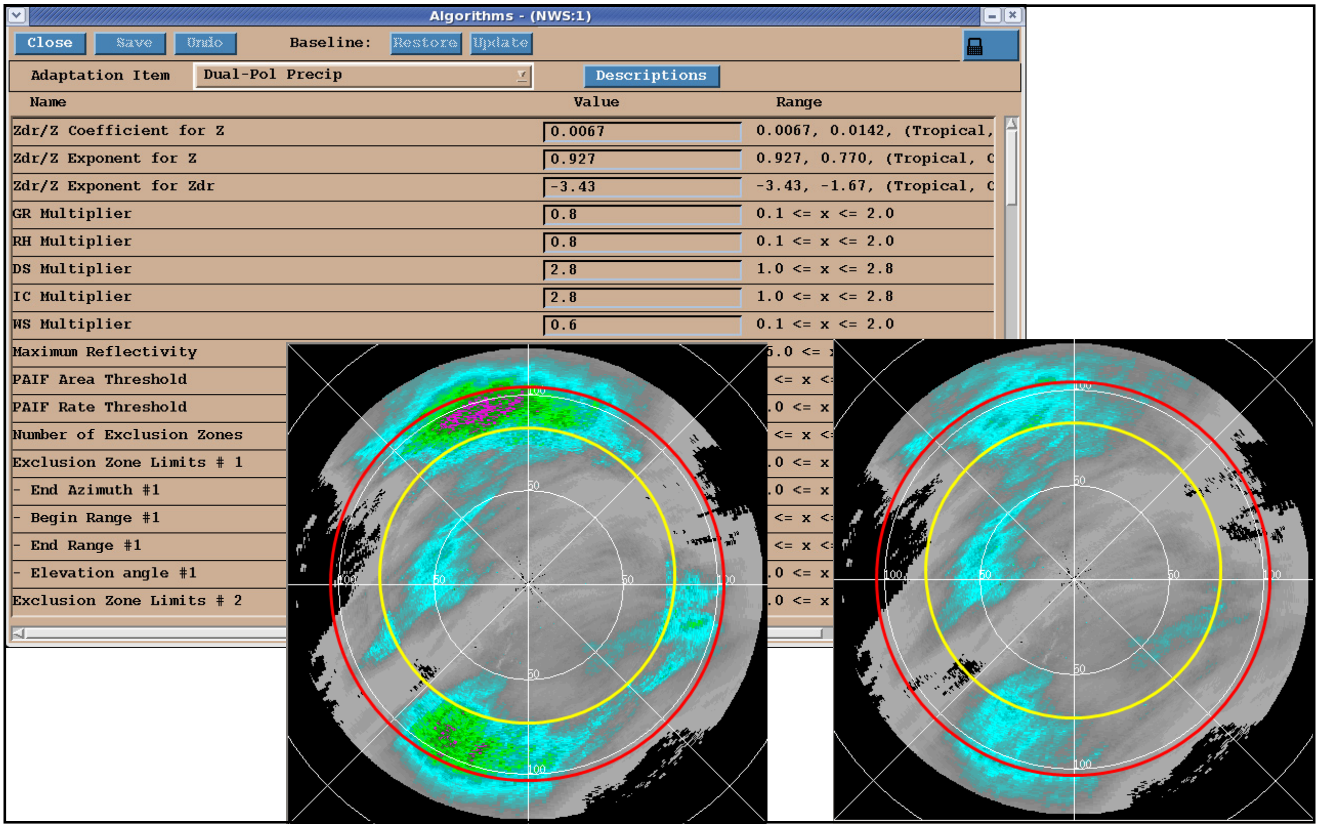
RDA/RPG Build 15.0

Training



Presented by the

Warning Decision Training Branch

Version: 1411

Overview

Build 15.0 is an upgrade for both the RDA and the RPG. Though this is primarily an RDA hardware upgrade, there are some software changes that affect operations. These changes are designed to improve the Dual Pol base data quality and the performance of the Dual Pol Quantitative Precipitation Estimation (QPE) algorithm.

Unit Radar Committee

The Build 15.0 changes at both the RDA and the RPG may affect Unit Radar Committee (URC) decision making. Coordination among URC members with respect to how Build 15.0 impacts URC protocols is encouraged.

The information presented in this document reflects the pre-Deployment state of knowledge of the operational impacts of Build 15.0.

RDA/RPG Build 15.0 Operational Impacts

The following Build 15.0 operational changes are presented in this document:

- For Dual Pol QPE:
  - Choice of tropical or continental R(Z/ZDR) relationship via ROC and URC guidance
  - Additional R(Z) multipliers are editable via ROC guidance
  - Change in QPE logic defining the top of the melting layer
- RPG Estimated ISDP Process

Dual Pol QPE Changes

Tropical vs. Continental R(Z,ZDR)

The Dual Pol Quantitative Precipitation Estimation (QPE) algorithm employs a R(Z,ZDR) equation (among others) for generating rainfall rates each volume scan and accumulating these rates over time. The use of the R(Z,ZDR) for any given range bin and any volume scan is dependent on the hydroclass value assigned and the height of the melting layer.

QPE Short Review

The QPE algorithm is particularly complex in that it relies on the results of two ***other*** Dual Pol RPG algorithms:

- Melting Layer Detection Algorithm (MLDA)
- Hydrometeor Classification Algorithm (HCA)

The best way to monitor the quality of these inputs into the QPE algorithm is by monitoring the Hybrid Hydrometeor Classification (HHC) product. This product is generated every volume scan by the QPE. It presents the hydroclass that has been assigned to each azimuth and range, which then determines which rain rate equation is used. In Figure 1, the majority of the hydroclass values are Dry Snow (DS). If this is a winter environment with a vertical temperature profile that is entirely below freezing, this HHC tells you that the inputs to the QPE make sense.

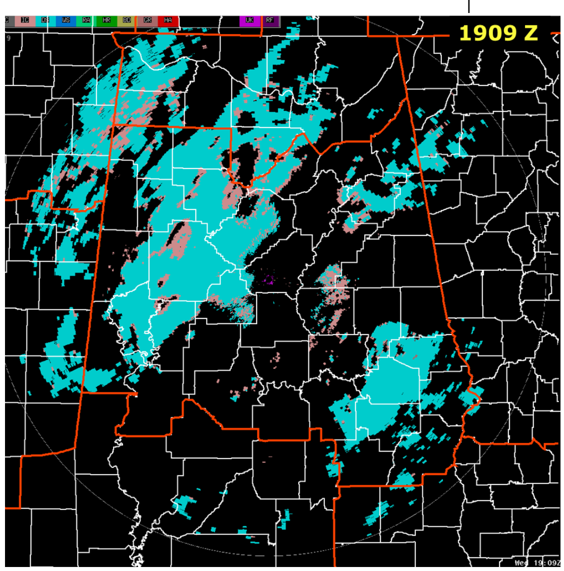


Figure 1. An example HHC product, with Dry Snow (DS) as the dominant hydroclass. This would make sense if the vertical temperature profile is below freezing.

Tropical or Continental R(Z,ZDR)

The dual pol variables, Differential Reflectivity (ZDR) and Specific Differential Phase (KDP), are used by the QPE to generate rain rates each volume scan, then those rates are used to accumulate rainfall. The R(Z,ZDR) equation is applied for hydroclass values that are liquid (e.g. light rain, heavy rain, or big drops), in other words below the melting layer, unless hail is identified as a hydroclass. The HHC product can be used to check where the R(Z,ZDR) equation is applied.

Prior to Build 15.0, the only R(Z,ZDR) equation was:

$$R(Z, ZDR) = (0.0067)Z^{0.927}ZDR^{-3.43}$$

With Build 15, this R(Z,ZDR) relationship ***remains the default version***. Since the dual-pol deployment, this version has shown somewhat better performance in dropsize environments dominated by smaller drops. Its coefficient and exponents are identified at the RPG as the Tropical version of the R(Z,ZDR) equation. This does ***not*** mean that this R(Z,ZDR) is now intended ***exclusively*** for tropical events. It remains the default because it has been used thus far and is more familiar.

With Build 15.0, there is an alternative R(Z,ZDR) relationship, known as the Continental version. The expectation is that this would be more appropriate for events dominated by deep convection. It’s coefficient and exponents are:

$$R(Z, ZDR) = (0.0142)Z^{0.770}ZDR^{-1.67}$$

Changing from the Tropical R(Z,ZDR) to the Continental and vice versa is performed at the RPG Algorithms adaptation data window, “Dual-Pol Precip”, which lists the adaptable parameters that are editable under URC guidelines. The first three parameters in Figure 2 pertain to the R(Z,ZDR) equation and the default coefficient and exponent values are for the ***Tropical*** R(Z,ZDR).

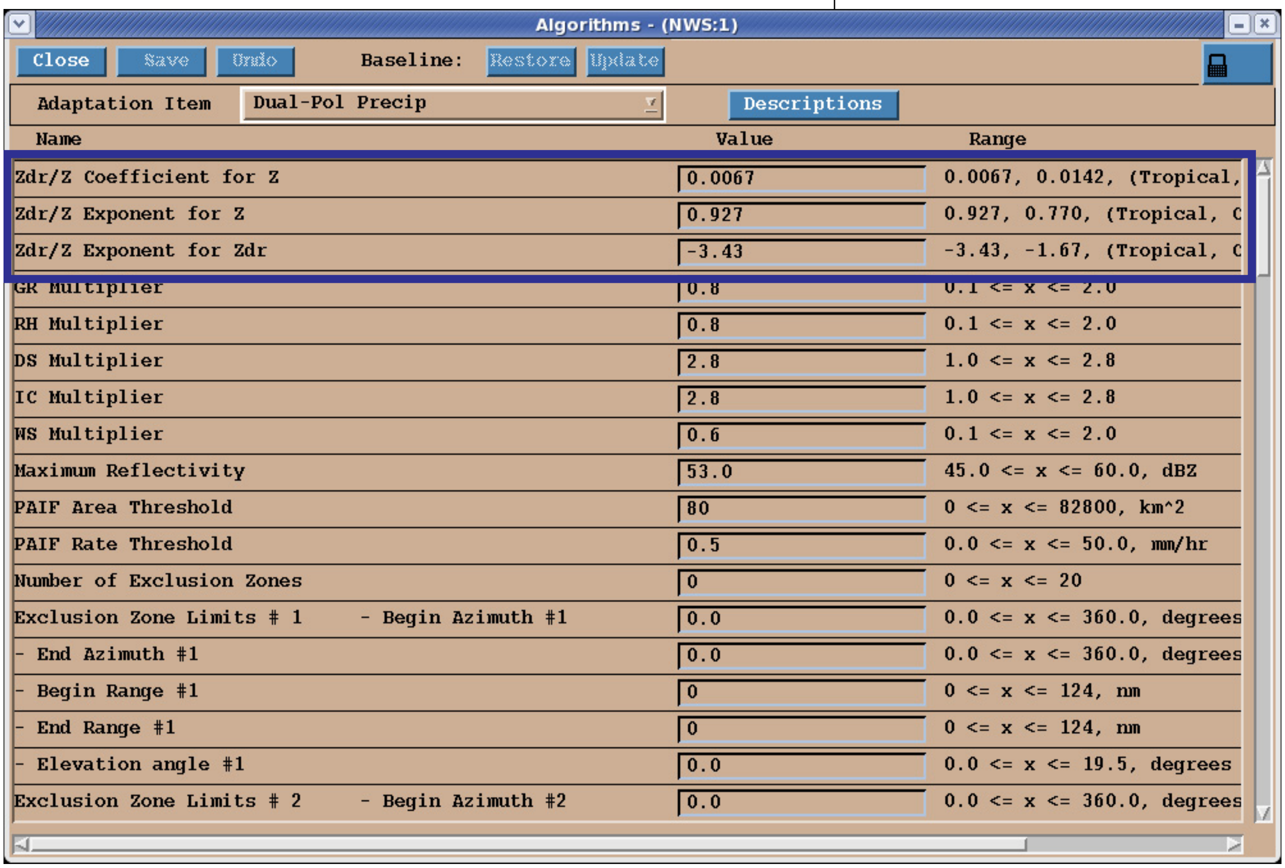


Figure 2. URC adaptable parameters for “Dual-Pol Precip”, aka QPE, at the RPG. The first three lines pertain to the R(Z,ZDR) equation (tropical or continental) that is used by the QPE.

Editing the coefficient and exponents for these equations must be done by selecting one of two possible values. The RPG will not allow any value other than the two that are listed in the Range column. Once the URC password is provided, there is an inverted arrow that reveals a drop down menu. One of the two possible values is selected then the changes must be saved before exiting the window.

Note: Always choose from the same class (tropical or continental) for the coefficient and the two exponents. Do ***not*** mix these values from the different classes. The consequences with respect to accuracy of rainfall estimates cannot be predicted!

“Tropical” QPE Not the Same as “Tropical” PPS

Even though the default QPE R(Z,ZDR) is labeled Tropical, it is ***not*** intended to be used for tropical events in the same way that the Tropical Z-R relationship in the Legacy Precipitation Processing Subsystem (PPS) is used. There is nothing inappropriate about using the Tropical (default) R(Z,ZDR) for QPE, while ***also*** using the default (non-tropical) Z-R for PPS at the same time.

R(Z) Multipliers Editable

R(Z) is used, with a multiplier, for the following hydroclass values in or above the melting layer:

- For Graupel (GR), 0.8*R(Z) is used
- For Hail possibly mixed with Rain (HA), 0.8*R(Z) is used
- For Wet Snow (WS), 0.6*R(Z) is used

All of the multipliers from this list are the current default values. With Build 15.0, these values are editable (Figure 3). However, they should ***not*** be changed unless instructed by the ROC.

Note: On the RPG “Dual-Pol Precip” parameters window (Figure 3), the “RH Multiplier” is actually referring to the hydroclass value of “HA” as seen on the products displayed on AWIPS. The identifier RH will be changed to HA with a later software build.

Change in QPE Logic Defining the Top of the Melting Layer

Where Dry Snow (DS) is identified above the melting layer, the QPE generates rain rates based on 2.8*R(Z). For cold season events particularly, this can result in an overestimation over a large area.

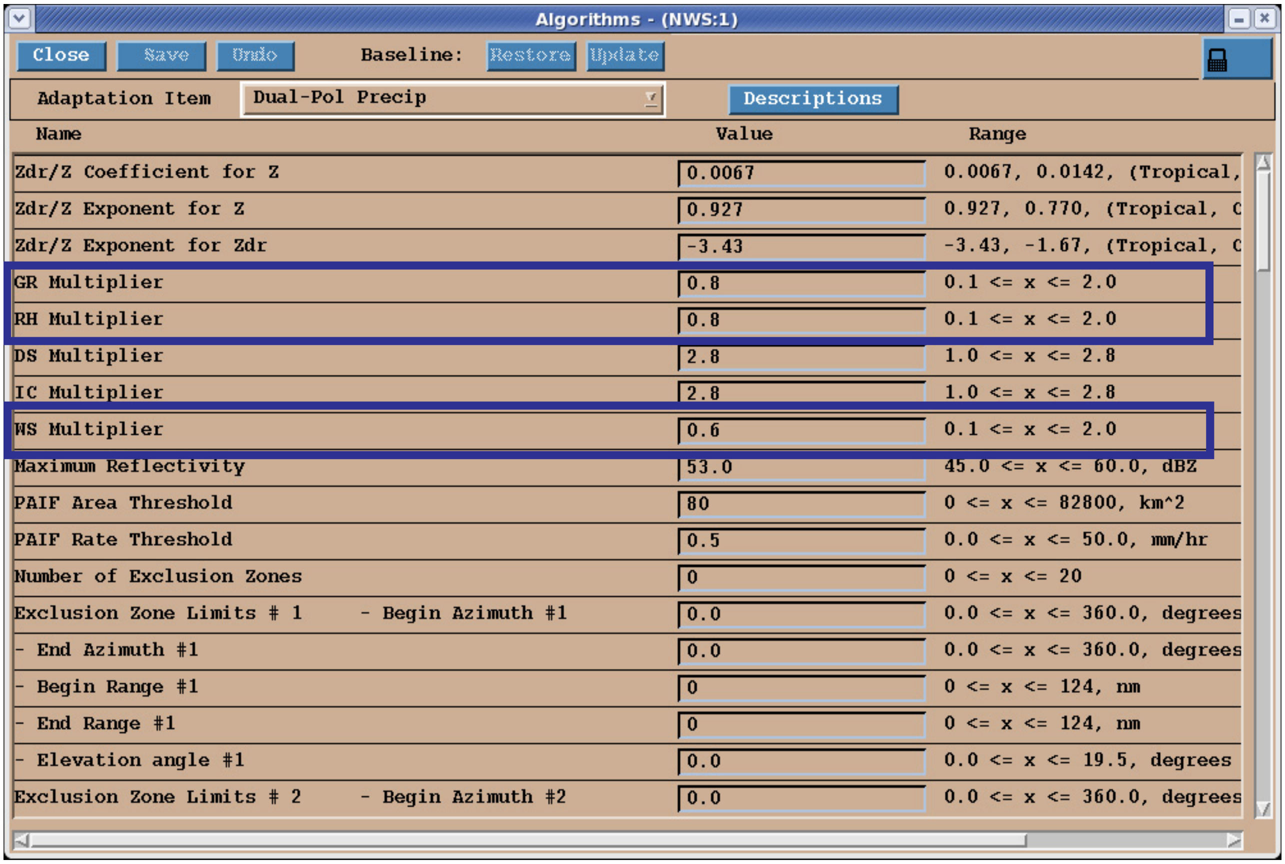


Figure 3. URC adaptable parameters for “Dual-Pol Precip”, aka QPE, at the RPG. The R(Z) multipliers within the boxes are editable only by ROC instruction.

RDA/RPG Build 15 adjusts the definition of the “top of the melting layer” within the QPE logic.

Prior to Build 15.0, the “top of the melting layer” that was used for implementing 2.8*R(Z) was actually where the beam ***centerline*** crossed the top of the melting layer. With Build 15.0, the QPE “top of the melting layer” is more appropriately defined as where the ***bottom*** of the beam crosses the top of the melting layer. This change in definitions reduces the areal coverage of rainfall estimates based on 2.8*R(Z) within the melting layer.

An example of the difference based on this change is displayed in Figure 4. The QPE Storm Total Accumulation products show the resulting accu-

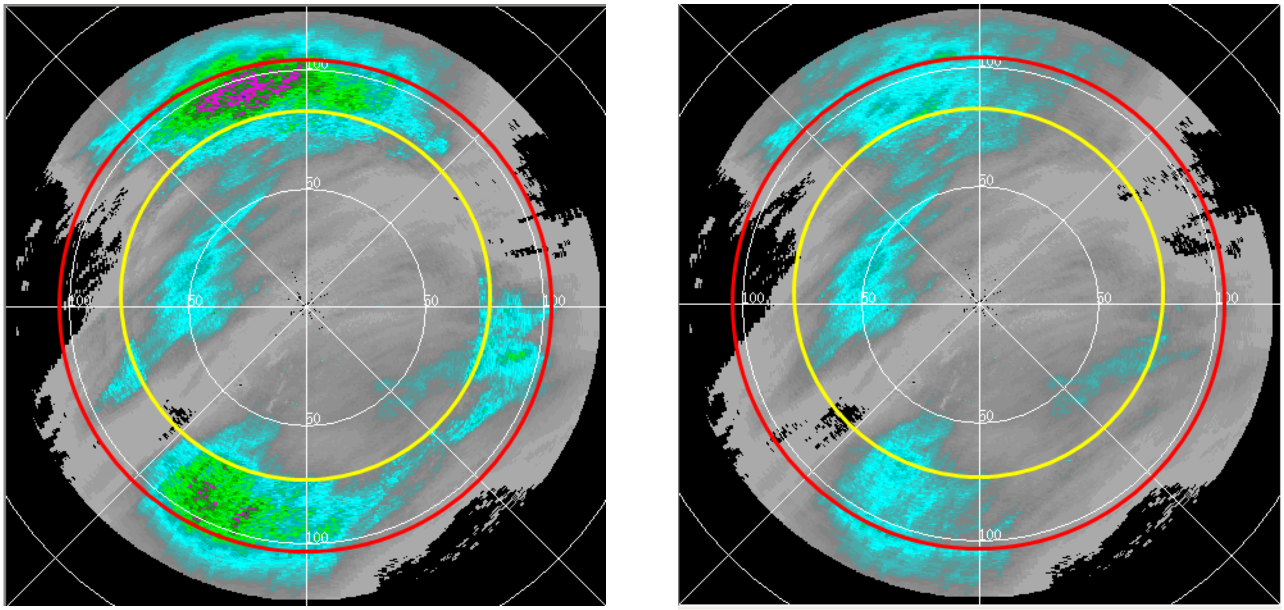


Figure 4. QPE Storm Total Accumulation (STA) products before (left) and after (right), the adjustment to the QPE logic definition of the top of the melting layer.

mulations with the pre-Build 15.0 logic on the left, and the Build 15.0 logic on the right. The red circle is the top of the melting layer, while the yellow circle is the bottom. Note that the estimates within the melting layer are lower, i.e less likely to be overestimates.

RPG Estimated ISDP Process

The Initial System Differential Phase (ISDP) is controlled by two RDA parameters. The goal of the RDA ISDP is to have the Differential Phase, ϕ_{DP}, near 60° when the beam first encounters precipitation. This allows ϕ_{DP} to increase down radial based on the relative amount of liquid water content. A valid ϕ_{DP} produces not only good quality dual pol base data products but also more accurate ϕ_{DP} base data for the dual pol RPG algorithms, especially the Quantitative Precipitation Estimation (QPE) algorithm.

ISDP Logic within RPG Dual Pol Preprocessor

As part of the RPG Dual Pol Preprocessor algorithm, the ISDP is estimated each volume scan. Using available data from up to the lowest three elevations, the ϕ_{DP} values are identified for segments along each radial that have returns that meet criteria for initial precipitation along a radial. The initial precipitation along a radial is based on the following:

- The first 11 consecutive bins with Correlation Coefficient (CC) between .98 and 1.0
- The bins must be at least 25 km from the radar
- The reflectivity value must be between -20 and 40 dBZ

Given that these conditions are met, the median for the 11 bins is saved. The lowest 10th percentile ϕ_{DP} value of the last 200 radials of this search is used as the estimated ISDP for that volume scan.

At the top of each hour, the results of this ISDP check are posted to the RPG Status window (Figure 5). The entry compares the RPG generated value to the RDA value which is controlled by two adaptable parameters. This does ***not*** replace the need to examine base data in a level 2 viewer periodically.

The ISDP Check entry lists:

- The RPG estimated ISDP
- The difference between the RPG estimate and the RDA value
- The RDA value which is shown as 60°, ***even if*** the ISDP Calibration needs to be rerun
- Whether or not the RPG estimate is being applied
- Whether the difference between the RPG estimate and the RDA value is within tolerance (±25°)

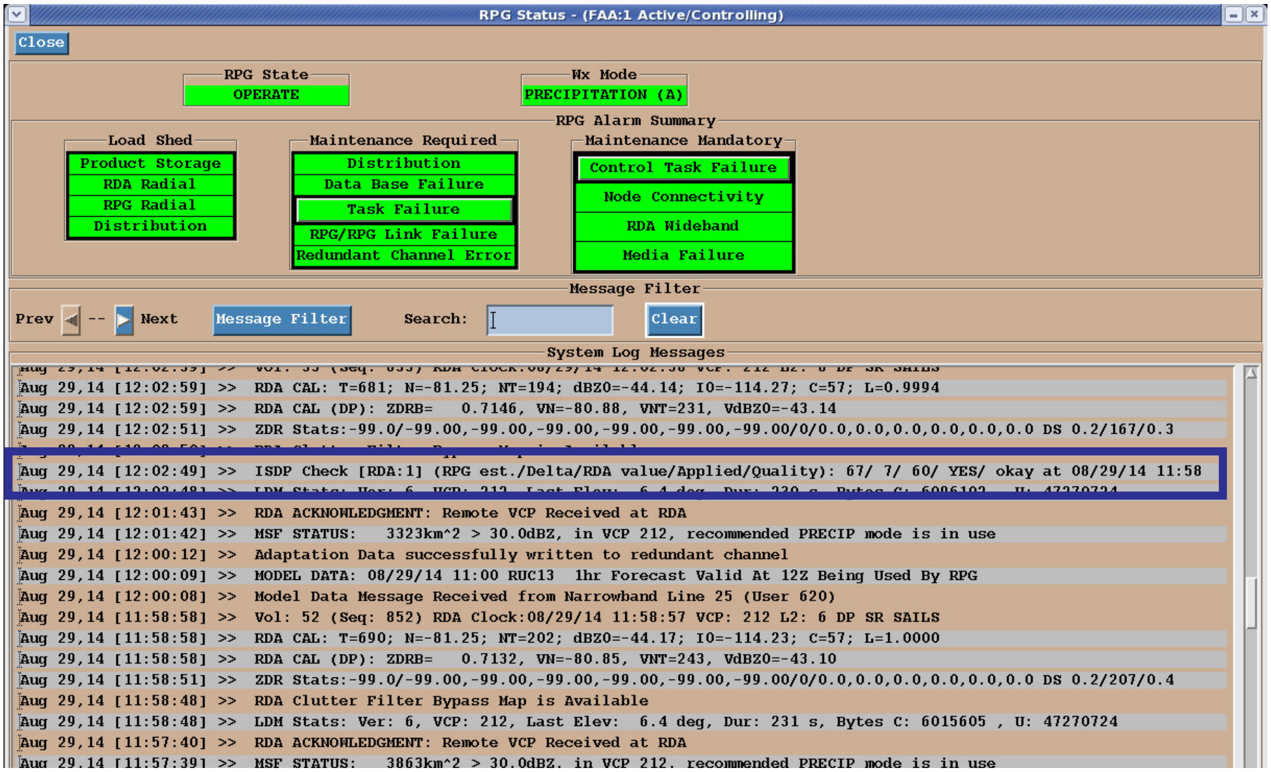


Figure 5. RPG Status window with ISDP Check at the top of the hour.

If the RPG estimate and the RDA value differ by more than 25° (the tolerance) for a particular volume scan, there will be a new status message on the RPG Status window. The background for the message is yellow, providing a caution.

ISDP Adaptable Parameter

The ISDP generated by the RPG Dual Pol Preprocessor algorithm can be applied to the generation of the RPG Dual Pol products. This is controlled by a new adaptable parameter, "Apply RPG estimated ISDP?", through the Algorithms window with DP Preprocessor selected (Figure 6). Note that the default setting for "Apply RPG estimated ISDP?" is No.

Figure 6. RPG Parameters window for the Dual Pol Preprocessor.

Setting “Apply RPG Estimated ISDP” to Yes

Applying the RPG estimated ISDP does ***not*** change the need to periodically run the ISDP calibration, which is an RDA function. ***Only*** the ISDP Calibration can correct the ISDP for the dual pol base data generated ***at the RDA***, which is also distributed to numerous users.

A setting of Yes will ***usually*** provide high quality RPG Dual Pol products. However, the RPG estimated ISDP can be adversely impacted when Correlation Coefficient (CC) is high due to biological targets, degrading product quality.

RDA ISDP Calibration Still Needed

The ISDP Calibration at the RDA ***still*** needs to be run periodically, and monitoring the ϕ_{DP} data when precipitation is close to the RDA is highly recommended. The ϕ_{DP} base data can be viewed through a level 2 viewer such as GR Analyst. Figure 7 shows two products, Z and ϕ_{DP} displayed in GR Analyst. In this example, a line of thunderstorms is just west of the RDA. Examining ϕ_{DP} when precipitation is close, but ***not*** over the RDA is necessary. In this case, ϕ_{DP} is well behaved and the values near the leading edge of the precipitation are near 60°, which is the preferred value.

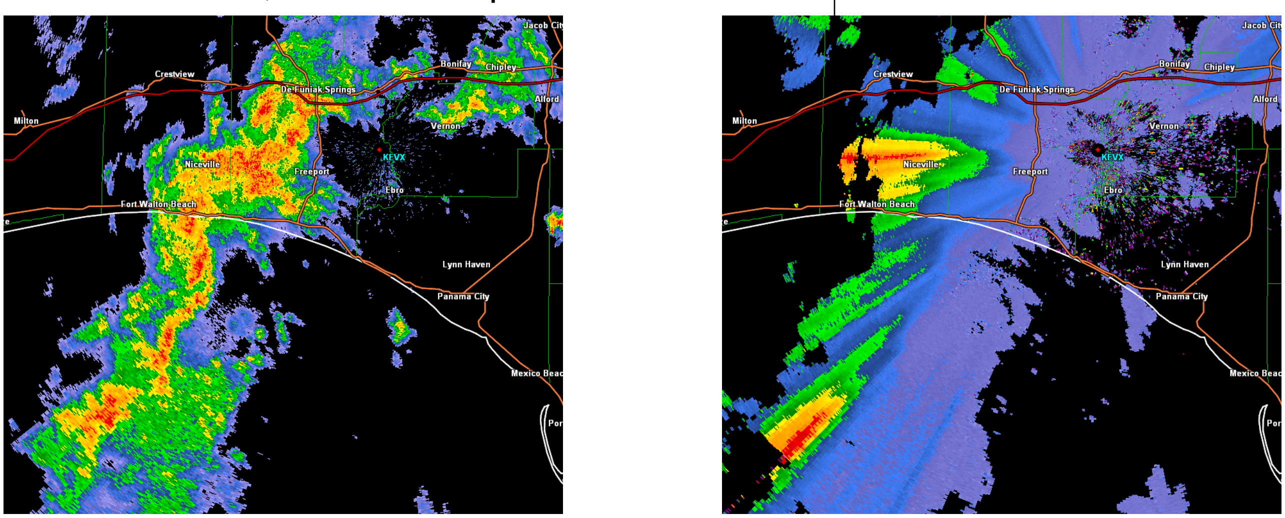


Figure 7. Viewing ϕ_{DP} for base data quality via GR Analyst.

Summary

Build 15.0 is an upgrade for both the RDA and the RPG. Though this is primarily an RDA hardware upgrade, there are some software changes that affect operations. These changes are designed to improve the Dual Pol data quality and the performance of the Dual Pol Quantitative Precipitation Estimation (QPE) algorithm.