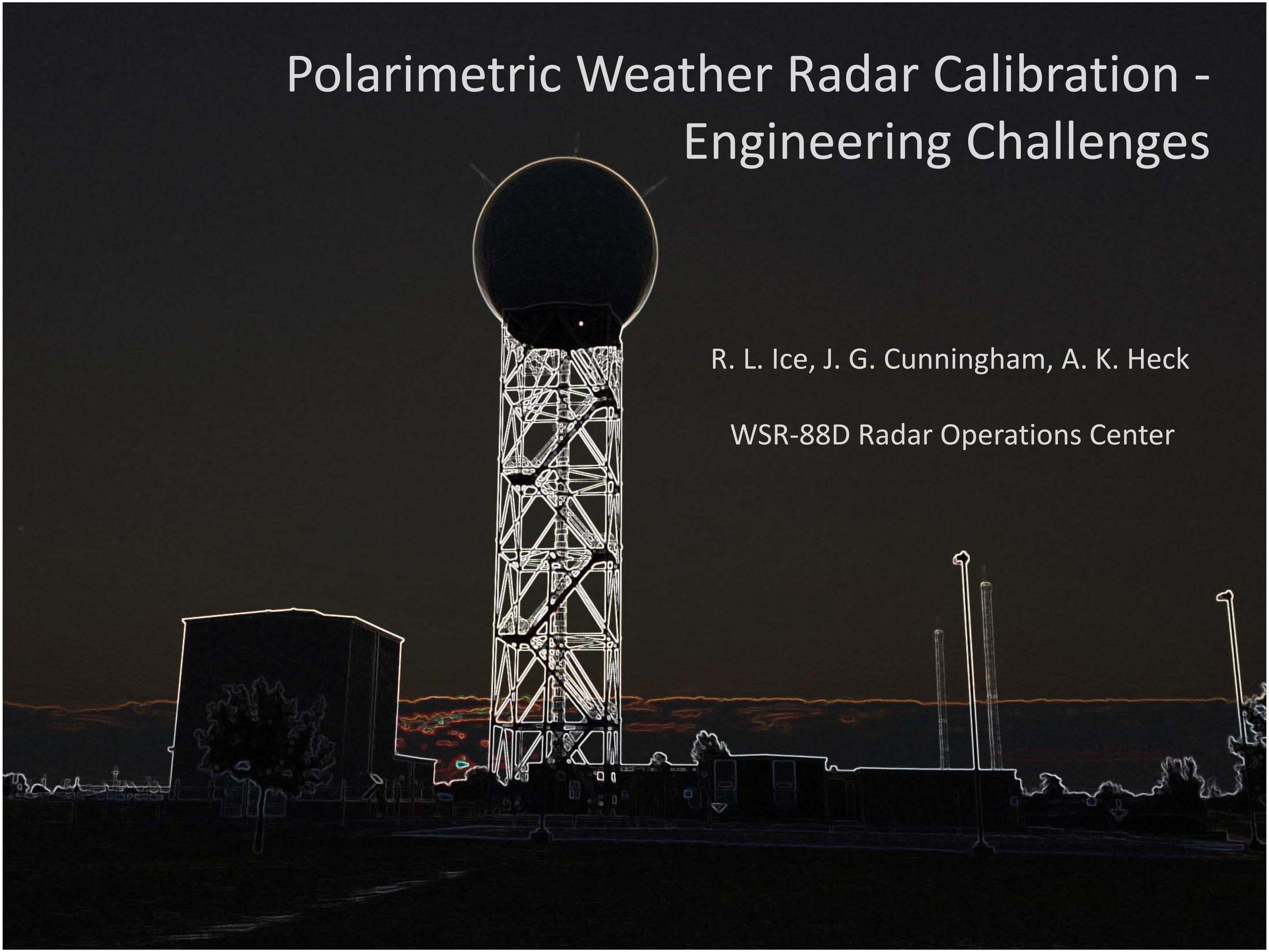
Polarimetric Weather Radar Calibration - Engineering Challenges



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Presenting Today:

- Baseline WSR-88D Zdr Calibration
- Fielded Performance
- ROC Monitoring Program (Cunningham et al)
- Cross Polarization Power (Meymaris)

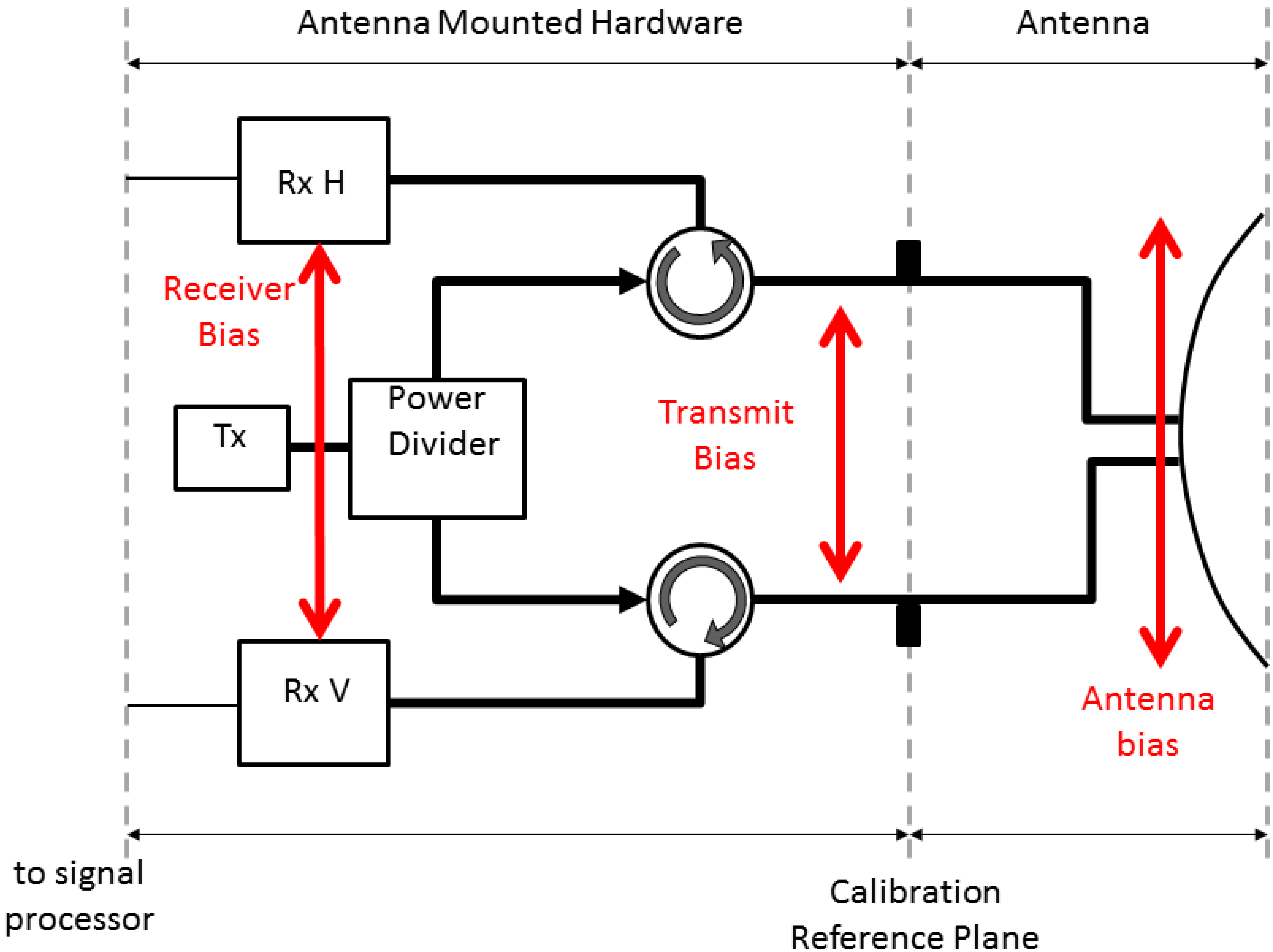
The Zdr Uncertainty Requirement!

0.1 dB: official requirement

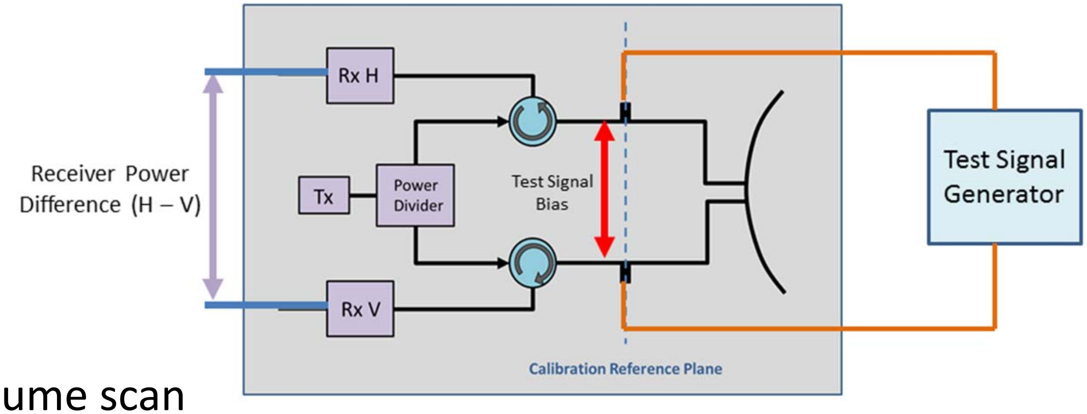
< 0.2 dB: good performance in HCA and QPE

> 0.3 dB: reduced benefit with polarimetric QPE

Zdr Calibration is the "removal" of system induced biases

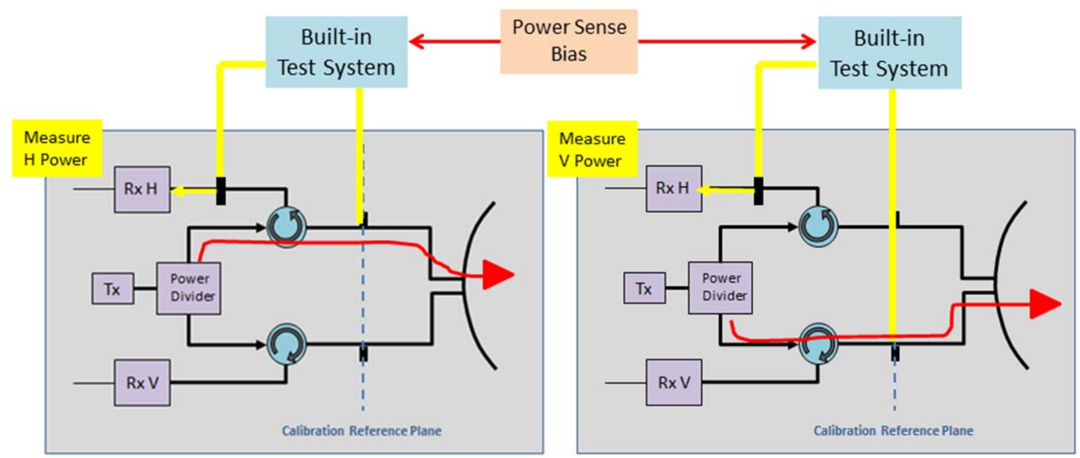


Measuring the Biases with built in test equipment (BITE) and solar scans

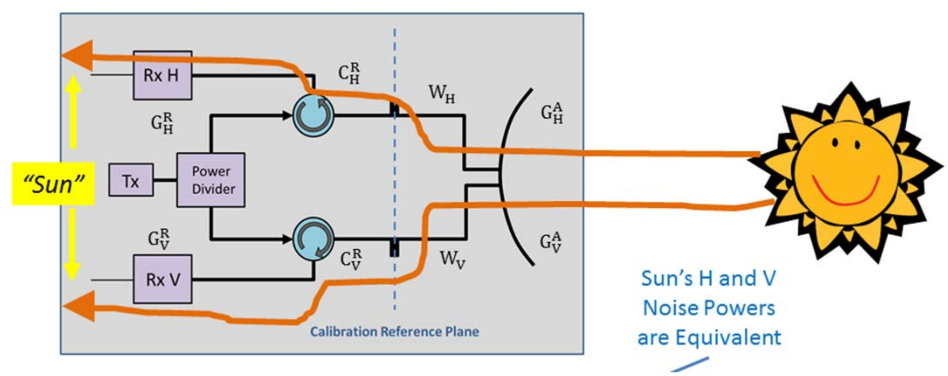


Receiver bias checked each volume scan

Transmitter bias checked every eight hours (performance check)



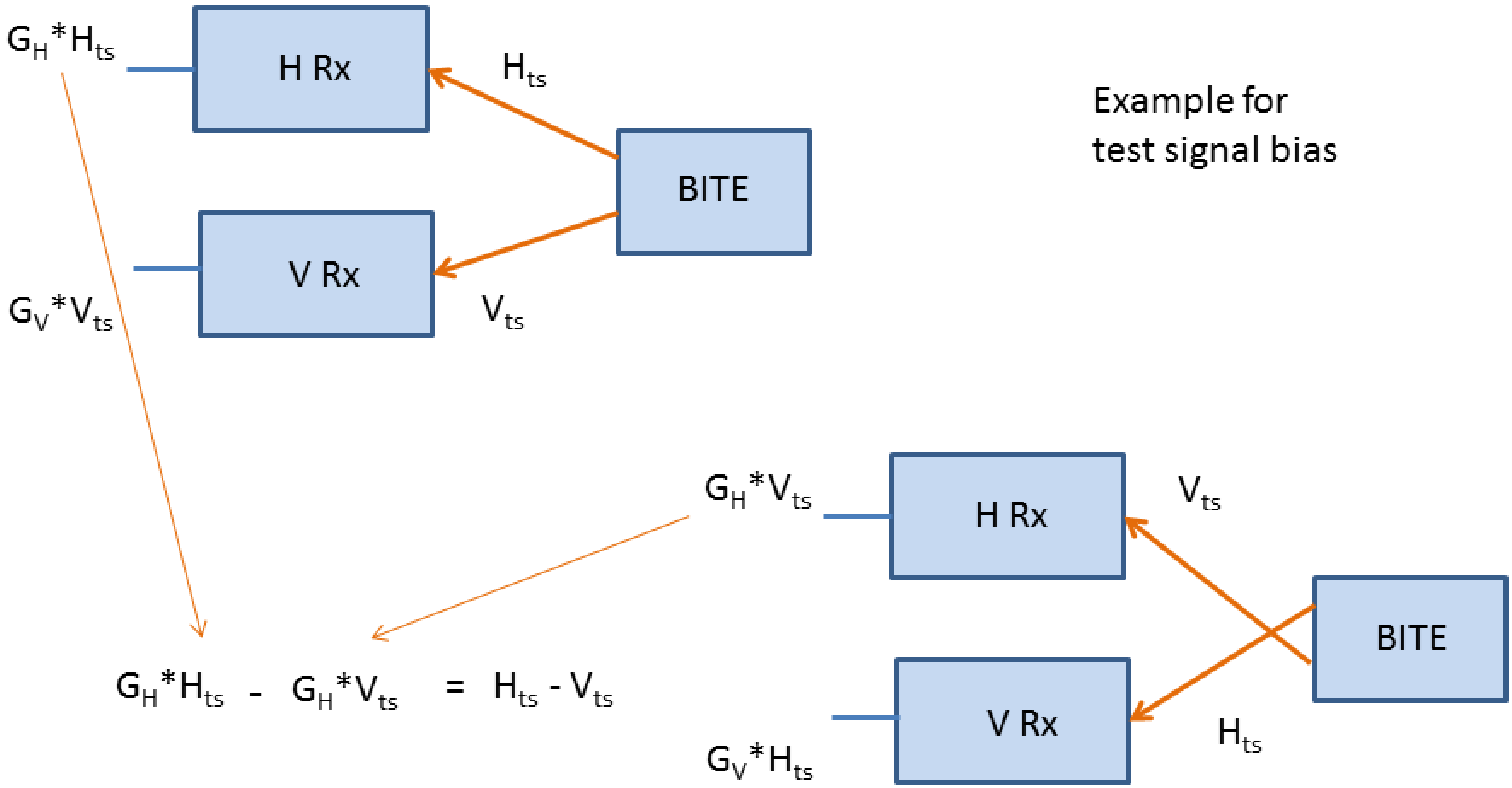
Antenna bias checked periodically with a solar scan



the test signal and power sensing equipment biases must be known and corrected

Measuring the Power Sense and Test Signal Bias

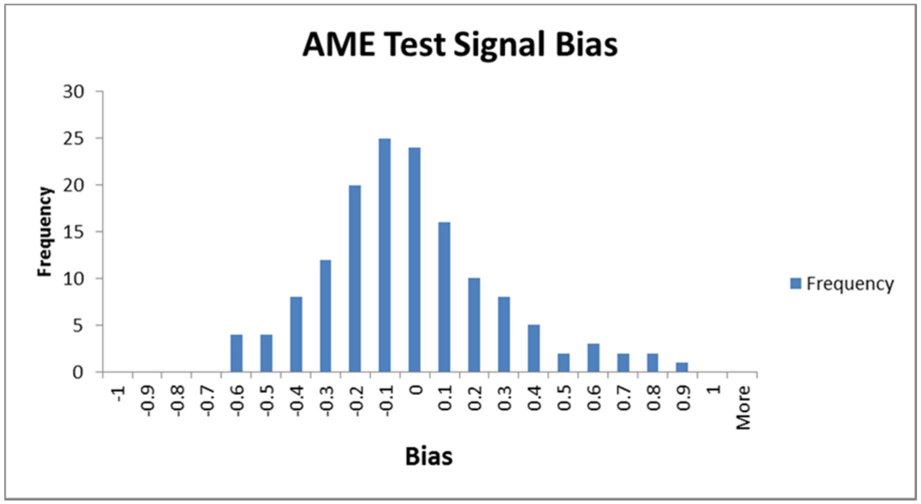
This is done with the “Crossed and Straight” calibration

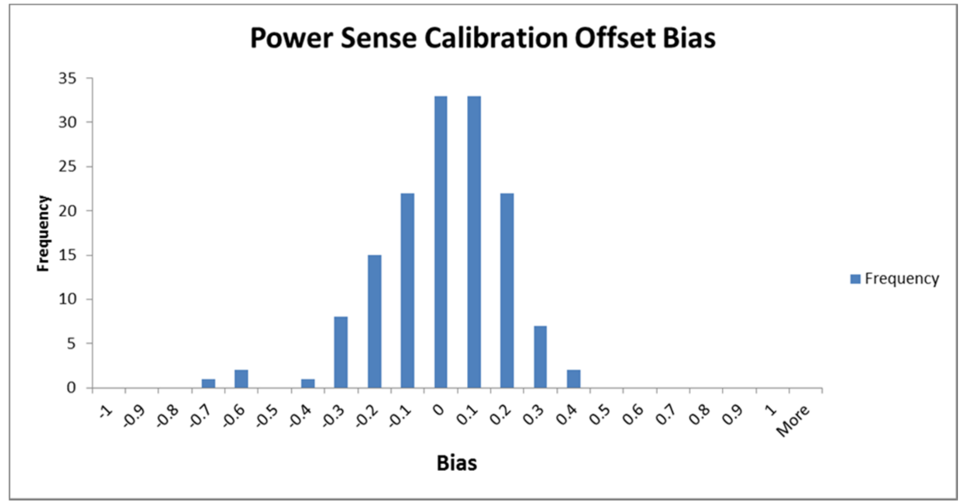


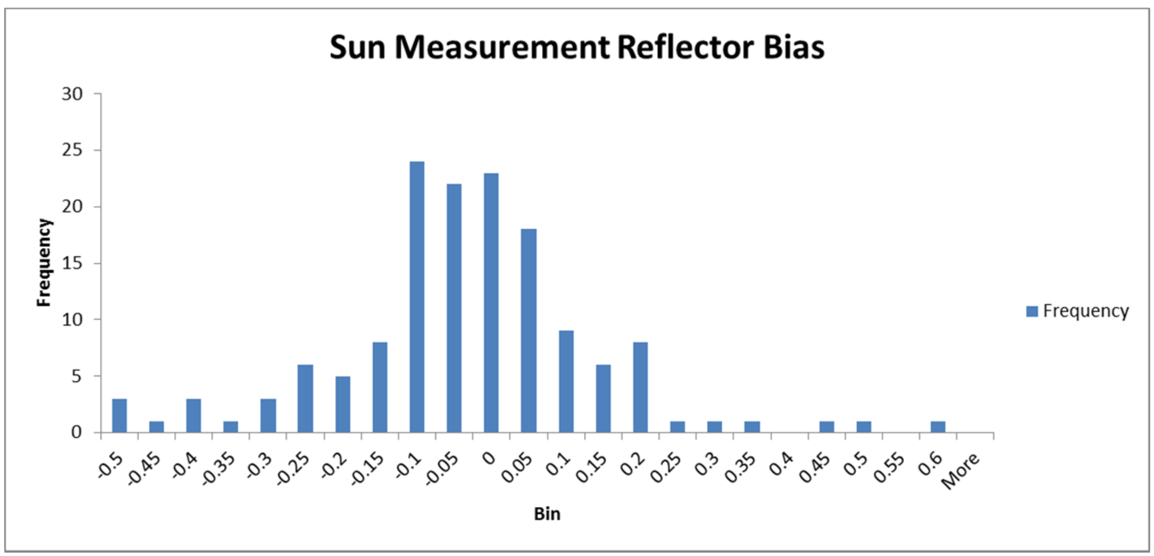

FERRITE CO GX307
MODEL NO SDC-28-02
SERIAL NO H4732


DC3J1

Data Reported from Installation Teams for 146 Sites

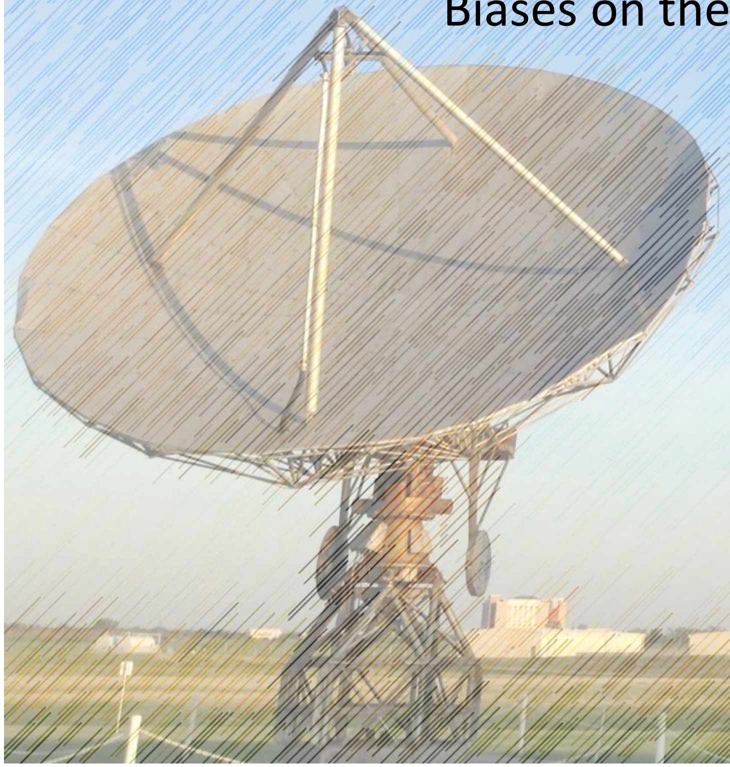






The ROC estimates performance using level 2 data

- weather method uses stratiform precipitation
- sun spike method uses assumption that the sun is un-polarized
- ROC is investigating use of Bragg scatter
- "Methods for Identifying Systematic Differential Reflectivity (Zdr) Biases on the Operational WSR-88D Network" Cunningham et al

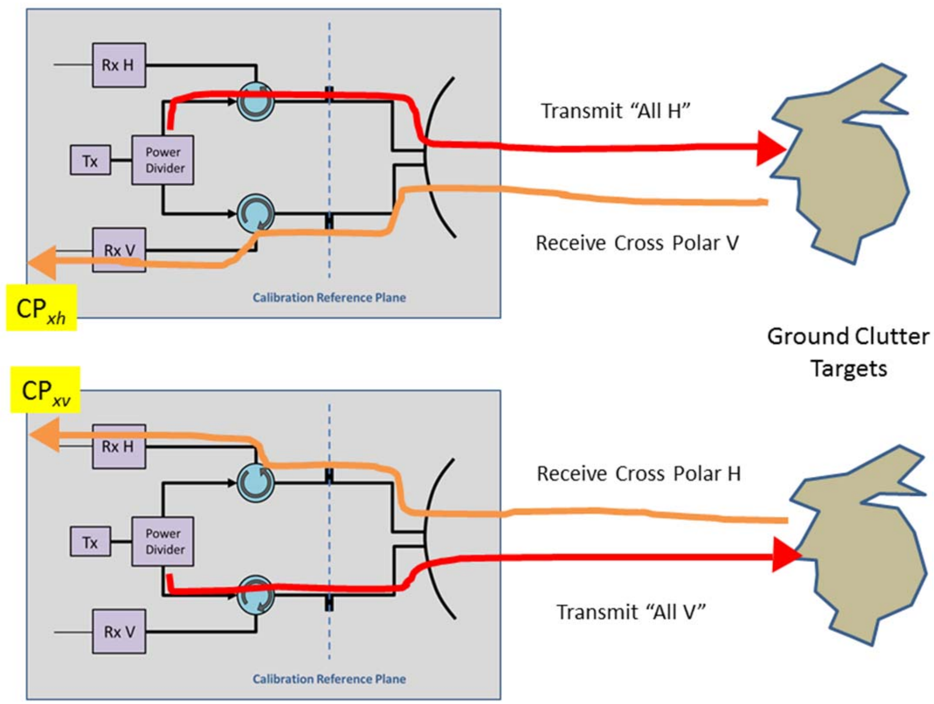


The ROC estimates that almost 60 % of sites have a Zdr bias error of < 0.2 dB

working with sites when issues are noted

Implementing cross polarization power as an alternate external method

Cross Polarization Power Method - Implementation Challenges



$$Zdr_{true} = Zdr_{meas} * \frac{CP_{xv}}{CP_{xh}} * (Sun)^2$$

WSR-88D simultaneous transmit and receive method requires independent H only and V only clutter scans

Reciprocity assumption requires the scans revisit the same resolution volumes

The WSR-88D antenna precision and stability lends a challenge to this requirement

Transmit full power to half power ratios must be monitored and corrections applied

Reference:

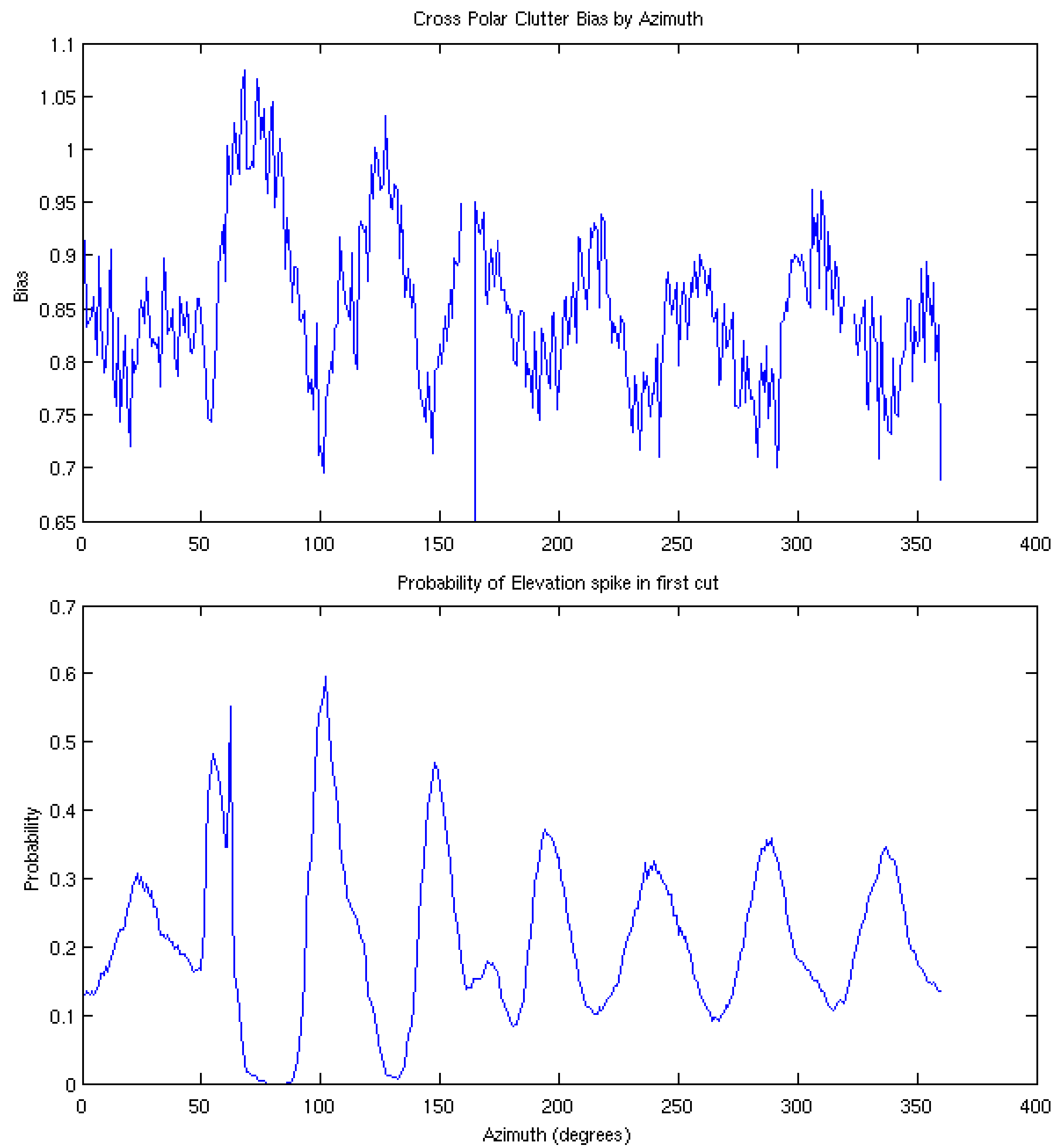
Meymaris, G, J. C. Hubbert, M. Dixon, R. L. Ice, A. K. Heck, and J. G. Cunningham, 2013, Operational considerations for Zdr Calibration using the Cross-polarimetric Technique, 36th Conference on Radar Meteorology

Hubbert, J. C., V. N. Bringi, and D. Brunkow, 2003, Studies of the Polarimetric Covariance Matrix. Part I: Calibration Methodology, J. Atmos. Oceanic Technol., 20, 696 - 706.

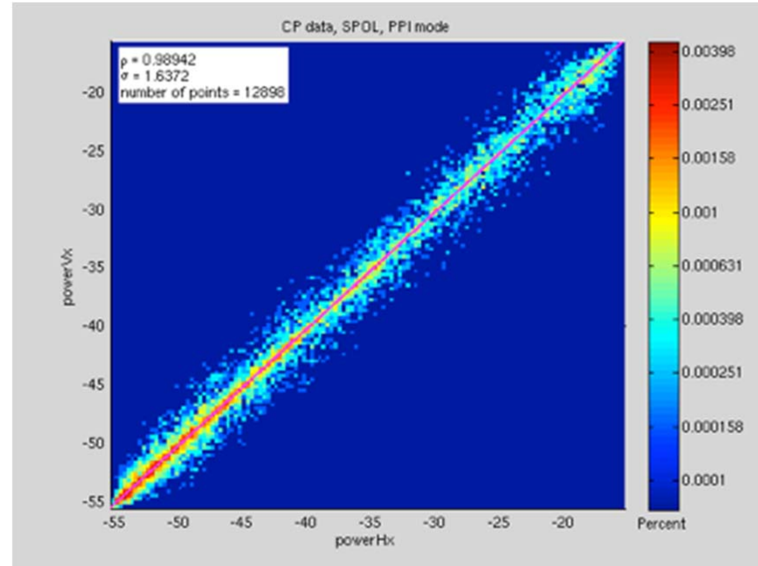
WSR-88D Pedestal Elevation Stability

Xpol Clutter Power Ratios by Azimuth

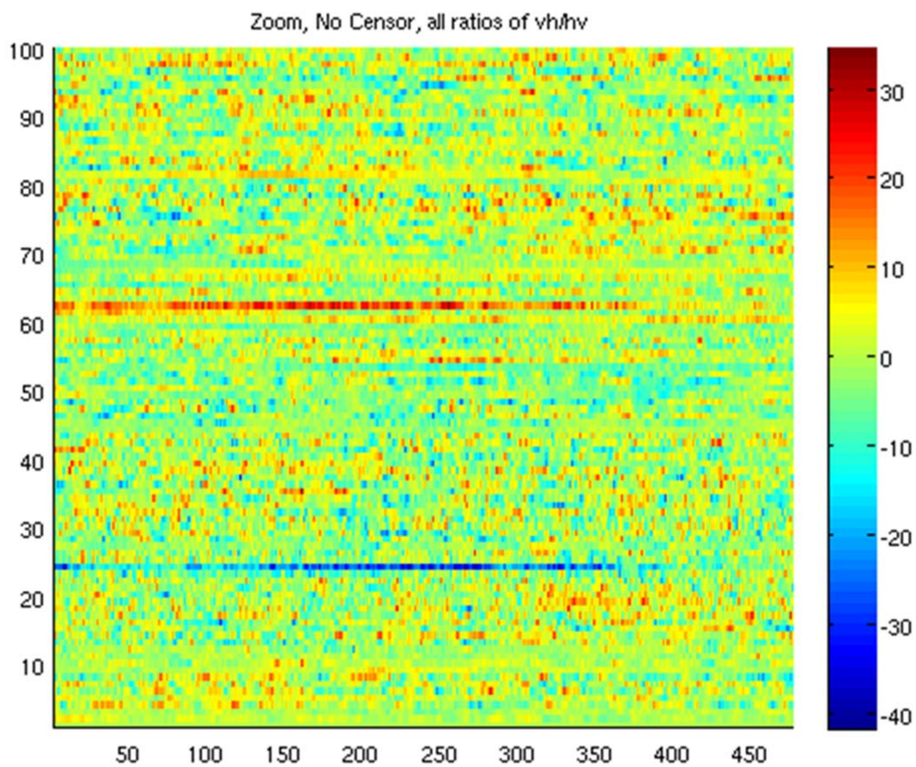
Likelihood of an elevation correction



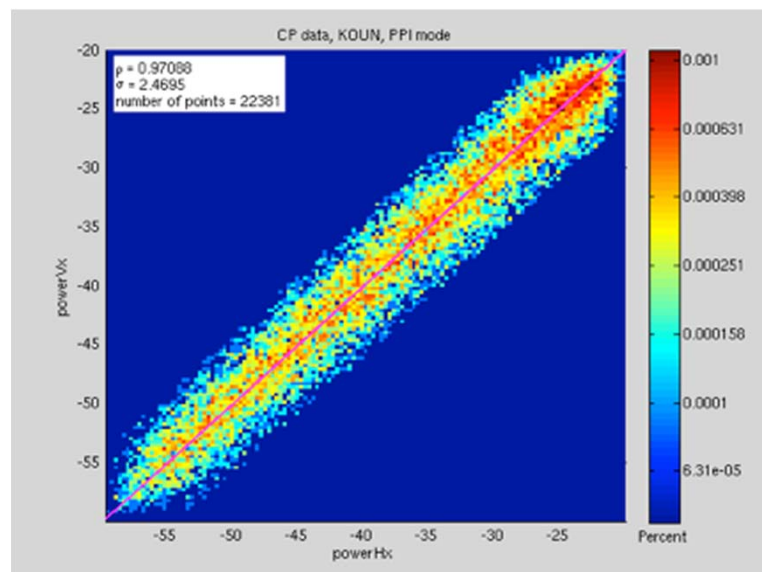
The ROC and NCAR teams are developing data acquisition and censoring techniques
to reduce variance and remove artifacts



Range-azimuth plot of cross pol clutter ratios, WSR-88D



Scatterplots of cross pol clutter ratios, S-Pol (top) WSR-88D (bottom)



Summary of the Engineering Challenges to Zdr Calibration

- Need consistency in BITE induced bias measurements
  - refining technical manuals and training
  - could look at hardware solutions
- Accurate solar scan results
  - possibly affected by pedestal control
  - may implement cross pol solar box scan method
  - some diurnal reflector bias changes observed
- Transmitter power monitoring stability
  - identified by cross pol project
  - may adjust measurement timing
- Cross pol implementation challenges result from differences in the research and operational radars
- The ROC is actively working with sites to identify and correct Zdr calibration performance issues