Traffic Density Mapping Service

Methodology

Version: V.2.0

Date: 20.01.2024

EMSA

Document History

Version	Date	Changes	Prepared
1.0	12/06/2019	Consolidated version. Includes amendments specified during the service implementation	EMSA
1.2.	16/03/2022	Updated version. Includes TDMS phase-2 developments	EMSA
2.0	20/01/2024	Included TDMS-2 requirements	EMSA

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List of Abbreviations

Abbreviation	Explanation
AIS	Automatic Identification System
DB	Database
EC	European Commission
EMSA	European Maritime Safety Agency
GIS	Geographic Information System
ICT	Information and Communications Technology
IMO	International Maritime Organisation
S-AIS	Satellite AIS
SEG	SSN Ecosystem Graphical Users Interface
SSN	SafeSeaNet
T-AIS	Terrestrial AIS
TDM	Traffic Density Map

List of Definitions

Definition	Explanation
Acquisition time stamp	Time reference information identifying when a certain event occurred.
AIS ship types	The ship type according to UNECE R28. The ship type is deducted using the information contained in the AIS-transmitted messages. The ship type is part of the ship's static information.
AIS ship type ranges	The ship type groups defined exclusively for the purpose of the TDM (e.g. Cargo, Fishing, Passenger, Tanker, All Other, All Traffic)
Aggregated ship positions	Ship positions data correlated with various data sources (e.g. S-AIS and T-AIS).
Colour code/ colour classification	A system of marking objects (e.g. ship routes lines) with different colours as a means of identification.
Down sampling	Process to make a dataset smaller by lowering its sampling rate or sample size.
EMODnet	European Marine Observation and Data Network.
EMODnet Human Activities portal	Single entry point for geographical information (portal) facilitating access to existing marine data on activities carried out in EU waters.
Esri Grid format	An ESRI data format for storing raster data that defines geographic space as an array of equally sized square cells arranged in rows and columns.
FTP transfer	The File Transfer Protocol (FTP) is a standard network protocol used for the transfer of files between a client and server.
Georeferenced image	An image where the geographic coordinates are assigned to a raster image in order to define its location.
GIS format	A standard of encoding geographical information into a computer file.
GIS grids	A network of parallel and perpendicular lines superimposed on a map and used for reference.
Line segment	Part of a line that is bounded by two distinct end points (in this case two consecutive ship positions)
Pathways	Ships routes visualised on the traffic density map.
Polyline	A continuous line composed of one or more line segments
PSC ship types	"Type of Ship" information which appears as a ship particular on certain statutory certificates. This information is used to easily verify the definitions and explanations of various ship types.
Raster format	The raster format of the data represents reality by uniform grid cells of a specific resolution. Each square (or grid cell) covers a given geographical area and an attribute value is assigned to the cell.
Raster data files	Spatial data models that define space as an array of equally sized cells. Each cell contains an attribute value and location.
S-AIS	Ships AIS transmissions (messages) detected by satellites.
Ship positions data	Data presenting the ship location at the given time.
Ships identification data	Data identifying the ship: Name; IMO number; MMSI number; Flag.
Ship route	Also – ship track. The actual path of a vessel. Also, the line connecting the object's consecutive positions.
Spatial join	A type of operation in which fields from one layer's attribute table are appended to another layer's attribute table based on the relative locations of the features in the two layers.
T-AIS	Ships AIS transmissions (messages) detected by the shore-based AIS systems.
Traffic Density Mapping Service	The EMSA service provided to visualize the vessel movement patterns for defined maritime geographical areas and time periods.
Vector format maps	A vector-based collection of geographic information system (GIS) data at various levels of detail.
Vessel paths	The actual path of a vessel with respect of the seabed, measured in degrees.

1. Introduction

Traffic Density Maps (TDMs) are a simple and effective way of displaying vessel movement patterns, which contribute to a better understanding of maritime traffic. They help having a better understanding of the locations of the main shipping lanes and which ship types are navigating on which routes. The source used to create TDMs is historical data of ship positions.

Following the HLSG's decision to develop a tool to generate TDMs, the Agency contacted several Member State authorities, EU Institutions and research bodies with prior experience in developing TDMs, as well as users who expressed their interest in a TDM service. EMSA's analysis demonstrated that it is important to develop a TDM service that allows a dynamic configuration of parameters (e.g. areas, time periods, types of ships) and respects the anonymity of the vessels and their locations.

EMSA could not identify any international standard or method for creating TDMs. However, most of the existing methodologies are based on the same approach whereas the monitored area is divided into cells to create a spatial grid. The method selected by EMSA to generate TDMs is **the ship routes restoring method**. This method rebuilds the track of each distinct ship from the recorded positions and counts how many routes are crossing each cell of the grid during the selected time period.

This method was chosen because it can be implemented in all regions (coastal and open sea), using all the available ship position data that EMSA holds in its databases. For TDMs in EU coastal areas, T-AIS can be used as the main source, while S-AIS can be used in open sea. This method also allows restoring the ship's route within areas with low coverage (see in Figure 1 below):

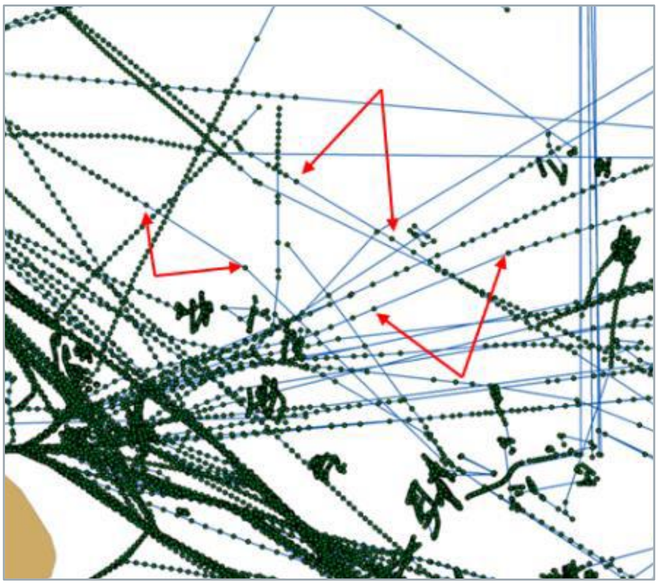


Figure 1: Restoring the routes

TDMS methodology was approved by HLSG at its 3rd meeting on 28 February 2018. Following the approval of methodology, a first version of the service was developed to produce "Standard" TDMs calculated using 1 x 1 km grid cells.

A second phase of the TDM project aimed at upgrading the service to calculate the following additional types of TDM and present them to the entitled users through the SSN Ecosystem Graphical user interface (SEG):

- Comparative TDM: presents the difference between two Standard TDMs of the same type, period, area but different time periods.
- Vector TDM: presents routes (polylines) of ships within specific areas of interest (SAIs), without revealing the ship's identity.

- Detailed TDM: presents traffic density using 200x200 m grid cells within specific areas of interest (SAIs).

The planned service enhancement and the new TDM concept were presented to the Member States at HLSG 5 (Brussels, 2 July 2019) and HLSG 6 (Brussels, 20 January 2020). Member States were asked to choose areas of interests to be included in the TDMs calculation service.

This document presents the methodology used for calculating the four types of TDMs:

- Standard,
- Detailed,
- Vector, and
- Comparative TDM.

The document also includes technical updates and examples of TDMs produced by using the methodology.

2. Methodology to calculate Standard TDMs

The following steps are used to calculate a Standard TDM:

a. Divide the selected area in cells,

b. Aggregate ships positions per grid cell,

c. Connect ship positions to create polylines, sort the polylines per ships type ranges,

d. Count grid cell crossings, and

e. Apply a density classification colouring.

The final result is a TDM per ship type range, per area and per the period of time. The steps are presented in Figure 2 below.

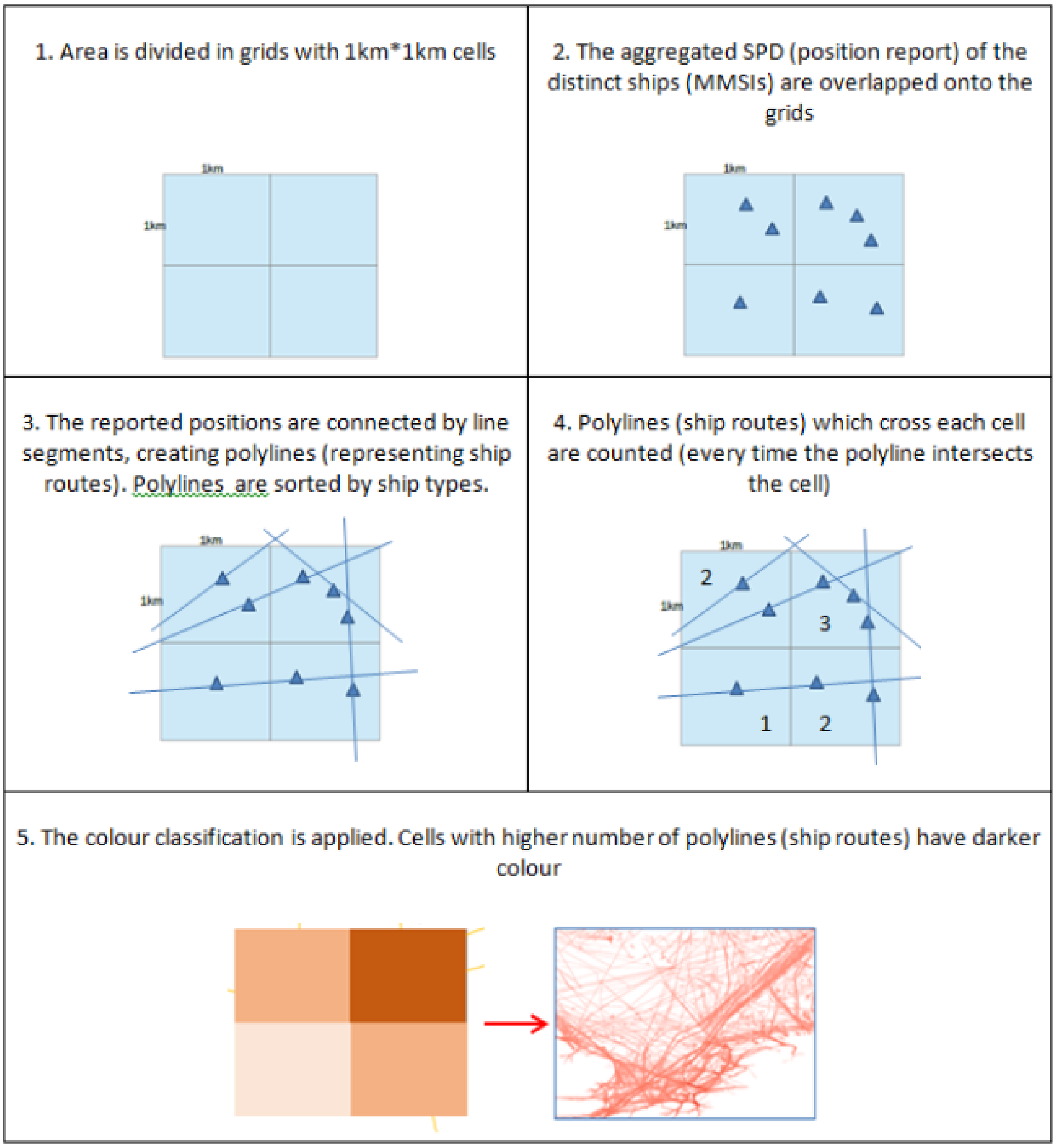


Figure 2: The steps for calculating a TDM

The following section presents the details of how TDMs are calculated.

2.1 Preparing ship positions data

2.1.1 Collecting position data

In order to build a TDM, the first step is to collect ship positions data from EMSA's ship position database. Terrestrial AIS (T-AIS) and Satellite AIS (S-AIS) data are collected by using an SQL query (filtering). Each ship position is collected with the indication of the ship's type.

The position data is collected and aggregated per period of time and target area. The output of this process is a list of points (ships positions) to create the polyline (ship's route).

2.1.2 Filtering

Positions are checked to remove improbable situations, such as:

- Erroneous positions (e.g. longitude or latitude equal to exactly 0).
- Duplicated positions (e.g. timestamp and remaining information is exactly the same).

2.1.3 Down-sampling

Position data with a high frequency acquisition (e.g. T- AIS data) is down-sampled (e.g. one position per 6 minutes) per ship (MMSI). S-AIS data is not down-sampled. The down-sampling rate is configurable.

2.1.4 Recreating ships routes

This step is required to link the consecutive vessel's positions in a chronological order. The collected position reports of each ship (MMSI) are selected.

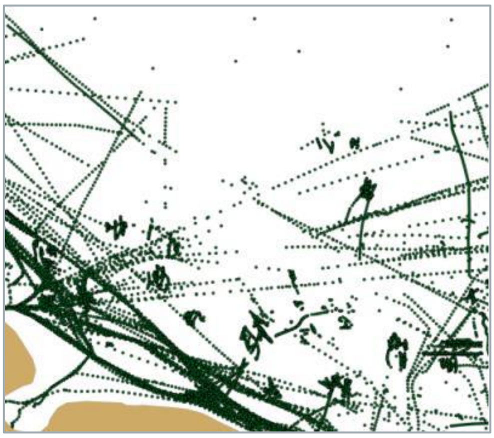


Figure 3: Individual position reports

The routes are recreated by connecting the position reports into polylines using the acquisition time stamp to order the points. The output of this process is a file containing the route polylines (e.g. as a shapefile) per MMSI for a configurable period of time.

Figure 4: Polylines

The polylines are then tagged per AIS ship types ranges. The result is a file with the ship routes and ship types information.

2.1.5 Lines filtering

This step removes the polyline segments which are obviously improbable, such as:

- Polyline segments joining two consecutive positions of the same vessel (MMSI) too distant in time from each other (e.g. 4 hours),
- Too long polyline segments joining two consecutive positions of the same vessel (e.g. >100 NM),
- Too short polyline segments joining two consecutive positions of the same vessel (e.g. <10m.),
- Polyline segments overlapping land area (either by checking if the polyline goes beyond existing grid cells or crosses a land polygon).

The filtering settings are configurable.

2.2 Standard TDM construction

The density map is created by counting the number of routes (polylines) crossing each cell and applying a colour code corresponding to the number of crossings. The process to create a map can be divided into the following steps:

2.2.1 Selecting grid cells

The area is divided into a number of grid cells. The grids used as reference to build the TDMs are constructed to cover all the target areas and have a definition of 1x1 km. They follow the INSPIRE data specifications on Geographical Grid systems described in: https://inspire.ec.europa.eu/id/document/tg/gg

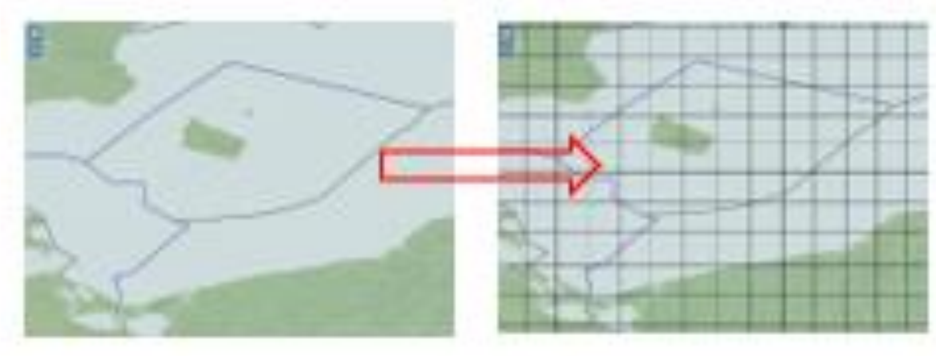


Figure 5: The area is divided into cells

2.2.2 Selecting routes (polylines)

The ship routes (created polylines) are selected inside each of the cells.

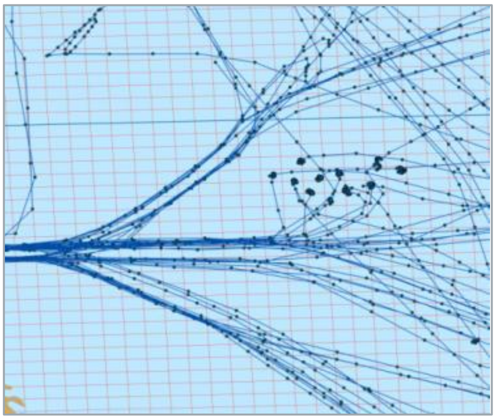


Figure 6: Ship positions connected by lines

2.2.3 Count and sum

The system counts the number of polylines crossing each cell.

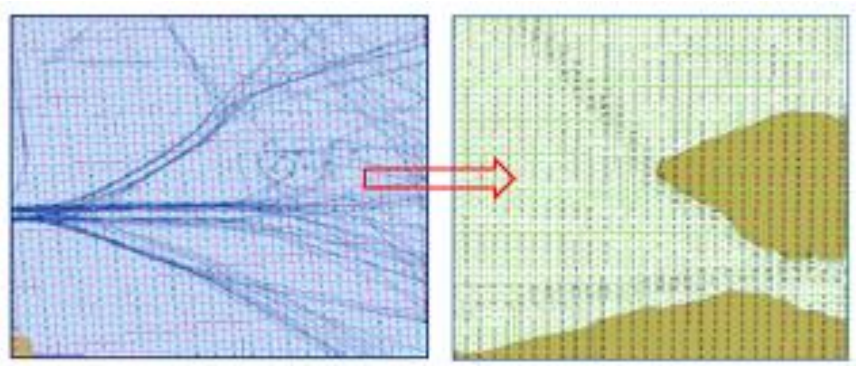


Figure 7: Counting the number of polylines crossing each cell

For each cell of the TDM grid (1x1 km) the number of lines crossing the cell boundary (entering / exiting) is counted.

The number of lines crossing the cell boundary (entering / exiting) are counted for each cell of the TDM grid. This is the output numeric value assigned to the output intermediary tile. The rules that are implemented to count cell crossings are presented in Figure 8.

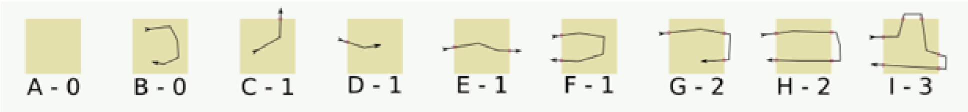


Figure 8: Cell crossings counting principles

The output of this process is a grid data file containing the number of vessel route crossings per cell. The files are created for all combinations of the predefined criteria (i.e. area, ship type range and time period).

2.2.4 Applying colours cods

The traffic density (the number of polylines crossing each cell) is presented by using a colour code. Depending on the number of crossings detected, a colour code is given to each cell. The number colour codes can be chosen depending on the ships density details to be presented.

1	
2-5	
5-10	
10-20	
20-100	
100-	

Figure 9: Colour cods (example)

The colour classification process is presented in Figure 10.

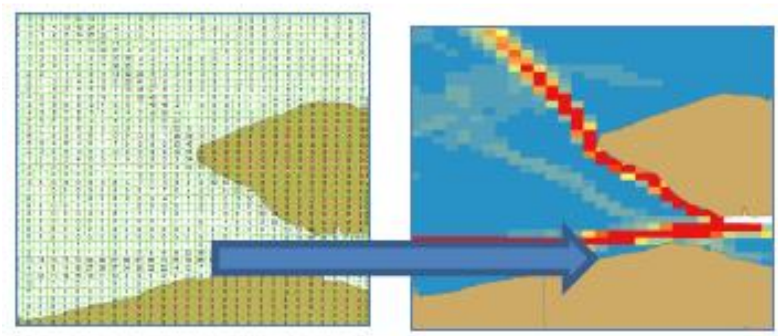
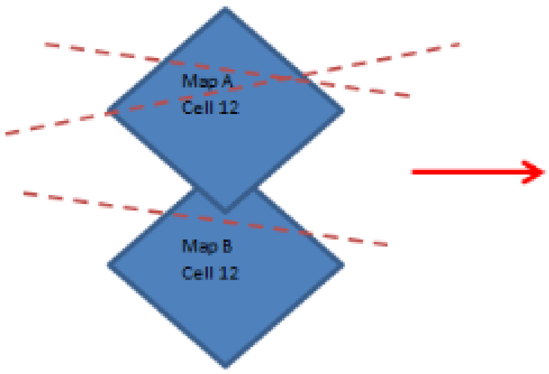


Figure 10: Colour classification

The output of this process is a georeferenced image file showing a density map with a predefined colour code by cell. The files are created for all combinations of the predefined criteria (i.e. area, ship type range and time period).

2.3 Combining TDMs

Once a set of basic maps (grid data files) have been created, they can be combined (using the sum function), to create maps for different time ranges.



	Map	Cell ID	Crossings
	A	12	2
	B	12	1
sum:	C	12	3

Figure 11: Combining TDMs

The basic maps are produced on a monthly basis. A seasonal map is created by combining the grid data files of the three months of the season. A year map is created by combining the grid data files of the twelve months of the year.

TDMs are stored in a raster format for later retrieval and use.

2.4 Reference data

2.4.1 Areas

The Standard TDMs are calculated for the following predefined areas:

- North Sea/North Atlantic
- Atlantic
- Mediterranean Sea
- Black Sea
- Baltic Sea
- All Europe.

The list of predefined areas is provided in Annex A. The limits of areas are specified by shapefiles.

2.4.2 Time criteria

The time categories for the Standard TDMs calculations are:

- Month - presents the data collected during a calendar month, from the 1st day till the last day of the corresponding month).
- Season - presents the data collected during the following periods:
  - Spring (period: March, April, May)
  - Summer (period: June, July, August)
  - Autumn (period: September, October, November)
  - Winter (period: December, January, February)
- Year - present the data collected during a calendar year.

The basic period for the TDMs is one month. All calculations are provided for the previous referenced periods.

2.4.3 Ship type ranges

The following AIS ship type ranges are considered for Standard TDMs:

- Passenger (AIS type codes 60 to 69)
- Cargo (AIS type codes 70 to 79)
- Tanker (AIS type codes 80 to 89)
- Fishing (AIS type code 30)
- All Other (i.e. all ship types not listed in the above bullet points);
- All Traffic (i.e. all ships monitored).

Ship position data is provided by STAR-Tracking with the indication of the ship's type using PSC ship types. The TDMS translates PSC ship types into AIS ship type ranges. The ship type ranges mapping table is available in Annex B.

2.5 Standard TDM files

The final TDMs are produced by aggregating (stacking and summing) the intermediate files generated according to the configured time criteria (i.e. monthly, seasonal and annual maps) and ship type ranges (i.e. Cargo, Fishing, Passenger, Tanker, All Other and All traffic) and finally clipping according to the preconfigured geographic areas (Mediterranean Sea, Baltic Sea, etc.).

The following files are produced for each Standard TDM:

- A georeferenced image showing a density map with a predefined colour code by cell (e.g. a GeoTiff file);
- A grid data file containing the number of vessels routes crossings per cell (e.g. GeoTiff 16 bit signed) (Value - 9999 is assigned for cells without data);
- A metadata file, which provides the following information about the TDM:
  - Creation date and time,
  - TDM type (value=Standard TDM),
  - Area covered,
  - Ship type range covered,
  - Time period category,
  - Start date,
  - End date,
  - Number of vessels,
  - Number of vessels per ship type range (only for the TDMs combining all monitored ship types),
  - Comment (if required), and
  - Colour legend (density value ranges and corresponding colour codes).

Annex C presents some examples of TDMs produced using the above methodology and visualised in SEG.

2.6 Process

The overall process for calculating TDMs, as presented above, can be summarised in the following process diagram (indicative example):

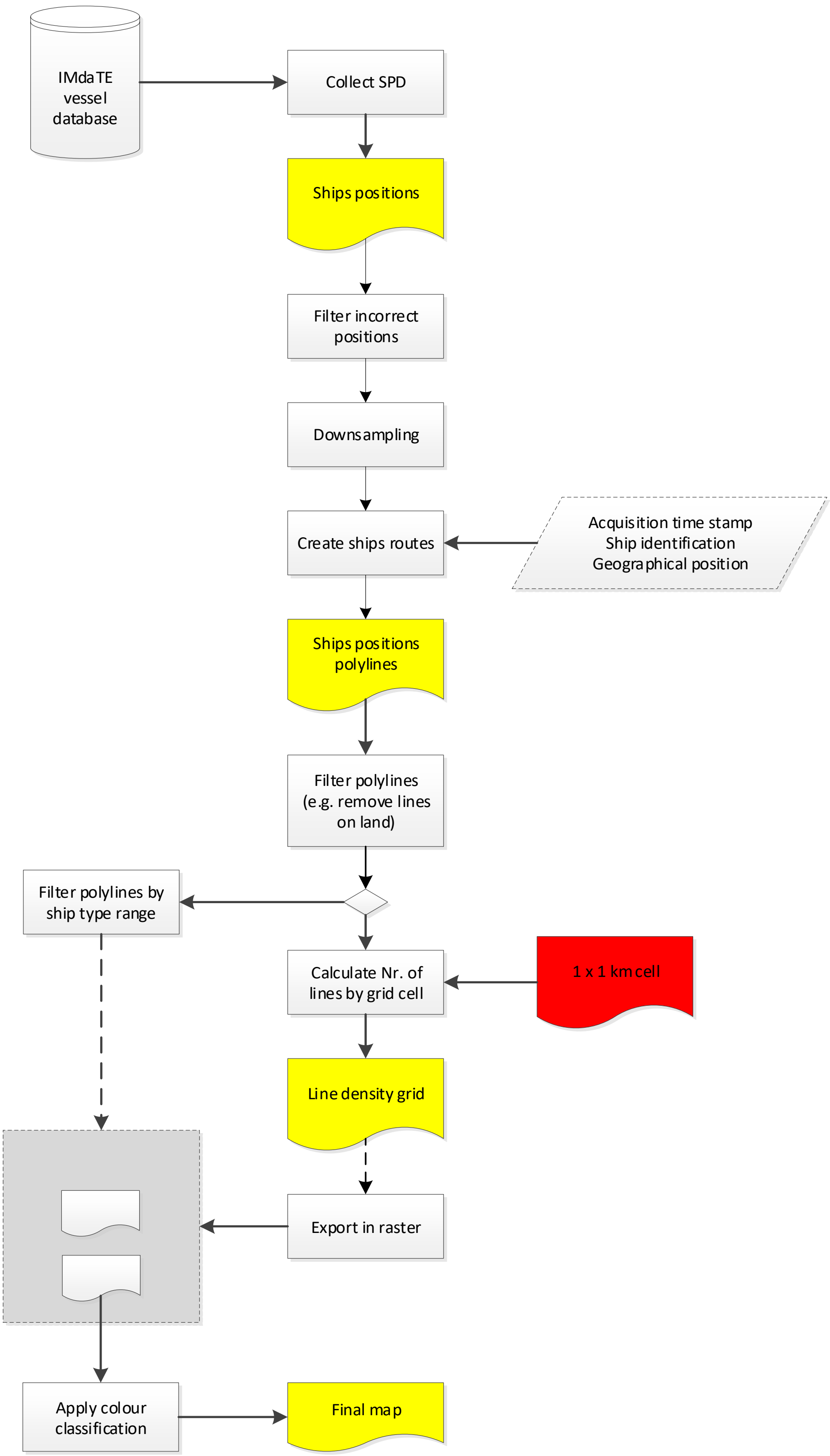


Figure 12: The process for calculating a TDM

3. Methodology to calculate Detailed TDMs

3.1 Detailed TDM construction

3.1.1 Methodology

The methodology applied for constructing Detailed TDM is the same as for Standard TDMs, but the size of grid cells is smaller (200 x 200 m). Detailed TDMs are calculated only for specific areas of interest (SAIs).

Detailed TDMs are constructed for all time categories (i.e. month, spring, summer, autumn, winter, year) and ship type ranges (i.e. Cargo, Tanker, Fishing, Passenger, All Other and All Traffic). The filtering and down sampling are the same as for Standard TDMs.

3.1.2 Areas

Detailed TDMs are calculated for specific areas (SAIs) only. The SAIs considered in Detailed TDMs are visualised in Figure 13 below and listed in Annex A.

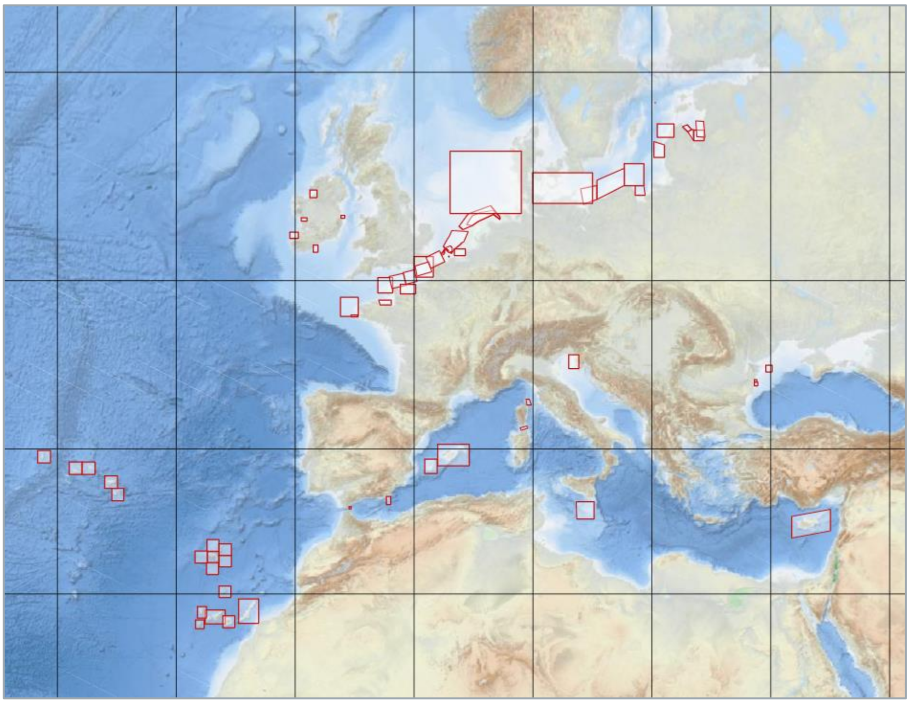


Figure 13: SAIs for Detailed TDMs

The reference grids used to build Detailed TDMs covers all SAIs. The grid cells are aligned to the cells used for the Standard TDMs.

Some of SAIs (polygons) might not match exactly with the regular grid boundaries. The grid that is generated for each SAI includes the entire original geometry of the polygon, as presented in Figure 14.

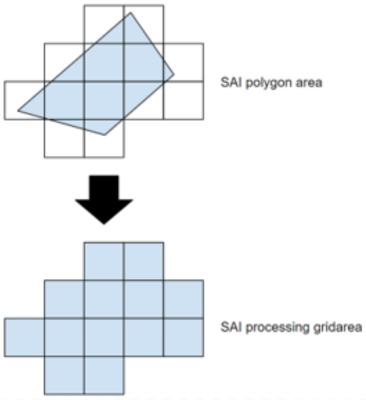


Figure 14: SAI geometry and grid

3.1.3 Ships positions data

Detailed maps are created using the same ships positions data as for Standard TDMs.

3.2 Detailed TDM files

The following files are produced for each detailed TDM:

a. A georeferenced image presenting a density map with a predefined colour code by cell.
b. A grid data file containing the number of vessels routes crossings per cell.
c. A metadata file providing the following information:

- Creation date,
- TDM type (value = “Detailed”),
- Reference area,
- Specific area of interest (SAI): code and name,
- Time period category,
- Start date,
- End date,
- Ship type range(s) covered,
- Number of unique ships in the area,
- Number of ships per ship type range (only for the Detailed TDM combining all monitored ship types), and
- Colour legend: value ranges of ships (crossings) numbers and corresponding colour codes.

After their creation, all files are stored in the TDM system.

4. Methodology to calculate Vector TDM

4.1 Vector TDM construction

4.1.1 Methodology

Calculation of Vector TDMs follows the same general methodology as for Standard TDMs but with some exceptions.

For Vector TDMs, the ship route is considered as a polyline connecting consecutive ship's positions[1] within the area, between the area's borders crossings (e.g. from the first position and till the last position in the area) [2]. Ships routes calculations follow the same algorithms as for Standard and Detailed TDMs. Also, the same filtering, down sampling and routes reconstruction configurations are applied. However, the reconstructed routes undergo an additional processing to calculate ships routes' metadata.

A Vector TDM contains the set of daily routes contained in a certain period. Since the algorithm is executed daily, the constructed routes are split into daily segments (Figure 15), and gaps between the segments are expected due to down sampling and filtering.

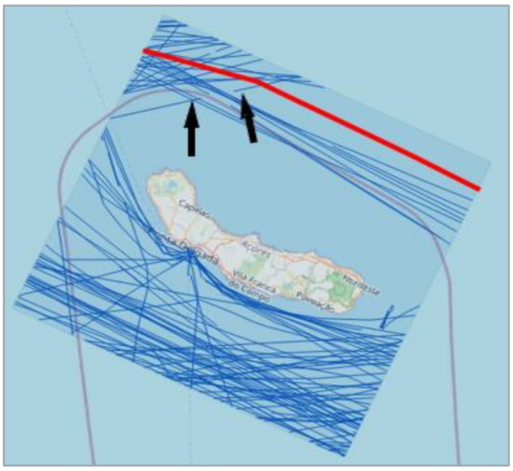


Figure 15: Daily segments in Vector TDM

All segments have a "route identifier attribute" assigned by the system. All daily segments within the SAI are counted.

4.1.2 Routes length

The system calculates the total length of all ship routes, measured from the ship's entrance in the area (or the first position) to the ship's exit from the area (or the last position).

The length of each route segment is also calculated. The statistics are calculated by aggregating the data.

4.1.3 Average ships speed

The system calculates the average ship speed of all routes.

The average speed of each route segment is also calculated. The statistics are calculated by aggregating the data.

[1] In Vector TDM the ship route is constructed by connecting the reported AIS positions.
[2] In some cases the area borders crossing (position and timestamp) is extrapolated (e.g. calculating from the nearest relevant positions).

4.1.4 Ships routes duration

The system calculates a total duration of all ship routes, measured from ship's entrance in the area (or the first timestamp) until the ship's exit from the area (or the last timestamp).

The system also calculates the duration of each route's segment. The statistics are calculated by aggregating the data.

4.1.5 Areas

Vector TDMs are calculated for specific areas (SAIs) only. SAIs are visualised in Figure 16 below. The list of SAIs for Vector TDMs is presented in Annex A.

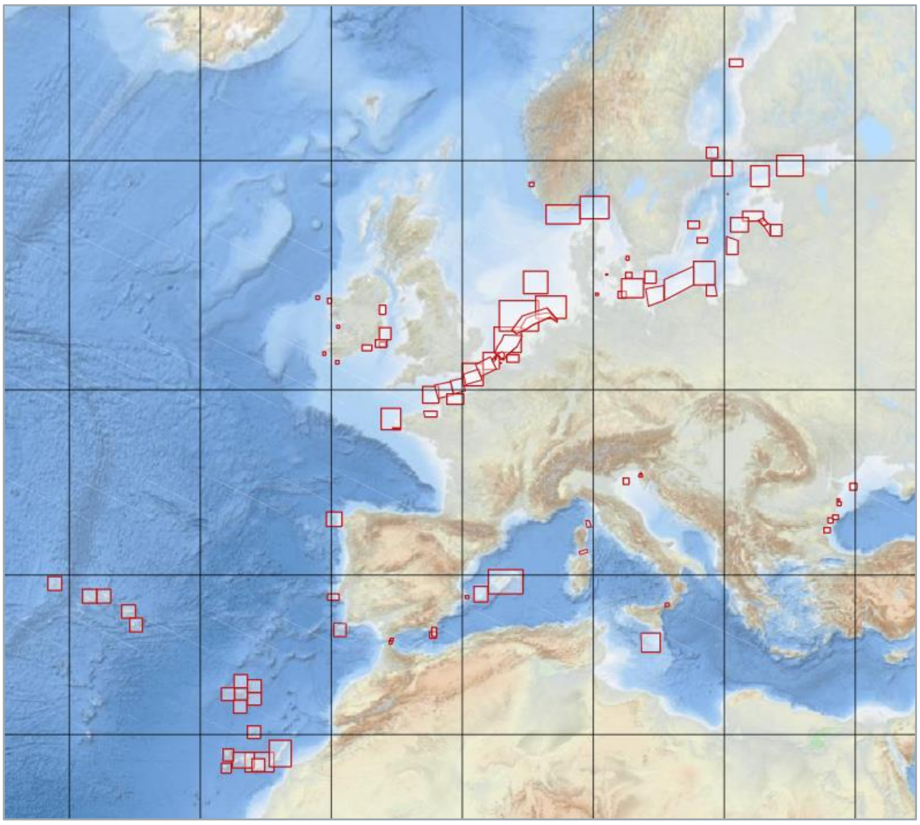


Figure 16: SAIs for TDMs

4.1.6 Time periods

Vector maps are provided per month only (other periods are not considered).

4.1.7 Ship type ranges

Vector TDMs are not generated per ship type ranges (the only proposed ship type range is "All traffic").

4.2 Vector TDM files

The following files are produced for each Vector TDM:

- A georeferenced set of vectors presenting ship routes (polylines).
- A metadata file providing the following information:
  - Creation date

    - TDM type (value = “Vector”)
    - Reference area
    - Specific area of interest
    - Time period category
    - Start date
    - End date
    - Ship type ranges covered (value always = “All traffic”)
    - Number of unique ships
    - Number of ship routes daily segments
    - Average ships speed
    - Total length of all ships routes
    - Total duration of all ship routes
- The routes’ segments metadata (for each daily segment):
    - Length
    - Average ship speed
    - Duration

There is no storage of actual Vector TDM, and the underlying data is stored as daily routes polylines.

5. Methodology to calculate Comparative TDMs

5.1 Comparative TDM construction

Comparative TDMs are constructed "on-the-fly", on the user's request in SEG, by comparing the traffic density values of two selected Standard TDMs or Detailed TDMs of the same area, time category and ship type range, but different time periods and presenting differences in values per cell.

Examples of Comparative TDMs are presented in Annex C.

The main steps for creating a Comparative TDM are presented in the sections below.

5.1.1 Selecting maps to be compared

As a parameter to create a Comparative TDM the TDM service requires the identification of two Standard or Detailed TDMs. Only existing maps (i.e. pre-calculated and stored in system's database) can be selected. The principle of creating Comparative TDMs is presented in Figure 17 below.

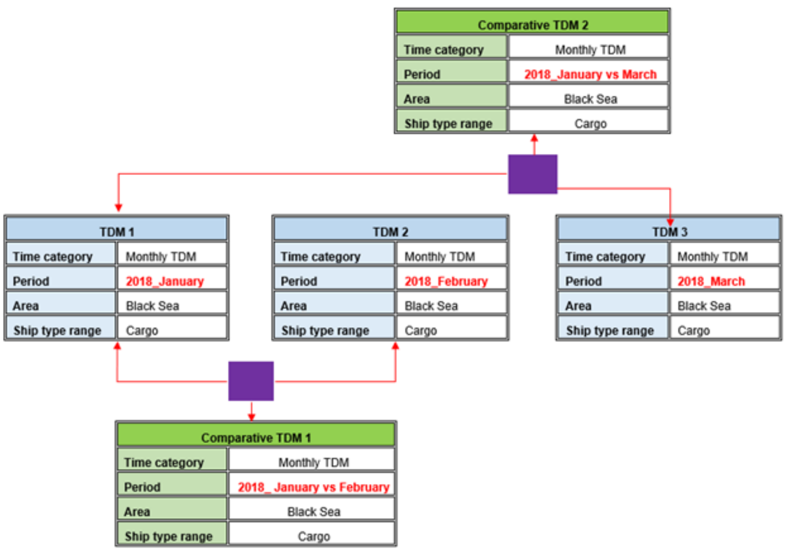


Figure 17: Comparative TDMs creating principle

5.1.2 Comparing the TDMs

The traffic density values in map A are compared against the values in map B. The most recent map is always used as a reference to present differences. The values comparing principle is presented in Figure 18.

Compared grid cells number (example)	**Map A**	**Map B**	**Comparative TDM**
	2019-06(June)	**2019-01(January)**	
1	25	44	In map A (newer) = lower
2	112	101	In map A (newer) = higher
3	0	0	No values
4	89	89	In map A (newer) = equal
5	46	12	In map A (newer) = higher
6	0	112	In map A (newer) = lower

Figure 18: Principle for the comparison of values

5.1.3 Visualising values

The differences in the traffic density values are presented in grades: lower (negative) density, equal (non null) density, higher (positive) density. The grid cells where both density values in map A and in map B are null are left transparent.

The corresponding colour codes are defined by the administrator and presented in the TDM information panel.

5.2 Comparative TDM files

The following files are produced for each Comparative TDM:

1) A georeferenced image, which presents shipping density values with a colour code per cell.
2) A data file containing the shipping density differences.
3) A metadata file, representing map's information:
   - Creation date,
   - TDM type (value = Comparative),
   - Reference area,
   - Time period category (e.g. Monthly),
   - Date range of map A,
   - Date range of map B,
   - Ship type range(s) covered,
   - Number of ships in map A,
   - Number of ships in map B,
   - TDM colour legend indicating the colours of compared values in the newer TDM (i.e. negative, equal, positive).

The files of Comparative TDM are not stored, as they are generated "on-the-fly".

Annex A: Areas

1. TDM areas

Each TDM corresponds to one of the reference areas:

- North Sea/North Atlantic
- Atlantic
- Baltic Sea
- Black Sea
- Mediterranean Sea
- All Europe

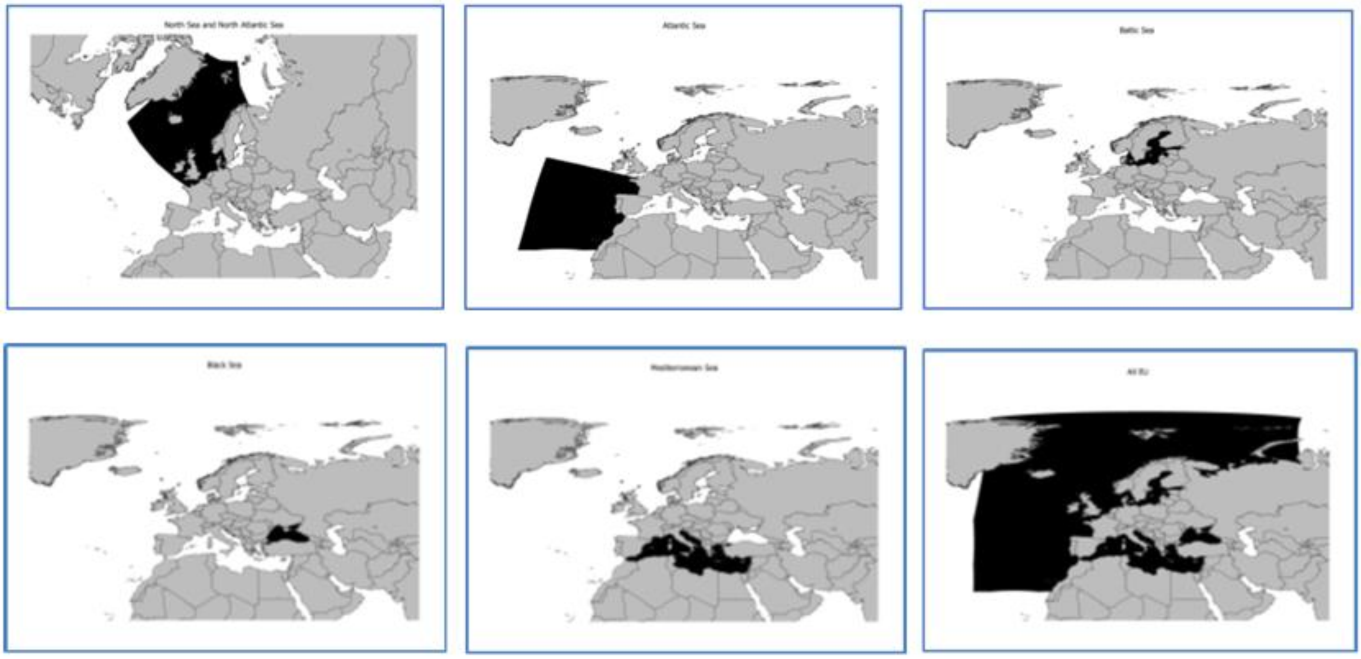


Figure 19: TDM areas (1)

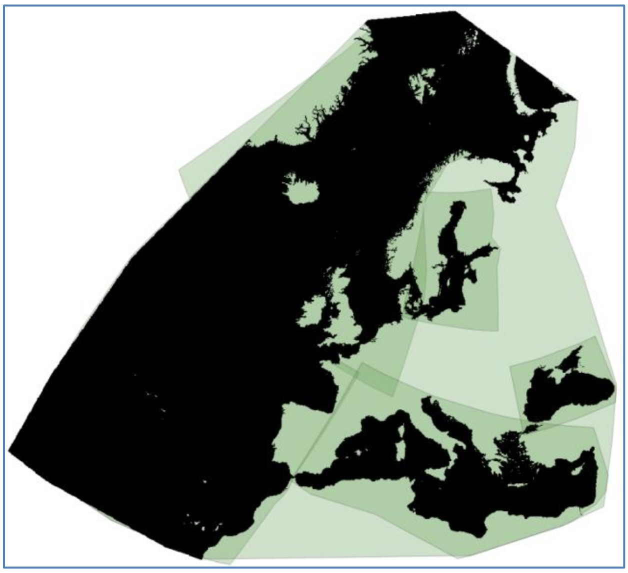


Figure 20: TDM areas (2)

The limits of areas are specified by shapefiles.

2. Specific Areas of Interests (SAIs)

Specific Areas of Interests (SAIs) are listed in the table. The limits of SAIs are specified by shapefiles.

Nr.	SAI - code and name	Reference area	Default TDM type
1	[N/A]	North Sea/ North Atlantic	N/A
2	TSS Off Tuskar Rock	North Sea/ North Atlantic	Vector
3	TSS Dover Strait	North Sea/ North Atlantic	Vector
4	TSS Hinder	North Sea/ North Atlantic	Vector
5	TSS Off Coast of the Netherlands	North Sea/ North Atlantic	Vector
6	TSS Tershellinger area	North Sea/ North Atlantic	Vector
7	TSS German Bight	North Sea/ North Atlantic	Vector
8	TSS Off South Norway	North Sea/ North Atlantic	Vector
9	TSS Skagerrak	North Sea/ North Atlantic	Vector
10	[N/A]	North Sea/ North Atlantic	N/A
11	SEZ BE Zone Noordhinder Noord	North Sea/ North Atlantic	Vector; Detailed
12	SEZ BE Zone Noordhinder Zuid	North Sea/ North Atlantic	Vector; Detailed
13	SEZ BE Zone Fairybank	North Sea/ North Atlantic	Vector; Detailed
14	SEZ BE Zone D	North Sea/ North Atlantic	Vector; Detailed
15	SEZ BE Zone E	North Sea/ North Atlantic	Vector; Detailed
16	POR Saint – Brieuc & Saint - Malo Bays	North Sea/ North Atlantic	Vector; Detailed
17	VTS Jobourg VTS	North Sea/ North Atlantic	Vector; Detailed
18	RSR North Cotentin	North Sea/ North Atlantic	Vector; Detailed
19	POR North Baie de Seine	North Sea/ North Atlantic	Vector; Detailed
20	POR Baie de Seine	North Sea/ North Atlantic	Vector; Detailed
21	TSS Dover Straight South-West	North Sea/ North Atlantic	Vector; Detailed
22	TSS Dover Straight North-East	North Sea/ North Atlantic	Vector; Detailed
23	EPZ Cooley Point to Skerries	North Sea/ North Atlantic	Vector
24	POR Wicklow Head to Carnsore Point	North Sea/ North Atlantic	Vector
25	TSS Wexford Harbour to Kilmore Quay	North Sea/ North Atlantic	Vector
26	EPZ Hook Head to Mine Head	North Sea/ North Atlantic	Vector
27	TSS Fastnet Rock	North Sea/ North Atlantic	Vector
28	EPZ Great Skellig	North Sea/ North Atlantic	Vector
29	EPZ Cliffs of Moher	North Sea/ North Atlantic	Vector
30	EPZ Corrib Gas Field	North Sea/ North Atlantic	Vector
31	EPZ Mullet Peninsula	North Sea/ North Atlantic	Vector
32	POR Dublin, Howth and Dun Laoghaire	North Sea/ North Atlantic	Detailed
33	POR Cork Harbour and Approaches	North Sea/ North Atlantic	Detailed
34	POR Approaches to Rive Shannon	North Sea/ North Atlantic	Detailed
35	POR Approaches to Galway	North Sea/ North Atlantic	Detailed
36	EPZ Donegal Bay	North Sea/ North Atlantic	Detailed
37	NSP Waddenzee 001	North Sea/ North Atlantic	Vector; Detailed
38	SRS Waddenzee 002	North Sea/ North Atlantic	Vector; Detailed
39	SRS North Sea South	North Sea/ North Atlantic	Vector; Detailed
40	NSP Zeeland	North Sea/ North Atlantic	Vector; Detailed
41	SRS Borssele	North Sea/ North Atlantic	Vector; Detailed
42	NSP German EEZ and TW North Sea	North Sea/ North Atlantic	Detailed
43	NSP German EEZ North Sea	North Sea/ North Atlantic	Vector
44	TSS Cabo San Vincenta	Atlantic	Vector
45	TSS Off Cabo da Roca	Atlantic	Vector
46	TSS Canarian Islands	Atlantic	Vector

47	TSS Off Cabo Finisterre	Atlantic	Vector
48	VTS Selvagens Islands	Atlantic	Vector; Detailed
49	VTS Madeira Island	Atlantic	Vector; Detailed
50	VTS North of Madeira	Atlantic	Vector; Detailed
51	VTS South of Madeira	Atlantic	Vector; Detailed
52	VTS West of Madeira	Atlantic	Vector; Detailed
53	VTS Porto Santo	Atlantic	Vector; Detailed
54	VTS South of Porto Santo	Atlantic	Vector; Detailed
55	VTS Occidental Azores	Atlantic	Vector; Detailed
56	VTS West of Central Azores	Atlantic	Vector; Detailed
57	VTS East of Central Azores	Atlantic	Vector; Detailed
58	VTS Azores S. Miguel	Atlantic	Vector; Detailed
59	VTS Azores S. Maria	Atlantic	Vector; Detailed
60	TSS Ushant	Atlantic	Vector; Detailed
61	NSP Raz de Sein	Atlantic	Vector; Detailed
62	NSP Tenerife and La Gomera	Atlantic	Vector; Detailed
63	NSP Gran Canarias	Atlantic	Vector; Detailed
64	NSP Fuerteventura and Lanzarote	Atlantic	Vector; Detailed
65	NSP La Palma	Atlantic	Vector; Detailed
66	NSP El Hierro	Atlantic	Vector; Detailed
67	TSS Gulf of Finland central	Baltic Sea	Vector
68	TSS Gulf of Finland west	Baltic Sea	Vector
69	TSS Entering Gulf of Botnia	Baltic Sea	Vector
70	TSS Marketskallen area	Baltic Sea	Vector
71	TSS Nordvalen area	Baltic Sea	Vector
72	TSS Irbe Strait	Baltic Sea	Vector
73	TSS West of Gotland	Baltic Sea	Vector
74	TSS South of Gotland	Baltic Sea	Vector
75	TSS West of Bornholm	Baltic Sea	Vector
76	TSS Bay of Mecklenburg	Baltic Sea	Vector
77	N/A	Baltic Sea	N/A
78	TSS The Storebelt area	Baltic Sea	Vector
79	TSS The Sound area	Baltic Sea	Vector
80	TSS The Kattegat area	Baltic Sea	Vector
81	NSP Pomorska Bay	Baltic Sea	Vector; Detailed
82	TSS Southern Baltic	Baltic Sea	Vector; Detailed
83	NSP South-East Baltic	Baltic Sea	Vector; Detailed
84	VTS Gulf of Gdansk	Baltic Sea	Vector; Detailed
85	NSP Approach to Riga	Baltic Sea	Vector; Detailed
86	NSP Approach to Ventspils	Baltic Sea	Vector; Detailed
87	NSP Approach to Liepaja	Baltic Sea	Vector; Detailed
88	NSP Gulf of Riga West	Baltic Sea	Vector; Detailed
89	NSP Approach to Mersrags	Baltic Sea	Vector; Detailed
90	NSP Gulf of Riga East	Baltic Sea	Detailed
91	NSP German EEZ and TW Baltic Sea	Baltic Sea	Detailed
92	NSP German EEZ Baltic Sea	Baltic Sea	Vector
93	TSS Approaches to Burgas	Black Sea	Vector
94	TSS Approaches to Varna	Black Sea	Vector
95	TSS Kaliakra Cape	Black Sea	Vector
96	TSS Approaches to Constanta	Black Sea	Vector; Detailed
97	TSS Approaches to Midia	Black Sea	Vector; Detailed
98	SRS Approaches to Sulina	Black Sea	Vector; Detailed

99	TSS Strait of Gibraltar	Mediterranean Sea	Vector
100	TSS Cabo de la Noa	Mediterranean Sea	Vector
101	MRS Bonifacio Strait	Mediterranean Sea	Vector; Detailed
102	TSS Messina Strait	Mediterranean Sea	Vector
103	TSS Alboran Sea	Mediterranean Sea	Vector
104	TSS Venezia VTS	Mediterranean Sea	Vector
105	TSS Gulf of Trieste	Mediterranean Sea	Vector
106	TSS Approaches to Koper	Mediterranean Sea	Vector
107	TSS Corsica Channel	Mediterranean Sea	Vector; Detailed
108	TSS North Adriatic Sea	Mediterranean Sea	Detailed
109	NSP East Mediterranean Sea - Cyprus	Mediterranean Sea	Detailed
110	SEZ Central Mediterranean Sea - Malta	Mediterranean Sea	Vector; Detailed
111	NSP Mallorca and Menorca	Mediterranean Sea	Vector; Detailed
112	NSP Ibiza	Mediterranean Sea	Vector; Detailed
113	NSP Cabo de Gata	Mediterranean Sea	Vector; Detailed
114	NSP Baiha de Algeciras	Mediterranean Sea	Vector; Detailed

Annex B: Ship type ranges

The system will consider the following ranges of ship types: Passenger, Cargo, Tanker, Fishing, All Other[3] and All Traffic[4].

Ship types (AIS and/or PSC[5]) are sorted per the above ship type ranges. The matching table between ship types and the ship type ranges is presented below.

CODE (AIS/ PSC)	TYPE	RANGES	
0	Not specified	All Other	All Traffic
1-19	Reserved for future use	All Other	All Traffic
20	Wing in ground (WIG), all ships of this type	All Other	All Traffic
21	Wing in ground (WIG), Hazardous category A	All Other	All Traffic
22	Wing in ground (WIG), Hazardous category B	All Other	All Traffic
23	Wing in ground (WIG), Hazardous category C	All Other	All Traffic
24	Wing in ground (WIG), Hazardous category D	All Other	All Traffic
25	Wing in ground (WIG), Reserved for future use	All Other	All Traffic
26	Wing in ground (WIG), Reserved for future use	All Other	All Traffic
27	Wing in ground (WIG), Reserved for future use	All Other	All Traffic
28	Wing in ground (WIG), Reserved for future use	All Other	All Traffic
29	Wing in ground (WIG), Reserved for future use	All Other	All Traffic
30	Fishing	Fishing	All Traffic
31	Towing	All Other	All Traffic
32	Towing: length exceeds 200m or breadth exceeds 25m	All Other	All Traffic
33	Dredging or underwater ops	All Other	All Traffic
34	Diving ops	All Other	All Traffic
35	Military Ops	All Other	All Traffic
36	Sailing	All Other	All Traffic
37	Pleasure Craft	All Other	All Traffic
38	Reserved	All Other	All Traffic
39	Reserved	All Other	All Traffic
40	High speed craft (HSC), all ships of this type	All Other	All Traffic
41	High speed craft (HSC), Hazardous category A	All Other	All Traffic
42	High speed craft (HSC), Hazardous category B	All Other	All Traffic
43	High speed craft (HSC), Hazardous category C	All Other	All Traffic
44	High speed craft (HSC), Hazardous category D	All Other	All Traffic
45	High speed craft (HSC), Reserved for future use	All Other	All Traffic
46	High speed craft (HSC), Reserved for future use	All Other	All Traffic
47	High speed craft (HSC), Reserved for future use	All Other	All Traffic
48	High speed craft (HSC), Reserved for future use	All Other	All Traffic
49	High speed craft (HSC), No additional information	All Other	All Traffic
50	Pilot Vessel	All Other	All Traffic
51	Search and Rescue vessel	All Other	All Traffic
52	Tug	All Other	All Traffic
53	Port Tender	All Other	All Traffic
54	Anti-pollution equipment	All Other	All Traffic

[3] "All other" is the combination of relevant ship types. This combination is considered for the purpose of TDMs only.
[4] "All traffic" is the combination of all the monitored ship types. This combination is considered for the purpose of TDMs only.
[5] Depending on the records in DB

55	Law Enforcement	All Other	All Traffic
56	Spare - Local Vessel	All Other	All Traffic
57	Spare - Local Vessel	All Other	All Traffic
58	Medical Transport	All Other	All Traffic
59	Ship according to RR Resolution No. 18	All Other	All Traffic
60	Passenger, all ships of this type	Passenger	All Traffic
61	Passenger, Hazardous category A	Passenger	All Traffic
62	Passenger, Hazardous category B	Passenger	All Traffic
63	Passenger, Hazardous category C	Passenger	All Traffic
64	Passenger, Hazardous category D	Passenger	All Traffic
65	Passenger, Reserved for future use	Passenger	All Traffic
66	Passenger, Reserved for future use	Passenger	All Traffic
67	Passenger, Reserved for future use	Passenger	All Traffic
68	Passenger, Reserved for future use	Passenger	All Traffic
69	Passenger, No additional information	Passenger	All Traffic
70	Cargo, all ships of this type	Cargo	All Traffic
71	Cargo, Hazardous category A	Cargo	All Traffic
72	Cargo, Hazardous category B	Cargo	All Traffic
73	Cargo, Hazardous category C	Cargo	All Traffic
74	Cargo, Hazardous category D	Cargo	All Traffic
75	Cargo, Reserved for future use	Cargo	All Traffic
76	Cargo, Reserved for future use	Cargo	All Traffic
77	Cargo, Reserved for future use	Cargo	All Traffic
78	Cargo, Reserved for future use	Cargo	All Traffic
79	Cargo, No additional information	Cargo	All Traffic
80	Tanker, all ships of this type	Tanker	All Traffic
81	Tanker, Hazardous category A	Tanker	All Traffic
82	Tanker, Hazardous category B	Tanker	All Traffic
83	Tanker, Hazardous category C	Tanker	All Traffic
84	Tanker, Hazardous category D	Tanker	All Traffic
85	Tanker, Reserved for future use	Tanker	All Traffic
86	Tanker, Reserved for future use	Tanker	All Traffic
87	Tanker, Reserved for future use	Tanker	All Traffic
88	Tanker, Reserved for future use	Tanker	All Traffic
89	Tanker, No additional information	Tanker	All Traffic
90	Other Type, all ships of this type	All Other	All Traffic
91	Other Type, Hazardous category A	All Other	All Traffic
92	Other Type, Hazardous category B	All Other	All Traffic
93	Other Type, Hazardous category C	All Other	All Traffic
94	Other Type, Hazardous category D	All Other	All Traffic
95	Other Type, Reserved for future use	All Other	All Traffic
96	Other Type, Reserved for future use	All Other	All Traffic
97	Other Type, Reserved for future use	All Other	All Traffic
98	Other Type, Reserved for future use	All Other	All Traffic
99	Other Type, No additional information	All Other	All Traffic

310	Tankship + cc	Tanker	All Traffic
311	NLS tanker	Tanker	All Traffic
312	Combination carrier	Tanker	All Traffic
313	Oil tanker	Tanker	All Traffic
314	Vegetank	Tanker	All Traffic
315	Fishing vessel	Fishing	All Traffic
316	Warship and naval auxiliary	All Other	All Traffic
317	Wooden ship of a primitive build	All Other	All Traffic
318	Government ship used for non-commercial purpose	All Other	All Traffic
319	Pleasure yacht not engaged in trade	All Other	All Traffic
320	Gas carrier	Tanker	All Traffic
321	Gas carrier LPG	Tanker	All Traffic
322	Gas carrier ING	Tanker	All Traffic
330	Chemical tanker	Tanker	All Traffic
340	Bulk carrier	Cargo	All Traffic
341	Cement carrier	Cargo	All Traffic
350	Unit. vessel	All Other	All Traffic
351	Barge carrier	Cargo	All Traffic
352	Vehicle carrier	Cargo	All Traffic
353	Container	Cargo	All Traffic
354	Pallet carrier	Cargo	All Traffic
355	Ro-Ro cargo	Cargo	All Traffic
360	General cargo/multipurpose	Cargo	All Traffic
361	Refrigerated cargo	Cargo	All Traffic
367	Livestock carrier	Cargo	All Traffic
370	Ro-Ro passenger ship	Passenger	All Traffic
371	Passenger ship	Passenger	All Traffic
372	Ice breaker	All Other	All Traffic
373	Fish factory	All Other	All Traffic
374	Research ship	All Other	All Traffic
375	Heavy load	All Other	All Traffic
376	Offshore supply	All Other	All Traffic
377	Standby ship	All Other	All Traffic
378	Dredger	All Other	All Traffic
380	MODU & FPSO	All Other	All Traffic
381	Dyncraft	All Other	All Traffic
382	Special purpose ship	All Other	All Traffic
383	High speed passenger craft	All Other	All Traffic
384	High speed cargo	All Other	All Traffic
385	Tug	All Other	All Traffic
399	Other special activities	All Other	All Traffic
Note: in case the ship type code has an empty value (not filled in) or the value is not listed in the table, it will be considered as range: "All Other" and "All Traffic"			

Annex C: Examples

Examples of TDMs in SEG:

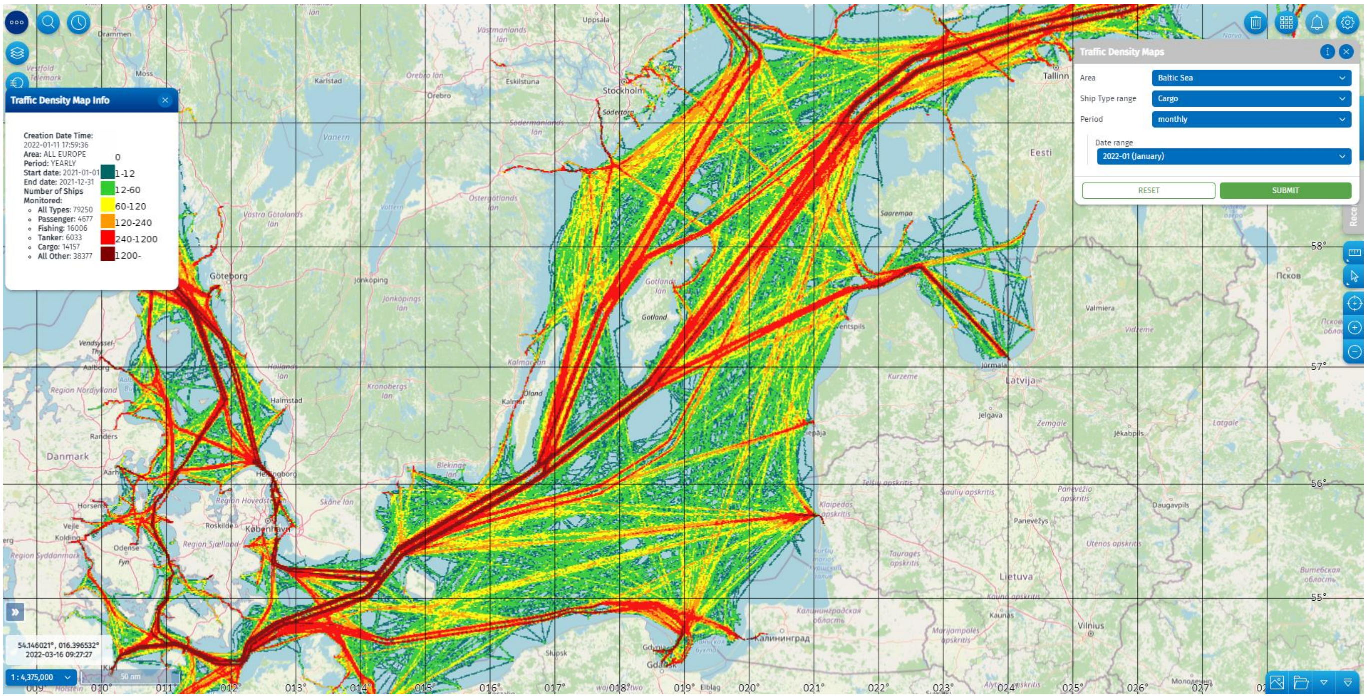


Figure 21: Standard TDM (Baltic Sea / Monthly / Cargo)

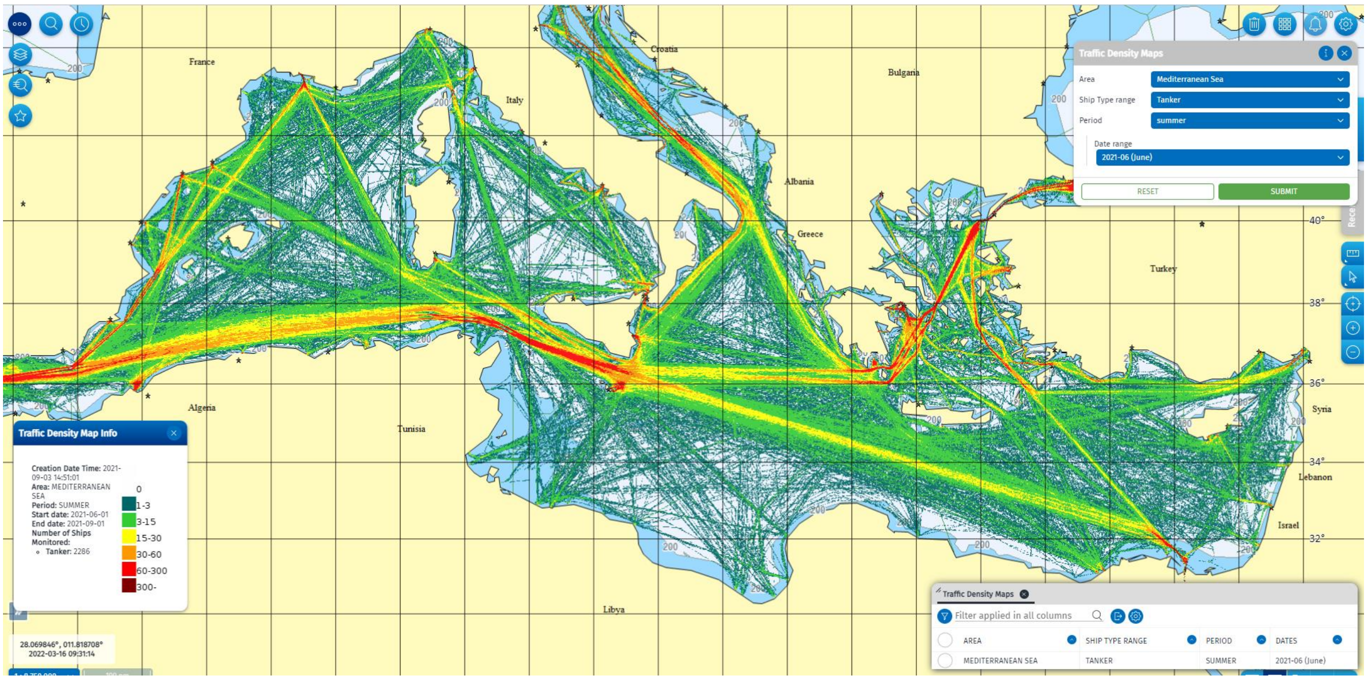


Figure 22: Standard TDM (Mediterranean Sea/ Monthly / Cargo)

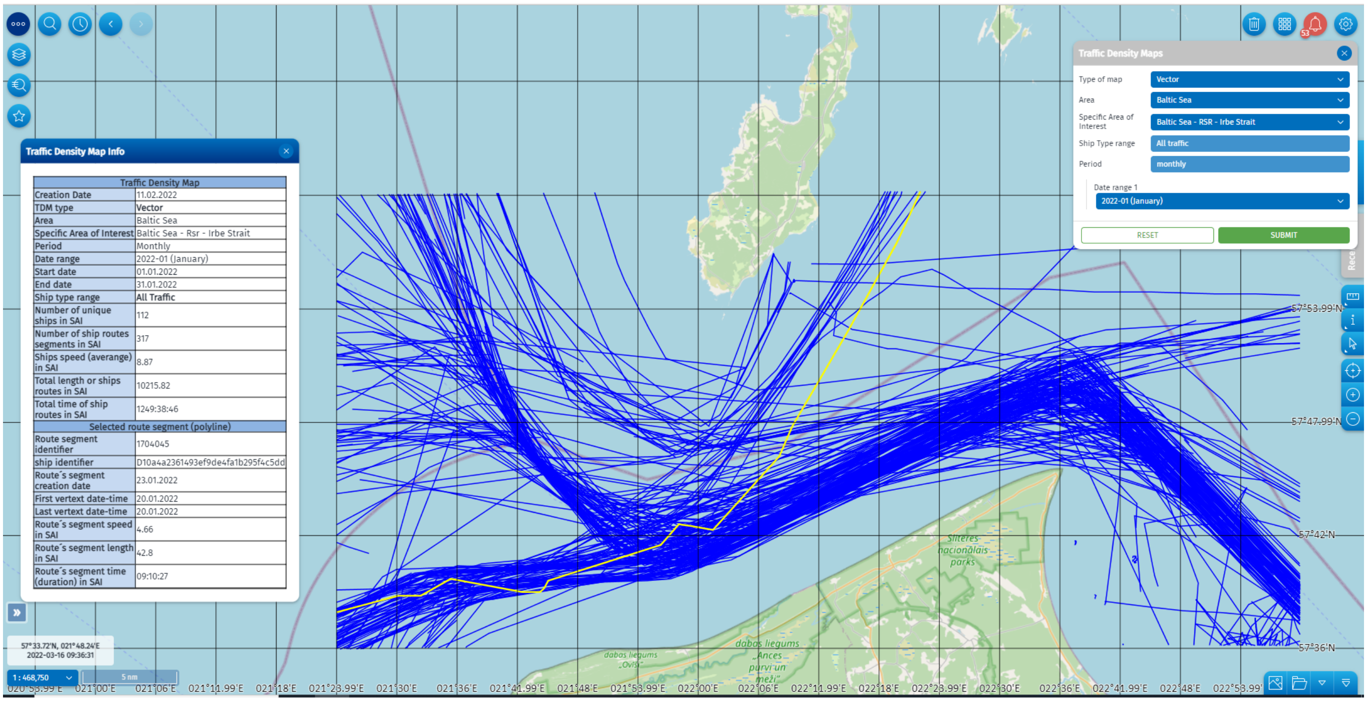


Figure 23: Vector TDM (test env.) - (Baltic Sea / RSR Irbe Strait / Monthly / All traffic)

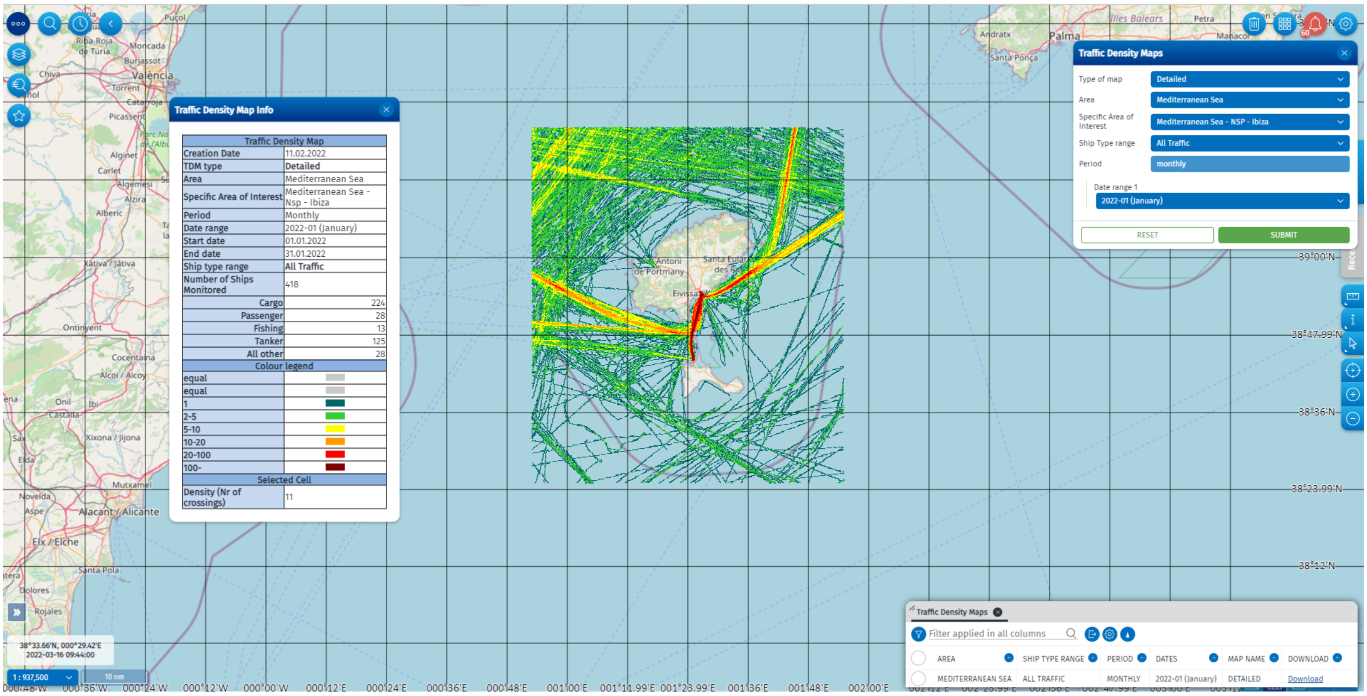


Figure 24: Detailed TDM (test env.) – (Mediterranean Sea/ NSP Ibiza/ Monthly / All traffic

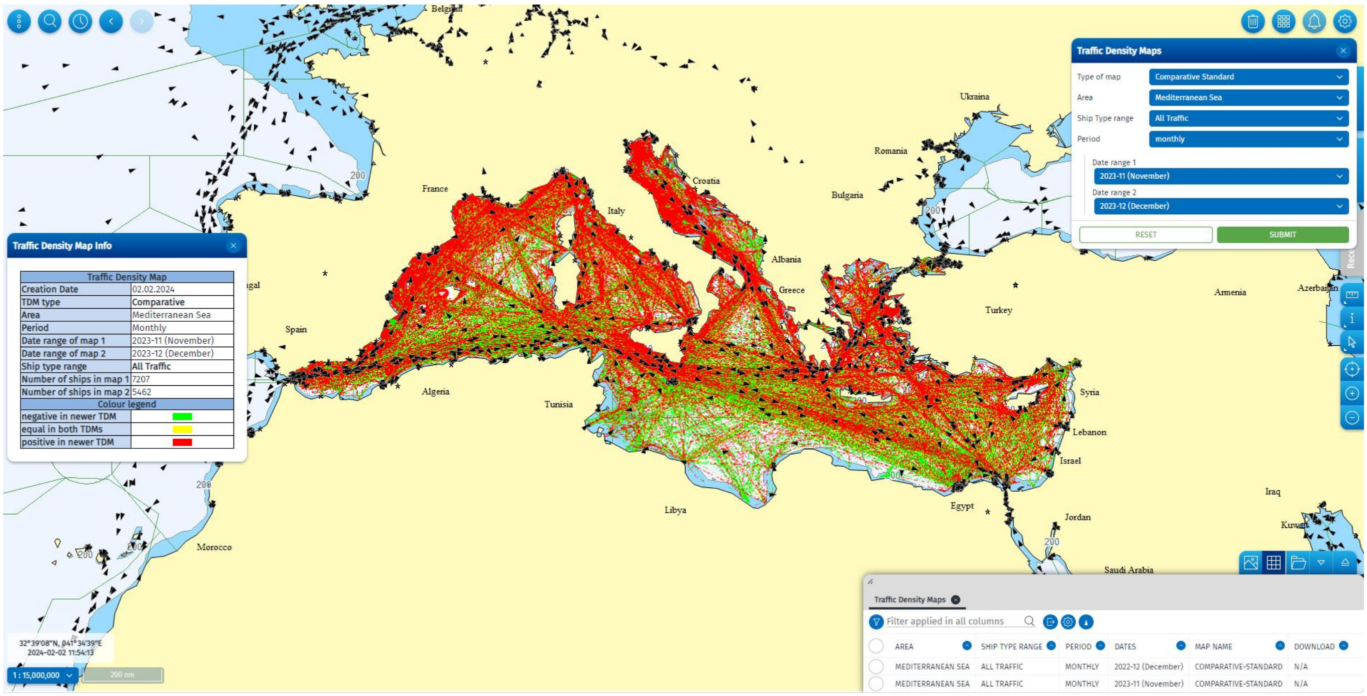


Figure 25: Comparative TDM (pre-prod env.) – (Mediterranean Sea / Nov 2023 – Dec 2023 / All Traffic)

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