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AIS Data: An Overview of Free Sources

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PURPOSE: The purpose of this Coastal and Hydraulics Engineering technical note (CHETN) is to describe the sources of Automatic Identification System (AIS) data available to the public, with a focus on federal employees who may need AIS data to carry out their official duties. AIS data, in this context, refer to both real-time and historic vessel position information.

INTRODUCTION: The AIS carried by vessels was originally designed to improve safety and collision reduction by improving maritime domain awareness. The technical specifications for AIS have been published through the multiple international associations involved in setting the standards that allow AIS to work all over the globe (IALA 2008; IEC 2001; ITU-R 2014; PIANC 2019). In US waters, the US Coast Guard (USCG) is the authority for setting AIS carriage requirements and archiving AIS transmissions within US waters. The information from these historic vessel movements has been used to investigate a wide variety of topics including dredged material placement (Ferguson and Kress 2022; Kress et al. 2020; Kress 2022; Mitchell and Scully 2014; Tabbert et al. 2020); vessel approach to locks (Tabbert et al. 2021); the *fluidity* of freight-carrying vessels approaching a large port (Kruse et al. 2022); designing storm surge barriers with vessel passage (Kress and Weintraub 2021); vessel dwelltime in ports (USDOT–BTS, n.d.); the impact of structure sheltering on vessel passage (Young and Scully 2018); and shipping connectivity and disruptions within a network (Scully and Chambers 2019; Touzinsky et al. 2018; Kress et al 2021). Figure 1 displays two images of vessel tracklines recreated from historic AIS data at different spatial and time scales; at left is the area between Miami, Florida, and the Bahamas, and at right is the channel leading to the Port of Brunswick, Georgia, after a vessel capsized next to the channel in 2019.

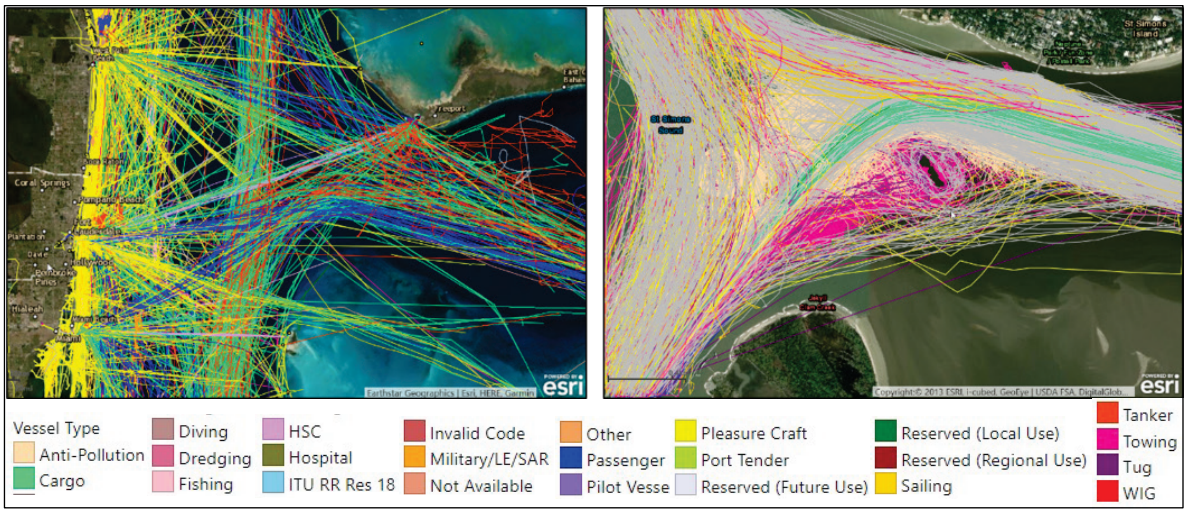

Figure 1. Vessel tracklines recreated from historic Automatic Identification System (AIS) data. *Left panel*: the coast of Miami, Florida, to the Bahamas in February 2020. *Right panel*: 100 days of vessel traffic in St. Simons Sound at Brunswick, Georgia, after the Golden Ray capsized in September 2019. *Both panels*: Tracklines are color coded by vessel type; these images show mostly cargo, pleasure craft, passenger, towing, and reserved. Source: US Coast Guard (USCG) Nationwide Automatic Identification System (NAIS) data processed through the AIS Analysis Package (AISAP) software (USACE 2018).

A visual example of connectivity is shown in Figure 2, with AIS data represented as a signal density map (heatmap) in Hawaii. The studies cited above (and numerous others) required AIS position report data as the *raw data* for analysis; other studies may use data derived from AIS position reports (e.g., transit counts). Since 2016, AIS carriage requirements include most commercial self-propelled vessels on US navigable waterways including any commercial vessel over 65 ft* in length, towing vessels over 26 ft in length with a greater than 600 hp engine, vessels certified to carry 150 or more passengers, dredges in or near a commercial channel, and vessels moving certain dangerous cargo (USCG 2018; US Code of Regulations 2019). This has resulted in an extensive archive of vessel position data that can be analyzed to answer important questions about waterway utilization. This CHETN provides an overview of existing AIS data sources that are generally provided for free and relevant details which may influence the choice of source selection.

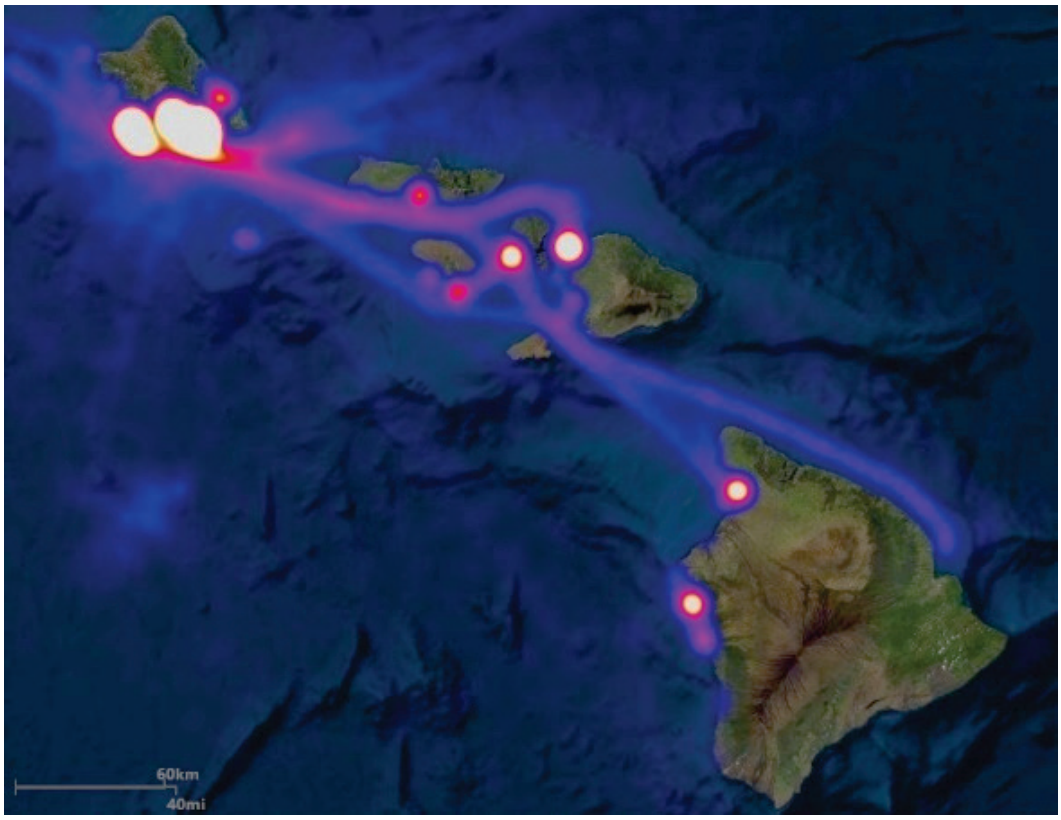

Figure 2. Signal density map showing vessel traffic in Hawaii from 15 June to 31 December 2017. Source: USCG NAIS data processed through the AISAP (USACE 2018).

METHOD: A list of AIS data sources was compiled (Table 1); additional information about each source is provided in the table. Additional sources, such as those that allow users to view vessel position data (but not download it) or that charge a fee to download data, were outside the scope of this survey.

*For a full list of the spelled-out forms of the units of measure and unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248–52 and 345–7, respectively. https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

Table 1. AIS data source comparison of spatial coverage and data availability.

Source Name	Website or Point of Contact	Individual Vessel Data Download Available	Spatial Coverage	Immediate Data Download Available	Access/ Use Restrictions
USCG AIS Historical Requests	https://www.navcen.uscg.gov/contact/ais-historical-request	Yes	Global	No	Yes
Marine Cadastre	https://marinecadastre.gov/ais/	Yes, for data from years 2015 and later	US	Varies, predefined areas immediately available	No
PROTEUS	Mr. Alan Hope, Proteus Program Manager, alan.hope@nrl.navy.mil	Contact for details	Contact for details	Contact for details	Yes
SeaVision	https://seavision.volpe.dot.gov/login?r=~2F	Yes	Global	Yes*	Yes
Maritime Safety and Security Information System (MSSIS)	https://mssis.volpe.dot.gov/Main/index.html	Yes	Global	No	Yes
Global Maritime Traffic Density Service	https://globalmaritimetraffic.org/index.html	No	Global	Yes	No
US Army Corps of Engineers AISAP	https://aisap.usacegis.us/aisap_portal/home.html	Yes	US	Varies*	Yes
ESRI Living Atlas, US Vessel Traffic	https://livingatlas.arcgis.com/vessel-traffic/	No, tracklines only	US	Yes	No

*Immediate download available after log-in, account creation required.

RESULTS: Additional commercial sources of AIS data exist beyond those presented here, and the sources listed that are currently accessible for free for US government employees may change their availability and functionality through time. However, this inventory is intended to serve as a starting point for managers, policy analysts, and researchers who need to acquire AIS data for their own purposes. Additional summary information about sources listed in Table 1 is included below.

US Coast Guard (USCG) Automatic Identification System (AIS) Historical Data Requests. From the form on the website https://www.navcen.uscg.gov/contact/ais-historical-request, users can request raw AIS data (NMEA 0183 Data File) or derived products such as comma separated values files, heatmaps, or Keyhole Markup Language files. Users must specify the coordinates of a bounding box for their request, as described on the website. Results are transmitted via a file transfer site once ready (USCG, n.d.).

Marine Cadastre–Data Download. Users can download 1 min sampling rate data for predefined dates and spatial areas at https://marinecadastre.gov/ais/. Different options are available depending on the year for which data are desired. The data from "2009 through 2014 are filtered to one minute [sampling rate] and formatted in zipped, monthly files by Universal Transverse Mercator (UTM) zone. . . . . For records from 2010 through 2014, ship name and call sign fields have been removed, and the MMSI (Maritime Mobile Service Identity) field has been encrypted . . . ." but later years have

these elements included. AIS records "for 2015 through present day are filtered to one minute and formatted in zipped, daily files for all US coastal waters" (NOAA-OCM 2022). At the time this publication was assembled, there is a delay of several months before the daily data become available for download.

Marine Cadastre–AccessAIS tool. Users can draw a box on top of a map and set a time range using a slider bar to set the request area at *https://marinecadastre.gov/accessais/*; the interface is shown in Figure 3. After the request has been submitted, users get an email from an account named "OCM AccessAIS" (email: *ocm.AccessAIS@noaa.gov*) with the details of the request and another email notification when the request is available for download. A sample request with the following parameters for the Newport, Oregon, area took approximately 4 hr to complete and be ready for download in June 2022:

[Date] From = 2017–01–01
[Date] To = 2022–03–31
X Min = −124.05851942510897
Y Min = 44.621307082562936
X Max = −124.03619900761382
Y Max = 44.633221026874395
File Size = 266.16 mb (NOAA-OCM 2022)

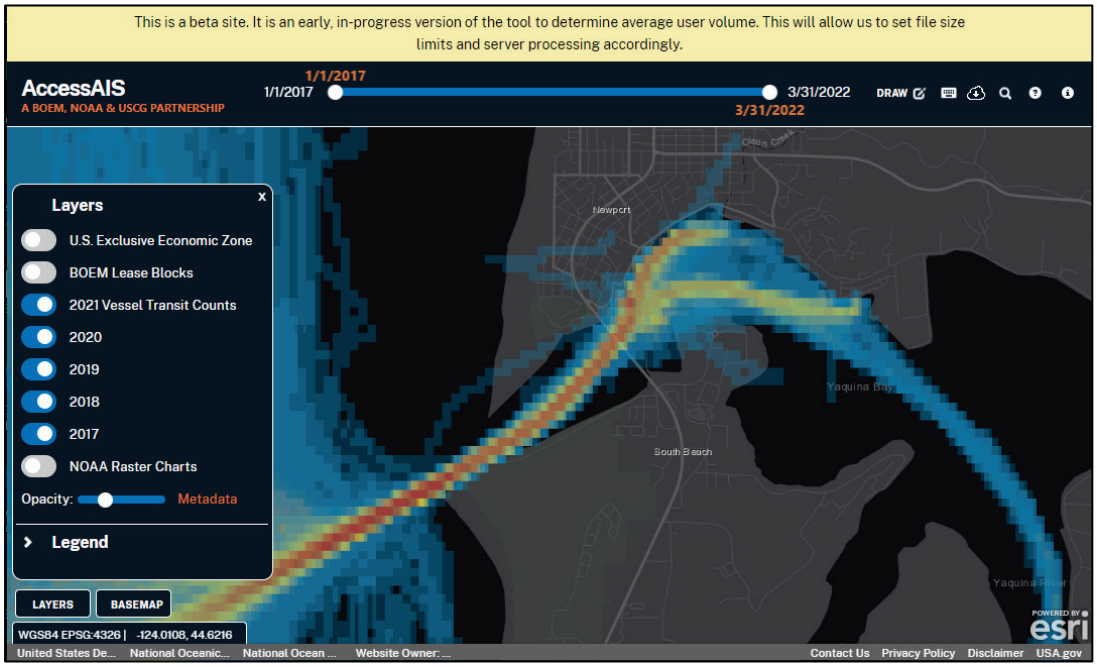

Figure 3. Screenshot from the Marine Cadastre–Access AIS website, displaying a signal density map for the Newport, Oregon, area from 1/1/2017 to 3/31/2022 (NOAA-OCM 2022).

PROTEUS. PROTEUS is an integrated system providing near real-time global maritime domain awareness. This is accomplished by supplying multisource data ingestion and fusion services at all security domains and automatically generating and maintaining worldwide vessel tracks. The PROTEUS system comprises a data collector and aggregator, a multisource data fusion engine, a complex event processor, a maritime domain awareness services layer and web-based common

operating picture/analytic tools.† All interested parties are directed to contact Mr. Alan Hope (*alan.hope@nrl.navy.mil*), PROTEUS program manager, for additional information and access requests.

SeaVision. The SeaVision website is run through the US Department of Transportation's Volpe Transportation Systems Center and was designed specifically for use by the US government and government agencies of international partner nations (USDOT, *SeaVision*, n.d.). SeaVision is a "web-based maritime situational awareness tool that enables users to view and share a broad array of maritime information"; this includes the ability to view and track the position of vessels around the world (USDOT, "SeaVision," n.d.). Users who wish to gain access may visit the website (*https://seavision.volpe.dot.gov/*) to request an account.

Maritime Safety and Security Information System (MSSIS). The Maritime Safety and Security Information System (MSSIS) is run by the US Department of Transportation's Volpe Transportation Systems Center and is the source of the AIS data used in SeaVision. MSSIS AIS data are in its *raw* NMEA 0183 format, so an application that can read and display raw AIS data is required. Volpe provides a free application (TV32), but other commercial off-the-shelf applications are available. MSSIS is live data, so there is no ability to download historical data (USDOT, "Maritime Safety," n.d.).

Global Maritime Traffic Density Service (GMTDS). The primary data products are maritime traffic density rasters, based on cleaned and enriched raw AIS messages from individual vessels that have been aggregated into 1 km^2 grid cells, displaying the cumulative time spent in each grid cell for all vessels in a given month. These time-density data are updated monthly and available historically for over 10 yr (GMTDS 2022). Figure 4 presents an example of the global vessel density map (in units of Vessel Hours per square kilometer) available on the Global Maritime Traffic Density Service (GMTDS) website (GMTDS 2022).

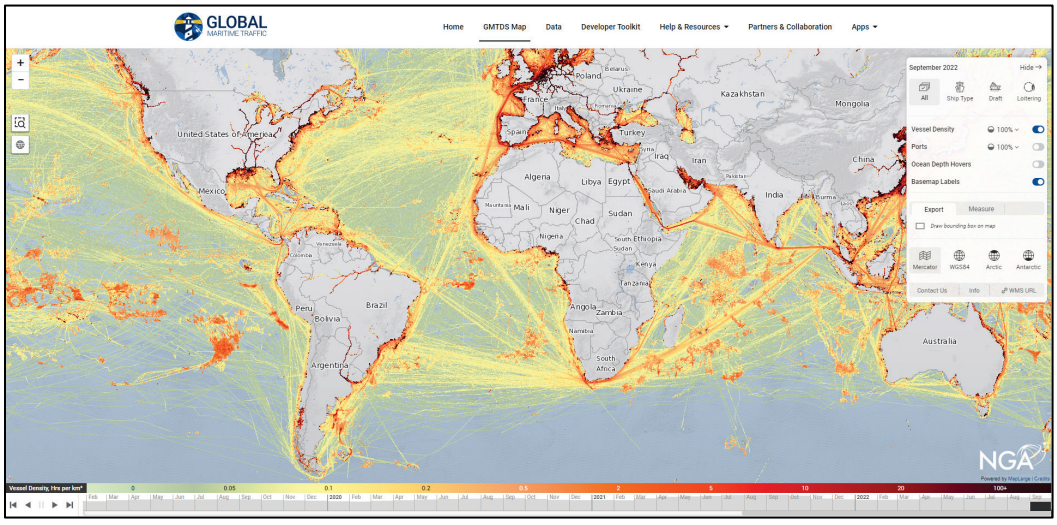

Figure 4. Global vessel density map (hours per square kilometer) from the Global Maritime Traffic Density Service (GMTDS) website (GMTDS 2022). *Darker red* colors indicates greater vessel density.

† Alan Hope, pers. comm., PROTEUS information, 21 July 2022.

US Army Corps of Engineers AIS Analysis Package (AISAP). The US Army Corps of Engineers AIS Analysis Package (AISAP) tool imports AIS data from the USCG Nationwide Automatic Identification System (NAIS) archive to an environment where users can visualize historical data using tracklines (Figure 1) or heatmaps (Figure 2) and explore various statistical summaries for the time, place, and vessel population of interest. Figure 5 shows an example of an AISAP-generated vessel speed plot showing the daily average speed (blue line) and 10-day moving average speed (red line) for vessels within a defined space and time. Summaries like these are automatically calculated and available to the user for each user-defined area of interest within a project.

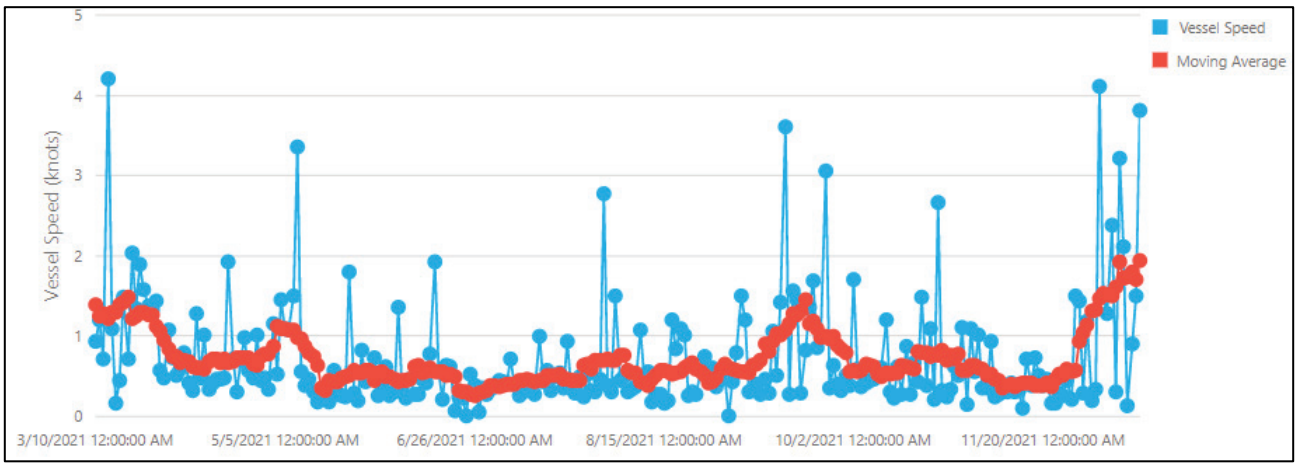

Figure 5. Sample multimonth vessel speed plot, showing daily average speed for vessels in the area of interest (*blue line*) and a centered 10-day moving average (*red line*). Created using AIS data from USCG NAIS archive, processed in the AISAP software (USACE-ERDC 2018).

ESRI Living Atlas, US Vessel Traffic. The US Vessel Traffic sites provide AIS tracklines starting in January 2017 and allow users to download individual monthly files for the vessel categories of Cargo, Fishing, Military, Passenger, Pleasure, Tanker, Tow, or Other (ESRI, n.d.). There are also different *zoom* levels available based on National Oceanic and Atmospheric Administration electronic chart levels (level 1, 2, or 3); if users want to download a smaller spatial area, these options are located under the Download Options menu (ESRI, n.d.).

SUMMARY: Multiple sources of AIS data exist; some are available to the general public via the internet or upon request while others require registration and permission to access. Questions about using historical vessel position to research waterway utilization may be directed to the authors.

ADDITIONAL INFORMATION: This CHETN was prepared by Marin Kress, Marin.M.Kress@usace.army.mil, Coastal and Hydraulics Laboratory (ORCiD https://orcid.org/0000-0002-5835-5686), US Army Engineer Research and Development Center. Special thanks to the USCG Navigation Center for provision of AIS data to the US Army Corps of Engineers (USACE) and the dedicated employees supporting AISAP. Publication of this study was funded by the USACE Navigation Systems Research Program. This technical note should be cited as follows:

> Kress, M. M., and K. N. Mitchell. 2023. *AIS Data: An Overview of Free Sources*. ERDC/CHL CHETN-IX-62. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/46491.

REFERENCES

ESRI. n.d. "US Vessel Traffic." Accessed 19 October 2022. https://livingatlas.arcgis.com/vessel-traffic.

Ferguson, M. W., and M. M Kress. 2022. *AIS Data Case Study: Dredge Material Placement Site Evaluation in Frederick Sound Near Petersburg, Alaska*. ERDC/CHL CHETN-IX-60. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/44141.

GMTDS (Global Maritime Traffic Service Density). 2022. "Global Maritime Traffic Service Density: Home." https://globalmaritimetraffic.org/index.html.

IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities). 2008. *Establishment of AIS as an Aid to Navigation*. Report ID 1062. https://www.iala-aism.org/product/establishment-of-ais-as-an-aid-to-navigation-1062/.

IEC (International Electrotechnical Commission). 2001. *EC 61993-2: 2001-12 Maritime Navigation and Radiocommunication Equipment and Systems - Automatic Identification Systems (AIS) - Part 2: Class A Shipborne Equipment of the Universal Automatic Identification System (AIS) - Operational and Performance Requirements, Methods of Test and Required Test Results*. https://www.iec.ch/index.htm.

ITU-R (International Telecommunications Union – Radiocommunication Sector). 2014. *Recommendation ITU-R M.1371: Technical Characteristics for an Automatic Identification System Using Time Division Multiple Access in the VHF Maritime Mobile Frequency Band*. https://www.itu.int/rec/R-REC-M.1371/en.

Kress, M. M. 2022. *Vessel Speed Analysis before and after Dredging around Missouri River Mile 282 in November 2020*. ERDC/CHL CHETN-IX-59. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/43283.

Kress, M. M., B. J. Tetreault, K. N. Mitchell, M. Balazik, and M. C. Booton 2020. *AIS Data: Real-Time Operation Support, Incident Investigations, and Waterway Use Analysis*. ERDC/CHL CHETN-IX-53. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/36395.

Kress, M. M., and S. Weintraub. 2021. *AIS Data Case Study: Selecting Design Vessels for New Jersey Back Bays Storm Surge Barriers Study.* ERDC/CHL CHETN-I X- 54. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/39779.

Kress, M. M., D. L. Young, K. F. Chambers, and B. M. Scully. 2021. *AIS Data Case Study: Quantifying Connectivity for Six Great Lakes Port Areas from 2015 through 2018*. ERDC/CHL CHETN-IX-56 Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/40720.

Kruse, C. J., D. H. Kang, K. N. Mitchell, P. K. DiJoseph, and M. M. Kress. 2022. *Freight Fluidity for the Port of Baltimore: Vessel Approach and Maritime Mobility Metrics*. ERDC/CHL TR-22-1. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/43000.

Mitchell, K. N., and B. N. Scully. 2014. "Waterway Performance Monitoring via Automatic Identification System (AIS) Data." *Transportation Research Record: Journal of Transportation* 2426 (1): 20–26. https://doi.org/10.3141/2426-03.

NOAA–OCM (NOAA, Office for Coastal Management). 2022. "MarineCadastre.gov: Vessel Traffic Data." https://marinecadastre.gov/ais/.

PIANC (The World Association for Waterborne Transport Infrastructure). 2019. *Guidelines and Recommendations for River Information Services. InCom Working Group*. Report Number 125/I-2019. https://www.pianc.org/publications/inland-navigation-commission/wg125-1.

Scully, B. M., and K. F. Chambers. 2019. "Measuring Port Disruptions with Automatic Identification System Data." *Ports 2019: Port Planning and Development.* Reston, VA: American Society of Civil Engineers.

Tabbert, C., J. Vest, A. Rhoads, D. Myers, T. Lauth, E. Brauer, J. Wallace, D. Gordon, and M. Kress. 2020. *AIS Data Case Study: St. Louis Area Commercial Vessel Fleeting Activity and Potential River Training Structures*. ERDC/CHL CHETN-IX-52. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. http://dx.doi.org/10.21079/11681/36334.

Tabbert, C. R., J. C. Vest, and M. M. Kress. 2021. "Waterway Engineering Applications of Automatic Identification System Data along the Mississippi River and at Lock Structures." *Journal of Waterway, Port, Coastal, and Ocean Engineering,* 147 (5): 04021020. https://doi.org/10.1061/(ASCE)WW.1943-5460.0000658.

Touzinsky, K. F., B. M. Scully, K. N. Mitchell, and M. M. Kress. 2018. "Using Empirical Data to Quantify Port Resilience: Hurricane Matthew and the Southeastern Seaboard." *Journal of Waterway, Port, Coastal, and Ocean Engineering* 144(4): 05018003. https://ascelibrary.org/doi/10.1061/%28ASCE%29WW.1943-5460.0000446.

USACE (US Army Corps of Engineers). 2018. *AIS Analysis Package (AISAP).* Software Package. Technical Lead K. N. Mitchell. https://aisap.usacegis.us/aisap_portal/home.html.

USCG (US Coast Guard). 2018. *Navigation Center: Automatic Identification System Overview*. Accessed 19 October 2022. http://www.navcen.uscg.gov/?pageName=AISmain.

USCG. n.d. "AIS Historical Request Form." Accessed 19 October 2022. https://www.navcen.uscg.gov/contact/ais-historical-request.

US Code of Regulations. 2019. *Title 33–Navigation and Navigable Waters*. "Part 164–Navigation Safety Regulations." 33 C.F.R. § 164.46. Washington, DC. https://www.govinfo.gov/content/pkg/CFR-2019-title33-vol2/xml/CFR-2019-title33-vol2-part164.xml.

USDOT (US Department of Transportation). n.d. *SeaVision.* Accessed 19 October 2022. https://seavision.volpe.dot.gov/login?r=~2F.

USDOT. n.d. *Maritime Safety & Security Information System*. Accessed 31 October 2022. https://mssis.volpe.dot.gov/Main/index.html.

USDOT–BTS (US Department of Transportation, Bureau of Transportation Statistics). n.d. "Port Performance Freight Statistics Program." Accessed 19 October 2022. https://www.bts.gov/ports.

Young, D., and B. Scully. 2018. "Assessing Structure Sheltering via Statistical Analysis of AIS Data." *Journal of Waterway, Port, Coastal, and Ocean Engineering* 144 (3): 04018002. https://doi.org/10.1061/(ASCE)WW.1943-5460.0000445.