P3.6 Application of Multisensor Precipitation Nowcaster to Flash Floods

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Introduction

Flash flooding is one of the greatest storm-related threats to life in the United States. National Weather Service (NWS) Weather Forecast Offices need to issue warnings for flash flooding conditions. The Office of Hydrologic Development has developed the Multisensor Precipitation Nowcaster (MPN) algorithm to provide NWS forecasters with additional guidance to increase the lead-time for issuance of flash flood warnings. Using radar rainfall data as the primary input, MPN algorithm produces very short-term (0-1 hour), deterministic, regional, 4-km gridded, precipitation forecasts (nowcasts). The precipitation forecasts produced by MPN can also be used to drive a distributed hydrologic model for flash flood forecasts. This presentation shows an evaluation of the accuracy of nowcast products from a scaled-down version of MPN. In order to expediently analyze a large number of cases, the results here are generated using input from a single radar and without rain gauge data (i.e., not utilizing the full multisensor capabilities) in order to establish a performance baseline. Cases without range degradation were selected.

Description of MPN

MPN will be implemented in the Advanced Weather Interactive Processing System (AWIPS). Radar input to MPN is derived from the NEXRAD Precipitation Processing System (PPS). Its major features are:

- Output: Forecasts of rain rates and 1-hour rainfall.
- Resolution: 4-km grid mesh, 5-min intervals for rainrate.
- Input: Multiple radar and rain gauge observations.
- Extrapolation method: Lagged-correlation pattern matching.
- Three spatial/temporal smoothing options.
- Simple growth and decay modeling (optional)

Results

27 verified flash flood cases within 18 radar umbrellas throughout the conterminous US are investigated. MPN runs with adaptable temporal smoothing method selected based on previous work (Guan et al., 2005). Fig. 1 shows examples of 1-hour forecast rainrate and rainfall and the corresponding observed radar images for verification. It is clear that MPN can forecast 1-hour rainrate and 1-hour accumulation rainfall very well.

In addition to MPN runs, we also test the typical case of persistence, in which the storms are assumed stationary, to serve as a baseline of performance. MPN results are compared with persistence results in terms of bias (Fig.2), the root mean square error (Fig.3), and linear correlation of spatial rainfall fields (Fig.4). Bias is sum of forecasted rainfall divided by sum of observed rainfall (based on radar) over entire umbrella.

Performance in terms of probability of detection (POD), false-alarm rate (FAR), critical success index (CSI) for 1-hour rainfall > 5 mm is shown in Fig.5

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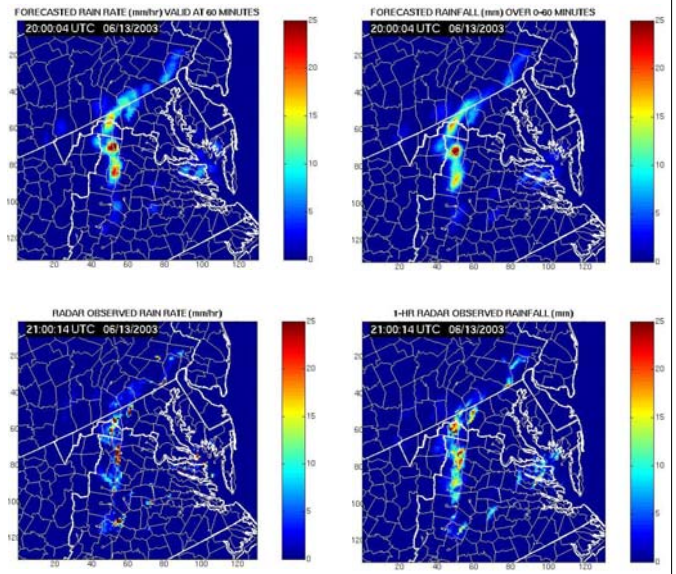
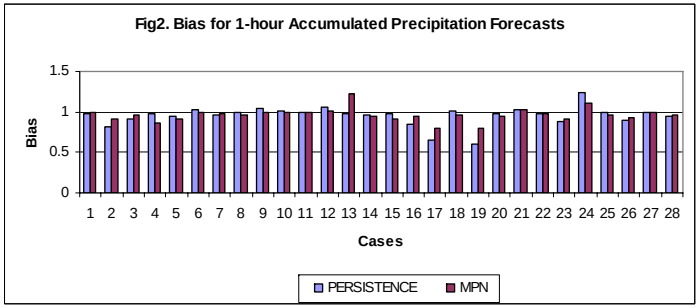
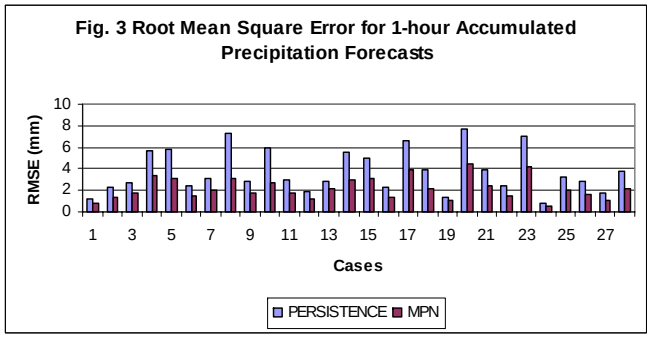
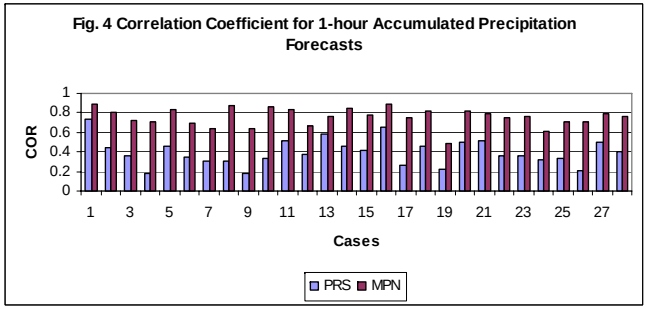
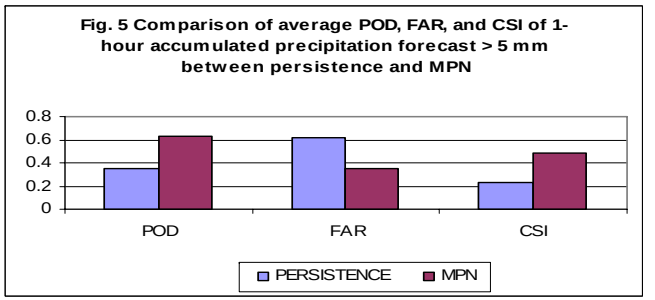


Fig.1 Example of observed and forecasted 60-minute rain rate and one-hour accumulation images for June 13, 2003.









REFERENCE

Guan, S., F. Ding, R. Fulton, and D. Kitzmiller, 2005: Preliminary results for the 0-1 hour multisensor precipitation nowcaster. 32nd Conference Radar Meteorology, October 24-29, Albuquerque, NM, 6R.4.

Summary

MPN substantially improves RMSE, COR, POD, FAR, and CSI relative to persistence method. Compared with persistence, MPN:

- Reduces RMSE by 45%.
- Raises POD by 77% for 1-hour accumulated precipitation > 5 mm.
- Decreases FAR by about 43%.
- Doubles CSI.