NOAA U.S. Weather Research Program (USWRP)

Hydrometeorology Testbed (HMT)
Multi-Radar Multi-Sensor (MRMS) Hydro Experiment

In Coordination with the HMT Flash Flood and Intense Rainfall (FFaIR) Experiment

-- 2018 HMT-Hydro Experiment Executive Summary --

Past HMT-Hydro Experiments focused on deterministic products forced by radar-derived quantitative precipitation estimations (QPEs) to improve the prediction and warning of flash floods, including high-resolution distributed hydrologic model forecasts that operated on the flash flood time scale. The next evolution of hydrologic modeling and flash flood prediction will integrate probabilistic information and uncertainty into the warning decision making process. The 2018 HMT-Hydro Experiment analyzed the utility of probabilistic gridded information developed within the Flooded Locations and Simulated Hydrographs (FLASH) system along with the application of ensemble 0–3 hour quantitative precipitation forecasts (QPFs) from the Warn-on-Forecast system for flash flood prediction.

The 2018 HMT-Hydro Experiment ran for three weeks from 25 June to 20 July 2018 with a total of ten participants from across the National Weather Service (NWS) and the National Water Center (NWC) contributing to the operational and evaluation activities of the testbed experiment. Each week contained two days of real-time experimental warning operations and two days of archived case studies. The details and products from the collaborative briefings provided by the Flash Flood and Intense Rainfall (FFaIR) Experiment helped determine the days during the week to focus on real-time experimental warning operations or on archived case studies.

Real-time experimental warning operations focused on the use of four probabilistic gridded flash flood products forced by Multi-Radar Multi-Sensor (MRMS) radar-derived QPEs (e.g., Figure 1):

- Probability of Receiving a Flash Flood LSR
- Probability of Exceeding Maximum Unit Streamflow Value (2 m^3 s^{-1} km^{-2})
- Probability of Exceeding Maximum Unit Streamflow Value (5 m^3 s^{-1} km^{-2})
- Probability of Exceeding Maximum Unit Streamflow Value (10 m^3 s^{-1} km^{-2})

Subjective evaluations and feedback from the participants showed the magnitude of the values of the Probability of Receiving a Flash Flood LSR product was generally perceived as higher than expected while the Probability of Exceeding Maximum Unit Streamflow Value for the 2 m^3 s^{-1} km^{-2} threshold was perceived as being too low. The probabilistic values with the higher exceedance thresholds were perceived as generally about right; however, there were very few major flash flood events during the experiment to add statistical significance.

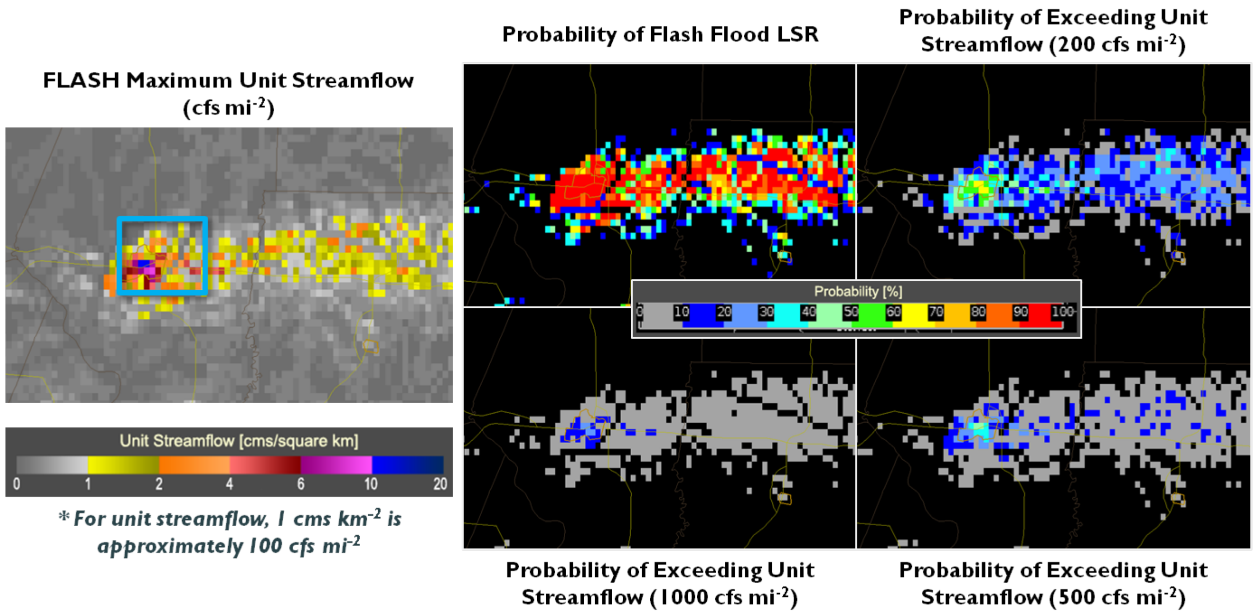

Figure 1. The Columbia, Missouri flash flood event as seen from the deterministic (left) and probabilistic (right) data at 1930 UTC 26 June 2018. The images were taken from the flash.ou.edu web page, which was used during the evaluations.

Participants utilized the probabilistic data to issue experimental flash flood warnings (FFWs) using a modified Hazard Services software package. Each FFW issued had user-assigned probabilities for minor and major flash flood potential. Reliability assessments of these minor and major probabilities found that participants had a tendency to overestimate the probabilities associated with the FFWs they issued. Perceived biases of the probabilistic data were adjusted by an average of 25 points in the experimental FFWs.

Archived case studies focused on the evaluation of the potential impacts of ingesting Warn-on-Forecast QPFs into the flash flood prediction process. Three data conditions were developed for each case and were made available to the forecasters using built-in procedures in the playback of the case through the Weather Event Simulator (WES) in AWIPS-II. These three conditions are the following:

- Condition #1: Deterministic Products (QPE-Only Forcing)
- Condition #2: Probabilistic Products (QPE-Only Forcing)
- Condition #3: Probabilistic Products (QPE + Warn-on-Forecast QPF Forcing)

Forecasters evaluated each condition in the order presented above at the top of each hour. A data collection form was provided for each case for the participants to fill out to discuss their observations and the different actions taken with each condition. Attention maps (i.e., where participants were focused on and potentially took action) showed that the areas of interest were generally smaller with the probabilistic products versus the deterministic condition. The addition of Warn-on-Forecast expanded the area garnering the attention of participants by an average of 2.4 counties per hour.

The addition of Warn-on-Forecast QPFs drastically changed participant actions at each hour (e.g., Figure 2). The threat assessment and monitoring phase started at least two hours earlier for most participants with earlier communication actions to the public and partners were also being considered. The issuances of FFWs were also earlier among a set of participants with the potential FFW issuance coming up to three hours earlier than using data with QPE-forcing only; however, other participants were not issuing FFWs earlier, likely from not having gained enough confidence in the Warn-on-Forecast system or were not comfortable issuing products before rain fell in the forecasted threat area.

The information gained during the 2018 HMT-Hydro Experiment will further the advancement of the science and application of probabilistic products and Warn-on-Forecast QPFs for flash flood prediction and warning issuance. The HMT-Hydro Experiment will continue in summer of 2019.

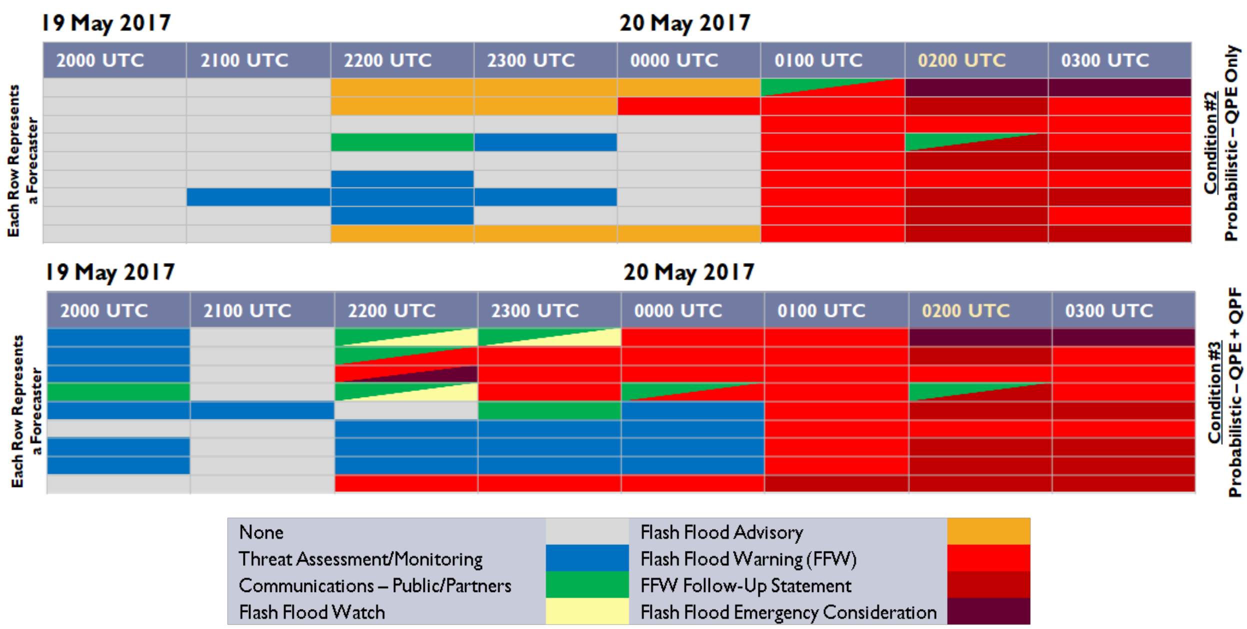

Figure 2. Timeline of all actions considered by the participating forecasters using Condition #2 (top) compared to Condition #3 (bottom) for the area of Murray and Carter Counties in south-central Oklahoma from 2000 UTC 19 May 2017 to 0300 UTC 20 May 2017. Cells containing multiple colors describe multiple actions taken by the participating forecaster as specifically described by their entries in the data collection form. The column for 0200 UTC 20 May represents the period when the first flash flood LSR was reported (specifically at 0155 UTC).

More information about the 2018 HMT-Hydro Experiment, including the full final report, can be viewed at https://blog.nssl.noaa.gov/flash/hwt-hydro/. For any questions regarding the 2018 HMT-Hydro Experiment, please contact the principal investigators:

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