NATIONAL WEATHER SERVICE
PRODUCT/SERVICE DESCRIPTION DOCUMENT (PDD)
TYPE: Official Product
DATE: September 25, 2020

Meteorological Model Ensemble River Forecasts

Part I – Mission Connection

1. Product/Service Description – The National Weather Service (NWS) Meteorological Model Ensemble River Forecasts web pages, graphics and text products are being produced by Eastern Region River Forecast Centers (RFCs) and the Southeast RFC to provide useful hydrologic information to users. The objective of this information is to provide short lead-time (<7 days) ensemble river forecasts using forcing fields provided by various meteorological ensemble systems.

   These ensemble river forecast are produced at the RFCs using a collection of software entitled Meteorological Model-based Ensemble Forecasting System (MMEFS). The MMEFS uses the temperature and precipitation output from the National Centers for Environmental Prediction (NCEP) Global Ensemble Forecast System (GEFS) and the North American Ensemble Forecast System (NAEFS). These ensemble members are processed through the Community Hydrologic Prediction System (CHPS) to generate an ensemble of river forecasts. These individual river forecasts are turned into probabilistic forecasts. The RFCs' CHPS software used to generate a suite of graphics to display this information (see Attachment 1 for some examples).

2. Purpose – The purpose of the ensemble river forecasts is to provide users with a short-term (<7 days) situational awareness by providing the probabilistic exceedance information relative to NWS flood categories and providing the ensemble river forecasts that in turn show a range of outcomes. These web pages complement information contained in the current short-term deterministic hydrologic forecasts and internal NWS WFO-requested *subjective* contingency forecasts. This service will support the NOAA mission goals of serving society's need for weather and water information and supporting the nation's commerce, economy, and planning for the protection of life and property.

3. Audience – The target audience for this service is the general public which needs hydrologic information and flood water response agencies like the US Army Corps of Engineers (USACE), US Geologic Survey (USGS), NWS Weather Forecast Offices (WFOs) and the emergency management community. Additional users include water reservoir managers (e.g. water supply managers for the large cities in the northeast or the power companies of the southeastern states), and recreational interests.

4. Presentation Format – The ensemble river forecasts can be viewed at *http://www.weather.gov/erh/mmefs*. The interface utilizes can be zoomed to individual forecast points and states. The information is selectable by "Ensemble/Model" type and the "Chance of Exceedance" for action, minor, moderate, and major flood stages is depicted for that "Ensemble/Model" type on the ESRI map. Please see sample presentations in Attachment 1. In addition to the spatial and graphic displays, MMEFS also provides data in a tabular summary page (see Figure 6) as well as a data download in KML format. The MMEFS webpage also contains data from the Hydrologic Ensemble Forecast System (HEFS). HEFS is described in its own PDD

Part II – Technical Description

1. Format and Science Basis –This service uses forcing parameters provided by various meteorological ensemble systems as input to the hydrologic model hosted by the RFC's Community Hydrologic Prediction System (CHPS). At this time, these products are generated for river forecast locations in the Northeast, Ohio River Valley, Mid-Atlantic and Southeast U.S using model outputs (operationally available members) from the National Centers for Environmental Prediction (NCEP) *Global Ensemble Forecast System* (GEFS) and *the North American Ensemble Forecast System* (NAEFS) produced at NCEP. The design of software supporting these products is flexible enough to easily add other meteorological ensemble sources. Even though the system has been automated, the staff of each RFC monitors the output and provides status messages to users as needed.

These ensemble river forecasts were developed for several reasons.

- Hydrologic forecast uncertainty is closely linked to the uncertainties associated with precipitation and temperature forecasts used by hydrologic simulation models.
- This service explicitly uses short-range meteorological model ensemble temperature and precipitation data, eliminating the need for historical precipitation and temperature data for its results.
- This service provides a means to further users' understanding of the effects of model inputs used in hydrologic simulations.
- These ensembles river forecasts are useful surrogates for multiple contingency runs that are typically used by river forecast centers to convey quantitative precipitation forecast (QPF) or quantitative temperature forecast (QTF) uncertainty for *worst case* scenarios.

2. Availability – The ensemble river forecast web pages are available 24-hours per day and 7days a week and are monitored by Eastern Region RFCs and the Southeast RFC staff.

3. Additional Information

a. An online course, designed to help *understand numerical weather prediction (NWP) models*, which includes a section on ensembles, is available from UCAR's COMET. Another online course from COMET provides an *Introduction to NAEFS.* In addition, the MMEFS webpage includes a link to a training video that describes the MMEFS and HEFS software and data.

There are some limitations/features of MMEFS that affect how the graphics are interpreted. Including:

1) MMEFS uses numerical interpretation between met. model grid points, i.e. terrain, climatology is not considered. Elevation-dependent significant temperature change scenarios are not accounted in MMEFS methods.
2) The met. models have varying native grid resolutions; the user should be aware of these and consider these in the interpretation of the MMEFS graphics. I.e. tropical or convective systems may not be adequately resolved by the coarser grid resolutions of the global model suite.
3) The known biases of the met. model precipitation estimates are unaddressed by MMEFS algorithms.
4) The uncertainty errors of the hydrologic models are not addressed by the MMEFS algorithms. During times of limited precipitation, the ensemble members will show very little spread.
5) The snow melt model in MMEFS is driven only by temperature and does not account for melt variations due to humidity and winds. For scenarios that include high dewpoints/winds (which amplify melt rates), the snow melt values will be underdone.

4. Contact – Comments on this product can be emailed to ahps.webmaster@noaa.gov.

Comments may also be provided to:
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Acknowledgements

MMEFS is a joint collaboration of the Northeast, Middle Atlantic, Ohio, and Southeast River Forecast Centers

Attachment 1. Examples of various displays from the web pages for the Meteorological Model Ensemble River Forecasts.

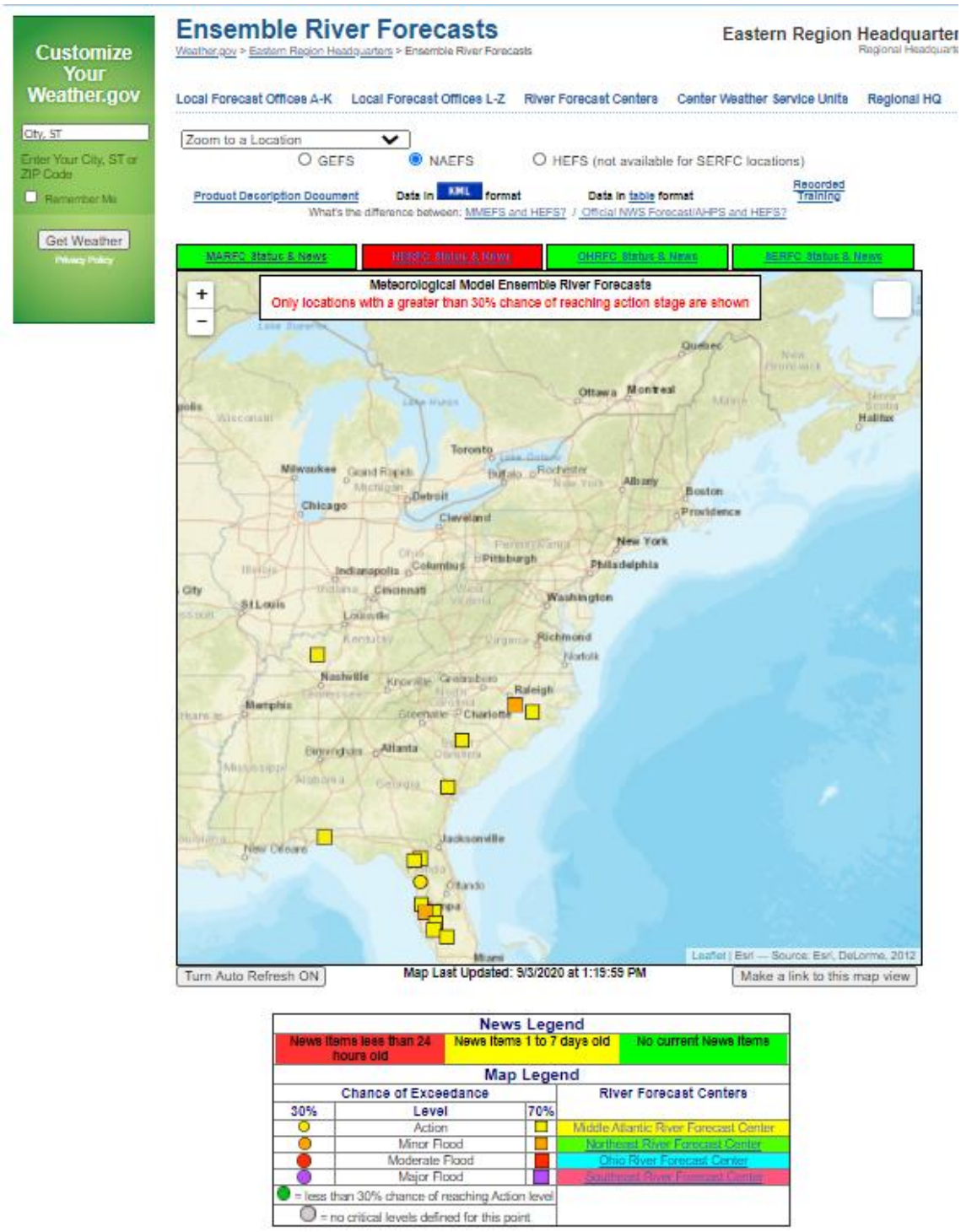

Figure 1. This figure is an example of the main overview map page for this service.

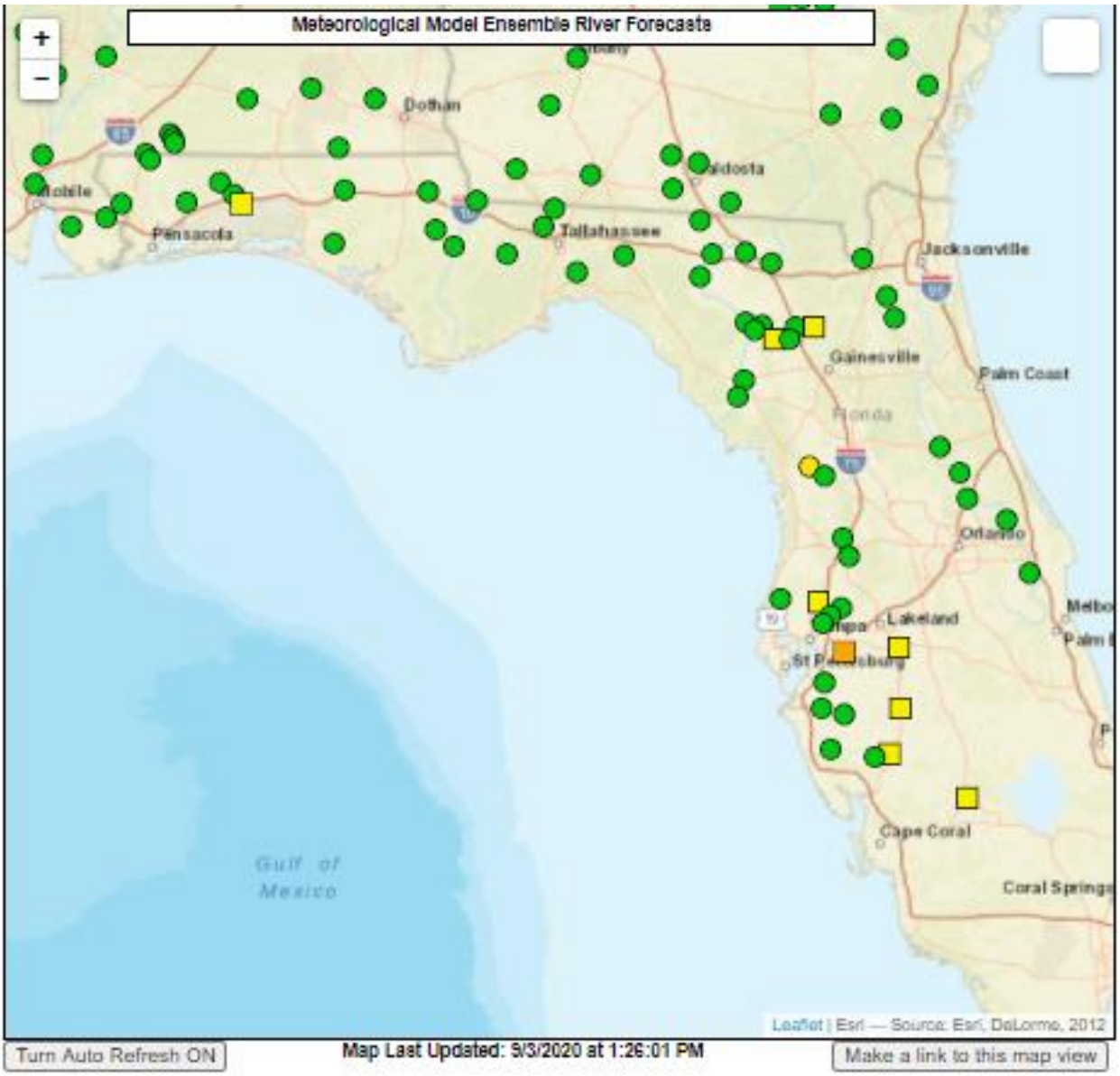

Figure 2. This figure is an example of single state (Florida) display capability from this service.

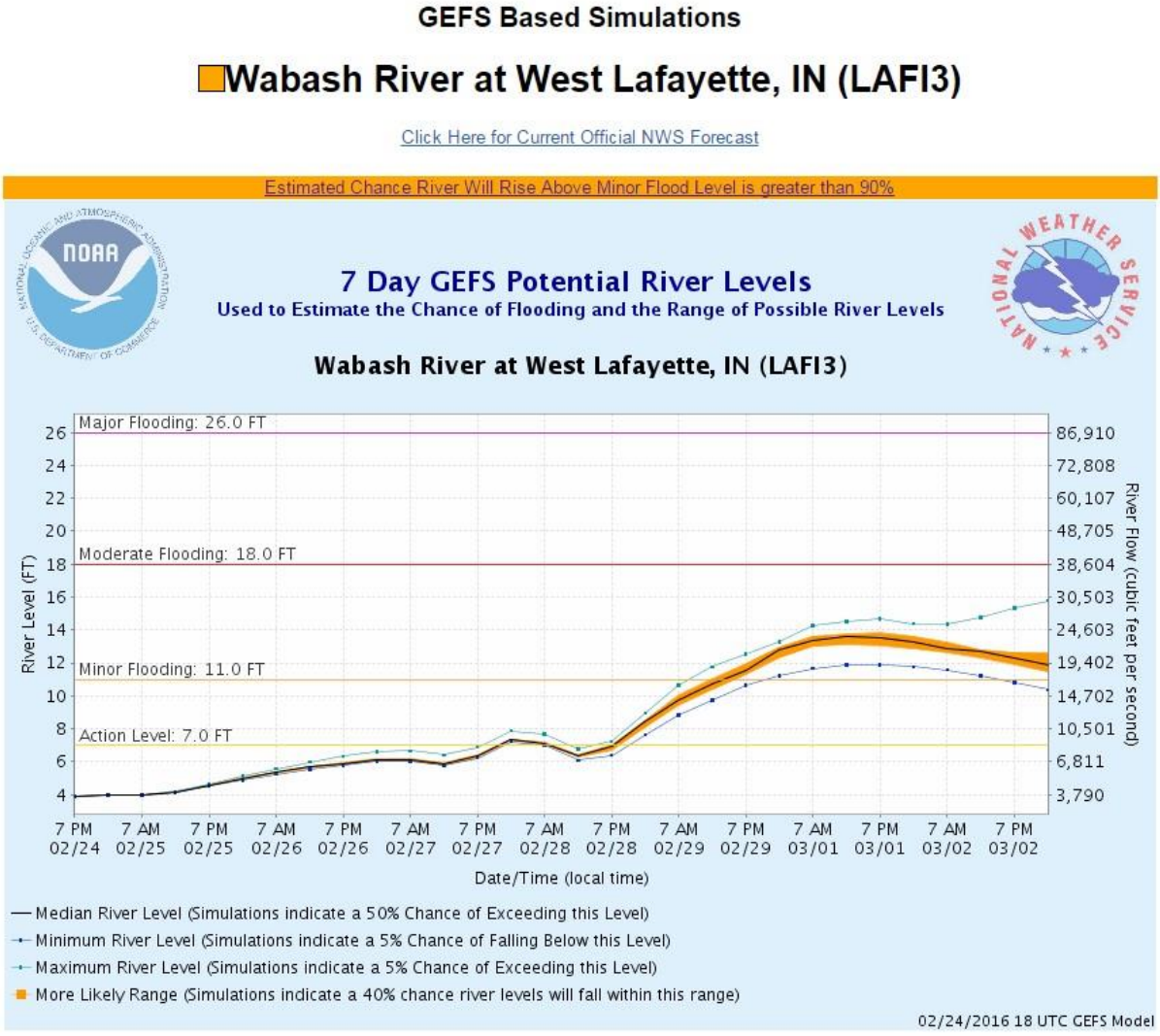

Figure 3. This figure is an example of the CHPS graphic capability from this service.

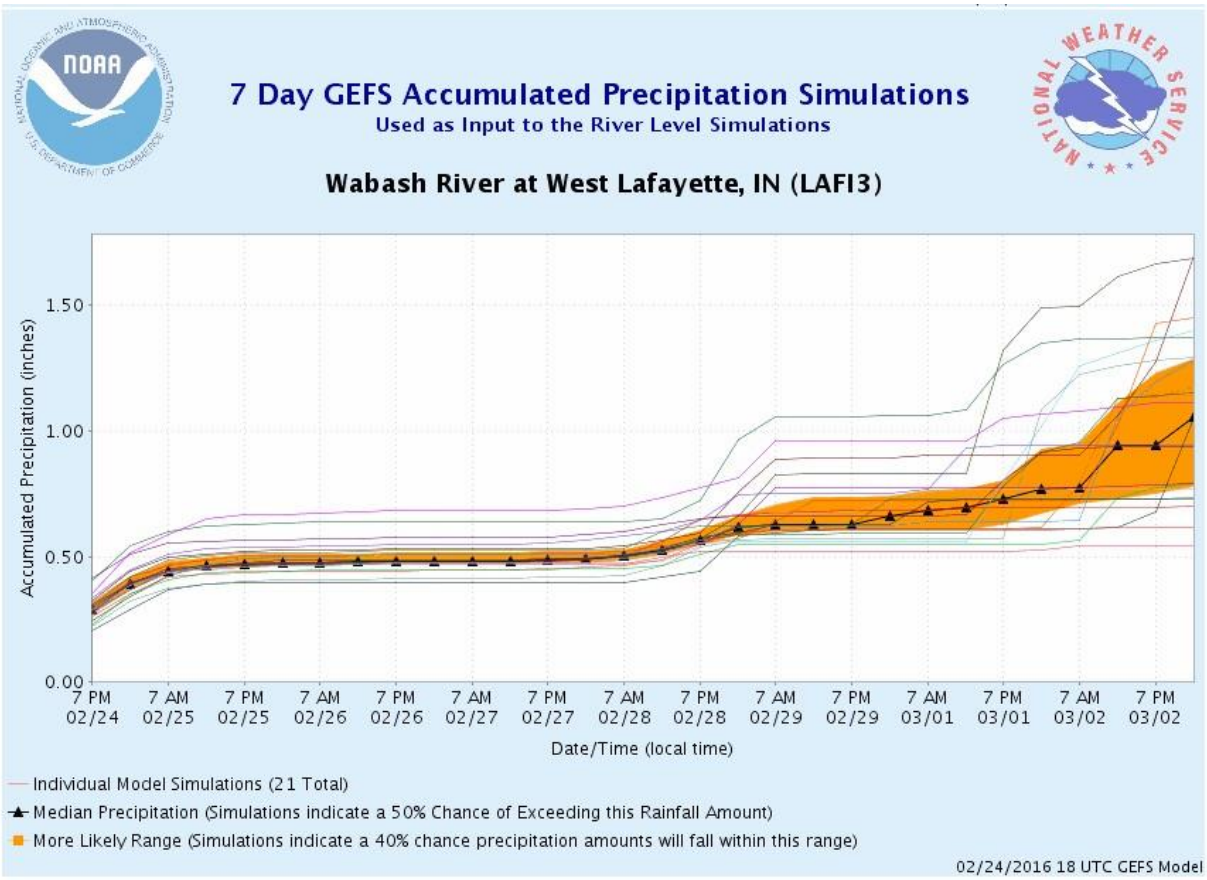

Figure 4. This figure is an example of the CHPS graphic capability from this service.

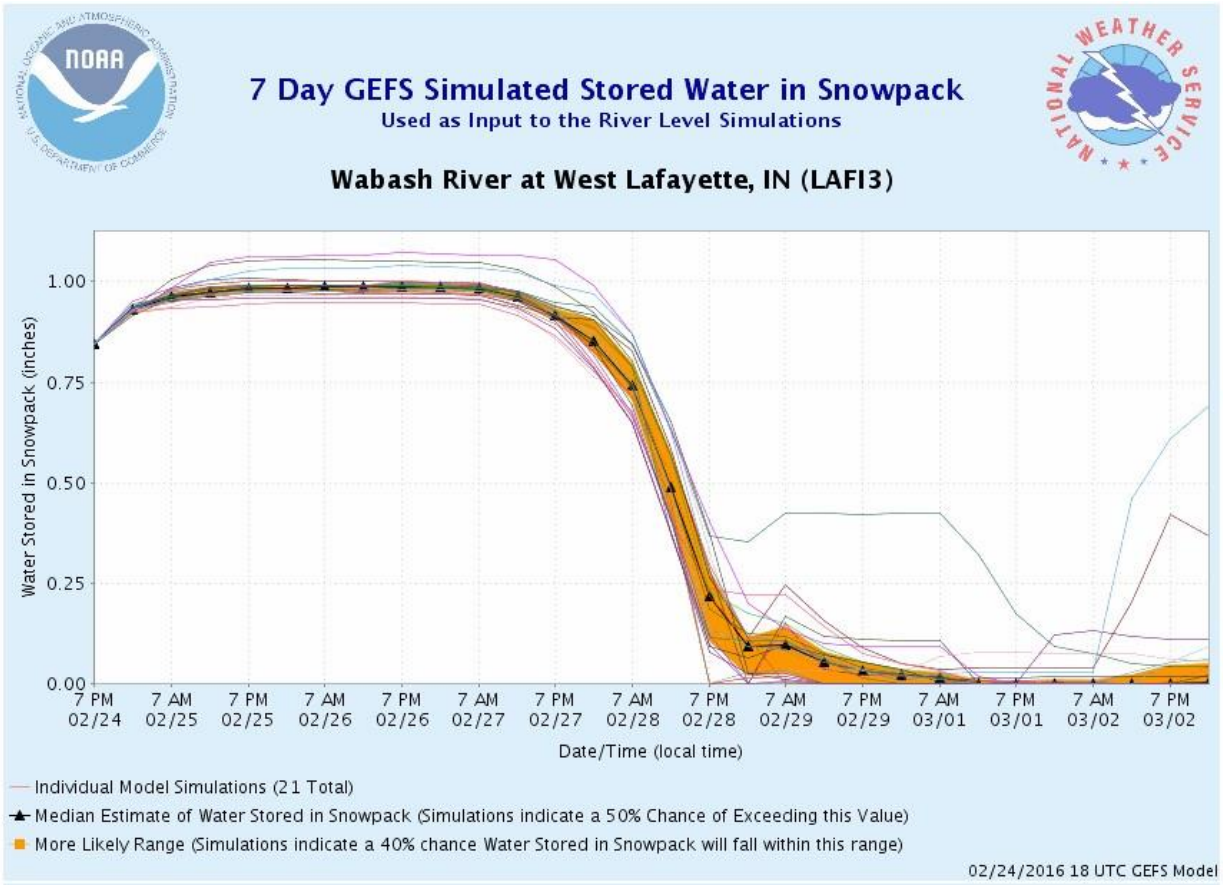

Figure 5. This figure is an example of the CHPS graphic capability from this service.

7 Day NAEFS River Level Probabilities

Forecast Period: 2020-09-03 - 2020-09-10

Used to Estimate Chances River Will Rise Above A Certain Level During the Forecast Period
Each Column Shows the River Level for A Specified Percent Chance of Exceedance
Click on the StationID to go to hydrograph page for that station
Table Last Updated : Thu Sep 3 07:16:26 EDT 2020

NC- CHOWAN FORECASTER

StationID	River	City,State	Exceedance Level (ft.)					Flood Levels (ft.)			
			10%	30%	50%	70%	90%	Action	Minor	Mod	Major
RAWV2	Nottoway River	Rawlings, VA	2.8	2.5	2.4	2.4	2.4	8.0	10.0	13.0	16.0
STYV2	Nottoway River	Stony Creek, VA	3.4	3.3	3.2	3.2	3.2	13.0	15.0	17.0	20.0
SEBV2	Nottoway River	Sebrell, VA	6.2	6.2	6.1	6.1	6.1	14.0	16.0	18.0	21.0
LAWV2	Meherrin River	Lawrenceville, VA	4.3	3.6	3.6	3.6	3.6	12.0	15.0	25.0	29.0
EPOV2	Meherrin River	Emporia, VA	6.9	6.9	6.9	6.9	6.9	13.0	23.0	25.0	27.0
FKNV2	Blackwater River	Franklin, VA	6.7	6.7	6.7	6.7	6.7	6.8	10.8	14.8	18.8

NC- CAPEFEAR FORECASTER

StationID	River	City,State	Exceedance Level (ft.)					Flood Levels (ft.)			
			10%	30%	50%	70%	90%	Action	Minor	Mod	Major
HAWN7	Haw River	Haw River, NC	4.8	4.8	4.8	4.8	4.8	16.0	18.0	23.0	27.0
BYNN7	Haw River	Bynum, NC	5.3	5.3	5.3	5.3	5.3	10.0	11.0	15.0	17.0
MONN7	Deep River	Moncure, NC	1.7	1.5	1.5	1.5	1.5	8.0	9.0	14.0	18.0
LLLN7	Cape Fear River	Lillington, NC	3.1	2.9	2.9	2.9	2.9	13.0	14.0	19.0	27.0
MANN7	Lower Little River	Manchester, NC	9.5	9.3	9.3	9.3	9.3	18.0	18.0	24.0	27.0
FAYN7	Cape Fear River	Fayetteville, NC	14.7	14.7	14.7	14.7	14.7	35.0	35.0	48.0	58.0
STPN7	Cape Fear River	W.O. Huske Lock, NC	36.2	36.2	36.2	36.2	36.2	41.0	42.0	50.0	65.0
ELZN7	Cape Fear River	Elizabethtown, NC	15.5	15.5	15.5	15.5	15.5	20.0	25.0	35.0	47.0
CPFN7	Cape Fear River	Lock 1, NC	18.1	18.1	18.1	18.1	18.1	22.0	24.0	26.0	28.0
CHIN7	N.E. Cape Fear River	Chinquapin, NC	5.6	4.1	4.1	4.1	4.1	12.0	13.0	16.0	18.0
BGWN7	N.E. Cape Fear River	Burgaw, NC	2.4	2.4	2.4	2.4	2.4	7.0	10.0	12.0	16.0
CLYN7	Neuse River	Clayton, NC	3.7	3.7	3.7	3.7	3.7	9.0	9.0	13.0	16.0
SMFN7	Neuse River	SMITHFIELD, NC	16.7	16.7	16.7	16.7	16.7	14.0	15.0	18.0	20.0
GLDN7	Neuse River	Goldsboro, NC	14.0	14.0	14.0	14.0	14.0	17.0	18.0	20.0	24.0
KINN7	Neuse River	Kinston, NC	13.5	13.5	13.5	13.5	13.5	13.0	14.0	18.0	21.0
HOKN7	Contentnea Creek	Hookerton, NC	8.4	8.4	8.4	8.4	8.4	12.0	13.0	16.0	18.0
FTBN7	Neuse River	Fort Barnwell, NC	9.0	8.9	8.9	8.9	8.9	12.5	13.0	16.0	18.0
EFDN7	Fishing Creek	Enfield, NC	10.6	10.6	10.6	10.6	10.6	16.0	16.0	18.0	20.0
LOUN7	Tar River	Louisburg, NC	8.3	6.0	6.0	6.0	6.0	20.0	20.0	22.0	23.0
ROKN7	Tar River	NC97 In Rocky Mount, NC	7.2	7.1	7.1	7.1	7.1	19.0	21.0	23.0	25.0
TARN7	Tar River	Tarboro, NC	7.3	7.3	7.3	7.3	7.2	17.0	19.0	24.0	32.0

Figure 6 – Example of tabular data available from MMEFS