

REPORT ON GEOSPATIAL ANALYSIS OF ARCTIC MARINE TOURISM – PHASE 1

REPORT BY THE BRITISH ANTARCTIC SURVEY

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**British
Antarctic Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

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REPORT ON GEOSPATIAL ANALYSIS OF
ARCTIC MARINE TOURISM – PHASE 1

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Distribution

This report and associated results are not for onward distribution beyond the organisations listed below.

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UK FCO

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1. Study context and aims

1.1. Context

This report summarises the first part of work completed by British Antarctic Survey (BAS) for the Protection of the Arctic Marine Environment (PAME) Working Group of the Arctic Council.

The work for PAME is a component of their Arctic Marine Tourism: Development in the Arctic and enabling real change project. Work package 1 of this project (“Arctic marine tourism knowledge and information”) will be completed by BAS.

The overall aims of work package 1 are to to compile data on tourism vessel statistics in the Arctic using PAME’s Arctic Ship Traffic Data (ASTD) System^[1] to better understand recent developments and identify gaps in data:

- i. Analyze the trends in the Arctic marine tourism based on information in the ASTD system, and potentially other complementary databases with respect to the number of cruise ships, their size, pollution information etc.
- ii. Identify where gaps in data exist, and potential ways to address these gaps.

BAS has been provided with access to the ASTD system in order to compile and analyse these data as part of work package 1.

1.2. Scope of work for BAS

BAS has three tasks to complete which are described in the Terms of Reference^[2] between PAME, BAS and the UK FCO (Foreign and Commonwealth Office).

Task 1: Clean/filter, organise and structure the data

Task 2: Passenger calculations

Task 3: Analysis and mapping presentation of results

This report summarises the methodology and presentation of results for tasks 1 and 2 as per the schedule set out in the Terms of Reference^[2]. Task 3 will be completed in the next phase.

2. Input data sources

2.1. Data sources

Arctic Ship Traffic Database (ASTD)

The ASTD Level 1 data^[1] contains AIS records for all IMO registered ships entering the ASTD area for the period 2013-2019. The records are georeferenced using latitude and longitude, and contain IMO number, information on ship size and category, as well we calculation estimates of emissions related information.

Analysis Zones

Geometries delineating the three zones, Iceland EEZ, Faroese EEZ and Polar Code area where provided in shapefile format and are illustrated in figure 1.



Figure 1. Map showing ASTD data extent and three analysis areas.

Ship Passenger numbers

We were provided with a database which gives information on the maximum number of passengers, and in some cases crew for each ship identified by IMO number. This database covered all ships in the ASTD ship categories of 'Cruise ships' and 'Passenger ships' but did not contain information for ships in the 'Other' (Yachts) category.

3. Data cleaning and formatting

3.1. *Data cleaning*

The ASTD Level 1 data was imported into a Postgres database with PostGIS extension for geospatial functionality. The following steps were then implemented.

- 1) As specified in the ASTD Data Document^[3], all ship signals with less than 10 positions per month were filtered out. This ensures that random ships that the satellites pick up from outside the area are not included in the final statistics.
- 2) A table was created of all ships that were tourist ships, as defined in the terms of reference, using the field 'lloydscat_5'.
- 3) The ASTD data points are located using latitude and longitude in WGS84 datum. Using this information, point geometries were calculated for each signal using PostGIS, which were then reprojected to Arctic Polar Stereographic Projection for mapping and visualisation.
- 4) Several individual signal returns were identified as being on land, and/or located very far from the rest of the associated ship track. In all these cases, the emissions information fields and the 'dist_nextpoint' (distance to next point) field were all 'NULL'. These points were removed from the table.

3.2. *Analysis of distance travelled per ship*

The ASTD data contains a field 'dist_nextpoint', which is the distance in metres to the next signal in time for that ship. However, to calculate total distance travelled for each ship over a month per analysis zone, it is not possible to simply sum this column, as some ships travelled in and out of the zone within any given month.

Instead, ship tracks were created for each ship on a monthly basis. These were intersected with each analysis area to output line geometries representing the ship tracks for each analysis zone. The geodesic lengths of the ship track lines were then calculated to give the total distance travelled per ship, per month for each zone.

3.3. *Data formatting*

The spreadsheets were put together by summing the grouping records together by their unique IMO number, by month and analysis area. Emissions fields were summed, to give a total for each output sheet.

The passenger numbers were added to each ship by cross matching the unique IMO numbers for each ship, to those in the passenger number database.

4. Results presentation

4.1. Spreadsheet delivery

We have provided two sets of 9 spreadsheets (delivered together with this report as PAME_Arctic_Marine_Tourism_GISAnalysis_BAS_spreadsheets_v1.0.zip which contains the files detailed in table 1. Both sets of spreadsheets break the data down spatially by the 3 analysis areas, and by 3 ship categories.

- The first set of 9 spreadsheets each contain 13 sheets, one for each month (aggregating all data across all years) and one summing all the data across the 12 month sheets. Each other these sheets lists the unique ships identified by their IMO number. These are termed ‘monthly aggregations’.
- The second set is provided in addition to what was specified in the Terms of Reference, but potentially allow more flexibility in drawing out trends across the year range. Each of the 9 spreadsheets contain 84 sheets, one for each month of each year across the time period. As with the first set, each sheet lists the individual ships identified by their IMO number. We have also included a sheet with some graphs providing some basic visualisations of the data. These are termed ‘individual months’.

Each spreadsheet also contains a cover sheet, detailing what area and ship type it is representing, and details on the sheets contained within. The spreadsheets are listed in table 1.

Analysis area	Monthly aggregations	Individual months
Faroese EEZ	01_faroe_cruise.xlsx	10_faroe_cruise_monthly.xlsx
	02_faroe_other.xlsx	11_faroe_other_monthly.xlsx
	03_faroe_passenger.xlsx	12_faroe_passenger_monthly.xlsx
Iceland EEZ	04_iceland_cruise.xlsx	13_iceland_cruise_monthly.xlsx
	05_iceland_other.xlsx	14_iceland_other_monthly.xlsx
	06_iceland_passenger.xlsx	15_iceland_passenger_monthly.xlsx
Polar Code	07_polarcode_cruise.xlsx	16_polarcode_cruise_monthly.xlsx
	08_polarcode_other.xlsx	17_polarcode_other_monthly.xlsx
	09_polarcode_passenger.xlsx	18_polarcode_passenger_monthly.xlsx

Table 1. Spreadsheets delivered.

4.2. Data gaps

Passenger numbers

The passenger number information was available for all ships within the ‘Cruise ship’ and ‘Passenger ship’ categories, but not for those in the ‘Other’ category.

Faroese EEZ and ASTD data extent

The ASTD data does not cover the entire area of the Faroese EEZ, as illustrated in figure 2.

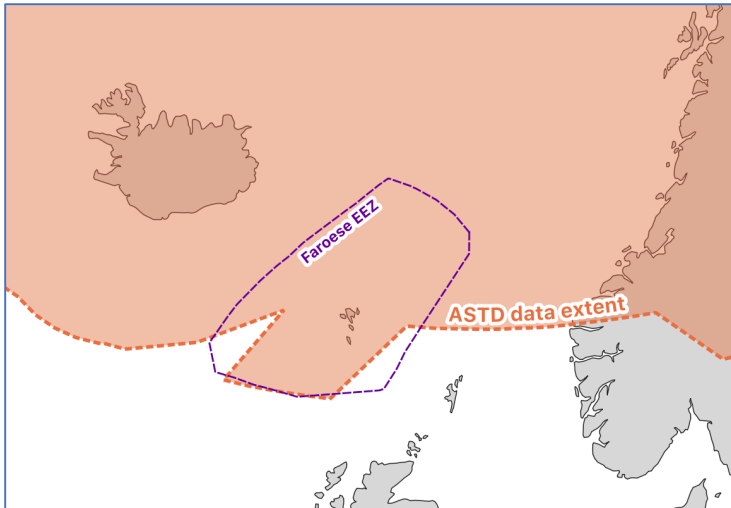
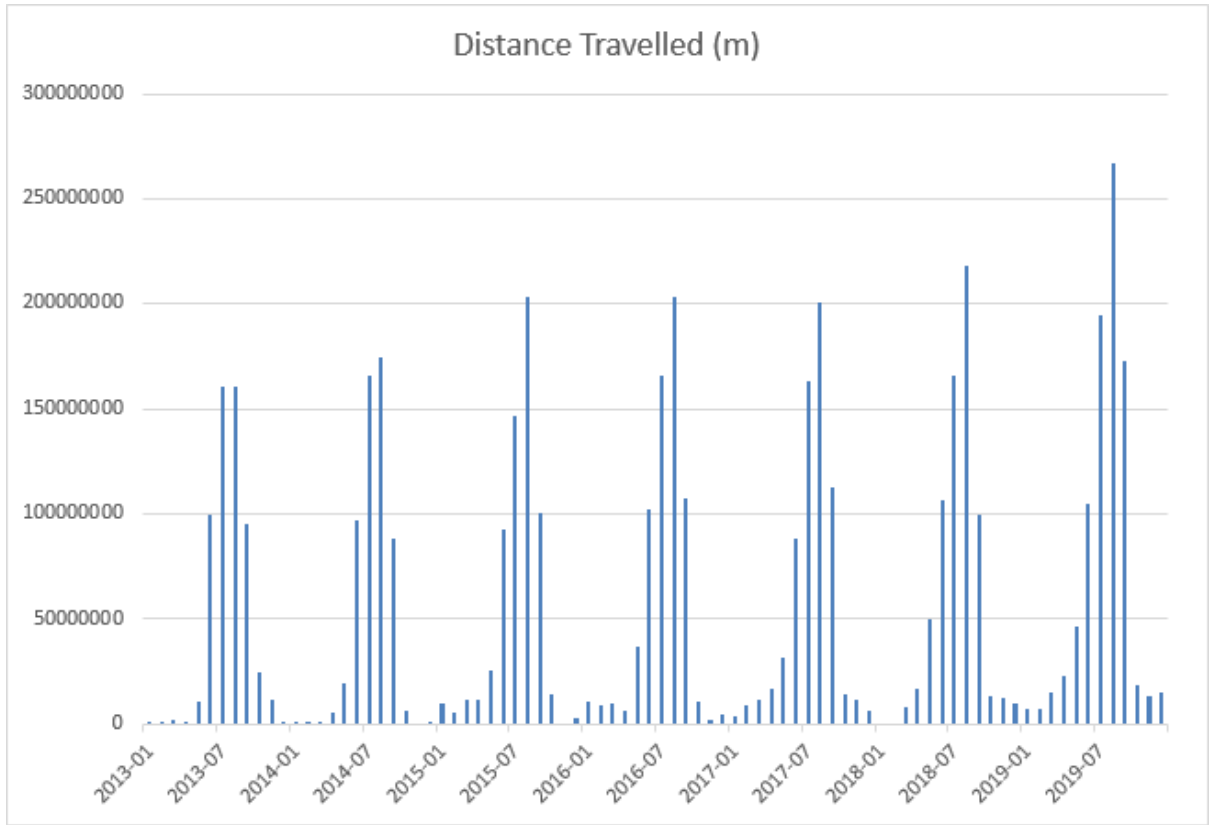


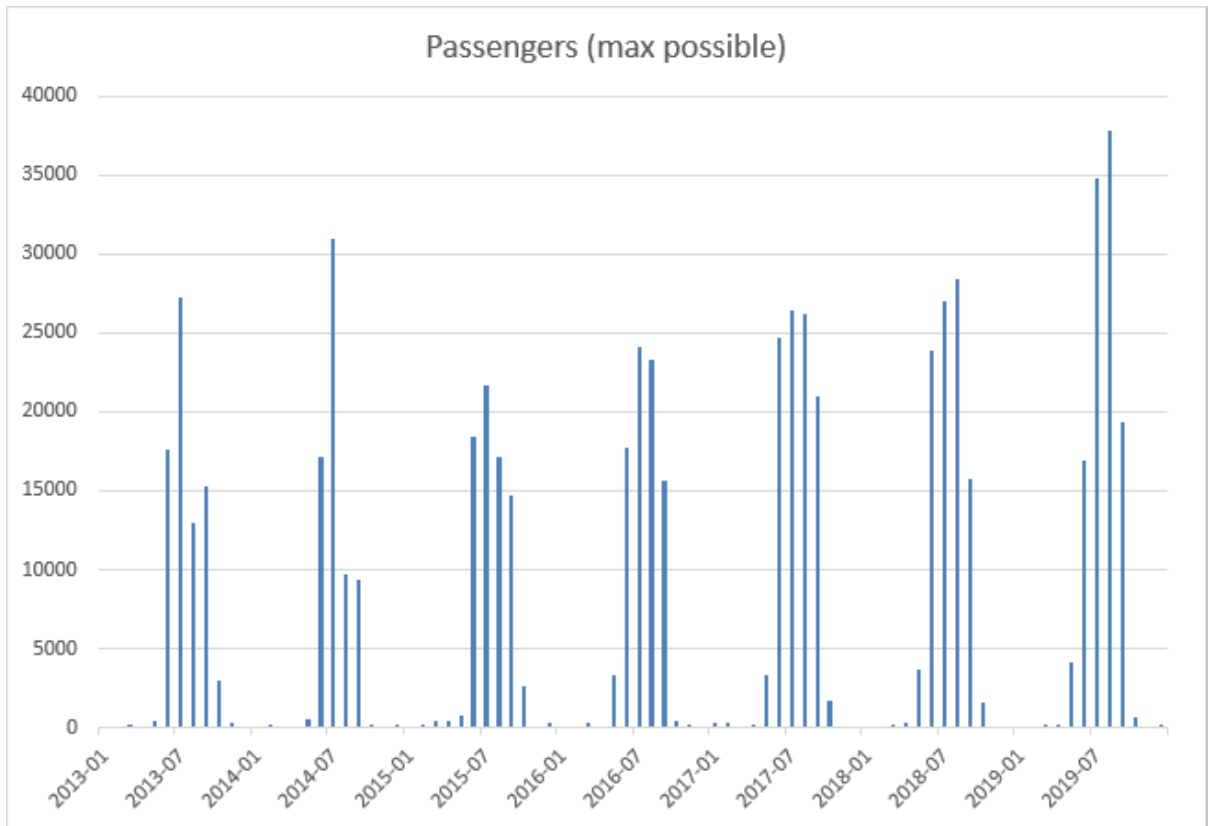
Figure 2. Map showing ASTD data coverage within the Faroese EEZ

4.3. Example trends

Using the additional set of spreadsheets which separates the data out across individual months, it is possible to produce some example visualisations of the data and trends across time. Graph 1 shows the distance travelled by all cruise ships entering the Polar Code analysis area on a monthly basis. Using the passenger number information, graph 2 shows the maximum number of passengers that on cruise ships entering the Polar Code analysis area, over time.



Graph 1. Distance travelled in metres for cruise ships entering the Polar Code analysis area.



Graph 2. Maximum possible number of passengers on cruise ships entering the Polar Code analysis area.

5. Next steps

As specified in the Terms of Reference, the next step is to complete Task 3 (analysis and mapping of data) by the deadline of 1st May 2020.

References

[1] PAME - Arctic Ship Traffic Data, Level 1 2013-2019. Retrieved from PAME January 2020.

<https://pame.is/index.php/projects/arctic-marine-shipping/astd>

[2] PAME-BAS Terms of Reference, PAME-FCO-BAS GIS expert_PE 19Mar20.pdf, document known to all parties involved.

[3] ASTD Data Document, accessed March 2020.

https://pame.is/images/03_Projects/ASTD/Documents/ASTD_data/ASTD_Data_20_March.pdf

Attachments

Items delivered with this report:

1. PAME_Arctic_Marine_Tourism_GISAnalysis_BAS_spreadsheets_v1.0.zip. Results spreadsheets as outlined in table 1.