#141 An Update on the Operational Multi-Radar Multi-Sensor QPE

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Introduction

- The Multi-Radar Multi-Sensor (MRMS) system has provided users with high resolution (1-km, 2-min) quantitative precipitation estimation (QPE) products across CONUS and oCONUS domains since 2014. The products have been used in many applications including the National Weather Service (NWS) flash flood warnings and hydrological predictions.
- Current operational MRMS radar QPE is generated through a number of processes (Fig.1) including quality control, blockage mitigation, vertical profile of reflectivity (VPR) correction, precipitation classification, dynamic R(Z) relationships within and above the melting layer and R(A), R(Kdp) and R(Z) synthetic QPE below.
- Several recent enhancements in the MRMS QPE are introduced here:
  - Wind farm and hardware issue mitigation
  - Dual-pol VPR (dpVPR) correction
  - R(A) QPE enhancements
  - Supplemental radars integration

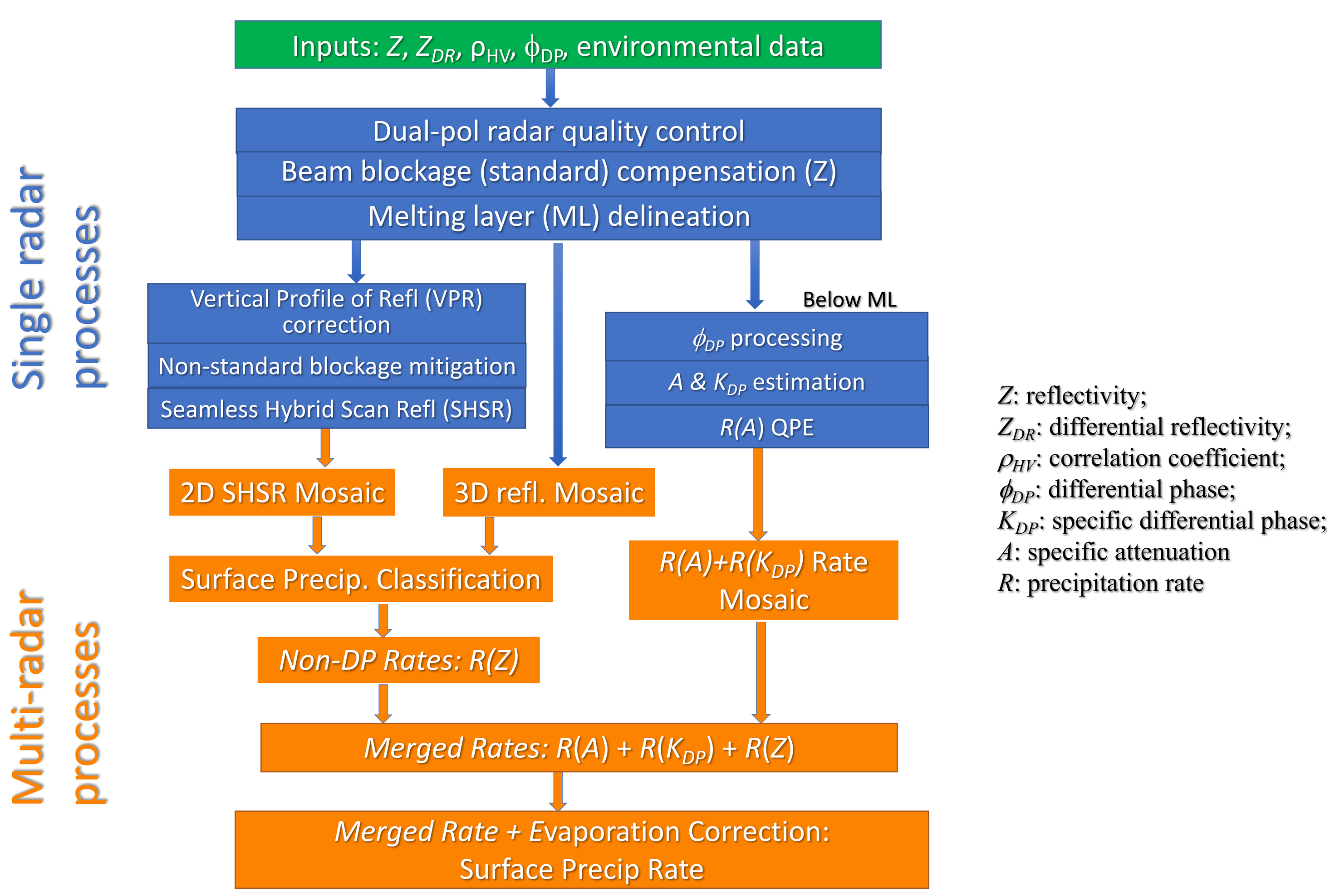
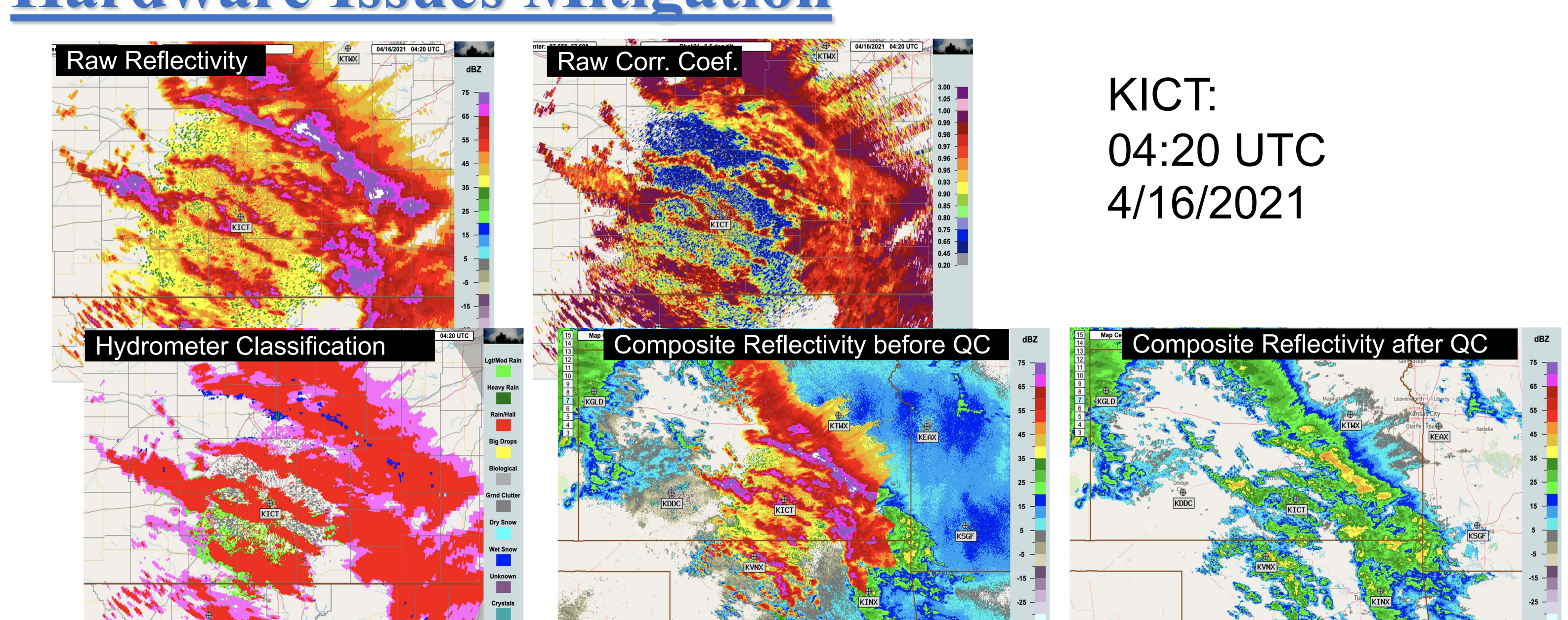


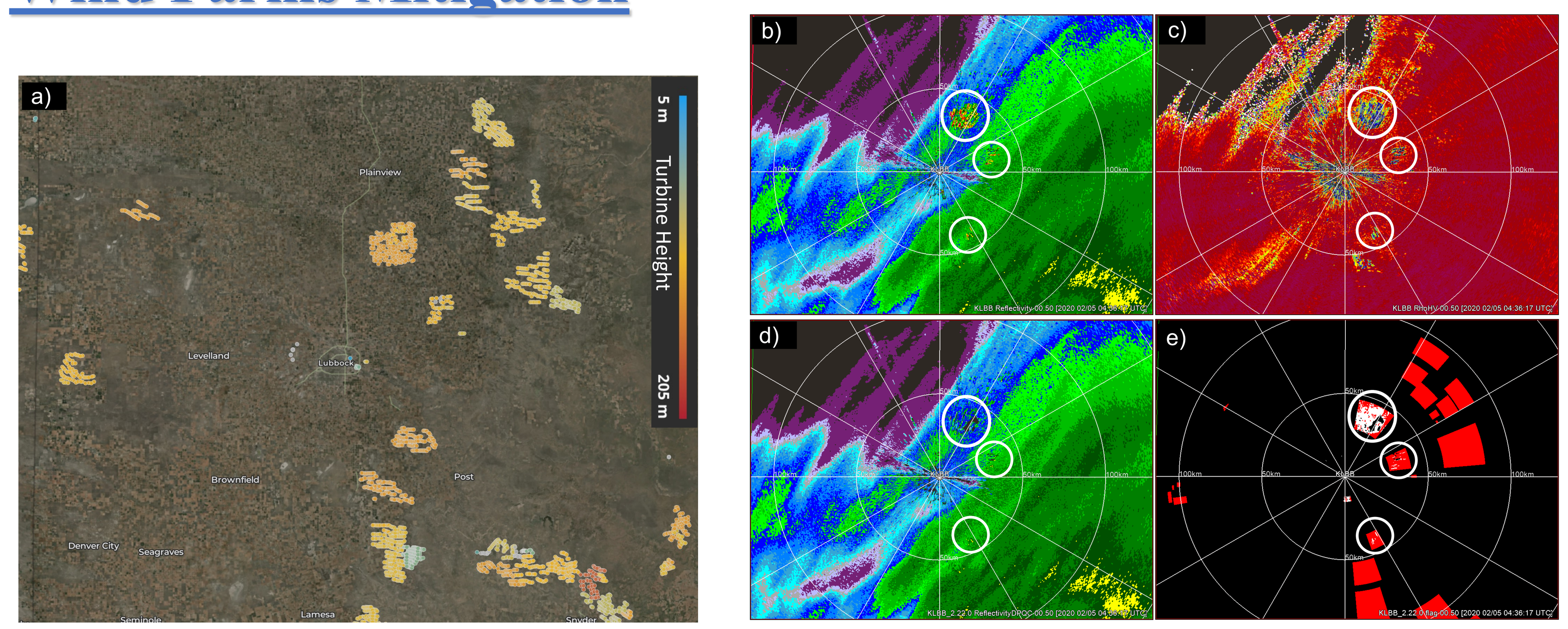
Fig. 1 The MRMS Radar QPE Flowchart

Hardware Issues Mitigation



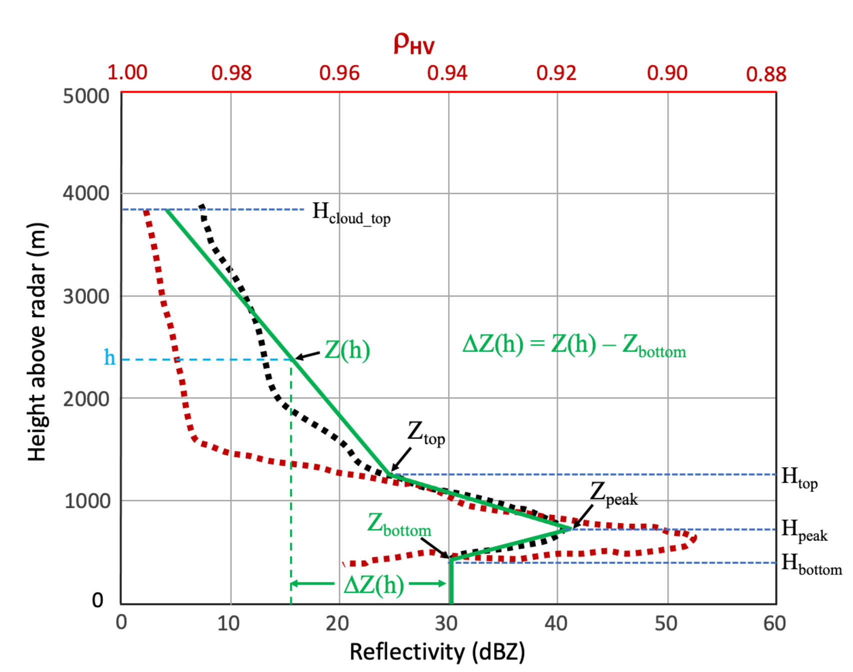
pixel-based QC global QC based on intensity and areal coverage

Wind Farms Mitigation

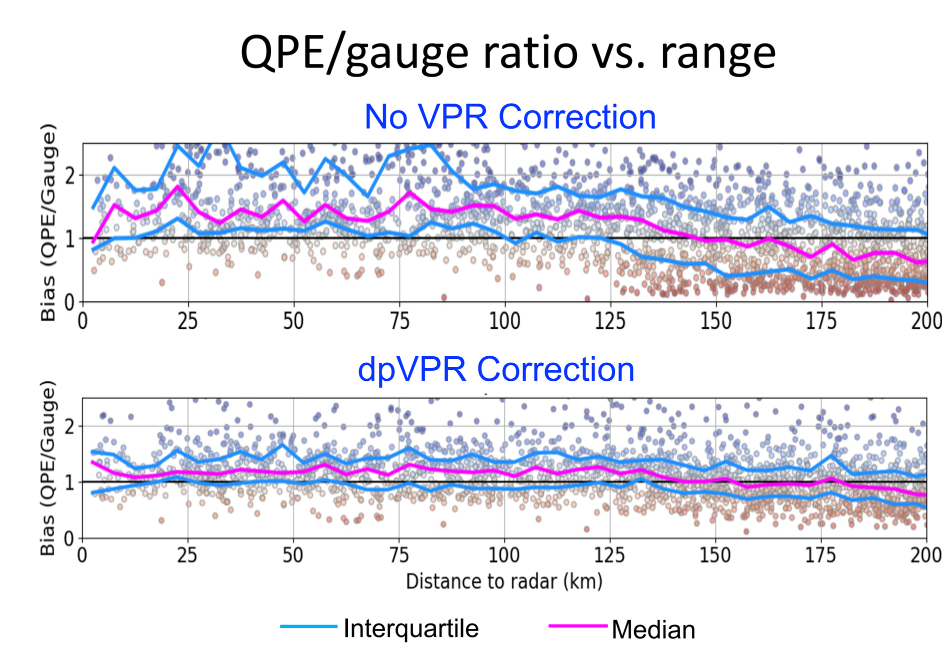


a) Image from the US turbine database
b) Raw reflectivity: white circles indicate areas of significant wind farm (WF) contaminations
c) Correlation coefficient field
d) QC'd reflectivity: the "hot" WF speckles in the white circles were removed and replaced with data from the neighborhood
e) QC flag: red boxes indicate pre-delineated areas of likely WF contamination; white areas within the red boxes represent pixels being identified as WF contamination

Dual-pol VPR Correction



Example sector mean range profiles of Z (black dotted line) and ρ_{HV} (red dotted line) and the linearly fitted dpVPR model (green line). The VPR correction at any given height, h, is based on $\Delta Z(h) = Z(h) - Z_{bottom}$ in the linear dpVPR.



- No VPR correction: radar QPE had significant overestimation near the radar (bright band contamination) and underestimation far away (radar beam overshooting) and large random errors.
- The dual-pol VPR correction reduced range-dependent biases and random errors.

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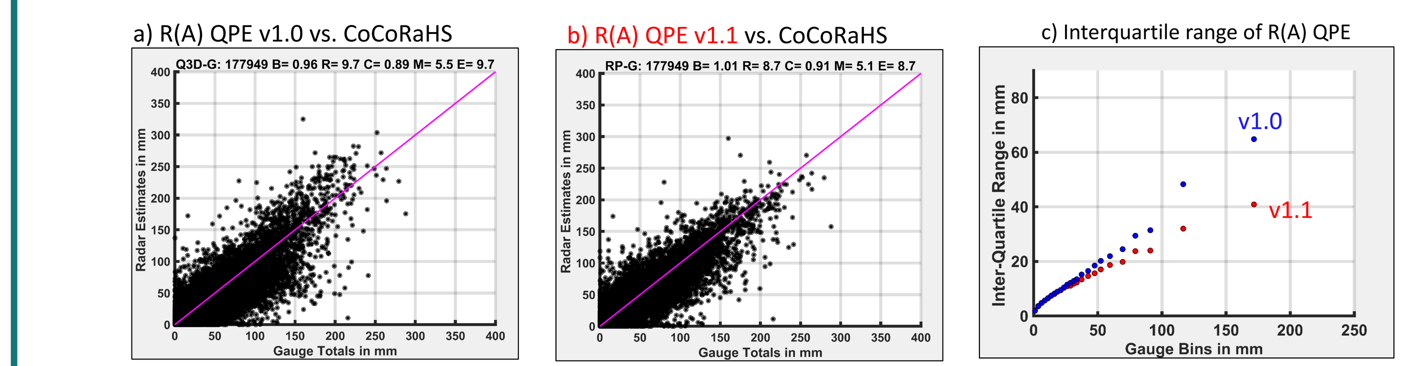
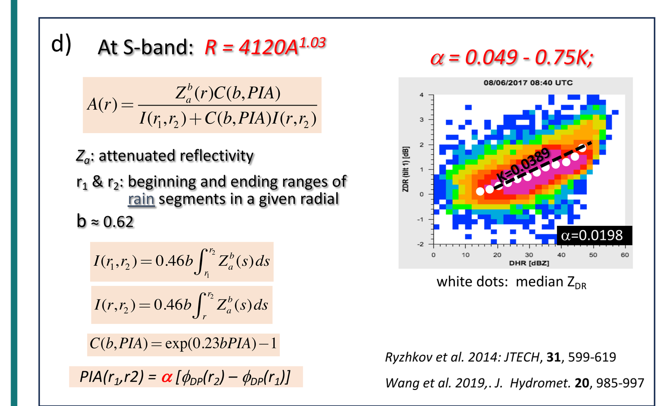
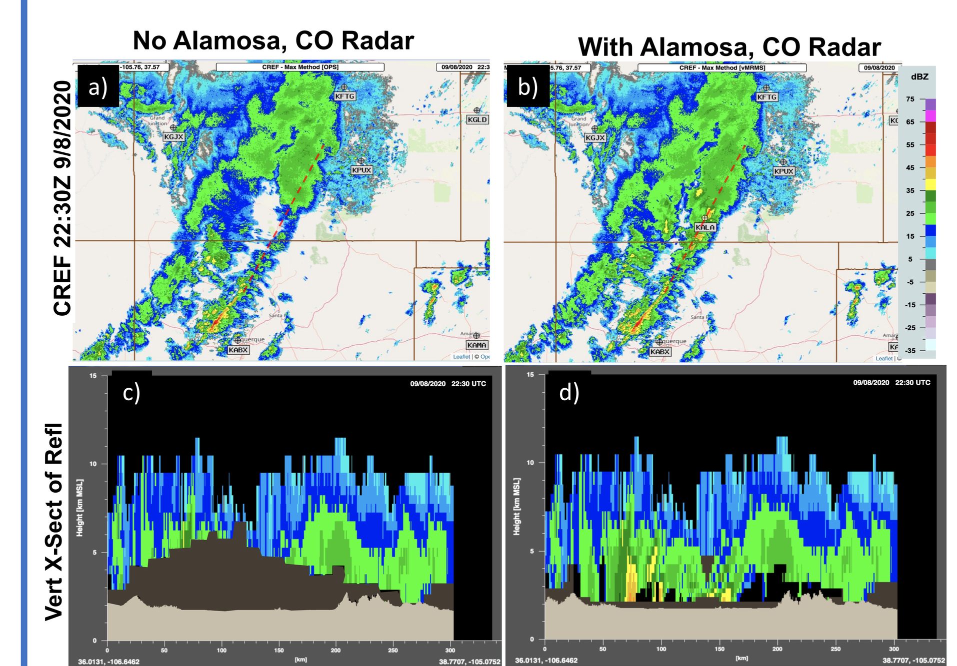
R(A) QPE Enhancements





a) R(A) QPE version 1.0 was based on Ryzhkov et al. 2014, in which a key parameter, α, was derived from the Zdr-Z slope K (see panel d), and only one α was derived and applied for the whole radar domain. This resulted in errors for precipitation of small scales and mixed regimes.
b) A local rate adjustment based on α-Z relationships derived from a large disdrometer dataset was developed (version 1.1) to account for local variations of drop size distribution.
c) The local adjustment significantly reduced the random errors in the RA QPE.

Supplemental Radar Integration



a, b) Composite reflectivity mosaic without (a) and with (b) the supplemental C-band dual-pol radar (Alamosa, CO). Note the additional precipitation info added by the KALA radar near the central southern Colorado border

c, d) Vertical cross sections of 3D reflectivity without (c) and with (d) the supplemental radar. Note the additional lower level coverage provided by the supplemental radar between the mountains.

Summary

- Continued R&D efforts are being made to improve the operational MRMS radar QPE to support the NWS flash flood warnings and hydrological predictions and for other applications.
- Radar data quality control is improved to handle hardware issues and to mitigate wind farm contamination
- Range-dependent biases and small-scale uncertainties are further reduced.
- Supplemental radars are integrated to improve the QPE quality in areas where the NEXRAD has poor lower level coverage.