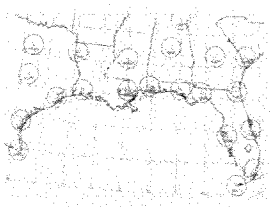
The Global Precipitation Measurement (GPM) Validation Network

Mathew Schwaller (NASA/GSFC) — K. Robert Morris (SAIC/NASA/GSFC)

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

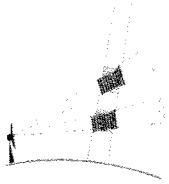
VN Ground Radars



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

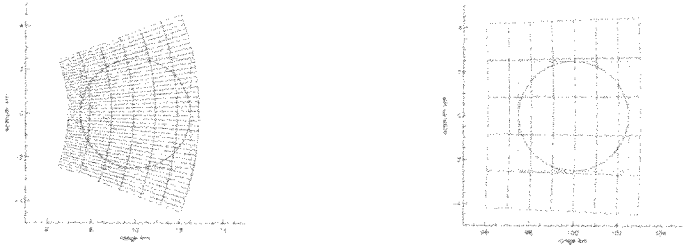
New Geometry-Matching Algorithm



- 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

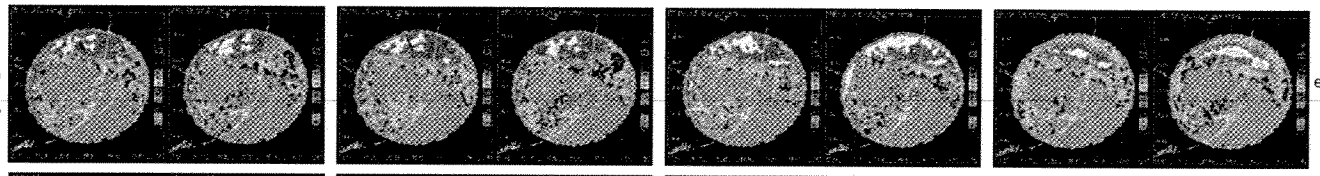
Intersection projected to the ground



Near Range

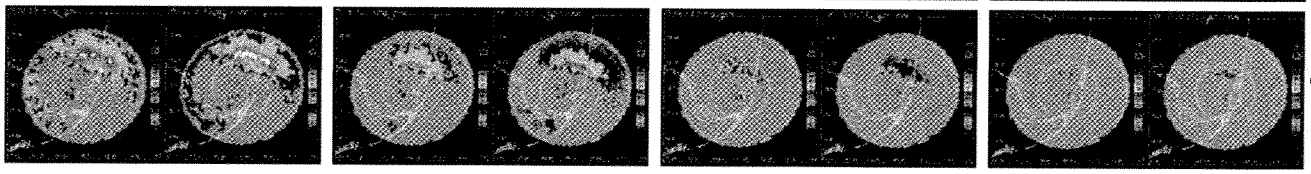
Far Range

GR elevation angle from 0.5°



GR elevation angle to 3.4°

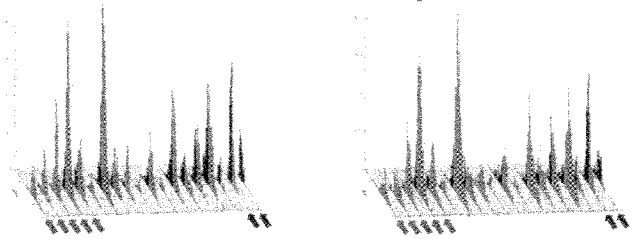
GR elevation angle from 4.3°



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

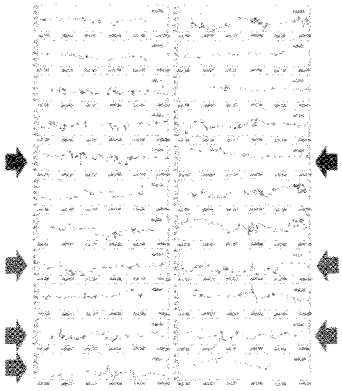
PR-GR Bias: Station-By-Station



- 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

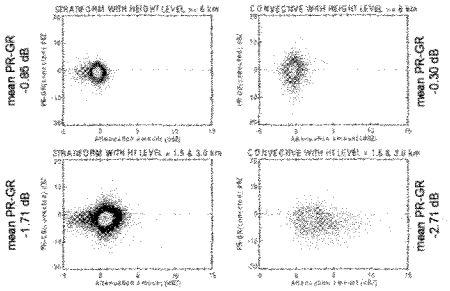
Red = PR-GR < 0 (GR is hot)
Blue = PR-GR > 0 (GR is cold)
Green = PR-GR = 0

PR-GR Bias: Time Series By Radar



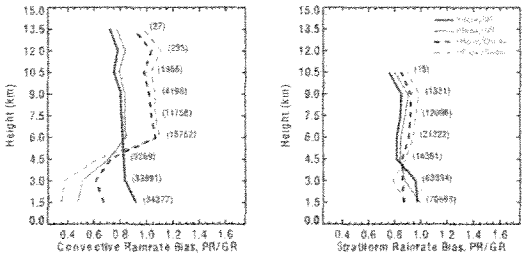
- Gulf coast radars KLCH, KLIX, KSHV, KTBW, KTLH run "hot" compared with PR
- Mid-state Texas radars KGRK and KFWS run "cold"
- Useful for tracking ground radar calibration over time

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



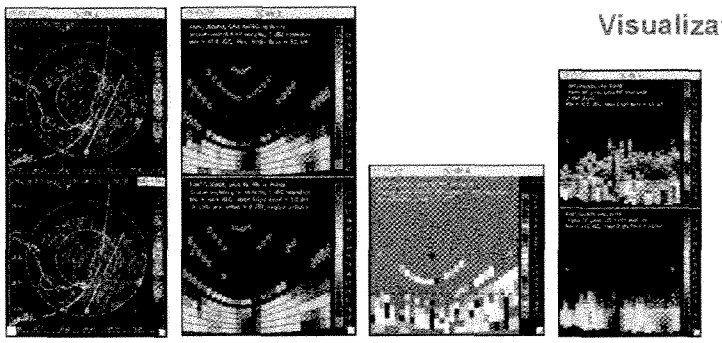
Scatterplot of reflectivity difference between matched-up PR and GR sample volumes

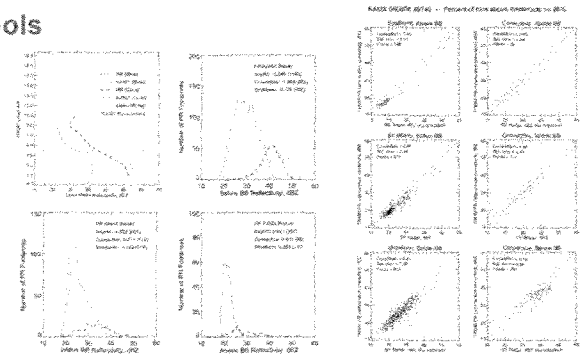
- Small difference in PR & GR reflectivity high in the atmosphere, relatively larger differences below
- Version 6 TRMM PR under-estimates rainfall in the case of convective rain in the lower part of the atmosphere by 30 to 40 percent
- Liao and Meneghini (2009) Ku/S-band corrections applied; KEVX and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