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A PYTHON-BASED RADAR DATA PROCESSING SYSTEM FOR NASA'S GPM GROUND VALIDATION PROGRAM

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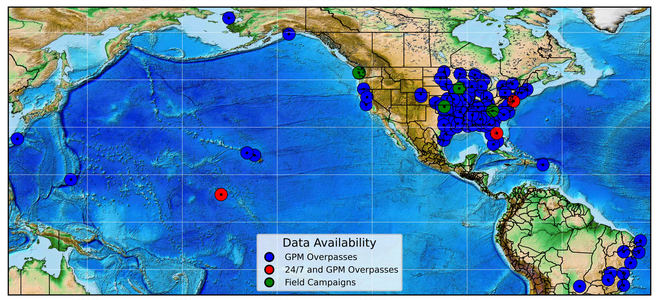
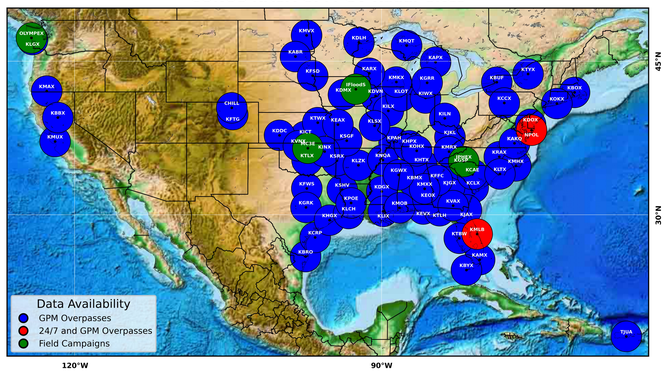
MISSION OVERVIEW

All NASA GPM-GV Validation Network Radar Sites



CONUS NASA GPM-GV Radar Sites



The Global Precipitation Measurement (GPM) Mission satellite an international mission led by NASA and JAXA was launched from Tanegashima, Japan on February 27, 2014. The GPM Ground Validation (GV) program has established a global network of over 90 dual polarimetric (DP) weather radars. The GV Validation Network program was developed to allow direct comparison between these ground-based radars and the dual-frequency radar onboard the GPM satellite.

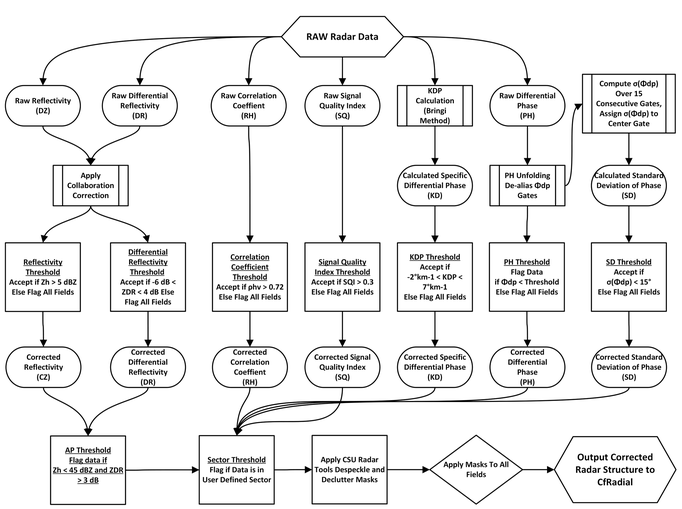
TRANSITION TO PYTHON

The science community's progression toward Python as a primary programing language, facilitated the GPM-GV program to develop a Python-based radar processing system referred to as GVradar. GVradar consists of two modules: Dual-Polarimetric Quality Control (DPQC), and dual-polarimetric precipitation product generation (dp_products). Both modules take advantage of the open-source Python Atmospheric Radiation Measurement (ARM) Radar Toolkit (Py-ART [Helmus and Collis 2016]) and Colorado State University's Radar Tools (CSU Radar Tools [Lang et al. 2019]).

PYTHON BASED DPQC

Within DPQC, parameter threshold gate filters are utilized to identify and remove nonprecipitating echoes based on freezing level, beam height, or by user defined sector.

Additional DPQC capabilities: unfolding of Differential Phase (Φdp), Specific Differential Phase (Kdp), velocity de-aliasing, and application of calibration offsets.



GVradar - DPQC Algorithm

All fields are modified in each step to remove non-precipitating echo. Threshold values are default, modified when needed.

DPQC

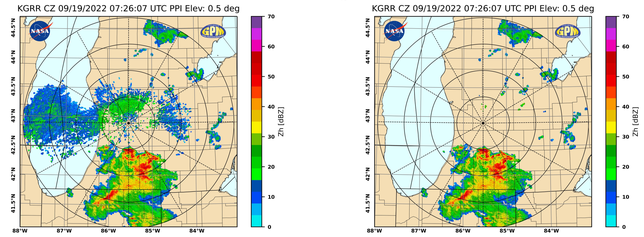
Merge Split Cuts and Remove MRLE

A stubborn false echo case during a GPM overpass at the WSR-88D KGRR radar on 09/19/2022 @2007 UTC. DPQC merges split cut and removes MRLE sweeps, simplifying comparisons with GPM data.

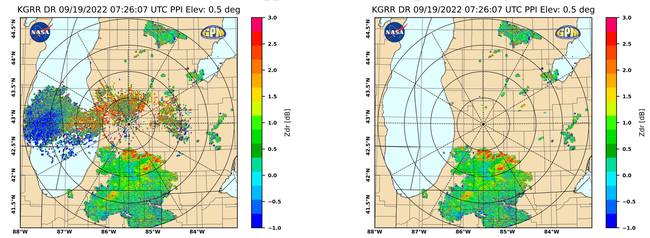
```
Processing --> KGRR20220919_072607_V06
VCP Pattern:   112

Merging WSR-88D Split Cuts
New merged elevation angles:
[ 0.48339844   0.87890625   1.3183594    1.8017578    0.48339844   2.4169922
  3.1201172    3.9990234    5.0976562    6.4160156    7.998047    10.019531
  12.480469    15.600586  ]

Removing MRLE sweeps
Following sweeps will be kept:
[0, 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13]
With the following elevations:
[ 0.48339844   0.87890625   1.3183594    1.8017578    2.4169922    3.1201172
  3.9990234    5.0976562    6.4160156    7.998047    10.019531    12.480469
  15.600586  ]
```

Default QC Thresholds *Case Specific Thresholds*

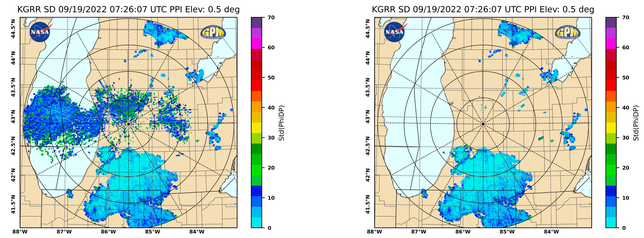
Corrected Reflectivity



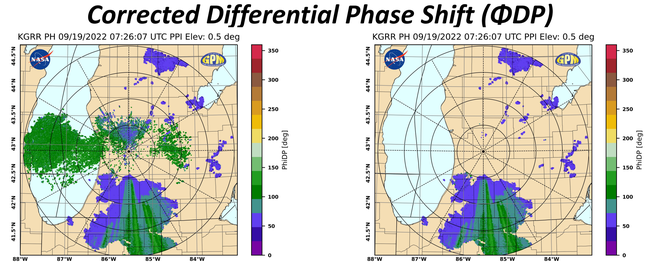
Corrected Differential Reflectivity



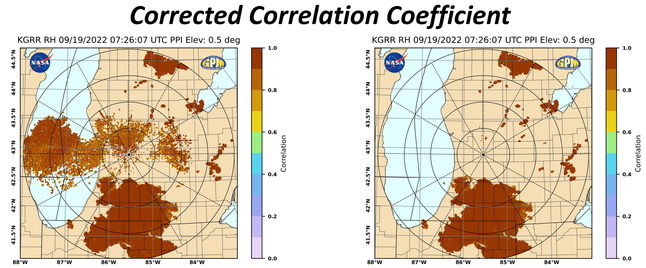
Corrected Standard Deviation of Phase



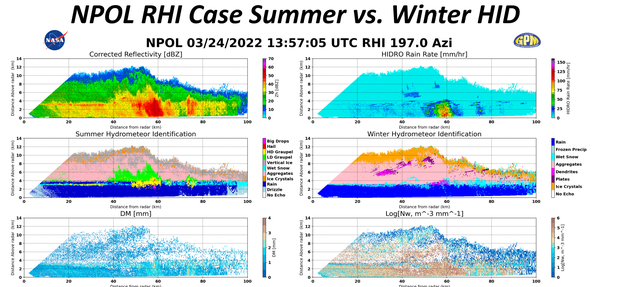
Corrected Differential Phase Shift (ΦDP)



Corrected Correlation Coefficient



NPOL RHI Case Summer vs. Winter HID

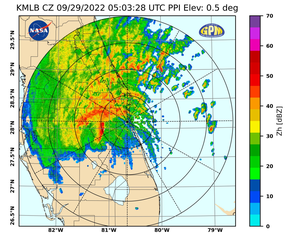


DP PRODUCTS

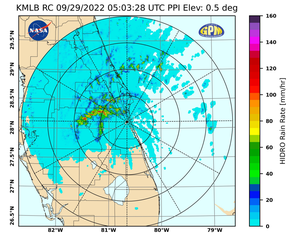
Precipitation products generated include HIDRO Rain Rate (RC), Hydrometeor Identification (FH), Ice and Liquid mass (MI, MW). Additional products mass weighted mean diameter (Dm) and normalized intercept parameter (Nw).

WSR-88D KMLB GPM OVERPASS HURRICANE IAN

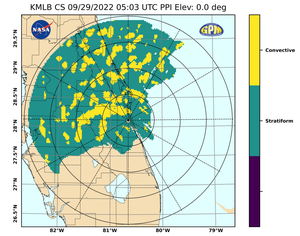
Reflectivity



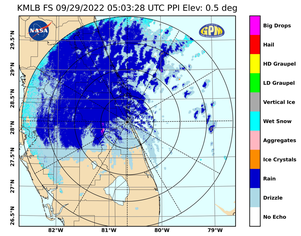
Rain Rate



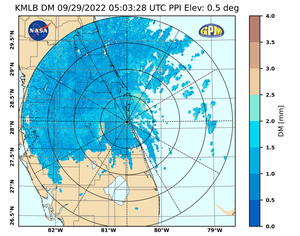
Convective/Stratiform



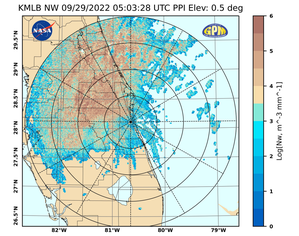
Summer HID



Mass Weighted Mean Diameter

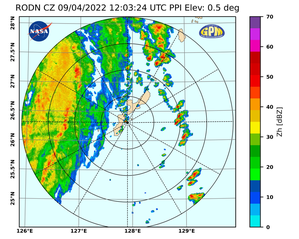


Normalized Intercept Parameter

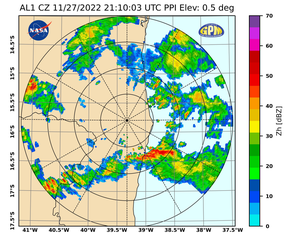


GPM Validation Network Consists of Multiple International Radars

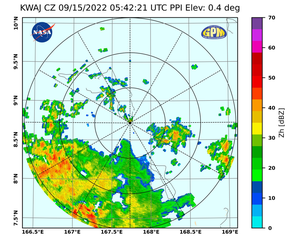
Kadena AB Okinawa, Japan



Almenara, Brazil

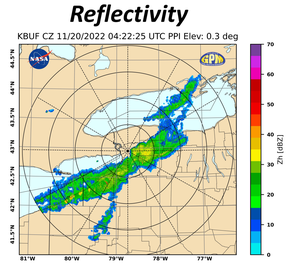


Kwajalein Atoll, Marshall Islands

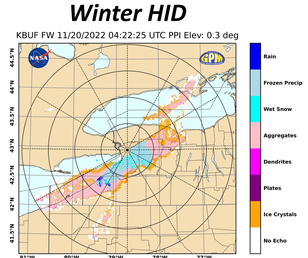


GPM Validation Network Captured Historic Buffalo (KBUF) Lake Effect Snow Event

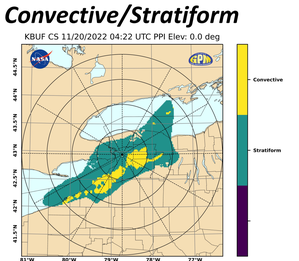
Reflectivity



Winter HID

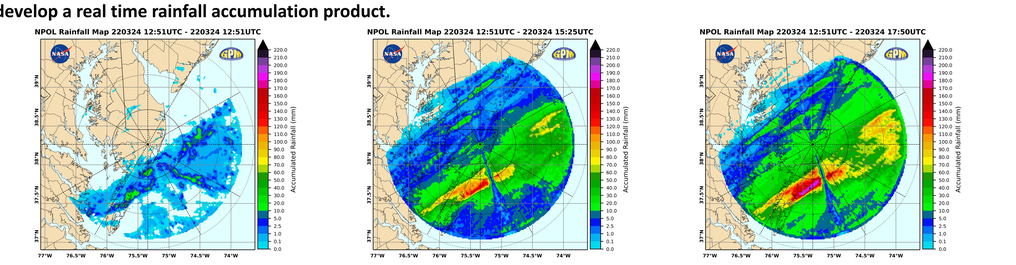


Convective/Stratiform



GVRADAR REAL-TIME APPLICATION

The ability of GVradar to retrieve sounding data from the Rapid Refresh (RAP) model allows DPQC to be applied and dp_products to be generated in near real-time. NPOL and KDOX radars utilize real time processing. GVradar facilitated the GPM-GV program to develop a real time rainfall accumulation product.



Accumulated rainfall maps; (a) beginning of event, (b) 2 hours 34 minutes into event, (c) completion of the 5 hour event. Wallops Island Virginia reported 32.26 mm during this event.

OPEN-SOURCE DOWNLOAD

The GVradar package can be found on Git Hub:

https://github.com/GPM-GV/GVradar

ACKNOWLEDGMENTS

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REFERENCES

For full list of references please scan QR code.
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