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Engineering Evaluation and Calibration of Iowa X-Band Polarimetric Radars

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The detailed knowledge and extensive monitoring of the precipitation structure at smaller temporal and spatial scales are critical to the scientific understanding of the hydrological cycle and associated processes. The hydrometeorological information at smaller scales is usually not available with the current weather radar systems which operate at lower frequencies such as S- and C-bands. This has necessitated the use of higher frequency (X-band) weather radars to obtain rainfall data at improved accuracy and near-ground coverage at shorter ranges.

The University of Iowa has acquired four scanning, mobile, X-band polarimetric (XPOL) Doppler weather radars with the objective of accurate quantitative estimation of the rainfall at a high temporal and spatial resolution. These four XPOL radars will be deployed for short-range multiple-view observations of the same weather event thus reducing uncertainties introduced by the signal attenuation and instrument-wide errors. This network of radars is intended to serve multiple areas of hydrological research including uncertainty modelling, urban hydrology, flood and flash-flood prediction, and soil erosion.

Compared to the existing networks of X-band weather radars, several features place the XPOL radar systems in a distinctly attractive position for the scientific community. Firstly, the Iowa XPOL radars are mounted on mobile platforms, and consequently, are deployed at any location of interest. Secondly, these systems are capable of acquiring data at a programmable range sampling which can be as low as 30m. Thirdly, the use of dual-polarization provides additional information about the hydrometeors at smaller scales. The radars can operate in staggered PRT and dual-PRF pulsing modes and can process data using either standard pulse-pair or spectral mode techniques.

The Iowa XPOL radar systems are currently being evaluated and calibrated to participate in their first field campaigns in the upcoming NASA IFloodS (Iowa Flood Studies) field experiment during Spring-Summer 2013. This paper will present results obtained through extensive system-level tests conducted on the transmitter-receiver unit and carried out largely in conformity with the NASA Global Precipitation Measurement – Ground Validation (GPM-GV) standards. This includes scrutinizing the temporal stability of the some of the performance parameters. The radar systems will also be calibrated against existing standard weather radar systems during the campaign. The experimental observations of the individual XPOL radar units with respect to the reference ground and weather targets will also be analysed. The paper will also present an inter-XPOL comparison of the findings of these experiments.