

ASTD DATA

INFORMATION DOCUMENT



PAME

Protection of the Arctic Marine Environment



ASTD DATA DOCUMENT

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

This document outlines and explains the ASTD data.

The document is intended for all ASTD Users.

Questions can be sent to the PAME Secretariat (pame@pame.is)

ASTD Data Document Version History

1.1: January 2019.

1.2: April 2020.

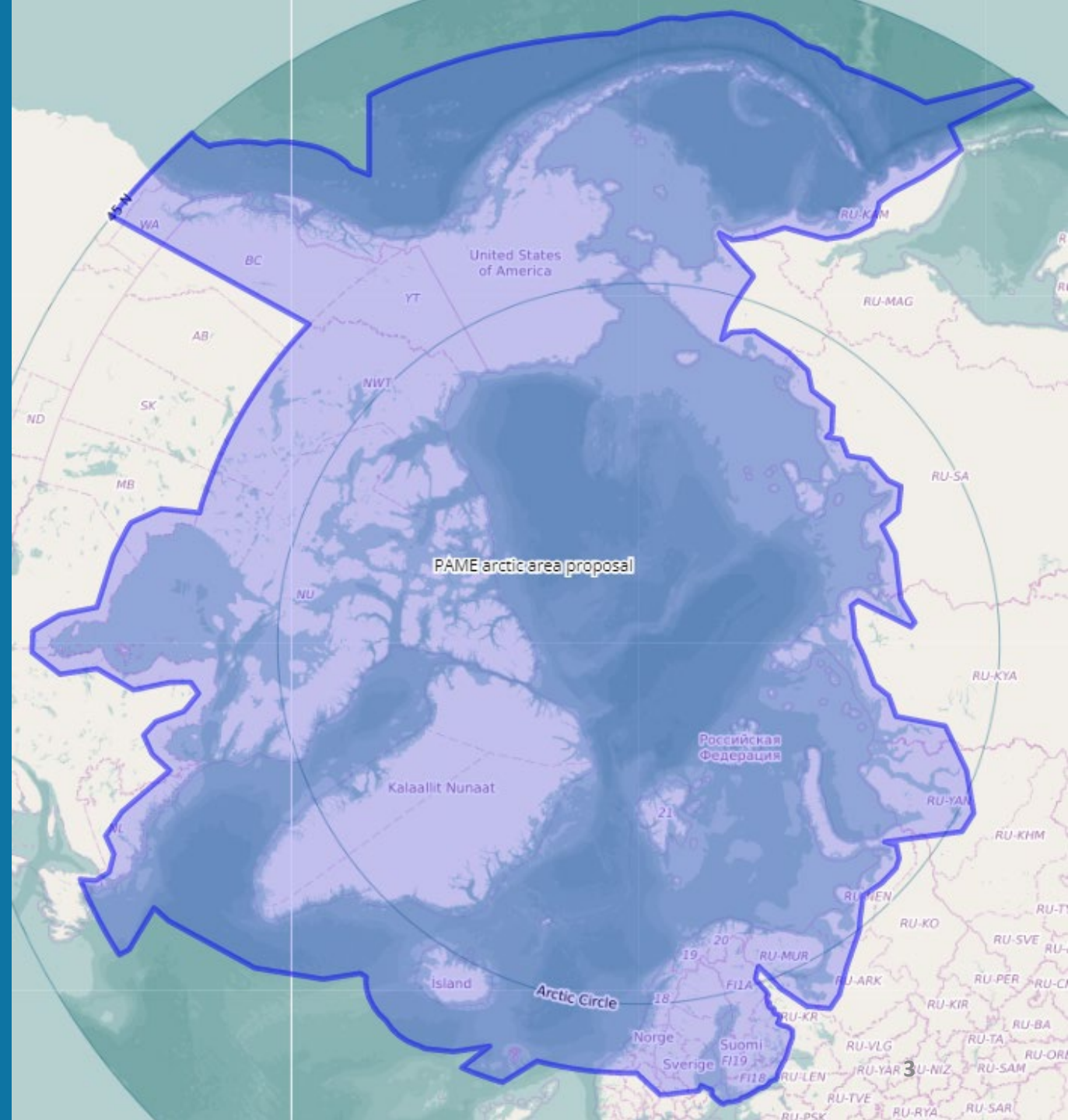
1.3: January 2021.

1.4: March 2021.

1.5: November 2022



Data from ASTD is collected with over 20 satellites and multiple base stations. Data is collected from a specific area, shown on the map to the right.



ASTD Data

The data from ASTD can be accessed by two means:

ASTD SYSTEM

- ✓ Easy access to data
- ✓ Quick analysis on pre-defined area
- ✓ Data is pre-calculated
- ✓ Simple to use

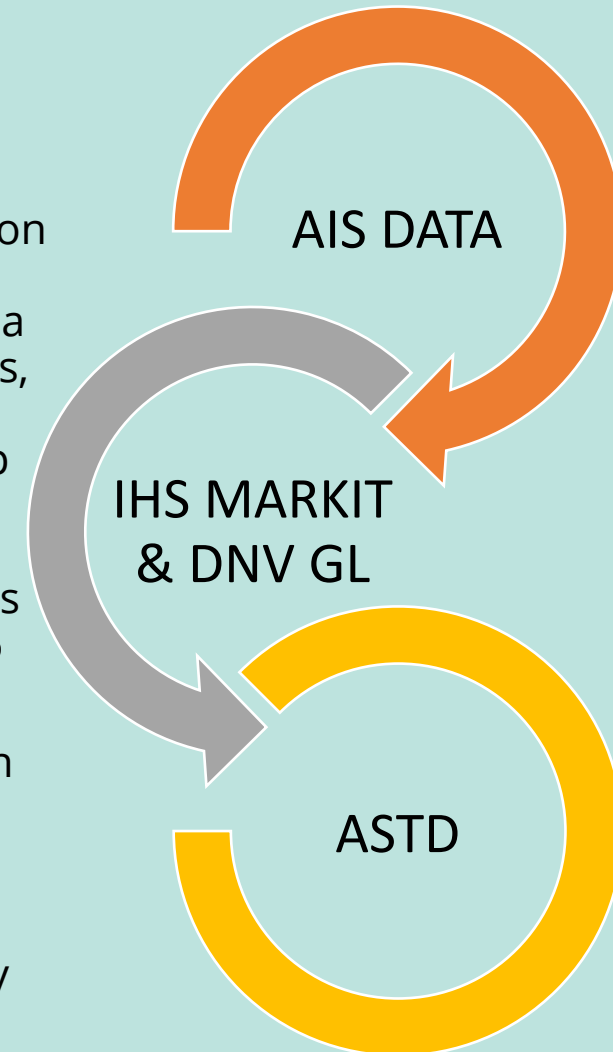
FTP SERVER

- ✓ Area from whole of ASTD area
- ✓ Data needs to be filtered, cleaned
- ✓ Needs professional GIS experts
- ✓ Vast amounts of data
- ✓ Intended for specific analysis
- ✓ Contact PAME for access

ASTD DATA

The ASTD Database contains four types of information. These are:

1. Automatic Identification System (AIS data) from ships operating in the Arctic.
2. Ship characteristic information (e.g., type, size, flag, gross tonnage, ownership, construction date) from IHS Markit. Since 1760 Lloyds Register collected information on ships and maintained a collective ship registry. In 2009 IHS acquired Lloyds Register. IHS Fairplay is a company servicing the IMO for a database of ships, and is the sole issuer of IMO numbers, contained in AIS information. An IMO number is a unique number to each ship. The IMO ship identification number scheme was introduced in 1987 as a measure to enhance ship safety and security. It assigned a permanent number to each ship for identification purposes. That number would remain unchanged through the ships life. These numbers appear on Port State Control required ships documentation such as the CSR – Continuous Synopsis Record, ISM and ISPS certificates*. From this, information in the table on page 6 is generated.
3. Information on the types of fuel ships are burning and calculated air emissions from such combustion are obtained from DNV. DNV made these calculations on IMO emission factors. DNV is the world's largest classification society and a recognized advisor for the maritime industry.
4. Sea ice data from the National Snow and Ice Data Center (NSIDC). ASTD contains monthly sea ice extent information obtained from the [NSIDC Sea Ice Index](#).



ASTD DATA – ACCESS LEVELS

- Arctic State approved government agencies and ministries, Arctic Council Permanent Participants and Arctic Council Working Groups get free access to the database. Others, such as Arctic Council Observers, have to pay a small fee for access to ASTD. A document which outlines the access has been created and is available [here](#).
- Access to ASTD data may be granted to eligible applicants at one of three access levels: Level I, Level II and Level III

I

Access to all available data

II

Access to all data in the System except that vessel identity data (MMSI, IMO ship identification number and ship name) is not included.

III

Access to the same data as under Level 2 except that ship type information is aggregated to 15 ship types instead of 56 ship types.

*See table on
page 7 what
is included in
the ASTD
Data for each
access level.*

ASTD DATA ACCESS LEVELS

DATA FIELD	LEVEL 1	LEVEL 2	LEVEL 3	EXPLANATION
mmsi	YES	NO	NO	MMSI Number
imonumber	YES	NO	NO	IMO Number
shipid	NO	YES	YES	Ship number in the file downloaded. The number is unique for each ships in the database.
date_time_utc	YES	YES	YES	Date of signal
vesselname	YES	NO	NO	Name of ship
flagname	YES	YES	YES	Flag of the ship or ship registry
iceclass	YES	YES	YES	Ice class (PC polar ice classes)
astd_cat	YES	YES	YES	Ship type according to the ASTD Category where over 200 ship types are aggregated to 13 ship types. Click this link to read more.
lloyds3_cat	YES	YES	NO	Ship types according to Lloyds/IHS Category 3 where over 200 ship types are aggregated to around 50 ship types. Click this link to read more.
lloyds5_cat	YES	NO	NO	Ship types according to Lloyds/IHS Category 5 - A detailed list of over 200 ship types where each ship is identified. Click this link to read more.
sizegroup_gt	YES	YES	YES	Ship Size (in gross tons) 7 groups: <ul style="list-style-type: none"><1000 GT1000-4999 GT5000-9999 GT10.000-24.999 GT25.000-49.999 GT50.000-99.999 GT>=100.000 GT

Data Field	LEVEL 1	LEVEL 2	LEVEL 3	EXPLANATION
fuelquality	YES	YES	YES	Type of fuel used (see next page)
fuelcons	YES	YES	YES	Fuel Consumption
dist_nextpoint	YES	YES	YES	Distance to next point
sec_nextpoint	YES	YES	YES	Seconds to next point
longitude	YES	YES	YES	Longitude
latitude	YES	YES	YES	Latitude
co	YES	YES	YES	Carbon monoxide
Co2	YES	YES	YES	Carbon dioxide
so2	YES	YES	YES	Sulfur dioxide
pm	YES	YES	YES	Particulate matter
nox	YES	YES	YES	Nitric oxide
n2o	YES	YES	YES	Nitrous oxide
nmvoc	YES	YES	YES	Non-methane volatile organic compounds emission
ch4	YES	YES	YES	Methane
blackcarbon	YES	YES	YES	Black carbon
organiccarbon	YES	YES	YES	Organic carbon
Oilbilgewater	YES	YES	YES	Oily bilge water
Blackwater	YES	YES	YES	Blackwater
Greywater	YES	YES	YES	Greywater
garbage	YES	YES	YES	Garbage

ASTD FUEL INFORMATION

As regulations on Sulphur content in fuel changed as of 1.1.2020, fuel information is different before and after that date. This goes for all ships in the Arctic and the information in ASTD.

[READ MORE:](#)

[IMO 2020
sulphur limit
implementation
- carriage ban
enters into force](#)

[IMO: March 2020](#)

BEFORE 1.1.2020

Fuel information can be categorized to six types of fuel

0	Distillate marine fuel (MGO/MDO)
1	Residual marine fuel and heavy distillate (ISO-F-10 - 80)
2	Residual marine fuel (IFO-F-80 - 180) heavy fuel oil
3	Residual marine fuel (IFO-F-180 - 380 or above) heavy fuel oil
4	Liquid natural gas (LNG)
5	Battery power

AFTER 1.1.2020

Fuel information can be categorized to four types of fuel

0	Distillate marine fuel (MGO/MDO)
4	Liquid natural gas (LNG)
5	Battery power
6	Residual marine fuel

DATA EXAMPLE: Data download function – Level 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	period	area_type	area_id	area_name	mmsi	imonumber	vesselname	flagcode	iceclass	norwegianshiptypeid	norwegianshiptypename	lloydsshiptypeid	lloydsshiptypename	lloyds5_cat	vesselsize	vesselsizedescription	fuelquality	distance_nm	consumption	co2emission	coemission	noxemission	so2emission	operationhour
2	2022-06	eez	14	Svalbard Fish	273291710	9157014	SOLSTRAUM	RUS	FS Ice Class 1A	2	Chemical	A12	Chemical	A12B2TR	2	1000 - 4999 GT	6	538.1767	3.628922					125.6769
3	2022-06	eez	14	Svalbard Fish	257677000	9190200	ISFJORD	NIS	FS Ice Class 1B	2	Chemical	A12	Chemical	A12B2TR	2	1000 - 4999 GT	6	1453.332	46.27442					633.5711
4	2022-06	eez	14	Svalbard Fish	215768000	9817133	HANSEATIC NATURE	MTA		17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	2934.803	379.5073	1211.166	2.621009	25.42015	3.409161	424.4158
5	2022-06	eez	14	Svalbard Fish	578000500	9502506	LE BOREAL	FRA	FS Ice Class 1C	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	3833.559	314.0965	999.5833	1.840583	15.10017	2.4864	719.8739
6	2022-06	eez	14	Svalbard Fish	576988000	8941808	REMBRANDT VAN RIJN	VAN		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	1907.546	17.94598	57.03662	0.1328	0.789623	0.032303	720.0364
7	2022-06	eez	14	Svalbard Fish	578001700	9846249	LE COMMANDANT CHARCOT	FRA		17	Cruise ship	A37	Passenger	A37A2PC	5	25000 - 49999	4	2848.368	1281.065	4092.3	9.138679	92.20183	11.96846	442.3775
8	2022-06	eez	14	Svalbard Fish	538009302	9861017	ULTRAMARINE	MAI		17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	3401.283	364.5519	1161.359	2.293525	20.26174	3.028657	678.4092
9	2022-06	eez	14	Svalbard Fish	229090000	9641730	MEIN SCHIFF 3	MTA		17	Cruise ship	A37	Passenger	A37A2PC	6	50000 - 99999	6	672.9713	184.5142	587.7794	1.341631	13.48362	1.664508	53.93667
10	2022-06	eez	14	Svalbard Fish	265509140	7912020	FREYA	SWD		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	2879.507	38.38534	122.0059	0.284052	1.688955	0.069094	720.0619
11	2022-06	eez	14	Svalbard Fish	229678000	9678408	MEIN SCHIFF 4	MTA		17	Cruise ship	A37	Passenger	A37A2PC	6	50000 - 99999	6	550.8593	175.8484	560.5585	1.277996	12.95961	1.612365	43.63083
12	2022-06	eez	14	Svalbard Fish	265472000	8226612	STOCKHOLM	SWD		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	3072.919	23.63486	75.0707	0.174898	1.039934	0.042543	721.675
13	2022-06	eez	14	Svalbard Fish	352842000	7739777	SJOVEIEN	PAN		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	3344.838	7.455974	23.72128	0.055174	0.328063	0.013421	719.9681
14	2022-06	eez	14	Svalbard Fish	265339000	5180295	ORIGO	SWD		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	2229.846	15.3872	48.92523	0.113865	0.677037	0.027697	719.73
15	2022-06	eez	14	Svalbard Fish	578000700	9502518	L'AUSTRAL	FRA	FS Ice Class 1C	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	3817.687	343.8703	1094.858	2.104654	17.97253	2.783975	720.0522
16	2022-06	eez	14	Svalbard Fish	352594000	9387085	MSC MAGNIFICA	PAN		17	Cruise ship	A37	Passenger	A37A2PC	6	50000 - 99999	6	735.5351	225.7801	719.6651	1.644382	16.66218	2.065955	57.285
17	2022-06	eez	14	Svalbard Fish	258932000	9370018	FRAM	NIS	FS Ice Class 1B	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	2925.587	295.2175	940.7666	1.843943	16.45416	2.486668	511.9528
18	2022-06	eez	14	Svalbard Fish	258157000	9434060	SPITSBERGEN	NIS	FS Ice Class 1C	17	Cruise ship	A37	Passenger	A37A2PC	3	5000 - 9999 GT	6	2887.929	261.9501	829.4862	1.442845	9.603219	1.10019	632.6283
19	2022-06	eez	14	Svalbard Fish	231763000	8913904	QUEST	FAS	FS Ice Class 1B	17	Cruise ship	A37	Passenger	A37A2PC	2	1000 - 4999 GT	0	3039.455	72.56219	230.9456	0.53696	3.239646	0.130612	719.7669
20	2022-06	eez	14	Svalbard Fish	215766000	9817145	HANSEATIC INSPIRATION	MTA		17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	761.5887	92.84173	296.301	0.646995	6.290926	0.834527	103.2583
21	2022-06	eez	14	Svalbard Fish	244091000	8650813	NOORDERLICHT	NTH		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	748.2198	4.952511	15.84732	0.036649	0.21791	0.008915	720.0717
22	2022-06	eez	14	Svalbard Fish	311000929	9842554	NATIONAL GEOGRAPHIC ENDURANCE	BAH	FS Ice Class 1A Super	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	4706.173	371.9565	1185.188	2.444567	22.08967	3.118645	660.8761
23	2022-06	eez	14	Svalbard Fish	244327000	9818709	HONDIUS	NTH		17	Cruise ship	A37	Passenger	A37A2PC	3	5000 - 9999 GT	6	3380.868	210.1551	665.2906	1.114627	7.283879	0.882651	719.9892
24	2022-06	eez	14	Svalbard Fish	246337000	5019800	ANTIGUA	NTH		17	Cruise ship	A37	Passenger	A37A2PC	1	< 1000 GT	0	1587.175	5.97593	19.09154	0.044222	0.262941	0.010757	719.9836
25	2022-06	eez	14	Svalbard Fish	246573000	7432044	PLANIUS	NTH	FS Ice Class II	17	Cruise ship	A37	Passenger	A37A2PC	2	1000 - 4999 GT	0	3326.456	128.8846	409.3023	0.953746	5.779309	0.231992	598.9817
26	2022-06	eez	14	Svalbard Fish	311000893	9880685	NATIONAL GEOGRAPHIC RESOLUTION	BAH	FS Ice Class 1A Super	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	893.0077	85.19031	271.9517	0.603222	5.936276	0.774044	85.62778
27	2022-06	eez	14	Svalbard Fish	311000866	9834648	GREG MORTIMER	BAH	FS Ice Class 1A	17	Cruise ship	A37	Passenger	A37A2PC	3	5000 - 9999 GT	6	2289.414	153.0139	484.4917	0.883891	5.910464	0.642658	397.2542
28	2022-06	eez	14	Svalbard Fish	255717000	6602898	OCEAN MAJESTY	MAR		17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	702.5487	65.48285	208.9769	0.463321	4.513774	0.587521	61.91139
29	2022-06	eez	14	Svalbard Fish	255806397	8802868	SEA SPIRIT	MAR	FS Ice Class II	17	Cruise ship	A37	Passenger	A37A2PC	2	1000 - 4999 GT	0	3751.034	219.0511	698.064	1.620978	9.755293	0.394292	719.9633
30	2022-06	eez	14	Svalbard Fish	255806400	8325432	OCEAN ATLANTIC	MAR	FS Ice Class 1B	17	Cruise ship	A37	Passenger	A37A2PC	4	10000 - 24999	6	3178.179	291.6064	928.6361	1.770206	15.19773	2.38245	580.8233

AIS

AIS is a maritime navigation safety communications system standardized by the International Telecommunication Union (ITU) and adopted by the International Maritime Organization (IMO) to provide information about ship type, position (recorded every 6 minutes in ASTD), course, speed, navigational status, and other safety-related information. The information is transmitted automatically and is received by appropriately equipped shore stations, other ships, and satellites.

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

<https://www.imo.org/en/OurWork/Safety/Pages/AIS.aspx>

AIS TRANSPONDERS

Automatic identification systems (AIS) transponders are designed to be capable of providing position, identification and other information about the ship to other ships and to coastal authorities automatically. There are two types of AIS transponders: Class A and Class B.

Class A transponders:

Class A transponders send a stronger signal than Class B transponders. Class A transponder signals may travel further and be received by a greater number of land-based stations and by satellites.

The frequency of AIS signals from Class A depends on the ships position and speed. For example, a Class A transponder on a ship traveling at a speed of 23 knots transmits an AIS signal every two seconds, while a Class A transponder on a ship traveling at a speed between 0-14 knots transmits an AIS signal every 10 seconds.

Class B transponders provide the safety and navigation benefits of Class A transponders to smaller vessels with lower cost and simpler installation. Class B transponders send fewer messages than Class A transponders.

<https://www.oceantimemarine.com/class-a-and-class-b-automatic-identification-system-ais/>

Only AIS signals from ships carrying AIS Class A transponders is included in ASTD. Many ships not required to carry AIS still opt to use it, and are therefore included (this includes smaller fishing vessels, and pleasure crafts, for example).

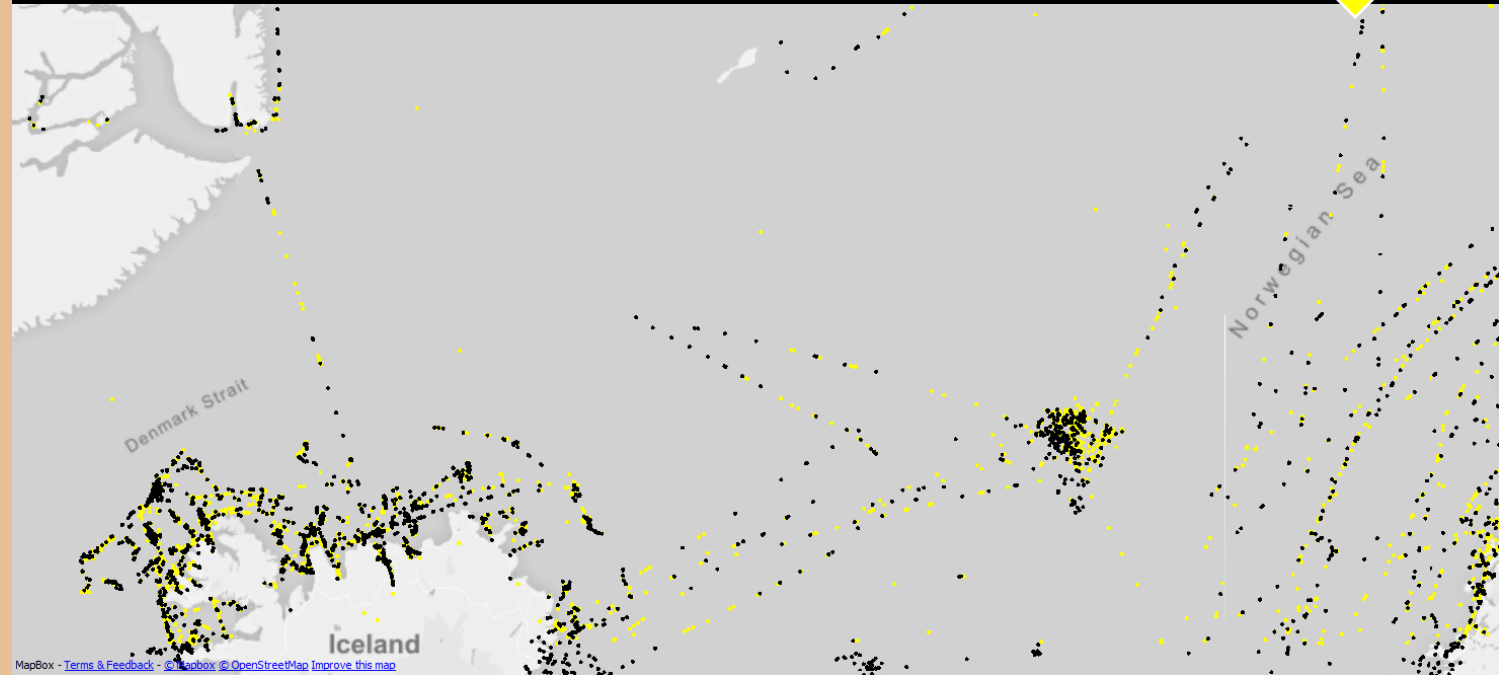
General AIS Limitations

AIS data in the ASTD system does not cover 100% of all ship traffic, but data quality is very high. This has been confirmed by comparing data from other sources, including national collected information. Identifying smaller pleasure craft and fishing vessels can be challenging because of limitation in registries and AIS information.

Numerous factors can affect the transmission and/or receipt of AIS signals, 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 satellite coverage

The image below shows how AIS Class A transponder data from the USA (yellow dots) supplements AIS Class A transponder data from Norway (black dots) to give ASTD a provide more detailed and more accurate coverage of ship traffic information.



ASTD Data Quality

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 on page 9, 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.

ASTD Data Calculations

Certain data in ASTD is based on calculations using algorithms included in the database. These algorithms were prepared in a very comprehensive work by Norway, including NCA and DNV, when information from thousands of ships operating in the Arctic was collected.

The methodology is from the IMO and is updated accordingly regularly.

This includes all the information in the *Statistics* section in *Arctic area traffic in ASTD*. One example of these data calculations is statistics on fuel consumption. The calculation is prepared for each ship.



[MORE FROM THE IMO
ON CALCULATIONS OF
EMISSIONS: GUIDELINES
ON THE METHOD OF
CALCULATION OF THE
ATTAINED ENERGY
EFFICIENCY DESIGN
INDEX \(EEDI\) FOR NEW
SHIPS](#)

Flag Codes

- ASTD includes codes for the flags of ships. This is to reduce the data contained in the database.
- Users should match the code to the flag if it is unknown to them. Several sources can help to look up the flag information.

EXAMPLE

This is how flag information looks like when downloaded from ASTD

flagcode	
RUS	Russia
NIS	Malta
MTA	
FRA	Marshall Islands
VAN	
FRA	
MAI	
MTA	Sweden
SWD	
MTA	
SWD	
PAN	France
SWD	
FRA	Panama
PAN	
NIS	Norwegian International Ship Register
NIS	
FAS	
MTA	
NTH	Netherlands
BAH	
NTH	

Ice Class of ships in ASTD

- Ice class refers to a notation assigned by a classification society or a national authority to denote the additional level of strengthening as well as other arrangements that enable a ship to navigate through sea ice. Some ice classes also have requirements for the ice-going performance of the vessel.
- ASTD ice classes are based on the Finnish-Swedish Ice Class Rules, which are developed in co-operation by the Finnish and Swedish authorities.



ICE CLASSES
OF SHIPS:
Finnish-
Swedish Ice
Class Rules
explained

Ship Types Aggregation

As 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 in the ASTD System.

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 Level I access may obtain the information in Ship Type Level 5, and therefore analyze more specific ship types.

A document showing how the ASTD System aggregates ship types is available to [download here](#).

Ship Types Aggregation - Example

ASTD SHIP TYPES (ASTD Level 3 Users)	IHS – LEVEL 3 (ASTD Level 2 Users)	IHS – LEVEL 5 (ASTD Level 1 Users)
Bulk carriers	Bulk Dry Bulk Dry / Oil Self Discharging Bulk Dry Other Bulk Dry Other activities	Bulk Carrier
		Bulk Carrier, Laker Only
		Bulk Carrier (with Vehicle Decks)
		Ore Carrier
		Bulk/Oil Carrier (OBO)
		Ore/Oil Carrier
		Bulk Carrier, Self-discharging
		Bulk Carrier, Self-discharging, Laker
		Cement Carrier
		Wood Chips Carrier
		Urea Carrier
		Aggregates Carrier
		Limestone Carrier
		Refined Sugar Carrier
		Powder Carrier
		Bulk Cement Storage Ship

Working with Data

If data is downloaded from the FTP Server - ASTD requires GIS analysis experts to work with data from the system.

Those who have access to ASTD can download data for analysis. The data can be downloaded in 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 Microsoft Excel, but others require specialized programs to work with, like CSV Explore, 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 Excel. One has to download data and convert from CSV but from there analysis can be performed.

Working with Data – “Data cleaning”

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, under certain atmospheric conditions. In the prefixed reports made directly from the ASTD System, ASTD Filters out all AIS Class A transponder signals from ships 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 ships outside the Arctic area covered by the ASTD System that satellites pick.

Please be aware that when downloading data from the FTP server, 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