Automatic Identification System (AIS) Data and Maritime Connectivity

Marin Kress
Research Physical Scientist, USACE-ERDC
Marin.M.Kress@usace.army.mil
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“The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.”
First, What is AIS?

- **Automatic Identification System (AIS)** is a real-time shipboard broadcast system, sending signals to other ships and to shore-based receivers.

- Designed as collision avoidance system, transmission frequency of 6 seconds.

- Data included in AIS broadcasts:
  - Time stamp
  - Latitude & longitude
  - Speed over ground
  - Course over ground & heading
  - Vessel ID
  - Ship type
  - Dimensions
  - Max draft

- Req. for most commercial vessels.

- Also used by recreational vessels.

- **U.S. Coast Guard Nationwide AIS** [www.navcen.uscg.gov/?pageName=NAISmain](http://www.navcen.uscg.gov/?pageName=NAISmain)

Source: United States Coast Guard Navigation Data Center
AIS Data – Multiple Uses

- Dwell time analysis
- Port system resiliency
- Tidal dependency quantification
- Wake-induced wave energy/shoreline erosion
- Vessel activity pre/post dredging
- Vessel response to river flow
- Vessel-structure interaction
- Invasive species introduction risk
- Understanding of waterway usage
AIS Signal Density Maps (Heat Maps)

Great way to visualize relative traffic densities across large spatial domains.
Vessel trackline maps

Type

Speed

Draft
Data request for Hamilton ON example:

Any vessel that passed through the gray box around the Hamilton ON port area during 2019 and was broadcasting via AIS.

Vessel position reports would include the entire 24-hour period within which the vessel was observed.
24-hr vessel tracklines for vessels passing through the Hamilton Ontario port during 2019. Tracklines are color-coded by vessel type as broadcast in AIS message. Data: U.S. Coast Guard NAIS data, processed through the AIS Analysis Package by USACE-ERDC.
Hamilton Ontario, CY 2019.
AIS vessel tracklines, color-coded by vessel type.
Data: U.S. Coast Guard NAIS, processed using AIS Analysis Package by USACE-ERDC.
Vessel tracklines recreated from AIS position reports, for vessels that passed through the port area at Hamilton, ON in 2019. Tracklines are color-coded by vessel type broadcast in AIS message; purple (Tug), or pink (Towing). Data: U.S. Coast Guard NAIS archive, processed using AIS Analysis Package by USACE-ERDC.
Vessel tracklines recreated from AIS position reports, for vessels that passed through the port area at Hamilton, ON in 2019, detail of Oshawa ON area. Tracklines are color coded by the vessel type broadcast in AIS message, purple (Tug), or pink (Towing). Data: U.S. Coast Guard NAIS archive, processed using AIS Analysis Package by USACE-ERDC.
Vessel tracklines recreated from AIS position reports, for vessels that passed through the port area at Hamilton, ON in 2019 and identified as 'Tanker' or 'Not Available' in their AIS message. Data: U.S. Coast Guard NAIS archive, processed using AIS Analysis Package by USACE-ERDC.
Vessel tracklines recreated from AIS position reports, for vessels that passed through the port area at Hamilton, ON in 2019 and identified as 'Cargo' or 'Other' in their AIS message. Data: U.S. Coast Guard NAIS archive, processed using AIS Analysis Package by USACE-ERDC.
Areas of interest (AOIs) that appear to be within a 24-hr travel time of Hamilton ON and had shared vessel traffic during 2019, indicated by AIS.

- Oswego NY
- Cleveland OH
- Niagara Falls ON
- Buffalo NY
- Welland Canal Ent.
AIS data can be used to understand maritime vessel traffic paths that support important supply chains.

<table>
<thead>
<tr>
<th>DEPARTURE AOI</th>
<th>Buffalo NY</th>
<th>Clarkson ON</th>
<th>Cleveland OH</th>
<th>Darlington ON</th>
<th>Hamilton ON</th>
<th>Oswego NY</th>
<th>SL Seaway Ent - north</th>
<th>Toronto ON</th>
<th>Welland Canal Ent.</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo NY</td>
<td>1</td>
<td>56</td>
<td></td>
<td>1</td>
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<td>70</td>
<td>123</td>
<td>379</td>
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<td></td>
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<tr>
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<td></td>
<td></td>
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<td>1</td>
<td>70</td>
<td>123</td>
<td>379</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamilton ON</td>
<td>56</td>
<td>1</td>
<td>43</td>
<td>1</td>
<td>70</td>
<td>123</td>
<td>379</td>
<td>672</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oshawa ON</td>
<td>1</td>
<td>1</td>
<td>56</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Oswego NY</td>
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<tr>
<td>Toronto ON</td>
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<td>3</td>
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<td></td>
<td></td>
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<tr>
<td>Welland Canal Ent.</td>
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<td>4</td>
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<td>335</td>
<td>11</td>
<td>120</td>
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<td>369</td>
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<tr>
<td>Grand Total</td>
<td>3</td>
<td>65</td>
<td>1</td>
<td>1</td>
<td>669</td>
<td>57</td>
<td>2</td>
<td>91</td>
<td>139</td>
<td>389</td>
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</tbody>
</table>

Basic summary of shared vessel traffic between 10 AOIs during 2019, all vessel types.
Summary of ‘Tanker’ and ‘Not Available’ vessel type traffic between selected AOIs during 2019, for vessels that passed through the Hamilton ON port area.

<table>
<thead>
<tr>
<th>DEPARTURE AOI</th>
<th>Clarkson ON</th>
<th>Hamilton ON</th>
<th>Oshawa ON</th>
<th>SL Seaway Ent - north</th>
<th>Toronto ON</th>
<th>Welland Canal Ent.</th>
<th>Grand Total</th>
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<tbody>
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<td>Hamilton ON</td>
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<td>5</td>
<td>23</td>
<td>10</td>
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<td>84</td>
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<td>Oshawa ON</td>
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<td>6</td>
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<td>1</td>
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<tr>
<td>Grand Total</td>
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<td>5</td>
<td>24</td>
<td>10</td>
<td>33</td>
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</table>
Supply chain resilience questions can be approached in multiple ways, including regional; port; infrastructure; or commodity-specific perspectives.

Understanding historic and existing traffic patterns is fundamental for planning and scenario-exploration purposes.

Automatic Identification System (AIS) data is an important source of vessel position information for commercial, and many recreational, vessels. AIS messages generally do not include commodity information.

AIS data is available from government and commercial sources. Position report density needs vary with the type of question being asked and can influence analysis results.

AIS data can be combined with other modal datasets to facilitate an understanding of regional supply chains.

Suggested additional reading:
Using Empirical Data to Quantify Port Resilience: Hurricane Matthew and the Southeastern Seaboard. DOI: 10.1061/(ASCE)WW.1943-5460.0000446
Use of Nationwide Automatic Identification System Data to Quantify Resiliency of MTS https://journals.sagepub.com/doi/abs/10.3141/2549-02
AIS data: real-time operation support, incident investigations, and waterway use analysis https://erdc-library.erdc.dren.mil/jspui/handle/11681/36395