# GPM GROUND VALIDATION AT 10 YEARS AND BEYOND


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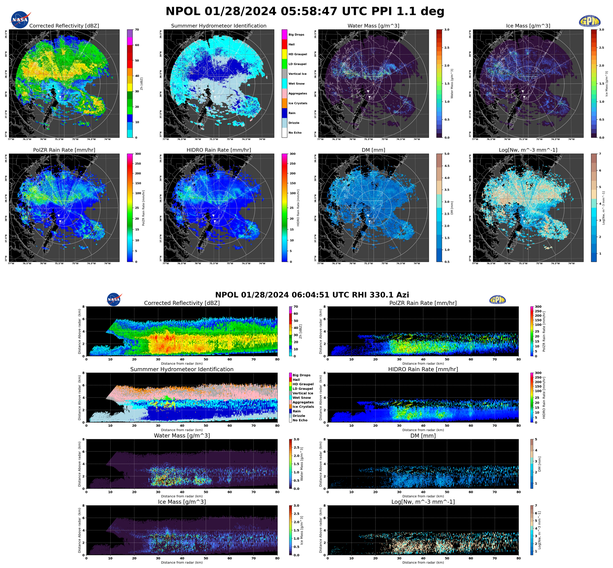
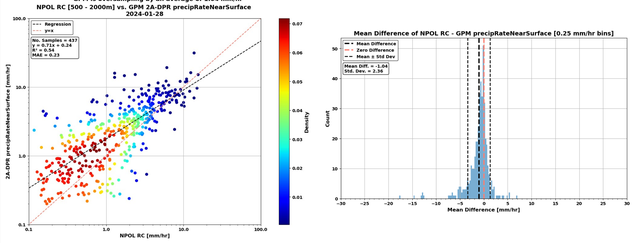
## GPM-GV Validation Network

To enable systematic satellite-to-ground comparisons, GV developed the Validation Network (VN), a framework that matches ground radar observations to GPM satellite retrievals. The VN currently comprises 80 sites across the U.S. and 21 international locations.



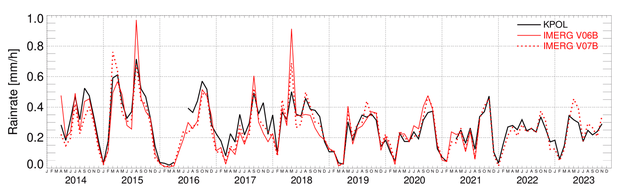

The NPOL radar is in the VN, was operational, and precipitation products were generated during overpass. Products produced; HIDRO Rain Rate (RC), Pol ZR Rain Rate (RP), Hydrometeor Identification (FH), Ice and Liquid mass (MI, MW), mass weighted mean diameter (Dm), and normalized intercept parameter (Nw).




Comparisons of NPOL and DPR (spaceborne radar) rain rate retrievals during overpass event. The use of ground-based radar and a network of automated disdrometers and tipping buckets allows for calibration and validation of the GPM satellite and its derived products.

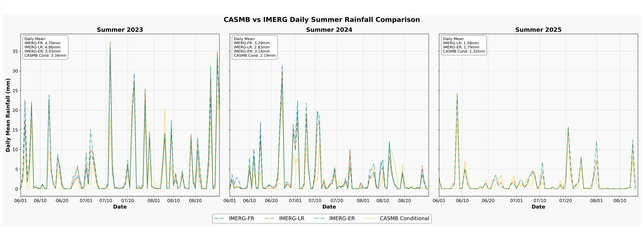
## NASA's Integrated Multi-satellitE Retrievals for GPM (IMERG) Comparisons

### Oceanic Tropical KPOL Comparison




KPOL radar generally shows higher monthly mean precipitation rates than IMERG, typically 15-30% higher.

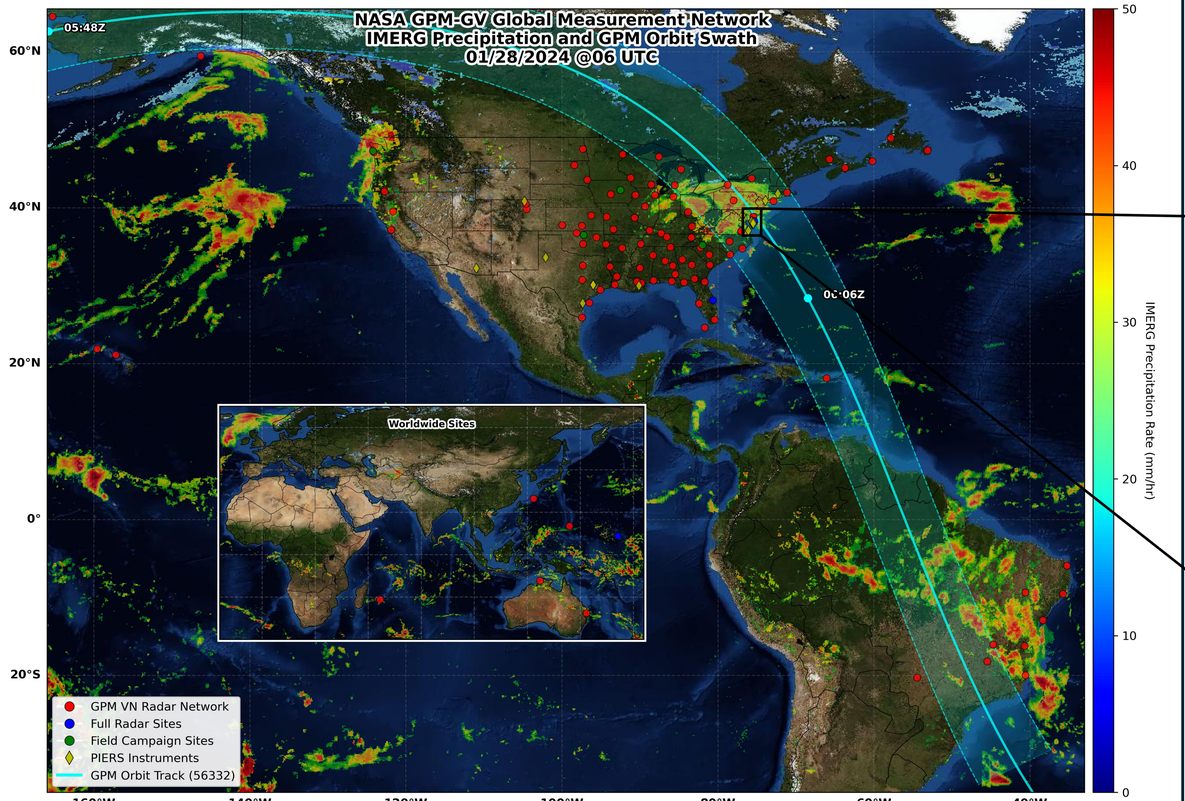
### High Latitude Canadian CASMB Radar Comparison



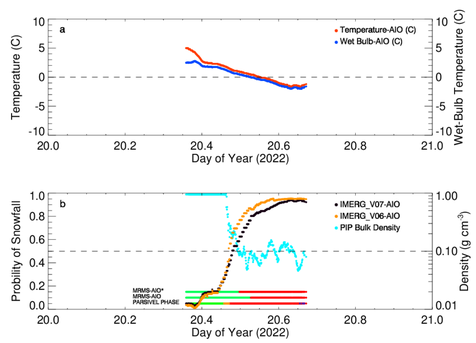

IMERG products systematically estimate 25-35% higher daily rainfall than CASMB radar across all three summers. During high-intensity events (>15mm/day), IMERG products tend to show even larger overestimation compared to radar.

## Overview

NASA's Global Precipitation Measurement (GPM) mission Ground Validation (GV) program was established over a decade ago to validate the accuracy of satellite-based precipitation estimates using surface-based observations. The GV program continues to support this mission through ongoing field campaigns, advanced data analysis, targeted research studies, and custom software development.




## GPM/IMPACTS (2022-2023) UCONN (2024-2025) Field Campaigns




a) Time series of surface air temperature (red) and wet-bulb temperature (dark blue) from AIO weather station when PARSIVEL is reporting precipitation on January 20, 2022, b) of PARSIVEL, MRMS-AIO original and MRMS-AIO* revised phase classification where red is snow, green is rain, orange is mixed precipitation (freezing rain and hail), and purple is unidentified precipitation. IMERG-AIO V06 and V07 time series are given in orange and black, respectively, and PIP bulk density time series is also shown in light blue.

## GPM-GV Developed Software

### GVradar

A Python based Radar Processing tool GVradar was developed to process and analyze ground-based radars.

### pySIMBA

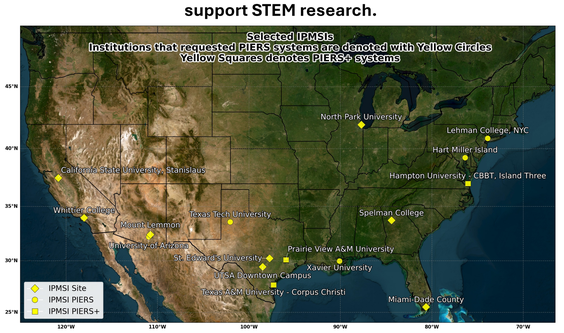
A Python based System for Integrating Multiplatform Data to Build the Atmospheric Column (pySIMBA), was developed to integrate multiple precipitation sensors from the ground and space into a user-defined cartesian grid.

GPM-GV Python packages can be found on Git Hub:
https://github.com/GPM-GV/

GPM-GV · GitHub

## GPM-GV Assets Assist Synergistic Field Campaigns

NASA's Improved Participation of Minority Serving Institutions (IPMSI) initiative through the deployment of gauges and disdrometers to support STEM research.




### Testing INCUS Methods Experiment – Suborbital preLaunch Investigations of Convective Evolution in Colorado (TIME-SLICE CO)

GPM-GV provided an MRR Pro, and a PIERS+ precipitation station for the campaign. TIME-SLICE CO will build an initial proving ground to determine the types of data needed to validate products for the NASA EV-3 Investigation of Convective Updrafts (INCUS) mission.
https://incus.colostate.edu/time-slice

### Snow Sensitivity to Clouds in a Mountain Environment (S2noCliME)

GPM GV-provided sensors: disdrometers, which measure snowflake size and rate; precipitation gauges, which track precipitation accumulation; and profiling radars, which help scientists understand snowfall event evolution.
https://catalog.eol.ucar.edu/s2noclime

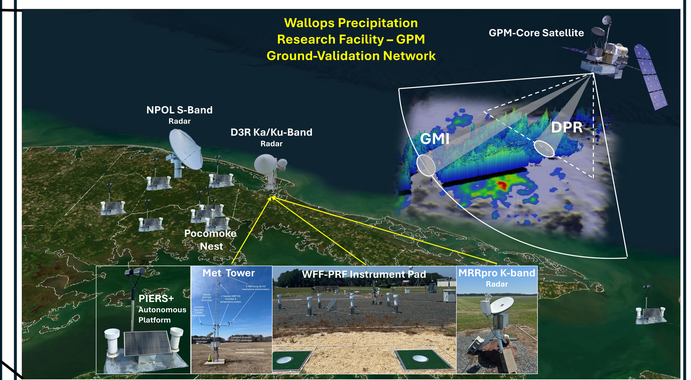
## Acknowledgements


We would like to thank the GPM Wallops Precipitation Research Facility engineers (Alexey Chibisov, Mick Boulanger, Mike Watson, and Edward Hickman) for installing, calibrating, and maintaining ground precipitation platforms. This research is funded by Will McCarty (Program Scientist at NASA Headquarters) and Dr. George Huffman (NASA/GSFC GPM Project Scientist).


## Precipitation Research Facility (PRF)

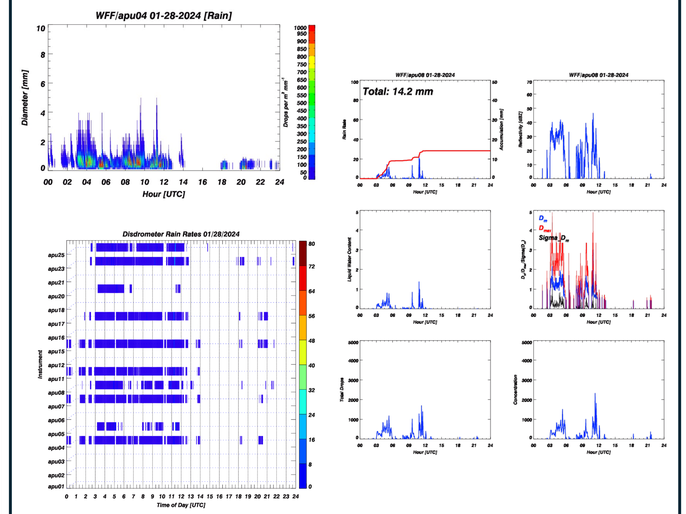
A cornerstone of the program is the Precipitation Research Facility (PRF), a permanent validation site located near NASA's Wallops Flight Facility in Wallops Island, Virginia. The PRF hosts a suite of ground-based and remote sensing instruments that enable detailed studies of precipitation microphysics.

- NASA's S-band Polarimetric radar (NPOL)
- Dual-polarization, Dual-frequency Doppler Radar (D3R)
- Disdrometers
- Micro Rain Radars (MRR)
- Precipitation Imaging Package (PIP)
- All-in-one weather sensors (MetOne, RMYoung)
- Campbell Scientific Weather Tower
- Multiple types of Precipitation Gauges



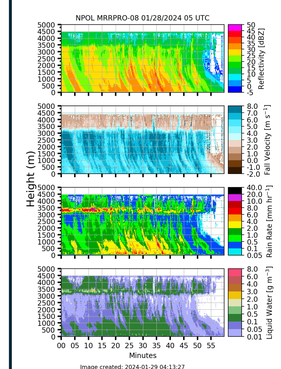

## Instruments Collect Data 24/7
## Data Below Collected During Pictured Overpass

### Autonomous Parsivel Unit (APU) Disdrometer



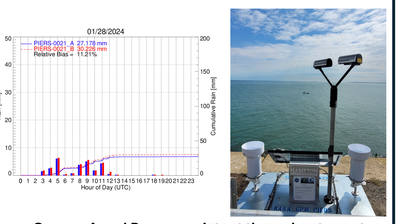

APU data provides a comprehensive picture of the precipitation event, capturing its temporal evolution, intensity variations, and drop size characteristics across multiple locations.

### Micro Rain Radar (MRR)




MRR-PRO located at NPOL Captured Classic Stratiform Precipitation Event

### Dual Met One Instruments Precipitation Gauges on PIERS Platforms




Gauges A and B are consistent throughout event

Wallops Precipitation Science Research Facility
wallops-prf.gsfc.nasa.gov