NASA Global Precipitation Mission Ground Validation Implementation

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The Global Precipitation Mission (GPM; core-satellite launch 2013) will provide Ka/Ku-band dual-frequency precipitation radar (DPR) and accompanying passive microwave radiometer-diagnosed precipitation estimates over a latitude range of 65º N to 65º S. The extended latitudinal domain of GPM coverage combined with requirements to detect (and in the case of liquid, *estimate*) liquid and frozen precipitation rates for values ranging from several hundred to just a few tenths of a millimeter per hour present new challenges to the development of physically-based satellite precipitation retrieval algorithms. To address these challenges, NASA GPM has devised a ground validation (GV) plan that implements three approaches to validating GPM retrieval algorithms:

1. *National Networks:* Direct statistical validation of GPM precipitation products at regional and continental scales (e.g., use of radar and rain gauge networks).
2. *Physical Process studies:* Targeted field studies of cloud and precipitation properties (e.g., size distributions, rates, contents, phase etc.) that support retrieval algorithm development.
3. *Integrated hydrometeorology applications:* Assessment of satellite precipitation products in integrated hydrologic applications (e.g., basin-scale water budget studies and modeling).

On regional scales select national and international resources such as existing calibrated radar and rain gauge networks can provide basic datasets that enable direct statistical validation of GPM core-satellite reflectivities and core/constellation rain rate measurements (approach 1). For example, the NASA GPM Project Office has developed prototype software capable of automatically geolocating coincident satellite-based radar data (use of TRMM Precipitation Radar data as a proxy for the DPR) with ground based radar data and performing a host of comparison statistics (3-D reflectivity structure etc.) for any given network of radars. These comparisons provide a coarse guide for detecting either spaceborne radar measurement/algorithm regional biases or biases in ground based network data. For the case of biases determined to be associated with the spaceborne platform, the national network comparisons then point to regions where more detailed studies (e.g., approach 2) may be needed and/or focused.

To facilitate pre-launch development and validation of algorithm physics (approach 2) in a variety of precipitation regimes detailed precipitation measurements will be made in several pre-launch field campaigns. The infrastructure planned to accomplish these measurements includes:

a) Airborne Ka/Ku-band and passive microwave radiometer suites deployed on high-altitude aircraft (e.g., NASA ER-2), and/or satellite-based radar (e.g., CloudSat) and radiometers, coordinated with in-situ airborne microphysical measurements; and,

b) Collocated and calibrated ground-based instrumentation arrays consisting of multi-frequency dual-polarimetric radars (Ka-Ku, X, C and S band), dense-scale (sub satellite-pixel) disdrometer and rain gauge arrays, and vertically-profiling radar platforms ranging from W to S band(s). NASA collection of polarimetric radar data will be further supported via the development of a new transportable Ka/Ku band scanning dual-polarimetric/frequency radar, and receiver/transmitter engineering studies associated with the procurement of a new antenna system for the NASA N-POL S-band dual-polarimetric radar. Both of these new/refurbished platforms will be ready for deployment no later than spring 2011, in time for the first GPM GV field campaign planned for central Oklahoma (~April 15-June 1, 2011).

Near-term planned field campaign involvements include Finland/Baltic Sea (fall 2010; joint CloudSat, GPM and European study of precipitation in low-altitude melting layers and snowfall in the vicinity of

the Helsinki testbed), central Oklahoma (spring 2011; joint with DOE ARM- precipitation retrievals over a mid-latitude continental land surface), and the Great Lakes region (winter 2011-12, snowfall retrieval);

For approach (3) NASA GPM has initiated a collaboration with the NOAA Hydrometeorological Testbed-Southeast (HMT-southeast). Current plans call for NASA GV observational infrastructure and coupled cloud and land-surface modeling resources to be used in conjunction with existing high-density NOAA hydrologic and precipitation measurements to examine the full end-to-end propagation of precipitation measurements and measurement errors through hydrologic prediction systems.

Collectively, the above approaches will be implemented for a wide variety of meteorological regimes set in the framework of both interagency and international partnerships.

The presentation will cover current implementation plans for GPM ground validation including near term priorities for addressing algorithm retrieval development/refinement in precipitation over land (e.g., use of higher frequency channels on passive microwave radiometers) and higher latitudes (snow, light precipitation, and situations of low-altitude melting layers).