11B.2 QUANTITATIVE APPLICATIONS OF BROADCAST MEDIA WEATHER RADAR DATA

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1. INTRODUCTION

This paper explores a collaborative effort between the University of Missouri – Columbia, KRCG-TV and the Premier Marketing Group that owns and operates a weather radar in Mid-Missouri. Columbia is a city of approximate population 100000 located almost equidistant between the St. Louis (KLSX) and Kansas City (Pleasant Hill – KEAX) NWS WSR-88D radars. The use of a locally situated radar allows for a number of potential advantages over radars located at range, even when those radars are superior in other ways. In particular the radar can reveal precipitation features at higher resolution and lower levels than the NWS radars, as well as low-level boundaries that serve to enhance severe weather development. This should allow the use of the radar data for improved severe weather warning, cold season precipitation observation and warm season precipitation estimation. These observations are of potential benefit to the local transport and agricultural communities, as well as the general population. In combination with NWS radar data exploration can be made of low level evaporation effects and the accuracy of rain and snowfall estimation at long range. The possibility of using RHI scans in severe weather situations is explored.

This paper discusses the format of the collaboration currently underway, how the project is expected to benefit both the media group and the University and the particular applications of the radar data that will be examined. The benefits to the media group and University relate to their mission of community support, while there are educational benefits to students in the atmospheric science program. These objectives should be applicable to many radar installations across the USA.

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KRCG-TV and the radio stations of the Premier Marketing Group cover the mid-Missouri area including the cities of Columbia and Jefferson City, as well as a number of other sizable towns. The total population is about 250000 and KRCG is rated as the 129th largest TV market in the USA. The radar itself is situated at Fulton, 20km to the east of Columbia and a similar distance north of Jefferson City.

2. ADVANTAGES OF BROADCAST RADARS

The major advantage that a broadcast radar may have is that it may be closer to the area of interest than the network radar. Naturally the majority of major population centers in the USA have good Nexrad coverage, but there remain some with populations significant enough to support TV stations large enough to operate a radar which do not have such coverage. Of these Mid-Missouri is a good example. Although within range of three NWS radars (St. Louis, Kansas City and Springfield, MO) the closest is approximately 140km distant and, therefore, the lowest elevation of any of the radars is at an altitude of approximately 3km. The broadcast radar is capable of observing features well below this level and these can be of great use in many circumstances. Similarly, the network radars at range have a poor horizontal resolution, prohibiting them from detecting small scale features, be they in the reflectivity or velocity field.

Another possible advantage of media run radars is that they need not perform a fixed scan sequence. There is a requirement, particularly during severe weather episodes, that the radars provide imagery for broadcast, as well as information for broadcast meteorologists. This means that for the vast majority of the year the radar may be left to perform a regular low elevation PPI that will produce a regular near-surface precipitation estimate with greater frequency than the Nexrad radars that have to perform volume scans.

Alternatively, one can remove the radar from a regular scan strategy altogether in order to 'target' particular features. Unlike Nexrad radars they are not required to continue on a fixed scan strategy to serve a wide area in a regular manner and feed into other tools. For example broadcast radars can perform sector scans to investigate particular storms or areas more frequently. In severe weather this can provide more rapid updates on the development of storms, in non-severe weather one can observe precipitation rates more frequently leading to better estimates of rainfall accumulations.

3. USES OF BROADCAST RADARS

There are three broad areas in which radars outside the national network may be of assistance. All of these derive their benefit from the proximity of the radar and its ability to observe precipitating systems closer to the surface. In particular there are applications to the observation of cold season precipitation, warm season precipitation and severe weather.

3.1 Cold season precipitation

The major problem exhibited by radars attempting to assess conditions at long range during the winter is that of precipitation being below the beam and the extrapolation of measurements made above the melting layer to surface precipitation rates. It is possible that a beam at a height of 2.5km can overshoot all significant hydrometeor concentrations making it impossible to ascertain precipitation rates at the surface. This is not an uncommon occurrence in Mid-Missouri.

There are also situations involving freezing rain and orographic growth, which, while not a particular problem in this area, may be aided by radars that can observe closer to the surface.

3.2 Warm Season Precipitation

The majority of precipitation in Mid-Missouri falls as warm season convective rain. However assessing the exact quantity of precipitation is problematic as, apart from the regular problems encountered when attempting to retrieve convective rainfall rates using reflectivity radar, the atmosphere is often warm and unsaturated at low levels leading to evaporation of precipitation and, in extreme cases, virga. This can lead to overestimation of rainfall totals when using a radar at distance. Accurate estimations of summer rainfall are important to the agricultural producers in this region.

3.3 Severe Weather Applications

Some of the main indicators of the nature, progression and development of severe weather systems can only be observed at low levels and / or at high resolution. Included amongst these are low-level rotation, small-scale rotation and the position and motion of low-level boundaries relative to convective storms.

The probability of detecting the signatures that may indicate the presence of mesocyclones and tornadic circulations is increased by proximity. The observation of these rotations extending toward the surface is a strong indicator of tornadogenesis.

If one is concerned with trying to determine whether a storm will persist, develop or dissipate then the ability of the radar to observe low reflectivity features, in particular boundaries, at low elevations is critical. Broadcast radars have this ability in areas where Nexrad radars may not.

Generally the radars are set to low level PPI and therefore scan at the lowest elevation more frequently than a network radar that must scan a range of elevations. There is no constraint as to how the radar can be used and therefore one can perform sector scans to obtain even more rapid observations of developing storms. One could also envisage obtaining RHIs to look at structures in thunderstorms (and possibly tropical storms) such as BWERS and elevated hail cores. However, in order to do this one must have a person with the ability and time during a severe weather outbreak to control the radar, with an eye on remembering that the primary use of the radar is to provide the best graphical information possible to appear on-air as a service to protect viewers from the hazard. Balancing these needs and the time constraints of a broadcaster who has to set up the graphics, refine the message and spend a large proportion of the time on-air during severe weather, is problematic. Our work seeks to study the possible interactions and use of the radar during severe weather without interfering with the primary broadcast need.

4. PROBLEMS OF BROADCAST RADARS

A number of problems need addressing before one can start to use broadcast radar in a quantitative manner, and the collaboration between the University of Missouri and the media organizations seeks effective means of turning a potentially useful tool into one of enhanced benefit to the community of Mid-Missouri.

In order to use the data from the radar either to estimate cold season precipitation, and therefore fill what is effectively a gap in the network, or obtain better warm season precipitation estimates, calibration of the precipitation retrieval technique must be effected. In practice this requires the systematic collection of the radar data and intercomparison with Nexrad estimates and gauge measurements. As the radar routinely scans in a simple low elevation PPI the regular retrieval of precipitation rates is generally straightforward.

However, in instances where significant weather is taking place this routine may be broken as the radar is used to concentrate on features indicative of severe weather. As implied above there is a personnel consideration that needs to be addressed when the radar is used in anything other than its routine PPI scan mode. Of primary concern is the necessary operation for the TV station which, in severe weather situations, means that the radar imagery be available for on-air transmission at all times. Therefore the interruption of the regular scan to detect features that cannot be usefully broadcast becomes a risky endeavour.

4.1 Broadcasters perspective and attitude

The radar is a major expenditure for the broadcaster and they require benefit from that investment. In a competitive market radars are presented as a community resource and the sponsors of the radars also support this aspect. The broadcasters therefore have an interest in supporting educational initiatives and community resources, hence any usage of data collected by the radar that aids community safety is viewed as supporting the broadcasters mission. Knowing that the radar of the particular station is being used in this quantitative manner will, in theory, encourage more viewers to tune in to that station's weather broadcasts, especially during severe weather. In that way the station wins and the public obtain the best advice.

5. THE EXAMPLE OF STORMLINK RADAR

The Stormlink Now radar at Fulton, MO is a Baron Services HDD250™. It is high powered with a 1° beamwidth. One can ascertain that it can provide better coverage than the Nexrad radars in terms of beam proximity to surface and / or resolution at an approximate range of 30km to the east (in the direction of the KLSX radar) and 50km to the west (toward the KEAX radar).

5.1 Examples from 4-10 May 2003

During the week of 4-10 May 2003 a series of tornado outbreaks struck the Central US and Mid-Missouri was one of the areas most affected. On several occasions there were a number of severe storms moving into and through the area simultaneously. Warnings made on a county basis cover wide areas and lead to the sounding of sirens in many areas not under threat and this puts pressure on the media to provide accurate information regarding exactly which storm cells are of concern to which locations and why. Identifying those storms that had rotation allowed meteorologists to categorize and rank storms by importance and many times this occurred when the lowest levels of the storms were not observed by Nexrad radars and after dark, when spotters cannot be used.

There were frequent occasions during the evening of May 6 when velocity fields from the Stormlink radar were used to identify low-level rotation that was not detected by the Nexrad radars. Therefore. Although tornado warnings were being issued by the NWS for storms with detected rotation on the county basis, at a more local level broadcasters were able to pinpoint precisely those storms that carried the greatest threat and convey that information to the public.

6. CONCLUSION

Media owned and operated weather radars are a potentially powerful, but underused, resource. The radars in question would have been considered adequate for operational use a few years ago and the information they provide can, with careful application, be of high quality. Work is required to turn this potential into reality, but the benefits of doing so may be great. These benefits will be to the communities and users of weather information in the vicinity of the radar. There is also benefit to the media organization and there is no reason why that benefit cannot be translated to the wider meteorological community.

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