13.6 INVESTIGATION INTO USING A NEURAL NETWORK TO SELECT BETWEEN USING FILTERED OR ALOFT MEASUREMENTS TO IMPROVE QPE IN CLUTTER CONTAMINATED REGIONS

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A major source of errors in quantitative precipitation estimation (QPE) comes from the fact that radar measurements are made aloft, whereas rainfall estimates at ground level are the quantity of interest. While the Met Office makes corrections for the vertical profile of reflectivity (VPR) in order to better estimate surface precipitation rates, it is known that the errors associated with this correction increase with altitude.

The application of ground clutter filters allows the use of more low elevation data than would be possible otherwise. However, it is known that in some meteorological conditions, ground clutter filtering can bias the reflectivity measurements. This can particularly be an issue when dealing with the low maximum unambiguous velocities associated with C-band rain-rate optimised pulse repetition frequencies (PRF).

As part of the collaboration between the Met Office Radar Systems team and the National Severe Storms Laboratory (NSSL) Advanced Radar Techniques team, the Clutter Environment Analysis using Adaptive Processing (CLEAN-AP^{TM}) [Torres and Warde 2014] and Weather Environment Thresholding (WET) algorithms have been implemented as the ground clutter mitigation solution on the Met Office Cyclops-D signal-processing system.

In this work we develop and evaluate a classifier to increase the accuracy of QPE by selecting radar data from CLEAN-AP/WET filtered low elevation scans, or higher elevation scans with a larger less accurate VPR correction. Supervised training of the classifier is carried out using a large dataset of synthesized volumetric tiles corresponding to a wide range of weather and clutter signal parameters. It is important that each tile preserves local spatial structure of the radar data fields, as well as contains data from each scan elevation. Each tile is generated by superposing I&Q data from un-contaminated weather echoes and clutter-only echoes. Using this method, for each tile, a VPR-corrected surface QPE can be computed from the un-contaminated, un-filtered superposed and filtered superposed data at each scan elevation. A ground-truth surface QPE is computed from the un-contaminated low elevation radar data. This allows the training set to be labeled with the elevation and filter selection that results in the minimum QPE error. A multi-layer perceptron network is trained using back propagation to allow a near-optimal selection to be made when the ground-truth is unknown; this results in an improved surface QPE.