



## What's Your Question?

There is quite a bit of interest in the upcoming Dual Polarization (Dual Pol) enhancement to the WSR-88D. Regarding this upgrade, the Engineering Branch of the Radar Operations Center received the following question, "A rumor floating around suggests the Dual Polarization upgrade, while providing additional polarimetric information, will cause a loss in radar sensitivity. I have two questions regarding this rumor. First, how much sensitivity loss can be expected with the upgrade? And second, will this loss in sensitivity impact the calibration of the strength of the reflectivity values we are used to seeing (e.g., storm cores, etc.)?"

First, the quick answers, followed with a more detailed explanation. Yes, the Dual Pol hardware upgrade will result in about a 3.5 to 4.0 dB loss in sensitivity. No, the loss of sensitivity *will not* impact the radar's displayed reflectivity values (calibration) or magnitude of the reflectivity return. An easy way to think of it is reds stay red, but some gray may be gone.

**Background:** The WSR-88D radar was designed to detect precipitation. More explicitly, it was designed to detect falling liquid precipitation. As liquid precipitation falls it assumes the shape of an oblate spheroid. In other words, due to the surface area being distorted by wind resistance, falling liquid drops have a larger horizontal cross section than vertical cross section. To increase detection capabilities, single polarized weather radars, such as the current WSR-88D, employ horizontally polarized waves to exploit this difference in cross section extent. The three base moments (Z, V and SW) are calculated from the return from this horizontal wave form. With improved weather radar signal processing capabilities, the benefits of comparing returns from hori-

zontal and vertical waveforms to infer drop shape has become feasible. The Dual Pol upgrade will enable the WSR-88D to transmit and receive in both the horizontal and vertical planes. Dual Pol variables are then calculated using both horizontal and vertical returns.

**Sensitivity:** Sensitivity is the minimum signal that a radar can detect at a given range. The two most important variables impacting sensitivity are transmitted power and system noise. The Dual Pol upgrade changes the WSR-88D from the single horizontally polarized transmit path to dual simultaneously transmitted horizontal and vertical polarization transmit paths. To accomplish this, the transmitted power is split between the horizontal and vertical transmit channels. Remember that a reduction (or increase) in power by  $\frac{1}{2}$  equals 3dB. Simply splitting the transmit power to accommodate the vertical channel results in 3dB less power available for the horizontal transmit channel. The Dual Pd hardware will cause an additional loss of about 0.5 – 1.0dB. Therefore, the expected loss of sensitivity in the horizontal channel due to the Dual Pol upgrade is 3.5 – 4.0dB.

As in the past, the Base Moments are calculated using only the horizontal return.

The reduced sensitivity will result in fewer of the lowest quantization reflectivity (gray) bins being displayed. The significance of the sensitivity loss is dependent on the type of return sampled by the radar, because the weaker returns are the most affected. The weather event that has the weakest precipitation return, and therefore may experience the greatest potential impact, is freezing drizzle.

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## GIS Methods for Evaluating Wind Turbine Impacts on NEXRAD

The Radar Operations Center (ROC) has had an outreach program to constructively engage the wind energy development community since 2006. One component of the program is the evaluation of the potential impact of proposed wind farms and wind turbines on neighboring WSR-88D installations. With only minimal information available at the time the evaluations are performed, ROC engineering and operations personnel found that a technique using radar line of sight (RLOS) penetration, the extent of that penetration, and the areal relationship of the wind turbines/farms to the radars provided the foundation for an impact assessment.

Building upon prior software and GIS (geographical information system) developments, the ROC created several GIS-enabled databases to model the interactions of wind farms and wind turbines with the WSR-88D network.

A natural outcome of the evaluations was the creation of historical databases of wind farm and wind turbine GIS data that could be used by the ROC Hotline for field support. For a more complete description of the data and processing visit <http://www.roc.noaa.gov/WSR88D/WindFarm/GIS.aspx?wid=dev>.

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**Calibration:** Calibration is the ability of the radar system to scale the returned power to a magnitude consistent with the standard derived from a known trusted source. The calibration procedure measures the path losses and system gains caused by the various radar hardware components. These gains and losses are included in the weather radar equation used to calculate the reflectivity magnitude related to the returned power. Given the same weather within the sample volume, every calibrated radar should produce the same magnitude (value) for reflectivity. Although the Dual Pol upgrade will change the calibration procedures, the resultant calibration should produce consistent reflectivity values. Thus, red on the radar display is still red!

**Summary:** While it is true that the Dual Pol upgrade will result in a reduction in sensitivity of about 3.5 – 4.0dB, it will not impact the accuracy of the radar's reflectivity. In other words, red is still red, but some gray may be gone.

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