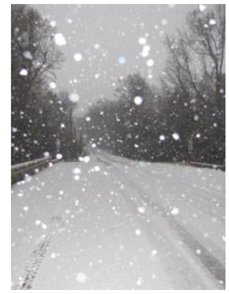
Examining Precipitation on a Globe of Blue

When you shake a snow globe, white flakes are suspended in the enclosed environment until they begin to fall on the miniature buildings and people. Because we are located outside that little world, we can observe the entire weather system taking place—where the biggest accumulations of flakes are occurring, and how long it takes until the storm clears. We have a similar view of our planetary globe from satellites located above the Earth and beyond our weather systems that can see where precipitation is falling.



Snow falling in Texarkana.
Photo courtesy of Dave Hall, Source: NOAA

A space-high view has multiple advantages for measuring rain.

Credit: CoCoRaHS

Ground instruments, such as rain gauges, do a great job of collecting measurements of precipitation in one place. But consider this: if a storm dumps rain on the hills above a town, and the town receives only a little rain, we would not know how much rain the area received if a rain gauge were only located in the town or in the hills. This situation is not unusual. Coverage from ground instruments is sparse or non-existent in developing countries and remote areas. In fact, if we gathered all the rain gauges in the entire world together, they would only fill two basketball courts. Most of Earth's surface- over 70%- is covered by water, and we can't place rain gauges there. By orbiting about 250 miles above Earth's surface, satellites can observe precipitation over land, including the unpopulated areas and over oceans. They can give us a quick and accurate idea of where, when, and how much precipitation is falling.

What the satellites see, in 3D.

The GPM Core Observatory
Credit: NASA/GPM

Even from the vantage point of space, one satellite can't see the whole world at once. But what about using ten satellites? The Global Precipitation Measurement (GPM) mission does just that! Working with international partners, data from multiple satellites is combined into one global view of rain and snow around the world. It's a wide and varied picture of precipitation that can take many forms: drizzle, rain, freezing rain, sleet, snow, ice needles, ice pellets, hail. Making plans for a day with drizzle might be very different than a day with hail or sunny skies. Satellites can give us information about precipitation as it is falling to the ground.

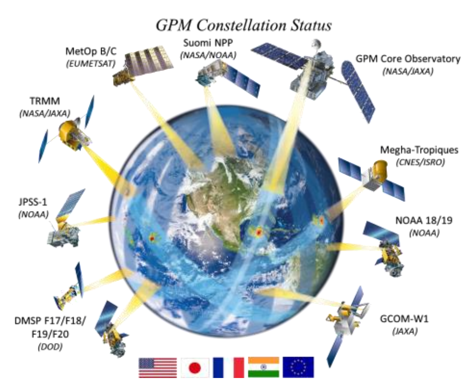
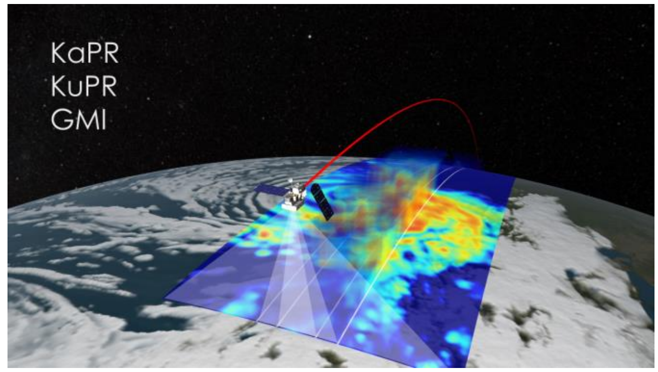
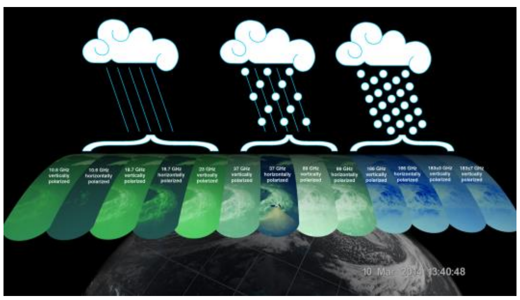


Illustration of the Global Precipitation Measurement Mission satellite constellation.
Credit: NASA/GPM

The GPM mission has a Core Observatory satellite with two instruments aboard to take measurements of all different types of precipitation. One instrument is the Dual-frequency Precipitation Radar; it works like a CAT scan. Its active radar sends out a pulse of energy that hits the precipitation particles inside clouds. The pulse bounces back from the particles to a sensor that reads the information. That information can provide clues into what size, type, and how much of different precipitation particles exist in the atmosphere -- in three dimensions.



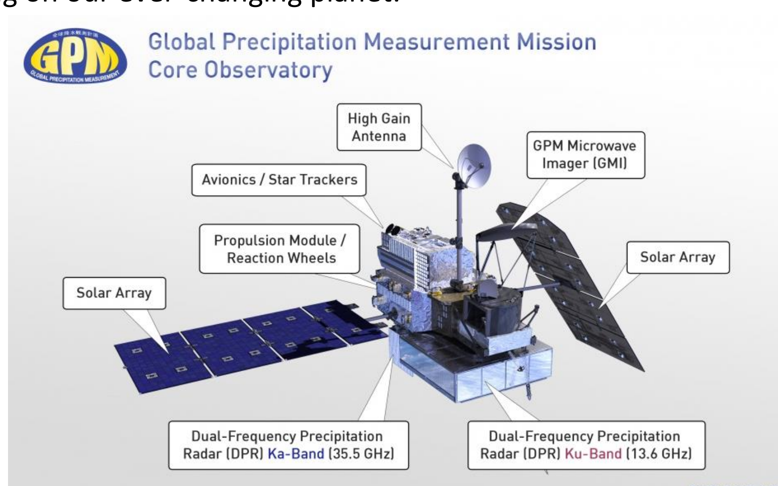
Instruments aboard the Core Observatory.
Credit: NASA/SVS



The 13 frequencies observed by the GMI
Credit: NASA/SVS

The other instrument is the GPM Microwave Imager (GMI); it acts like an x-ray. It measures energy that naturally radiates from the precipitation particles. Based on the energy, it can tell the difference between light rain, heavy rain and falling snow and ice. Together, both instruments can tell us what is inside of a cloud.

Algorithms—a step-by-step way to solve a math problem; or a process (similar to a recipe) for a computer to follow—convert the information from the satellite instruments into precipitation data. The precipitation data can then be compared to ground-based information that comes from rain gauges and radar around the world. Scientists can use this data in weather forecast models, to examine changes in global climate over time, and for offering other information critical to understanding and living on our ever-changing planet.



Links for more about the images used in this article:

Winter Storm of 1/9/2011: http://go.usa.gov/XCcW
Rain gauge: http://www.cocorahs.org
GPM Core Observatory: http://go.nasa.gov/1opuhnJ
GPM Constellation: http://go.nasa.gov/1vxw3UO
GPM instruments: http://go.nasa.gov/1opu7N8
Data from the GMI: http://go.nasa.gov/1opv7RA
Parts of the satellite: http://go.nasa.gov/1opvrQ2