The development and use of a comprehensive US-wide flash flood database for evaluating forecasting tools

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Introduction

- Flash flooding claims more lives than any other storm-related hazard in the United States (and worldwide).
- No single observation data source accurately captures the number, distribution, or intensity of flash floods.
- Combining flash flood reports from diverse sources allows for the evaluation of forecast tools using the US National Weather Service’s (NWS) Flash Flood Guidance (FFG) product.

Database Sources

1. NWS reports are intended to be comprehensive, are made by trained spotters or emergency managers, and are then recorded by forecasters.
   - 1 Oct 2006 to 31 Dec 2011
   - 19,419 flash flood reports
   - 12,832 river flood reports

2. USGS stream gauge reports consist of intervals where a gauge’s stream flow value exceeds a two-year return period for a given basin.
   - Data from 1927 to 2010 for 10,106 gauges
   - 59,272 instances of two-year return period exceedance

3. SHAVE reports are from the general public. They are more densely spaced and event focused than the other two sources2.
   - Data for 2008-2010 for early May through end of August in each year
   - 9,369 total reports of severe flooding, non-severe flooding, or no flooding

FFG Evaluation

- FFG is a product issued by the NWS River Forecast Centers (RFCs).
- It is defined as the amount of rain needed to cause flooding in small streams over a given amount of time (1, 3, or 6 hours).
- The exact version of FFG in operational use can vary between RFCs.
- Local Weather Forecast Offices (WFOs) have the final responsibility to monitor when radar QPE exceeds FFG and to issue flash flood warnings if necessary.

Evaluation Technique

- Search for instances when QPE-to-FFG ratio of 1.0 is exceeded and a flash flood is indicated.
- These FFG exceedances are compared to NWS reports and also to USGS reports to populate a contingency table.

- Critical success index (CSI)
  - Hits / (Hits + Misses + FA)

FFG Skill (vs. USGS basin-max)

Figure 7: CONUS-wide skill of FFG as a function of QPE to FFG ratio for 1 hr, 3 hr, and 6 hr operational FFG. Here, it has been evaluated against USGS basin maximum ratios from October 2006 to September 2010.

- FFG performs better when evaluated against USGS basin maximum ratios.
- 6 hr FFG is the best-performing product in this evaluation.
- The maximum skill for all three products occurs at a ratio of 1.25.
- At this ratio, 6 hr FFG has a CSI of 0.10.

FFG Skill (vs. USGS basin-mean ratio)

Figure 8: CONUS-wide skill of FFG as a function of QPE to FFG ratio for 1 hr, 3 hr, and 6 hr operational FFG. Here, it has been evaluated against USGS basin mean ratios from October 2006 to September 2010.

- FFG evaluated against USGS basin-mean ratios produces higher skill than in the basin-max or NWS analyses.
- 6 hr FFG is the best-performing product in this evaluation.
- The maximum skill for 1 hr FFG (CSI = 0.09) occurs at a ratio of 0.5.
- 6 hr FFG at a ratio of 1.0 has a CSI of 0.13, the highest skill for any product in this analysis.

Conclusions

- Operational FFG performs poorly when verified against NWS flash flood reports or USGS stream gauges.
- The skill (CSI) of FFG at a QPE to FFG ratio of 1.0 ranges from 0.03 to 0.13.
- Forecasters should consider ratios other than 1.0 when issuing flash flood warnings.
- Further research should explore the differences in FFG skill between RFCs and between the different hydroclimatic regimes of the US.

Database available at
ftp.nssl.noaa.gov/users/gourley/ff_database/2012_v1/

REFERENCES: