Verification of the S-PolKa DYNAMO $K_a$-band reflectivity by comparison to S-band

In order to verify the Ka-band reflectivity (Z) calibration, comparisons of the S-PolKa S-band and $K_a$-band Z values measured during DYNAMO were performed using a modified version of the Radar Estimated Profiles of Humidity (REPoH) algorithm. Comparisons were made on days in October, November and December. The table showing the results is below, listed are: the date/time; mean bias between S- and $K_a$-band Z; the variance; and number of comparisons. The results show that the $K_a$-band Z appears calibrated well relative to the S-band Z within the accuracy of the comparison methodology (expected to be ~0.5 dB).

| Date/time | Mean bias (dB) | Variance (dB) | Number of comparisons |
|---|---|---|---|
| 2011 1223 0605 | 0.12 | 0.66 | 15 |
| 2011 1223 1050 | 0.05 | 0.73 | 6 |
| 2011 1223 1020 | 0.45 | 0.23 | 3 |
| 2011 1223 1605 | 0.08 | 0.26 | 14 |
| 2011 1223 1650 | 0.11 | 0.13 | 5 |
| | | | |
| 2011 1008 2005 | -0.33 | 0.056 | 5 |
| 2011 1017 1720 | 0.39 | 0.40 | 12 |
| | | | |
| 2011 1106 1920 | 0.28 | 0.89 | 6 |
| 2011 1107 2335 | 0.22 | 0.78 | 12 |

REPoH compares measured S-band and $K_a$-band Z to make estimates of gaseous attenuation over long paths. This makes REPoH a useful tool for S- and $K_a$-band Z comparisons in general. To minimize the impact of gaseous attenuation, the REPoH algorithm was modified to make Z comparisons at short ranges to the radar. The 2-way atmospheric attenuation is very strong at DYNAMO, on the order of 0.5 dB/km, and must be taken into account even with short ray path lengths. Due to the spatial and temporal variability of humidity that was demonstrated in the sounding data (balloon and dropsondes), the comparisons were limited to areas close in space and time to the Gan soundings in an attempt to accurately account for the gaseous attenuation. Therefore REPoH was set up to make comparisons at a range interval of 3 to 10 km in a region within 20 degrees of the Gan soundings. Gan had 3 hourly soundings so the nearest measurement was at most 1.5 hours different than the analysis time. Using the soundings the gaseous attenuation was estimated using the microwave propagation model of Liebe (1985).

Each Z comparison is made over an average of at least 15 range gates selected objectively by the REPoH algorithm. The averaging is done to reduce the impact of the measurement variances of Z in the comparison. Several thresholding criteria are applied to the data to eliminate contamination from Mie scattering, biological scatterers, Bragg scattering among other data quality artifacts. A description of the criteria can be found in Ellis and Vivekanandan (2010).

Outliers in the Z comparison occurred at about the same frequency as the real-time REPoH humidity retrievals and were discarded. These outliers are assumed to be radar artifacts that are

not properly removed by the thresholding criteria currently used in REPoH. More investigation is needed.

References

Ellis, S. M. and J. Vivekanandan, 2010: Water Vapor Estimates Using Simultaneous Dual-wavelength Radar Observations. *Radio Sci*., **45**, doi:10.1029/2009RS004280.

Liebe, H. J., 1985: An Updated Model for Millimeter Wave Propagation in Moist Air. *Radio Sci.*, **20**, 1069-1089.