# WDTB's Dual-Polarization Radar FAQ Page

## Introduction

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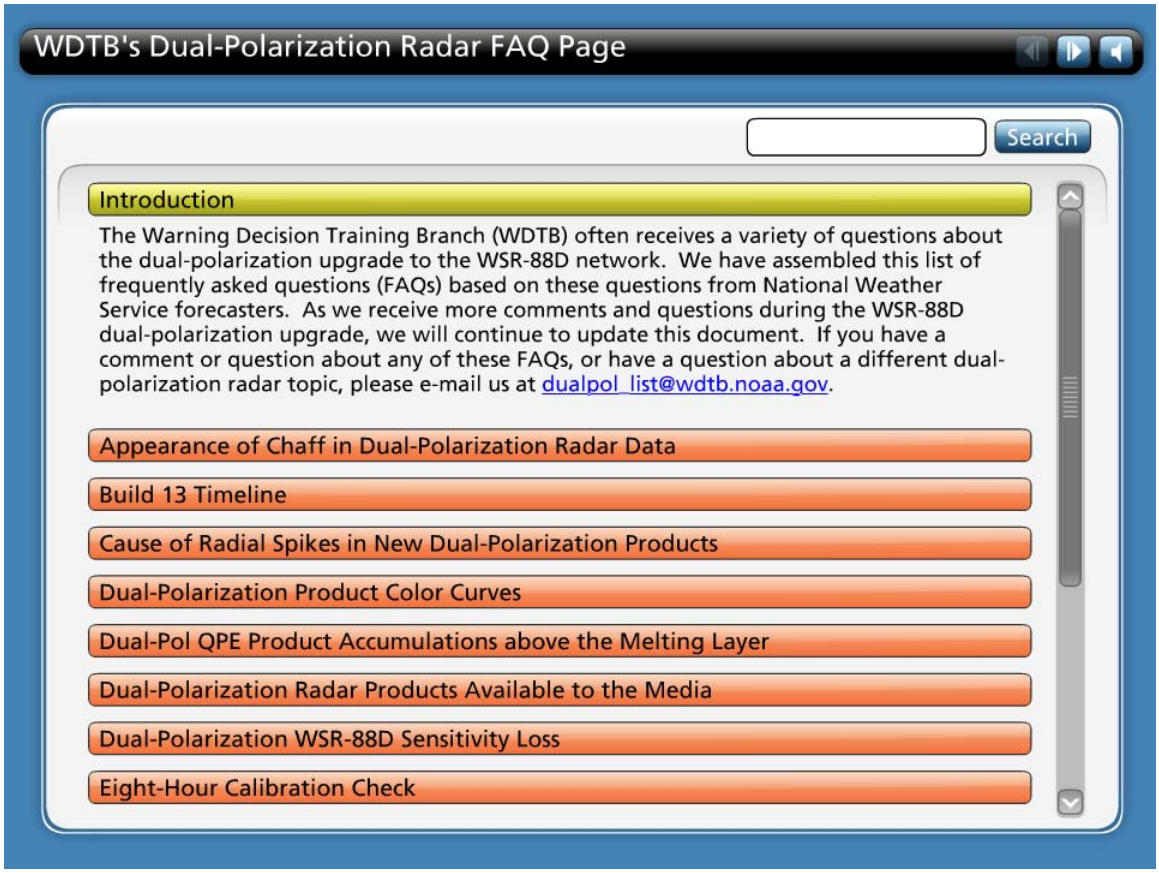


### *Question Text*

The Warning Decision Training Branch (WDTB) often receives a variety of questions about the dual-polarization upgrade to the WSR-88D network. We have assembled this list of frequently asked questions (FAQs) based on these questions from National Weather Service forecasters. As we receive more comments and questions during the WSR-88D dual-polarization upgrade, we will continue to update this document. If you have a comment or question about any of these FAQs, or have a question about a different dual-polarization radar topic, please e-mail us at gov.noaa.wdtb@list_dualpol.

# Appearance of Chaff in Dual-Polarization Radar Data

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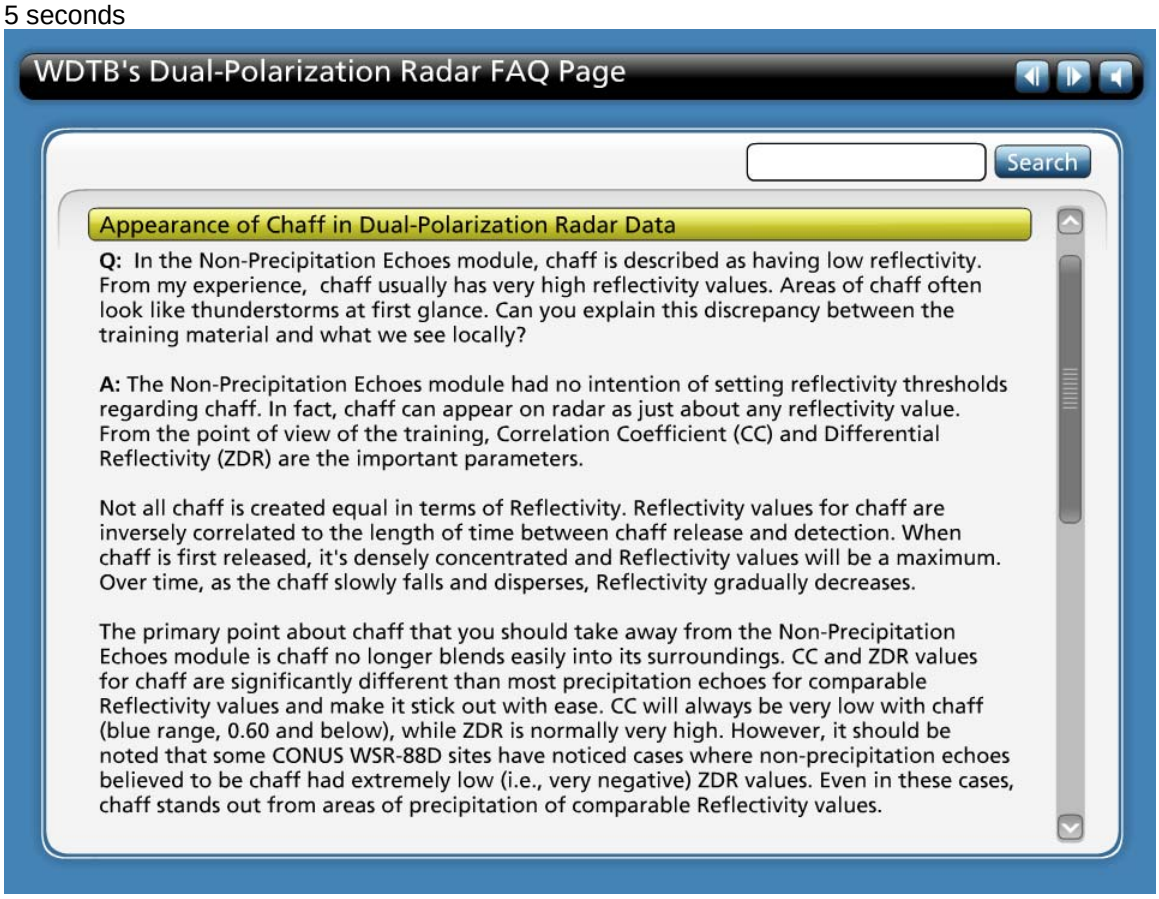


## *Question Text*

**Q:** In the Non-Precipitation Echoes module, chaff is described as having low reflectivity. From my experience, chaff usually has very high reflectivity values. Areas of chaff often look like thunderstorms at first glance. Can you explain this discrepancy between the training material and what we see locally?

**A:** The Non-Precipitation Echoes module had no intention of setting reflectivity thresholds regarding chaff. In fact, chaff can appear on radar as just about any reflectivity value. From the point of view of the training, Correlation Coefficient (CC) and Differential Reflectivity (ZDR) are the important parameters.

Not all chaff is created equal in terms of Reflectivity. Reflectivity values for chaff are inversely correlated to the length of time between chaff release and detection. When chaff is first released, it's densely concentrated and Reflectivity values will be a maximum. Over time, as the chaff slowly falls and disperses, Reflectivity gradually decreases.

The primary point about chaff that you should take away from the Non-Precipitation Echoes module is chaff no longer blends easily into its surroundings. CC and ZDR values for chaff are significantly different than most precipitation echoes for comparable Reflectivity values and make it stick out with ease. CC will always be very low with chaff (blue range, 0.60 and below), while ZDR is normally very high. However, it should be noted that some CONUS WSR-88D sites have noticed cases where non-precipitation echoes believed to be chaff had

extremely low (i.e., very negative) ZDR values. Even in these cases, chaff stands out from areas of precipitation of comparable Reflectivity values.

# Build 13 Timeline

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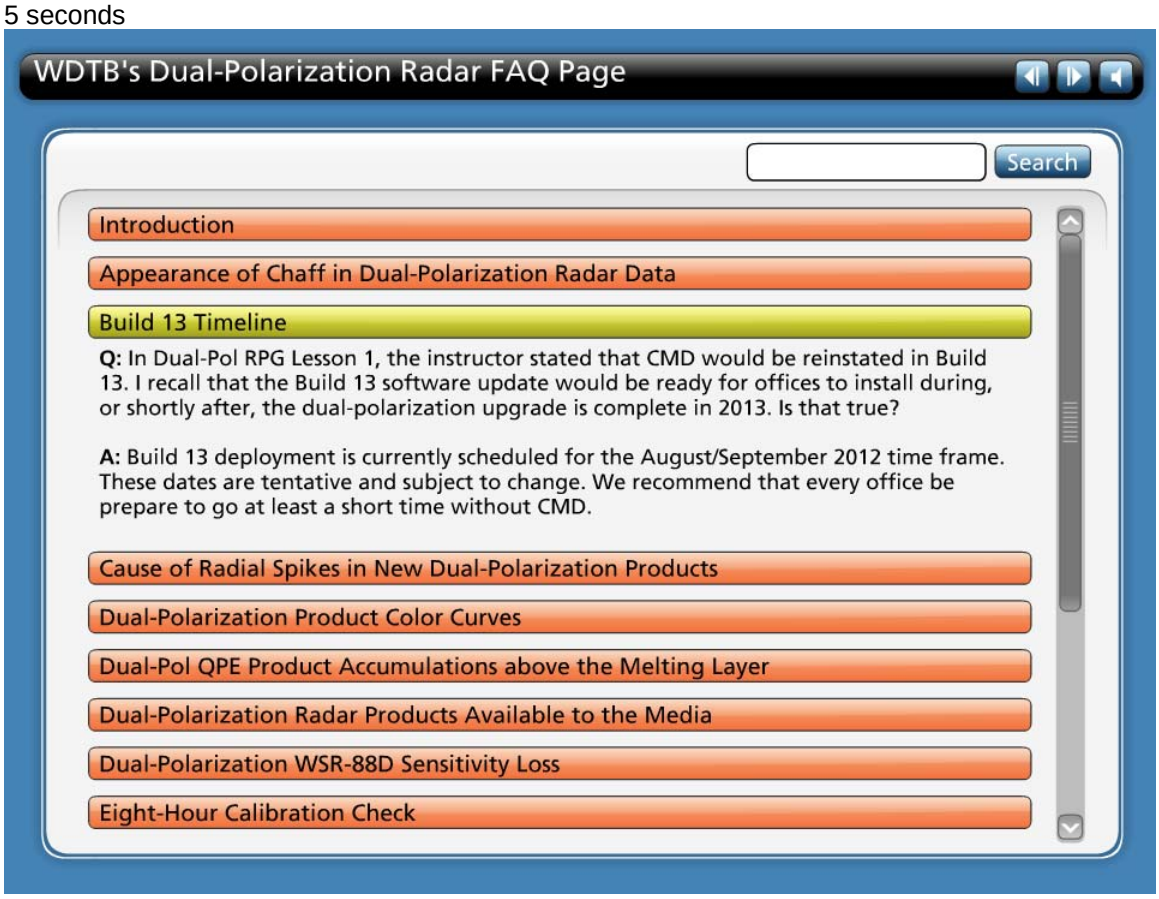


## *Question Text*

**Q:** In Dual-Pol RPG Lesson 1, the instructor stated that CMD would be reinstated in Build 13. I recall that the Build 13 software update would be ready for offices to install during, or shortly after, the dual-polarization upgrade is complete in 2013. Is that true?

**A:** Build 13 deployment is currently scheduled for the August/September 2012 time frame. These dates are tentative and subject to change. We recommend that every office be prepare to go at least a short time without CMD.

# Cause of Radial Spikes in New Dual-Polarization Products

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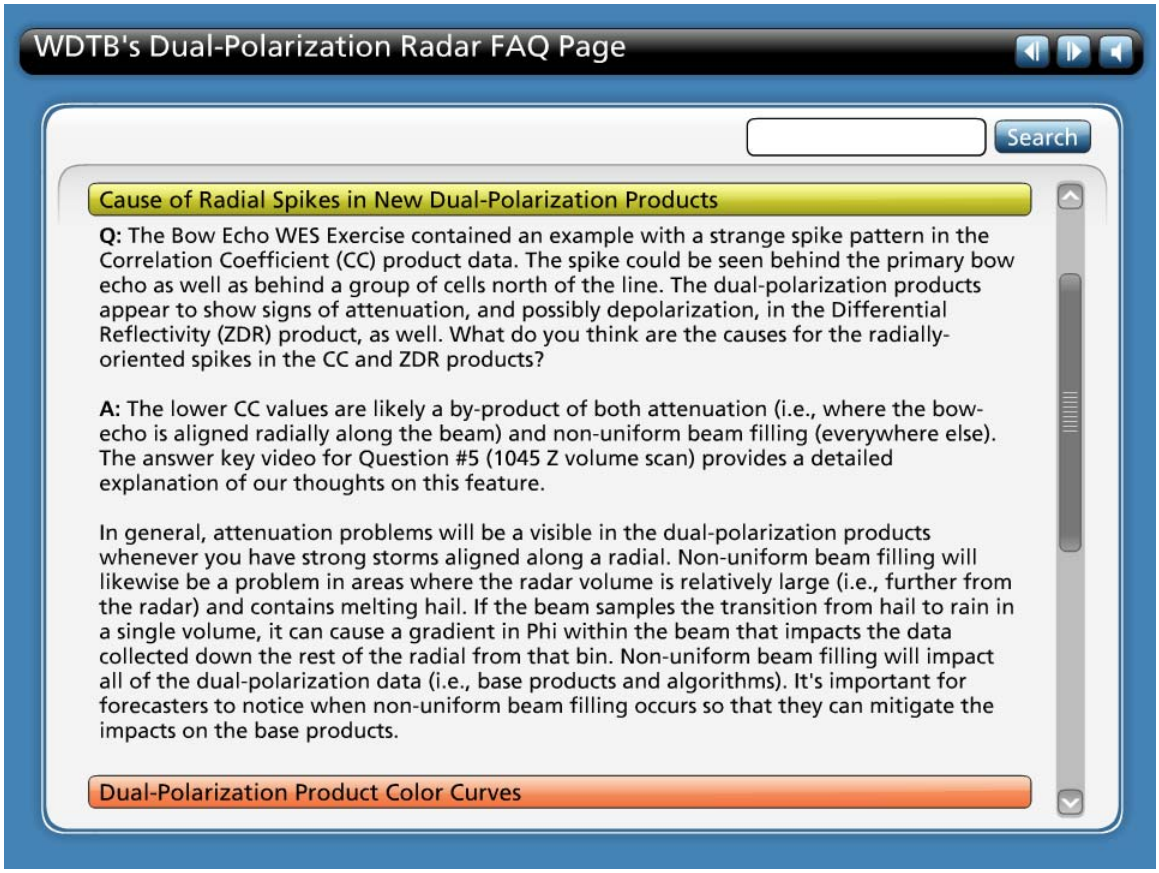


## *Question Text*

**Q:** The Bow Echo WES Exercise contained an example with a strange spike pattern in the Correlation Coefficient (CC) product data. The spike could be seen behind the primary bow echo as well as behind a group of cells north of the line. The dual-polarization products appear to show signs of attenuation, and possibly depolarization, in the Differential Reflectivity (ZDR) product, as well. What do you think are the causes for the radially-oriented spikes in the CC and ZDR products?

**A:** The lower CC values are likely a by-product of both attenuation (i.e., where the bow-echo is aligned radially along the beam) and non-uniform beam filling (everywhere else). The answer key video for Question #5 (1045 Z volume scan) provides a detailed explanation of our thoughts on this feature.

In general, attenuation problems will be a visible in the dual-polarization products whenever you have strong storms aligned along a radial. Non-uniform beam filling will likewise be a problem in areas where the radar volume is relatively large (i.e., further from the radar) and contains melting hail. If the beam samples the transition from hail to rain in a single volume, it can cause a gradient in Phi within the beam that impacts the data collected down the rest of the radial from that bin. Non-uniform beam filling will impact all of the dual-polarization data (i.e., base products and algorithms). It's important for

forecasters to notice when non-uniform beam filling occurs so that they can mitigate the impacts on the base products.

# Dual-Polarization Product Color Curves

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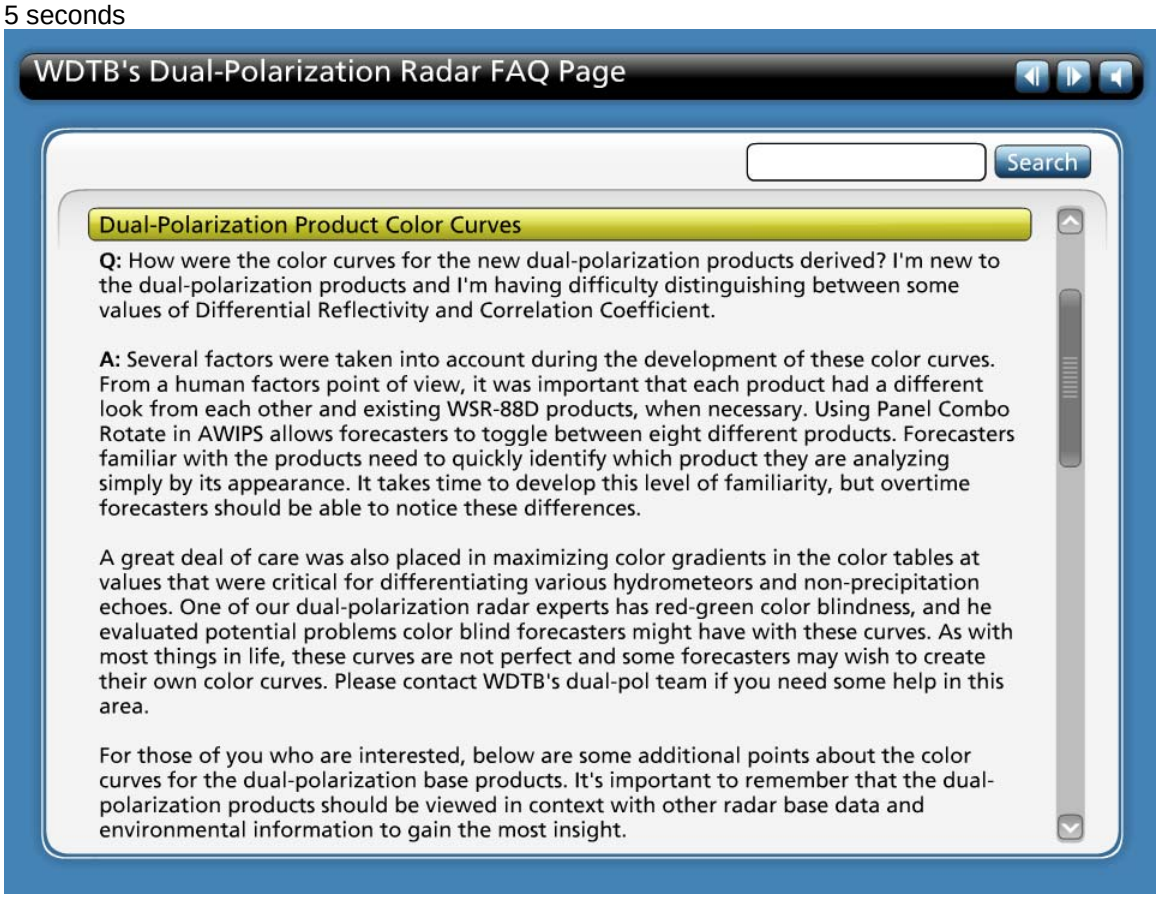


## *Question Text*

**Q:** How were the color curves for the new dual-polarization products derived? I'm new to the dual-polarization products and I'm having difficulty distinguishing between some values of Differential Reflectivity and Correlation Coefficient.

**A:** Several factors were taken into account during the development of these color curves. From a human factors point of view, it was important that each product had a different look from each other and existing WSR-88D products, when necessary. Using Panel Combo Rotate in AWIPS allows forecasters to toggle between eight different products. Forecasters familiar with the products need to quickly identify which product they are analyzing simply by its appearance. It takes time to develop this level of familiarity, but overtime forecasters should be able to notice these differences.

A great deal of care was also placed in maximizing color gradients in the color tables at values that were critical for differentiating various hydrometeors and non-precipitation echoes. One of our dual-polarization radar experts has red-green color blindness, and he evaluated potential problems color blind forecasters might have with these curves. As with most things in life, these curves are not perfect and some forecasters may wish to create their own color curves. Please contact WDTB's dual-pol team if you need some help in this area.

For those of you who are interested, below are some additional points about the color curves for the dual-polarization base products. It's important to remember that the dual-polarization products should be viewed in context with other radar base data and environmental information to gain the most insight.

**Potential Differential Phase (KDP):**
As values increase, data are represented by warmer colors. This color scheme is analogous to Reflectivity and should help forecaster identify heavier rain. Values near zero, which have little meaningful use, are represented by darker hues that help them sink into the background.

**Differential Reflectivity (ZDR):**
As values increase, generally indicating larger drops, data are represented by warmer colors. The strengths of this curve is that areas of large diameter drops show up well, hail can be more easily distinguished from heavy rain, and aggregated snow should stand out from ice crystals. In addition, well defined melting layers are easily identifiable in ZDR data as areas of higher values surrounded by lower values above and below.

The downside to the ZDR color curve is in areas with strongly negative and near zero ZDR values. Strongly negative ZDR values can be easily mistaken for areas of no data. Likewise, the current color curve will show a strong visual difference between slightly negative (gray) and slightly positive (blue) ZDR values.

**Correlation Coefficient (CC):**
The inverse logarithmic scale for CC made this color table challenging to develop. Areas of non-weather signal (in colors of gray, blue, & green) are clearly distinguishable from weather targets (in maroon, red, and orange), with light greens and yellows filling in the transition areas (i.e., melting layer, mixed-phase precipitation, and hail). Areas of uniform (i.e., all rain or all snow) precipitation also stand out well from areas of mixed precipitation (i.e., dark red/marroon vs. yellow/orange/ light red).

# Dual-Pol QPE Product Accumulations above the Melting Layer

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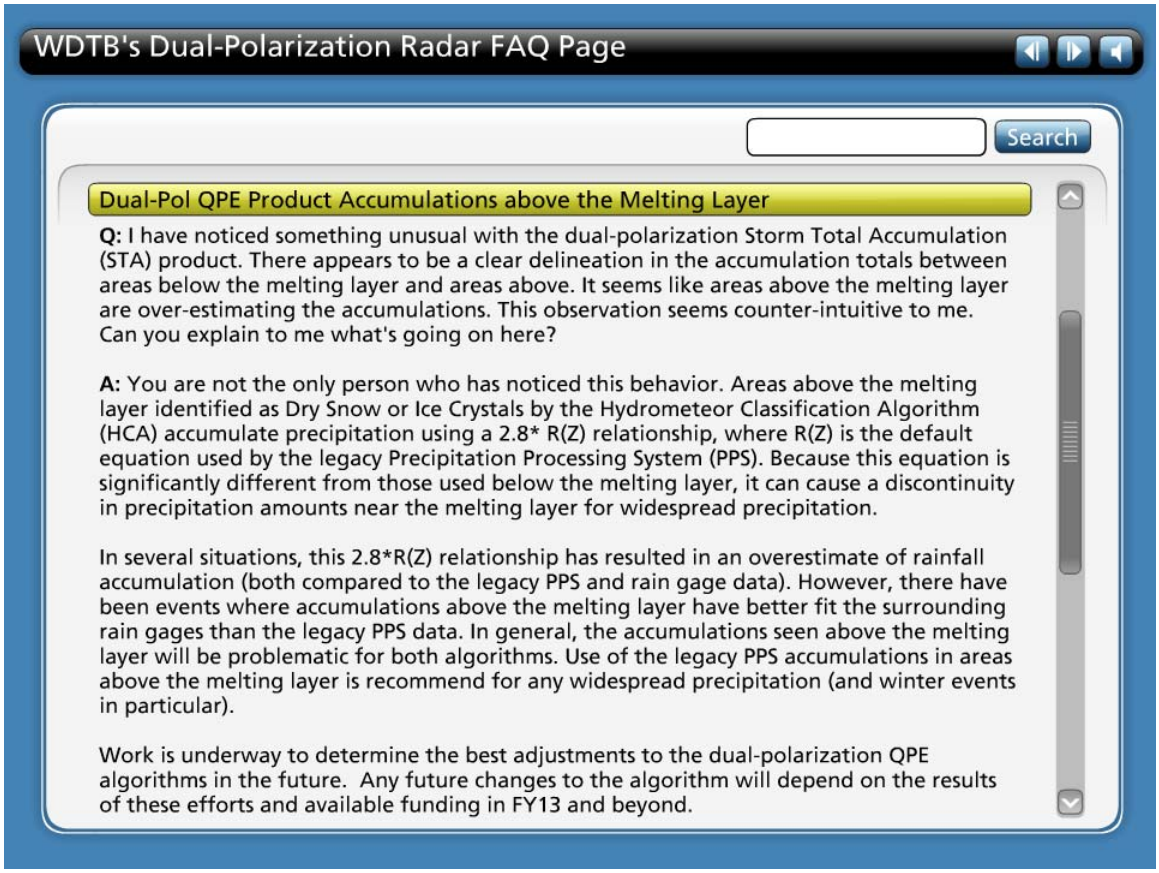


## *Question Text*

**Q:** I have noticed something unusual with the dual-polarization Storm Total Accumulation (STA) product. There appears to be a clear delineation in the accumulation totals between areas below the melting layer and areas above. It seems like areas above the melting layer are over-estimating the accumulations. This observation seems counter-intuitive to me. Can you explain to me what's going on here?

**A:** You are not the only person who has noticed this behavior. Areas above the melting layer identified as Dry Snow or Ice Crystals by the Hydrometeor Classification Algorithm (HCA) accumulate precipitation using a 2.8* R(Z) relationship, where R(Z) is the default equation used by the legacy Precipitation Processing System (PPS). Because this equation is significantly different from those used below the melting layer, it can cause a discontinuity in precipitation amounts near the melting layer for widespread precipitation.

In several situations, this 2.8*R(Z) relationship has resulted in an overestimate of rainfall accumulation (both compared to the legacy PPS and rain gage data). However, there have been events where accumulations above the melting layer have better fit the surrounding rain gages than the legacy PPS data. In general, the accumulations seen above the melting layer will be problematic for both algorithms. Use of the legacy PPS accumulations in areas

above the melting layer is recommend for any widespread precipitation (and winter events in particular).

Work is underway to determine the best adjustments to the dual-polarization QPE algorithms in the future. Any future changes to the algorithm will depend on the results of these efforts and available funding in FY13 and beyond.

# Dual-Polarization Radar Products Available to the Media

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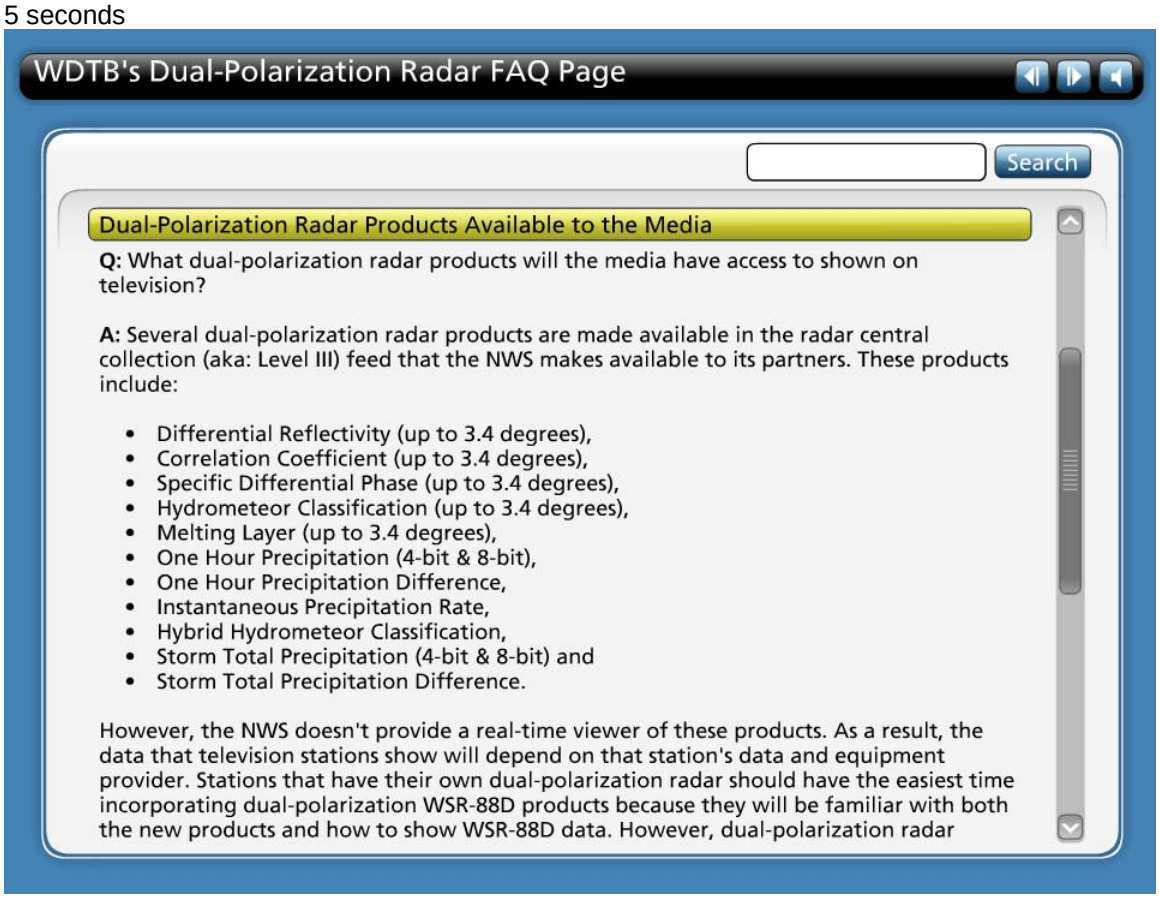


## *Question Text*

**Q:** What dual-polarization radar products will the media have access to shown on television?

**A:** Several dual-polarization radar products are made available in the radar central collection (aka: Level III) feed that the NWS makes available to its partners. These products include:

- Differential Reflectivity (up to 3.4 degrees),
- Correlation Coefficient (up to 3.4 degrees),
- Specific Differential Phase (up to 3.4 degrees),
- Hydrometeor Classification (up to 3.4 degrees),
- Melting Layer (up to 3.4 degrees),
- One Hour Precipitation (4-bit & 8-bit),
- One Hour Precipitation Difference,
- Instantaneous Precipitation Rate,
- Hybrid Hydrometeor Classification,
- Storm Total Precipitation (4-bit & 8-bit) and
- Storm Total Precipitation Difference.

However, the NWS doesn't provide a real-time viewer of these products. As a result, the data that television stations show will depend on that station's data and equipment provider. Stations that have their own dual-polarization radar should have the easiest time

incorporating dual-polarization WSR-88D products because they will be familiar with both the new products and how to show WSR-88D data. However, dual-polarization radar product interpretation of television radars (generally 3-to-5-cm in wavelength) and the WSR-88D will be significantly different. As a result, you may notice some significant misidentifications of certain hydrometeors by local TV meteorologists if they are toggling back and forth between data from their radar and the WSR-88D.

# Dual-Polarization WSR-88D Sensitivity Loss

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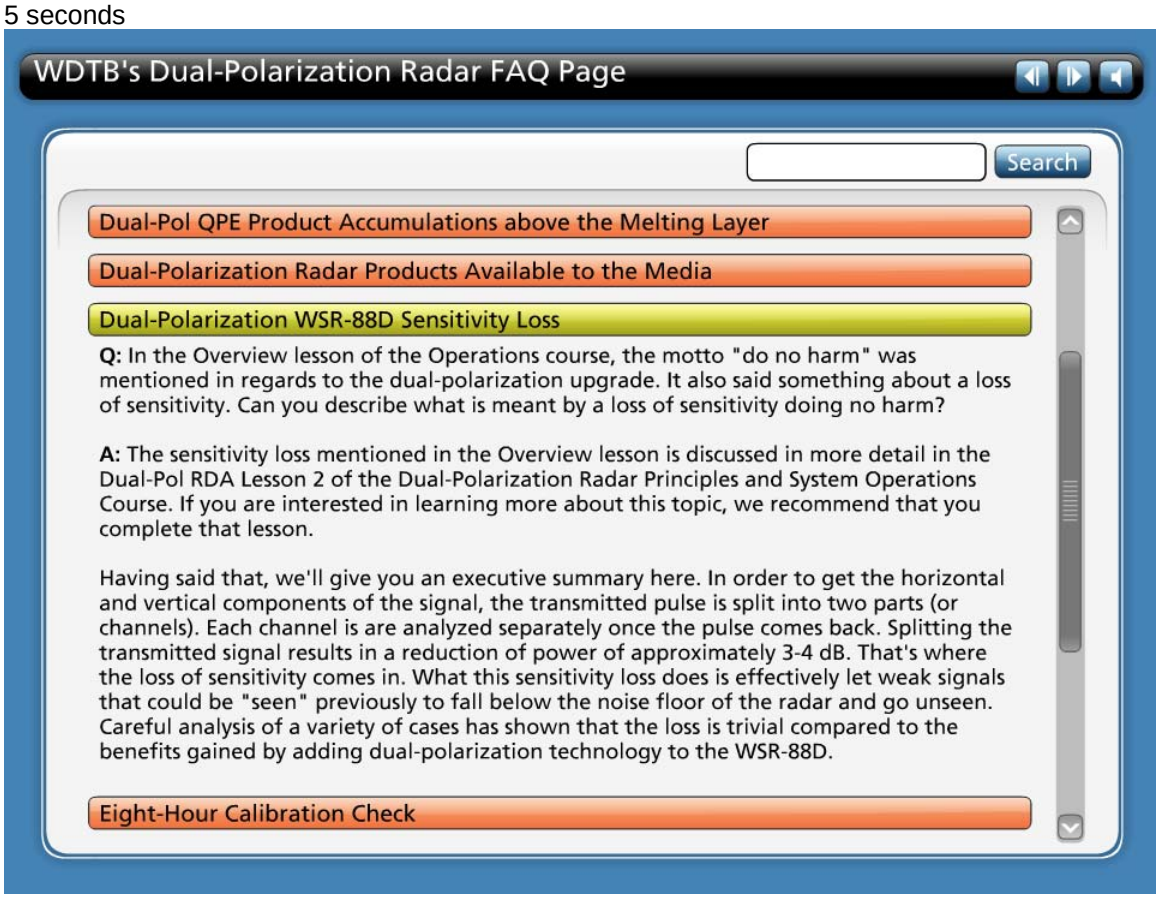


## *Question Text*

**Q:** In the Overview lesson of the Operations course, the motto "do no harm" was mentioned in regards to the dual-polarization upgrade. It also said something about a loss of sensitivity. Can you describe what is meant by a loss of sensitivity doing no harm?

**A:** The sensitivity loss mentioned in the Overview lesson is discussed in more detail in the Dual-Pol RDA Lesson 2 of the Dual-Polarization Radar Principles and System Operations Course. If you are interested in learning more about this topic, we recommend that you complete that lesson.

Having said that, we'll give you an executive summary here. In order to get the horizontal and vertical components of the signal, the transmitted pulse is split into two parts (or channels). Each channel is are analyzed separately once the pulse comes back. Splitting the transmitted signal results in a reduction of power of approximately 3-4 dB. That's where the loss of sensitivity comes in. What this sensitivity loss does is effectively let weak signals that could be "seen" previously to fall below the noise floor of the radar and go unseen. Careful analysis of a variety of cases has shown that the loss is trivial compared to the benefits gained by adding dual-polarization technology to the WSR-88D.

# Eight-Hour Calibration Check

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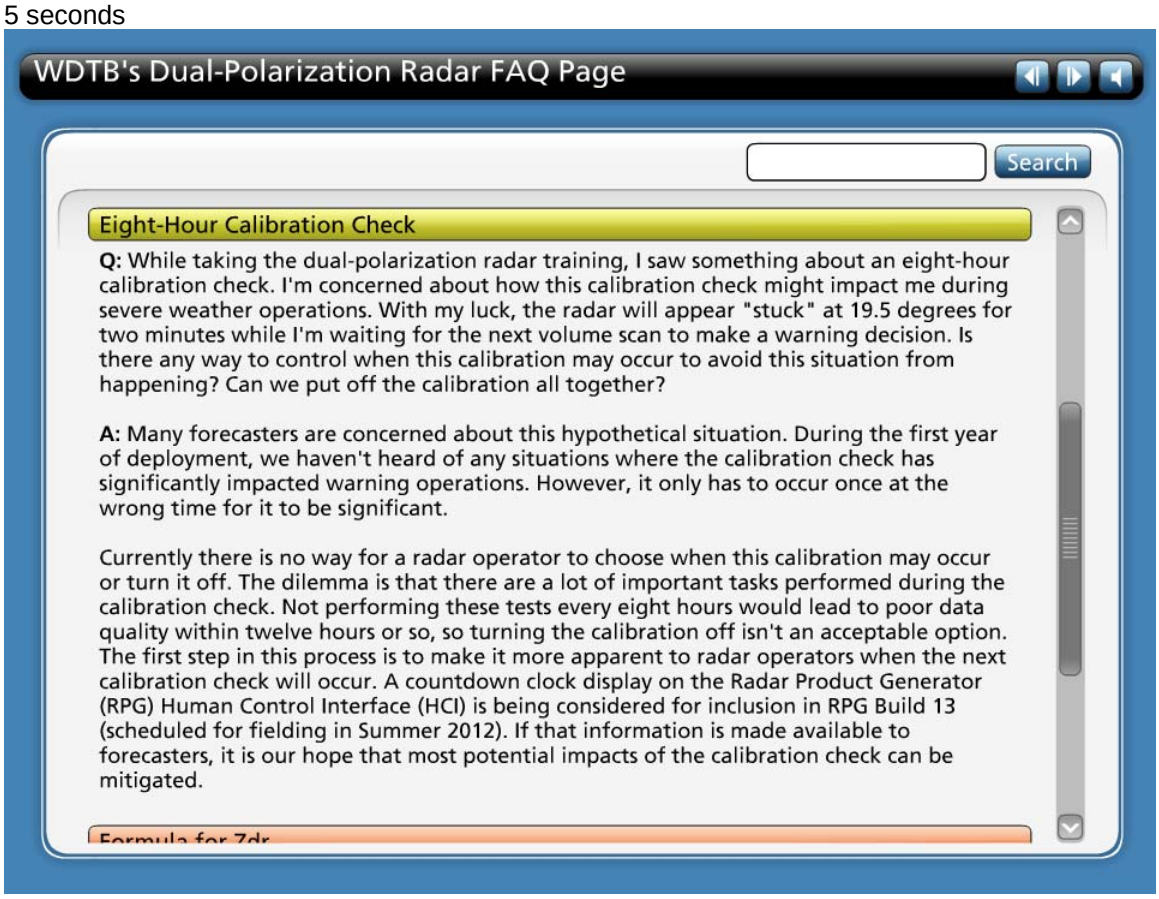


## *Question Text*

**Q:** While taking the dual-polarization radar training, I saw something about an eight-hour calibration check. I'm concerned about how this calibration check might impact me during severe weather operations. With my luck, the radar will appear "stuck" at 19.5 degrees for two minutes while I'm waiting for the next volume scan to make a warning decision. Is there any way to control when this calibration may occur to avoid this situation from happening? Can we put off the calibration all together?

**A:** Many forecasters are concerned about this hypothetical situation. During the first year of deployment, we haven't heard of any situations where the calibration check has significantly impacted warning operations. However, it only has to occur once at the wrong time for it to be significant.

Currently there is no way for a radar operator to choose when this calibration may occur or turn it off. The dilemma is that there are a lot of important tasks performed during the calibration check. Not performing these tests every eight hours would lead to poor data quality within twelve hours or so, so turning the calibration off isn't an acceptable option. The first step in this process is to make it more apparent to radar operators when the next calibration check will occur. A countdown clock display on the Radar Product Generator (RPG) Human Control Interface (HCI) is being considered for inclusion in RPG Build 13 (scheduled for fielding in Summer 2012). If that information is made available to forecasters, it is our hope that most potential impacts of the calibration check can be mitigated.

# Formula for Zdr

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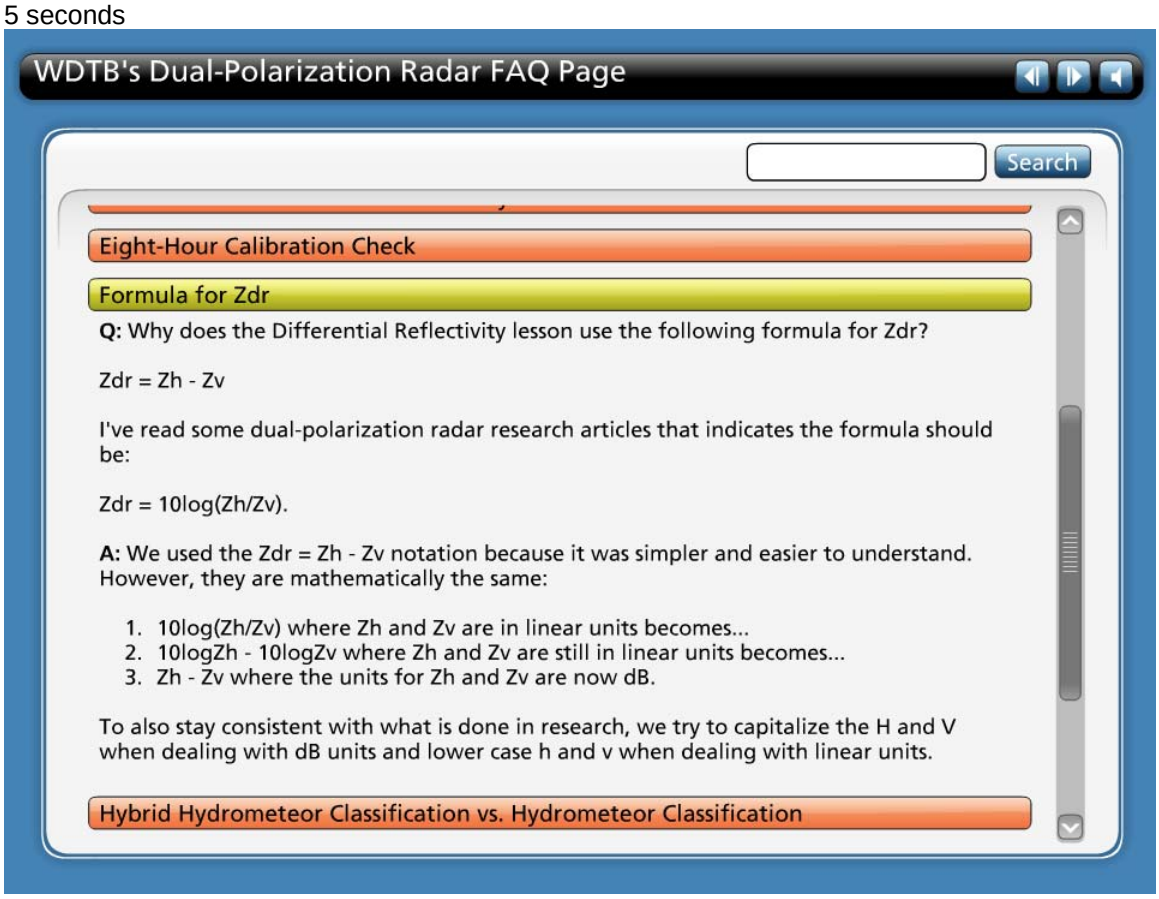


## *Question Text*

**Q:** Why does the Differential Reflectivity lesson use the following formula for Zdr?

Zdr = Zh - Zv

I've read some dual-polarization radar research articles that indicates the formula should be:

Zdr = 10log(Zh/Zv).

**A:** We used the Zdr = Zh - Zv notation because it was simpler and easier to understand. However, they are mathematically the same:

1. 10log(Zh/Zv) where Zh and Zv are in linear units becomes...
2. 10logZh - 10logZv where Zh and Zv are still in linear units becomes...
3. Zh - Zv where the units for Zh and Zv are now dB.

To also stay consistent with what is done in research, we try to capitalize the H and V when dealing with dB units and lower case h and v when dealing with linear units.

# Hybrid Hydrometeor Classification vs. Hydrometeor Classification

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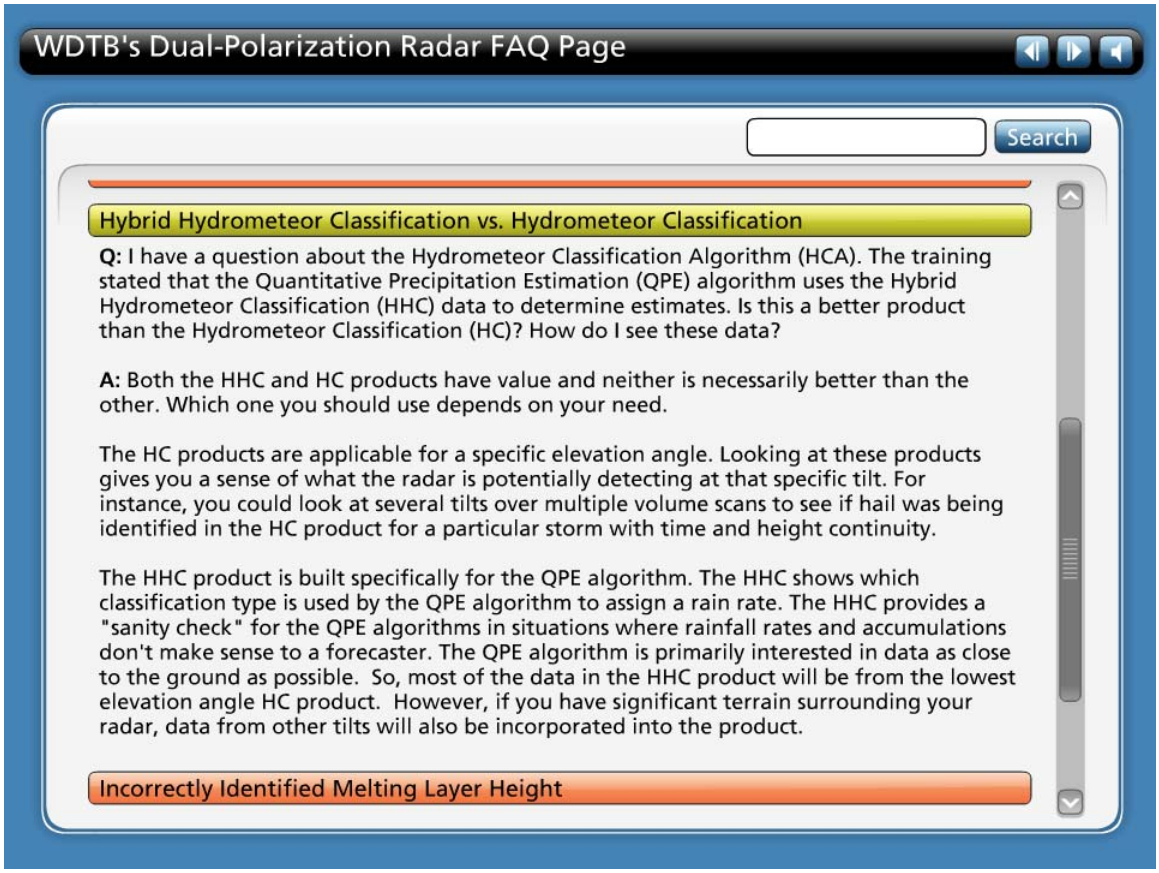


## *Question Text*

**Q:** I have a question about the Hydrometeor Classification Algorithm (HCA). The training stated that the Quantitative Precipitation Estimation (QPE) algorithm uses the Hybrid Hydrometeor Classification (HHC) data to determine estimates. Is this a better product than the Hydrometeor Classification (HC)? How do I see these data?

**A:** Both the HHC and HC products have value and neither is necessarily better than the other. Which one you should use depends on your need.

The HC products are applicable for a specific elevation angle. Looking at these products gives you a sense of what the radar is potentially detecting at that specific tilt. For instance, you could look at several tilts over multiple volume scans to see if hail was being identified in the HC product for a particular storm with time and height continuity.

The HHC product is built specifically for the QPE algorithm. The HHC shows which classification type is used by the QPE algorithm to assign a rain rate. The HHC provides a "sanity check" for the QPE algorithms in situations where rainfall rates and accumulations don't make sense to a forecaster. The QPE algorithm is primarily interested in data as close to the ground as possible. So, most of the data in the HHC product will be from the lowest

elevation angle HC product.  However, if you have significant terrain surrounding your radar, data from other tilts will also be incorporated into the product.

# Incorrectly Identified Melting Layer Height

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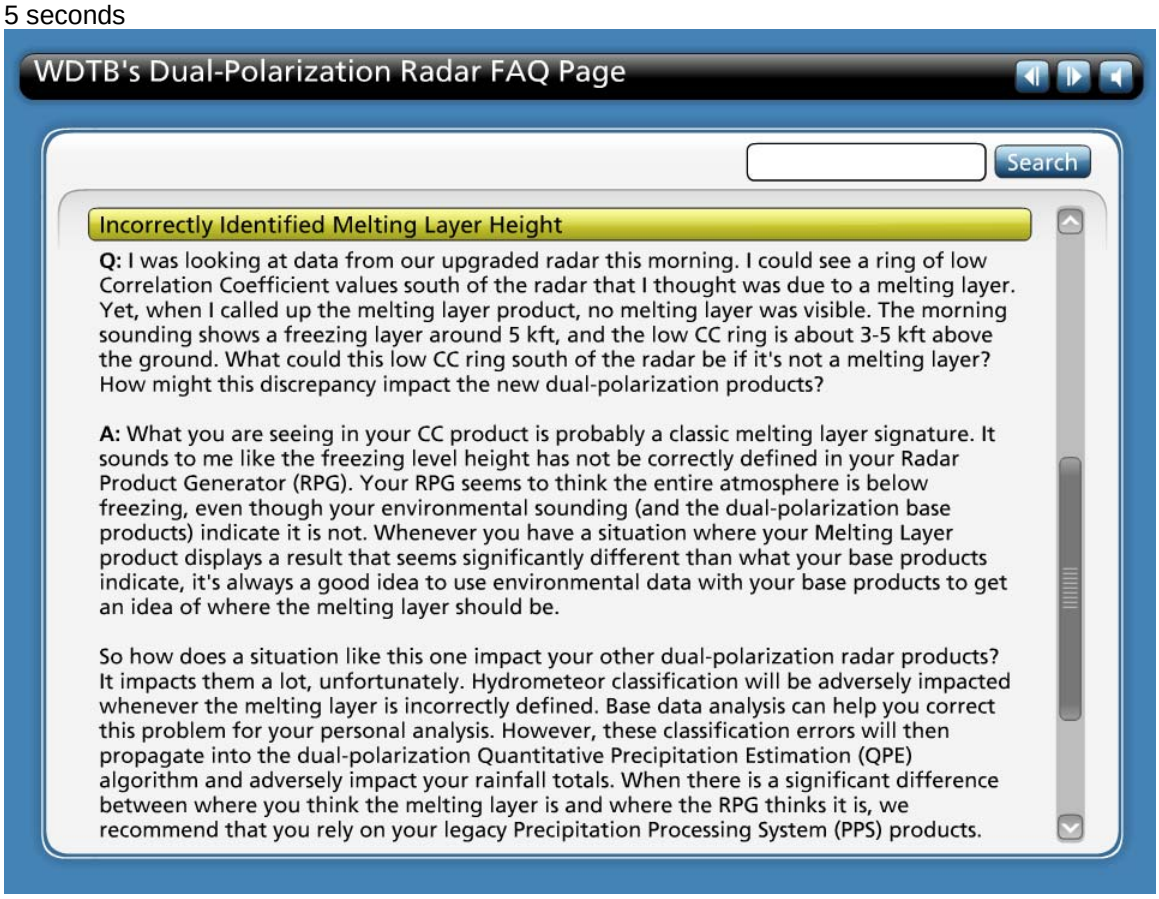


## *Question Text*

**Q:** I was looking at data from our upgraded radar this morning. I could see a ring of low Correlation Coefficient values south of the radar that I thought was due to a melting layer. Yet, when I called up the melting layer product, no melting layer was visible. The morning sounding shows a freezing layer around 5 kft, and the low CC ring is about 3-5 kft above the ground. What could this low CC ring south of the radar be if it's not a melting layer? How might this discrepancy impact the new dual-polarization products?

**A:** What you are seeing in your CC product is probably a classic melting layer signature. It sounds to me like the freezing level height has not be correctly defined in your Radar Product Generator (RPG). Your RPG seems to think the entire atmosphere is below freezing, even though your environmental sounding (and the dual-polarization base products) indicate it is not. Whenever you have a situation where your Melting Layer product displays a result that seems significantly different than what your base products indicate, it's always a good idea to use environmental data with your base products to get an idea of where the melting layer should be.

So how does a situation like this one impact your other dual-polarization radar products? It impacts them a lot, unfortunately. Hydrometeor classification will be adversely impacted whenever the melting layer is incorrectly defined. Base data analysis can help you correct this problem for your personal analysis. However, these classification errors will then propagate into the dual-polarization Quantitative Precipitation Estimation (QPE) algorithm

and adversely impact your rainfall totals. When there is a significant difference between where you think the melting layer is and where the RPG thinks it is, we recommend that you rely on your legacy Precipitation Processing System (PPS) products.

# Plans for Using QPE Algorithms with Snow Products

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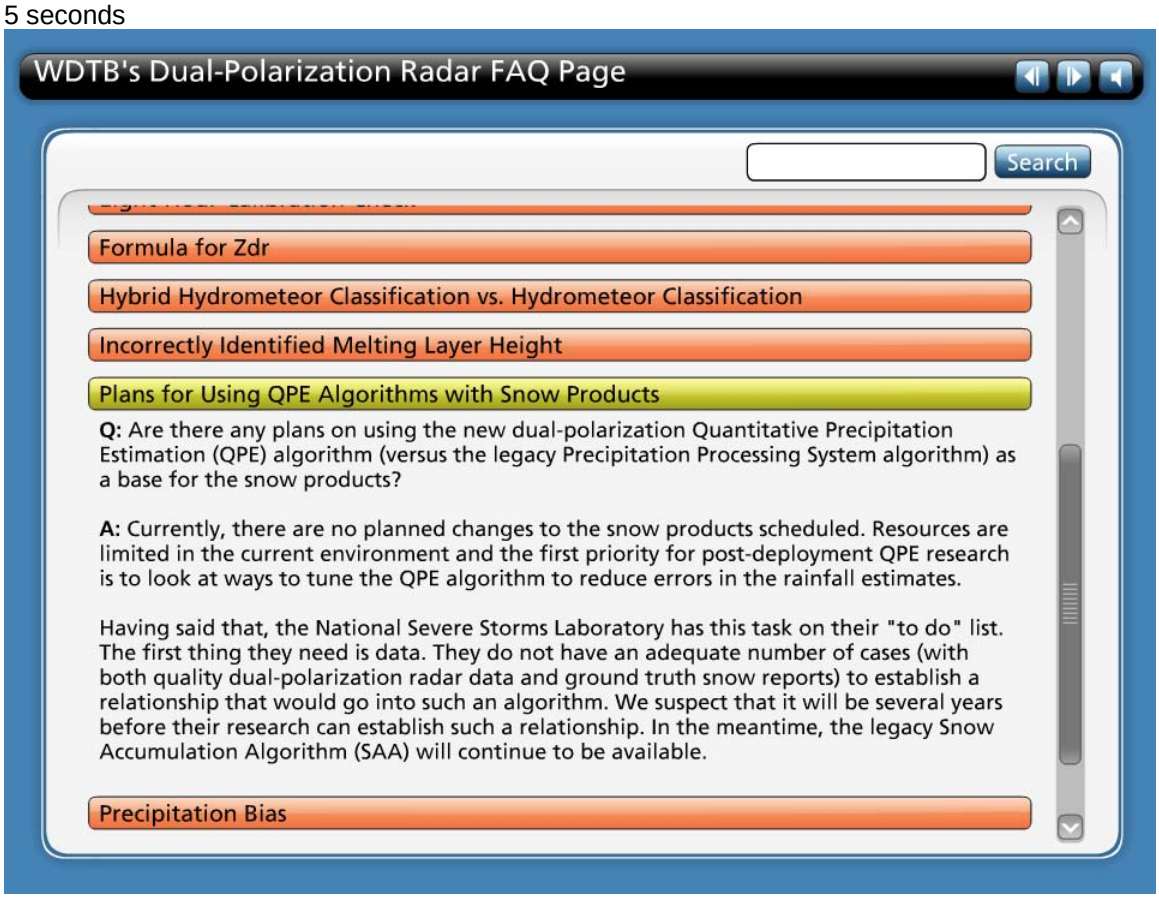


## *Question Text*

**Q:** Are there any plans on using the new dual-polarization Quantitative Precipitation Estimation (QPE) algorithm (versus the legacy Precipitation Processing System algorithm) as a base for the snow products?

**A:** Currently, there are no planned changes to the snow products scheduled. Resources are limited in the current environment and the first priority for post-deployment QPE research is to look at ways to tune the QPE algorithm to reduce errors in the rainfall estimates.

Having said that, the National Severe Storms Laboratory has this task on their "to do" list. The first thing they need is data. They do not have an adequate number of cases (with both quality dual-polarization radar data and ground truth snow reports) to establish a relationship that would go into such an algorithm. We suspect that it will be several years before their research can establish such a relationship. In the meantime, the legacy Snow Accumulation Algorithm (SAA) will continue to be available.

# Precipitation Bias

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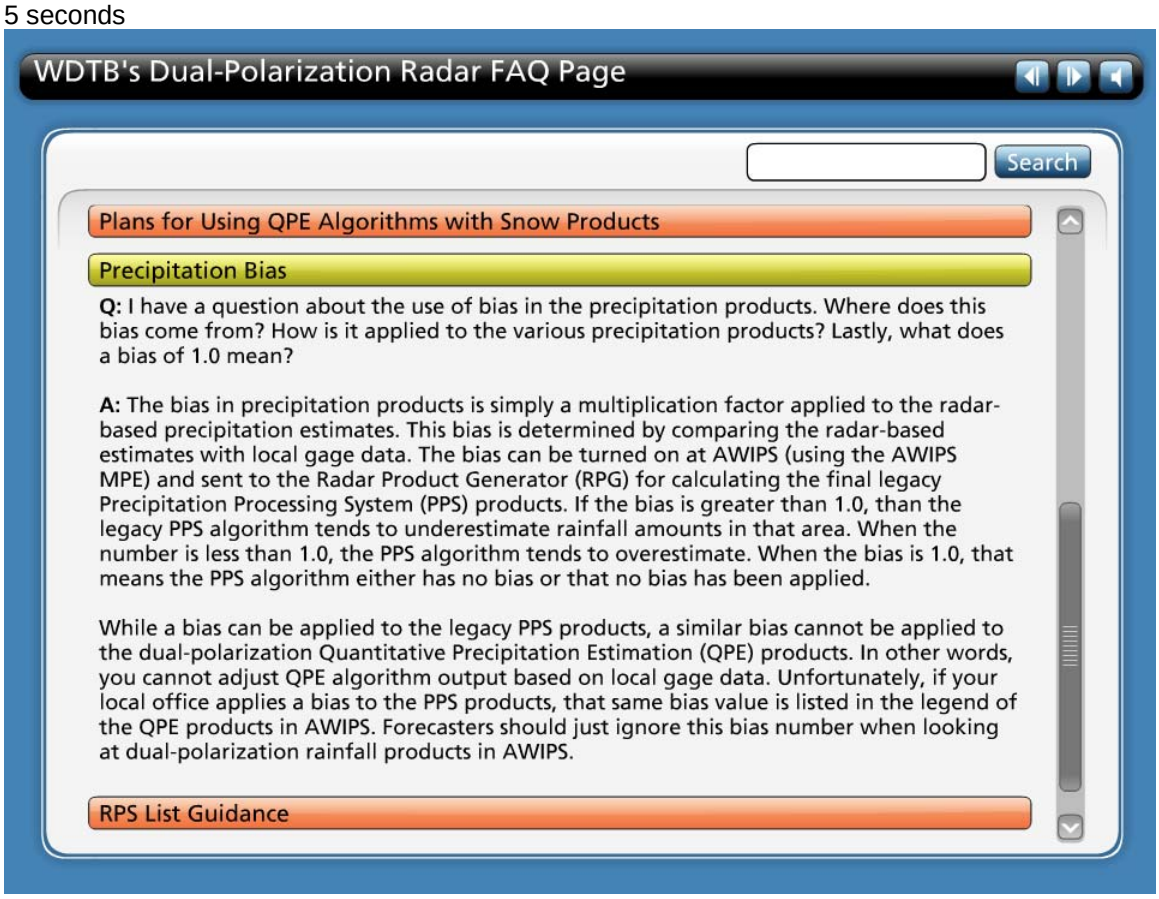


## *Question Text*

**Q:** I have a question about the use of bias in the precipitation products. Where does this bias come from? How is it applied to the various precipitation products? Lastly, what does a bias of 1.0 mean?

**A:** The bias in precipitation products is simply a multiplication factor applied to the radar-based precipitation estimates. This bias is determined by comparing the radar-based estimates with local gage data. The bias can be turned on at AWIPS (using the AWIPS MPE) and sent to the Radar Product Generator (RPG) for calculating the final legacy Precipitation Processing System (PPS) products. If the bias is greater than 1.0, than the legacy PPS algorithm tends to underestimate rainfall amounts in that area. When the number is less than 1.0, the PPS algorithm tends to overestimate. When the bias is 1.0, that means the PPS algorithm either has no bias or that no bias has been applied.

While a bias can be applied to the legacy PPS products, a similar bias cannot be applied to the dual-polarization Quantitative Precipitation Estimation (QPE) products. In other words, you cannot adjust QPE algorithm output based on local gage data. Unfortunately, if your local office applies a bias to the PPS products, that same bias value is listed in the legend of the QPE products in AWIPS. Forecasters should just ignore this bias number when looking at dual-polarization rainfall products in AWIPS.

# RPS List Guidance

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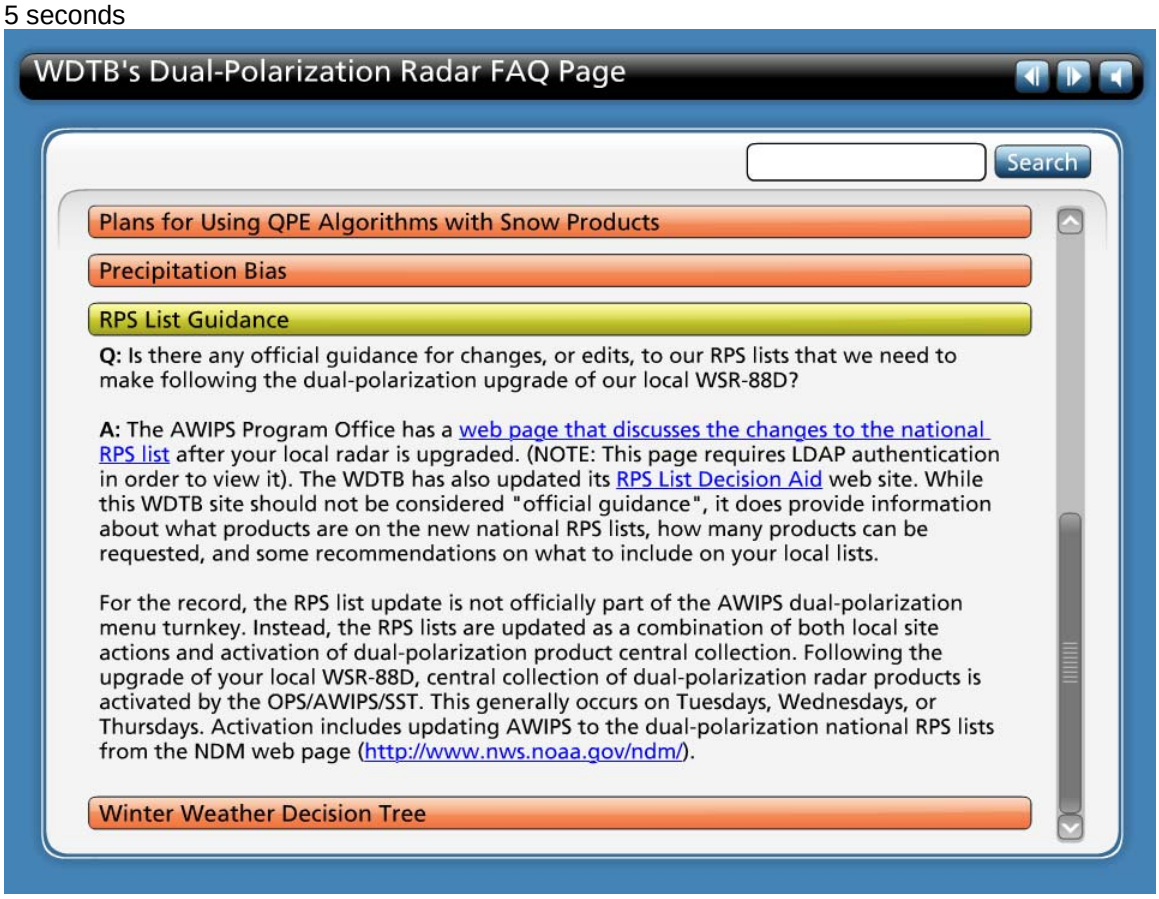


## *Question Text*

**Q:** Is there any official guidance for changes, or edits, to our RPS lists that we need to make following the dual-polarization upgrade of our local WSR-88D?

**A:** The AWIPS Program Office has a web page that discusses the changes to the national RPS list after your local radar is upgraded. (NOTE: This page requires LDAP authentication in order to view it). The WDTB has also updated its RPS List Decision Aid web site. While this WDTB site should not be considered "official guidance", it does provide information about what products are on the new national RPS lists, how many products can be requested, and some recommendations on what to include on your local lists.

For the record, the RPS list update is not officially part of the AWIPS dual-polarization menu turnkey. Instead, the RPS lists are updated as a combination of both local site actions and activation of dual-polarization product central collection. Following the upgrade of your local WSR-88D, central collection of dual-polarization radar products is activated by the OPS/AWIPS/SST. This generally occurs on Tuesdays, Wednesdays, or Thursdays. Activation includes updating AWIPS to the dual-polarization national RPS lists from the NDM web page (http://www.nws.noaa.gov/ndm/).

# Winter Weather Decision Tree

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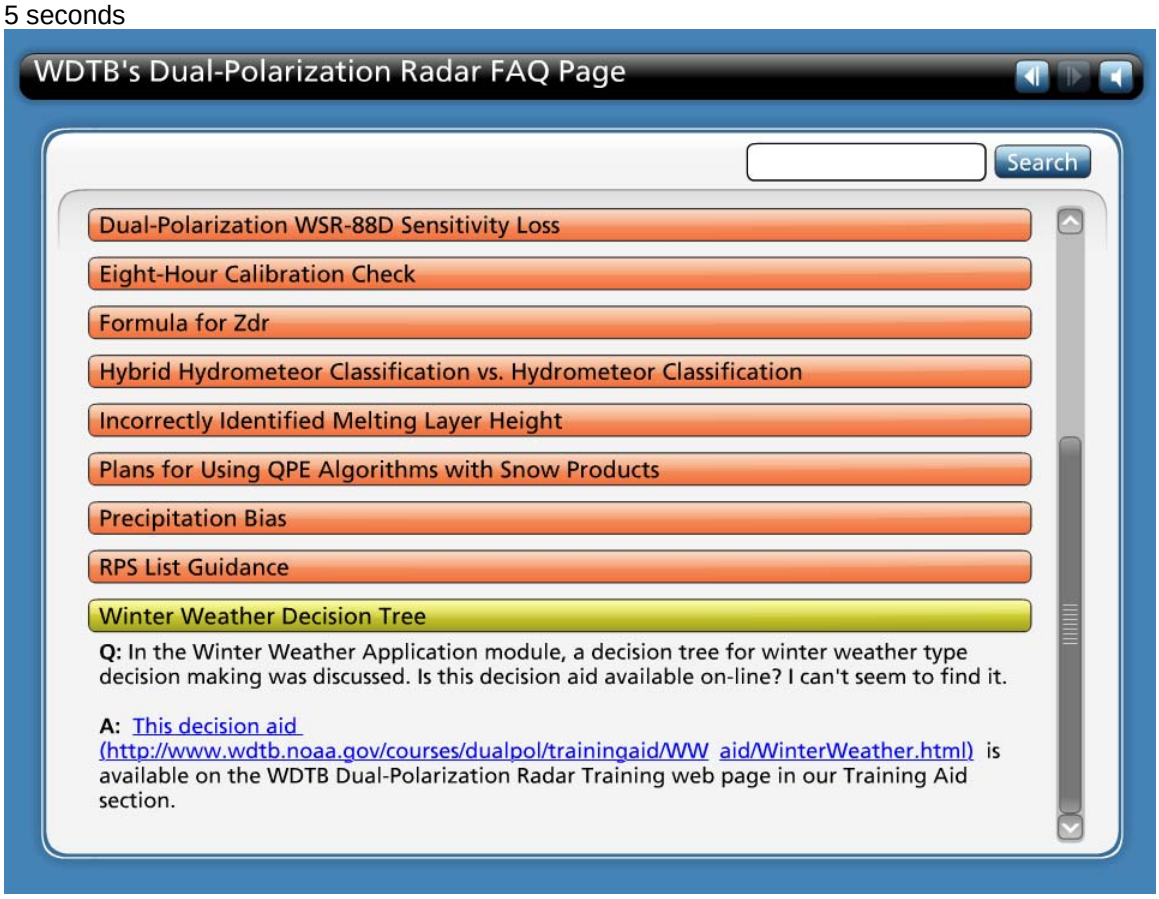


## *Question Text*

**Q:** In the Winter Weather Application module, a decision tree for winter weather type decision making was discussed. Is this decision aid available on-line? I can't seem to find it.

**A:** This decision aid (http://www.wdtb.noaa.gov/courses/dualpol/trainingaid/WW_aid/WinterWeather.html) is available on the WDTB Dual-Polarization Radar Training web page in our Training Aid section.