



THE **GLOBE** PROGRAM

A Worldwide Science and Education Program



Atmosphere



Clouds

Atmosphere

Clouds Training Module

Read the module content and take the test that follows to
earn the GLOBE Atmosphere: Clouds certificate.



Cloud Protocols

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

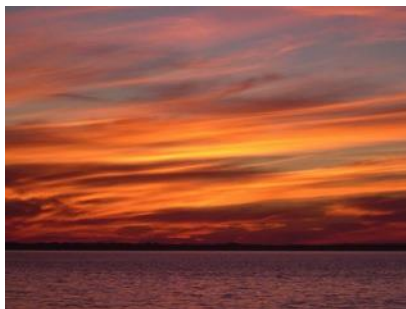
E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

- *“We seek to remind people that clouds are expressions of the atmosphere’s moods, and can be read like those of a person’s countenance.”*
- - From the Manifesto of the Cloud Appreciation Society





Overview and Learning Objectives

Overview

- This module:
- Describes how to select and define a GLOBE atmosphere Clouds protocol study site
- Provides a step by step introduction of the protocol

Learning Objectives

- After completing this module, you will be able to:
- Explain what clouds are and how they form
- Explain why clouds are an important element of the Earth system
- Explain why cloud observations are important for understanding our changing Earth system
- Identify a Clouds study site and take observations of the sky
- Upload data to the GLOBE database
- Visualize data using GLOBE's Visualization Site
- Have ideas for questions you can address using cloud observations

Estimated time to complete this module: 1.5 hours

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Overview and Learning Objectives

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- **What are clouds?**
- Water in the atmosphere exists in all three phases (solid, liquid, gas). It changes phase depending on temperature and pressure. Like most other gases that make up the atmosphere, water vapor is **invisible** to the human eye.
- Unlike most other gases in our atmosphere, under the right conditions water vapor can change from a gas into solid particles or liquid drops.



Though we cannot see it, there is still water (vapor) present in a clear blue sky. Image: NASA.



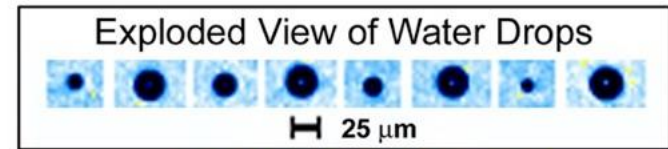
How do clouds form?

How do clouds form?

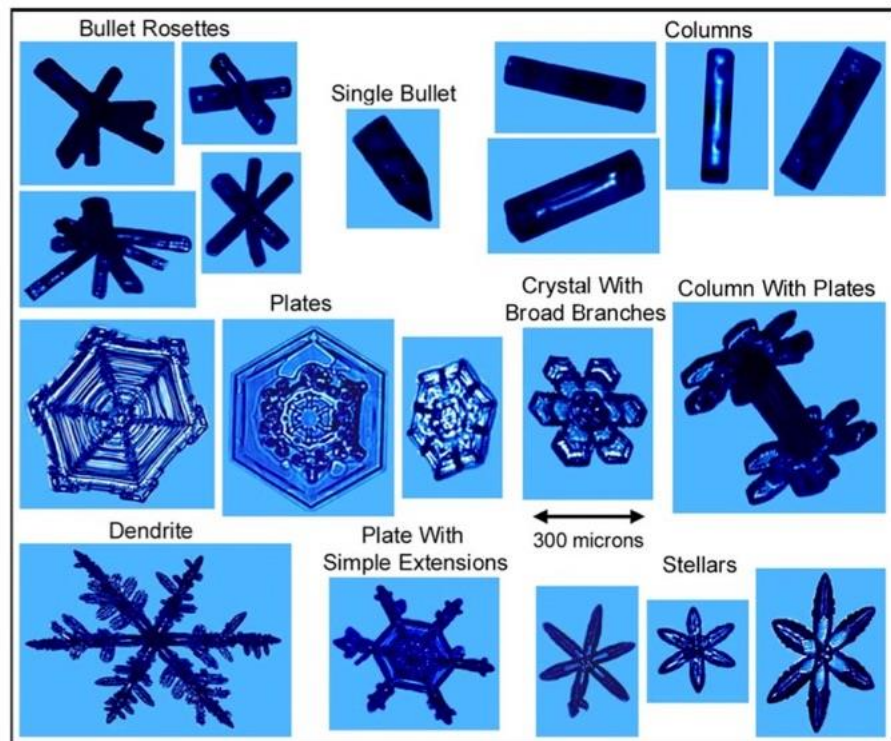
If temperatures are above freezing, the water vapor will condense on cloud condensation nuclei (CCN*) into **water droplets**.

If temperatures are below freezing, as they always are high in the atmosphere, tiny **ice crystals** will mostly form instead.

*CCN are small particles (dust, smoke, salt, etc) in the atmosphere that water vapor can "stick" to. Without them clouds would not form above -40°C .



1 micron =
0.000001 meter



Images from Cloud Particle Imager (CPI)



What are Clouds?

When a large number of water droplets or ice crystals are present, they scatter enough light for us to see them – they form **visible** clouds.

At any given time, over half of Earth's surface is shadowed by clouds.



- *“Clouds are so commonplace that their beauty is often overlooked.”* -Manifesto of the Cloud Appreciation Society

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What can clouds tell us?

- Clouds tell us something about air temperature, water and wind up in the sky
 - Helps to predict weather
- Clouds also affect how much sunlight is reaching the ground and how much heat is escaping back to space
 - Helps to understand climate



Dry air aloft



Moist air aloft
Wind perpendicular
to contrail



High, thin clouds transmit sunlight



Low, thick clouds block sunlight

Images: NASA

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Science Questions that depend on cloud observation: Question 1

How much does cloud cover affect surface temperature and surface air temperature?

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Image NASA



Science Questions that depend on cloud observation: Question 2

How can clouds contribute to prediction of weather and precipitation?

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

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Science Questions that depend on cloud observation: Question 3

How will clouds respond to a changing climate?

On balance:

High Clouds Warm

Low Clouds Cool

If clouds never formed in Earth's atmosphere, our planet would be over 5°C warmer on average.

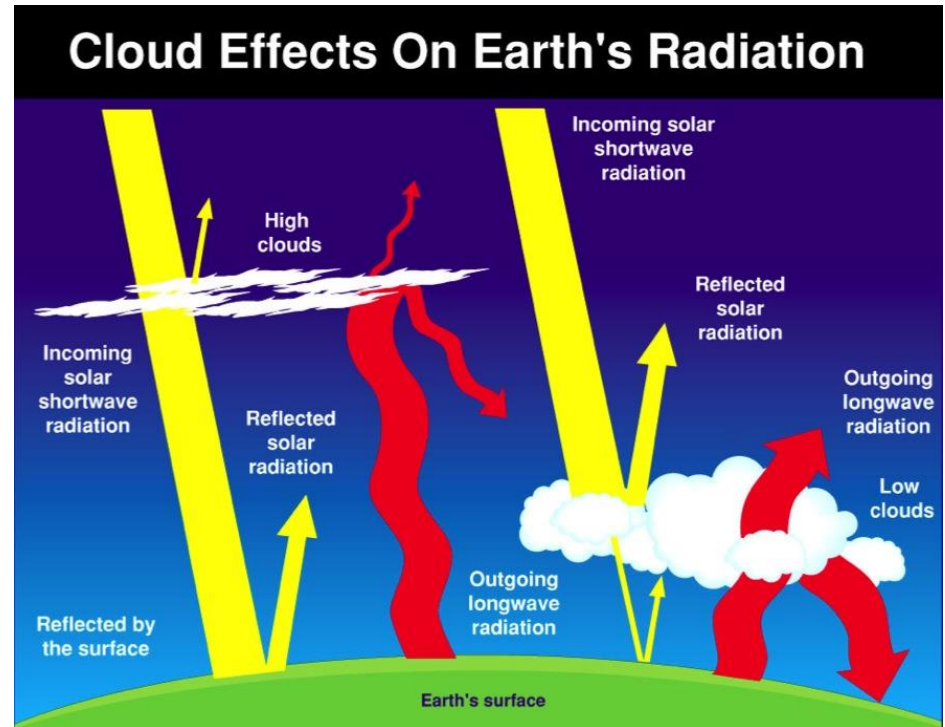


Image: NASA S'COOL

[Learn more](#)

- A. What are clouds?
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Science Questions that depend on cloud observation: Question 4

4. Is there a relationship between contrails and cloud cover?
5...And more!

Contrails, or condensation trails, are the linear clouds formed when a jet aircraft passes through a portion of the atmosphere having the right combination of moisture and temperature.



Image: NASA

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Your measurements can help!

A. What are clouds?

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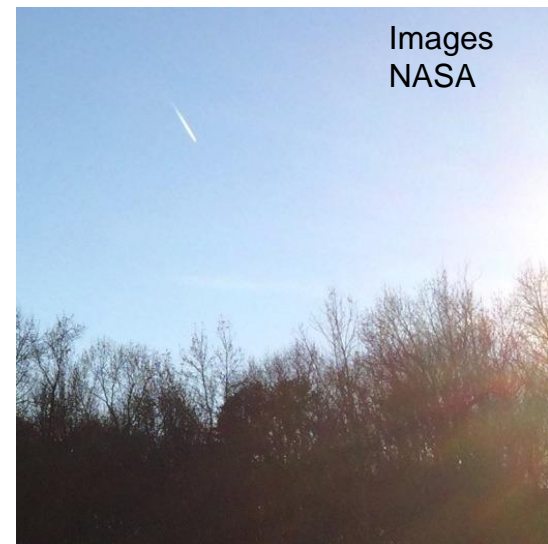
- Understand how cloud climatology may be changing

Human observers can identify qualitative aspects (i.e., cloud type clues) that automated sensors cannot.



- Provide ground-based data on contrails

Human observers can see small features (i.e., short-lived contrails) that are not visible from satellite.





More ways your measurements can help!

- Verification and improvement of automated remote sensing
- Improve interpretation of satellite observations of Earth's energy balance

Hint: Observations timed to coincide with satellite imagery provide useful comparisons, for scientists, and for you!



From the bottom: Blue sky provides great contrast



From the top:
Varied surface confounds detection

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Atmosphere Clouds



What do you need to start?

<i>Instrument</i>	Your eyes
<i>References</i>	GLOBE cloud chart and contrail ID chart (English/French/Spanish) (Russian/Chinese/Arabic)
<i>When</i>	Good: Any time Better: Within one hour of local solar noon Best: Within +/- 15 minutes of a satellite overpass
<i>Where</i>	A good observation site (See Documenting your atmosphere study site)





What makes a good observation site?

A. What are clouds?

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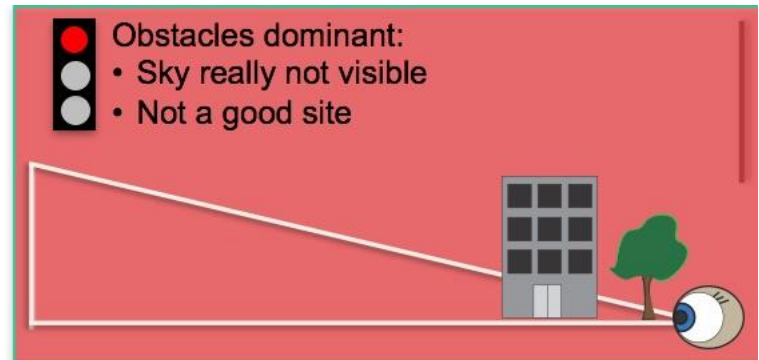
G. Quiz yourself!

H. Further resources.

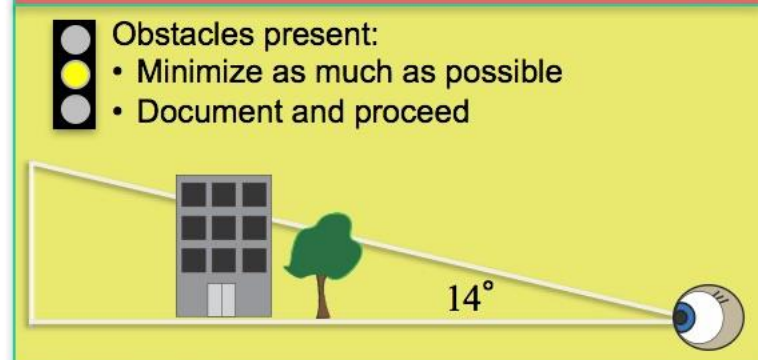
Best to observe from a consistent location each time.

Although for clouds it's easy to set up new sites with the mobile app if you are in a different place.

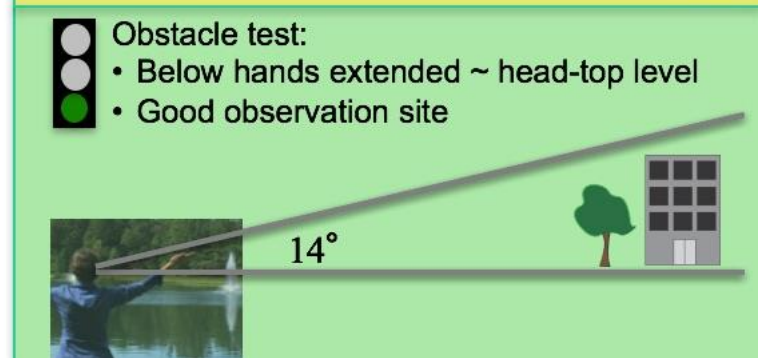
Bad



OK



Good





How to Observe - Introduction

! NEVER look directly at the Sun!

- Look at the sky in every direction above 14° .
- This is a good observation to do with a small group (each can take a sky quadrant) although individuals can do it also.
- Cloud identification is an art; you will get better with practice.
- The most important step is the first and easiest:



Image NASA

Is the Sky Clear

Cloudy

Obscured?

Keep going

By what?

(Fog, Smoke, Haze...)

Report!

A. What are clouds?

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How to Observe: Obscuration

By what?

If more than 1/4 of the sky is obscured by one of these, record and report the reason on the data sheet.



Blowing Snow



Heavy Snow



Heavy Rain



Fog



Spray



Volcanic Ash



Smoke



Dust



Sand



Haze

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How to Observe: Cloud Type Introduction



A. What are clouds?

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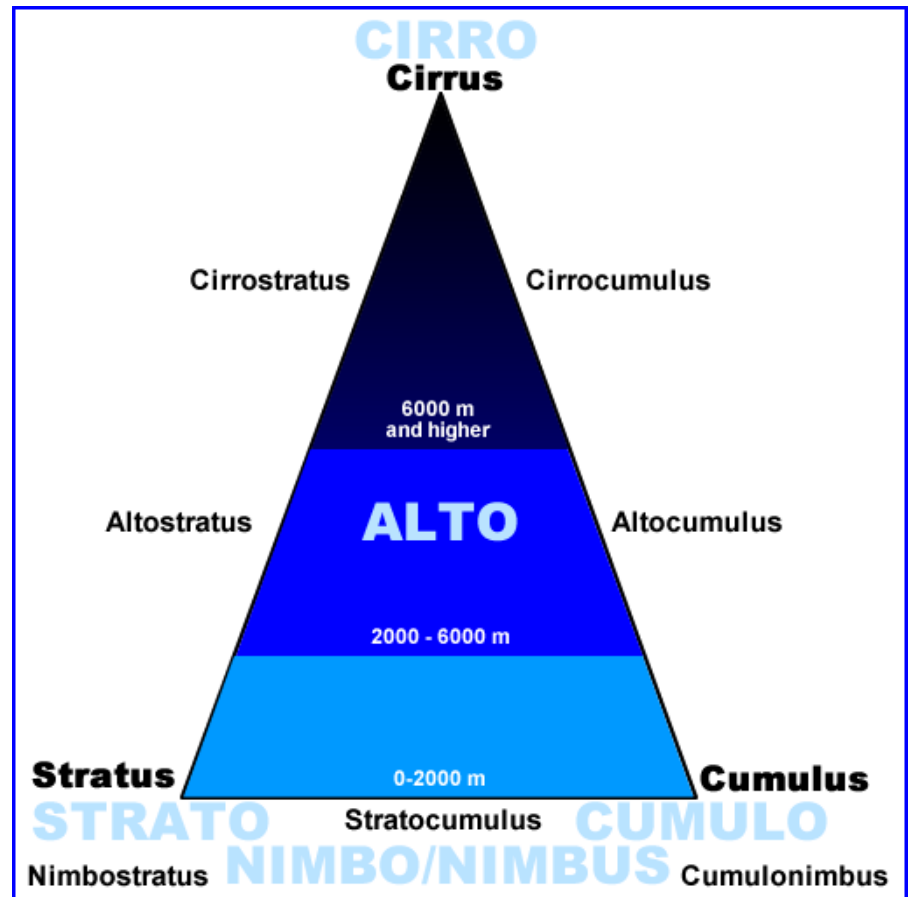
H. Further resources.

Clouds can be defined by:

- Their shape & form
- The cloud base altitude
- If they are precipitating

The Cloud Triangle is a useful memory device

The Cloud Triangle





How to Observe: Cloud Type

Factor 1: Cloud Shape



The 3 main cloud shapes are:



Cumulus
(Puffy)



Stratus
(Layered)



Cirrus
(Wispy)

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How to Observe: Cloud Type

Factor 2: Cloud Height

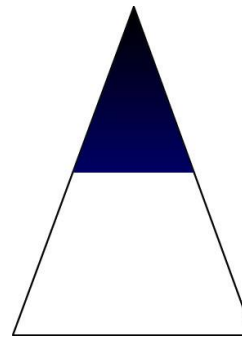
↓
**Identify
clouds**

High Clouds: Composed of ice crystals, which gives them a delicate appearance. Generally, the Sun can be seen through high clouds and ice particles in cirrostratus scatter sunlight to form a bright ring, called a halo, around it.



Cirrus

Note: Contrails are also high clouds, but are considered separately. See slides 27-28.



**High-level
clouds**



Cirrocumulus



Cirrostratus

Base above 6 km

With Halo



NEVER look directly at the Sun! Images NASA



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How to Observe: Cloud Type

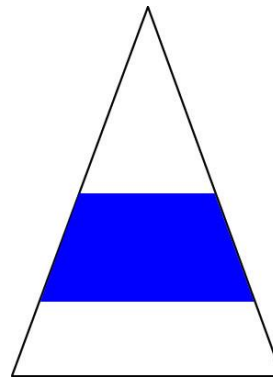
Factor 2: Cloud Height-2

↓
**Identify
clouds**

Middle Clouds -Always begin with the prefix alto- and are predominantly comprised of water droplets; may contain some ice. Sometimes the sun can be seen through these clouds, but without a ring.



Altostratus



Mid-level clouds

Base between 2-6 km



Altostratus

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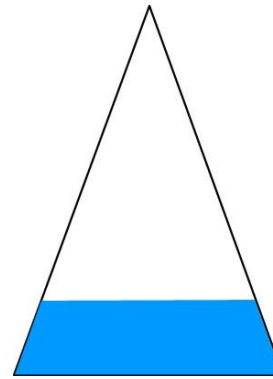


How to Observe: Cloud Type

Factor 2: Cloud Height-3

↓
**Identify
clouds**

Low Clouds: Closest to the observer, and often appear to be quite large compared to higher clouds. They may be much darker and grayer than high or middle clouds.



Low clouds may extend to much higher altitudes, which can be seen when there are clear gaps between the clouds.

Low-level clouds

Base below 2 km



Stratus



Stratocumulus



Cumulus

- A. What are clouds?
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How to Observe: Cloud Type

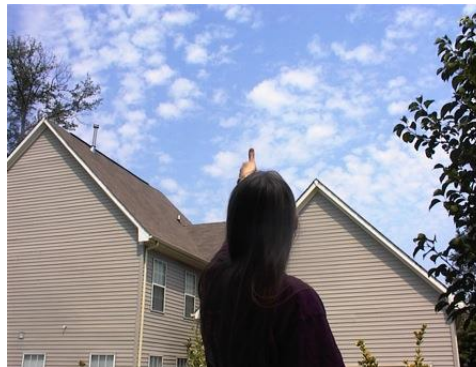
Factor 2: Cloud Height-4

↓
**Identify
clouds**

Hint: For cumulus (puffy) clouds, use fist/thumb/pinky finger rule to estimate cloud height.



High clouds (cirrocumulus) appear comparable in size to pinky finger held at arm's length



Mid-level clouds (altocumulus) appear comparable in size to thumb held at arm's length



Low clouds (cumulus) appear comparable in size to fist held at arm's length

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How to Observe: Cloud Type

Factor 2: Cloud Height-5

↓
**Identify
clouds**

Hint: For stratus (layered) clouds, look for clues near the Sun.

! NEVER look directly at the Sun!



Cirrostratus is the only cloud type which can produce a halo around the Sun or moon. The halo will have all the rainbow colors in it.



Altostratus will produce a thinly veiled Sun or moon, and will often be darker in appearance, a medium gray color



Stratus will usually be very gray and often very low to the ground

- A. What are clouds?
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- A. What are clouds?
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↓
**Identify
clouds**

How to Observe: Cloud Type Factor 3: Precipitation?

Images NASA

Clouds with precipitation

Nimbus means cloud in Latin

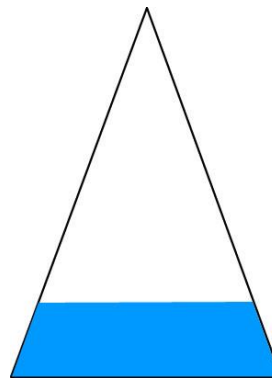
Seen from afar



Seen from below



Nimbostratus



Low-level clouds

Cumulonimbus



How to Observe: Cloud Type Practice and Support



Identify
clouds

Try the interactive tool found in the eTraining section under “supporting material: [Cloud Type practice](#)

THE GLOBE PROGRAM
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Atmosphere

Identify Clouds in the Field

Cloud Identification Key

Identify Clouds
in My Sky

Use this key to identify clouds in the field.
Click images that best answer the questions posed by the key
to identify your cloud.

This Cloud Identification Interactive is based on the original Cloud Dichotomous Key developed by
Dr. Tina Cartwright, Marshall University, West Virginia

USA Spain France

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How to Observe: Cloud Fraction

Divide the sky in 4 quadrants (North, South, East, West) and estimate cloud cover in each first. Then take the average to get the whole sky value.



What Percent of the Sky is Covered by Clouds?



No Clouds
0%



Clear
0 - 10%



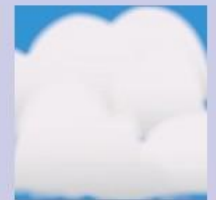
Isolated
10 - 25%



Scattered
25 - 50%



Broken
50 - 90%



Overcast
>90%

Observing hint: If directly overhead there is a pattern of cloud cover with puffs or rolls of cloud separated by clear areas, it is reasonable to infer that pattern continues and the cloud cover is not 100% toward the horizon.



Images NASA

A. What are clouds?

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How to Observe: Contrail Type

- If contrails are present (from dichotomous key):
 - **Count** the number of each type



Short- Lived: Contrails that form short line segments that fade out as the distance from the airplane that created them increases.



Persistent Non-spreading

Remain long after the airplane has left the area. They form long, generally straight, lines of ~constant width across the sky. These contrails are **no wider than** your index finger held at arm's length.



Persistent Spreading

Remain long after the airplane has left the area. They form long streaks that have widened with time since the plane passed. These contrails are wider than your index finger held at arm's length.



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How to Observe: Contrail Cover

- If contrails are present (from dichotomous key):
 - **Estimate** the total cover of contrails
 - The quadrant technique is also useful here
 - One single persistent contrail crossing the sky covers less than 1% of the sky. Therefore, counting contrails can also be helpful.

Contrail Cover Categories



No Contrails
0%



0-10%



10-25%



25-50%



>50%

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B. Why collect cloud data?

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How to Record Observations

A. What are clouds?

B. Why collect cloud data?

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Atmosphere Investigation

Clouds 1-Measurement Data Sheet

* Required Field

School Name: _____ Study Site: _____

Observer names: _____

Date: Year _____ Month _____ Day _____ Universal Time (hour:min): _____

Sky Conditions (Check one):

- ☐ Clear (no Clouds Visible)
- ☐ Clouds Visible (1% to 100% Covered by Clouds or Contrails)
- ☐ Obscured (More than 25% of the Sky is not Visible)

Note: selecting **Obscured** will prevent data entry on clouds and contrails; therefore skip the cloud type and cover and the contrail type and cover sections and proceed to the Obscured section. If clouds and contrails are visible in non-obscured areas of the sky, these data can be entered in the Metadata field.

If Clouds are Visible select all Cloud Types Seen

High (in the sky):
(Check all types seen)



☐ Cirrus ☐ Cirrocumulus ☐ Cirrostratus

Middle (of the sky):
(Check all types seen)



☐ Altostratus ☐ Altocumulus

Low (in the sky):
(Check all types seen)



☐ Stratus ☐ Stratocumulus ☐ Cumulus

Rain or Snow Producing
Clouds:
(Check all types seen)



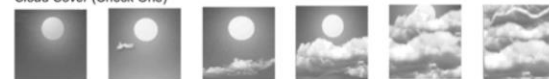
☐ Nimbostratus ☐ Cumulonimbus

* Required Field

Study Site: _____ Date: _____ Time (UT): _____

What Percent of the Sky is Covered by Clouds? (Check One) *Three-quarters or More of the Sky is Visible:*

Cloud Cover (Check One)



No Clouds ☐ 0% ☐ Clear ☐ >0 to 10% ☐ Isolated ☐ 10 to 25% ☐ Scattered ☐ 25 to 50% ☐ Broken ☐ 50 to 90% ☐ Overcast ☐ >90%

Are There Contrails in the Sky? (Check One) ☐ No Contrails ☐ Contrails are Visible

If Contrails are Visible Record the Number of Each Type Seen



Number Observed Number Observed Number Observed

What Percent of the Sky is Covered by Contrails? (Check one):

☐ 0 to 10% ☐ 10 to 25% ☐ 25 to 50% ☐ >50%

If you Selected Obscured (> 25% of the Sky is not Visible) (Check all that apply):



☐ Blowing Snow ☐ Heavy Snow ☐ Heavy Rain ☐ Fog



☐ Sand ☐ Spray ☐ Volcanic Ash ☐ Smoke



☐ Dust ☐ Haze

Comments: _____



Entering Data on the GLOBE Website

You have 4 options:

1. Download the Data Entry app from the [App Store](#)
2. Download the Observer app from the App Store
3. [Live Data Entry](#): These pages are for entering environmental data – collected at defined sites, according to protocol, and using approved instrumentation – for entry into the official GLOBE science database.
4. [Email Data Entry](#) – If connectivity is an issue, data can also be entered via email.



Report!



Set up an Atmosphere Site

A. What are clouds?

B. Why collect cloud data?

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Site Definition

Add site type

Atmosphere

☐ Atmosphere

☐ Surface Temperature

Hydrology

☐ Hydrology

Land Cover/Biology

☐ Land Cover

Earth as a System

☐ Greening

☐ Phenological Gardens

Soil

☐ Soil Characteristics

☐ Soil Moisture and Temperature

Photos →

Site Name *

* indicates a field is required

Lat/Long Crossing

Site ID 35040

Coordinates

Latitude *

45 °

Longitude *

-90 °

Elevation *

410 m

☒ North ☐ South

☐ East ☒ West

Source of Coordinates Data *

☐ GPS ☒ Other

Map Satellite

Google

[Terms of Use](#) [Report a map error](#)

Comments

Example site



Site created successfully.



Set up an Atmosphere Site: Document with Photos

Photos

Photo Date: 2015-11-25 [+ Change Date](#)

[+ Add](#) [ⓘ Edit](#) [Show Instructions](#)

North No Image	South No Image
East No Image	West No Image
Upward No Image	Downward No Image

[Update Site](#) [Reset](#)

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Set up an Atmosphere Site: Select “No Thermometer”

A. What are clouds?

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For clouds, atmosphere site specification is very simple:
No Thermometer

Add site type

Atmosphere

☒ Atmosphere

☐ Surface Temperature

Hydrology

☐ Hydrology

Land Cover/Biology

☐ Land Cover

Earth as a System

☐ Greening

☐ Phenological Gardens

Soil

☐ Soil Characteristics

☐ Soil Moisture and Temperature

Photos →

Atmosphere [Expand/Collapse](#) [Remove](#)

Comment

Obstacles (trees, buildings, etc. that appear above 14 degrees elevation angle when viewed from the site)

Buildings (within 10 meters of the instrument shelter)

Slope Angle

Rain Gauge Height cm

Ozone Clip Height cm

Thermometer Height cm

Thermometers

Thermometer Type:

Surface Cover Description

Surface Cover:



Begin new cloud report

My Organizations and Sites

- [Lat/Long Crossing](#)

Latitude 45, Longitude -90, Elevation 410m

Atmosphere

Aerosols ★

New observation

Past observations

Clouds 1-Day ★

New observation

Past observations

Multi-Day Soil And Air Temperatures ★

New observation

Past observations

Surface Ozone ★

New observation

Past observations

Air Temperature 1-Day ★

New observation

Past observations

Integrated 1-Day ★

New observation

Past observations

Multi-Day Soil And Soil Temperatures ★

New observation

Past observations

Water Vapor ★

New observation

Past observations

Click here to
start a new
report



A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

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H. Further resources.



Enter date and time

Clouds 1-Day *Creating*

Enter The Date And Time Of The Observation (UTC 24hr)

☐

UTC

☐

Local

[Get Current UTC Time](#)

Note:

From this point, the [GLOBE Data Entry App](#) for mobile devices follows basically the same steps as the website

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.



Select Cloud Condition

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

Clouds 1-Day *Creating*

Enter The Date And Time Of The Observation (UTC 24hr)

2015-11-25



17:24



☒ UTC

☐ Local

[Get Current UTC Time](#)

Your UTC time converted to Local (EST) time is 2015-11-25 12:24

Solar Noon: 17:47 UTC



* indicates required sections or fields

Cloud

You can upload a photo after you successfully submit a cloud observation.

Is The Sky Clear, Cloudy Or Obscured?

Clear (No Clouds)

Clouds Visible (1% To 100% Covered By Clouds Or Contrails)

Obscured (More Than 25% Of The Sky Is Not Visible)

Comments

Send Data

Cancel

Reset



Clear Sky Report

- A. What are clouds?
- B. Why collect cloud data?
- C. How your measurements can help!
- D. How to collect your data.
- E. How to report data to GLOBE.
- F. Understand the data.
- G. Quiz yourself!
- H. Further resources.

Why clear days matter:
Some GLOBE reports are compared to satellite data. Determination of absolutely clear sky is a challenge for satellites, but easy from the ground.

For clear days,
reporting is easy
(and important!)



😊 Observation created successfully. [Print this submission](#) or [create a new one](#).

Clouds 1-Day *Editing*

Enter The Date And Time Of The Observation (UTC 24hr)

2015-11-25 17:29 ☐ UTC ☒ Local [Get Current UTC Time](#)

Your UTC time converted to Local (EST) time is 2015-11-25 12:29

Solar Noon: 16:52 UTC

* Indicates required sect

Cloud

Do You Have Pictures Of The Sky?

Photos

+ Add Edit Show Instructions

North No Image	South No Image	East No Image	West No Image
Upward No Image	Downward No Image		

One or more photos optional, but useful

Is The Sky Clear, Cloudy Or Obscured?

☒ Clear (No Clouds) ☐ Clouds Visible (1% To 100% Covered By Clouds Or Contrails)

☐ Obscured (More Than 25% Of The Sky Is Not Visible)

Comments

Send Data Cancel Reset



Cloudy Sky Report

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.











Choose
cloud
types –
all that
apply.
Record
cloud
cover



Is The Sky Clear, Cloudy Or Obscured?

☐ Clear (No Clouds) ☒ Clouds Visible (1% To 100% Covered By Clouds Or Contrails) ☐ Obscured (More Than 25% Of The Sky Is Not Visible)

Click All Cloud Types Seen

High In The Sky	 Cirrus	 Cirrocumulus	 Cirrostratus
Middle Of The Sky	 Altostratus	 ✓ Alto cumulus	
Low In The Sky	 Stratus	 Stratocumulus	 Cumulus
Rain Or Snow Clouds	 Nimbostratus	 Cumulonimbus	

Is Covered By Clouds?

None 0 Percent
Clear 0 To 10 Percent
Isolated 10 To 25 Percent
Scattered 25 To 50 Percent
Broken 50 To 90 Percent
Overcast 90 To 100 Percent

Observation created successfully.



When contrails are present

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.


G. Quiz yourself!

H. Further resources.

Enter NUMBER
of contrails by
type

Enter percent of
sky covered


Descriptive
comments are
always useful

 Observation created successfully.

Are There Contrails In The Sky?


☐ No Contrails ☒ Contrails Are Visible

Short Lived




0

Persistent Non Spreading



2

Persistent Spreading



30

What Percent Of The Sky Is Covered By Contrails?

25 To 50%

Comments

Extensive morning air traffic leaving tracks in the sky



When ONLY contrails are present

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

Enter NUMBER
of contrails by
type



Enter percent of
sky covered



Descriptive
comments are
always useful

What Percent Of The Sky Is Covered By Clouds?

No Clouds

Are There Contrails In The Sky?

No Contrails

Contrails Are Visible

Short Lived



Observed

Persistent Non Spreading



Observed

Persistent Spreading



Observed

What Percent Of The Sky Is Covered By Contrails?

Comments



How to Explore Data: Data Counts

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

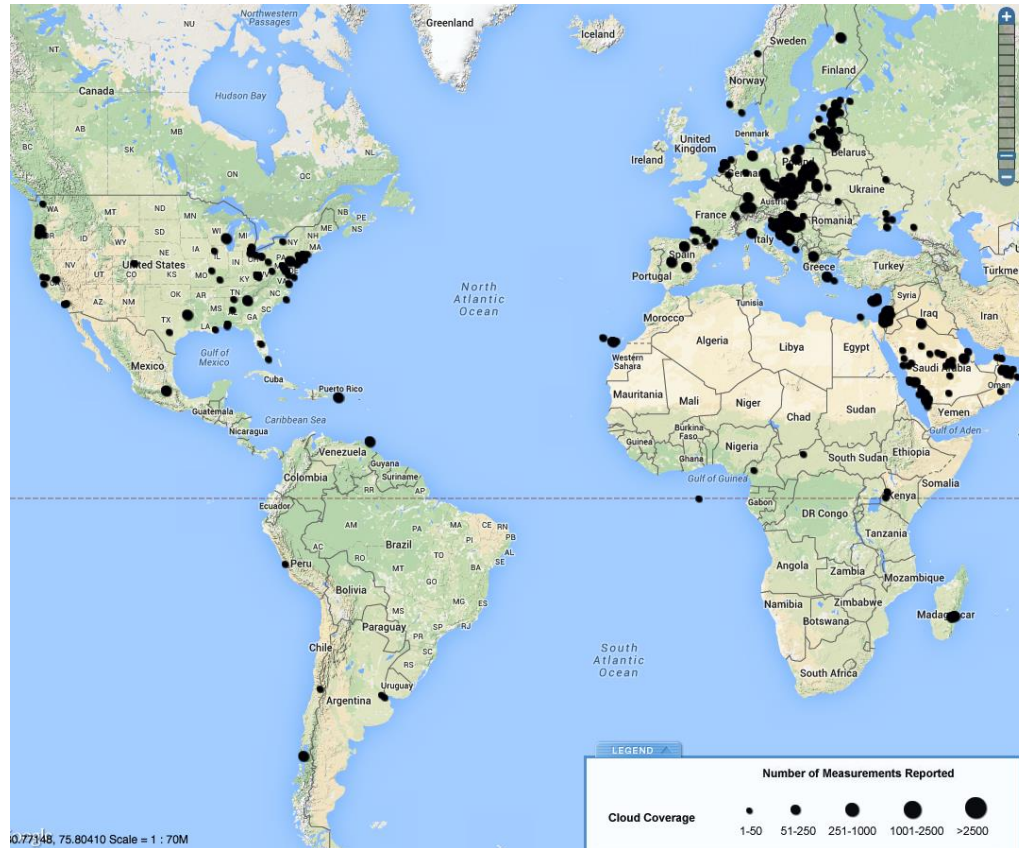
D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.



[E-training](#) is available to explore the full power of the [GLOBE Visualization System](#)



How to Explore Data: Measurements

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

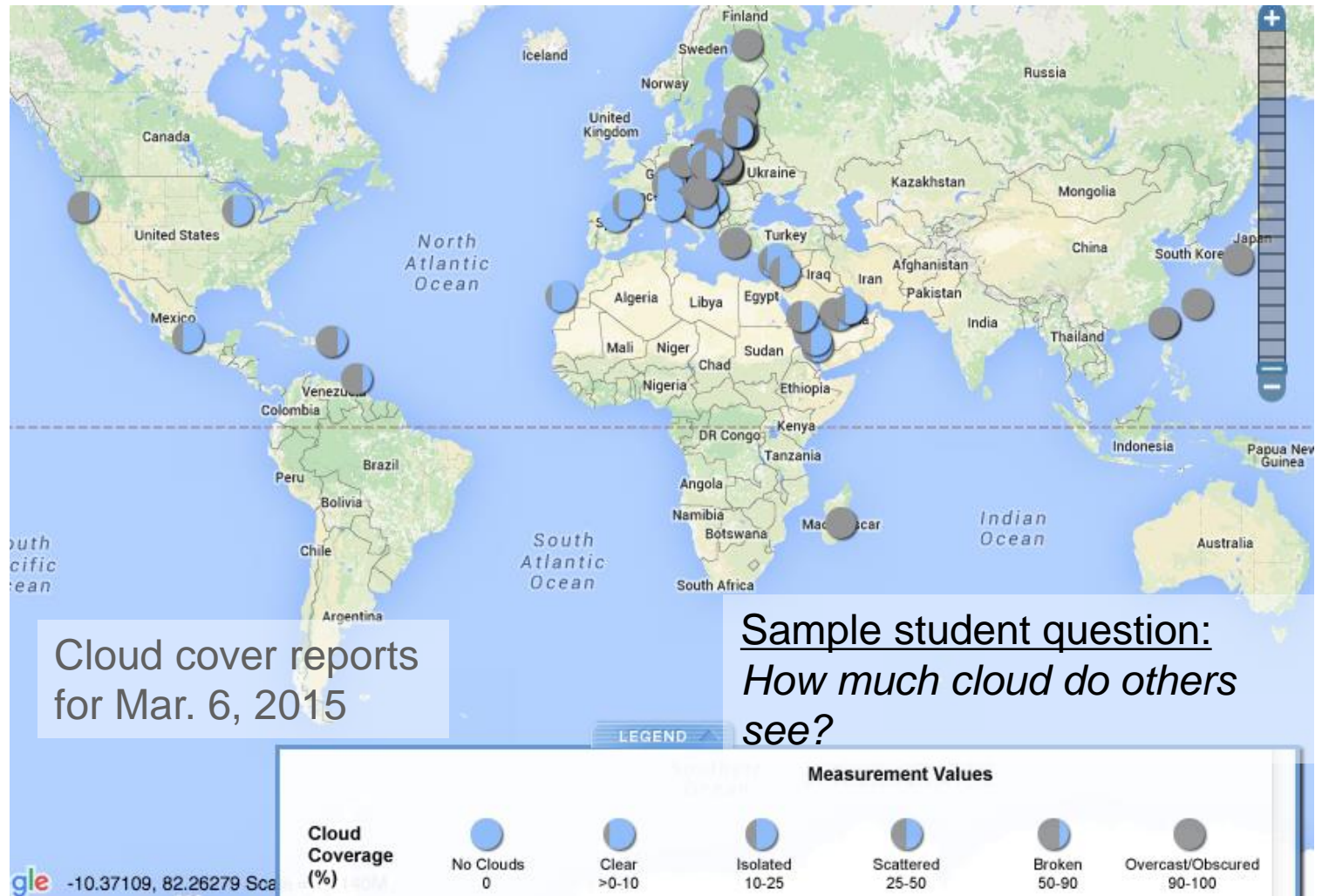
D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.



Sample student question:
How much cloud do others see?



How to Explore Data: Possible questions to explore in GLOBE Viz

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

- Do cloud patterns change during the year? How?
 - Explore “All Cloud Types” layer
- Are contrails often seen in the local area? Why or why not?
 - Explore various “Contrail coverage” layers
- Are the types of clouds and contrails you observe related?
 - Explore various “Cloud Types” and “Contrail coverage”



How to Explore Data: Possible questions to explore with further measurements

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

- Does the amount of cloud cover affect the local temperature?

- Add air temperature protocols

- How reliable are local weather forecasts based on cloud type observations alone? Can they be improved by using other GLOBE measurements?

- Add air temperature, barometric pressure, precipitation, relative humidity, surface temperature, water vapor, or wind protocol(s)

- Do cloud conditions and phenomena that block our view of the sky influence the types of vegetation and soil in our area? If so, how?

- Add biometry, land cover or soils protocols



How to Explore Data: Possible questions to explore with outside information

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

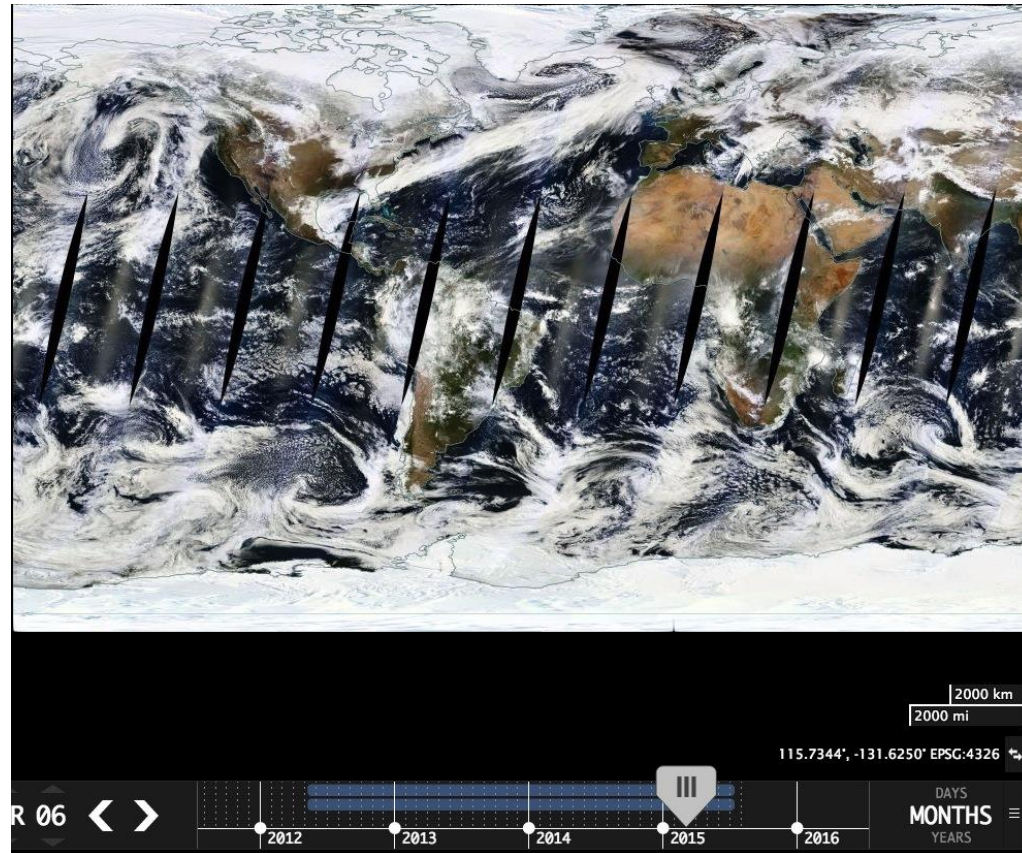
H. Further resources.

- How do the clouds you see relate to nearby mountains, lakes, large rivers, bays, or the ocean?
 - Add maps or satellite imagery
- How do our cloud observations compare with satellite images of clouds?
 - Explore NASA or NOAA resources – see next slides for an example



Understand Data: Context from Satellite

- A. What are clouds?
- B. Why collect cloud data?
- C. How your measurements can help!
- D. How to collect your data.
- E. How to report data to GLOBE.
- F. Understand the data.**
- G. Quiz yourself!
- H. Further resources.



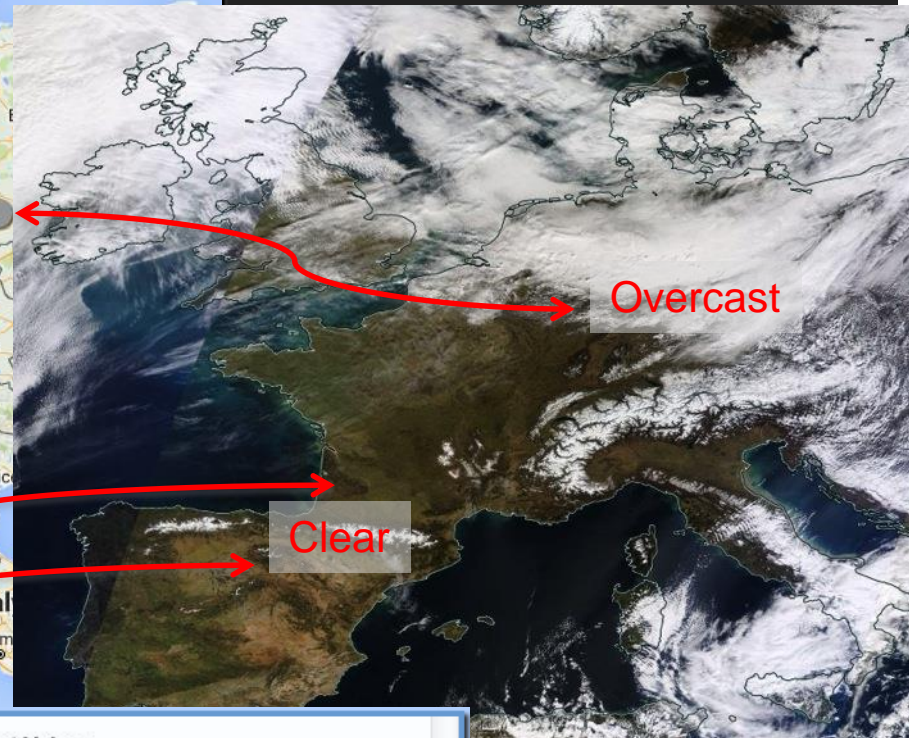
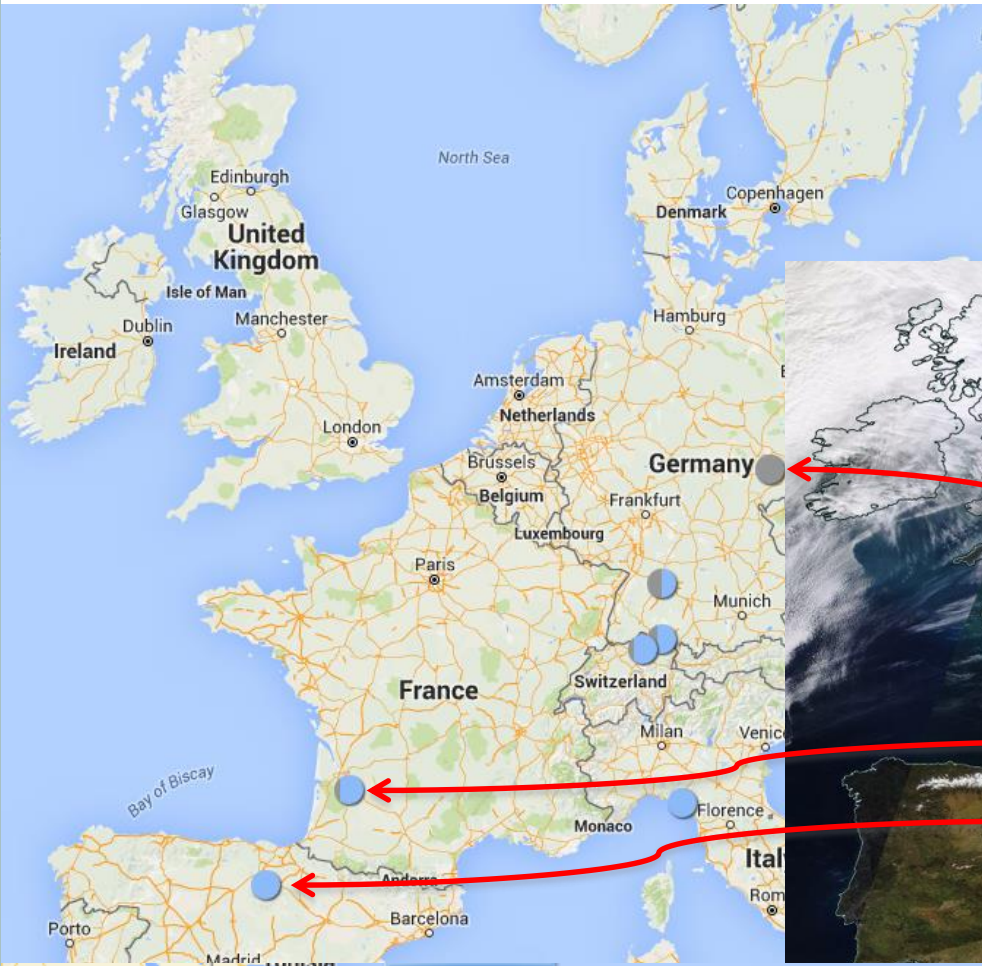
The NASA Worldview site provides contextual information on cloud cover from the MODIS instrument on the Terra and Aqua satellites.

[Satellite imagery for March 6, 2015](#)



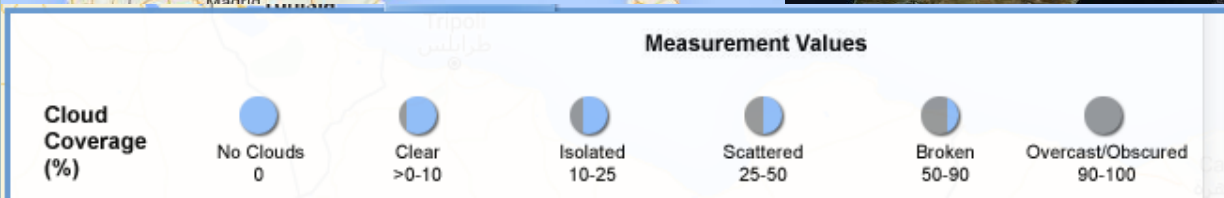
Better Understand Data : Compare to satellite

- A. What are clouds?
- B. Why collect cloud data?
- C. How your measurements can help!
- D. How to collect your data.
- E. How to report data to GLOBE.
- F. Understand the data.
- G. Quiz yourself!
- H. Further resources.



Overcast

Clear



March 6, 2015



What have you learned?

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

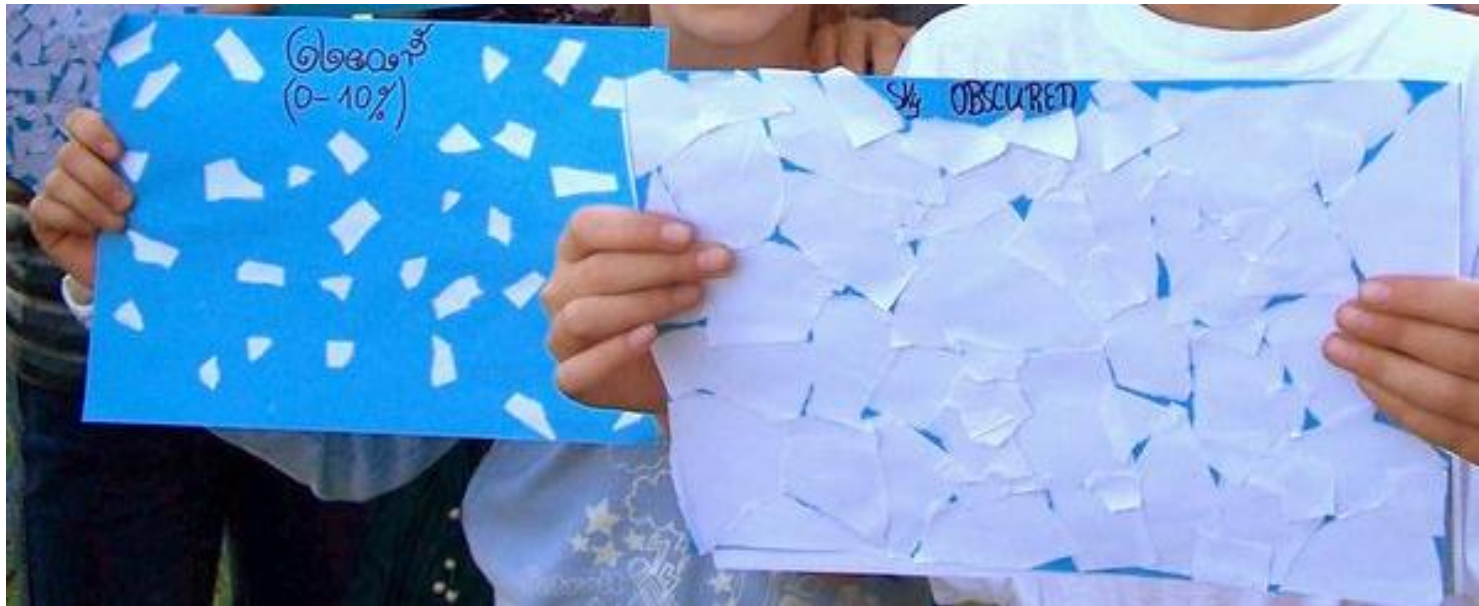
1. What are the key factors in how clouds form?
2. What are the 3 factors that define cloud type?
3. What factors determine whether and what type of contrail will form?
4. What are some reasons that clouds are important?
5. If the sky is clear, should you still submit a cloud observation report?
6. What feature of clouds makes some days darker?
7. If it is raining, what two cloud types might it be?
8. You hear thunder and see lightning. Hard rain is falling. What is the cloud type?
9. You can imagine lots of fun shapes in the clouds. What is the type?
10. What can you use to help determine cloud height?
11. Should you observe and report clouds all the way to the horizon?
12. How much of the sky needs to be obscured to report that state?



GLOBE Learning Activities

[Cloud Watch](#) – monitor clouds and weather to understand the connections

Cloud Cover: Try this [fun activity](#) to train your eye.



Or try a [new, high tech](#) version

[Observing, Describing, and Identifying Clouds](#) – begin to learn cloud types and names

- A. What are clouds?
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Elementary GLOBE Learning Activities

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

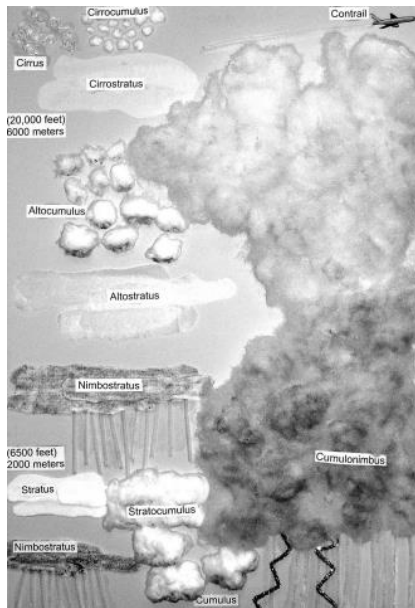
F. Understand the data.

G. Quiz yourself!

H. Further resources.

Try the GLOBE [Clouds storybook](#)
And related [Learning Activities](#):

- Cloud Fun
- Cloudscape
- To Spread or Not to Spread



Elementary GLOBE Do You Know That Clouds Have Names?

NAME: _____

Cloud Fun Student Activity Sheet

I found a cumulus cloud!

Date _____

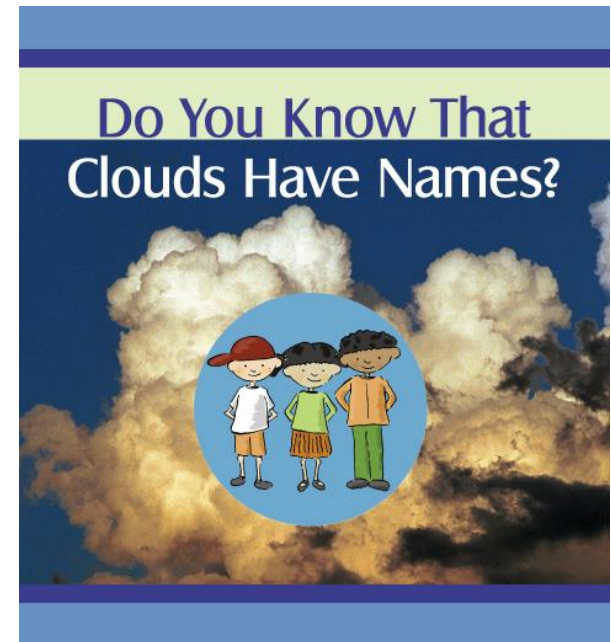
My cumulus cloud looks _____

The weather was _____

_____ on the day I observed my cumulus cloud.

Draw a picture of your cloud and what the weather was like when you observed it.

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NASA Resources

A. What are clouds?

B. Why collect cloud data?

C. How your measurements can help!

D. How to collect your data.

E. How to report data to GLOBE.

F. Understand the data.

G. Quiz yourself!

H. Further resources.

Earth Observatory [feature article on clouds](#)

NASA Fact Sheet:

[The Importance of Understanding Clouds](#)

Clouds and Aerosols [Quiz](#)

Imagery from Space:

Explore [NASA Worldview](#) or [Visible Earth](#)



You are done!

- You have now completed the training module. If you are ready to take the assessment, sign on and take the quiz corresponding to the **Clouds Protocol**.
- When you pass the quiz, you are ready to take **Clouds Protocol** observations! Welcome to the GLOBE atmosphere community!
- Please provide us with feedback about this module. This is a community project and we welcome your comments, suggestions and edits! Comment here: [eTraining Feedback](#)
- Questions about this module? Contact GLOBE eTraining: rlow@ucar.edu

A. What are clouds?

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Credits

- **Chief Scientist: Dr. Lin Chambers, NASA LARC**
- *Version 12/1/16. If you edit and modify this slide set for use for educational purposes, please note “modified by (and your name) on this page. Thank you.*

A. What are clouds?

B. Why collect cloud data?

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