Knowledge Discovery of Human Activities at Sea in the Arctic using Remote Sensing and Vessel Tracking Systems

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Implementing the European Commission's Joint Research Centre mission in the EU policy cycle

Maritime Surveillance Data

Categories of data

- Ship reporting data: AIS, LRIT, VMS, ...
- Observation systems: Cameras, radars, ...;
from Shore, airplane, satellite, ...
- Ship registries, data bases: Fishing fleet, Equasis, blacklists, ...
- Intel: Reports, Local knowledge, ...
- Supporting: Maps, ENC, weather, oceanographic, ...

Integration

- Many applications need a fairly complete picture of what is happening at sea
- No single data source is adequate on its own
- Data of many sources needs to be integrated into a single picture

Sentinel -1:

Europe's Earth Observation radar

- **Since Oct 2014**
- **Open data policy**
- **Routinely
acquiring images
over the Arctic**

Maritime:

- **Ice cover**
- **Oil pollution**
- **Ship traffic**
- **Wind, waves**

Sentinel -1:

Longyearbyen

Use of two polarisation channels for ship detection

Arctic challenge: Ship detection in sea ice

17 Oct 2014

S-1 data (c) Copernicus 2014

Sentinel-1 and AIS ice pathways analysis

Yenisei Gulf (Siberia 72.4N, 79.6E) (120 km E-W x 67 km N-S)

Sentinel-1 image from 2105-04-19 01:28:13 (UTC)

Sentinel-1 and AIS ice pathways analysis

Yenisei Gulf (Siberia 72.4N, 79.6E) (120 km E-W x 67 km N-S)

Sat-AIS from 2105-01-01 to 2015-04-22 (3.5 months): 5088 messages

From EU to worldwide tracking and traffic routes

One-month of EU LRIT CDC data, revealing the main global traffic routes and enabling the implementation of innovative decision support tools

Using density maps to predict vessel routes

Historical LRIT data can be used to predict where a vessel will be up to a few days in advance

Coding vessel behaviours

☒ **MMSI search**

Data time range: -40 days

Var(COG) range: ± 45 min

Analysis

Research and Survey Vessel Behaviour

Fishing Behaviour

OTB - bottom otter trawler

TBB – rapid bottom trawler

PTM – midwater pair trawler

OTB - bottom otter trawler

Historical fishing activities

Real time fishing behaviour

From vessel densities to activities mapping

By coding the relevant behaviours it is possible to isolate shipping (blue), fishing (red) and exploration (green) activities.

Time period: from 2014-08-01 to 2014-08-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2014-09-01 to 2014-09-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2014-10-01 to 2014-10-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2014-11-01 to 2014-11-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2014-12-01 to 2014-12-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2015-01-01 to 2015-01-30

Time period: from 2015-02-01 to 2015-02-30

Time period: from 2015-03-01 to 2015-03-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2015-04-01 to 2015-04-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2015-05-01 to 2015-05-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

Time period: from 2015-06-01 to 2015-06-30

Time period: from 2015-07-01 to 2015-07-30

Fishing activity
Research/exploration
Shipping
Service/icebreakers
8/10ths Sea ice concentration
Marginal Ice Zone

April 2014

April 2015

July 2014

July 2015

Time period: from 2014-08-15 to 2014-09-15

Source: AMSA

2006 - 2015

Source: Smith, L. C., & Stephenson, S. R. (2013).
New Trans-Arctic shipping routes navigable by midcentury

The Arctic Blue Hub: Interoperability and Information Sharing

The Arctic Blue Hub

Conclusions

- **The Knowledge of human activities at sea and their trends can be enhanced by vessel tracking data.**
- **Such knowledge can support operational authorities (emergency response) and policy makers (impact assessment & planning).**
- **Arctic Blue Hub – a web platform to gather/analyse/share data, enabling a better decision-support product for different applications.**