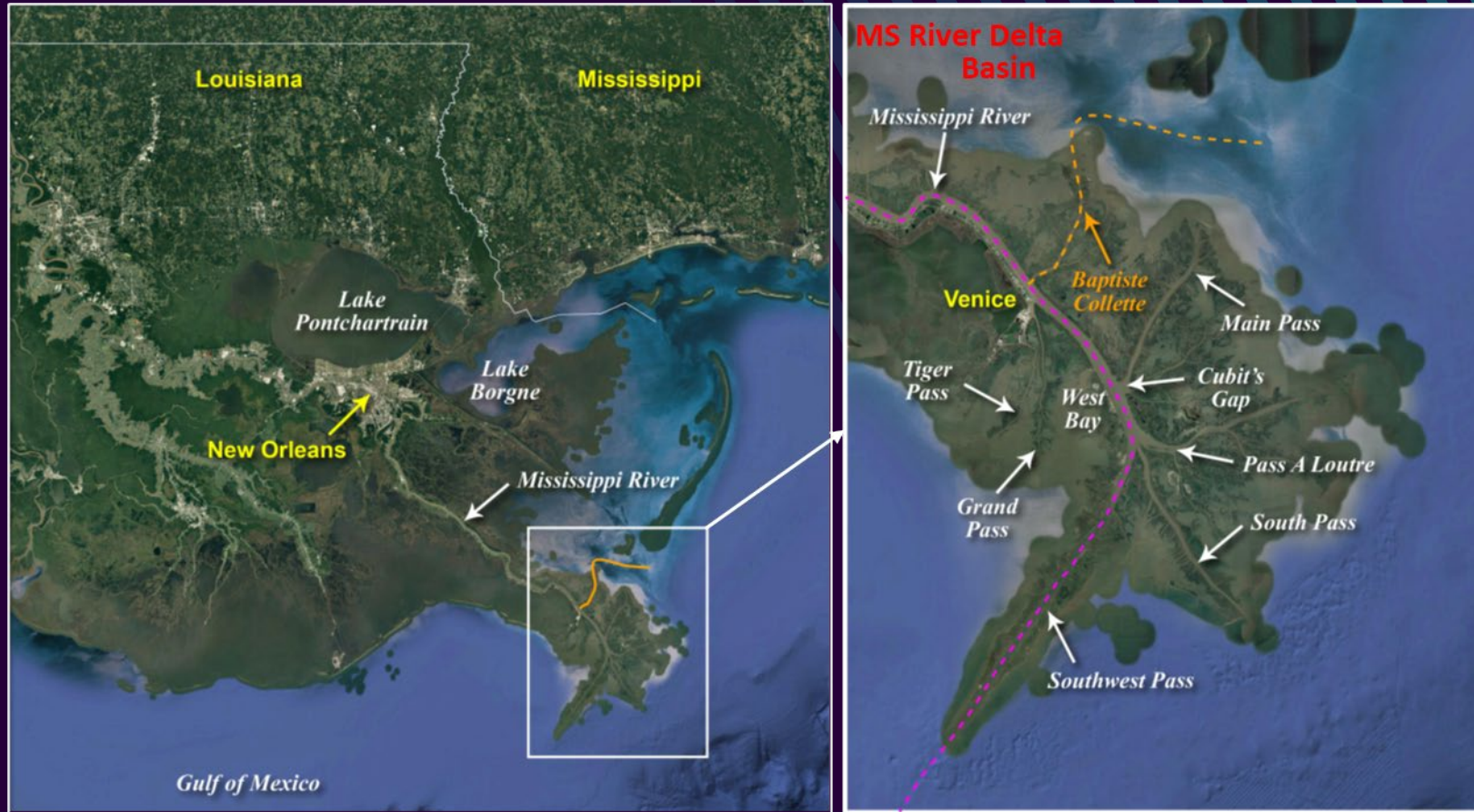


NUMERICAL MODELING OF BAPTISTE COLLETTE SHIP CHANNEL, LOUISIANA, FOR NAVIGATION IMPROVEMENT SUPPORT

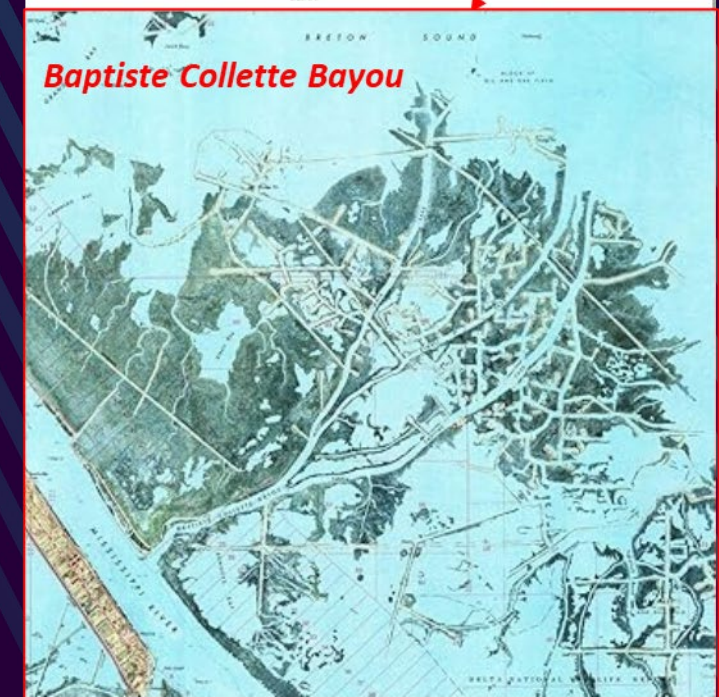
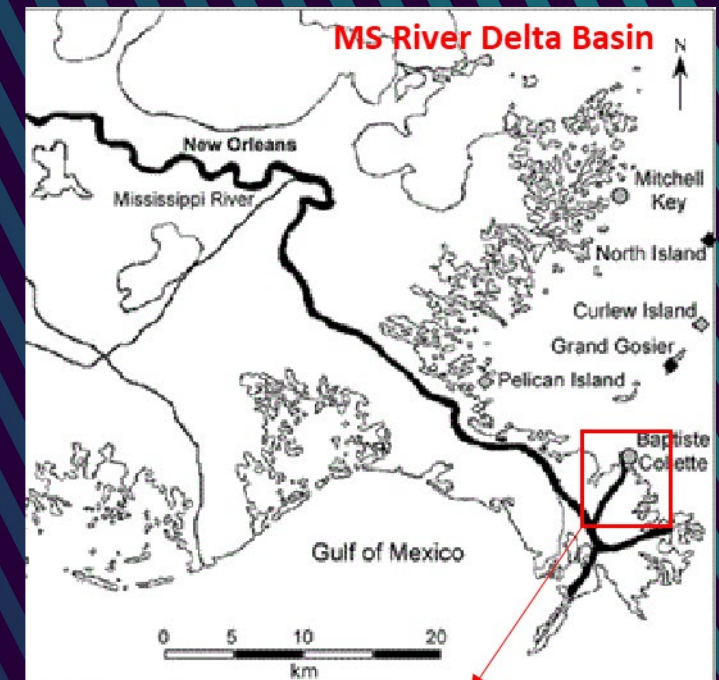


Lihwa Lin and Zeki Demirbilek, USACE, Engineer Research & Development Center (ERDC)



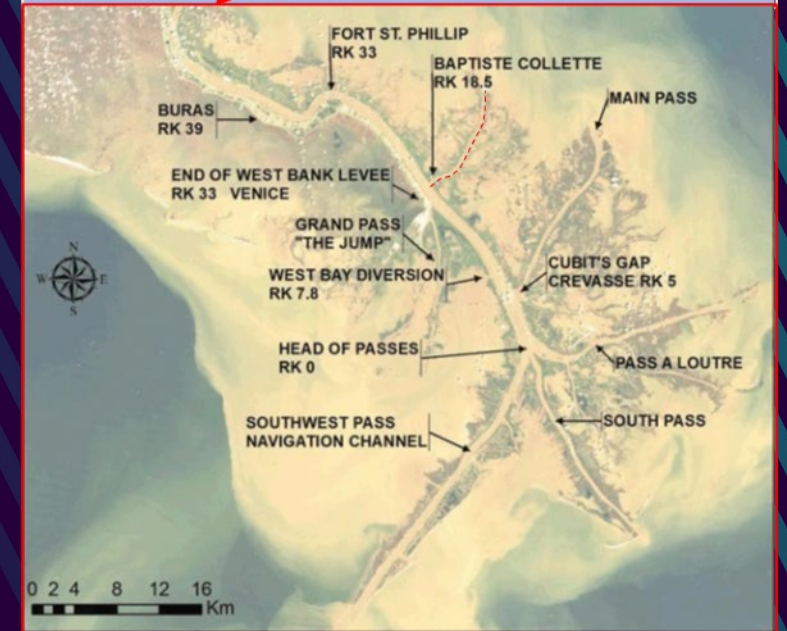
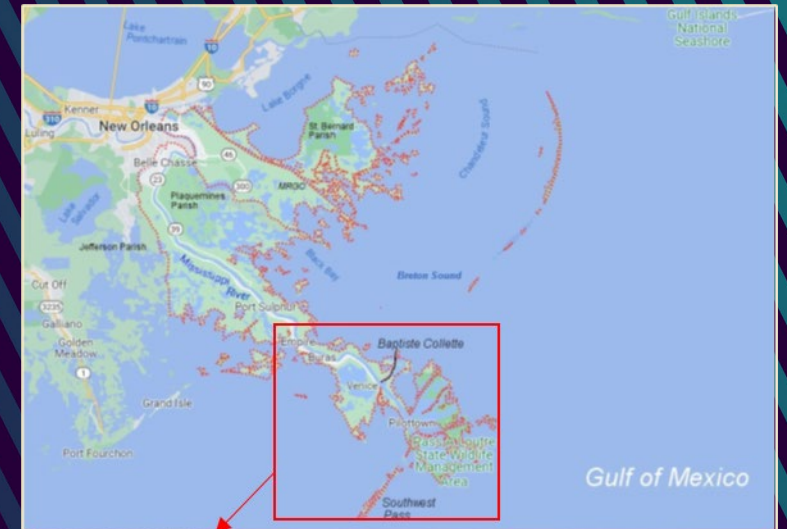
OUTLINE

- Background & Objectives
- Available Field Data
- Coastal Modeling System (CMS)
- Numerical Simulations
- Summary & Conclusions



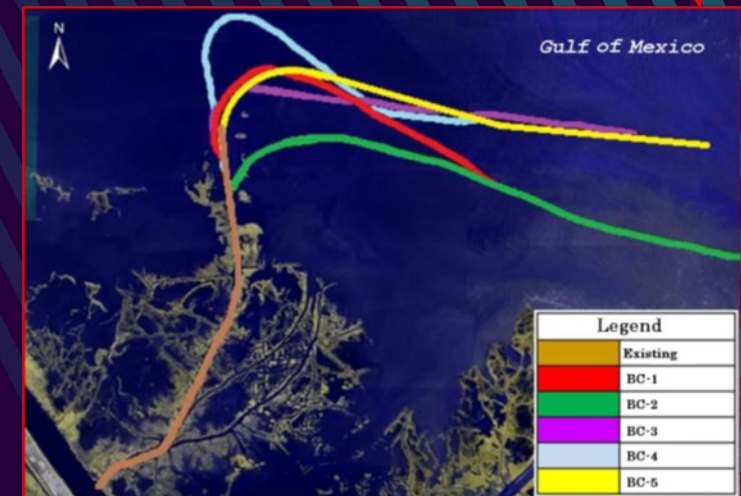
BACKGROUND

- Baptiste Collette Bayou, a distributary of the Mississippi River, approximately 75 miles southeast of New Orleans in Plaquemines Parish, serves as a short cut from Mississippi River near Venice to the eastern and east-central Gulf of Mexico.
- The existing Baptiste Collette navigation channel, approximately 10.7 mile long, has a controlling depth of 14 feet, ref. to the Mean Low Gulf datum (MLG), over a width of 150 feet and a Gulf entrance in open water of 16 feet deep (MLG) over a width of 250 feet.
- The Baptiste Collette channel was constructed between November 1977 and May 1978, with a pair of rocky jetties completed in May 1979 to protect the Gulf entrance of the channel.



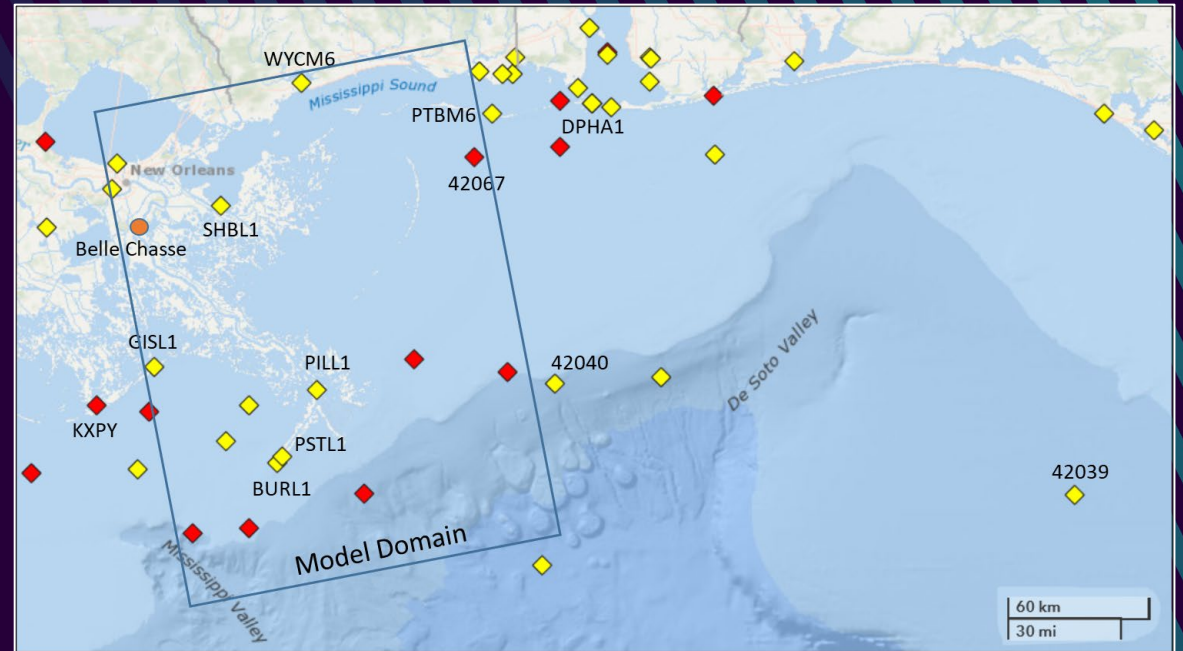
OBJECTIVES

- Conduct numerical modeling of coastal wind, waves, tides, river flow, hydrodynamics, and littoral processes at Baptiste Collette Bayou.
- Calibrate and validate Coastal Modeling System (CMS) with field measurements; apply the CMS to simulate sediment transport and morphology change at Baptiste Collette Navigation Channel.
- The USACE ERDC is assisting the New Orleans District to investigate the authorized navigation improvement at Baptiste Collette Bayou that includes deepening the channel from the existing depth of 14 ft to the recommended depth of 20.5 ft in the canal section and from 16 ft to 22.5 ft in the open water section.

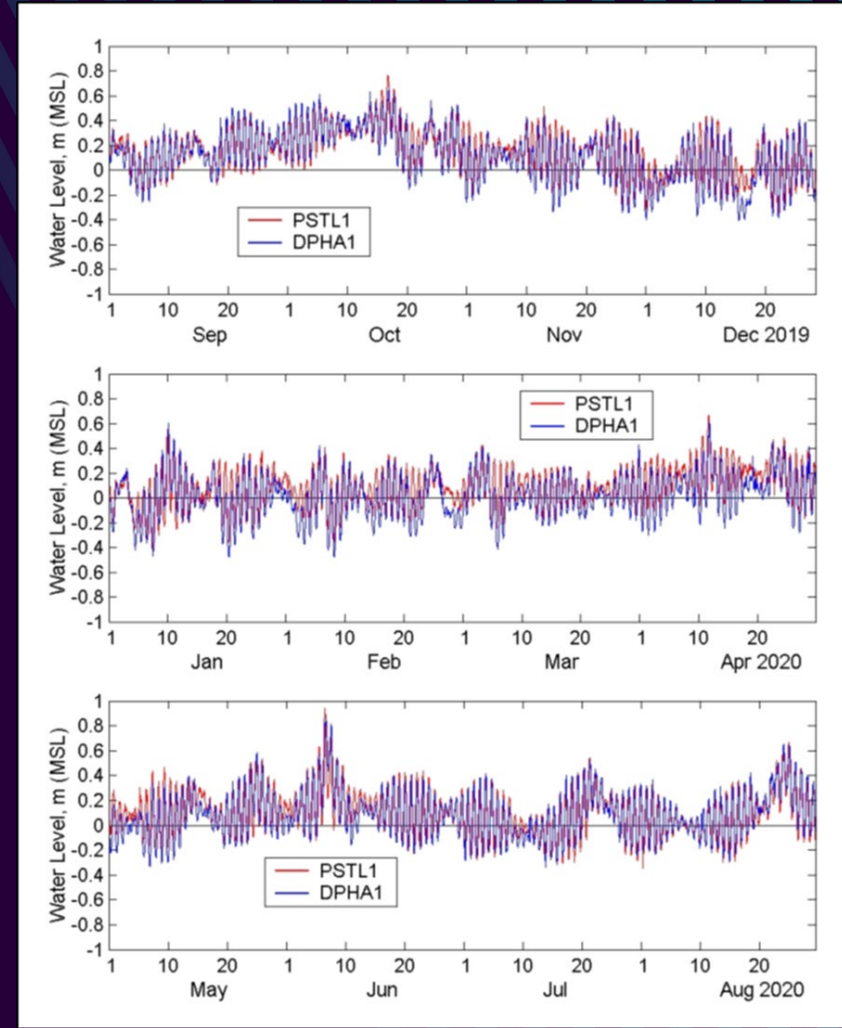
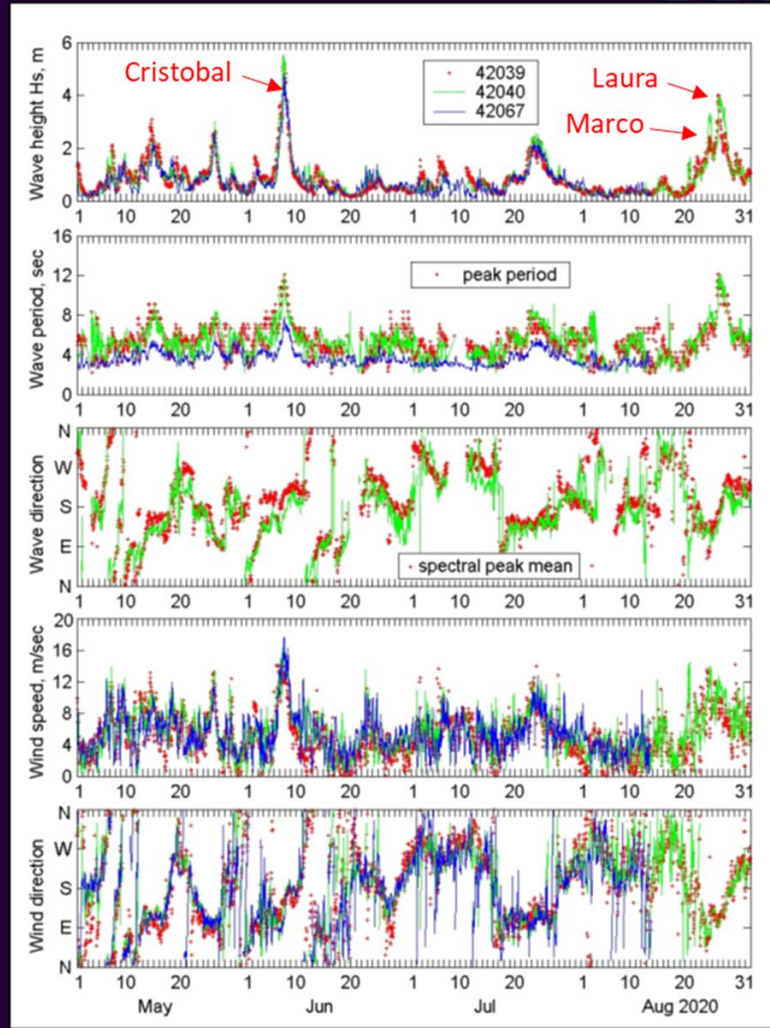


AVAILABLE FIELD DATA FOR THE STUDY

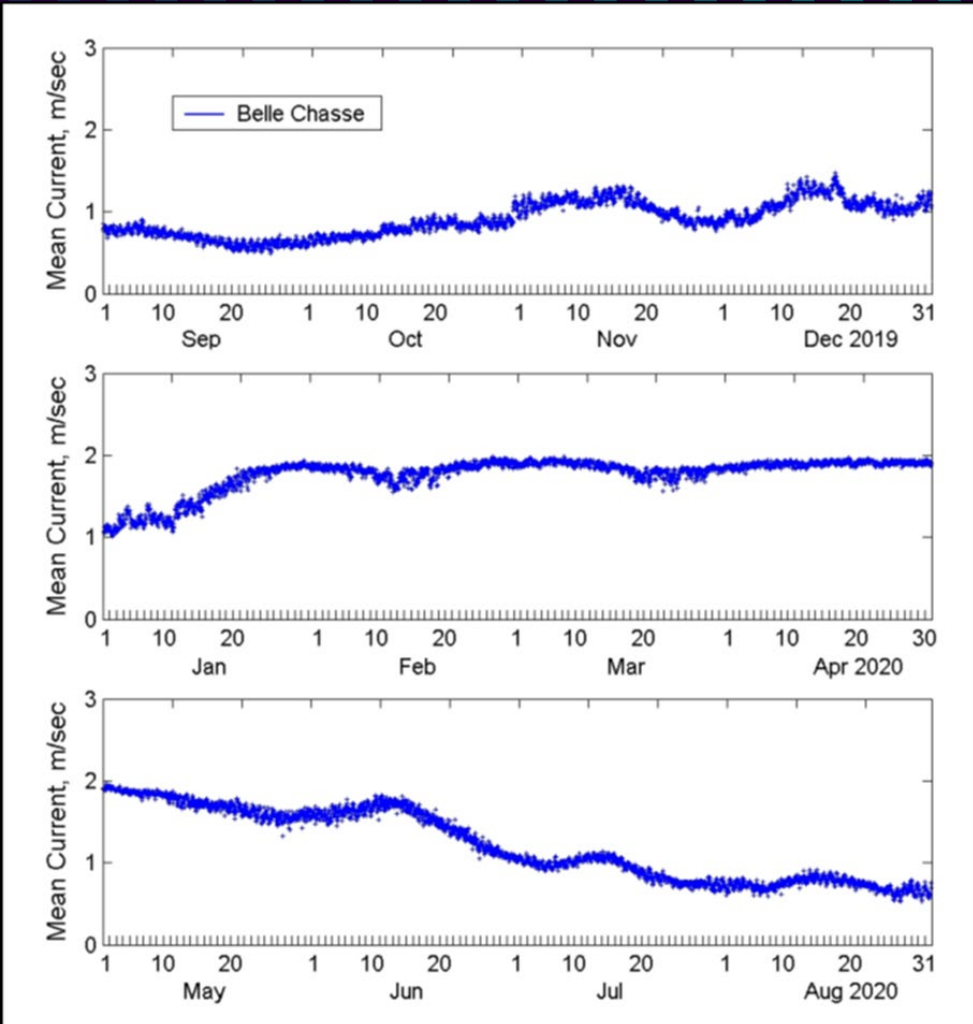
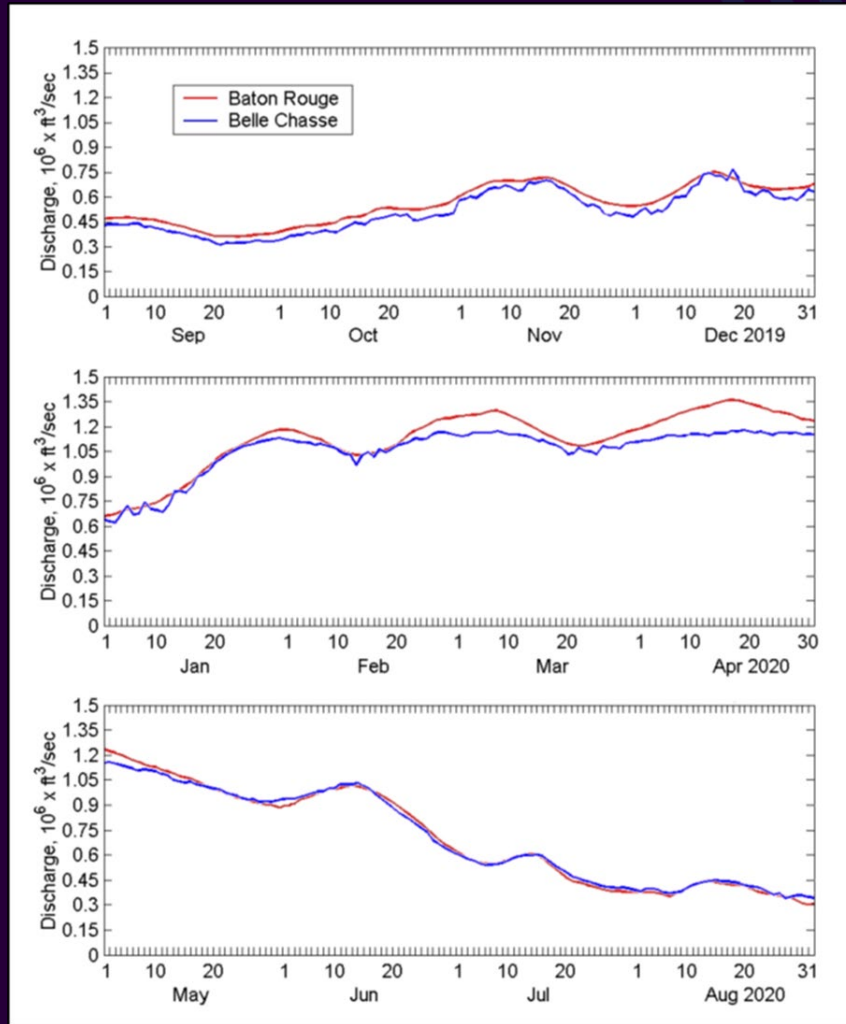
- NOAA coastal stations at BURL1, PILL1, PSTL1, KXPY, SHBL1, and WYCM6 (long-term wind, air pressure & water level data).
- NDBC Buoys 42039, 42040, and 42067 (wind, wave, and air pressure data).
- USGS Mississippi River stations at Baton Rouge and Belle Chasse, LA (river flow & water level data).
- NOAA/USGS Coastal Relief Models (DEM), USACE/USGS Lidar data (2011 and 2013), and USACE recent channel surveys (2021 - 2023).
- Historical dredge record of Baptiste Collette Channel available from 2010 to 2022.



Example of NDBC Buoy and Water Level Data

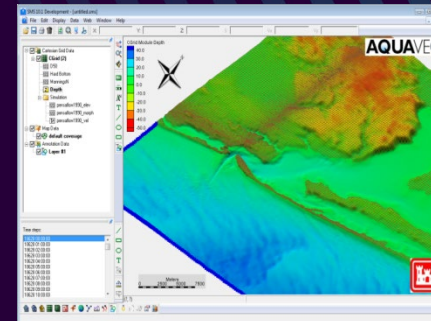
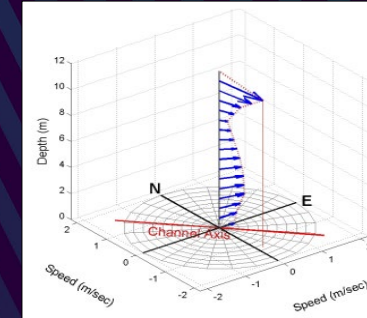
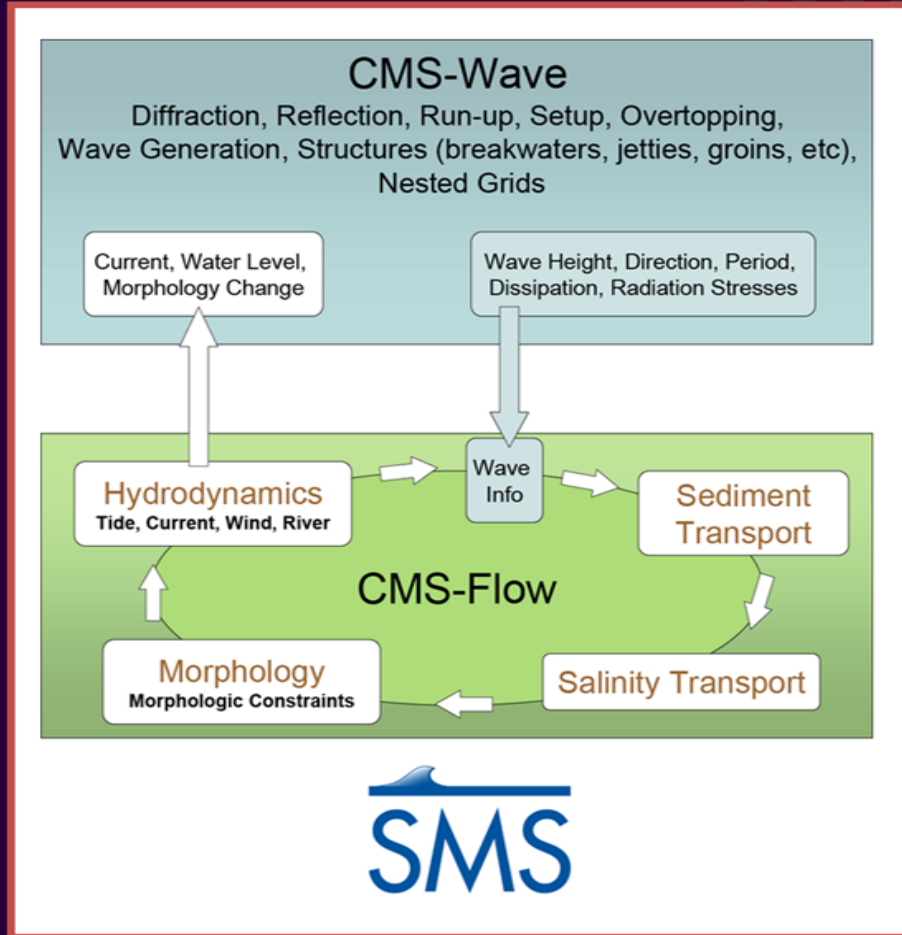


Example of Mississippi River Flow & Discharge



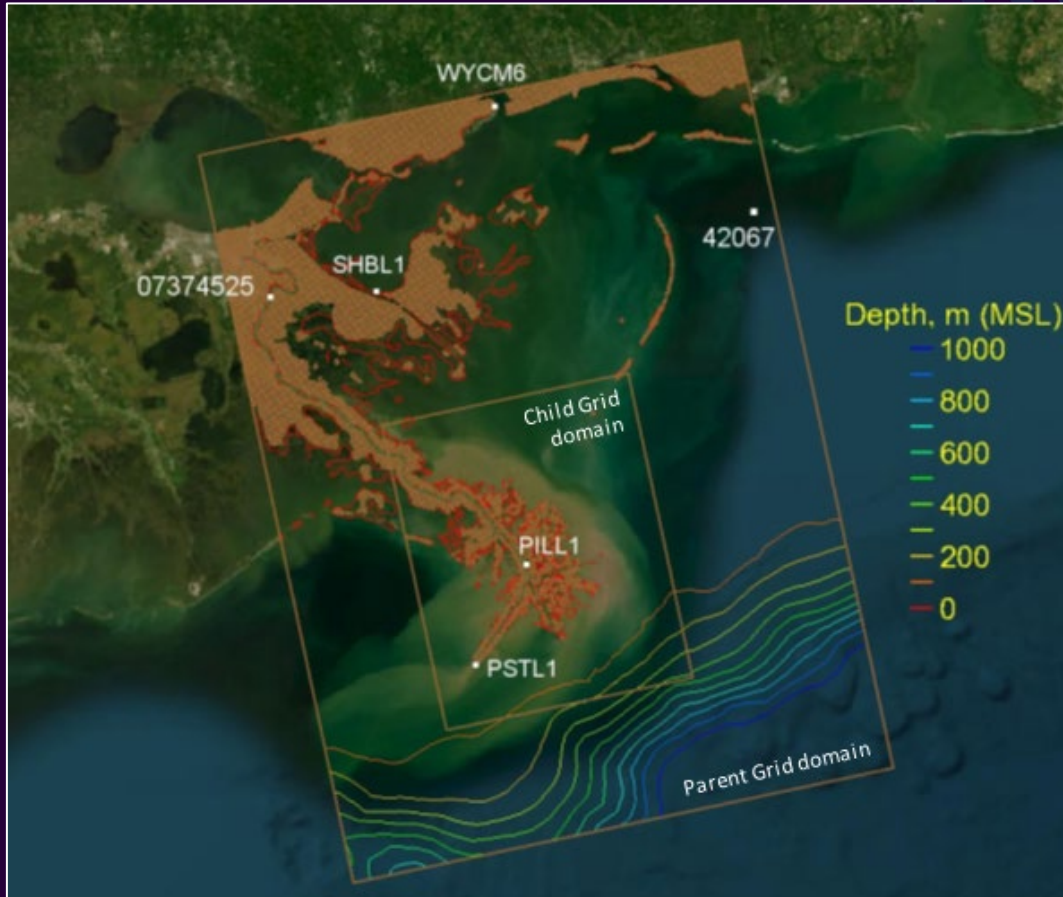
NUMERICAL MODELS

Coastal Modeling System (CMS)



- A suite of time-dependent flow, salinity, wave, & mixed sediment transport models
- Physics-based to simulate complete coastal processes
- Integrated with visual interface thru Surface-water Modeling System (SMS)

CMS MODEL BATHYMETRY GRID SYSTEM



Mississippi River Delta Basin CMS Grid system

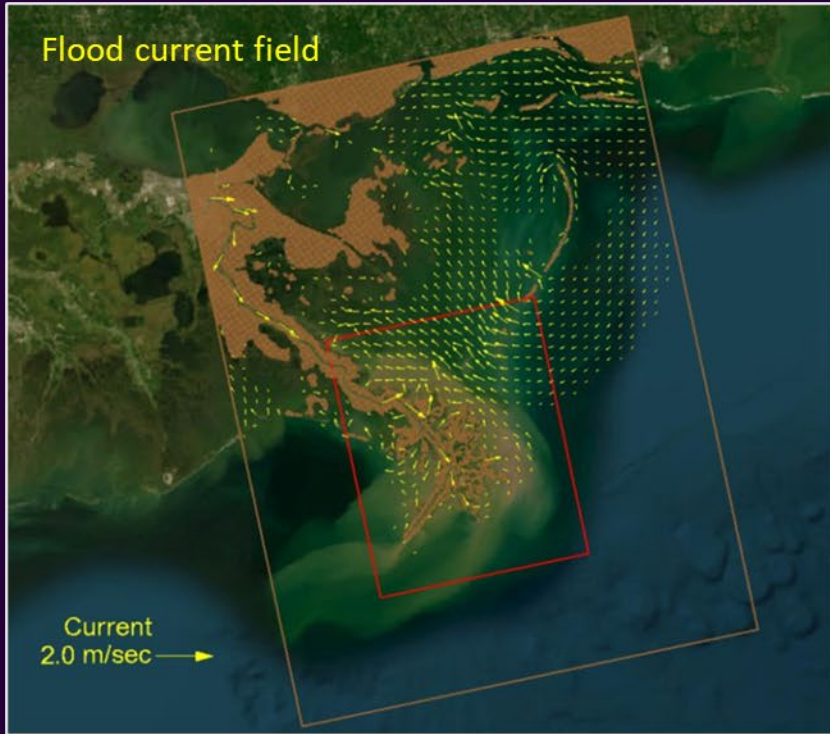
Parent Grid (PG) covers 154 km x 206 km, with a constant grid cell spacing of 500 m.

Child Grid (CG) covers 70 km x 87 km, with varying cell spacing of 40 m along Baptiste Collette and 300 m at offshore boundary.

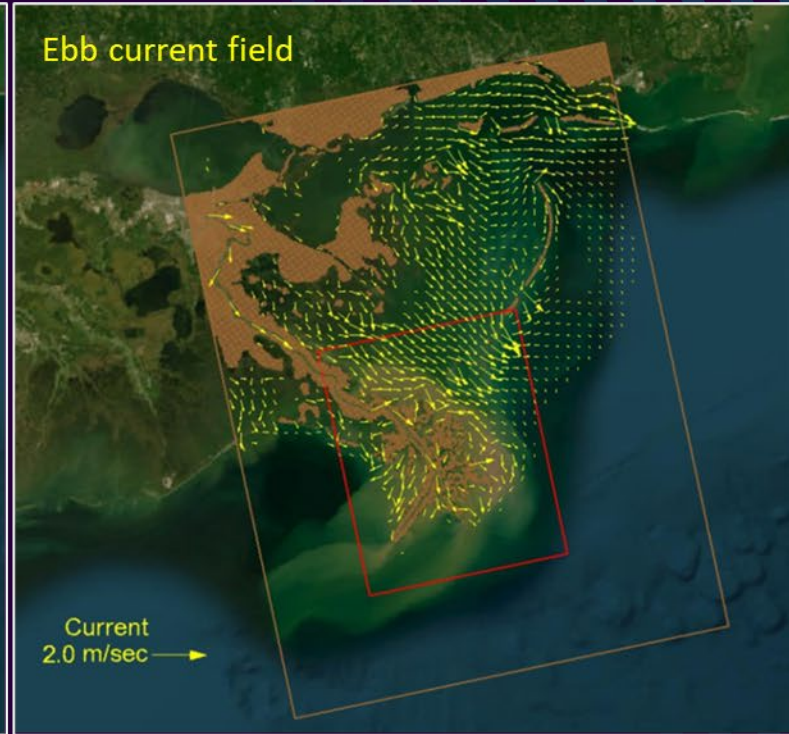
Manning's coefficient, n (bottom friction) = 0.013 inland and 0.023 in open water.

Sediment medium diameter D_{50} (mm) \sim 0.08 inland and 0.1 in the open water.

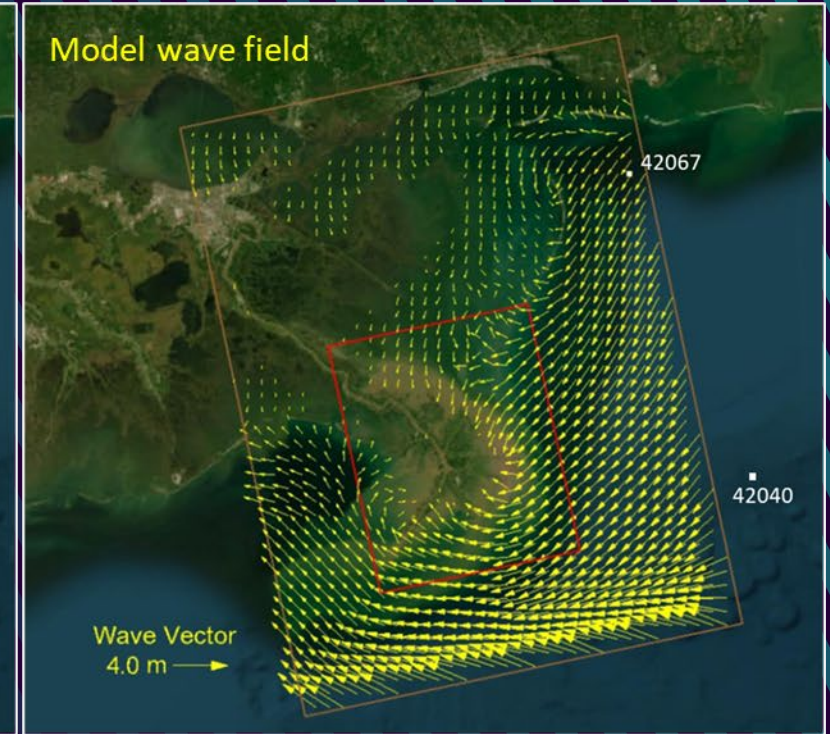
Example of Model Current and Wave Fields



12/17/2019 @ 0300 UTC

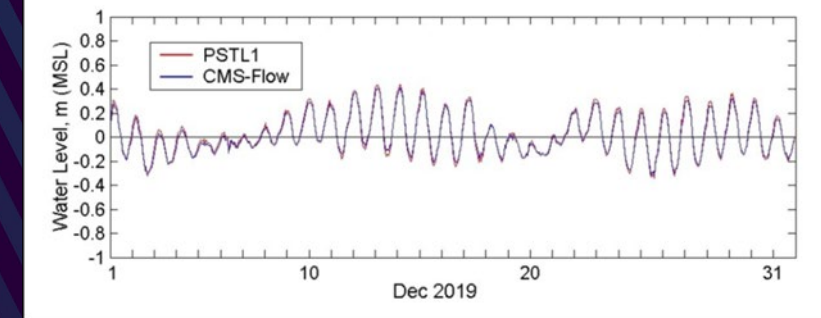
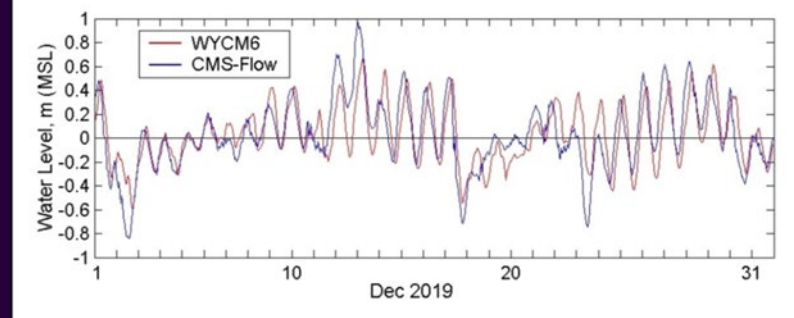
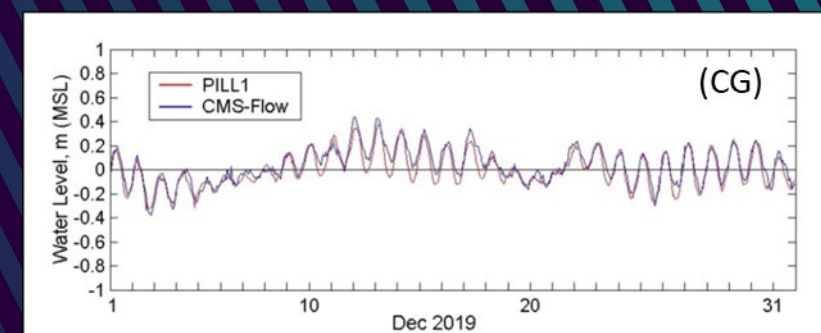
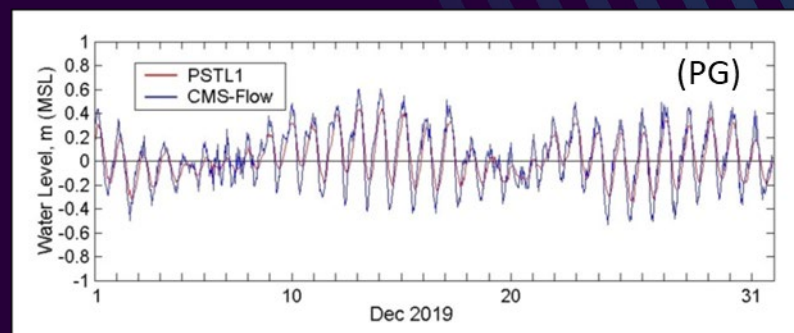
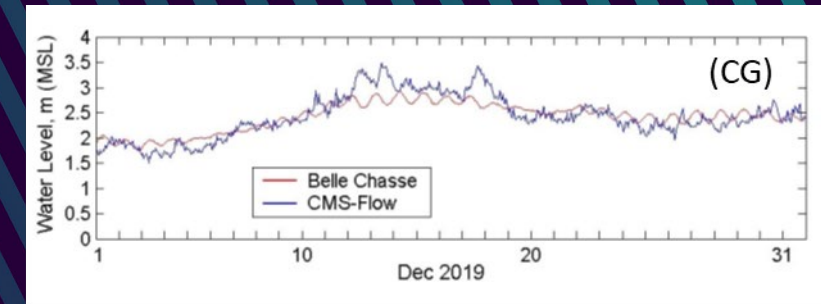
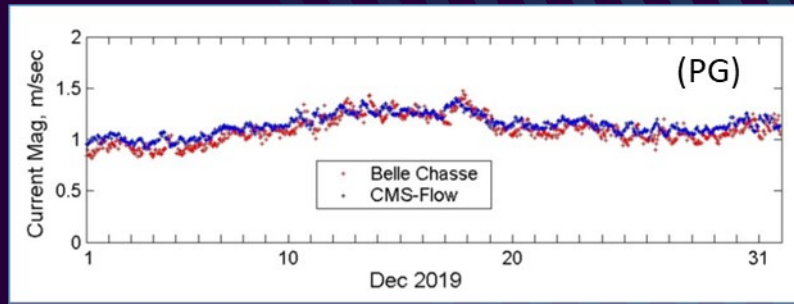
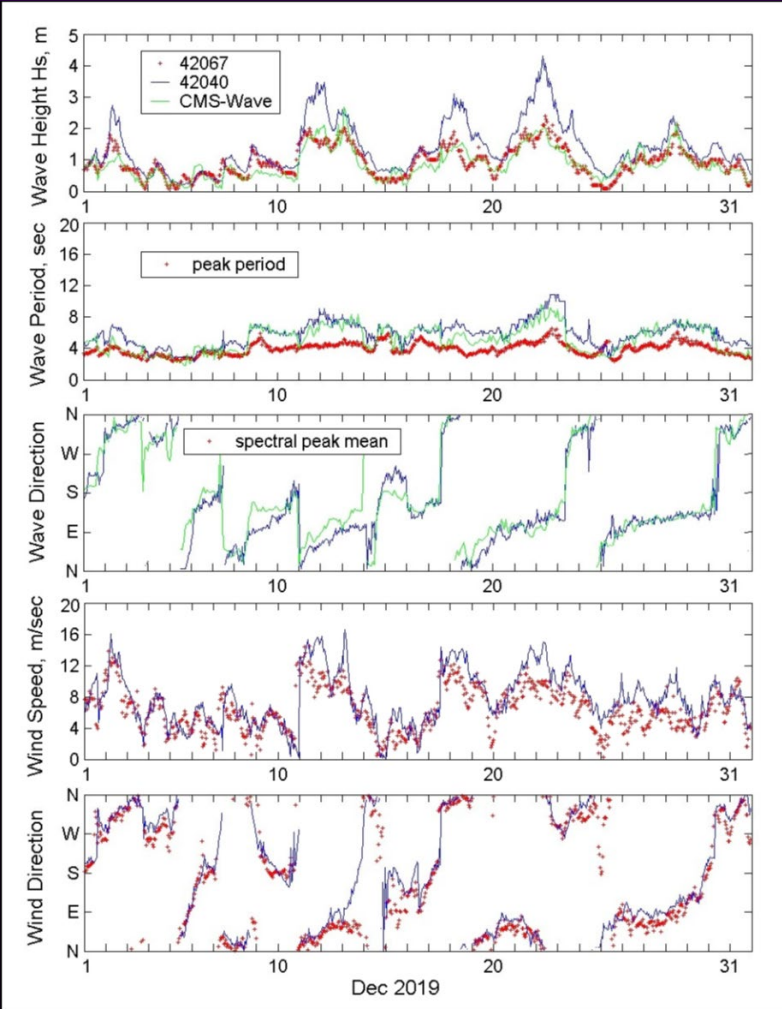


12/17/2019 @ 1500 UTC



12/18/2019 @ 1800 UTC

MODEL Wave/Current and Water Level versus Data



MODEL CALIBRATION FOR MORPHOLOGY CHANGE

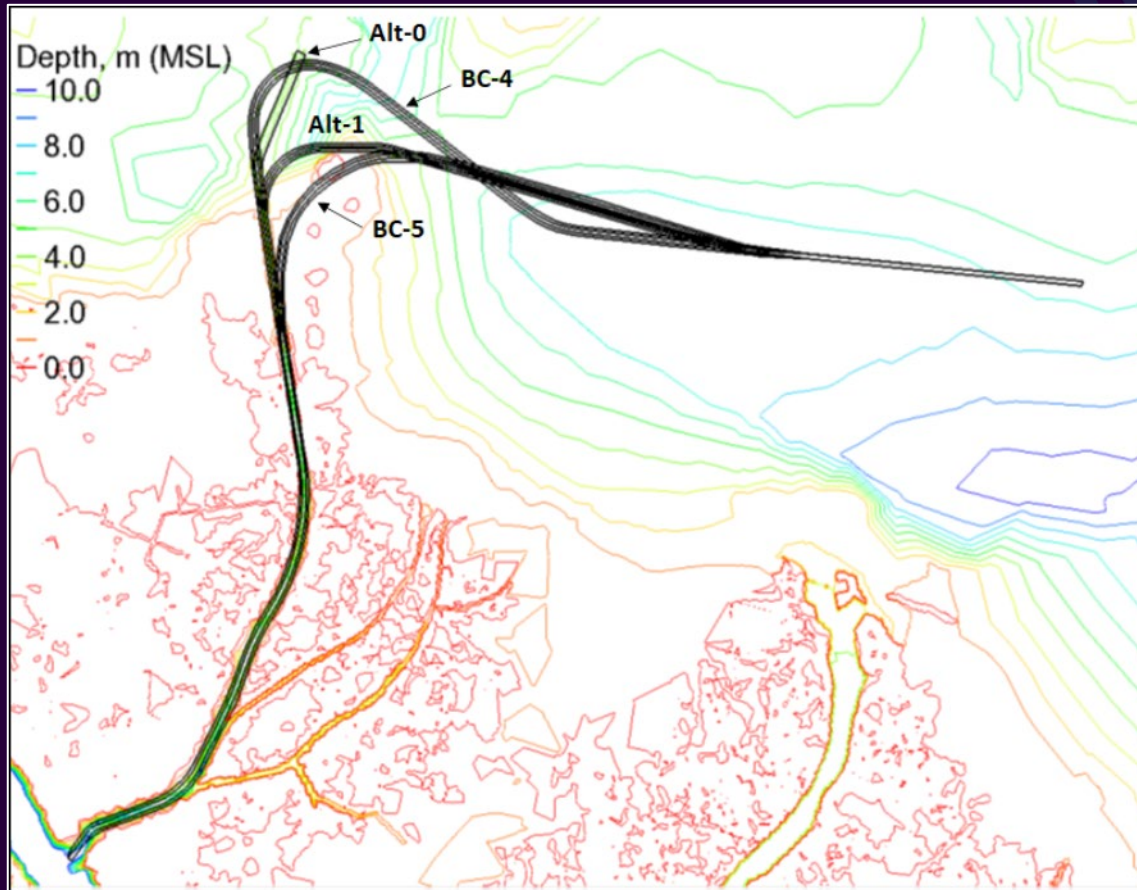


Month, Year	Channel Shoaling Volume (m ³)
September, 2019	71,800
October	71,100
November	81,600
December	71,200
January, 2020	71,400
February	57,400
March	46,100
April	41,700
May	37,600
June	35,700
July	33,000
August	34,400
September 2019 – August 2020	629,100 m³ (822,900 yd³)

Model Channel Shoaling (September 2019 – August 2020) = 822,900 yd³ (Mile 5.2 to 10.7)

Baptiste Collette Channel Maintenance (annual average) = 850, 000 yd³ (Mile 5.2 to 10.7)

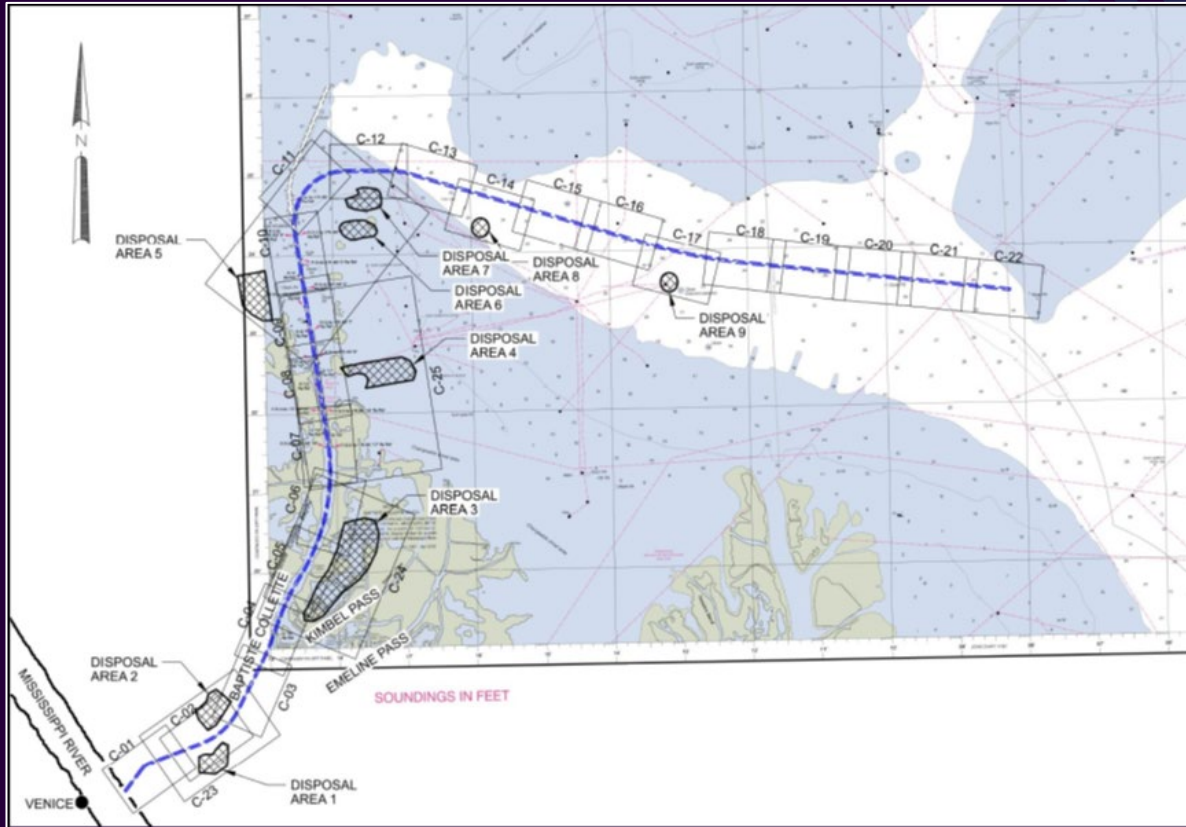
Model Alternatives for Navigation Improvement



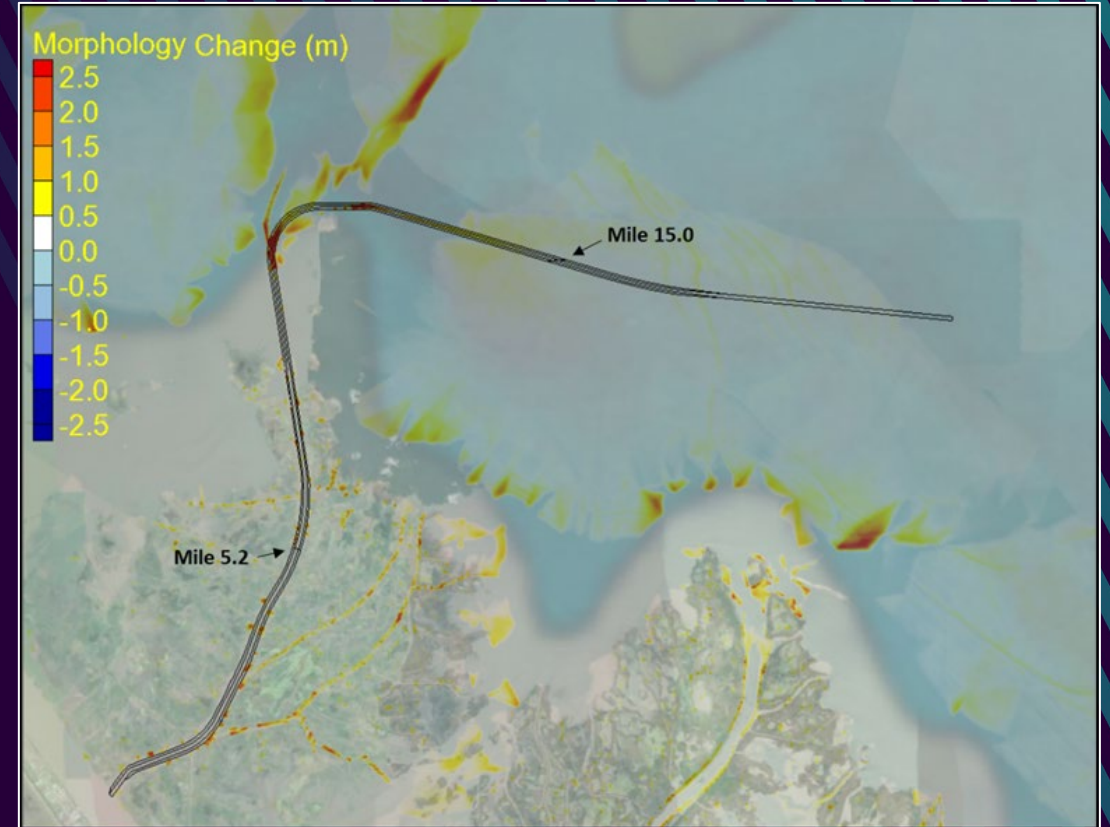
Alternative	Description
Alt 0* (Existing)	A 10.7-mi long channel; 14-ft deep (MLG), 150-ft wide in the inland reach, and 16-ft deep, 250-ft wide in the open water reach.
Alt 1 (Preferred)	Deepen the inland reach to 20.5-ft (MLG). Deepen the open water reach to 22.5-ft, realign and extend the trench channel eastward into Breton Sound.
BC-4	Similar config. to Alt 1 but with a longer north route outside jetty entrance.
BC-5	Similar config. to Alt 1 but with a shorter turning route just outside jetty entrance.

* The channel is limited to vessels with a max 10-ft draft.

Alt 1: Model Simulation for Sep 2019 - Aug 2020



Alt 1 – Channel layout and beneficial placement areas

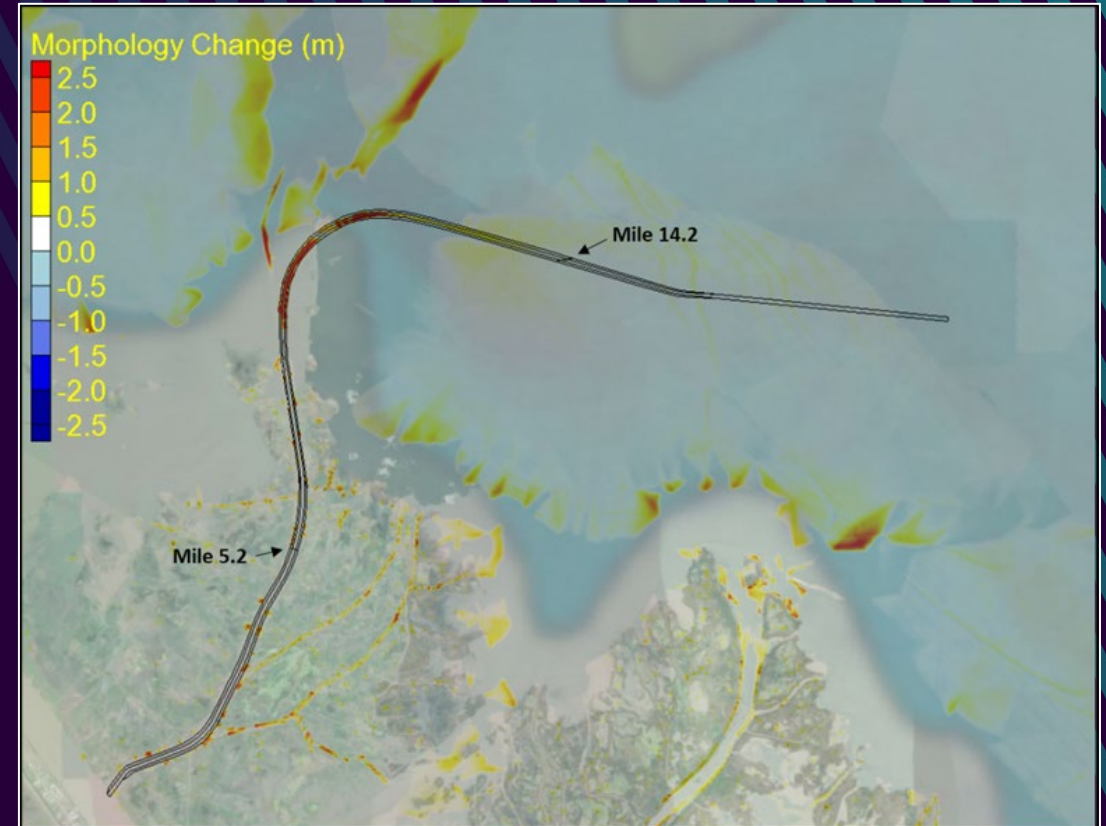


Model 1-year morphology change

Model 1-Year Morphology Change, BC-4 and BC-5



BC-4

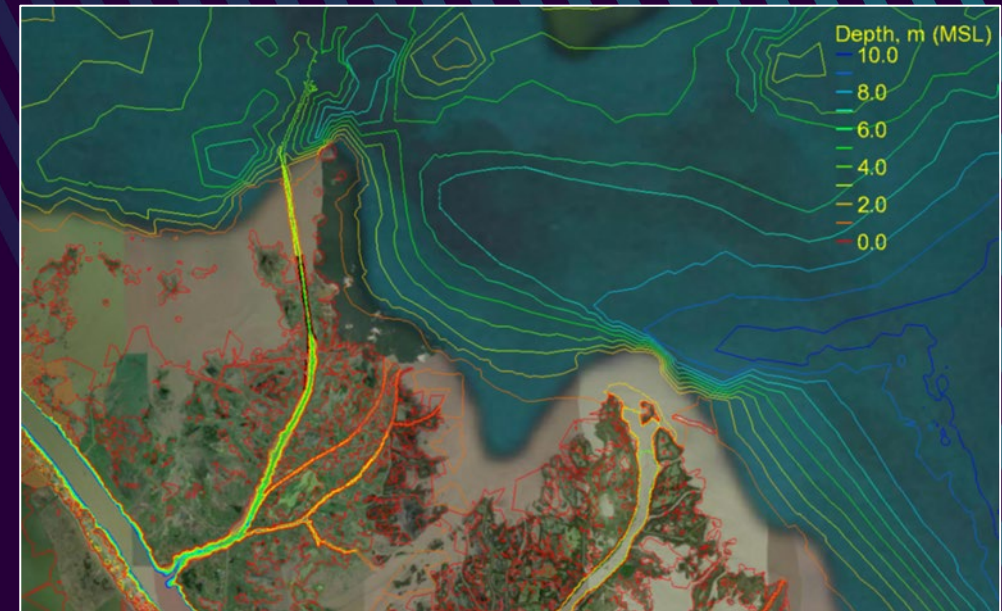


BC-5

Model Monthly Shoaling and Initial Dredging Volumes

Month, Year	Channel Shoaling (m ³) from Mile 5.2 to an open water depth reaching 22.5-ft MLG		
	Alt-1	BC-4	BC-5
September, 2019	228,500	182,900	340,900
October	152,600	221,400	196,100
November	149,800	176,500	218,700
December	157,300	237,800	247,800
January, 2020	185,400	194,200	272,600
February	152,600	163,000	228,800
March	136,300	148,200	194,700
April	153,000	203,800	212,300
May	138,200	186,400	209,900
June	150,800	166,800	221,100
July	121,000	135,800	179,000
August	100,100	113,600	144,700
September 2019 – August 2020	1,825,700 m ³ * (2,388,000 yd ³)	2,130,400 m ³ (2,786,600 yd ³)	2,666,600 m ³ (3,487,900 yd ³)

Initial dredging volume (m ³) from Mile 5.2 to an open water depth reaching 22.5-ft MLG		
Alt-1	BC-4	BC-5
5,000,000 m ³ (6,500,000 yd ³)	5,500,000 m ³ (7,200,000 yd ³)	6,500,000 m ³ (8,500,000 yd ³)



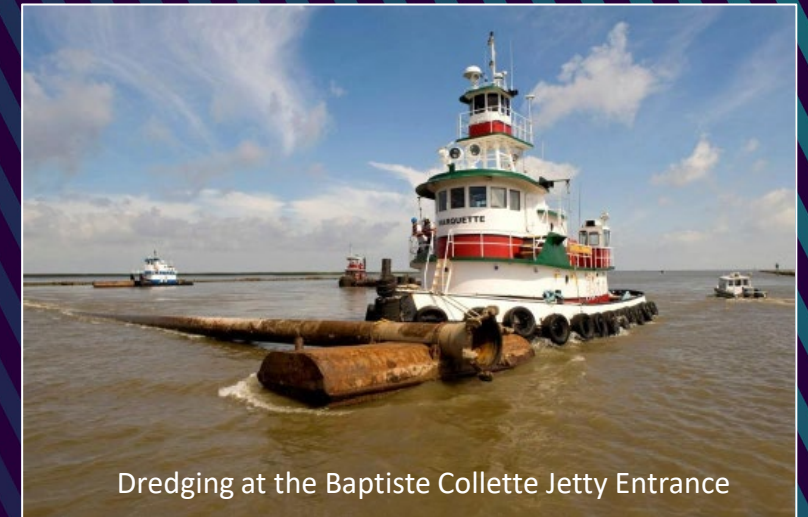
* Corresponds to 2-yr to 2.5-yr dredging cycle

Alt 0 – initial bathymetry



SUMMARY AND CONCLUSIONS

- US Army Engineer CIRP is teamed with New Orleans District to investigate the improvement of navigation channel for Baptiste Collette Bayou by numerical modeling.
- The Coastal Modeling System (CMS) was calibrated and validated using the field data (waves, wind, water levels, Lidar & survey data) and applied in the Baptiste Collette modeling.
- Both model and field observation indicate most channel shoaling occurs nearshore outside the Gulf entrance where cross-channel currents and wind wave breaking appear strong on the daily basis.
- Model results show the preferred alternative (Alt-1) in the authorized channel deepening project has the smallest channel shoaling rate than the two other alternatives with a longer north route (BC-4) and shorter south route (BC-5) in the outer channel.



THANK YOU



Questions?



Lihwa Lin and Zeki Demirbilek, USACE, Engineer Research & Development Center (ERDC)
Raymond C. Newman and Tzenge-Huey Shih, USACE, New Orleans District (MVN)