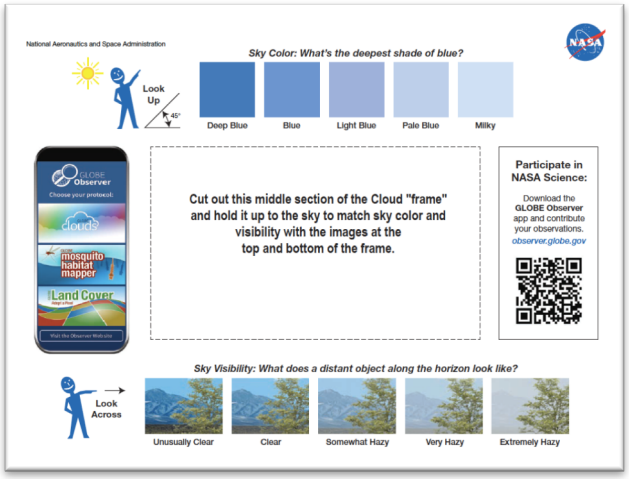
Sky color and visibility are indicators of the amount of aerosols or particles in the sky. Following are tips and tricks for observing. A good tool to practice making observations of sky visibility is the GLOBE Cloud "Frame," (see image below) which can be downloaded at: http://bit.ly/CloudFrame

Identifying **Sky color** is best when there are few or no clouds present. It is easy to confuse a white-ish sky with very thin high clouds. Find more information at: bit.ly/GLOBESkyColor

Tip: Report sky color when the sky is clear of clouds (0-10% cloud cover).
Trick: Look for the bluest part of the sky and report that color!

Sky visibility is looking at how many aerosols or particles in the sky are near the ground. Find more information about observing sky visibility at: bit.ly/SkyVisibility

Tip: Visibility is hard at dusk or at night. Only report it during the day.
Trick: Look across the horizon and find a landmark in the distance to estimate sky visibility.



Right: The GLOBE Clouds Frame is a field guide for observing the sky – cut out the middle and hold it up to the sky. Download at http://bit.ly/CloudFrame.

Finding Local STEM Experts and Collaborators

Libraries can plug into their local STEM ecosystem and volunteer experts can be a key ingredient in your programming. Partner with local schools, museums, science centers and other STEM organizations. Following are suggestions of networks and volunteer experts that you might consider.

Local TV or Radio Stations and Weather Expertise
The American Meteorological Society (AMS) has professional certification programs that identify broadcast and consulting meteorologists who have achieved a high level of competency in communicating complex weather, water, and climate information.

- Check to see if your local radio and television weather broadcaster is designated as a Certified Broadcast Meteorologist (CBM) or AMS Certified.
- Check the AMS Weather and Climate Service Providers Directory for local experts: https://wcdirectory.ametsoc.org/home

Local Colleges and Universities
Many colleges and universities have Earth science or meteorology departments. Others may have clubs or local chapters of professional societies. Once you connect with a faculty or staff member they might also be able to also suggest undergraduate and graduate students who could volunteer at your event.

The GLOBE Program Partners, Schools, and Teachers
Check the listing of U.S. GLOBE Partners at: https://www.globe.gov/web/united-states-of-america/home/resources. GLOBE Partners are at colleges, universities, or other science organizations that may be interested in collaborating with your library. You can also learn more about the GLOBE community and potential collaborators at: https://www.globe.gov/globe-community/find-a-collaboration-partner

NASA Solar System Ambassador Program
http://solarsystem.nasa.gov/ssa/home.cfm
The Solar System Ambassadors (SSA) program works with motivated volunteers across the nation to share the latest science and discoveries of NASA's missions through a variety of events that inspire their communities. Find Your Local Ambassador. Check the online directory to find an SSA near you or check the Event Calendar to see if an Ambassador event is happening near you.

NASA Museum Alliance
https://informal.jpl.nasa.gov/museum/
Connect with more than 1,900 professionals at over 1,000 U.S. and 130 international museums, science centers, planetariums, NASA Visitor Centers, Challenger Centers, observatory and park visitor centers, nature centers, zoos, aquariums, libraries, camps, and youth-serving organizations who are partners in the NASA Museum Alliance. These organizations use NASA educational products, images, visualizations, video, and information in their educational and public programs and exhibits.

NISE Network – National Informal STEM Education Network
http://www.nisenet.org/
Originally launched in 2005, the Network is now led by 14 museums and universities across the nation and has partnered with over 500 organizations nationwide. The NISE Network community within the U.S. is organized around four Regional Hubs based on geographic proximity. Regional hubs facilitate partner interaction in the Network, help museum educators connect with scientists and each other, and provide support to institutions in their region. To get more involved with the Network, contact your Regional Hub Leader – see http://www.nisenet.org/contact

SciStarter Librarian's Guide to Citizen Science
Think Like a Citizen Scientist Girl Scout Journey
Search SciStarters extensive database at https://scistarter.org/ to find hundreds of additional citizen science projects. SciStarter has created a Librarian's Guide to Citizen Science (planned to be available in mid-late April at https://scistarter.org/library.)

Does your library offer programming with local Girl Scout Troops? In association with SciStarter, Girl Scouts USA have designed their *Think Like a Citizen Science Journey* to include a small number of curated citizen science projects, which Girl Scout troops complete for their journey, and a larger list of Girl Scout-friendly projects. These include GLOBE Observer Clouds and GLOBE Observer Mosquito Habitat Mapper. See https://scistarter.com/girlscouts/volunteer/landing

STAR-Net Libraries
Go to http://www.starnetlibraries.org/, where you will find a clearinghouse of resources, projects, and a calendar of upcoming events and webinars. It's free to register online and join a community of libraries offering STEM programming.

Promotional Resources

Banners and Handouts

(Include links to the GLOBE Observer Toolkits section with these resources when it's launched)

- Banner that can be printed and posted as an exhibit
- GLOBE Observer card – This oversized "bookmark" can be a take-away for patrons.

Media Template Package

Samples could be included for the following promotional pieces, which can be customized

A. Sample Public Service Announcements for local media
B. Sample Press Release/Community Letter (e.g. to Friends of the Library or library newsletter)
C. Sample Social Media Shareables
D. Sample Media Consent and Release Form (Photo/Video/Audio Release Form)

A. Sample Public Service Announcements

(Would these be useful for libraries? These would be sample scripts for 10 second/20 second/30 second PSAs that can be sent to local radio/tv)

B. Sample Press Release/Community Letter Sample

(Would this useful for libraries?)

[DATE]

[LIBRARY NAME] is participating in a special citizen science project that is viewing clouds from above and below.

[DETAILS ON YOUR PROGRAM, e.g., Join us on {DAY, DATE) at (TIMES) in the (ROOM, LOCATION) observe clouds using a free and easy-to-use app on a smartphone or tablet – photograph clouds, record sky observations and compare them with NASA satellite images. Our program will include (BRIEF DESCRIPTION OF WHAT THE PROGRAM IS ABOUT – cloud observing, hands-on activities, children's stories, etc.)]

Clouds play an important role in our Earth System. They affect incoming energy, in the form of sunlight, as well outgoing energy, heat emitted from Earth's surface back to space. NASA has a number of satellites orbiting Earth and collecting data about clouds and Earth's energy. Combining NASA's global view from above with ground observations of clouds and sky conditions from below helps scientists get a more complete picture of clouds in our atmosphere. Because clouds can change rapidly, frequent observations are needed from citizen scientists.
Citizen science engages volunteers in the collection and analysis of data relating to the natural world, typically as part of a collaborative project with professional scientists. Through the GLOBE Observer app, citizen scientists of all ages can learn more about clouds and participate in NASA science. Formal training in science is not required to participate.

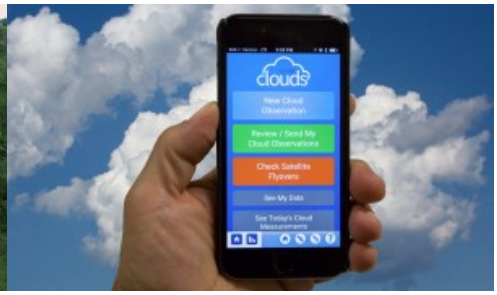
We hope you join us as we introduce this opportunity to contribute to NASA science!

C. Sample Social Media Shareables

Following are examples texts and images that can be shared on your social channels (Facebook, Twitter) to promote a specific event, remind your community to take and submit observations, or tips for observing the sky.

Sample Text: “Citizen science has been around a long time, but NASA’s GLOBE Observer app allows you to do it in a cool new way. Join us on (DATE), at (LIBRARY NAME AND TIME) to learn how!” (LINK TO LIBRARY PAGE WITH DETAILS).

Following are examples of shareable images to post with text in a Tweet or Facebook Post. You might also consider posting photos from your events (see sample photo/video consent form, next page). Download high resolution files of these images, and more at: (Link to toolkit/facilitators guide). Social



Above: Social media sharables with tips and tricks for using GLOBE Observer are available at: bit.ly/GO_Tips_Facebook. These can be downloaded and shared on social or used in presentations and displays.

D. Sample Media Consent and Release Form (Photo/Video/Audio)

I, _____, hereby authorize _____ (the "Library"), and its partners, agents, representatives, assigns, successors in interest and licensees, to photograph, audiotape, and/or videotape me and grant the Library and its partners the irrevocable right to use my photograph, audio recording, video recording, or any reproduction or modification thereof (the "Photograph," "Audio," and/or "Video"), in any manner or medium throughout the world an unlimited number of times in perpetuity in advertising, trade, promotion, exhibition, or any other lawful purpose.

I understand that I will not receive any monetary compensation for the permissions I am granting herein. I hereby waive any right of inspection of approval of the uses to which the Library may put the Photograph, Audio, and/or Video. I acknowledge the Library will rely on this permission and hereby release and discharge the Library from any and all claims and demands arising out of or in connection with the Photograph or the exercise of the permissions granted here, including any or all claims for libel, invasion of privacy, or emotional distress.

I understand that I cannot withdraw my consent after I sign this form and that this consent and release is binding on me and my heirs, legal representatives and assigns.

YES NO (please check one)

☐ ☐ **I grant permission for Photographs** to be collected and used by the Library.

☐ ☐ **I grant permission for Audio** to be collected and used by the Library.

☐ ☐ **I grant permission for Video** to be collected and used by the Library.

Date: _____ Signature: _____

Address: _____

Phone Number: _____ Email Address: _____

If the individual named above is under 18 years of age, please complete the following:
I am the parent or legal guardian of the individual named above, and I hereby sign this Media Consent and Release on behalf of such individual in accordance with the statements above.

Name: _____ Date: _____

Signature: _____

Address: _____

Phone Number: _____

Acknowledgements

Most of the content in this guide is based upon resources developed by the GLOBE Clouds Team at NASA Langley Research Center. These resources have been adapted or adopted for library audiences.

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