

# The use and usefulness of AIS data

AIS data have been used in various research areas in the maritime domain beyond its intended and practical purpose of providing ship information during voyage execution. It offers the possibility to understand historical and typical ship behaviour, as well as generate real-time decision-support solutions for mariners and shore-based operators. SSPA has engaged in various research and development projects using AIS data as their basis, and even offers important and novel commercial tools that function via algorithmic analyses of historical and real-time AIS data.

## What is AIS?

The Automatic Identification System (AIS) has been in full operation for around fifteen years. It is an automatic nautical tracking system on board ships that gathers and provides ship information to other ships and shore organisations such as the Vessel Traffic Services (VTS). It assists ships and maritime authorities to identify and monitor ships' movements.

AIS includes the ship's identification number, position, course, speed, type of cargo, among other ship and voyage specificities. This information is typically displayed on the Electronic Chart Display and Information System (ECDIS) screens in complement to the marine radar, which is still the primary tool on board for collision avoidance during voyage execution.

The transfer of AIS information is done via AIS transponders on board ships in connection with satellites. AIS transponders integrate electronic sensors such as a Global Positioning System (GPS), a Very High Frequency (VHF) transceiver, a rate of turn indicator and a gyro-compass, to capture up-to-date ship statuses such as rate of turn and geographical direction.

According to the International Maritime Organization's (IMO) convention for Safety of Life at Sea (SOLAS), vessels over 300 gross tonnage are obliged to be equipped with an AIS transponder, class A, that can transmit and receive all message types.

## In what contexts are AIS data useful?

There are AIS base stations located along coastlines that can receive and record a large amount of AIS data. Beyond the original purpose of AIS, having access to AIS records also opens up unique possibilities in research and development projects (alone or combined with other data sources). They enable learning about shipping patterns and integrating them into optimisation models or simulations, new services and applications, and thereby helping to reduce uncertainty.

SSPA's researchers have identified that there are at least ten different research areas in which

AIS data are used today:

- traffic (e.g., mapping ships' routes);
- logistics and transport economy (e.g., traffic between ports, delays and trade);
- monitoring (e.g., abnormal ship behaviour);
- collisions and navigational safety (e.g., probability of accidents);
- emissions (e.g., air emissions from ships' movements);
- oil spills (e.g., mapping and monitoring marine oil pollution);
- noise (e.g., the relationship between noise and underwater fauna);
- interaction with whales (e.g., distribution of blue whales in relation to current shipping lanes);
- fishing (e.g., density mapping and fishing vessel movements), and
- ice (e.g., navigation and performance in ice).

Within these areas, AIS data can benefit actors within the IMO, maritime administrations, national and local authorities, the VTS, shipping companies, governments, fourth-party logistics companies, ports, coastguards and military, as well as various industrial stakeholders and actors associated with maritime infrastructures, shipment and wildlife.

## AIS data-based research, development and innovation

SSPA has stored years of AIS data, both from Swedish coastal waters by the Swedish Maritime Administration (SMA), and from across Europe via the crowd sourcing initiative AIS Hub. At SSPA, we also have the ability to load any AIS data in NMEA format for customer-specific analysis.

The regional project, MariA – Maritima Analyser, funded by Interreg Öresund-Kattegat-Skagerrak, is one of the platforms where SSPA has performed several AIS data-based studies. SSPA's researchers have, for example, revisited the concept of "ship domain" (distance to other ships/land), based on AIS data analysis. They concluded that the characteristics of different waters and the type of ship intersections

influence the shape and size of the ship domain.

Another example concerned the study of the Gothenburg container port conflict, between port operators and a labour union in 2016–2017, and how traffic and goods flow were affected, by using a combination of official port statistics and AIS data. Results showed that Gothenburg suffered a large decline in productivity and in the total number of containers handled, whereas the other ports in Sweden were only partly able to handle their increased volumes. Instead, there was a significant environmental impact as trucks had to bring containers to and from European ports.

Other AIS data analyses have been performed at SSPA, such as those in the FAMOS Odin project (closed in June 2019) for route optimisation analysis and investigation of common under-keel clearance (UKC) distances in the Baltic Sea. Read more about these projects in Highlights 66.

## Commercial applications of AIS data

AIS data also form the basis of commercial developments at SSPA since 2016, primarily within SSPA's service area dealing with Environment, Risk and Operations. When combined with SSPA's extensive knowledge of the hydrodynamic fundamentals of ships, it is possible to produce



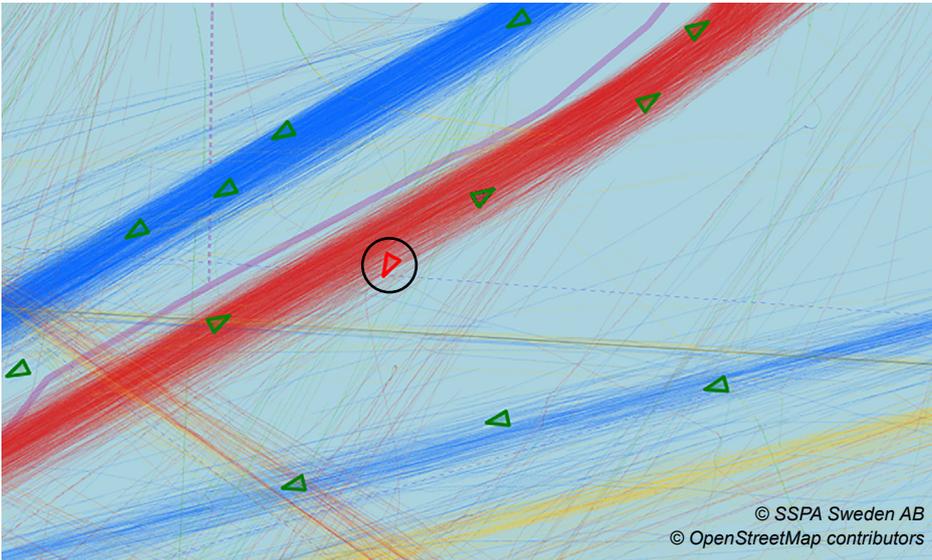
**MARIA**  
MARITIMA ANALYSER

MariA is a research project (2017–2020) co-funded by Interreg ÖKS and the European Regional Development Fund, coordinated by SSPA, in partnership with the Danish Maritime Authority. The aim is to develop and test improved maritime data analysis methods and tools to reduce shipping accidents, the environmental footprint and maritime infrastructure costs, and increase the accessibility of shipping compared to road-based transport.

**Interreg**

Öresund-Kattegat-Skagerrak  
European Regional Development Fund





SSPA's Automated Behaviour Monitoring (ABM) tool interface, where red triangles represent ships with an abnormal course for that area.

operational and environmental analyses both at an aggregated and individual level, supplying information and decision support to ship operators and environmental and maritime authorities.

AIS data are also a powerful tool in establishing risk scenarios for ship-to-ship and ship-to-shore collisions and groundings, for instance in the Björnåfjord project. AIS data from the relevant geographical area were fundamental in establishing a basis for the Monte Carlo simulations performed. Read more in Highlights 60.

SSPA's Automated Behaviour Monitoring (ABM) tool is another example of the commercial applications of AIS data. The ABM tool uses big data analyses and simple Artificial Intelligence (AI) functionality to identify abnormal behaviour of ships operating in a specific area. This can be used to establish early warning systems of potential maritime accidents to initiate evasive manoeuvres and emergency response activities before a serious maritime accident occurs.

### The future of AIS

For future research, it is proposed that AIS data could be useful in studies about the spread of marine litter, shallow water effects, fuel consumption, the fill rate of cargo ships, or how political and historical events such as Brexit affect maritime traffic. Continuous research on the technical challenges of AIS is also recommended, e.g. its coverage issues and bandwidth, security and reliability.

Past research has shown that AIS is generally perceived by ship officers as an important aid in improving their situational awareness. Yet, statistically, it is not clear that it has had a significantly positive impact on the number of collisions. Especially during the infancy of AIS, there were AIS stations transmitting erroneous data, and although it is believed that this has

improved over time, ship officers and shore operators still report being cautious with trusting AIS information.

In some parts of the world, the AIS communication link is reaching its capacity limit. At the same time, there is a will to introduce new functionality and to extend the type of information sent over AIS. A potential new standard under development is VHF Data Exchange System (VDES), which utilises both terrestrial and satellite radio communication in the VHF maritime mobile band. It allows for ship-to-ship, ship-to-shore and ship-to-satellite communication. The bandwidth should be roughly 32 times higher than today.

Newly proposed functionality to be added, mainly related to IMO's e-Navigation initiative, is ship-to-ship and ship-to-shore route exchange, exchange of port information and adjustment of Estimated Times of Arrival (ETAs), exchange of weather and ice data, improved information exchange in Search and Rescue (SAR), update of electronic charts, and receipt of navigational warnings directly into the ECDIS.

Within the Sea Traffic Management (STM) project, interviews performed by SSPA with various operators identified, however, that they reckon instead that the reliability and proper display of functions already available today are a more urgent matter. SSPA has also done work in this direction within the EfficienSea projects, having developed and demonstrated methods for automatic surveillance of AIS data quality.

The usage of AIS/VDES data in algorithm development, decision-support and automated systems on board and ashore, should also be subject to user and interaction studies to assess user needs, trust, increased automation and its impact on operations.

References are available at [www.sspa.se/the-use-and-usefulness-of-AIS-data](http://www.sspa.se/the-use-and-usefulness-of-AIS-data)



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