

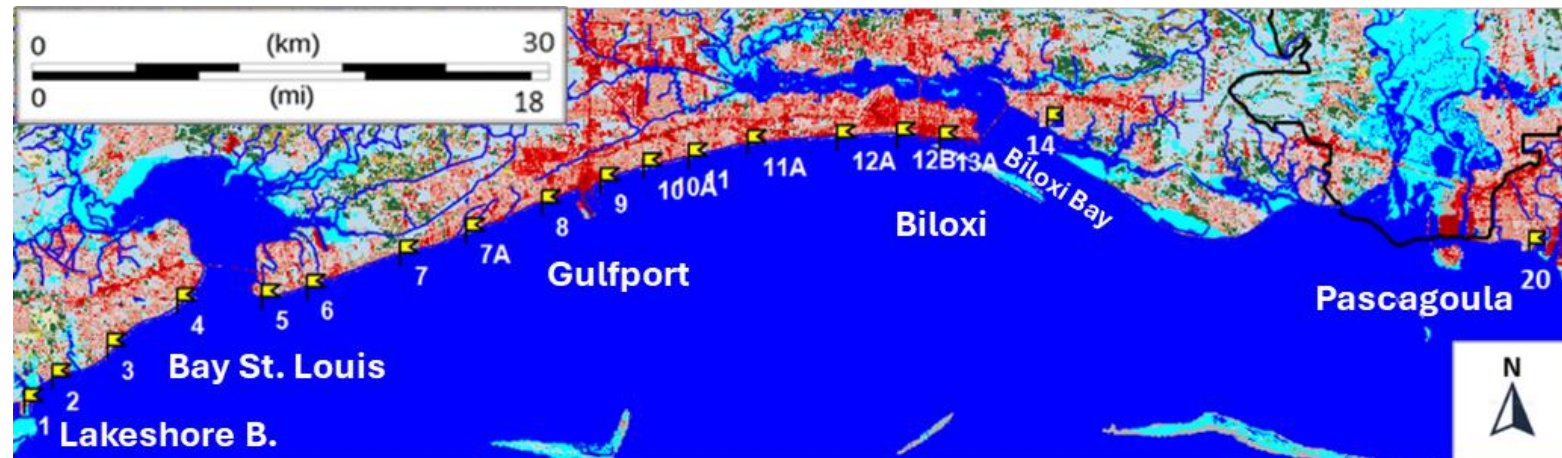
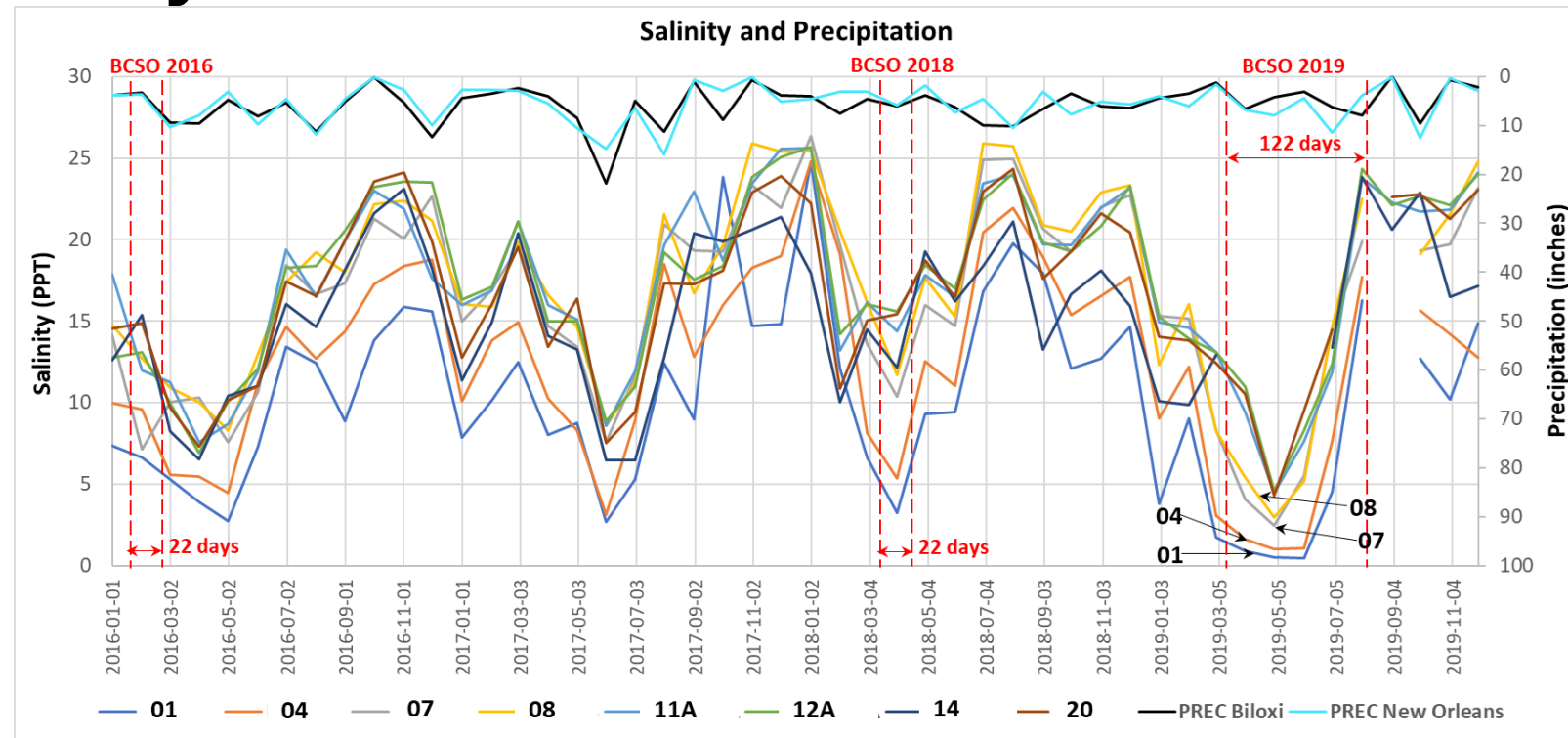
A Conceptual Model for Water Quality Simulation in the Mississippi Sound, USA

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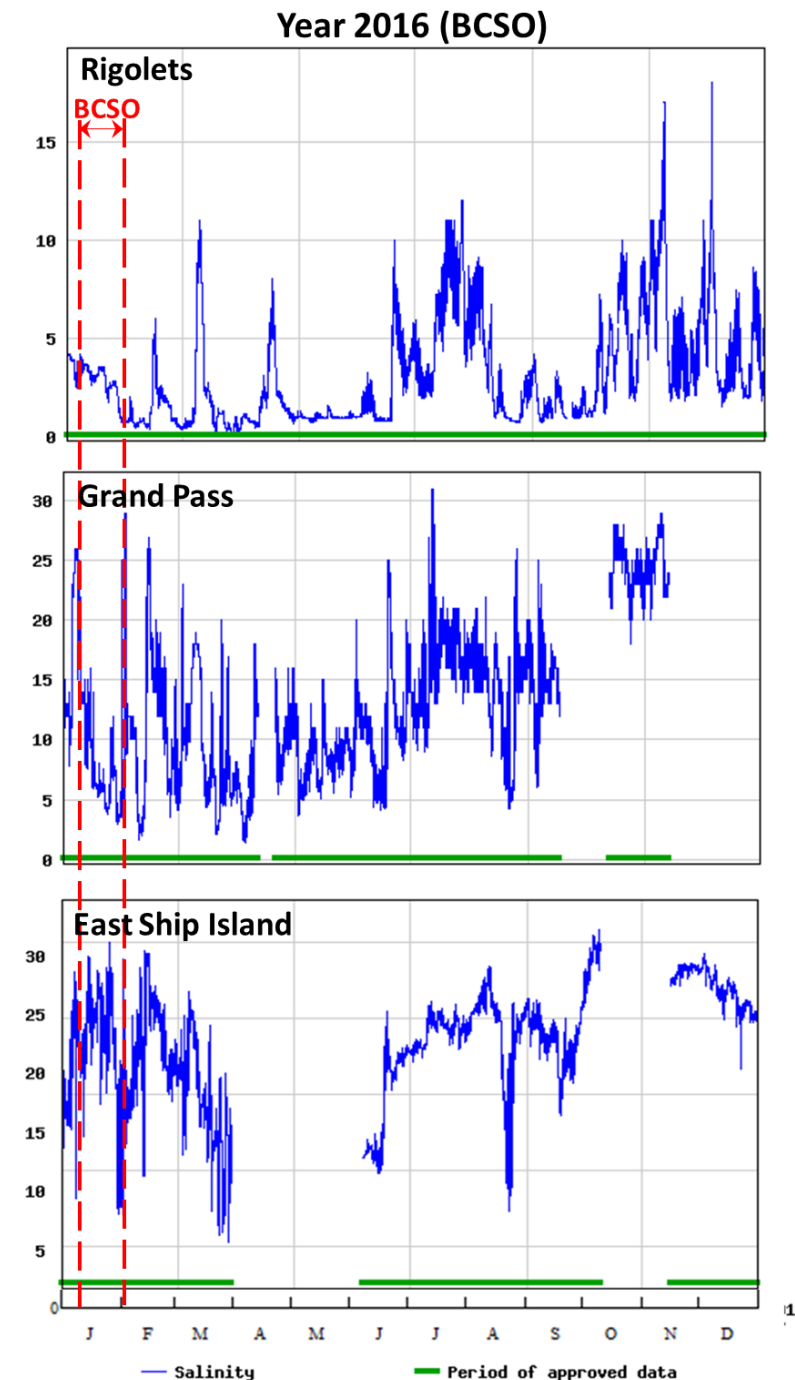
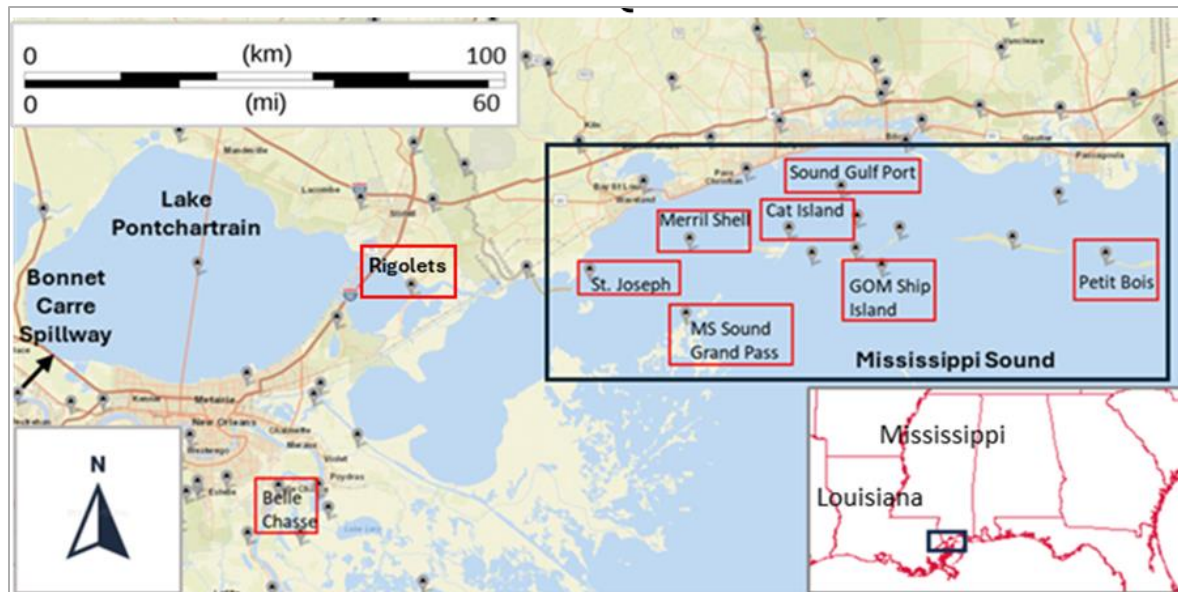
Delimitation of study area

- Observed salinity data were analyzed to set geographical limits to the modeling study
- Coastal MDEQ data show that Bonnet Carre openings severely decrease salinity as far as Gulfport (Station 8). Salinity < 5 PPT.
- Effects at Biloxi, Front Beach, and Pascagoula are comparable to effects from intensive rain events during 2014. Salinity > 5 PPT.



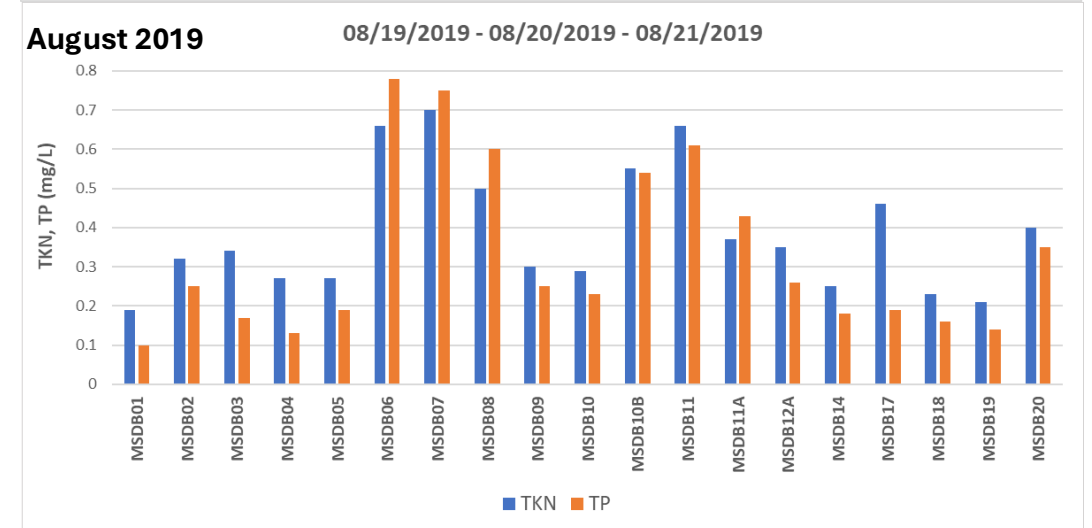
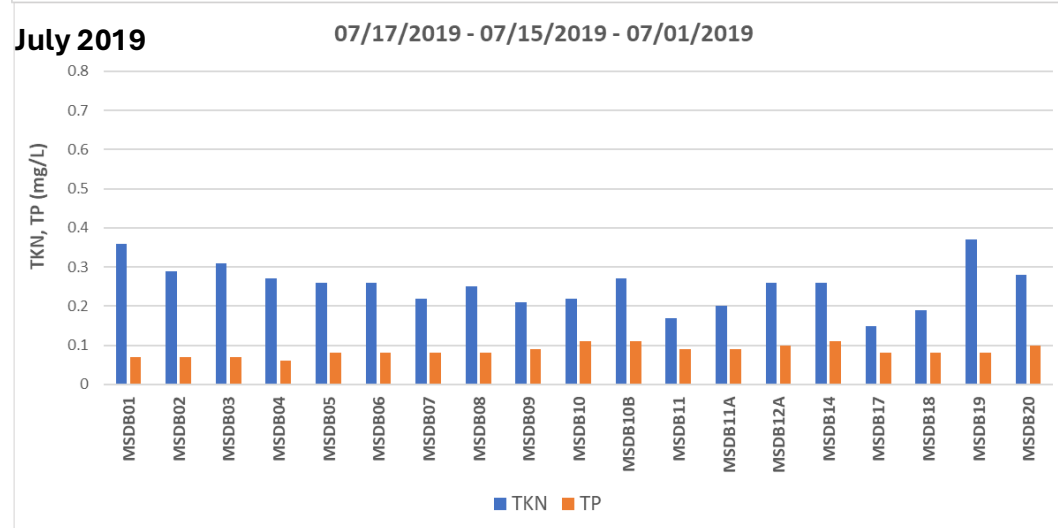
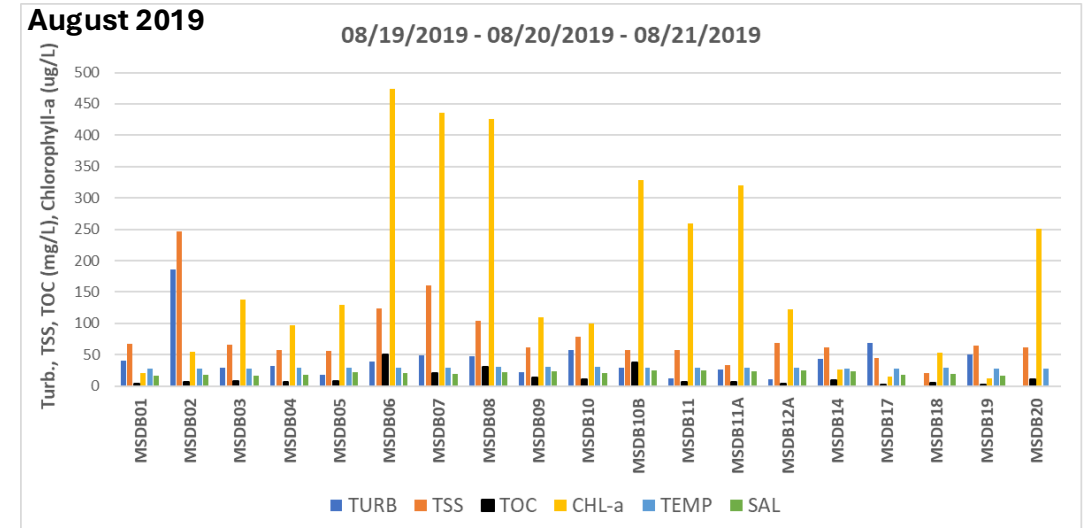
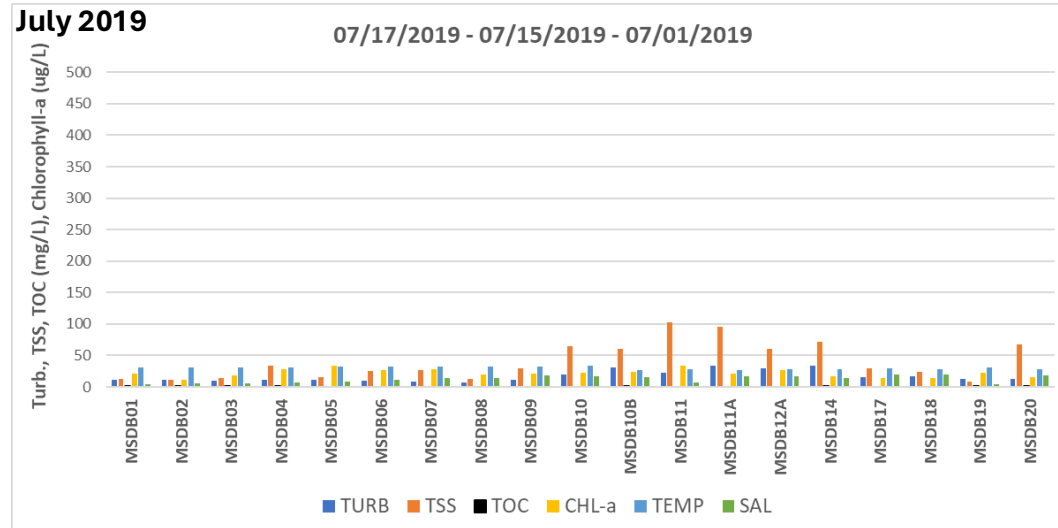
Delimitation of study area

- Hourly salinity data collected at USGS Stations show that Bonnet Carre openings strongly affects salinity at Rigolets USGS Station (salinity < 5 PPT).
- Effects at East Ship Island USGS off-shore station are shown to be comparable to rain events effect (salinity > 8 PPT).
- Coastal and off-shore salinity stations suggest that the eastern limit for a water quality modeling study could be located between East Ship Island and Pascagoula.
- If salinity is affected, water quality will also be affected.



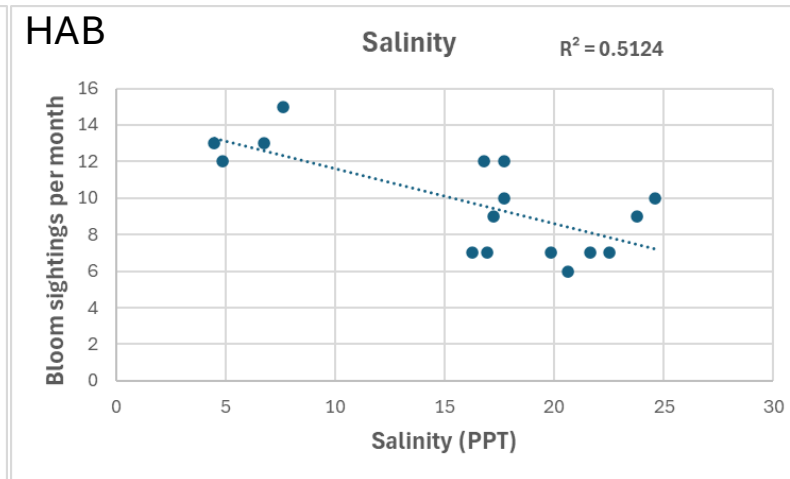
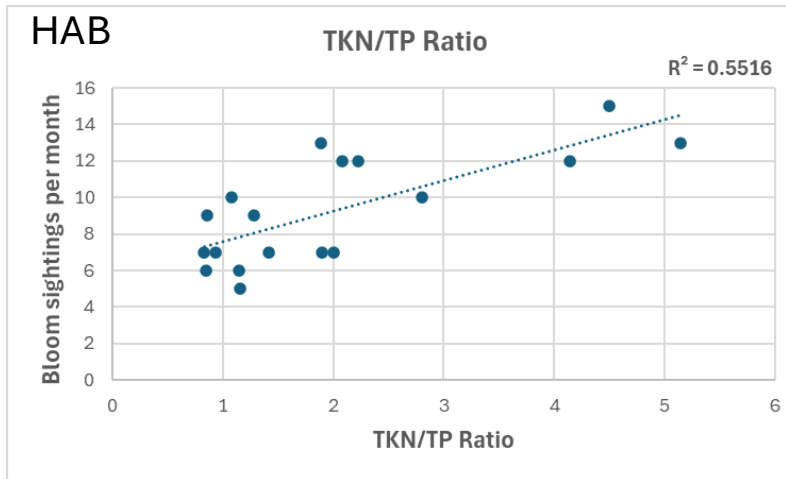
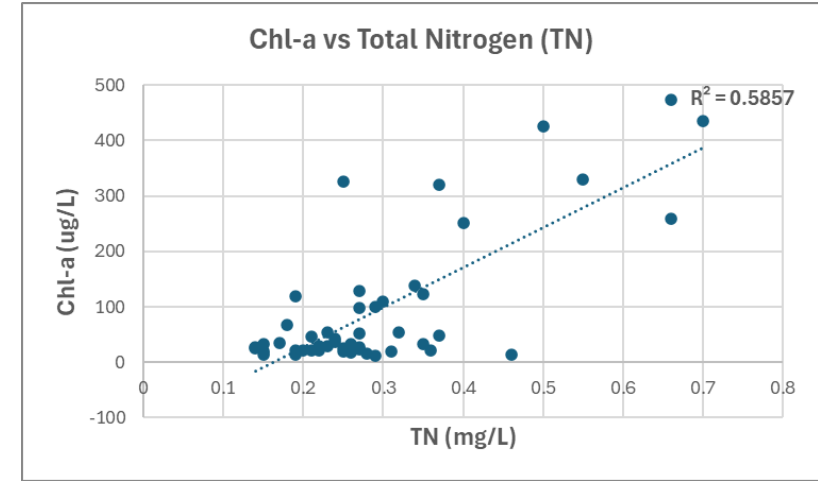
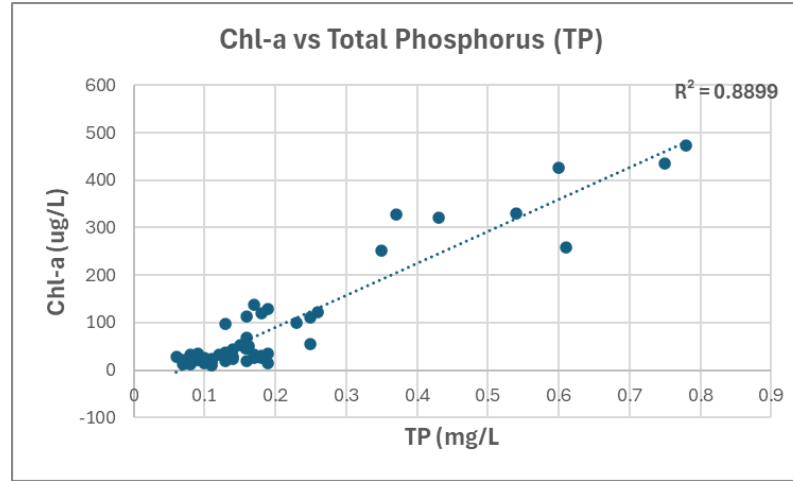
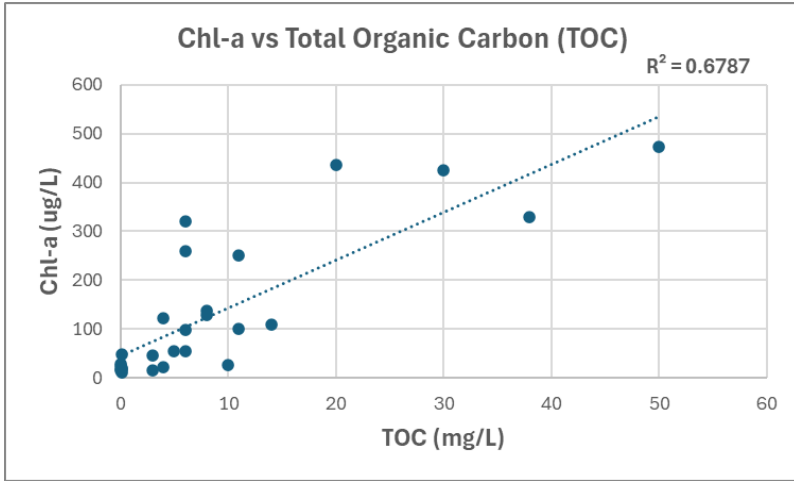
Water quality inputs: MDEQ stations

- In 2019 (year during which MS Sound WQ was mostly impaired) Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), Total Suspended Solids (TSS), and chlorophyll-a (Chl-a) were the parameters most affected.
- The effects were more evident during August 2019 than during July (after BC closing). The effects reach as far as Biloxi, probably due to a combination of hydrodynamic transport and inputs from the dense urban sprawl.



Relationship between water quality constituents

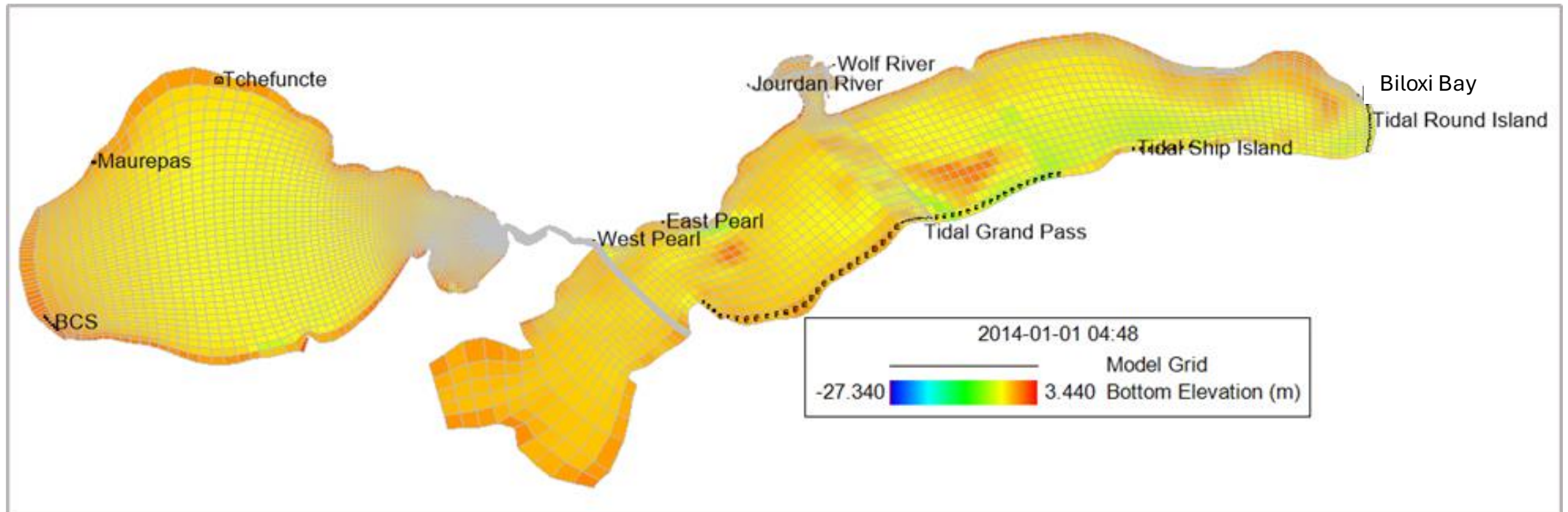
- Year 2019 MDEQ data showed that Chlorophyll-a correlates with TOC, TP, and TN concentrations.
- Harmful algal bloom sightings correlate with TKN/TP ratio, and salinity. These water quality constituents should be included in WQ modeling/simulation.



Harmful Algal Bloom (HAB)

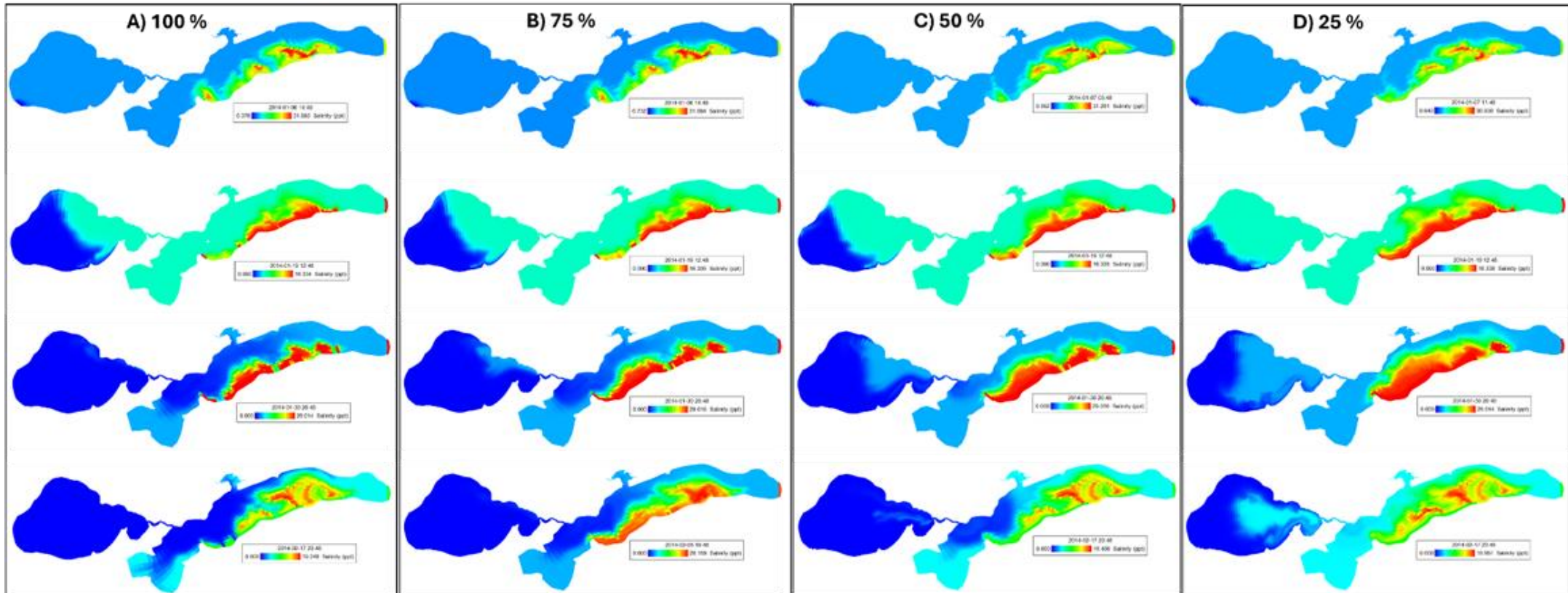
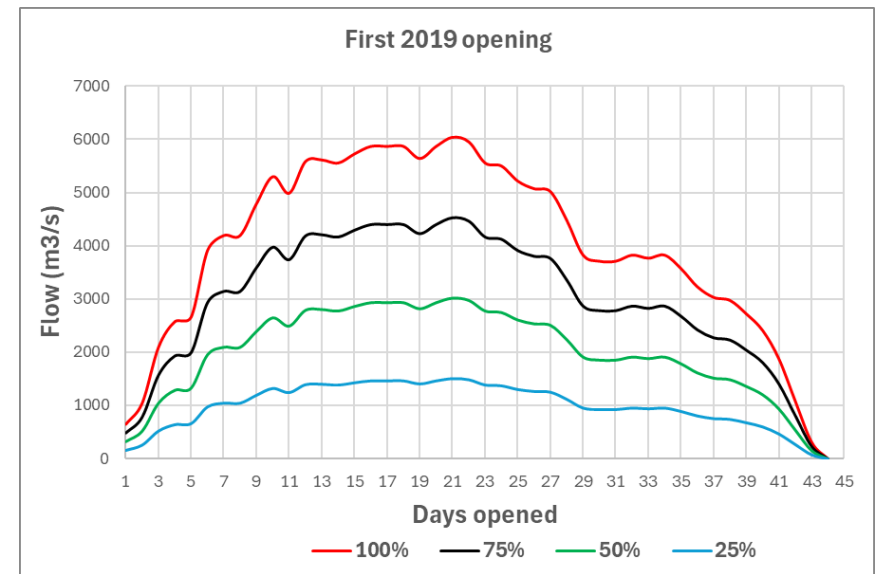
Conceptual model

- The area encompassed between Bonnet Carré Spillway (BCS) at Lake Pontchartrain and the Round Island USGS station is proposed as computational domain.
- Freshwater inputs from the Bonnet Carre Spillway, Pass Manchac (Maurepas), Tchefuncte, Pearl, Jourdan, and Wolf Rivers, will be set up as freshwater boundary conditions.
- Three open ocean boundaries between the Grand Pass USGS Station and Round Island USGS Station would capture salinity and tidal effects throughout the MS Sound and Lake Pontchartrain. This conceptual model was used to develop the water quality model shown below (software used: EFDC, EEMS Plus 11.8).



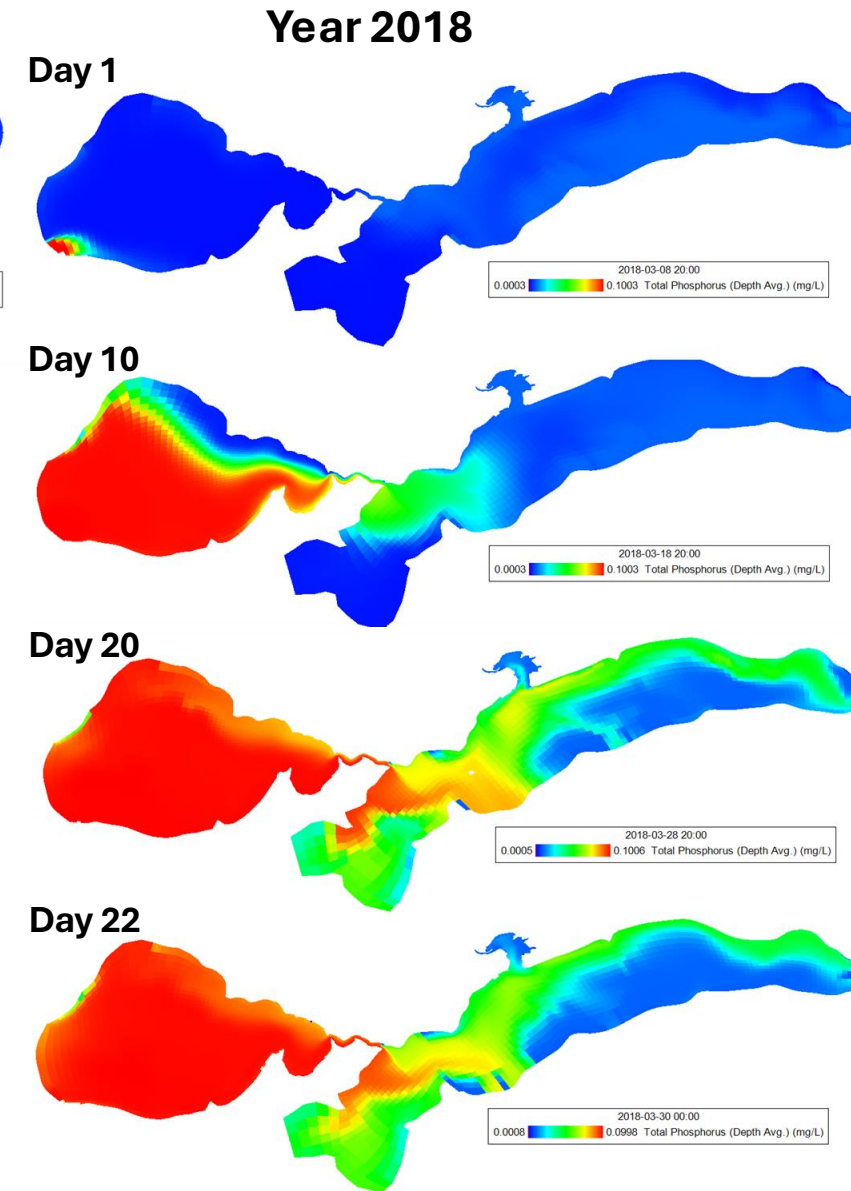
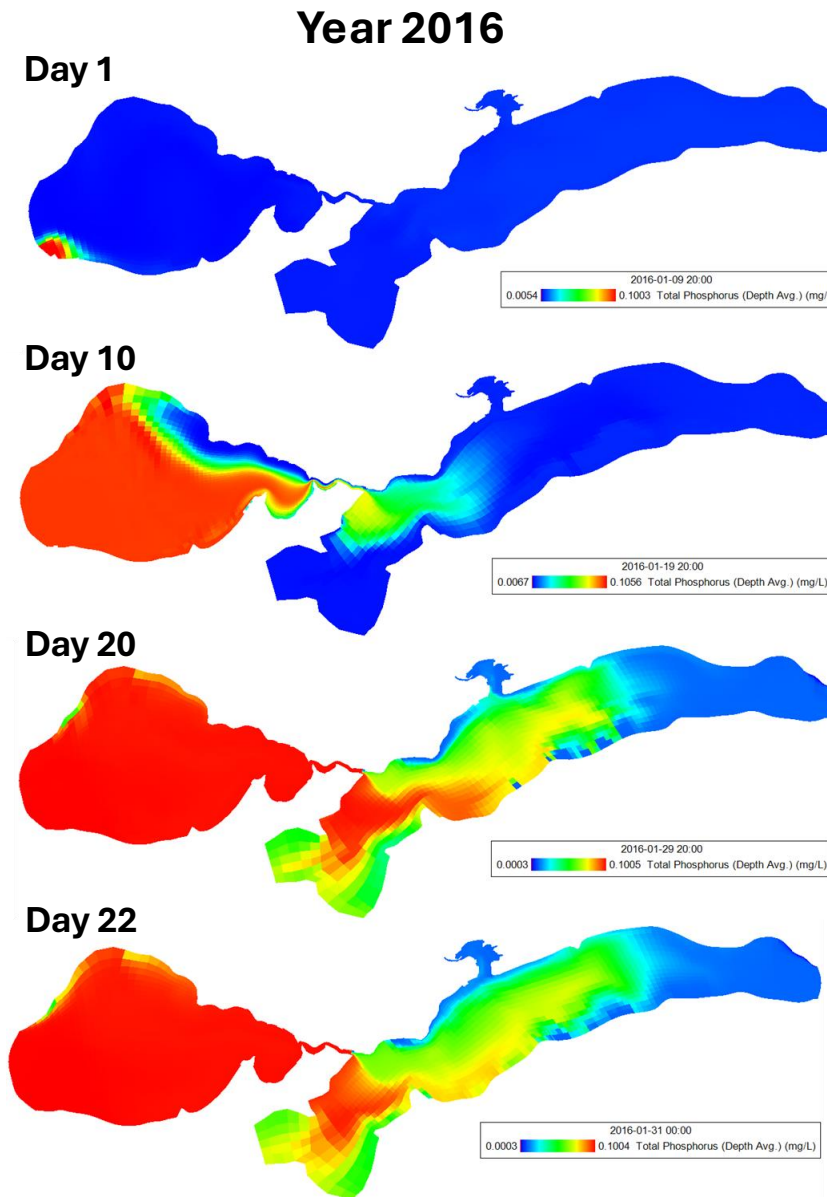
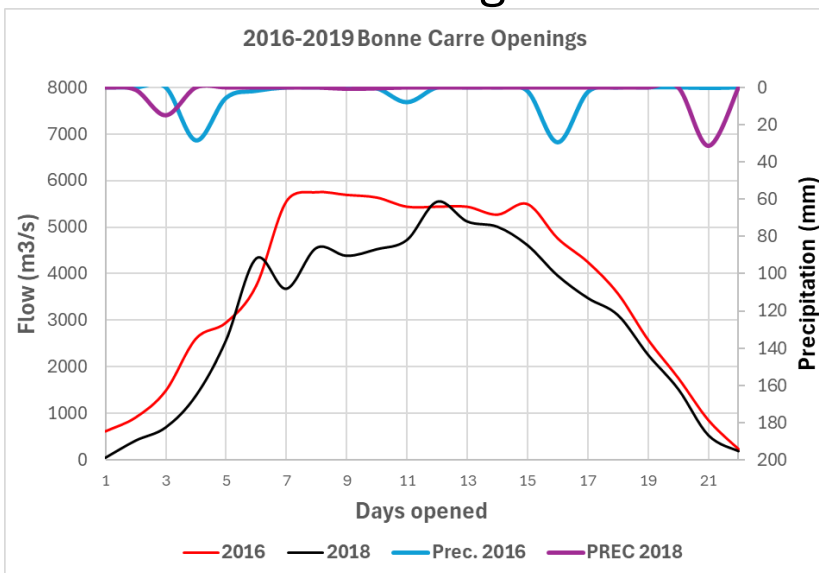
Preliminary test of the model

- Four Bonnet Carré Spillway openings effects on salinity were simulated, based on the first 2019 opening (43-days).
 - 100%: actual flow time-series.
 - 75%: $0.75 \times$ actual flow. 50%: $0.5 \times$ actual flow. 25%: $0.5 \times$ actual flow
- Lake Pontchartrain simulated flushing time ranged between 24 days (100) and 33 days for 75%. After 43 days of BCSO, Lake Pontchartrain does not flush completely for 50% and 25%.



Preliminary test of the model

- Total Phosphorus transport during January 2016 and March 2018 Bonnet Carre openings.
- Although both 22-day openings were similar in magnitude and duration, the TP plume seem to reach farther East during 2018.
- This may be due to March 2018 being a dryer month than January 2016. Therefore, TP concentrations high.



Next steps

- Calibration/validation using historical data and additional data that we are collecting during 2025.
- Evaluate necessity:
 - Hydrological modeling of coastal watersheds.
 - Extend the computational grid for main rivers towards inland locations where tidal effects disappear.
 - Additional statistical analysis: PCA, etc.



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