

REAL TIME FLOOD FORECASTING APPLICATION FOR A PILOT LOCATION IN CONTRABAND BAYOU IN CALCASIEU PARISH, LOUISIANA

North American Deltares Software Days

March 13-14th, 2019



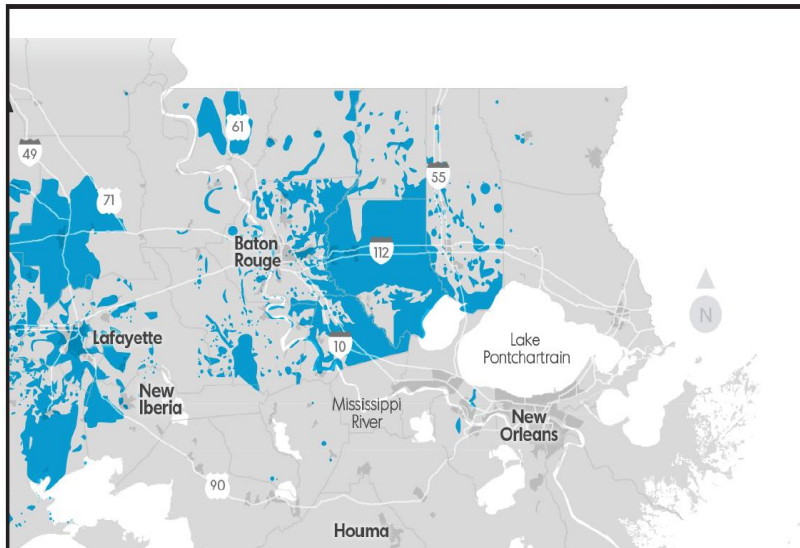
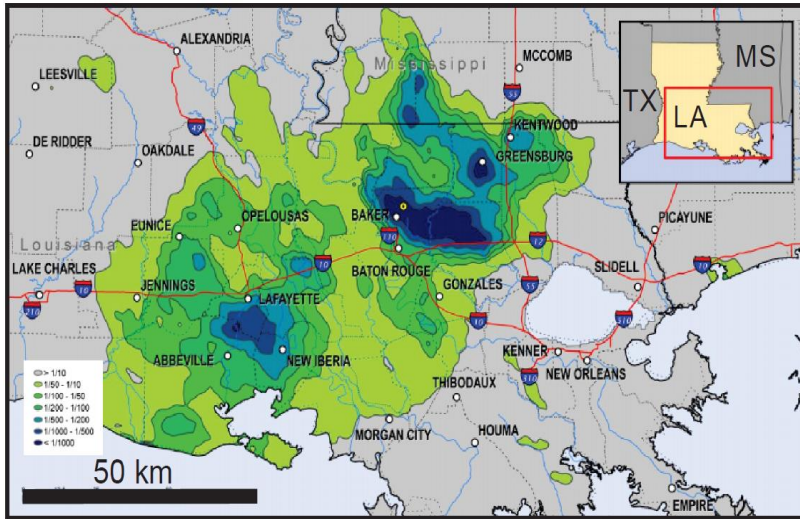
**THE WATER INSTITUTE
OF THE GULF™**



LOUISIANA AUGUST 2016 FLOOD



LOUISIANA AUGUST 2016 FLOOD



NOAA/NWS flood exceedance probability map
(08/11-13/2016) and flood extent in the August 2016

Real Time Forecasting for Contraband Bayou

BUSINESSES OF THE NINE-PARISH BATON ROUGE AREA

IMPACTS OF THE 2016 FLOOD

7,364 OR **21%** OF THE REGION'S BUSINESSES LOCATED IN FLOOD AREAS

73,907 OR **18%** OF THE REGION'S EMPLOYEES AFFECTED

THE HARDEST HIT INDUSTRIES

- RETAIL
- CONSTRUCTION
- HEALTHCARE
- MANUFACTURING
- FOOD AND BEVERAGE SERVICES

BASED ON ANALYSIS RELEASED ON AUGUST 19, 2016 AND PERFORMED BY THE BATON ROUGE AREA CHAMBER'S ECONOMIC COMPETITIVENESS AND BUSINESS INTELLIGENCE DEPARTMENTS, USING DATA FROM LOUISIANA STATE UNIVERSITY'S STEPHENSON DISASTER MANAGEMENT INSTITUTE AND THE GOVERNOR'S OFFICE OF HOMELAND SECURITY AND EMERGENCY PREPAREDNESS



HOMES OF THE NINE-PARISH BATON ROUGE AREA

IMPACTS OF THE 2016 FLOOD

31% OF REGION'S HOMES LOCATED IN FLOOD AREAS

110,000 HOMES LOCATED IN FLOOD AREAS

\$20.7 BILLION TOTAL PROPERTY VALUE OF HOMES IN FLOOD AREAS

15% OF HOMES IN THE REGION HAVE FLOOD INSURANCE

RESIDENTS LOCATED IN FLOOD AREAS **280,910**

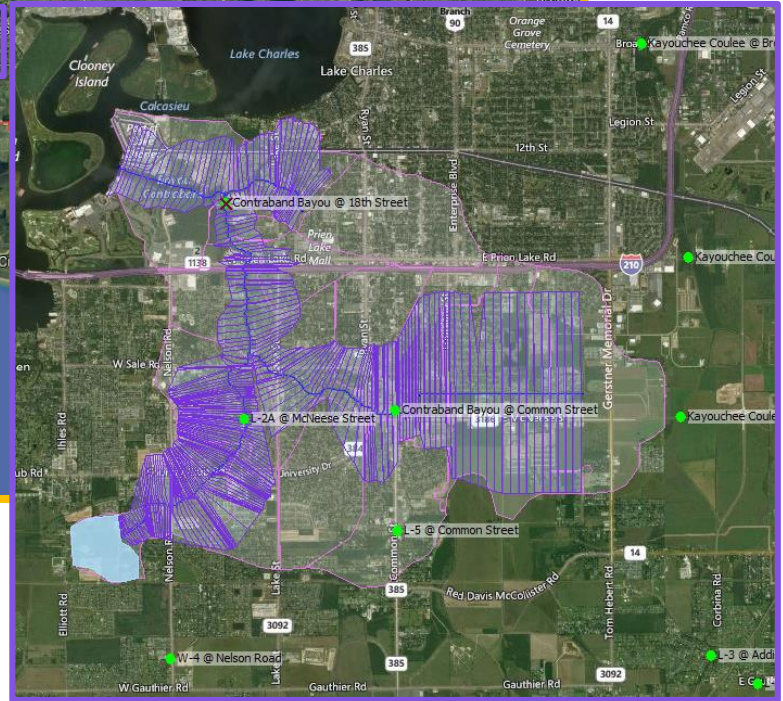
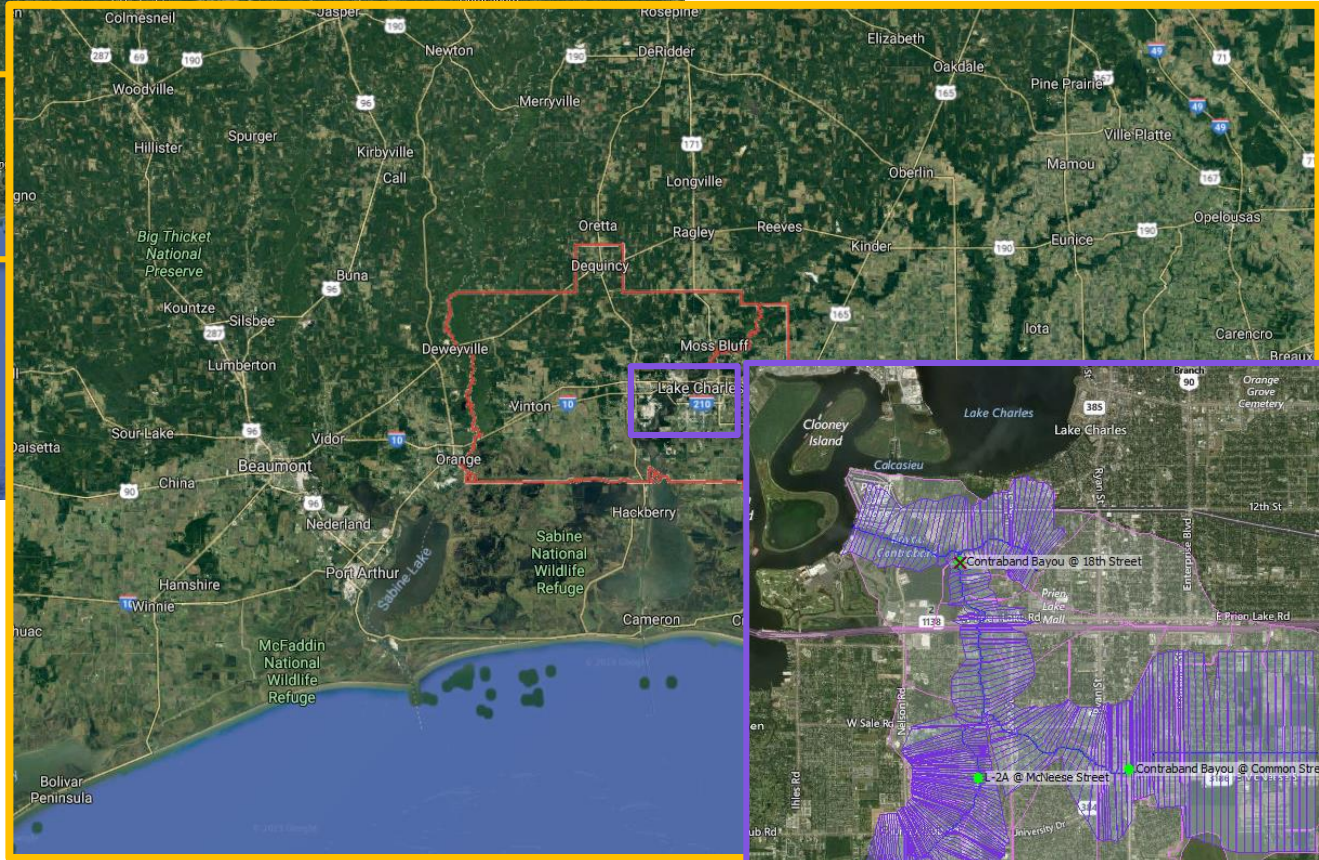
BASED ON ANALYSIS RELEASED ON AUGUST 19, 2016 AND PERFORMED BY THE BATON ROUGE AREA CHAMBER'S ECONOMIC COMPETITIVENESS AND BUSINESS INTELLIGENCE DEPARTMENTS, USING DATA FROM LOUISIANA STATE UNIVERSITY'S STEPHENSON DISASTER MANAGEMENT INSTITUTE AND THE GOVERNOR'S OFFICE OF HOMELAND SECURITY AND EMERGENCY PREPAREDNESS



Baton Rouge Area Chamber®

Leading Economic Development
in the Baton Rouge Area

This aerial map shows the Houston area. A yellow rectangle highlights the area around Beaumont, Texas, and a red rectangle highlights the area around Dequency, Texas. The map includes labels for various cities and towns, as well as major highways and the Gulf of Mexico.



COUPLING FLOOD WARNING SYSTEM WITH NWS AND COASTAL FORECAST MODELS



Atmospheric
Forecast Model

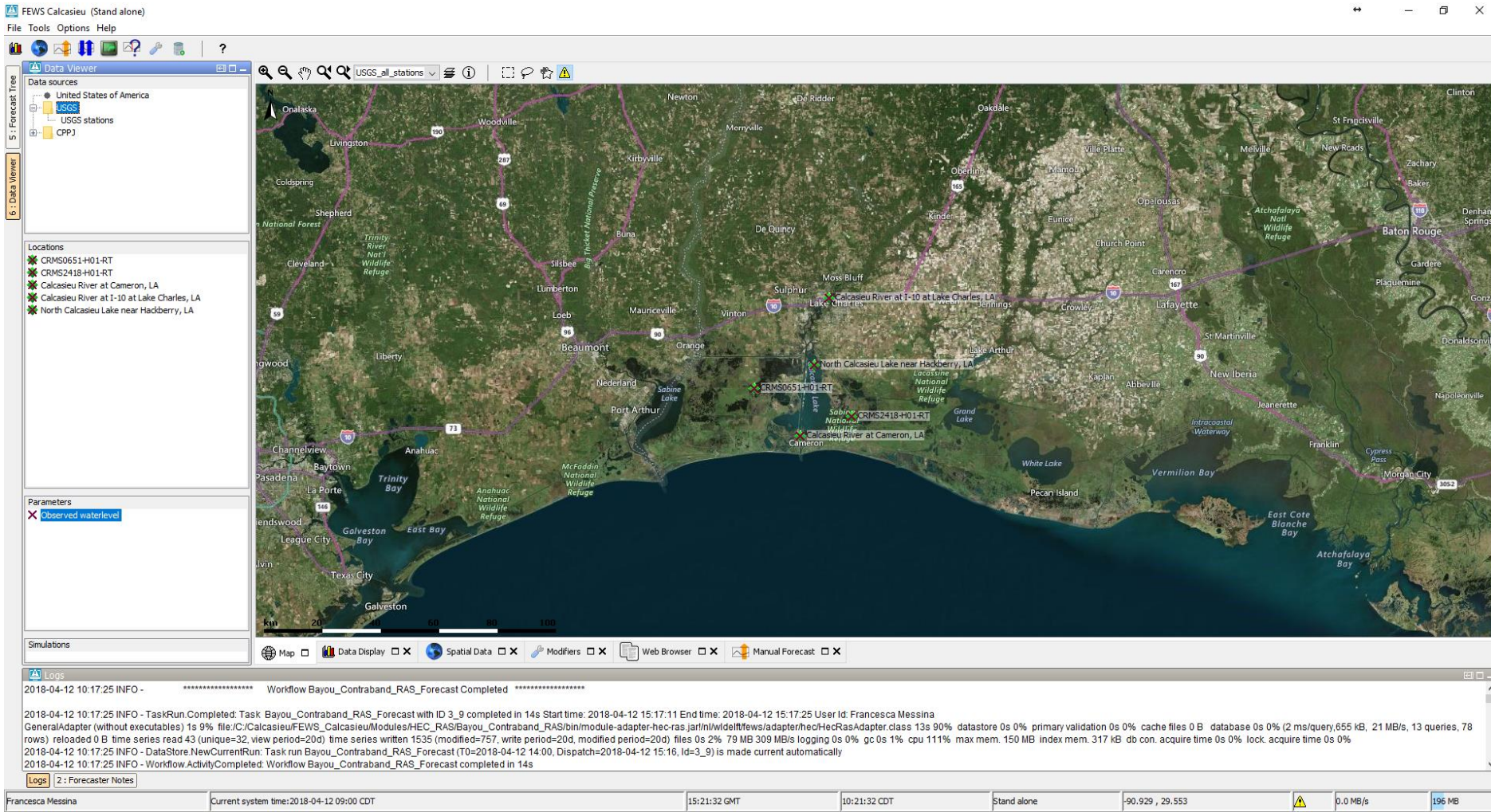
- Coupling watershed models with Coastal models
- Capture SLR & Surge

- Coupling with NWS & other NOAA Forecasting tools
- Expand streamflow forecasting with urban hydrology to capture continuous development



SYSTEM OVERVIEW

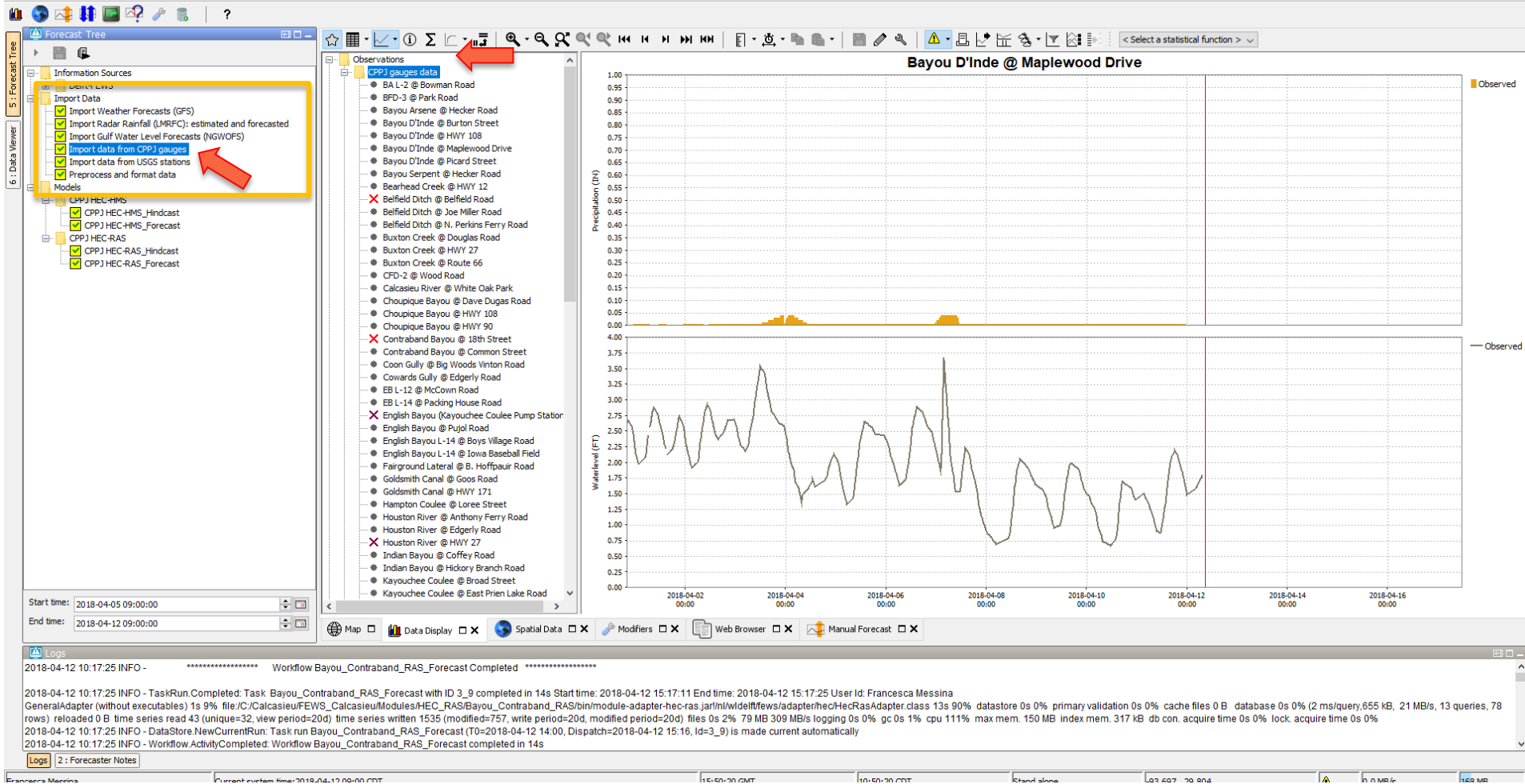
MAP - USGS GAUGES



DATA/EXTERNAL FORECAST IMPORT TIMESERIES – CPPJ GAUGES

FEWS Calcasieu (Stand alone)

File Tools Options Help



DATA/EXTERNAL FORECAST IMPORT TIMESERIES – USGS GAUGES

FEWS Calcasieu (Stand alone)

File Tools Options Help



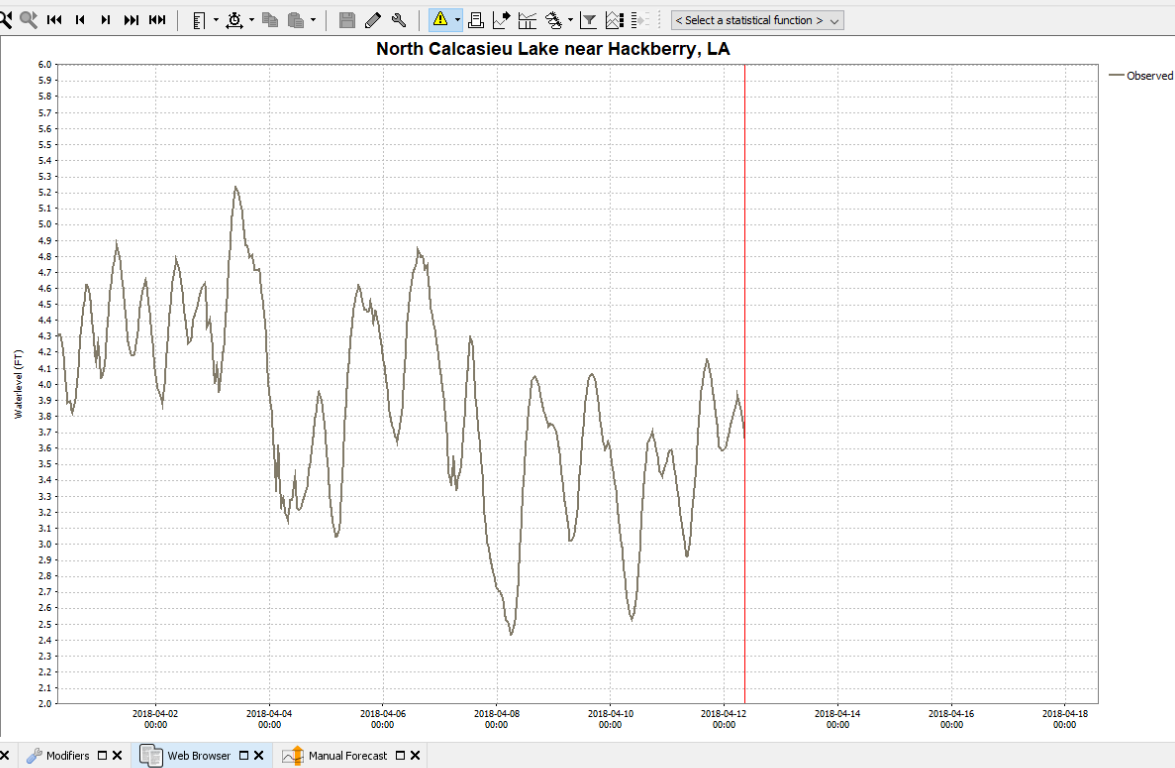
Forecast Tree

- Information Sources
 - Import Data
 - ☒ Import Weather Forecasts (GFS)
 - ☒ Import Radar Rainfall (LMRFC): estimated and forecasted
 - ☒ Import Gulf Water Level Forecasts (NGWOFs)
 - ☒ Import data from CPPJ gauges
 - ☒ **Import data from USGS stations**
 - ☒ Preprocess and format data
 - Models
 - CPPJ HEC-HMS
 - ☒ CPPJ HEC-HMS_Hindcast
 - ☒ CPPJ HEC-HMS_Forecast
 - CPPJ HEC-RAS
 - ☒ CPPJ HEC-RAS_Hindcast
 - ☒ CPPJ HEC-RAS_Forecast

Start time: 2018-04-05 09:00:00
End time: 2018-04-12 09:00:00

Observations

- CPPJ gauges data
- USGS stations data
 - CRMS0651-H01-RT
 - CRMS2418-H01-RT
 - Calcasieu River at Cameron, LA
 - Calcasieu River at I-10 at Lake Charles, LA
 - North Calcasieu Lake near Hackberry, LA**
- Tidal boundary
- CPPJ HEC-HMS Model
- CPPJ HEC-RAS Model
- CPPJ HEC-RAS Input: Downstream
- CPPJ HEC-RAS Model Results
- HEC-RAS Model Results + Data: pilot location stations
 - Contraband Bayou @ Common Street
 - Contraband Bayou @ 18th Street
 - L-2A @ McNeese Street



Logs

2018-04-12 10:17:25 INFO - ***** Workflow Bayou_Contraband_RAS_Forecast Completed *****

2018-04-12 10:17:25 INFO - TaskRun.Completed: Task Bayou_Contraband_RAS_Forecast with ID 3_9 completed in 14s Start time: 2018-04-12 15:17:11 End time: 2018-04-12 15:17:25 User Id: Francesca Messina

GeneralAdapter (without executables) 1s 9% file:/C:/Calcasieu/FEWS_Calcasieu/Modules/HEC_RAS/Bayou_Contraband_RAS/bin/module-adapter-hec-ras.jar/ml/widelfeews/adapter/hecHecRasAdapter.class 13s 90% datastore 0s 0% primary validation 0s 0% cache files 0 B database 0s 0% (2 ms/query, 655 KB, 21 MB/s, 13 queries, 78 rows) reloaded 0 B time series read 43 (unique=32, view period=20d) time series written 1535 (modified=757, write period=20d, modified period=20d) files 0s 2% 79 MB 309 MB/s logging 0s 0% gc 0s 1% cpu 111% max mem. 150 MB index mem. 317 KB db con. acquire time 0s 0% lock. acquire time 0s 0%

2018-04-12 10:17:25 INFO - DataStore.NewCurrentRun: Task run Bayou_Contraband_RAS_Forecast (T0=2018-04-12 14:00, Dispatch=2018-04-12 15:16, Id=3_9) is made current automatically

2018-04-12 10:17:25 INFO - Workflow.ActivityCompleted: Workflow Bayou_Contraband_RAS_Forecast completed in 14s

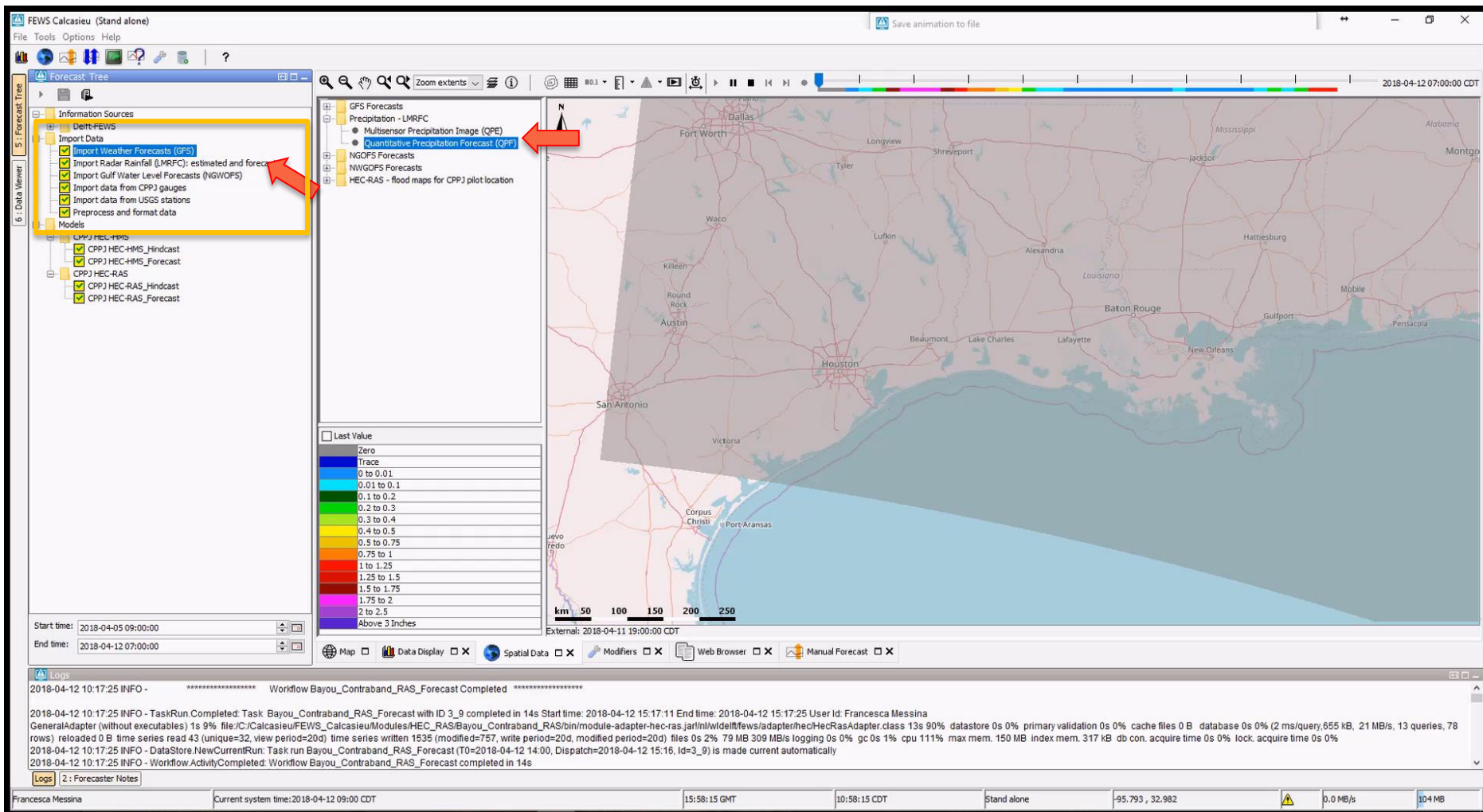
Logs 2: Forecaster Notes

Francesca Messina Current system time: 2018-04-12 09:00 CDT 15:52:34 GMT 10:52:34 CDT Stand alone -93.697 -79.804 0.0 MB/s 180 MB



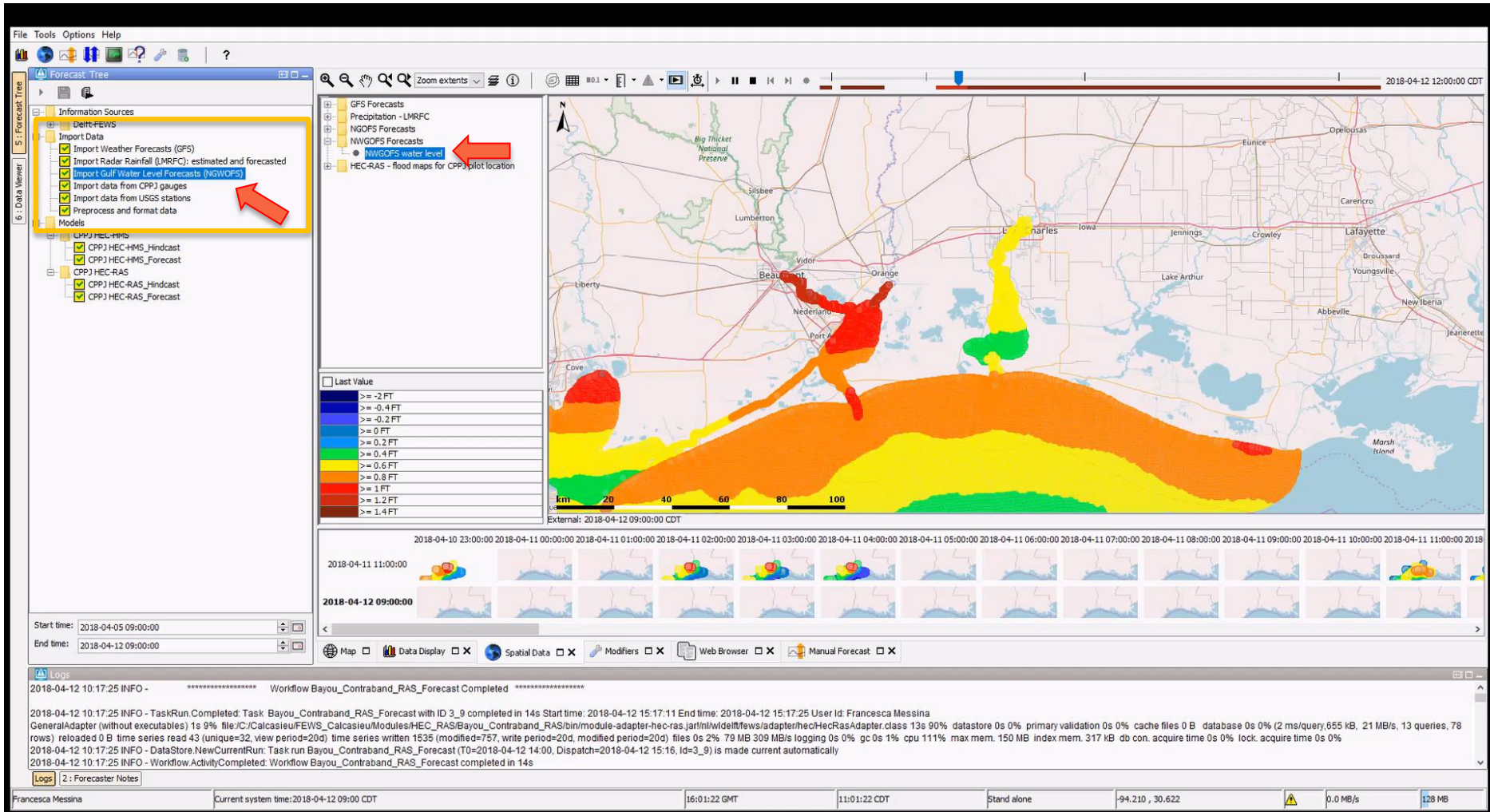
DATA/EXTERNAL FORECAST IMPORT

SPATIAL DATA – LMRTF

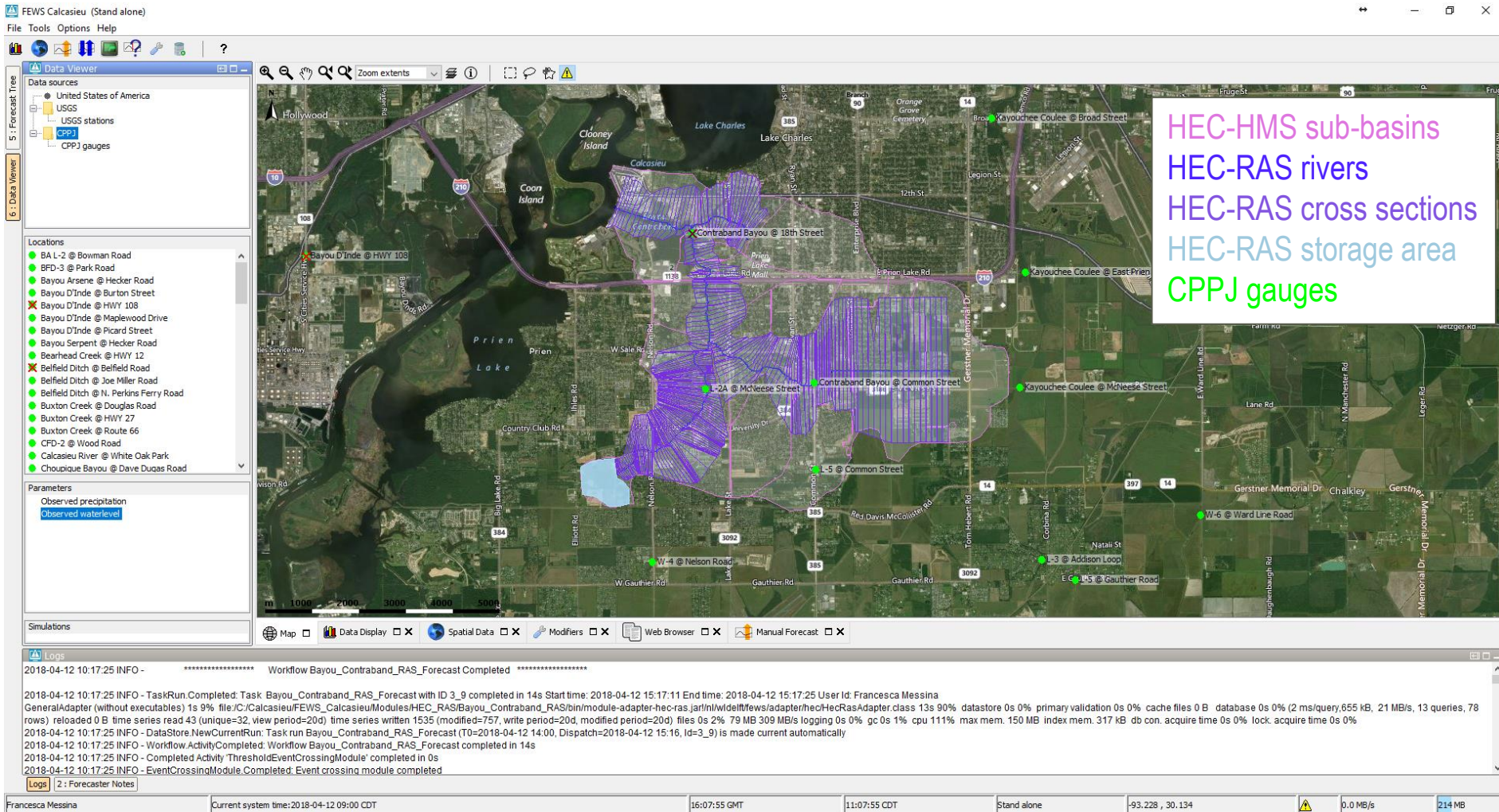


DATA/EXTERNAL FORECAST IMPORT

SPATIAL DATA – NWGOFS

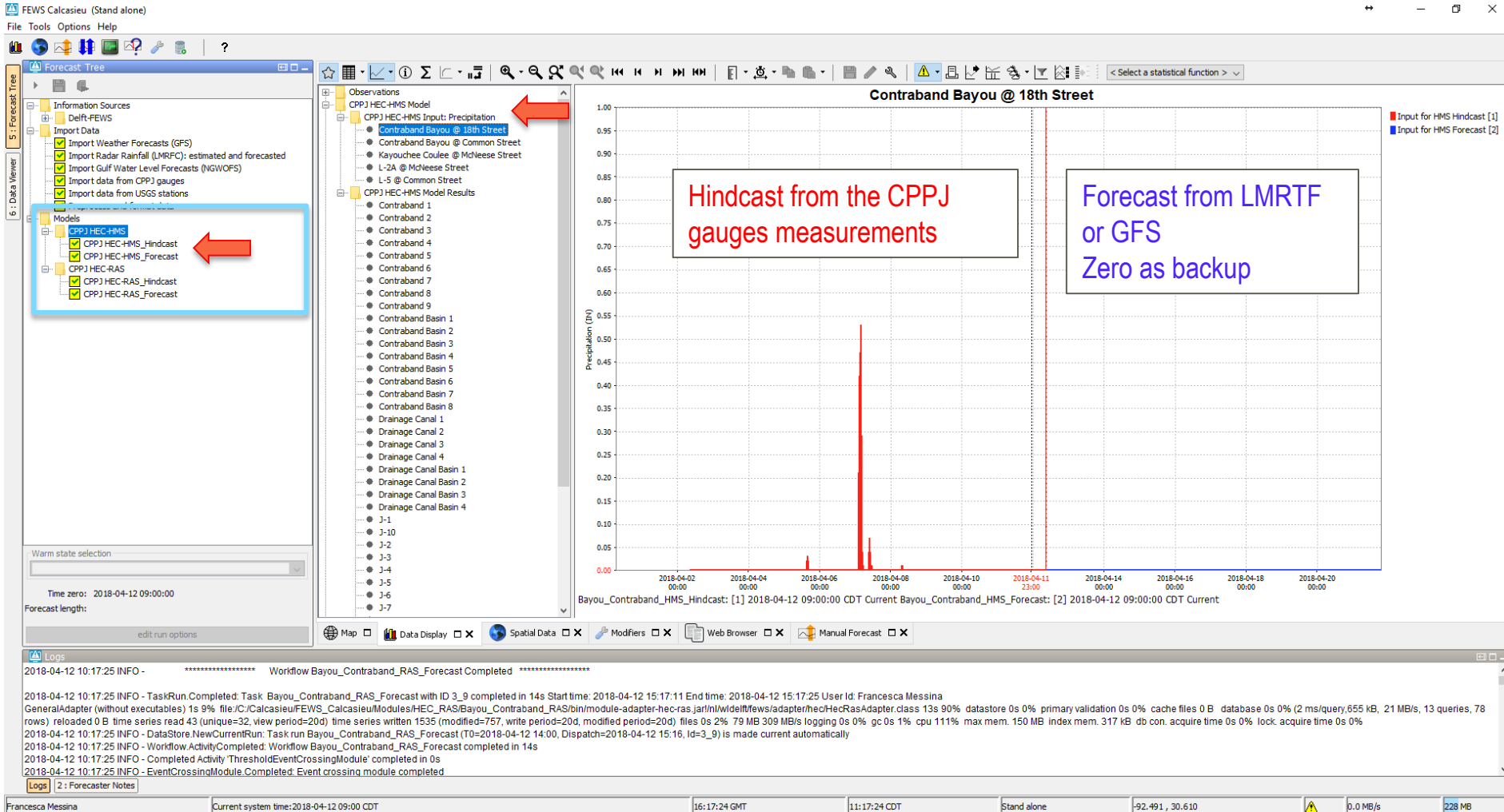


NUMERICAL MODELS



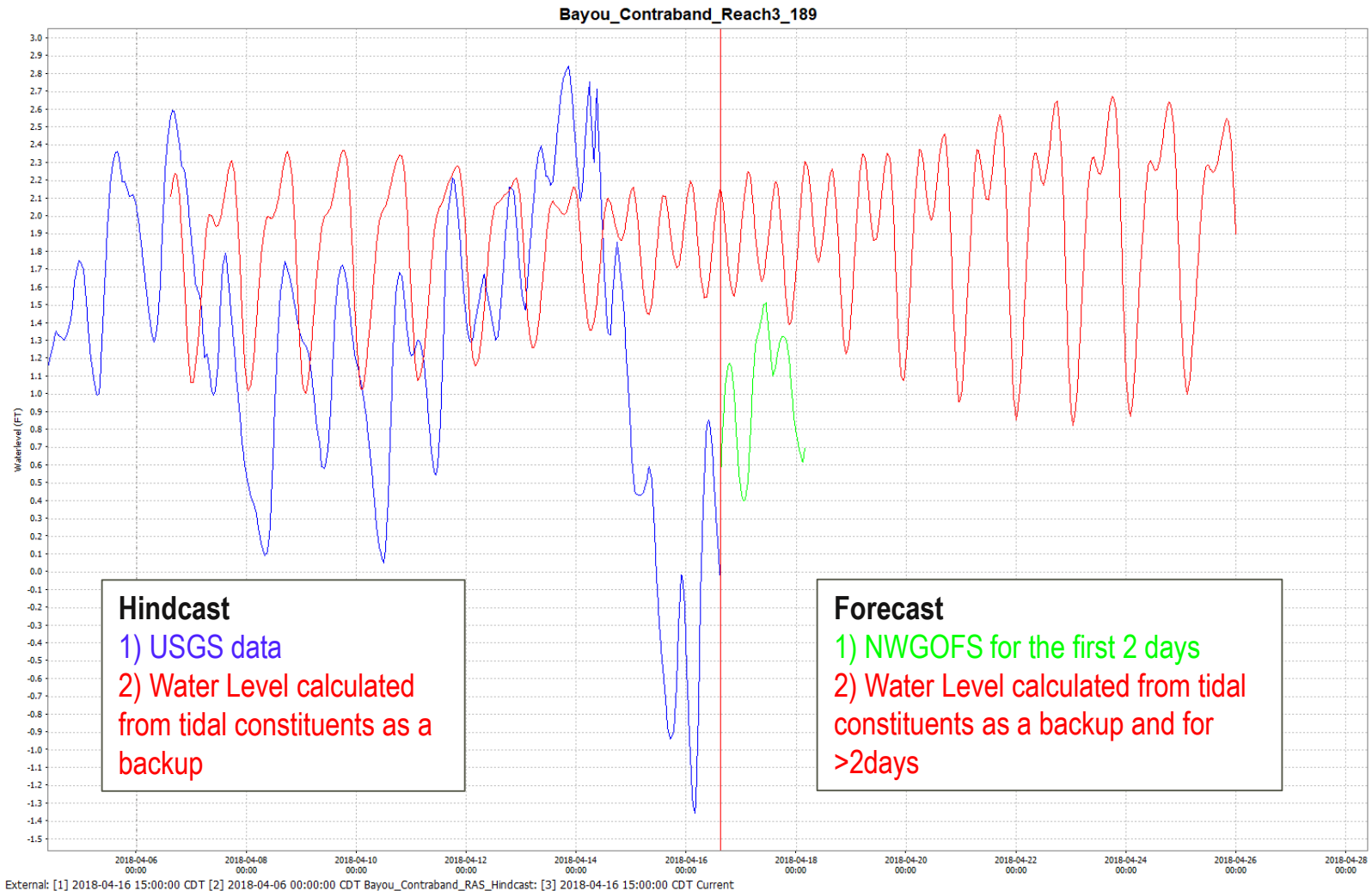
NUMERICAL MODELS

HEC-HMS INPUTS



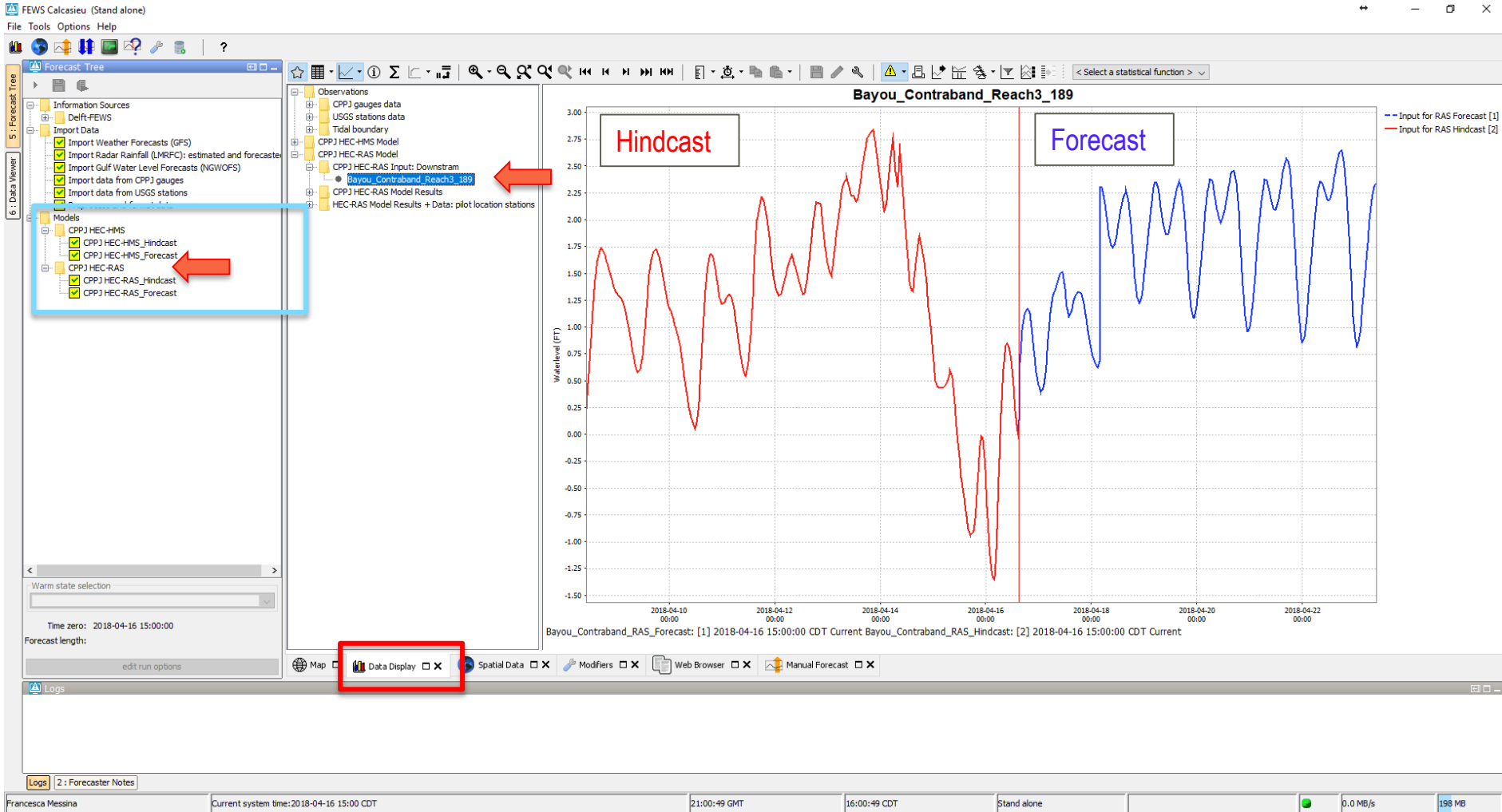
NUMERICAL MODELS

HEC-RAS DOWNSTREAM BOUNDARY (1)



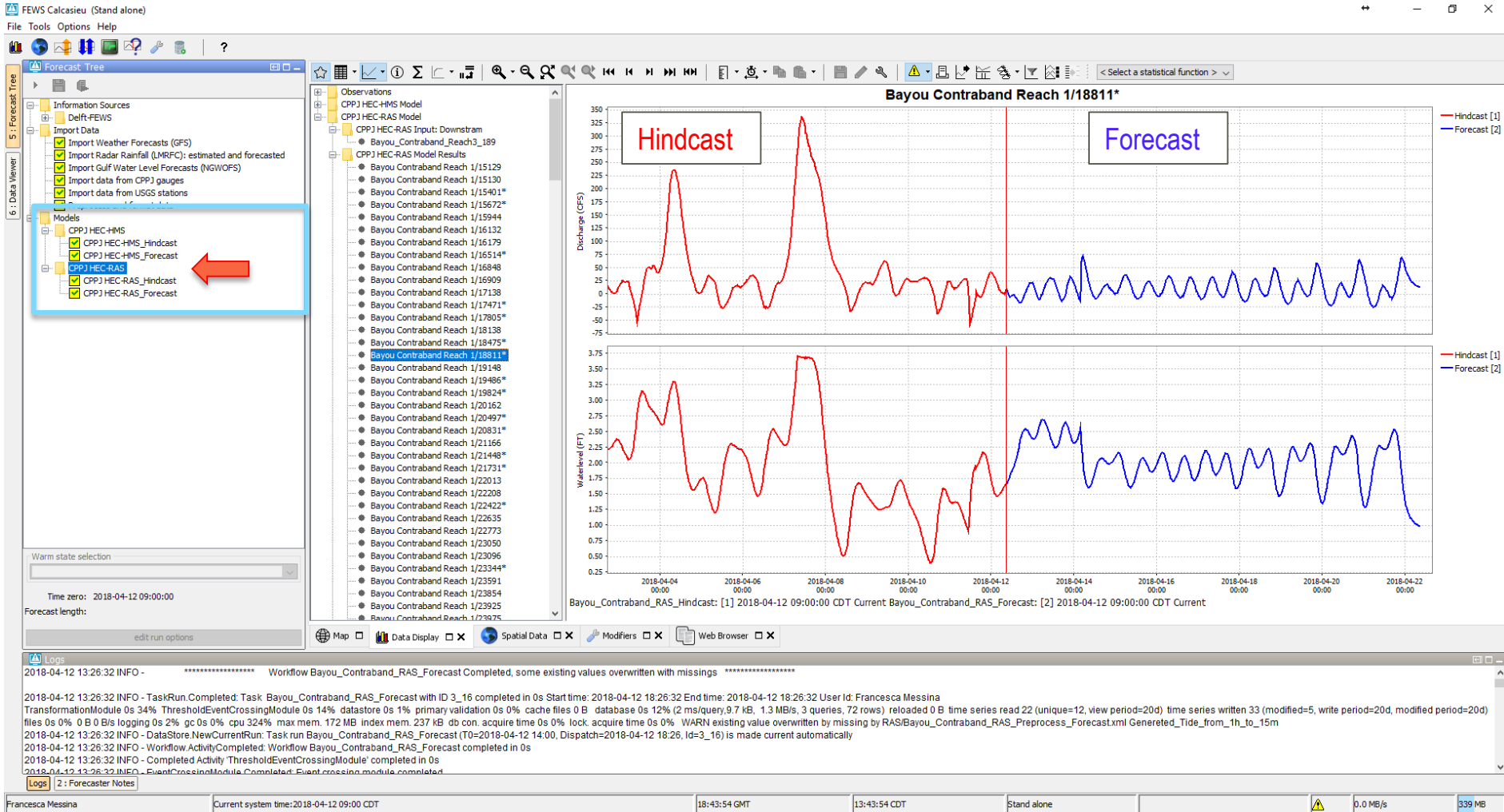
NUMERICAL MODELS

HEC-RAS DOWNSTREAM BOUNDARY (2)



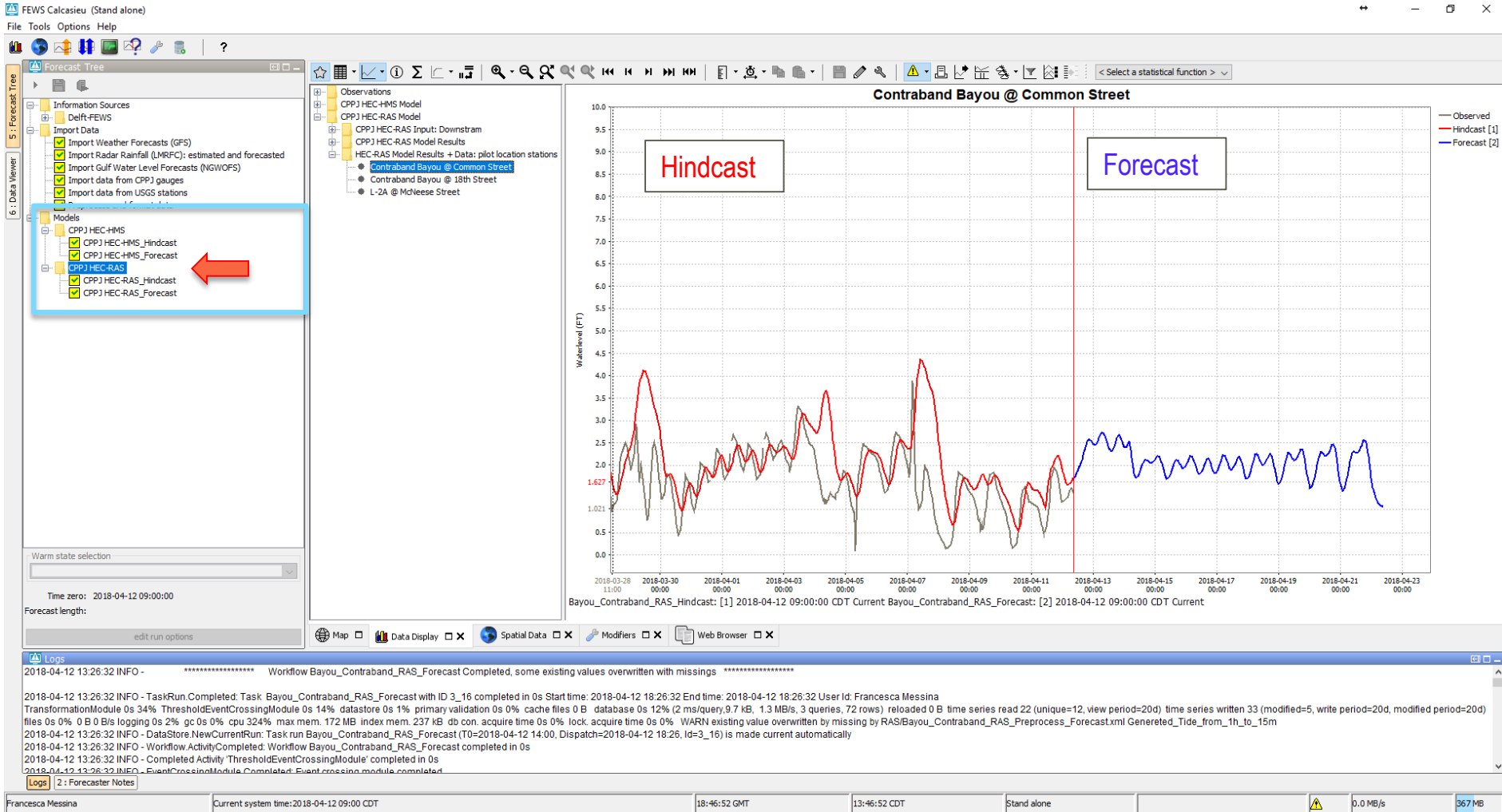
NUMERICAL MODELS

HEC-RAS RESULTS



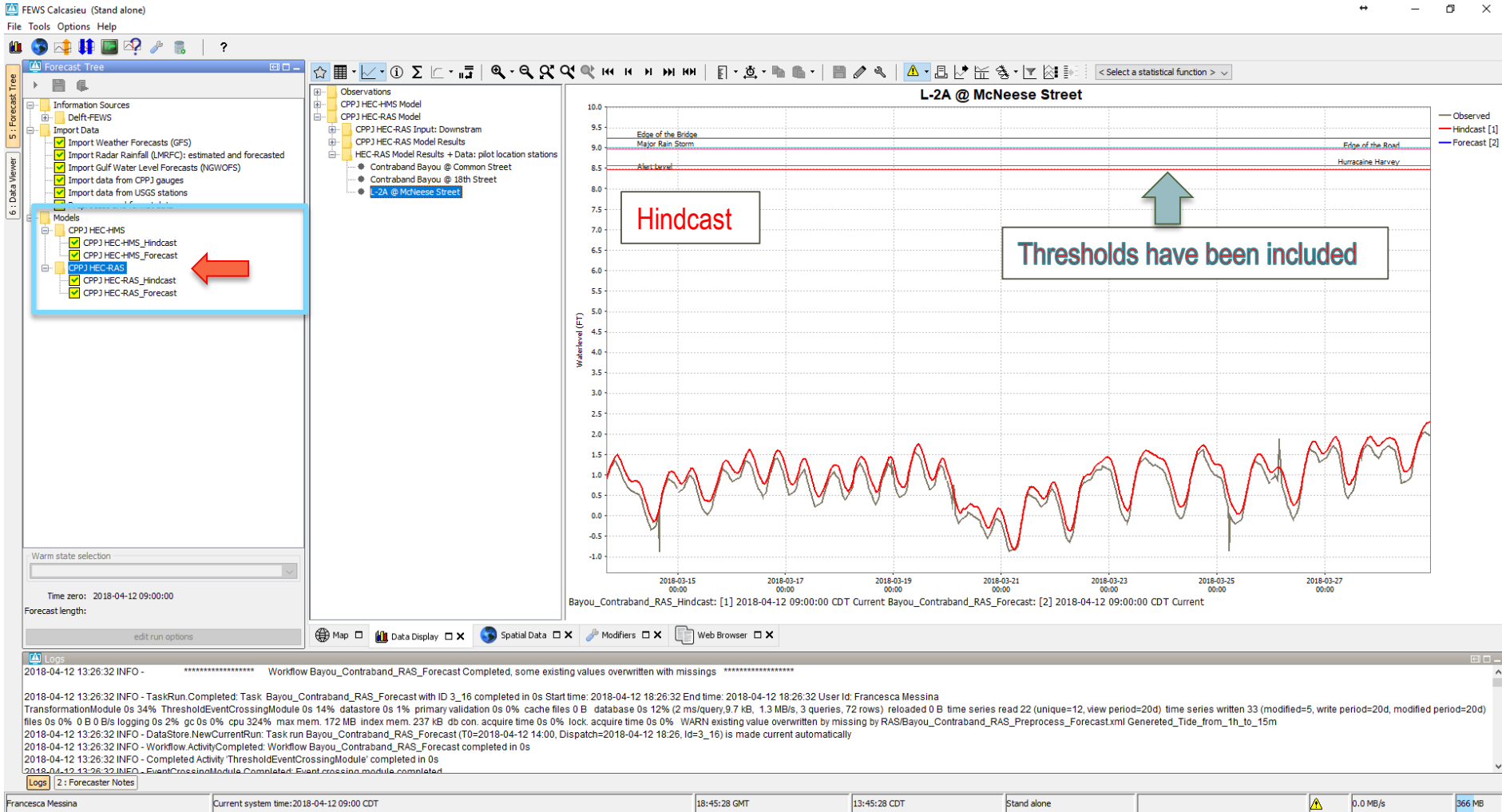
NUMERICAL MODELS

HEC-RAS RESULTS – DATA COMPARISON



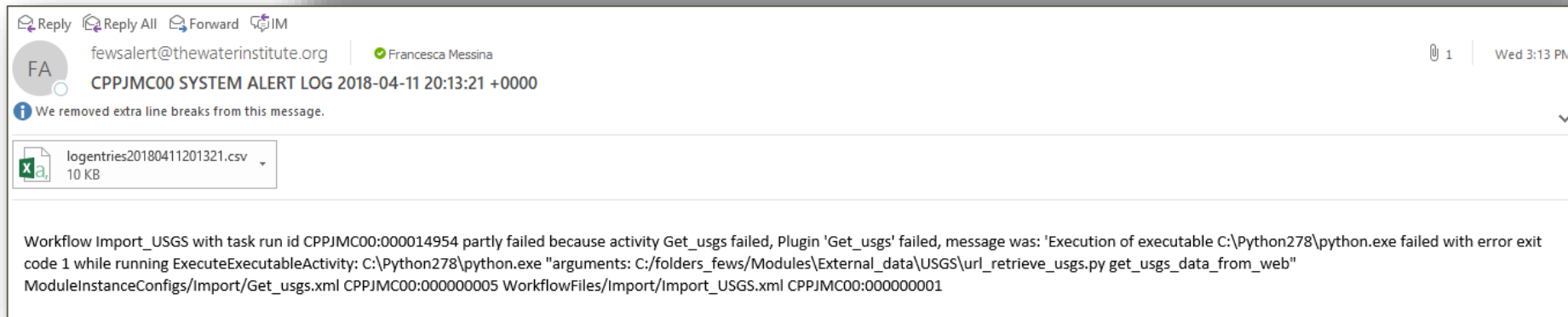
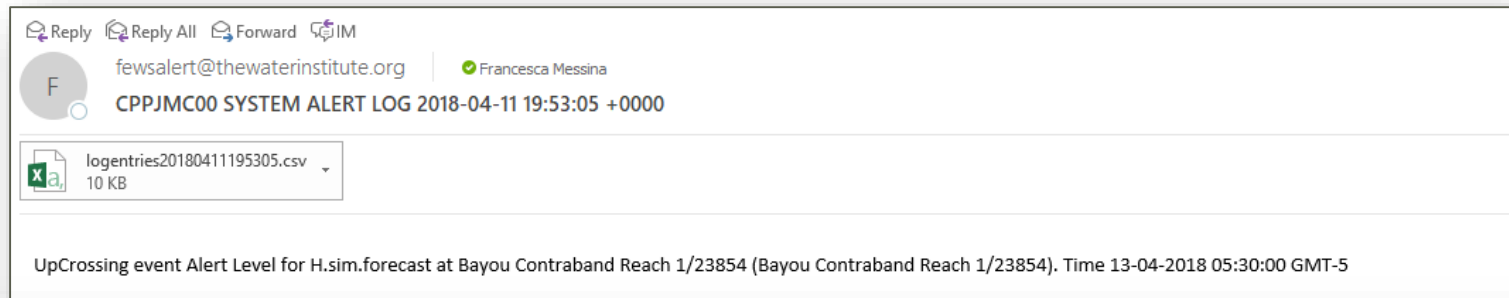
NUMERICAL MODELS

HEC-RAS RESULTS – DATA COMPARISON



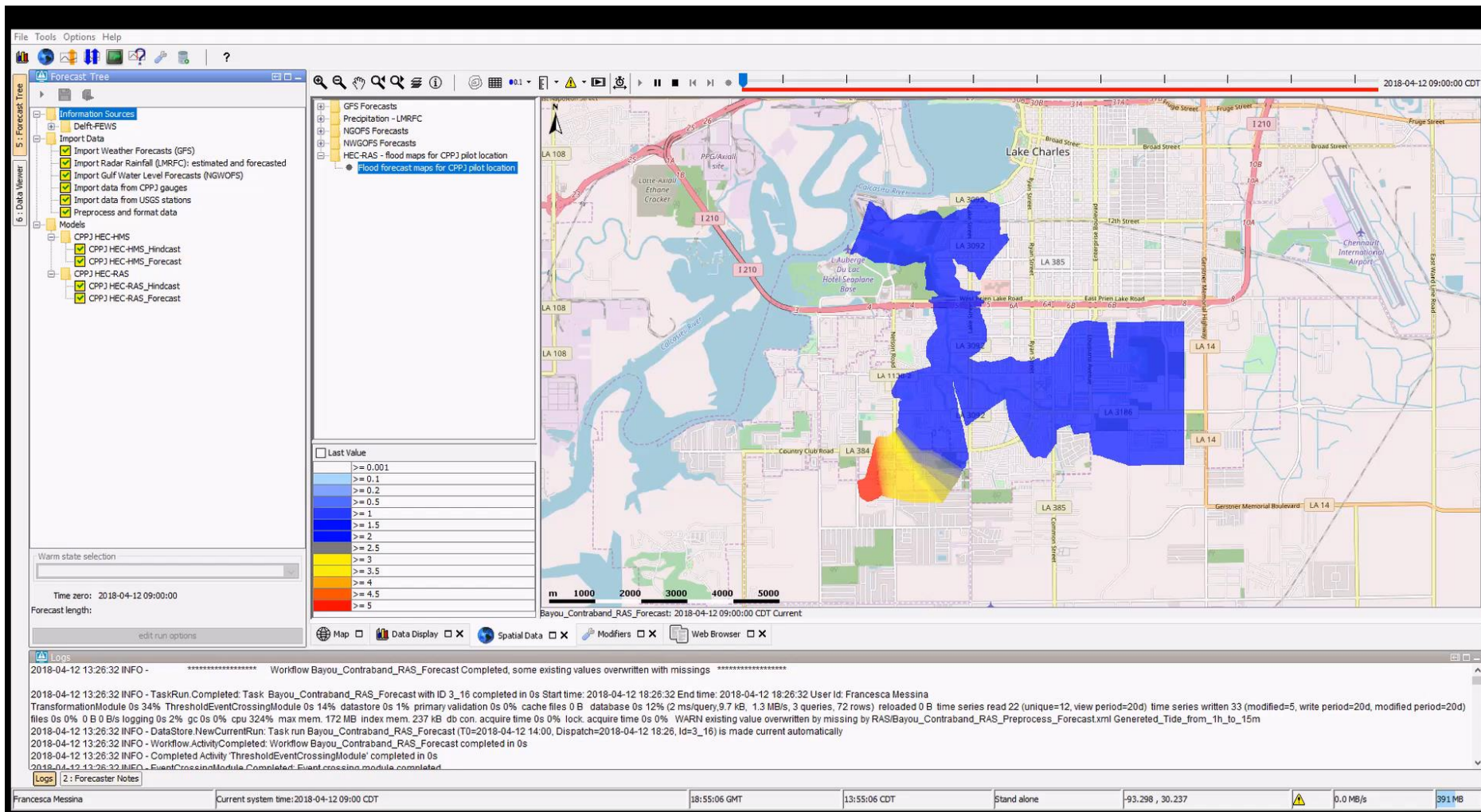
EMAIL FUNCTIONALITY

- Automatic emails will be sent if:
 - one of the tasks fails
 - data (from CPPJ gauges) or RAS modelled water level exceed one of the alert thresholds



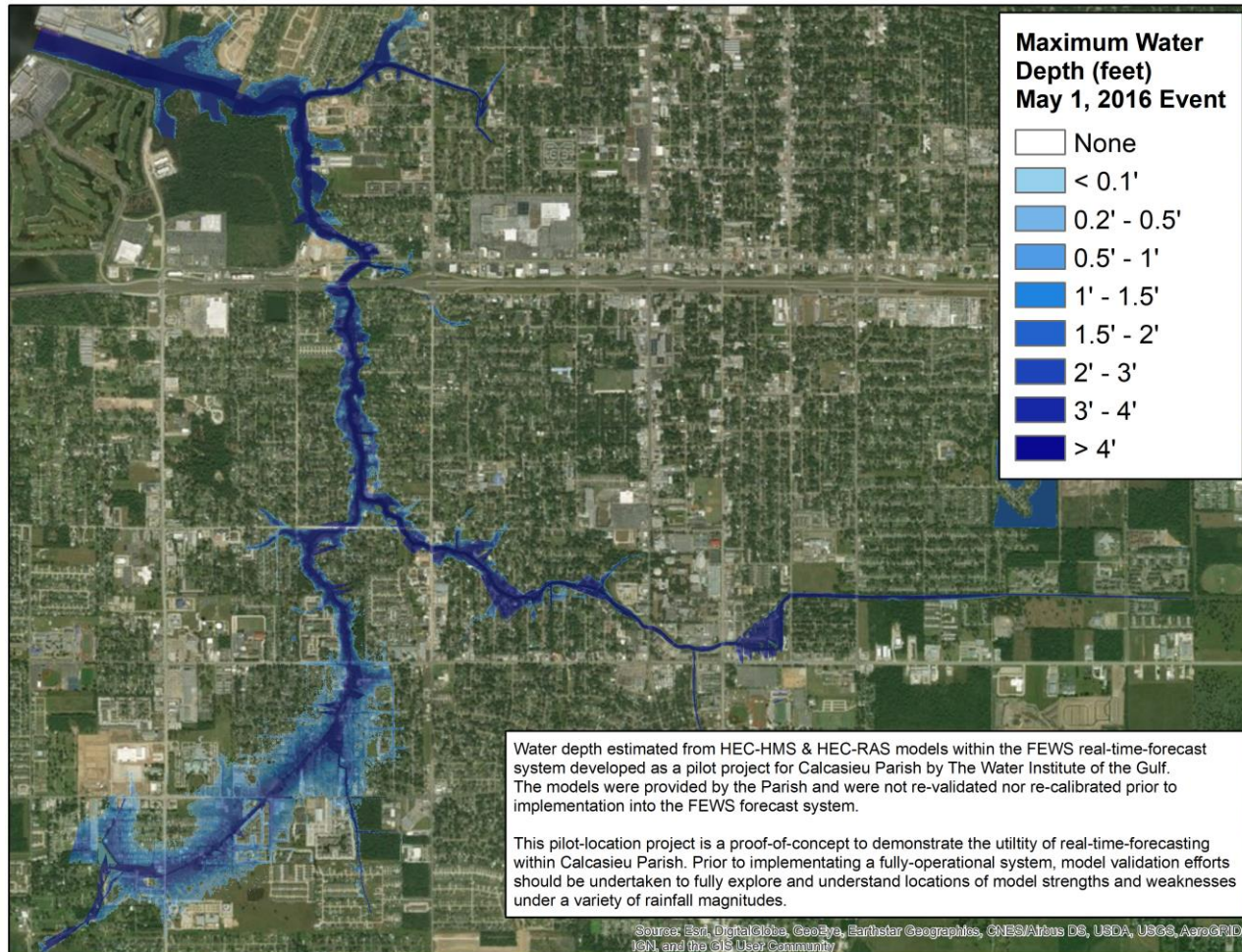
NUMERICAL MODELS

WATER LEVEL MAPS/ANIMATIONS



NUMERICAL MODELS

WATER LEVEL MAPS/ANIMATIONS



COASTAL ECOMORPHOLOGICAL REAL-TIME FORECASTING (CERF) SYSTEM

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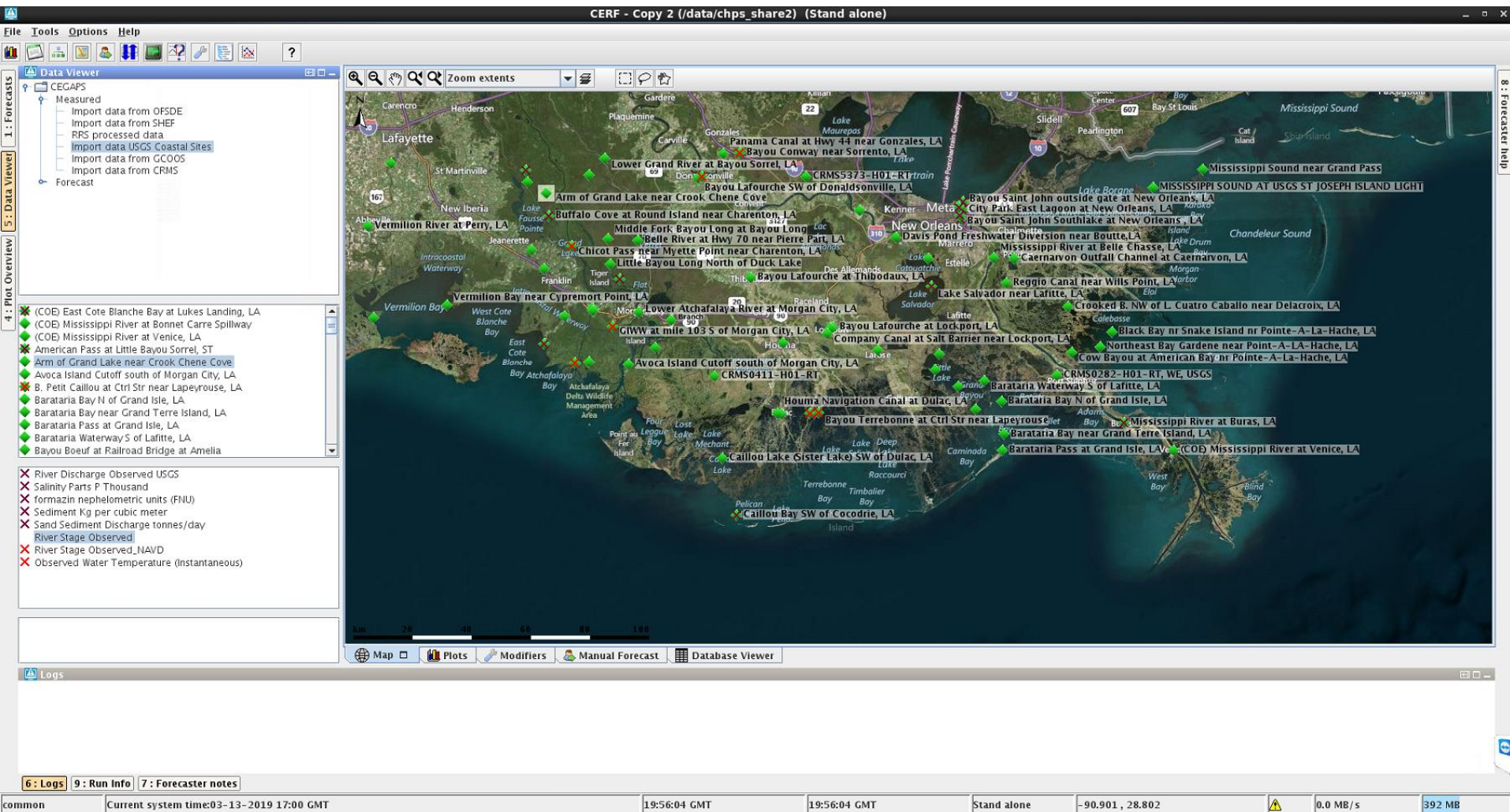


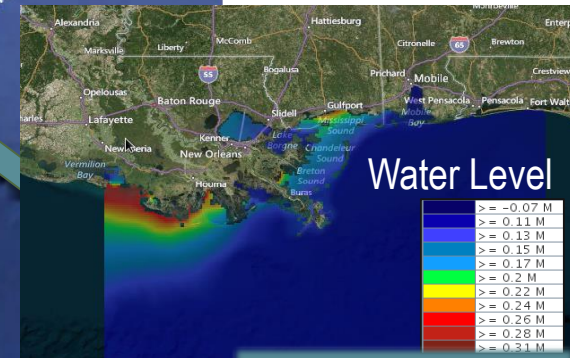
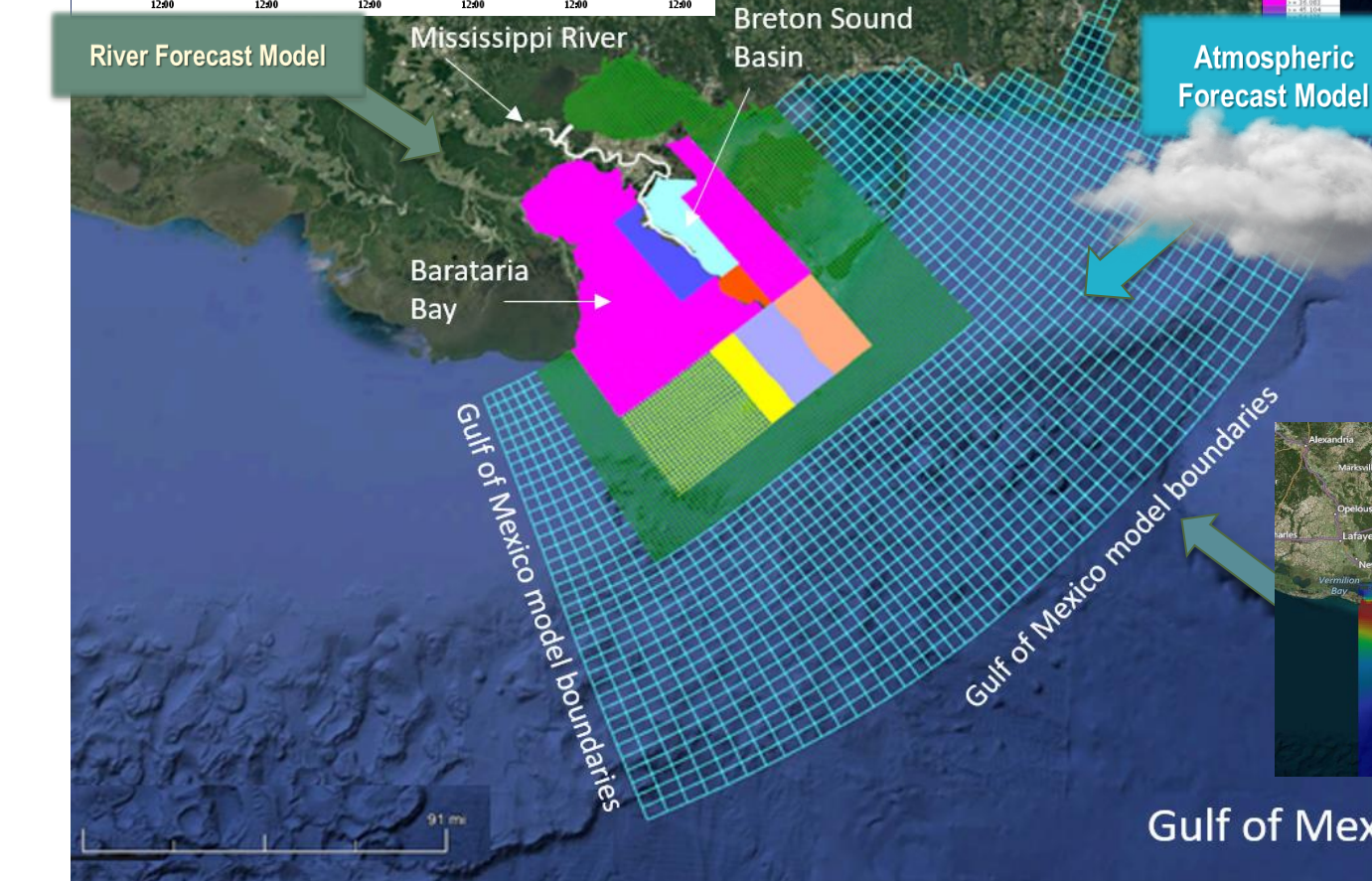
OBJECTIVES

- Develop a forecast system for Coastal Louisiana to:
 - Provide real-time forecast for
 - Water level
 - Salinity
 - Temperature
 - Support the management of existing restoration projects
 - e.g. Davis Pond and Caernarvon
 - Support the design of large scale monitoring programs
 - e.g. SWAMP



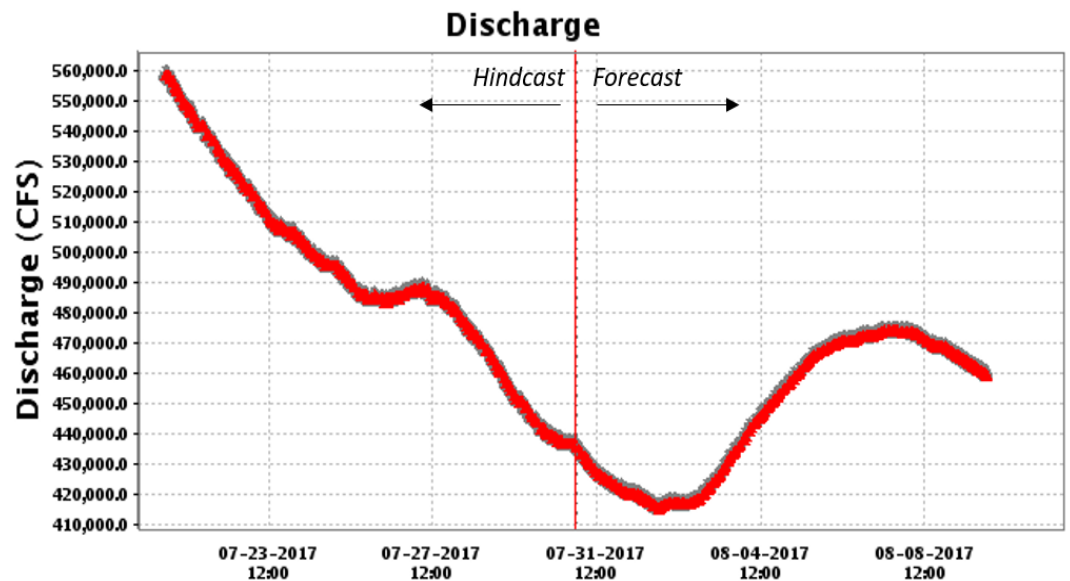
CERC SYSTEM OVERVIEW





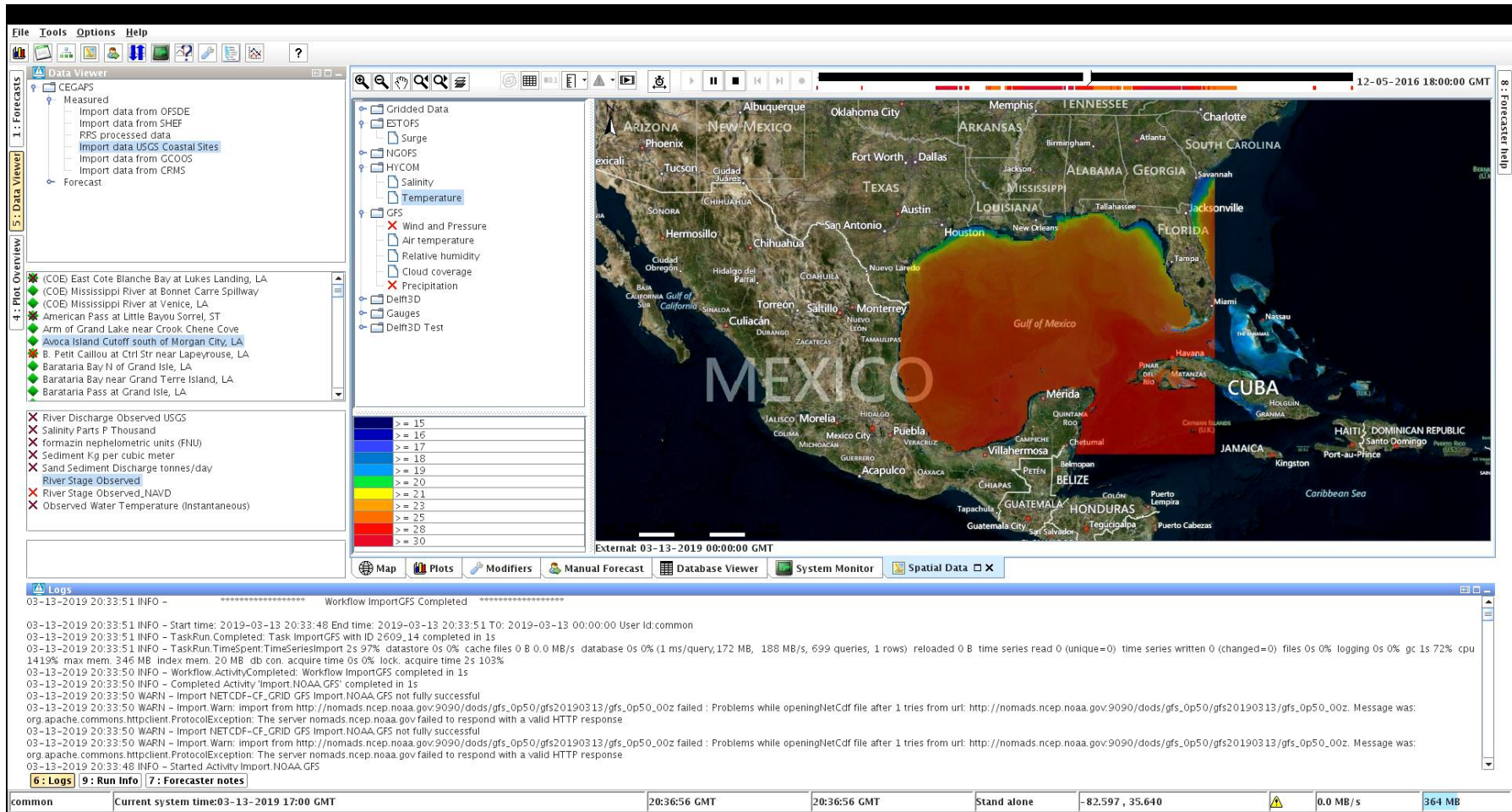
MODEL INPUT BOUNDARY CONDITIONS

- Mississippi River
 - Water inflow
 - Hindcast: USGS and USACE data
 - Forecast: NOAA (National Weather Service)
 - Temperature
 - Hindcast: USGS data
 - Forecast: USGS data extrapolation



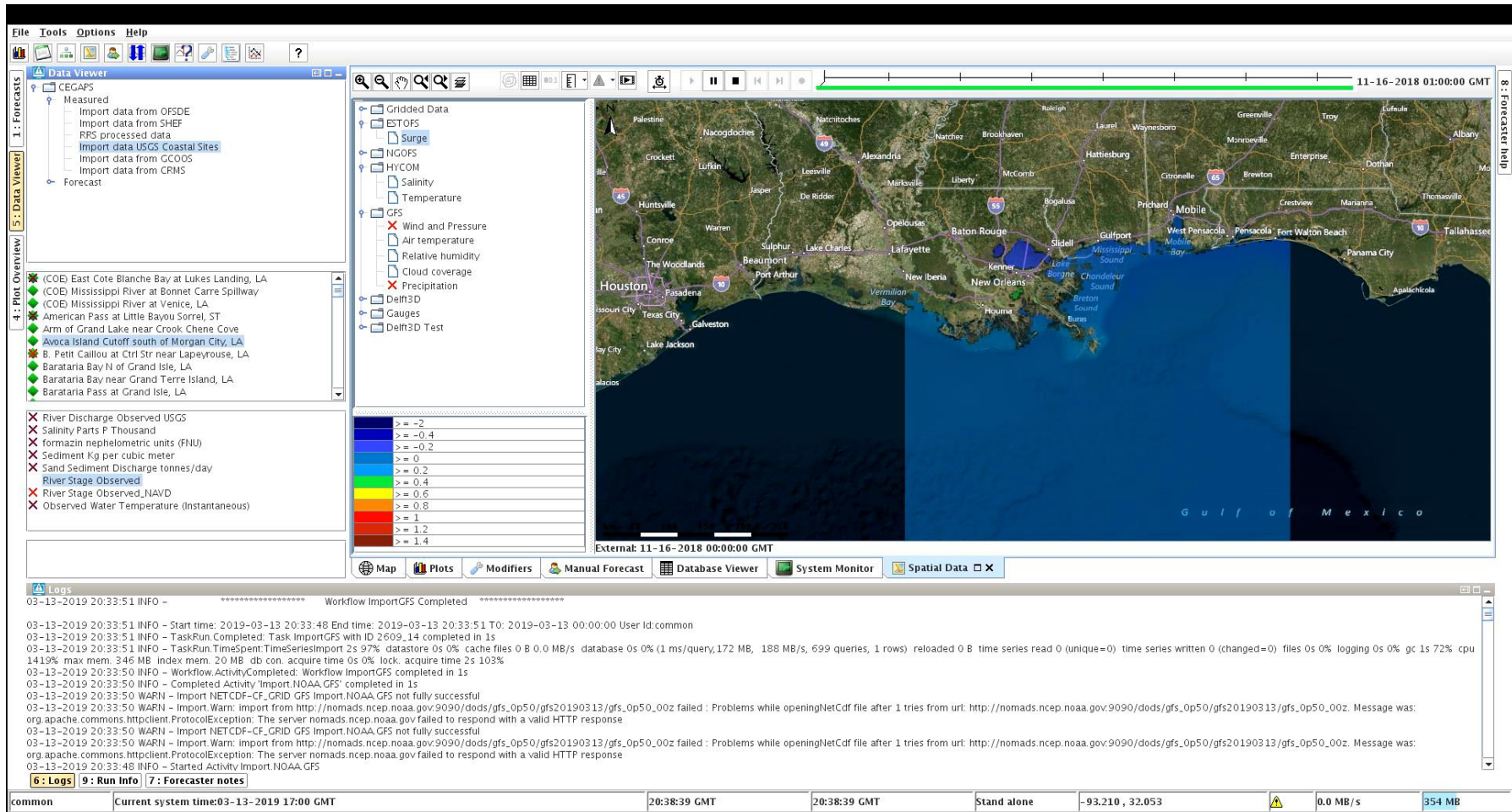
MODEL INPUT BOUNDARY CONDITIONS

- Hybrid Coordinate Ocean Model (HYCOM) for Salinity and Temperature BC at the Gulf

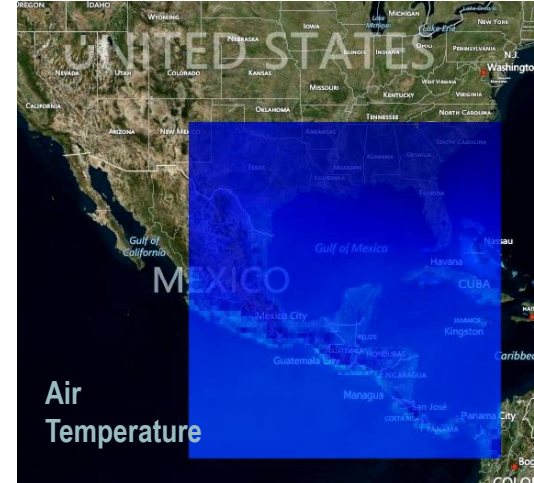
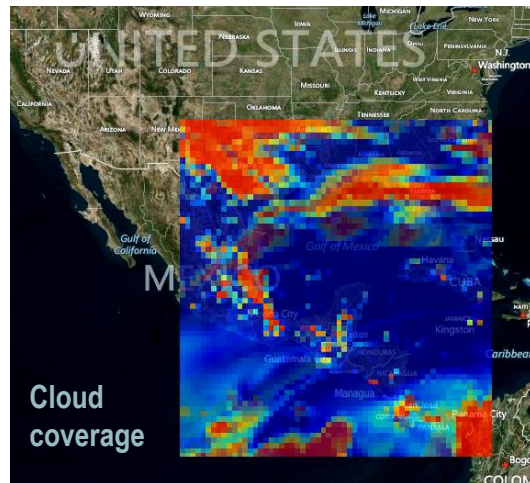
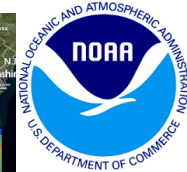
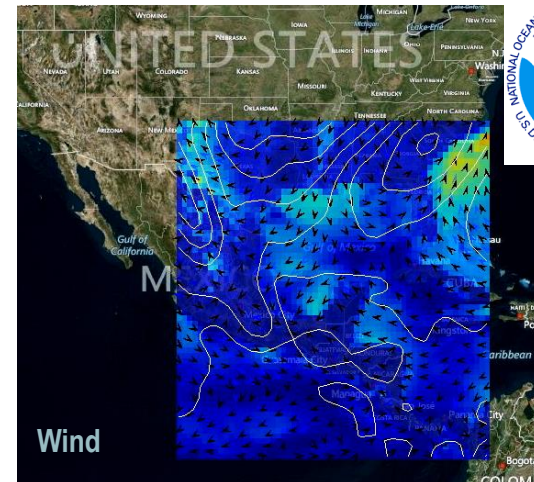
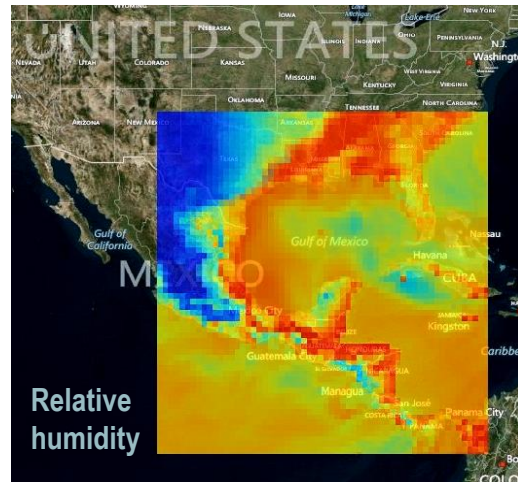


MODEL INPUT BOUNDARY CONDITIONS

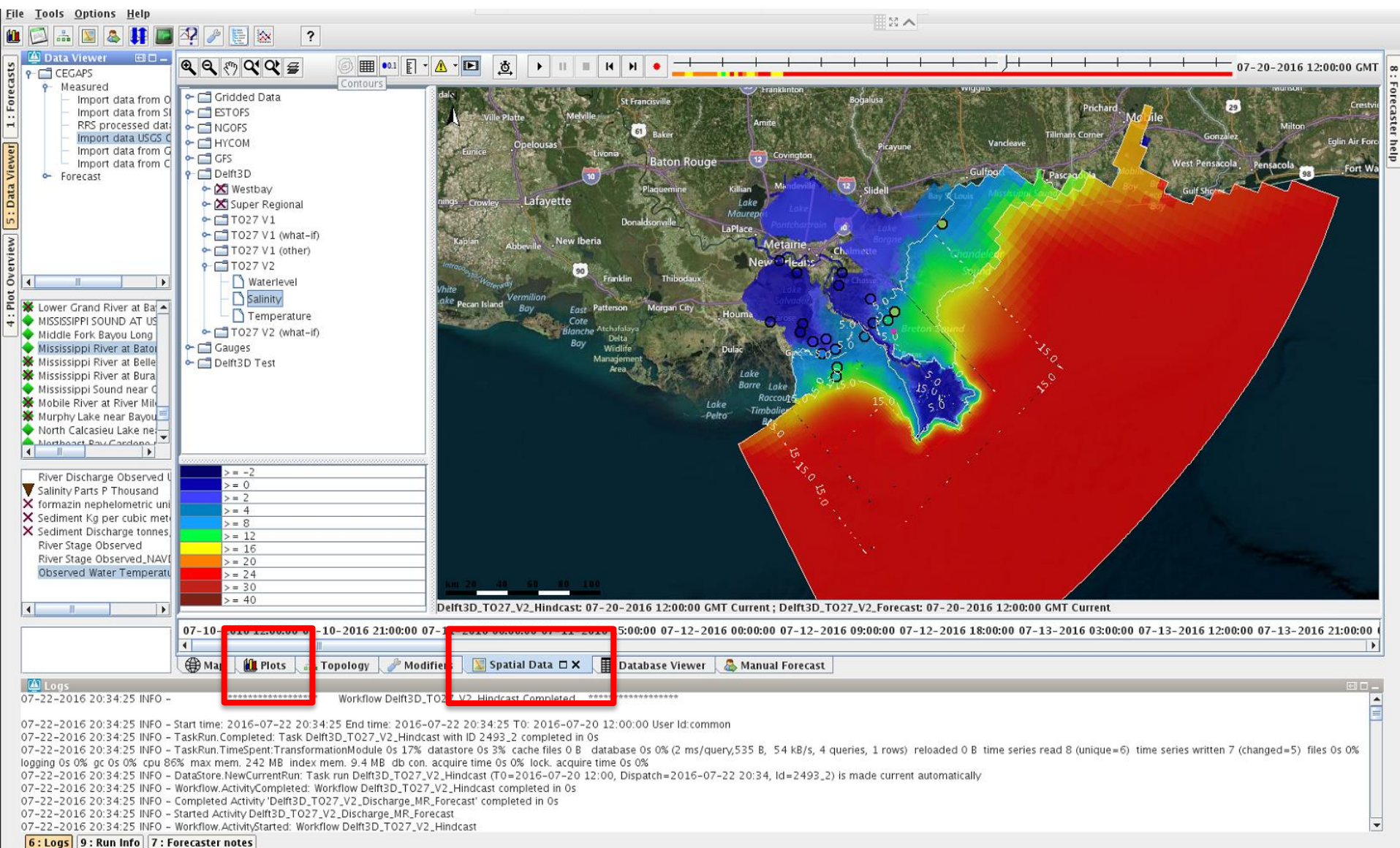
- Extratropical Surge and Tide Operational Forecast (ESTOFS) for Water Level BC at the Gulf



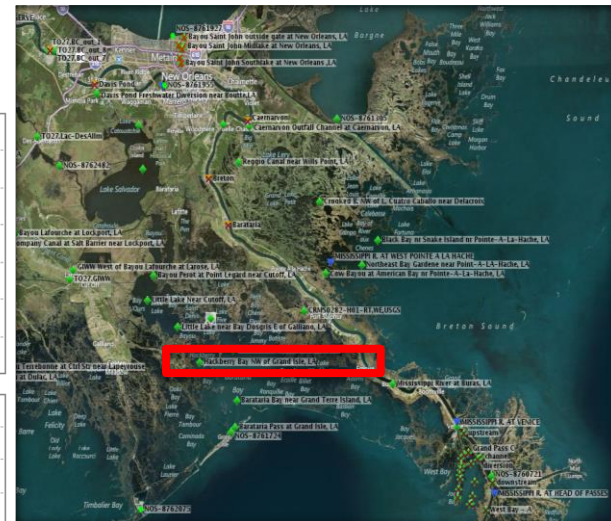
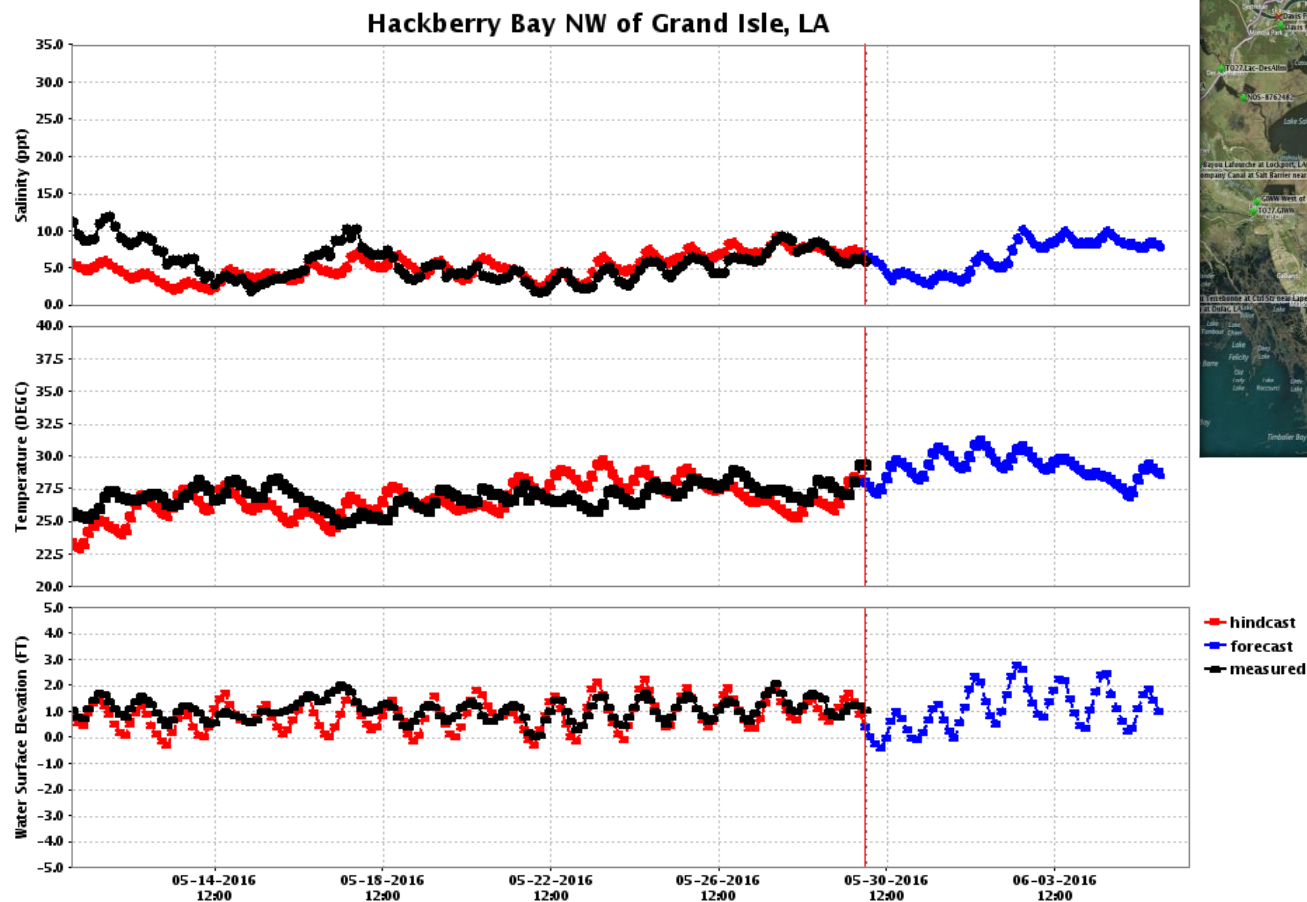
MODEL INPUT ATMOSPHERIC FORCING



CERF: MODEL OUTPUT

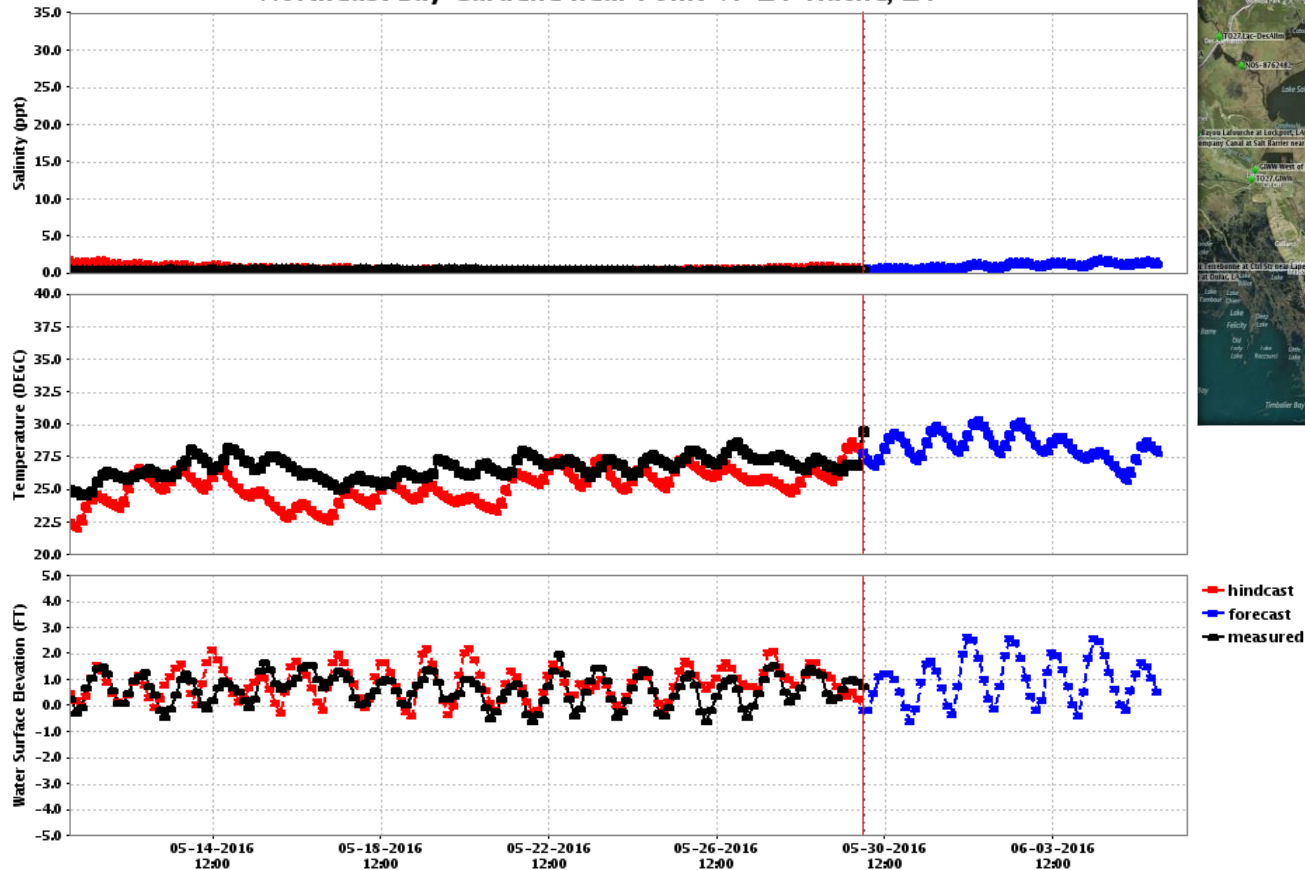


MODEL OUTPUT TIMESERIES

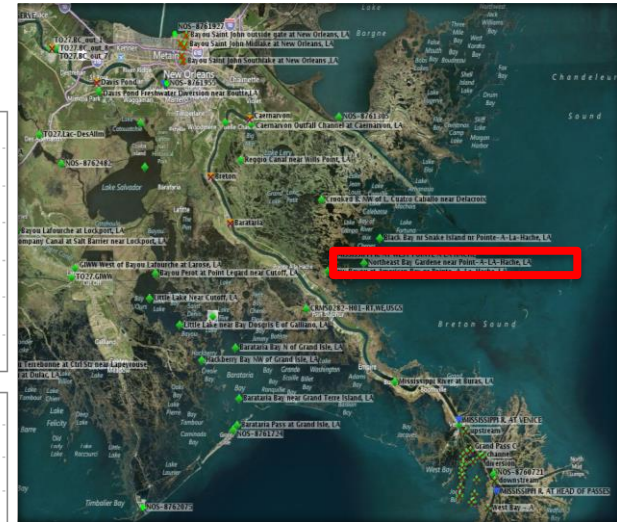


MODEL OUTPUT TIMESERIES

Northeast Bay Gardene near Point-A-LA-Hache, LA

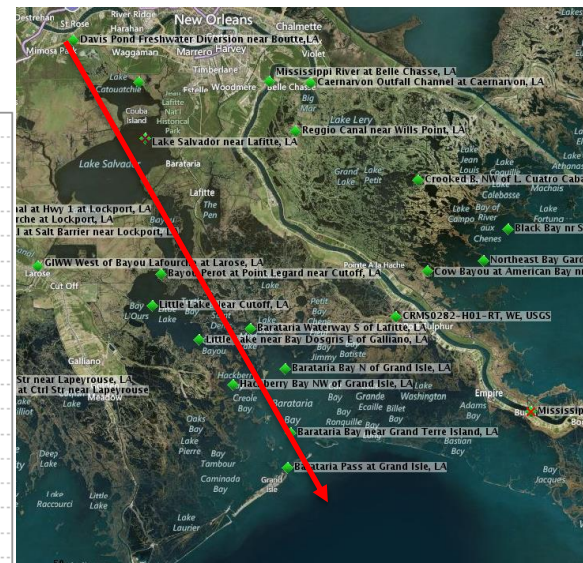
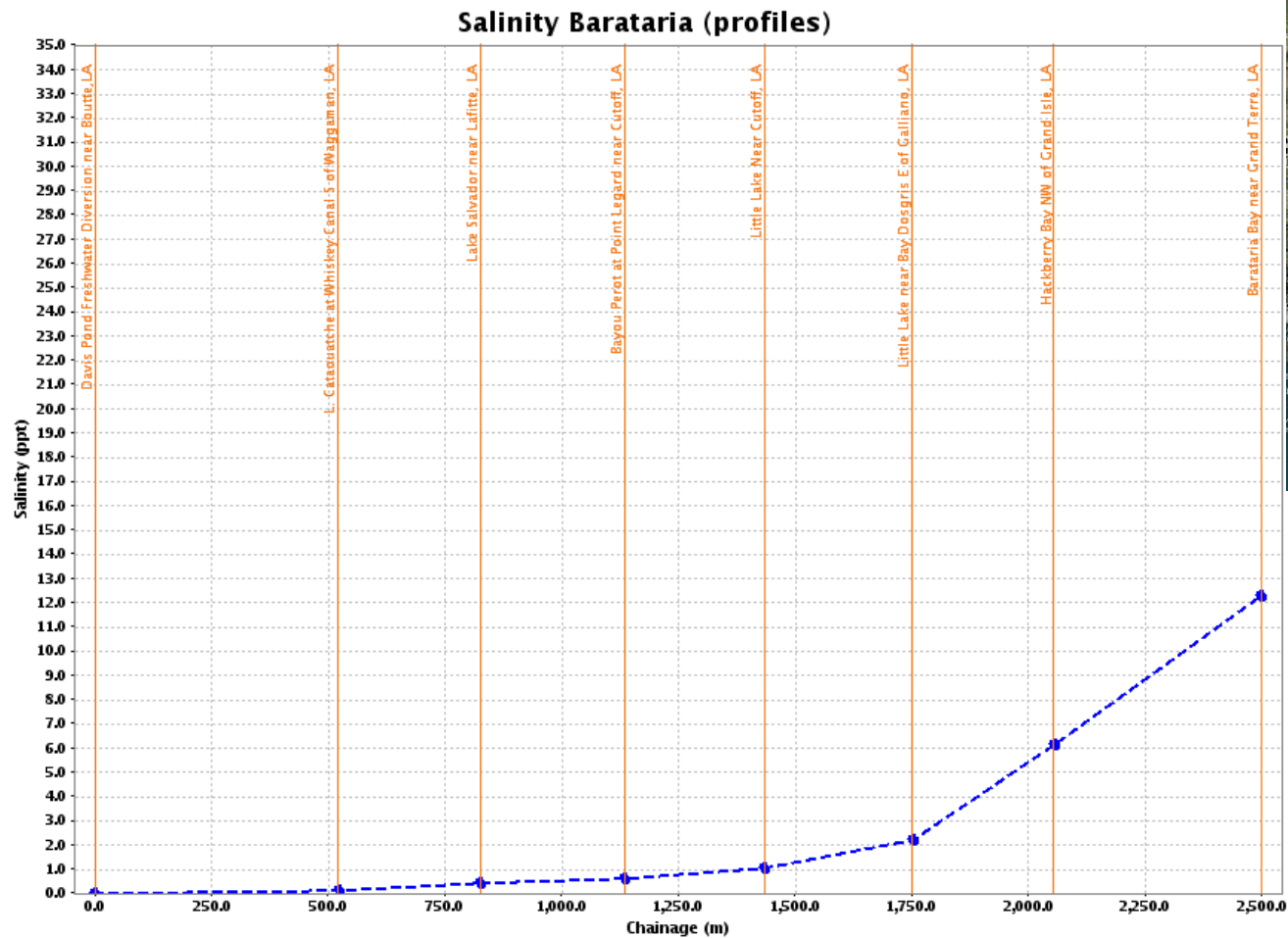


Delft3D_T027_V2_Hindcast: [1] 05-30-2016 00:00:00 GMT Current Delft3D_T027_V2_Forecast: [2] 05-30-2016 00:00:00 GMT Current

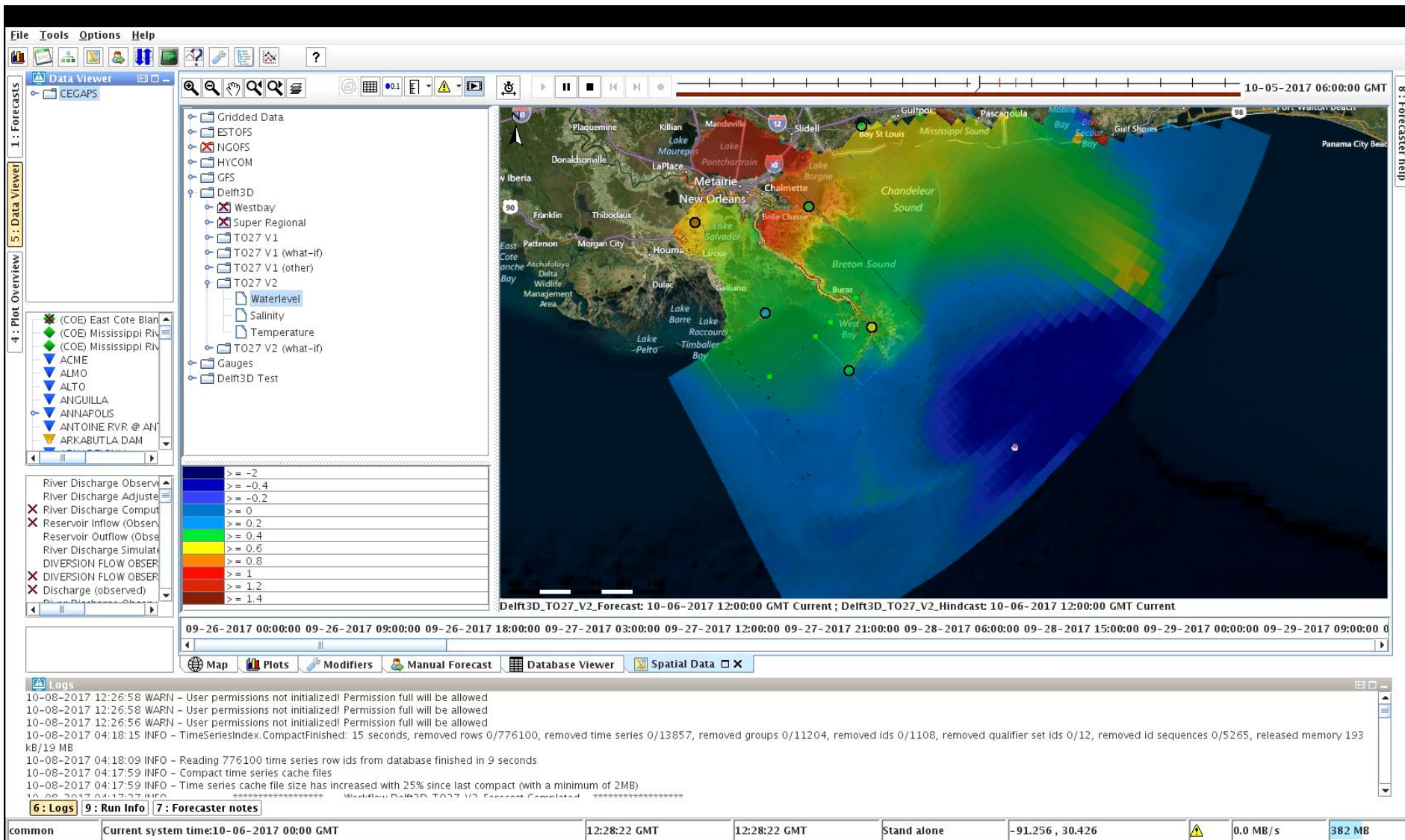


MODEL OUTPUT

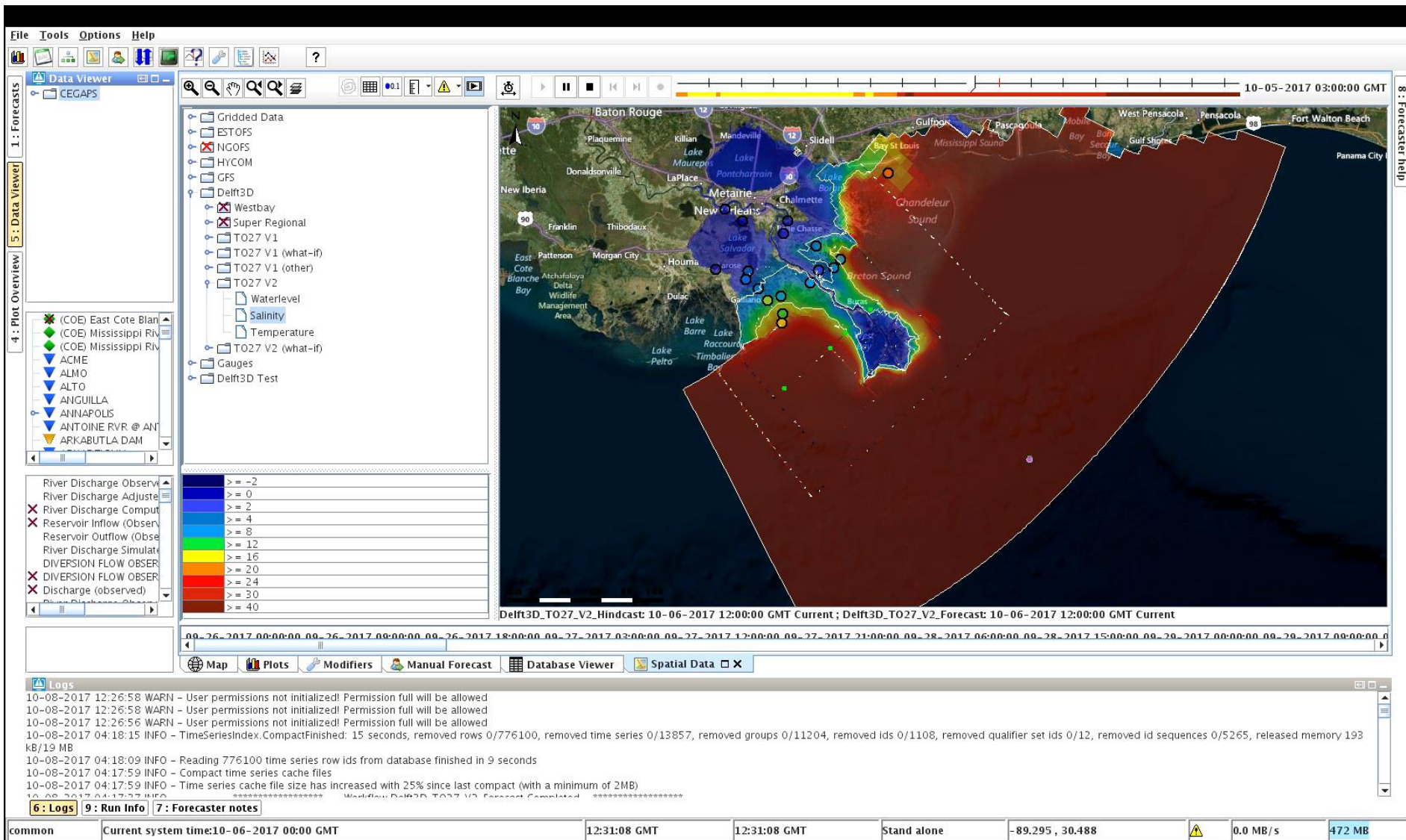
SALINITY PROFILE



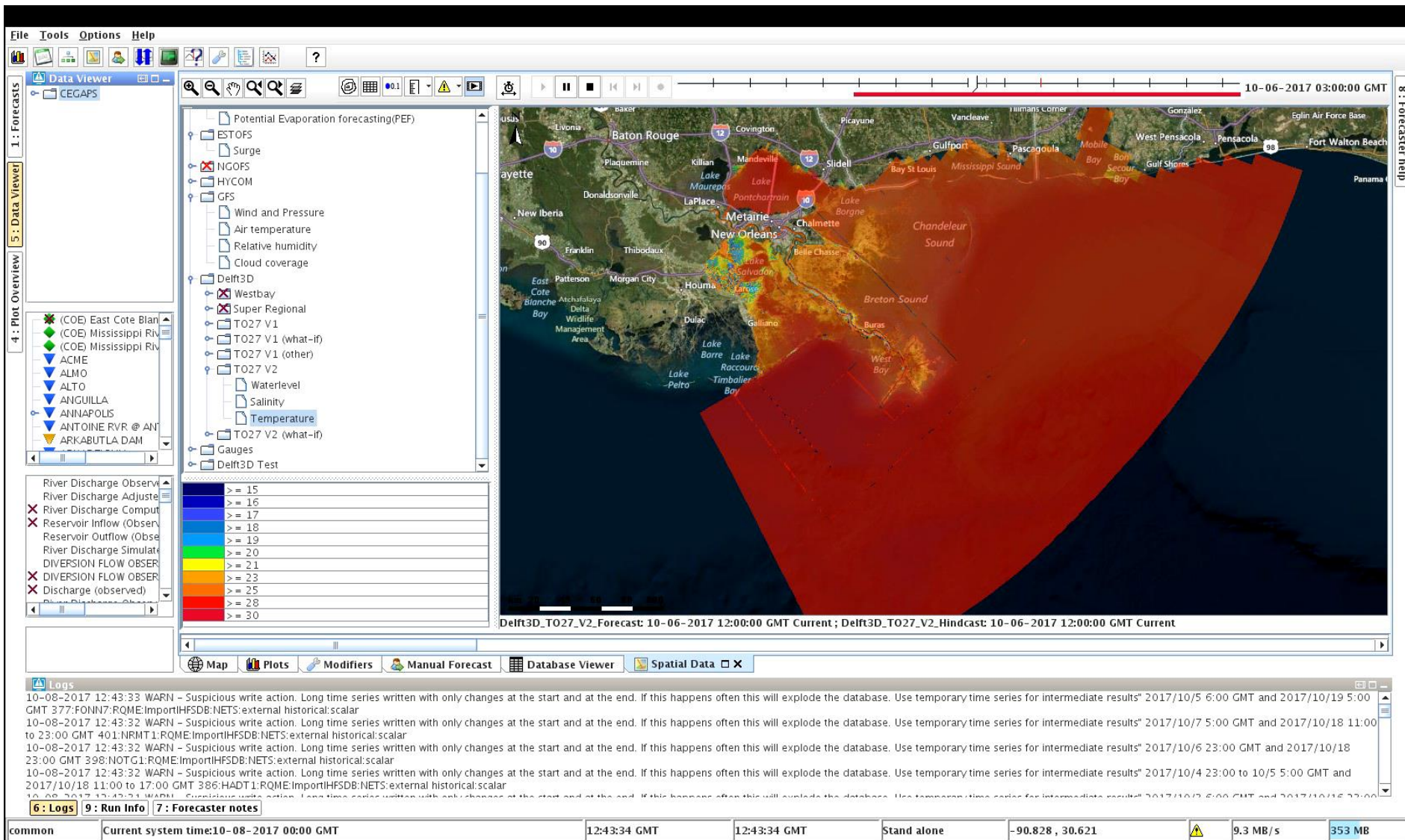
WATER LEVEL



SALINITY

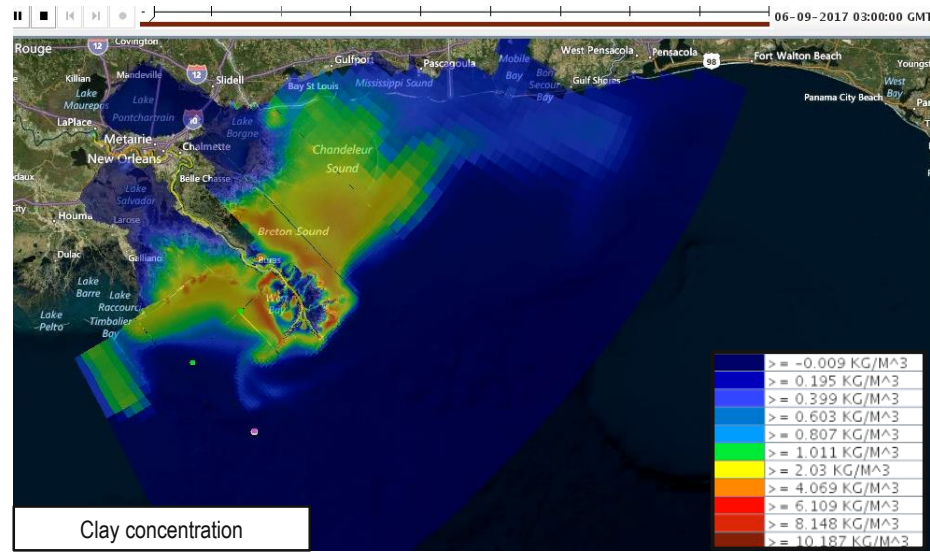
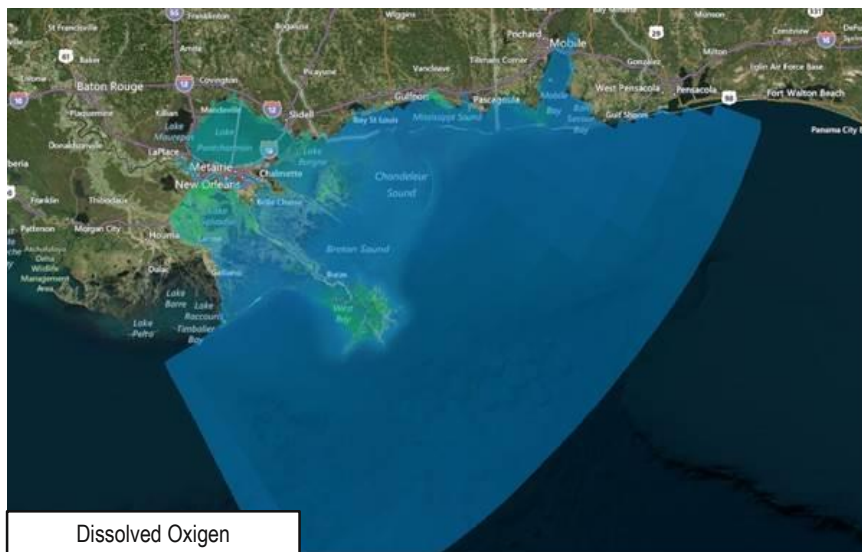


TEMPERATURE



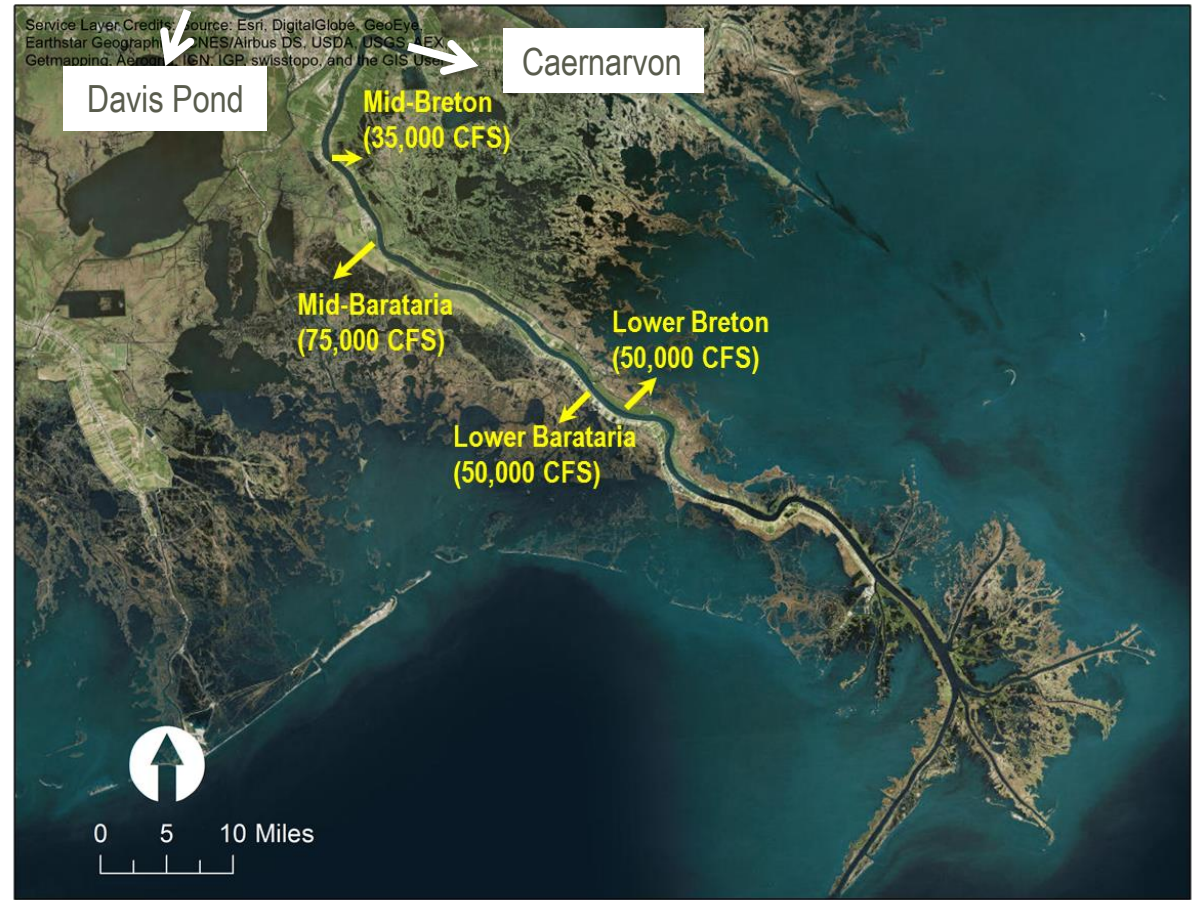
SEDIMENT CONCENTRATION AND WATER QUALITY

- Selected nutrients (*Chl-a*, DO) and TSS have been implemented
- WAQ grid has been converted to a shape file which is then visualized in FEWS

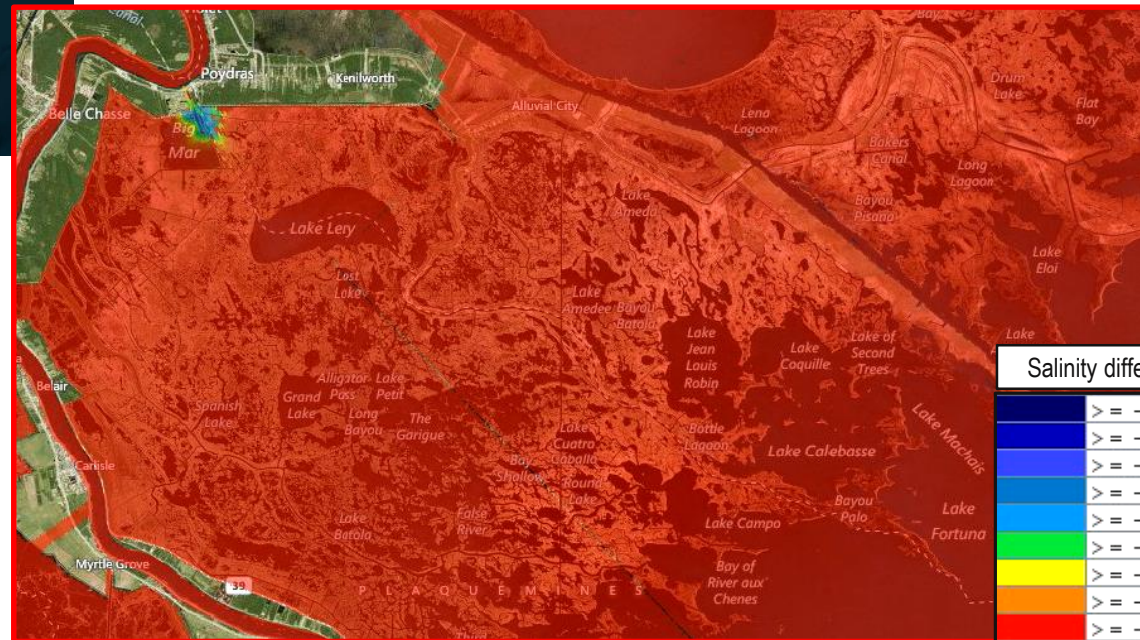
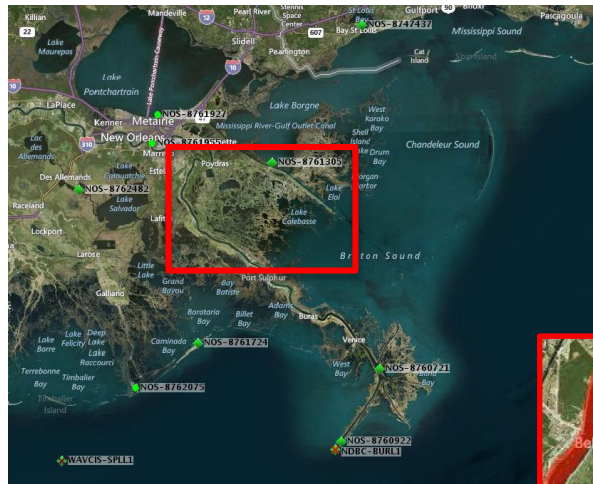


APPLICATIONS: MANAGING DIVERSIONS

- Forecast information on operation scenarios
- Coordinate operations among multiple diversions



APPLICATIONS: MANAGING DIVERSIONS



Salinity difference (ppt)	
>= -2.152 ppt	
>= -1.987 ppt	
>= -1.822 ppt	
>= -1.657 ppt	
>= -1.327 ppt	
>= -0.998 ppt	
>= -0.668 ppt	
>= -0.337 ppt	
>= -0.008 ppt	
>= 0.487 ppt	
>= 1.311 ppt	

- Salinity difference between:
 - Caernarvon discharge: 0 cfs
 - Caernarvon discharge: 8,000 cfs





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THANK YOU

Francesca Messina, PhD

Eric White, PE
Ehab Meselhe, PhD PE
Ashok Khadka
Katelyn Costanza

Edwin Wells, Deltares USA
Lora Buckman, Deltares
Daniel Twigt, Deltares

1110 RIVER ROAD S., SUITE 200
BATON ROUGE, LA 70802

(225) 448-2813
WWW.THEWATERINSTITUTE.ORG

