The Global Precipitation Measurement (GPM) Validation Network

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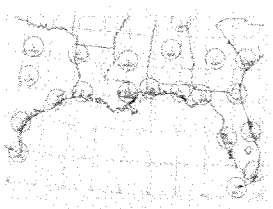
Objectives

- Assess the first-order errors of satellite precipitation retrievals over land
- Leverage the national infrastructure of weather radars and rain measurements in the U.S. and internationally
- Initially, match TRMM/GPM PR/DPR satellite observations to ground measurements; ultimately, add microwave radiometer
- Understand (and minimize) the errors associated with the geometry and timing of joint satellite and ground measurements
- Contribute to an error model of precipitation measurements
- Validate and improve precipitation retrievals, PR/DPR attenuation algorithms. Evaluate ground radar calibration accuracy/stability

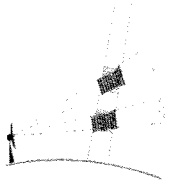
VN Ground Radars



Current VN prototype includes data from

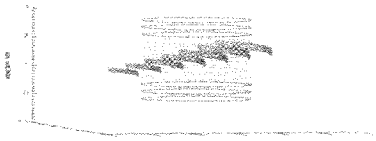
- 23 WSR-88D ground radar sites in the southeast U.S.
- A selection of international contributions from S. Korea (KMA), Australia (BOM), and the Kwajalein atoll

New Geometry-Matching Algorithm

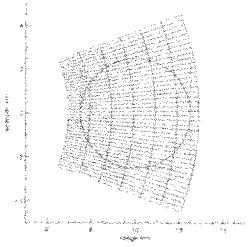


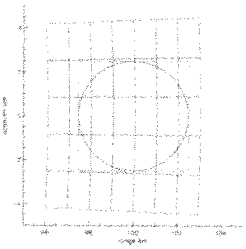
- The method averages the minimum TRMM PR and Ground Radar (GR) sample volumes needed to match-up spatially/temporally coincident PR and GR data types
- PR and GR averages are calculated at the geometric intersection of the PR rays with the individual Ground Radar (GR) sweeps
- Along-ray PR data are averaged only in the vertical, GR data are averaged only in the horizontal
- Based on Bolen & Chandresekar, 2000; Liao, Meneghini & Iguchi, 2001

Ground Radar and TRMM PR intersection



Intersection projected to the ground

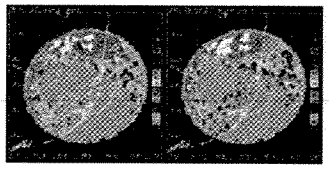


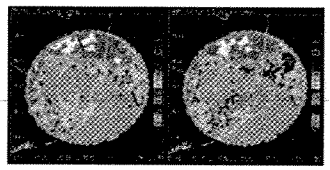


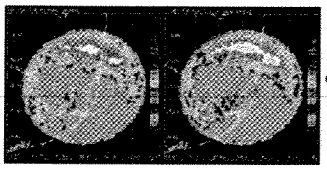
Near Range

Far Range

GR elevation angle from 0.5°

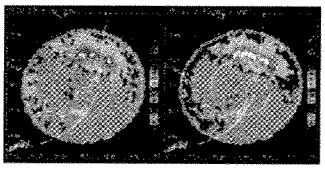


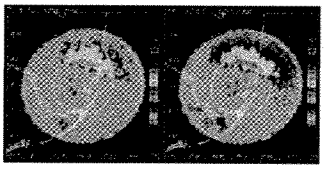


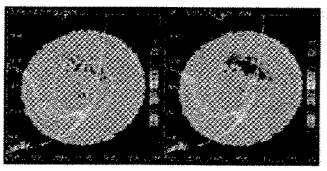


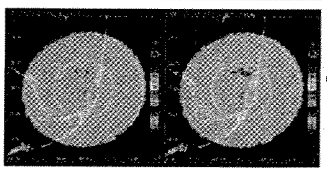
GR elevation angle to 3.4°

GR elevation angle from 4.3°







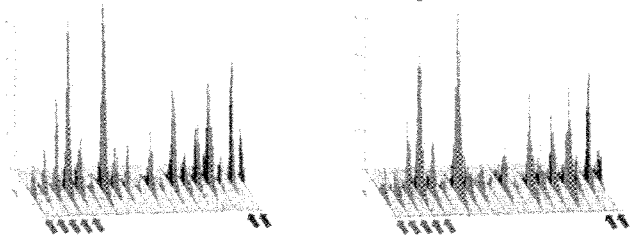


GR elevation angle to 14.6°

Intersecting Precipitation Radar (L) and Ground Radar (R) radar reflectance factor for various GR sweep angles at the KAMX station in Florida

4th International GPM Ground Validation Workshop, Helsinki, Finland, June 21-23, 2010

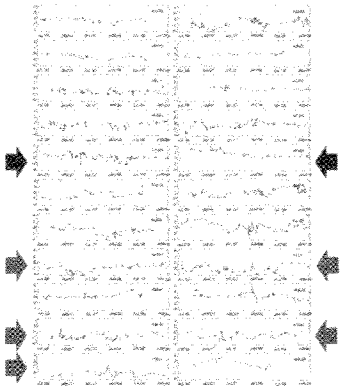
PR-GR Bias: Station-By-Station



- PR-GR reflectivity for each NEXRAD station above (L) and below (R) the bright band
- Gulf coast radars noted above run hot
- Mid-state Texas radars run cold

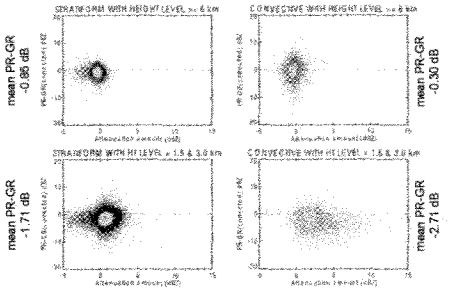
Red = PR-GR < 0 (GR is hot)
Blue = PR-GR > 0 (GR is cold)
Green = PR-GR = 0

PR-GR Bias: Time Series By Radar



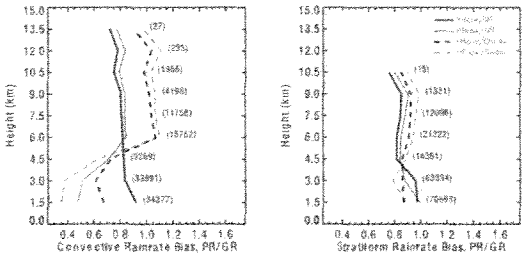
- Gulf coast radars KLCH, KLIX, KSHV, KTBW, KTLH run "hot" compared with PR
- Mid-state Texas radars KGRK and KFWS run "cold"
- Useful for tracking ground radar calibration over time

PR-GR Bias: TRMM PR Under-Estimates Rainfall Compared to Ground Radars



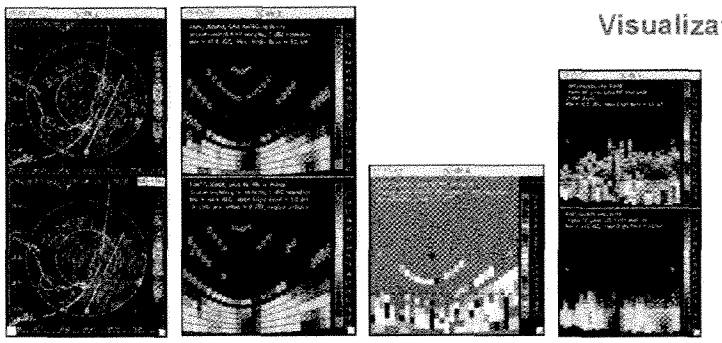
Scatterplot of reflectivity difference between matched-up PR and GR sample volumes

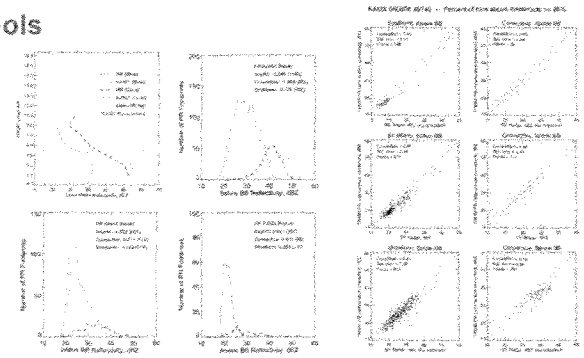
- Small difference in PR & GR reflectivity high in the atmosphere, relatively larger differences below
- Version 6 TRMM PR under-estimates rainfall in the case of convective rain in the lower part of the atmosphere by 30 to 40 percent
- Liao and Meneghini (2009) Ku/S-band corrections applied; KEVX and KMOB data omitted



Rainrate from Z=250R^1.2

Visualization Tools





- Volume-match PPIs, vertical cross sections, PR-GR differences, PPI animation/alignment check
- Matching full-resolution PR cross sections, GR PPIs

- Vertical profiles, scatter plots, histograms, bias statistics
- Control "goodness" of matchups, S-to-Ku adjustment, etc.

Fun Facts about the VN Data Products

- Dataset extends from August 2006 to present (U.S. sites)
- 34,913 site overpasses, 2,742 rainy cases as of 3/2009
- Currently using PR version 6, testing version 7 products
- Accepts GR radar as UF, WSR-88D Level-II, or TRMM 1C-51
- Many PR variables included (raw and corrected reflectivity, surface and 3-D rainrate, others)

Join the GPM Validation Network!

- Access raw TRMM PR and WSR-88D GR, plus geo-matchup data products, and the *VN Data User's Guide*

http://gpm.gsfc.nasa.gov/groundvalidation.html

- Download open source VN software and visualization tools

http://opensource.gsfc.nasa.gov

... Or contribute your ground radar data to the VN!