

The move to quantitative radar measurement in the Australian Bureau of Meteorology

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The provision of weather and hydrological services associated with quantitative rainfall and severe weather are of increasing importance to the Bureau, which has recently received significant funding to upgrade the Australian Radar network of 50 radars. Service improvements in these areas will rely on the quantitative and automated applications based on the use of high quality radar data. These quantitative and severe weather products are required by a range of users including severe weather forecasters, hydrology and the aviation industry.

The move away from current qualitative processes towards the quantitative use of radar data for both severe weather and rainfall estimation applications implies that new and more stringent demands will be made of the weather radar network in terms of both data quality and availability. The focus of the paper is largely on what radar signal processing is required within an end to end conventional Doppler system, but related longer term and operational issues are also discussed.

In this context it is important to remember the utility of a radar network depends on a number of inter-related issues. They include the location of the radar, the type of radar and size of the antenna, scanning strategies and operational standards, the signal processing used to digitise the returned signals, and finally the algorithms used to generate products.

There is a conflict between the operational requirement for a uniform radar specification and antenna programme throughout the radar network, and the need to optimize each radar given the local climate and topography. This becomes a significant issue in Australia, which has radars from the tropics to the mid-latitudes.

Although dual polarisation has only been used for research application so far, it is clear from this research that dual polarisation offers considerable advantages. These include accurate rainfall estimates of convective rain, the detection of damaging hail and improved quality control. There are also potential advantages in areas with significant orographic rain. The latter will be a prime area of research and development with the CP2 radar. Note that the US NWS is currently upgrading the WSR-88D (NEXRAD) network to include polarimetric capability. The Bureau is several years from deploying

such radars operationally, apart from the CP2 radar in Brisbane that will be quasi-operational. However, decisions made now impact the future. Dual polarisation places stringent demands on the quality of the antenna and radomes in particular, so current designs should allow for polarimetric upgrades without the replacement of such expensive items. High quality antennas and radomes will make a significant contribution to quantitative rainfall estimation in any event, so benefits will accrue from these components even if the decision not to move towards dual-polarisation is made at some stage in the future.

Future radar products will include high quality mosaics of radar data. This in turn has implications for the radar operation and maintenance as this ideally requires volumetric scanning and calibrated radars. The new digital receiver system that has been developed in radar section offers the capability of correcting for the affects of second trip echoes, overlaid echoes, optimal estimation of both reflectivity and Doppler velocity, clutter suppression etc that will lead to high qualitative quantitative products. The approach to obtaining the best quality Doppler and reflectivity data possible will be discussed.

All the new radar systems will be capable of employing dual PRT (pulse repetition time) techniques to minimise issues related to the Nyquist velocity of the radar. These methods produce some speckle in the data, but algorithms to correct this are well developed. A simple algorithm is currently in use on the Kurnell radar and a slightly more complex algorithm is used operationally in Canada (see Joe and May, J. Atmos. Oceanic Tech, 2003). This produces high quality data suitable for both manual and objective analysis.