Big data for Maritime Domain Awareness: An AIS case study

Waldo Kleynhans, IMIS Global

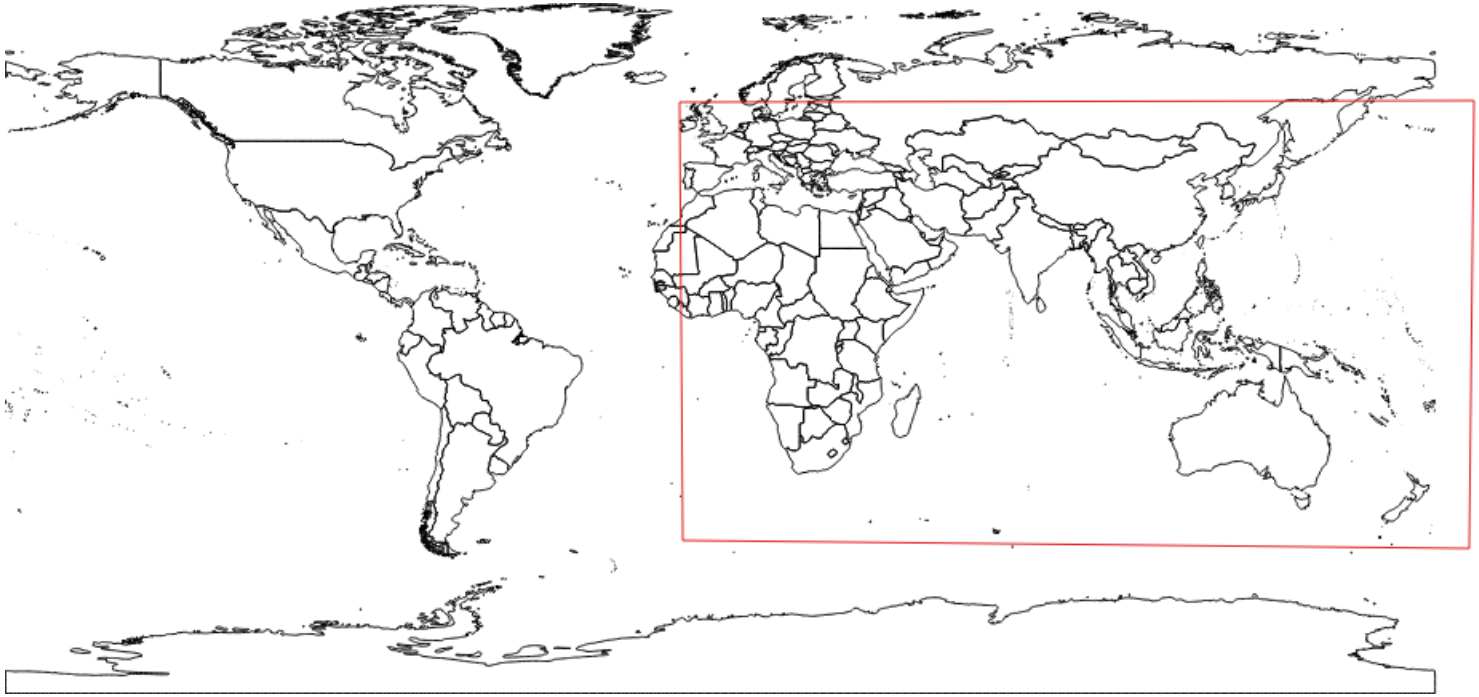
- The world's oceans is of critical importance to humanity as it is key to fisheries, shipping as well as the environment.
- As maritime activities increase globally, there exist a greater dependency on technology in the monitoring, control and surveillance of vessel activities.
- One of the most prominent systems for monitoring vessel activity is Automatic Identification System (AIS).
- There are however some challenges with the use of AIS data.

AIS data fidelity:

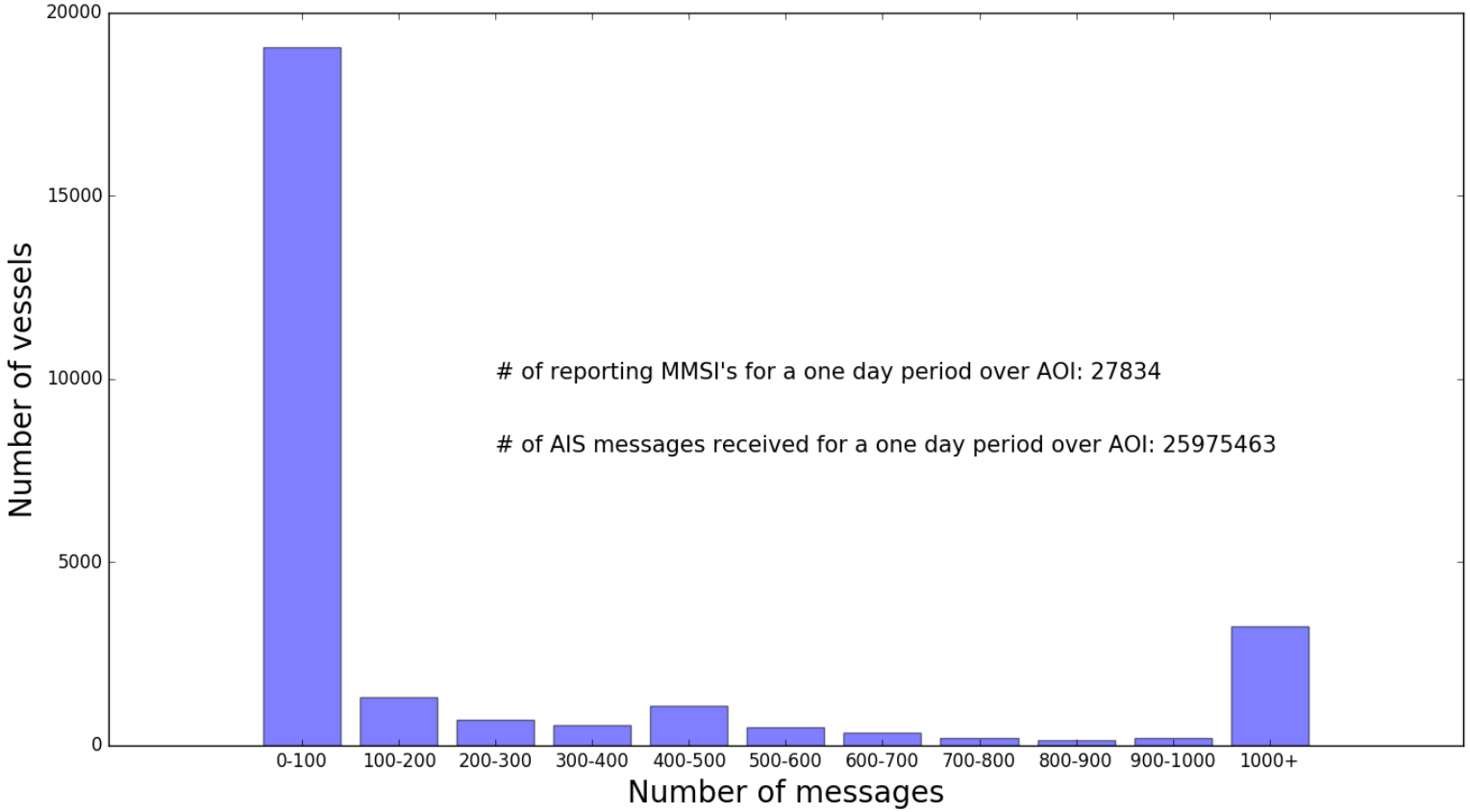
- Information could be manipulated / corrupted
- AIS receivers are not controlled in the same manner as AIS transmitters

Significant volume increase of AIS messages:

- Due to the global increase in vessels fitted with AIS transmitters as well as the proliferation of satellite and terrestrial receiving stations.
- While increased AIS data volumes is beneficial, the processing and storage of these large data volumes can become problematic.

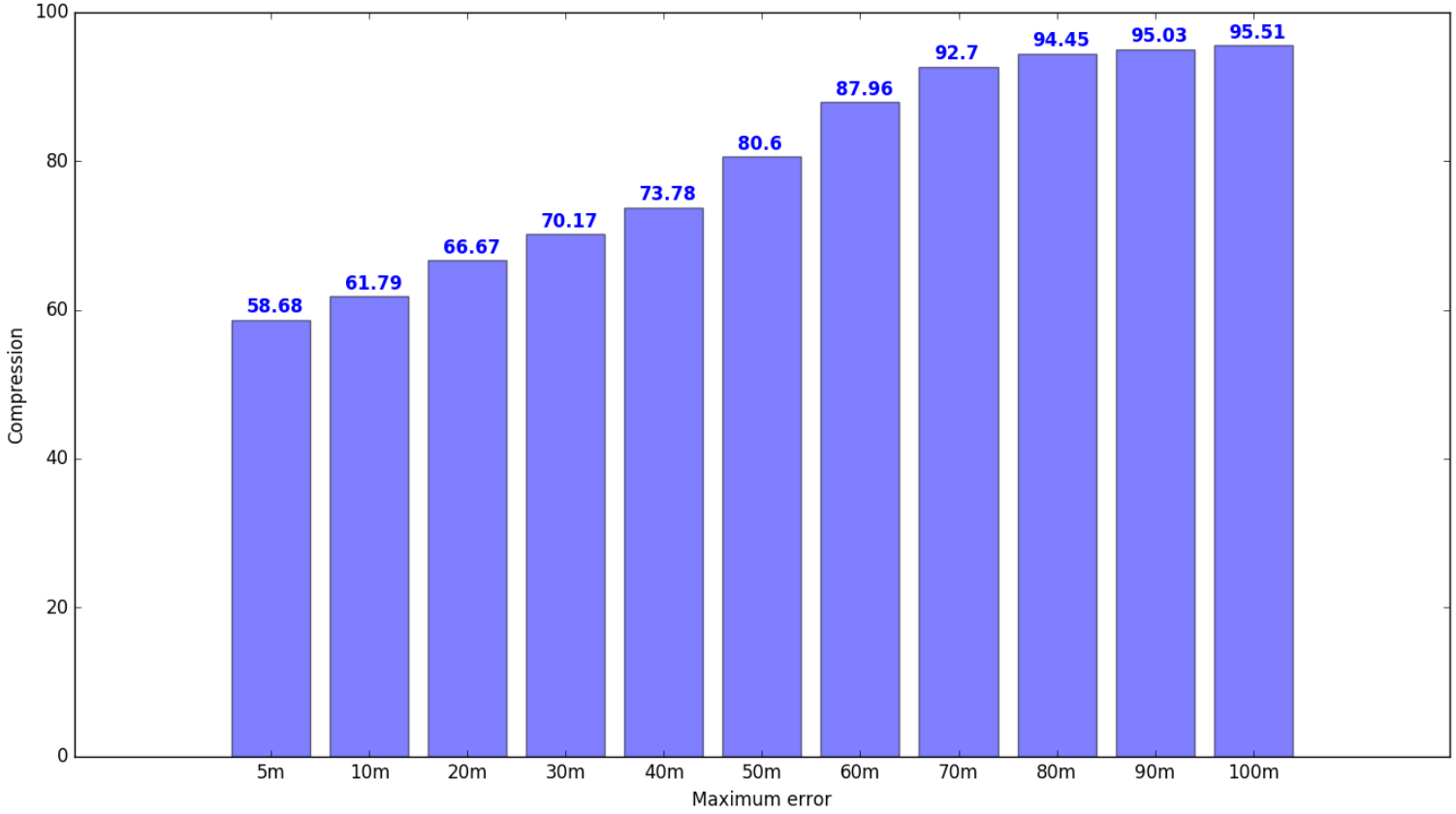


- The study area covers a significant portion of the Globe.
- Snapshot of all AIS messages received over 24 hours for 17 March 2018 was concidered
- AIS data from this area is provided by more than a hundred AIS data sources which includes terrestrial receivers, base stations as well as satellites
- The total number of vessels that was received during the day was 27834.
- These vessels transmitted a combined total of approximately 26 Million AIS messages during the 24 hour period


20000
15000
10000
5000
0
Number of vessels
# of reporting MMSI's for a one day period over AOI: 27834
# of AIS messages received for a one day period over AOI: 25975463
0-100
100-200
200-300
300-400
400-500
500-600
600-700
700-800
800-900
900-1000
1000+
Number of messages

- >70% of vessel's transmitted AIS messages were received only 0-100 times
- Approx. 15% of vessel's total received AIS messages for the day > 1000
- 10% of the vessels generated 90% of the AIS messages received through the network of receivers in the AOI.

- An on-line lossy track compression methodology was used in the filtering process of the positional AIS data
- Method tracked the AIS message stream originating from each ship in an on-line fashion
- Spatio-temporal information contained in each newly presented AIS message compared to current vessel track history using a spatio-temporal distance metric
- A decision was made to include the newly presented positional information or discard it based on the maximum allowable distance metric
- The goal was to be able to do historic vessel track reconstruction as a function of the maximum allowable track distance error
- It was shown that a compression ratio of approximately 90% could be achieved when the error metric of between 60m and 70m is selected.


100
80
60
40
20
0
Compression
58.68
61.79
66.67
70.17
73.78
80.6
87.96
92.7
94.45
95.03
95.51
5m
10m
20m
30m
40m
50m
60m
70m
80m
90m
100m
Maximum error

- Volume of AIS data is increasing significantly 40% increase over the last 4 years.
- Maritime industry needs to able to deal with with these large data volumes.
- Data pre-processing and compression is essential to enable effective downsteam processing.
- A simple framework was presented to showcase an example of AIS on-line data compression.
- Initiatives such as datAcron is crutial for the practical implimentation of opperational systems able to effectively deal with AIS data of these orders of magnitude.