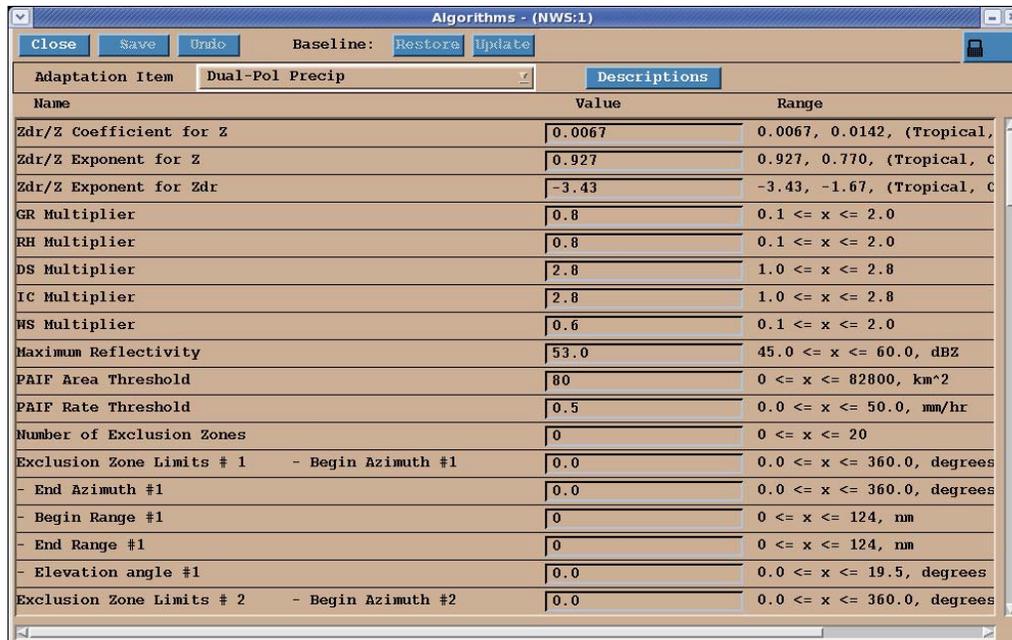


# RDA/RPG Build 15.0

## Preview



The screenshot shows a software window titled "Algorithms - (NWS:1)". The window has a menu bar with "Close", "Save", and "Undo". Below the menu bar is a "Baseline:" section with "Restore" and "Update" buttons. The main area is a table with a dropdown menu set to "Dual-Pol Precip" and a "Descriptions" button. The table has three columns: "Name", "Value", and "Range".

Name	Value	Range	
Zdr/Z Coefficient for Z	0.0067	0.0067, 0.0142, (Tropical, C	
Zdr/Z Exponent for Z	0.927	0.927, 0.770, (Tropical, C	
Zdr/Z Exponent for Zdr	-3.43	-3.43, -1.67, (Tropical, C	
GR Multiplier	0.8	0.1 <= x <= 2.0	
RH Multiplier	0.8	0.1 <= x <= 2.0	
DS Multiplier	2.8	1.0 <= x <= 2.8	
IC Multiplier	2.8	1.0 <= x <= 2.8	
WS Multiplier	0.6	0.1 <= x <= 2.0	
Maximum Reflectivity	53.0	45.0 <= x <= 60.0, dBZ	
PAIF Area Threshold	80	0 <= x <= 82800, km^2	
PAIF Rate Threshold	0.5	0.0 <= x <= 50.0, mm/hr	
Number of Exclusion Zones	0	0 <= x <= 20	
Exclusion Zone Limits # 1	- Begin Azimuth #1	0.0	0.0 <= x <= 360.0, degrees
- End Azimuth #1		0.0	0.0 <= x <= 360.0, degrees
- Begin Range #1		0	0 <= x <= 124, nm
- End Range #1		0	0 <= x <= 124, nm
- Elevation angle #1		0.0	0.0 <= x <= 19.5, degrees
Exclusion Zone Limits # 2	- Begin Azimuth #2	0.0	0.0 <= x <= 360.0, degrees

***Beta Test Version***

**Presented by the  
Warning Decision Training Branch**

## 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 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-Beta Test 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 that reduces areal coverage of Dry Snow (DS) overestimate above 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) relationship (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.

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 would be a case where the inputs to the QPE make sense.

QPE Short Review

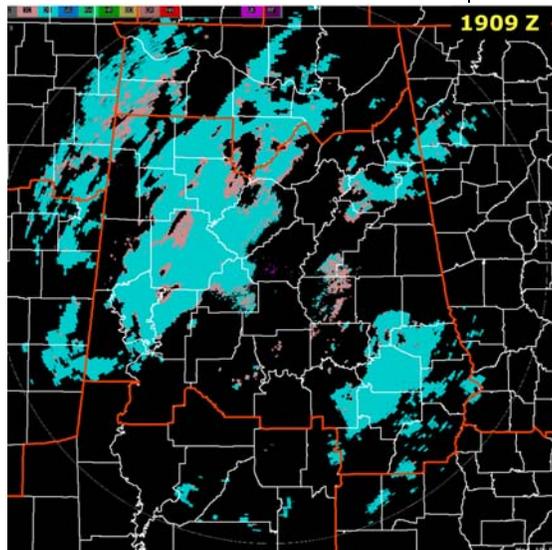


Figure 1. An example HHC product.

**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 can be used to check where the R(Z,ZDR) equation is applied.

Prior to Build 15.0, the 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**. It has performed better in more tropical environments, dominated by smaller drops. Its coefficient and exponents are identified at the RPG as the Tropical version of the R(Z,ZDR) equation.

With Build 15.0, there is an alternative R(Z,ZDR) relationship, known as the Continental version. It's coefficient and exponents are:

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

Transitioning from the Tropical R(Z,ZDR) to the Continental 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).

Name	Value	Range
Zdr/Z Coefficient for Z	0.0067	0.0067, 0.0142, (Tropical, C)
Zdr/Z Exponent for Z	0.927	0.927, 0.770, (Tropical, C)
Zdr/Z Exponent for Zdr	-3.43	-3.43, -1.67, (Tropical, C)
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IC Multiplier	2.8	1.0 <= x <= 2.8
WS Multiplier	0.6	0.1 <= x <= 2.0
Maximum Reflectivity	53.0	45.0 <= x <= 60.0, dBZ
PAIF Area Threshold	80	0 <= x <= 82800, km^2
PAIF Rate Threshold	0.5	0.0 <= x <= 50.0, mm/hr
Number of Exclusion Zones	0	0 <= x <= 20
Exclusion Zone Limits # 1 - Begin Azimuth #1	0.0	0.0 <= x <= 360.0, degrees
- End Azimuth #1	0.0	0.0 <= x <= 360.0, degrees
- Begin Range #1	0	0 <= x <= 124, nm
- End Range #1	0	0 <= x <= 124, nm
- Elevation angle #1	0.0	0.0 <= x <= 19.5, degrees
Exclusion Zone Limits # 2 - Begin Azimuth #2	0.0	0.0 <= x <= 360.0, degrees

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.

Since the Tropical version is the default, it will be necessary to change these parameters to transition to the Continental version. There are only two possible entries for the coefficient and each of the exponents. 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.

Tropical is Default

**Note:** Always choose from the same class (tropical or continental) for both 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!

**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),  $0.8 \cdot R(Z)$  is used
- For Hail possibly mixed with Rain (HA),  $0.8 \cdot R(Z)$  is used
- For Wet Snow (WS),  $0.6 \cdot R(Z)$  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.

Name	Value	Range
Zdr/Z Coefficient for Z	0.0067	0.0067, 0.0142, (Tropical, C
Zdr/Z Exponent for Z	0.927	0.927, 0.770, (Tropical, C
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Exclusion Zone Limits # 2 - Begin Azimuth #2	0.0	0.0 <= x <= 360.0, degrees

**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.

**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.

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. By adjusting the definition of the “top of the melting layer” within the QPE logic, the areal coverage is reduced in many cases.

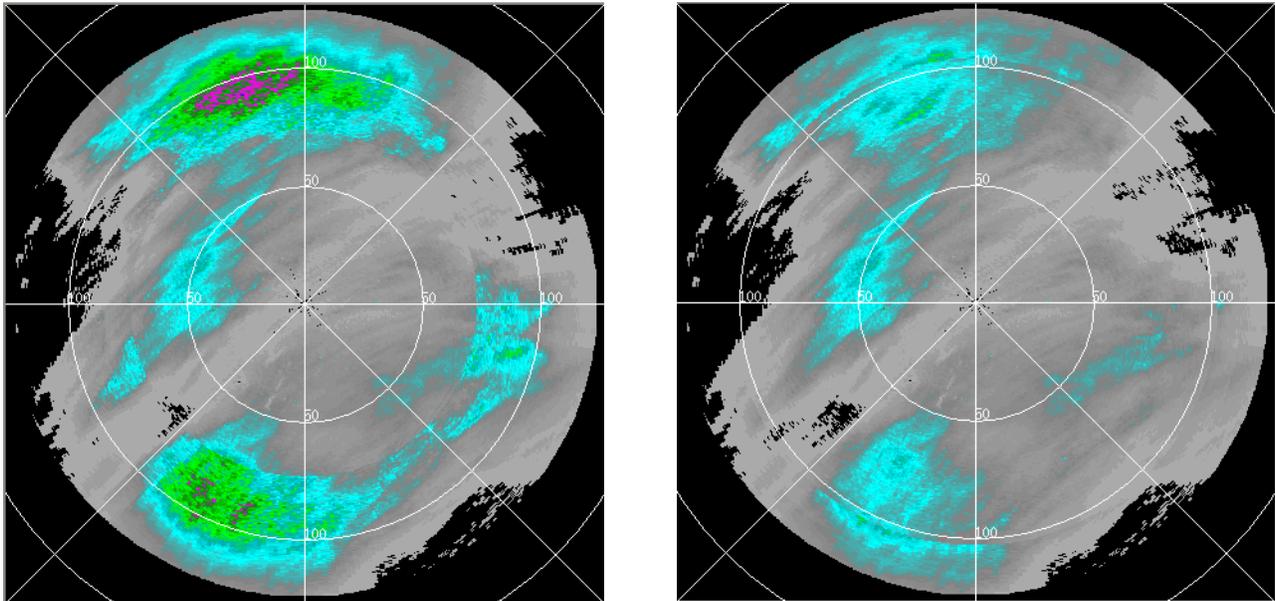
Prior to Build 15.0, the “top of the melting layer” that was used for implementing  $2.8 * R(Z)$  was actually where the beam **centerline** crossed the top of the melting layer. With Build 15.0, the QPE “top of the melting layer” is more appropriately defined as where the **bottom** of the beam crosses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

An example of the difference based on this change is displayed in Figure 4. The QPE Storm Total Accumulation products show the resulting accumulations with the pre-Build 15.0 logic on the left, and the Build 15.0 logic on the right.

The Initial System Differential Phase (ISDP) is controlled by two RDA parameters. The goal of the RDA ISDP is to have the Differential Phase,  $\phi_{DP}$ , near  $60^\circ$  when the beam first encounters precipitation. This allows  $\phi_{DP}$  to increase down radial based on the relative amount of liquid water content. A valid  $\phi_{DP}$  produces not only good quality

**Change in QPE Logic:  
Reduce Areal Coverage  
of DS Overestimate**

**RPG Estimated  
ISDP Process**



**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.

### ISDP Logic within Dual Pol Preprocessor at the RPG

dual pol base data products but also more accurate  $\phi_{DP}$  base data for the dual pol RPG algorithms, especially the Quantitative Precipitation Estimation (QPE) algorithm.

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  $\phi_{DP}$  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
- Those 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  $\phi_{DP}$  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. The idea is to have an automated way to determine if the ISDP Calibration process needs to be run. This does *not* replace the need to examine base data in a level 2 viewer periodically.

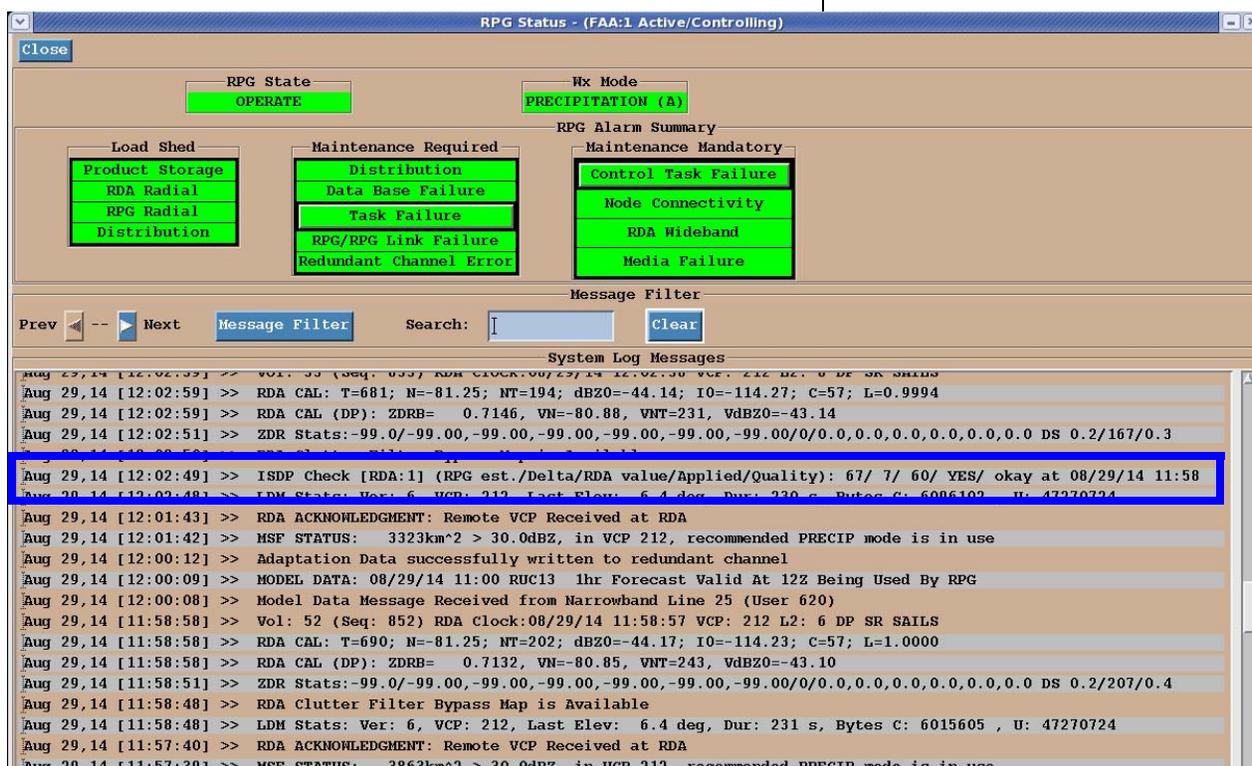


Figure 5. RPG Status window with ISDP Check at the top of the hour.

The ISDP Check line lists:

- The RPG estimated ISDP
- The difference between the RPG estimate and the RDA value

- The RDA value which will be listed 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 ( $\pm 25^\circ$ )

If the RPG estimate and the RDA value differ by more than  $25^\circ$  (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 Dual Pol Preprocessor algorithm at the RPG can be applied to the generation of the RPG 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 Yes.



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

Implications of “Yes”

It is important to understand that applying the RPG generated 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**.

This option will improve the RPG generated products that are used locally by NWS offices and dis-

tributed via central collection. However, it does not fix the quality of the base data (Level 2), which is also distributed to numerous users.

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

RDA ISDP Calibration Still Needed

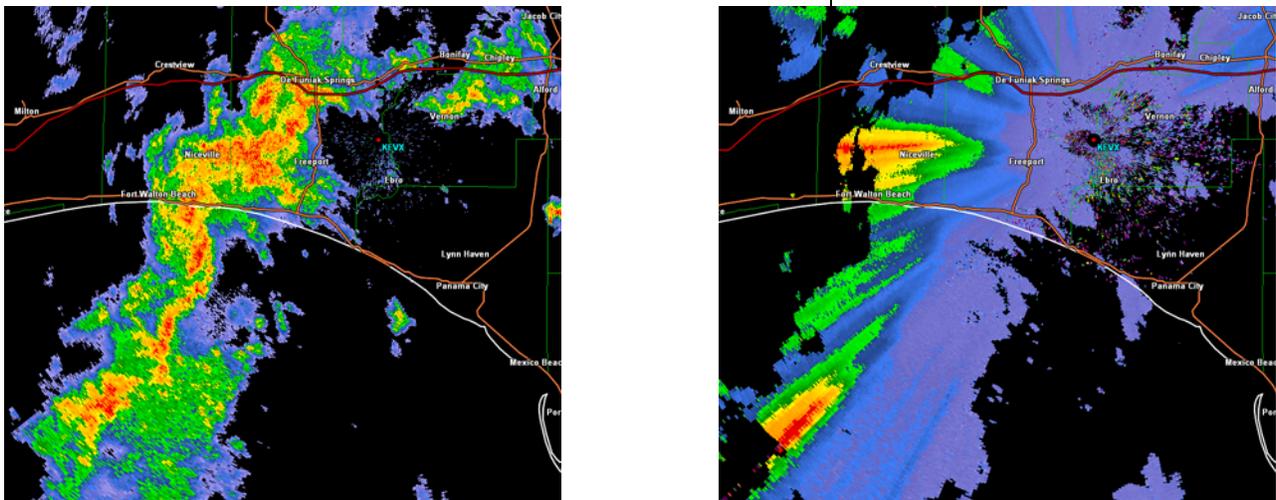


Figure 7. Viewing  $\phi_{DP}$  for base data quality via GR Analyst.

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.

## Summary

## Warning Decision Training Branch

