

Abstract

In the US, flash flooding is the number one killer among all weather-related hazards. Every year more than 140 fatalities are reported due to flash floods (NOAA).

National Weather Service (NWS) River Forecast Centers regularly (1, 3 and 6-hour) issue Flash Flood Guidance during the day for every county. Flash Flood Guidance estimates the average precipitation by inch for given durations required to generate flash flooding in the indicated county. These estimates are based on current soil moisture conditions.

The objective of this research is the validation of Gridded Flash Flood Guidance (GFFG) system currently being used for the Arkansas Basin River Forecast Center (ABRFC). The verification and analysis will be done by comparing between the forecasted GFFG and event occurred at that time and measured precipitation by radar and gauge (MPE). Then eventually, a new flood guidance based on satellite soil moisture estimation will be applied for the improvement of GFFG for a time period of 2010-2011.

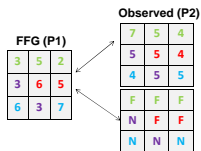
What is a Flash Flood?



- Flash flood is "a rapid flooding of water over land caused by heavy rain or a sudden release of impounded water in a short period of time, generally within minutes up to several hours".
- Flash floods are distinguished from a regular flood by a timescale less than six hours.
- In 1969, flood events and severe weather conditions caused in Ohio 41 deaths and 559 injuries.
- 1976, Big Thompson Flood killed 145 people, destroyed hundreds of homes and business.

Methodology

- Event based Analysis FFG System
- Determine the severity of Error (difference of FFG and MPE precipitation)



- Hit:**
- $P1 \leq P2$: The GFFG system is accurate forecasting a flash flood.
 - $P1 > P2$: The GFFG values are too high so no warning is issued even though there was a flash flood.
- False Alarm:** A warning is issued based on GFFG values, but the warning was not necessary since no flash flood occurred.
- Miss:** The GFFG system fails to forecast the flash flood

Verification				
FFG (inch)	MPE (inch)	Analysis	Event	Define
P1	P2	$P1 \leq P2$	Flood	Hit
P1	P2	$P1 < P2$	No Flood	False alarm
P1	P2	$P1 \geq P2$	Flood	Miss
P1	P2	$P1 > P2$	No Flood	Hit

FFG: Flash Flood Guidance
MPE: Multi-sensor Precipitation Estimation
F = Flood, N = No Flood

Probability of Detection and Probability of False Alarm Ratio

The probability of Detection (POD) is defined as a fraction of observed flash floods that were correctly forecasted by the GFFG system.

$$POD = \frac{\text{Number of Hits}}{\text{Number of Hits} + \text{Number of misses}}$$

The probability of False Alarm Ratio (FAR) is defined as the number of false alarms divided by the number of forecasted events.

$$FAR = \frac{\text{False Alarm}}{\text{Hits} + \text{False Alarm}}$$

Acknowledgement

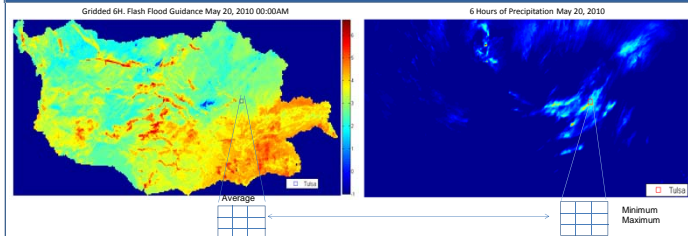
"This publication was made possible by the National Oceanic and Atmospheric Administration, Office of Education Educational Partnership Program award NA11SEC4810004. Its contents are solely the responsibility of the award recipient and do not necessarily represent the official views of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration." This study is supported by the National Science Foundation under the Grant No. AGS-1062934. I am thankful to Research Experience for Undergraduate (REU) program, Dr. Reginald Blake, Dr. Shakita Merchant, Dr. Reza Khanbilvardi, and Chinedu Chukuglwge.



Flash Flood Guidance

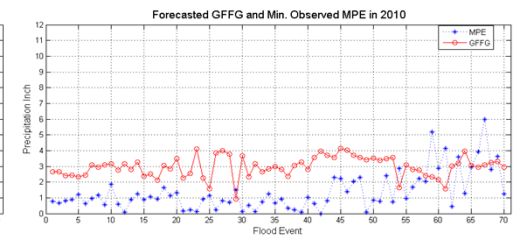
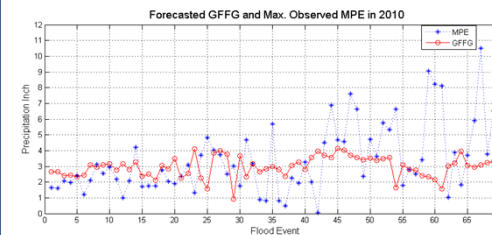
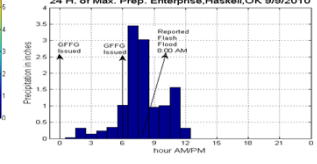
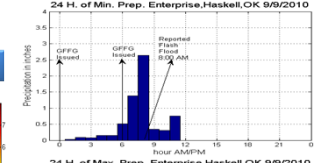
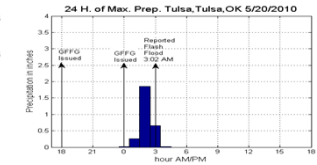
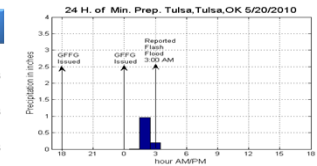
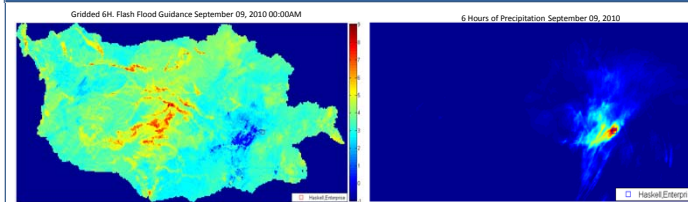
- Flash Flood Guidance "estimates the average number of inches of rainfall for given durations required to produce flash flooding in the indicated county" (National Weather Service).
- The National Weather service (NWS) issue GFFG 3 times daily for every county in their area.
- The River Forecast Centers produces and determines 1, 3 and 6 hour Flash Flood Guidance.

Short Storm:



- The Average GFFG was selected from nine cells, and each cell covers an area of 4Km x 4Km.
- The Minimum and Maximum precipitation (MPE) was selected from every hour for a 24 h. period.

Long Storm



Results

- GFFG operated more effectively for long storms since it yields a POD of 0.7 for September 9, 2010.
- GFFG system has a low accuracy when short storms take place (May 20, 2010)
- The standard deviation was calculated for every hour (from 9 pixels) for all the events in 2010. There were 218 (from 972) hours of rainfall with a standard deviation greater than 0.2

	Probability of Detection (POD)		
	Short Storm 05/20/2010	Long Storm 09/09/2010	Total Cases 2010
Ave. GFFG and Min MPE	0	0.71	0.26
Ave. GFFG and Max MPE	0.54	0.7	0.6

Conclusion

- Short Storm: In May 20, 2010, the soil was too saturated. Therefore, An average of 3 hour of continuous precipitation was enough to cause a flash flood.
- Long Storm: In September 09, 2010, A longer period of continuous rainfall was necessary to cause a flash flood.
- The standard deviation for some events was greater than 0.2, meaning rainfall is not constant in an area of 12km x 12km