

Producing Rapid and Simplified Inundations with Limited Information

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Abstract

The U.S. Army Corps of Engineers (USACE) Modeling Mapping and Consequences Production Center (MMC) mandatory center of expertise mission includes producing hydraulic modeling, mapping, and consequence analysis for USACE dams and Levees in support of the USACE Dam & Levee Safety. The MMC has developed processes, tools, and standards for creating hydraulic models in support of dam and levee breach hydraulic models for use in emergency action plans (EAP) and watershed-wide modeling in support of the Corps Water Management System (CWMS) program. As a result of this experience, the MMC also provides Flood Inundation Modeling support during real-time flood events with its Flood Inundation Mapping Cadre (FIM). After supporting the 2011 Mississippi River flood, the MMC worked to develop a national FIM Cadre. The mission of the FIM Cadre is to assist districts and other government agencies when called upon to run real-time hydraulic models, prepare forecast inundation maps, and develop consequence estimates for significant flood events. For areas that have USACE projects, the cadre typically has existing data and models to produce inundations. However, in areas where information is limited, some simplifications and assumptions must be made.

This presentation will provide examples of performing rapid inundations in support of flood events and for dam & levee breach modeling with limited information. The use of mapping during extreme events (floods, droughts, hurricanes, dam & levee breaching, etc.) has provided, and continues to provide, critical situational and real-time information for emergency responders, decision makers, and key stakeholders. This information is helpful not only to USACE, but also to federal, state, local, and emergency responder partners. This presentation will provide case studies of rapid inundations performed by the MMC during flood events and performed by special requests. It will show some of the unique ways that the MMC has produced models with limited data and provide some general sources of basic information.

Since the passage of the Flood Control Act of 1917, USACE has played a significant role in managing flood risk nationwide. To provide consistent products across all USACE districts, the MMC has developed a Standard Operation Procedure (SOP) for Flood Inundation Mapping. The FIM SOP also includes a production guide which augments the FIM SOP and includes additional technical and procedural details necessary to support USACE development of consistent FIM products that adhere to agency policy. When the FIM cadre is activated, the team lead and/or hydraulic modeler will review the existing district models and the locations of inundation products requested to determine which modeling approach will be utilized during the flood event. The preferred order of preference for modeling is:

- CWMS suite of models
- HEC-RAS model developed for CWMS implementation
- Other district HEC-RAS model (including dam breach RAS models) or other existing hydraulic models

- Quick HEC-RAS 2-Dimensional (2D) model

CWMS is the preferred method of hydraulic modeling during a flood event. Should a district not have a CWMS suite of models for the watershed, or not have a fully implemented CWMS suite of models, HEC-RAS models are the next preferred method of modeling. The hydraulic modeler can use an existing HEC-RAS model from the district, a HEC-RAS model from a CWMS implementation, or a HEC-RAS model from an MMC dam breach analysis. Should no models exist at the district, or the district has limited confidence in the accuracy of existing models, the preferred method of modeling is a quick (not detailed) HEC-RAS 2D model. At a minimum, this modeling method requires a known downstream boundary condition and a flow hydrograph for the upstream end of the model and for hurricane events, precipitation may be applied across the 2D boundary. This presentation will be focused on the latter option of creating rapid 2D models for areas where data is limited.

Due to the latest advancements and features in HEC-RAS 2D models, the FIM cadre has been able to rapidly produce inundations models or small and large areas during flood events and in support of simplified dam breaches for non-USACE dams. The MMC has produced procedures and developed lists of data sources to be utilized during flood events to help streamline the production of these models and provide reasonable inundation mapping in areas where no models exist, or limited information exists. These processes have been used for the multiple events including but not limited to Hurricane Dorian (2019), Midland, Michigan Dam Breach (2020), Hurricane Laura (2020), Hurricane Sally (2020), Tropical Storm Beta (2020), Piney Point, FL dam breach analysis (2021), Hurricane Henri (2021), Hurricane Ida (2021), Hurricane Ian (2022), and Hurricane Nicole (2022). In addition, the MMC has supported simplified dam breach analysis in Puerto Rico, South America, Africa, Asia, and Europe.

References

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