First-time Mobile Doppler Radar Observations of Heavy Rain-Producing Thunderstorms in Northwest New Mexico

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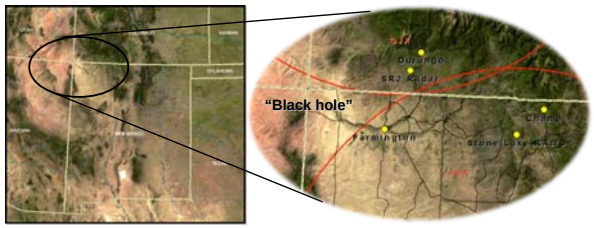
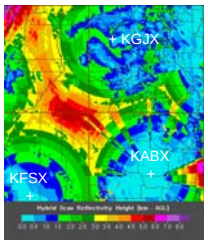
Project Overview

A mobile Doppler radar was deployed near Durango, Colorado during the Southwest Colorado Radar Project in August 2010 to collect data on monsoonal thunderstorms and the resultant flash flooding in the Four Corners Region.

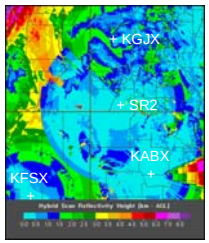


Four Corners area with zoomed in view. 230 km range rings overlaid in red.

This area suffers from poor radar coverage by the existing National Weather Service radar network, leaving NWS forecasters with much uncertainty concerning rainfall rates, surface circulations and other near-ground phenomena. The project targeted this infamous "black hole" in radar coverage in the heart of monsoon season.



WSR-88D beam heights in km above ground level. Light blue indicates best coverage.



Same as left image except with the Shared Mobile Atmospheric Research and Teaching Radar, SR2, coverage added.

Data Processing

- All radar data were processed by NSSL's National Mosaic and Multi Sensor Quantitative Precipitation Estimation System (NMQ).
- Mobile radar data were transmitted via cell phone to a NSSL server where it was converted from polar coordinates to a 1 km x 1 km grid.
- After ground clutter was removed, the gridded mobile radar data were merged with surrounding radars.
- A dynamic rain rate relation algorithm used environmental data to assign a specific rainfall rate to each grid point.
- It should be noted that this is different than current NWS precipitation processing algorithms; aside from not using a specific Z-R relationship for the entire domain, the full 460 km range is used for QPE processing. NWS QPE processing is limited to 230 km.

Acknowledgements

We would like to thank Ami Arthur and Carrie Langston at NSSL for assistance with data formats and retrieval. We would also like to thank the NASA SPoRT Program for the CIRA precipitable water images.

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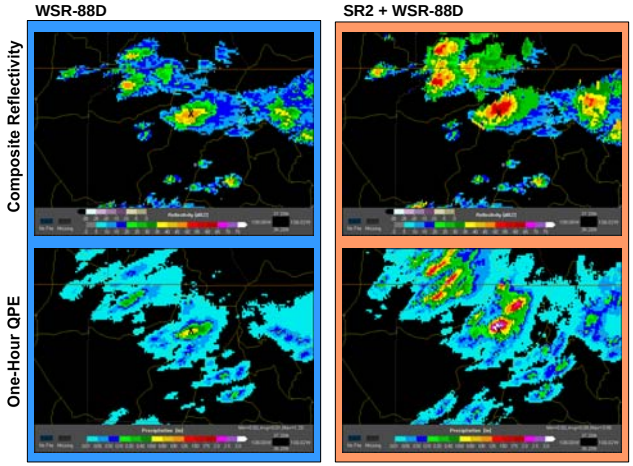
August 4th Case Study

During the afternoon of August 4, 2010, the second Shared Mobile Atmospheric Research and Teaching Radar, SR2, was deployed on Bridge Timber Mountain, southwest of Durango, Colorado. Similar to many monsoon days, thunderstorms developed over the higher terrain of Colorado and New Mexico. These thunderstorms exhibited high reflectivity and little movement, which contributed to increased flash flood potential. Attention was focused in Rio Arriba County, NM near Stone Lake.



Composite reflectivity images taken at 2150 UTC. One-hour QPE images are valid between 2130 and 2230 UTC. X marks the spot of the Stone Lake RAWS site.

The differences in composite reflectivity at 2150 UTC and one hour QPE ending at 2230 UTC are staggering. Images using merged SR2 data with regional radar data show the following:

- 50 dBZ echo near and north of Stone Lake.
- Approximately 1.50 inches of precipitation.

The Stone Lake RAWS site reported 1.49 inches of precipitation through 2230 UTC. Using WSR-88D data alone would have only yielded QPE estimates of approximately 0.75 inches, or 50% of the actual measured precipitation, giving forecasters a false sense of security in an area of varied terrain.

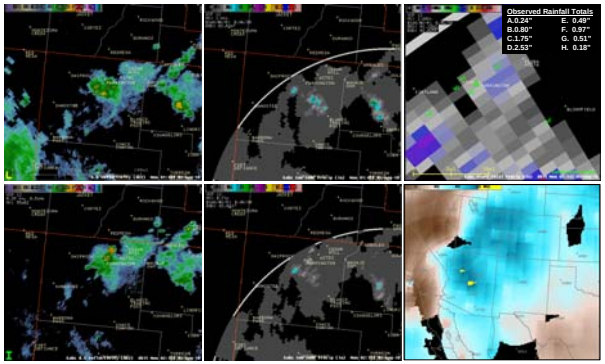
SR2 side view. Photo courtesy of Jennifer Palucki.

SR2 rear view. Photo courtesy of Jennifer Palucki.

SR2 on Bridge Timber Mountain looking north. Photo courtesy of Steve Vasiloff.

August 1st Flash Flood Event

Monsoonal thunderstorms marched northward during the evening of August 1st across the Four Corners Region. These thunderstorms dropped over 2 inches of rain in less than 30 minutes over Farmington, a city of over 40,000 people. Approximately $2 Million in damage occurred. Given the poor radar coverage in this region, flash flood warnings are often based on satellite and other observational data as well as regional radar data.



Left: KABX 0.5 degree reflectivity image at 0145 UTC (top) and 0214 UTC (bottom) on 2 August.
Middle: KABX one hour QPE ending at 0145 UTC (top) and 0214 UTC (bottom) on 2 August.
Right: Storm Total Precipitation and observed rainfall table (top) and CIRA percent of normal precipitable water (bottom). Imagery taken on 1 August at 2153 UTC.

Radar imagery did not support the severity of the flash flooding that was occurring in northeast Farmington. In fact, radar estimates less than 0.50" fell. Fortunately, based on prior experience, above normal precipitable water values and these radar images, flash flood warnings were issued for the area.

Flash flooding near intersection of Hubbard and Peace Valley in Farmington, NM on August 1, 2010.

Flash flooding at the San Juan Country Club in Farmington, NM on August 1, 2010.

Potential Outcomes

Had SR2 data been available during this event, it is likely that:

- Warning lead time would have increased.
- Confidence in warning issuance would have increased.
- More specific locations could have been mentioned in the warning.
- Severity of event would have been better recognized.
- Earlier or more direct contact with emergency managers would have transpired.