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Introduction

The recent upgrade of the WSR-88D radar network to dual polarization (DP) and the availability of research DP radars, such as NPOL and KPOL, allows NASA's GPM Ground Validation program (GPM-GV) to capture unique polarimetric data to foster improved understanding o rophysics, and provide essential input for of precipitation retrieval algorithms. The quality control (QC) of these data sets is a critical first step in this process.

- GPM-GV developed an algorithm based on Ryzhkov et al. 1998, that uses DP parameters to QC radar data (DPQC).
- A previous version of DPQC was discussed in Marks et. al 2011. Updates include:
- The ability to process WSR-88D data
- Improved method of applying QC, the freezing level is determined and QC is only applied below this level using radar beam height.
- Addition of modules that remove or apply thresholds to a sector.
- The algorithm is applied daily to twenty-five radars selected for evaluation of GPM (Fig. 1).



Fig. 1. Twenty-five GPM-GV radar sites that use DPQC for quality control.

DPQC Algorithm

The goal of this effort was to develop a DPQC algorithm that is both modular and physically based. The modular functions and procedures were written using RSLin-IDL so that the programs can easily be used with other polarimetric radars via passing of an RSL "radar" structure. **RSL-in-IDL allows DPQC to:**

- View and manipulate the radar structure by volume, sweep, ray, and range.
- Apply threshold modules that are dependent on DP fields (Table 1).
- Apply QC to multiple scan types i.e. PPI, RHI, and PPS.
- Output a QC UF and plots of all QC fields.

Field	Description
ZT (Sigmet)	Raw reflectivity [dBZ]
DZ (WSR-88D)	Level II reflectivity [dBZ]
CZ	Corrected reflectivity [dBZ] Created by DPQC
DR	Differential reflectivity [dBZ]
RH	Co-polar cross correlation
PH	Differential phase [deg]
SD	Standard deviation of PH [deg] Created by DPQC
SQ	Signal quality index. Sigmet only
KD	Specific differential phase [deg km-1] Created by DPQC for WSR-88D
VR	Radial velocity [m s-1]

Flow Chart of the DPQC Algorithm



Table 1. Fields within the RSL "Radar" structure used by DPQC.

DUAL POLARIMETRIC QUALITY CONTROL FOR NASA'S GLOBAL PRECIPITATION MEASUREMENT (GPM) MISSION GROUND VALIDATION PROGRAM

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<u>CZ Threshold</u>

- Removes very light echo that is usually associated with
- Depicted in Fig. 2a is a DZ PPI plot of a test case with abundant false echo from KLIX (New Orleans, LA) on July 3, 2013 at 1433Z.
- Fig. 2b is the resulting CZ PPI plot from applying a 5 dBZ CZ threshold.





<u>RH Threshold</u>

- Common RH values for precipitation range from 0.9-1.0, ice and large wet aggregates can have values below 0.9.
- Continuing our sequential test case, Fig. 3a displays a RH PPI plot.
- Fig. 3b is the resulting CZ PPI plot from applying a 0.80 **RH threshold**



<u>DR Threshold</u>

- Typical values of DR for precipitation range from 0-5 dB, frozen precipitation can fall bellow 0 dB.
- Fig. 4a displays a DR PPI
- Fig. 4b is the resulting CZ PPI plot from applying a DR threshold with a range of -2 to 5 dB.



SD Threshold

- Observations of SD for GPM-GV radars revealed that within precipitation SD is usually less than 24°.
- Calculated over over consecutive de-aliased resulting gates, σ(Φ applied to center gate.
- Fig. 5a displays a SD PPI
- Fig. 5b is the resulting CZ PPI plot from applying a 24° SD threshold.

Summary

The DPQC algorithm, using default thresholds, is applied daily to all GPM-GV sites producing a nearly clean radar product. The default data is reviewed daily and additional adjustments are made to produce the highest quality radar product. Final output includes QC plots, QC UF, and a parameter file detailing which modules were run and their corresponding thresholds.

Future developments for DPQC include a conversion of the IDL code to C for greatly decreased processing time. When future data issues arise the DPQC algorithm will be updated with code changes or additional modules. DPQC will be used for all future **GPM-GV** radar sites and field experiments.

The QCed DP data will allow improved understanding of precipitation microphysics, and provide essential input for development of precipitation retrieval algorithms. The resulting data will prove essential for calibration of the core GPM satellite and for development of physically based passive microwave radiometer algorithms.

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Algorithm Availability and Contacts

To obtain the DPQC algorithm, or for questions/comments, please contact, Jason.L.Pippitt@nasa.gov; or David.A.Marks@nasa.gov

Information on NASA's Radar Software Library (RSL) and the programming language RSL_in_IDL can be found on the PMM Ground Validation Office web site:

http://trmm-fc.gsfc.nasa.gov/trmm_gv/software/software.html

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