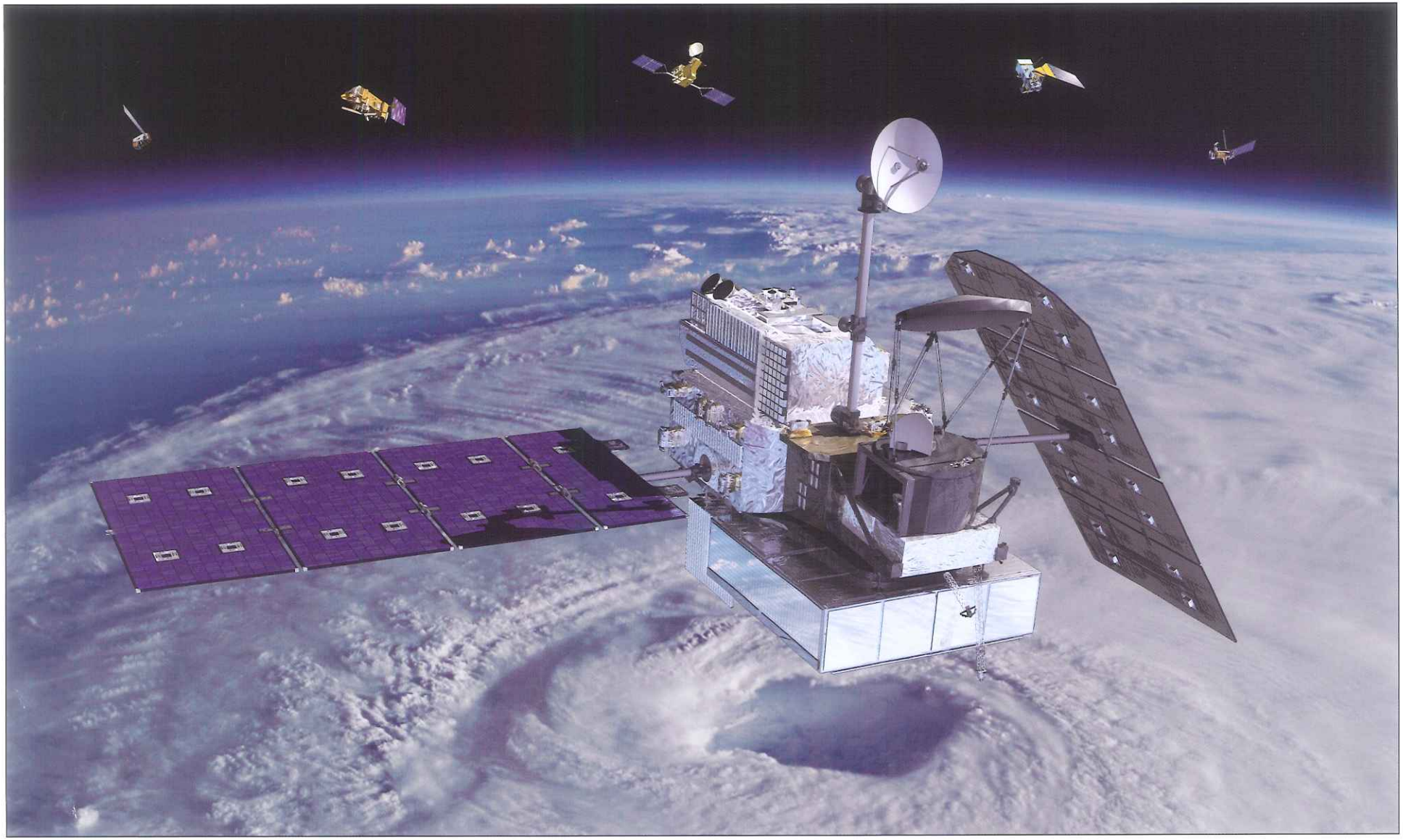
National Aeronautics and Space Administration

GPM: Global Precipitation Measurement



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An international satellite mission that unifies and advances precipitation measurements from space for scientific research and societal applications.

Mission Overview

The Global Precipitation Measurement (GPM) mission is an international constellation of satellites that will provide next-generation observations of global precipitation approximately every three hours. The mission centers on the deployment of the GPM Core Observatory spacecraft built by NASA and the Japan Aerospace Exploration Agency (JAXA), which will carry advanced instruments that will set a new standard for precipitation measurements. The highly-detailed data provided by the GPM Core Observatory will be used to unify precipitation measurements made by other satellites in the constellation. This integrated approach will help scientists to quantify when, where, and how much it rains or snows around the world.

With frequently-sampled high-quality precipitation measurements, the GPM mission will help advance our understanding of Earth's water and energy cycles, improve the forecasting of extreme events that cause natural disasters, and extend current observational capabilities to directly benefit society.

GPM Core Observatory: Building on TRMM's Legacy

The GPM mission concept builds on the success of the Tropical Rainfall Measuring Mission (TRMM), a joint NASA and JAXA satellite launched in 1997 that measures moderate and heavy rainfall in the tropics and subtropics. The TRMM satellite has shown the importance of collecting measurements at different times of day to improve observations of weather systems and real-time monitoring of hurricanes. The GPM Core Observatory will continue this sampling strategy and will extend coverage to include high latitudes ranging from the Antarctic Circle to the Arctic Circle.

The design of the GPM Core Observatory advances TRMM's highly successful rain-sensing instrument package, which uses a radar capable of providing information on precipitation particles, layer-by-layer, within clouds, as well as a passive microwave imager capable of sensing the total precipitation within all cloud layers. Since light rain and falling snow account for a significant fraction of precipitation occurrence in middle and high latitudes, the instruments onboard the GPM Core will extend the capabilities of the TRMM sensors to detect falling snow, measure light rain, and improve estimates of precipitation particle properties in three-dimensions.

GPM Core Observatory

The GPM Core Observatory will measure precipitation using two science instruments: the GPM Microwave Imager (GMI) and the Dual-frequency Precipitation Radar (DPR). The GMI will supply information on cloud structure and on the type (i.e., liquid or ice) of cloud particles. Data from the DPR will provide insights into the three-dimensional structure of precipitation, along with layer-by-layer estimates of the sizes of raindrops or snowflakes, within and below the cloud. Together these two instruments will provide a database of measurements against which other partner satellites' microwave observations can be meaningfully compared and combined to make a global precipitation dataset.

The GMI uses 13 microwave channels to observe energy from the different types of precipitation within clouds, from heavy to light rain as well as falling snow. As the satellite passes over Earth, the GMI constantly scans a region that is 550 miles (885 kilometers) across. The Ball Aerospace and Technology Corporation built the GMI under contract from NASA's Goddard Space Flight Center.

The DPR provides three-dimensional information about precipitation particles by transmitting energy at two frequencies, from two different radars, into the cloud and observing the reflected energy from different heights within the cloud system. This allows the radar to infer the sizes of precipitation particles and provides information directly related to a storm's physical characteristics. The DPR's Ka-band frequency radar scans across a region that is 78 miles (125 kilometers) wide, nested within the wider scan of the Ku-band frequency radar that is 158 miles (254 kilometers) wide. JAXA and Japan's National Institute of Information and Communications Technology (NICT) built the DPR.

The GPM Core Observatory satellite will fly at an altitude of 253 miles (407 kilometers) in a non-sun-synchronous orbit. The Core Observatory was developed and tested at NASA's Goddard Space Flight Center. A Japanese H-IIA rocket will carry the GPM Core Observatory into orbit from JAXA's Tanegashima Space Center on Tanegashima Island, Japan, in 2014.

GPM Science and Applications

Water is fundamental to life on Earth. Knowing when, where, and how much it rains or snows is vital to understanding how weather and climate impact both our environment and Earth's water and energy cycles, including effects on agriculture, fresh water availability, and responses to natural disasters. Rain and snowfall vary greatly from place to place and over time. Satellites can provide broader coverage and more frequent measurements than traditional ground-based instruments, which tend to have large gaps between instrument sites on land and even larger gaps over oceans. GPM's next-generation global precipitation data will lead to:

- Improved knowledge of Earth's water cycle and its link to climate change;
- New insights into precipitation microphysics, storm structures and large-scale atmospheric processes;
- Extended capabilities in monitoring and predicting hurricanes and other extreme weather events;
- Improved forecasting abilities for natural hazards, including floods, droughts and landslides;
- Improved numerical prediction skills for weather and climate; and
- Improved agricultural crop forecasting and monitoring of freshwater resources.

Constellation Partners

The GPM mission initiated by NASA and JAXA is designed to unify precipitation measurements made by the GPM Core Observatory satellite and a constellation of NASA and partner satellites to achieve global coverage with a high sampling frequency. Each partner constellation satellite 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 following agencies are planning to contribute satellite data to the GPM mission:

- NASA
- Japan Aerospace Exploration Agency (JAXA)
- French Centre National d'Études Spatiales (CNES)
- Indian Space Research Organisation (ISRO)
- U.S. National Oceanic and Atmospheric Administration (NOAA)
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
- U.S. Air Force Defense Meteorological Satellite Program (DMSP)

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