



PORTFOLIO -SCALE VESSEL ANALYSES: UNDERKEEL CLEARANCE IN NAVIGATION CHANNELS *COASTAL NAVIGATION PORTFOLIO MANAGEMENT*

David L. Young, PhD, PE

Brandan M. Scully, PE, PhD

Sean P. McGill

James Ross, PhD

District/Division PDT Members

Dylan Davis (SAD)

Heather Schlosser (SPD)

Doug Stamper (NAD)

COASTAL INLETS RESEARCH PROGRAM

FY21 IN PROGRESS REVIEW

**Tiffany
Burroughs**

HQ Navigation
Business Line
Manager

Eddie Wiggins

Technical Director, Navigation

Morgan Johnston

Acting Associate Technical Director,
Navigation



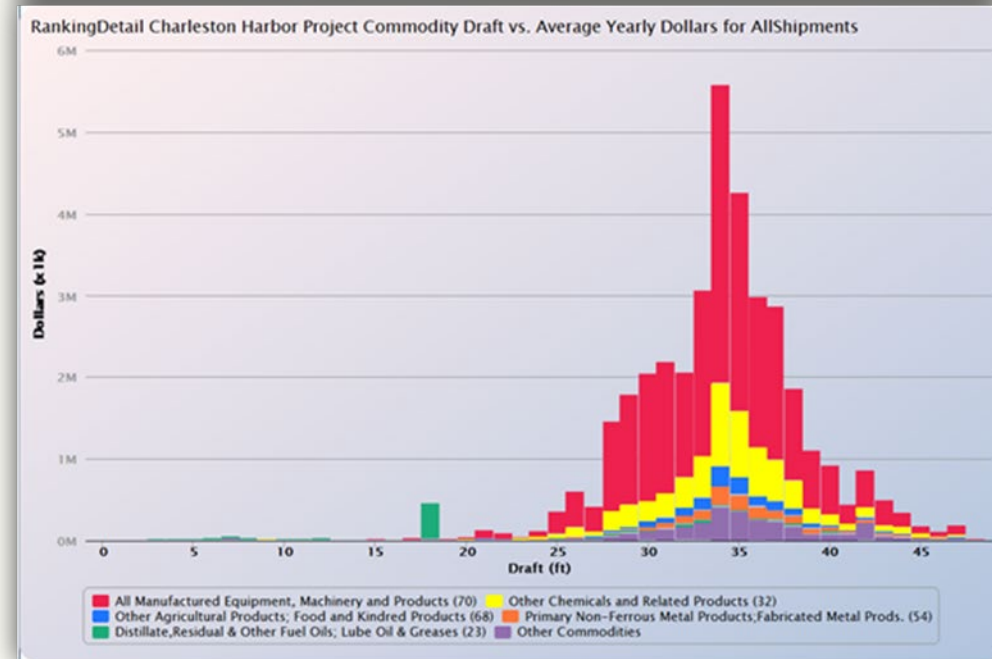
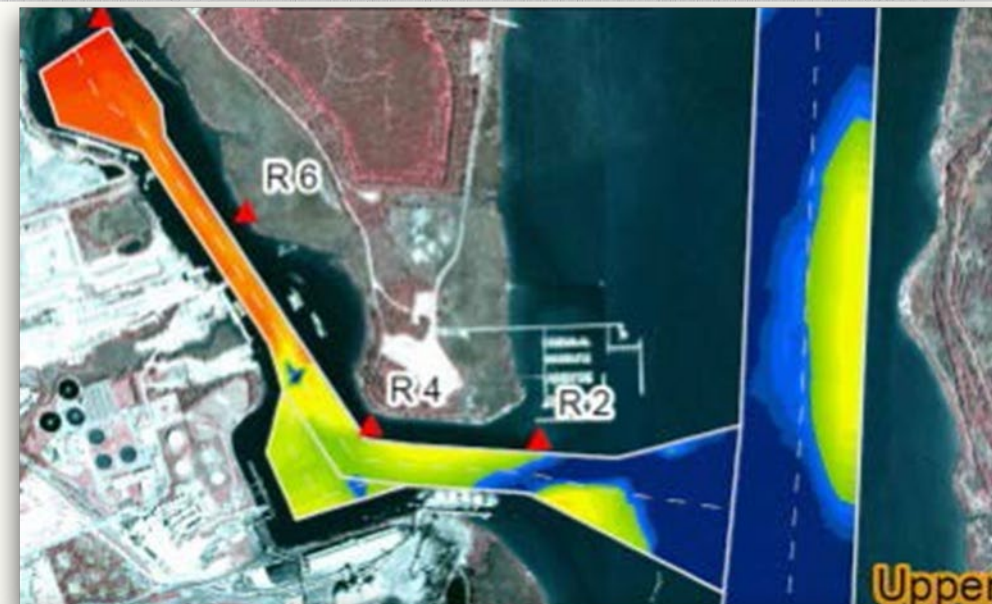
US Army Corps
of Engineers®



ERDC
Engineer Research and Development Center

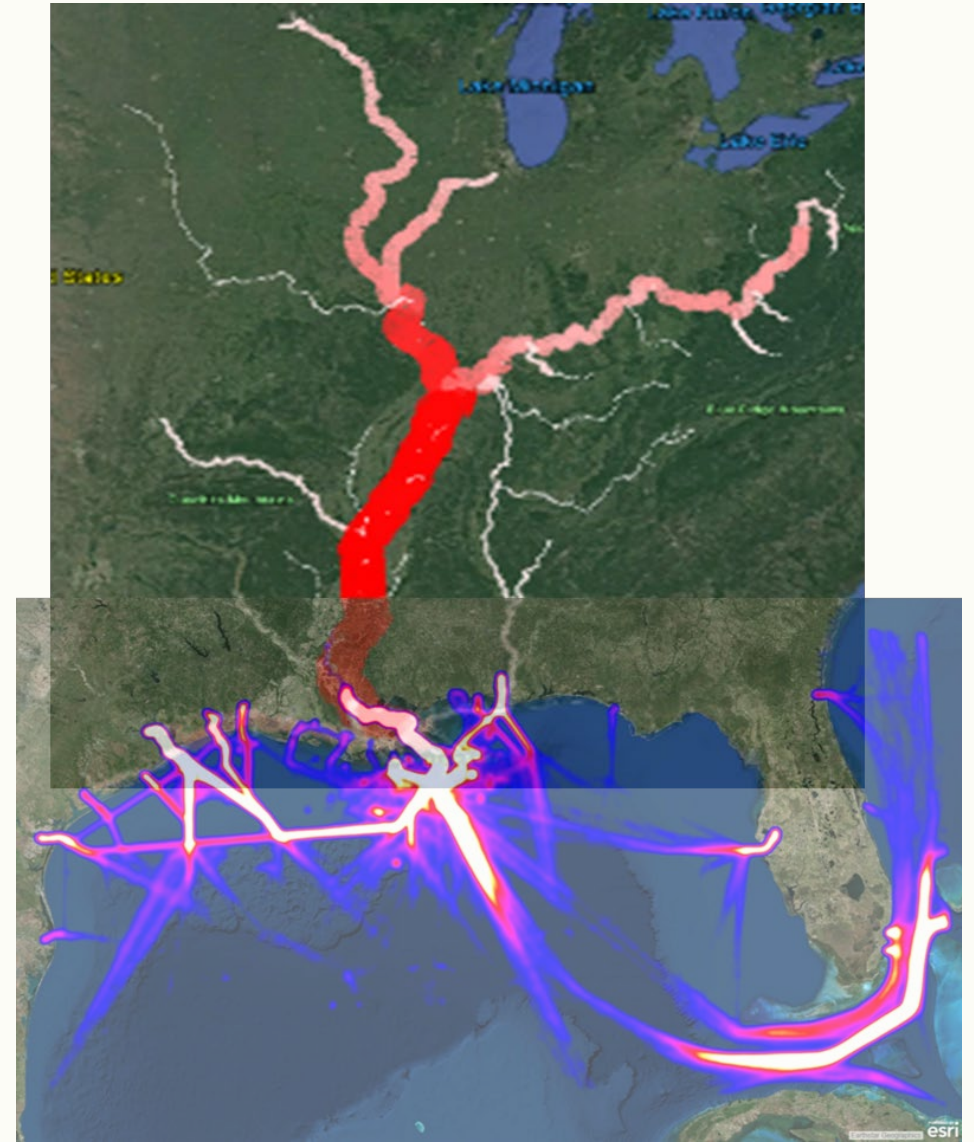
Why this Matters?

- USACE spends approximately \$1B annually on dredging.
- USACE routinely reports low channel availability due to constrained maintenance funding.
- Increasing vessel size trends increases C, O&M dredging.
- Inadequate channel depth impacts the safety and efficiency of waterborne goods movement.
- Dredge reassignment has costly network implications in NAV and FRM BLs (WRDA 2020).

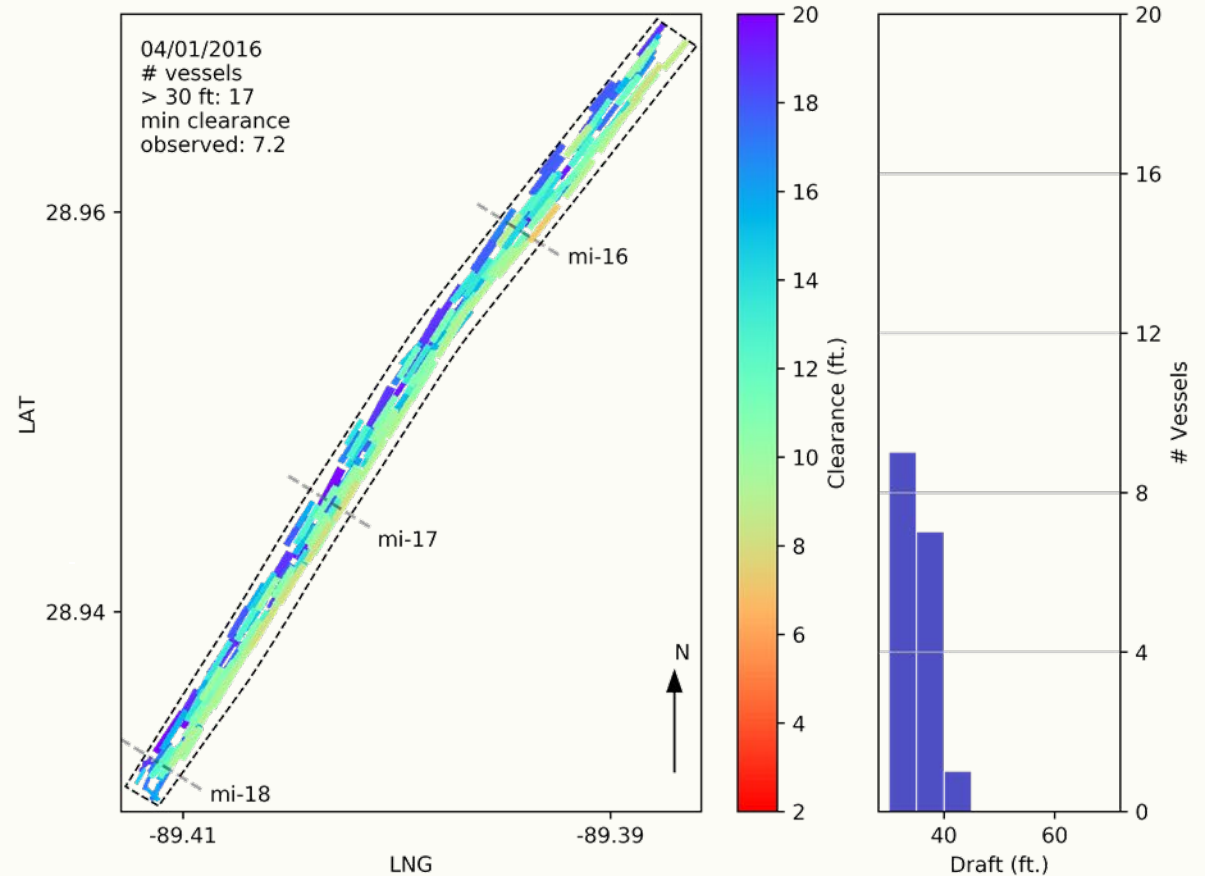
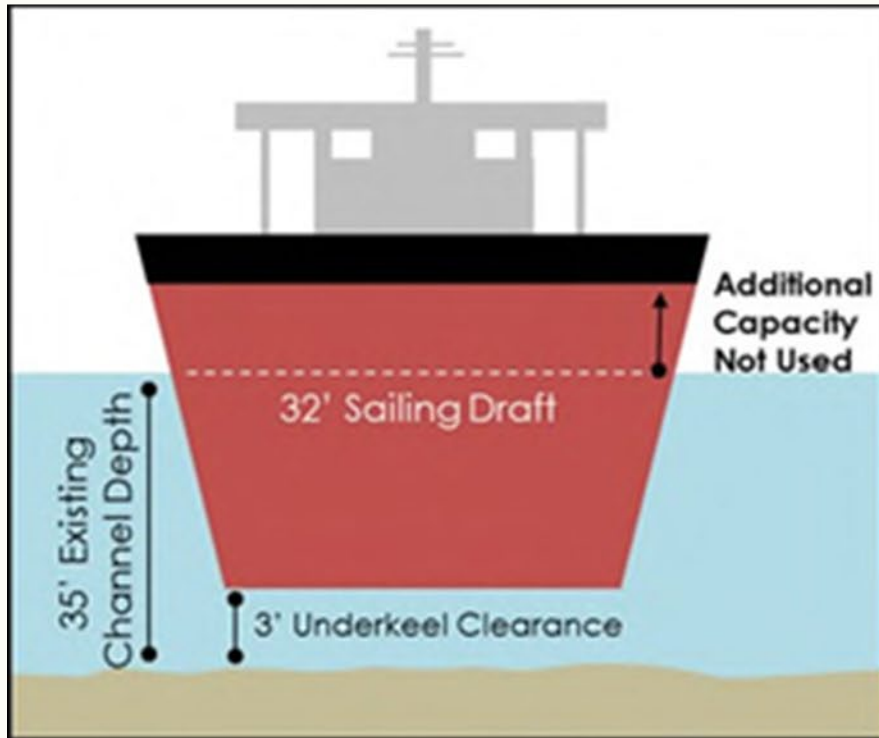


Problem Statement

- Prioritizing maintenance dredging funds in ad hoc framework with Cargo tonnage and value.
- Gains in vessel navigability from dredge activity are not measured.
- Existing performance metrics for coastal navigation channels allocate appx. \$1B annually for dredging but indirectly describe channel performance.
- SoN's:
 - Strategic R&D work that advances Machine Learning / Artificial Intelligence capabilities related to connecting, integrating and analyzing data and model output to produce navigation decision support information.
 - 2019-N-1332 – Waterway transit times from AIS Data
 - 2017-N-52 Further Development of CPT and AIS software



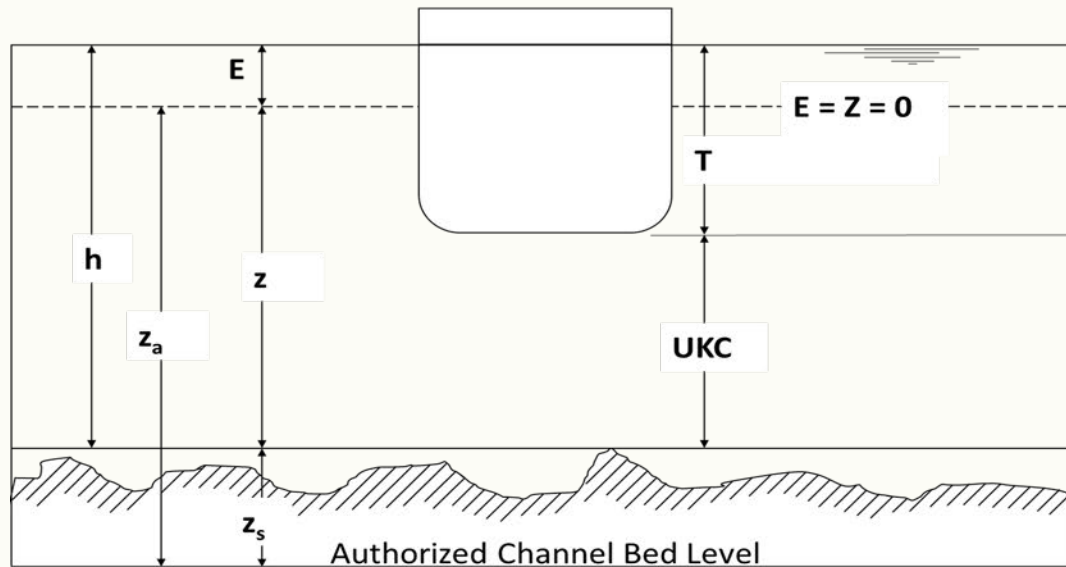
Capability and Strategic Impact Statement



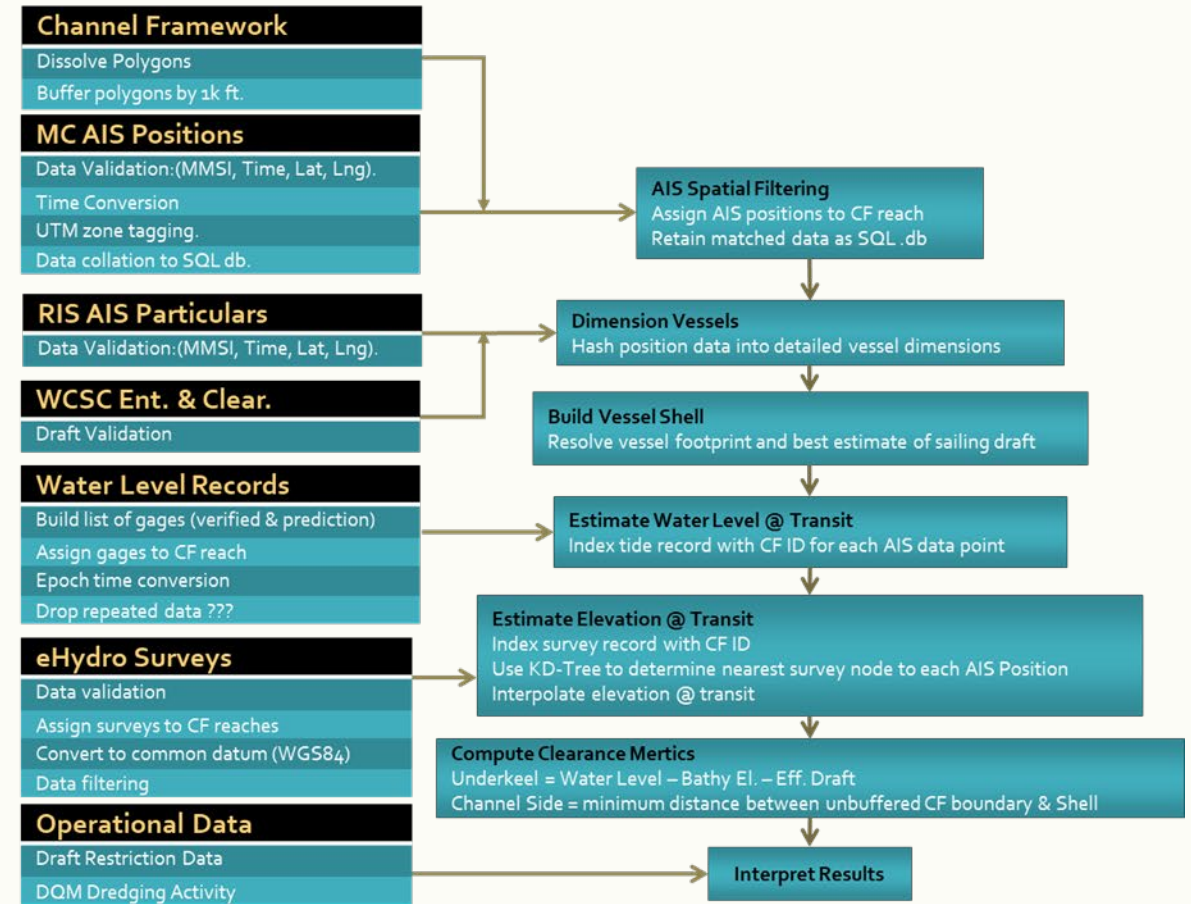
Vessel clearance and footprint over shoals can be estimated for nearly all transits made by commercial vessels in USACE managed waterways and will vastly improve how we describe channel performance.

Fusing Relevant Data

- AIS data from Marine Cadastre.
- Survey data from eHydro.
- Water level data from NOAA/USGS.
- Vessel draft info from Foreign Vessel Entrances & Clearances.

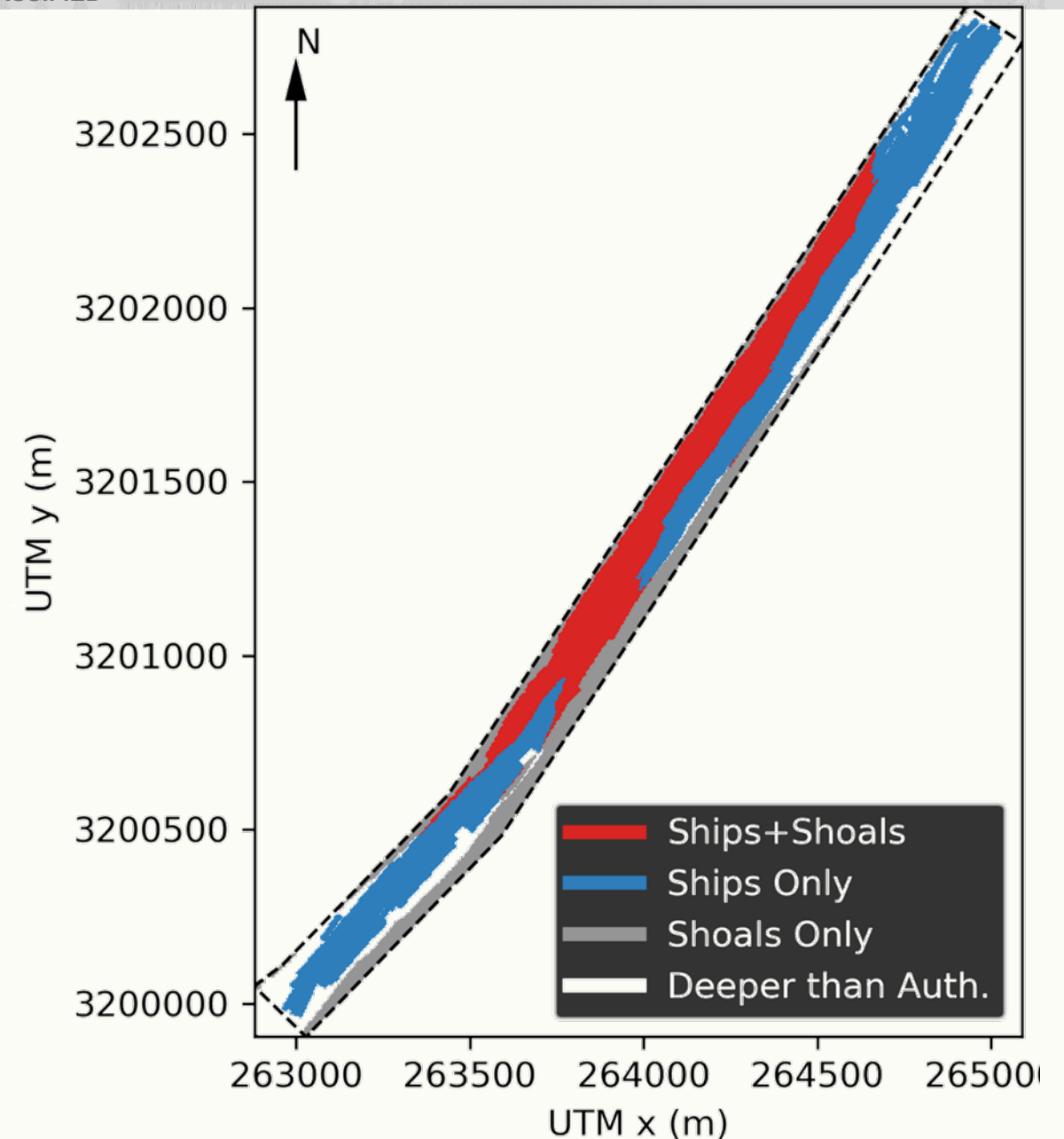
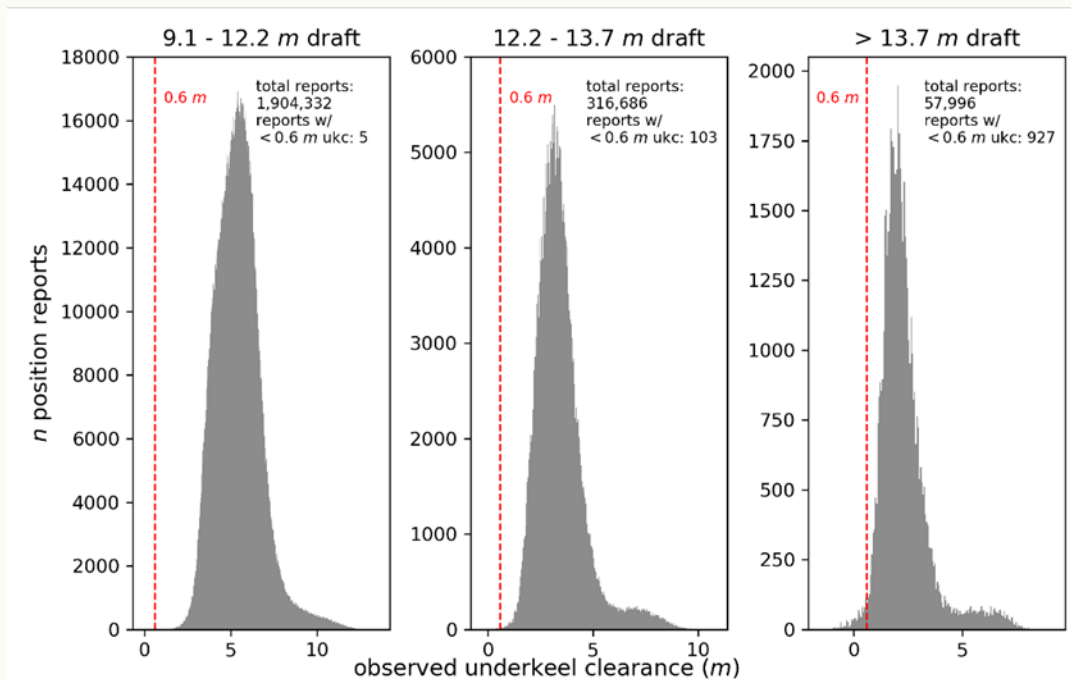


HPC Data Modeling Approach

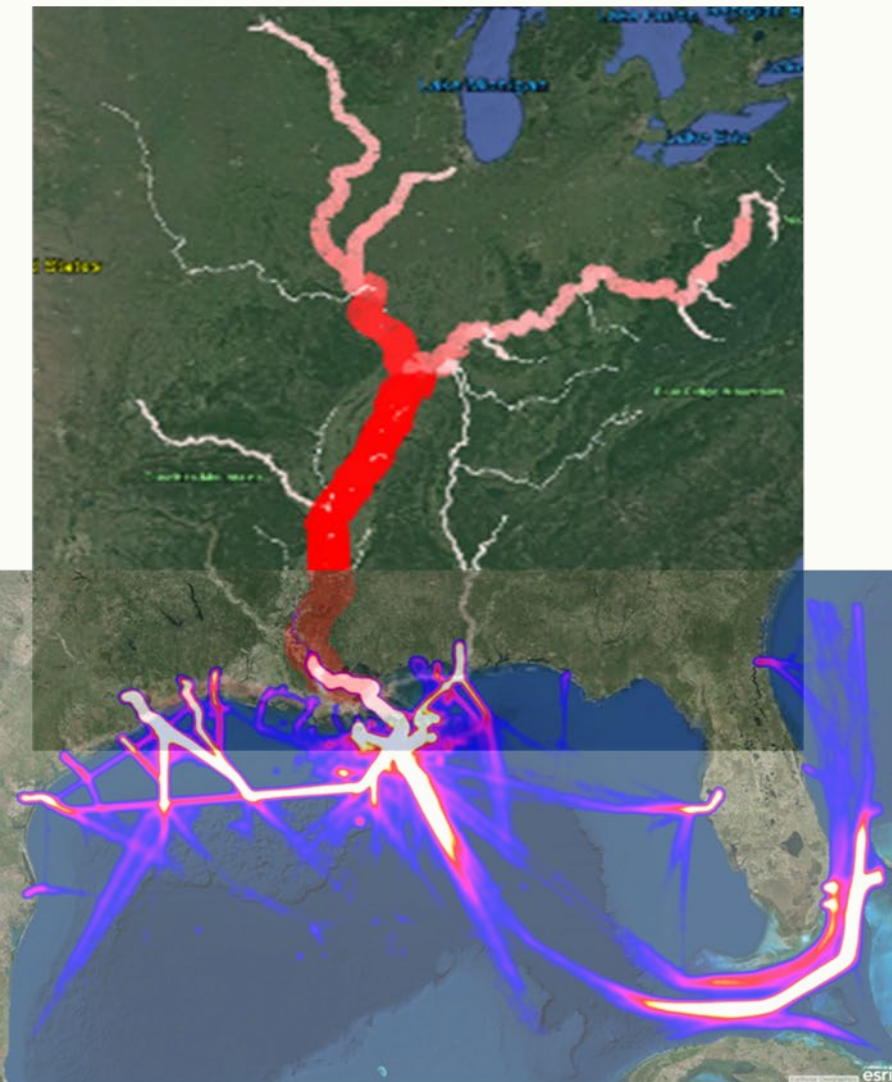


Compute Direct Metrics

- How much are vessels using the service USACE provides them – available draft.
 - Vessel footprint over shoals.
 - Underkeel clearance for vessels.
 - Horizontal clearance for vessels.



Southwest Pass

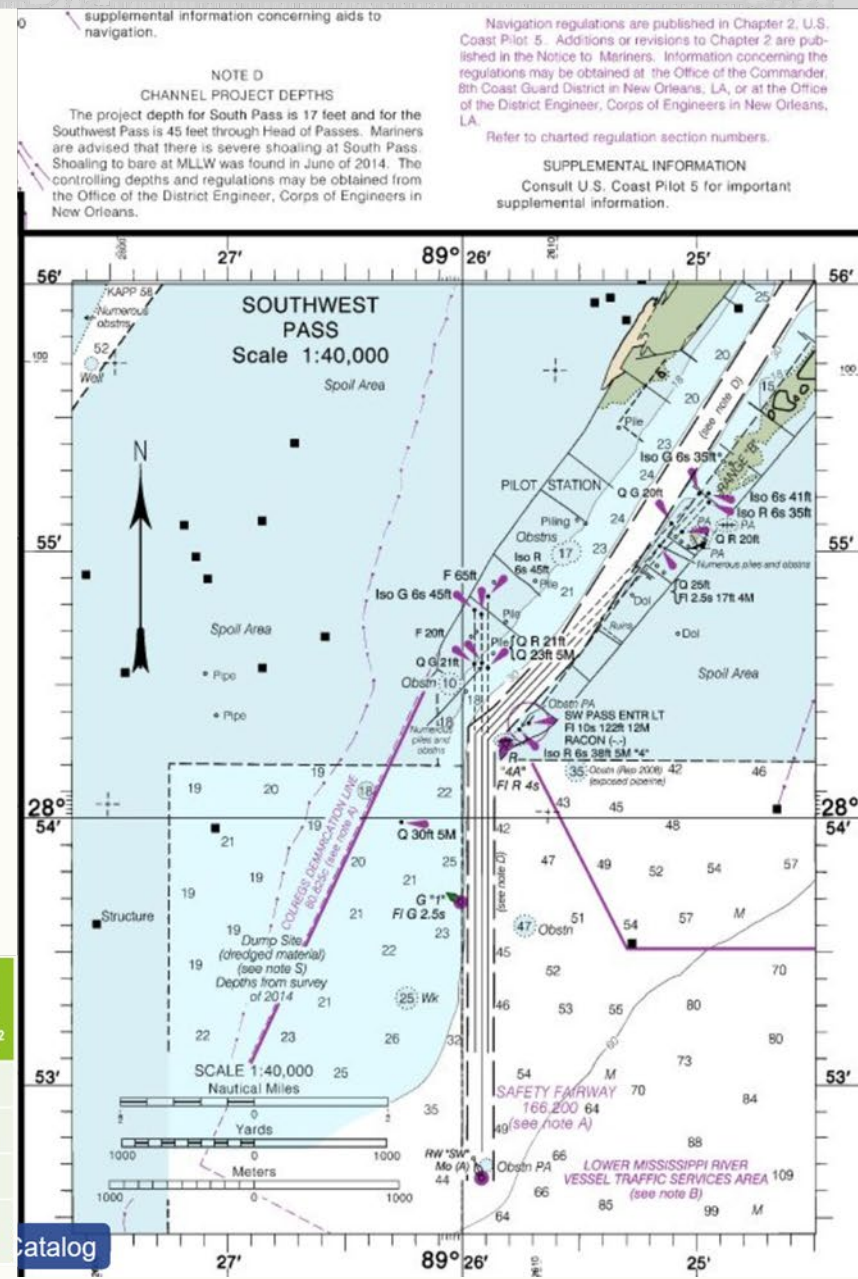


“Controlling depths and regulations may be obtained from the Office of the District Engineer, Corps of Engineers in New Orleans.”

Shoaling conditions are so dynamic that NOAA can't keep soundings up to date on Chart 11361.

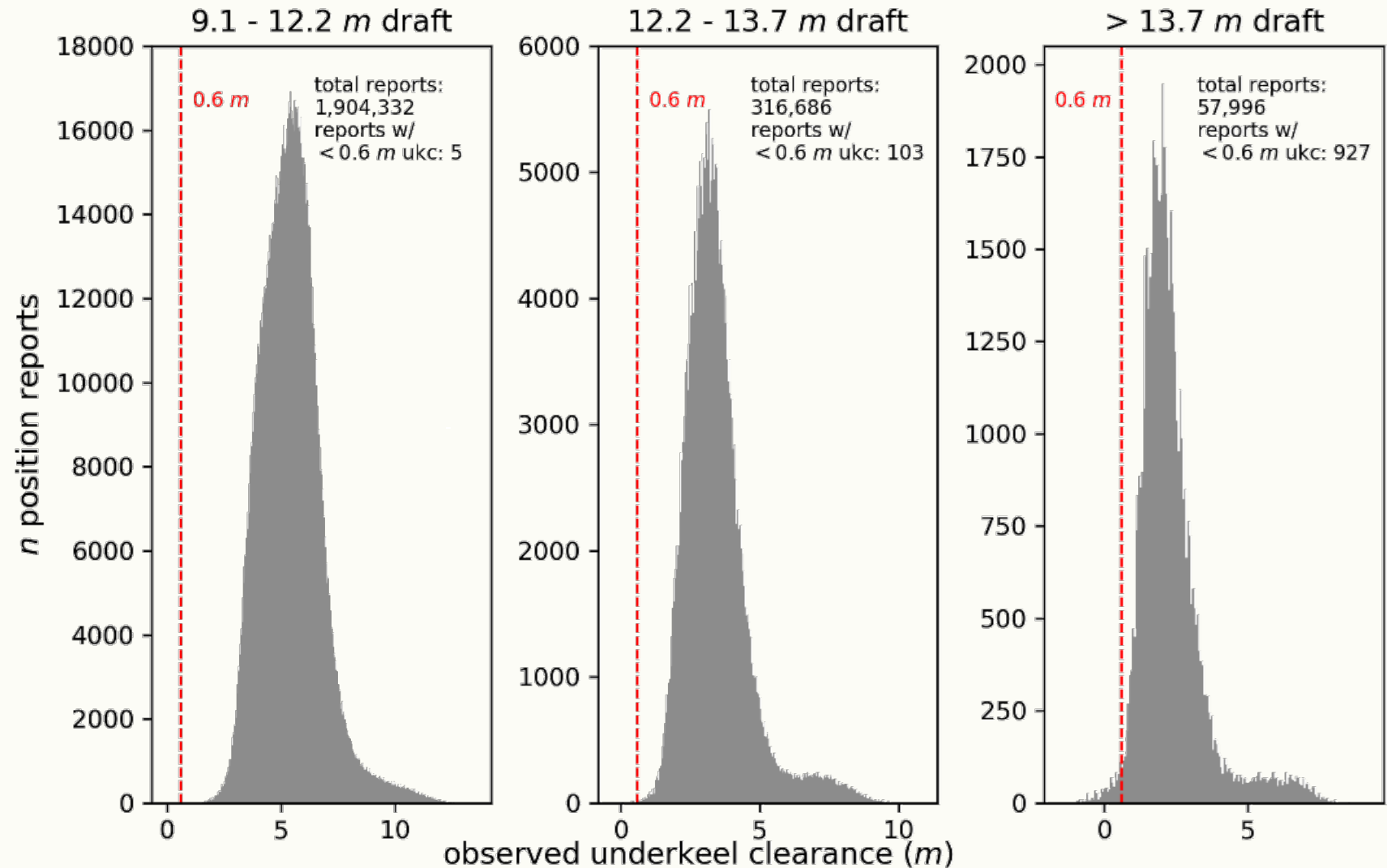
Fiscal Year	Dollars (\$M) ¹	Dredged Volume (million m ³) ¹	Cargo Throughput (Megatonnes) ²
2015	66	14	216
2016	65	16	221
2017	62	17	236

1. Obtained from agency internal communication.
 2. USACE B 2018

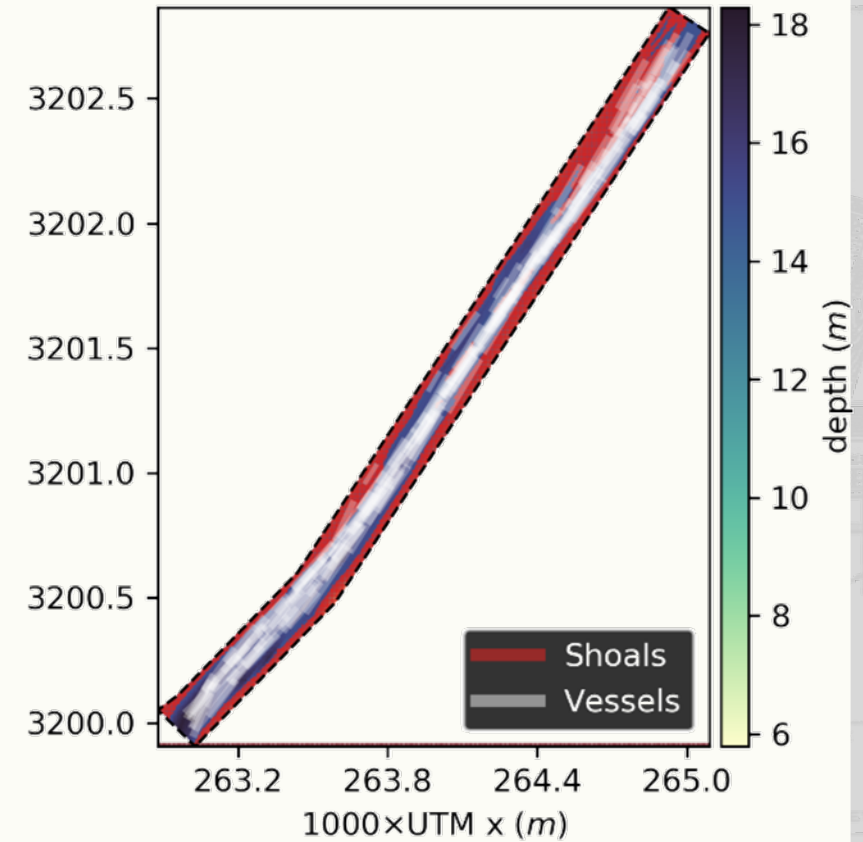
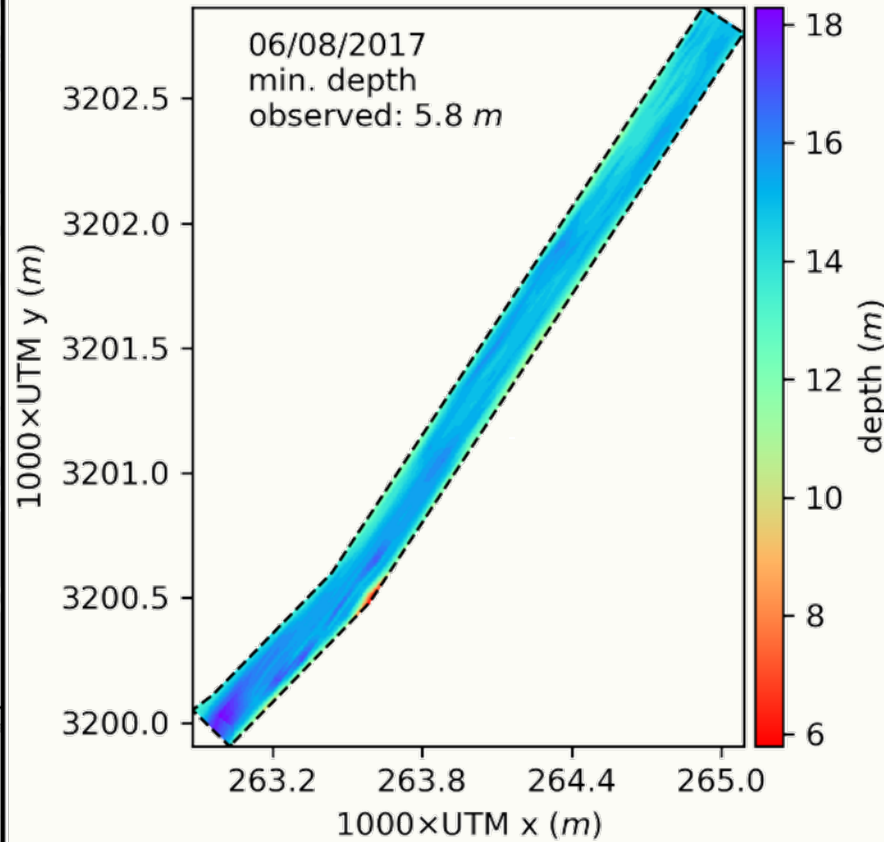
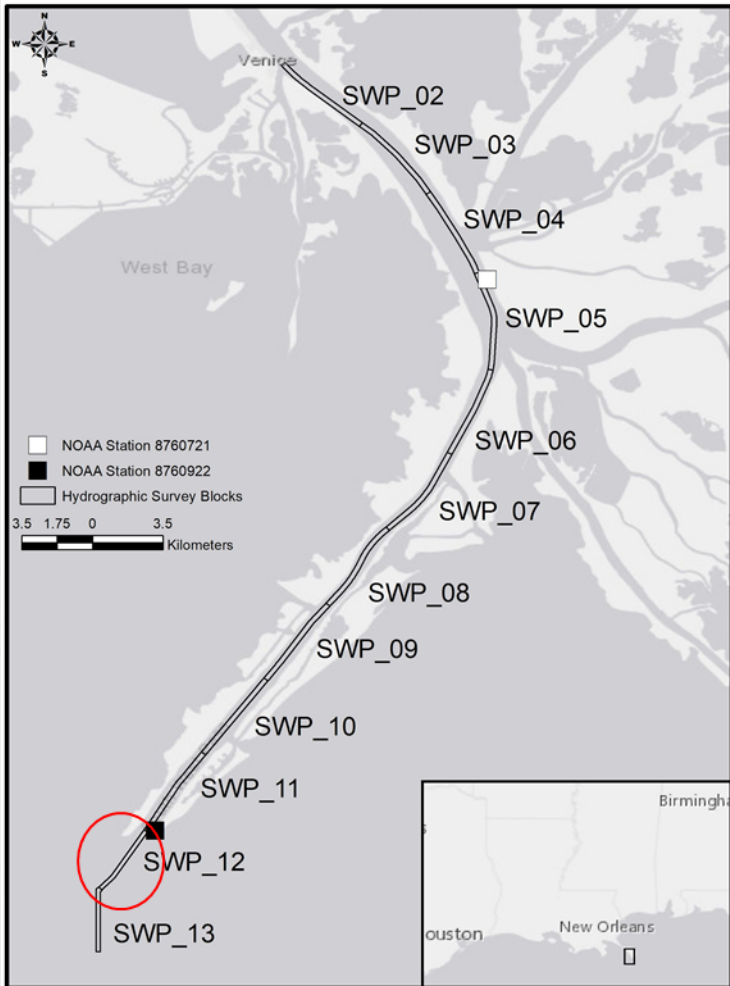


Results: 2015-2017 (1)

- 586 million available depth calculations.
- 588 million accumulated sediment calculations.
- 2.5 million unique vessel position reports observed.
- 2.5 million UKC calculations.
- 96% of vessels had known dimensions.
- 89% of vessels matched in the Foreign Vessel Entrances and Clearances.
- 0.045% of position reports calculated to have less than 0.6 m (2 ft) UKC.



Results: 2015 – 2017 (2)



Left: The shoalest depth of SWP_12 was 5.8 m (19 ft). Right: Vessel positions and shoal locations during peak shoaling do not overlap substantially.

Southwest Pass below Venice, Louisiana.

Results: 2015-2017 (3)

A traffic-informed way to think about dredging.

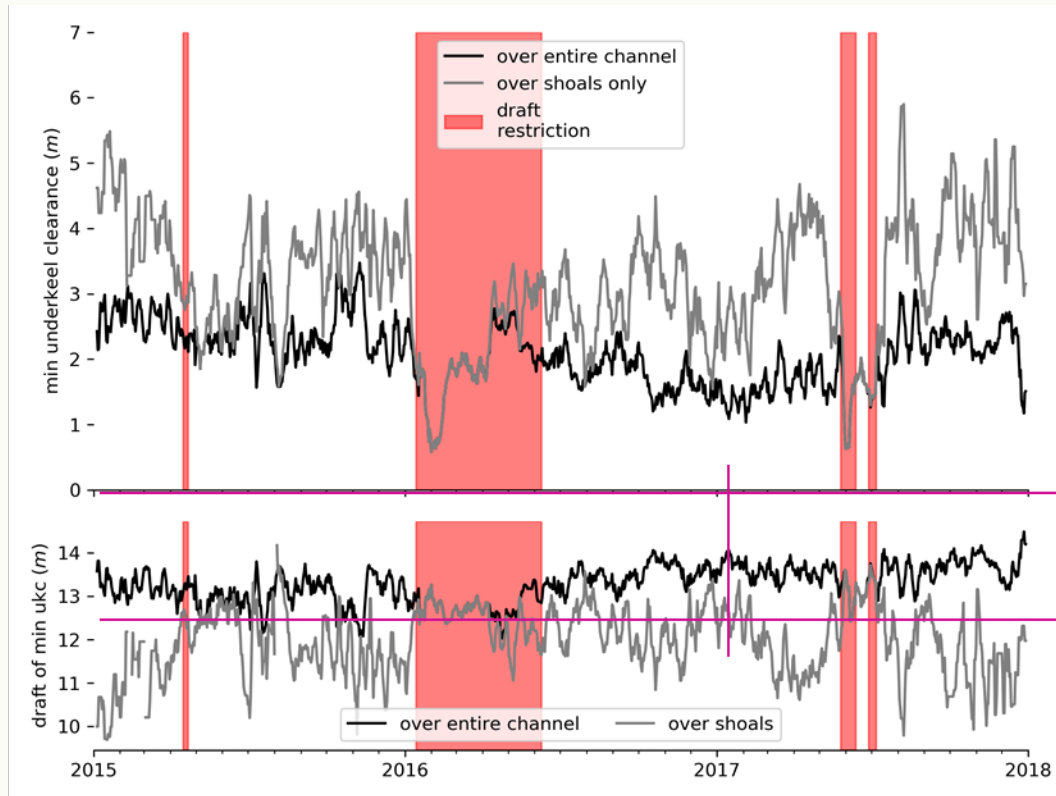
Fiscal Year	Dollars (\$M) ¹	Dredged Volume (10 ⁶ m ³) ¹	\$/m ³	Cargo Throughput (Megatonnes) ²	\$/tonne	Encountered Shoaling (10 ³ ha-days)	\$/ha-day
2015	66	14	-	216	-	-	-
2016	65	16	\$4.74	221	\$0.29	14.2	\$4,600
2017	62	17	\$4.06	236	\$0.26	7.4	\$8,900

1. Obtained from agency internal communication.
2. USACE 2018

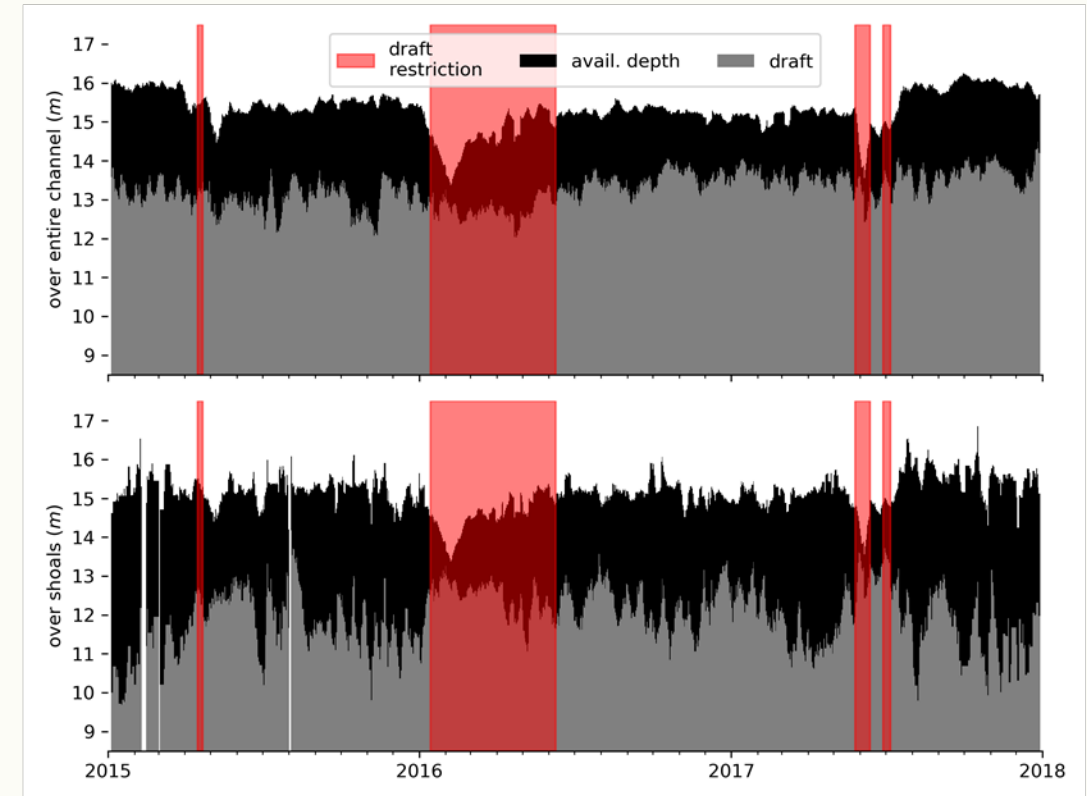
Hectare-day – Number of days where shoaling was observed in the swept path of vessels x the shoaled area (in hectares) within the swept path of vessels

Results: 2015-2017 (4)

There is more variability in the draft of vessels than in the available depth resulting either from water level variation or bathymetric elevation.



Above, 7-day rolling average of minimum UKC in SWP_12. Below, 7-day rolling average of vessel draft incurring minimum UKC.



Available channel depth in terms minimum observed UKC and draft of vessel incurring minimum UKC over the entire channel (above) and over shoals (below).

Summary

FY21 Major Advances in Capability

- Built capability to compute UKC.
 - ▶ Demonstrated in Southwest Pass.
- Data for comparison between top-10 ports in progress.

FY21 Major Products & Collaborations

- District/Division Webinar (4/14/2021)
- CIRP TD (12/08/2020)
- Southwest Pass Journal Article (4/9/2021).

Planned Outyear Products/Advances

- JP: Treatment of UKC for top 10 ports by tonnage.
- Expand UKC to all channels in USACE portfolio.
- Add in x,y clearance measurements.
- Additional automation.
- Prepare for transition to cloud – migrate to gitlab.

