Radarnet IV Algorithm Development: Project Outcomes II October 2009

The Radarnet IV algorithm development project aimed to improve radar precipitation rate data quality by upgrading the algorithms used to process weather radar data. Five proposals were chosen by radar data users at a workshop in 2007:

- Using data from several elevation scans (as opposed to just one) to improve the corrections made for the vertical profile of reflectivity.
- Compositing directly from polar single site radar data.
- Using a different method to composite radar data.
- Using additional channels available from Meteosat second generation (MSG) satellite to generate alphas used for anaprop removal.
- Diagnosing anaprop in radar data using CI data.

Of these proposals, two have presented an improvement to the quality of radar data and are described in more detail below.

Polar compositing

The new polar compositing method has given rise to a significant improvement to the quality of weather radar data, allowing much finer detail to be resolved in precipitation as seen in Figure 1. Previously, radar data was re-sampled from a polar to a Cartesian grid for each radar by averaging the polar cells whose centres were within each grid square. 5 km, 2 km and 1 km resolution Cartesian single-site products were being generated out to 255 km, 100 km and 50 km from the radar respectively and the data with the lowest sample volume were selected for each grid square in the composite.

The new algorithm uses polar data directly to create the composite; this allows any loss of data quality associated with re-sampling to occur as late as possible in the processing. Now data from the radar with the lowest sample volume can be used in a weighted average for each 1 km grid square. The weights depend on the range of the centre of each polar cell from the centre of the 1 km grid.

In summary, the algorithm allows better use of the information received from the weather radars and reduces the amount of information discarded. Comparisons with rain gauges have shown improved performance by the new 1km product when compared with the previous merged 1/2/5 km resolution product.

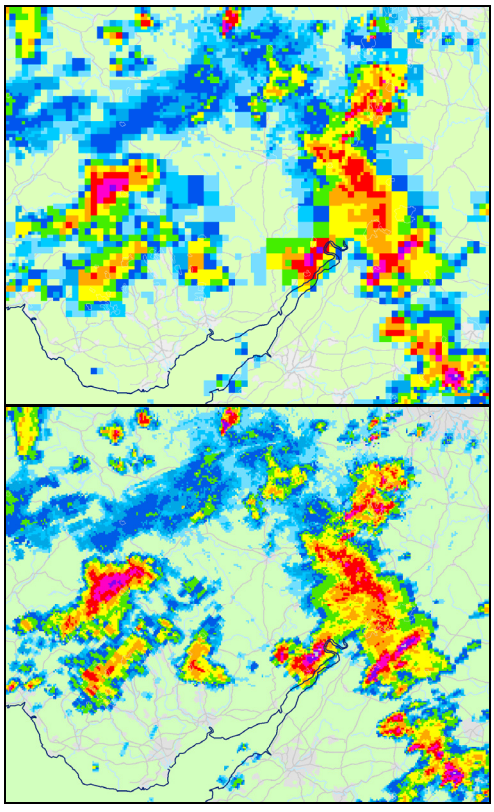

Figure 1: (above) 1 km product used previously, (below) New 1 km product using new polar compositing method.

MSG Alphas

Alphas are analogous to a set of odds, equal to the probability of precipitation divided by the probability of no precipitation, generated using satellite data (Pamment and Conway, 1998). Where there is less than a 50/50 chance of precipitation, any co-located radar echo is flagged as spurious. This method already removes many anomalous propagation echoes as well as other spurious echoes such as birds or residual ground clutter. An example of alphas data during frontal precipitation is given in Figure 2.

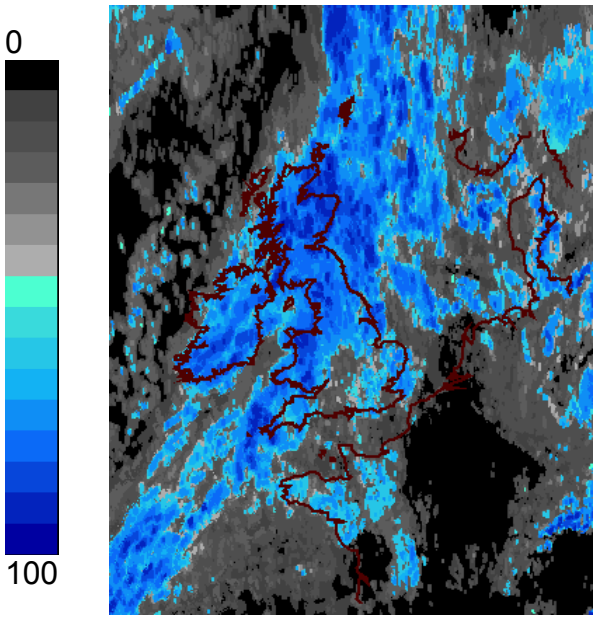

Figure 2: Example of alpha values derived from satellite data for the UK nimrod domain (100 = high probability of precipitation, 0 = low probability of precipitation).

Alphas are derived empirically and are defined as the ratio of two conditional probabilities (Cheng et al, 1993). The first being the probability of a grid point containing precipitation, given a satellite observation of the grid point and the latter being the probability of a pixel containing no precipitation given the same observation.

Satellite data has been used for a number of years as a means of identifying spurious echoes in weather radar data. Other data sources were used in combination with satellite data (synoptic data and advected alpha values); due to the low temporal resolution of the first generation satellite data and the reduction in the skill of the alphas after sunset (reduced number of channels - Infra-red only). However the data from the second generation satellite has a higher temporal resolution and offers more channels from which to derive the alphas.

The improved product which makes use of additional satellite channels has shown benefit in the final precipitation rate products, reducing the false alarm rate at the higher precipitation rate values due to its increased skill at diagnosing areas with a low probability of precipitation.

Pamment, J. A. and B.J. Conway. Objective identification of echoes due to anomalous propagation in weather radar data. J. Atmos. Ocean. Tech., 15: 98-113, 1998.

Cheng, M., R. Brown, and C. Collier. Delineation of precipitation areas using Meteosat infrared and visible data in the region of the United Kingdom. J. Appl. Meteo, 32:884_898, 1993.

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