

Use of Hydrometeors, Bragg Scatter, and Sun Spikes to Determine System ZDR Biases in the WSR-88D Fleet

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Recently, the United States' National Weather Service completed an upgrade of its network of the Weather Surveillance Radar – 1988 Doppler (WSR-88D) to dual polarization. The method, simultaneous transmission and reception of horizontal and vertical (slant 45°) waves, provides estimates of differential reflectivity, differential phase, and correlation coefficient. All three fields provide valuable information about the nature of hydrometeors and are used to identify the types of precipitation such as rain, hail, and / or snow in a hydrometeor classification algorithm (HCA). Where the HCA identifies light, moderate, or heavy rain (including rain with large drops), differential reflectivity (ZDR), in combination with reflectivity (Z), is used by the WSR-88D's Quantitative Precipitation Estimate (QPE) Algorithm to estimate rain rate. While the WSR-88D requires a calibration of Z to within 1 dBZ, the required accuracy for ZDR is 0.1 dB for the QPE algorithm to obtain optimal precipitation estimates. To arrive at a true ZDR value, the WSR-88D calculates and applies an offset to the measured ZDR based on measured receiver, transmitter, and antenna path losses in the horizontal and vertical channels. Use of hardware measurements for estimating ZDR biases has proven challenging. As an alternate means of estimating system ZDR bias, the authors have concentrated on evaluating in situ ZDR measurements under conditions where the ZDR estimate should inherently be near zero. These conditions are light rain, dry snow, and Bragg scatter for full path ZDR bias estimates, and sun spikes for estimating receiver path biases only. These four conditions, being mutually exclusive, provide independent estimates for individual sites. This paper shows that biases from each technique, when averaged over several days, show similar results and can be used to determine system ZDR bias trends.