SNAPSHOT

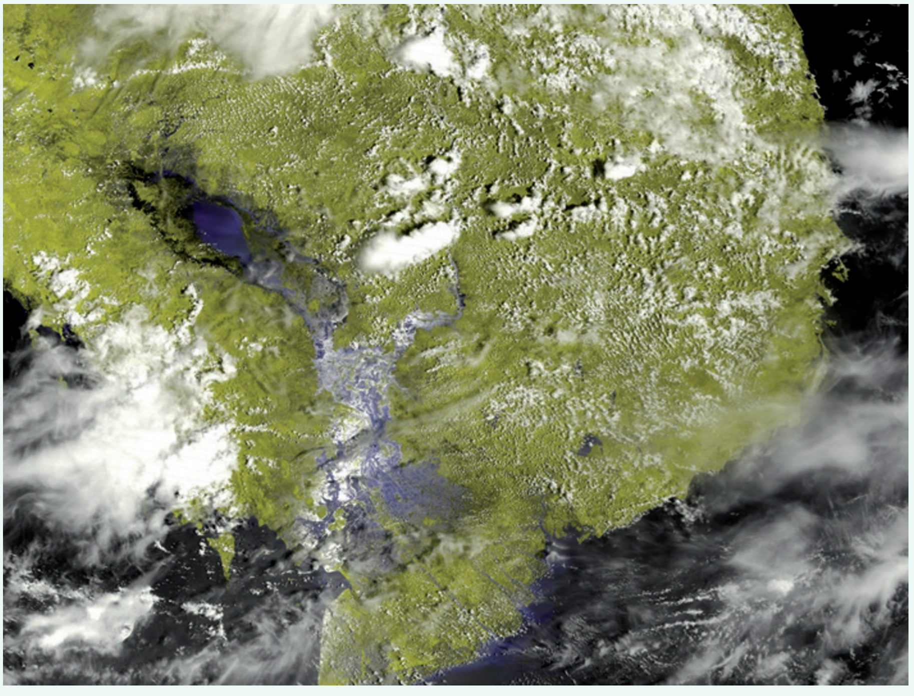
Rain from space

An international satellite project is underway to improve remote sensing coverage of global precipitation. The Global Precipitation Measurement (GPM) mission is a collaboration between the National Aeronautics and Space Adminstration (NASA) and Japan Aerospace and Exploration Agency (JAXA), with the launch of a satellite expected next year (A. Hou *et al.*, *Bull. Am. Meteorol. Soc.* http://dx.doi.org/10.1175/BAMS-D-13-00164.1; 2013).

Precipitation data have less spatial and temporal coverage than other data sets such as temperature. Greater observational coverage is available on land, but there are many regions that are sparsely populated or difficult to access. Knowledge of precipitation timing, intensity and distribution is necessary for understanding the hydrological cycle and efficient water management. The new mission aims to provide measurements every three hours for almost the entire globe, which will be available within hours of observation.

Remote sensing allows uniform measurement on a global scale. However, so far the various methods employed have provided different information. Infrared sensors use top-of-cloud temperatures to infer precipitation. Cloud temperature and distribution are not consistent around the globe, hindering the global application of this methodology. Microwave sensors, on the other hand, measure microwave radiation emissions from the land surface, precipitation particles (raindrops or snowflakes) and the atmosphere. They supply more accurate measurements and will be used in the new project.

The GPM mission builds on the Tropical Rainfall Measuring Mission (TRMM), which was launched in 1997. TRMM is, like GPM, a joint project between Japan and the USA. As the name suggests, it is a single satellite that focuses on the tropical and subtropical regions (35° N to 35° S) and measures the heavy rainfall there. Precipitation and associated energy transfer/heat release in these regions — the tropical convection — drive global atmospheric circulation. Knowledge of precipitation in the tropics will therefore lead to greater understanding and improved projections of global atmospheric cycles and the impacts of climate change.



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TRMM has contributed to our understanding of the El Niño Southern Oscillation and its cycles, and has also provided information on tropical weather systems over oceans. The instrumentation chosen — a precipitation radar, the first for a satellite, and more conventional remote sensing equipment such as microwave imagers — and sampling resolution (temporal and spatial) allows TRMM to be used as a reference for all satellite remote sensors. The precipitation radar can measure the three-dimensional structure of rainfall, so the spatial extent of precipitation, as well as the cloud height, can be monitored. Sensors onboard GPM will extend the range of TRMM, and will also provide a reference to facilitate comparison between different data sets — past, present and future.

The GPM mission will launch a core observation satellite and coordinate with other satellites from the partner agencies (nine in total). Whereas TRMM is a single satellite, the inclusion of several satellites in the GPM project will provide greater coverage with measurements up to the high latitudes (65° N to 65° S, covering ~90% of the planet). The expanded scope compared with TRMM increases the types of precipitation that can be measured; however, light rain and snowfall still pose a challenge due to their small size. Operating in dual-band, the enhanced radar will be able to detect precipitation rates as low as 0.2 mm per hour. In addition, it will provide information on the size distribution of the precipitation.

The GPM mission will deliver measurements from all corners of the world on both land and sea surfaces. It builds on the technology from TRMM, and will offer greater data quality with more frequent measurements. These data will help to improve understanding of the climate system and feed into global climate models for better representation of the physical system.

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