EMODnet Sea-basin Checkpoints
Tender no MARE/2016/05

EMODNET Oil Platform Leak Bulletin

Date: 13/05/2016

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Executive Summary

The EMODNET Oil Platform Leak Bulletin contains the forecast/scenario information on the fate and transport of oil leaks emanating from the DG Mare:

At 8:15 CET this morning (10/05/2016), following an unknown incident, the captain of an oil tanker (located at LAT: 47,330945; LON: -4,366687) sent a mayday reporting that the ship was breaking in several parts. By 10:00 CET the ship had released all of its 8,000 tons of heavy fuel oil n°6.

The first part of this bulletin presents the methodology and the environmental conditions (bathymetry, seabed substrate, wind and current data) used to forecast the oil spill behaviour. The oil spill scenario is set up in OSCAR (Oil Spill Contingency and Response), a model developed by SINTEF for simulating oil spill fate at sea and operated by CLS under license.

Then, oil spill results are provided in the second part in terms of mean concentration in the water column and oil surface thickness. This forecast will help oil spill management and set up of mitigation plans (activation of specialized ships dedicated to pollution missions for example).

The third part of the document will aim to assess environmental impacts relative to marine ecosystems and human activities and to set up mitigation and contingency plans. It could result for example in the deployment of booms to protect touristic beaches or in the activation of recovery operations at sea and mechanical clean-up on the shoreline.

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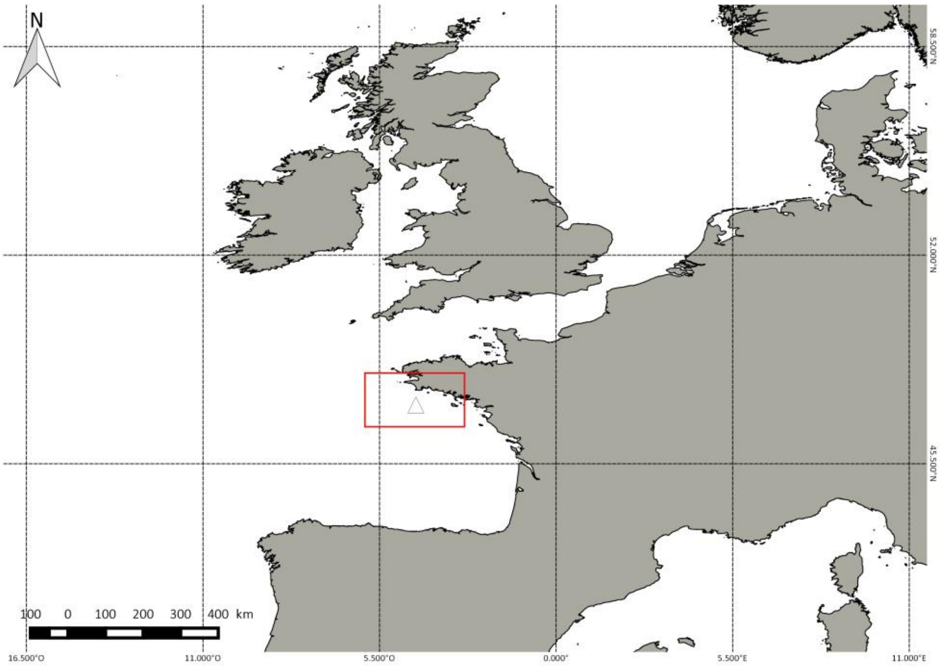

Figure 1: Location of the oil spill

The oil spill is affecting an area situated in the Exclusive Economic Zone of France and in the corresponding Large Marine Ecosystem (LME) of the Celtic Biscay shelf.

The Celtic Biscay shelf is mainly under the influence of the Shelf-Slope-Front (SSF) that extends along the shelf break/upper continental slope from the Bay of Biscay around the British Isles up to the Faroe-Shetland Channel where it joins the North Atlantic Current Front. The SSF, however does not appear continuous, suggesting that the Shelf edge Current is likely not always continuous. The area is a moderatly productive ecosystem (150-300 $gCm^{-2}yr^{-1}$). The living marine resources in the area include a wide range of organisms and traditionally, the LME has been a region of intense fishing activity. The most important fish caught in its shelf water include various pelagic fish species, as well as cod and hake. Human activities in the coastal areas also include aquaculture and farming.

Population densities at the coastal edges of the Celtic-Biscay Shelf LME are increasing and OSPAR estimates that 47.2 million people live in the catchment areas draining into the Bay of Biscay and Iberian coastal waters.

The release site is situated south of a moderate ship traffic area that contains routes joining the main maritime axe which crosses through the English Channel.

2. Methodology and oil spill scenario

2.1 Oil spill scenario parameters

The parameters related to the release were given by DG-MARE in the input data form and are summarized in the Table 1. Those parameters will be used as inputs in OSCAR.

Table 1 : Release information and time window.

Location:	
Release point 1	
Geographic Latitude	47.330945
Geographic Longitude	-4.366687
Water depth:	
m	114.9
Time window for blowout event:	
Earliest date for blowout event	2016-05-10	07:15 UTC
Release duration - minutes	105
Oil volume release rate:	
tonnes	8000
Release on the surface:	
	YES (assumption)

The oil released in the accident is **heavy fuel oil n°6**. As OSCAR has predefined oil profiles, the oil type used in the simulation is taken from those profiles. It has been chosen the IFO-380 HEAVY FUEL OIL –

HEAVY BUNKER with American Petroleum Institute (API) 15.1 and specific gravity 0.965 as it is the most similar profile available.

2.2 Environmental input data

The datasets used for input in the OSCAR oil spill model include bathymetry, sea bed substrate, wind and current forecast and temperature and salinity profiles. They are presented in this section.

a. Bathymetry and model grid

The bathymetry necessary for input was extracted from EMODnet database. The model bathymetry grid is presented in the figure below:

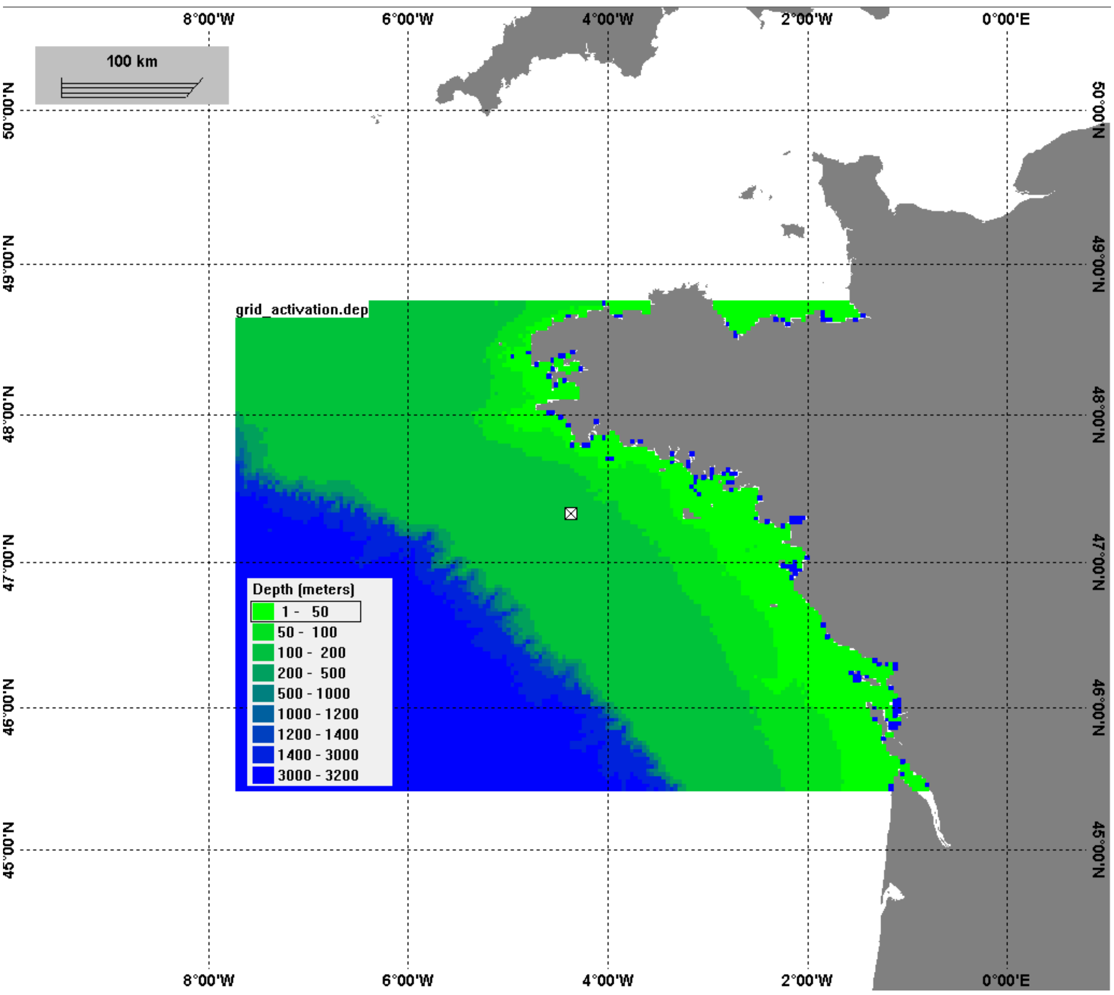

Figure 2: Grid map and EMODnet bathymetry used in the simulation. The white marker represents the release site

b. *Sea bed substrate*

Sea bed susbrates are extracted from EMODnet database. The region presents a large variety of substrates but muddy sand is largely present offshore (especially aroun the release site). The coastal area is mainly composed of coarse sediments and sandy mud as presented in Figure 3.

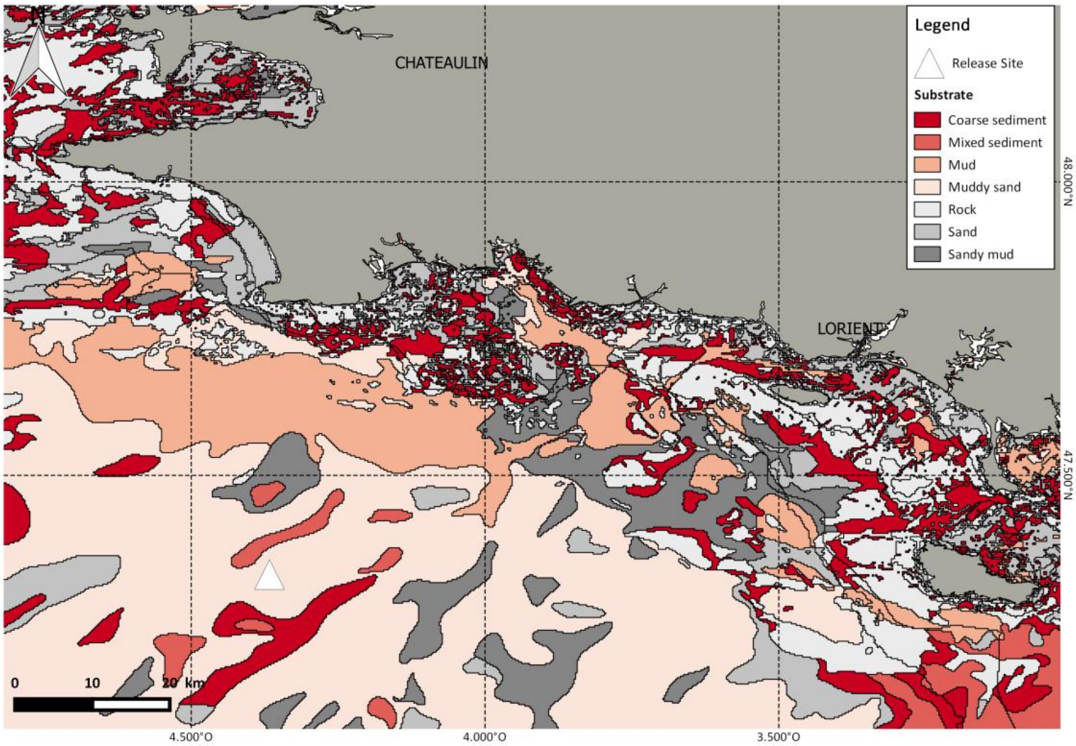

Figure 3: Sea bed substrate in the region of the oil spil

c. *Currents and Winds*

The currents used in the simulation are extracted from the Global Ocean 1/12° Physics Analysis and Forecast of Mercator Ocean. The product is provided on a regular grid with 1/12° resolution and hourly time step. Considering the high influence of tides in the area of interest, a tide component from CLS tides products is added to the currents grid. Tides are provided on a regular grid with 1/8° resolution and 1 h time step and have been interpolated to the current grid before importing in OSCAR. Data covers the period between 2016-05-10 | 07:00 UTC to 2016-05-15 | 16:00 UTC. A snapshot of the current field at the release time is presented in Figure 5.

Wind data was imported from the NCEP NOAA – Analysis and Forecast in the period between 2016-05-10 | 07:00 UTC and 2016-05-15 | 07:00 UTC. The wind-data extracted have a 1/8° degrees resolution and a 3-hour time step. A snapshot from the imported wind field is presented in Figure 4.

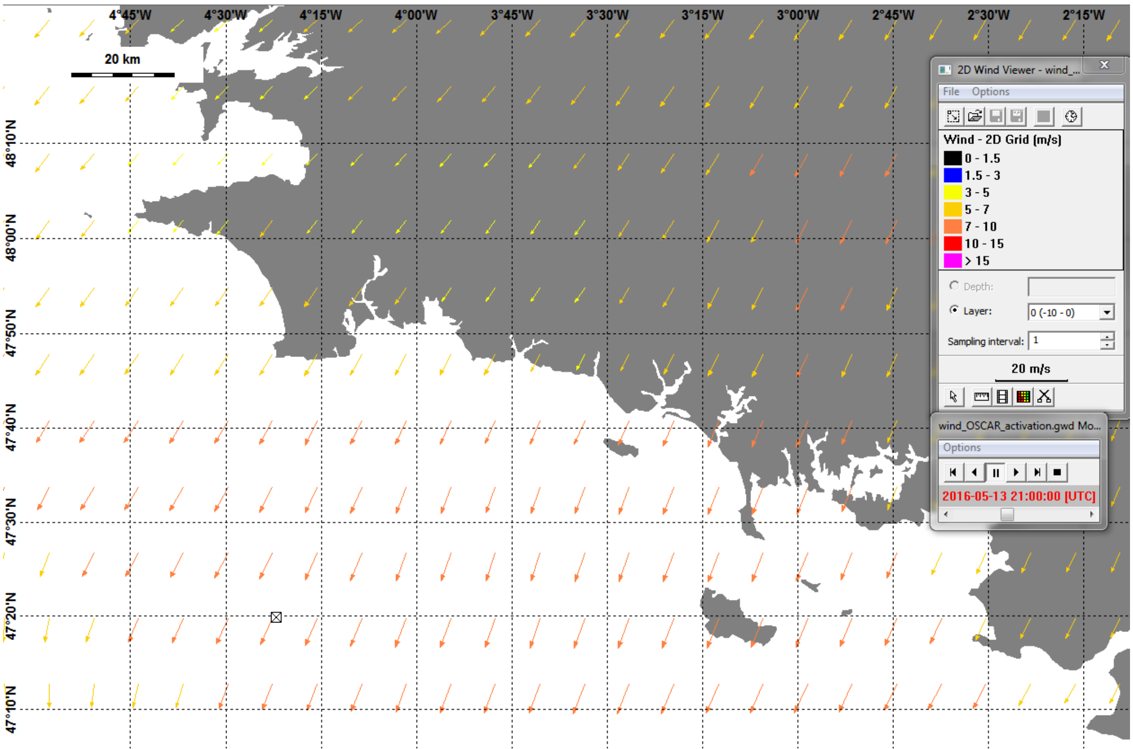

Figure 4: Snapshot of NCEP wind data imported in OSCAR for May, 13th 2016

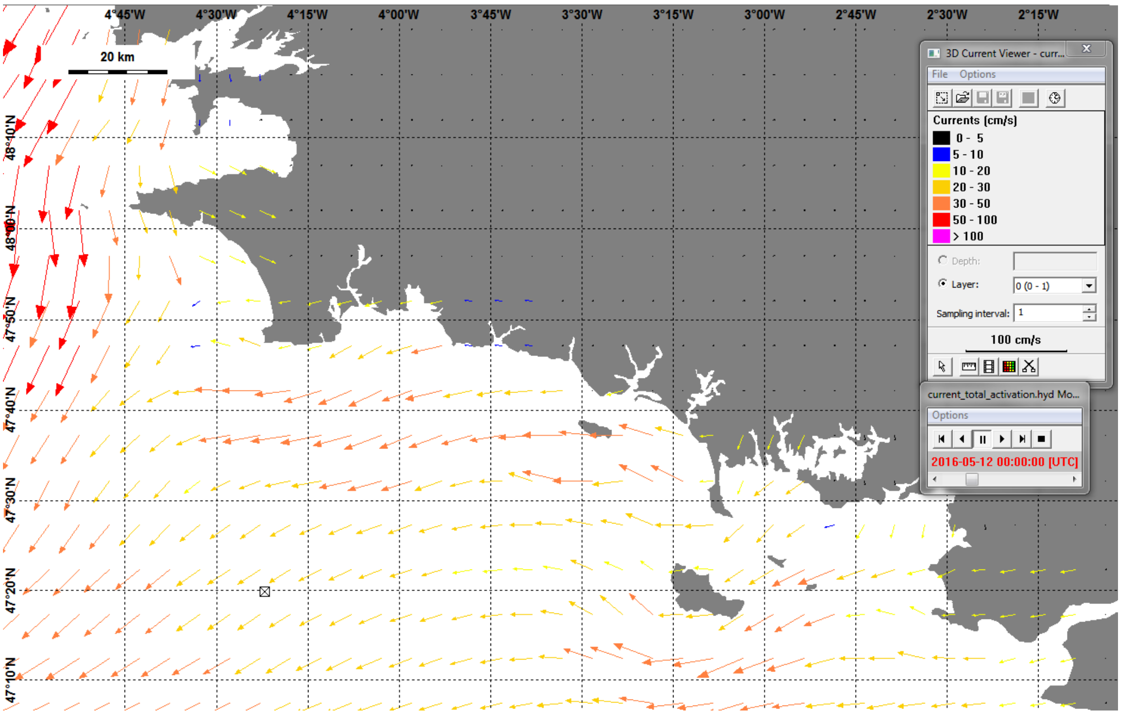

Figure 5: Snapshot of current field (current from Copernicus and tide from AVISO) for May, 12th 2016

d. Temperature and salinity profiles

Temperature and salinity profiles are extracted from the Global Ocean 1/12° Physics Analysis and Forecast of Mercator Ocean at the release location. As OSCAR doesn't allow giving temporal series of temperature and salinity in input, a profile averaged on the simulation time is set up.

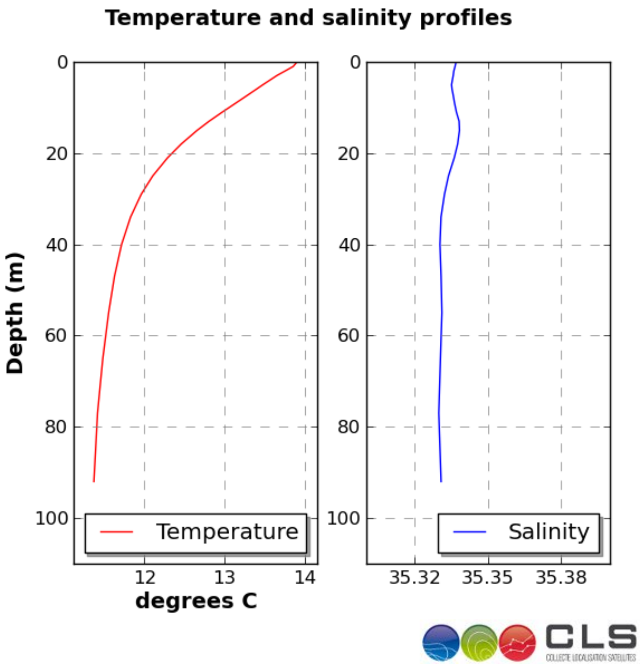

Figure 6: Temperature and salinity profiles used inOSCAR simulation

3. Oil slick behaviour

A detailed analyze of the oil slick evolution is proposed in this section in order to help oil spill management. Figure 7 summarizes the oil spill behavior at the surface for the next 5 days.

During the first three days, the oil slick mostly remains contained around the release site. From that moment on, the oil slick spreads toward South-West under the influence of land breeze. Indeed, the current regime in the region during the simulation time is mostly driven by the tidal component. As the release occurred during the neap tide period, the current regime doesn't present a dominant tendency that could influence greatly the oil slick behaviour.

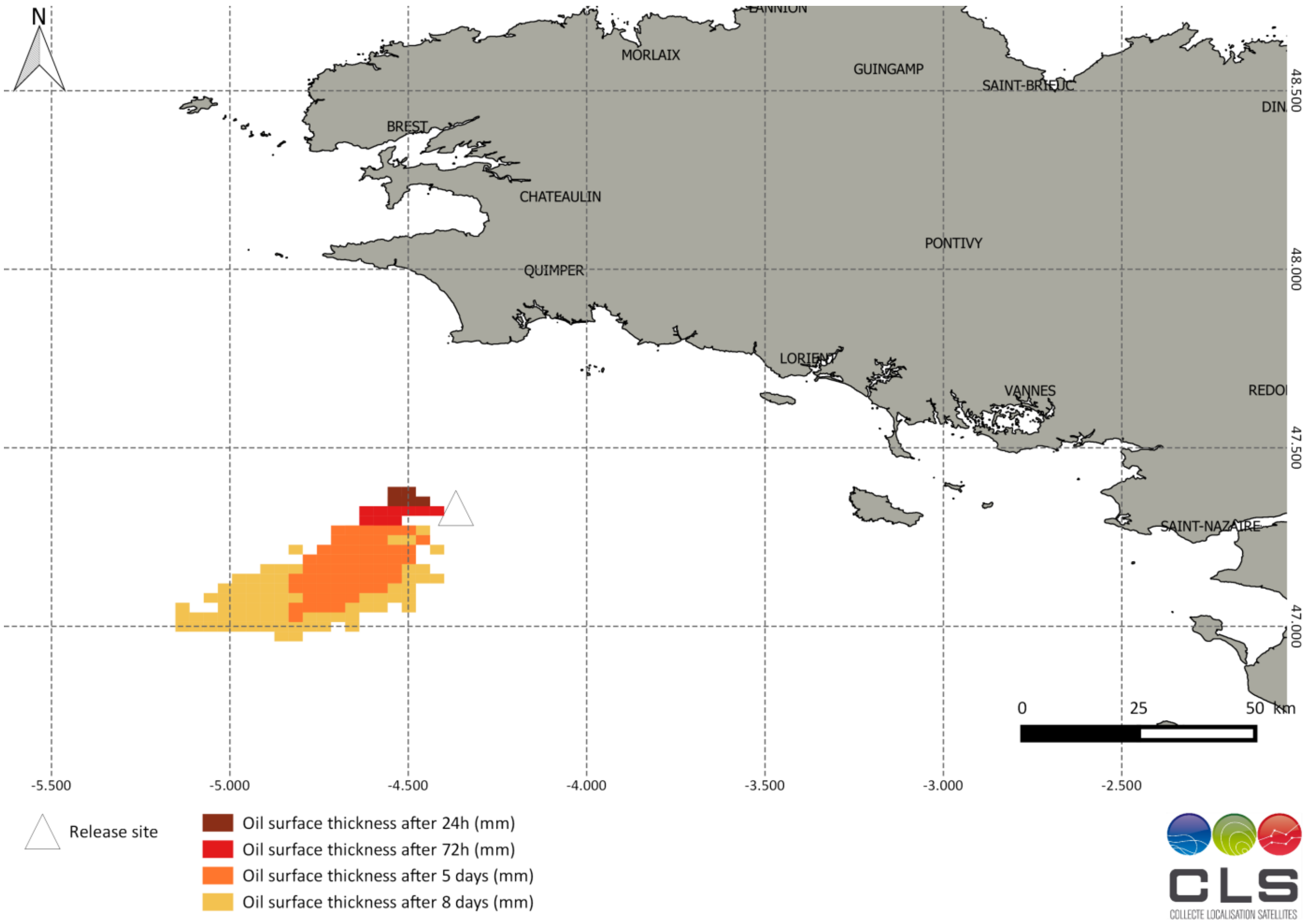

Figure 7: Chronological spreading of the surface oil spill

The detailed forecast is presented below in terms of surface oil thickness and mean concentration in the water column.

As it will be presented, the oil slick mainly remains on the surface, far from the shoreline. As a result, no sediment deposition or concentration along the shoreline can be observed 7 days after the release.

3.1 24-hour forecast

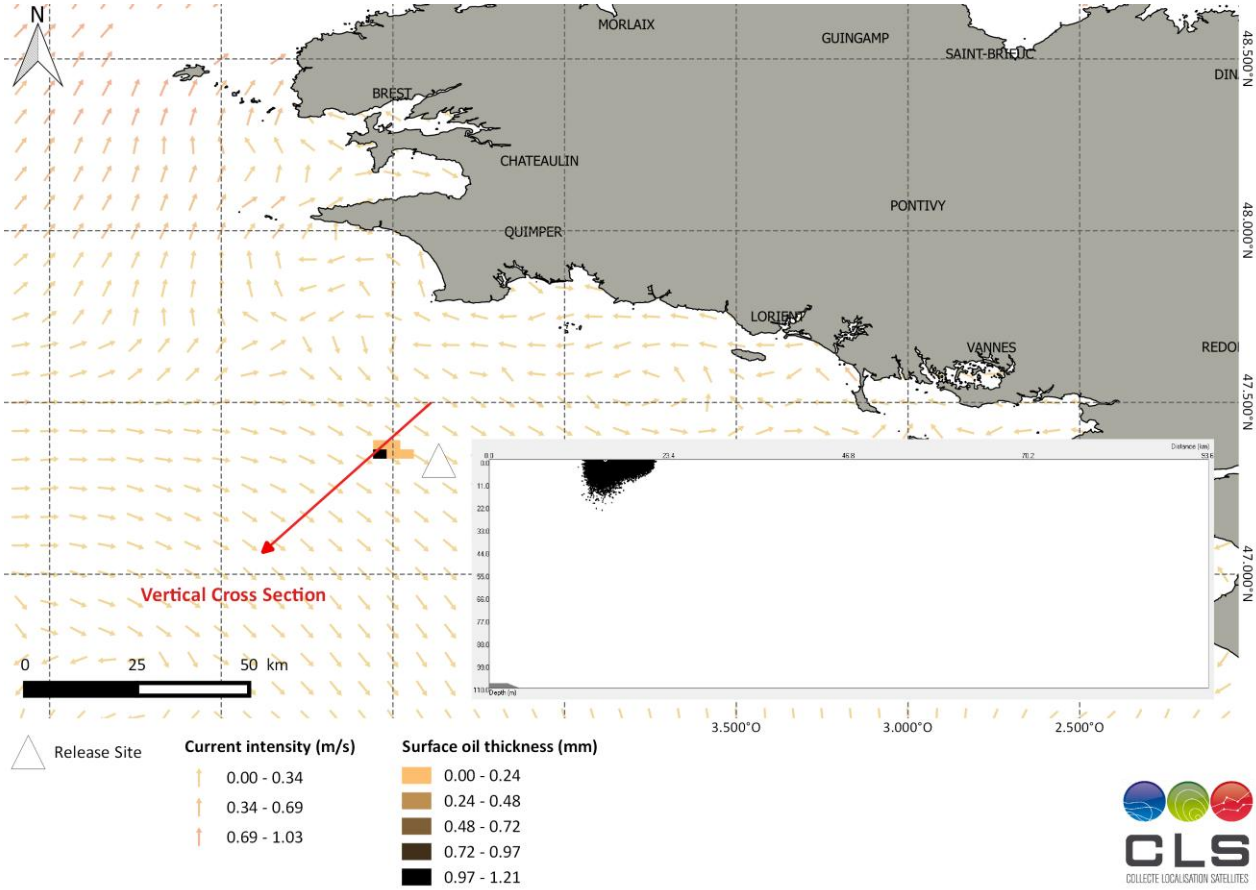

Figure 8: Maximum thickness of oil on the surface 24h after the release

The above figure presents a vertical cross section with the repartition of submerged particles. It may be noticed that it presents the bathymetry (nearly not visible in this section) along the vertical cross section and **all of the submerged particles emitted** (not only along this section).

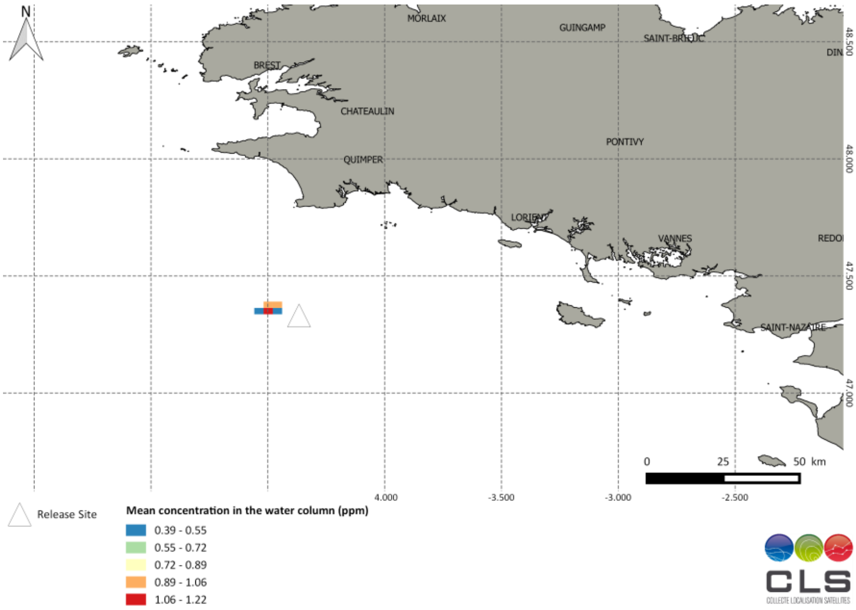

Figure 9: Mean concentration in the water column 24h after the release

3.2 72-hour forecast

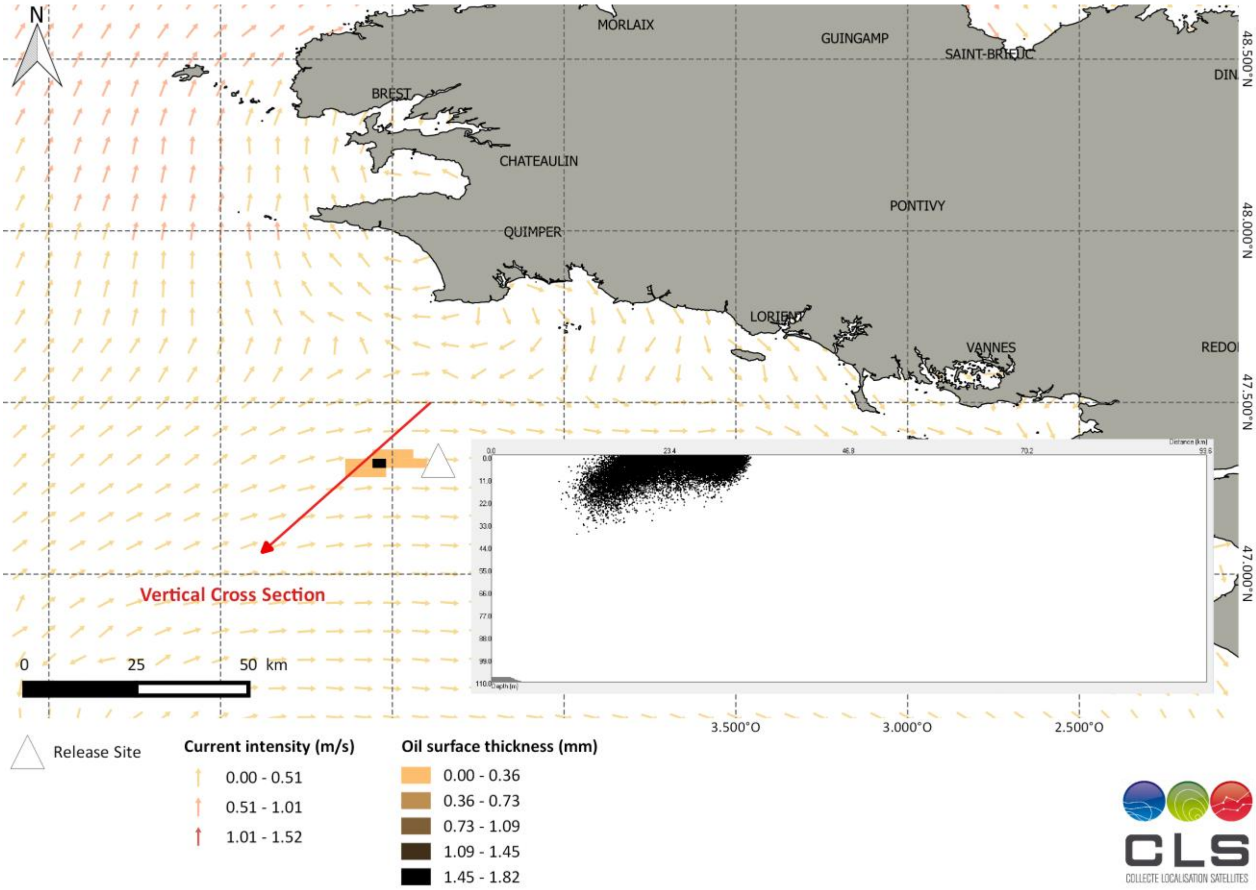

Figure 10: Maximum thickness of oil on the surface 72h after the release

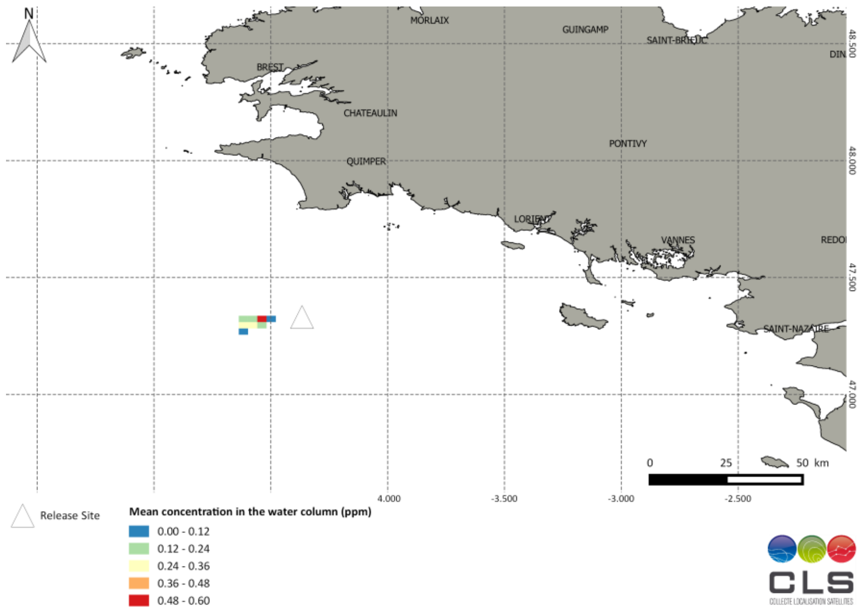

Figure 11: Mean concentration in the water colum 72 h after the release

3.3 5-day forecast

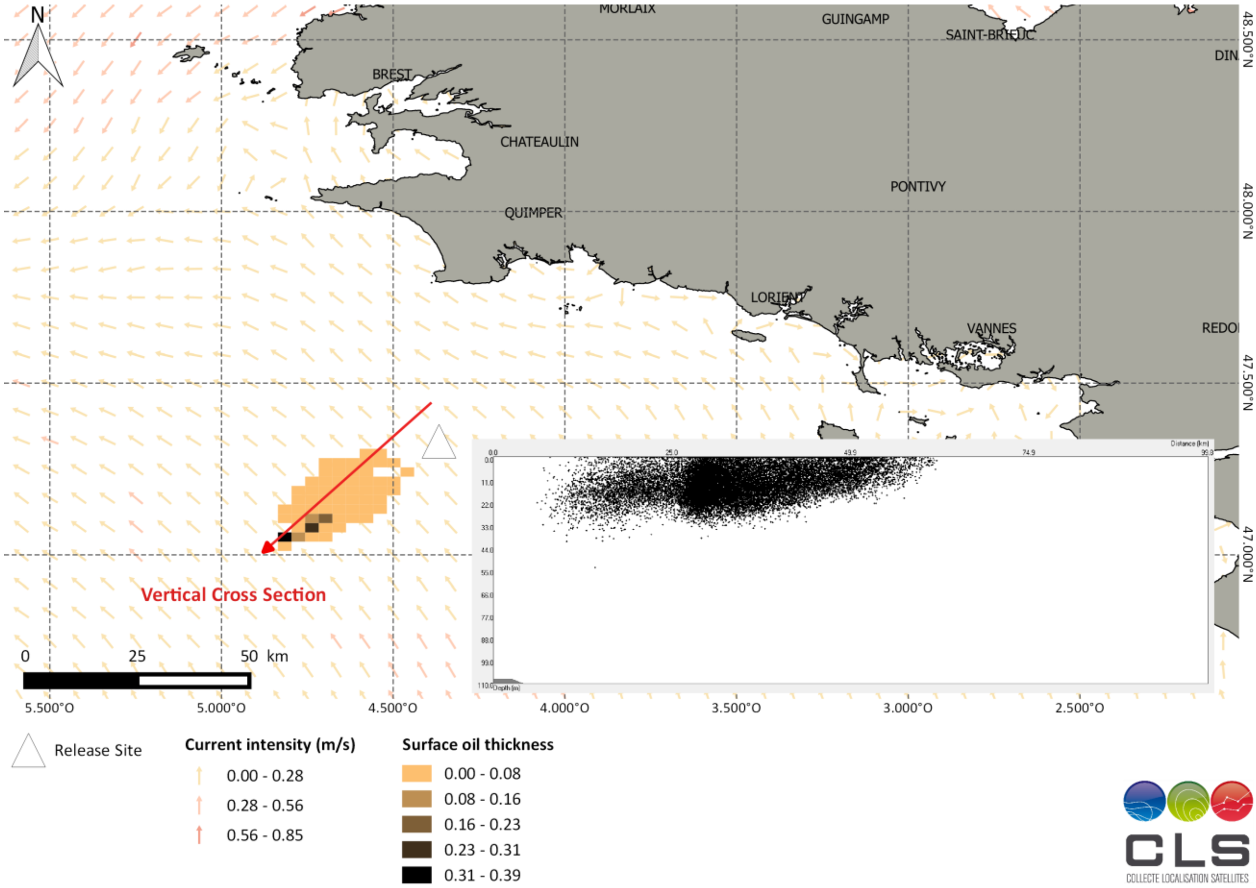

Figure 12: Maximum thickness of oil on the surface 5 days after the release

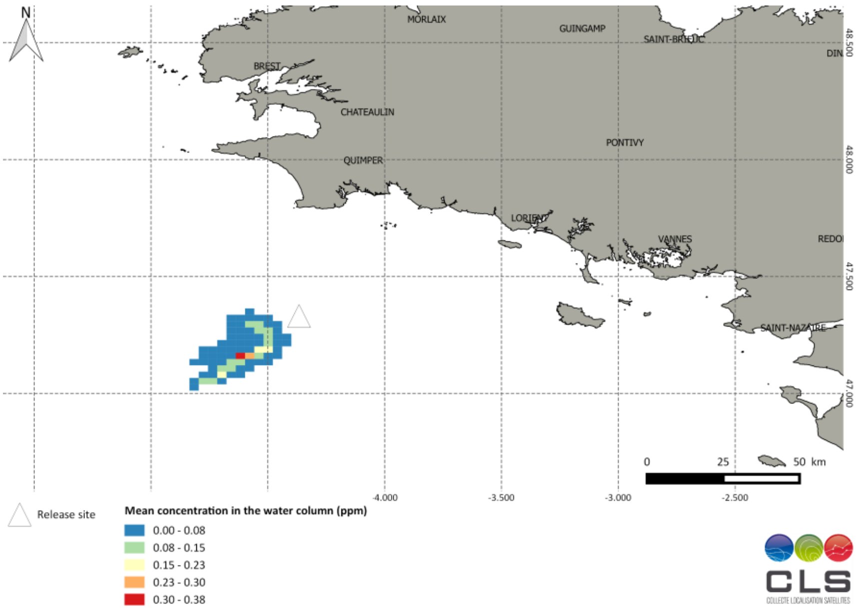

Figure 13: Mean concentration in the water column 5 days after the release

3.4 8-day forecast

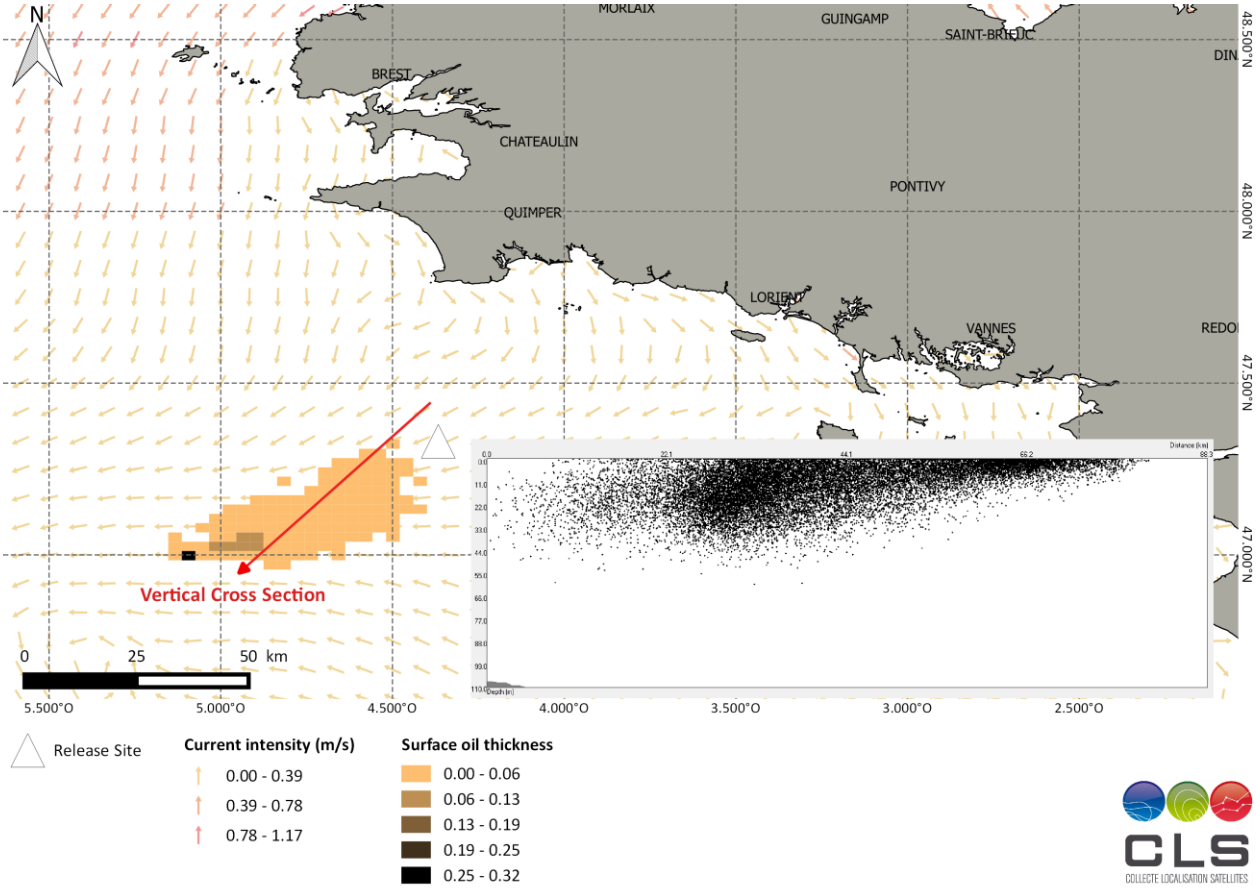

Figure 14: Maximum thickness of oil on the surface 8 days after the release

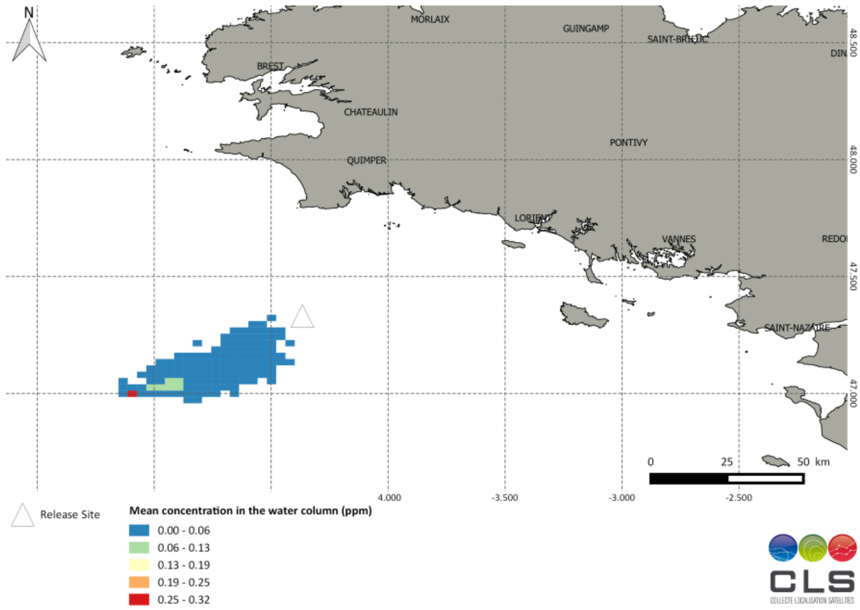

Figure 15: Mean concentration in the water column 8 days after the release

Mass balance for this simulation is presented in percentage in Figure 16. During the first three days, the oil slick mainly remains at the surface, and only a small percentage (< 1%) is evaporated. 80 hours after the beginning of the release, the slick starts to be dispersed and spreads reaching a maximum area of 6100 km² as presented in Figure 17. Moreover, N°6 fuel oil is persistent oil and due to its composition, only 2% has evaporated at the end of the simulation. During the 8 first days of simulation, the oil slick doesn't reach the sea floor and no impact will be noted on the sea bed substrate.

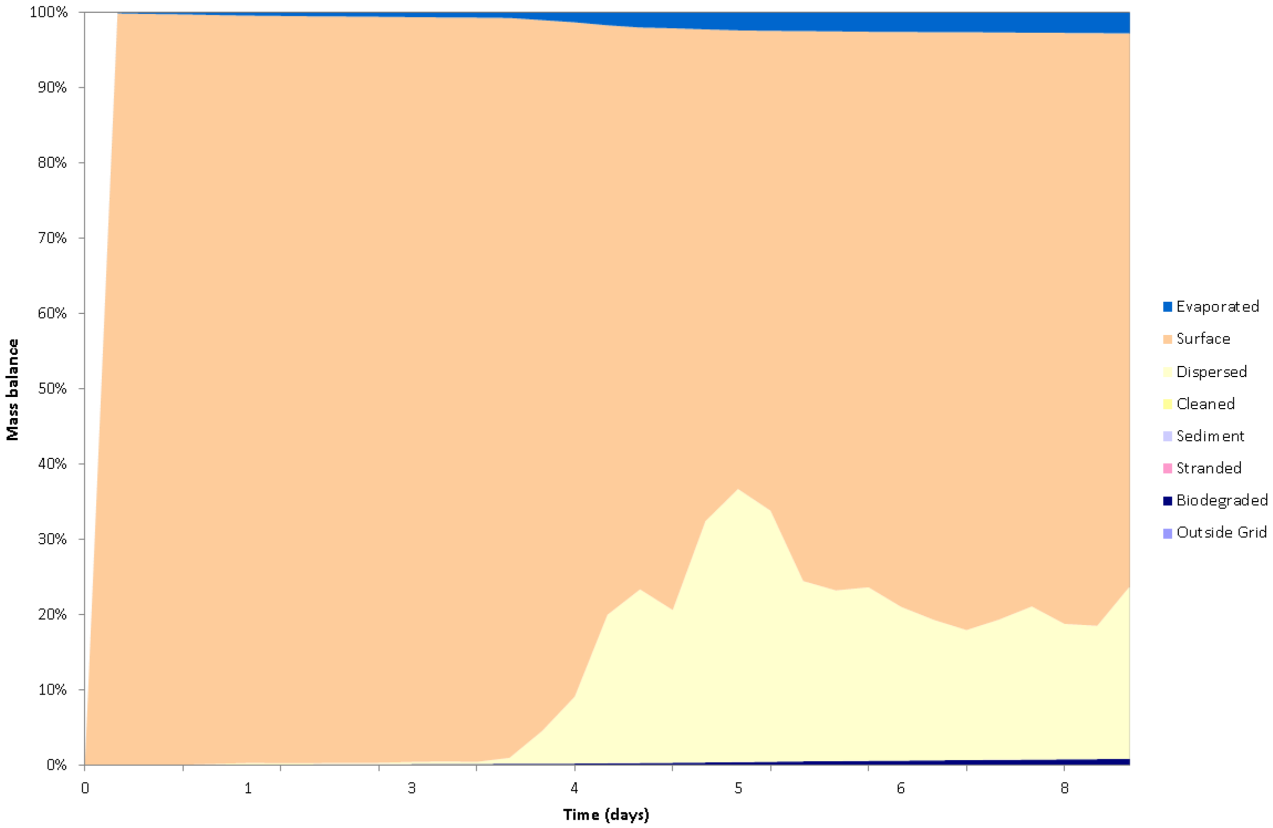

Figure 16: Mass balance in percentage for the simulation

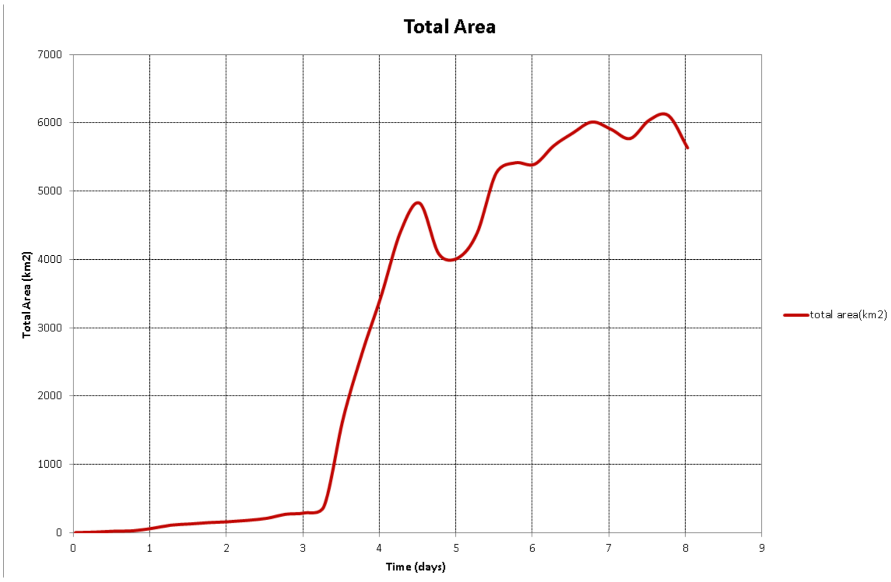

Figure 17: Evolution of the exposed area

3.5 Stochastic simulation

In order to get some confidence estimates, a stochastic simulation (combination of scenarios to generate probabilistic outputs for the oil fate) has been run. Stochastic results were based on 7 simulations run during a 8-day period and allowed to produce the following stochastic surface and water column maps. In both case, a threshold of 0 mm (surface thickness) and 0 ppm (total concentration) has been used in order to make the resulting maps as conservative as possible.

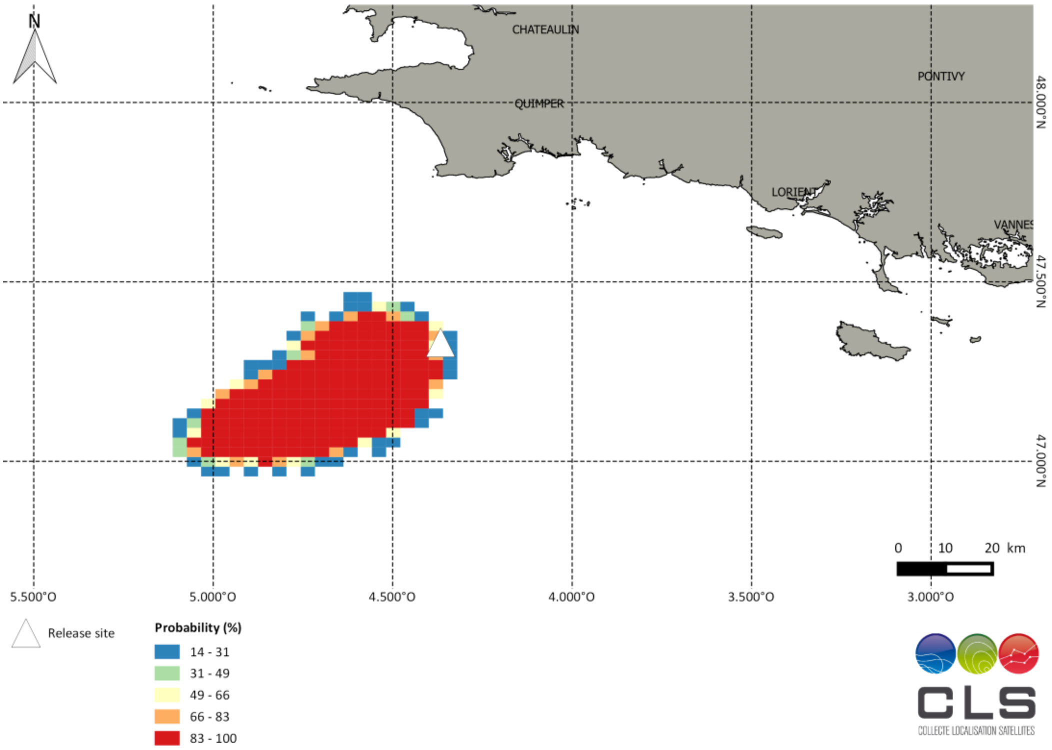

Figure 18: Water column probability map of contamination after 8 days

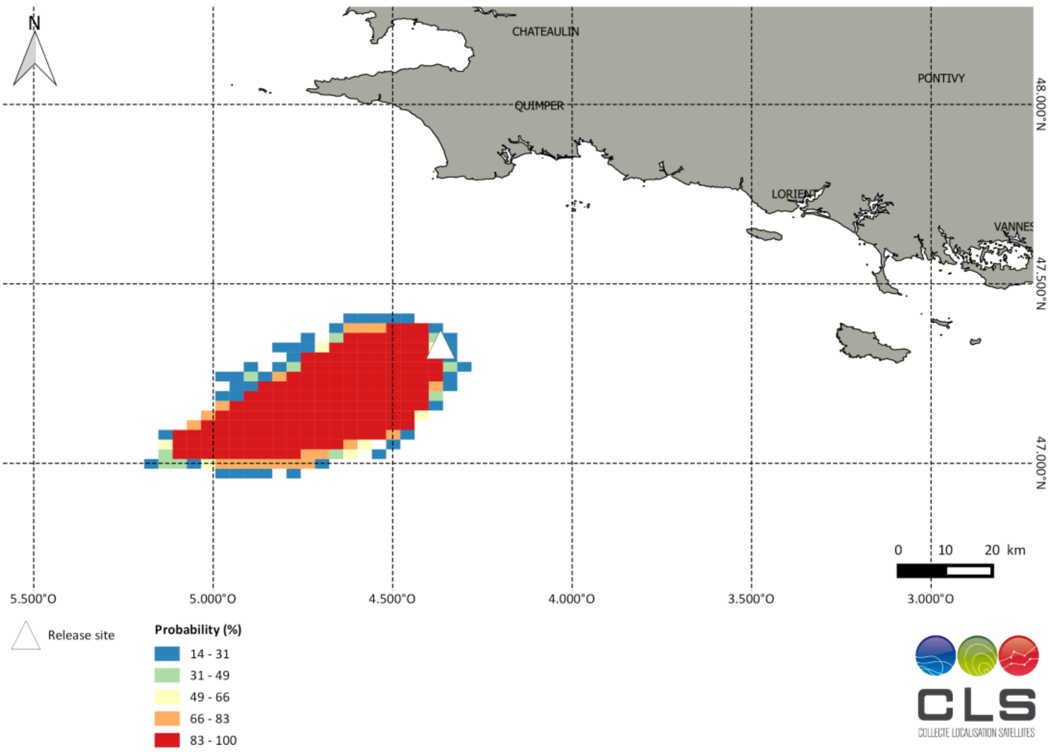

Figure 19: Surface probability map of oil contamination after 8 days

3.6 Remarks on the results

The oil profile defined for the heavy fuel oil n°6 assumed in OSCAR model has a API 15.1and a specific gravity 0.965. However the specific gravity of heavy fuel oils can vary from 0.965 to greater than 1.03. As the specific density of seawater is 1.03, the oil can float, suspend in the water column or sink. A greater specific density could result in a different behaviour of the oil slick and especially in a higher deposition on the sea floor. Moreover, the water density driven by the salinity and temperature is also a determining factor that dictate if the oil will sink or float (NOAA)

Another key point, is the influence of the wave field in the natural dispersion of the oil slick. Indeed, this process results in the transfer of the oil from the surface to the water column. The oil can be dissolved in the water column or remain in the form of droplets. The main forcing for this process are the wind and the waves. In OSCAR, the calculation of the wave height is done by the model and only takes into account the local wind, omitting potential swells. As a result, the dispersion process may be underestimated by the OSCAR model.

Moreover, the current forecast provided by Mercator doesn't extend beyond 5 days, which limits the the duration of the simulation and then the capacity to anticipate.

4. Impact assessment

This section presents the impact assessment on the affected area considering different aspects of analysis such as existence of marine protected areas, sensitive ecosystems or human activities (industrial or touristic). Considering the oceanic and atmospheric conditions when the accident took place, the oil slick hasn't spread in direction of the coast and no deposition on the sea floor can be observed 7 days after the release.

As a result, no impact has been noted on Marine Protected Area or Natura 2000 sites.

The mariculture activities are unlikely to be affected as there is no finfish production site in the affected area and the shellfish production sites remain quite far from the impacted area.

No wind farm or hydrocarbon extraction sites (platforms) are present in the region.

As for the touristic activities, no tourist beach (identified from the quality of bathing water) of the region will be affected.

The following figures present the different aspects of the impact analyse.

4.1 MPA and sensitive ecosystems

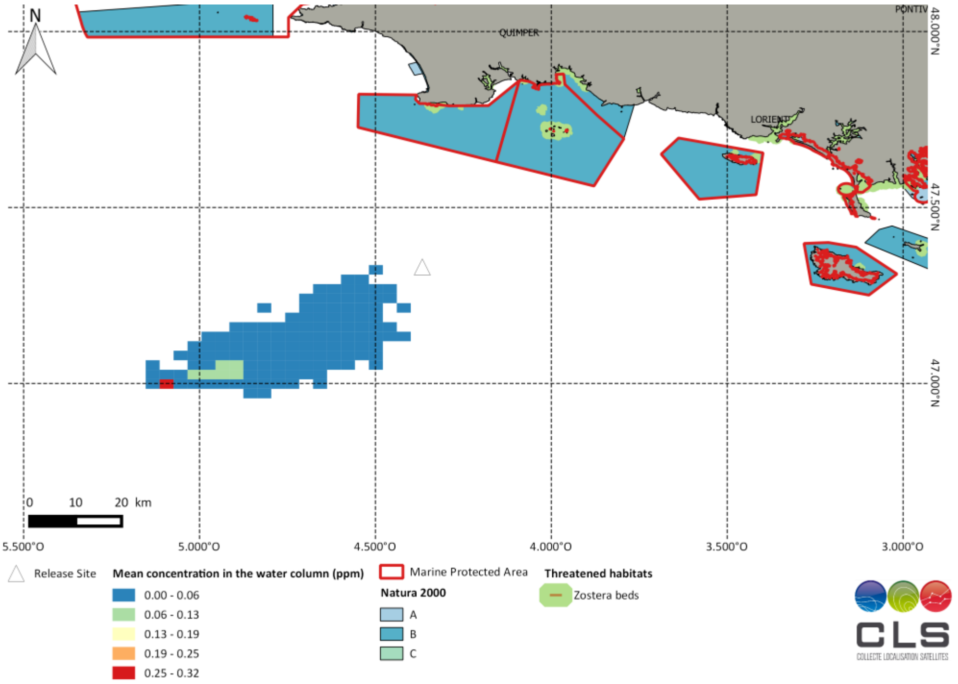

Figure 20: Impacted area 8 days after the oil spill (mean concentration in the water column)

4.2 Fisheries and aquaculture

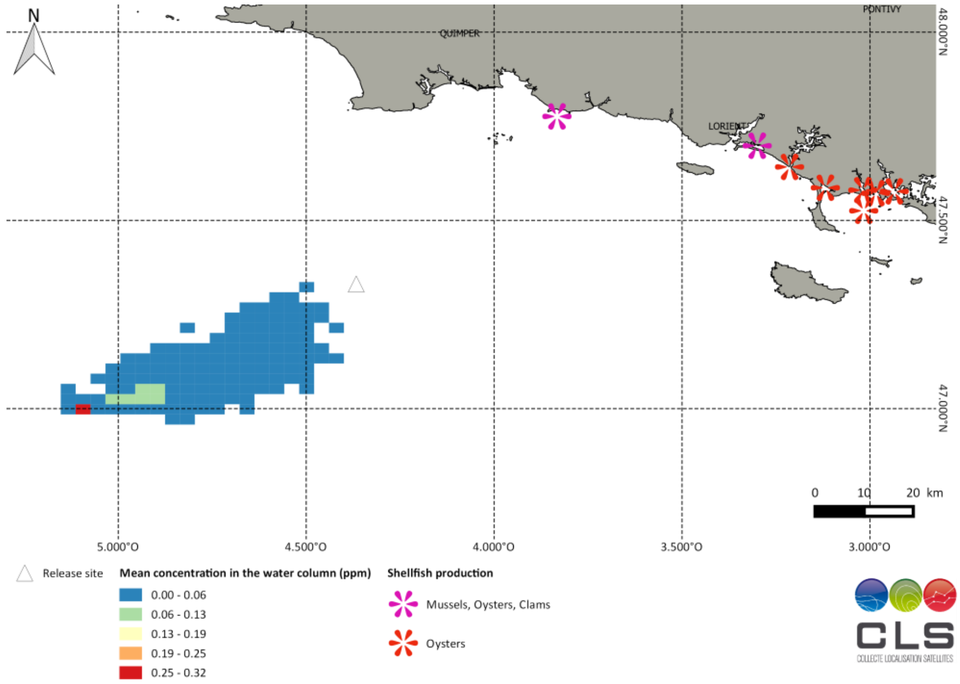

Figure 21: Impacted area 8 days after the oil spill (mean concentration in the water column)

4.3 Other human activities

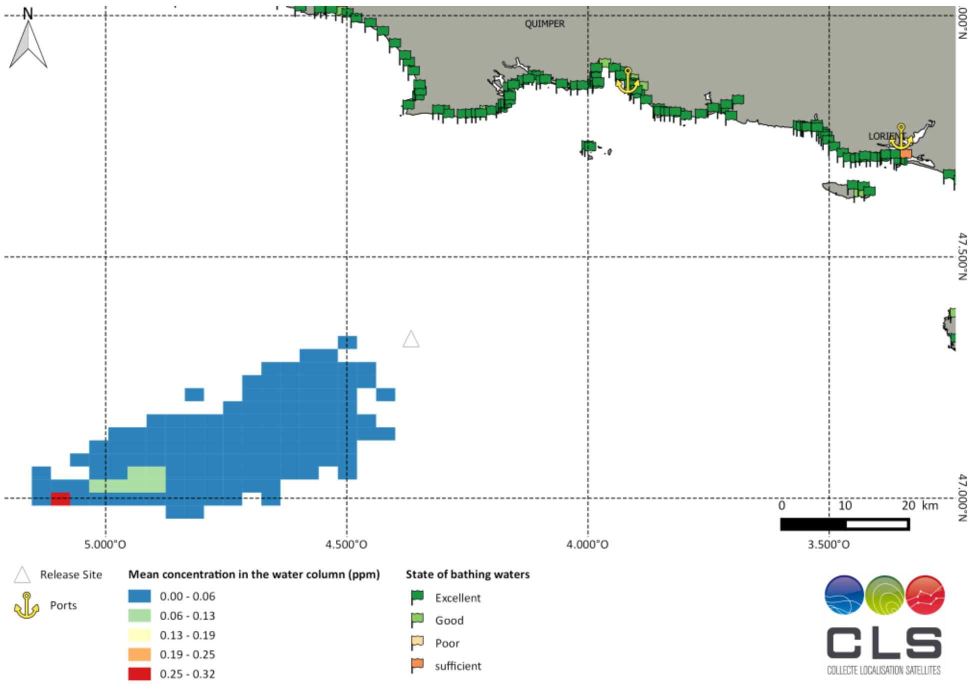

Figure 22: Impacted area 8 days after the oil spill

Finally, the impacts on environment and human activities associated to this oil accident remain very moderated. A long-term stay of the oil in the water column may lead to sediment contamination but the slow spreading of the oil slick and its tendency to remain floating at the surface may turn easier the set up of a contingency and collect campaign.

5. Assessment of data and recommendations

The purpose of the EMODnet Sea-Basin checkpoints is to analyse the marine data collections available for the North-Atlantic basin and to examine how relevant they are to solve problems and challenges such as the exercise presented in this report.

Through this oil leak alert, it is aimed to demonstrate the value of marine data resources and information systems and to assess the adequacy of such datasets (performance, visibility and accessibility criteria). To achieve the exercise within 24 and 72 hours, it is necessary to get an ensemble of data quickly available, with easy access and generic format.

The data collection collected is quite complete and enables a fast and efficient forecast of the oil spill behaviour and assessment of impact. This assessment is particularly well achieved for environmental aspect a various data has been found about marine protected area, environmental threatened species, etc…

Some data gaps relative to human activities have been identified and are presented below. Please note that those gaps are relative to the **curent exercise**. A more detailed and complete analyse will be found in the *data adequacy report.*

- Assessment of the impact on fishery activities: limited as no dataset relative to the importance of fishery efforts for a given location (more restricted than FAO fishery statistical areas) has been found.

-**Assessment of impact on tourist beaches:** the dataset used refers to the quality of bathing water (EMODnet dataset). However, a better indicator (relative to beach use or proximity to infrastructures such as parking or camping) could be set up.

-**Assessment of impact on marine traffic:** no shapefile database available (or at least, easily found) to assess and display in QGIS tool the impact of an oil spill on marine traffic.

6. Dataset used

Data Index	Dataset	Data provider	Data originator
CH4_Input1	Global Ocean 1/12° Ohysics Analysis and Forecast Daily	Copernicus Marine Environment Monitoring Service	Mercator Ocean
CH4_Input47	Global Tide – Fes2012	AVISO	Collecte Localisation Satellite
CH4_Input22	US Coastal Relief Model	National Environmental Satellite, Data, and Information Service	NOAA / National Geophysical Data Center
CH4_Input18	Global Forecast System	NCEP/NOAA	NCEP/NOAA
CH4_Input25	Digital Terrain Model	EMODnet Bathymetry	EMODnet Bathymetry
CH4_Input27	Predicted broad-scale EUNIS habitats - Atlantic area	EMODnet Seabed Habitats	Join Nature Conservation Comittee
CH4_Input32	Large Marine Ecosystems of the World	NOAA Fisheries Service	NOAA National Marine Fisheries Service
CH4_Input26	OSPAR Threatened and/or Declining Habitats 2014	EMODnet Seabed Habitats	Joint Nature Conservation Committee
CH4_Input39	Shellfish production	EMODNet Human Activities	EMODNet Human Activities
CH4_Input38	Finfish production	EMODNet Human Activities	EMODNet Human Activities

CH4_Input50	Wind Farm Sites	EMODNet Human Activities	EMODNet Human Activities
CH4_Input36	Inventory of Offshore Installations	OSPAR Convention	OSPAR Convention
CH4_Input43	State of Bathing waters	EMODnet Human Activities	European Environmental Agency
CH4_Input45	Word Port Index	National Geospatial Intelligence Agency	National Geospatial Intelligence Agency

7. Bibliography

NOAA, O. o. (n.d.). *no 6 fuel oil spill*. Retrieved 05 11, 2016, from NOAA: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/no-6-fuel-oil-spills.html