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Use of Specific Differential Phase (Kdp) for Rain Rate Estimation in the UK

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The programme to upgrade the Met Office's UK weather radars to provide them with dual polarisation capability is nearing completion. One of the key goals, since the first upgrades in 2012, has been to utilise the dual-polarisation data to improve the accuracy of the Quantitative Precipitation Estimates (QPE) which are routinely generated within the Met Office's radar data processing system, Radarnet.

There is already a large body of published work describing the use of specific differential phase (KDP - the range derivative of differential phase, φDP) as part of an R(KDP) rain rate estimator, and generally the reported results have been positive. One of the key advantages in using an R(KDP) relationship is that it is less sensitive to drop-size distributions than the widely-used reflectivity-based R(Z) relationships, and its accuracy is less hampered in this sense. The flip side is that at low rain rates, φDP is noisy, and therefore KDP is not suitable for use for rain rate estimation.

In this paper, we describe the technical implementation of a new QPE scheme, which adopts the hybrid approach – making use of an R(Z) relationship at low and medium rain rates, whilst employing an R(KDP) relationship at higher rain rates. We look at the impact of incorporating this new scheme into Radarnet – where it has been running operationally since November 2015 – by analysing performance both during shorter-term high-impact weather events and longer-term routine monitoring. Here the radar QPEs are compared with measurements from a country-wide network of tipping bucket rain gauges. It is found that during routine weather, the new scheme results in no detriment (or a slight improvement) to the radar QPE performance. For the higher-impact events, it can result in reductions in root-mean-squared-error (RMSE) values of up to around 25% overall, or significantly more when only higher rain rate thresholds are considered.