FFMP: Advanced Design

Statement of Need

OB8

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1. Title:

Flash Flood Monitoring and Prediction (FFMP): Advanced Design

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4. Description:

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service has a need to improve flash flood warnings to the public. Flash Flood Monitoring and Prediction (FFMP) is the premier Advanced Hydrologic Prediction Service (AHPS) decision assistance tool that integrates observed and forecast meteorological and hydrologic information to assess the threat of flash flooding. Outlined below are top priority needs, identified by the AHPS Flash Flood Services Team and a recent FFMP survey of Weather Forecast Office (WFO) FFMP users, to improve FFMP and allow forecasters to provide better flash flood forecast services.

- Currently, the precipitation input into FFMP is the radar based Digital Hybrid Reflectivity (DHR) product. To improve the precipitation estimation input in FFMP and thereby improve flash flood warnings in areas not covered by radar or areas covered by multiple radars there is a need for FFMP to ingest gridded precipitation estimates that use multi-sensor precipitation estimation techniques. Additionally, there is a need for the forecaster to have the capability to select the precipitation estimation source FFMP uses to monitor the threat of flash flood. This capability should include a method to blend precipitation sources in time (i.e., the forecaster can choose to monitor a 3 hour window with the first two hours a gridded precipitation QPE product and the final hour a gridded QPF product).

- To improve forecaster training on FFMP there is a need to provide an AWIPS standard FFMP archiving capability. This archiving capability would allow forecasters to archive FFMP precipitation accumulation data and use the playback capability of the AWIPS Weather Event Simulator (WES). WES could then be used to review and train other forecasters on the use of FFMP with real-world locally relevant flash flooding scenarios. The basic requirement to provide FFMP playback capability on the WES is that FFMP must store precipitation accumulation data for a time period equal to the time until data is purged.

- A 2005 NOAA-USGS task force was created to develop a plan for the implementation and operation of a NOAA-USGS system to issue joint Outlooks, Watches and Warnings for areas deemed to be at risk for debris flows as a result of current or forecast precipitation. Debris flow guidance behaves in a similar way as the flash flood guidance used as guidance input into FFMP. A technological opportunity exists to expand FFMP guidance input to include debris flow guidance and allow for monitoring and prediction of multiple guidances. FFMP can then be used to monitor and predict debris flows allowing NWS forecasters the capability to provide debris flow warnings. Expanding FFMP to ingest and monitor multiple guidances prepares FFMP to ingest and monitor future flash flood guidance inputs currently being investigated in the 'Distributed Hydrologic Modeling for Flash Flood Forecasting' OSIP project and Colorado Basin River Forecast Center Flash Flood Potential Index project.

This functionality is intended for AWIPS OB8.

5. Justification:

5.1 Origination, Documentation, and Drivers:

This SON was proposed by the NWS/Office of Climate, Water and Weather Services (OCWWS), Hydrologic Services Division (HSD) as a technology opportunity to improve the lead time, accuracy and specificity of flash flood forecasts. Funding for fiscal year (FY) 2006 was requested through the Advanced Hydrologic Prediction Service (AHPS).

5.2 Linkages:

This project is consistent with the NWS mission and Strategic Goal 3, "Serve Society's Need for Weather and Water Information."

This project directly links to the NWS Government Performance and Results Act (GPRA) goal to increase the flash flood accuracy and lead time. In addition, this project is specifically mentioned by name in the AHPS FY 2006 Annual Operating Plan (AOP) and budget submissions. The project has been approved by the AHPS Review Committee (ARC). As such, this project falls under the AHPS OSIP Umbrella, High Mission Priority Statement of Need (SON).

6. Existing capabilities/capacities and limitations related to the need:

FFMP is a decision assistance tool that integrates observed and forecast meteorological and hydrologic information to assess the threat of flash flooding. FFMP ingests the DHR ORPG radar product and using rules similar to the ORPG Precipitation Processing System (PPS) creates a quantitative precipitation estimate for each hydrologic basin under the radar umbrella. Since the single source of precipitation data is radar, FFMP's functionality to assess flash flood risk is limited to those areas with decent radar coverage. This method does not allow for the skill and information provided by satellite and in-situ data to be included in rainfall estimates. Additionally, the precipitation estimations are computed for a single radar at a time. The precipitation estimates for a Hydrologic Service Areas served by more than one radar does not take advantage of combining information from overlapping radar umbrellas.

FFMP stores precipitation accumulation data in a file system with a moving window. This current method for archiving FFMP precipitation accumulation data does not interface well with the AWIPS WES. To achieve WES playback capabilities with the current archiving paradigm requires cumbersome data archive manipulation which at times is not effective. The lack of a consistent WES playback capability critically limits forecaster ability to review and train on the use of FFMP with real-world locally relevant flash flooding scenarios.

Currently, FFMP only ingests one guidance source (flash flood guidance). Although this serves the flash flood prediction need well, providing multiple guidances can expand the functionality and usefulness of this warning decision assistance tool. A demo project occurring at two WFOs has shown that FFMP can be used to provide guidance for debris flow warnings. The Forced Flash Flood Guidance GUI is used to over-ride the flash flood guidance provided by the RFC. It is typically used by WFO forecasters to adjust the RFC flash flood guidance for areas with known problems. A current demonstration project is using the forced flash flood guidance GUI to force debris flow guidance into FFMP. There is a visual cue in the small basin table of FFMP indicating that the guidance value is from the Forced Flash Flood guidance GUI. For the two demonstration sites, the forecaster must remember that for the small basins indicated by the visual cue, they are monitoring and predicting for debris flow and not flash flood. This demonstration was established to prove the concept that debris flows can be monitored and predicted with FFMP. Since this has been proven, the next step is to enhance FFMP to allow monitoring of multiple guidances in an automated way.

7. Benefits and Performance Impact:

7.1 Performance Measure Impacts:

The project was conceived to help meet the Weather and Water Mission Goal cited above. More specifically, the end goal is to improve the accuracy and lead times for flash flood forecasts. Because FFMP is only one component of the flash flood forecast process, it is beyond the scope of this study to quantify the overall gains expected for flash flood forecasts in terms of Government Performance and Results Act (GPRA) statistics. The quality of FFMP output is tied closely to the quality of its precipitation input. Providing the forecaster a gridded multi-sensor precipitation input

will yield a capability to provide flash flood warning services for areas outside of a traditional radar umbrella as well as improve precipitation estimates within the existing radar umbrella. Providing an AWIPS standard archiving capability will allow FFMP data to be used with the AWIPS WES. This capability will improve forecaster training of FFMP thus improving flash flood forecast lead time and accuracy. Providing the capability to input multiple guidance criteria allows the forecaster to monitor and predict multiple phenomenons (like debris flow) or compare guidance for one phenomenon. This capability will allow NWS forecasters together with USGS to issue debris flow outlooks, watches and warnings to better serve society's need for weather and water information.

7.2 Socio-economic Impacts:

The primary social-economic impacts would be the improvements in FFMP would promote the delivery of accurate/timely flash flood forecasts and, in effect, save lives and property.

8. Key Customers and Stakeholders:

8.1 Customers:

- WFOs
- Warning Decision Training Branch
- Federal Emergency Management Administration (FEMA) and other Federal Emergency responder Agencies
- State and Local Government Agencies
- General Public

8.2 Stakeholders:

- Field Office Personnel (at WFOs)
- Office of Climate, Weather and Water Services (OCWWS)
- Office of Science and Technology, MDL Decision Assistance Branch

9. Supporting Information:

Debris Flow Project web page:	**http://landslides.usgs.gov/research/wildfire**
Debris Flow Project description:	**http://pubs.usgs.gov/circ/2005/1283/pdf/Circular1283.pdf**
AHPS web page:	**http://www.weather.gov/oh/ahps**
NWS mission statement:	**http://www.nws.noaa.gov/mission.shtml**
FFMP web page:	**http://www.nws.noaa.gov/mdl/ffmp**