# Maritime Data Analytics: lessons learnt (& new challenges) from MarineTraffic.com

Δημήτρης Ζήσης [1,2]

[1] *Τμήμα Μηχανικών Σχεδίασης Προϊόντων και Συστημάτων, Παν. Αιγαίου*

[2] *MarineTraffic.com*


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# Πρόγραμμα Διάλεξης

1. Το MarineTraffic
2. Trajectory Data Mining (theory & practise)
   - Πηγές δεδομένων
   - trajectory pre-processing
   - Indexing and retrieval
   - trajectory pattern mining
3. Μελλοντικές κατευθύνσεις

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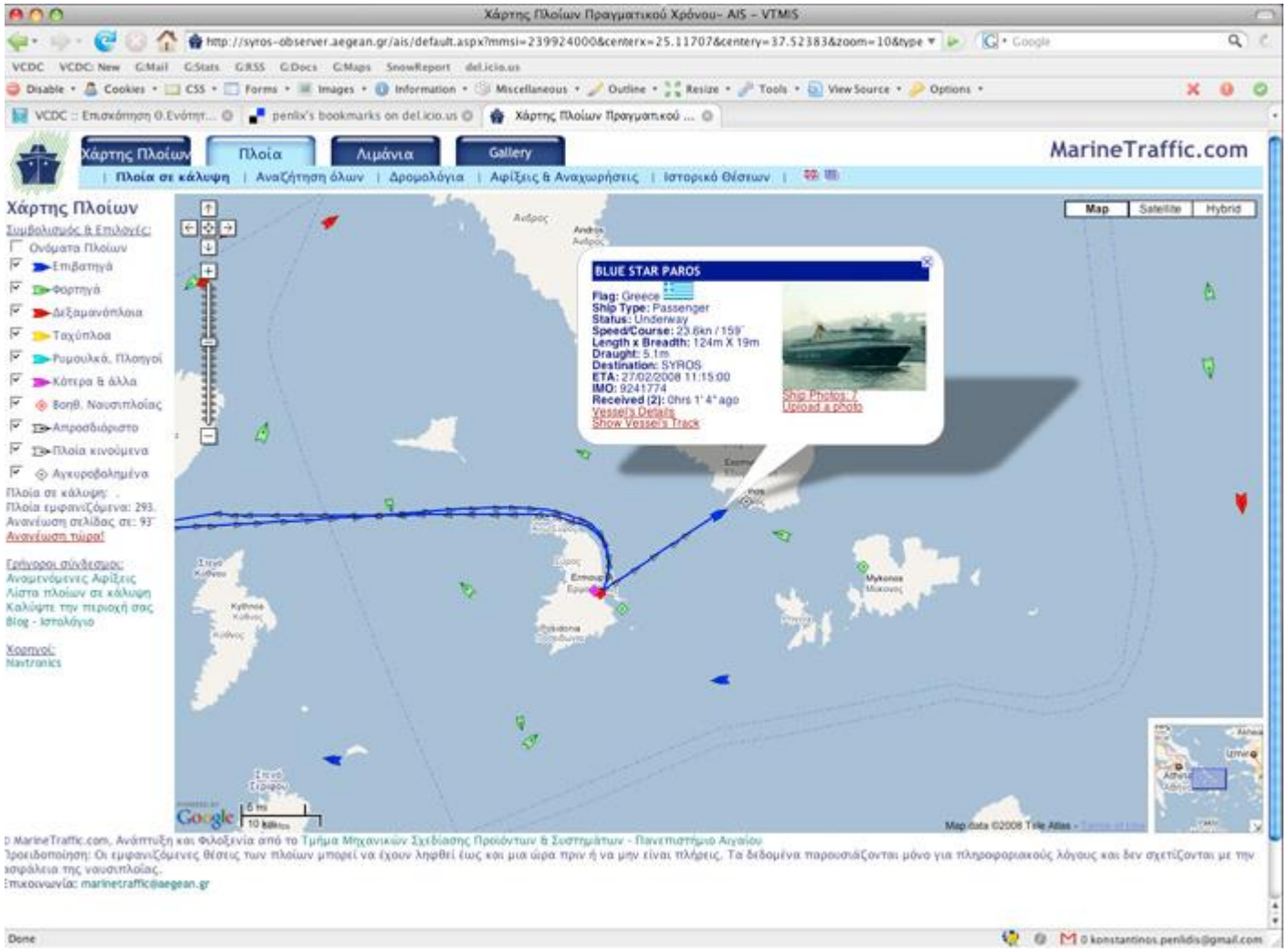
# Syros-observer.aegean.gr

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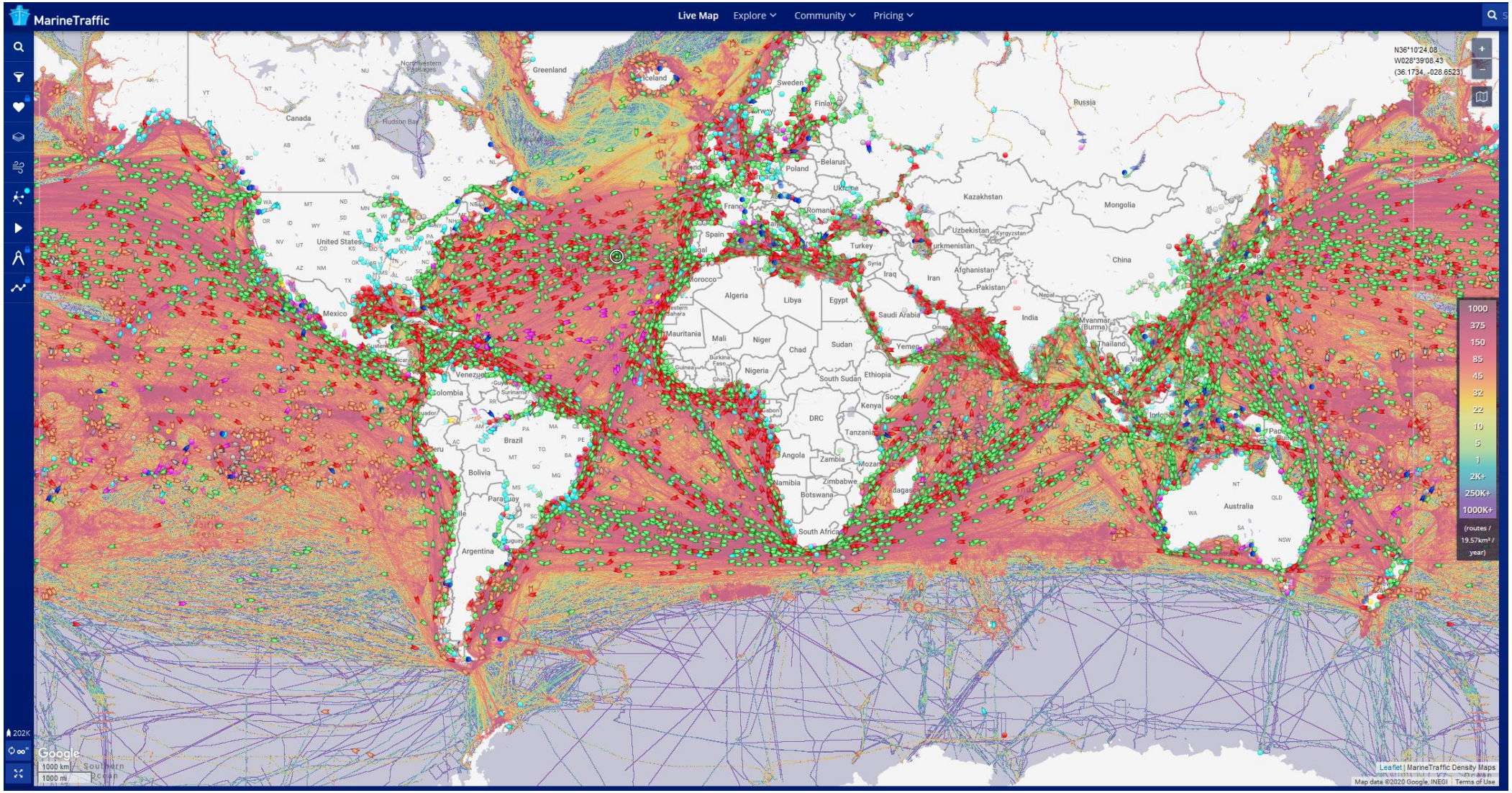
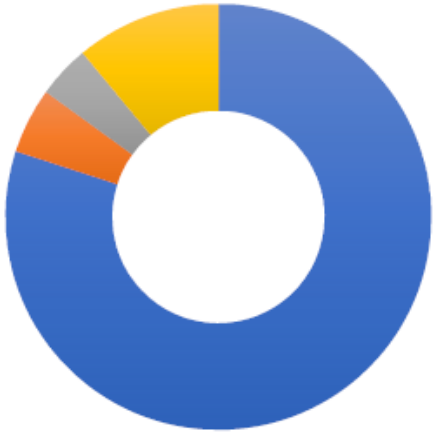
# Big (spatial) Data



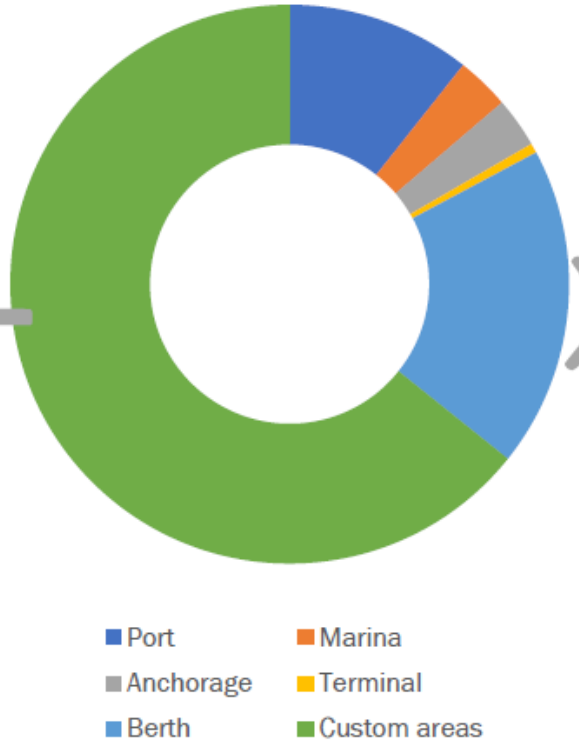
# A day at MarineTraffic - serving 550k users

200k Vessels

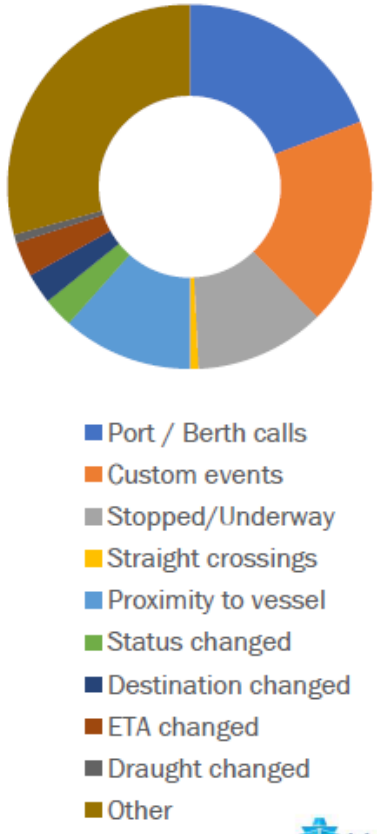

750M AIS Messages



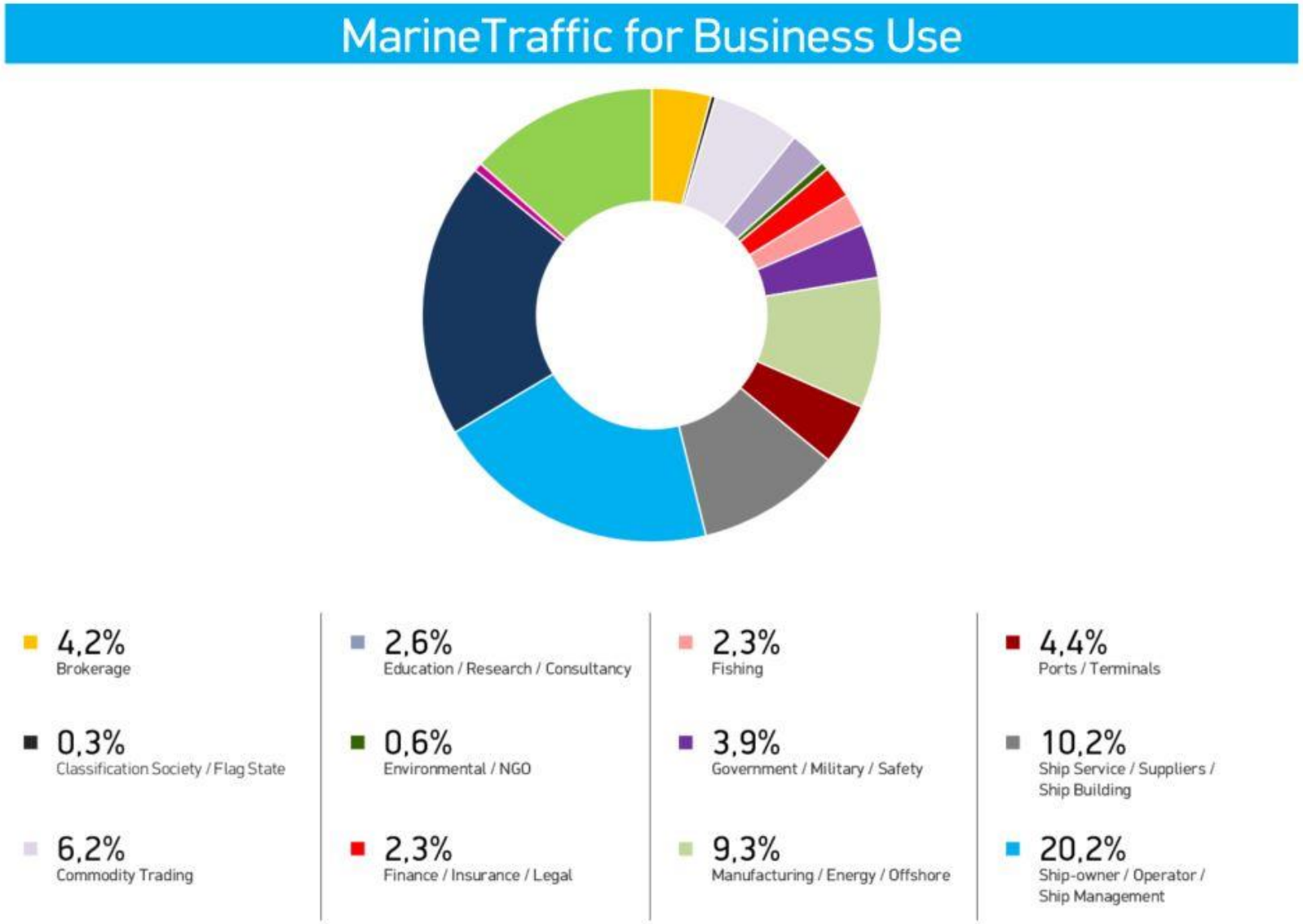

100k Reference Geos




1.3M Events



# Ενδιαφέρεται κανείς για αυτές τις πληροφορίες;



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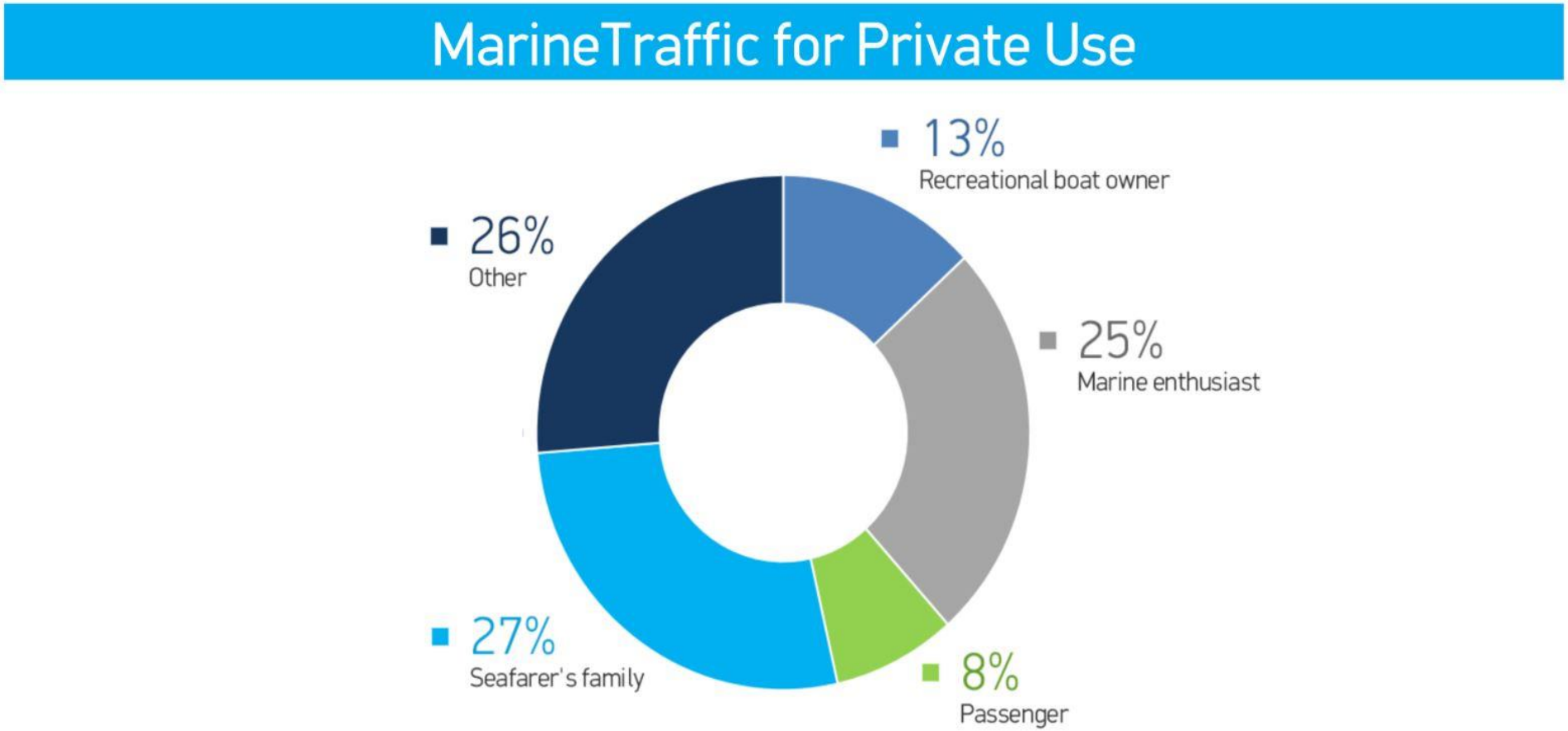

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6.5 million monthly unique visitors

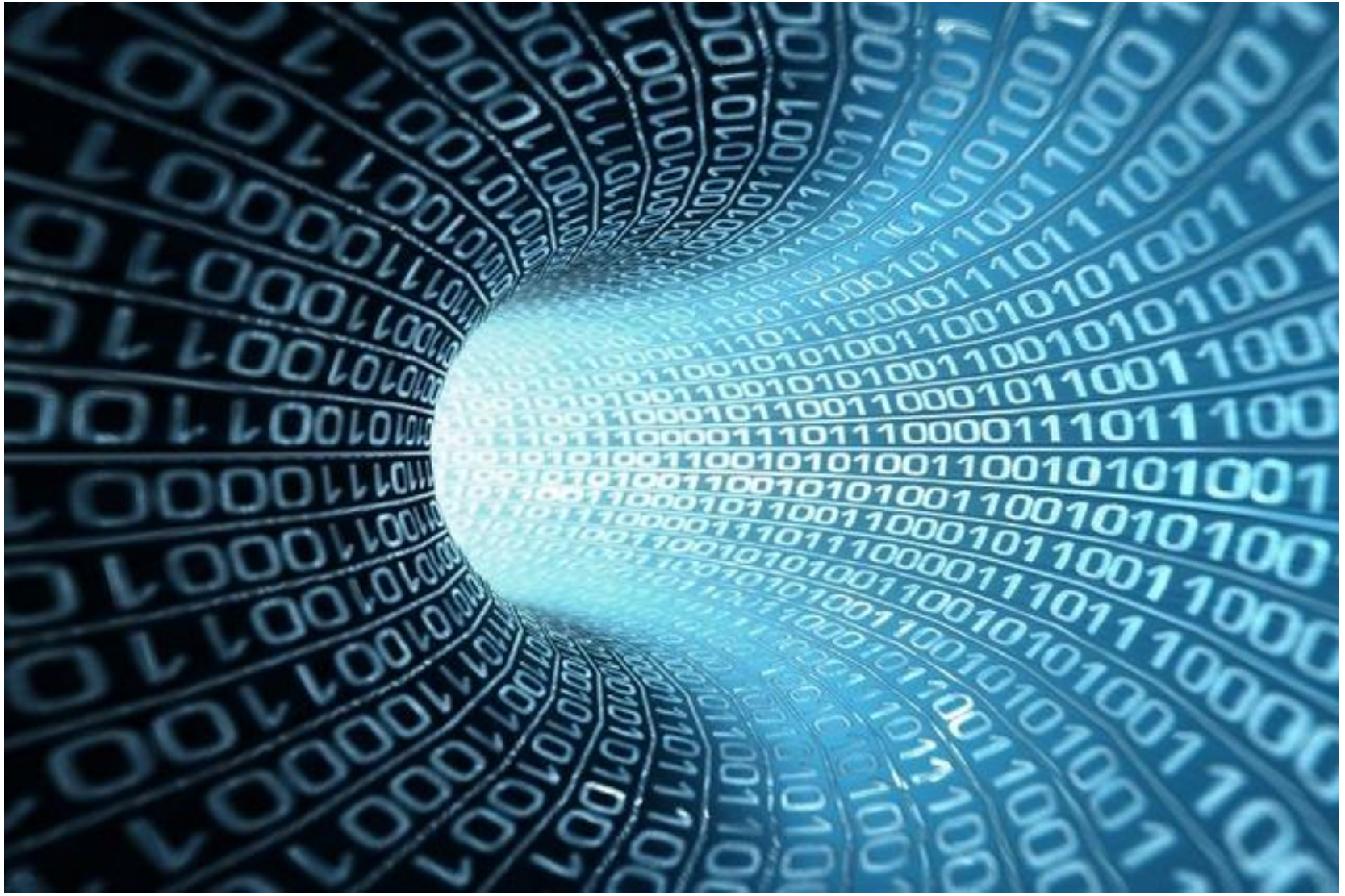
400 thousand daily visits

800+ thousand registered users


# Συγκεκριμένες Υποσχέσεις

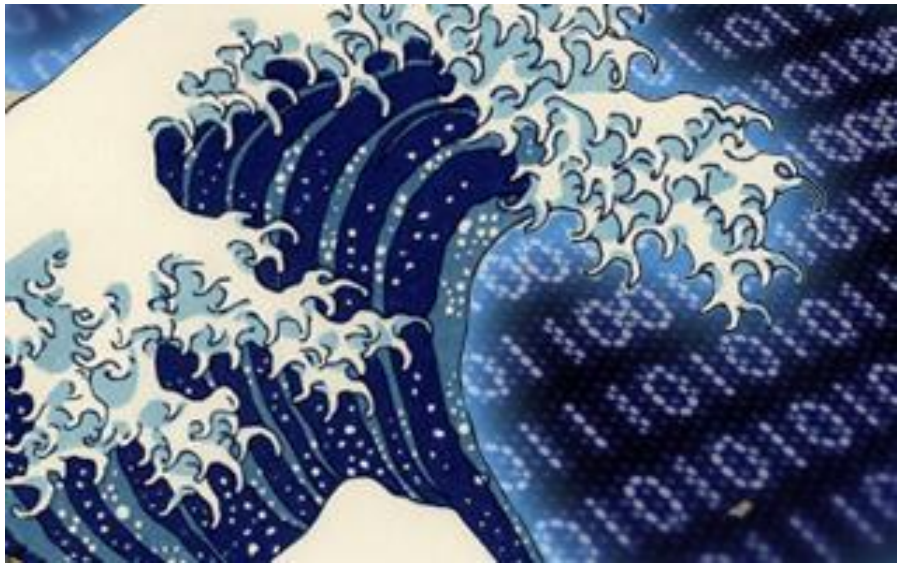
- Achieve **a reduction of accidents at sea** by timely detecting hazardous situations (including malicious events) based on the vessels trajectory, “behaviour” (e.g. speed, course) and context (e.g. weather conditions or nearby ships), while proposing measures of proactive prevention .
- Accomplish **a decrease in port congestion and seaways** by monitoring and improving the forecasting of vessel arrivals (ship sizes, cargoes, ETAs, loading/discharge times) to enable better planning and execution of port operations (virtual arrivals).
- **Effectively manage traffic and cut down fleet monitoring costs**
- **reduction of green-house gas (GHG) emission**

# Που είναι το δύσκολο;



# Μεγάλα Δεδομένα (Big Data)

- Όγκος
  - 45GB per day (synopsis!)
    - 50 bytes per message
- Ταχύτητα
  - 1 message per minute per vessel
  - >0.5 Billion messages per day
  - >200,000 streams
- Ποικιλία
  - Όσο αυξάνονται οι πηγές δεδομένων, αυξάνονται και οι δυσκολίες επεξεργασίας και διαχείρισης



# Ανάλυση κίνησης αντικειμένων

- A *spatial trajectory* is a trace generated by a moving object in geographical spaces, usually represented by a series of chronologically ordered points, e. g. $p1 \rightarrow p2 \rightarrow \cdots \rightarrow pn$, where each point consists of a geospatial coordinate set and a timestamp such as $p=(x,y,t)$.

```
POS_ID,MMSI,STATUS,STATION,SPEED,LON,LAT,COURSE,HEADING,TIMESTAMP,SHIP_ID
1094062019,667002119,0,1466,91,"27,41997","36,84816",208,511,16/09/14 12:54,763967
1094076566,667002119,0,1466,91,"27,41625","36,84376",218,511,16/09/14 12:56,763967
1094091446,667002119,0,1468,93,"27,41197","36,83942",218,511,16/09/14 12:58,763967
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1094211580,667002119,0,1466,94,"27,38013","36,80176",208,511,16/09/14 13:16,763967
```
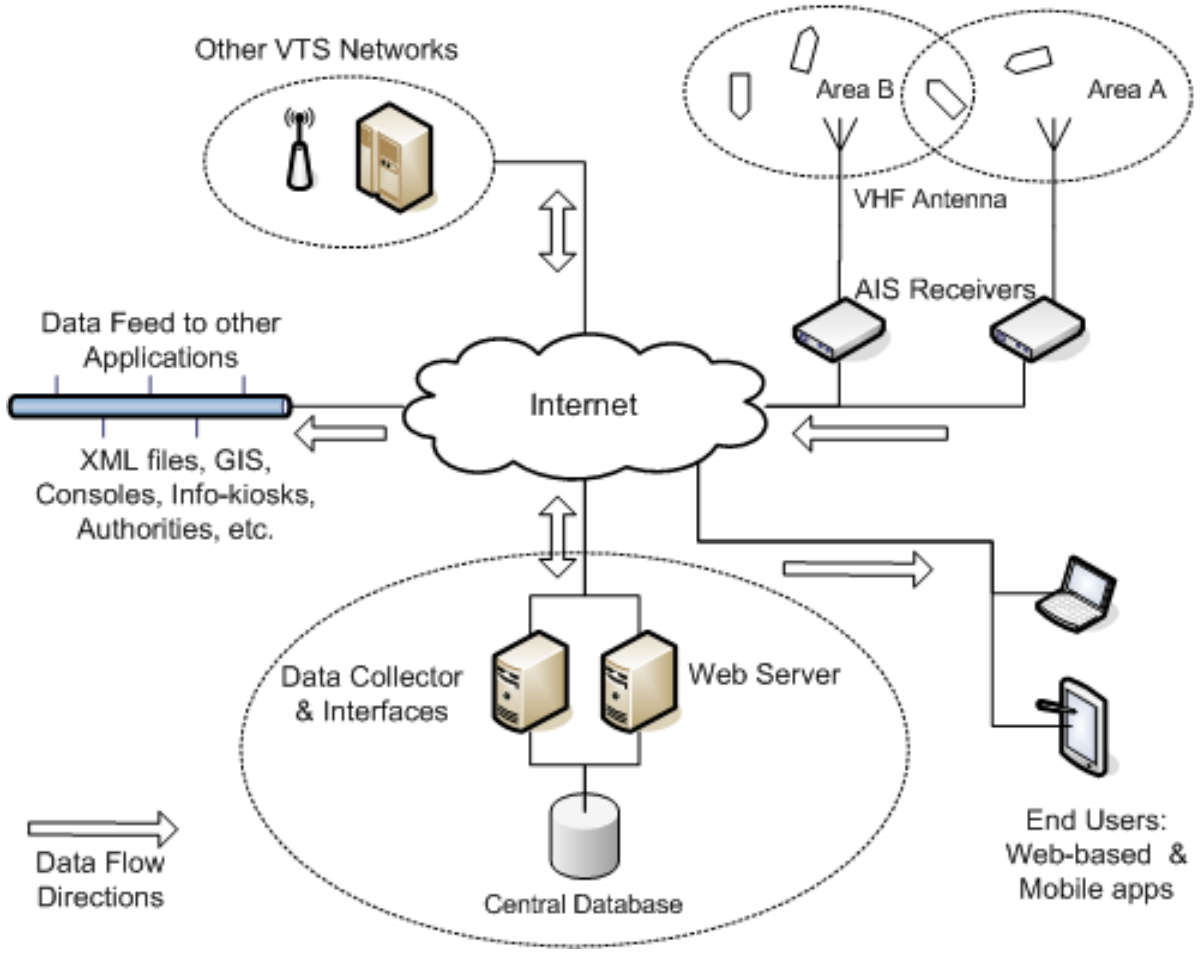
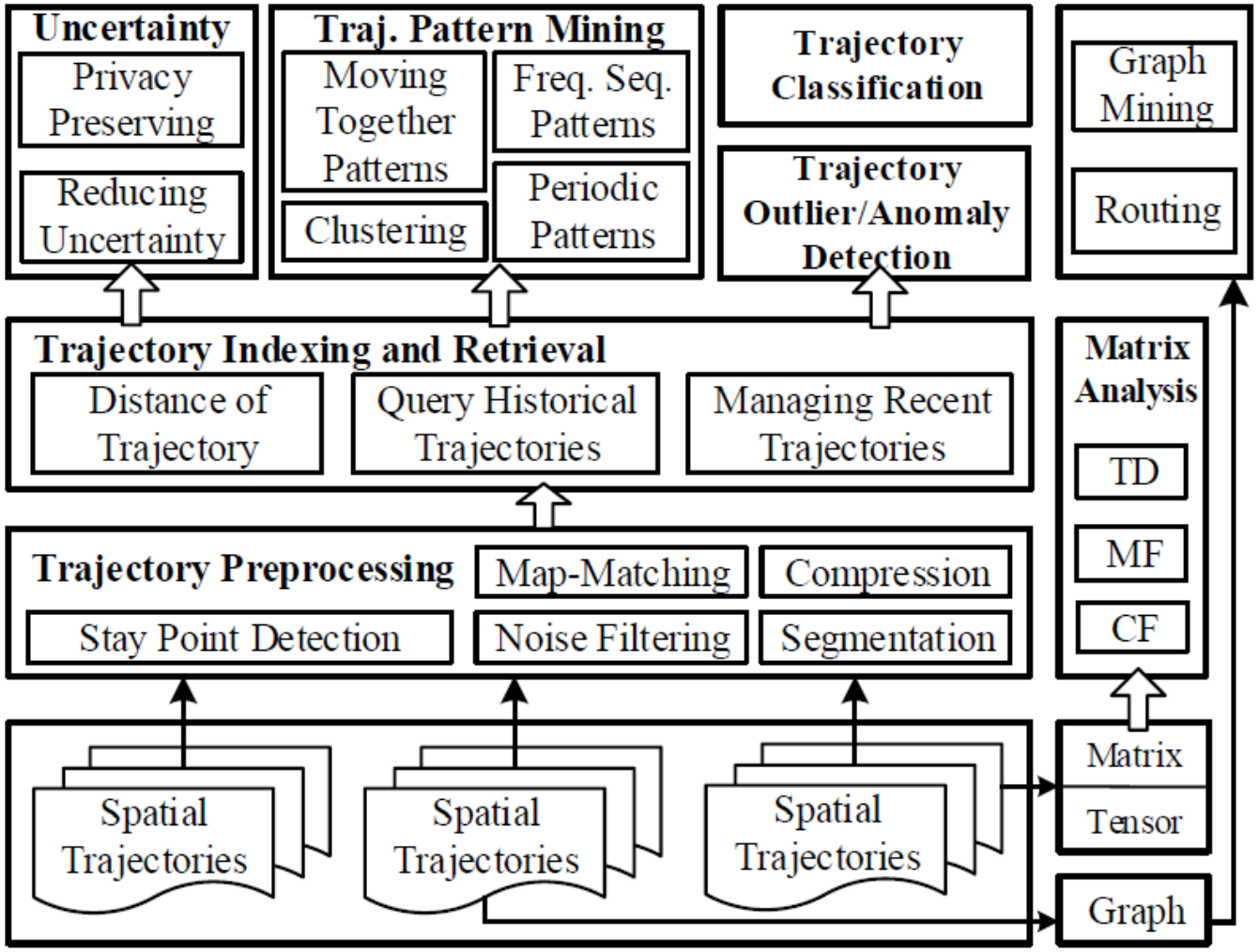

# System Model for LBSs

- The locations of tracked moving objects are reported to the location server.
- The LBS applications submit queries to the server to retrieve moving object data for analysis or other application needs.

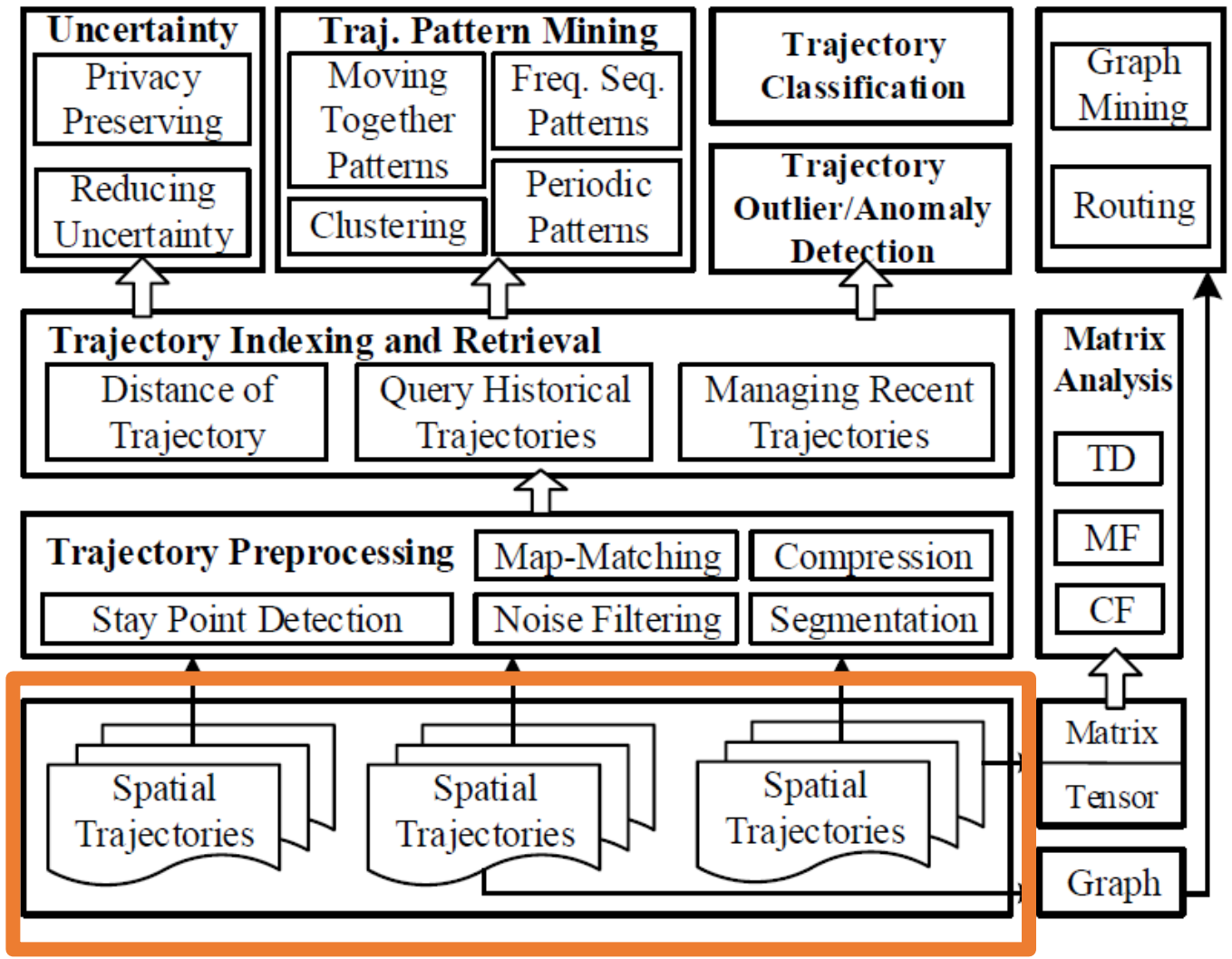


# Trajectory Data Mining




Yu Zheng. Trajectory Data Mining: An Overview. ACM Transactions on Intelligent Systems and Technology. 2015, vol. 6, issue 3.

# Τα δεδομένα μας



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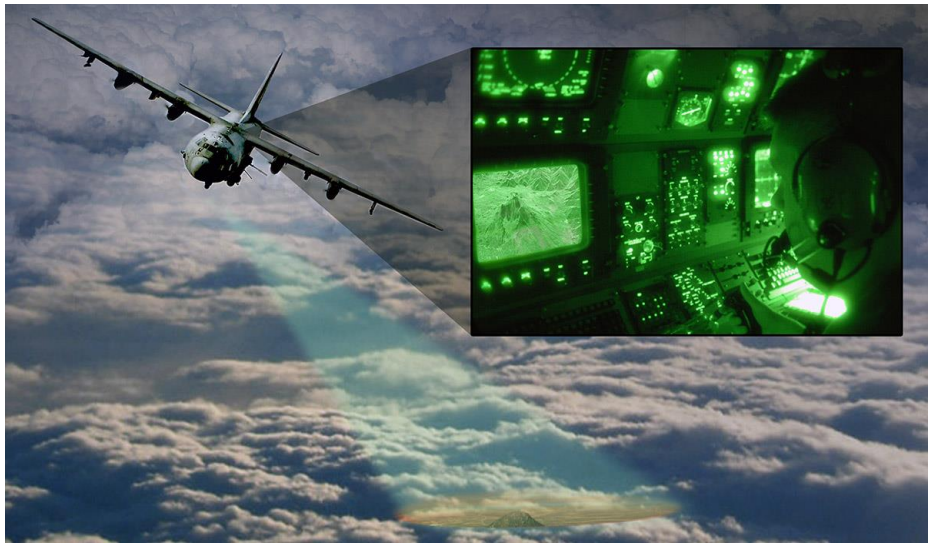
# Μεγάλα δεδομένα ναυτιλίας και αντίστοιχες πηγές

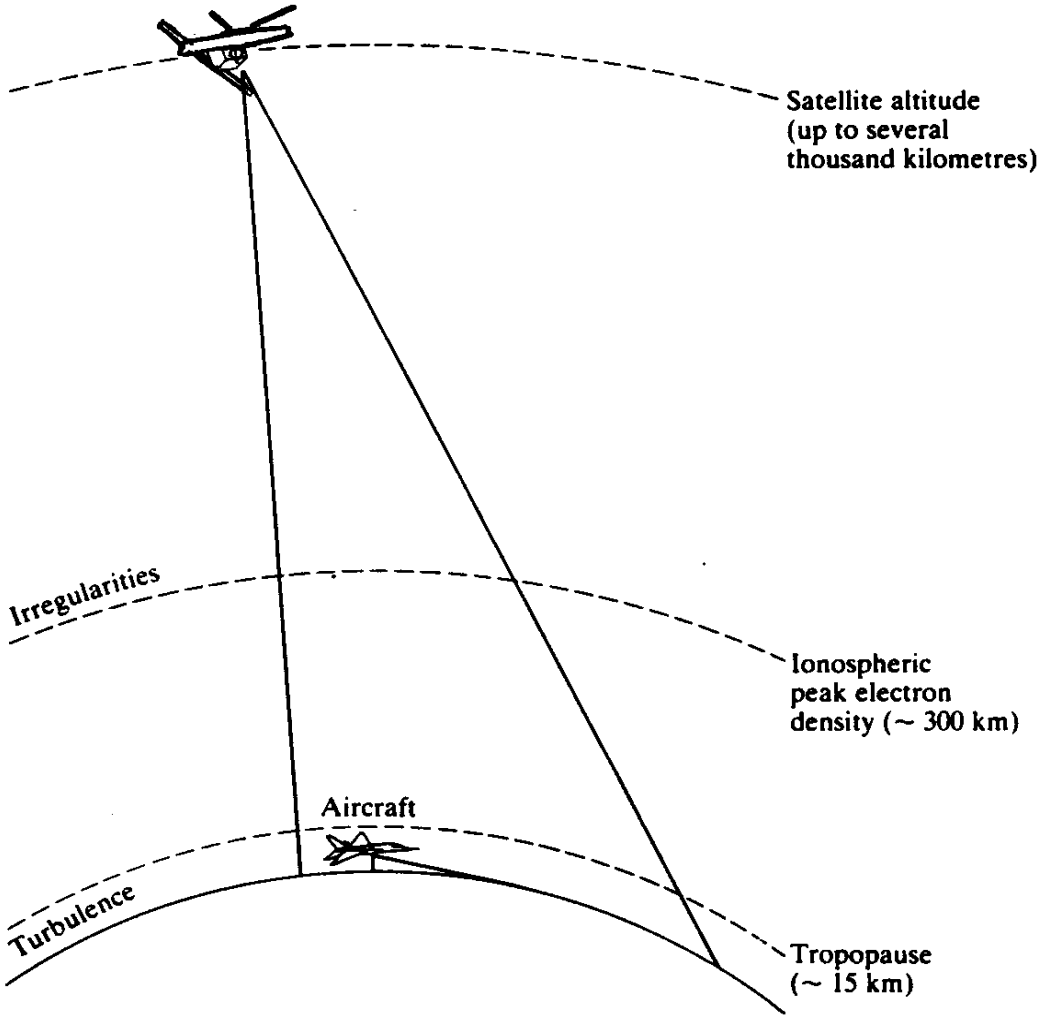
- Σήμερα παράγεται ένας τεράστιος όγκος δεδομένων από πολλά διαφορετικά συστήματα επιτήρησης
- Αυτά τα συστήματα μπορούν να κατηγοριοποιηθούν ως
  - Συνεργατικά συστήματα παρακολούθησης/αναγνώρισης
    - *Automatic Identification System* (*AIS*)
    - *Long-Range Identification and Tracking* (*LRIT*)
    - *Vessel Monitoring Systems (VMS)*
  - Μη συνεργατικά συστήματα παρακολούθησης/αναγνώρισης
    - Κάμερες
    - ραντάρ συνθετικής απεικόνισης Synthetic Aperture Radar (SAR)

# Μη συνεργατικά συστήματα αναγνώρισης: Ραντάρ συνθετικής απεικόνισης/ ανοίγματος

- Ο όρος SAR είναι η συντομογραφία για το Synthetic Aperture Radar ή ραντάρ συνθετικού ανοίγματος
- Πρόκειται για μια ειδική τεχνική ραντάρ που επιτρέπει στους χρήστες να λαμβάνουν υψηλής ανάλυσης εικόνες ραντάρ από μεγάλες αποστάσεις, π.χ. αεροσκάφος (airborne) ή δορυφόρο (spaceborne).
  - Η λειτουργία του βασίζεται στην εκπομπή μικροκυματικών σημάτων και στη συνέχεια στη λήψη των ανακλάσεων από τα διάφορα αντικείμενα που φωτίζονται από το σήμα εκπομπής.
  - Για ένα μόνο στόχο ο χρόνος καθυστέρησης t της ηχώς μπορεί να χρησιμοποιηθεί για να καθοριστεί η απόσταση R αυτού αφού τα μικροκύματα ταξιδεύουν, στο κενό και προσεγγιστικά στον αέρα, με την ταχύτητα του φωτός.
- Το ραντάρ συνθετικής απεικόνισης(SAR) παρέχει την μοναδική δυνατότητα απεικόνισης υψηλής ανάλυσης της επιφάνειας της γης υπό οποιεσδήποτε καιρικές συνθήκες ανεξαρτήτου ημέρας ή νύχτας.

# Μη συνεργατικά συστήματα αναγνώρισης: Ραντάρ συνθετικής απεικόνισης/ ανοίγματος





# Sentinel 1

- Ευρωπαϊκό πρόγραμμα *Copernicus* φέρει ένα προηγμένο ραντάρ για την παροχή παντός καιρού, μέρας-και-νύχτας εικόνων της επιφάνειας της Γης.
- Συνεχόμενη ροή δεδομένων
  - For Sentinel-1, the most frequently used products are IW-GRDH and EW-GRDM, with resolutions of 20 m and 90 m respectively. The latter has very limited ability for ship classification, a challenging task already for the 20 m resolution.

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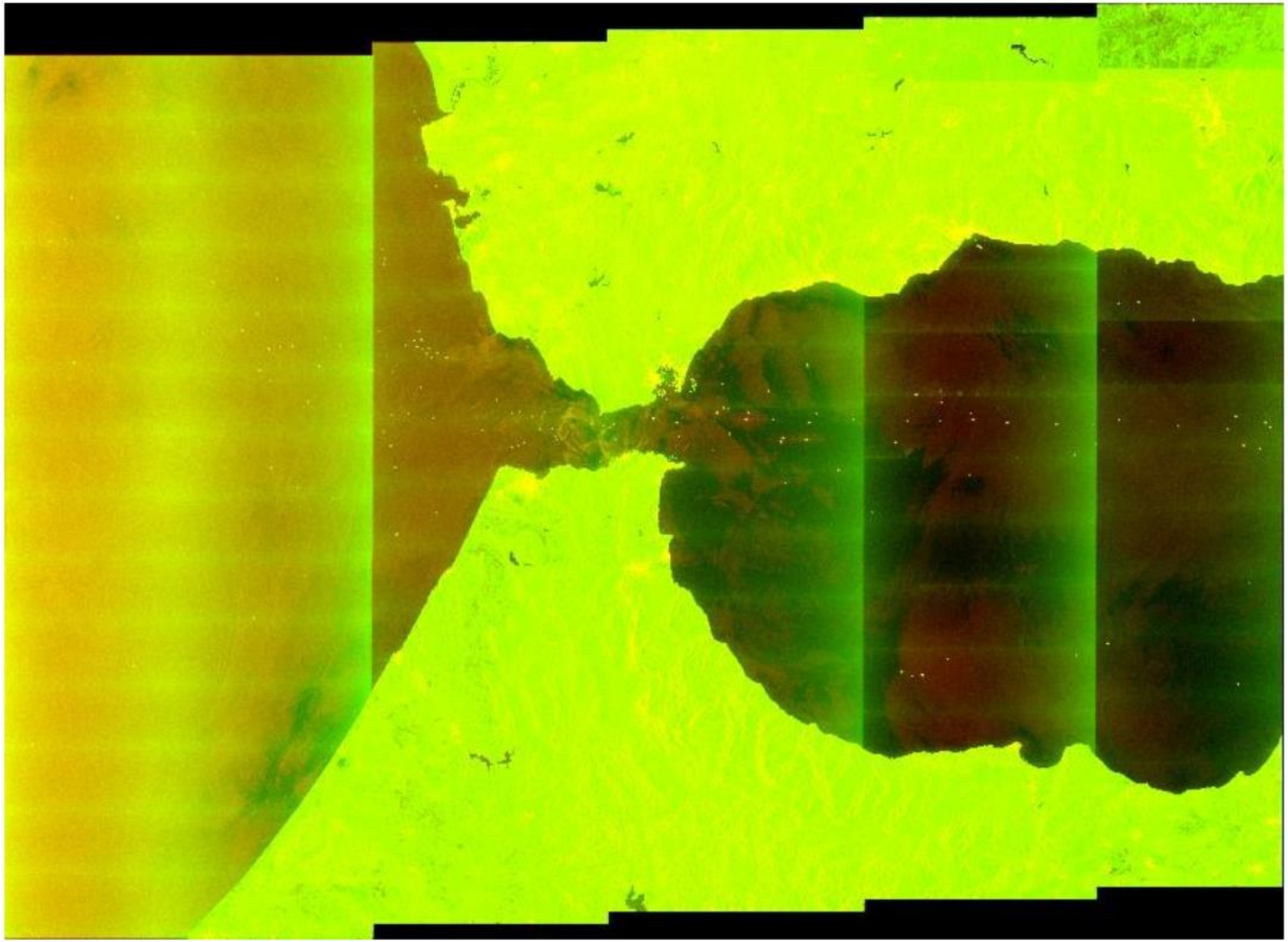

Strait of Gibraltar. Ships (there are  many) show up as bright dots.

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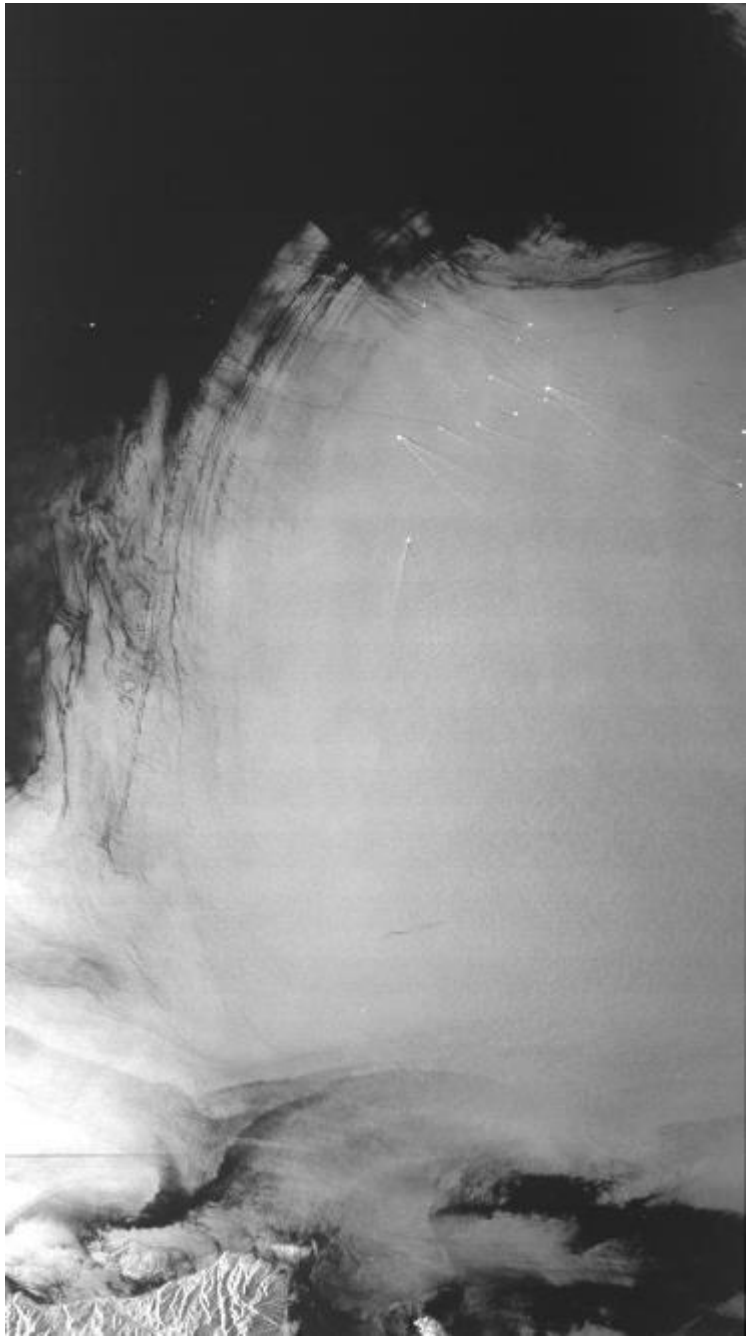
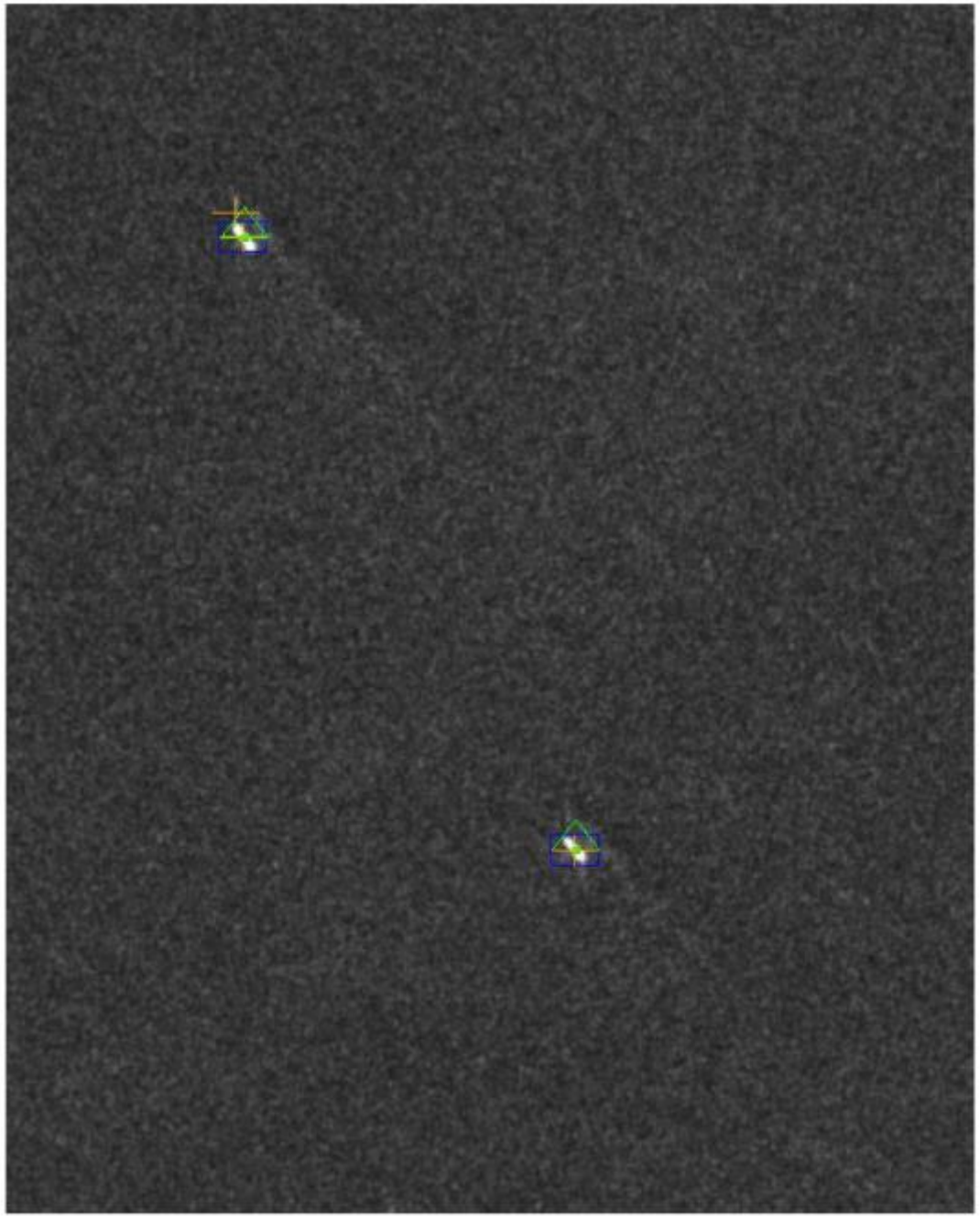
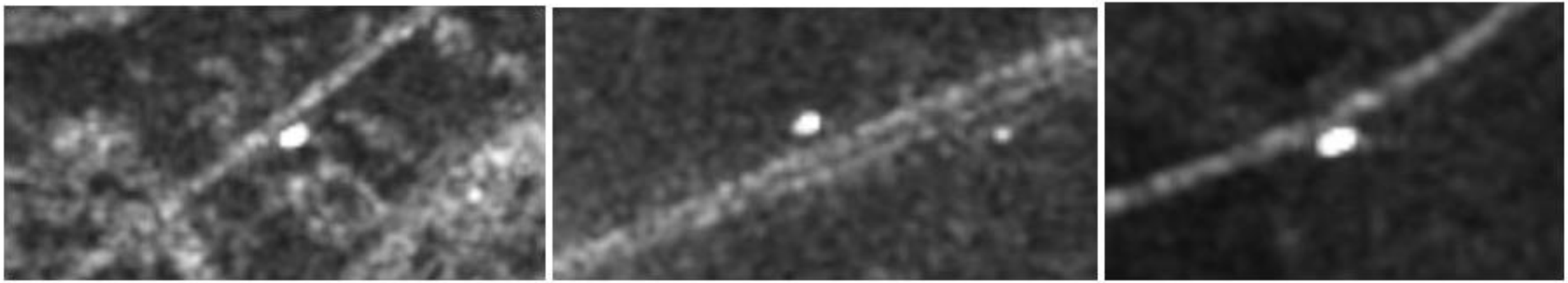
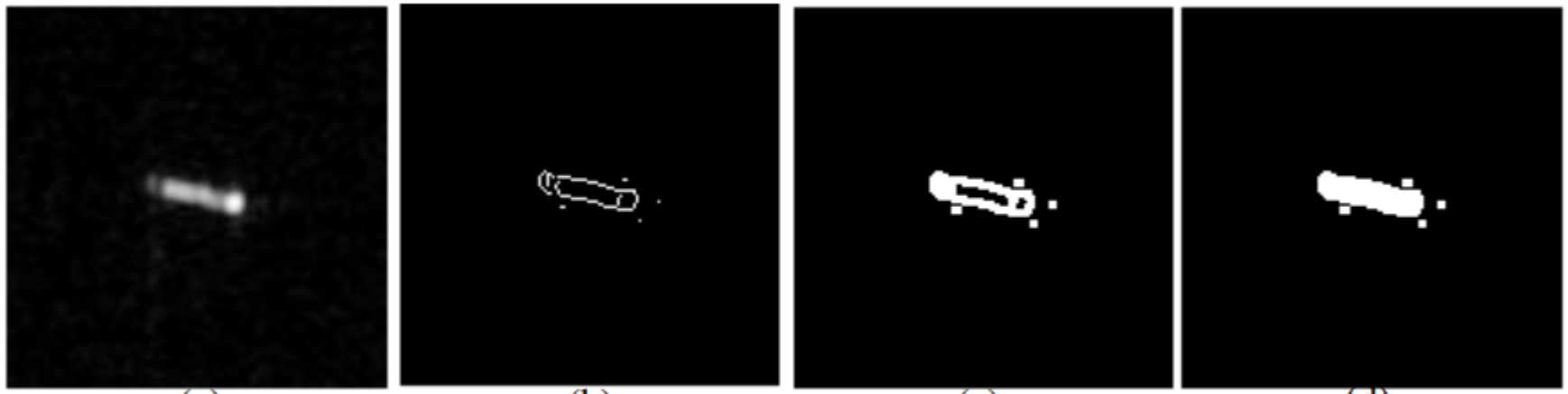


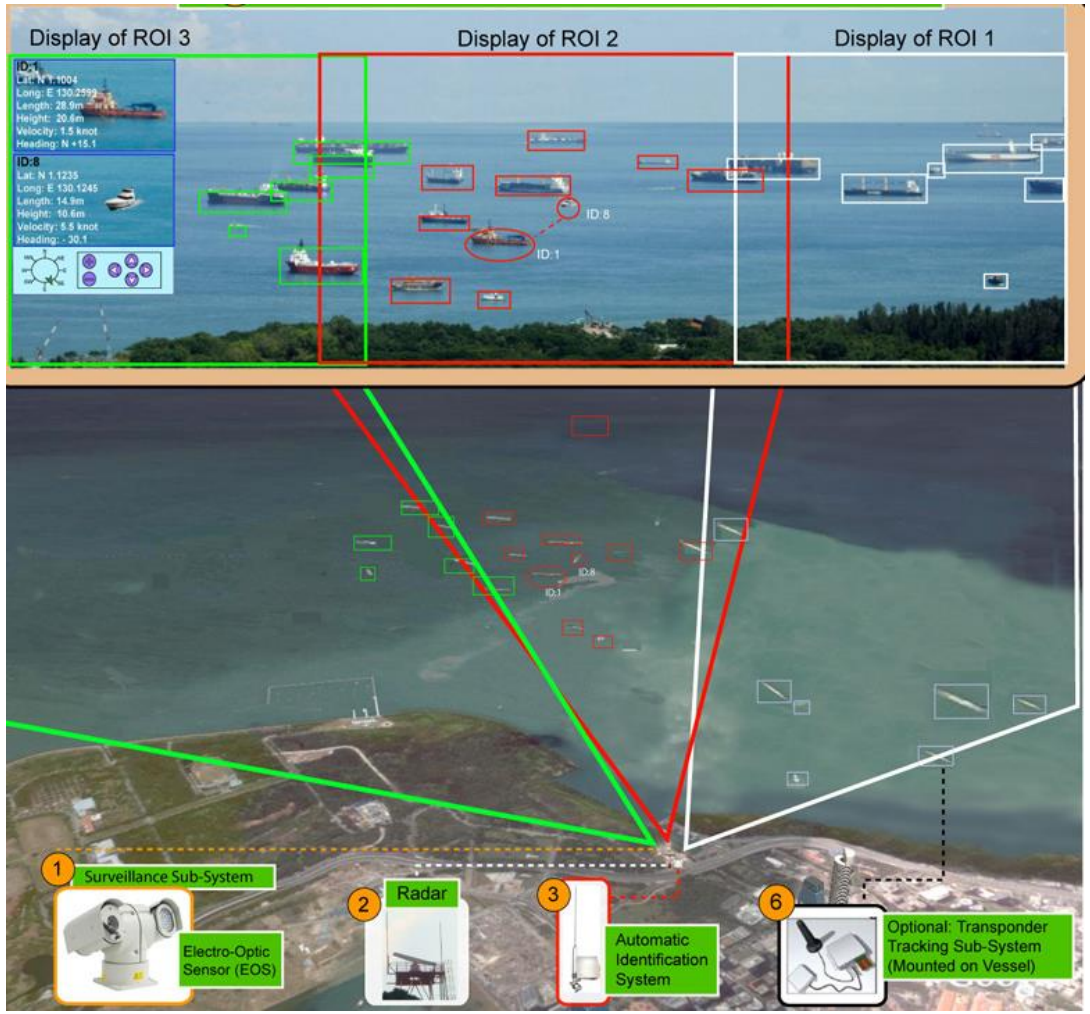




*ship targets seen next to the track through the sea ice.*



# Μη συνεργατικά συστήματα αναγνώρισης: Vessel Identification and Positioning System

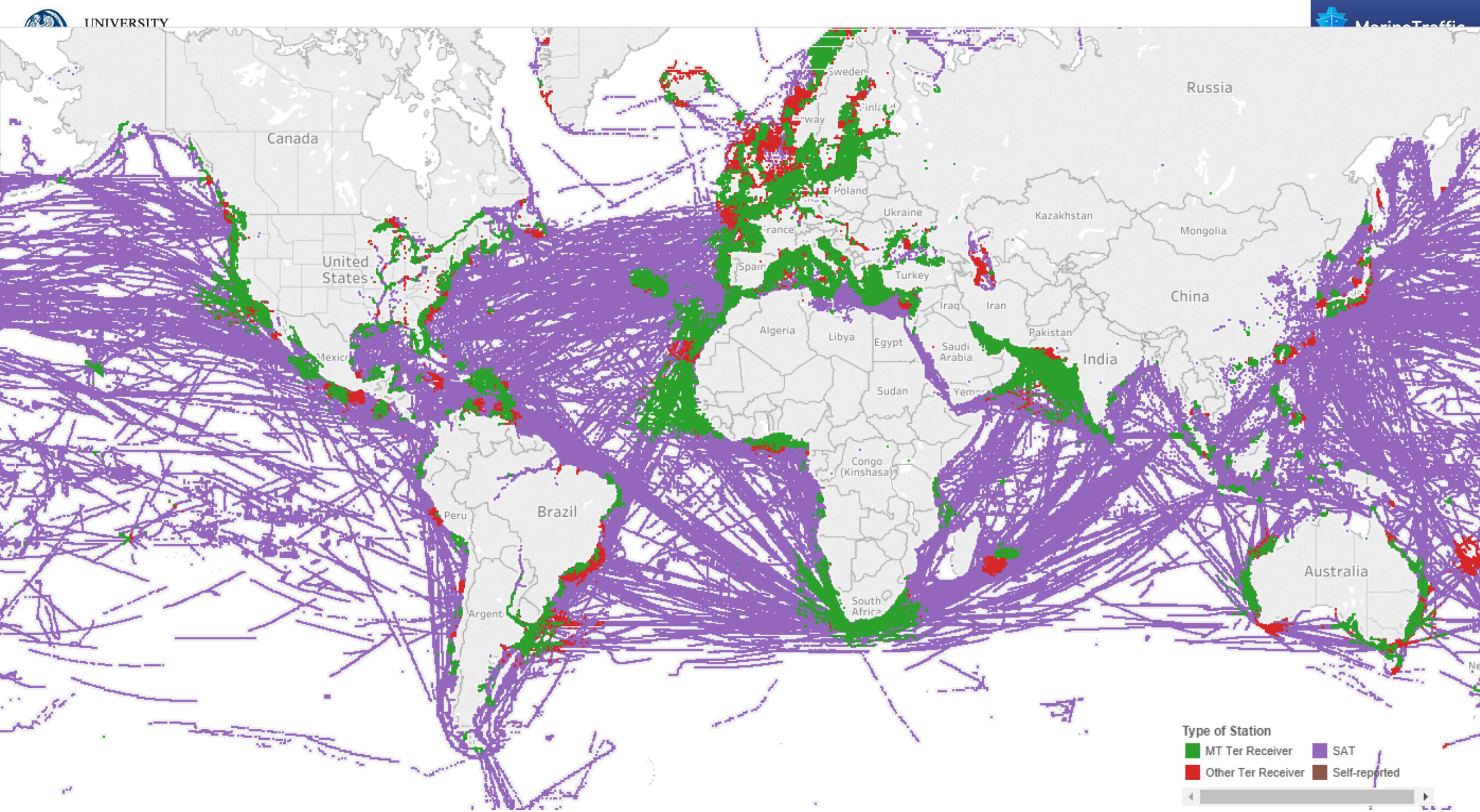


# Συνεργατικά συστήματα παρακολούθησης/αναγνώρισης

- Εφαρμογή του Συστήματος Αναγνώρισης & Εντοπισμού Πλοίων Μακράς Αποστάσεως (Long Range Identification & Tracking of Ships – LRIT)
- *Vessel Monitoring Systems (VMS)*
  - συστήματος παρακολούθησης αλιευτικών σκαφών
- *Automatic Identification System* (*AIS*)

# Automatic Identification System

- The AIS is a **collaborative**, self-reporting system that allows marine vessels to broadcast their information to nearby vessels and on-ground base stations.
- It uses digital radio signals to exchange real time information between vessels and shore based stations on dedicated VHF frequencies.
  - Collision detection
  - Although mandatory for large commercial vessels to carry device, it is not mandatory to use it.
  - Not a replacement of radar as it cannot detect land masses, navigation beacons and vessels not equipped with AIS


Russia
Canada
United States
China
India
Brazil
Australia
Sweden
Poland
Ukraine
Kazakhstan
Mongolia
Turkey
Iraq
Iran
Pakistan
Saudi Arabia
Algeria
Libya
Egypt
Sudan
Congo (Kinshasa)
South Africa
Peru
Type of Station
MT Ter Receiver
SAT
Other Ter Receiver
Self-reported

## Class A Transceivers

Class A AIS transceivers transmit and receive AIS signals. AIS transceivers are currently mandatory on all commercial vessels exceeding 300 tons that travel internationally (SOLAS vessels).

The following information can be transmitted by a Class A AIS system:

- Static data. Includes information such as vessel name, vessel type, MMSI number, call sign, IMO number, length, beam and GPS antenna location.
- Voyage related data. Includes information such as draft, cargo, destination, ETA and other relevant information.
- Dynamic data. Includes information such as time (UTC), ship's position, COG, SOG, heading, rate of turn and navigational status.
- Dynamic reports. Ship's speed and status.
- Messages. Alarms and safety messages.

Remember that not all vessels will transmit all of the information.

## Class B Transceivers

Class B AIS transceivers transmit and receive AIS signals, but use a reduced set of data compared to Class A (see *Data Summary*). A Class B AIS transceiver can be fitted on any vessel not fitted with a Class A transceiver, but is not mandatory aboard any vessel.

| Data | Class A (receive) | Class B (send) | Class B (receive) |
|---|---|---|---|
| Call sign | Yes | Yes | Yes |
| IMO number | Yes | No | No |
| Length and beam | Yes | Yes | Yes |
| Antenna location | Yes | Yes | Yes |
| Draft | Yes | No | No |
| Cargo Information | Yes | Yes | Yes |
| Destination | Yes | No | No |
| ETA | Yes | No | No |
| Time | Yes | Yes | Yes |
| Ship's position | Yes | Yes | Yes |
| COG | Yes | Yes | Yes |
| SOG | Yes | Yes | Yes |
| Gyro heading | Yes | Yes* | Yes |
| Rate of turn | Yes | No | No |
| Navigational status | Yes | No | No |
| Safety message | Yes | No | Yes |

# Μη ομοιόμορφη κατανομή δεδομένων

- AIS information is classed as either static or dynamic. Statis is broadcast when data has been amended or upon request or by default every 6 minutes.

**Class A systems**

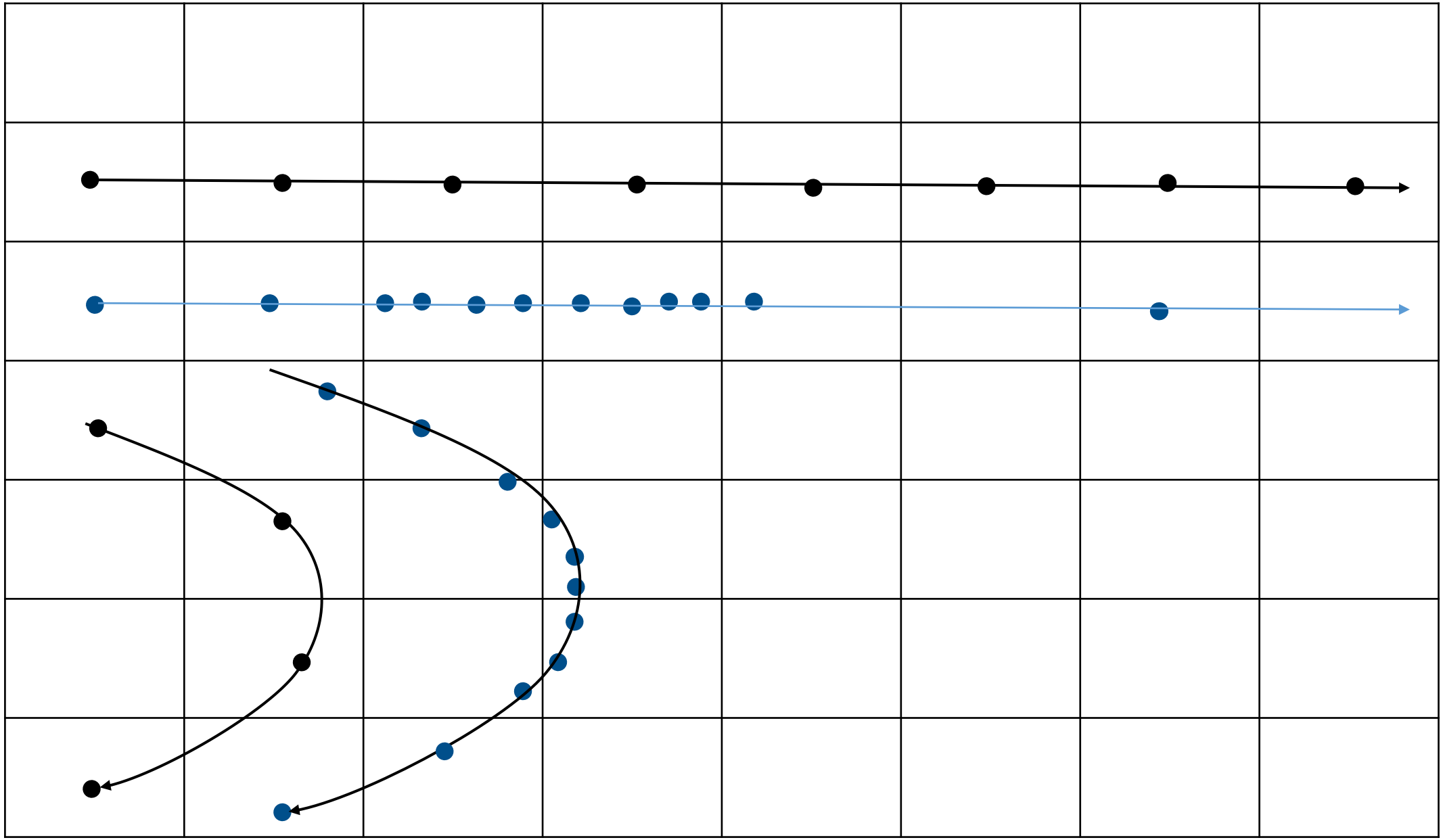
| Ships Dynamic Conditions | Reporting rate |
|---|---|
| At anchor or moored | 3 Minutes |
| 0-14 knots | 10 Seconds |
| 0-14 knots and changing course | $3^{1}/_{3}$ Seconds |
| 14-23 knots | 6 Seconds |
| 14-23 knots and changing course | 2 seconds |
| Faster than 23 knots | 2 seconds |
| Faster than 23 knots and changing course | 2 seconds |

**Class B systems**

| Ships Dynamic Conditions | Reporting rate |
|---|---|
| 0 to 2 knots | 3 Minutes |
| Above 2 knots | 30 Seconds |

**Other AIS sources**

| Source | Reporting rate |
|---|---|
| Search and Rescue (SAR) aircraft | 10 seconds |
| Aids to navigation | 3 minutes |
| AIS base station | 10 seconds or 3.33 seconds, depending on operating param |



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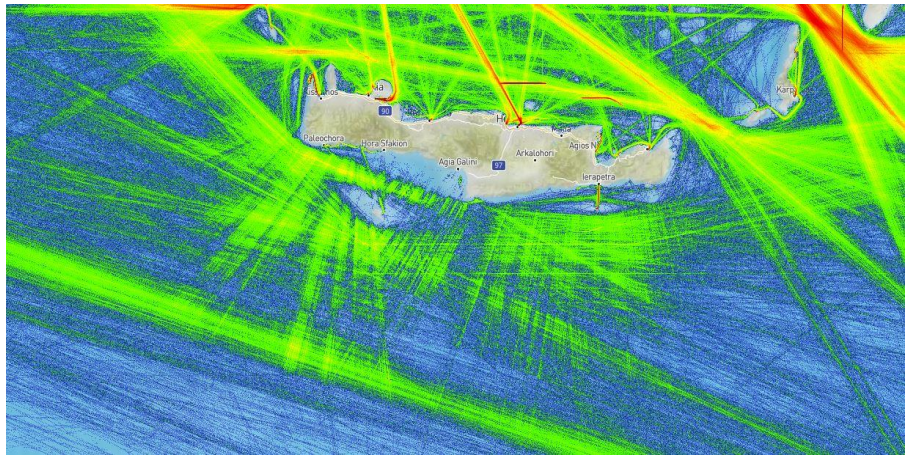
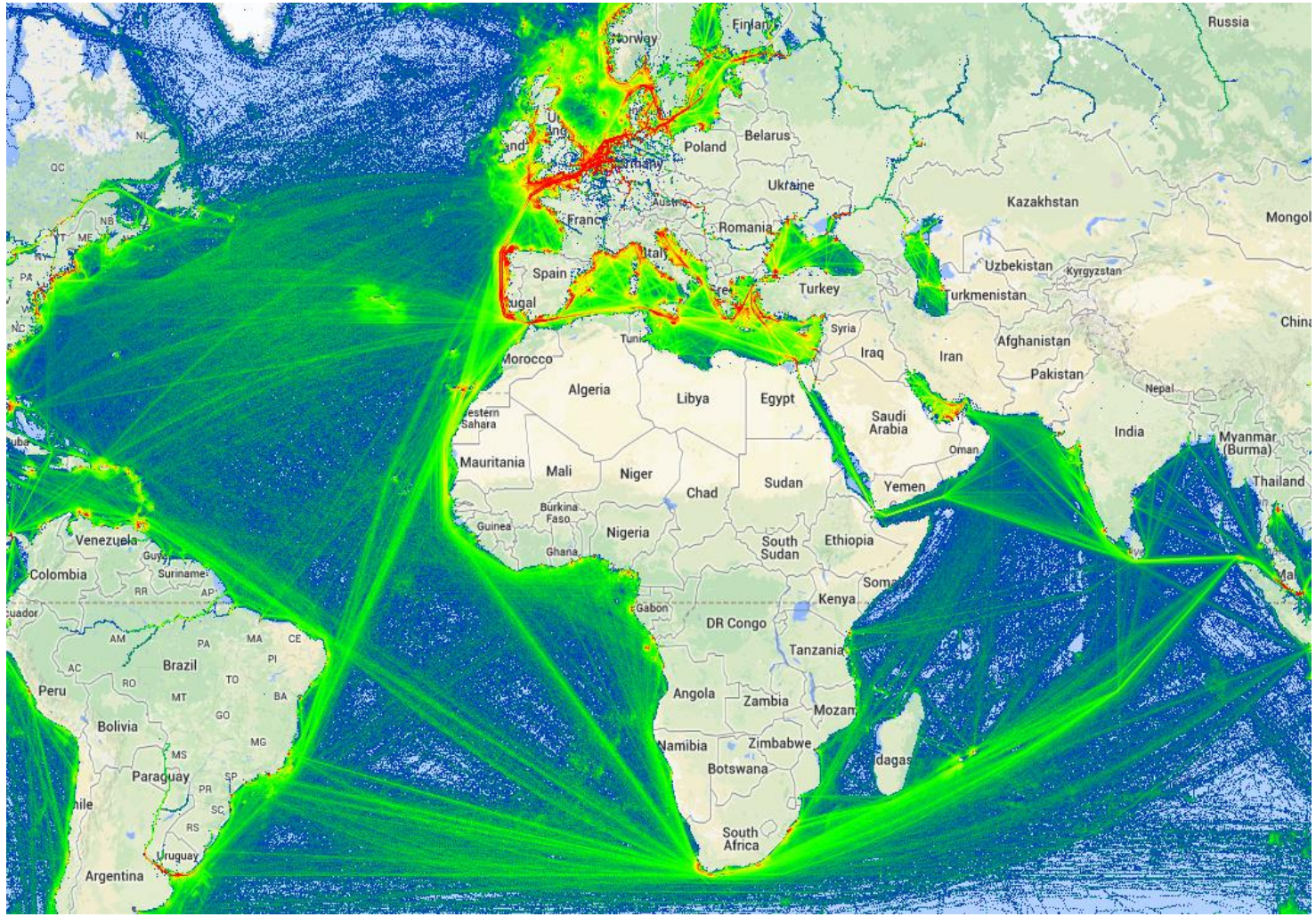
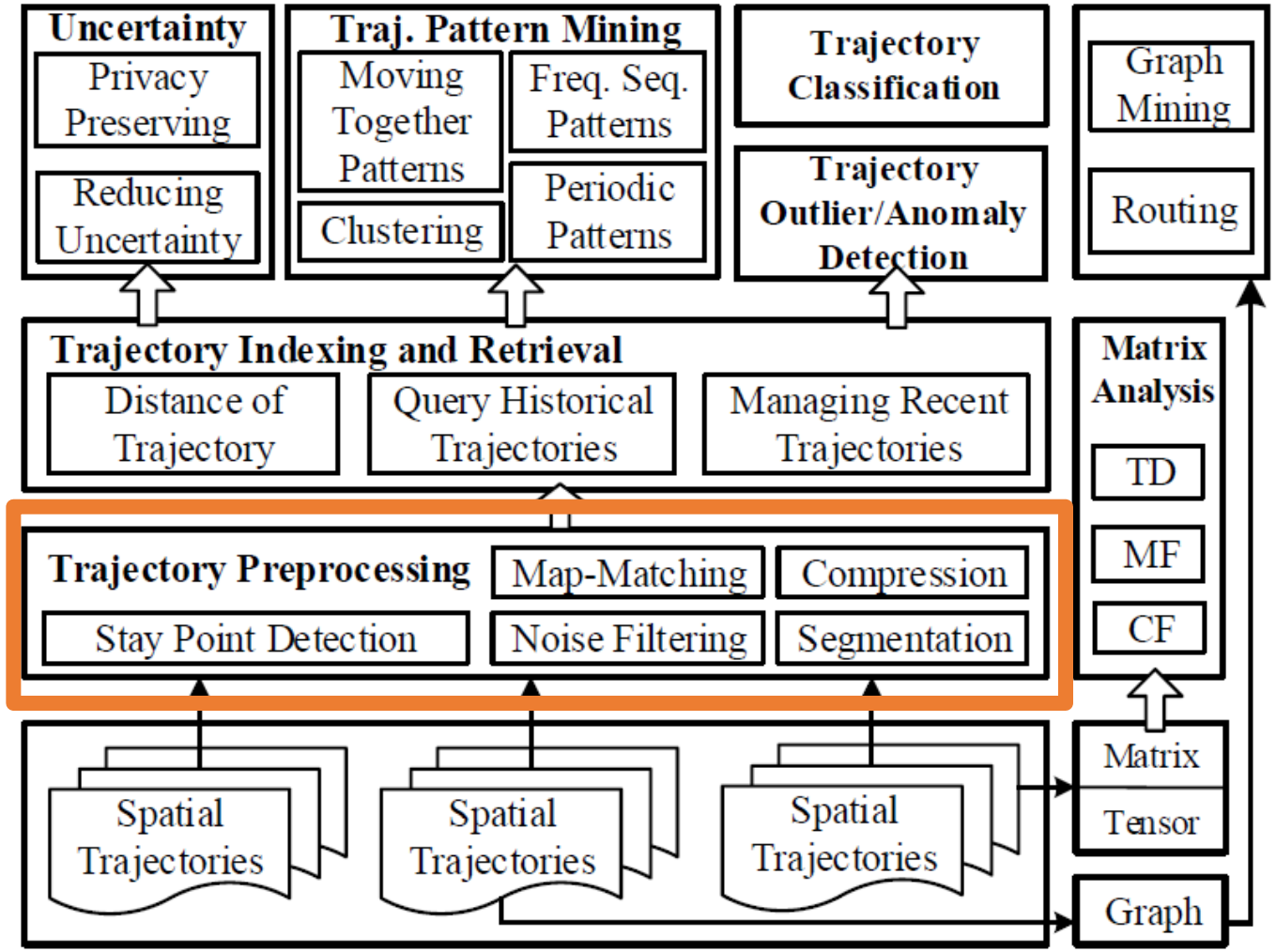
# Μη ομοιόμορφη κατανομή δεδομένων

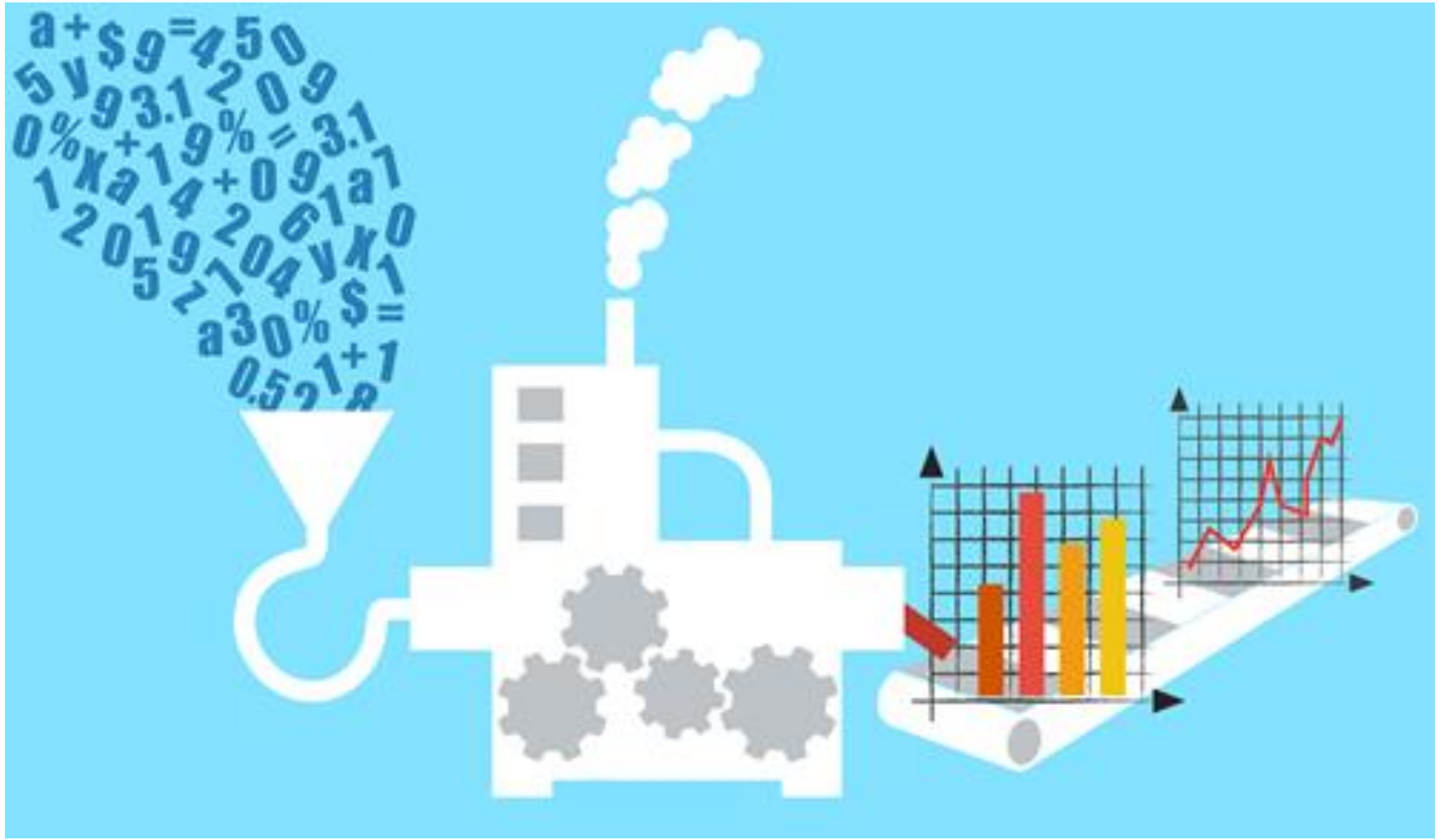




# Trajectory Preprocessing



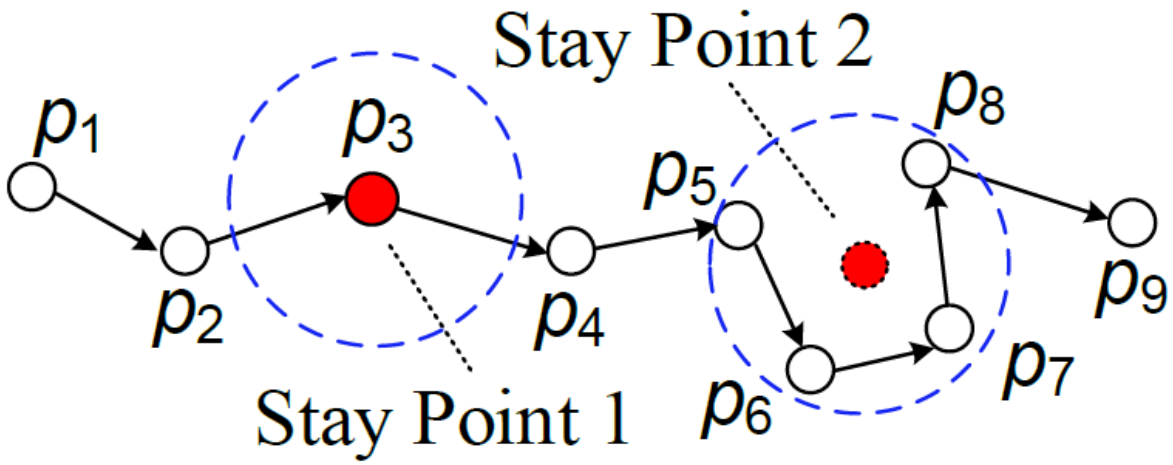
# Big data to useful data



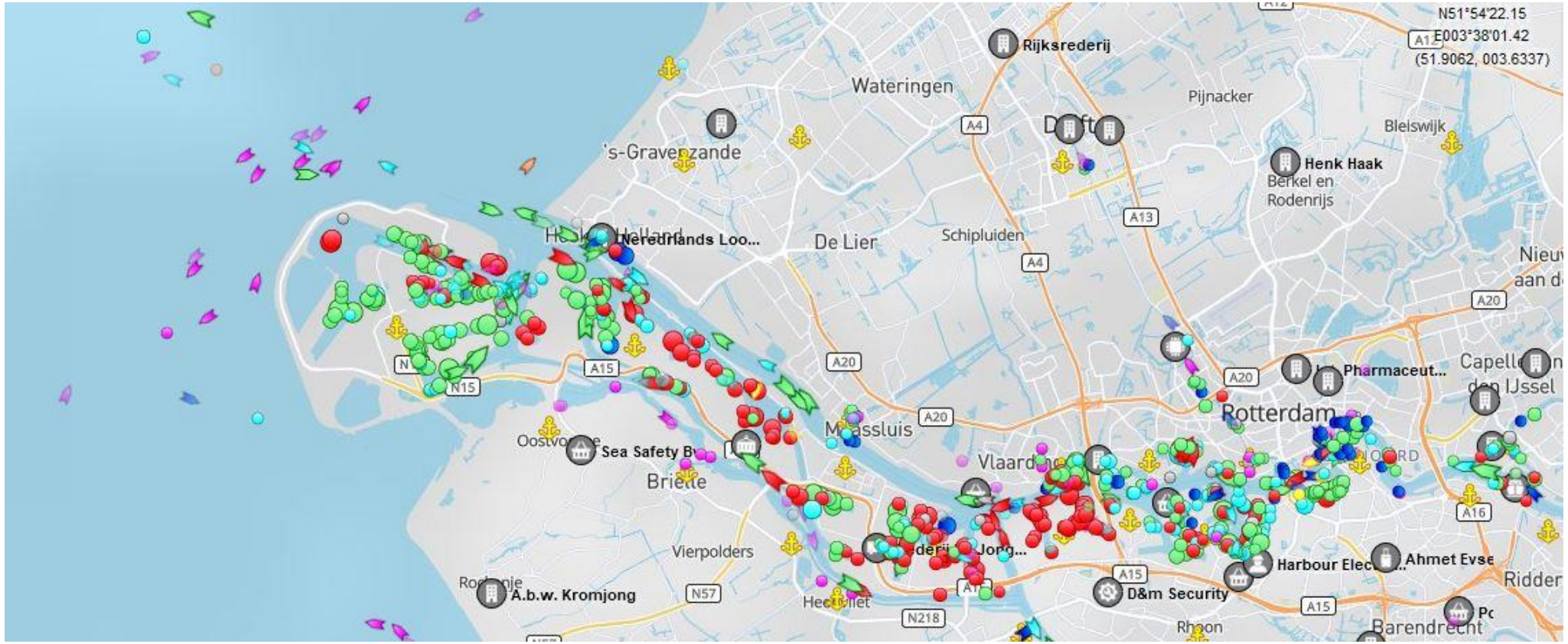
# Stay Point Detection

- Spatial points are not equally important in a trajectory.
- Some points denote locations where objects have stayed for a while
  - such as shopping malls and tourist attractions, or gas stations where a vehicle was refueled.

With such stay points, we can turn a trajectory from a series of time-stamped spatial points $\boldsymbol{P}$ into a sequence of meaningful places $\boldsymbol{S}$,
$\boldsymbol{P}=p1\rightarrow p2\rightarrow\cdots\rightarrow pn, \Rightarrow \boldsymbol{S}=s1\Delta t1\rightarrow s2\Delta t2\rightarrow ,\ldots,\Delta tn-1\rightarrow sn,$



# Καθορισμός των ορίων των λιμένων και επιχειρησιακών περιοχών




**A distributed approach to estimating sea port operational regions from lots of AIS data**

Millefiori, L.M., Zissis, D., Cazzanti, L. , IEEE Big Data, 2016

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# Scalable and distributed sea port operational areas estimation from AIS data


**A distributed approach to estimating sea port operational regions from lots of AIS data**

Millefiori, L.M., Zissis, D., Cazzanti, L. , IEEE Big Data, 2016

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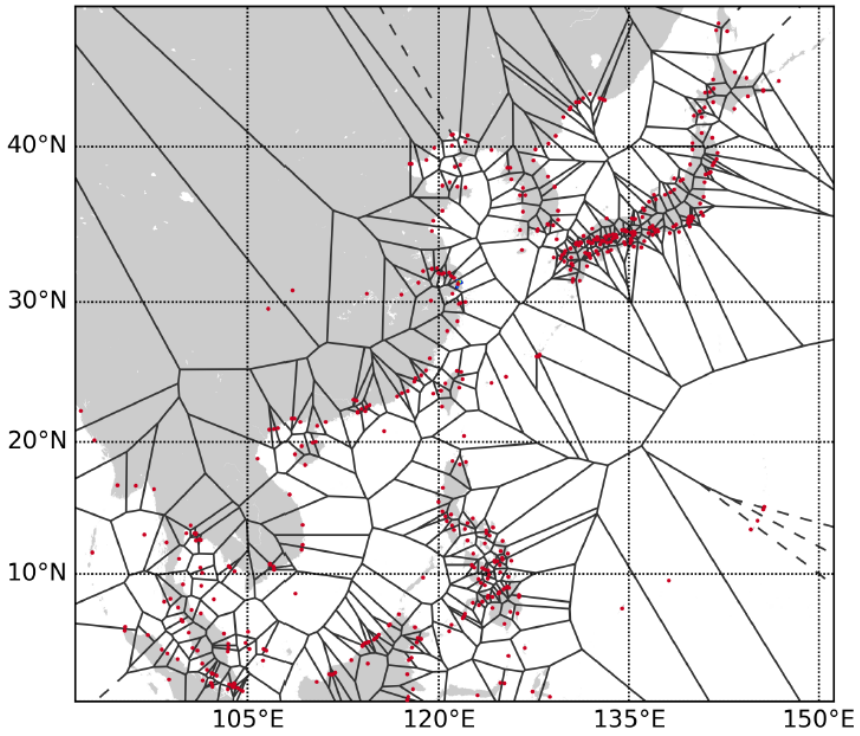
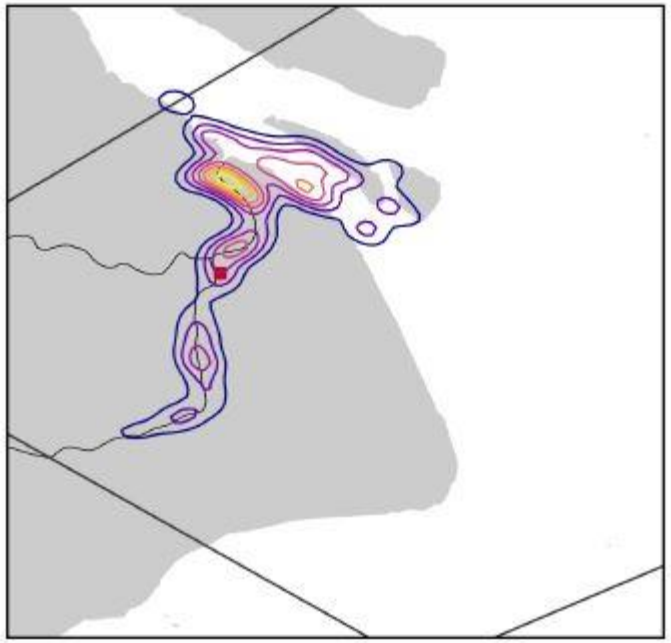
# SHANGAI PORT



>57 million AIS messages!

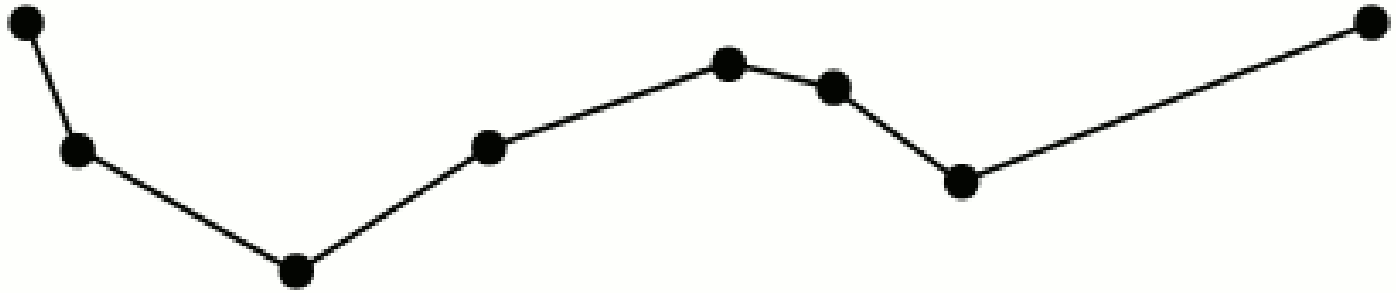
recorded during the month of March 2015

**Scalable and distributed sea port operational areas estimation from AIS data**

Millefiori, L.M., Zissis, D., Cazzanti, L. Arcieri, G, IEEE International Conference on Data Mining, 2016

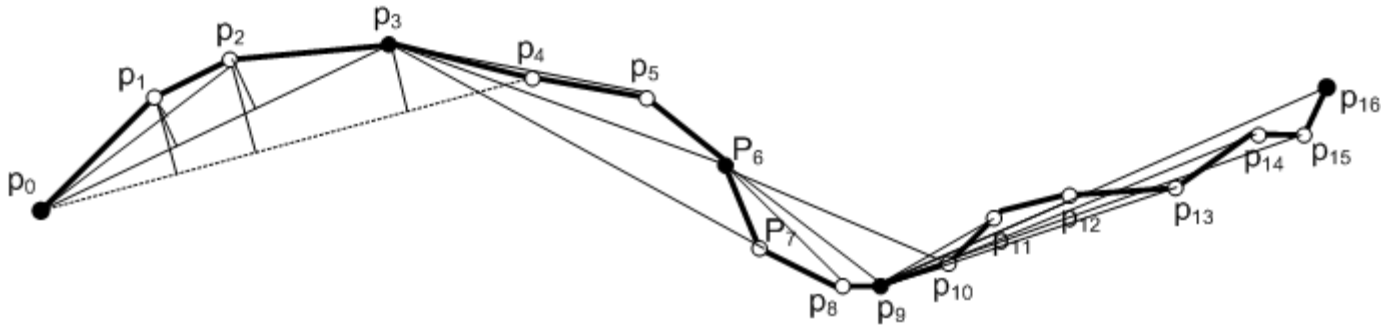
# *Compression*

- Given a trajectory that consists of a full series of time-stamped points, a batched compression algorithm aims to generate an approximated trajectory by discarding some points with a negligible error from the original trajectory
- A well-known algorithm, called Douglas-Peucker, is used to approximate the original trajectory.
- the idea of Douglas-Peucker is to replace the original trajectory by an approximate line segment, e.g. $p1p12$.
- If the replacement does not meet the specified error requirement (Perpendicular Euclidean Distance is used in this example), it recursively partitions the original problem into two sub-problems by selecting the point contributing the biggest error as the splitting point.

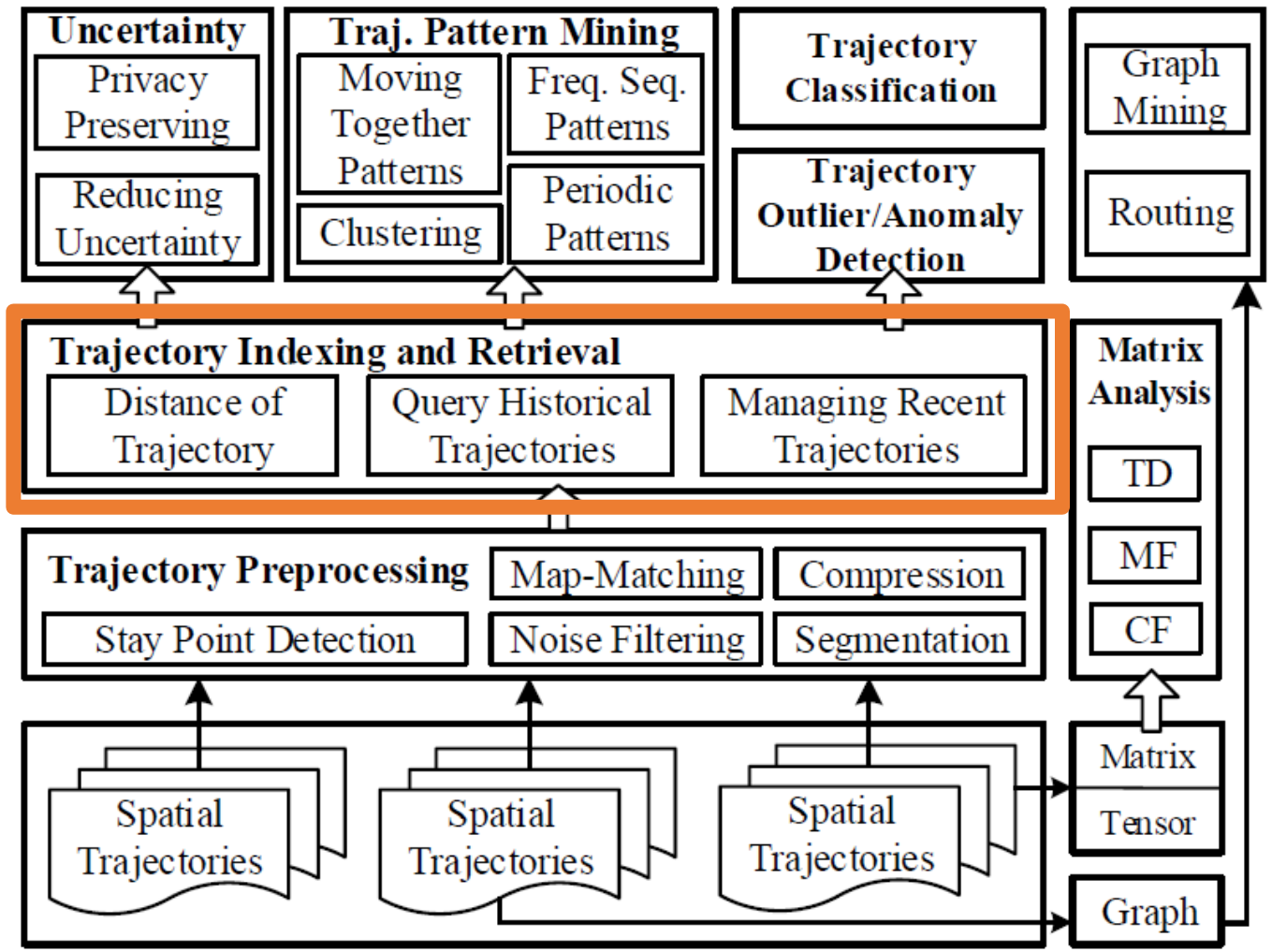


# On-line Compression – Sliding Window

- Fit the location points in a growing sliding window with a valid line segment and continue to grow the sliding window until the approximation error exceeds some error bound.
  1. First initialize the first location point of a trajectory as the anchor point $p_a$ and then starts to grow the sliding window
  2. When a new location point $p_i$ is added to the sliding window, the line segment $p_a\, p_i$ is used to fit all the location points within the sliding window.
  3. As long as the distance errors against the line segment $p_a\, p_i$ are smaller than the user-specified error threshold, the sliding window continues to grow. Otherwise, the line segment $p_a\, p_{i-1}$ is included as part of the approximated trajectory and $p_i$ is set as the new anchor point.
  4. The algorithm continues until all the location points in the original trajectory are visited.

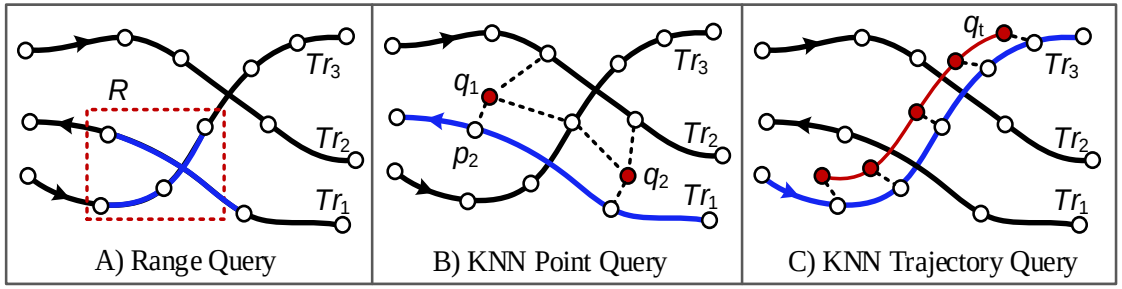


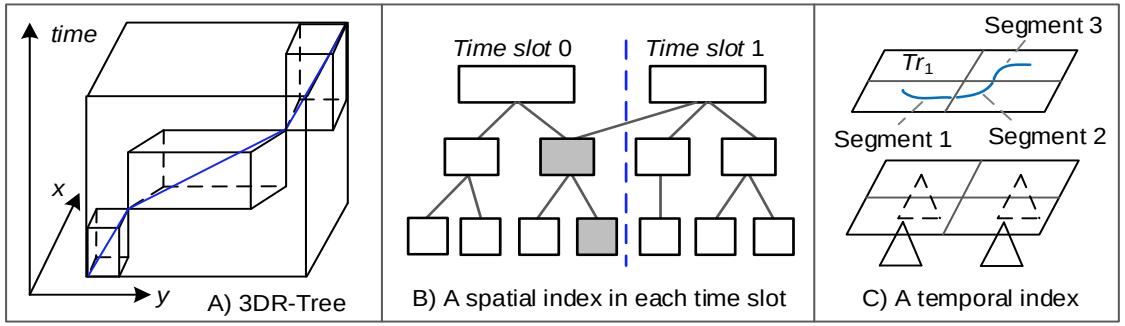
# Trajectory Indexing / Retrieval



# Trajectory Data Management

- Spatial Databases
- Queries
  - Range queries
  - KNN queries
- Distance metrics
  - The distance between a point $q$ and a trajectory
  - The Distance between two trajectories
  - The distance between two trajectory segments
- Indexing structures
- Retrieval algorithms



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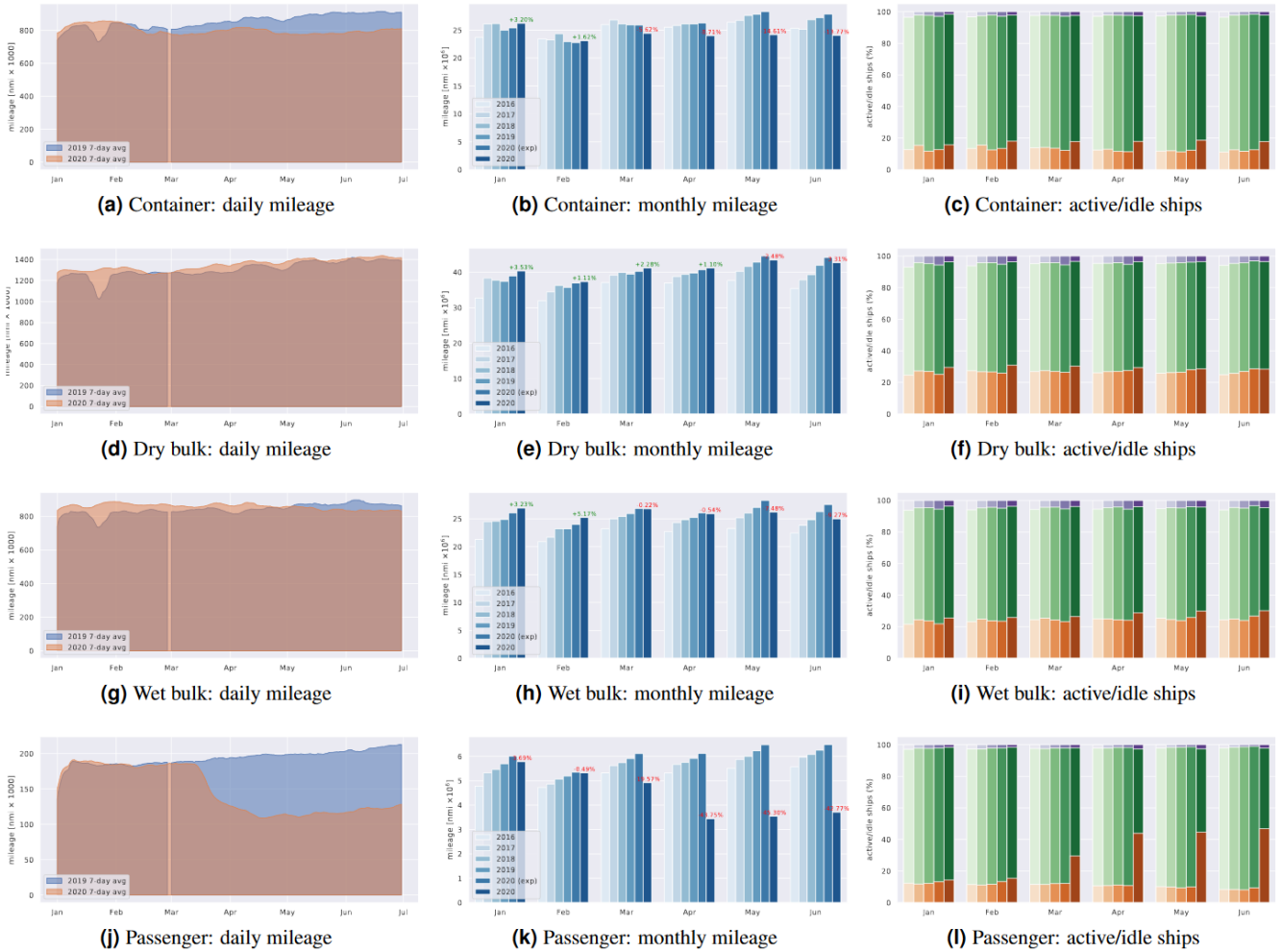
The total size of the dataset is approximately 55 TB and it is stored in a big data architecture. The processing is based on a distributed cluster of40virtual cores and 128 GB of RAM. The overall processing time was less than 4 hours.




**(a)** Container: daily mileage **(b)** Container: monthly mileage **(c)** Container: active/idle ships

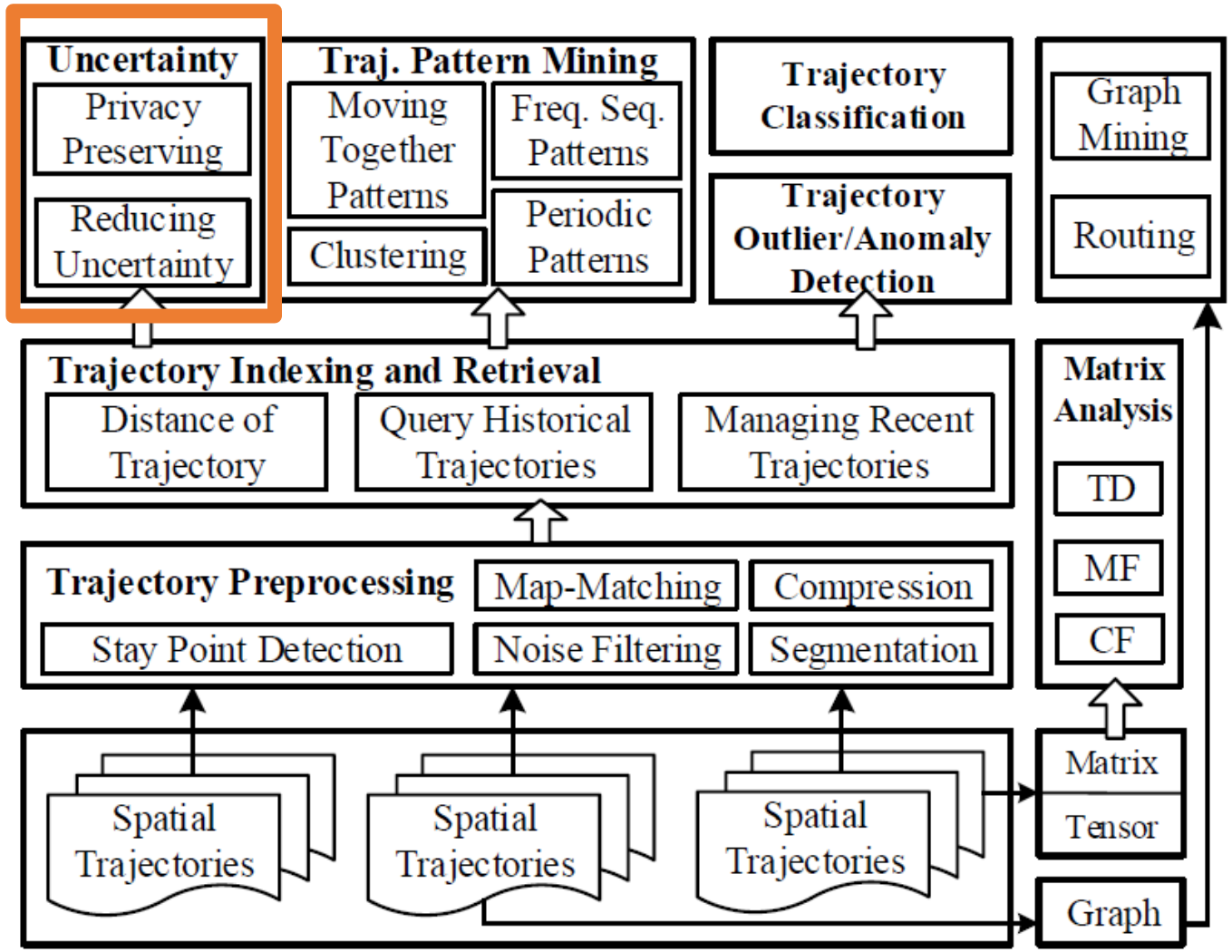
**(d)** Dry bulk: daily mileage **(e)** Dry bulk: monthly mileage **(f)** Dry bulk: active/idle ships

**(g)** Wet bulk: daily mileage **(h)** Wet bulk: monthly mileage **(i)** Wet bulk: active/idle ships

**(j)** Passenger: daily mileage **(k)** Passenger: monthly mileage **(l)** Passenger: active/idle ships

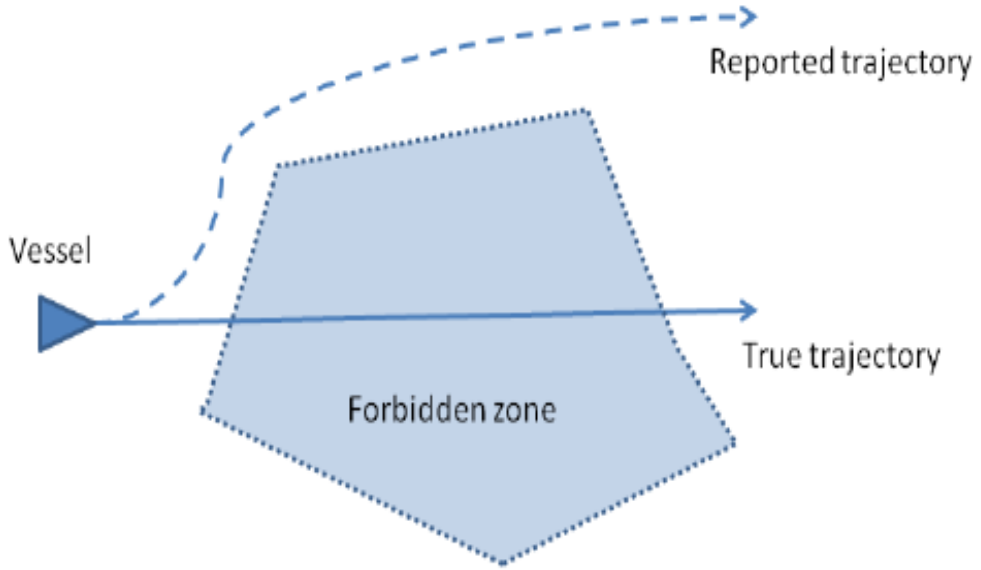
*COVID-19 Impact on Global Maritime Mobility, LM Millefiori, P Braca, D Zissis, G Spiliopoulos, S Marano, PK Willett, ... arXiv preprint arXiv:2009.06960*

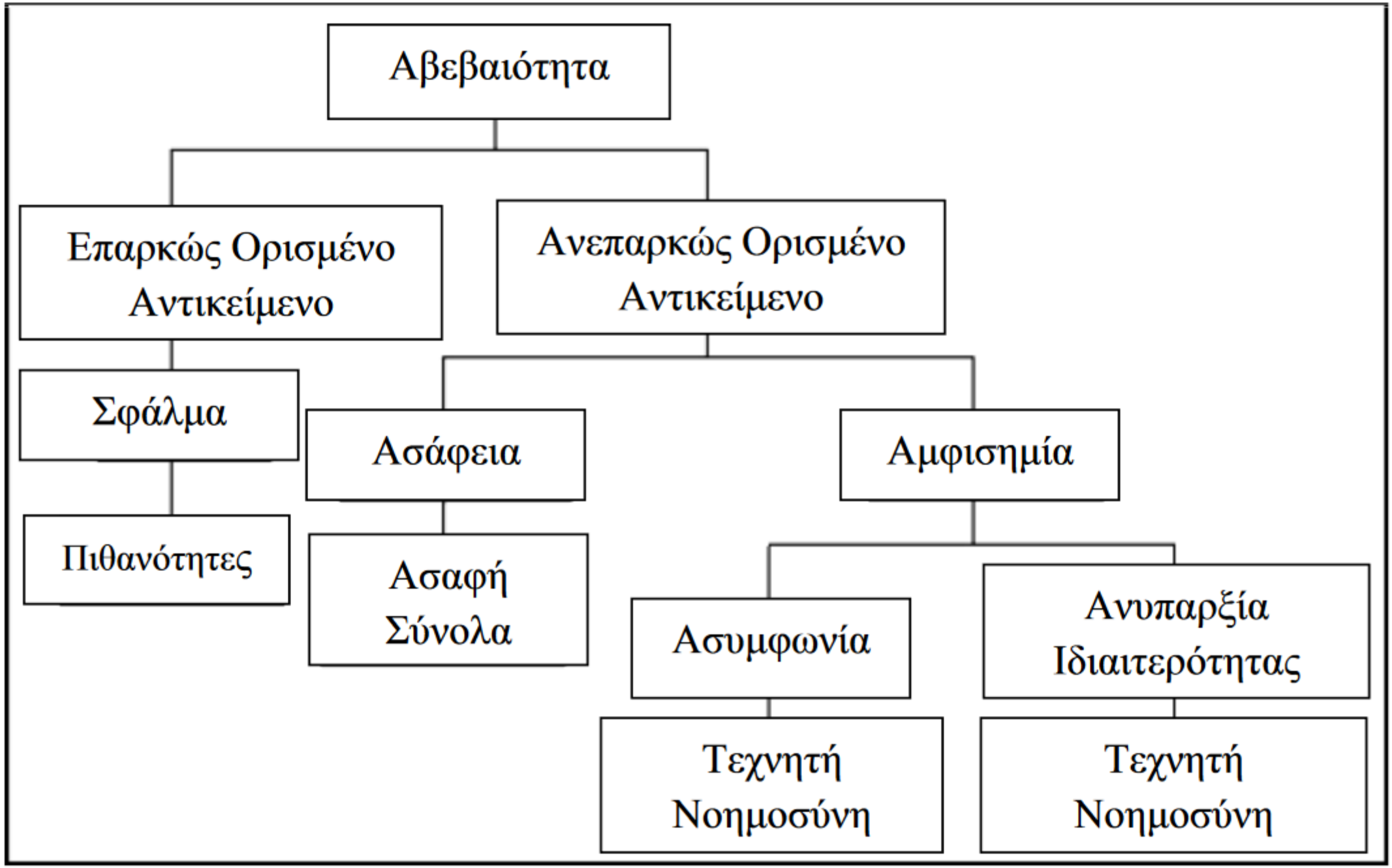
# UNCERTAINTY IN A TRAJECTORY



# Uncertain Trajectories

- As the location of a moving object is recorded at a certain time interval, the trajectory data we obtain is usually a sample of the object's true movement. On one hand, the movement of an object between two consecutive sampling points becomes unknown (or called uncertain). To this end, we expect to reduce the uncertainty of a trajectory.
- On the other hand, in some applications, to protect a user's privacy that could be leaked from her trajectories, we need to make a trajectory even more uncertain.




Αβεβαιότητα
Επαρκώς Ορισμένο Αντικείμενο
Ανεπαρκώς Ορισμένο Αντικείμενο
Σφάλμα
Πιθανότητες
Ασάφεια
Ασαφή Σύνολα
Αμφισημία
Ασυμφωνία
Τεχνητή Νοημοσύνη
Ανυπαρξία Ιδιαιτερότητας
Τεχνητή Νοημοσύνη

# Origin-destination information

- An essential preprocessing task is assigning to all positional data collected through AIS, origin-destination information.
  - Although AIS messages often include a destination port, this field is ignored in our study, as it is manually entered by each vessel's crew, without following a specific standard, making it thus prone to errors.

| Case | Message (t-1) | Message (t) | Travelling Status | Port Move |
|---|---|---|---|---|
| #1 | In Port(A) | Not in Port | Departure from Port(A) at t (time) | True |
| #2 | Not in Port | In Port(A) | Arrival at Port(A) at t (time) | True |
| #3 | In Port(A) | In Port(A) | In Port(A) | False |
| #4 | Not in Port | Not in Port | Travelling at open sea | False |

# Interpolation or Gap filling (through fusion)

## Sanctioned Iranian Tanker Adrian Darya 1 Goes "Dark" Off Syria

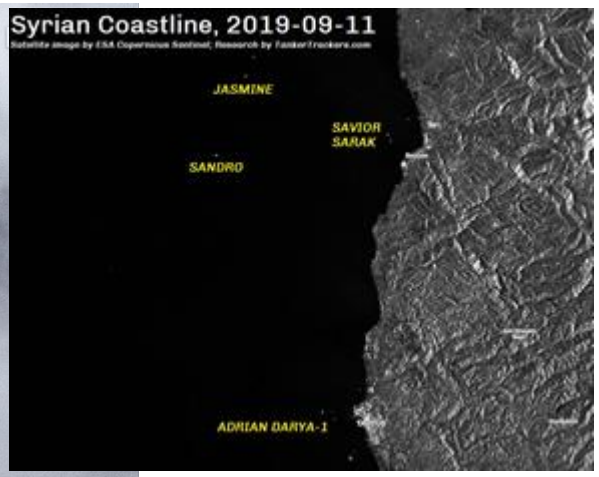

MarineTraffic via TankerTrackers / Twitter

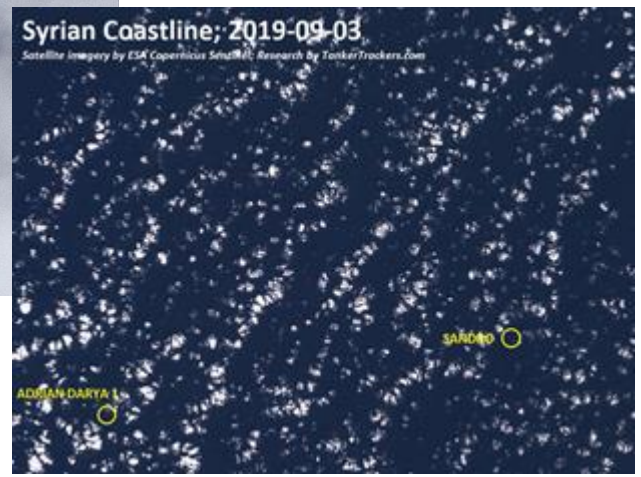
BY **THE MARITIME EXECUTIVE** 09-02-2019 09:11:33

The U.S.-blacklisted tanker *Adrian Darya 1* has gone "dark" off the coast of Syria, where she is widely expected to deliver her controversial cargo of Iranian crude oil.

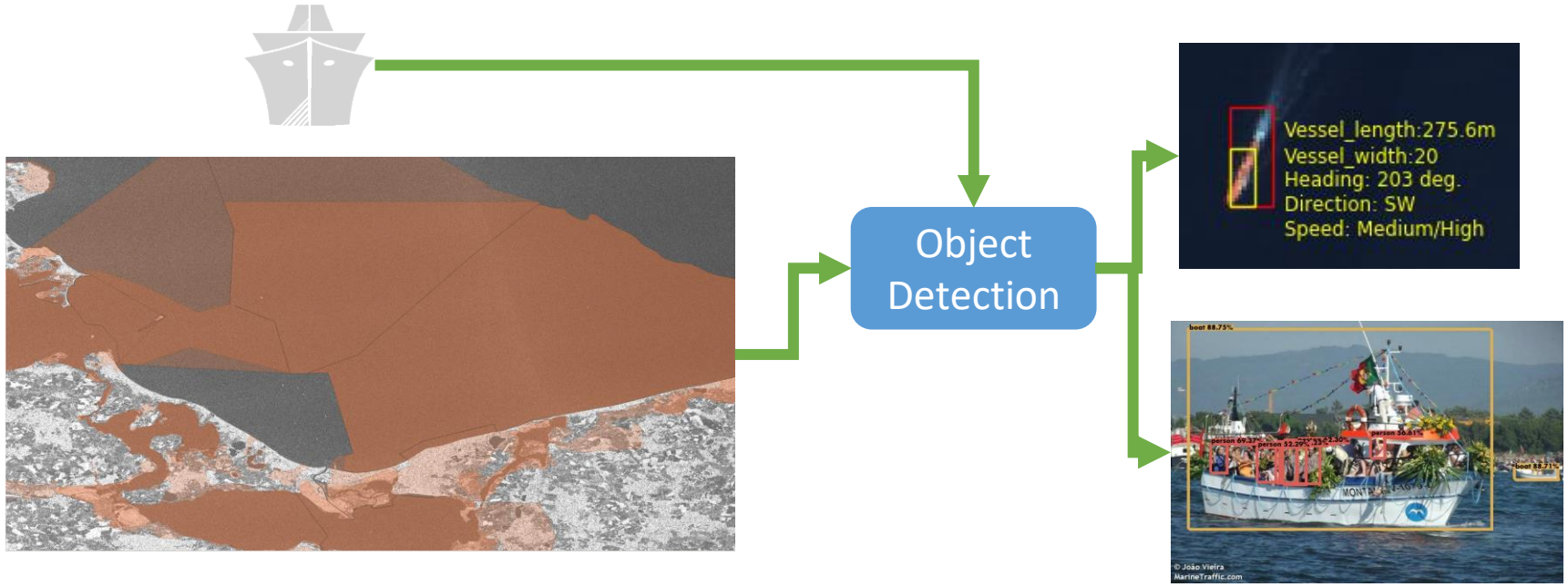
# Interpolation or Gap filling (through fusion)

- Using satellite imagery
  - PlanetLabs,
  - Sentinel 1,
  - Sentinel2

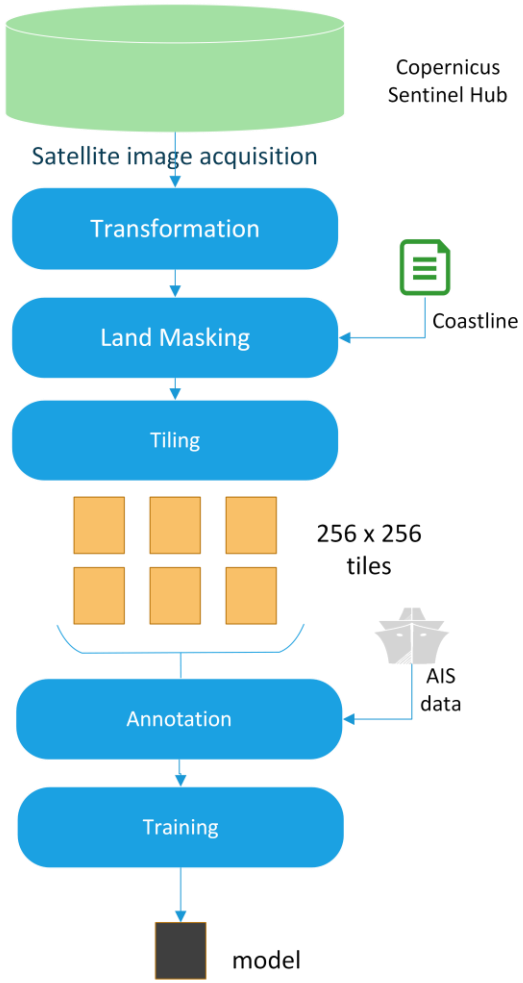


# Interpolation or Gap filling (through fusion)



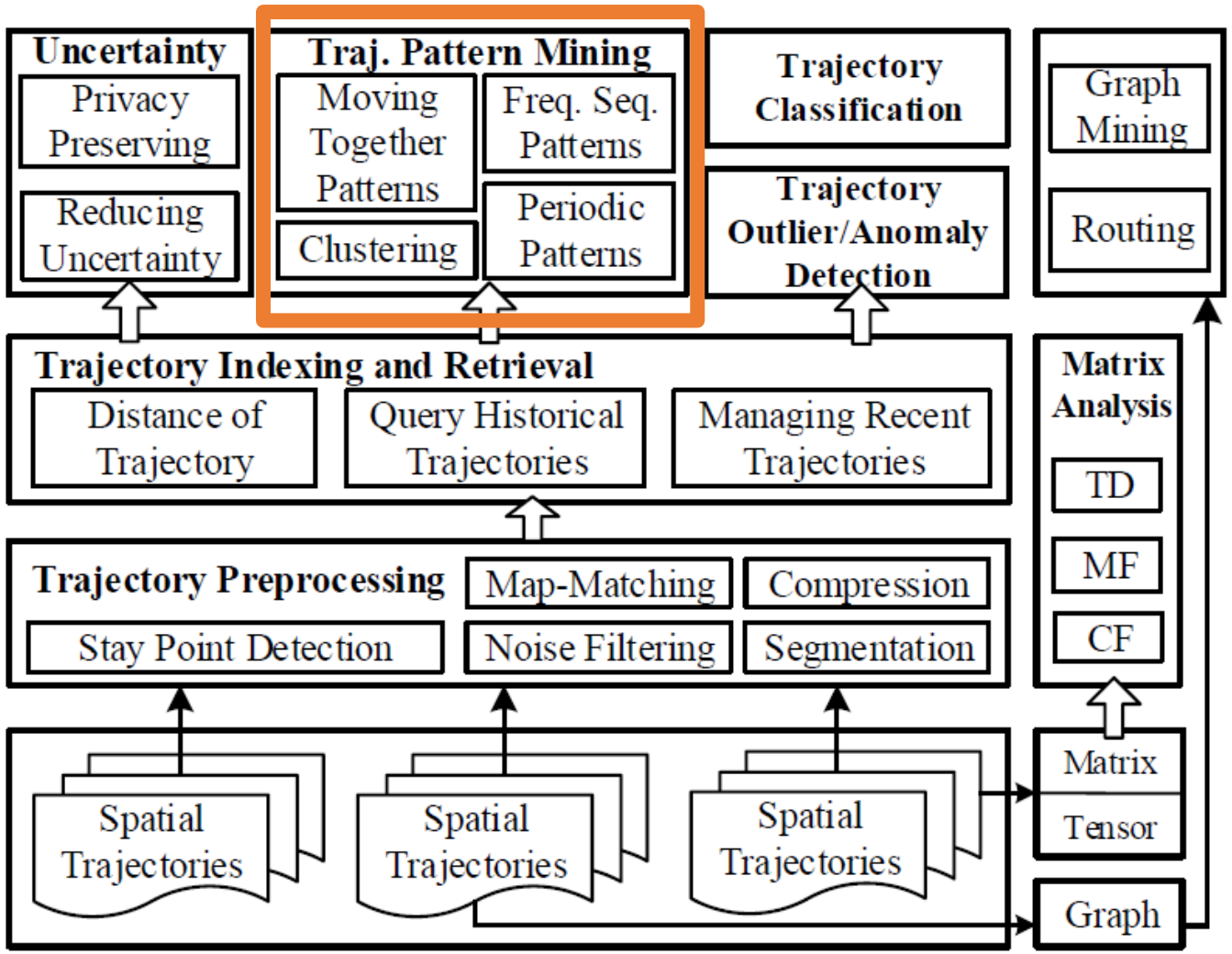
# Interpolation or Gap filling (through fusion)




IGARSS 2020

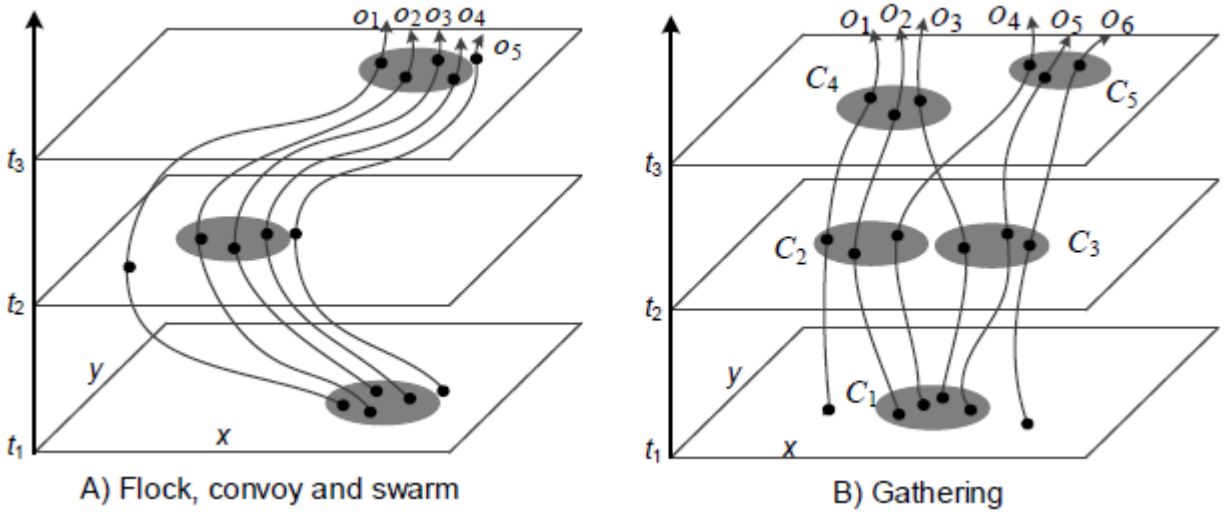
- Transformation to WGS84
- Intersection with coastline shapefile (using GDAL)
- Tiling produces 256 x 256 tiles
- Annotation using AIS data
- +Manual annotation for the segmentation task
- Training using CNN
- 3 classes (vessel, land, cloud)

# Traj. Pattern Mining



# Trajectory pattern mining

Στη βιβλιογραφία έχουν προταθεί διαφορετικοί ορισμοί για τις ομάδες κινούμενων αντικειμένων, όπως flocks, convoys, movingclusters, grouppatternsκαι swarms




A) Flock, convoy and swarm

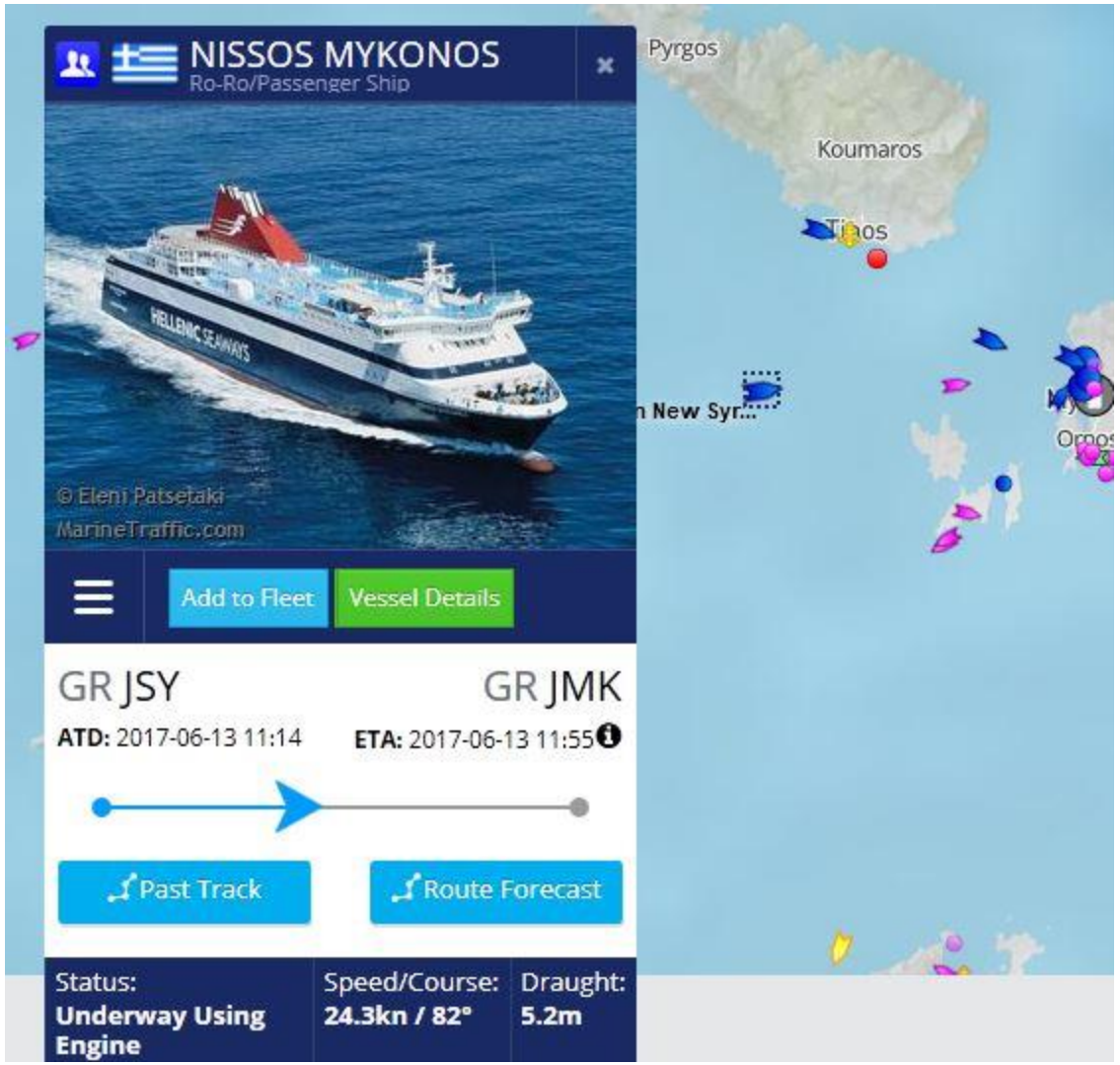
B) Gathering

https://dspace.lib.ntua.gr/xmlui/bitstream/handle/123456789/8613/vlachakia_trajectorymining.pdf?sequence=3&isAllowed=y

# Trajectory Clustering

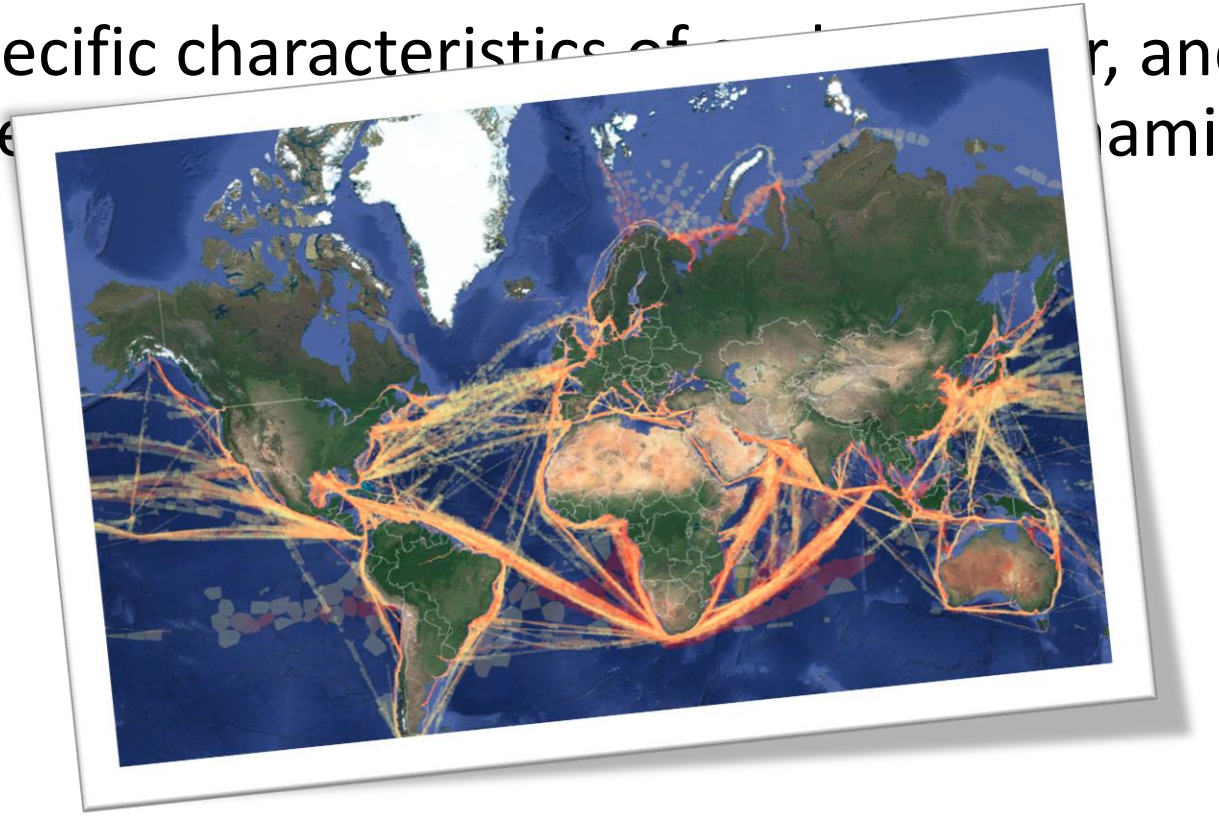
- Η ομαδοποίηση τροχιών έχει ως στόχο την αναγνώριση ομάδων στις οποίες οι τροχιές ακολουθούν όμοια πρότυπα κίνησης.
- Η πιο συνηθισμένη προσέγγιση καθορίζει τις ομάδες με βάση την πυκνότητα των τροχιών σε κάποιο χώρο
- Εύρεση ενδεικτικών τροχιών / κοινών διαδρομών στη θάλασσα

# Γιατί όμως είναι χρήσιμες;




# Routes as traffic corridors (1)

- In the real world though, ships do not travel on these thin lines, as traffic corridors have a variable width, volume, and distribution
- identifying the specific characteristics of [illegible]r, and fundamentally the [illegible]amics.



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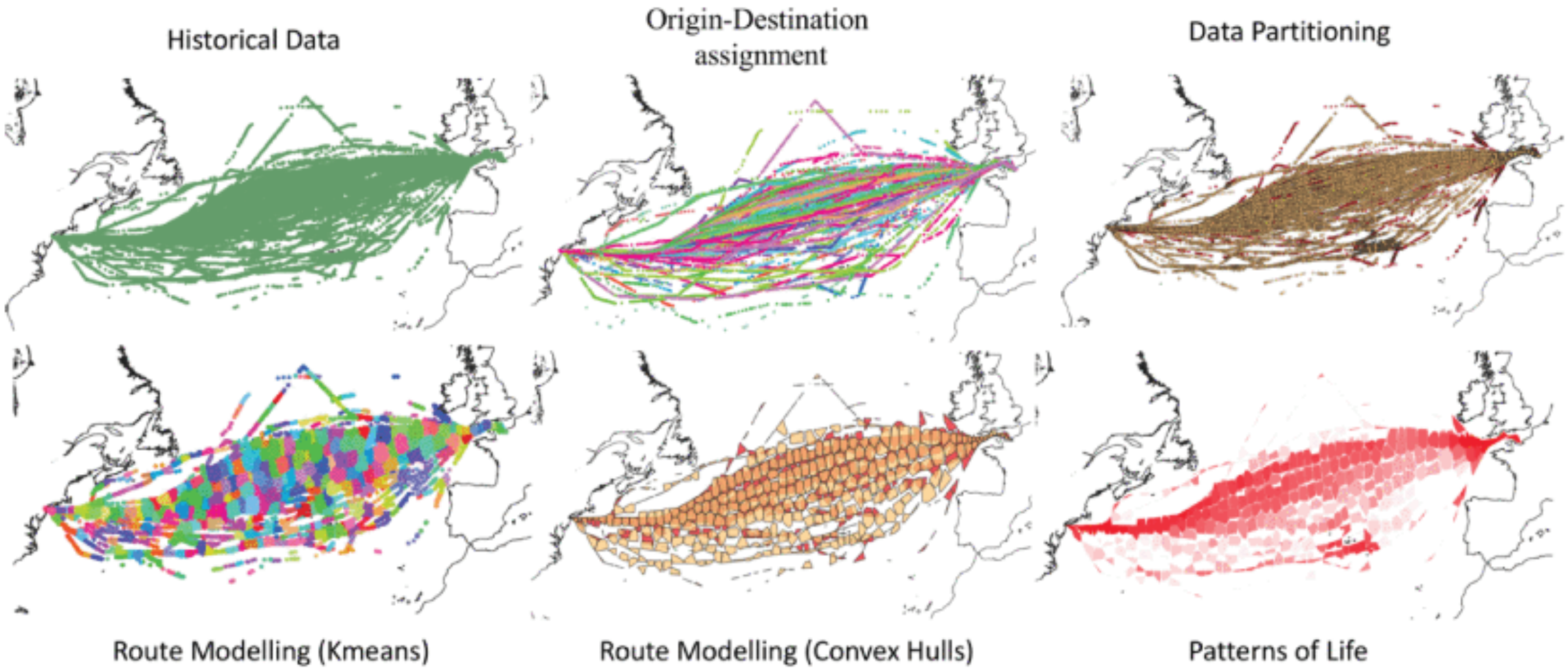
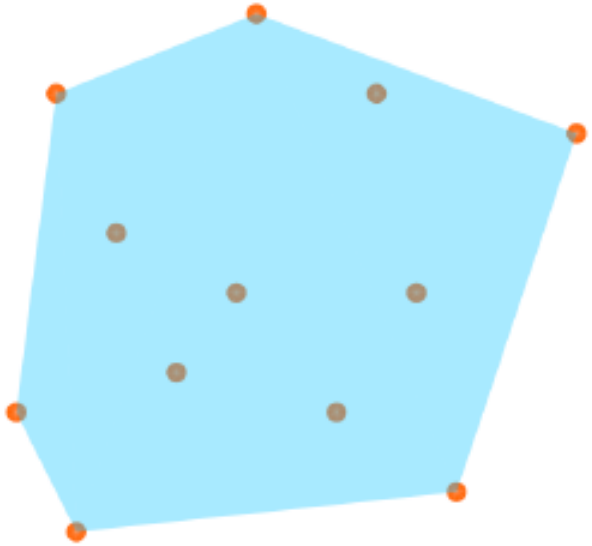
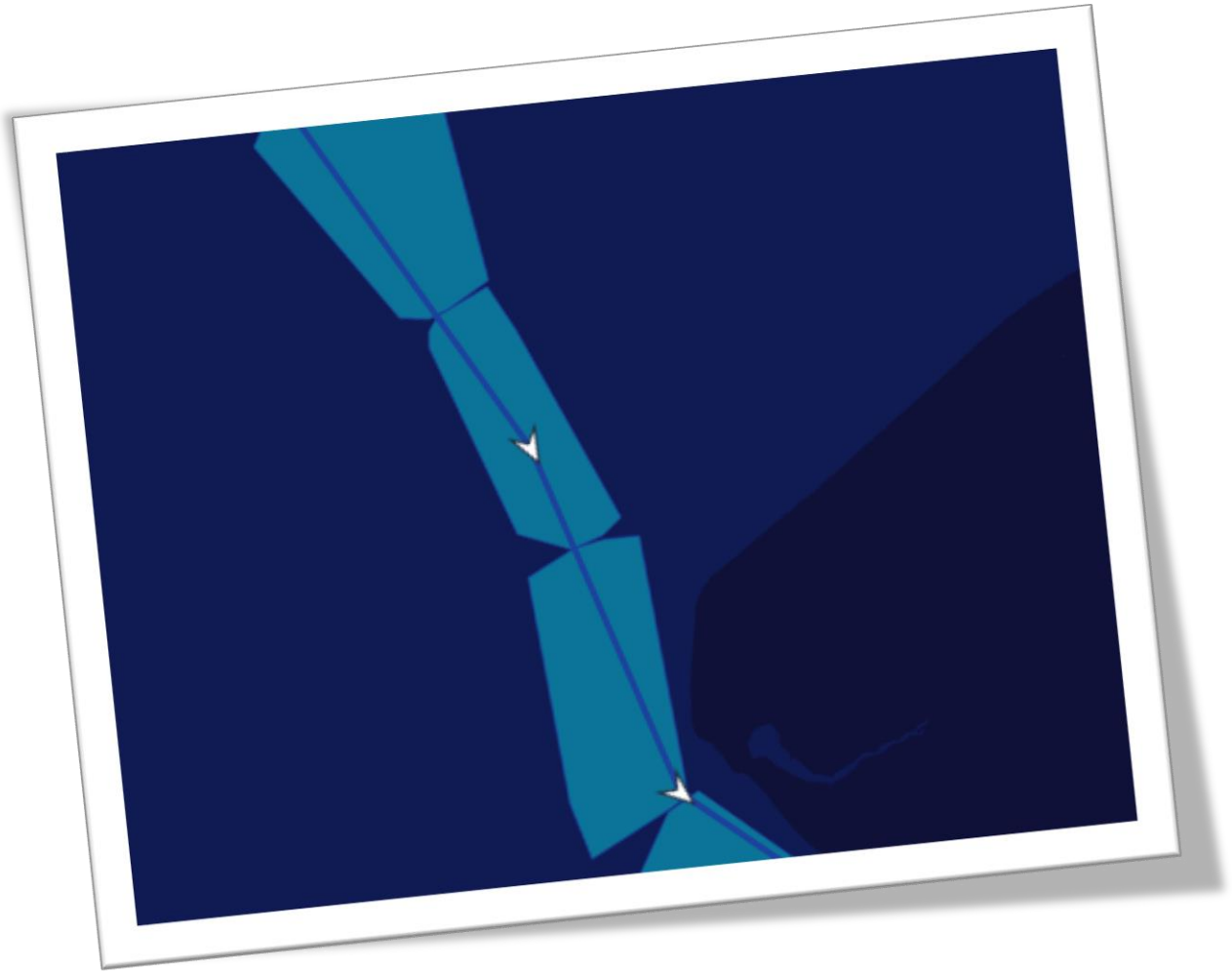
# Patterns of Life



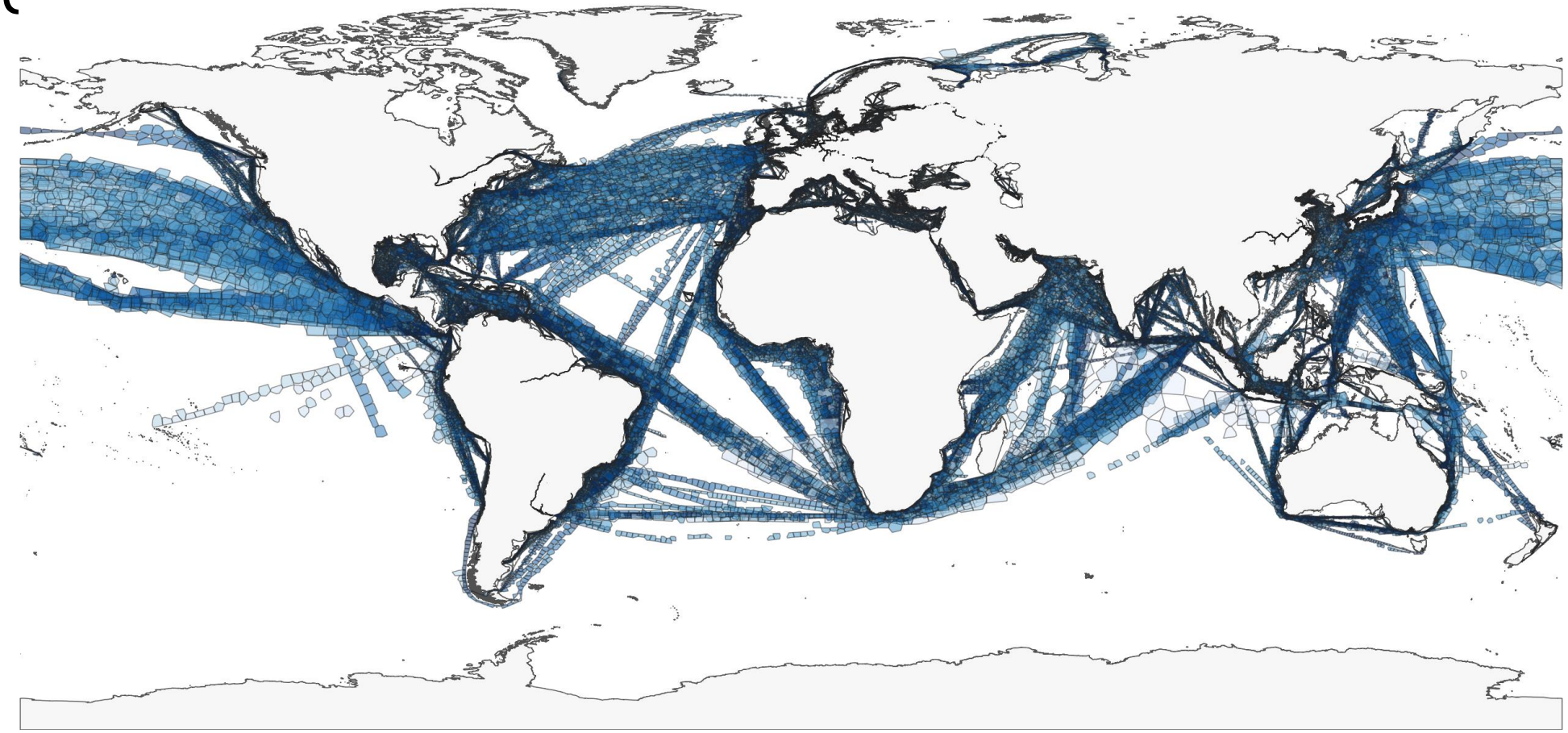
# Routes as traffic corridors (2)



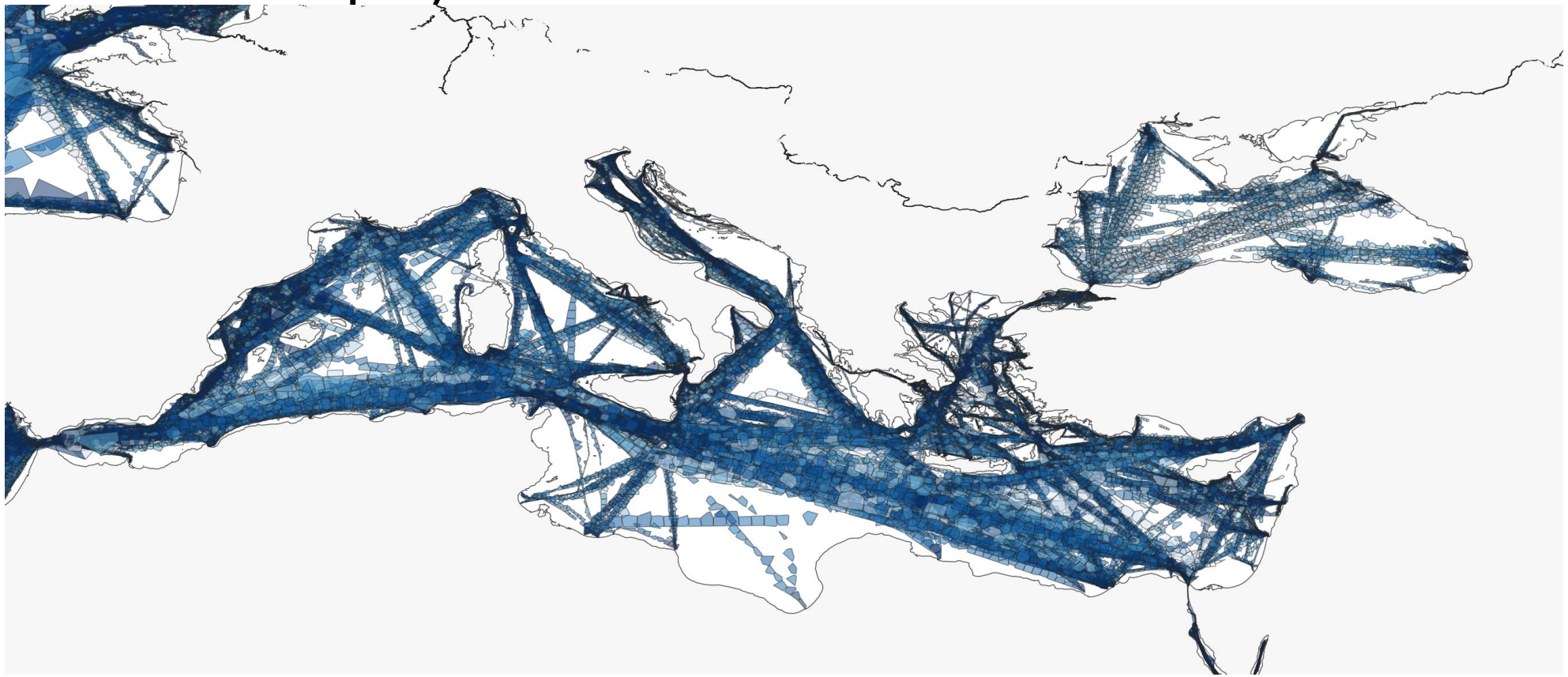
a convex polygon of 95% of clustered locations



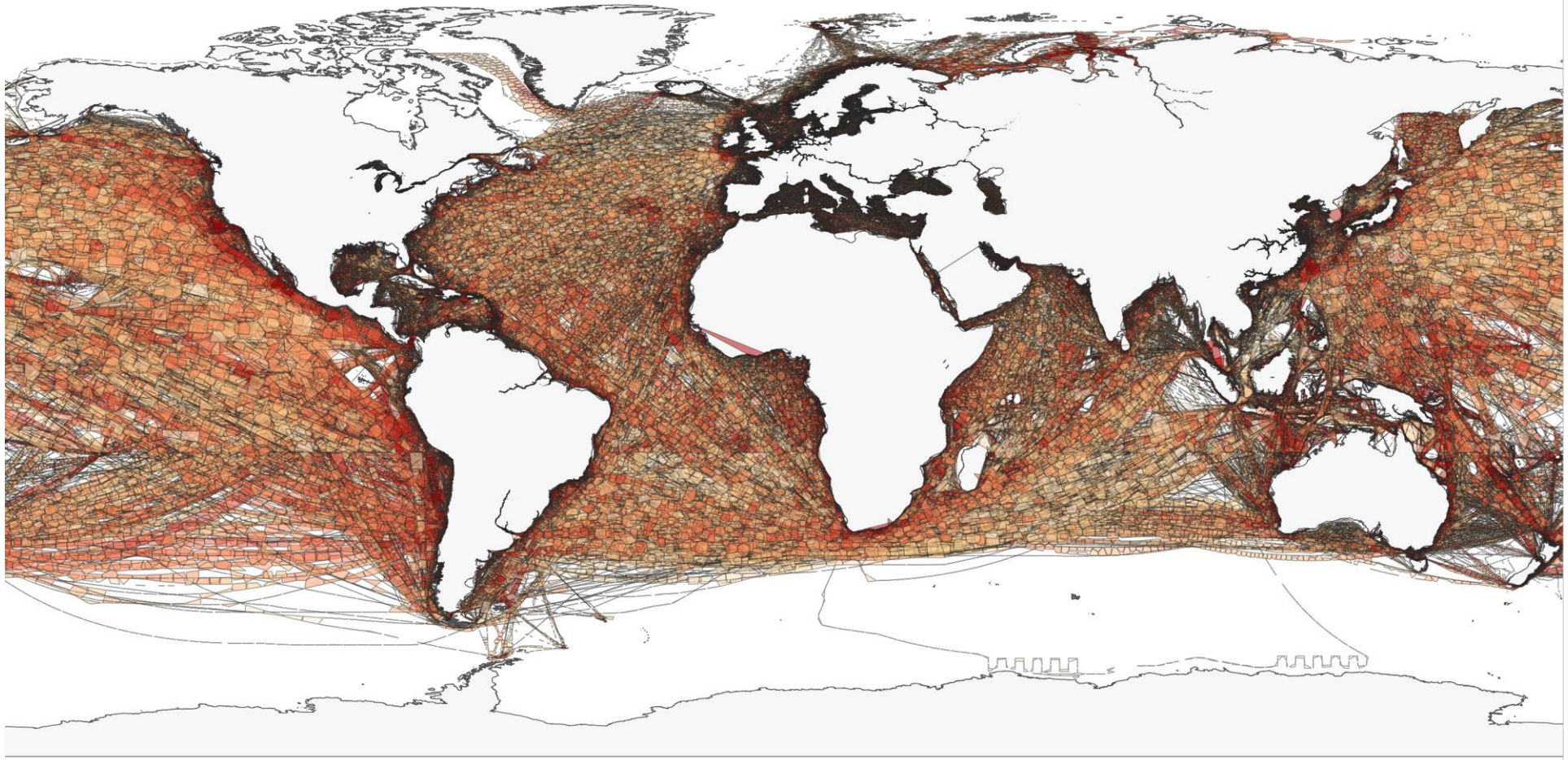
# Global Tanker PoL (more than 100 trips per route)



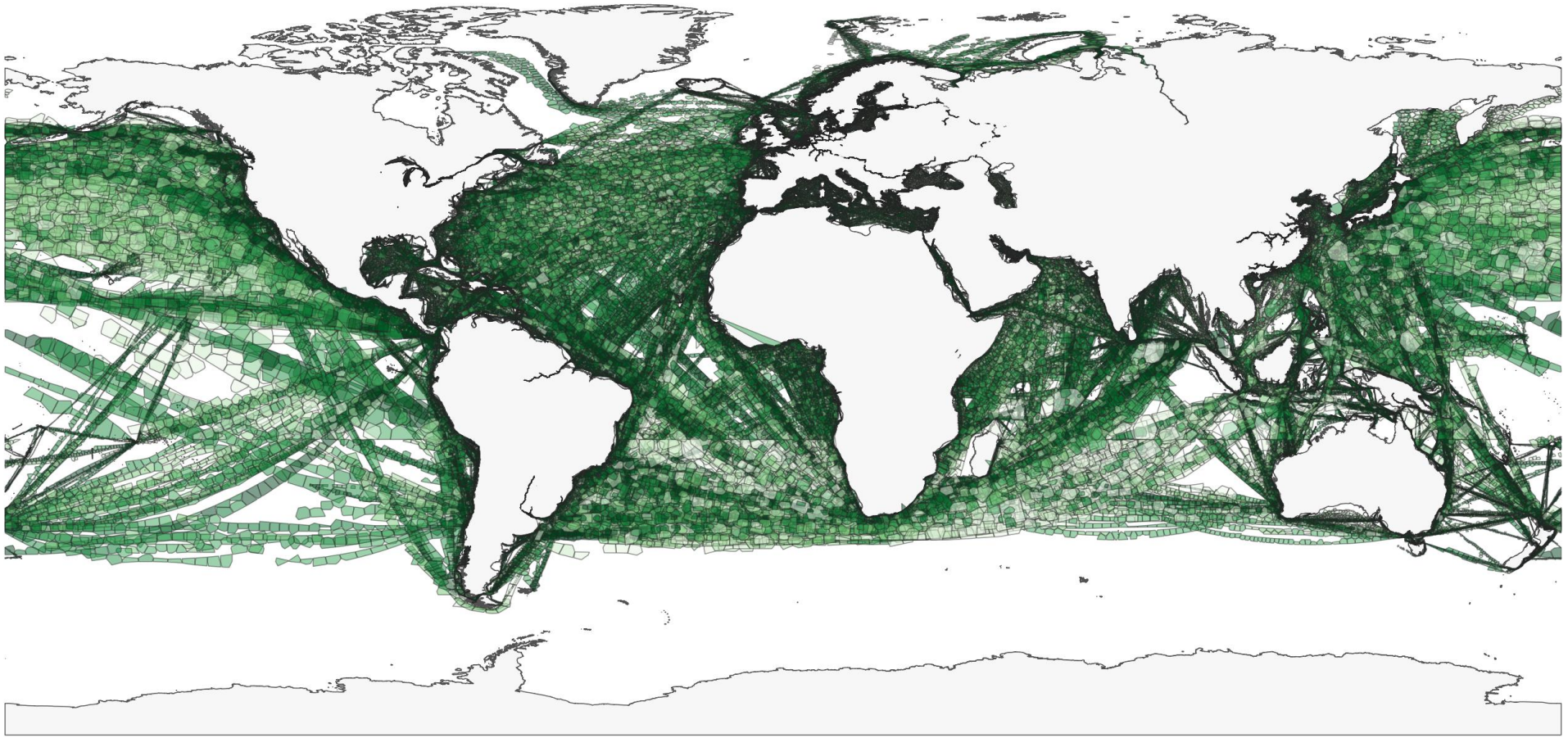
# Tankers PoL in Mediterranean (with more than 100 trips)



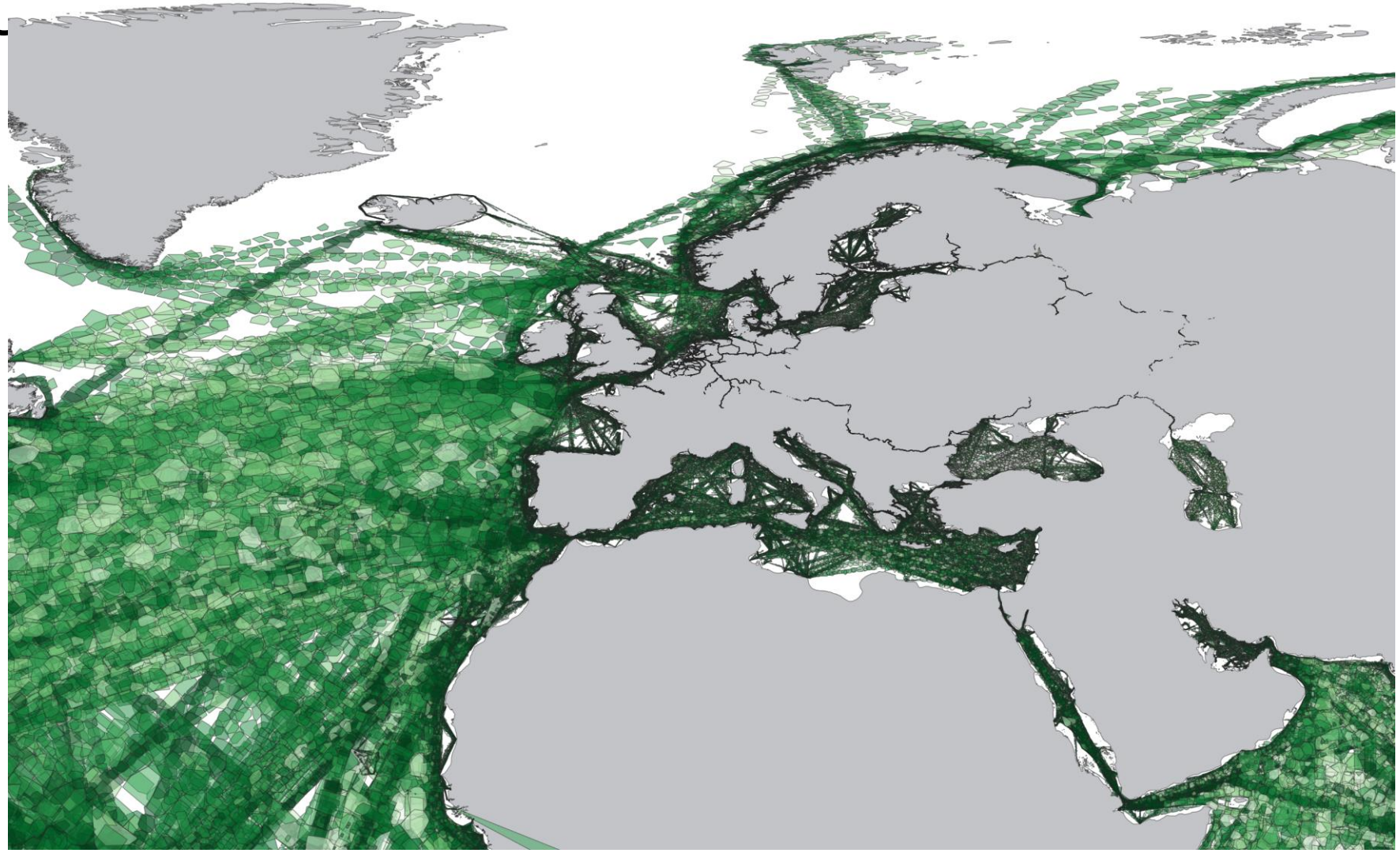
# Global Cargo PoL (more than 5 trips per rou



# Global Cargo ships PoL (more than 100 trips per route)



# EU Cargo Corridors



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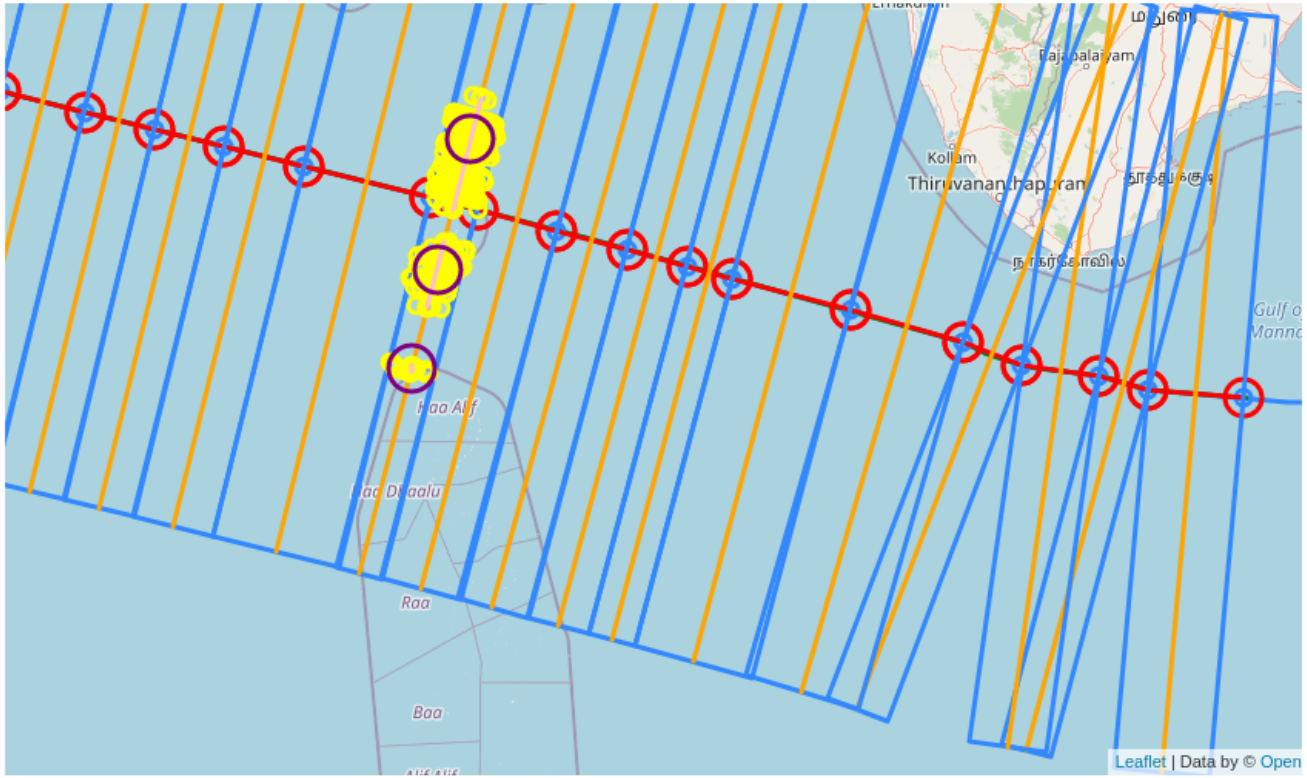
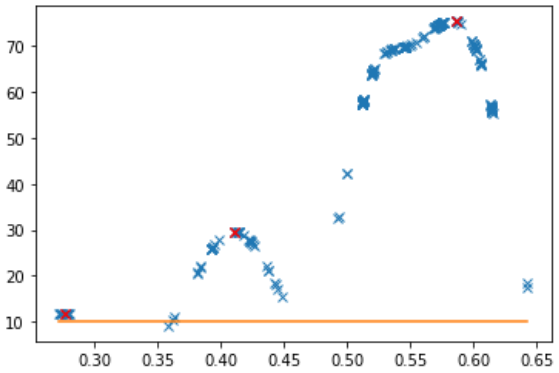
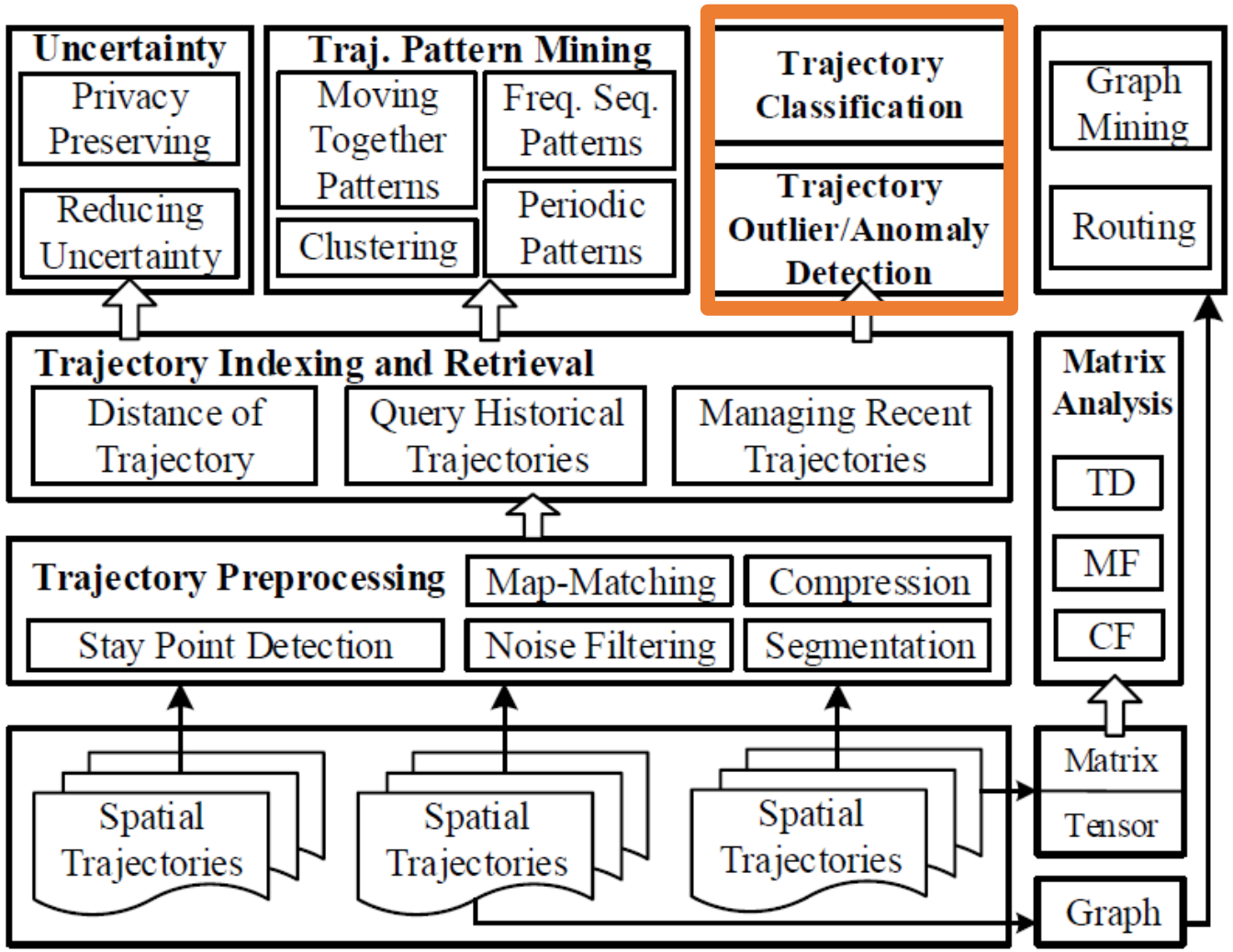
# Corridors



# Trajectory Classification/ Anomaly Detection



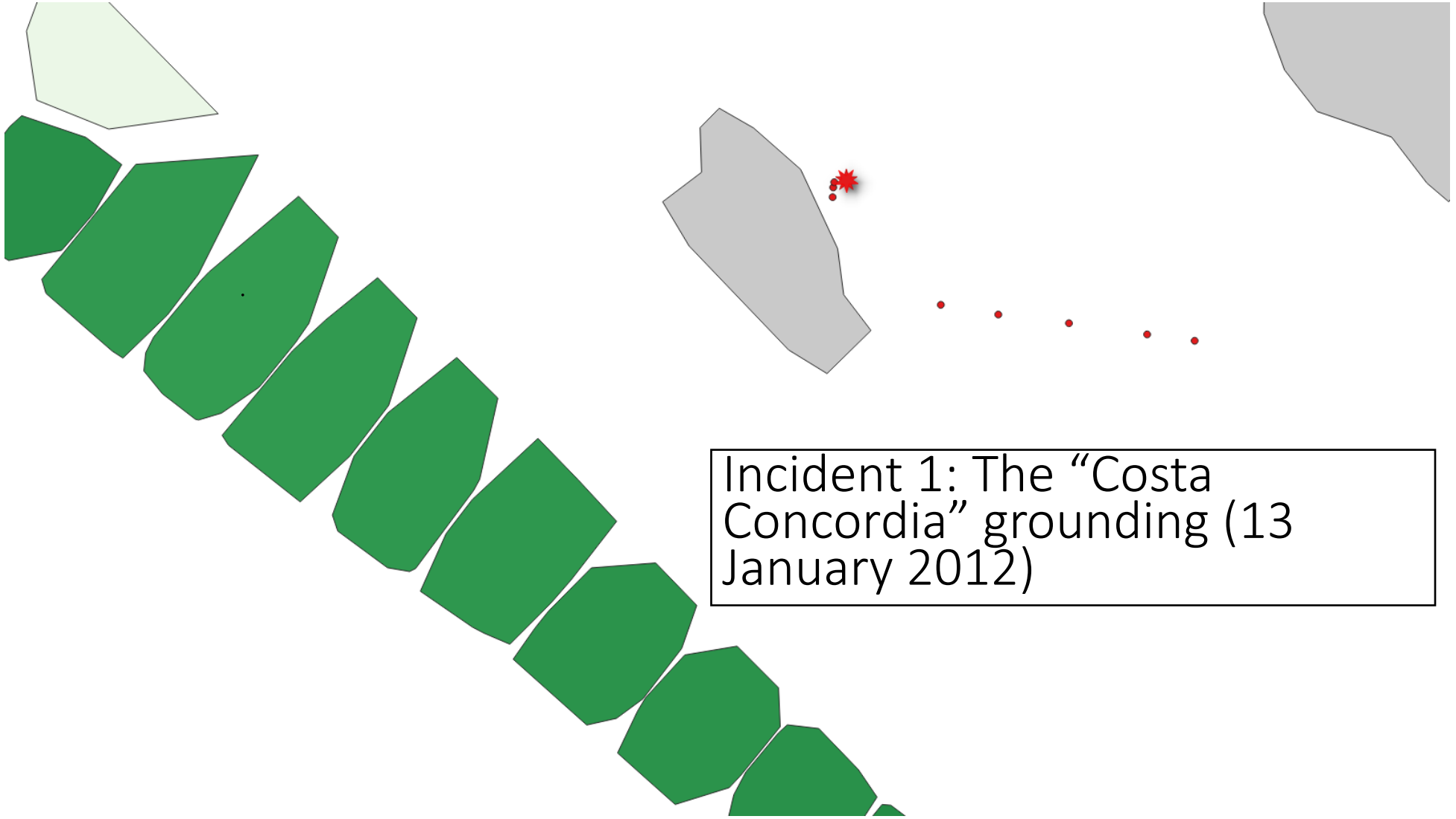
# Classification attributes on each position/ trajectory

- Η κατηγοριοποίηση τροχιών έχει ως στόχο να αναθέσει μια τροχιά σε ένα προκαθορισμένο σύνολο κατηγοριών.
- Μια απλή προσέγγιση είναι ανάθεση της τροχιάς στην κατηγορία στην οποία ανήκουν οι περισσότεροι από τους κ κοντινότερους γείτονες

- Anomaly detection: καθορισμός ως Outlier

# Detecting real world “anomalies”

# Detecting real world “anomalies”



Incident 1: The “Costa Concordia” grounding (13 January 2012)

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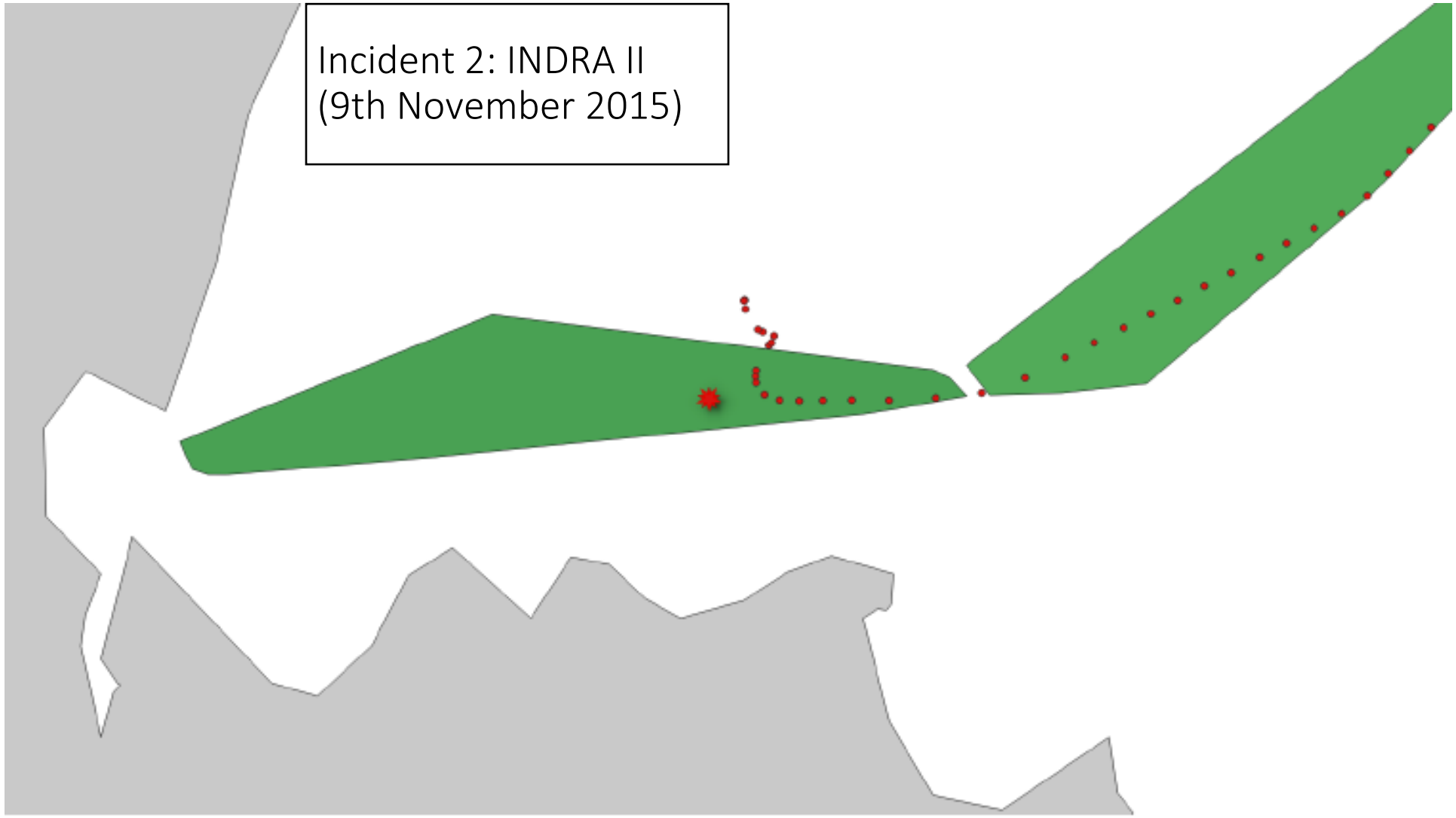
# Detecting real world “anomalies”



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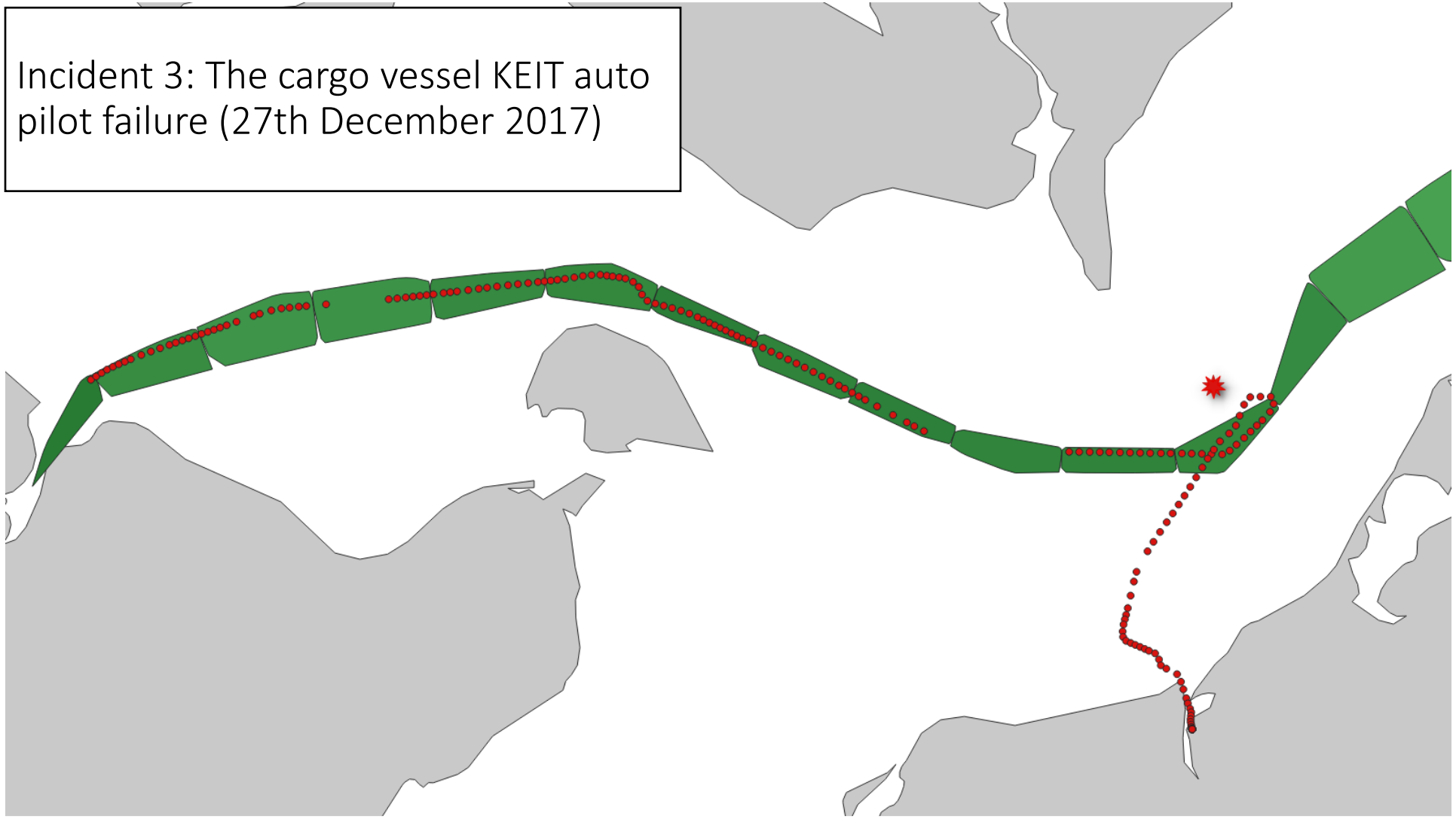
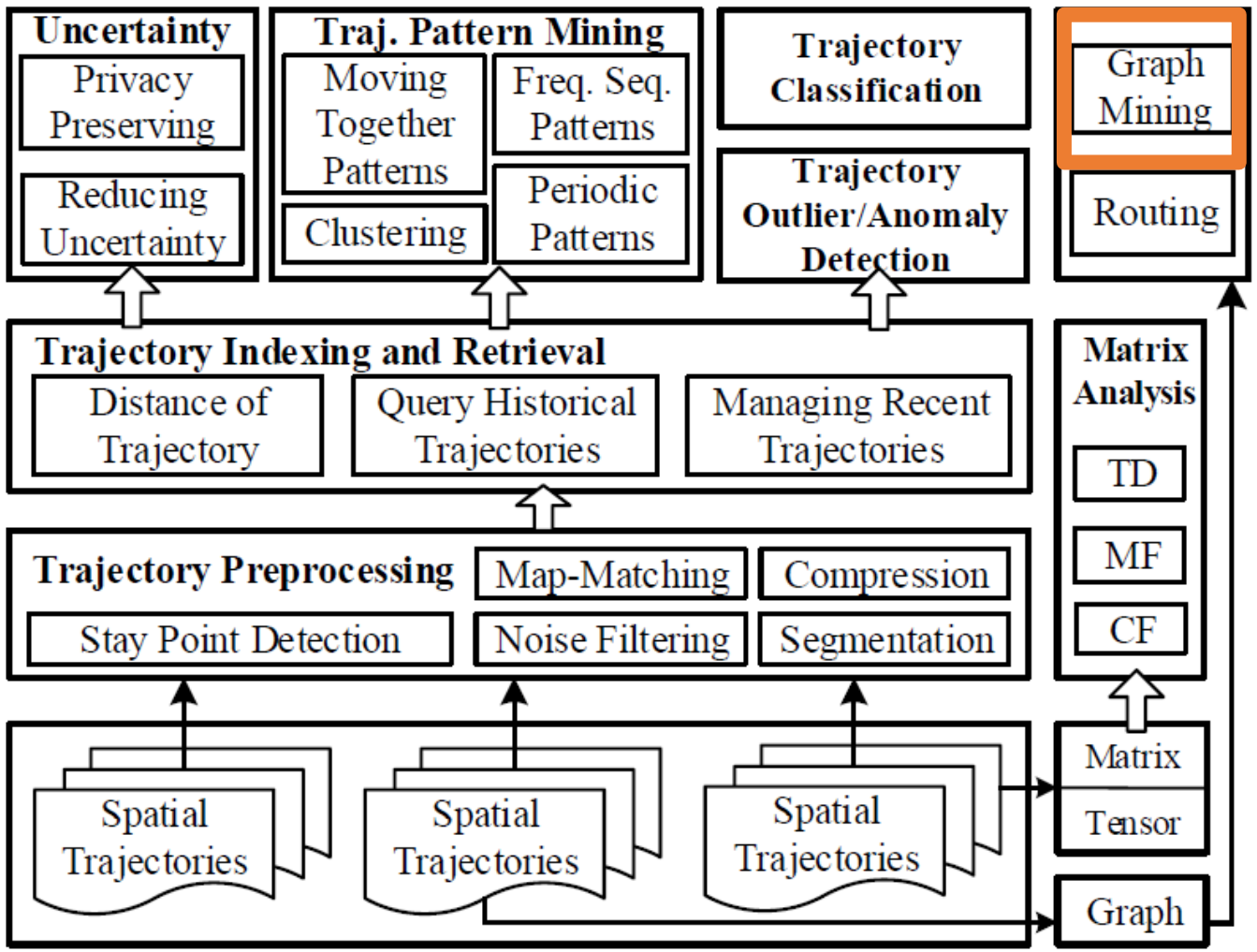
# Detecting real world “anomalies”

Incident 3: The cargo vessel KEIT auto pilot failure (27th December 2017)



# Graph Mining



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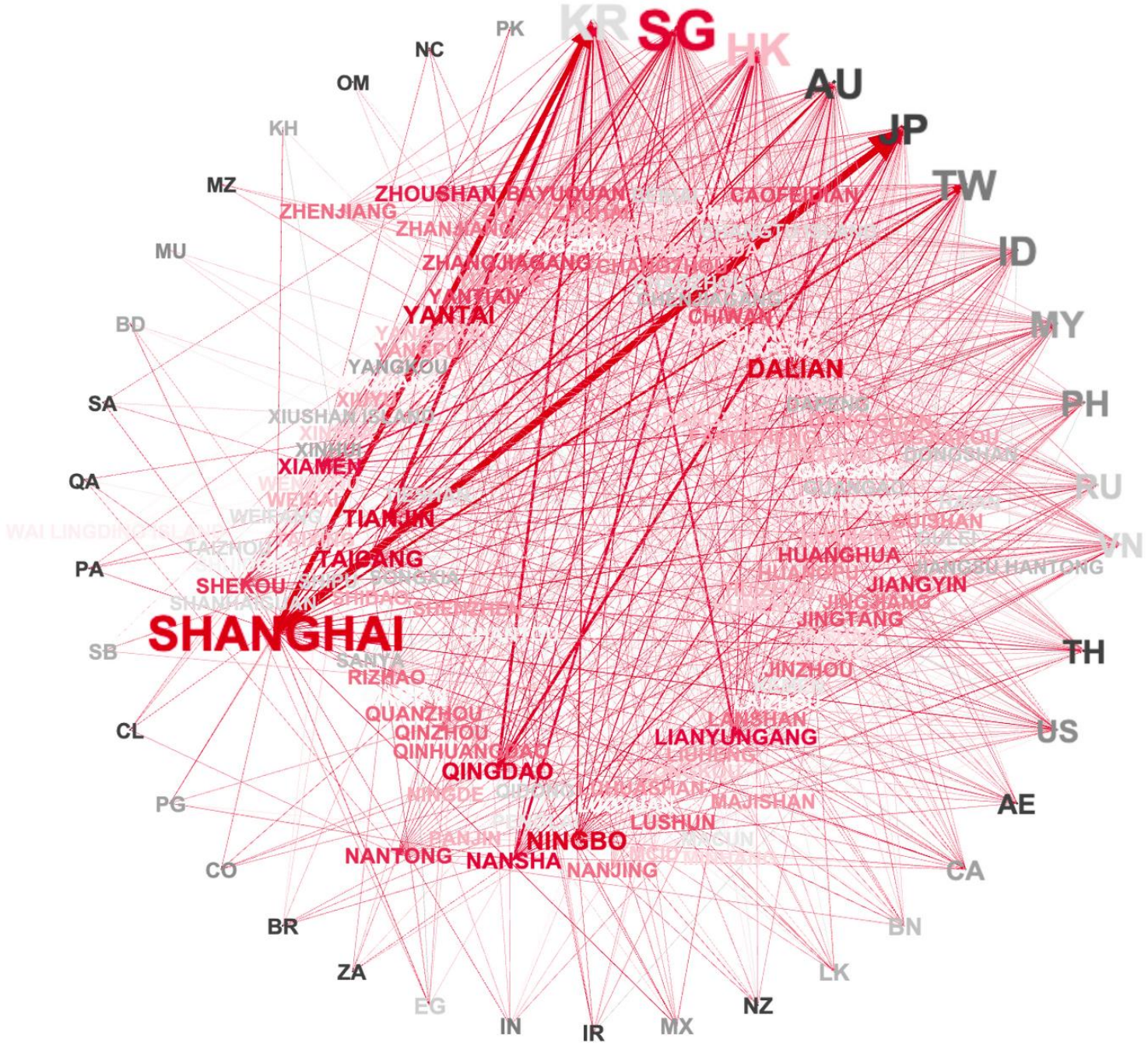

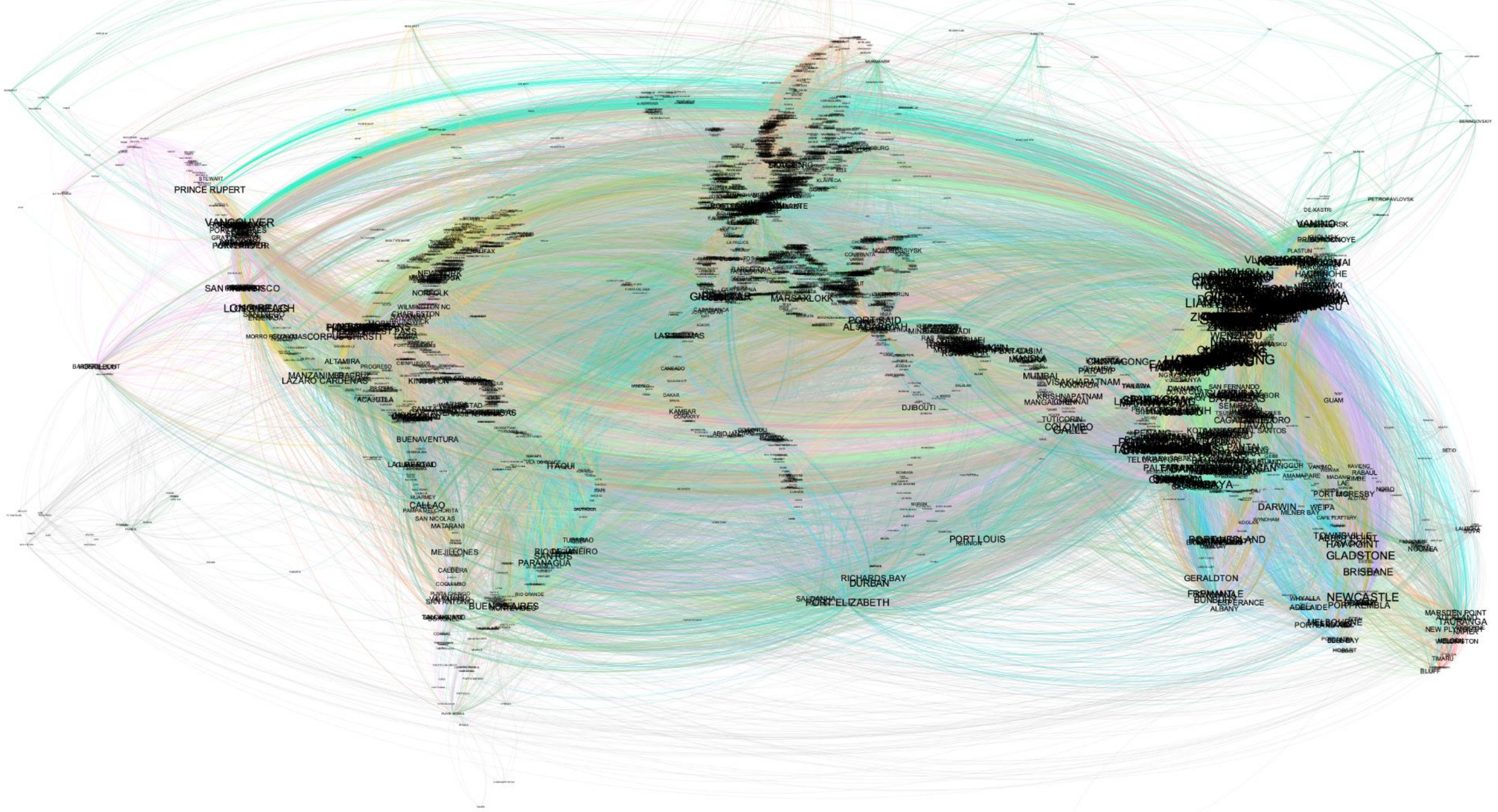
PRINCE RUPERT
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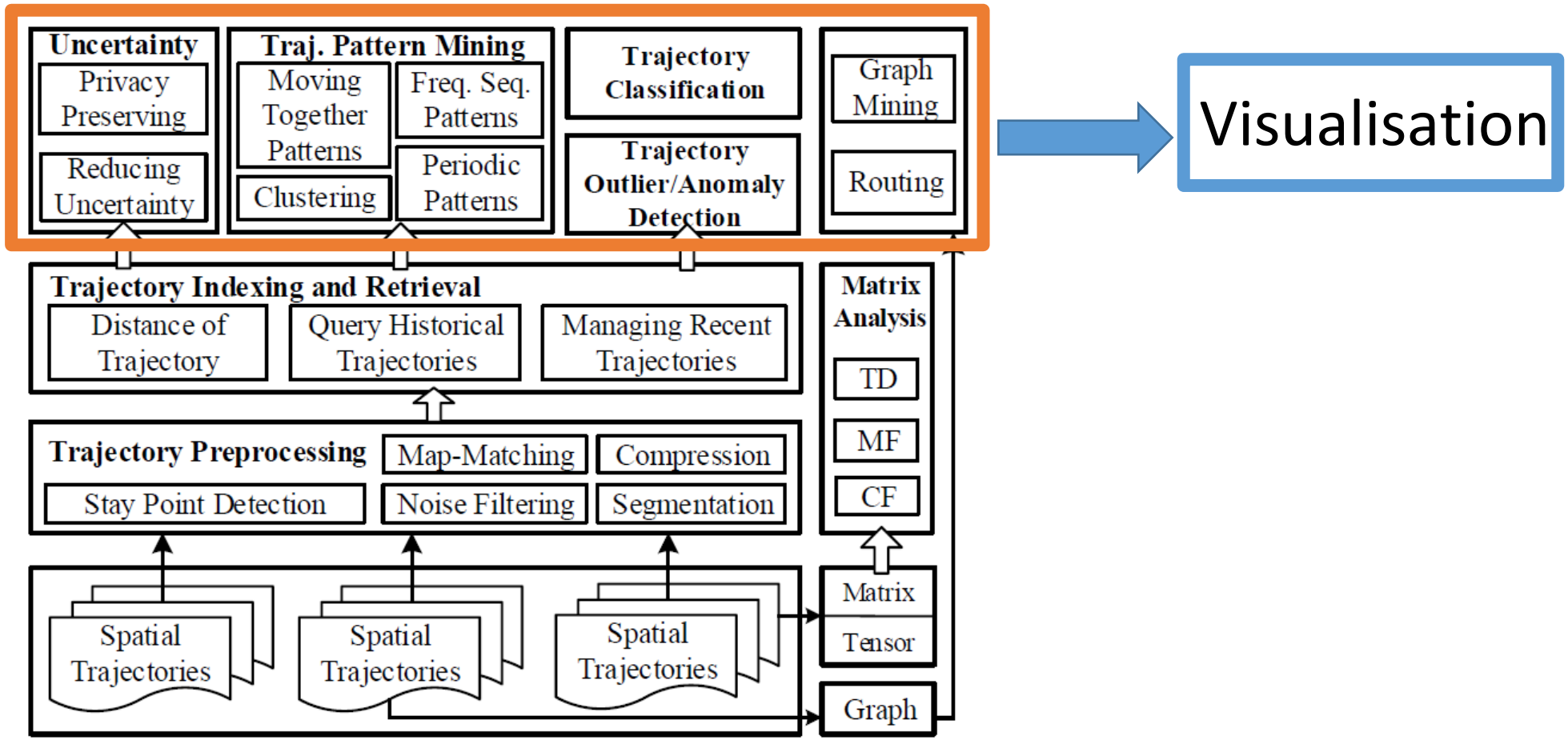
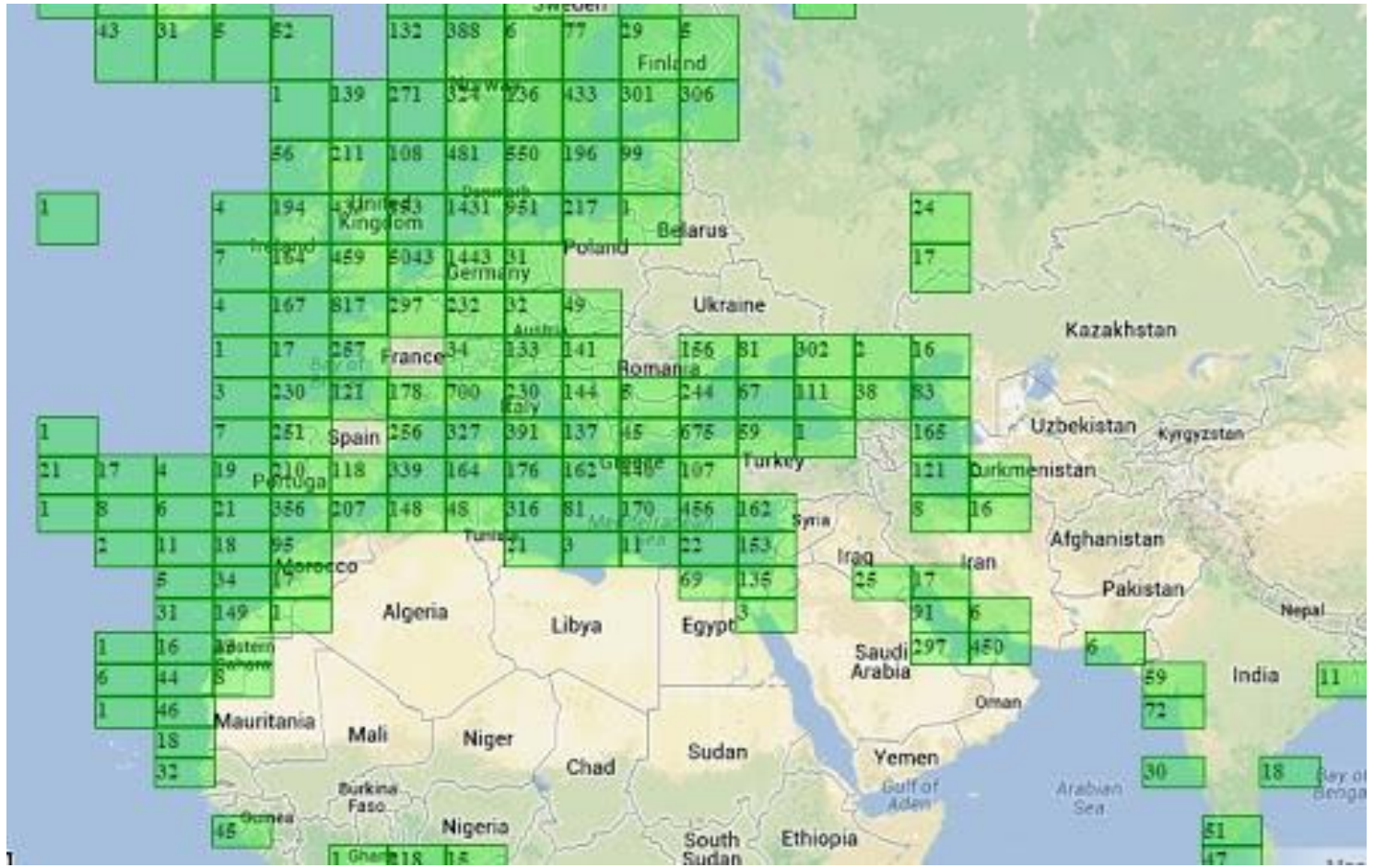
SAN FRANCISCO
LONG BEACH
CORPUS CHRISTI
LAZARO CARDENAS
BUENAVENTURA
CALLAO
MEJILLONES
PARANAGUA
SANTOS
RIO DE JANEIRO
BUENOS AIRES
NORFOLK
NEW YORK
HALIFAX
MARSAXLOKK
LAS PALMAS
DJIBOUTI
PORT LOUIS
RICHARDS BAY
DURBAN
PORT ELIZABETH
COLOMBO
MUMBAI
VISAKHAPATNAM
DARWIN
GERALDTON
FREMANTLE
ADELAIDE
BRISBANE
GLADSTONE
NEWCASTLE
PORT KEMBLA
GUAM
NOUMEA

# Visualisation




Çanakkale
Bursa
Adapazarı
Ankara
Balıkesir
Eskişehir
Akhisar
Uşak
Bolvadin
Nazilli
Konya
Isparta
Antalya
Alanya
Vessels.


Finland
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Ukraine
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Turkmenistan
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Iran
Iraq
Syria
Morocco
Algeria
Libya
Egypt
Saudi Arabia
India
Nepal
Oman
Yemen
Mauritania
Mali
Niger
Chad
Sudan
Burkina Faso
Nigeria
South Sudan
Ethiopia
Arabian Sea

# Vessel Density Maps

- The term “vessel density” has several co-notations and thus is used with several meanings in this domain. Therefore, vessel density can refer to
- 1. the average number of vessels within a defined geographical area / spatial grid within a given timeframe;
- 2. the average number of crossings within a defined geographical area / spatial grid within a given timeframe (often also referred to as “vessel traffic density”).
- There is a considerable difference in the methods used for the creation of density maps according to the definition used, including calculations based on the number of ship positions available in a defined geographical area, the number of ships tracks, ship track length, tracks with time and length characteristics and similar approaches.

https://www.emodnet-humanactivities.eu/documents/Vessel%20density%20maps_method_v1.5.pdf

Figure 1 – Calculating density based on number of ship tracks

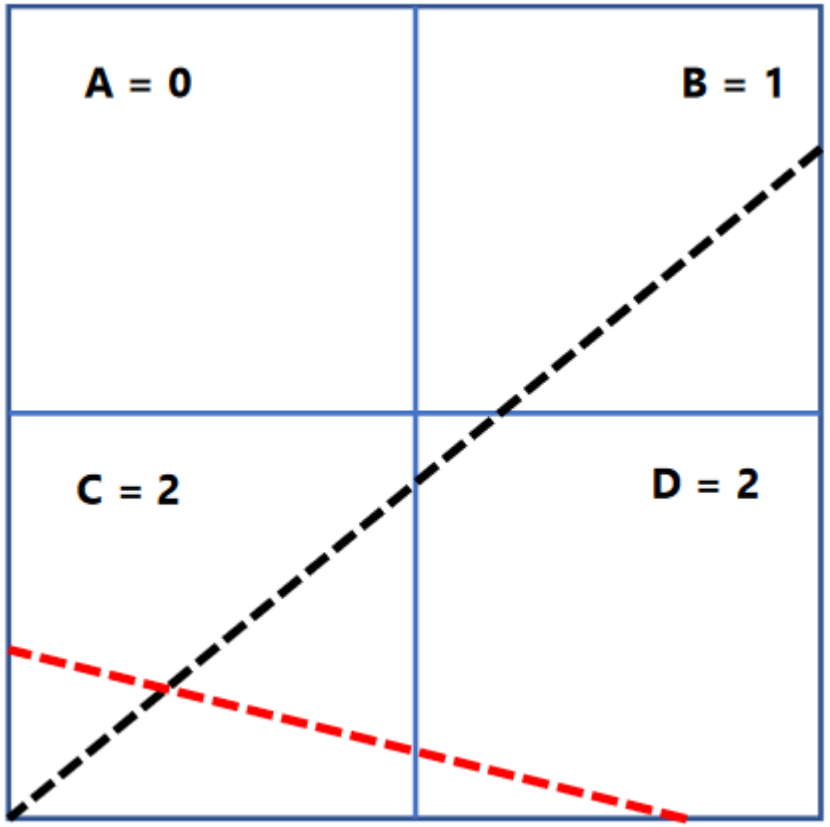
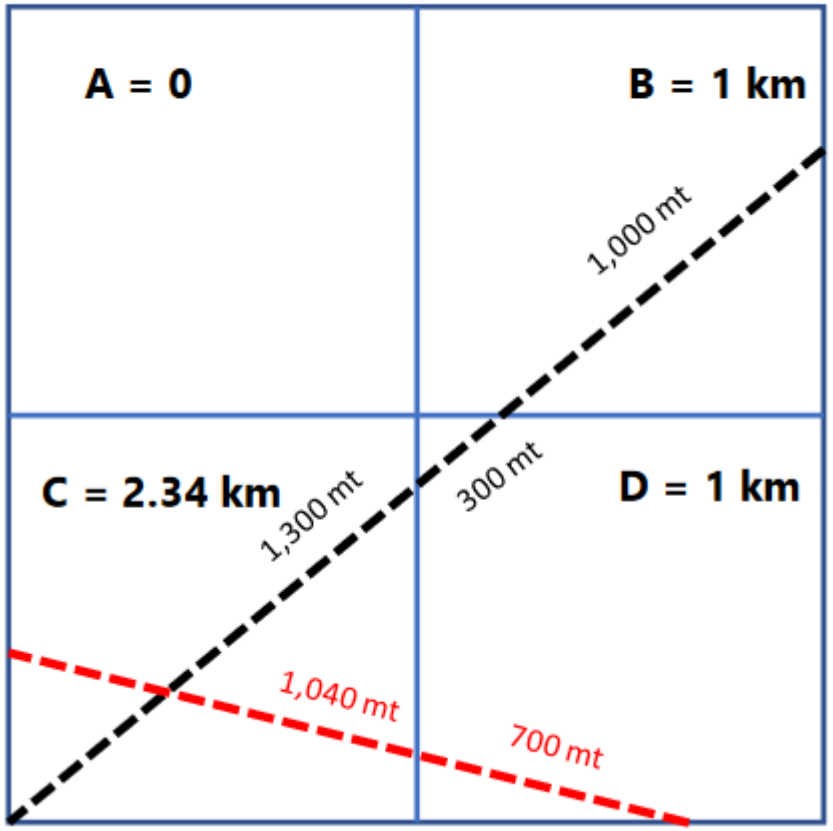



Figure 2 – Calculating density based on ship track length




https://www.emodnet-humanactivities.eu/documents/Vessel%20density%20maps_method_v1.5.pdf

Figure 3 – Calculating density from number of AIS positions

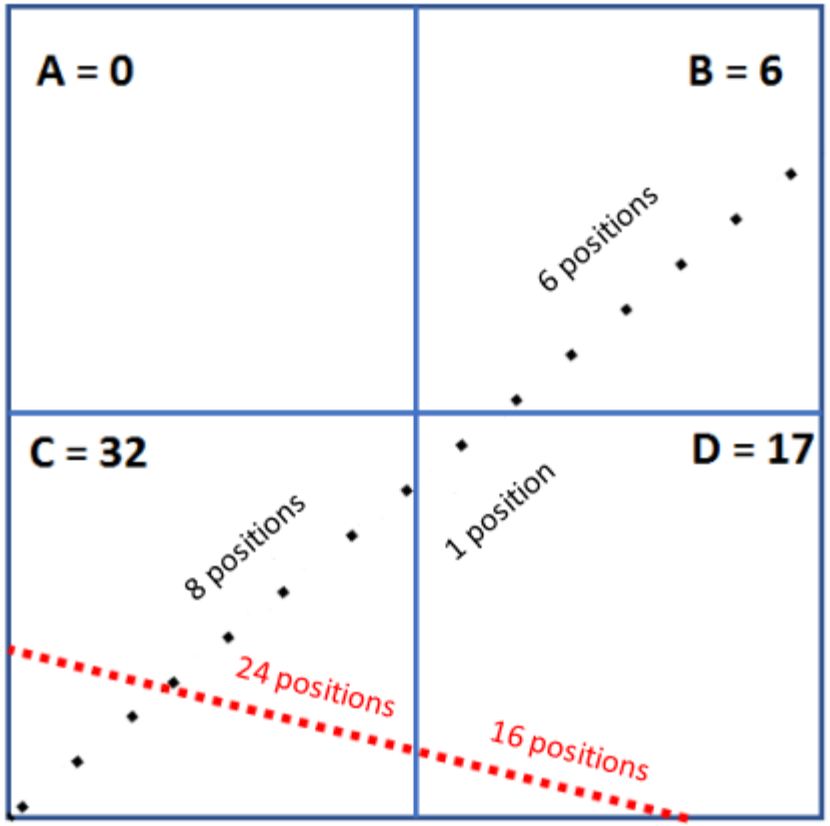
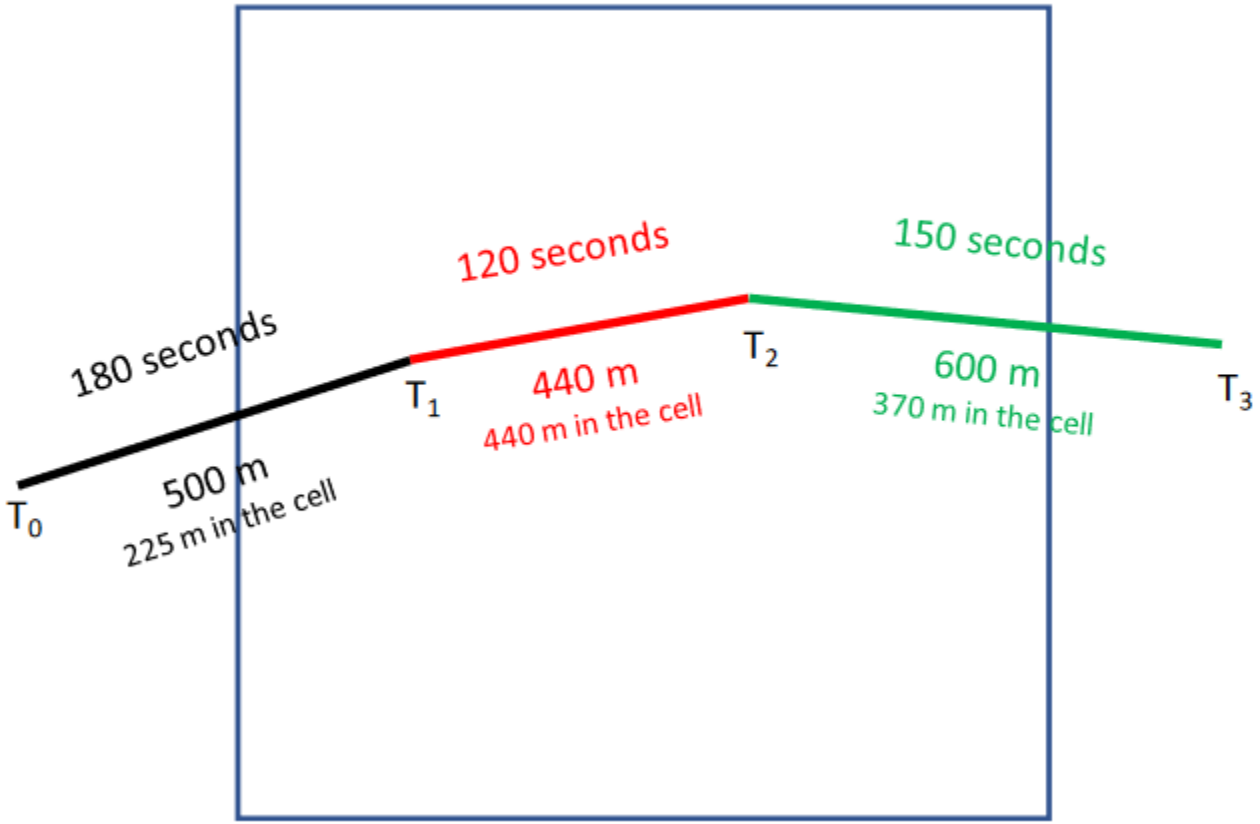
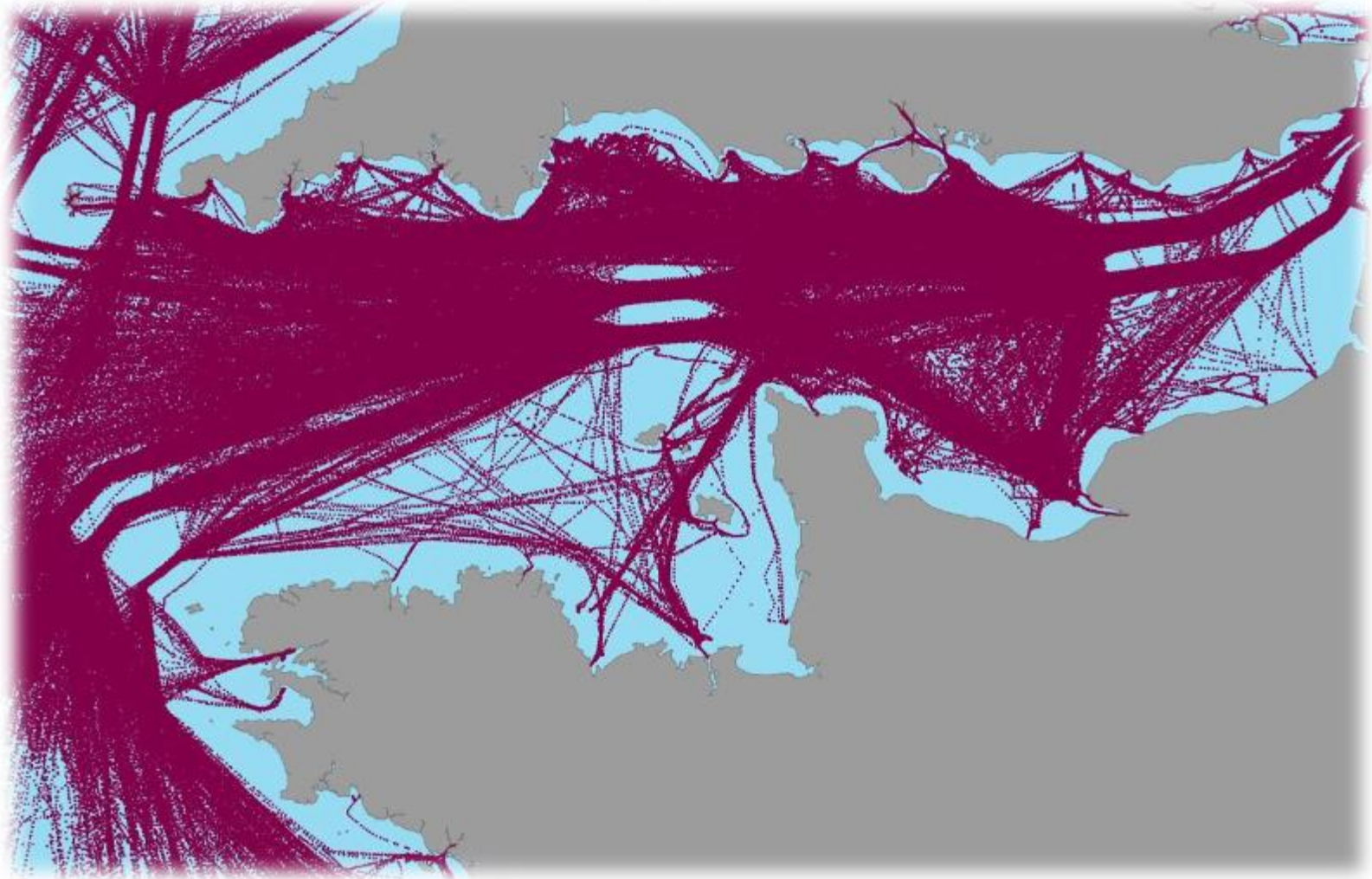



Figure 4 – Calculating density with EMODnet's method

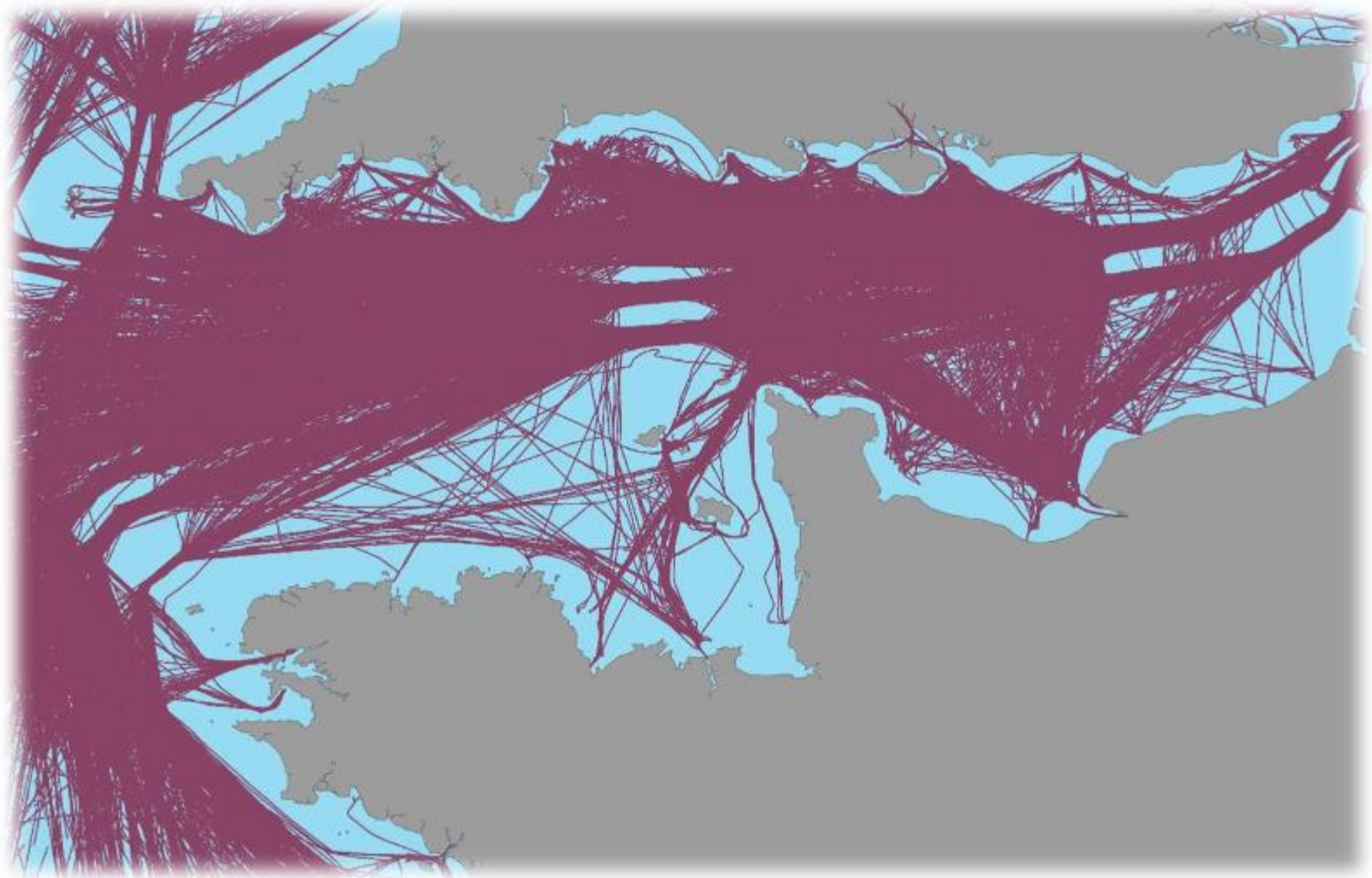



https://www.emodnet-humanactivities.eu/documents/Vessel%20density%20maps_method_v1.5.pdf

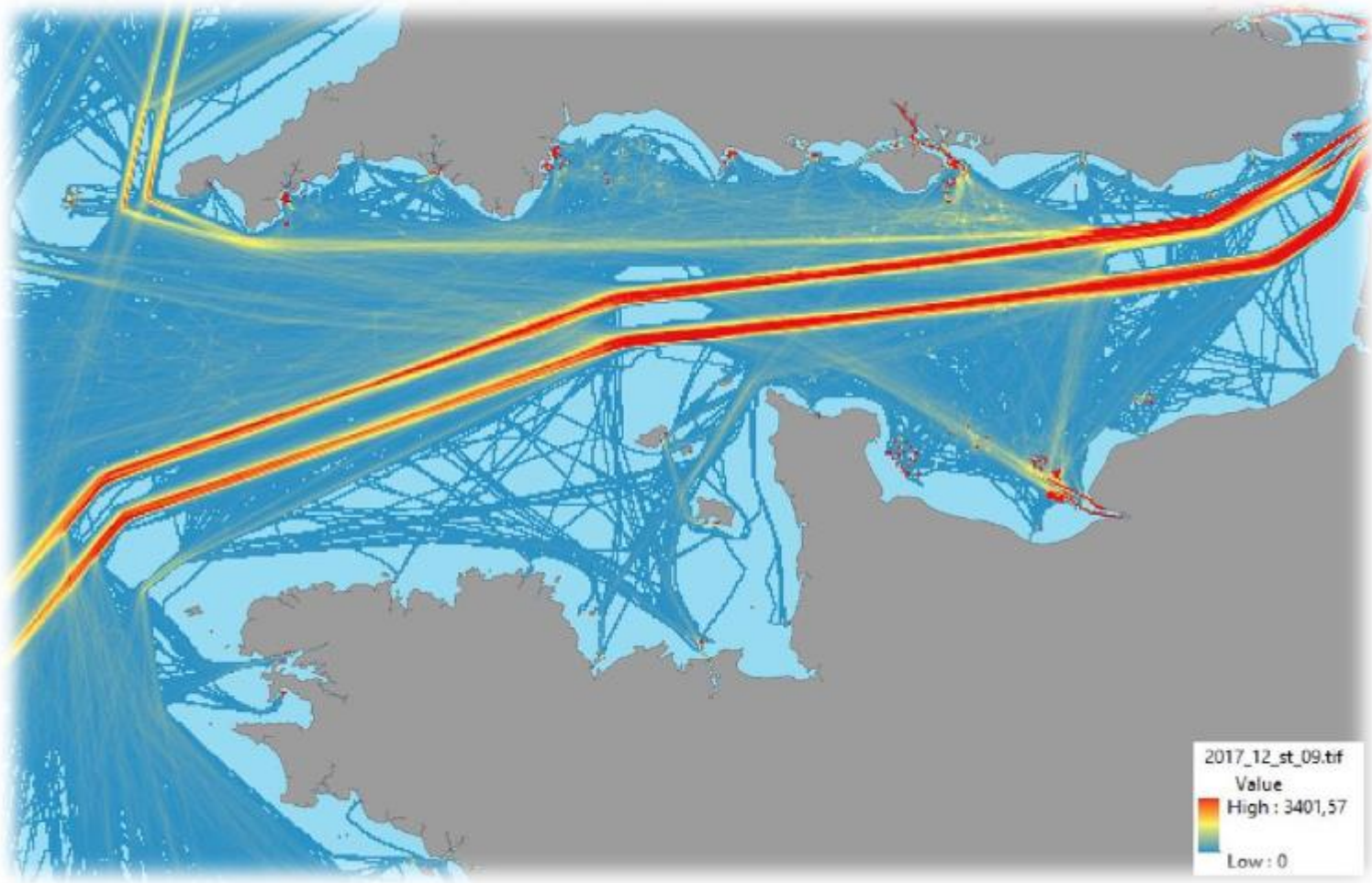
Figure 14 – Example of points (positions) in the English Channel (Cargo, December 2017)

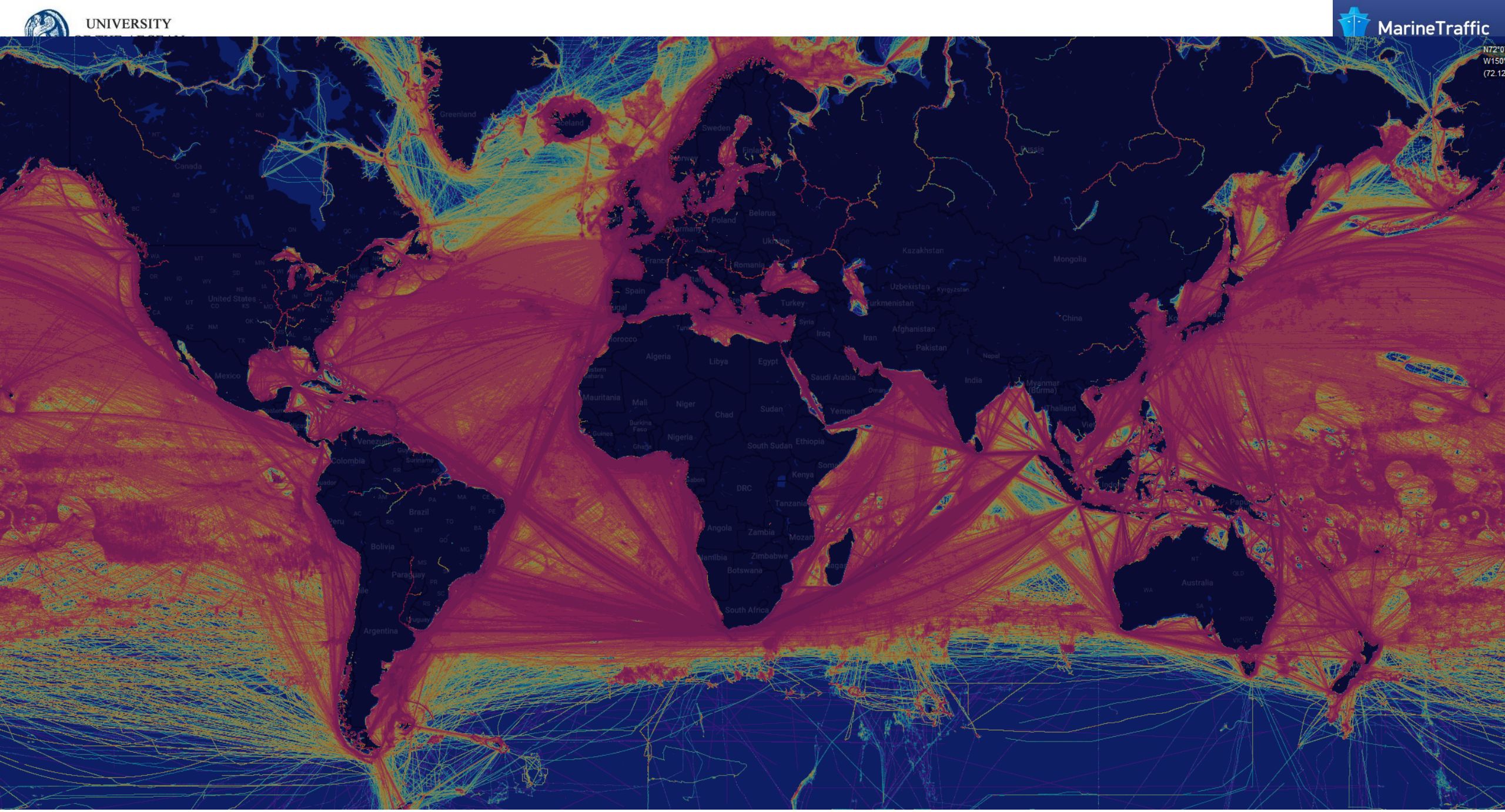


| Field name | Data type |
|---|---|
| OBJECTID | Object ID |
| Shape | Geometry |
| MMSI | Long integer |
| LocDate | Date |
| LocTime | Text |
| Lon | Double |
| Lat | Double |
| DateTime | Date |
| X1 | Double |
| Y1 | Double |



| Field name | Data type |
|---|---|
| OID | Object ID |
| Shape | Geometry |
| X1 | Double |
| Y1 | Double |
| X2 | Double |
| Y2 | Double |
| LineTime | Double |
| Shape_length | Double |


2017_12_st_09.tif
Value
High : 3401,57
Low : 0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https://youtu.be/vg0A9Ve7SxE

# Σας ευχαριστώ για την προσοχή σας

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