6.6 ASSESSING ZDR VARIABILTY USING DEDICATED SOLAR BOX SCANS AND OPERATIONAL ZDR MONITORING RESULTS

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The calibration of differential reflectivity Z_{DR} with a target accuracy of 0.2 dB is a challenging task especially for operational weather radar networks. In recent years, end-to-end methods have been developed and implemented to monitor and adjust automatically Z_{DR} within the DWD (German Meteorological Service) polarimetric weather radar network. Monitoring and adjustment of ZDR is based on a combination of sources that characterize the differential imbalance of the transmit and receive path. At DWD, the primary source of the diurnal calibration of Z_{DR} is the birdbath scan. In addition, solar hits extracted from operational scanning are used to monitor the Z_{DR} of the receive path and the positioning accuracy of the radar system. On average this approach appears to capture most of the Z_{DR} variability. However, we have observed a dependency of Z_{DR} on temperature which has not been fully understood. A comprehensive investigation using NCAR's S-Pol research radar suggests that the observed temperature dependence may be related to thermal expansion of the antenna assembly. There, solar box scans proved to be one effective source to systematically separate out the sources of ZDR variability (Hubbert, 2017). DWD polarimetric radar systems (EEC DWSR5001SDP/CE)) up to now do not have the same capabilities as the research system at NCAR. However, using DWD's Hohenpeienberg research radar (which is identical to the radars in the network), we systematically employ solar box scans in order to better understand the observed variability within the DWD radar network. To this end over 800 solar box scans have been carried in 2017/18. Typically, consecutive solar box scans were carried throughout the day every 5 minutes. The resulting pseudo ZDR antenna patterns match very well with antenna pattern taken during the site acceptance in 2011. The peak power solar beams are about 30 dB above noise. Contrary to S-Pol, our system has an air-conditioned (AC) radome. Thus the AC was used to control the temperature environment for the antenna receiver assembly. We find up 0.2 dB variation in Z_{DR} over a temperature range of 20 K. With those measurements we show that the azimuthal Z_{DR} variability introduced by the radome appears negligible (the radome manufacturer claimed ¡ 0.005 dB, which is a number based on simulations). Also, using the solar box scans, we demonstrate a Z_{DR} 0.1 dB bias introduced by lightning protection. The solar box scans are compared to the operational Z_{DR} monitoring measurements from the operational solar hit analysis and the birdbath scan. These measurements are also effective for assessing the attitude of the pedestal / antenna assembly. Furthermore, those measurements can be used to assess the azimuth bias as a function solar azimuth angle, which directly relates to the condition of the azimuth drive.