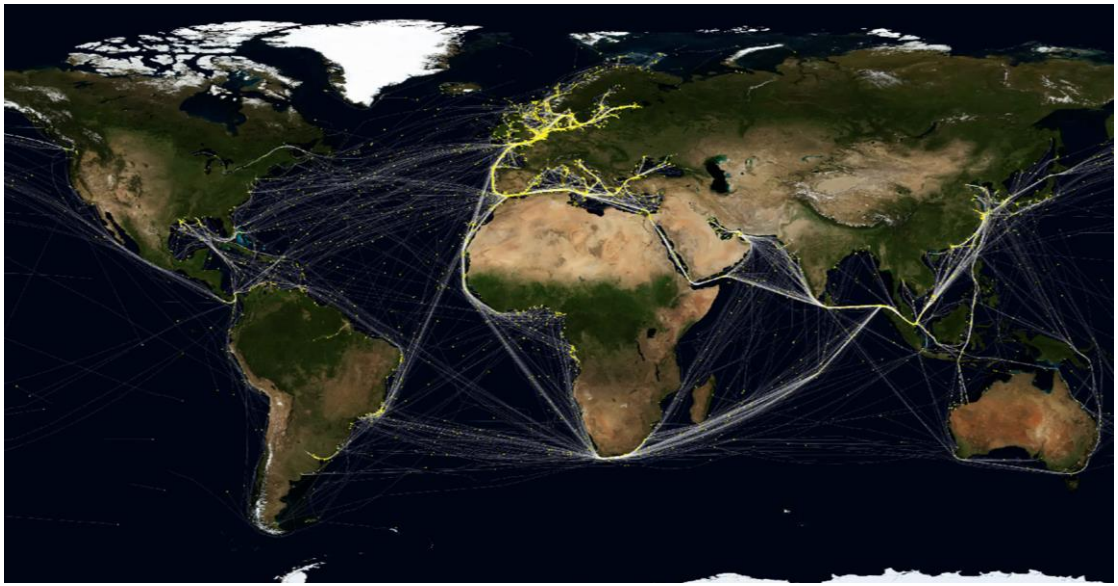
Findings Global Ship Movements & PMAR Project Updates



Michele Vespe

Joint Research Centre

Maritime Affairs Unit

michele.vespe@jrc.ec.europa.eu

Outline

The Joint Research Centre

PMAR project updates

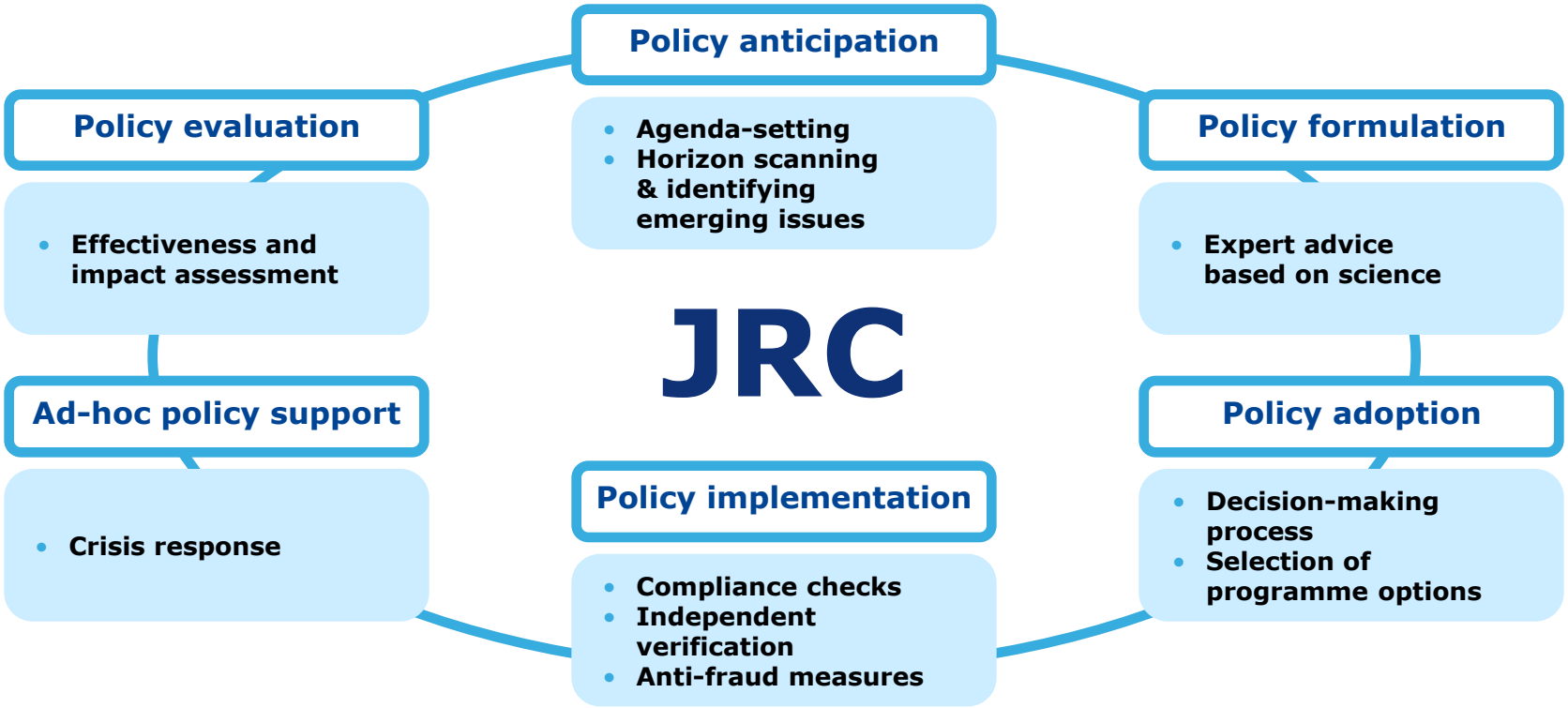
The potential of LRIT data:

- The dataset
- Unveiling global routes
- Patterns extraction and analysis
- Time evolution of extracted patterns

Final Remarks and Future Analysis

European Commission

Implementing the JRC Mission in the EU Policy Cycle



JRC Maritime Affairs Unit - activity areas:

- **Maritime transport** (maritime surveillance related to border control - EUROSUR, maritime security, oil pollution and fisheries monitoring)
- **Space policy** (Copernicus Security)
- **Anti-fraud and security** (maritime containers monitoring related to anti-fraud, crime and terrorism)
- **Multimodal transport safety** (air, maritime and rail)
- **Fisheries** (Common Fisheries Policy & aquaculture / fish farming)
- **EU Common Security and Defence Policy** (Anti-piracy: Regional Maritime Capacity Building)

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Objectives

Not to "sell" one system

- PMAR is only experimental

But instead, to:

Quantify

- What is the quality, completeness of the picture
- What are the costs, efforts

Capacity building

- Skills with operators, analysts, IT staff
- Familiarization, culture of maritime awareness

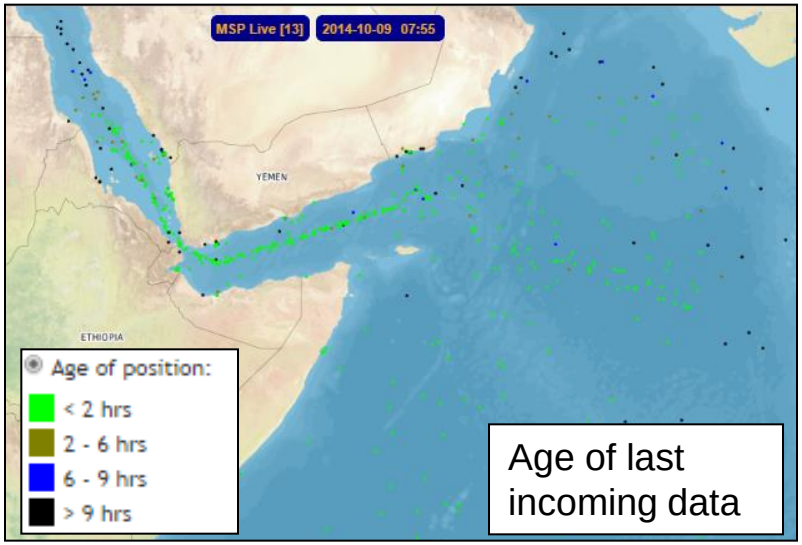
Enable choices

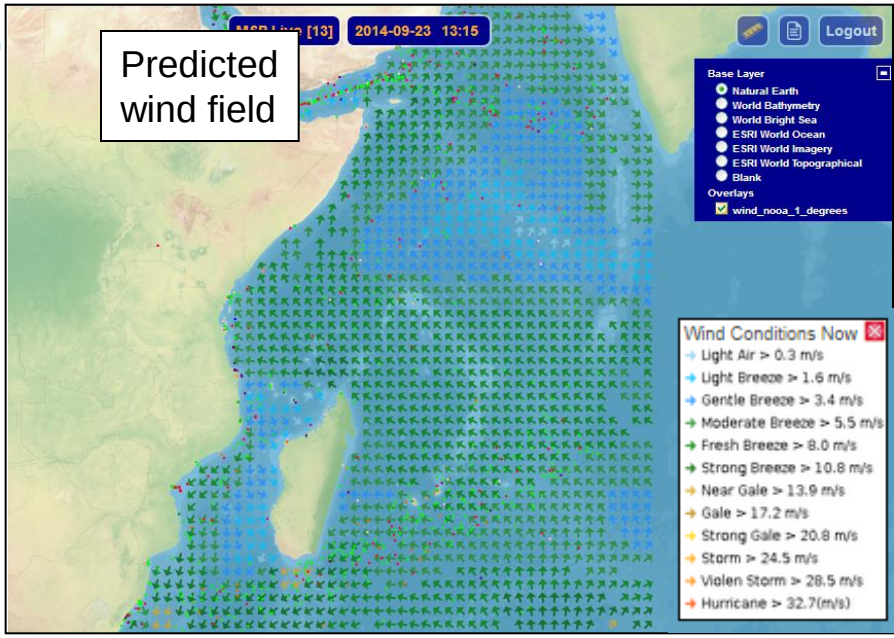
- Information on possibilities for decision makers
- Scoping of operational maritime awareness systems

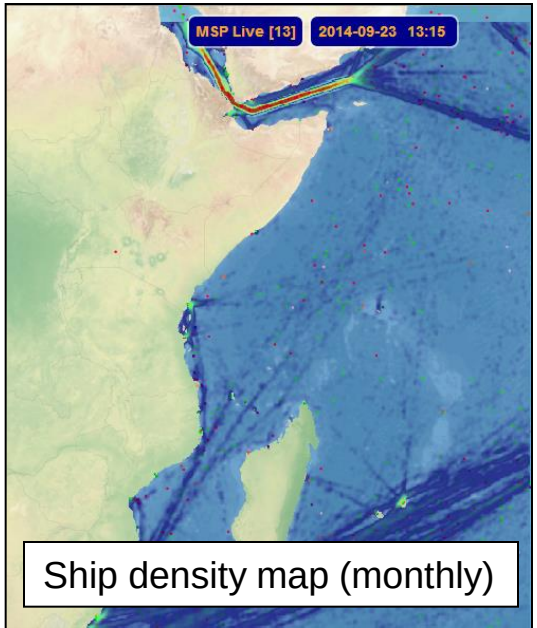
European Commission

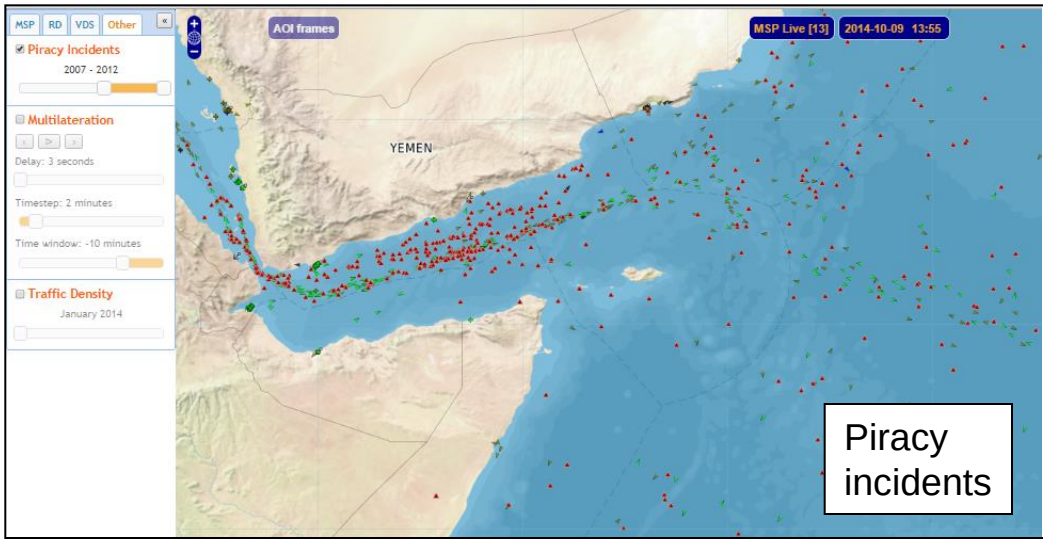
Region-Wide Maritime Awareness

Joint Research Centre


MSP Live [13]
2014-10-09 07:55
YEMEN
ETHIOPIA
Age of position:
< 2 hrs
2 - 6 hrs
6 - 9 hrs
> 9 hrs
Age of last incoming data


Predicted wind field
MSP Live [13]
2014-09-23 13:15
Logout
Base Layer
Natural Earth
World Bathymetry
World Bright Sea
ESRI World Ocean
ESRI World Imagery
ESRI World Topographical
Blank
Overlays
wind_nooa_1_degrees
Wind Conditions Now
Light Air > 0.3 m/s
Light Breeze > 1.6 m/s
Gentle Breeze > 3.4 m/s
Moderate Breeze > 5.5 m/s
Fresh Breeze > 8.0 m/s
Strong Breeze > 10.8 m/s
Near Gale > 13.9 m/s
Gale > 17.2 m/s
Strong Gale > 20.8 m/s
Storm > 24.5 m/s
Violen Storm > 28.5 m/s
Hurricane > 32.7(m/s)


MSP Live [13]
2014-09-23 13:15
Ship density map (monthly)


MSP
RD
VDS
Other
Piracy Incidents
2007 - 2012
Multilateration
Delay: 3 seconds
Timestep: 2 minutes
Time window: -10 minutes
Traffic Density
January 2014
AOI frames
MSP Live [13]
2014-10-09 13:55
YEMEN
Piracy incidents

Way ahead

PMAR-MASE is running up to Sept 2015 at:

- RMRCC Mombasa
- IOC Anti-Piracy Unit Seychelles

PMAR shows the level of maritime awareness that is obtainable at regional scale

- Feasible for users in Africa
- Gathering feedback from operational users, and implementing it
- Capacity building with operators, analysts, IT staff
- Use for requirements formulation and scoping of operational systems (e.g. from industry)

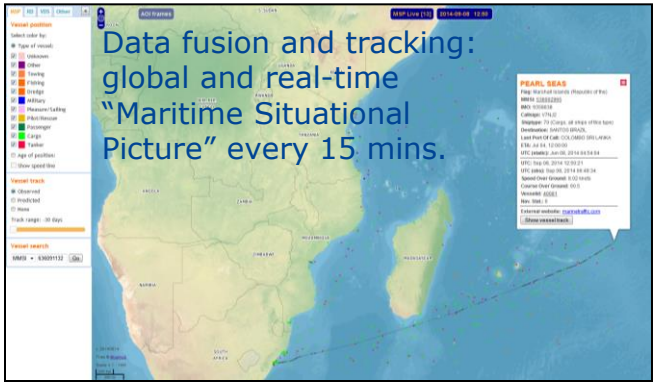
Possible next steps

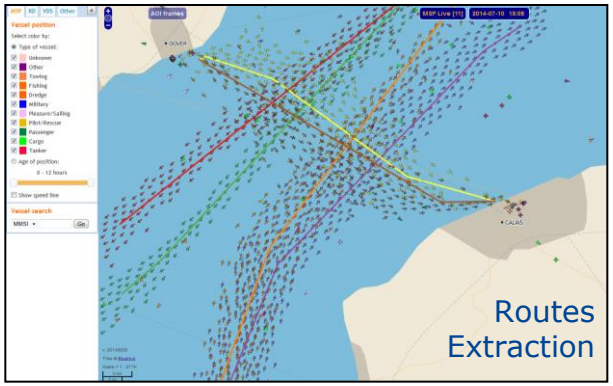
- Application with more (e.g. national) operational users
- Application in Regional Information Fusion Centres

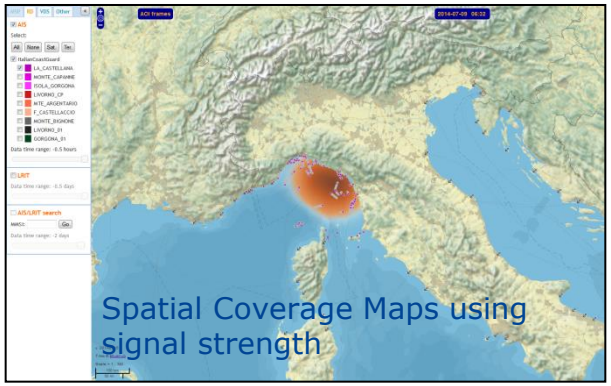
European Commission

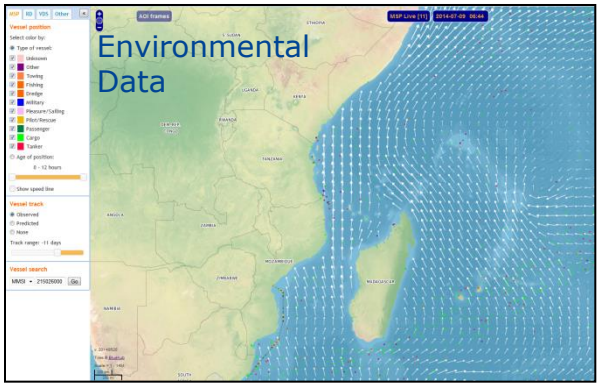
Blue Hub

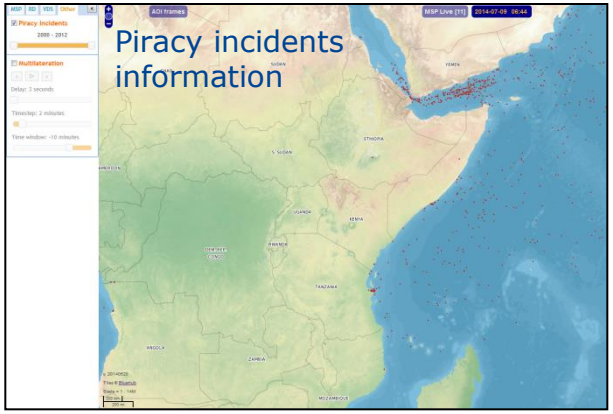
Pre-operational integrated tools

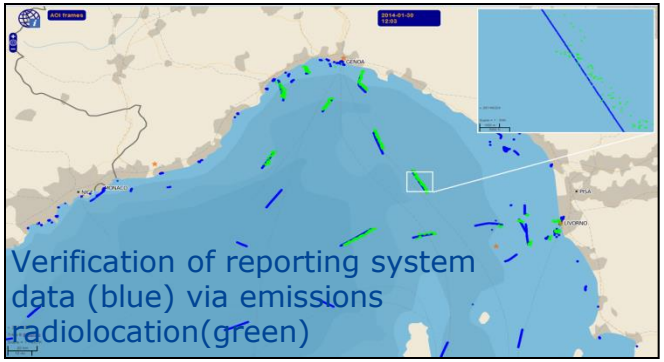


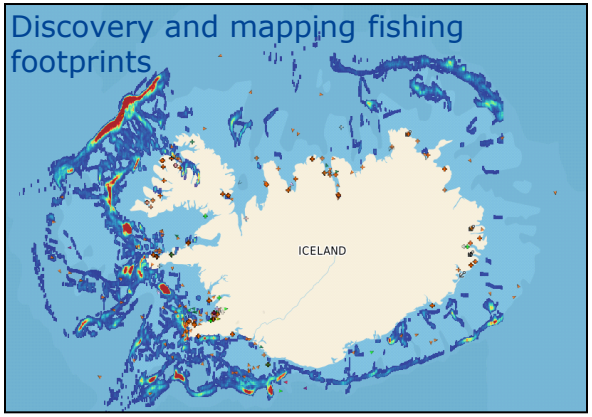












Joint Research Centre

Outline

The Joint Research Centre

PMAR project updates

The potential of LRIT data:

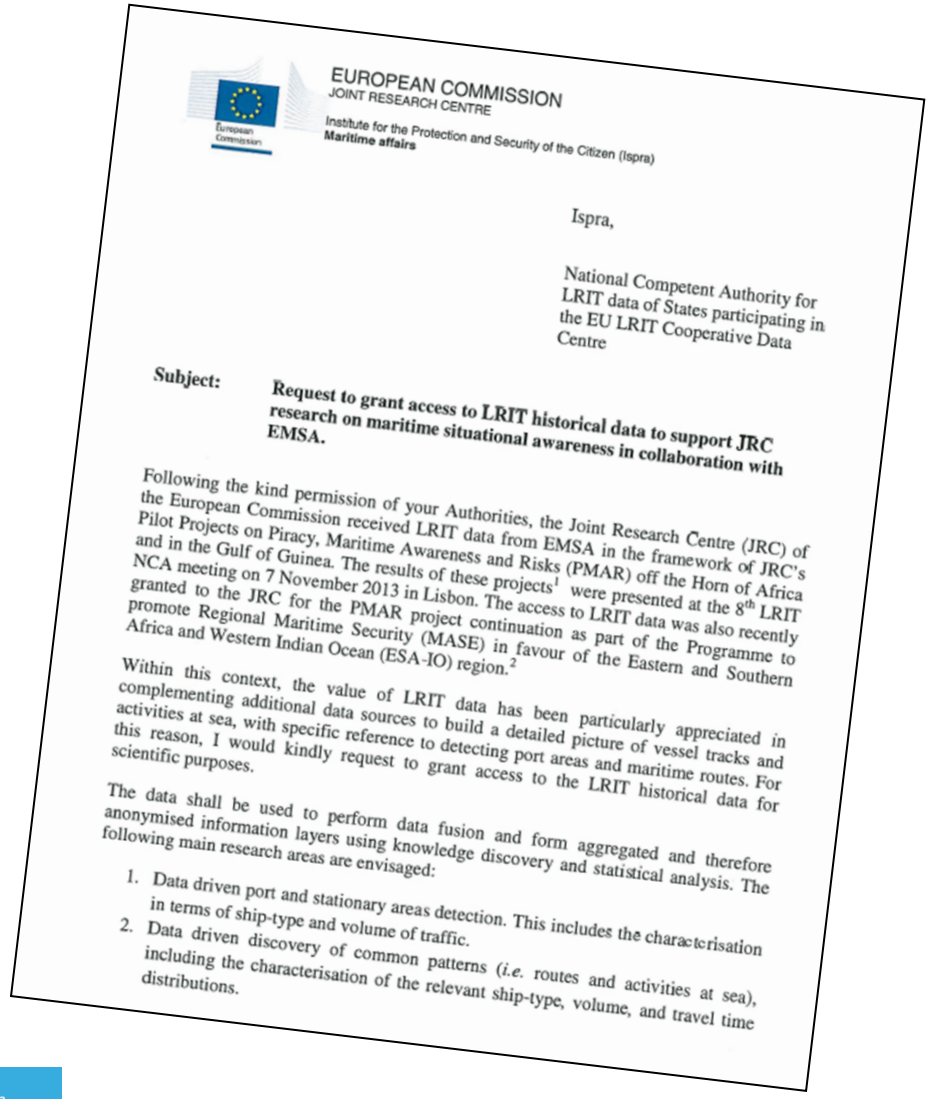
- **The dataset**
- Unveiling global routes
- Patterns extraction and analysis
- Time evolution of extracted patterns

Final Remarks and Future Analysis

The Dataset

Access to **LRIT historical data** for scientific and statistical purposes to be able to perform data fusion and form aggregated anonymised information layers.

To investigate patterns in terms of **ship-type and volume of traffic** as well as **ship routes and activities** and therefore be able to **detect anomalies** as deviations from the detected "normality" behaviour.



EUROPEAN COMMISSION
JOINT RESEARCH CENTRE
Institute for the Protection and Security of the Citizen (Ispra)
Maritime affairs

Ispra,

National Competent Authority for LRIT data of States participating in the EU LRIT Cooperative Data Centre

Subject: **Request to grant access to LRIT historical data to support JRC research on maritime situational awareness in collaboration with EMSA.**

Following the kind permission of your Authorities, the Joint Research Centre (JRC) of the European Commission received LRIT data from EMSA in the framework of JRC's Pilot Projects on Piracy, Maritime Awareness and Risks (PMAR) off the Horn of Africa and in the Gulf of Guinea. The results of these projects[1] were presented at the 8th LRIT NCA meeting on 7 November 2013 in Lisbon. The access to LRIT data was also recently granted to the JRC for the PMAR project continuation as part of the Programme to promote Regional Maritime Security (MASE) in favour of the Eastern and Southern Africa and Western Indian Ocean (ESA-IO) region.[2]

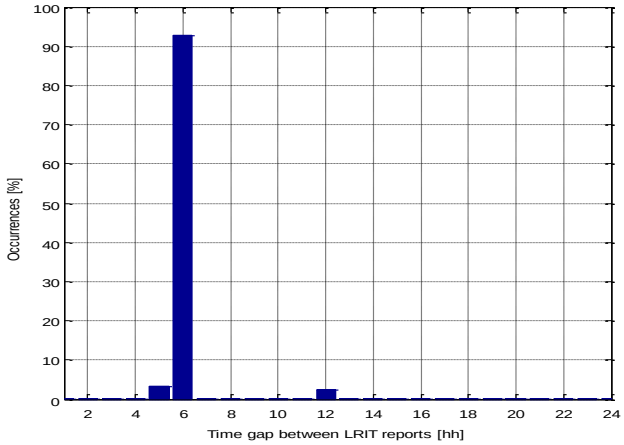
Within this context, the value of LRIT data has been particularly appreciated in complementing additional data sources to build a detailed picture of vessel tracks and activities at sea, with specific reference to detecting port areas and maritime routes. For this reason, I would kindly request to grant access to the LRIT historical data for scientific purposes.

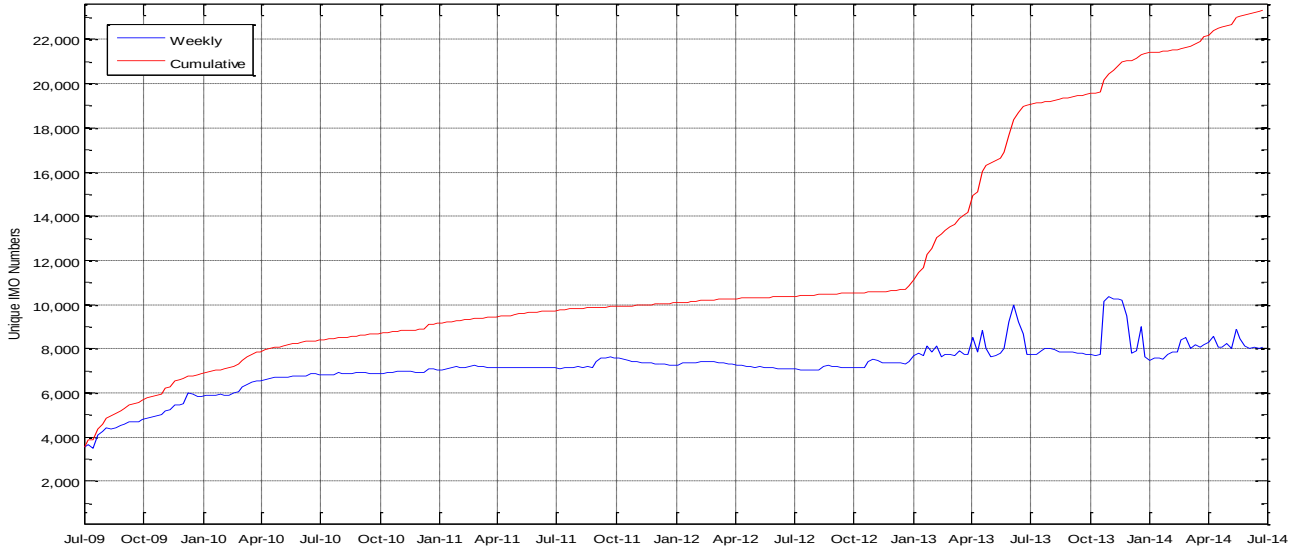
The data shall be used to perform data fusion and form aggregated and therefore anonymised information layers using knowledge discovery and statistical analysis. The following main research areas are envisaged:

1. Data driven port and stationary areas detection. This includes the characterisation in terms of ship-type and volume of traffic.
2. Data driven discovery of common patterns (*i.e.* routes and activities at sea), including the characterisation of the relevant ship-type, volume, and travel time distributions.

Data Analysis I

- Archive data from July 2009 to July 2014
- more than 90% time gaps between LRIT reports is 6 hours;
- Spatial coverage is global with no-gaps;
- Vessel coverage (i.e. # of unique IMO numbers) varies depending on specific data.

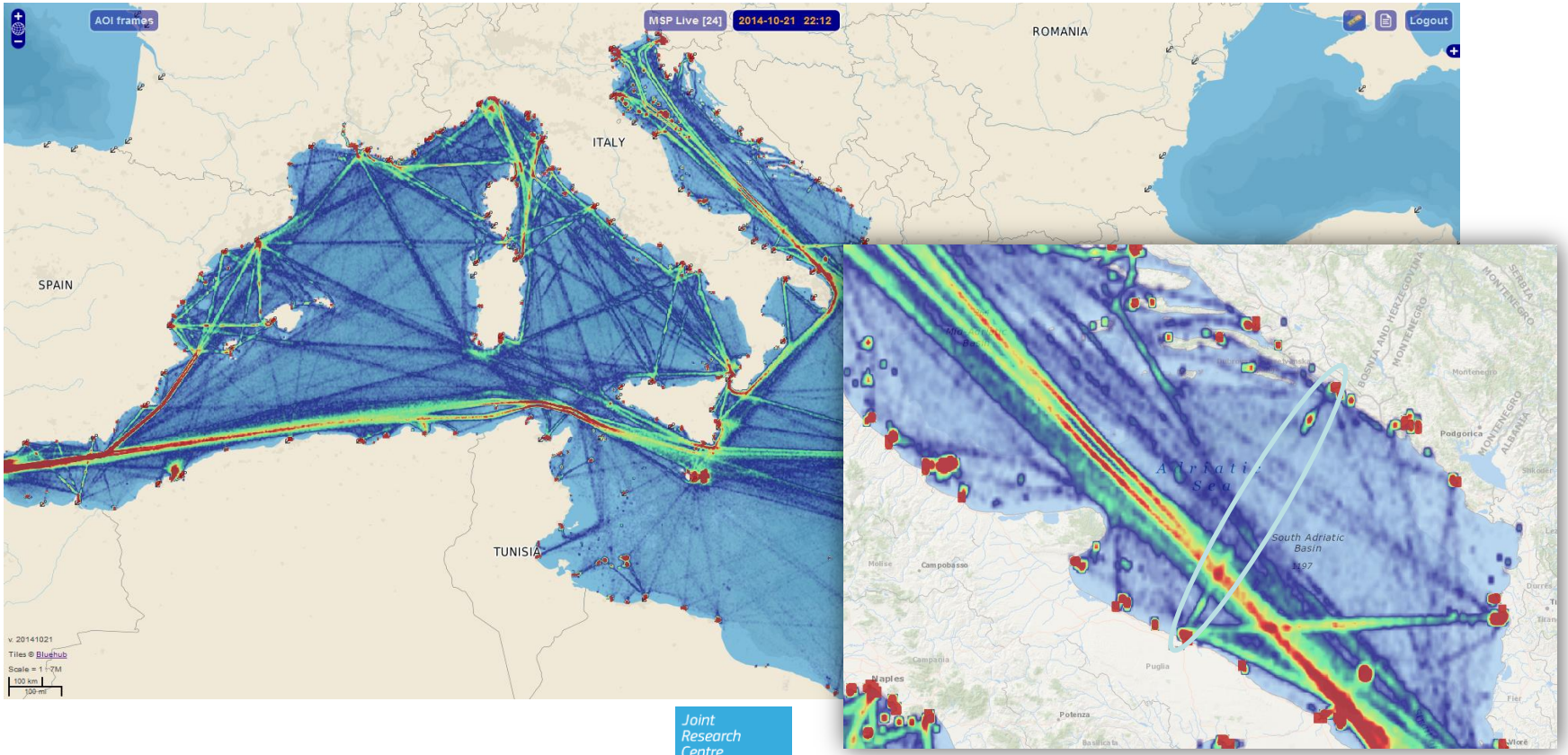




European Commission

Data Analysis II

LRIT, although commonly refreshed at 6 hh rate, shows the potential to extract more accurate traffic **density layers** since *almost* decoupled from spatial coverage performance.



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The Joint Research Centre

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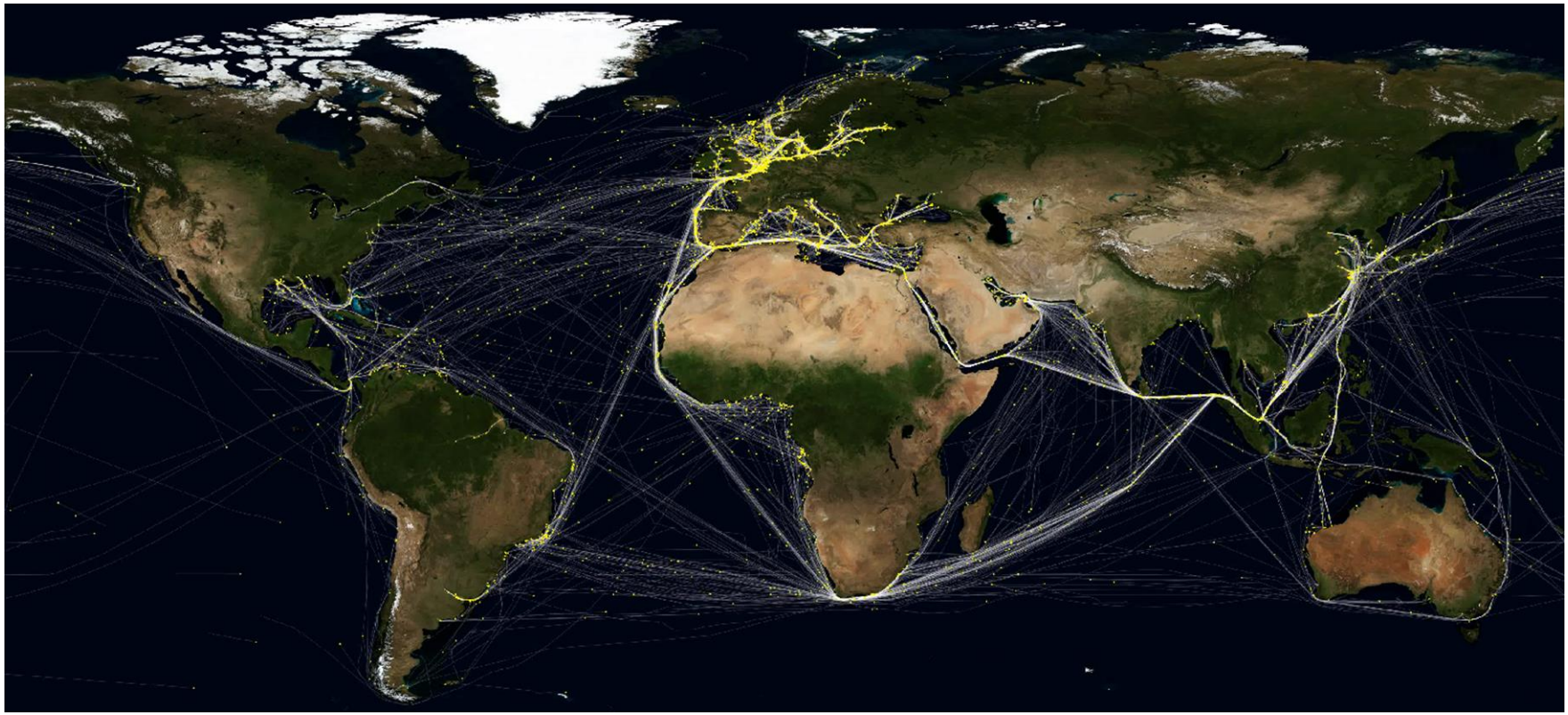
Final Remarks and Future Analysis

European Commission

Handling Long Range Identification and Tracking (LRIT) data



One-month EU LRIT CDC data. The data unveil the main traffic routes followed at global scale by EU LRIT participating countries. This analysis can be used to enable the implementation of innovative tools for route prediction and anomaly detection.

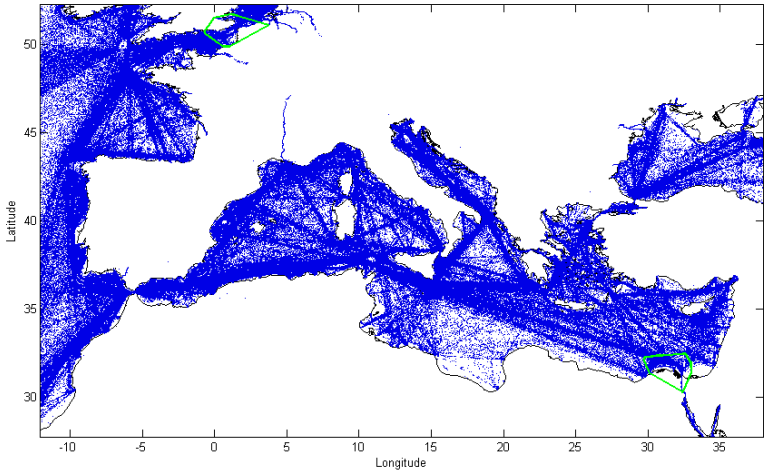
Joint Research Centre

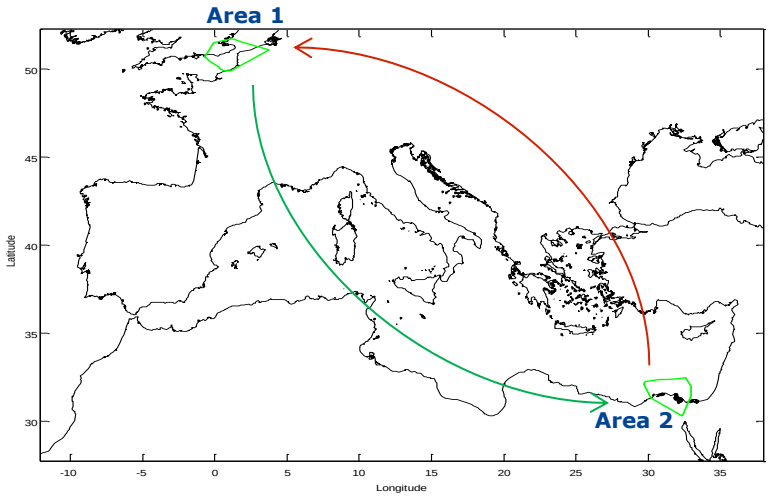
European Commission

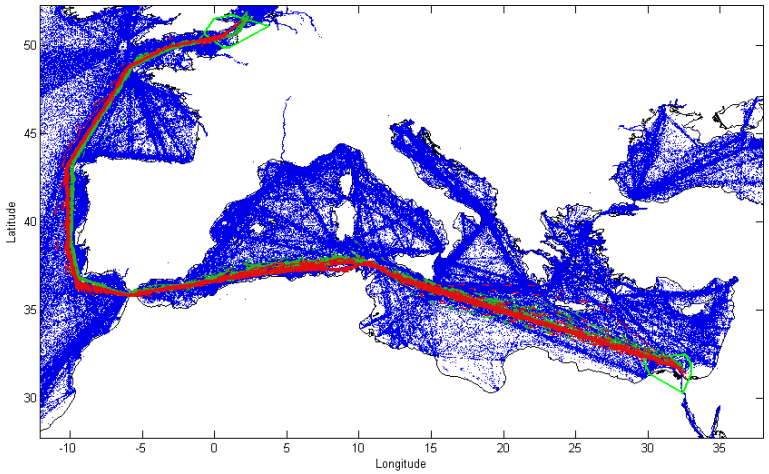
Video

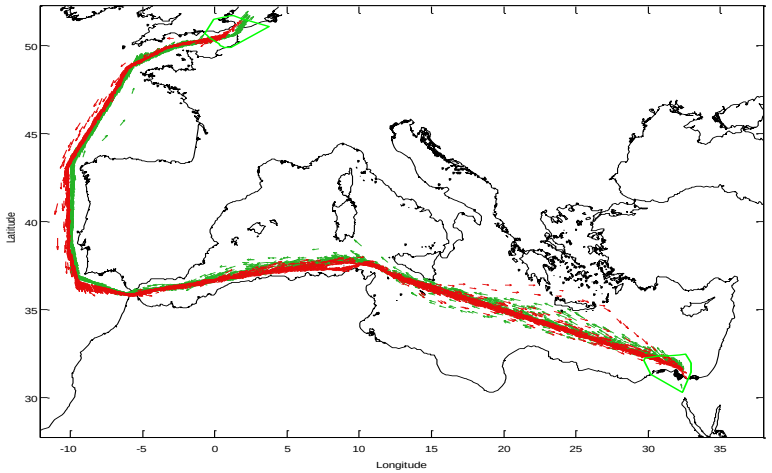
Joint Research Centre

Pattern Extraction



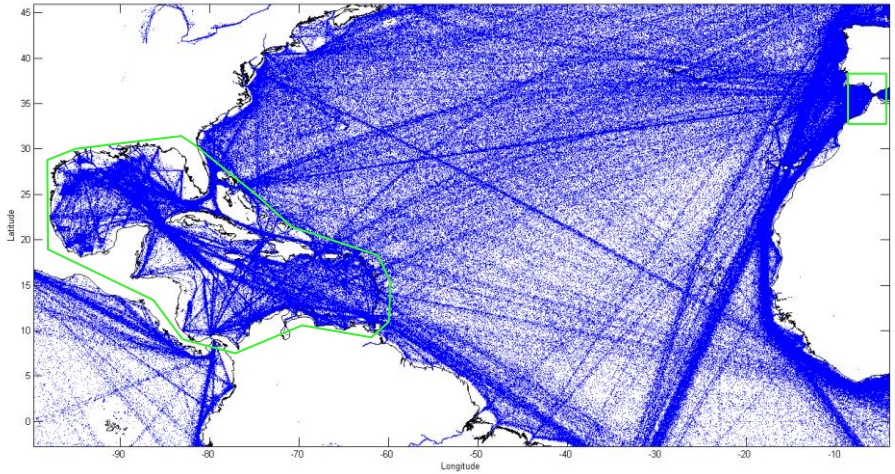




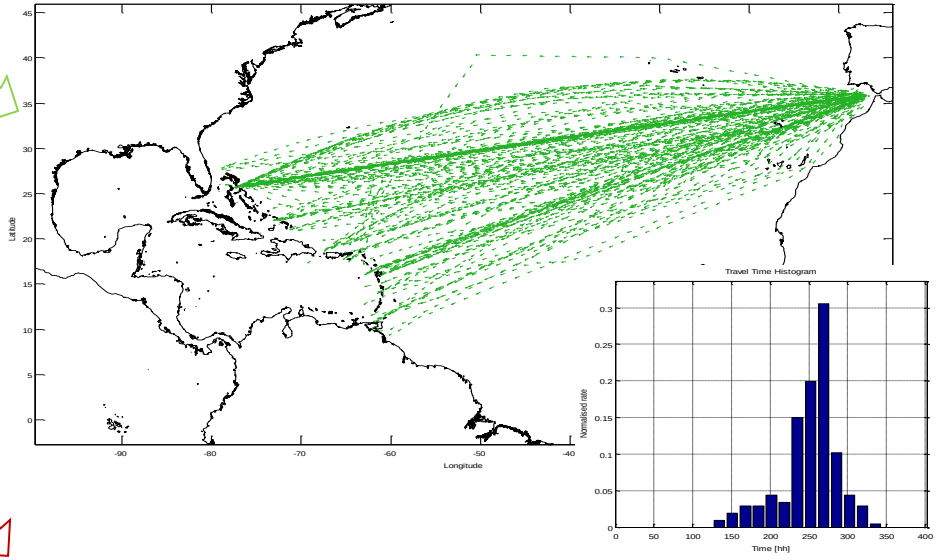


European Commission

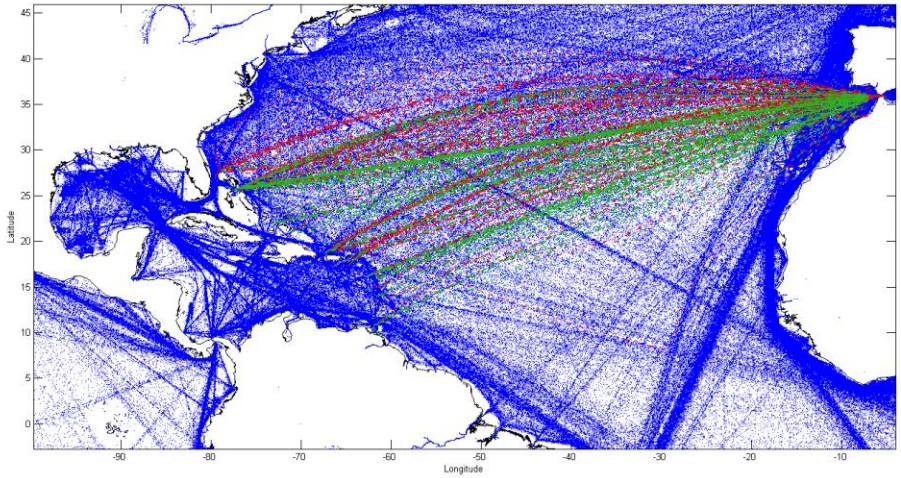
One-year LRIT Data



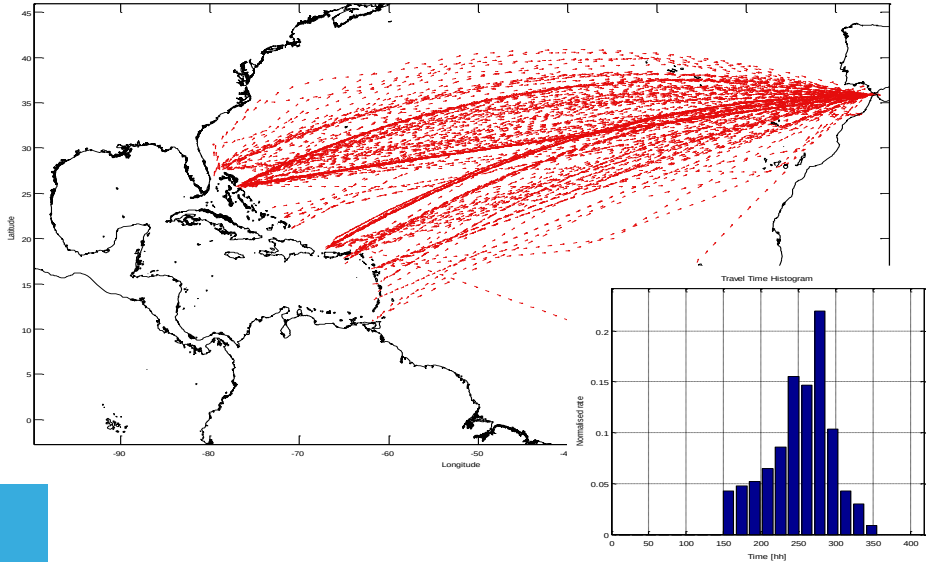
West-bound route (Gibraltar to Caribbean Sea)



Patterns Overlay



East-bound route (Caribbean Sea to Caribbean Sea)



Joint Research Centre

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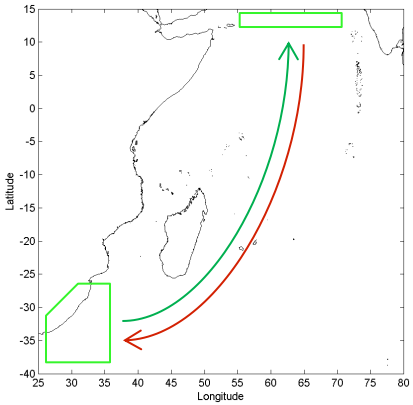
Main Traffic Routes

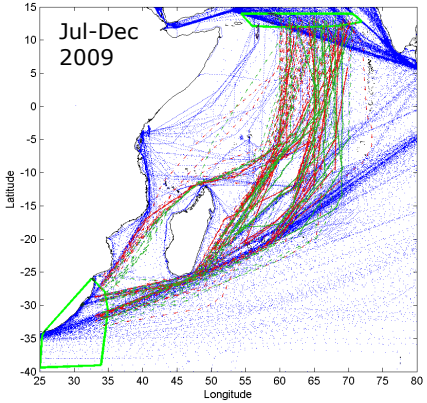
Maritime traffic patterns are "de facto" routes subject to variability due to the following factors:

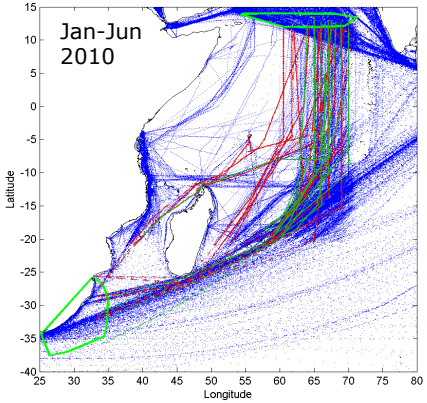
- Seasonal and changing climate conditions (e.g. currents, ice);
- Geopolitical issues (e.g. conflicts, embargoes and barriers to trade);
- Security threats (e.g. piracy, terrorism);
- Regulatory aspects (Marine spatial planning, Environmentally sensitive areas);
- …

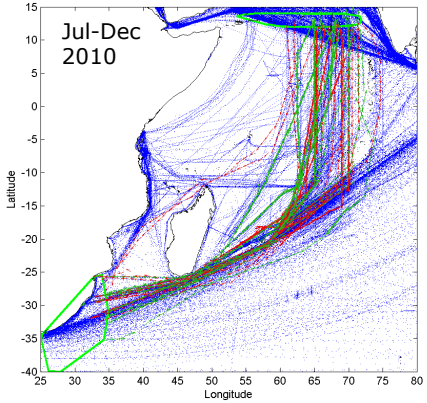
European Commission

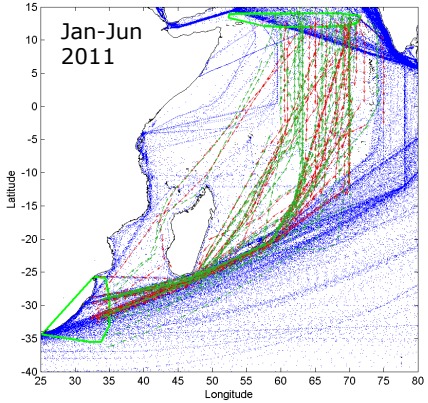
Piracy effects on maritime routes in the Western Indian Ocean

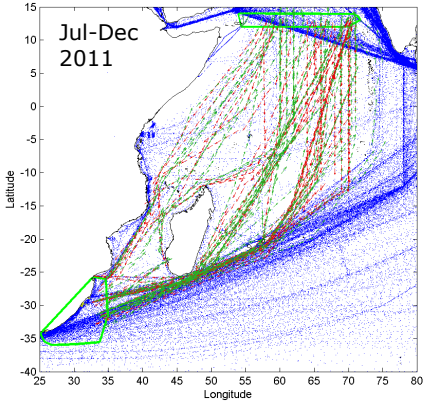


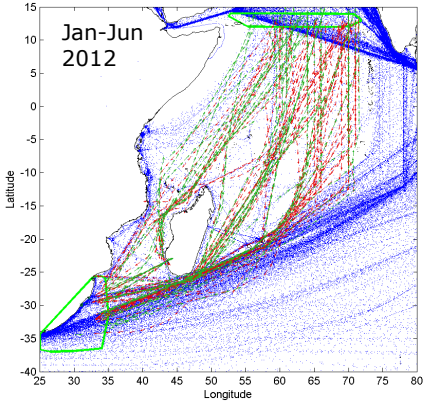


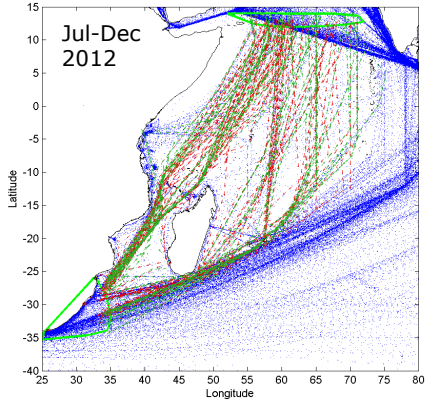


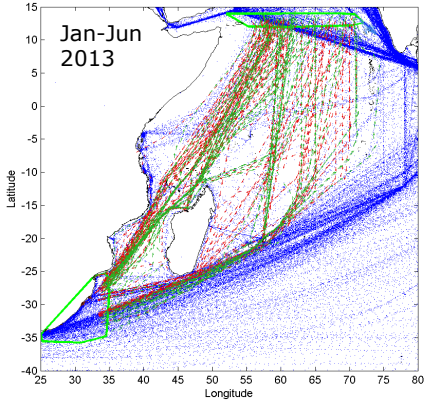


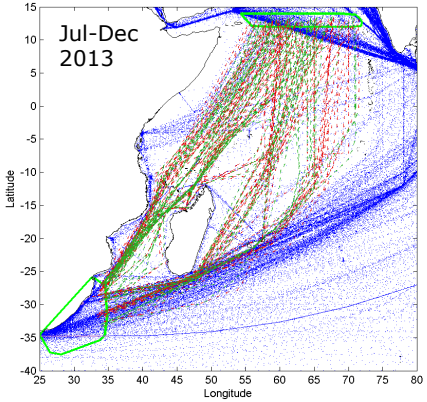


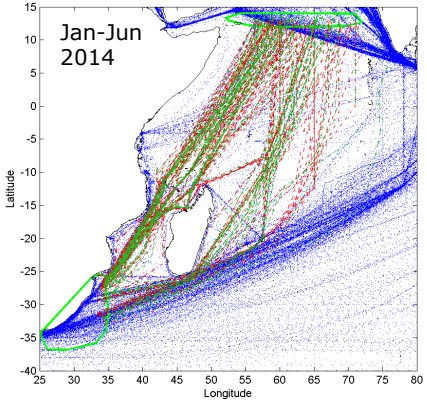






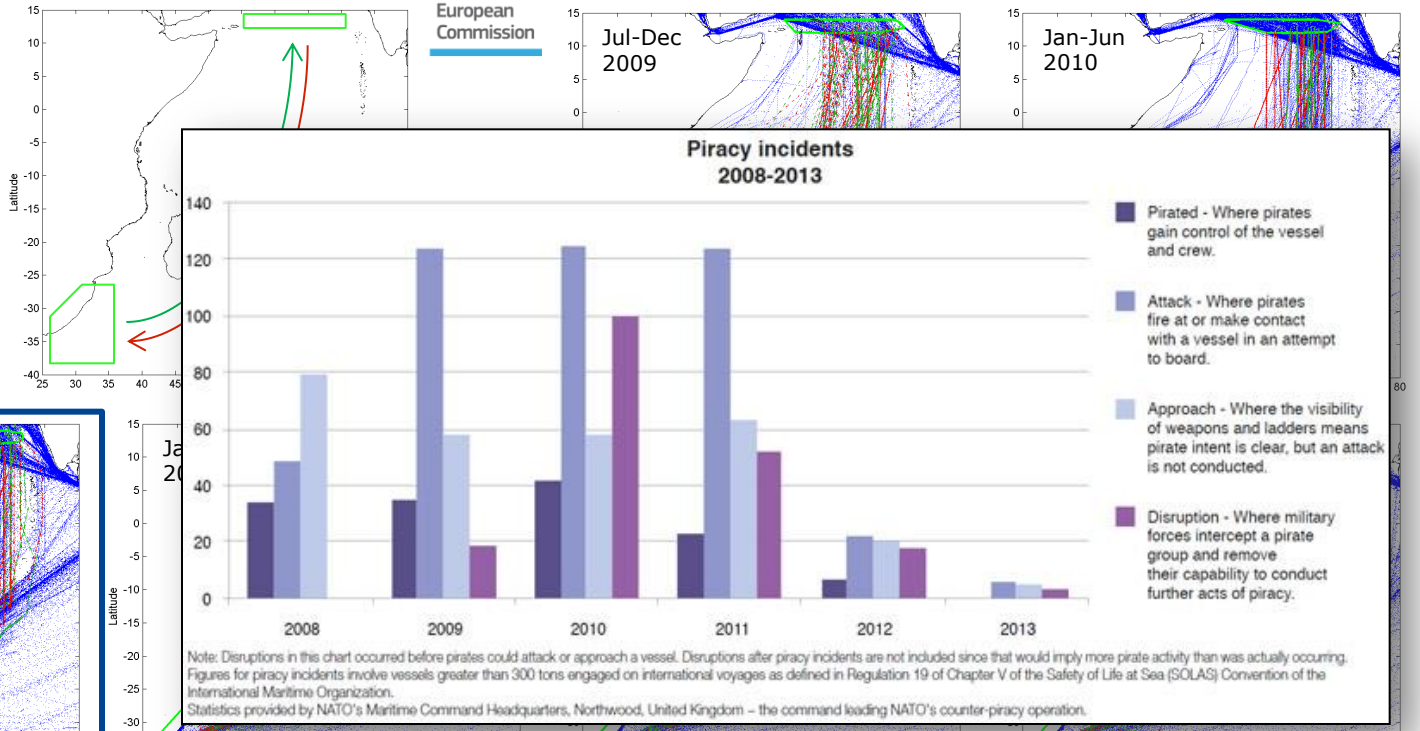


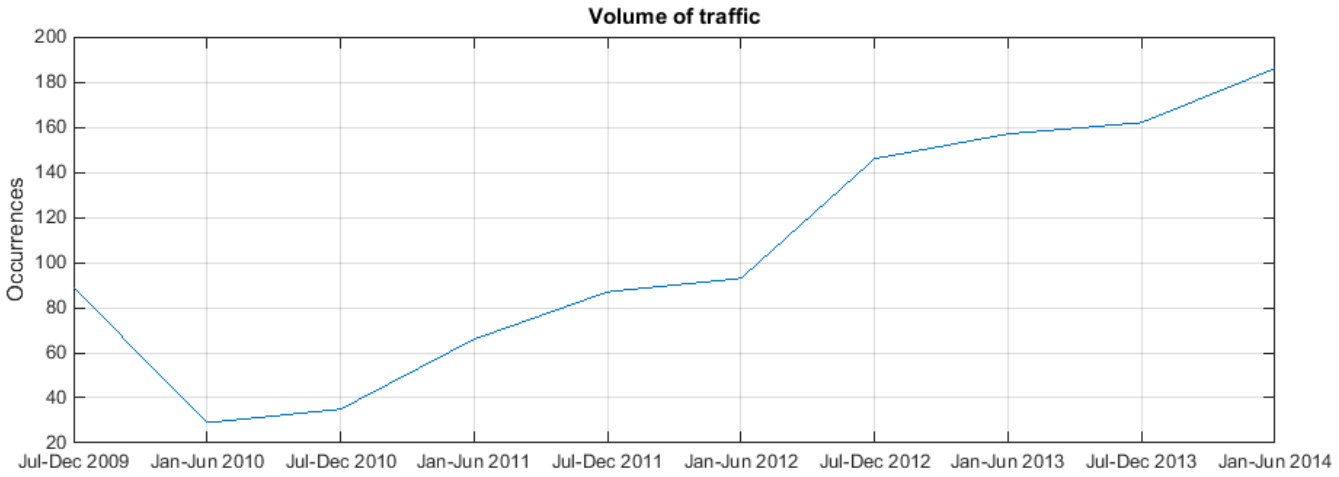




Piracy effects on maritime routes in the Western Indian Ocean

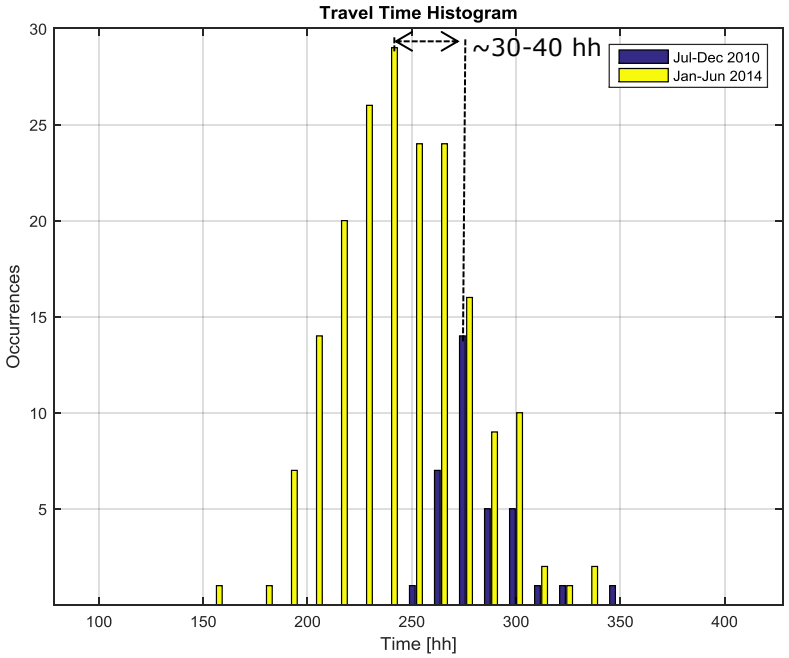
European Commission





Between Jul-Dec 2010 and Jan-Jun 2014 an approximate x5 increase of volume of traffic can be observed crossing the Indian Ocean between the highlighted areas.

Moreover, an average travel time reduction of 30 to 40 hours can also be observed.



Final Remarks and Future Directions

The preliminary analysis of LRIT archive data shows a significant potential for traffic pattern analysis.

The knowledge extracted can be used to implement anomaly detection and route predicion.

Ad hoc analysis of the data can be performed to understand and quantify the impact of geopolitical factors on maritime transport at global scale.

We are ready to shape future activities taking into account your feedback or specific needs.