Florida International University
Department of Civil and Environmental Engineering
Optimization in Water Resources Engineering, Spring 2020

LECTURE: OPTIMIZATION OF FLOOD CONTROL

Arturo S. Leon, Ph.D., P.E., D.WRE

CAUSES OF FLOODS

- Heavy rainfall
- Inadequate capacity of rivers to carry the high flood discharge
- Inadequate drainage to carry away the rainwater quickly to stream/rivers
- Ice jams or landslides blocking streams
- Hurricanes/Cyclones
- Poor permeability of the soil
- Dam (including gate opening), levees, retention ponds, or any water retaining structure breakage
- High accelerated snow melting
- Highly silted river system
- Steep and highly erodible mountains
- Unusual high tides (e.g., King Tides in South Florida)
- Tsunamis
- Exceeding of water flow rate compared to the capacity of the river channel, particularly at bends or meanders in the waterway

FLOOD MITIGATION

STRUCTURAL MEASURES

SHORT TERM

- Inspection and maintenance of structures, embankments, and flood walls
- Channel improvement
- Drainage clearance
- Diversion of flood water

LONG TERM

- Dams and reservoirs
- Embankments, flood walls, sea walls
- Natural detention basins
- Channel improvement
- Drainage improvement
- Diversion of flood water
- Flood-safe public utility installations

FLOOD MITIGATION (CONT.)

NON-STRUCTURAL MEASURES

SHORT TERM

- Flood insurance
- Public awareness about health problems and illness

LONG TERM

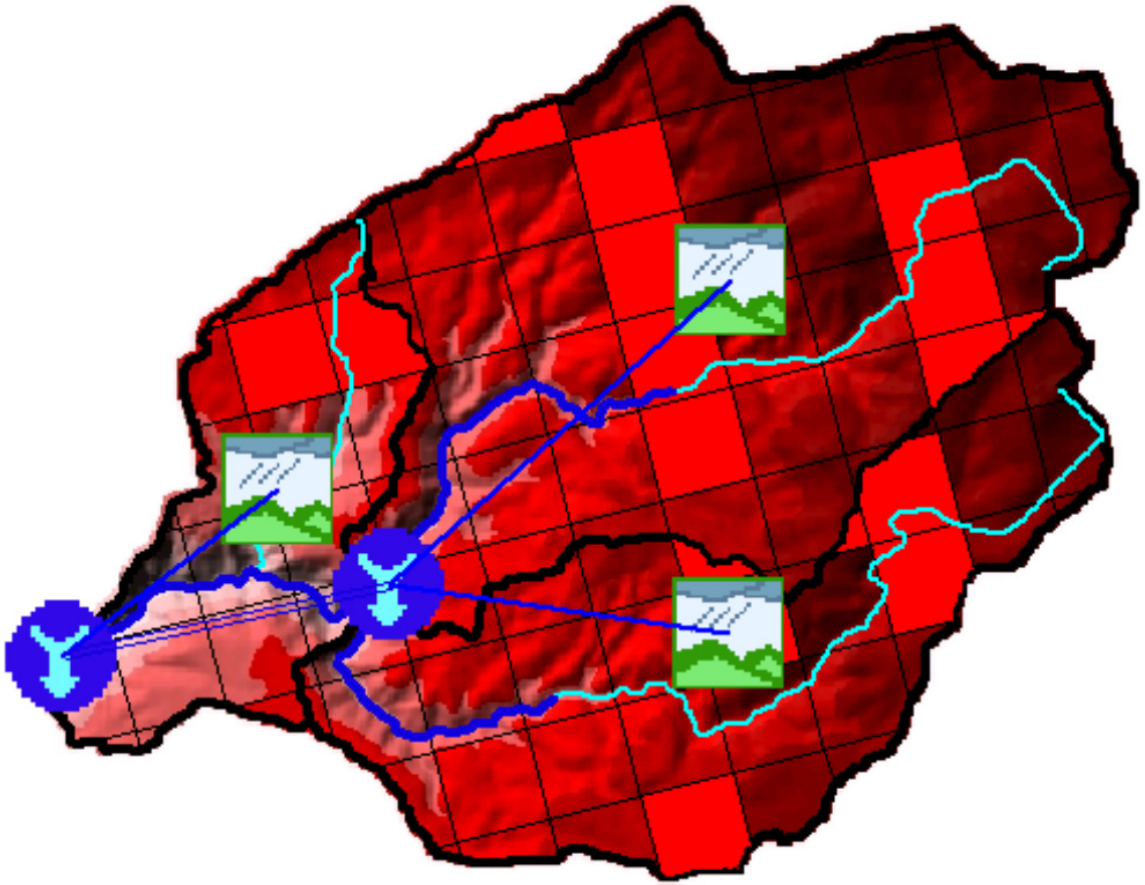
- Flood forecasting models and real-time simulation models
- Flood plain zoning
- Removal of human encroachments from flood plains
- Early flood warning
- Rainfall forecasts with place, time, and intensity for stakeholders to take preparedness measures
- Public awareness
- Professional training

TOWARDS INTEGRATED AND COORDINATED FLOOD CONTROL AT THE WATERSHED SCALE

- The Decision Support System (DSS) to be presented can help in guiding the optimal water releases from an array of wetlands, detention ponds and other storage systems for mitigating floods.
- This approach enables adaptive water release hours or days ahead of rainfall events, thereby maximizing storage capacity and minimizing flooding.
- For this approach to be implemented, conventional storage systems such as detention ponds would be retrofitted (e.g., adding large gates) and the gates would be remotely controlled
- This decision support system incorporates components of hydrological modeling (HEC-HMS), inundation modeling (HEC-RAS) and optimization.
- The automated exchange of data between these models is made via Python Scripts and other shells.

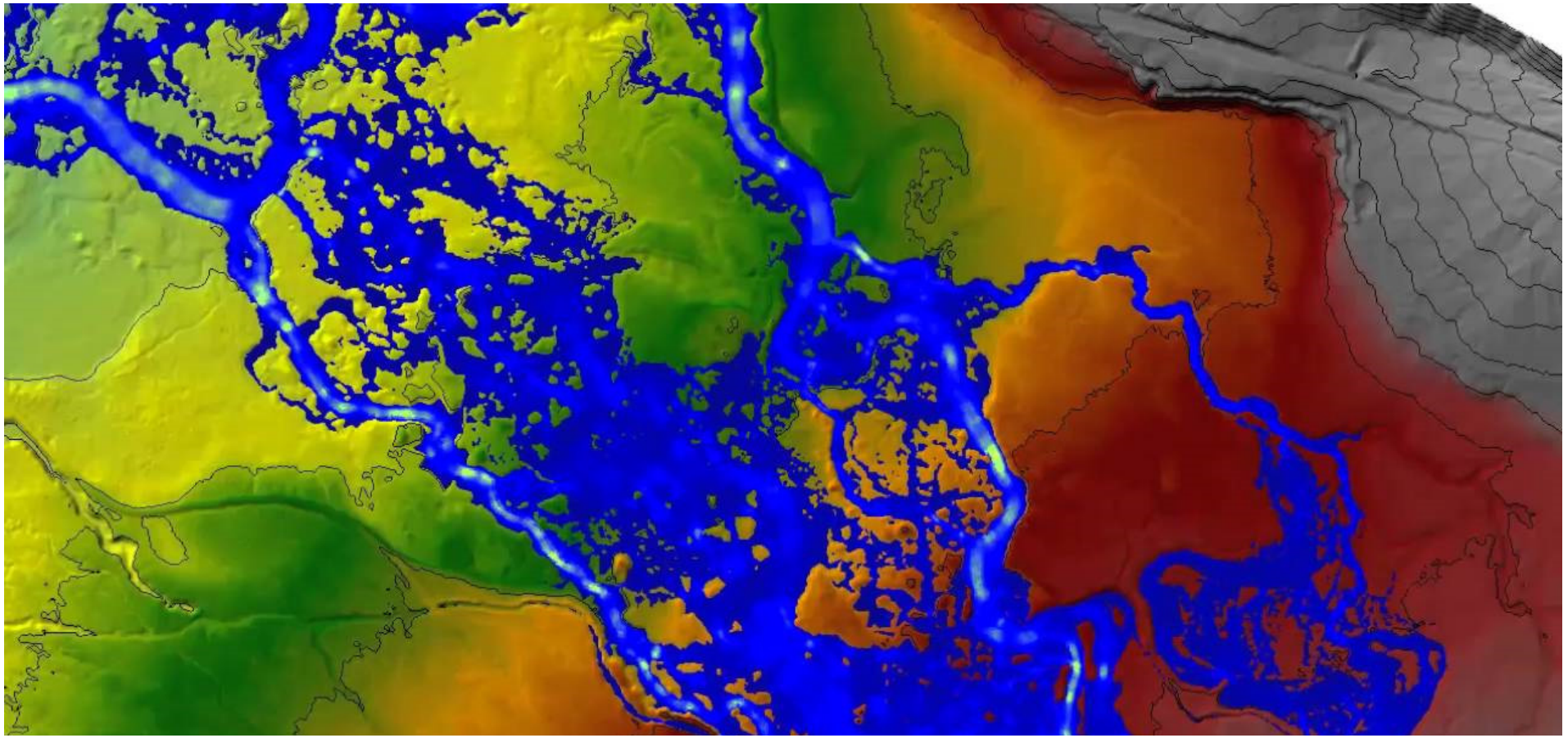
HANDS-ON DEMO OF HEC-HMS
(HEC-HMS 4.3)

Download from https://www.hec.usace.army.mil/software/hec-hms/downloads.aspx



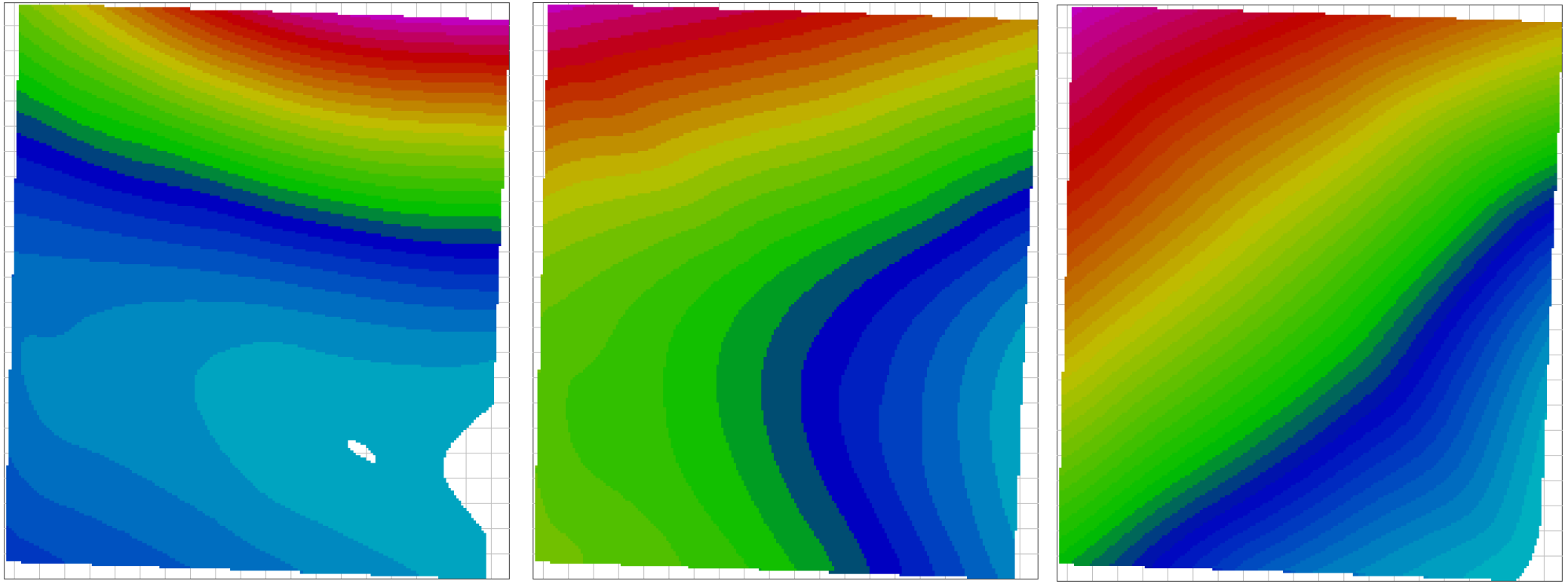
HANDS-ON DEMO OF HEC-RAS
HEC-RAS 5.0.7

Download from https://www.hec.usace.army.mil/software/hec-ras/download.aspx



HEC-DSS DATA VISUALIZATION
(HEC-DSSVUE-V3.0.1.42)

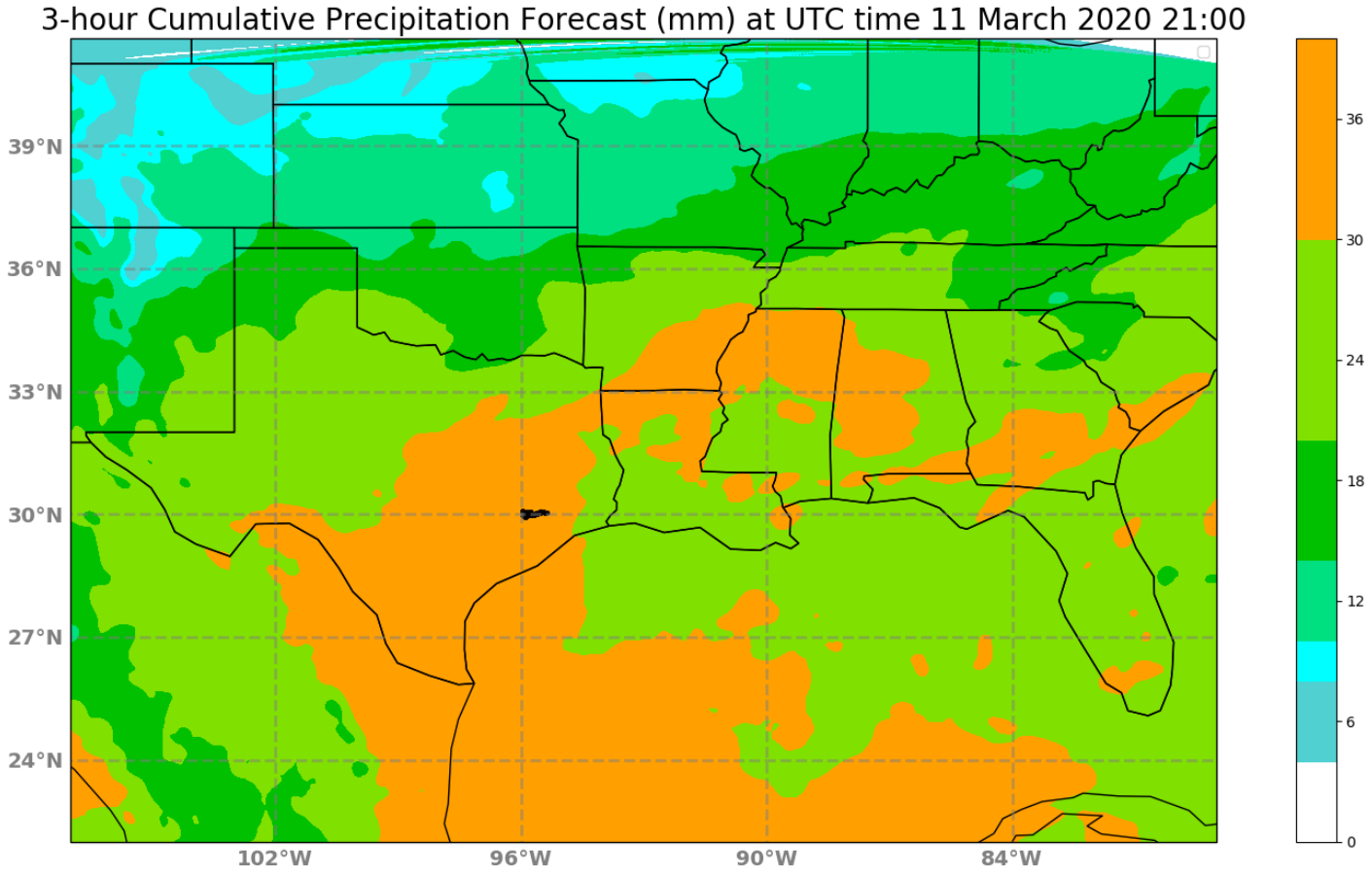
Download from https://www.dropbox.com/s/t1gatebiyal3fj2/HEC-DSSVue-v3.0.1.42.exe?dl=0



Gridded rainfall forecasts

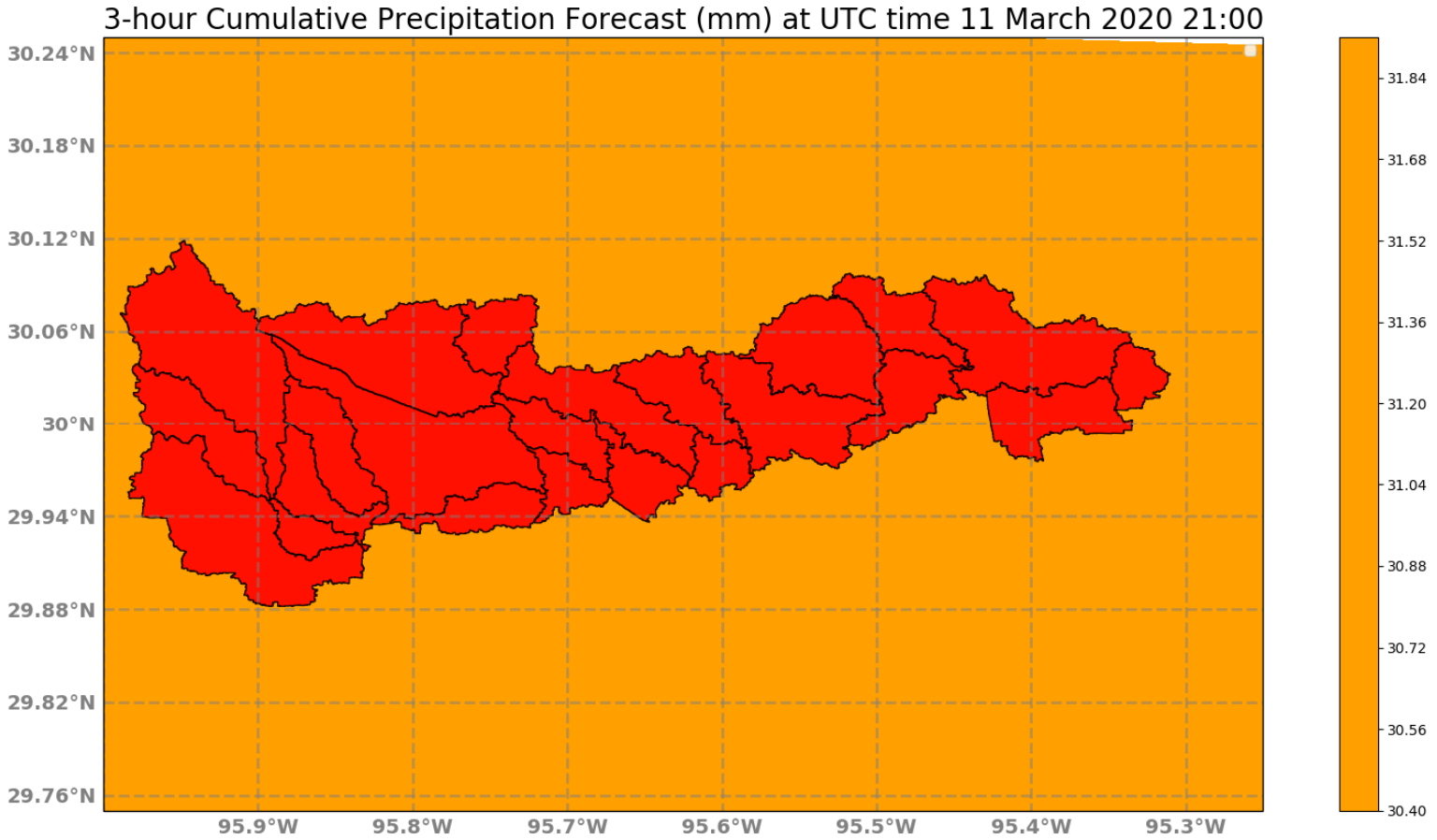
PYTHON SCRIPS FOR ACQUIRING RAINFALL FORECASTS

- Download instructions to install Python 3.6.8 and required libraries
- Download python script from FIU Canvas (**Rainfall Forecast to DSS** Folder).



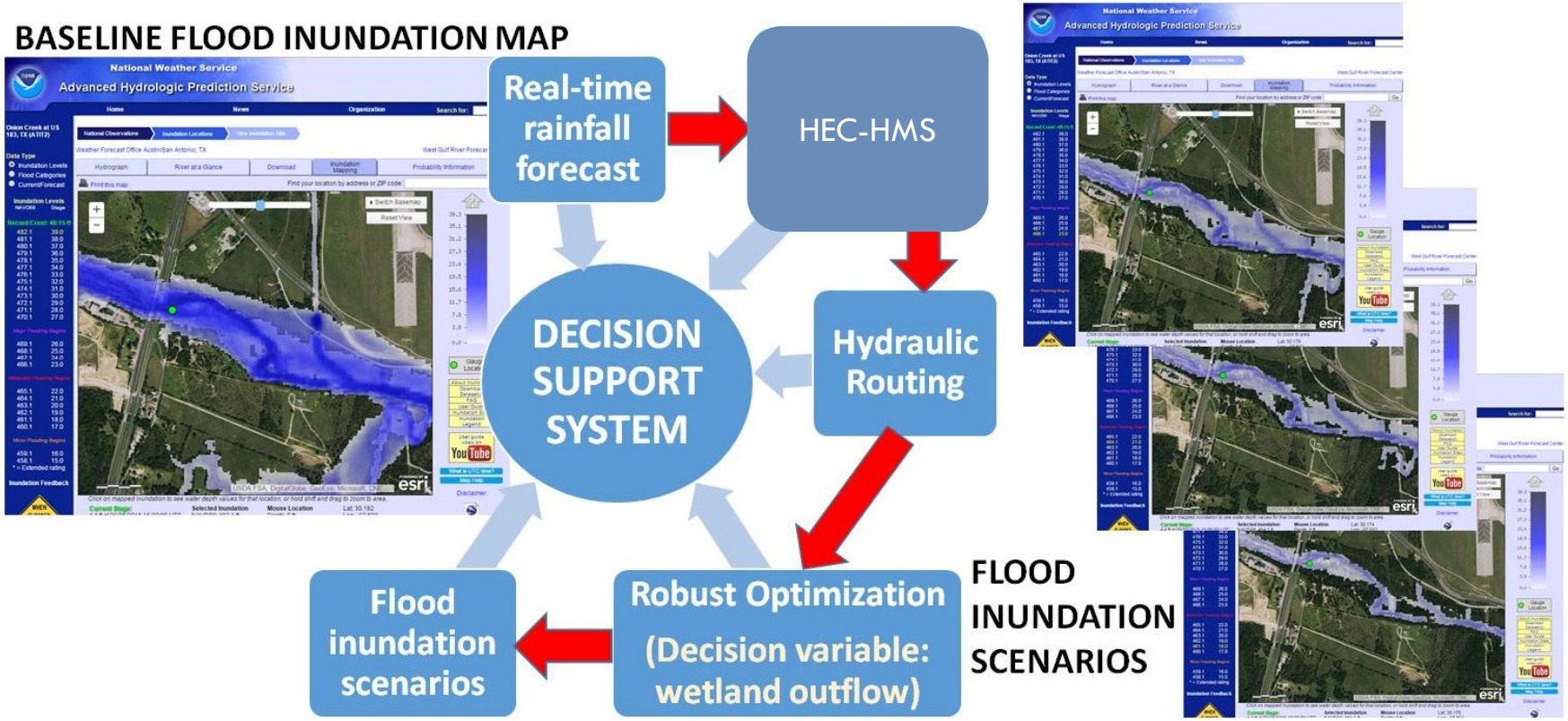
PYTHON SCRIPTS FOR ACQUIRING RAINFALL FORECASTS

- Zoom-in to watershed



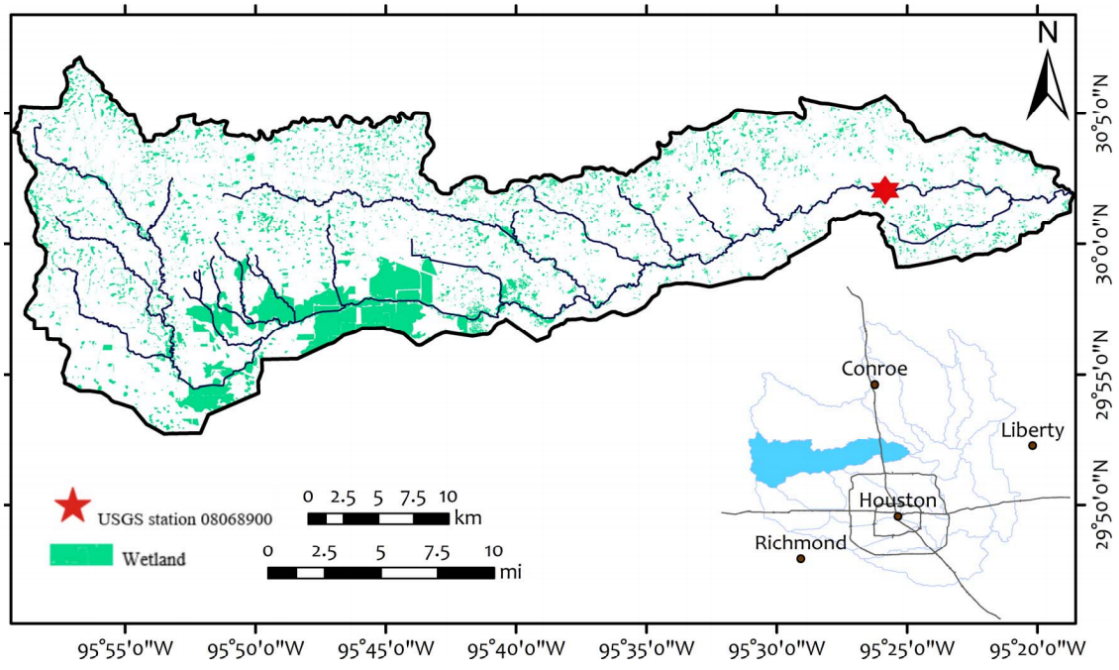
HANDS-ON DEMO OF INTEGRATED FLOOD CONTROL

Download code from FIU Canvas (**Flood Control** Folder).

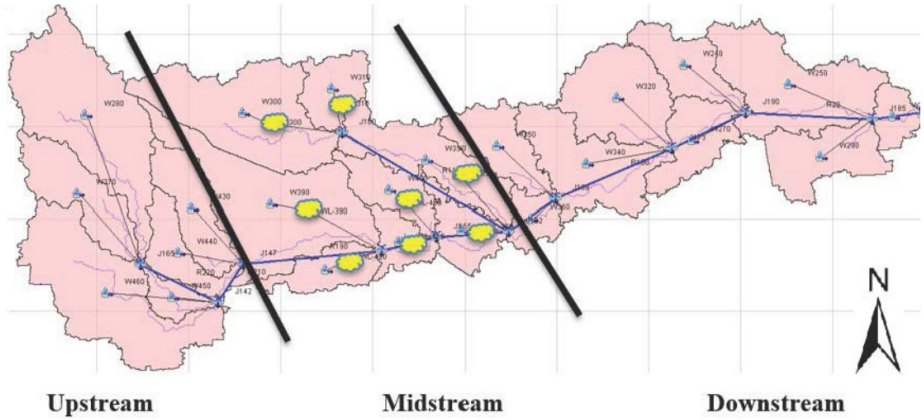


Case study: Cypress Creek, Texas.

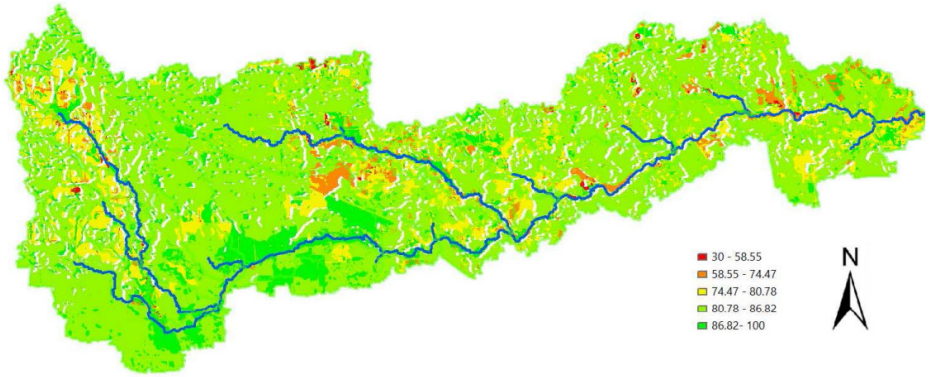
Download data and code from FIU Canvas (**Flood Control** Folder).



Geographic Location of Cypress Creek

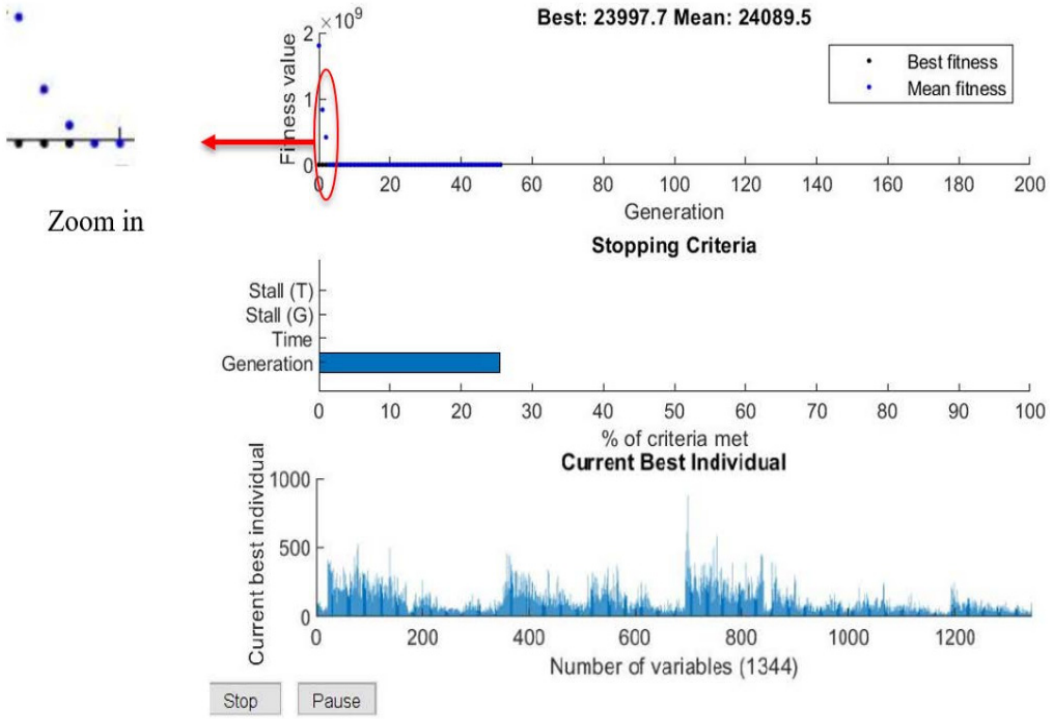


Location of eight hypothetical wetlands

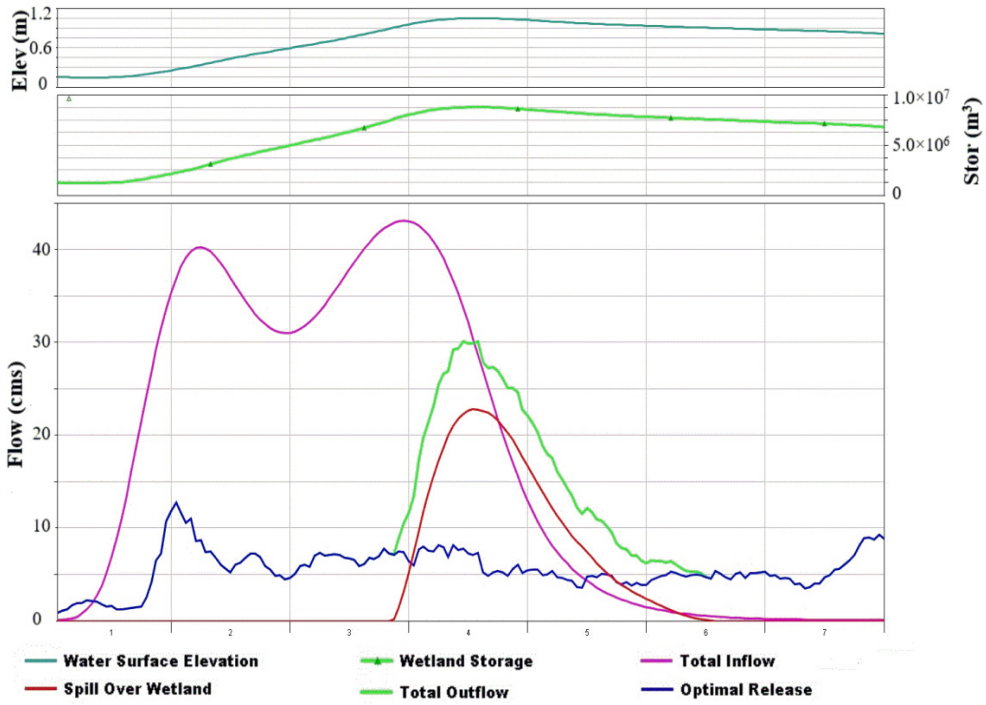


Curve Number Grid Map of Cypress Creek

CASE STUDY (CONT.)



Convergence process for wetland optimal outflows



Typical time traces of water storage, water level, and optimal release for one of the wetlands