Overview & Scientific Agenda of Global Precipitation Mission

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The scientific success of the Tropical Rainfall Measuring Mission (TRMM) and additional satellite-focused precipitation retrieval projects, particularly those based on use of passive microwave radiometer measurements, have paved the way for a more advanced global precipitation mission. The new mission is motivated by a number of scientific questions that TRMM research has posed over a range of space-time scales and within a variety of scientific disciplines that are becoming more integrated into earth system science modeling. Added to this success is the realization that satellite rainfall datasets are now a foremost tool in understanding global climate variability out to decadal scales and beyond. This progress has helped motivate a more comprehensive global measuring strategy -- leading to the "Global Precipitation Mission" (GPM). GPM is planning to expand the scope of rainfall measurement through use of a satellite constellation. The intent is to address looming scientific questions arising in the context of global climate-water cycle interactions, hydrometeorology, weather prediction and prediction of fresh water resources, the global carbon budget, and biogeochemical cycles. This paper addresses the status of that mission currently planed for launch in the 2007-2008 time frame. The GPM notional design involves a 9-member satellite constellation, one of which will be an advanced TRMM-like "core" satellite carrying a dual-frequency Ku-Ka band radar (DFPR) and a TMI-like radiometer. The other eight members of the constellation will be considered daughters of the core satellite, each carrying some type of passive microwave radiometer measuring across the 10.7-85 GHz frequency range -- likely to include a combination of lightweight satellites and co-existing operational/experimental satellites carrying passive microwave radiometers (i.e., SSM/I and AMSR-E & -F). The constellation is designed to provide no worse than 3-hour sampling at any spot on the globe using sun-synchronous orbit architecture for the daughter satellites, with the core satellite providing relevant measurements on internal cloud-precipitation microphysical processes and the "training-calibrating" information for retrieval algorithms used on daughter satellite measurements. The GPM is organized internationally, currently involving a partnership between NASA in the US, NASDA in Japan, and ESA in Europe (representing the European community nations). The mission is expected to involve additional international participants, sister agencies to the mainstream space agencies, and a diverse collection scientists from academia, government, and the private sector. A critical element in understanding the scientific thinking, which has motivated the GPM project is an understanding of what scientific problems TRMM has and has not been able to address and at what scales. The TRMM satellite broke important scientific ground because it carried to space an array of rain-sensitive instruments, two of which were specifically designed for physical precipitation retrieval. These were the 9-channel TRMM Microwave Imager (TMI) and the 13.8 GHz Precipitation Radar (PR). By the same token, because TRMM is a single satellite in a low inclination, low altitude, non-sun-synchronous orbit, it cannot provide global coverage or regular diurnal sampling. These features are essential for many current scientific inquiries involving physical processes of climate and the global water cycle, the modeling of hydrometeorological-biogeochemical cycling, and coupled land-atmosphere/ocean-atmosphere exchanges. Moreover, TRMM has not been able to retrieve explicit properties of the drop size distribution (DSD), a final major barrier to making accurate rain measurements, because the single frequency TRMM radar cannot measure differential reflectivity. which is a minimal requirement for attacking rain retrieval within the framework of extinction cross-section-dependency. GPM is expected to surmount much of the DSD retrieval problem because its core satellite will have the capacity to make differential reflectivity measurements with its Ku-Ka band radar (13.6-35 GHz) called DFPR – being developed by NASDA/CRL in Japan. This paper will provide an overview of the above issues as well as present a discussion on the expected measurement improvements.