A study of Satellite AIS Data and the Global Ship Traffic through Singapore Strait

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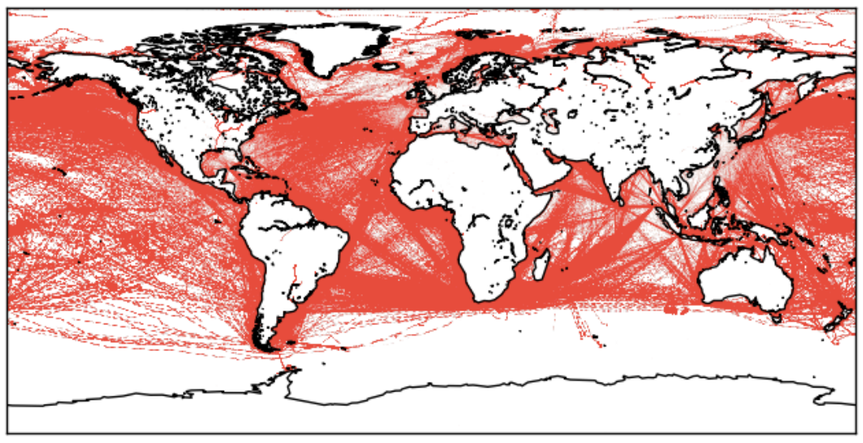

Figure 1: Global ship traffic in August 2014, based on satellite AIS-data from AISSAT-1 and AISSAT-2

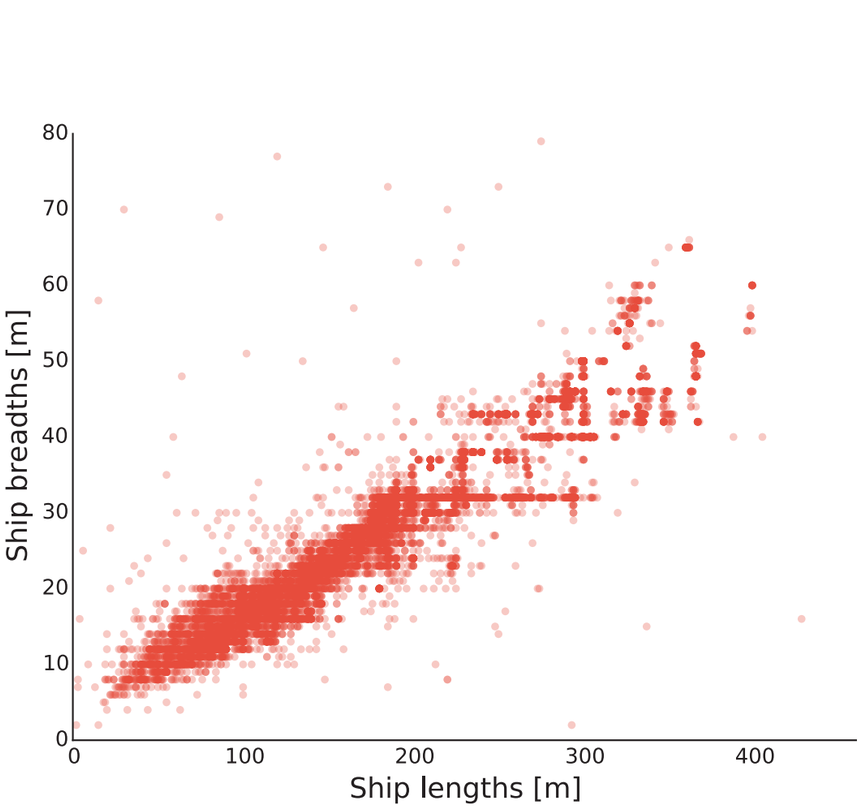

Figure 2: Breadth and length for all cargo ships present in the satellite AIS data.

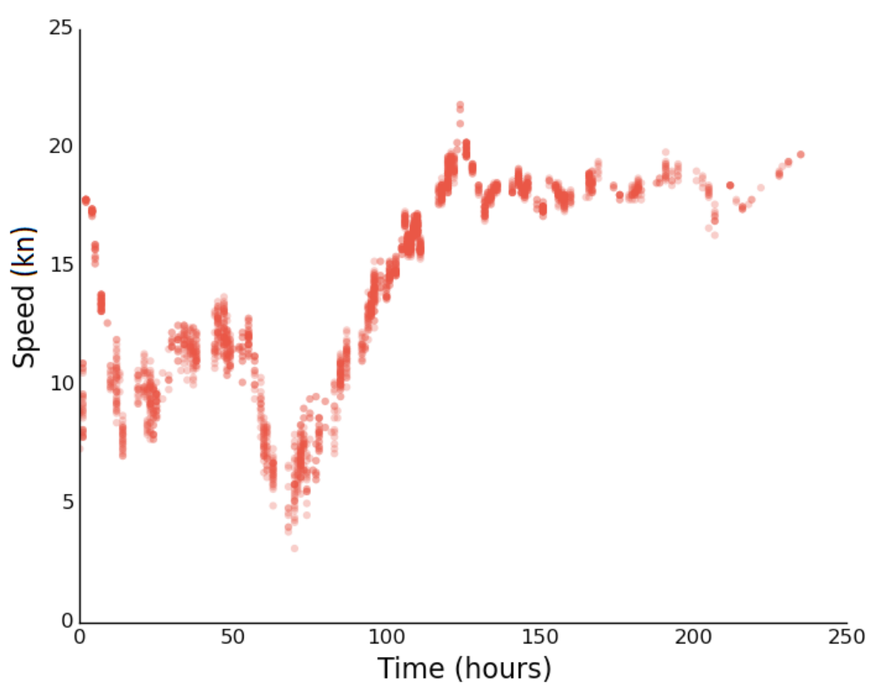

Figure 3: Speed plot for the vehicles carrier Galveston Highway from 28. July to 06. August, retrieved from satellite AIS data.

Introduction

The Automatic Identification System (AIS) was introduced as a means to avoid accidents and to monitor ship traffic, especially in highly trafficked waterways. The AIS data is transmitted via radio waves and contains information on ship dimensions, draught, speed, heading and position. This data is transmitted from all ships over a certain size. As an effort to extend the coverage area from the previously land based base stations, satellites have been launched to receive AIS data from all over the world. This is a rather new development, that gives a lot of new opportunities in monitoring and analysing global ship traffic.

In this master thesis we have investigated whether these large amounts of Satellite AIS data are a reliable source of information. We have given examples on how Satellite AIS data can be used in analyses of ship traffic. As a case study, we have investigated the traffic through Singapore Strait, and whether Satellite AIS data can be used to track ships entering Singapore Strait back to their port of origin. This exploration into AIS data and Satellite AIS data done in this thesis will be benecial for both ship operation analyses and emission analyses.

Method

We have retrieved Satellite AIS (S-AIS) data spanning the time period 15. May to 15. September, 2014. These data were collected by the two Norwegian Satellites, AISSat-1 and AISSat-2. The global ship traffic in August 2014 is presented through positional data from the S-AIS data in Figure 1. In addition, we retrieved AIS data from the Singapore Strait, spanning the same time period. These data were collected by land based base stations. The AIS data was sorted, and indexed in a database, to speed up the analytical process. The sorting process consisted of deleting obviously erroneous data, such as extremely large ship lengths, erroneous ship identification (MMSI or IMO number), improbable high speed or obviously wrong positional data.

Results

The data collected by the satellites amounted to 197 million AIS messages from 85,108 different vessels from all around the world. The base stations in Singapore had a much higher reception rate compared to the satellites. This was evident by the very much larger amount of data, 526 million AIS messages from 17,026 different vessels. This is attributed to a combination of interference problems for the satellite antennas, as well as the orbital passing rate for the satellites, which was two to fifteen times per day per satellite. There is a higher passing rate in the northern and southern hemisphere. The interference problems arise in areas with a high amount of ship traffic.

Out of the 145,092 arrivals of tankers and cargo ships into Singapore Strait over the whole time period, we were able to track an excess of 64,000 back to their port of origin with the satellite AIS data. The median voyage length for these was 470 hours.

In addition, we developed heuristics to identify the specific ship type of different vessels solely based on the information retrieved from the AIS data. This heuristic was based on AIS data such as length and breadth (Figure 2) and speed data (Figure 3). The specific ship type allows us to differentiate between for example LNG vessels and Oil Tankers, which both are registered as tankers in the AIS data. The prelimenary results of this heuristic can be seen in Table 1. With the specific ship type, together with speed data and positional data, it is possible to give an estimate on the greenhouse gas emissions from different types of ships, ship types or shipping lanes. This means that with historical satellite AIS data, it is possible to monitor whether measures to reduce greenhouse gas emissions such as slow steaming is more or less prevalent than before.

Table 1: Prelimenary heuristic performance

Ship type	AIS ship type	Vessels in world fleet	Vessels in ideal group	Identified in S-AIS data	Accuracy
Total LNG	Tankers	388	291	282	99%
General LNG Carriers		-	255	249	99%
Q-Flex		-	24	26	100%
Q-Max		-	10	10	100%
UL/VLCC s	Tankers	624	465	374	99%
Panamax Container ships	Cargo	875	665	807	90%
Panamax Bulk Carriers	Cargo	2,405	1,210	2,346	98%

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