Vessel tracking using Automatic Identification System data in the Arctic

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ShipArc2015
Malmø, 26 August 2015
Content

• Use of SAT-AIS data from AISSat-1 and AISSat-2 for trend analysis as well as situational awareness

• Number of ships per month north of 67°
  – In the entire area north of 67° (Arctic)
  – In sectors of 45° longitude
  – By flag state
  – By ship type

• Number of ships through the Northeast Passage

• Ship densities and tracks

• Quality of SAT-AIS service
Views on the Arctic, sea ice, and ship traffic
Number of ships per month
- 5 years; class A, B, and total number of ships
Number of ships per month
- 4 years; monthly trend lines (August example)

Number of ships north of 67°N per month

\[
y = 200x + 1418
\]

\[
y = 128x + 1234
\]

\[
y = 73x + 184
\]

<table>
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<th>Time (month, year)</th>
<th>Class A</th>
<th>Class B</th>
<th>Total</th>
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<th>Lineær (Class B)</th>
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FFI Forsvarets forskningsinstitutt
Number of ships per month
- Average annual growth (from trend lines)

Average annual growth in number of ships north of 67°N by month

Time (month)

Growth (ships/year)

Class A
Class B
Total

Class A
Class B
Total
Number of ships per month
- 2015; Observations and prediction intervals

Number of ships observed north of 67°N per month with prediction interval of estimates for 2015

Time (month)

Number of ships

0 500 1000 1500 2000 2500 3000

1 2 3 4 5 6 7 8 9 10 11 12
Number of ships per month - 2015; Observations and prediction intervals

Number of ships observed north of 67°N per month with prediction interval of estimates for 2015

<table>
<thead>
<tr>
<th>Time (month)</th>
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<th>Class B</th>
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Number of ships observed north of 67°N per month with prediction interval of estimates for 2015.
Number of ships per month - 5 years; by ship type
Geographic distribution in 45°-lon sectors - 5 years; total number of ships

Total number of ships per month north of 67°N in 45° sectors
Geographic distribution in 45°-lon sectors - 5 years; total number of ships (zoom)
Geographic distribution in 45°-lon sectors
- growth in total numbers from 2013 to 2014

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Geographic distribution in 45°-lon sectors - growth in total between 2011 and 2014

Annual growth in total number of ship-months per year north of 67°N
Geographic distribution in 45°-lon sectors - growth in total between 2011 and 2014 (zoom)
Geographic distribution in 45°-lon sectors - relative growth in total between 2011 and 2014
Number of ships counted by flag state - August 2014 in the entire Arctic north of 67°N

Entire area

- NO: 1002
- RU: 561
- Other: 149
- FO: 31
- CA: 34
- DK: 35
- MT: 38
- PA: 44
- NL: 46
- US: 46
- BS: 47
- IS: 48
- noFl: 54

MH: 15
FR: 15
VC: 12
AG: 17
CY: 15
GB: 21
GL: 31
RU: 561
NO: 1002
Number of ships counted by flag state - August 2014 in sectors of 45° longitude
Ships crossing the Northeast Passage - 5 years; Count of ships per month
Ships crossing the Northeast Passage - 5 years; Total ship-months with uncertainty

Observed total annual ship-months with prediction interval as well as prediction for 2015

Year (2010+axis value)

Observations (ship-months/year)
Seasonal variations in ship tracks

August 2014

November 2014

February 2015

May 2015
Annual ship densities in July 2011 - 2014
Ship tracks on 14 August 2014

Ship photos courtesy of MarineTraffic. Background map courtesy of Google Earth.
Ship positions coloured by the number of observations for each ship
Quality of service parameters distributions

Histogram of messages received per ship (bin size: 10)
- Data: Flt_2_U_1
- Polygon: 067_080N-100_0100E
- Date: 2014-06-14
- n_uniqMMSI: 1122 of 1128

Histogram of observations per ship
- n_obs avg: 13.7
- median: 13.0

Histogram of max time gap between observations per ship
- dT_max avg: 9.1 h
- median: 6.7 h

Cumulative histogram of max time gap between observations per ship
- 50% 70% 90%
Summary

• The number of reporting ships per month has varied from 1073 (December 2010) to 2272 ships (August 2014).
• The growth in number of reporting ships varies with month; from 113 at the minimum in November to 201 ships/year at the maximum in July.
• The growth is partly due to changes in regulations, i.e. EC 1224/2009 (the Control Regulation) by 31 May 2014 all fishing vessels above 15m.
• The highest number of ships are in the 0-45°E sector, 1723 of 2272 ships in August 2014. The annual growth has been around 10%.
• The highest relative growth is in the following three eastern sectors, having an average growth between 15% and 24% per year.
• Monthly ship-type counts give 600 fishing vessels, 430 cargo ships, 120 tankers, 100 passenger ships, 100 tugs and 280 other ships (in 2014).
• Up to 1200 vessels are observed per day, of which 1100 are using AIS Class A and 100 Class B.
• The median number of position updates per ship per day are typically 13 and the largest daily time gaps are smaller than 6.7 hours.
Number of ships counted by flag state - August 2014 by sector

Number of vessels v.s. month and flag in the sectors
Class A, August 2014

Class B, August 2014