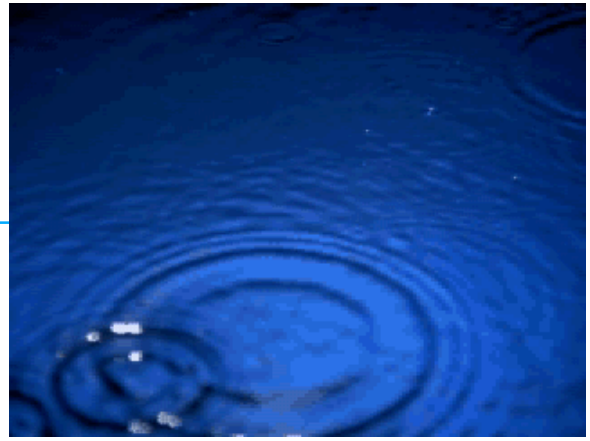
GPM

GLOBAL PRECIPITATION MEASUREMENT

Global Precipitation Measurement (GPM)



NASA GPM Ground Validation Implementation Planning

7rd International GPM Ground Validation Workshop — Buzios, Brazil

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GODDARD SPACE FLIGHT CENTER

NASA

GPM GVS Implementation Strategy

GPM Ground Validation System
- Managed by the GPM Spaceflight Project
- Supports pre-launch GPM algorithm development
- Supports post-launch product evaluation

The GPM Science framework has 3 components	GPM *GV System* supports the Science framework with
•Integrated Science Validation •Physical Process Studies	Field Campaigns & Instrumentation
•Direct product validation	A validation network

Field Campaign Implementation Approach

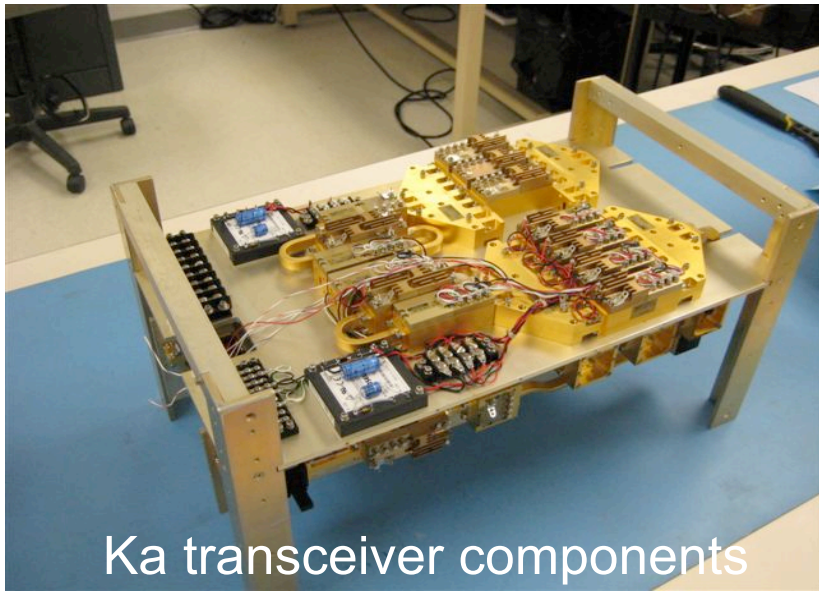
- Deployable instrumentation
  - No single“super site” location within the US that can meet all of the GV scientific and programmatic needs for all time
  - Adaptive decisions on where and when to deploy GV instruments based on validation network statistical comparison studies & other criteria
- Radar observations
  - NASA-procured, mobile Ka/Ku-band dual polarization radar
  - S-band (NASA’s N-Pol) and X-band (PI-provided) dual polarization measurements
- A complement of additional instrumentation and infrastructure, including
  - PI-managed dual frequency radar profiler, radiometer, disdrometers & gauges, soundings
  - Radiometric and microphysical aircraft measurements

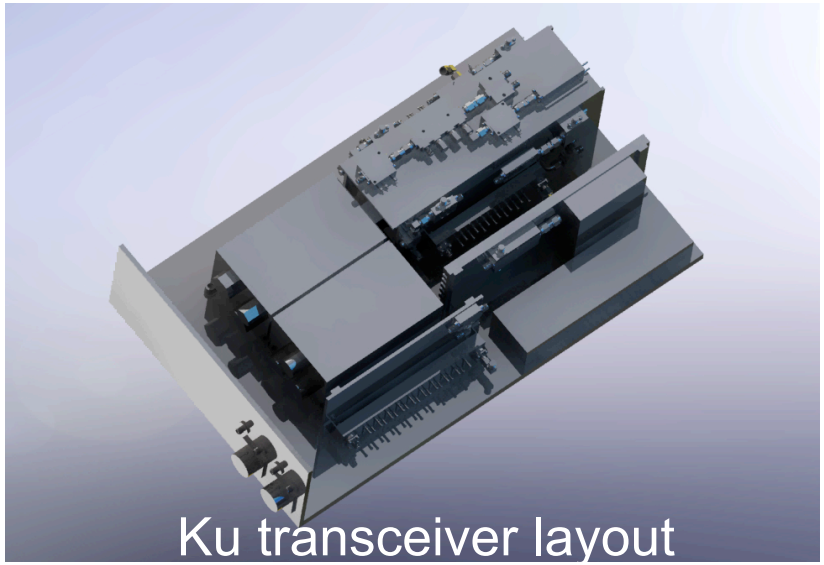
Field Campaign Planning

- Campaigns are conducted in coordination with operational agencies
  - Participation in Environment Candada's C3VP in winter 2006/2007
  - Discussions underway with US Department of Energy, NOAA and international partners
- Field campaigns start prior to GPM Core satellite launch
  - Start in 2010/2011 and continue at 1 to 2 year intervals
  - Continental US sites contribute to precip retrieval over land, especially light rain (example: DOE/CART)
  - High-latitude sites address solid precipitation (C3VP and possible follow-on)
  - Integrated hydrology is also a target (example: NOAA Hydrometeorological Testbed)
  - Extended Operational Periods (EOPs) include routine observations over long periods
  - Intensive Operational Periods (IOPs) focus additional measurements, perhaps including aircraft on shorter time periods
  - Instrumentation provided by NASA, partner agencies, and by funded investigators

New Instrument Development: NASA Ka-/Ku-band Radar

- NASA will build a mobile Ka/Ku-band, dual polarization scanning radar for GPM GV field studies
- A risk-reduction prototype will be funded for delivery later this year
- Some characteristics:
  - Solid-state Ka and Ku power amplifiers
  - Pulse compression
  - Multi-chirp waveform
  - Usual list of dual-pol products: Z_{VV}, Z_{HH}, Z_{VH}, Z_{HV}; Z_{DR}, ρ_{hv}, K_{DP}, φ_{DP} , LDR
  - Plus radial Doppler and scene microwave brightness temperature T_H, T_V


Ka transceiver components

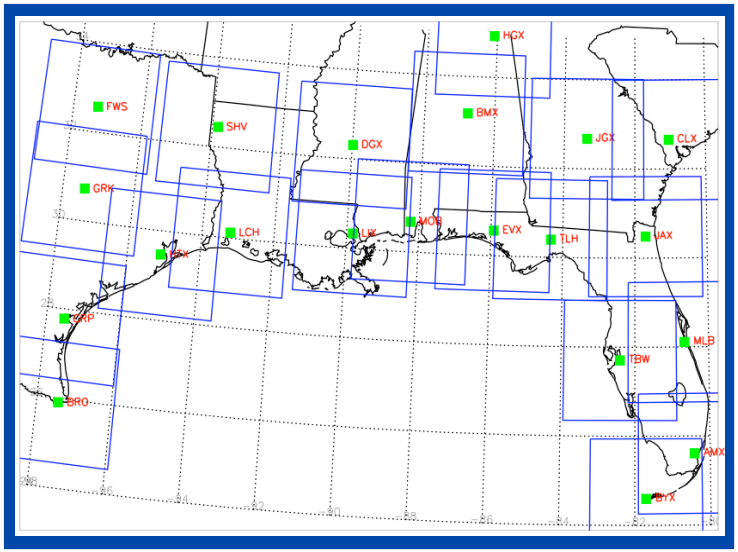

Ku transceiver layout

Instrument Development & Deployment

- Ka/Ku radar
  - Spring 08 transceivers integrated and tested
  - Fall 08 lab & field testing of fixed-look radar
  - Summer 09 limited field testing of volumetric radar
  - Spring 10 operational radar ready for joint DOE field campaign
- NASA N-Pol S-band radar
  - Antenna system upgrade in planning
- X-band radar, radar profilers, radiometers, disdrometers & gauges, soundings & data archive/distribution
  - Instruments provided by partner agencies; or provided by Principal Investigators with NASA funding
  - Data system provided by partner agencies or by NASA GPM GVS
- GPM GVS under project management for budget, schedule, and design reviews

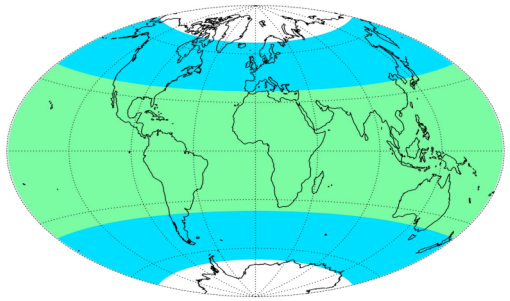
Validation Network Initiatives

- Q2 national map comparisons discussed previously by Walt Petersen
- Some additional details on the Validation Network tool
  - Suite of ***portable*** software designed to statistically compare DPR and ground radar networks
  - 21 sites in the southeast US in the current VN
  - 19,801 valid coincident overpass events occurred between August 8, 2006 and March 2007 (>25% overlap with >25% confirmed rain)
  - Software is ***scalable*** designed for export
  - 300 x 300 km grid defined for each site
  - 4 km horizontal resolution, 75 grid elements in x- & y-direction
  - 1.5 km vertical resolution
  - 13 vertical slices up to 19.5 km
  - Statistics and plots generated for each match-up



Participate in GPM Ground Validation

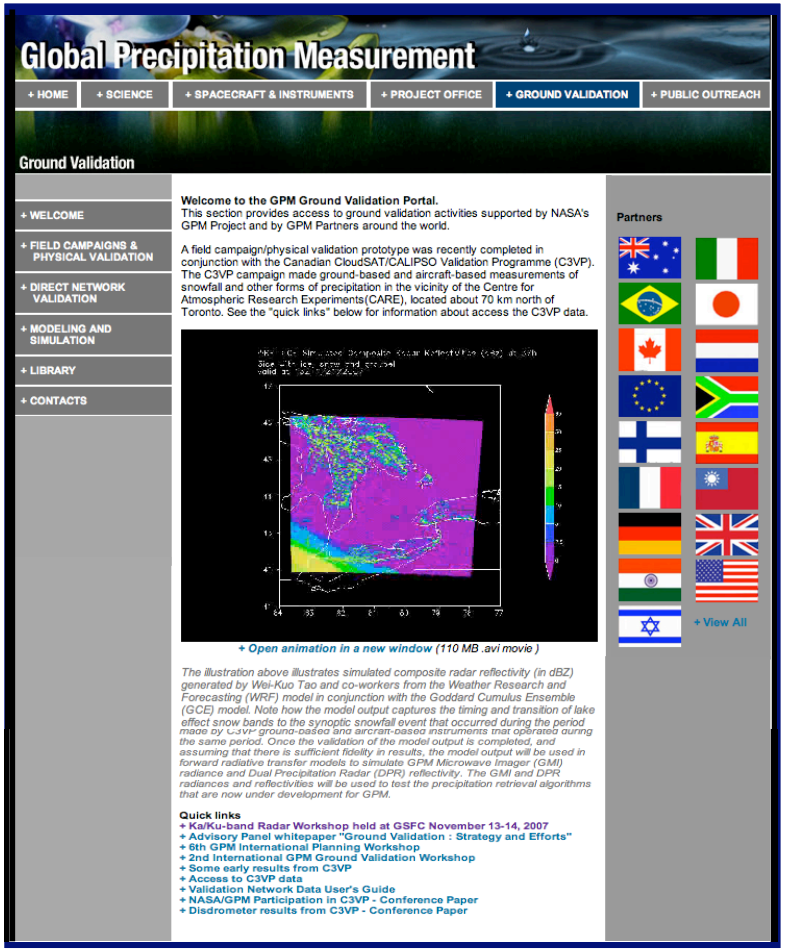
- Contribute to the Validation Network
  - Contribute QC'd radar reflectivity and precip data
    - > TRMM/PR era: view is between ~37° N/S latitude
    - > GPM/DPR era: view is between ~67° N/S latitude
  - Receive matching TRMM/PR and GPM/DPR data
  - Australia's Bureau of Meteorology (Darwin S-band) and University of Alabama, Huntsville (ARMOR C-band) are contributing polarimetric data
  - Discussions underway with INPE/Brazil about potential contributions



- Get TRMM/GPM data & software tools
  - Access the raw and match-up data via the GV website
  - Match-up software is being prepared for open source distribution, again via the web site
- Example applications
  - Exploring C-band attenuation correction (Petersen/UAH)
  - Comparing TRMM PR v6 and v7 algorithms (Iguchi/JAXA, Kwiatkowski/PPS)

GPM GV Data Access

- GPM GV web site provides access to VN data
  - Data that meet the 25%/25% criteria are available by ftp
  - ftp access information is on the GPM GV web site
  - A VN user's guide provides details on the netCDF file formats
  - No restrictions on access or distribution of the VN
  - VN software is also available as "open source"
- GV web site is also a portal to C3VP field campaign data…
- And to GV sites from other partners

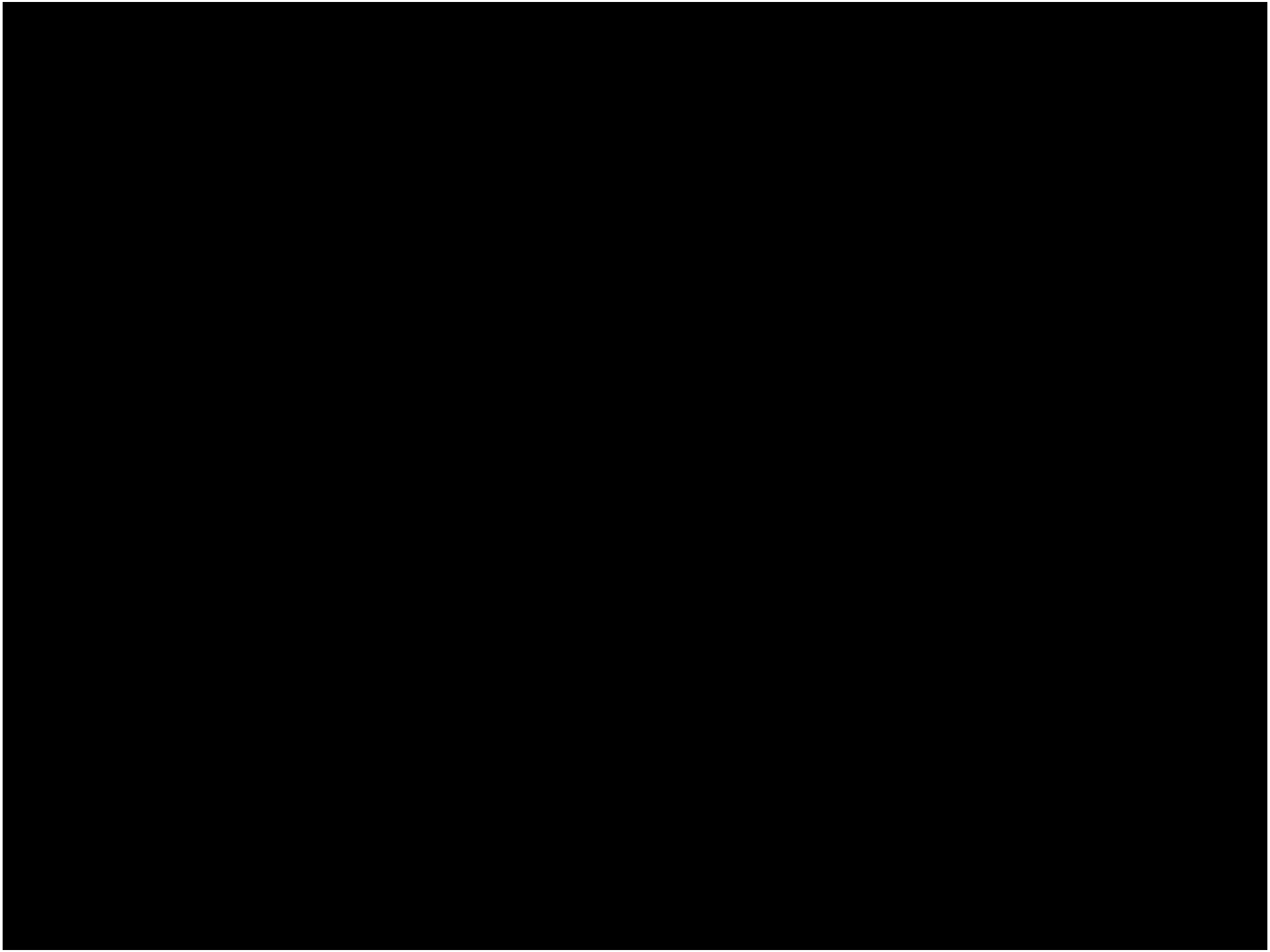


http://gpm.gsfc.nasa.gov/groundvalidation.html

Contribute to Field Campaigns & the GV Portal

- Field Campaigns
  - Use the PMM “template process” to propose complimentary or joint research activities
  - Participate in scheduled field campaigns by contributing instrumentation
  - Propose campaigns in additional regimes
- Contribute to the GV Portal
  - These countries can revise and expand existing links

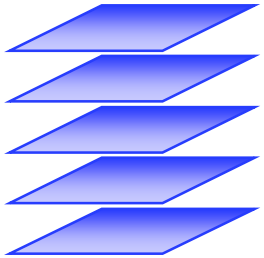
  - These countries don’t have links yet … please add a url and a short summary of your ground validation activities!



PR and WSR-88D Resampling

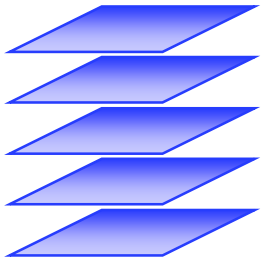
Grid characteristics

- Local Cartesian grid, centered on WSR-88D site
- 4 km horizontal spacing
- 13 vertical layers, 1.5-19.5 km; 1.5 km vertical spacing



PR and WSR-88D data are resampled to common grid

- Gridded PR and WSR-88D stored in separate netCDF files

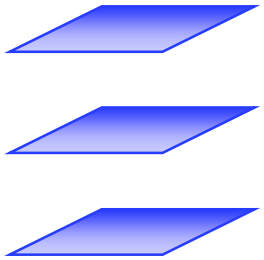


3-D grids

- PR: raw and attenuation-corrected reflectivity; rain rate
- WSR-88D: reflectivity (from TRMM 2A-55 via SPRINT)

2-D grids

- PR: land/ocean flag, bright band height, rain flag
- PR, WSR-88D: near-surface rain; rain type (stratiform, convective, other)



Scalable & Portable

- The VN was designed to be scalable
- PostGRESQL database tracks all raw and analyzed data files and precip event metadata
- Perl and bash scripts run the data acquisition and cataloging
- All raw and processed data permanently retained
- Minimal human intervention in normal operations
  - Except for manual QC of WSR-88D by TRMM GV in the 2A-55 data processing stream

- Additional sites and grid layers can be added easily
  - HGX site was added in December 2006
  - ARMOR
  - TRMM PR-TMI rain rates (2B31) grid processing added
  - Discussions held with INPE about adding stations from Brazil