ASTD Data

The Cooperative Agreement among the Arctic States Regarding Arctic Ship Traffic Data Sharing outlines access to ASTD and use of its data.

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Prepared in January 2019.

PAME

Protection of the Arctic Marine Environment

What is AIS

Automatic Identification Systems (AIS) is technology onboard ships to provide information about the ships type, position (downsampled to 6 minutes for ASTD), course, speed, navigational status and other safety-related information. The information is sent automatically to appropriately equipped shore stations, other ships and to satellites. This information is fed into the ASTD database.

IMO regulation 19 of SOLAS requires AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages; cargo ships of 500 gross tonnage and upwards not engaged on international voyages; and all passenger ships irrespective of size. The requirement became effective for all ships by 31 December 2004.

AIS Class A and B

Two types of AIS transponders are available, Class A and Class B. Class B transponders have been developed to provide the safety and navigation benefits of AIS to smaller vessels with lower cost and simpler installation when compared to Class A. The signal from Class A is stronger and therefore picked up by more land-based stations or Satellite-AIS. Class B also sends fewer messages.

The frequency of AIS signals from Class A depends on the ships position and speed. For example, a ships at the speed of 23 knots sends signals every 2 seconds, whilst ships sailing on between 0-14 knots sends a signal every 10 seconds. AIS receivers vary, but Class A transponders are prioritized to Class B. Therefore, signals from Class B are not recorded as frequently – its signal is only picked up when there is room on the AIS channel receiving the signals. However, the frequency is still very high and very adequate for safety of smaller ships.

AIS signals from all ships is included in ASTD.

AIS Limitations

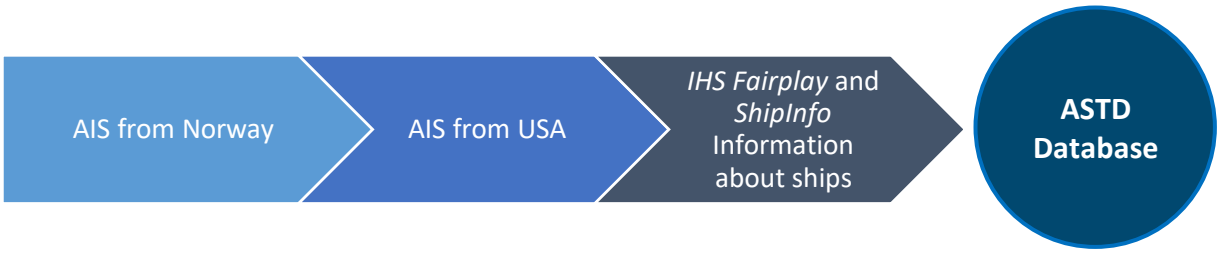
AIS data in the ASTD system does not cover 100% of all ship traffic, identifying smaller pleasure craft and fishing vessels can be a challenge because of limitations in registries and AIS information.

Numerous factors can affect AIS messages, including:

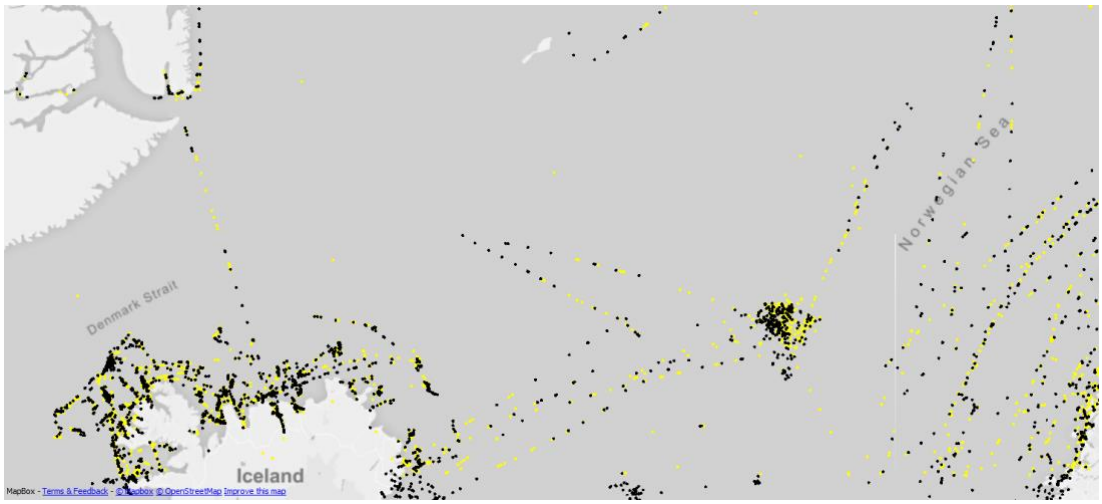
- Technical failure due to faulty infrastructure (vessel and data flow).
- Erroneous onboard installation (vessel infrastructure)
- Problems with data links/networks
- AIS signals being manipulated
- Data noise
- Challenges regarding data coverage

ASTD data collection

The AIS data in ASTD is provided by Norway and USA. Norway has around 50 AIS land-based stations that collect AIS signals, collecting information to around 40-60nm from the coast. These base-stations are located along the Norwegian coastline and in Svalbard. Norway also collects information with four AIS-satellites in Polar orbit. USA provides data for ASTD with 19 satellites orbiting the Arctic. Data in the ASTD is supplemented with information from other data sources, including IHS ship details, and information from DNV-GL.



The image below shows how the data from USA (yellow dots) supplement the Norwegian data (black dots) to give ASTD a more detailed coverage – therefore providing more accurate information.



ASTD Data quality/accuracy

The data in ASTD is very accurate. The data collected is vast, hundreds of gigabytes every year. Approximately 4 million records are added to the database every 24 hours. As outlined above, AIS signals are not 100% accurate, there are many variables which effect databases like ASTD. There are many other data sources like ASTD, and when comparing data between them, the information might not be 100% aligned. This could for example be differences in satellites who collect AIS signals. However, data quality in ASTD is ***very high***.

Ice data is collected from National Show and Ice Data Center (NSIDC) and processed by the NCA to fit the purpose. Data is collected on a monthly basis.

Data calculations

Certain data in ASTD is based on calculations with algorithms inserted to the database. This includes all the information in the *Statistics* section in *Arctic area traffic*.

Emissions is calculated for each ship sailing and aggregated up to categories for statistics. Each ship type and size has their own algorithm for emission estimates. A generalized example of the methodology is shown in the box.

$$E_{i,j} = \sum_{t=0}^{t=n} ((P_{ME_i} * \left(\frac{SOG_{i,t}}{V_{max_i}}\right)^3 * EF_{ME_{j,k,l,m}} + D_{AE_{p,i}} * EF_{AE_{j,k,l,m}} + D_{BO_{p,i}} * EF_{BO_{j,m}}) * 1\text{ hour})$$

Where:

- i = ship
- j = pollutant
- t = time (operating hour, h)
- k = engine type
- l = engine tier
- m = fuel type
- p = phase
- $E_{i,j}$ = emissions (g) for ship i and pollutant j
- P_{ME_i} = main engine power (kW) for ship i
- $SOG_{i,t}$ = speed over ground (knots) for ship i at time t
- V_{MAX_i} = maximum speed (knots) for ship i
- $EF_{ME_{j,k,l,m}}$ = main engine emission facor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m
- $D_{AE_{p,t}}$ = auxiliary engine power demand (kW) in phase p for ship i
- $EF_{AE_{j,k,l,m}}$ = auxiliary engine emission factor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m
- $D_{BO_{p,i}}$ = boiler power demand (kW) in phase p for ship i
- $EF_{BO_{j,m}}$ = boiler emission factor (g/kWh) for pollutant j and fuel type m

The algorithm utilizes the information from AIS to determine the engine the ship uses, find its KW numbers, adds the speed the vessels travels and calculates the fuel consumption.

Where the fuel type is unknown, it is filled in by looking at a “sister ship” or similar ships (RPM engine).

The fuel consumption is also used to calculate information about emissions from ships. The box to the right shows how emissions are calculated. ASTD has many types of emissions from ships and is capable of showing these emissions in a certain time and for certain areas.

More details on the statistics is provided in the metadata for the statistics in the ASTD system.

Ship types aggregation

Asa a main rule, ships need to be registered to be eligible to navigate. Each ship is designated a ship type. ASTD utilizes *the IHS Markit StatCode 5 Shiptype Coding System* to categorize ship types. IHS has 5 category levels which are then aggregated from around 230 ship types to 15.

For example, level 5 of the IHS Fairplay information has over 10 different types of chemical tankers, including *Vegetable Oil tanker* and *Wine tanker*. This information is aggregated to *Chemical tankers* in the ASTD ship types.

However, when downloading data, users with access of level 1 can get the information in *Ship Type Level 5*, and therefore analyse quite specific ship types. That availability is dependent on user rights.

A document that shows how the ship types are aggregated has been produced.

The Ship type document is available to download here.

Working with data

ASTD requires GIS analysis experts to download and work with data from the system.

Those who have access to ASTD can download data for analysis according to your user rights. The data can be downloaded on different formats, but .CSV is the most common format. CSV stands for comma-separated values and is a delimited text file that uses a comma to separate values. A CSV file stores tabular data in plain text. Each line of the file is a data record. Each record consists of one or more fields, separated by commas. Each .csv file can contain millions of rows and can be very large, up to many gigabytes in size. Smaller .csv files can be opened with Excel, but others require specialized programs to work with them, like CSV Explore, Microsoft Access, Python or SQL databases like MySQL and PostgreSQL. This work requires not only a data expert, but a powerful computer as well.

Keep this in mind when downloading large amounts of data.

However, smaller data samples can be downloaded by regular users, not specific GIS experts, and analyzed with Excel. One has to download data and convert from CSV but from there analysis can be performed.

Cleaning up data

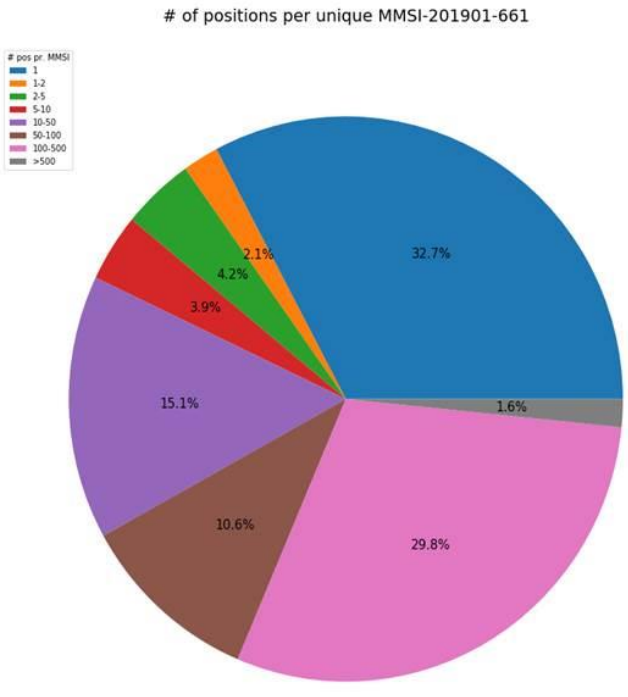
Please note that specific corrections are needed after downloading data to have as correct data as possible.

Satellites in orbit randomly pick up signals from far away, outside the Arctic area, if the atmospheric conditions are applicable. In the prefixed reports made directly from the system, we have filtered out all signals with less than 10 positions in one month. This means that ships with sailing time less than one hour in a whole month are filtered out and therefore not included in the report. This has very limited effects for the reports as most of the signals are from random ships that satellites pick up outside the area.

Please be aware that when downloading data you need to do this cleanup yourself as you are downloading raw data. We recommend cleaning up positions of less than 10 positions each month.

This pie chart is an example of data from a data provider. It shows that 42,9% of the data is from ships with less than 10 positions in one month. A large majority of this are signals picked up by error. Hence, filtering (clean-up) is needed before using the data for analysis.

If this filtering is not done, it will result in wrong numbers and a wrong analysis.



Citations

When using data from ASTD, this citation can be used:
PAME - Arctic Ship Traffic Data. (insert date when data is collected). Retrieved from ASTD.is.

Sources:

- http://www.imo.org/en/OurWork/Safety/Navigation/Pages/AIS.aspx
- https://www.oceantimemarine.com/class-a-and-class-b-automatic-identification-system-ais/