Precipitation Student Field Campaign

Teacher Participation Guide

Purpose

Water – the main reason for life on Earth - continuously circulates through one of Earth's most powerful systems: the water cycle. Precipitation is one very important aspect of that cycle, and while the effects of precipitation are felt at local scales, understanding how Earth's water cycle interacts with other Earth systems requires a global view. With that goal in mind, NASA launched the Global Precipitation Measurement Mission Core Observatory in February 2015 to help fill in the gaps between ground-based rain gauges and radars, and give a truly global view of precipitation. However, the way satellites "see" rain is not the same as the way rain gauges collect precipitation on the ground, and to make sure the algorithms used by the satellites to provide rain totals are working well, we need to do what is called ground validation. This campaign is an opportunity for students to participate in ground validation for the GPM satellite, looking at the question, "How do ground-based observations compare to satellite rainfall estimates?" Students will also be able to compare their data with that of participating schools around the globe, networks of "official" rain gauges, as well as to long-term climatological data, and look for patterns and anomalies.

Overview

Using GLOBE precipitation protocols and a GLOBE-approved rain gauge, students will collect data during concentrated observing periods of the Student Precipitation Field Campaign, similar to the field campaigns conducted by professional scientists, and upload the data to the GLOBE database. Students can compare their data to that collected by other schools around the world, as well as to climatological averages for their area. In addition, GPM scientists will analyze the data and compare it to GPM satellite data products as they become available, as well as other rain gauge networks and ground-based radar data.

Key science objectives

The following are the key science objectives for the Global Precipitation Measurement Mission:

- Advancing precipitation measurement from space
- Improving knowledge of precipitation systems, water cycle variability, and freshwater availability
- Improving climate modelling and prediction
- Improving weather forecasting and 4-D climate reanalysis
- Improving hydrological modeling and prediction

The data collected by students can be used to help validate the satellite measurements, and to help understand local patterns of precipitation. For more details about the objectives, visit http://gpm.nasa.gov/GPM/science-objectives. Ideas for student research questions can be found starting on page 5 of this document.

Time frame for observations

The campaign will officially kick off February 1, 2015 and run until April 15. Rain gauges should be in place by Friday, January 30 to start data collection the following week. We prefer that you collect precipitation data daily during the entire campaign period for a greater data density to aid in analysis. If you are new to collecting precipitation data or run in to logistical challenges, you might consider collecting during just the first week of each month. Remember that multi-day accumulations can be submitted over weekends or other periods during which daily observations were not possible.

Events during the campaign

A kick-off webinar for teachers will be held on Wednesday, January 21 at 12:00 pm Eastern Standard Time, UTC-5, with a second identical session at 7:00 pm EST/UTC-5. The webinar will give an overview of the campaign and the basics of the Global Precipitation Measurement Mission. Kick-off webinars for students will occur at several different times on February 2nd. Each short webinar (15-20 minutes) will consist of a brief presentation about the mission and the plans for the campaign, and the chance to ask questions of a GPM Education Specialist. Currently planned times (all EST, UTC-5) are 10:00 am, 12:00 pm, 2:00 pm and 4:00 pm. It may be possible to arrange a virtual visit by a GPM scientist or education specialist. If you are interested, contact the GPM Education and Communication Team at http://gpm.nasa.gov/education/contact.

Other webinars on topics ranging from ground validation to applications of satellite precipitation data will be scheduled monthly throughout the campaign. For details of these and how to join the events, go to http://www.globe.gov/web/gpm/overview/webinars. NOTE: Webinars and other outreach opportunities are also open to schools in non-GLOBE countries, although they will not be able to participate in actual data collection.

Participation will be tracked, and top participants recognized on the field campaign website. Points for participation can be earned by:

1. Entering precipitation data into the GLOBE database (1 point per data entry)
2. Joining one of the GPM mission and precipitation science webinars (5 points per webinar)
3. Becoming a member of the GPM community on GLOBE (5 points)
4. Completing a GPM lesson or activity – see suggestions below (5 points per activity)
5. Developing and carrying out a research project (10 points)
6. Hosting a Rain EnGAUGE event or otherwise involving the wider school community in the campaign (25 points)
7. Having students complete the online pre/post assessment of general precipitation measurement knowledge (15 points)
8. Completing the online teacher feedback survey after the campaign (15 points)

Materials needed

- If your school has not already set up an atmosphere observation site, refer to the Instrument Construction, Site Selection and Set-Up Guide as needed (http://go.usa.gov/m2qe)

- Rain gauge that meets the GLOBE requirements (Only a rain gauge is required for this campaign, not an instrument box, snow board, etc. For teachers in the United States, if you do not have a rain gauge available, contact the GPM Education and Communication team, http://gpm.nasa.gov/education/contact, and we may be able to help you procure one.)
- GPM Precipitation Field Campaign Data Sheet (see Appendix A). The Atmosphere Investigation Integrated 1-Day Data Sheet, http://go.usa.gov/GbyC, can be used if other types of atmosphere observations will be made at the same time.
- Field guide for Precipitation Protocols, http://go.usa.gov/VvrG (The emphasis for this campaign is on liquid precipitation i.e. rainfall, but the protocols for solid precipitation can be used if needed.)
- Pencil or pen
- Clipboard

Time needed to participate

- If it is necessary to identify and establish a precipitation observation site: *30-45 minutes, or done by teacher outside of class*
- Initial training for students to make precipitation observations: *approximately 30 minutes*
- Daily observations during the data collection weeks: *10-15 minutes, may be done by just 1-2 students each day rather than the entire class*

What to do and how to do it

1. Join the GPM community (http://www.globe.gov/web/gpm) on the GLOBE website to get the latest updates on the campaign and join in on discussions.
2. If you wish, use the GPM Precipitation Field Campaign Presentation (PowerPoint format), to introduce your students to the reasons behind the GPM mission and NASA's study of Earth and precipitation, and to their involvement in the campaign.
3. Collect precipitation data
   - Identify and establish an observation study site for precipitation, if your school does not have one previously established. Refer to the Instrument Construction, Site Selection and Set-Up (http://go.usa.gov/VdF4) for information regarding selecting and setting up an observation site.
     - Note: Only a rain gauge is needed for this campaign, not an instrument box, snow board, etc. For teachers in the United States, if you do not have a rain gauge available, contact the GPM Education and Communication team (http://gpm.nasa.gov/education/contact) and we may be able to help you procure one.
   - Follow the Precipitation Protocols (http://go.usa.gov/VdtY) directions for collecting data.
     - If you have an automated weather station, that can also be used for reporting. See specific protocols for different types of approved stations at the bottom of the Atmosphere Protocols page (http://www.globe.gov/web/atmosphere-climate/protocols).
4. Report data to the GLOBE data base

- From the main GLOBE homepage, click the "Enter Live Data" button in the middle of the page, or go directly to the data entry page via https://data.globe.gov.
- Find your study site in the list of previously-defined sites, or define a new site using the "Add site" link to the right of your study site name on the data entry page.
- Enter your precipitation data.
- A data entry video tutorial is available at http://go.usa.gov/GD29.

View precipitation data

- Precipitation data can be viewed in the GLOBE visualization (http://vis.globe.gov/GLOBE/) system. Once you enter the visualization system, go to "Data Layers" in the upper left part of the map, hit the "Add +" option and choose Precipitation and Rain Depth from the Protocol drop down menu and Add Layer Then click on a school with data from the map, and you can select various graph and table views and date ranges.
- A tutorial on the basics of the visualization tools is available here.
- Use the My NASA Data Live Access Server (http://mynasadata.larc.nasa.gov/) to view precipitation data from GPM's predecessor satellite, the Tropical Rainfall Measuring Mission (TRMM). Instructions for how to get climatology averages can be found here: http://go.nasa.gov/1p6UWHW.
- More file formats for TRMM and GPM data can be found on the mission's data access website, http://pmm.nasa.gov/data-access.

Student research questions

While ground validation campaigns, such as those upon which this field campaign was modelled, generally take place over only a short period of time, many of the most interesting investigations into precipitation require longer-term data provided from other sources. Some of the questions below will go beyond the data collected by students during the campaign, and will require seeking out additional data sources such as those listed in the section above. Additional resources to help you do this will be available on the field campaign website.

- What is the pattern of seasonal rainfall for your location? When does the maximum rainfall occur? Minimum? What might be the cause of any differences?
- How does the amount and type of precipitation seen by the satellite in your area compare with what you observe on the ground? If they don't match, why might that be the case?
- How do your measurements compare to other ground-based rain data, from nearby official weather stations (often at airports) or what is reported on the news? If they don't match, why might that be the case?
- How do the patterns of rainfall in your location during the campaign compare to other data being collected in different locations? What might explain differences and similarities? What does that tell you about climate and weather patterns around the globe?

- How does the rainfall you recorded during the campaign compare to climate averages for your location? If there are differences, can you think of any reasons why that might be the case? (HINT: You may need to seek out other sources of data such as temperature, humidity, etc. to formulate an explanation)
- Are there trends in precipitation patterns in the historical data? If your location is getting more or less precipitation than usual, how will those changes have an impact on ecosystems and human societies? Can you use your precipitation measurements to make predictions about future weather or the risk of flooding, landslides, or other natural hazards? What additional information might you need to make accurate forecasts in these areas?

Encourage your students to post a student research report on GLOBE's website, using these questions or others they generate on their own. More information and examples of previously submitted reports can be found here: http://go.usa.gov/y8ae.

Next Generation Science Standards and Supplemental Educational Activities:

Science and Engineering Practices: *Constructing explanations and designing solutions*

- Rain Gauge Design Challenge: Design, build and test an instrument to measure precipitation.
  - As informal lesson/activity: http://go.nasa.gov/1j5PFMh or http://go.nasa.gov/1hXmRar
  - As formal lesson: http://go.nasa.gov/1o99Ckq

K-ESS2-1 – *Use and share observations of local weather conditions to describe patterns over time.*

- Earth Systems Storybook: "All About Earth – Our World on Stage" - http://go.usa.gov/y8aY

3-ESS2-1 – *Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.*

- Geographical Influences: Students will compare the climatograms for different locations around the United States to observe patterns in temperature and precipitation. http://go.nasa.gov/1hzTLic
- S1: What Can We Learn About Our Seasons? Students develop a qualitative understanding of the characteristics and patterns of seasons and highlight the relationship of seasons to physical, biological and cultural markers. http://go.usa.gov/y8cd
- All Year Long: Each student will keep a science journal during each of the four seasons. Students will record observations of the general outdoor environment they visit and then will make observations of one specific item from the habitat in each season. At the end of the school year, students will compare of their seasonal drawings and share their results with the class. http://go.usa.gov/y8YC
- Earth System Science Poster and Activity Guides (including a new MY NASA DATA digital poster) http://go.usa.gov/y8YW

5-ESS2-1 – *Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere and/or atmosphere interact*

- Survivor: Earth Lesson Series: Students learn about local and global water issues through hands-on activities done largely outdoors and include scientific data collection based on simplified GLOBE protocols. http://go.nasa.gov/1pc7zyz
- Weather and Climate iQuest: Students learn how weather and climate are shaped by complex interactions involving sunlight, the ocean, the atmosphere, clouds, ice, land, and life forms. http://go.nasa.gov/KETueu
- Earth Wheel: A physical interactive that allows students to explore and compare data from four current satellite missions: Aquarius, GRACE, Terra and TRMM. http://go.nasa.gov/1vWhtpm. For a full lesson plan and accompanying webquest, visit: http://go.nasa.gov/1vWhHMZ

MS-ESS2-4 – *Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity*

- Exploring the Water Cycle: A lesson to teach students about the water cycle and the forces that drive the processes that move water through Earth's systems. http://go.nasa.gov/1w3zX9K
- The Water Cycle: In this one-hour long activity, students participate in a webquest to learn about the water cycle, and then build a mini-model of the water cycle to observe how water moves through Earth's four systems. http://go.nasa.gov/WP7Nml
- Water Cycle Webquest: A longer version of the webquest from the previous activity, students learn a little about the GPM mission and then focus on online resources about the water cycle. http://go.nasa.gov/WP8E6L
- Additional water cycle educational resources: http://gpm.nasa.gov/education/water-cycle

HS-ESS2-2 – *Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.*

- Earth System Science Poster and Activity Guides (including a new MY NASA DATA digital poster) http://go.usa.gov/y8YW

For more about the connections between GLOBE and the NGSS, see http://go.usa.gov/y84e. For sample assessment items to use with students during or after the campaign, see Appendices A & B. For more GLOBE assessment tools, see http://go.usa.gov/VvTz.

The link for an online pre-post assessment testing basic knowledge of precipitation measurement and ground validation will be posted on the discussion board on the GPM community page on the GLOBE website. Examples of questions that may be included can be found in Appendix B. In addition, teachers who participate in the campaign will be invited to complete a post-campaign evaluation survey, also to be linked from the discussion board. Teachers who respond and/or have their students complete the pre-post assessment will be sent a certificate of participation, and will be entered in a drawing for a hardcover copy of the NASA "Earth as Art" book (virtual version available here http://go.nasa.gov/1pcfqu4), or a kit for a special model of the GPM Core Observatory (details here http://go.nasa.gov/Qrq3zh).

Appendix A: Data Sheet

GLOBE-GPM Precipitation Student Field Campaign

Data Sheet

School Name/Location: _____ Study Site:_____

Date					
Local time (hour:min)					
Universal time (hour:min)					
Number of days since your last measurement					
**For participants with U.S.-system rain gauges, not to be reported to GLOBE **					
Rainwater in rain gauge (inches)					
To convert inches to millimeters, multiply each value by 25.4 and enter below before submitting data					
Rainwater in rain gauge (mm)					

Date					
Local time (hour:min)					
Universal time (hour:min)					
Number of days since your last measurement					
**For participants with U.S.-system rain gauges, not to be reported to GLOBE **					
Rainwater in rain gauge (inches)					
To convert inches to millimeters, multiply each value by 25.4 and enter below before submitting data					
Rainwater in rain gauge (mm)					

Remember:

- Record 0.0 when there has been no rainfall.
- Record M for missing if there was rain and you weren't able to take an accurate reading.
- Record T for trace if the amount of rainfall is less than 0.5 mm.

Make sure you enter your data into the GLOBE system daily or at least at the end of each week of the campaign to ensure it is included in the overall analysis by a NASA scientist, the results of which will be posted in the ongoing blog on the GPM-GLOBE community page, http://www.globe.gov/web/gpm.

Appendix B: Question Bank

Examples of questions that may be on the online pre/post assessment for the external evaluation of the campaign, and/or to be used for the teacher's own assessment purposes as desired

General Questions about Precipitation Measurement: (multiple choice)

1. Which instrument pictured below is the best choice to measure precipitation on the ground?

a.	b.	c.	d.
			

2. Which location is the best for placing a rain gauge?

a. 

b. 

c. 

d. 

3. What is the difference between weather and climate?
   a. There is not a difference – the terms can be used interchangeably.
   b. Climate is the collection of all the weather reports for a country for one day.
   c. Climate is the location where the weather is occurring.
   d. Climate refers to weather patterns in an area over a long period of time.

4. Which of these is NOT an advantage of measuring precipitation from space?
   a. We can get data from remote locations where there isn't ground data from gauges or radar.
   b. We can replace all the rain gauges and never have to do ground observations again.
   c. We can see where precipitation is anywhere in the cloud, not just what is happening at the surface.
   d. We can see precipitation and storms forming over oceans, where it's impossible to have rain gauges.

5. The GPM mission is able to collect worldwide data because:
   a. International partners have satellites to fill in data
   b. Its Core Observatory has instruments pointing in different directions
   c. Ground validation fills in the gaps
   d. It makes a couple of passes every day

6. The term "ground validation" means:
   a. Making sure the satellite stays the correct distance from Earth's surface.
   b. Removing the rain gauges on the ground under where the satellite passes because we don't need them anymore.
   c. Comparing ground precipitation observations to satellite data to make sure the systems are working.
   d. All the checks they do on the satellite on the ground to make sure the instruments work before they launch it into space.

General Questions about Precipitation Measurement: (short answer)

1. Describe (or draw) an instrument we might use to measure precipitation on the ground. What characteristics should it have and where should we place it?_____

2. Why do we also measure precipitation from space using satellites? _____

3. What is the difference between weather and climate? _____

4. What does the term "ground validation" mean? _____

Appendix C: Sample Assessment Items Related to Next Generation Science Standards

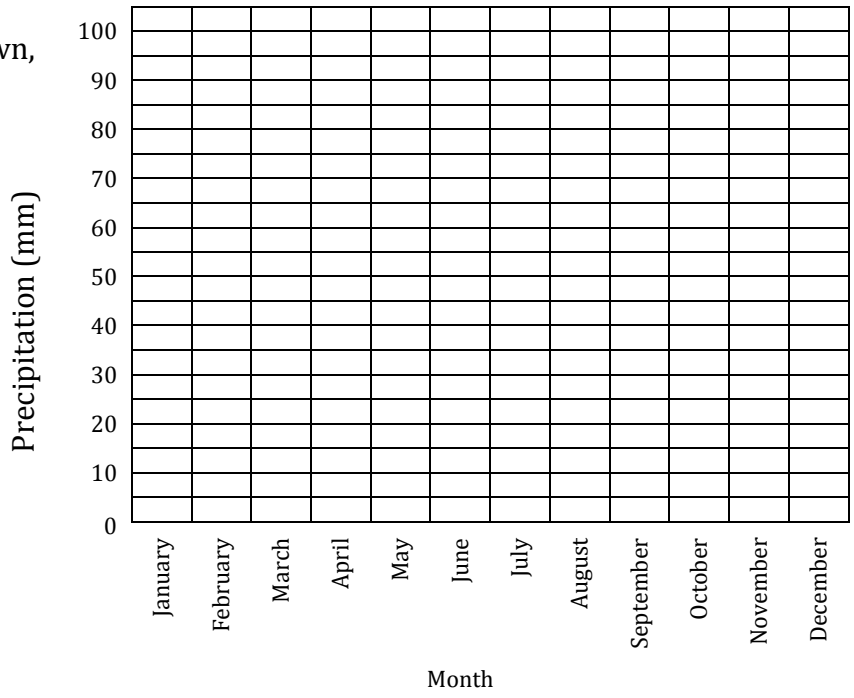
K-ESS2-1 – *Use and share observations of local weather conditions to describe patterns over time.*
Draw a picture of what the weather looks like today.

Draw pictures showing what the weather is like at different times of year where you live.

3-ESS2-1 – *Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.*

1. Make a graph of this precipitation data for Cape Town, South Africa.

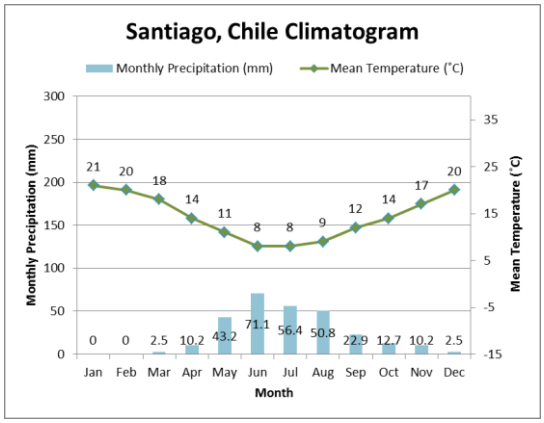
Month	Monthly Precipitation (mm)
Jan	15.2
Feb	15.2
Mar	20.3
Apr	40.6
May	68.6
Jun	94
Jul	83.8
Aug	76.2
Sep	40.6
Oct	2.5
Nov	0
Dec	17.8
MEAN	39.6
RANGE	94



2. Describe seasonal patterns you see in the data. Which months are wettest? Which are driest? ___

3. Which months have precipitation amount closest to the mean? ___

Now look at this climatogram, with both temperature and precipitation data for Santiago, Chile.



5. Describe the differences you see in precipitation for the different seasons. ___

6. What type of weather could you expect in Santiago were you to visit right now? ___

5-ESS2-1 – *Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere and/or atmosphere interact*

Precipitation is an important part of the water cycle, and involves all of the Earth's spheres. Using the pictures below to help with ideas, describe how precipitation involves interactions between the geosphere, biosphere, hydrosphere and atmosphere.

Hint: If it helps, you might imagine yourself as a drop of rainwater moving through the world as part of the water cycle. When do you encounter the air (atmosphere)? When do you encounter the ground, like dirt and rocks (geosphere)? When do you encounter plants and animals (biosphere)? When do you encounter other sources of water like oceans, lakes and rivers (hydrosphere)?

How does precipitation involve interactions between the geosphere, biosphere, hydrosphere and atmosphere?

Images selected from the winners of NASA's Global Precipitation Measurement Mission's "Let it Snow" and "Unique Perspectives" photo contests. Top row: "Rainin' on my Birthday" by Bryan Lee Jie Lon, "Sunset 102" by Sharon Yencharis, and "Rain in the Pines of Fort Valley" by Gill Couto. Bottom: Mount Roy, Wanaka, New Zealand by Steven Sandner. For more information see, http://go.nasa.gov/1AzBJ3m &

MS-ESS2-4 – *Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity*

Draw a diagram of the water cycle. Label changes of state involving heat (energy from the sun) and gravity. Use the word bank to help you, but do not be limited by those terms. Use other vocabulary you have learned where appropriate.

Word bank:

evaporation	condensation	precipitation	runoff	infiltration	groundwater flow	transpiration
storage	ice cap	lake	river	ocean	aquifer	

The Water Cycle