5 NEW SCIENCE FOR THE WSR-88D: STATUS OF THE DUAL POLARIZATION UPGRADE

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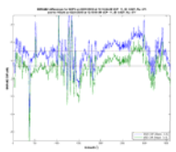
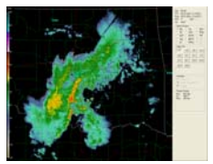
Engineering Evaluation

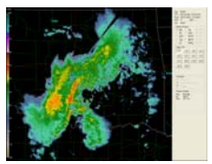
ROC Engineering directly compared the Norman Oklahoma collocated test-bed radar, KCRI, to the dual polarization prototype, KOUN. They compared the difference between KCRI and KOUN Reflectivity and Signal to Noise Ratio (SNR) values as seen in the plot below. Additionally, they performed a signal processing validation and monitored system parameters for stability.



KCRI/KOUN Z (green) and SNR (blue) comparison

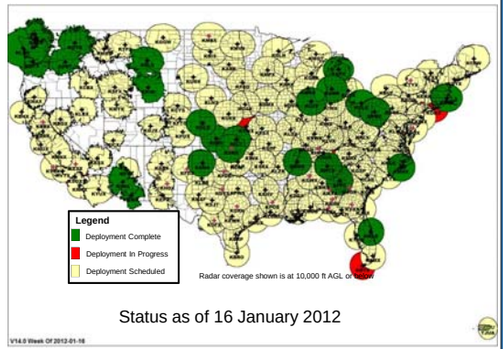


KOUN



KCRI

Status: *Deployment Underway*



Status as of 16 January 2012

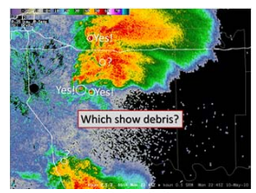
Validation Process

The NEXRAD tri-agencies (DOC, DOD, DOT) determined that adding dual polarization to the WSR-88D will provide increased information that will enhance the decision making of the users who rely on the national network of weather radars. The mission of the Radar Operations Center (ROC) is to manage the life-cycle support of this network. Therefore, the ROC ensured the upgrade was validated and determined it was ready for deployment through a subcommittee of their Data Quality Team. The success of this committee was due to the collaboration between all of its members. Five key tasks spanned a two-year effort are mentioned here:
1) Dual Polarization Upgrade, 2) Engineering Evaluation, 3) Meteorological Evaluation, 4) Operational Assessment, and 5) Zdr Calibration Validation.

Meteorological Evaluation

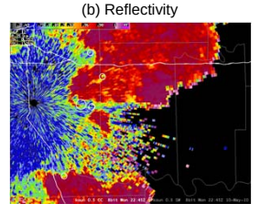
The WDTB, with the help of ROC Applications Branch, summarized and presented evaluations of nearly all weather events that passed through the dual polarization prototype's umbrella. Evaluations expanded to include Beta Sites as they came online. Below are two examples.

(a) Velocity

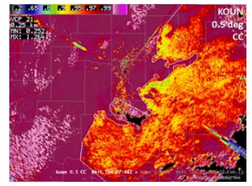


(b) Reflectivity

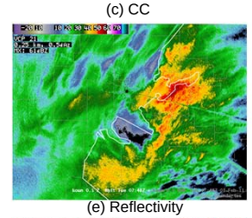
Images from KOUN during the tornado outbreak in Norman, Oklahoma on 10 May 2010. Velocity PPI (a) shows five couplets (circled) indicating rotation. The same five regions are circled in the reflectivity PPI (b). Only three show increased reflectivity values. The Correlation Coefficient (CC) PPI (c) shows reduced correlation in all five regions.



(c) CC

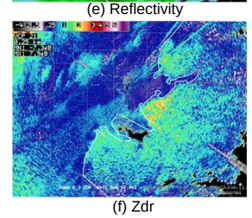


(d) CC



(e) Reflectivity

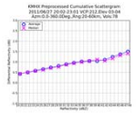
Images from KOUN during a blizzard in Norman, Oklahoma on 1 February 2011 illustrating the benefits of dual polarization variables in winter weather events. The CC PPI (d) shows a clear transition between all snow (maroon colored CC values) and mixed phase (green, yellow, and orange). The outline of the transition is overlaid onto the Reflectivity PPI (e) where the band of snow to the northeast is not discernible. The Differential Reflectivity (Zdr) PPI (f) shows low Zdr values to the northeast.



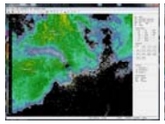
(f) Zdr

Zdr Calibration Validation

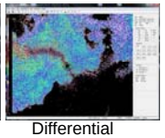
The contractor provided a performance analysis of the engineering method for Zdr calibration. The ROC subcommittee worked to develop an independent means for validating Zdr accuracy requirements with critical contributions from the National Severe Storms Laboratory (NSSL) and an independent consultant. As data became available through the Winter, Spring, and Summer of 2010, the subcommittee adjusted their evaluation methods. Scatterplots of Reflectivity versus Differential Reflectivity for stratiform rain proved to be the method with the least variance. However, observed variance in this method slightly exceeds accuracy required. Meanwhile, the cross-polarization power technique is being adapted to the WSR-88D dual polarization design.



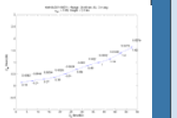
For Z between 20-22 dBz, Zdr expected to be 0.23 dB



Reflectivity (Z)



Differential Reflectivity (Zdr)



For low Z, Zdr expected to approach zero

Operational Assessment

ROC Applications Branch and the Warning Decision Training Branch (WDTB) collaborated to organize and execute two subject matter expert reviews and an operational assessment of the dual polarization upgrade. The subject matter expert panels reviewed the impact of possible loss of sensitivity due to the dual polarization upgrade and determined that a loss up to 4 dB was not operationally significant. The operational assessment provided valuable feedback as a training, technology exposure and transition exercise. Forecasters who participated in the operational assessment felt that the additional dual polarization variables enhanced warnings and forecasts, especially in forecasting winter weather.

Dual Polarization Upgrade

L-3 STRATIS and Baron Services, Inc. were selected to design and implement the upgrade. They collaborated with the NSSL and the ROC on design recommendations and validation efforts. They added two antenna elevation arm mounted units, the RF Pallet and the Antenna Mounted Electronics (AME).

AME

RF Pallet