# NEXRAD Correction of Vertically Integrated Liquid in Areas of Partial Beam Blockage


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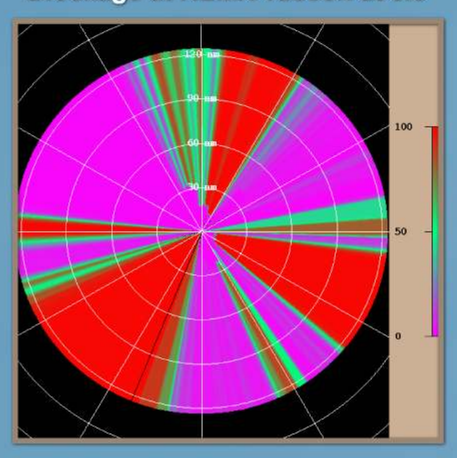
## Background

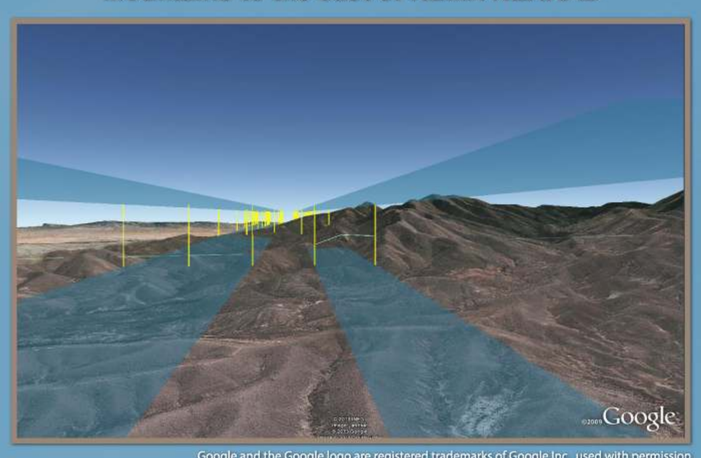
**Objective: Automatically correct Vertically Integrated Liquid (VIL) for partial beam blockage effects using differential phase, which is immune to partial blockage and miscalibration**


Radars with >50% blockage in >10% of radials at 0.5° tilt circled in red

Blockage at KEMX Tuscon at 0.5°




Mountains to the east of KEMX NEXRAD

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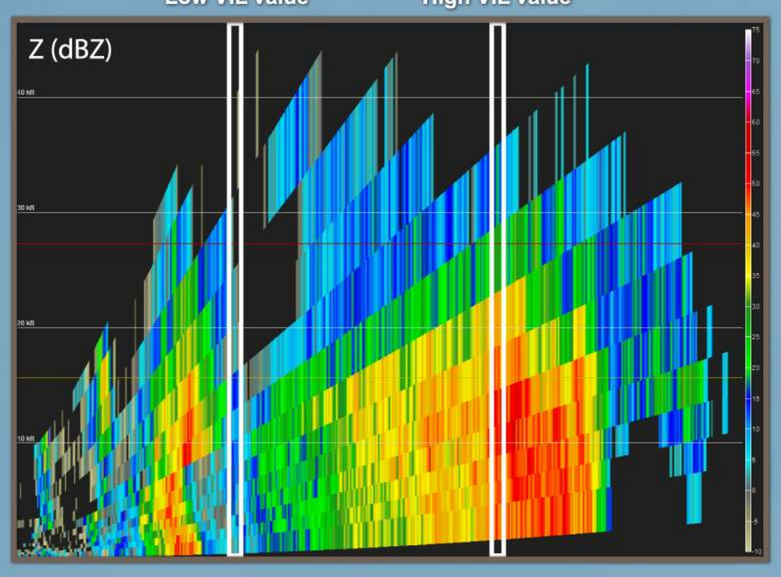
- Safe and efficient routing of air traffic relies on the quality of VIL
- Partial beam blockage negatively biases reflectivity and decreases VIL
- Blockage maps do not account for unexpected blockage sources due to anomalous propagation
- NEXRAD dual polarization upgrade introduces a new variable, differential phase, to correct partial beam blockage without the need for blockage maps

## Algorithm

**VIL is the integration of Liquid Water Content (LWC) M over a column of space**

$$VIL = \int M(h)dh$$

Low VIL value High VIL value

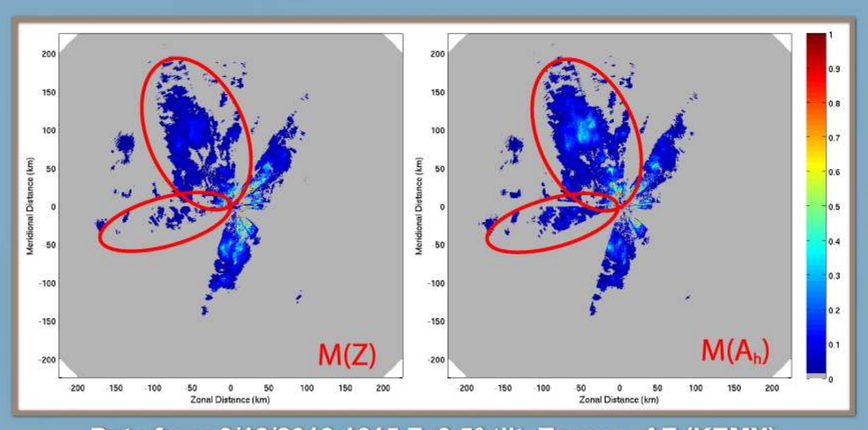



$$A_h = \frac{Z^b(r) * \{10^{0.1b\gamma\Delta\Phi} - 1\}}{I(r_1, r_0) + \{10^{0.1b\gamma\Delta\Phi} - 1\} I(r, r_0)}$$

$$I(r, r_0) = 0.46b \int_r^{r_0} Z^b(s)ds$$

$$a(t) = 70.8 + 2.04t + 0.21t^2$$

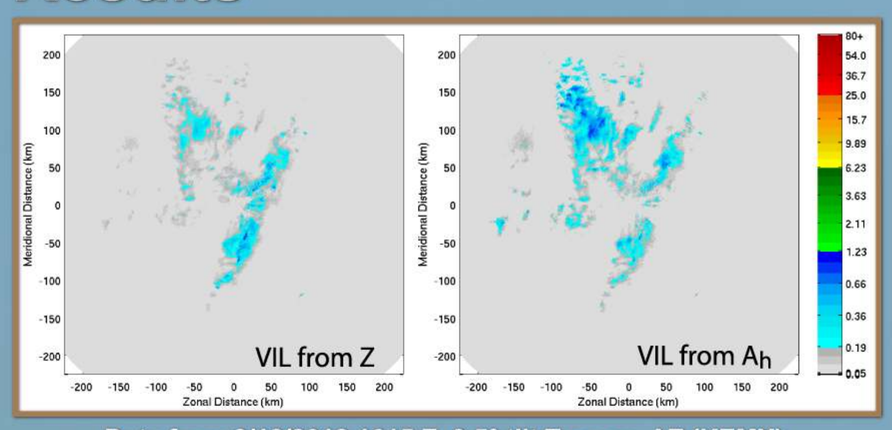
$$M = 3.44 * 10^{-3} Z^{\frac{4}{7}} \qquad M = a(t) {A_h}^{0.93}$$




Data from 3/18/2012 1615 Z, 0.5° tilt, Tucson, AZ (KEMX)

- Specific attenuation ($A_h$) is obtained from the radial profiles of reflectivity and differential phase (Testud *et al.*, 2000)
- LWC is estimated directly from $A_h$
- Vertical profiles of temperature are required as a temperature dependent factor, a(t), is used in the estimation algorithm
- Highlighted areas reveal a difference in LWC estimates

## Results




Data from 3/18/2012 1615 Z, 0.5° tilt,Tucson, AZ (KEMX)

- Recovery of VIL to the northwest and west is clearly visible
- VIL is reduced to the southeast due to an underestimation of LWC in the current implementation
- Structure of the storm preserved

## Conclusions

- Recovery of VIL in partially blocked areas is possible using specific attenuation
- Application of algorithm will benefit the entire NEXRAD network with more accurate estimates of VIL

## Future Work

- Integrate gridded model temperature data
- Resolve underestimation of LWC in affected radials
- Compensate for possible discontinuities at the dual polarization range limit of 300 km
- Blend LWC estimation methods where necessary to take advantage of the strengths of each relation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