Accomplishments from 3-years of Global Precipitation Measurement (GPM) Data: NASA's Perspective

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Precipitation is a key source of freshwater; therefore, the observation of global patterns of rain and snow and their intensity is important for science, society, and understanding our planet in a changing climate. In 2014, NASA and the Japan Aerospace Exploration Agency (JAXA) launched the Global Precipitation Measurement (GPM) Core Observatory (GPM-CO) spacecraft. The GPM-CO carries the most advanced precipitation sensors currently in space including a Dual-frequency Precipitation Radar (DPR) provided by JAXA measuring the three-dimensional structures of precipitation and a well-calibrated, multi-frequency passive microwave imaging radiometer (GPM Microwave Imager –GMI) providing wide-swath precipitation data. The GPM-CO was designed to measure rain rates from 0.2-110.0 mm h^{-1} and to detect moderate to intense snow events. The GPM-CO is a key part of the GPM mission, which is defined to encompass multi-satellite unified precipitation estimates. The GPM-CO serves as a reference for unifying data from a constellation of about 10 (in 2016) partner satellites (see Fig. 1) to provide next-generation, merged precipitation estimates globally and with high temporal (0.5 to 3.0 hours) and spatial (5 to 15 km) resolutions. Through improved measurements of rain and snow, precipitation data from GPM provides new information such as: details of precipitation structure and intensity; observations of hurricanes and typhoons as they transition from the tropics to mid-latitudes; data to advance near-real-time hazard assessment for floods, landslides and droughts; inputs to improve weather and climate models; and insights into agricultural productivity, famine, and public health. Since launch, GPM teams have calibrated satellite instruments, refined precipitation retrieval algorithms, expanded science investigations, and processed and disseminated precipitation data for a range of applications.

The GPM-CO spacecraft is an advanced successor to the Tropical Rainfall Measuring Mission (TRMM), with additional channels on both the DPR and GMI with capabilities to sense light rain and falling snow (Hou et al., 2014, Hou et al., 2008). The GPM-CO was launched at 18:37 UTC 27 February 2014 and operates in a non-sun-synchronous orbit with an inclination angle of 65° (Fig. 2). The prime mission lifetime (instrument design life) is 2 months for checkout and 3 years for operations, but operations could last 15-24 years according to fuel projections in November 2016 (see Appendix E for fuel charts) assuming the instruments/spacecraft systems (e.g., batteries) do not fail and fuel requirements do not increase. The inclined orbit allows the GPM-CO to sample precipitation across all hours of the day from the Tropics to the Arctic and Antarctic Circles. GPM expands TRMM's reach not only in terms of global coverage, but also through more sophisticated satellite instrumentation, systematic inter-calibration of datasets from other microwave radiometers, refined merged precipitation data sets, reduced latency for delivering data products, simplified data access, expanded global ground-validation efforts, and integrated user applications. Because of the application focus of GPM, the public release of precipitation products is required in NRT (1-5 hours after the observations are downlinked to the ground stations).

Accomplishments of the Prime Mission lifetime (March 2014-May 2017) can be categorized into four topics: Instrument calibration, Improvements in the Retrieval Algorithm, Progress toward the Scientific Objectives of the GPM mission, and Meeting the GPM Level 1 Mission Requirements. These accomplishments and future activities will be presented.

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