ERDC Automated Navigation Tools

ERDC
Engineer Research and Development Center

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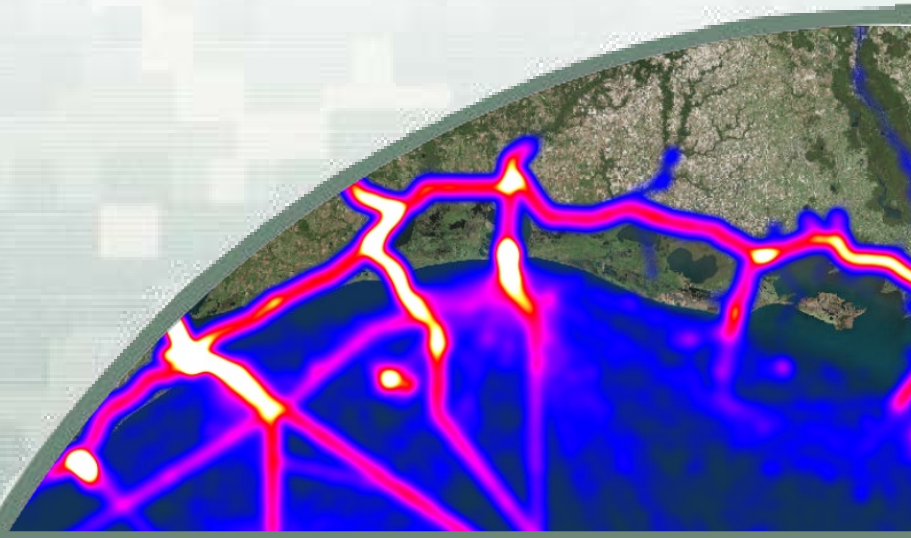
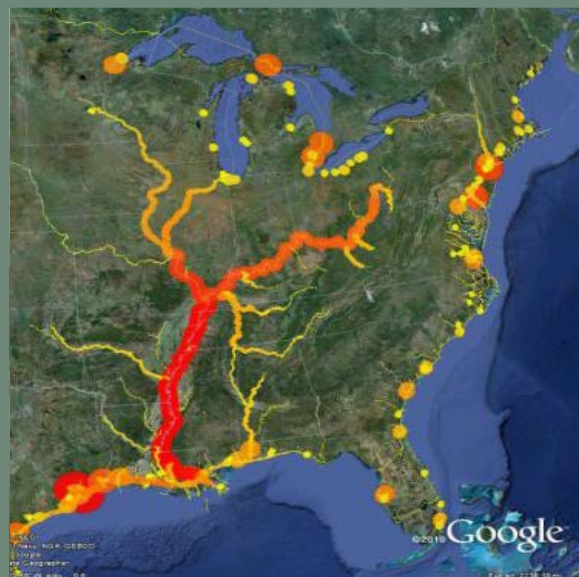


WEDA Gulf Coast Chapter
Annual Conference
Galveston, Tex.
16 NOV 2016



US Army Corps of Engineers®

Background

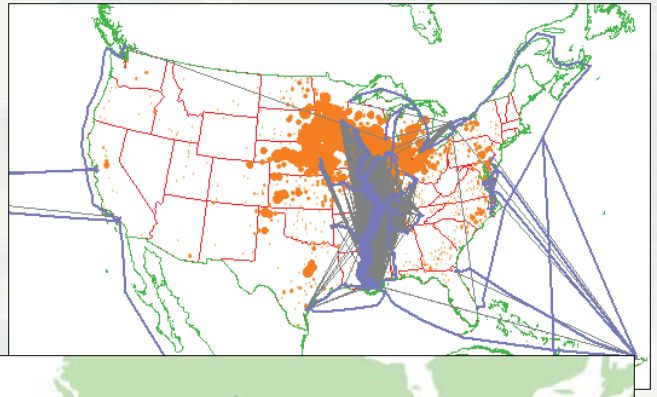
- Corps is resource-constrained but must maintain an aging water resources infrastructure portfolio that is critical to national well-being.
- Navigation projects at coastal ports and along inland waterways facilitate marine transportation and help support complex, dynamic, global freight supply chains.
- Challenge going forward is how to optimally support these existing and emerging freight corridors using available resources.

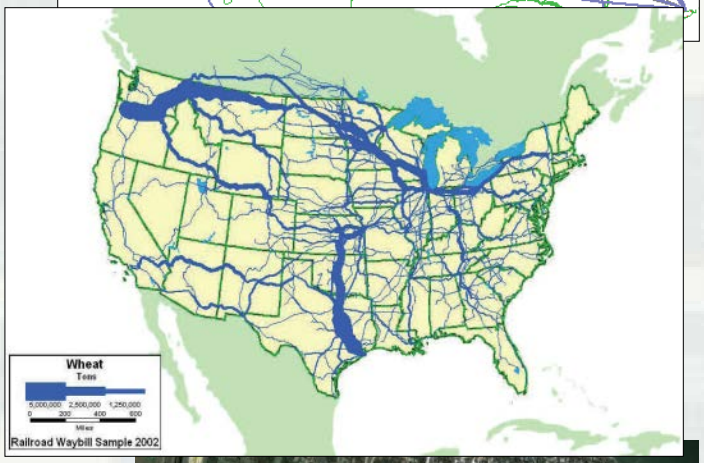
Intermodal Freight Systems

- Waterborne freight corridors cannot be separated from landside (road, rail, pipeline) systems.

- Recent federal transportation bills increasingly focus on intermodal systems and the need to evaluate supply chains across modes.

- Corps Senior Leadership has been stressing systems-based approaches to mission execution.





Navigation Performance Monitoring Tools

- Channel Portfolio Tool (CPT) – https://cpt.usace.army.mil
  - provides Corps personnel with improved access to and understanding of the data provided by the Waterborne Commerce Statistics Center (WCSC)
  - web-based decision-support tool which helps convey the importance of Corps dredging activity to the efficient movement of maritime commerce
  - provides consistent, objective prioritization of Corps Operations and Maintenance (O&M) dredging activities for allocation of Harbor Maintenance Trust Fund (HMTF) outlays

- Automatic Identification System Analysis Portal (AISAP) – http://ais-portal.usace.army.mil
  - web-based tool for acquiring, analyzing, and visualizing real-time and archival data from the U.S. Coast Guard's National Automatic Identification System (NAIS).
  - Unprecedented access to quantitative, statistically robust measures of navigation project performance through time

Waterborne Commerce Data

- The Corps' Waterborne Commerce Statistics Center (WCSC) collects and collates data from several sources concerning commercial use of US waterways.
  - Dock-level, origin-to-destination routing (Corps-use-only)
  - Includes tons, commodity types, vessel counts, drafts
  - Aggregated data already published at project level

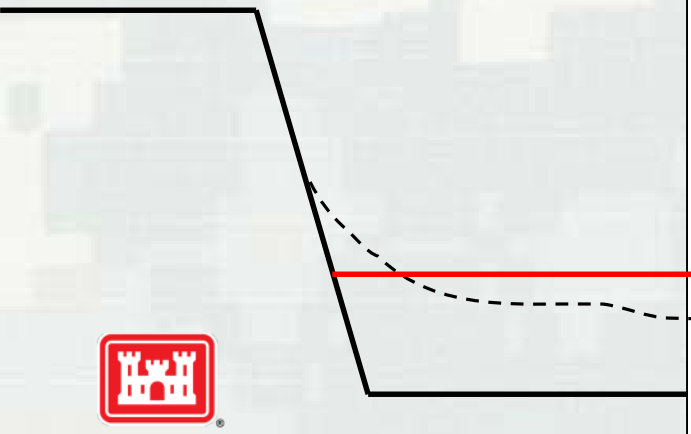
  http://www.navigationdatacenter.us/wcsc/wcsc.htm

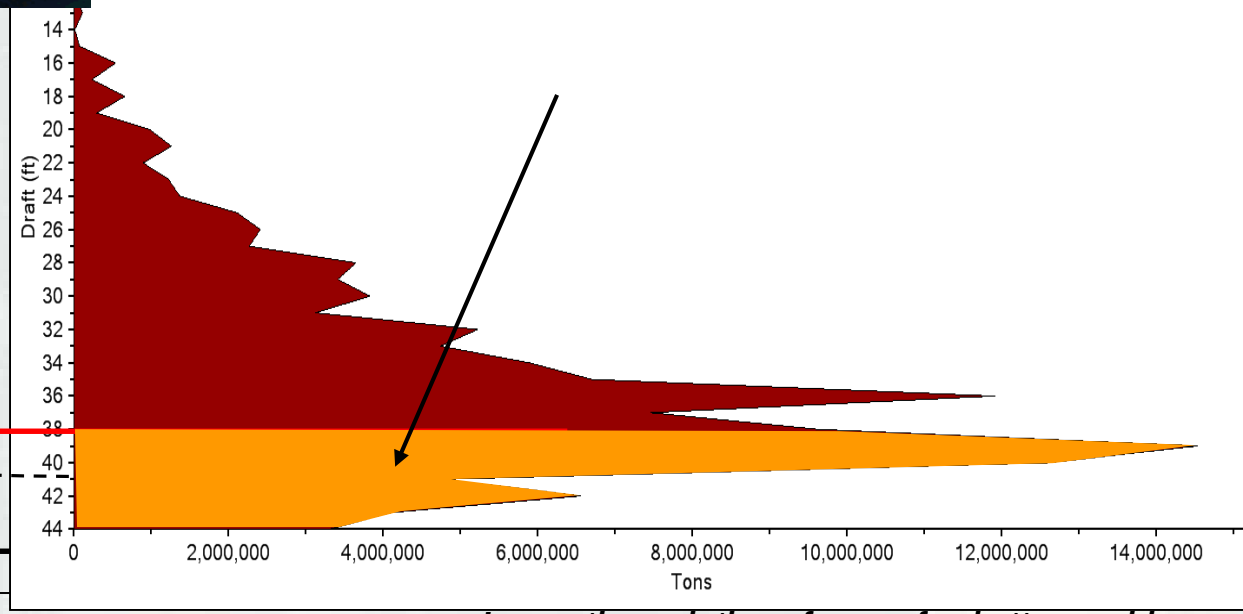
  - Corps Planning community has used WCSC data to support harbor deepening projects and inland studies
- Corps dredging operations community has not consistently used this data beyond project-level tonnage and ton-mile metrics for O&M budget development.

Depth Utilization Analysis

CPT can generate depth-utilization profiles showing the distribution of cargo across the range of maintained depths for any system of navigation channels.

CPT then compares these tonnage-draft profiles to the segment controlling depths resulting from present shoaling conditions.





CPT for Commodity Flows

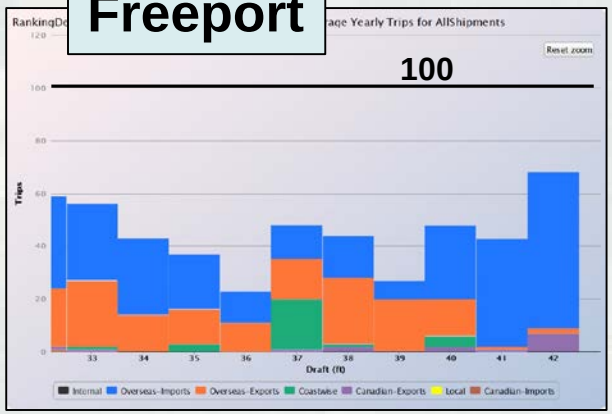
CPT to make system-wide comparisons

Annualized totals disrupted by a 39-ft draft restriction at each respective Project

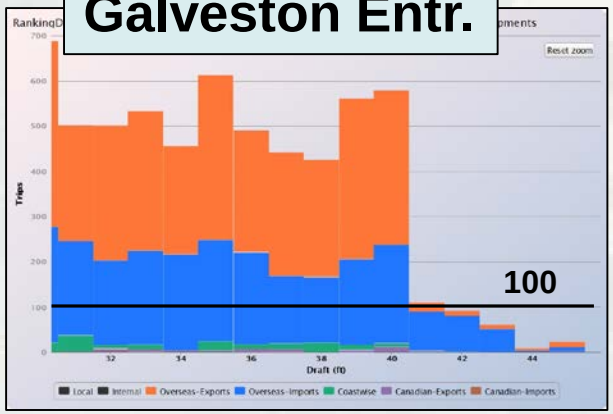
Rank	District	Project	Tons (x1k)	Dollars (x1k)	Trips
1	New Orleans	Lower Mississippi River - MVN	102,715.01	$37,770,115.12	2,003.80
2	Galveston	Galveston Harbor and Channel	51,008.34	$31,744,609.26	836.4
3	Galveston	Houston Ship Channel	50,283.61	$31,042,794.79	821.6
4	Los Angeles	Los Angeles - Long Beach Harbors	41,020.40	$99,106,874.85	1,078.40
5	Norfolk	Norfolk Harbor	39,864.57	$27,173,609.37	782.8
6	Galveston	Sabine-Neches Waterway	27,134.49	$15,631,298.02	452.6
7	Philadelphia	Delaware River, Philadelphia to the Sea	27,069.61	$15,937,894.64	252
8	New York	New York Harbor	23,073.10	$57,568,337.66	1,214.60
9	Norfolk	Newport News	20,740.15	$15,773,655.63	253.6
10	New York	New York and New Jersey Channels	19,749.45	$48,827,188.72	1,066.20
11	Portland	Columbia and Lower Willamette Rivers	18,272.98	$7,095,768.11	357.8
12	Mobile	Mobile	17,257.70	$4,075,296.99	269
13	Baltimore	Baltimore Harbor	15,715.22	$5,360,768.96	314
14	Galveston	Corpus Christi Ship Channel	14,914.57	$7,471,341.79	234
15	Alaska	Valdez Harbor	14,909.97	$8,931,916.62	148.2
16	San Francisco	San Francisco Bay	13,844.59	$9,841,160.08	455.2
17	New York	Newark Bay	11,563.33	$41,807,625.57	889.2
18	Galveston	Texas City Channel	11,431.26	$6,711,782.84	171.4
19	Galveston	Freeport Harbor	10,116.05	$5,536,363.85	133.2
20	New Orleans	Calcasieu River and Pass	9,764.08	$5,074,180.45	142.4

Focus on deepest drafting trips

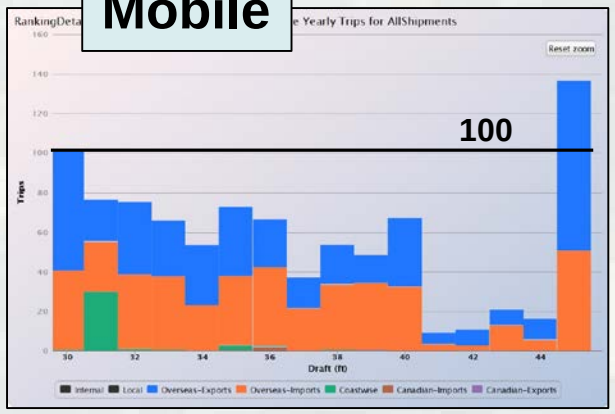
Freeport



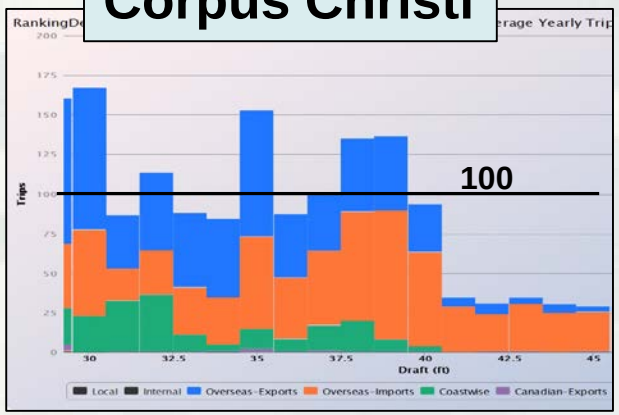
Galveston Entr.



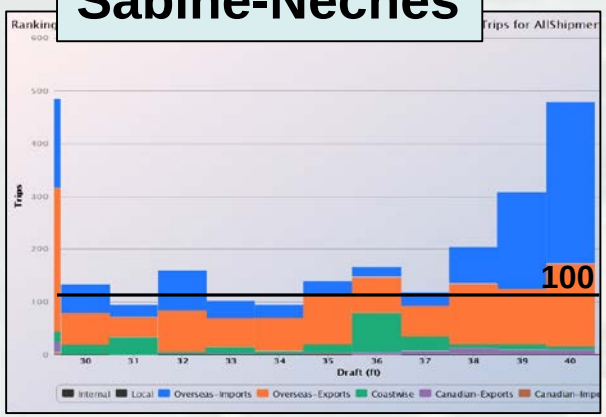
Mobile



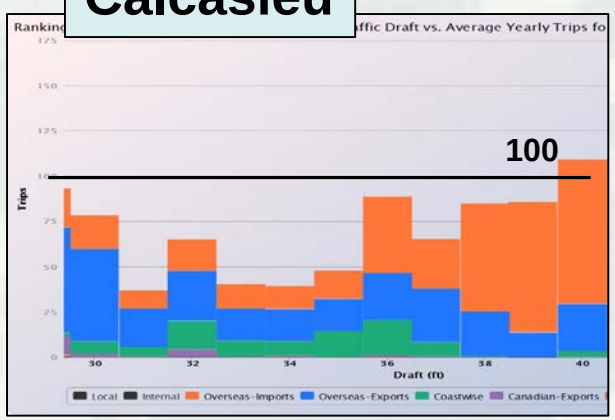
Corpus Christi



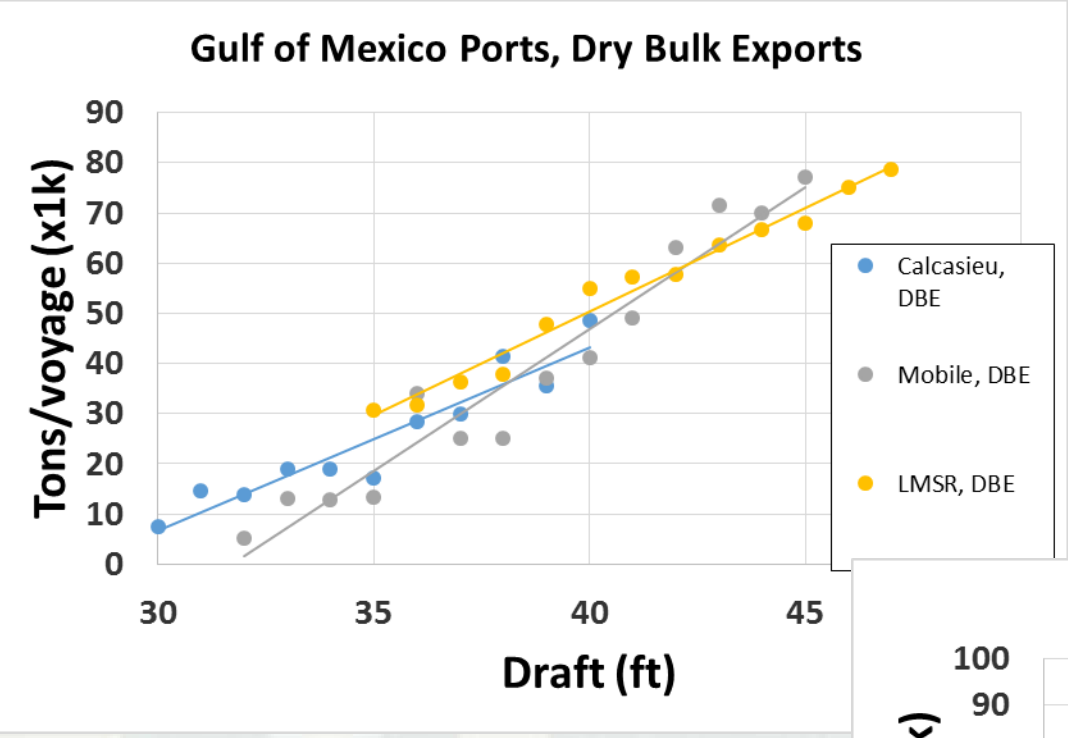
Sabine-Neches

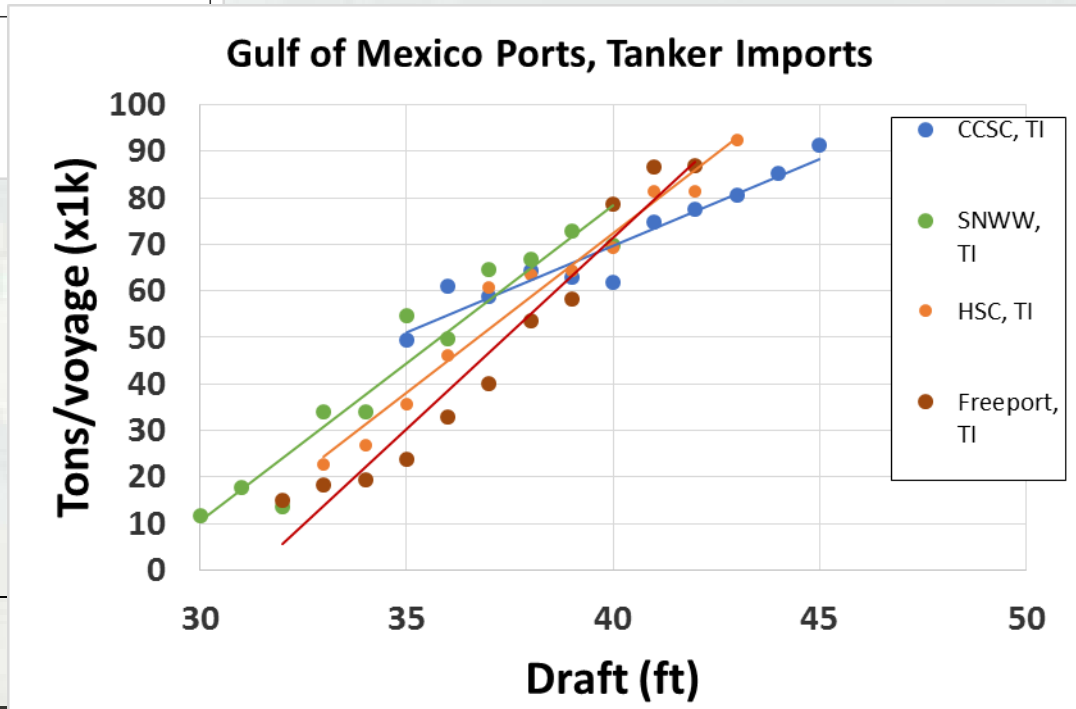


Calcasieu



Tons per vessel trends





39-ft Draft Restriction. Annualized Impacts Lower Mississippi River

Traffic-Vessel Type	Tons/ft/vessel	Tons offloaded cargo (x1M)	# required additional voyages
Tanker Imports	7,316	4.65	99
Tanker Exports	3,748	2.58	74
Dry Bulk Imports	3,623	2.07	43
Dry Bulk Exports	4,082	10.56	220
Total		19.9M	436

Estimates of Avg. Voyage Distances

- Using country of origin/destination data from 7 years (2006-2012) worth of US Customs records, estimate average distance of foreign voyages into and out of the respective ports by ship type.
- Estimate average shipping costs per voyage using assumed vessel speeds and average operating costs per hour.
- Estimates can fluctuate significantly from year to year, as well as for different draft ranges; important to keep all this in mind when conducting shoaling impact analyses.

Lower Miss. River Average Voyage Distances (nautical miles), 2006-2012

Tanker Imports: 3669	Dry Bulk Imports: 4165
Tanker Exports: 4151	Dry Bulk Export: 6936

39-ft Draft Restriction. Annualized Impacts Lower Mississippi River

Traffic-Vessel Type	Tons/ft/ vessel	Tons offloaded cargo (x1M)	# required additional voyages	Additional Shipping Costs ($M)
Tanker Imports	7,316	4.65	99	$29.0
Tanker Exports	3,748	2.58	74	$24.5
Dry Bulk Imports	3,623	2.07	43	$12.0
Dry Bulk Exports	4,082	10.56	220	$101.7
Total		19.9M	436	$167.2M

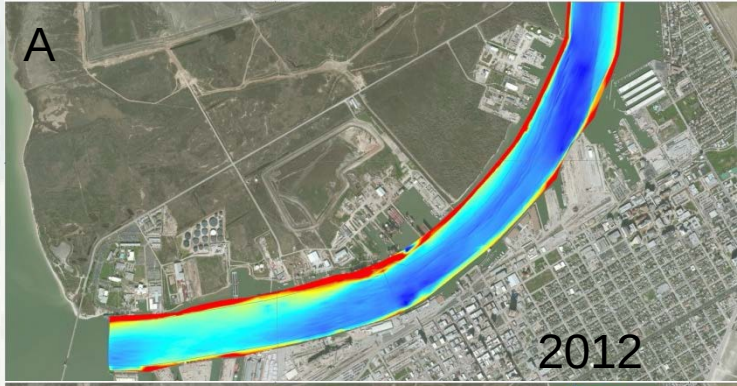
*** Based on avg. vessel speeds of 15 kts and operating costs of between $1,200 and $1,000 per hour.**

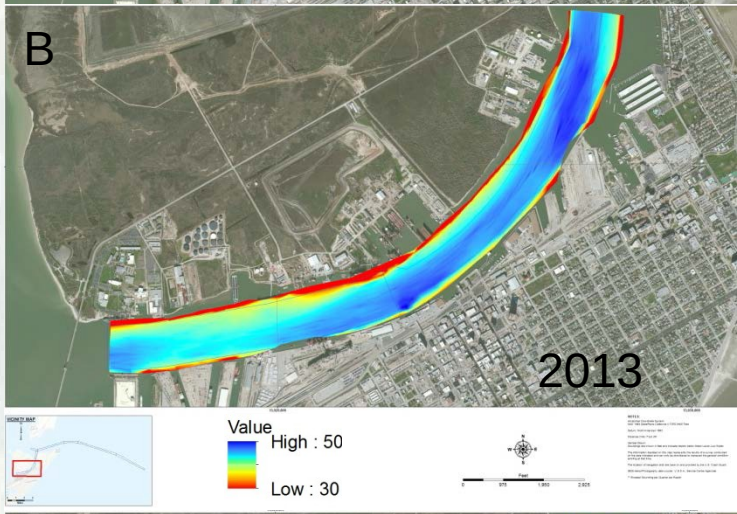
Draft Restrictions in Context

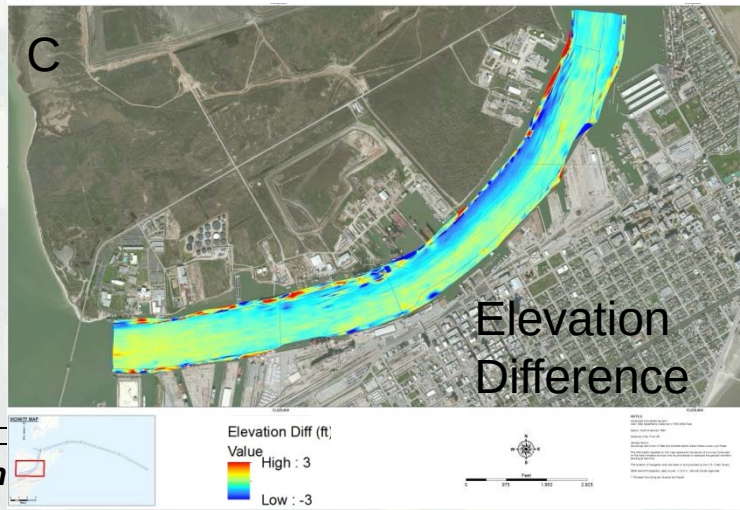
		# of Additional Required voyages (6-ft reduction in controlling depth)					
	Avg. Total Tonnage (xM)	Tanker Imports	Tanker Exports	Dry Bulk Imports	Dry Bulk Exports	Total Additional Shipping Costs	
Lower Miss.	412.6	99	74	43	220	$167.2M	1
HSC-Galv.-TX-City	210.8	95	51	6	11	$34.2M	5
Sabine-Neches	81.8	444	184	30	68	$110.5M	2
Corpus Christi	66.7	30	2	2	7	$11.9M	7
Mobile	54.3	--	--	62	82	$39.1M	3
Calcasieu	52.8	55	21	12	32	$26.8M	6
Freeport	23.9	144	19	--	--	$34.7M	4

Corps Shoaling Analysis Tool

- *What will the channels look like in the future?*
- Use historical survey data from eHydro and generate difference grid sets between dredging events
- Predict average shoaling rates and dredging requirements per channel reach
- Report volumes at different depth/time intervals and shoaling rates
- *Efficiently process large spatial datasets*







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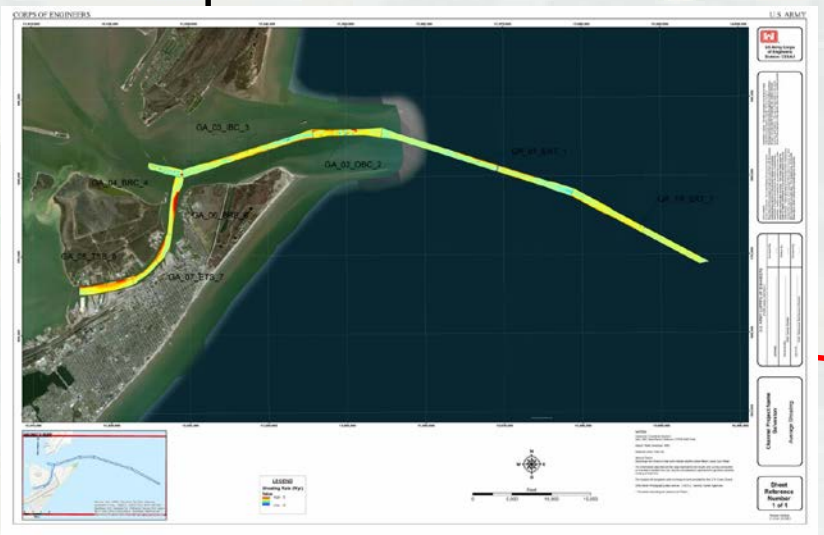
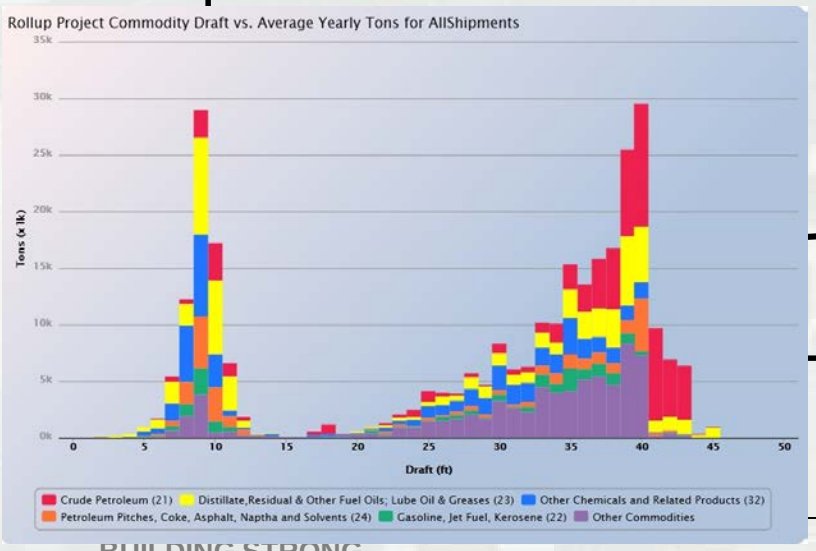
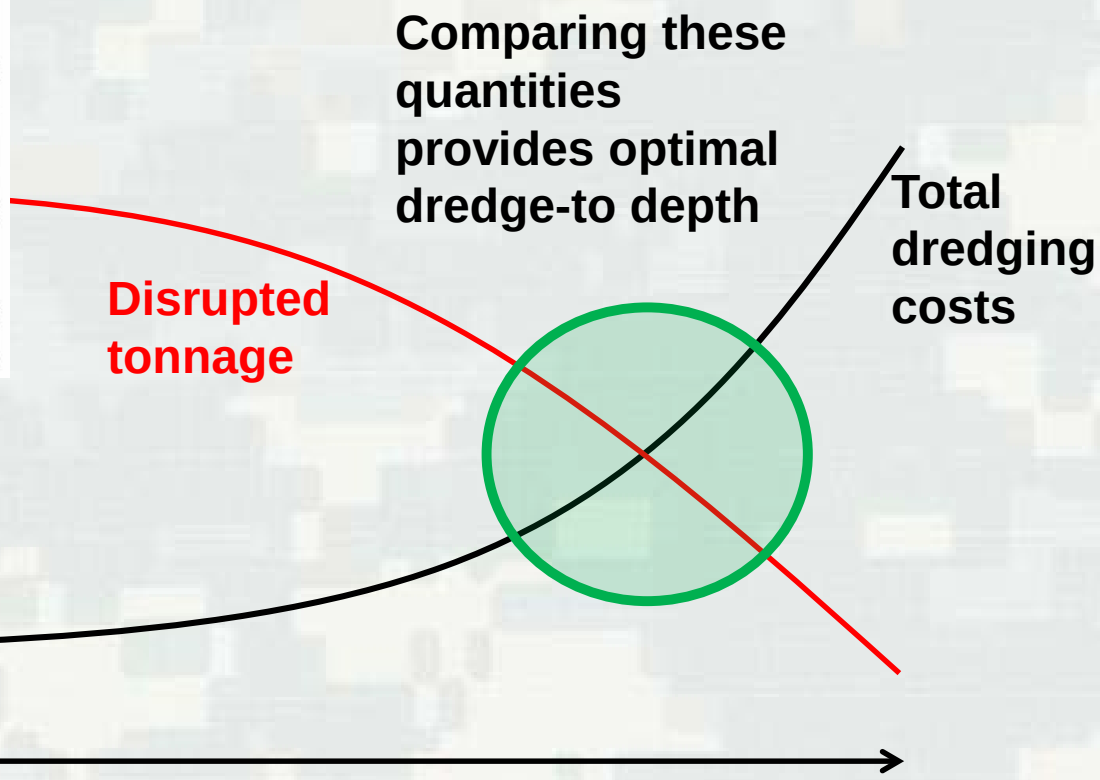
CPT/e-Hydro/CSAT Integration

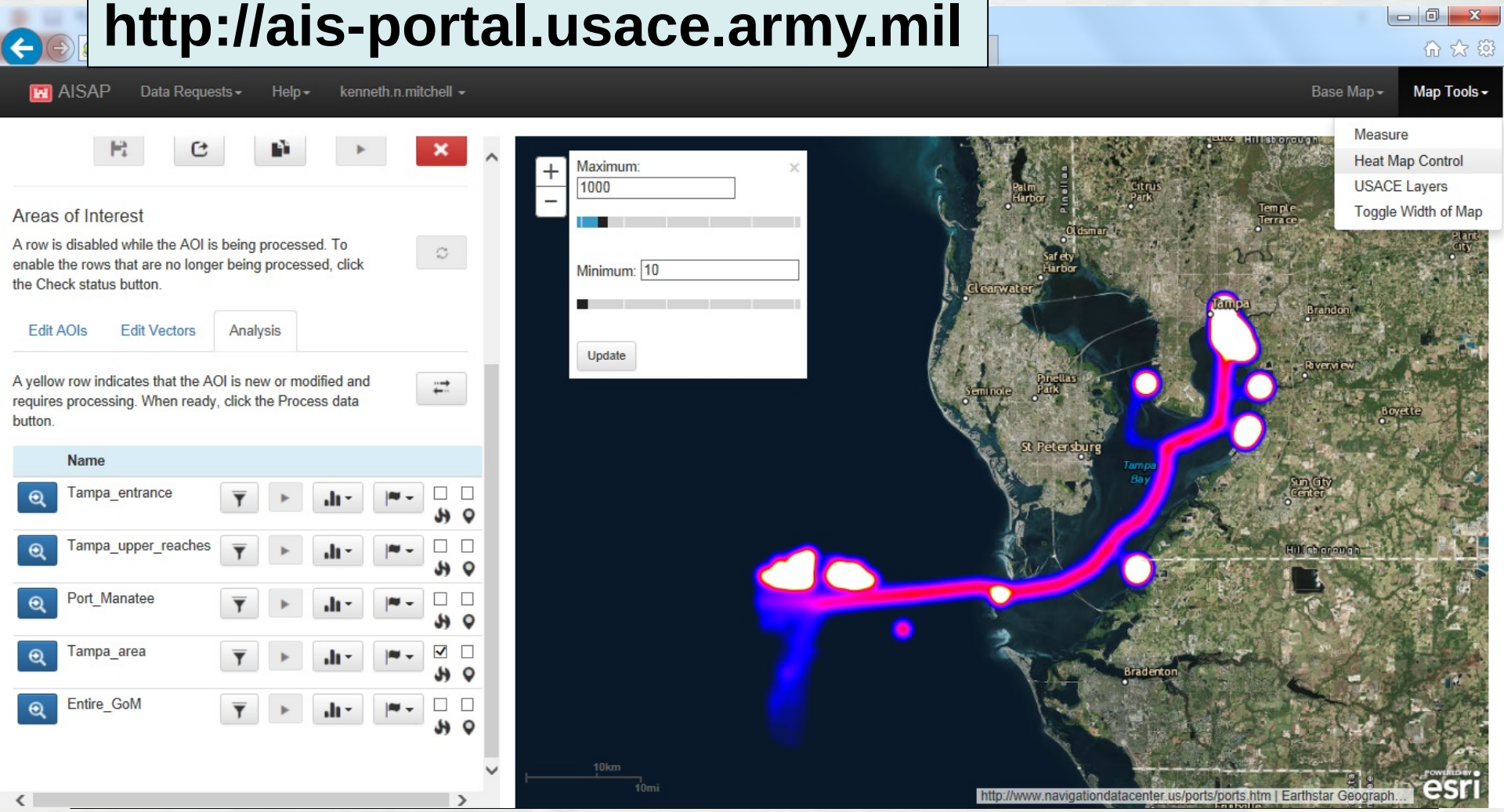






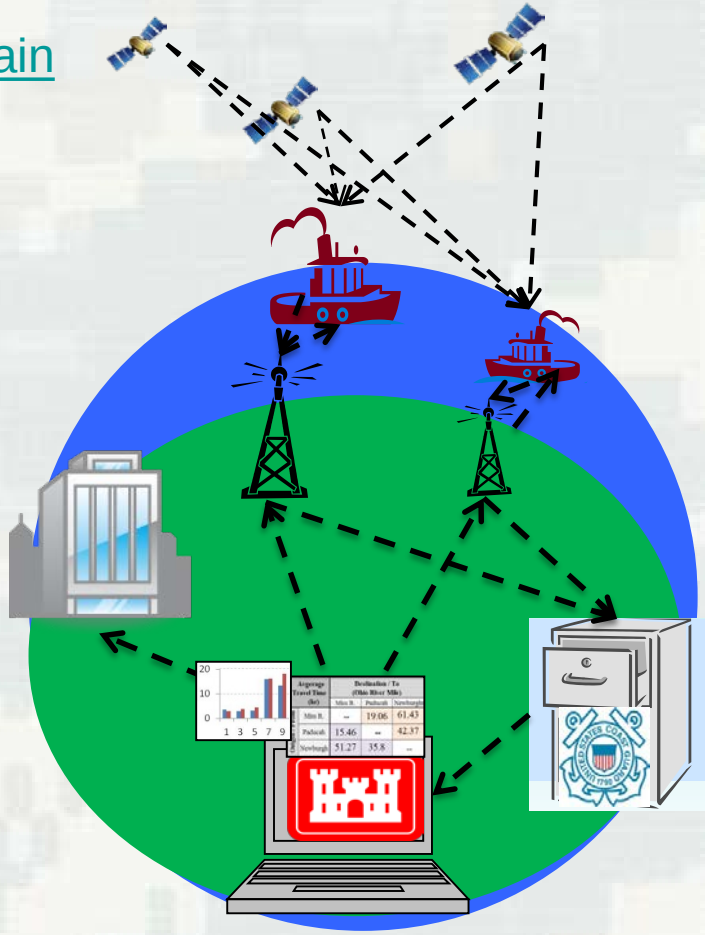
Automatic Identification System Analysis Package (AISAP)

http://ais-portal.usace.army.mil



US Coast Guard's Nationwide Automatic Identification System (NAIS)

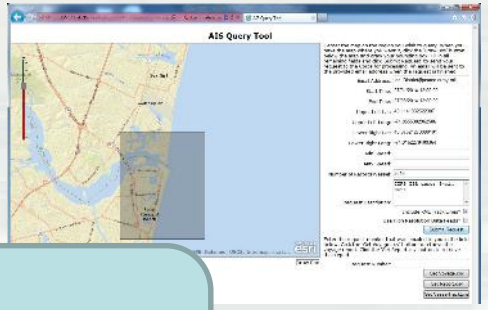
- http://www.navcen.uscg.gov/?pageName=NAISmain
- Information included in AIS:
  - Vessel identification
  - Location (longitude and latitude)
  - Time stamp
  - Heading
  - Speed
  - Vessel characteristics
- Discrete data points
  - Transmission frequency of 6 secs.
- Vessels act as passive probes



AISAP Functional Layout

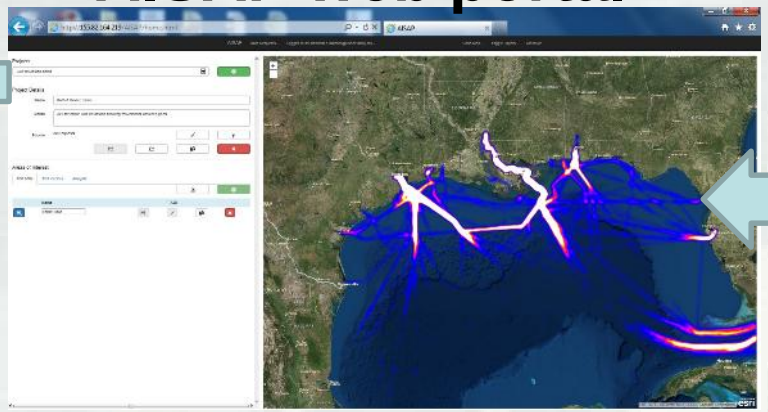
USCG NAIS

USCG web services

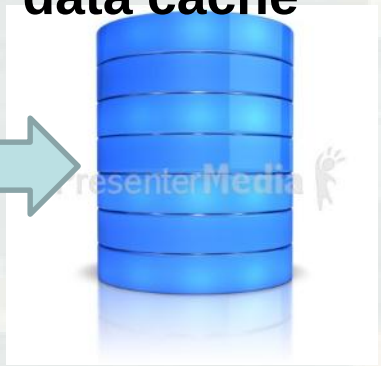


Scripts for batch service calls via GUI

AISAP web portal

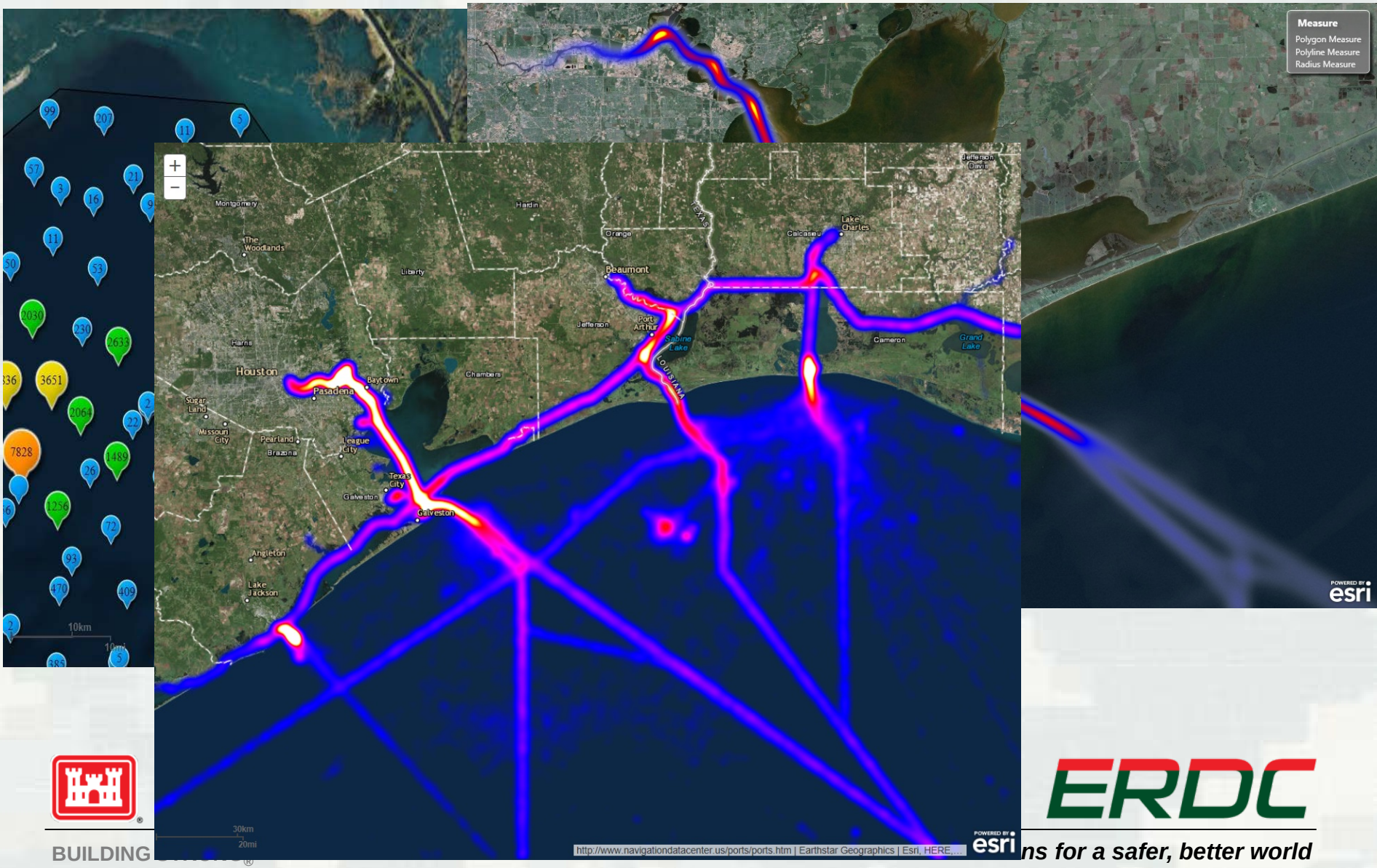


SAM-OPJ data cache



Basic data retrieval (.csv and .kml)

AISAP for traffic density comparisons



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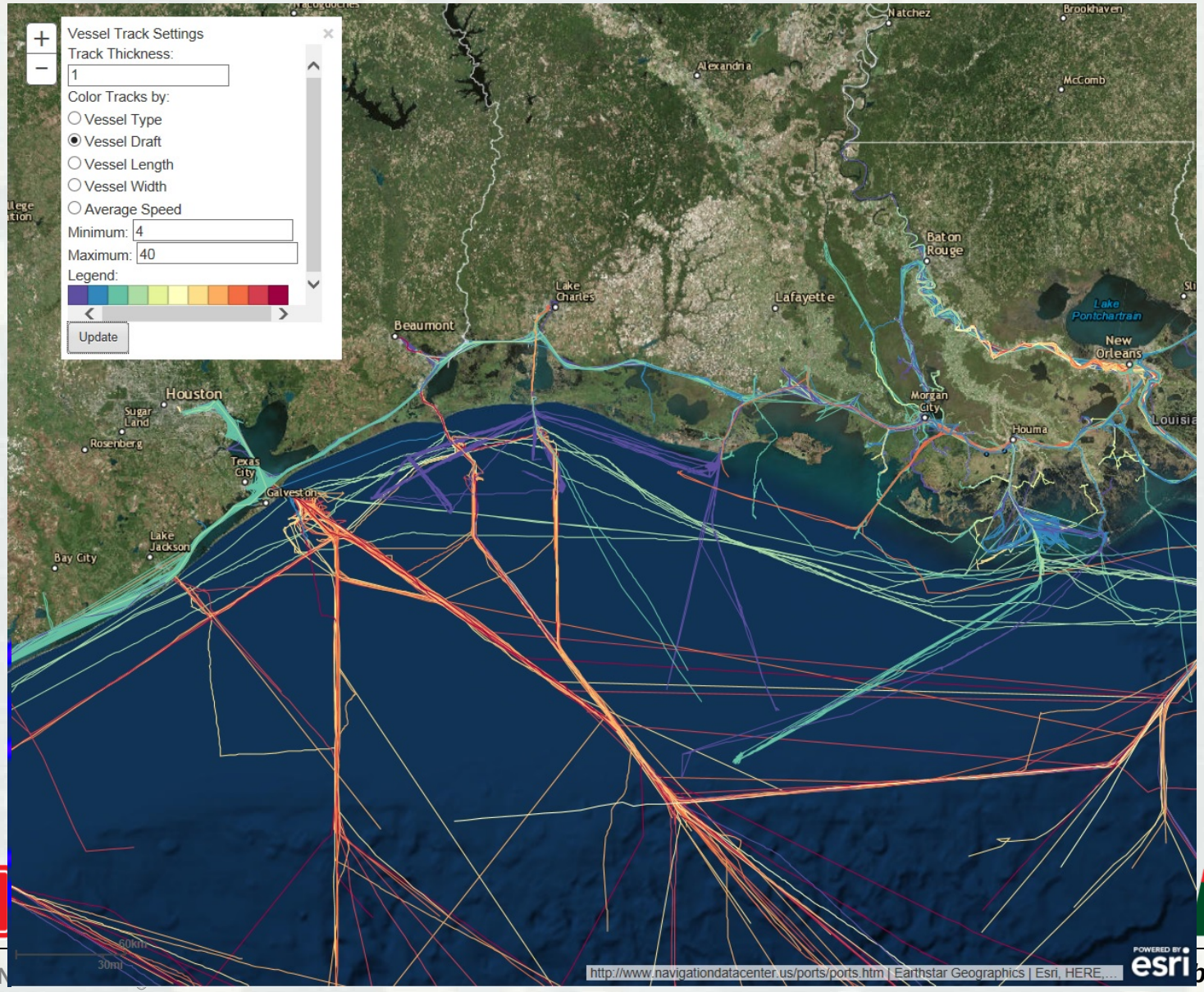


Traffic Summary Statistics

Summary

Report Date Range: 2015-08-01T00:05:00 to 2016-02-15T23:55:00

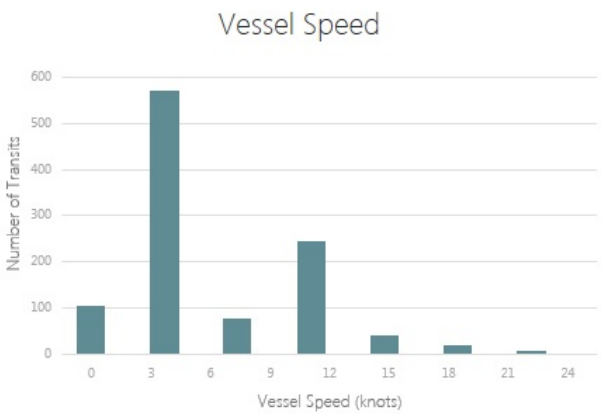
Num Reports: 65658

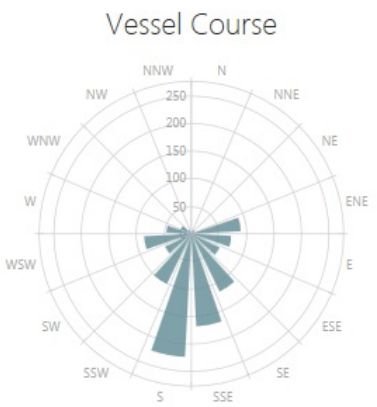
Num Unique Vessels: 565

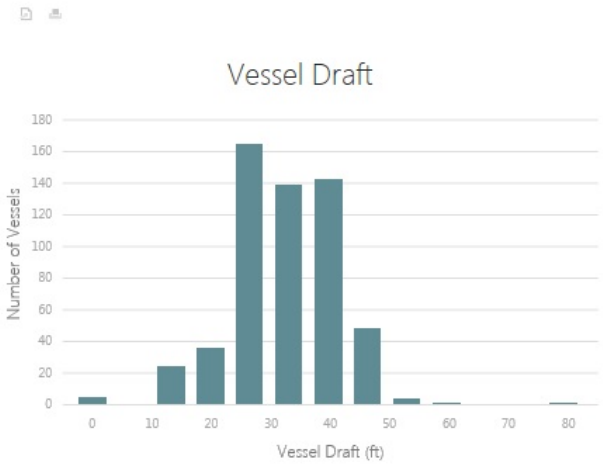
Num Transits: 1060

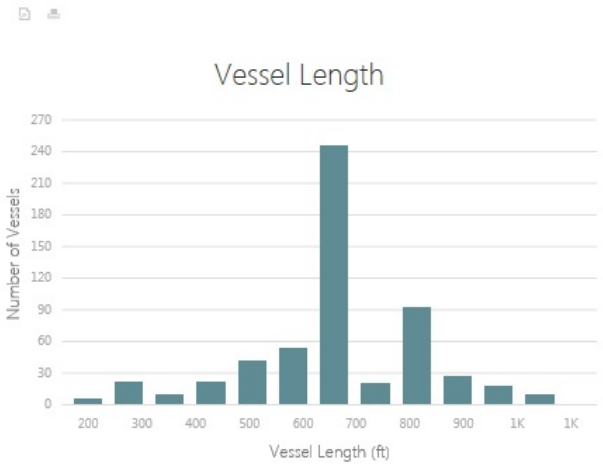
Traffic Sample Statistics

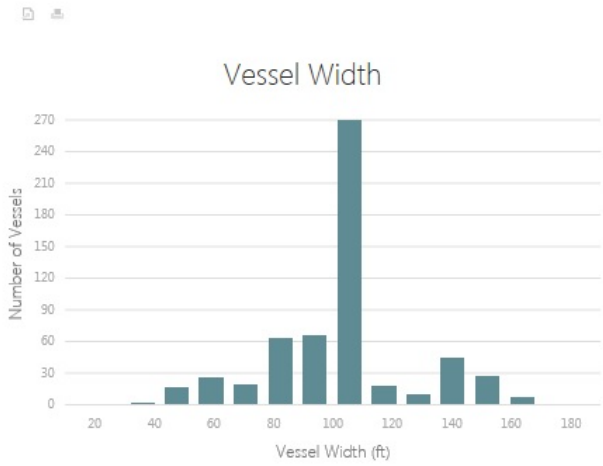
Metric	Mean	StdDev
Vessel Draft (ft)	28.85	8.66
Vessel Length (ft)	618.54	155.95
Vessel Width (ft)	99.26	23.9
Vessel Speed (knots)	3.82	0.77





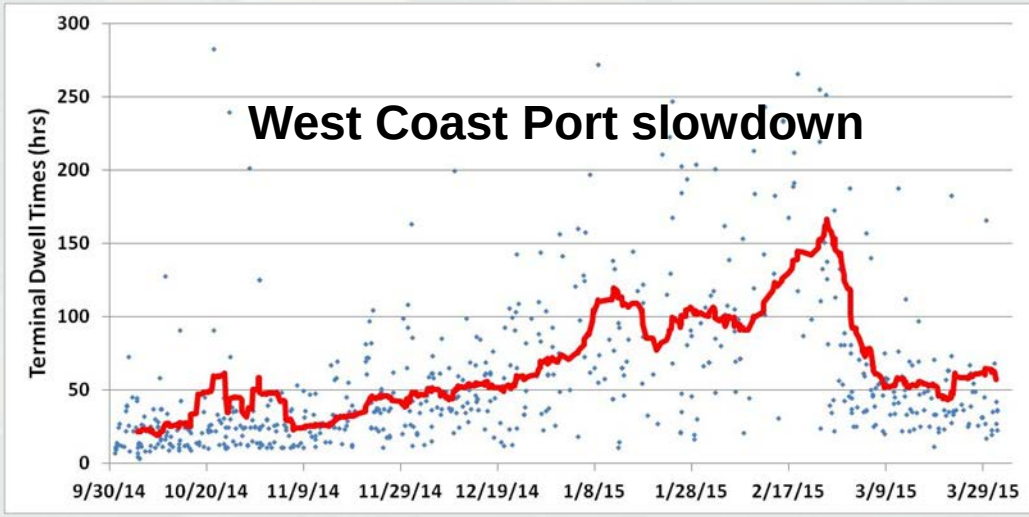


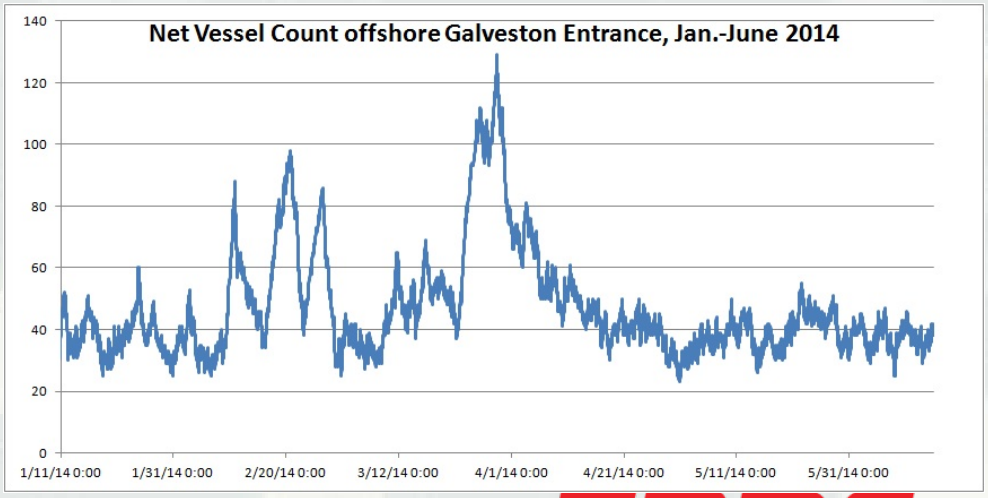




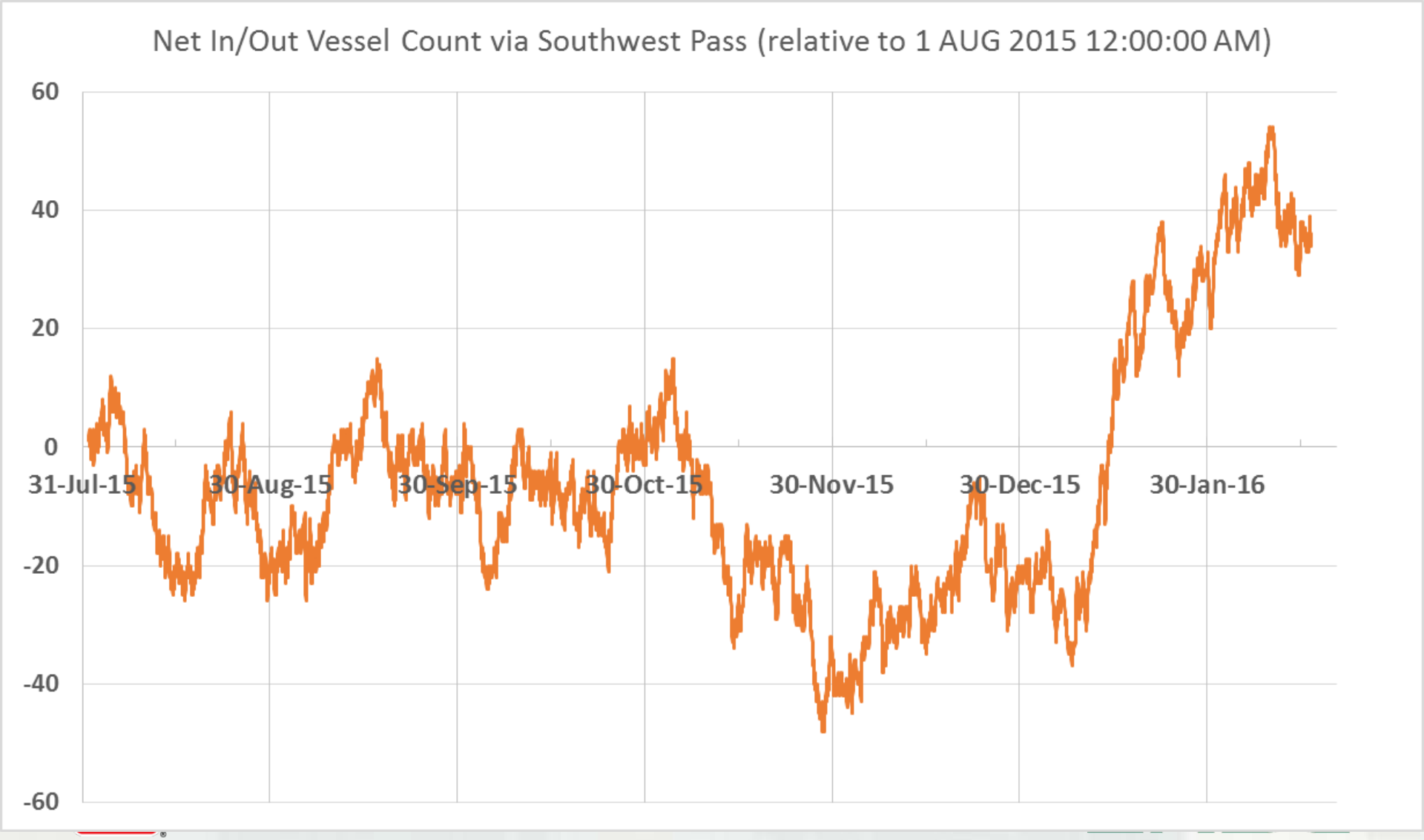
Potential Applications

- Travel Times and Dwell Times
- Port System Performance Monitoring and Resiliency assessments
- Vessel Transit counts
- Speed analysis ~ Wake-induced wave energy for shoreline erosion studies
- Vessel tracks/speeds pre/post dredging
- Asian carp studies (CAWS)
- Impacts of invasive aquatic vegetation





AIS for Monitoring Southwest Pass



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Questions?

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