8.9 ASSESSING THE IMPACT OF ADVANCED NOWCASTING SYSTEMS ON SEVERE WEATHER WARNING DISSEMINATION

[1]Neil Fox[*], [2]Ewan Mitchell, [2]Peter Dunda, [3]John Bally, [3]Geoff Freeman, [4]Clive Pierce, [1]Michael Sleigh, [5]David Sills and [3]Tom Keenan

[1]University of Salford, Greater Manchester, UK.
[2]Bureau of Meteorology, Sydney, Australia
[3]BMRC, Melbourne, Australia
[4]JCHMR, The Met Office, Wallingford, UK.
[5]Meteorological Service of Canada, King City, Canada.

1. INTRODUCTION

One of the objectives of the Sydney 2000 Forecast Demonstration Project (Keenan *et al*., 2001) was to investigate the manner in which nowcast products can be presented to operational forecasters and whether they are capable of having an impact on severe weather forecasting. Bally *et al*. (2001) describe the web-based display by which forecasters could access nowcasting information during the FDP. Warnings were semi-automatically dispatched to the State Emergency Service and 'BridgeClimb', a commercial operation conducting tours of the Sydney Harbour Bridge.

On 3 November 2000 a severe storm tracked across the Sydney Metropolitan area, causing significant damage due to hail and tornadoes (Sills *et al*., 2001). This paper presents an assessment of the benefit to forecasters afforded by the presence and accessibility of the advanced nowcasting systems, both in terms of the lead-time of warnings and their accuracy. In making this assessment the authors draw upon their observations on the day of the storm and the logs kept by both FDP participants and operational forecasters. The observations are discussed chronologically and the utility of each individual system highlighted at each stage of the storm. The impact on warning dissemination is discussed at the end.

2. STORM INITIATION

In the early stages of the storm development there were a number of possible areas where small cells were apparent and it was difficult to anticipate where one should focus attention. Early on (about 1130LT) the forecasters' attention was drawn to the presence of hail in a cell to the NW of Sydney by the WDSS and CARDS systems. This was the first indication of severe weather and although this area did not prove to be the most important it allowed a warning to be made earlier than would have been done otherwise as the hail was not noticed by the forecasters using conventional systems.

[*] Corresponding author address: Neil I. Fox, Telford Institute of Environmental Systems, Univ. of Salford, Salford, M5 4WT, UK; email: n.i.fox@salford.ac.uk.

The greatest benefit in the initiation stage was the identification of the cells most likely to develop strongly. This was achieved to some extent by GANDOLF, but most successfully by Autonowcaster. This system predicted the interaction between the most southerly of the cells visible at around1200LT and the sea breeze front. This led to a forecast of severe convection inland of Wollongong which proved very accurate. This was initially forecast to move to the east, but it was evident that there would be some steering of the cell along the sea breeze front. This information was conveyed to the forecasters and they were able to monitor the situation in this area and observe the rapid development earlier than they may otherwise have done. One could claim that this provided an opportunity to warn areas in the path of the storm of the probability of severe weather, and this was certainly the case for Campbelltown which was later hit by golfball size (4-5cm) hail.

3. STORM MOTION

The impression of users at the time of the event was that, although the tracking algorithms (WDSS and TITAN) did a good job, they were occasionally unstable in that they oscillated a little to the right of the left turning storm. Reviewing the track predictions afterwards reveals that this was a false impression and that the tracks were far less erratic than thought. During the critical, most damaging, phase of the storm the systems did an excellent job of forecasting the cell motion.

The important point seems to be that a single glance at a system output can be misleading. It is natural that for a given forecast the track may be in error, but by repeated viewing one can determine the turning of the storm (from the visible past track, even when the forecast track is in error) and an experienced forecaster can predict the motion well. The forecast tracks also formed the basis of the 'Thunderbox' (Bally et al., 2001) dissemination system and their reliability was therefore critical to the success of that system.

4. STORM DEVELOPMENT

The use of information to gauge convective development and forecast continued development is hard to assess. The systems specifically designed to diagnose these aspects (GANDOLF, Autonowcaster)

did not have accompanying display systems that enable the forecaster to access the information easily. To assess the current state of the cell and its development trend the forecasters, under the time constraints of a critical situation, used more accessible tools. The 3D rapic display enabled the forecasters to examine the overall structure of the storm, identifying features such as bounded weak echo regions (BWER), high altitude reflectivity cores and so on.

5. SEVERE STORM SIGNATURES

The provision of severe storm signatures was one of the great successes of the day. The CARDS algorithms for severe hail occasionally produced what were probably overestimates of maximum hail size, but it is difficult to disprove the presence of at least a small amount of 8 and 9cm hail. The empirical algorithm was an excellent indicator of the presence of large and giant hail. Early on in the storm 'golfball size' hail (4-5cm) was reported at Campbelltown and CARDS was flagging this at the time. This provides the forecasters with a level of confidence which is developed by confirmed reports of severe hail at that time. The CARDS giant hail detection was supported by evidence provided by WDSS and CPOL which identified the presence of severe hail (>2cm diameter) without estimating a maximum size. Having had the confirmed success of the system toward the beginning of the event this facilitated the forecasters' identification of hail within certain areas of the storm later in the event.

Most notable was the recognition of mesocyclone signature by CARDS and WDSS. This alerted the forecasters to the presence of strong rotation within the storm. This prompted the issuing of warnings for severe and damaging winds prior to the formation and reporting of the tornadoes. Mesocyclone signatures were recorded at the time that witnesses reported seeing tornadic vortices on the ground between 1600LT and 1700LT.

6. OTHER CELLS

A number of other storms were initiated during the course of the day. Although the main cell produced the most severe weather and the majority of the damage, other cells were significant. In a number of areas large hail was reported. The hail associated with these storms was well detected by the algorithms within the systems and their tracks were also well forecast.

7. DISCUSSION

Although there will be a full examination of the accuracy of nowcast products generated throughout the FDP (Brown et al., 2001), the evidence from this particular day suggests that the forecasters adapted to the new technologies and these were of major benefit. A further study is looking at the impact of the FDP products on the operational forecasts and warning dissemination, as well as the forecasters experience of using the products. The initial study of this one case has raised a number of issues with regard to the display of radar based products and the training and support required prior to and during implementation of novel systems.

8. CONCLUSION

It was clear that the advanced nowcast systems available during this event were of benefit to the severe weather forecasting team. In particular, certain aspects of the storm, including its initial development, the presence of severe hail and the likelihood of tornadic vortices, were indicated clearly and in a more timely fashion. This allowed the forecasters to issue warnings of severe hail and 'very damaging winds' earlier than they may have done in the absence of the systems. It is hard to gauge the real benefit of even a few minutes additional warning on these hazards.

The most notable advantage offered by the WWRP systems was that the forecasters were able to more efficiently focus upon areas of the storm that were of most concern (using the tools that they were most familiar with, such as 3D rapic). Coupled to this was the added confidence given by the systems that what the forecasters believed to be happening and believed likely to happen was correct. This contributed to the improved warning dissemination.

9. ACKNOWLEDGEMENTS

The authors would like to thank all the staff of the Bureau of Meteorology, New South Wales Regional Office, Sydney for their support. This work was supported in part by the University of Salford research development fund.

10. REFERENCES

Bally, J., T. Keenan and P.T. May, 2001: Generating severe weather warnings from TITAN and SCIT thunderstorm tracks during the Sydney Olympics. AMS 30th Int. Conf. Radar Met., Munich, Germany, 19-24 July, 2001.

Brown, B.G. and co-authors, 2001: Forecast verification activities for the Sydney 2000 Forecast Demonstration Project. AMS 30th Int. Conf. Radar Met., Munich, Germany, 19-24 July, 2001.

Keenan, T. and co-authors, 2001:The World Weather Research Programme Sydney 2000 Forecast Demonstration Project overview. AMS 30th Int. Conf. Radar Met., Munich, Germany, 19-24 July, 2001.

Sills, D. and co-authors, 2001: Meteorological aspects of the 3 November 2000 severe storms in Sydney, Australia. AMS 30th Int. Conf. Radar Met., Munich, Germany, 19-24 July, 2001.