A Research Framework to Bridge GPM Core and Constellation Sensors using Polarimetric National Mosaic QPE (NMQ)

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Context

Characterization of the error associated to satellite surface rainfall estimates with focus on current TRMM and future GPM.
Needed for data assimilation, climate; over land in hydrological modeling of natural hazards and budgeting water resources

Objectives

- use the NOAA/NSSL National Mosaic Quantitative Precipitation Estimation (NMQ or Q2) system to provide a consistent reference research framework for creating conterminous US (CONUS)-wide error characterization of precipitation retrievals across TRMM/GPM core and constellation satellites.
- This cross-platform error characterization will act as a bridge to intercalibrate active and passive microwave measurements from the GPM core satellite to the constellation satellites.

Space sensors

TRMM-PR/TMI, SSMIS, AMSR-2, DMSP-SSM/I, Megha-Tropique-MADRAS MHS, ATMS, WindSat, AMSU-B, GPM-DPR/GMI

Background: NMQ-Q2

Q2 provides 3D reflectivity mosaics and QPE products over CONUS at 1-km²/5-min resolution
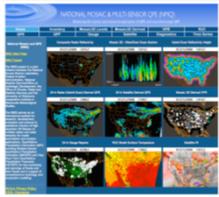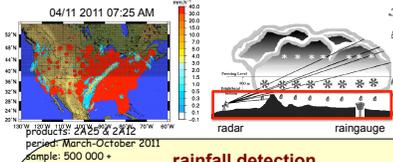
Real-time platform to develop, test, and assess advanced techniques in quality control, data integration and precipitation estimation.
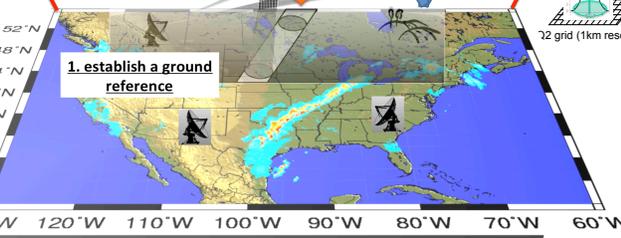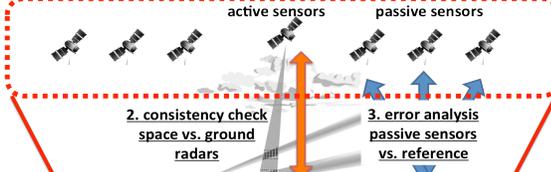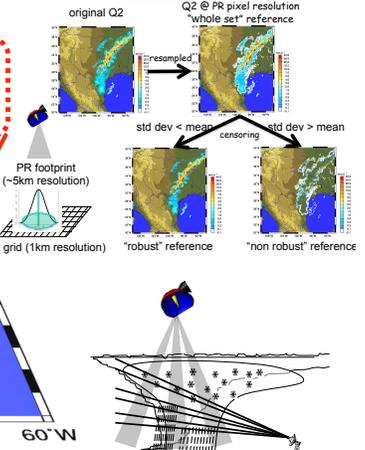
http://nmq.ou.edu

1. Reference rainfall

Establish a trustworthy reference precipitation database

04/11 2011 07:25 AM

products: 2A25 & 2A12
period: March-October 2011
sample: 500 000 +

radar   raingauge

4. Bridge between GPM core sensors and the constellation sensors
active sensors   passive sensors

2. consistency check space vs. ground radars
3. error analysis passive sensors vs. reference

1. establish a ground reference

1. Resampling Q2 to satelite pixel resolution

original Q2   Q2 @ PR pixel resolution "whole set" reference

resampled

std dev < mean   std dev > mean

censoring

"robust" reference   "non robust" reference

PR footprint (~5km resolution)
Q2 grid (1km resolution)

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2. comaprison space (TRMM-PR) vs. gound radars

3-4. analysis and bridging with passive sensors

rainfall detection

Probability of Detection

std dev >> mean
std dev << mean

Relative Non Uniform Beam Filling

Rain fraction (%)

TRMM-PR
TRMM-TMI
missed light rain:
2A25 - 48% occ 4% vol
2A12 - 68% occ 20% vol

CDF occ.
CDF vol.

Hits (%)
Reference rainrate (mm/h)

rainfall classification

Reference rainfall as a function of reference convective contribution

Reference rainfall (mm/h)
Reference convective contribution (%)

2A25 convective rainfall as a function of reference convective contribution

2A25 convective rainfall (mm/h)
Reference convective contribution (%)

Convective contribution 2A25 / Reference

2A25 convective contribution (%)
Reference convective contribution (%)

Convective contribution 2A12 / Reference

2A12 convective contribution (%)
Reference convective contribution (%)

rainfall quantification

Residuals systematic bias

Systematic bias [mm.hr⁻¹]
NUBF - Q2 std deviation [mm.hr⁻¹]

Residuals Random error

Random error [mm.hr⁻¹]
NUBF - Q2 std deviation [mm.hr⁻¹]

convective
stratiform
version 6
version 7

Residual systematic bias

Systematic bias (mm/h)
Reference rainrate (mm/h)

Residual random error

Random error (mm/h)
Reference rainrate (mm/h)

TRMM-PR
TRMM-TMI

Relevance and Broader Impact :

- development, evaluation, and validation of TRMM and GPM retrieval algorithms
- on-going **NMQ dual-pol upgrade** and future **GPM products**

I have initial results and am soliciting your feedback on the following topics!!
- error factors to be accounted for PR: PIA, NUBF
- error factors to be accounted for GPROF-TMI: VIL, soil moisture, vegetation