

GPM

Global Precipitation Measurement

Mission Overview

Global Precipitation Measurement (GPM) is an international satellite mission to provide next-generation observations of rain and snow worldwide every three hours. NASA and the Japan Aerospace Exploration Agency (JAXA) will launch a GPM “Core” satellite carrying advanced instruments that will set a new standard for precipitation measurements from space. The data provided by the Core unifies precipitation measurements made by an international network of partner satellites to quantify when, where, and how much it rains or snows around the world.

The GPM mission advances our understanding of Earth’s water and energy cycles, improves the forecasting of extreme events that cause natural disasters, and extends current capabilities of using satellite precipitation information to directly benefit society.

GPM Core Observatory

The foundation of the GPM mission is the Core Observatory satellite. The Core satellite measures rain and snow using two science instruments: the GPM Microwave Imager (GMI) and the Dual-frequency Precipitation Radar (DPR). The GMI captures precipitation intensities and horizontal patterns, while the DPR provides insights into the three dimensional structure of precipitating particles. Data collected from these two instruments provide a reference standard for unifying precipitation measurements from research and operational satellites launched by a consortium of GPM partners in the United States, Japan, France, India, and Europe.

The GPM Core Observatory satellite will fly at an altitude of 253 miles (407 kilometers) in a non-Sun-synchronous orbit that covers the Earth from 65°S to 65°N—from about the Antarctic Circle to the Arctic Circle. The Core Observatory is being developed and tested at NASA Goddard Space Flight Center. Once complete, a Japanese H-IIA rocket will carry the GPM Core Observatory into orbit from Tanegashima Island, Japan in 2014.

GPM Science and Applications

Water is fundamental to life on Earth. Knowing where and how much rain and snow occur globally is vital to understanding how weather and climate impact our environment as well as Earth’s water and energy cycles. Natural disasters like floods and droughts are directly related to precipitation, as is the availability of fresh water for consumption and agriculture. Since rainfall and snowfall vary greatly from place to place and over time, satellites can provide more uniform observations of rain and snow around the globe than ground instruments, especially in areas where surface measurements are difficult. GPM’s next-generation global precipitation data will lead to scientific advances and societal benefits in the following areas:

- Improved knowledge of the Earth’s water cycle and its link to climate change
- New insights into precipitation microphysics, storm structures and large-scale atmospheric processes
- Better understanding of climate sensitivity and feedback processes
- Extended capabilities in monitoring and predicting hurricanes and other extreme weather events
- Improved forecasting capabilities for natural hazards, including floods, droughts, and landslides
- Enhanced numerical prediction skills for weather and climate models
- Advanced agricultural crop forecasting and monitoring of freshwater resources

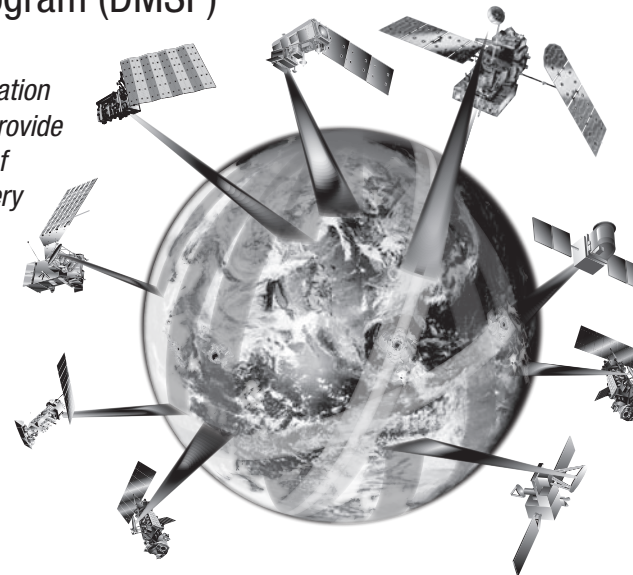
Constellation and Partners

The GPM mission was initiated by NASA and JAXA and is specifically designed to unify precipitation measurements made by the GPM Core satellite along with a constellation of partner satellites. The GPM constellation of satellites can observe precipitation over the entire globe every 2-3 hours.

Each constellation member has its unique scientific or operational objectives but contributes microwave measurements to GPM for the generation and dissemination of uniform global precipitation products for worldwide user communities. The agencies planning to contribute satellite data the GPM constellation include:

- NASA
- Japan Aerospace Exploration Agency (JAXA)
- French Centre National d’Études Spatiales (CNES)
- Indian Space Research Organisation (ISRO)
- National Oceanic and Atmospheric Administration (NOAA)
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
- United States Department of Defense Meteorological Satellite Program (DMSP)

The GPM constellation of satellites will provide global coverage of rain and snow every three hours.



Educational Activity: Freshwater Availability

This activity can be used with any age level, from elementary level students to adult groups.

Educational Standards:

Earth and Space Science: Structure of Earth System

- Water, which covers the majority of the Earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the “water cycle”
- Fresh water, limited in supply, is essential for some organisms and industrial processes. 4B/M8*

Classroom Activity

This activity is designed to introduce participants to the concept that although about 70% of Earth’s surface is covered by water, only a small fraction of that water is available to humans as an essential resource.

ENGAGE: Show participants a picture of the Earth taken from space to begin a discussion about water on Earth and how we have learned about water on Earth from satellites in space.

Put this image up:

http://visibleearth.nasa.gov/view_rec.php?id=2429, and use the following questions as discussion starters:

- What do you see in this image? (land, water, clouds)
- How was this image taken? (on a satellite from space)
- Do you think there is more land or water on Earth? Why?

EXPLORE: Direct the conversation toward the value of water to humans and other living organisms on Earth.

Questions to steer this discussion:

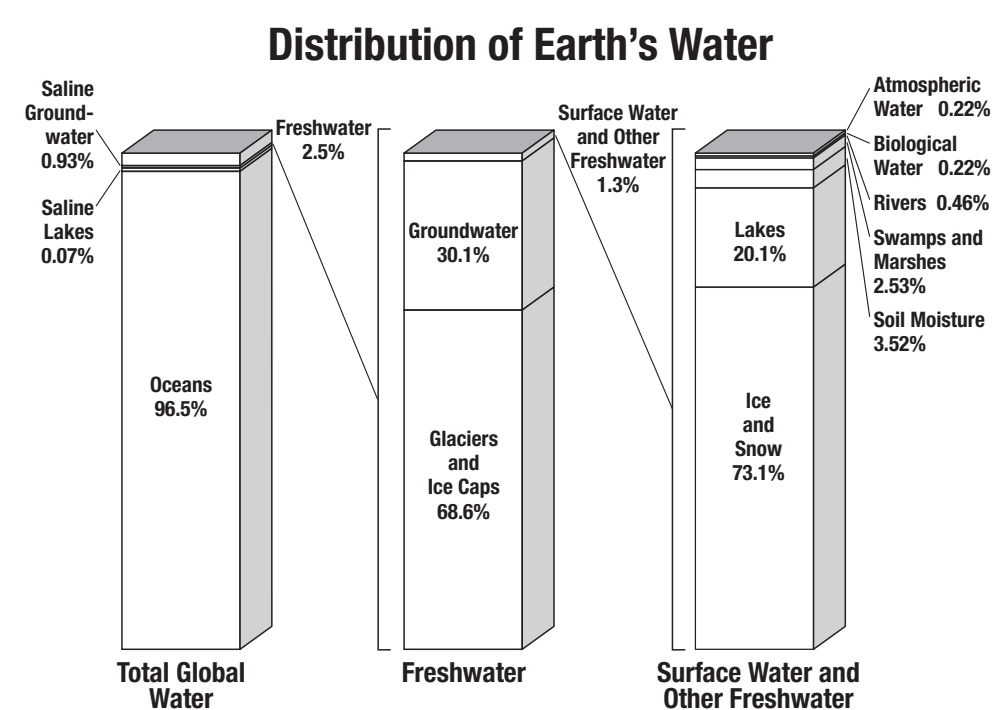
- What are some of the ways that you use water every day?
- Where does the water that you use come from?
- Is water a finite or infinite resource? How do you know?

EXPLAIN: Share the following information with the participants. Have participants work in small groups to discuss the information, or lead the discussion to ensure they are reading the graphic information accurately. Begin by having them read the following information from NASA’s TRMM web site.

Water is essential to life, as it nourishes our cells and removes the waste they generate. Water determines whether plants produce food, or whether they wither from drought or rot from dampness. Water is essential to our homes and factories, to our production of food, fiber, and manufactured goods, and to just about everything else we produce and consume. Although water covers more than 70 percent of the Earth’s surface, only about 3 percent is fresh water—and about 69 percent of that is inaccessible because it is frozen in glaciers and icecaps.

Rainfall is one of the most important weather and climate variables that determine whether humankind survives, thrives, or perishes. Water is so ever-present on planet Earth that we often take it for granted. Too much water results in devastating floods, and the famine caused by too little water (drought) is responsible for more human deaths than all other natural disasters combined. Water comprises more than 75 percent of our bodies and as much as 95 percent of some of the foods we eat¹.

Next, share this graphic with the participants and have them discuss the information:



Some younger audiences will need help interpreting the graphic data. Be sure they understand that each image to the left represents only a small portion of the image before it. Take time to discuss some of the vocabulary.

Guiding questions could include:

- What does “saline” mean? How does salinity affect water for human usage?
- What is “groundwater”? How does water get into the ground?
- What is a “glacier”? Where do we find glaciers on Earth?
- What is “atmospheric water”?
- What do you think “biological water” might be?

EVALUATE: Ask the participants to think about their perception of Earth as the “Water Planet”, and then to think about how much of that water is actually accessible for us to use. Have them consider what the implications might be knowing that although Earth has a lot of water, only about 1% is available to humans as a freshwater resource.

EXTEND: Have participants discover how much water is in an apple. They should peel the apple, and then weigh and record the weight. Now put it in a dry location, leave it for about two weeks, and then weigh it again. Have students determine the percentage of weight that has disappeared. Ask them to explain why the apple weighs less now.

¹ Benchmarks for Science Literacy (2009), Chapter 4: *The Physical Setting*, American Association for the Advancement of Science, <http://www.project2061.org/publications/bsl/online/index.php?chapter=4#B3>

² from TRMM (http://pmm.nasa.gov/sites/default/files/document_files/educational/Weather_04.pdf)

³ <http://ga.water.usgs.gov/edu/earthwherewater.html>