NEXT-GENERATION GLOBAL PRECIPITATION PRODUCTS AND THEIR APPLICATIONS

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Abstract

The Global Precipitation Measurement (GPM) mission is an international satellite mission to unify and advance precipitation measurements from a constellation of dedicated and operational sensors to provide "next-generation" precipitation data products for research and applications [1]. Relative to present-day multi-satellite global rainfall data, next-generation products will be characterized by (1) inter-calibrated brightness temperatures from constellation radiometers within a unified framework and (2) precipitation retrievals from all constellation radiometers using a common observation-constrained cloud/hydrometeor database. These products will also benefit from GPM's advanced instrument capability in providing more accurate measurement of precipitation, especially light rain and cold-season solid precipitation.

At the heart of the GPM mission is the deployment of a Core Observatory in a unique 65^{o} non-Sun-synchronous orbit to serve as a physics observatory and calibration reference to improve precipitation measurements by all constellation radiometers. The GPM Core Observatory will carry a Ku/Ka-band Dual-frequency Precipitation Radar (DPR) and a multi-channel (10-183 GHz) GPM Microwave Radiometer (GMI). The DPR will provide measurements of 3-D precipitation structures and quantitative estimates of microphysical properties, which are key to achieving a better understanding of precipitation processes and improving retrieval algorithms for passive microwave radiometers. The GMI is designed with special attention to accuracy and stability to serve as a transfer standard to reconcile the differences in center frequencies, view geometries, spatial resolutions, etc. of the constellation

radiometers. The combined use of DPR and GMI measurements will place greater constraints on possible solutions to radiometer retrievals to improve the accuracy and consistency of precipitation retrievals from all constellation radiometers.

The GPM constellation is envisioned to comprise 5 or more conical-scanning microwave radiometers provided by partners, augmented by 4 or more cross-track microwave sounders on operational satellites for improved sampling over land. GPM is currently a partnership between NASA and the Japan Aerospace Exploration Agency (JAXA). In addition to the joint development and deployment of the GPM Core Observatory, NASA will provide a second GMI to be flown on a partner-provided Low Inclination Observatory (LIO) in a non-Sun-synchronous orbit at ~40^o inclination to improve temporal sampling and near-realtime monitoring of tropical and mid-latitude storms, and JAXA will provide data from the Global Change Observation Mission-Water (GCOM-W) satellite. Additional partnerships are under development to include microwave radiometers on the French-Indian Megha-Tropiques satellite and U.S. Defense Meteorological Satellite Program (DMSP) satellites, as well as humidity sounders on operational satellites such as the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP), POES, NPOESS, and EUMETSAT MetOp satellites, which are use to augment samplings over land. GPM's constellation sampling capabilities may be further enhanced by a GPM radiometer in the tropics currently under planning by the Brazilian Space Agency, as well as by data from Chinese and Russian microwave radiometers made available under the auspices of the Committee on Earth Observation Satellites (CEOS) and Group on Earth Observations (GEO).

As a science mission with integrated application goals, GPM is designed to (1) advance precipitation measurement capability from space through combined use of active and passive microwave sensors, (2) advance the knowledge of the global water/energy cycle and freshwater availability through better description of the space-time variability of global precipitation, and (3) improve weather, climate, and hydrological prediction capabilities through more accurate and frequent measurements of instantaneous precipitation rates and time-integrated rain accumulation. By make data available in near realtime, GPM is expected to extend current capabilities in operational use of satellite precipitation data to directly benefit the society. An overview of how GPM data can be used to improve natural hazard monitoring, numerical weather prediction, freshwater resource management, and hydrological model prediction will be presented.

References:

[1] A. Y. Hou, G. Skofronick-Jackson, C. D. Kummerow and J. M. Shepherd, “Global precipitation measurement,” *Precipitation: Advances in Measurement, Estimation, and Prediction* (Ed. Silas Michaelides), Springer-Verlag, pp. 131-164, 2008.