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AWRA VIRTUAL ANNUAL WATER RESOURCES CONFERENCE

NOVEMBER 9 – 11, 2020

AWRA 2020 VIRTUAL
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N2L Web-based Flood Forecasting System: High-resolution Flood Forecasting for Small Coastal Plain Rivers Using Containerization

3B Session 2

PRESENTERS: Mohamed ElSaadani, Haitham A. Saad, Brian Miles, and Emad Habib

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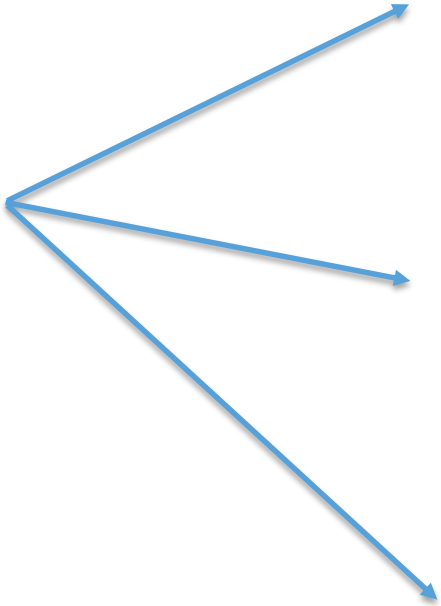
HOUSEKEEPING

TIPS



- All attendees' microphones will be muted.
- Use the Discussion Q&A function to submit questions for the presenter and/or moderator.
- Use the Video Chat function to join the Live Q&A and ask questions.
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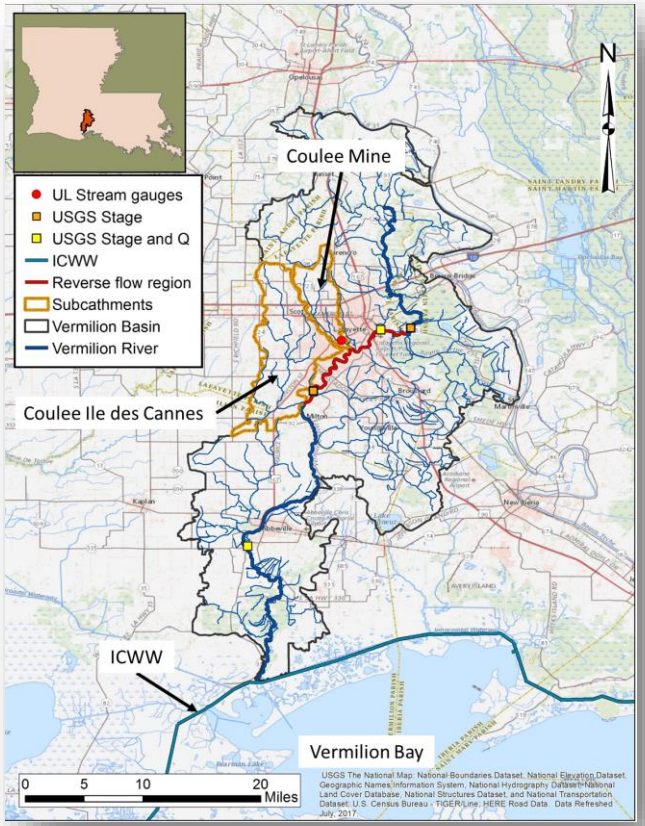
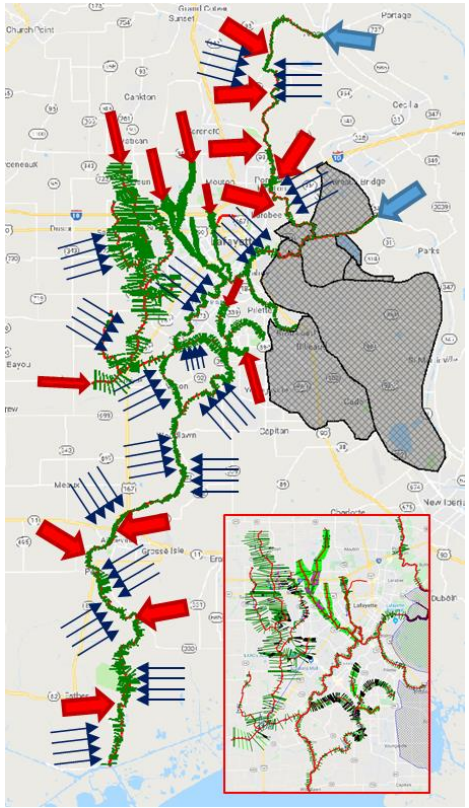
Introduction

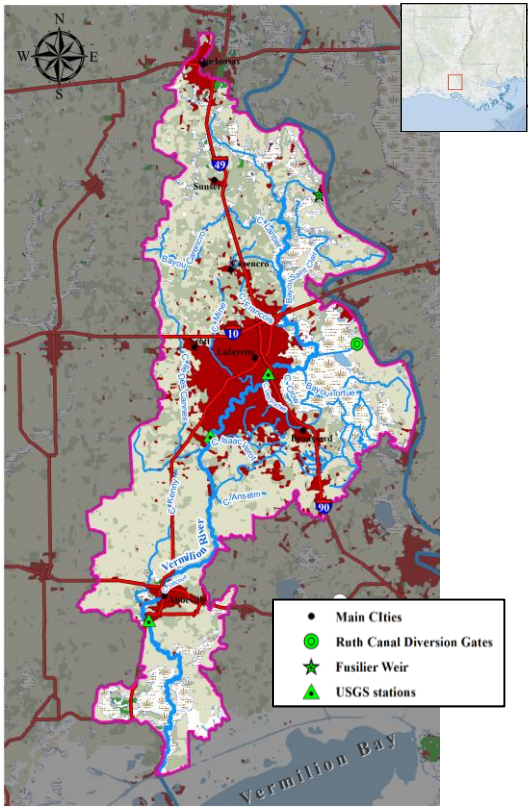
- Our current study area is the Vermilion River basin in South Louisiana.
- The river, which connects to the Vermilion Bay and the Gulf of Mexico, spans ~70 miles and is characterized by low-gradient topography.
- The river passes through several urban communities that contribute significant flows through a set of major tributaries and channels (also called coulees).
- The flow directions in the river are heavily influenced by both tide and wind, especially during low flows. More interestingly, the river witnesses some complex flow regimes where reverse flows are often observed by eyewitness reports and high-water mark surveys following flood events.
- Reverse flows were frequently reported at river sections as far as ~40 miles from the Vermilion Bay and other locations near the intersection with Coulee Ile des Cannes (red line).



Vermilion River Hydrodynamic Model

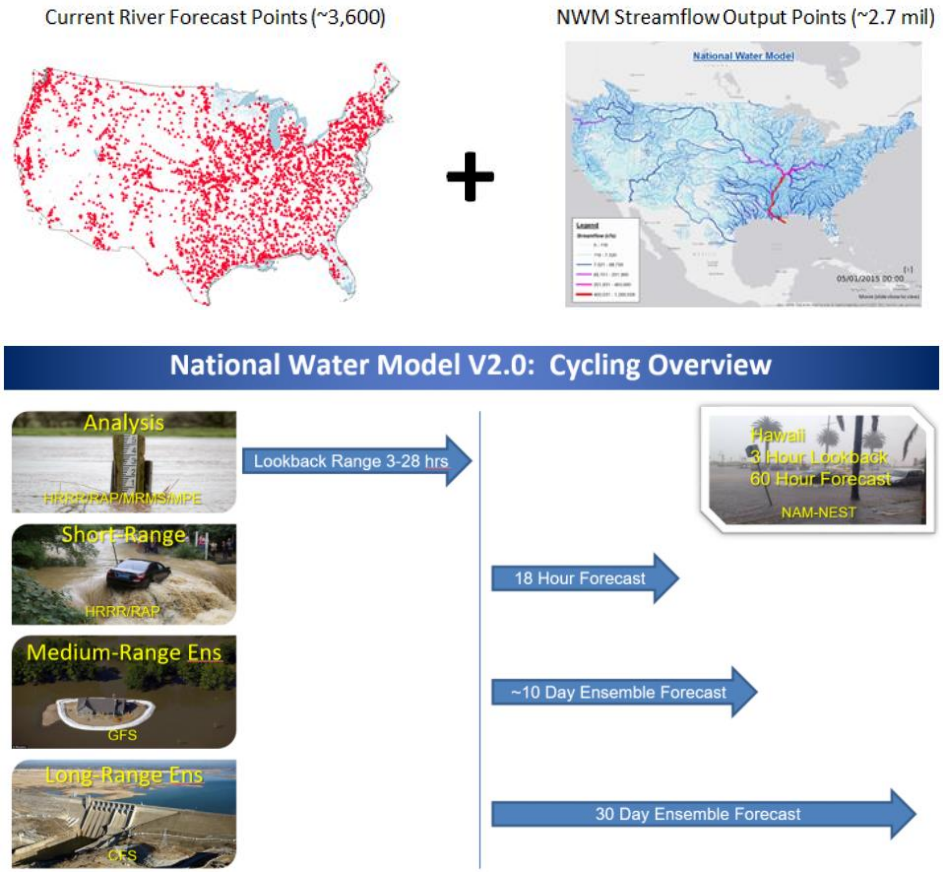
- Our team at the Louisiana Watershed Flood Center has developed a 1D/2D hydrodynamic model (HEC-RAS) which captures the flow dynamics in the Vermilion River in high details.
- Drainage area: 601 miles^2; Length: 69.2 miles; Average slope: 1 ft /10 miles.
- The model hydrologic forcings take the forms of direct input hydrographs (red arrows), lateral input hydrograph, or rain-on-grid over swamp areas.



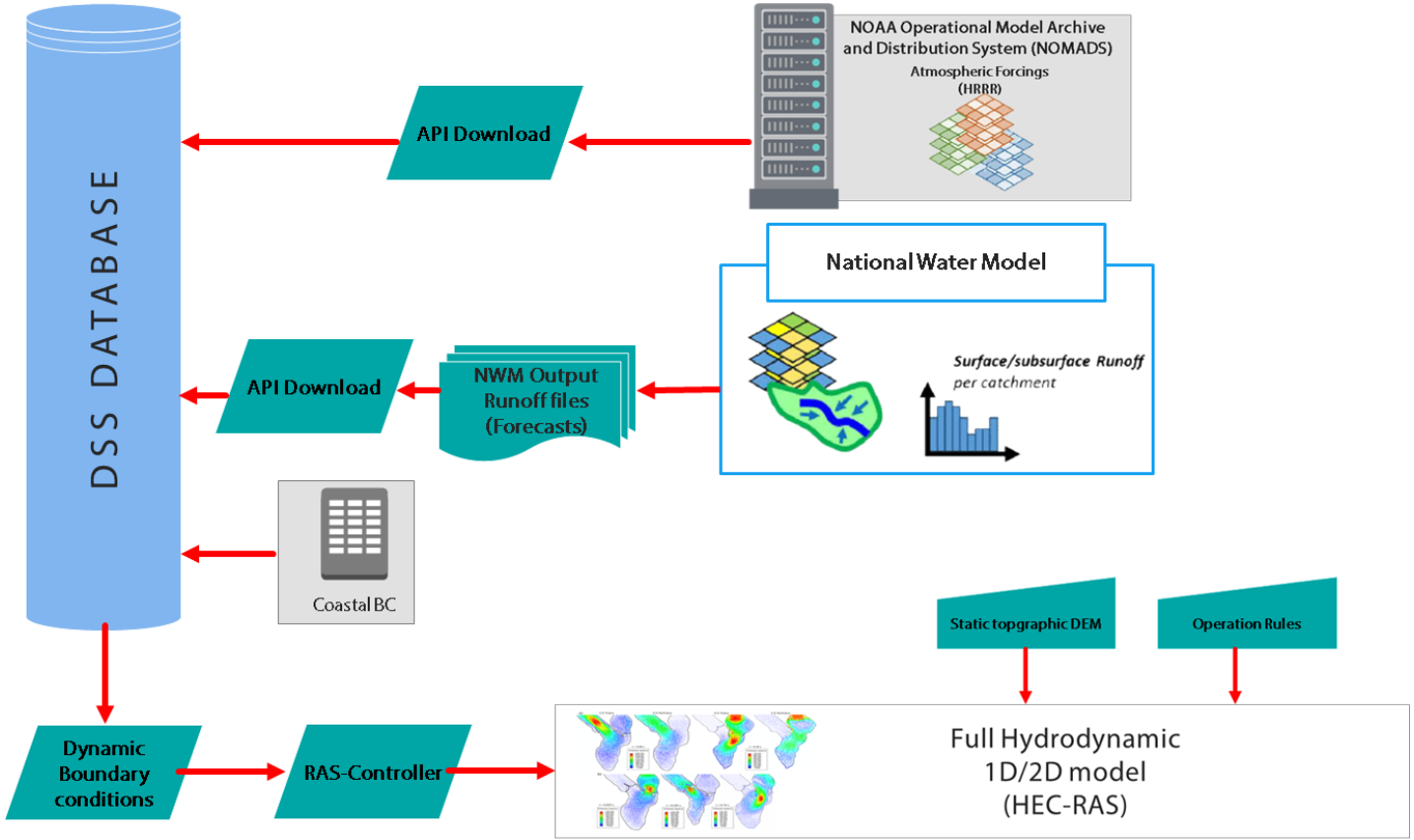


Model Input sources

- Our system uses the National Water Model (NWM) short-term forecast data.
- This includes the High Resolution Rapid Refresh (HRRR) forcings to be used over swamp areas (rain-on-grid) and the NWM hydrologic outputs (runoff) to be used as direct and lateral flow hydrographs.
- The data is downloaded directly from the operational NWM web repositories.

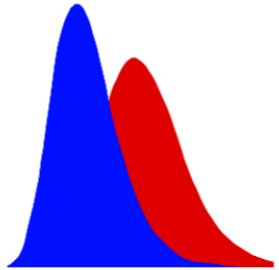


National-to-Local (N2L) FORECAT-WEB

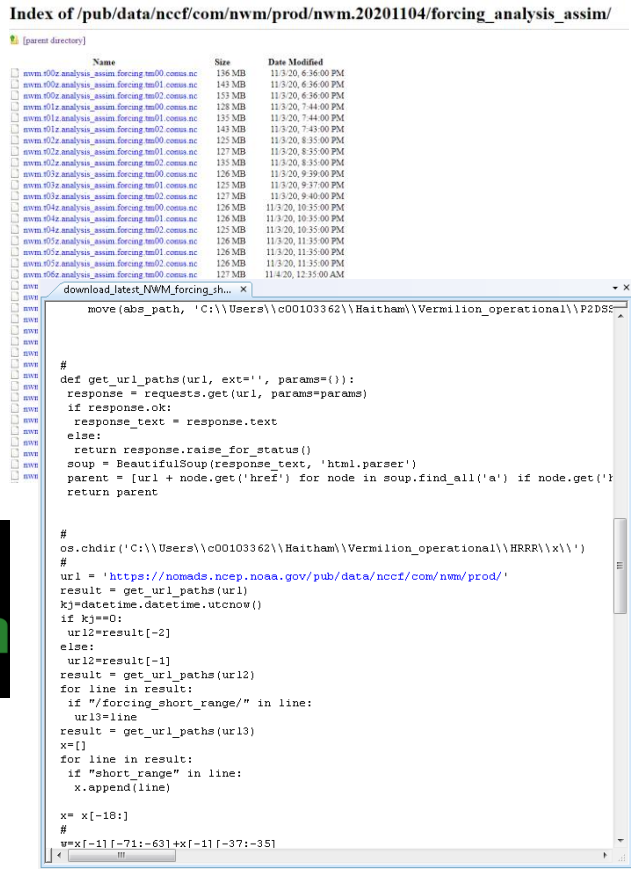


N2L FORECAT-WEB Setup (Data Download)

- NWM forecast inputs and outputs are downloaded from the NWM web-portal using python codes.
- The data are parsed and stored in intermediate csv files.
- The csv files are then ingested into the USACE DSS files which are the input format for HEC-RAS.
- A new DSS file is stored with the same name and referred to inside the HEC-RAS model to acquire hydrology inputs.



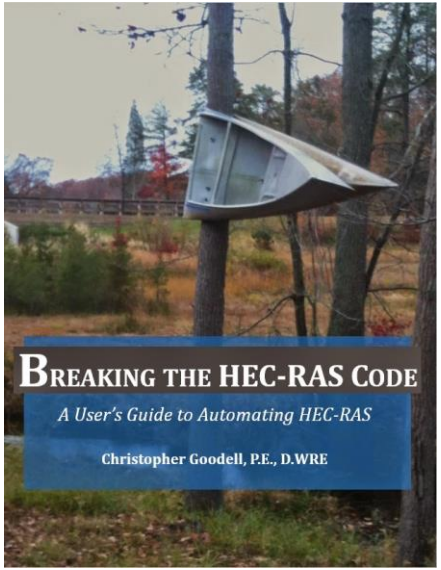
HEC-DSSVue



N2L FORECAT-WEB Setup (RAS-Controller)

- After all model inputs are setup, HEC-RAS runs are performed using RAS-Controller.
- The RAS-Controller is run through a Win32 Client using Python.
- RAS-Controller is used to update the plan and unsteady HEC-RAS files.
- Start and end dates of each simulation are specified prior to execution.

Win32 client

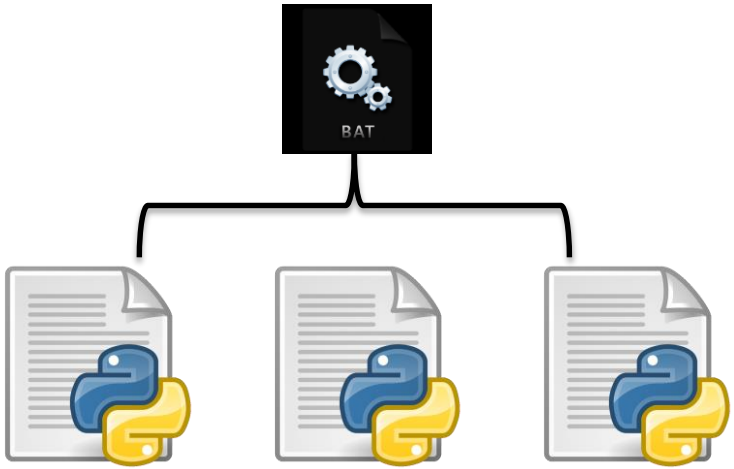


N2L FORECAT-WEB Setup (Task Scheduler)

- All data download, model runs, and API upload codes are run on hourly bases.
- The python/Jython codes are controlled with Windows batch files.
- The batch files are executed using Windows Task Scheduler indefinitely.

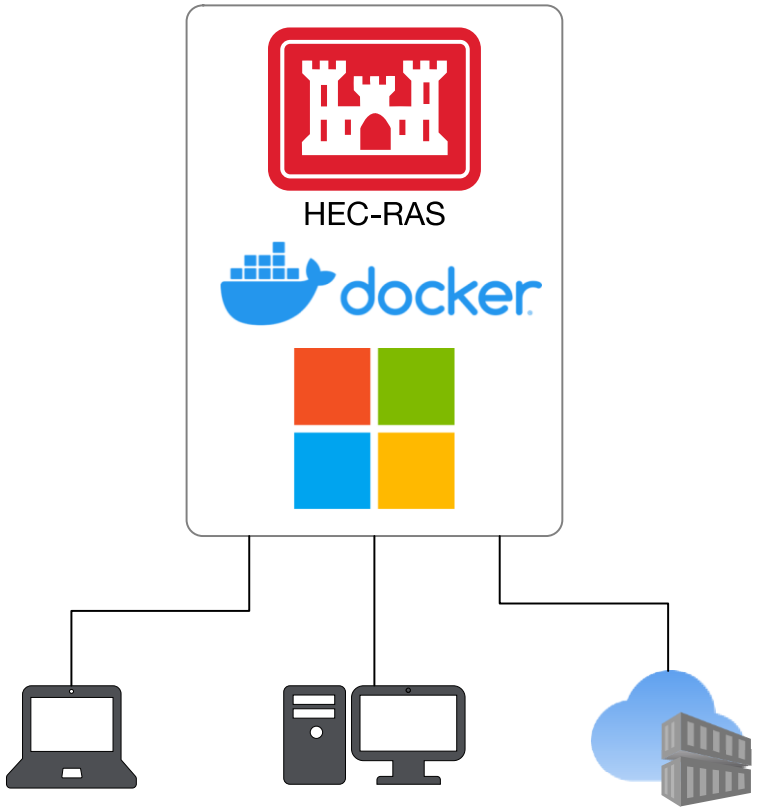
Windows Task Scheduler

Batch Files



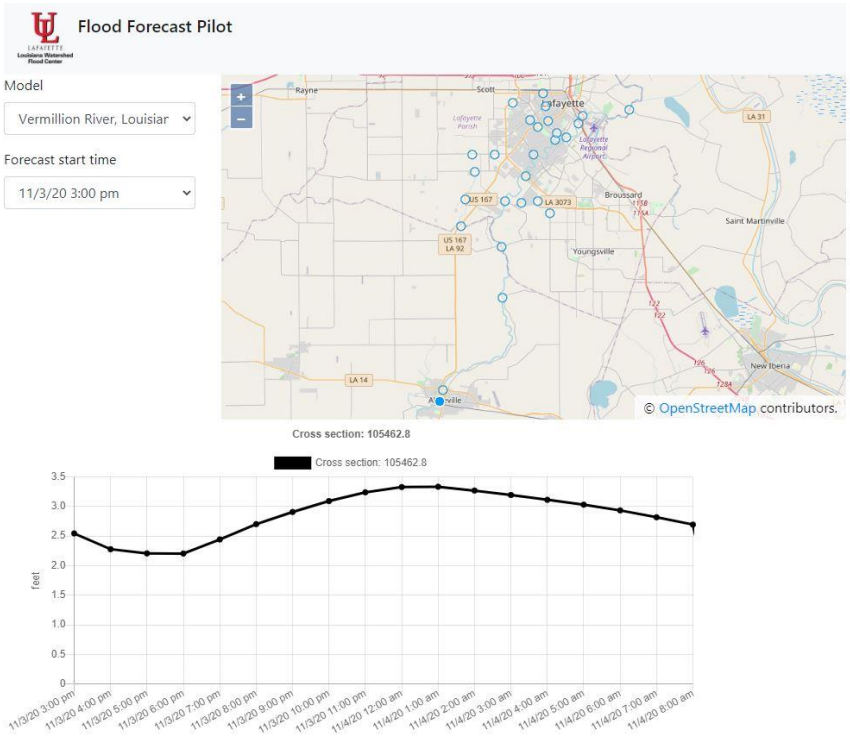
N2L FORECAT-WEB Setup (Container)

- What is a container?
  - An isolated environment that encapsulates an application and its software dependencies
  - Similar to a virtual machine, but requires less overhead
  - Docker is a popular container platform, and now supports Windows applications
- Benefits
  - Provides executable documentation of an application's configuration
  - Allows for rapid and repeatable deployment across diverse computation environments:
    - Laptop
    - Workstation
    - Server
    - Cloud



N2L FORECAT-WEB Setup (Interactive Web-App)

- After each model run is completed, the results of the model are pushed to a PostgreSQL database through python codes.
- The database is connected to a JavaScript/HTML web-app via Rest API.
- The web-app allows the user to choose the model to be visualized and check the results at pre-defined key locations.
- The web-app also allows the user to review historical forecasts at these key locations.
- The web-app is set up for the addition of additional models in the future.



Current and Future Work

- Improving the web-app interface by doing the following:
  - Adding additional spatial layers (e.g., forecasted rainfall)
  - Adding information from USGS gauges and other sensors available in the region.
- Adding more computational capabilities (e.g., cloud computing resources) to run multiple models simultaneously.
- Improving user experience and providing capabilities for feedback collection.

THANK YOU FOR PARTICIPATING!

CONTACT US WITH QUESTIONS

Presenters: Mohamed ElSaadani, PhD (mohamed.elsaadani@louisiana.edu)

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