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Navigation Systems Research Program

Inland Marine Transportation System Fluidity

Case Studies from the Ohio River, Lower Mississippi River, and Gulf Intracoastal Waterway

Kenneth N. Mitchell, Patricia K. DiJoseph, Matthew Chambers, and Marin M. Kress

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"Port Performance and Resiliency"

Abstract

Freight fluidity, defined here as travel time reliability or consistency, has important implications for many sectors of the national economy. Due to limited information, waterway fluidity has historically been difficult to measure. However, with time-stamped and geo-referenced vessel position reports now available through the U.S. Coast Guard Nationwide Automatic Identification System archives, it is possible to conduct detailed examinations of fluidity along most portions of the U.S. inland waterway system. This report presents case studies of waterway fluidity and seasonal trends for three heavily trafficked segments of the inland waterway system: the Upper Ohio River from the Port of Pittsburgh to the Ports of Cincinnati-Northern Kentucky (above the metropolitan Cincinnati, OH area), the Lower Mississippi River Main Stem from the Port of Metropolitan St. Louis to the Port of South Louisiana near New Orleans, LA, and the Gulf Intracoastal Waterway from the Port of Houston, TX, to the Port of South Louisiana near New Orleans, LA.

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Preface

This study was conducted as part of a reimbursable project for the U.S. Department of Transportation, Bureau of Transportation Statistics, through an interagency agreement (number DTOS5917X00596) with the U.S. Army Corp of Engineers Navigation Systems (NavSys) Research Program, Work Unit 476923, “Port Performance and Resiliency.” The NavSys Program Manager was Mr. Charles E. Wiggins, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC-CHL). The work was performed by the Coastal Engineering Branch of the Navigation Division and the Navigation Branch of the Navigation Division. At the time of publication of this report, Ms. Lauren Dunkin was Chief of the Coastal Engineering Branch, and Mr. Benjamin Burnham was Chief of the Navigation Branch; Dr. Jacqueline S. Pettway was Chief of the Navigation Division, ERDC-CHL; Mr. Charles E. Wiggins was the ERDC Technical Director for Navigation. The Director of ERDC-CHL was Dr. Ty V. Wamsley, and the Deputy Director was Mr. Jeffrey R. Eckstein.

Valuable reviews of the draft version of this report were provided by Ms. Katherine Chambers and Dr. Brandan Scully, ERDC-CHL.

Figures 1 and 3 of this report were created by Ms. Kelsey Taylor of the U.S. Department of Transportation as part of a collaborative work effort.

The Commander of ERDC was COL Teresa A. Schlosser, and the Director was Dr. David W. Pittman.

1 Introduction

Background

Many businesses depend on reliable transportation systems and require consistent network performance to plan shipments and operate efficiently. This transportation movement reliability is called *fluidity* and is measured by assessing travel time consistency for the mode or modes of interest (Transportation Research Board 2016).

Objective

This report demonstrates the use of Automatic Identification System (AIS) data to quantify measures of fluidity for several port-to-port corridors along the U.S. inland maritime transportation system.

Approach

To explore inland port fluidity, this report examines three different inland waterway corridors; each corridor connects two inland ports relevant to the 2017 Top 25 port lists from U.S. Department of Transportation, Port Performance Freight Statistics Report (U.S. Department of Transportation, Bureau of Transportation Statistics 2018). Travel time consistency is assessed for vessels transiting waterways connecting each port pair. In this context, fluidity is not synonymous with total travel time; rather, it is an indicator of travel time dependability, reliability, or predictability. Applied thusly, fluidity is a useful indicator of port performance. The AIS-derived travel time observations presented here demonstrate the capability to monitor port performance in terms of fluidity; however, myriad variable factors such as directional flow currents, weather conditions, traffic congestion at navigation locks, and seasonal demand for specific commodities can contribute to fluidity. Therefore, additional work and data sets are needed before definitive conclusions can be made concerning the main underlying drivers of travel time reliability along any particular portion of waterway.

2 Methods

Data source

To support the analysis presented in this report, archived vessel position reports from calendar year 2017 were sampled from the U.S. Coast Guard Nationwide Automatic Identification System (NAIS). Position reports were acquired through web services provided by the NAIS to the U.S. Army Corps of Engineers AIS Analysis Package (AISAP) web tool (https://ais-portal.usace.army.mil) (USACE-ERDC 2018). Automatic Identification System (AIS) vessel position reports provide a date-time stamp for vessels within the port areas defined for this study.

Key assumptions

Vessel travel times between the inland ports that define the three respective corridors were inferred by comparing the date-time stamps of unique vessels as they moved from one port to another. Due to the computational processing expense involved, it is impractical to analyze the entire track of every vessel transiting between the respective ports. Therefore, it is not known whether any particular observed transit involves stoppages for loading or unloading of cargo, refueling, crew changes, or other activities that incur delays in the travel time but that cannot be attributed to waterway performance per se. This knowledge gap is an area for potential future improvements in this type of analysis.

Analysis of the full population of observed transits and associated travel times typically shows a clear grouping of trips that can be inferred to have made “straight shot” transits. A “straight shot” transit in this context is one in which the vessel travels directly from origin to destination, with no detours, prolonged stops, or significant interruptions. Experience working with similar data sets shows that using the 25th percentile travel time serves as a practical baseline for establishing “free flow” conditions (with no meaningful delays encountered) on the waterway segment in question. In turn, this baseline is helpful—along with other statistical measures such as median, mean, and standard deviation—when setting an upper bound on what are considered to be valid travel times for the purposes of the fluidity assessment.

Inland port overview

Inland ports and their riverfront facilities are part of the U.S. Inland Marine Transportation System (IMTS), which includes more than 12,000 miles of navigable inland waterways and is part of the larger U.S. Marine Transportation System (MTS). On average, approximately 500 million tons of cargo move along the IMTS annually. This cargo movement is critical for the domestic agriculture, construction, and energy economic sectors.

Inland ports are collections of terminals and freight transfer facilities. These facilities may be physically concentrated or spread out across a broad geographic area. Some inland ports are located along several miles of riverfront while others span significantly longer areas of the waterway (e.g., Ports of Cincinnati-Northern Kentucky span over 200 miles of river). In contrast, coastal ports such as the Ports of Oakland or Boston are typically located within a relatively compact physical area.

Inland waterways analyzed in this report consist mostly of Congressionally designated fuel-taxed inland waterways (shown in Figure 1). There are approximately 11,000 miles of fuel-taxed waterways, as defined in 33 U.S.C. § 1804 (USGAO 2016). However, as broadly understood, the term *inland waterways* also includes inland waterways along the deep-draft portions of the Lower Mississippi River Main Stem (downriver from Baton Rouge, Louisiana) and the Lower Columbia River below Portland, Oregon; the Okeechobee Waterway in Florida, and portions of the intracoastal waterway along the Florida Gulf coast. These waterways are included as part of the total inland network displayed in yellow in Figure 1.

Figure 1. Major U.S. IMTS waterways. Source: U.S. Department of Transportation, Bureau of Transportation Statistics based on U.S. Army Corps of Engineers, Fuel-Taxed Inland Waterway System at https://www.iwr.usace.army.mil/.

As shown in Table 1 and Figure 2, the IMTS primarily carries bulk commodities such as coal, grains, aggregates, and petroleum products. The overall cargo mix is diverse, with year-over-year commodity totals fluctuating in response to regional, national, and global economic forces.

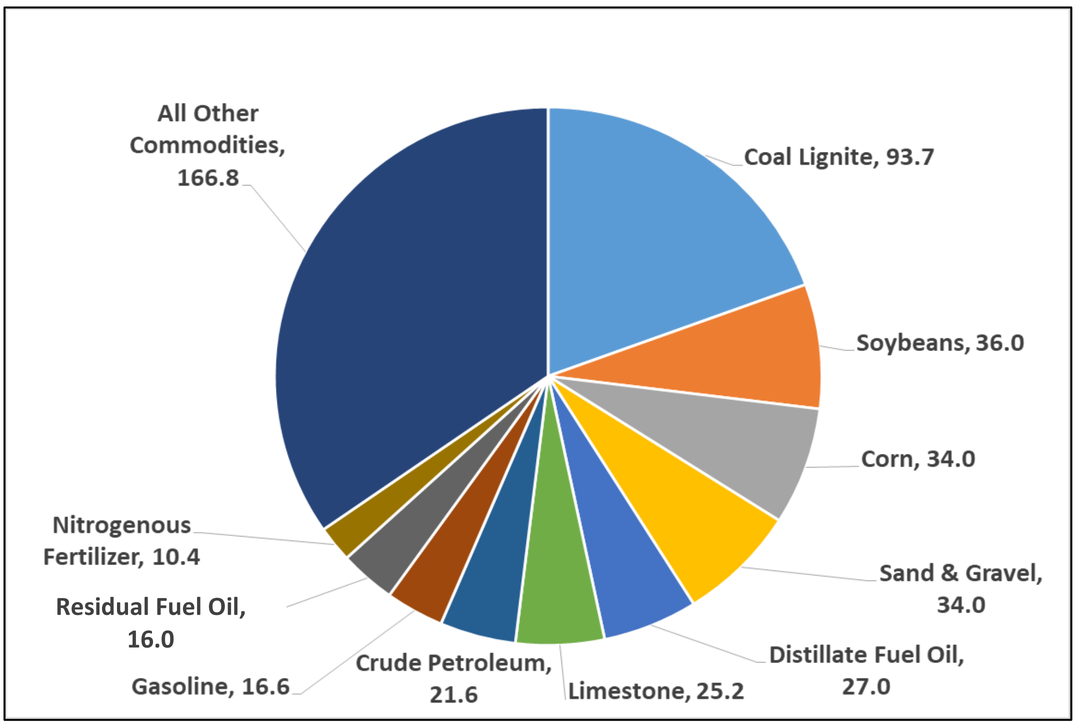
Table 1. IMTS commodity summary and 5-year trends.

Commodity Type	Total Short Tons FY2017		Average Distance Traveled	
	Tons x 1 million	5 yr % change	Miles	5 yr % change
Coal Lignite	93.7	-40.0%	334	-23.3%
Soybeans	36.0	+53.0%	982	+4.6%
Corn	34.0	+33.0%	1,114	+3.0%
Sand and Gravel	34.0	+23.1%	207	-4.4%
Distillate Fuel Oil	27.0	+11.6%	273	+10.2%

Commodity Type	Total Short Tons FY2017		Average Distance Traveled	
	Tons x 1 million	5 yr % change	Miles	5 yr % change
Limestone	25.2	+11.0%	378	-0.2%
Crude Petroleum	22.2	-18.1%	308	-11.9%
Gasoline	16.6	+12.0%	265	+4.9%
Residual Fuel Oil	16.0	-17.7%	229	-5.6%
Nitrogenous Fertilizer	10.4	+25.8%	954	-1.7%
All Other Commodities	166.8	+2.4%	604	-1.3%
TOTAL	481.9	-5.9%	513.5	+2.3%

SOURCE: U.S. Army Corps of Engineers, Waterborne Commerce Statistic Center data as processed via the Channel Portfolio Tool (CPT), special tabulation, October 2018.

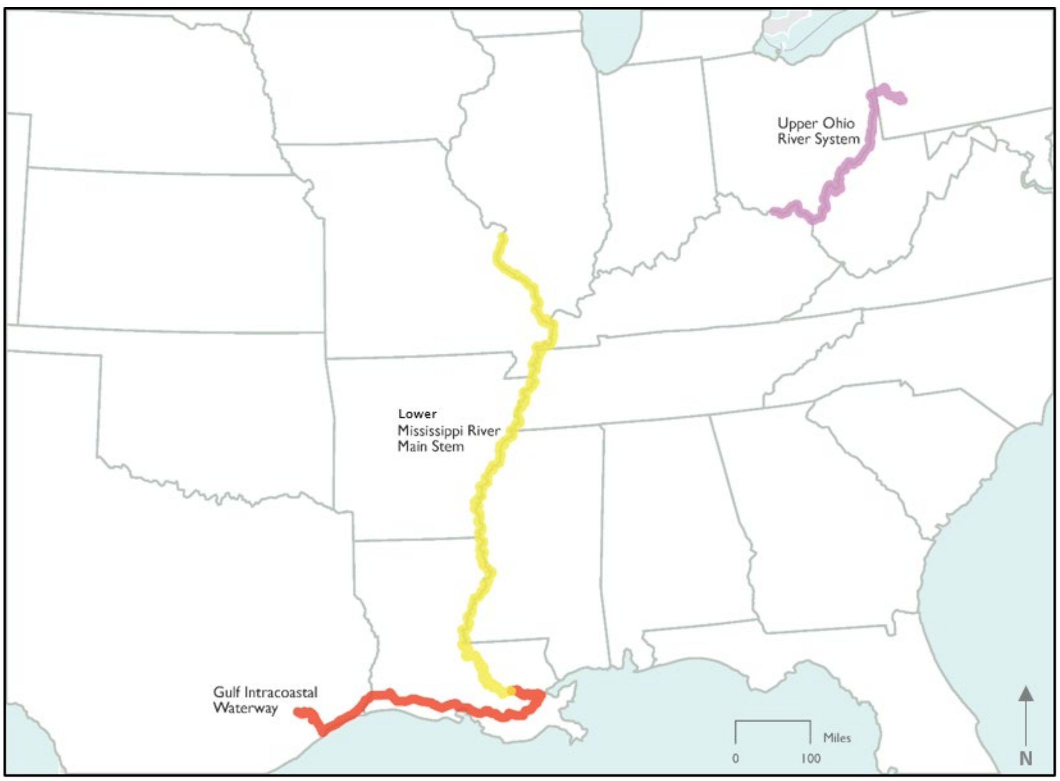
Figure 2. Distribution of major commodities transported on U.S. inland waterway system, fiscal year 2017. The group "All Other Commodities" includes multiple commodities such as manufactured goods, other agricultural products, forest products, and other chemicals. Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistic Center data as processed via the CPT, special tabulation, October 2018.



As shown in Figure 2, coal is the single largest commodity type shipped via the IMTS, with many movements originating at ports along the Ohio River system; in the last 5 years, the total tonnage and average distance traveled for coal has decreased. Agricultural shipments from ports in the

Midwestern interior, bound for export via the Lower Mississippi River, characterize much of the other cargo movement along the IMTS. Petroleum products (e.g., distillate fuel oil, crude petroleum, gasoline, and residual fuel oil) and bulk chemical (e.g., nitrogenous fertilizer, ammonia, inputs for various plastics) shipments originating along the Gulf Intracoastal Waterway (GIWW) and Lower Mississippi River also represent a significant percentage of overall IMTS commodity flows. Figure 3 provides a map view of the three waterway corridors examined in this report and the port pairs that they connect.

Figure 3. IMTS section corridors analyzed in this report: (1) Upper Ohio River System (pink), (2) Lower Mississippi River Main Stem (yellow), (3) Gulf Intracoastal Waterway connecting Houston, TX, and New Orleans, LA (red). Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2018).



The Upper Ohio River System connects the Port of Pittsburgh to the Ports of Cincinnati-Northern Kentucky. The Lower Mississippi River Main Stem connects the Port of Metropolitan St. Louis with the Port of South Louisiana (Figures 3 and 8). The GIWW connects the Port of Houston with the Port of South Louisiana (Figure 6). The commodities moving between these respective port pairs represent industrial sectors that are highly dependent upon the availability of safe, reliable, and cost-effective marine transportation. The sections below provide assessments of fluidity along each of these waterway corridors. In reality, all of these waterway corridors interact with the larger, more expansive IMTS; however, for the purposes of this project, these three port pairs were selected for closer examination.

Fluidity assessment 1: Corridor between Port of Pittsburgh and the Ports of Cincinnati-Northern Kentucky (Upper Ohio River)

The Port of Pittsburgh is connected to the Ports of Cincinnati-Northern Kentucky by a 386-mile stretch of the Upper Ohio River. This stretch of river includes 11 navigation lock structures necessary to ensure year-round navigable depths of at least 9 feet to support cost-effective shipping. Though critical to the viability of the Ohio River navigation system, the locks also represent traffic bottlenecks that can significantly impact travel time reliability in the event of service outages or traffic-induced congestion delays. Figure 4 provides a map view of the portion of river used in this travel time fluidity assessment. The official extent of the Ports of Cincinnati-Northern Kentucky encompasses over 226 miles of river (Paul 2016), but the section of river used in this analysis does not include the metropolitan Cincinnati, Ohio, area. This portion of the Ohio River was selected to allow a focus on commodity movements in the industrial corridor upriver from the Cincinnati area.

Figure 4. Upper Ohio River between Port of Pittsburgh and Ports of Cincinnati-Northern Kentucky, shown in pink. Navigation locks in yellow.

Table 2 provides the commodity summary by direction for cargo exchanged between the Port of Pittsburgh and the Ports of Cincinnati-Northern Kentucky. Note that this summary captures cargo that originates and terminates within the respective port areas, so the data represent only a small portion of total cargo flows along this section of the Upper Ohio River.

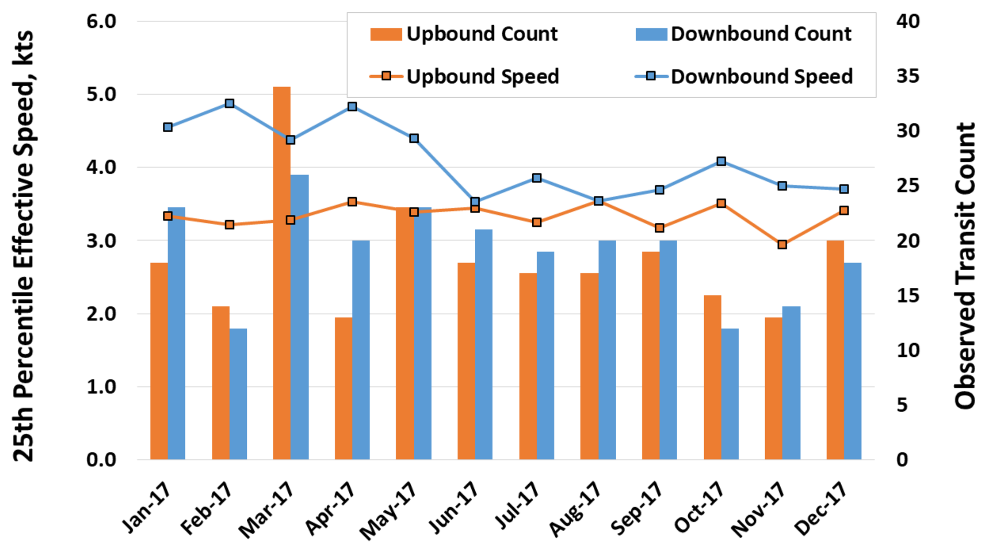
Table 2. Commodity summary by direction for Upper Ohio River, Fiscal Year 2017.

Commodity Type	Originating from Port of Pittsburgh (Terminating at Ports of Cincinnati-Northern Kentucky)	Terminating at Port of Pittsburgh (Originating at Ports of Cincinnati-Northern Kentucky)
Coal Lignite	2,163k	
Sand and Gravel		408.2k
Iron and Steel Scrap	155.2k	25.0k
Gypsum		288.3k
Limestone		90.2k
Coal Coke	51.5k	

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistic Center data as processed via the CPT, special tabulation, October 2018.

AIS vessel position reports were analyzed across the entirety of calendar year 2017, with travel times inferred from the date-time stamps for unique vessels observed within the respective port areas. For the purposes of outlier removal, a 1-week (168-hour) upper bound was applied to the travel time observations, with the remaining sample of data points used for generating summary statistics by month. With this filter applied across the full year, there were 221 observed transits moving downbound from Pittsburgh to the Ports of Cincinnati-Northern Kentucky. There were 228 transits observed moving upbound between these two ports. Figure 5 provides the monthly effective speeds (total distance traveled divided by total travel time) for vessel trips in the 25th percentile of all observed travel times between Port of Pittsburgh and the Ports of Cincinnati-Northern Kentucky.

Figure 5. Effective speed of vessel trips in the 25th Percentile for Travel Time between the Port of Pittsburgh and the Ports of Cincinnati-Northern Kentucky, Calendar Year 2017.



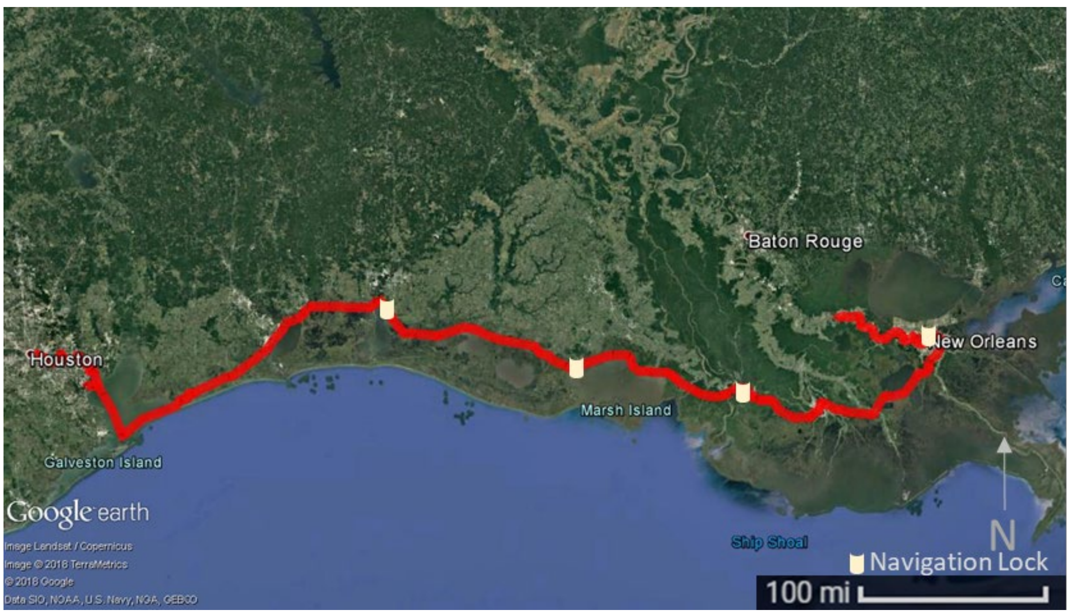
Source: U.S. Army Corps of Engineers, AIS data as processed via the AISAP, special tabulation, October 2018.

Downbound transits go along with the prevailing flow of water, so these transits generally have higher effective speeds than upbound transits. However, overall difference in transit speeds by direction (downbound/upbound) is reduced by the numerous navigation lock and dam structures, which suppress water flow velocities along the Ohio River. Twenty-five percent of the vessel transits in each indicated direction travel faster than the effective speeds shown in Figure 5, while the remaining 75% of observations (within the 7-day limit of normal traffic) travel more slowly. In terms of fluidity throughout the calendar year, the 25th percentile effective speeds for downbound traffic are shown to fluctuate by approximately 36%, with peak values of almost five knots in February and April to lows of approximately 3.5 knots in June and August (coinciding with seasonal variations in snow melt, rainfall, and river flow). Upbound traffic is observed to have more consistent 25th percentile effective speeds throughout the year, albeit slower on average than downbound transits. In terms of actual travel times between the respective ports in 2017, these 25th percentile effective speeds translate to 81.4 hours (3.39 days) for upbound transits and 66.5 hours (2.77 days) for downbound transits.

Fluidity assessment 2: Corridor between Port of Houston and Port of South Louisiana along the Gulf Intracoastal Waterway (GIWW)

In addition to being a major deep-draft port for oceangoing cargo, the Port of Houston is also connected to the rest of the IMTS via the GIWW, which provides a sheltered transportation route for inland towing vessels moving between ports along the U.S. Gulf Coast. As shown by the map view in Figure 6, cargo exchanges between the Port of Houston and the Port of South Louisiana travel along a 425-mile segment of waterway that includes part of the GIWW and part of the Lower Mississippi River.

Figure 6. GIWW between Port of Houston and the Port of South Louisiana, shown in red. Navigation locks shown in yellow.



Vessels following the route illustrated in Figure 6 must transit through four navigation lock structures, each of which can act as a traffic bottleneck in the event of service outages or congestion-driven delays. Table 3 provides the commodity summary by direction for cargo exchanged between the Port of Houston and the Port of South Louisiana. Note that this summary captures cargo that originates and terminates within the respective port areas, so it represents only a portion of total cargo flows along this section of the IMTS that includes portions of multiple waterways including the GIWW, the Houston Ship Channel, the Sabine-Neches Waterway, and the Lower Mississippi River.

Table 3. Commodity flow summary by direction for corridor between Port of Houston and Port of South Louisiana, Fiscal Year 2017.

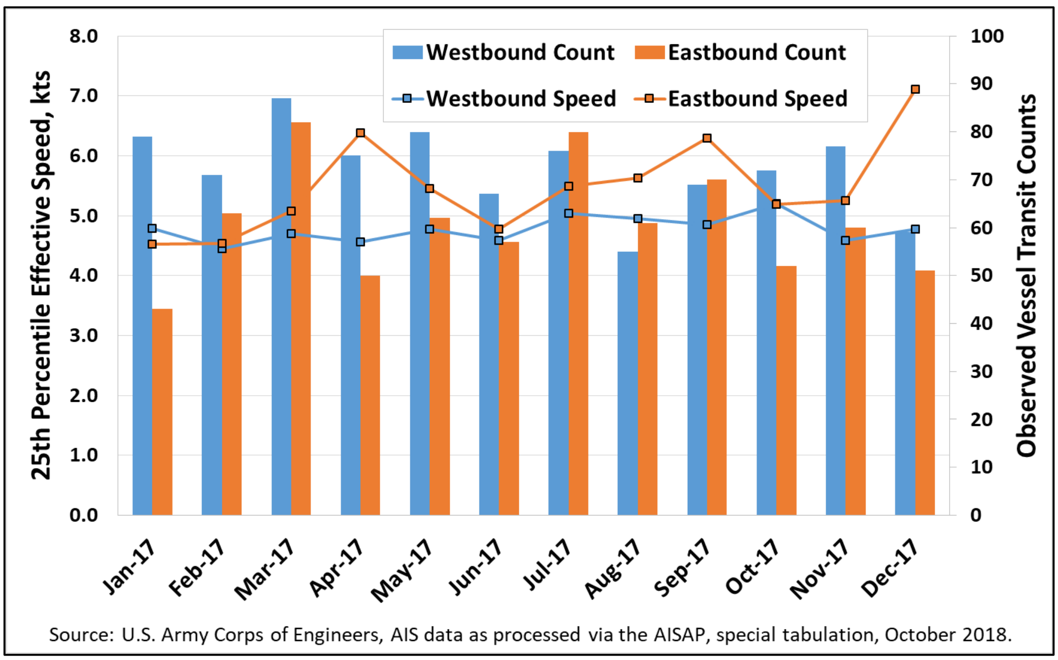
Commodity Type	Originating from Port of Houston (Terminating at Port of South Louisiana)	Terminating at Port of Houston (Originating at Port of South Louisiana)
Gasoline	269.1k	257.0k
Sulphuric acid	260.2k	299.7k
Benzene and Toluene		435.5k
Distillate fuel oil	325.7k	86.0k
Naphtha and solvents	155.6k	193.6k
Residual fuel oil	167.5k	166.4k
Petroleum products not elsewhere classified	145.8k	
Alcohols		88.7k
Asphalt, tar, and pitch		85.3k
Acyclic hydrocarbons		68.1k

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistic Center data as processed via the CPT, special tabulation, October 2018.

Though not shown in Figure 6, there is a secondary inland route that goes from Morgan City, Louisiana, to Baton Rouge and then down the Lower Mississippi River to the Port of South Louisiana. Based on the AIS position reports used for this fluidity assessment, approximately 25% of vessel trips between the Port of Houston and the Port of South Louisiana appear to use this alternate route. The route choice decision is apparently determined by the location of the origin or destination docks along the 54 miles of river encompassed by the Port of South Louisiana. Only the route shown in Figure 6 was considered for the fluidity analysis described here.

As with the previously discussed port pair, AIS vessel position reports covering the entirety of 2017 were analyzed to extract inferred travel times for unique vessels observed in each of the respective port areas. Again, a 1-week (168-hour) upper bound was applied for outlier removal, with the remaining filtered travel time observations used for generation of summary statistics by month. After filtering, there were 867 observed westbound transits from the Port of South Louisiana to the Port of Houston. There were 731 eastbound transits originating from the Port of Houston. Figure 7 shows the 25th percentile effective speeds by month and direction of travel for observed vessel trips between the Port of Houston and the Port of South Louisiana. Interestingly, eastbound traffic is observed to travel faster overall, despite the fact that there are no significant prevailing directional currents along the GIWW (prevailing winds, however, do travel from west to east in this area) (U.S. Department of Commerce 2019). Eastbound traffic also experiences greater variability in 25th percentile effective speeds (and corresponding travel times), with a low of 4.5 knots in January to a peak of over 7 knots in December, with two intermediate peaks in excess of 6 knots throughout the year. In contrast, westbound traffic moves at a more consistent pace with monthly effective speeds for the 25th percentile varying only between 4.4 knots and 5.2 knots. In terms of actual travel times between the respective ports, overall for the year these 25th percentile effective speeds translate to approximately 78 hours (3.25 days) for westbound traffic and 70 hours (2.92 days) for eastbound traffic.

Figure 7. Effective speed of vessel trips in the 25th percentile for travel time between the Port of Houston and the Port of South Louisiana, Calendar Year 2017.



Fluidity assessment 3: Corridor between Port of Metropolitan St. Louis and the Port of South Louisiana (Lower Mississippi River Main Stem)

The Port of Metropolitan St. Louis is located approximately 935 miles upriver from the Port of South Louisiana. Commodity exchanges between these two ports must navigate the Lower Mississippi River Main Stem, one of the most highly trafficked waterways in the world. Below St. Louis, Missouri, the river is free flowing, as there are no lock and dam structures to control water depths for navigation. As such, water levels and associated currents can vary significantly throughout the calendar year, with navigable conditions for commercial shipping threatened during extremely high and low river stages. However, the absence of navigation locks also removes the potential for shipping delays due to service outages and traffic congestion at the lock sites. Figure 8 provides a map view of this critical portion of the IMTS.

Figure 8. Lower Mississippi River Main Stem, shown in yellow, between Port of Metropolitan St. Louis and the Port of South Louisiana.

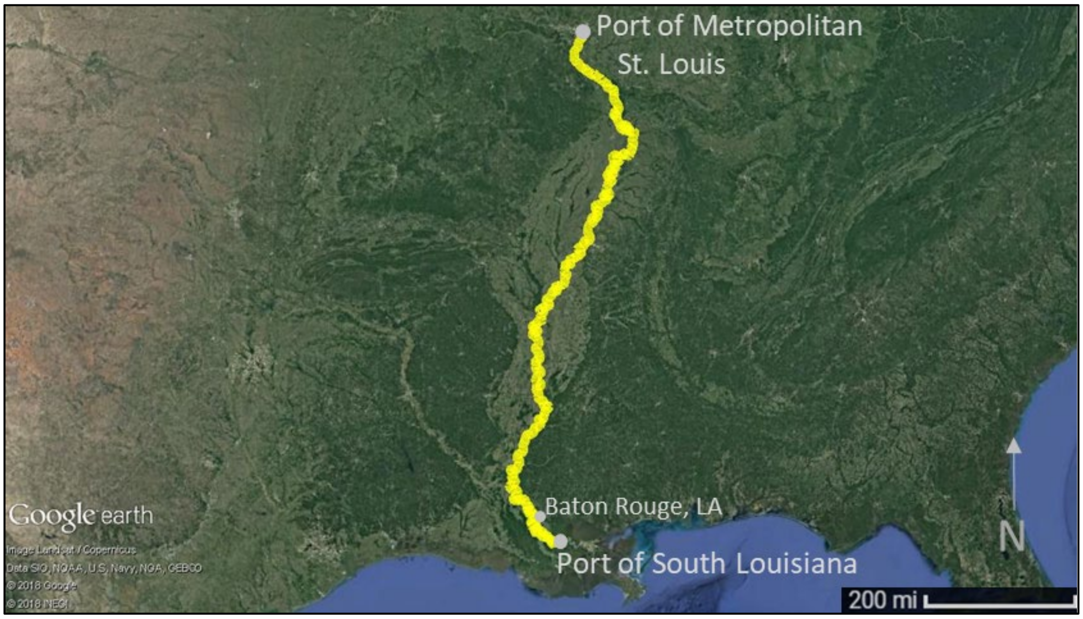


Table 4 provides the commodity summary by direction for cargo exchanges between the Port of Metropolitan St. Louis and the Port of South Louisiana. As with the waterway segments between the other port pairs, the summary provides information only for the fraction of traffic along the Lower Mississippi River Main Stem that originates and terminates at these respective ports.

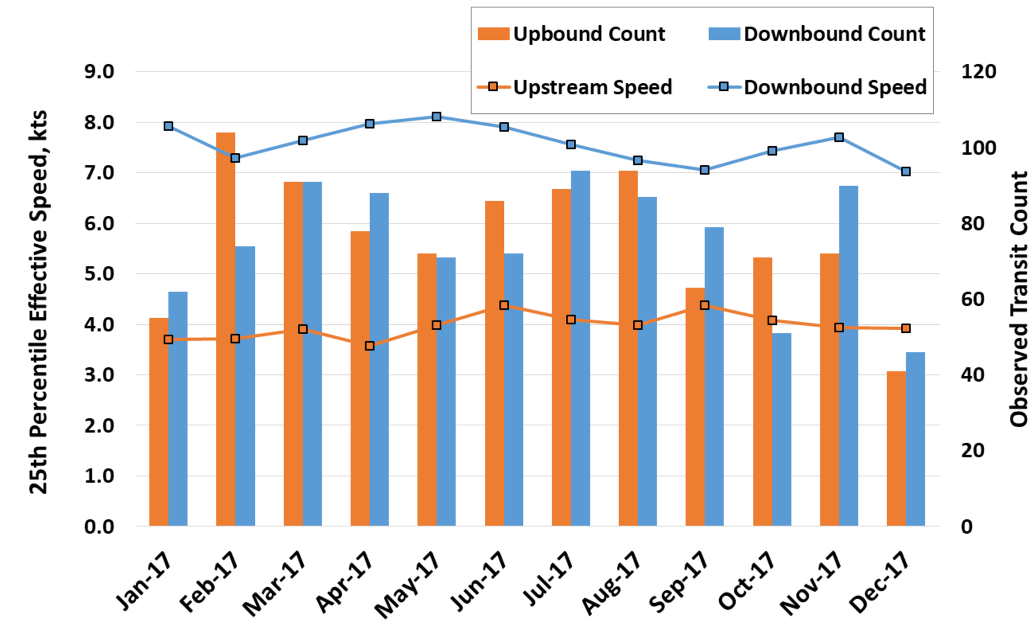
Table 4. Commodity flow summary by direction for corridor between Port of Metropolitan St. Louis and Port of South Louisiana, Fiscal Year 2017.

Commodity Type	Originating from Port of Metro St. Louis (Terminating at Port of South Louisiana)	Terminating at Port of Metro St. Louis (Originating at Port of South Louisiana)
Soybeans	3,397.0k	
Corn	2,930.4k	
Animal feed, prepared	796.0k	
Crude petroleum	654.8k	
Nitrogenous fertilizers		590.3k
Oilseeds not elsewhere classified	558.8k	
Petroleum coke	435.2k	
Alcohols	362.5k	
Fertilizers and mixes not elsewhere classified		346.2k
Wheat	288.1k	
Potassic fertilizer		102.7k
Phosphatic fertilizer		94.7k
Sodium hydroxide		52.1k

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistic Center data as processed via the CPT, special tabulation, October 2018.

AIS data were used to infer unique vessel transit times between the Port of Metropolitan St. Louis and the Port of South Louisiana for calendar year 2017. Specifically, a 14-day (336-hour) upper bound was used to screen outliers for upbound traffic while an 8-day (192-hour) upper bound was used for outlier filtering of downbound traffic. These bounds were chosen due to the distance and distribution of observed travel times. For the full year, there were 916 filtered transits observed in the upbound direction and 905 transits observed in the downbound direction. Figure 9 shows the monthly effective speeds for vessels in the 25th percentile of filtered AIS-derived travel time observations.

Figure 9. Effective speed of vessel trips in the 25th percentile for travel time between the Port of Metropolitan St. Louis and the Port of South Louisiana, Calendar Year 2017.



Source: U.S. Army Corps of Engineers, AIS data processed via the AISAP, special tabulation, October 2018.

Unlike the previously discussed port pairings, in this case the effect of water flow currents is pronounced and significantly affects the resulting speed of waterborne commerce. Downbound transits move at approximately twice the speed of upbound transits. The U.S. Geological Survey records water flow in terms of cubic feet per second, a proxy for surface current speeds. Long-term records show that between the years 2000 and 2018, water flow at the St. Louis, Missouri, station (ID 07010000) has varied from approximately 50,000 to 900,000 cubic feet per second while water flow at Baton Rouge, Louisiana, station (ID 07374000) has varied from approximately 150,000 to 1,41,000 cubic feet per second (U.S. Geological Survey 2019). How vessels navigate these changing water flow conditions depends on many factors, including vessel size and type, wind conditions, crew knowledge, and other river traffic (an exploration of these individual factors is beyond the scope of this report). In terms of actual travel times, for the entire 2017 year, these 25th percentile effective speeds translate to 204 hours (8.5 days) for upbound traffic and 106 hours (4.4 days) for downbound traffic.

3 Summary Conclusion

Fluidity studies are well established for roadways but historically have been limited for waterways due to the difficulties of making temporally consistent observations over large geographic scales (Texas A&M Transportation Institute 2019; Transportation Research Board 2016). The advent of AIS data and the availability of time-stamped vessel position reports has created a new opportunity to explore vessel movements through coastal and inland waterways. Table 5 summarizes the three fluidity assessments presented in this report, each focused on a waterway freight corridor that moves millions of tons of cargo every year.

Table 5. Summary of fluidity assessments and number of observations used in corridor study.

Corridor Name	Corridor Length	Upbound / Westbound	Downbound / Eastbound
Upper Ohio River (upbound/downbound)	317 miles	25th percentile effective speed: 81.4 hours (3.39 days) *221 observations*	25th percentile effective speed: 66.5 hours (2.77 days) *228 observations*
GIWW (eastbound/westbound)	425 miles	25th percentile effective speed: 78 hours (3.25 days) *731 observations*	25th percentile effective speed: 70 hours (2.92 days) *867 observations*
Lower Mississippi River Main Stem (upbound/downbound)	935 miles	25th percentile effective speed: 204 hours (8.5 days) *916 observations*	25th percentile effective speed: 106 hours (4.4 days) *902 observations*

The need to understand and quantify baseline fluidity measurements for waterways has been discussed before (e.g., Kress et al. 2016; Transportation Research Board 2016). Previously, AIS data have been used to analyze the response of a single port or group of ports to a singular disruption (Farhadi et al. 2016; Touzinsky et al. 2018). However, the application of AIS-derived vessel position reports to waterway fluidity quantification on a large scale is a new endeavor. It is expected that this type of fluidity analysis and quantification will be used to produce regularly updated waterway travel time estimates for portions of the inland waterway system with sufficient AIS signal coverage to generate the raw inputs. Through regular monitoring of travel times and associated fluidity, it may be possible to identify priority locations for waterway maintenance actions before they become problems significant enough to impede traffic.

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Unit Conversion Factors

Multiply	By	To Obtain
miles (nautical)	1,852	meters
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Case Studies from the Ohio River, Lower Mississippi River, and Gulf Intracoastal Waterway

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14. ABSTRACT
Freight fluidity, defined here as travel time reliability or consistency, has important implications for many sectors of the national economy. Due to limited information, waterway fluidity has historically been difficult to measure. However, with time-stamped and geo-referenced vessel position reports now available through the U.S. Coast Guard Nationwide Automatic Identification System archives, it is possible to conduct detailed examinations of fluidity along most portions of the U.S. inland waterway system. This report presents case studies of waterway fluidity and seasonal trends for three heavily trafficked segments of the inland waterway system: the Upper Ohio River from the Port of Pittsburgh to the Ports of Cincinnati-Northern Kentucky (above the metropolitan Cincinnati, OH area), the Lower Mississippi River Main Stem from the Port of Metropolitan St. Louis to the Port of South Louisiana near New Orleans, LA, and the Gulf Intracoastal Waterway from the Port of Houston, TX, to the Port of South Louisiana near New Orleans, LA.

15. SUBJECT TERMS
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