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Next-Generation Global Satellite Precipitation Data Products: U.S. Status
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In the modern age the scientific understanding of global precipitation patterns and processes, and the application of this information for societal benefits, depends critically on satellite data. Over the past 15 years the Tropical Rainfall Measuring Mission (TRMM) has acquired a key role in advancing these studies, thanks to the dedicated cooperation of the Japanese Aerospace Exploration Agency (JAXA) and the U.S. National Aeronautics and Space Administration (NASA). Now the two agencies are developing the Global Precipitation Measurement (GPM) mission, scheduled to launch in early 2014, as an international satellite mission to unify and advance precipitation measurements from a constellation of research and operational sensors to provide ”next-generation” precipitation products every 3 hours around the globe. Compared to current global rainfall products, GPM data products will be characterized by: (1) more accurate instantaneous precipitation measurements (especially for light rain and cold-season solid precipitation), (2) more frequent sampling by an expanded constellation of domestic and international microwave radiometers including operational humidity sounders, (3) inter-calibrated microwave brightness temperatures from constellation radiometers within a unified framework, and (4) physically-based precipitation retrievals from constellation radiometers using a common a priori cloud/hydrometeor database derived from GPM Core sensor measurements.

How do we achieve these advances? The cornerstone of the GPM mission is the deployment of a Core Observatory in a unique 65-deg. non-Sun-synchronous orbit to serve as a physics observatory and a calibration reference to improve precipitation measurements by a constellation of 8 or more dedicated and operational, U.S. and international passive microwave sensors. The Core Observatory's Ku/Ka-band Dual-frequency Precipitation Radar (DPR) will provide measurements of 3-D precipitation structures and microphysical properties, which are key to achieving a better understanding of precipitation processes. The Core Observatory will also carry a 13-channel (10-183 GHz) GPM Microwave Radiometer (GMI). 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. Compared to TRMM sensors, the GPM instruments will have improved detection of falling snow, estimation of light rain, and, for the first time, quantitative estimation of microphysical properties of precipitation particles.

The GPM constellation is planned to consist of 8 or more microwave sensors provided by partners, including both conical imagers and cross-track sounders. Besides NASA and JAXA, planned partnerships include microwave radiometers on the French-Indian Megha-Tropiques satellite and U.S. Defense Meteorological Satellite Program (DMSP) satellites, as well as humidity sounders or precipitation sensors on operational satellites such as the Suomi National Polar-orbiting Partnership (NPP) satellite, NOAA-NASA Joint Polar Satellite System (JPSS) satellites, European MetOp satellites, and DMSP follow-on sensors. In addition, data from Chinese and Russian microwave radiometers may be available through international cooperation. All of these data, together with surface precipitation data, will be combined in various ways. For example, the U.S. team is developing a combined algorithm that unifies and advances work done in the TRMM era.

The talk will end with a short summary of the expected path to full GPM-based precipitation estimates after launch. This includes consideration of the key practice in TRMM, and now GPM, of carrying out scheduled, consistent reprocessings of the entire data record.

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