P6B.8 RAINFIELDS: THE AUSTRALIAN BUREAU OF METEOROLOGY SYSTEM FOR QUANTITATIVE PRECIPITATION ESTIMATION

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1 Introduction

The Australian Bureau of Meteorology has developed a new system for quantitative radar rainfall estimation as part of the Radar Network & Doppler Services Upgrade Project. This project will deliver improved forecasts of severe weather phenomena and quantitative precipitation estimation to the general public though the Bureau web site as well as providing improved rainfall estimates for river and flash flood warning services. A number of applications are integrated into the nowcast server which is a single end-to-end system; TITAN (Dixon and Wiener 1993) is used to generate storm tracks, TIFFS (Bally 2004) is used to automatically generate text messages for severe weather warnings, WDSS (Eilts et al 1996) is used to detect mesocyclone circulations, and rainfields is used for quantitative rainfall estimation and forecasting. This paper will highlight some of the technical and scientific aspects of the rainfields component.

2 System design

The basic aim of rainfields is to be able to serve grids of geo-referenced rainfall data or averages over user-defined catchments to a wide range of clients in a convenient form. The data are archived in a database and are served to clients as XML-based messages through the SOAP protocol. The database recognizes fields of radar reflectivity, rainfall depth, forecast rainfall, and advection and, in the case of rainfall, serves grids or spatial averages over user-defined catchments for arbitrary accumulation periods together with ancillary geo-referencing information. All parameters that are required for each radar are stored in a data base and a web-based interface has been developed to examine and modify these parameters for each radar.

3 Radar Quality Control

The raw reflectivity is returned from the remote radars to the nowcast server in the form of volume scan data. Rainfields performs the following basic quality control on these data:

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3.1 Ground and Sea Clutter

Some ground clutter breaks though the Doppler filters that are applied by the signal processing system at the radar. These echoes are reduced through the use of masks that contain the probability that a bin in the volume scan contains clutter and by evaluating the vertical profile of reflectivity. Bins that are deemed to be clutter are flagged and excluded from further analysis. Figure 1 shows the probability of observing clutter in the base scan of the Adelaide radar.

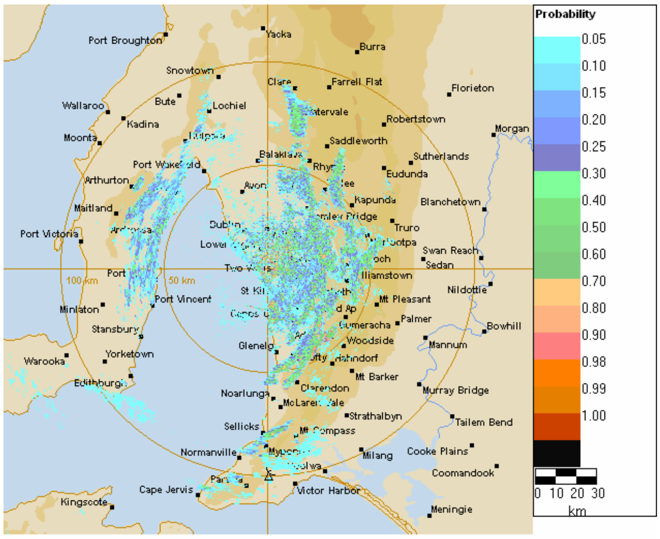

Figure 1 Probability of observing clutter in the 0.5° elevation scan of the Adelaide radar.

3.2 Partial Beam Blocking

A digital elevation model is used to estimate the loss of power due to topography for each bin in the volume scan. The loss of power is calculated by integrating the beam power over the area of the beam that is below the level of the topography, assuming a standard atmosphere. The lost power is added to a polar bin if it is calculated to be less than 3dB, or the bin is marked as clutter if the loss is greater than 3 dB.

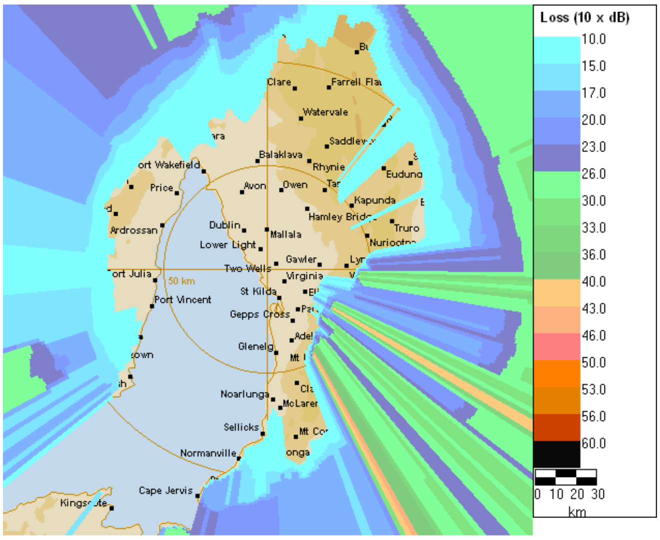

Figure 2 Partial occultation in the in the 0.5° elevation scan of the Adelaide radar.

3.3 Constructing the CAPPI

The CAPPIS are constructed using a Kriging interpolation technique (Seed and Pegram, 2001, Wesson and Pegram, 2006) that takes into account the anisotropy between the vertical and horizontal variability of radar reflectivity and the convolution of the beam pattern with vertical profile of reflectivity. The mean vertical profile is calculated using non-zero echoes that are less than 50 km from the radar and this is used to calculate the effective vertical profile for ranges beyond 50 km.

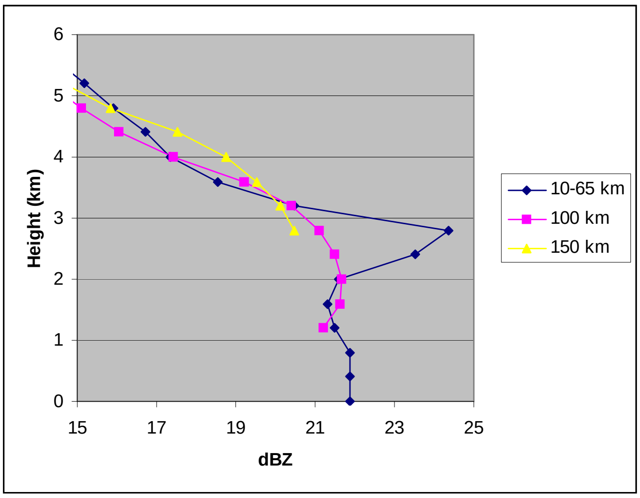

Figure 3 An example of the convolution of the mean vertical profile with the beam pattern at 100 km and 150 km from the radar.

4 Converting Reflectivity to Rainfall

The radar reflectivity field is classified into stratiform and convective rainfall using the Steiner et al. 1995 technique and then each pixel in the Cartesian map is converted into rain rate based on two Z-R relations. Thereafter, the 10-minute rainfall depth is calculated by advecting the rainfall intensity field backwards over the 10-minute period using a field of advection vectors that are derived using the optical flow technique of Bowler et al. 2004.

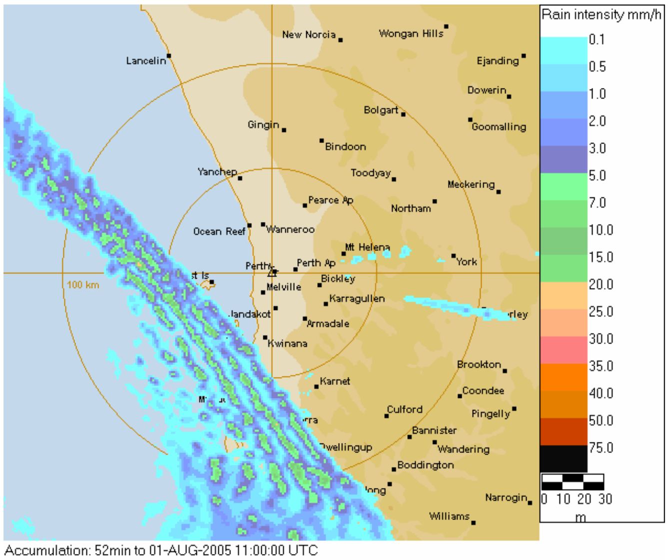

Figure 4 Example of a 60-minute rainfall accumulation with no field advection.

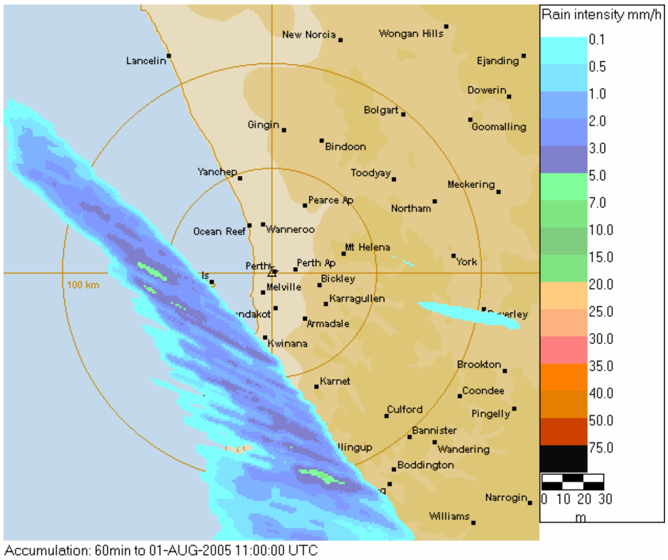

Figure 5 Same as above, but this time using field advection in the accumulation.

Finally, a Kalman filter is used to update the current estimate of the mean field bias at hourly intervals (Chumchean et. al. 2006). The mean field bias is stored as an attribute in the database and is applied to the field at the time the server is required to provide data to a client. Real-time performance indicators are provided to the client applications in the form of summaries of mean field bias, mean standard error, and number of raining gauges for the preceding hour.

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