

# Data Sources and Performance Measures for the Marine Transportation System

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TRB 5<sup>th</sup> International Transportation  
Systems Performance Measurement  
and Data Conference

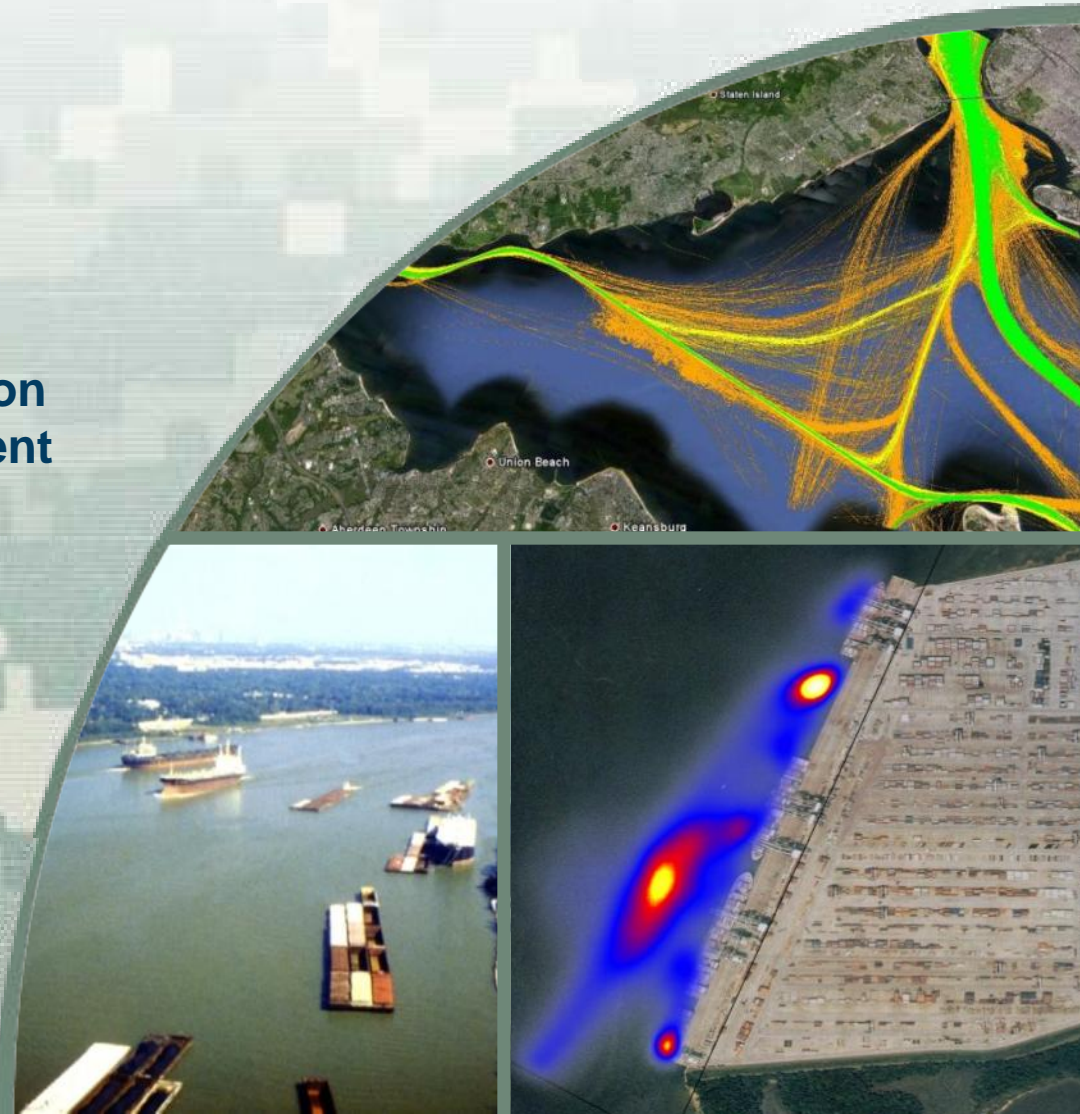
Denver, CO  
June 2, 2015



**US Army Corps  
of Engineers®**

**ERDC**

Engineer Research and  
Development Center



# 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 truly be separated from landside (road, rail, pipeline) systems.
- Federal policy discussions and sponsored research increasingly center on intermodal systems and the need to evaluate supply chains across modes.
- USACE Leadership has been stressing systems-based approaches to Civil Works mission execution.



# Marine Transportation Data Spectrum

Reported (but not observed!) data

WATERBORNE  
COMMERCE  
OF THE  
UNITED STATES

Calendar Year 2011

Part 1—  
Waterways and Harbors  
Atlantic Coast



U.S. Customs

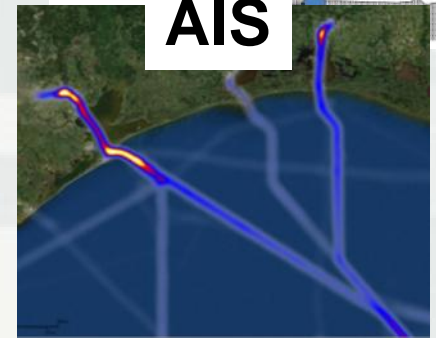
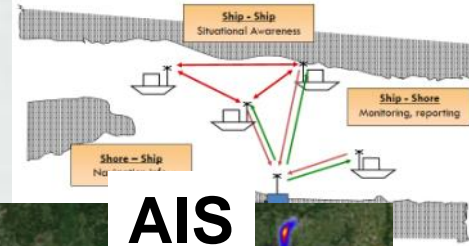


Directly observed in transit

LPMS data



Continuous system monitoring



Inland barge data



Tradeoffs ...



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# Some Public Data Sources

<http://www.navigationdatacenter.us/data/data1.htm>



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<http://www.navigationdatacenter.us/lpms/lpms.htm>



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U. S. Waterway Data  
[Commodity Codes \(WCUS\) Cross Reference](#)

[Commodity Codes \(Hazardous\) Cross Reference](#)

[Dredging Statistics](#)

[Entrances and Clearances](#)

[Foreign Cargo](#)

[Lock Characteristics](#)

[Port and Waterway Facilities](#)

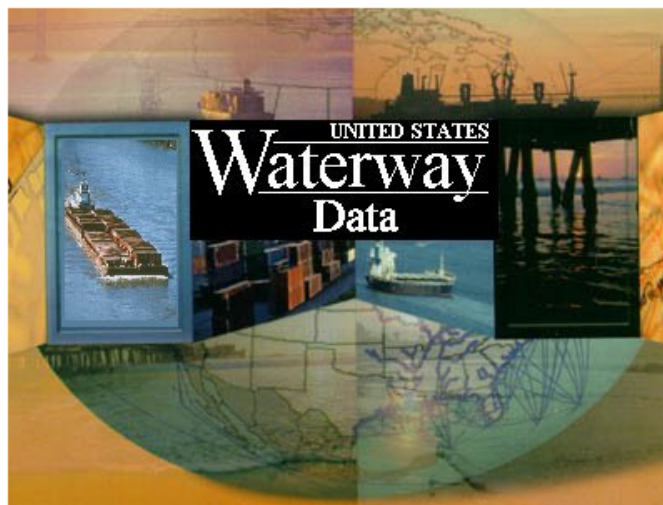
[Principal Ports](#)

[Schedule K Classification of Foreign Ports](#)

[State Tonnages](#)

[State to State and Region to Region Commodity Tonnages](#)

[USCG Vessel](#)



[NDC Home](#) | [Overview](#) | [Goals and Objectives](#) | [Data Standardization](#)

## Overview

The U.S. Waterway Data is a collection of data related to the navigable waters in the United States, including inland waterways, off-shore waters, the Great Lakes, and the Saint Lawrence Seaway. Data on commerce, facilities, locks, dredging, imports and exports, and accidents are included along with the geographic waterway network. The data were compiled from several agencies, including the U.S. Army Corps of Engineers Navigation Data Center, the U.S. Bureau of the Census, the U.S. Coast Guard, Oak Ridge National Laboratory, and Vanderbilt University. One of the objectives of this coordinated effort is to make waterway data more widely available and easily accessible.

[NDC Home Data](#)

[FTP Directory](#)

New LPMS Forms  
[Lockage Log - front](#)  
[Lockage Log - reverse](#)  
[Vessel Log - front](#)  
[Vessel Log - reverse](#)  
[Detailed Vessel Log - front](#)  
[Detailed Vessel Log - reverse](#)

[Corps Locks](#)

[Notice To Navigation Interests](#)

[Navigation Information Connection](#)

[EROC CODES](#)

[Lock Use, Performance, and Characteristics](#)

[Mission](#)

[Notice To Navigation Interests \(NTNI\) Announcement](#)

[Corps Locks Announcement](#)

[Locks by Waterway, Tons Locked by Commodity group, Calendar Years 1993-2013](#)  
(Updated 19 February 2014)

[Locks by Waterway, Lock Usage, Calendar Years 1993-2013](#)  
(Updated 19 February 2014)

[Locks by Waterway, Locks Unavailability, Calendar Years 1993-2013](#)  
(Updated 19 February 2014)

The **Key Lock Report** provides a monthly summary and year-to-date totals of commodity tonnages and barge traffic for key locks on the inland waterways.

**Key Lock Report**



# Dredging Information System (DIS)

<http://www.navigationdatacenter.us/data/datadrgsel.htm>

- Thousands of dredging events (O&M and new deepenings) over last 25 years.
- Location, quantities of material moved, cost, start/end dates.



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[NDC Home](#)  
[Data](#)  
[Back](#)

## U.S. Waterway Data Dredging Information System

### [File Description: Corps Owned Dredges](#)

Information about dredging activities performed by the Corps owned and operated dredges.

### [File Description: Dredging Contracts](#)

Information about each awarded dredging contract advertised by the Corps of Engineers.

Contact for Additional Information  
Department of the Army, Corps of Engineers  
CEIWR-NDC  
7701 Telegraph Road, Casey Bldg  
Alexandria, Virginia 22315-3868  
Point of Contact: [NDC](#)

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This document was last revised: 11/28/2014

# Entrances and Clearances

- Reconstructed trip chains for container vessels calling at multiple U.S. ports
- Vessel draft provides a way to infer net cargo on/offloaded
- Could be coupled with separate port-level counts of TEUs, tonnage, etc.

EC10 Outbound.xlsx - Microsoft Excel



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Navigational Data Center

U.S. Waterway Data

Vessel Entrances and Clearances

SDC Home  
Data

U.S. Waterway Data  
Vessel Entrances and Clearances

<http://www.navigationaldatacenter.us/data/dataclen.htm>

**File Description:** Calendar Year 2012 by Port  
- [Foreign Traffic Vessel Entrances and Clearances](#)  
- [The International Classification of Ships by Type \(ICST\)](#)  
- [Flag Master File](#)

[Data Dictionary](#)

**File Directory:**

[Download in comma delimited \(.txt\)](#)

[Download in dbase format \(.mdb or .dbf\)](#)

[Archived Reports 2011-1997](#)

**Foreign Traffic Vessel Entrances and Clearances**

**Abstract**

These files contain the following data for each major port or waterway: the date a vessel made entry into (entrance record) or cleared (clearance record) the U.S. Customs port; the vessel's full name; the type of vessel by one digit rig type or ICST (International Classification of Ships by Type) code; the vessel's flag of registry; the vessel's last (entrance record) or next (clearance record) port of call, whether foreign or domestic; the



PWW	Name	Vessname	Rig	
CORPUS CHRISTI, TX	TOCAMA	ELIO	2	1
CORPUS CHRISTI, TX	OVERSEAS BERYL	BARCAROLLE	2	1
CORPUS CHRISTI, TX	MARITEC	ANATOLI	1	2
CORPUS CHRISTI, TX	ESTHER SPIRIT	WILMINA	2	1
CORPUS CHRISTI, TX	PACIFICGAS	MINERVA HELEN	2	1
CORPUS CHRISTI, TX	SPT CHAMPION	MSC BEIJING	1	3
CHARLESTON HARBOR, SC	HERO	APL ARABIA	1	3
MIAMI HARBOR, FL	CARNIVAL DESTINY	NEW COMMAND	1	2
LONG BEACH HARBOR, CA	SH BRIGHT	SH BRIGHT	1	2
LONG BEACH HARBOR, CA	KESTREL ARROW	KESTREL ARROW	1	3
LONG BEACH HARBOR, CA	OOCL ASIA	OOCL ASIA	1	3
LONG BEACH HARBOR, CA	OVERSEAS LONG BEACH	OVERSEAS LONG BEACH	2	1
LONG BEACH HARBOR, CA	OCEANIC ANGEL	OCEANIC ANGEL	1	2
LONG BEACH HARBOR, CA	CARNIVAL PARADISE	CARNIVAL PARADISE	1	3

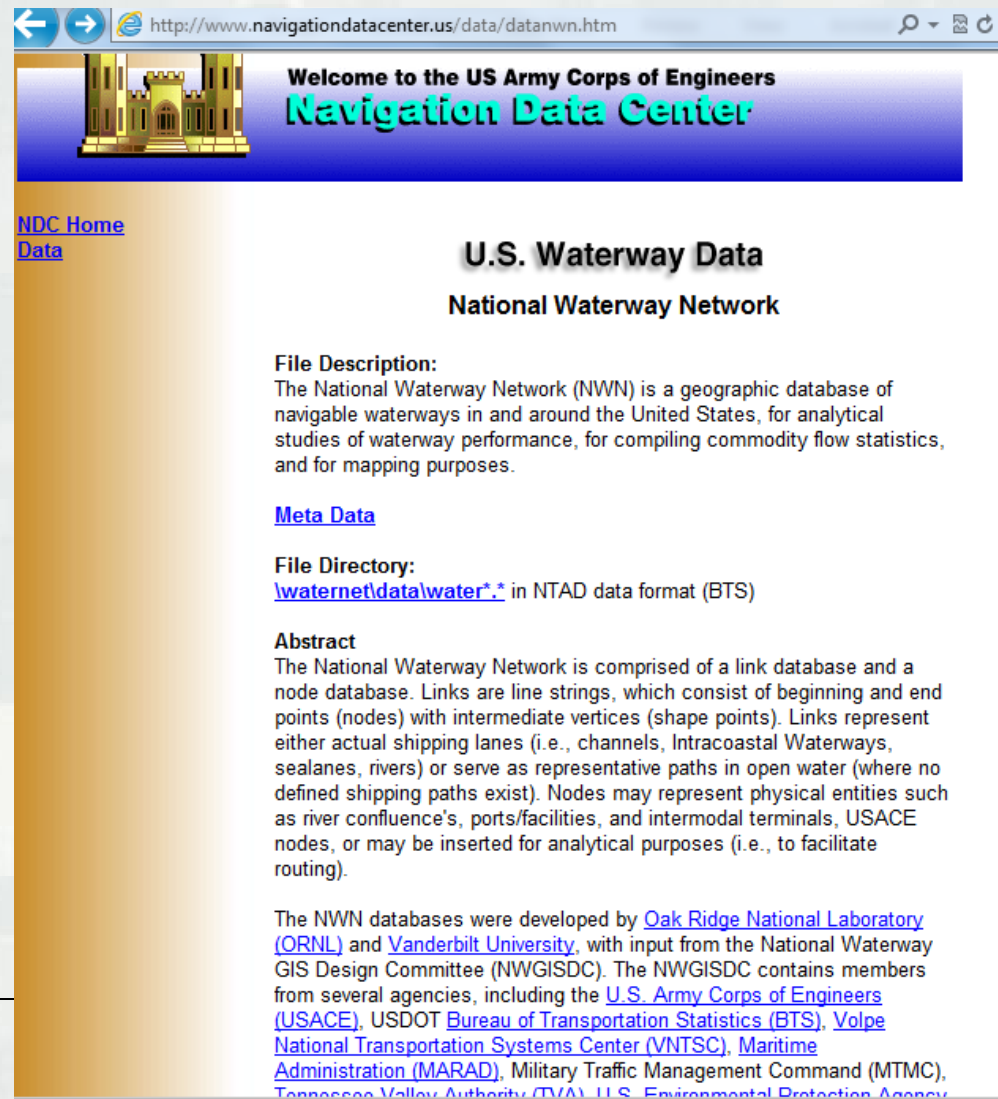
# National Waterway Network

<http://www.navigationdatacenter.us/data/datanwn.htm>

- Transiting tonnage totals by commodity group for 3000+ waterway segments around the U.S.
- Spatial network for GIS application development
- Segment-level flows and transfers to/from road/rail/pipeline can be inferred.



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← → <http://www.navigationdatacenter.us/data/datanwn.htm> 🔍 🔄

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[Data](#)

## U.S. Waterway Data

### National Waterway Network

**File Description:**  
The National Waterway Network (NWN) is a geographic database of navigable waterways in and around the United States, for analytical studies of waterway performance, for compiling commodity flow statistics, and for mapping purposes.

**Meta Data**

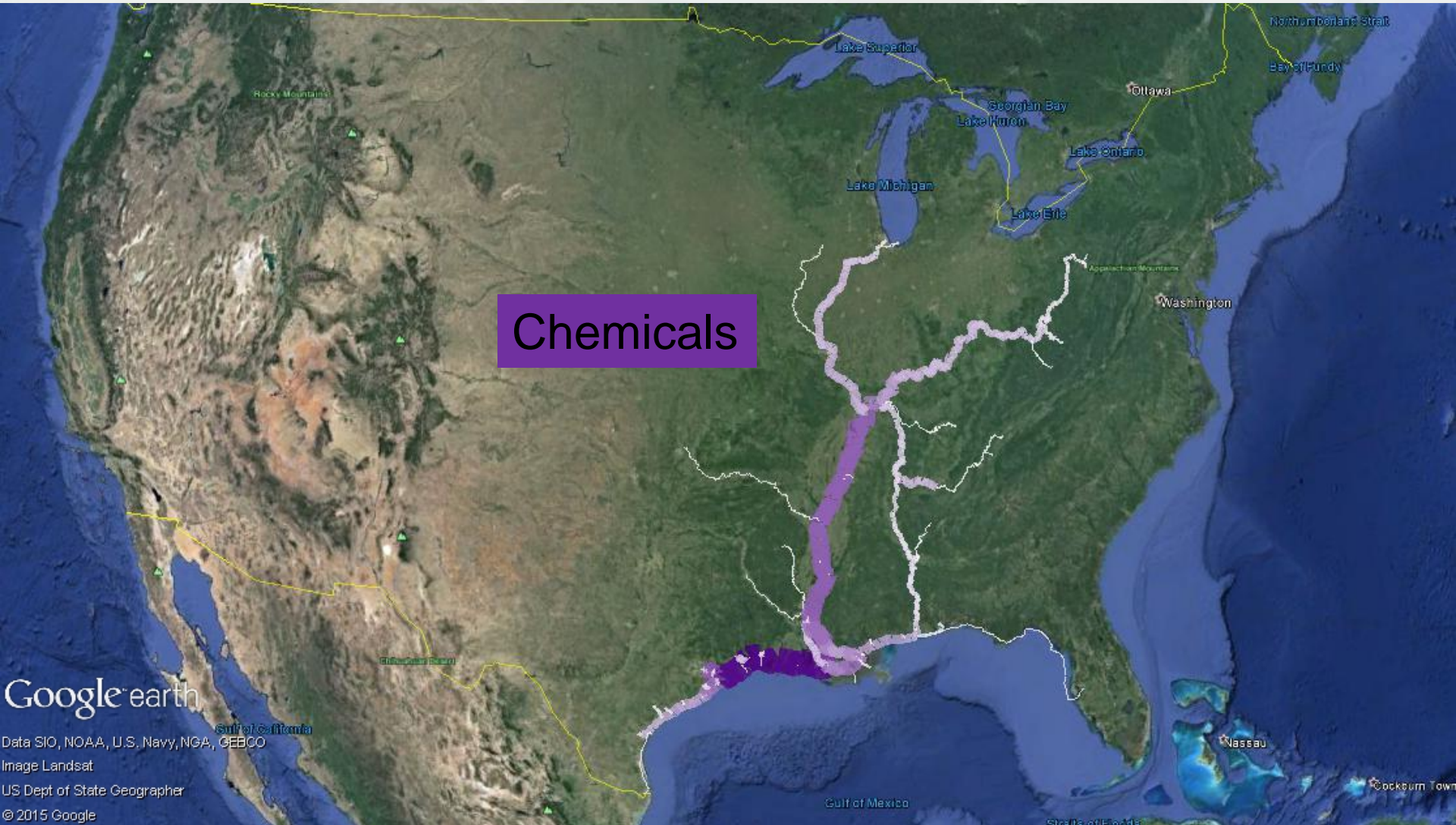
**File Directory:**  
[\waternet\data\water\\*.\\*](#) in NTAD data format (BTS)

**Abstract**  
The National Waterway Network is comprised of a link database and a node database. Links are line strings, which consist of beginning and end points (nodes) with intermediate vertices (shape points). Links represent either actual shipping lanes (i.e., channels, Intracoastal Waterways, sealanes, rivers) or serve as representative paths in open water (where no defined shipping paths exist). Nodes may represent physical entities such as river confluence's, ports/facilities, and intermodal terminals, USACE nodes, or may be inserted for analytical purposes (i.e., to facilitate routing).

The NWN databases were developed by [Oak Ridge National Laboratory \(ORNL\)](#) and [Vanderbilt University](#), with input from the National Waterway GIS Design Committee (NWGISDC). The NWGISDC contains members from several agencies, including the [U.S. Army Corps of Engineers \(USACE\)](#), USDOT [Bureau of Transportation Statistics \(BTS\)](#), [Volpe National Transportation Systems Center \(VNTSC\)](#), [Maritime Administration \(MARAD\)](#), [Military Traffic Management Command \(MTMC\)](#), [Tennessee Valley Authority \(TVA\)](#), [U.S. Environmental Protection Agency](#)



# Waterway Freight Corridor Examples



Chemicals

Google earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image Landsat  
US Dept of State Geographer  
© 2015 Google

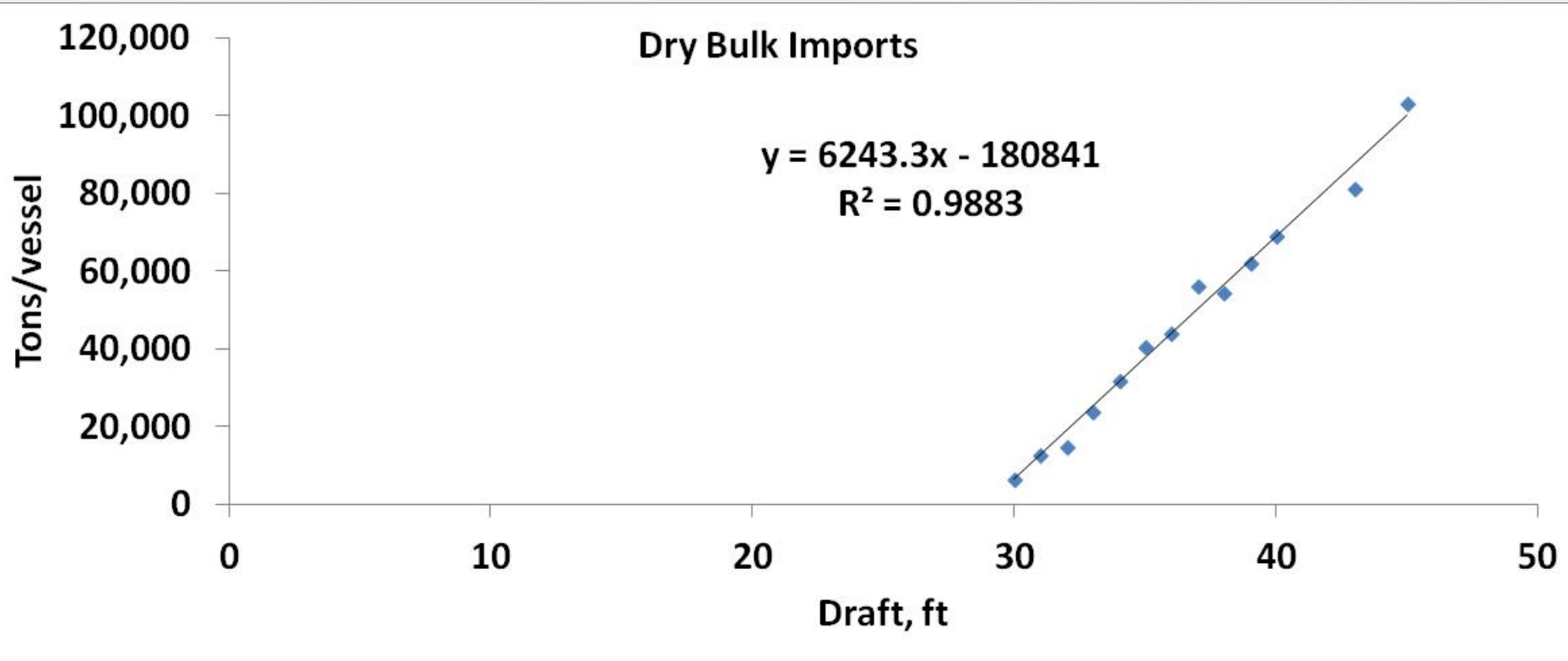


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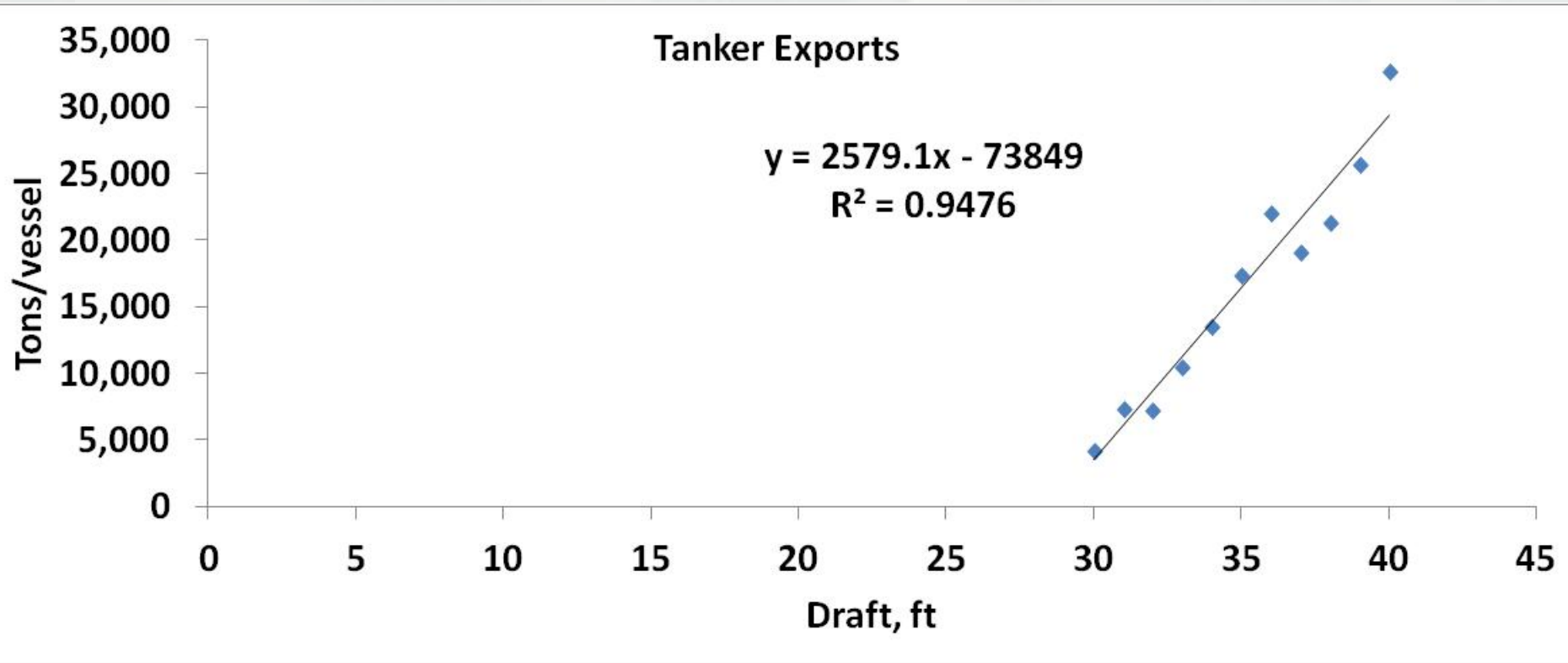


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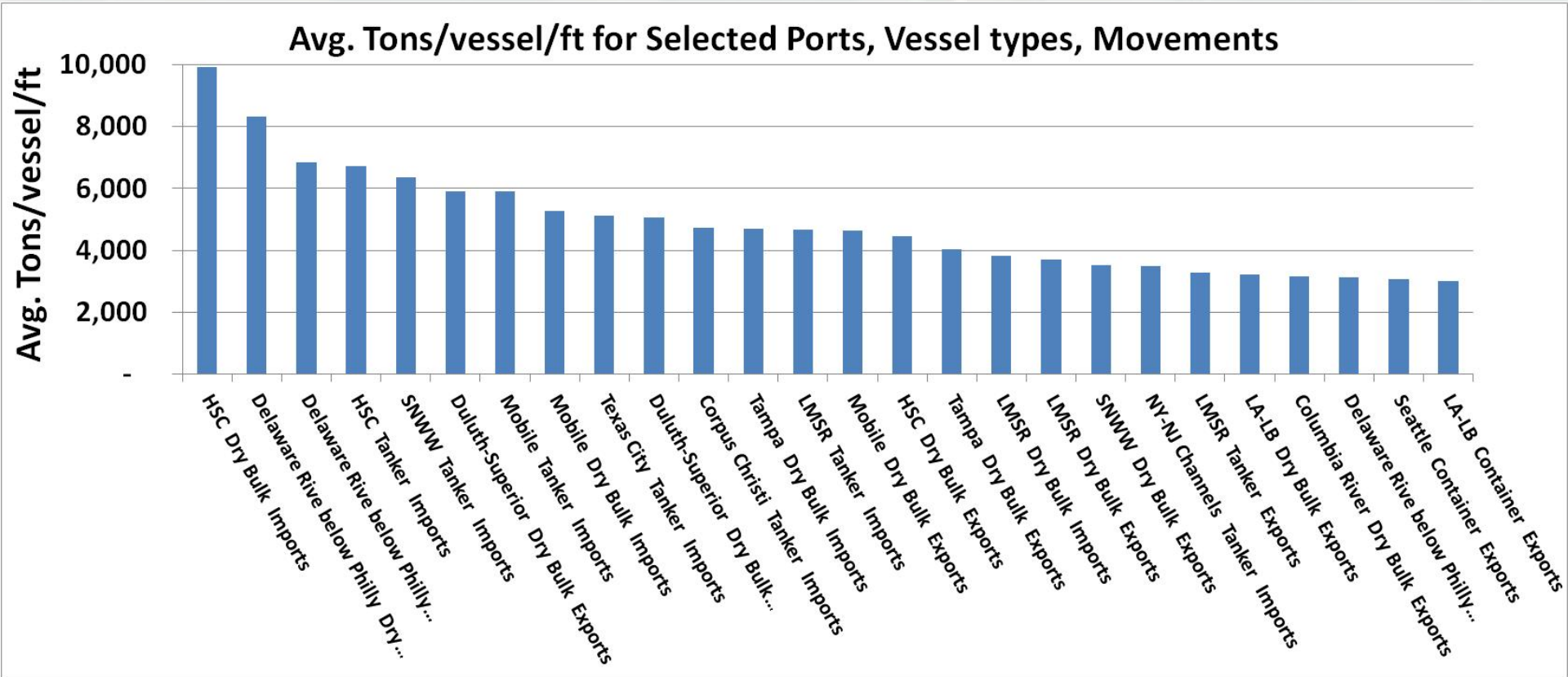
# Tons per voyage analysis: National Summary



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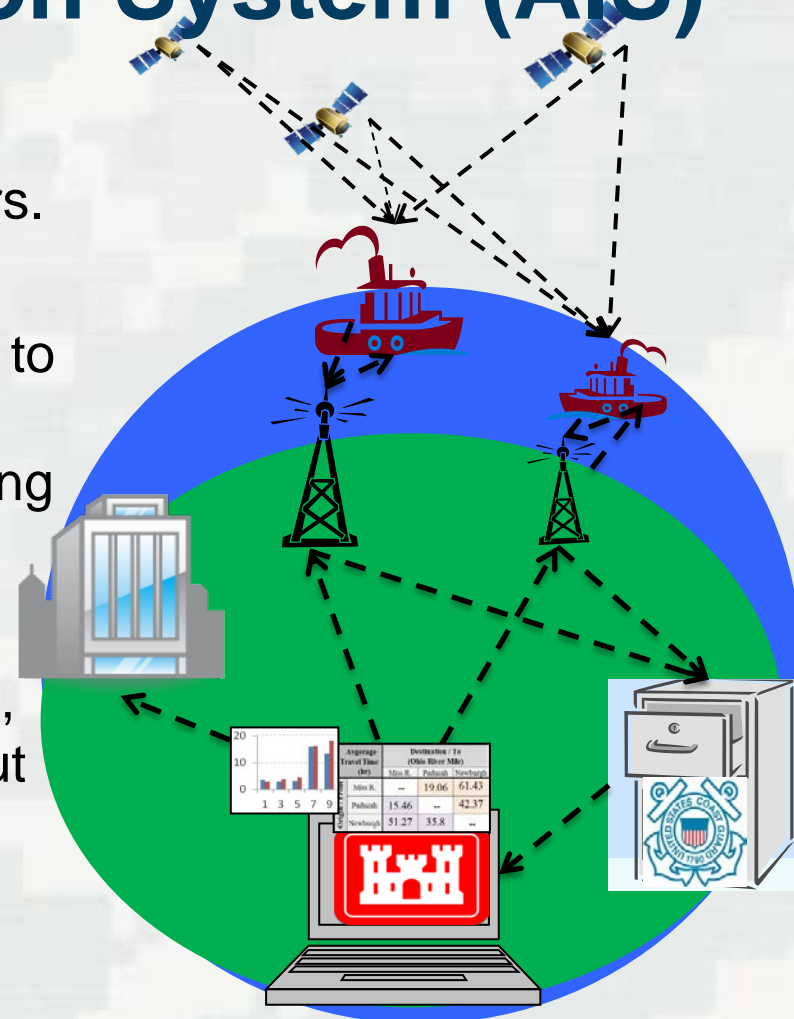


# Vessel Draft Sensitivities

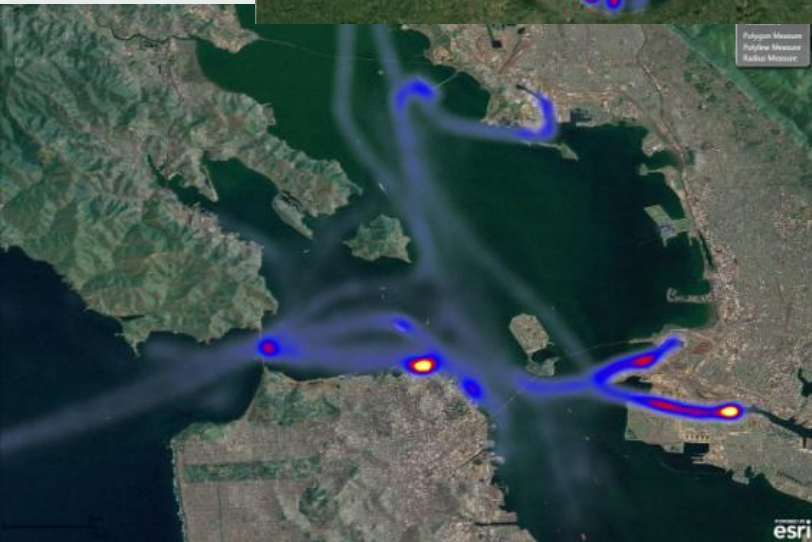
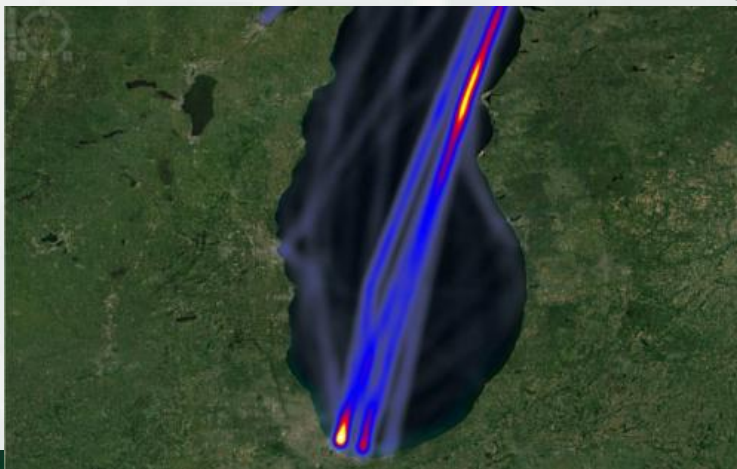


# Automatic Identification System (AIS)

- Coast Guard mandate for nearly all commercial vessels operating in U.S. waters.
- VHF messages broadcast from the vessels to network of shore-based towers at intervals between 2 seconds and 5 minutes depending on operating state.
- Envisioned for maritime domain awareness, i.e. collision avoidance and port security, but shows great potential for many other applications to the national Marine Transportation System (MTS).



# Navigation Systems Performance Monitoring via AIS



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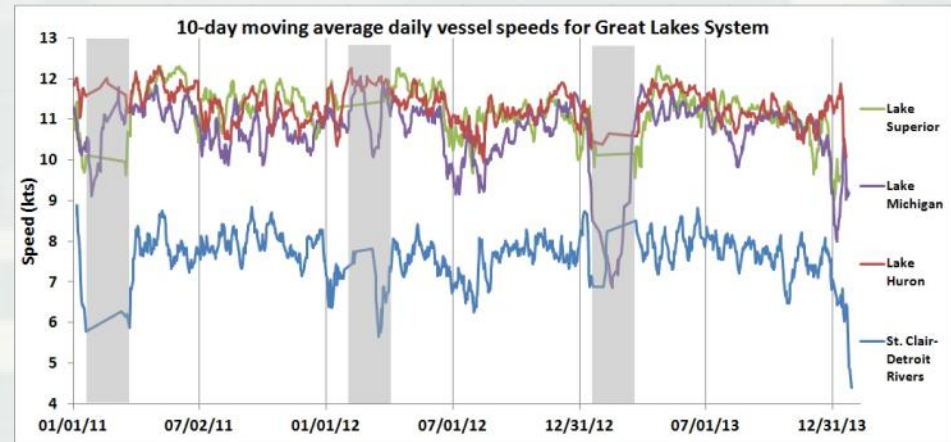
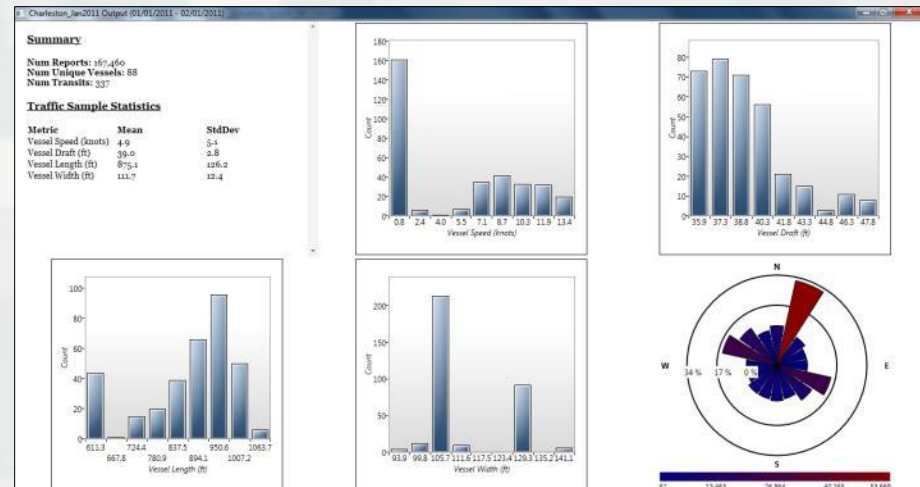
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# Performance Monitoring via AIS

## Automatic Identification System Analysis Package (AISAP)

- traffic densities
- O-D travel times, dwell times
- fleet characteristics, movements and seasonal variations
- traffic response to disruptions or waterway improvements
- Tidal dependence
- incident investigations

Analyses are *scalable* across time and space, so single channels can be monitored for a few hours, or entire coasts can be monitored for years.



# Bayport Ship Channel, Texas



<http://wvpress.org/news/gps-takes-big-rig-driver-narrow-pocahontas-road/>

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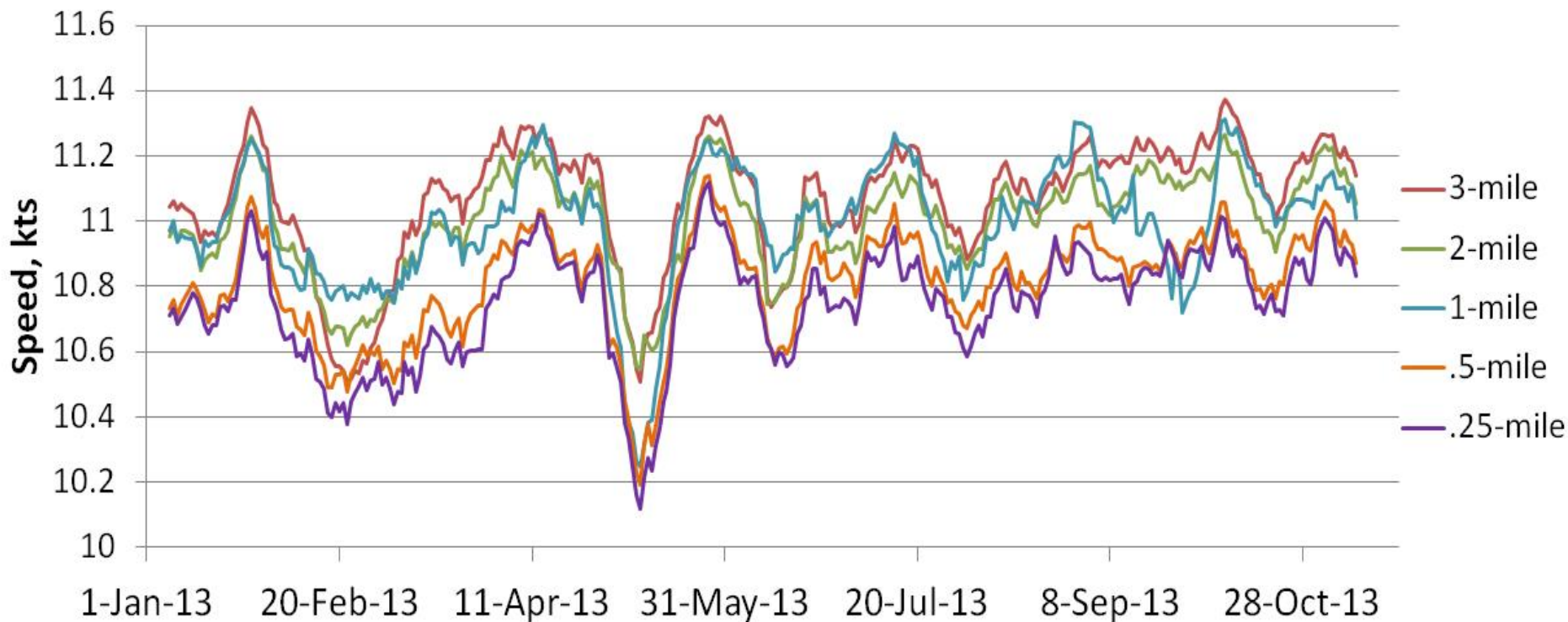
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# AIS Vessel Transit Data

## Vessel Speeds Approaching Bayport Flare

10-day Average Vessel Speeds, HSC below Bayport, 2013



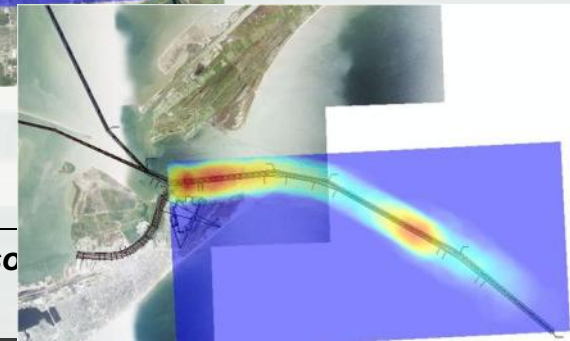
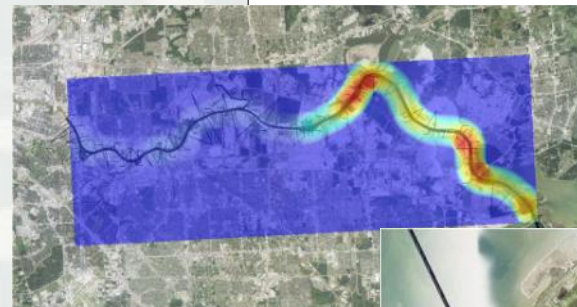
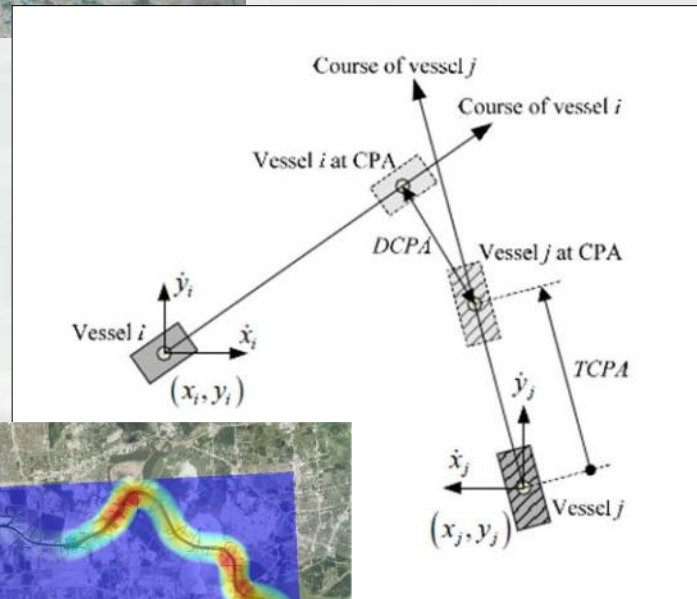
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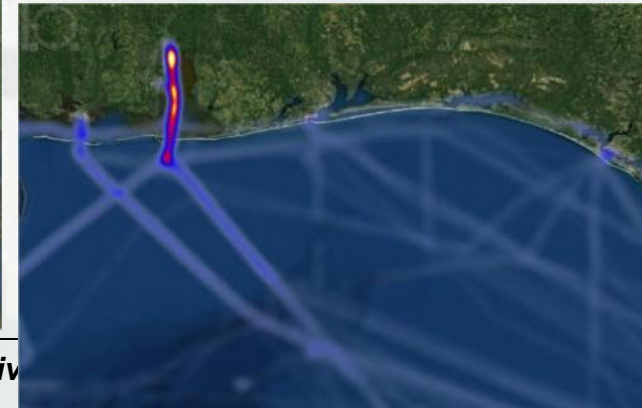
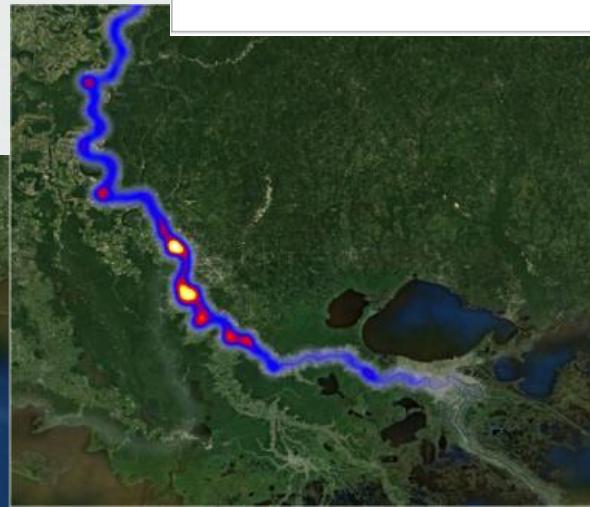
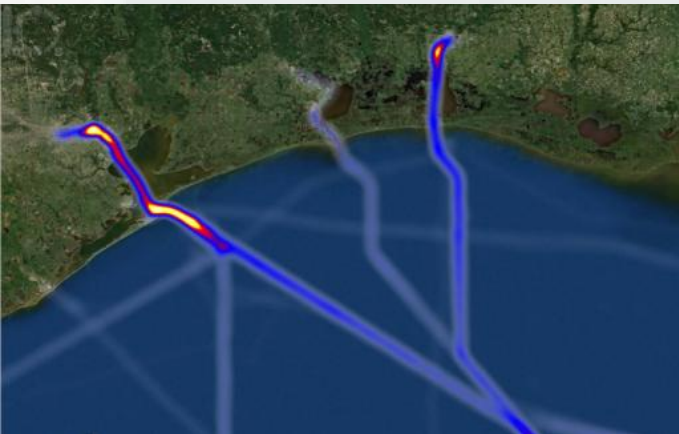
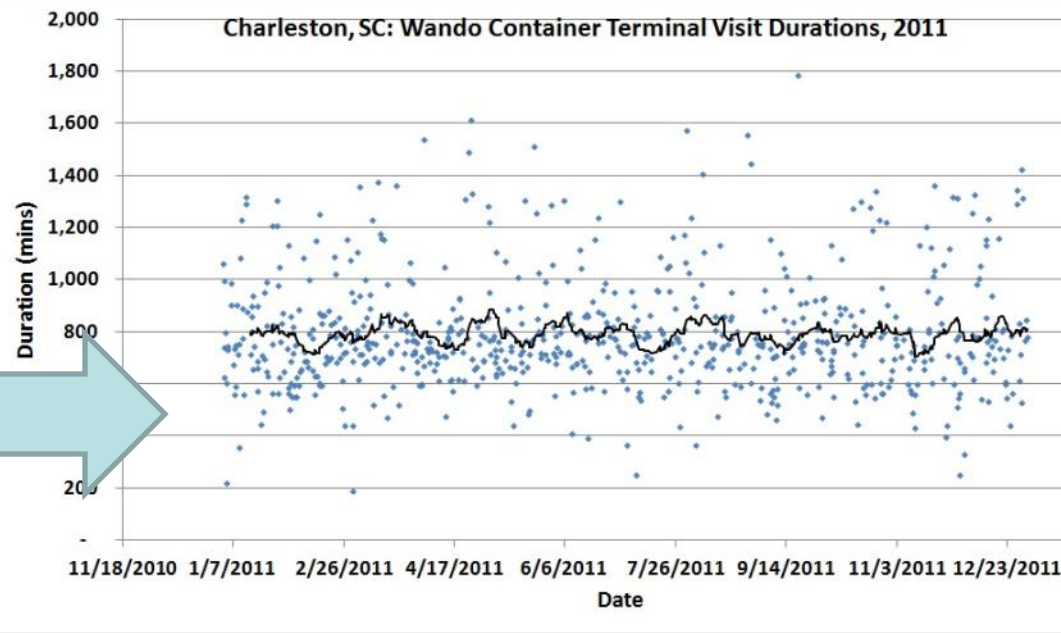
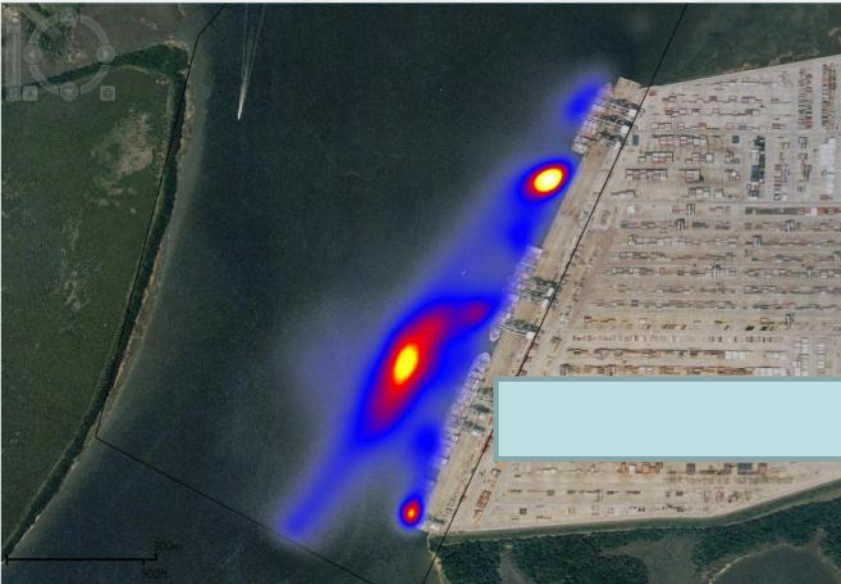
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# AIS for Collision Risk Analysis:

- ▶ Use archival AIS data to establish baseline collision risk levels within ports and waterways
- ▶ Compare segments of waterway based on proximity of transiting vessels to one another, with consideration of respective headings, courses over ground, and speeds
- ▶ Several methodologies in the literature, usually with very localized application → NAIS provides basis for national assessments

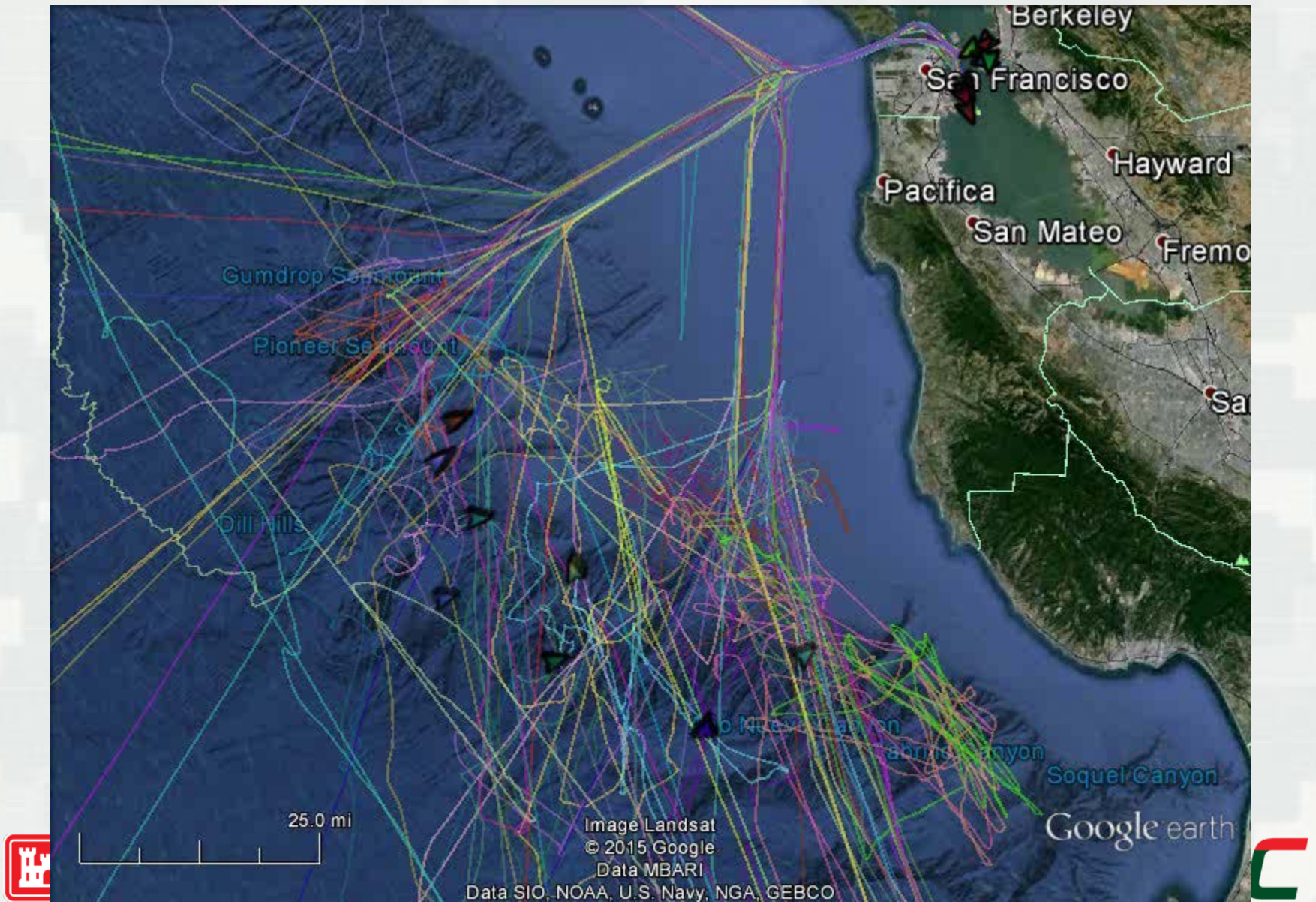


# Port/Anchorage Dwell Times, Travel Times

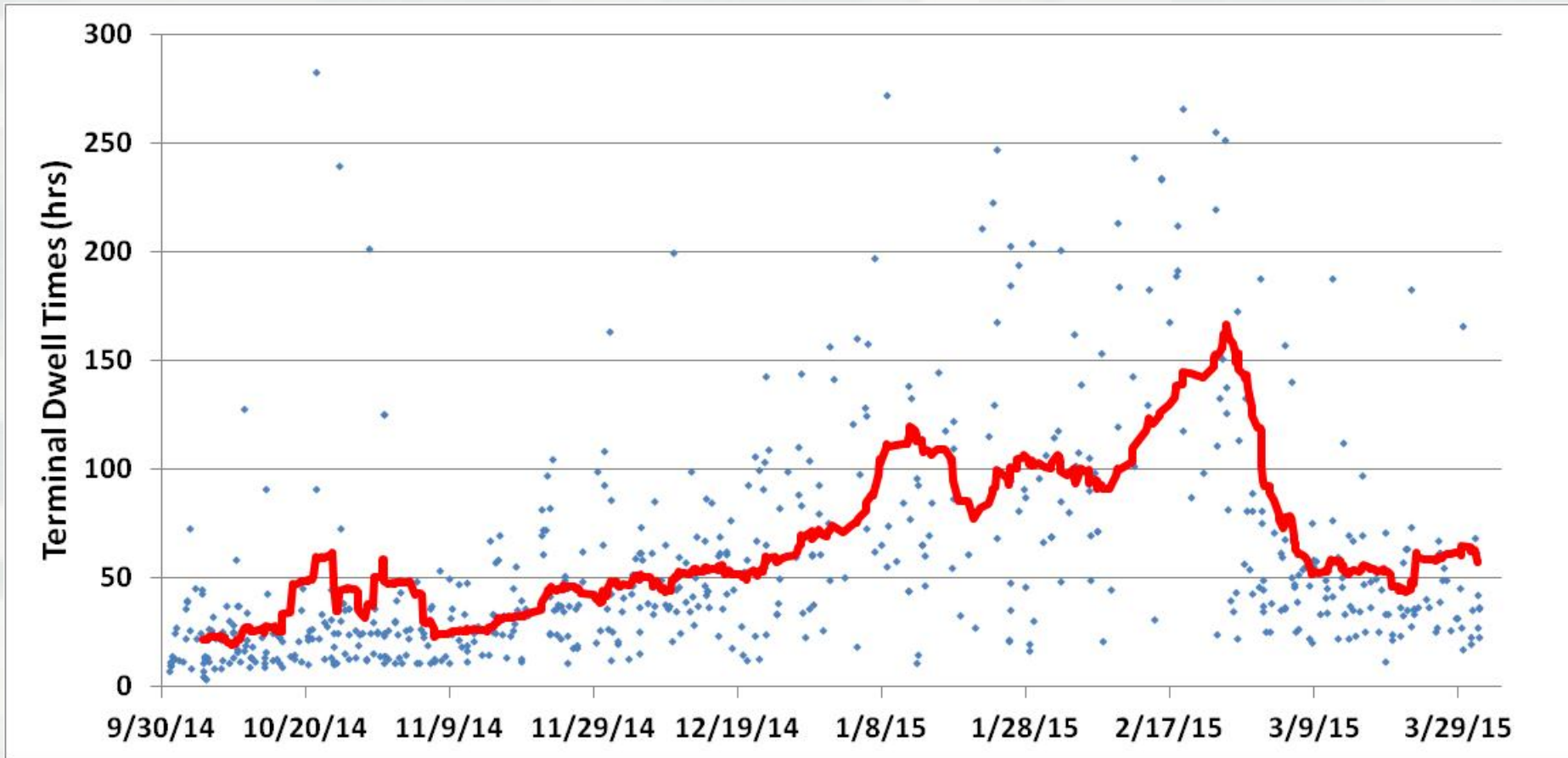


Innovativ

# West Coast Port Slowdown: Oakland



# West Coast Port Slowdown: Oakland

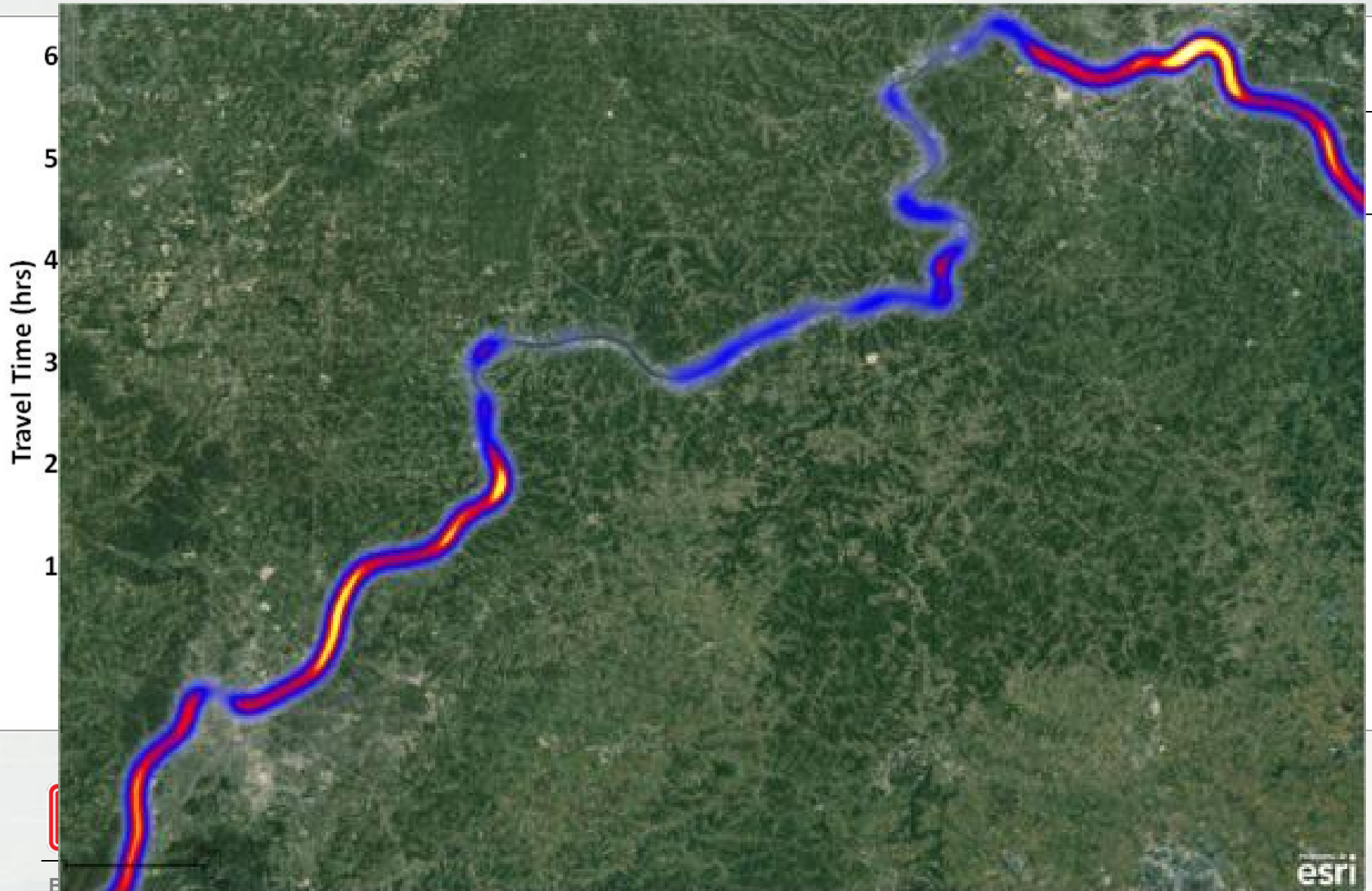


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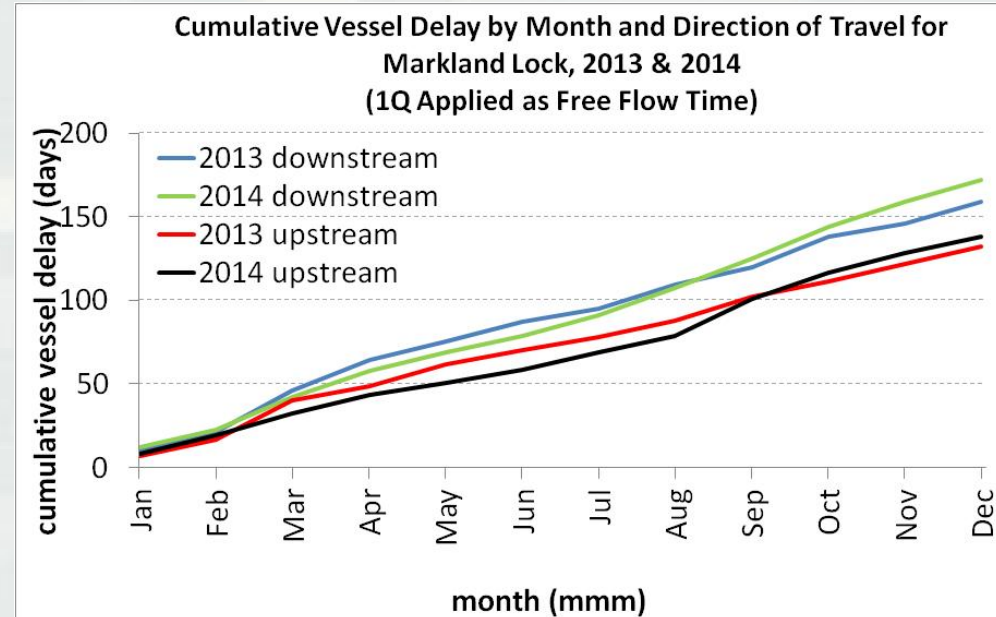
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# Inland Waterways Example



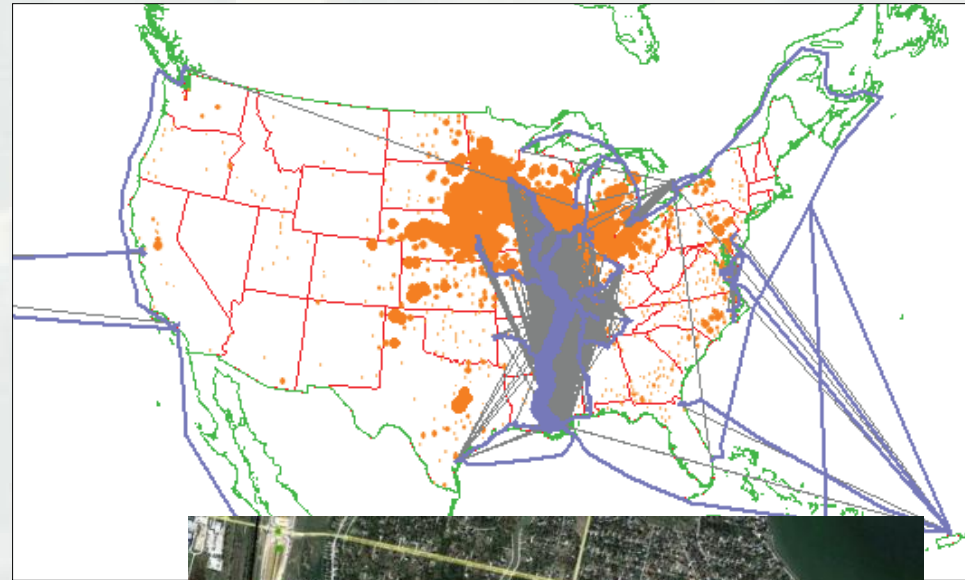
# Inland Waterways Example

- Cumulative delay provides an objective baseline, combining congestion metric (avg. delay) with traffic volume.
- Performance can be tracked through time, comparisons made between locks, and correlations with nearby segments tracked ~> system disruptions.



# Towards Freight Fluidity Analysis

- Ultimately we seek a means of evaluating the performance of entire intermodal freight supply chains.
- Data from across the spectrum help inform this process.
- Opportunity to merge AIS and GPS probe datasets with traditional reported data to provide a more complete picture of intermodal freight fluidity.





# Data Sources and Performance Measures for the Marine Transportation System

## Questions?

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**601-634-2022**



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