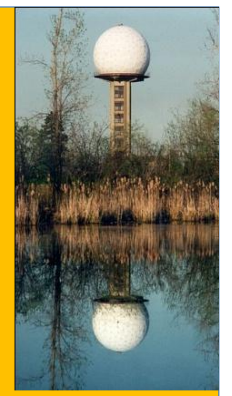
P 325 Real-Time Radar Reflectivity Calibration from Differential Phase Measurements



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PROCEDURE: Based on Lee and Zawadzki (2006), Journal of Hydrology, p. 83-97.

- RUC-2 forecasts provide initial indication of the 0° C isotherm height. No analysis is performed if < 2 km.
- A 5-point smoother is applied to the Φ_{DP} and Z_H measurements.
- Polarimetric info used to omit any path with non-liquid precipitation.
- Measured and theoretical Φ_{DP} differences are deduced for all rain paths > 20 km.
- Theoretical Φ_{DP} is derived from $Z_H = 5.7 \times 10^4 K_{DP}^{1.075}$ (Brandes et al. 2005)
- A path along a given azimuth can contribute only one ($\Phi_{DP\text{-}meas}$,$\Phi_{DP\text{-}theor}$) pair.
- A path may be composed of more than one segment.

- Rain paths are taken over 4 elevation angles (0.5°, 0.9°, 1.4° and 2.2°) and along azimuths free of ground echoes and/or shadows and at heights at least 0.5 km above ground and 0.5 km below the bright band.

-Unlike Lee and Zawadzki (2006) who only considered $\Phi_{DP\text{-}theor}$ > 3°, all paths are kept regardless of the intensity, allowing its application to cases of light precipitation.
- $\Phi_{DP\text{-}meas}$ differences may be negative in light precipitation due to significant noise caused by our fast scanning (6 rpm) radar antenna but are not rejected.

- Data from any 5-min radar cycle with fewer than 50 paths (selectable) are rejected.
- Data from cycles where the ($\Phi_{DP\text{-}meas}$,$\Phi_{DP\text{-}theor}$) correlation Υ < 0.4 are rejected.
-The accepted 5-min pairs are combined to produce a daily estimate at 1200 UTC.

- Calibration correction ε (to be added) is derived from the slope m of the least-square fit: $\varepsilon = 10b\log_{10}(m)$ where b=1.075, the exponent of the Z_H - K_{DP} relationship used.

- The inclusion of a sufficiently large number (~10^3) of ($\Phi_{DP\text{-}meas}$,$\Phi_{DP\text{-}theor}$) pairs inevitably leads to a reliable estimate of the calibration.

OBSERVATIONS and CONCLUSIONS:

-Polarimetric calibration with the selected Z_H-K_{DP} relationship can be used for light and moderate stratiform precipitation if based on a sufficiently large number of paths (~10^3).

-The assumed Z_H-K_{DP} relationship fails in heavy precipitation, in particular, when the average Z_{DR} over the path exceeds 2 dB.

-One of the Z_H-K_{DP}-Z_{DR} relationships proposed by Vivekanandan et al. (2003), $K_{DP}=3.32\times10^{-5}Z_H Z_{DR}^{-2.05}$ has been shown to overcome the limitation of the two-parameter relationship but any inconsistency found between the power and phase measurements cannot be attributed to only Z_H but to a combination of Z_H and of Z_{DR}.

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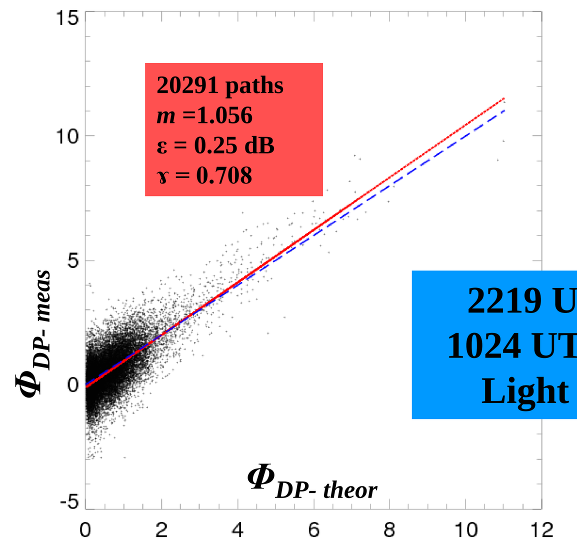
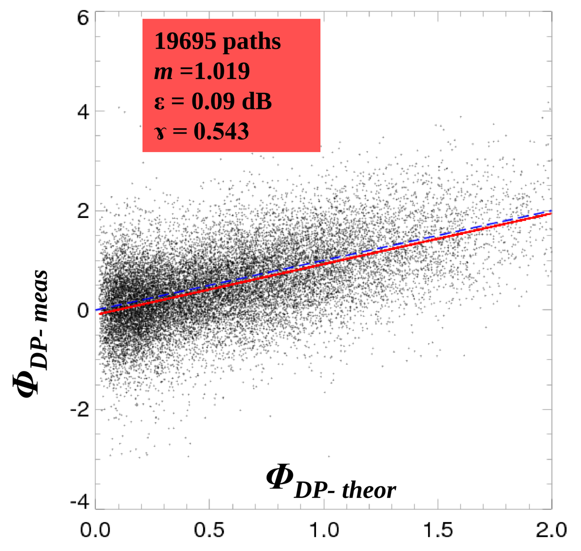
2219 UTC 10 May to 1024 UTC 11 May 2013 Light Precipitation

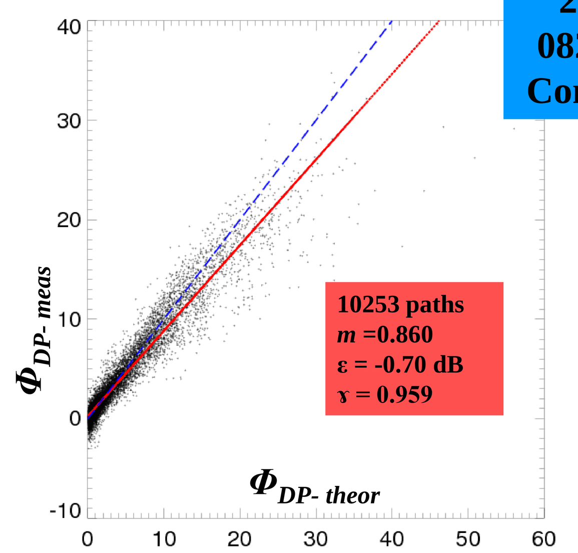


Scatter plot of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ differences for an event with relatively light precipitation. The red line is the least-square fit yielding ε = 0.25 dB while the blue dash line represents the 1:1 correspondence.

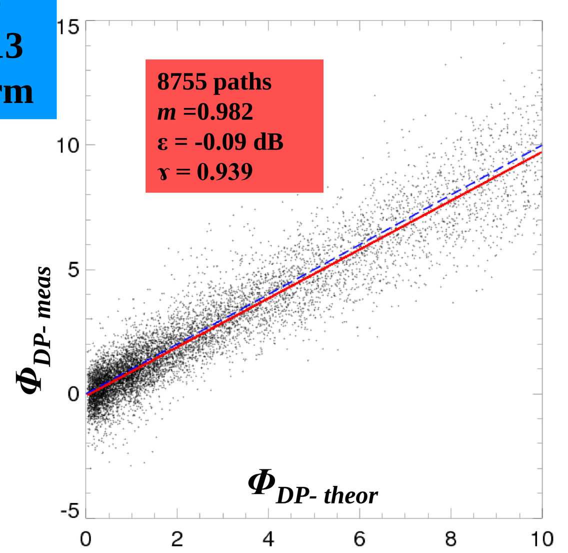


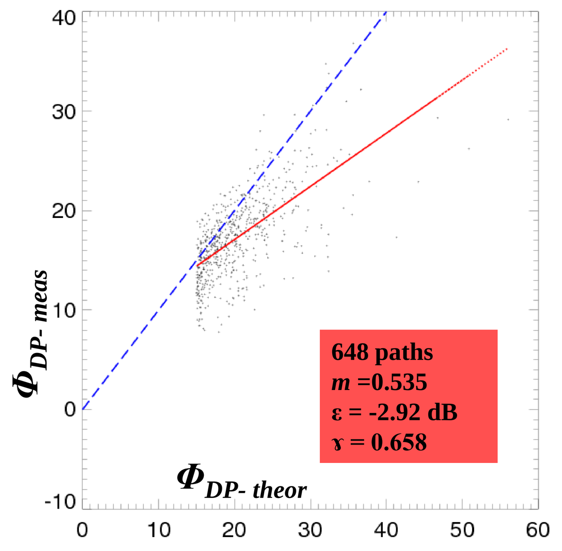
Scatter plot of the same event but considering only those paths with $\Phi_{DP\text{-}theor}$ < 2°. The resulting calibration correction ε is 0.09 dB.

2124 UTC 22 May to 0824 UTC 23 May 2013 Convective & Stratiform



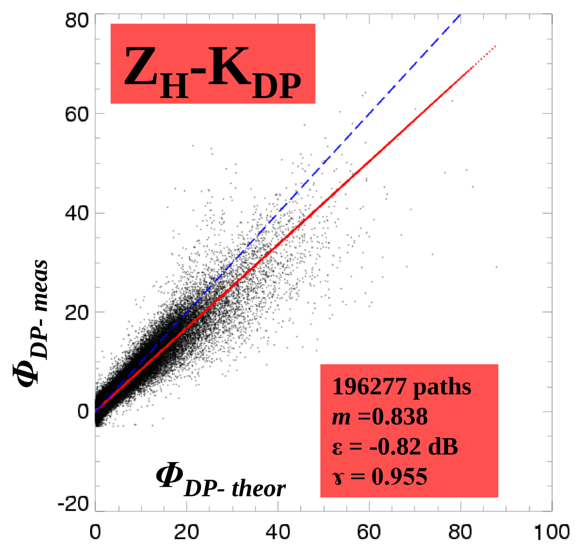
Scatter plot of all $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ differences for an event with convective and stratiform precipitation. ε=-0.70 dB but the larger Φ_{DP} differences are clearly overestimated by the theoretical assumption.



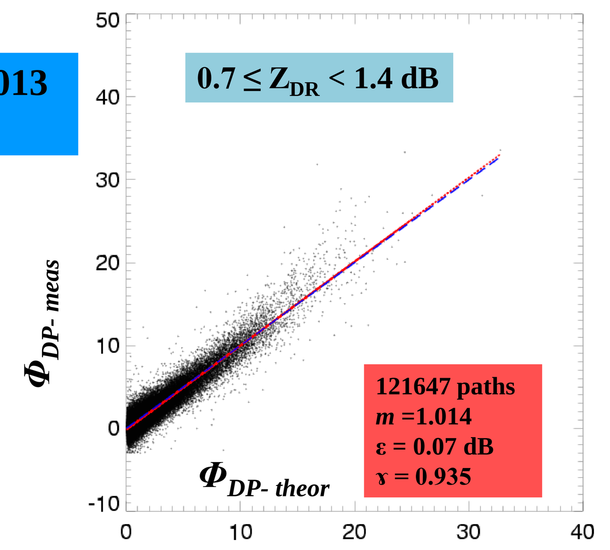


Left: Scatter plot of the same event but considering only those paths with $\Phi_{DP\text{-}theor}$ < 10°. ε = -0.09 dB. Right: Considering only the paths with $\Phi_{DP\text{-}theor} \geq 15°$. ε=-2.92 dB. The assumed Z_H-K_{DP} relationship is obviously no longer valid for these paths.

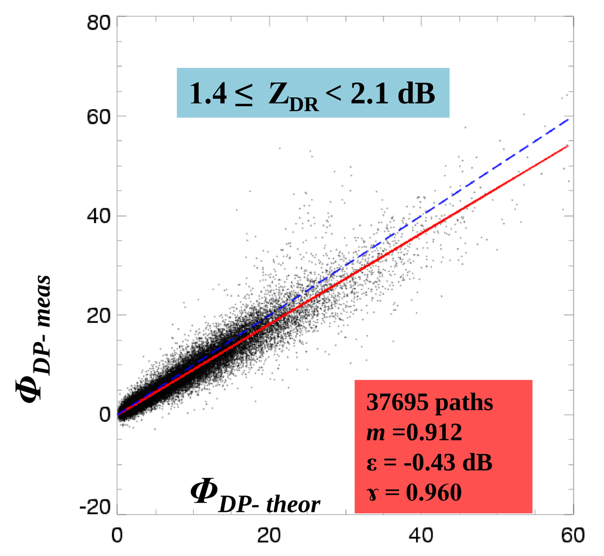
May to July 2013 88 hours



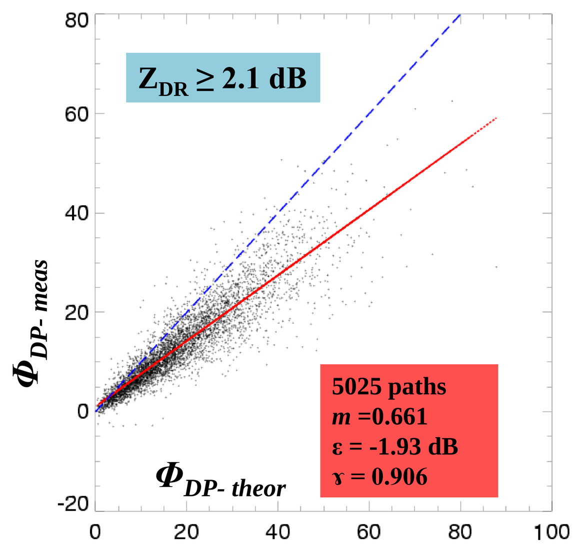
Scatter plot of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ differences for a variety of events over a 3-month period.



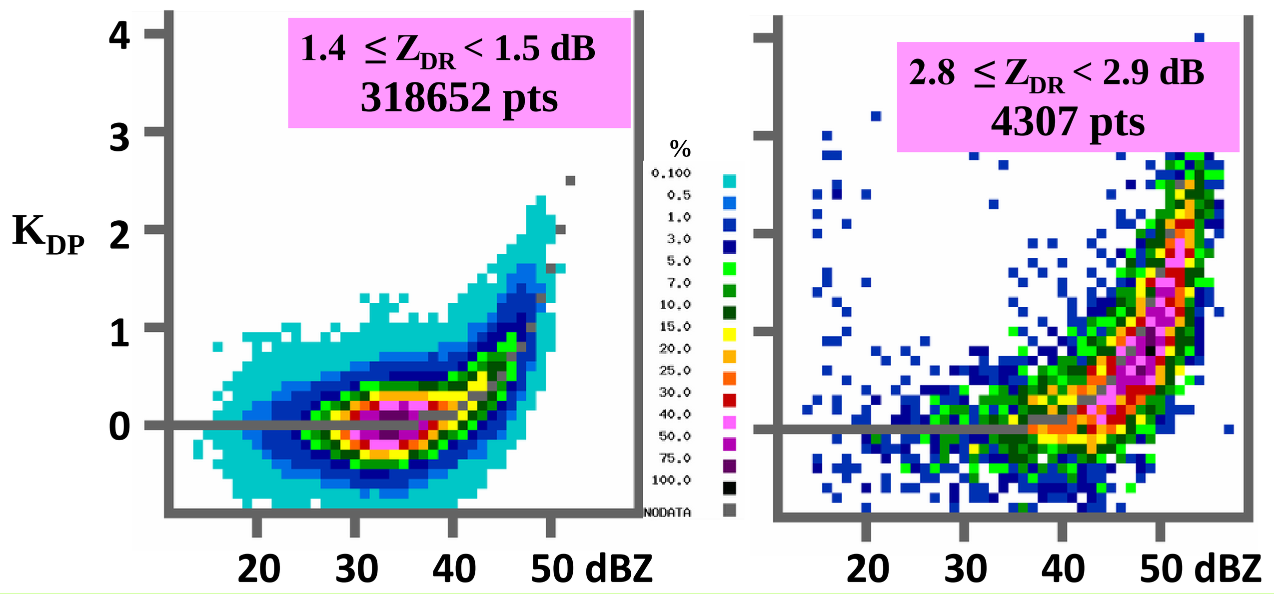
Scatter plot of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ for paths with $0.7 \leq Z_{DR} < 1.4$ dB. ε= 0.07 dB. ε remains nearly unchanged (-0.15 dB) for paths with $\Phi_{DP\text{-}theor}$ < 5° (Plot not shown).



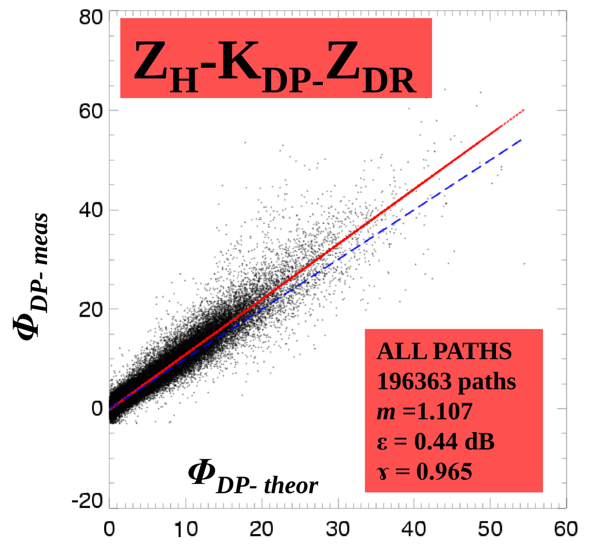
Scatter plot of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ for paths with $1.4 \leq Z_{DR} < 2.1$ db. ε =-0.43 dB. ε essentially unchanged (-0.40 dB) for paths with $\Phi_{DP\text{-}theor}$ < 10° (Plot not shown).

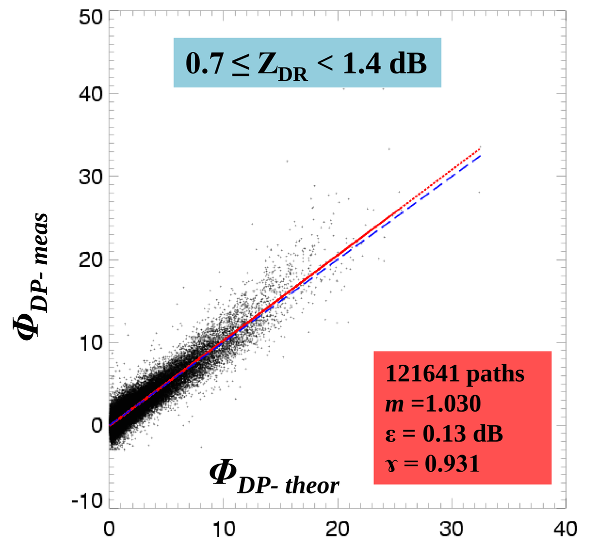


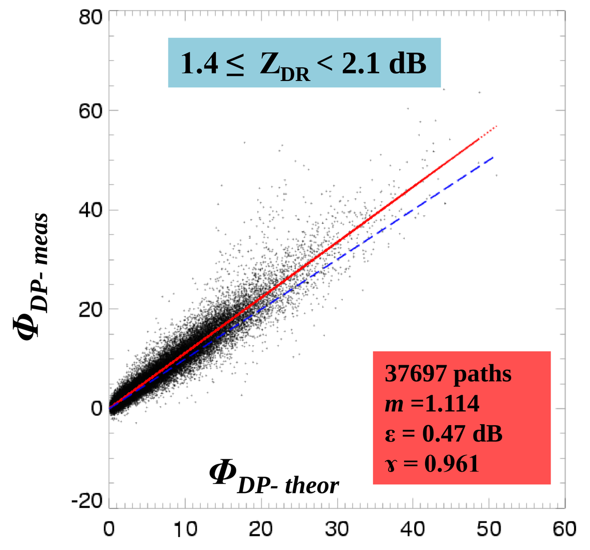
Scatter plot of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ for all paths with $Z_{DR} \geq 2.1$ dB. ε =-1.93 dB. ε increases slightly to -1.55 dB for paths with $\Phi_{DP\text{-}theor}$ < 20° (Plot not shown)

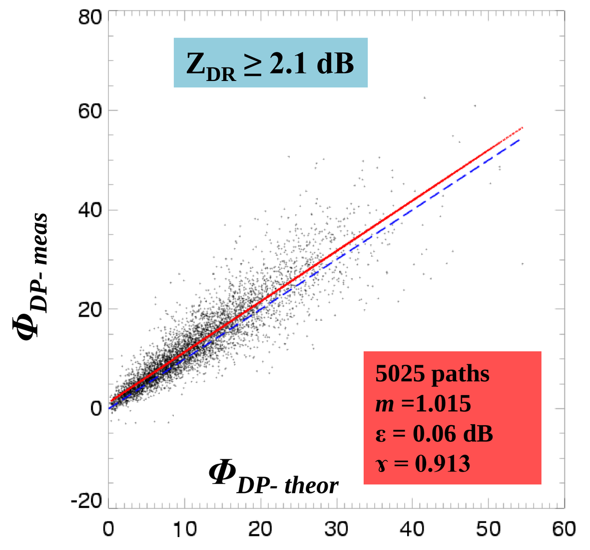


Distributions of observed K_{DP} vs observed Z_H for all paths within the indicated Z_{DR} interval, normalized to 100% at the (K_{DP},Z_H) pair of greatest occurrence. The grey pixels through the distribution represent the selected Z_H-K_{DP} relationship. K_{DP} is overestimated at high Z_{DR}.









Scatter plots of $\Phi_{DP\text{-}meas}$ vs $\Phi_{DP\text{-}theor}$ differences obtained with the Z_H-K_{DP}-Z_{DR} relationship derived by Vivekanandan et al. (2003) for the same 3-month data set stratified by the average Z_{DR} over the path. Φ_{DP} differences are better predicted for all ranges of Z_{DR}.