P13B.15 THE AUSTRALIAN WEATHER RADAR NETWORK: CURRENT AND FUTURE CHALLENGES

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1. INTRODUCTION

This paper looks at long term directions in the Australian weather radar network. It starts with a brief description of the network's history, from its origins as an upper air wind-finding network, through to the extensive and sophisticated network we have today. It considers a number of challenges currently being addressed, including management of competing user requirements, and concludes with a synopsis of a current review of the radar network, which is aimed at improving radar coverage and weather services in Australia.

2. HISTORY

The early discovery that wind-finding (balloon-tracking) radars were also efficient at tracking precipitation patterns, and the opportunity this presented for improved tropical cyclone warnings over Australia's northern coastline, has shaped the evolution and development of Australia's weather radar network over the past 60 years. It wasn't long after the purchase of the Bureau's first 277F naval radars in the 1940s that wind-find radars were discovered to be efficient at weather watch and tropical cyclone detection also. Their ability to target storms cells also provided research scientists with innovative data with which to study the extent and movement of precipitation. Consequently, the value of using these radars for weather watch was immediately obvious, and in the 1960s the Bureau purchased the MARCONI SNW51, the Bureau's first dedicated weather watch radar. By the early 1980s the Bureau's original 277F radars required urgent replacement, so in 1981 the Bureau received its first C-band radar. Over the following 25 years, the Bureau installed 43 C-band radars and 17 S-band radars (plus 3 high resolution Dopplers) across Australia.

Today the Bureau operates 63 radars, including 30 dedicated to weather watch, providing real-time data for forecasts, warnings and quantitative applications (Figure 1). The rest of the network comprises dual role radars which perform both wind-finding and weather watch functions.

3. CURRENT CHALLENGES

The steady growth of quantitative applications based on radar data, for example radar-derived rainfall estimates, and the ensuing dependence and popularity of these applications with forecasters and the general public, have put pressure on the Bureau's radar network managers to continuously improve the performance of its weather radars, to provide consistently high quality data, and at the same time balance the needs of all the Bureau's radar data users.

Due to the increasing importance of quantitative radar-based applications for hydrological and weather services, concerted effort is going towards ensuring the delivery of consistently high quality data. Signal processing techniques used to improve data quality include Discrete Fourier Transform (or frequency domain filtering) for the removal of ground clutter, and the Joe and May algorithm (Joe and May, 2003) for velocity dealiasing. Radars are calibrated 6-monthly according to the Bureau's engineering maintenance policies, and calibration metadata is archived in a centralised database. Currently the Bureau is reviewing its calibration and maintenance policies for radars and radomes, with the aim of improving radar pointing accuracies and reducing signal attenuation.

Due to the magnitude and complexity of Australia's radar network, the Bureau has endeavoured to implement a standard set of radar configurations, however this has proved to be a major challenge due to the need to optimise each radar given the local climate and topography. The Bureau's newest high resolution Doppler radars provide an additional challenge - finding a balance between unambiguous range and Nyquist velocity, and clear air data versus rapid update cycles (Gunn et al., 2007).

Lastly, but perhaps most critical, is the considerable challenge faced by the Bureau in protecting its weather radars from radio frequency interference. Emerging issues include interference to C-band radars from wireless LAN devices and lobbying by the telecommunications industry to acquire additional spectrum in the S-band for IMT 2000.

4. FUTURE

The growth of Australia's weather radar network does not look to be slowing, with work underway on the Bureau's own 2nd generation digital receiver technology, and a radar network review which aims to improve radar coverage for Australia.

The Radar Engineering Group in Melbourne is actively working on a 2nd generation digital receiver

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system which builds on the single channel (horizontal polarisation) digital receiver system currently installed at several radars. The new system will deliver an increase in the number of receiver channels, allowing dual polarisation, dual role (weather watch and wind-finding), and will also be suitable for wind profilers. These hardware improvements will result in greater spatial resolution and an increase of approximately 15dB in dynamic range. A prototype is expected to be available by early 2008.

While radar coverage of Australia has been improved due to the Bureau's most recent radar upgrade project (Jarrott et al., 2007), there still remain significant parts of Australia which have no or inadequate weather radar coverage and therefore inadequate warning of approaching severe weather. Add to this the increasing demand for quantitative rainfall measurements, and it is clear that there is a need for improved radar coverage across Australia. To address this issue, a radar network review is currently underway, which aims to identify gaps in radar coverage, and explore improvements that would bring significant benefits to the Australian community. Proposed developments will be subject to a systematic assessment of benefits versus costs.

5. CONCLUSION

In this paper we describe the evolution of Australia's weather radar network, from it's foundations as an upper-air wind-finding network, through to today's network which provides processed real-time data for the public, forecasters and for quantitative hydrological and weather applications. The in-house designed 2nd generation digital receiver for which a prototype is expected in early 2008, and the current radar network review which aims to identify gaps in Australia's radar coverage will contribute further to the evolution of the network.

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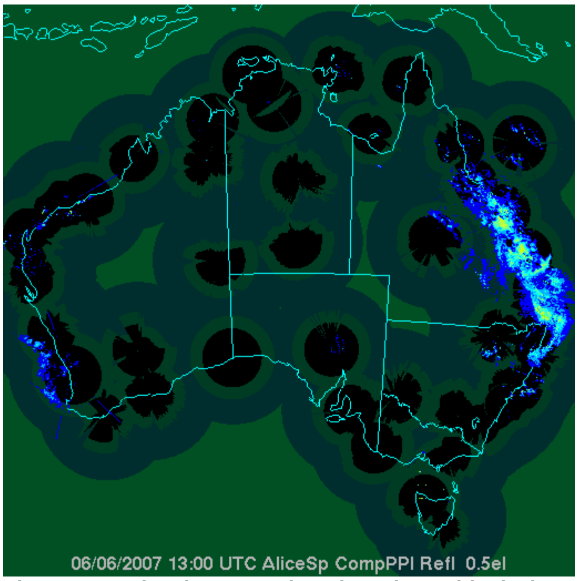

Figure 1. Radar data mosaic, where inner black rings define radar coverage at 1000m altitude.