Correction of Polarimetric Observations from SSPA X-band Weather Radar

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Rapid monitoring of severe weather is important for the prevention of disasters in big cities due to the high population density and the concentration of infrastructure over metropolitan area. The X-band weather radar network has many advantages due to its compact size, low cost, small facilities and high performance on gap filling among operational S- and C-band weather radar networks. Korea Meteorological Administration has introduced three X-band dual-polarization radars for detecting severe weather phenomena over Seoul metropolitan area. New X-band radar is equipped with four solid state power amplifiers (SSPAs) with low peak power of 1 kW. SSPA X-band radar utilizes the pulse compression technique transmitting the modulated long pulse in order to enhance sensitivity while maintaining the spatial resolution. Hybrid pulse technique, which consecutively transmits two pulses with different pulse width, is used to fill the blind zone of long pulse. Unfortunately, discontinuities in radar sensitivity and polarimetric observations are inevitable if hybrid pulses technique has been utilized.
In this study, we proposed the technique for correction of discontinuity in polarimetric observations of SSPA X-band radar and then calibrated the system biases of reflectivity (ZH) and differential reflectivity (ZDR) obtained from long and short pulses. The sensitivity of hybrid pulse was examined by using the long-term ZH data. It has been found that the hybrid pulse improves the sensitivity at the long range. The discontinuity in differential phase shift (PH) was significant at transition zone between two pulses. The discontinuity in PH needed to be mitigated to correct rain attenuation. The FIR (iterative filtering technique) filter was applied to reduce the PH noise. And then, the PH in long pulse region was shifted to mitigate the discontinuity in PH. The attenuation by raindrops was corrected using the relationships between specific attenuation and specific differential phase shift (KDP)/differential specific attenuation. The calibration bias in ZH was calculated based on self-consistency between polarimetric observations. The calculated PH is estimated by integrating the KDP calculated from ZH-KDP relationship along the ray. The measured PH is defined as the PH change in rain region along the same ray. The measured PH and the calculated PH were compared to calculate calibration bias in ZH The theoretical ZH-ZDR relationship was used to calculate the calibration bias in ZDR. The calibration bias in ZDR was separately calculated for each pulse in the analysis.

Keywords: Solid-state power amplifier, Hybrid pulse transmission technique, Rain attenuation, Calibration bias, Self-consistency