EMODnet Sea-basin Checkpoints Tender no MARE/2012/11

EMODNET Oil Platform Leak Bulletin

Date: 13/05/2016

The European Marine Observation and Data Network (EMODnet) is financed by the European Union under Regulation (EU) No. 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Programme to support the further development of an Integrated Maritime Policy.

Executive Summary

In August 2013 an incident occurred during a tanker loading operation at a buoy off the coast of the Sidi Kerir terminal of the Sumed pipeline (LAT: 31,130824N; LON: 29,75227E) with an estimated rate of 5000m3 Brent crude oil spilled during a period of 24 hours starting 8:15 CET on 13/08/2013. The accident went largely unattended in the aftermath of the 2013 Egyptian Coup d'état during a period of unrest and instability.

The EMODnet Oil Platform Leak (OPL) Bulletin has been produced after 24 hours from the DGMARE request reporting the simulation of the transport and transformation of the oil in the days following the incident and the likelihood of impacts on the environment, considering the available forcing data sets for wind and current fields to run a MEDSLIK-II simulation.

The short daily summaries (each morning before 11:00 CET) with few illustrations of the results are provided for informing interested stakeholders.

Preface

On May the 10th 2016 at 11.23 DGMARE alerted about the following situation (Fig.1):

"In August 2013 an incident occurred during a tanker loading operation at a buoy off the coast of the Sidi Kerir terminal of the Sumed pipeline (LAT: 31,130824; LON: 29,75227) with an estimated rate of 5000m^3 Brent crude oil spilled during a period of 24 hours starting 8:15 CET on 13/08/2013. The accident went largely unattended in the aftermath of the 2013 Egyptian Coup d'état during a period of unrest and instability."

Figure 1: Release point of the oil spill (LAT: 31,130824; LON: 29,75227).

Bulletin Content

- Hindcast of currents and wind
- Fate, transport and dispersion of the oil at the surface and on coasts during the first 72 hours from the time of the incident

- Potential Impact on environmental and human activities

Data and Method

Tab.1 summarizes the input data used to run the oil spill models.

INITIAL ASSUMPTIONS	
OIL TYPE	Brent crude oil (API=38)
LEAK POSITION	LAT: 31,130824 LON: 29,75227
TIME OF THE LEAK	8:15 CET on 13/08/2013
DURATION OF SPILLAGE	24 hours
RATE OF SPILLAGE	177 Ton/hr
TOTAL AMOUT OF OIL SPILLED	5000m3

Tab 1: oil spill model set up parameters

The production of the OPL-Bulletin relies on the availability of meteo-oceanographic analyses for the Mediterranean Sea provided through CMEMS (Copernicus Marine Environment Monitoring Service) portal and other national forecasting systems. The necessary input characteristics are:

- Horizontal velocity of the water column (currents)
- Temperature of the water column
- Wind velocity components
- Wave direction (not compulsory)

Two SCENARIOS have been simulated one at INGV and one at OC-UCY and Tab.2 summarizes the forcing datasets used for the OPL Bulletin in the two systems.

Ocean currents and temperature have been downloaded from the available CMEMS MED-MFC data archive containing daily averages of model analyses. Hourly data are not available for the past years since CMEMS maintains only a 30 days rolling archive for hourly data. Atmospheric analyses from ECMWF (SCENARIO 1) are available for the test period. SCENARIO 2 considered 1-hourly SKIRON wind fields and CYCOFOS 3 hourly wave simulations.

SCENARIO	1	2
Production Centre	**INGV**	**OC-UCY**
Oil spill model	**MEDSLIK II**	**MEDSLIK**
WIND	**ECMWF**	**SKIRON**
temporal resolution	6 hours	1 hour
spatial resolution	25 km	5 km
update frequency	daily	saily
CURRENTS and SST	**CMEMS**	**CMEMS**
temporal resolution	daily means	daily means
spatial resolution	6.5 km	6.5 km
update frequency	daily	daily
WAVES	-	**CYCOFOS**
temporal resolution	-	3 hours
spatial resolution	-	10km
update frequency	-	daily

Tab. 1 Prediction systems implemented to produce the OPL-Bulletin results.

Description of the results

Oil spill after 2 hours
13/08/2013 10:15 CET

SCENARIO 1

Sea surface currents are estward (Figure 2) and turn slightly south approaching the coastline. Wind is north-westerly and reaches a velocity of about 6 m/s.

The oil spill 2 hours after the reported incident did not impact the coastal zone.

SCENARIO 2

In the Sidi Kerir terminal the sea surface currents are North-East, while the wind is North-West with low intensity as low as 3.1 m/s.

The oil spill 2 hours after the reported incident was at sea surface 82.9% without any impact at the coastal zone.

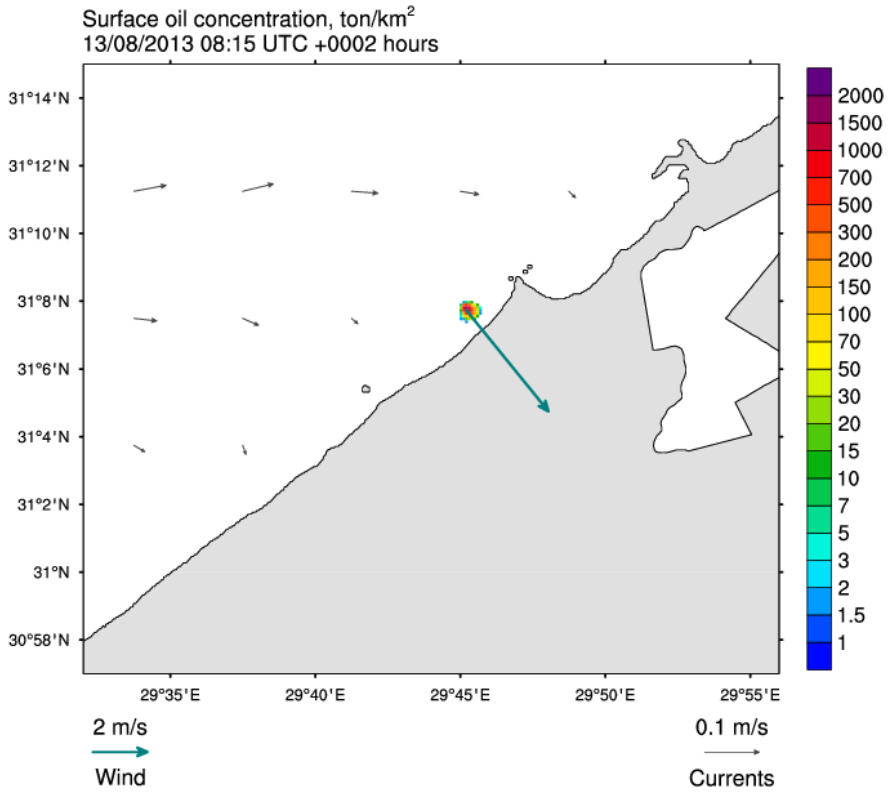

Figure 2: **SCENARIO 1** - Position of the oil slick at 10:15 of 13/08/2013 (oil concentration is given in units of ton/km^2) and the corresponding daily surface currents **(black arrows)** and wind **(green arrow)** produced by INGV.

Figure 3: **SCENARIO 2** - Position of the oil slick at 10:15 of 13/08/2013 (oil

	concentration is given in units of cu.m) and the corresponding daily surface currents **(black arrows)** and wind **(white arrow)** produced by OC-UCY.

Oil spill after 24 hours 14/08/2013 08:15 CET

SCENARIO 1

Sea surface currents are south-estward (Figure 3) and turn south approaching the coastline. Wind is northwesterly and reaches a velocity of about 6 m/s.

The oil spill impacted the coastal zone after 6 hours of simulation (15:15 CET) and there is a progressing beaching of the oil.

SCENARIO 2

The oil started to be beached at the coastal zone of Sidi Kerir terminal 3 hours after the reported time of the incident. After 24 hours of the oil spill incident, the oil on the coast (permanent and potential releasable) constitutes the 43.68% of the total released amount, while 39.20% was evaporated (Figures 4-5)

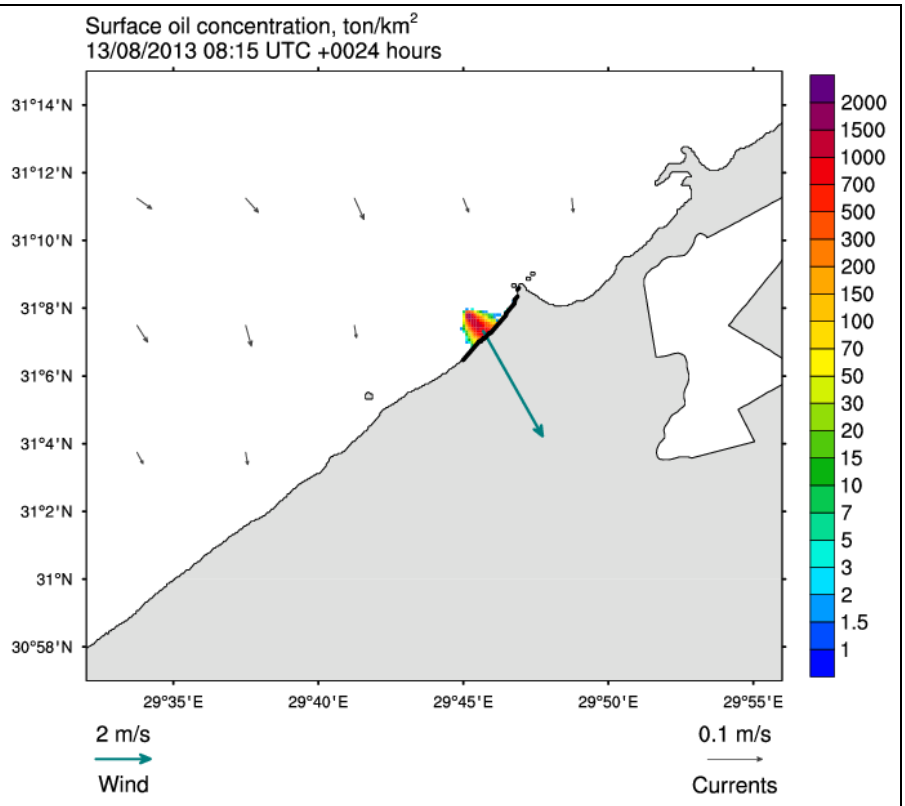

Figure 3: **SCENARIO 1** - Position of the oil slick at surface and on the coasts at 08:15 of 14/08/2013 (oil concentration is given in units of ton/km2) and the corresponding daily surface currents (black arrows) and wind (green arrow) produced by INGV.

Figure 4: **SCENARIO 2** - Position of the oil slick at 08:15 of 14/08/2013 (oil concentration is

given in units of cu.m) and the corresponding daily surface currents (black arrows) and wind (white arrow) produced by OC-UCY.

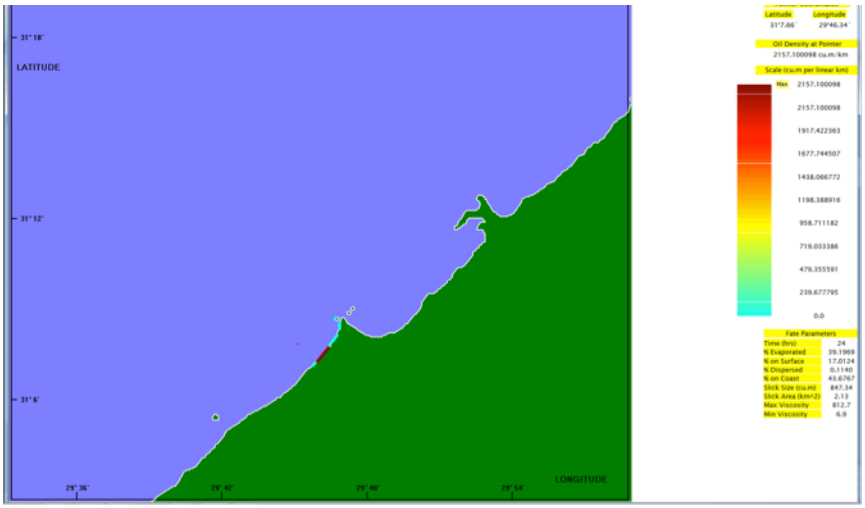

Figure 5: **SCENARIO 2** - oil on the coasts after 24 hours in cu.m.

Oil spill after 48 hours 15/08/2013 08:15 CET

SCENARIO 1

Surface currents are eastward, turning south-eastward and the wind is north-westerly at about 6 m/s. The oil stacks at the coastal zone.

SCENARIO 2

In the Sidi Kerir terminal the sea surface currents continue to be North-East, while the wind is West with low intensity 2.7 m/s. The oil stacks at the coastal zone (permanent and potential releasable constitutes the 42.64% of the total amount, while 57.33% was evaporated, during the 48 hours of the simulation.

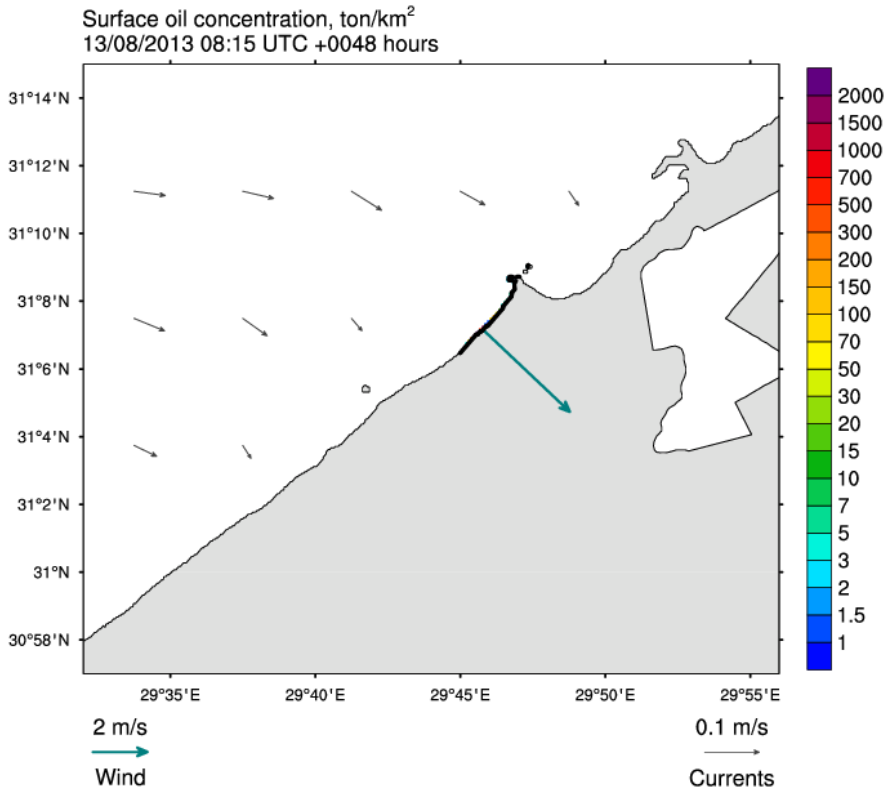

Figure 4: **SCENARIO 1** - oil at the surface and on the coasts in tons/km after 48 hours.

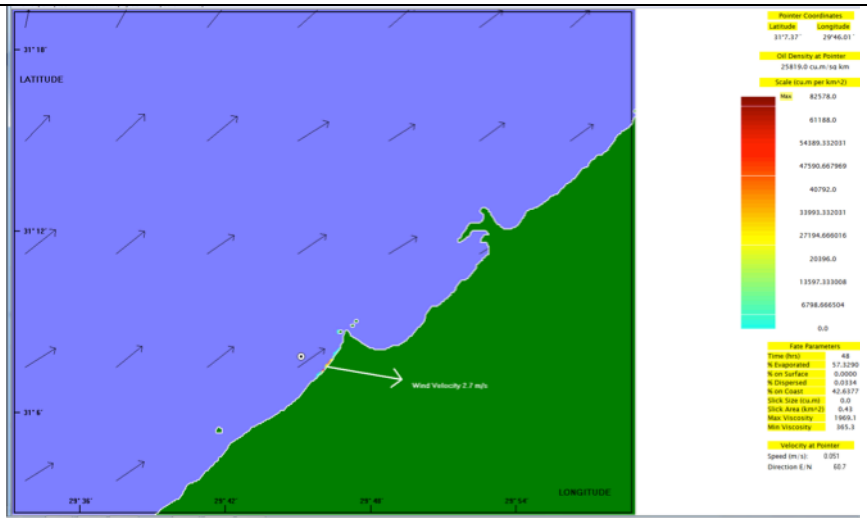

Figure 5: **SCENARIO 2** - Position of the oil slick at 08:15 of 15/08/2013, oil concentration is given in units of cu.m.

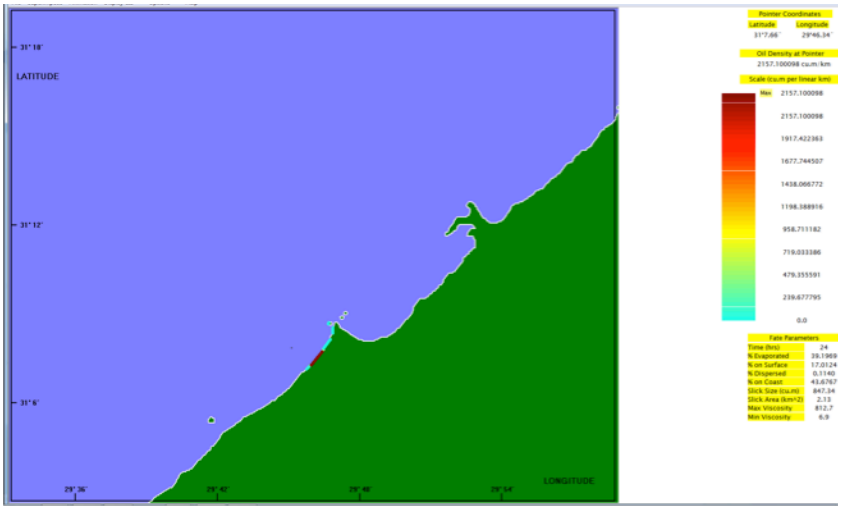

Figure 6: **SCENARIO 2** - oil on the coast after 48 hours in cu.m

Oil spill after 72 hours 16/08/2013 08:15 CET

SCENARIO 1

Surface currents are eastward, turning south-eastward and the wind is north-westerly at about 6 m/s. The oil stacks at the coastal zone.

SCENARIO 2

In the Sidi Kerir terminal the sea surface currents are continue to be North-East. The wind is North-West with low intensity as low as 3.2 m/s.

The oil stacks at the coastal zone (permanent and potential releasable) constitutes the 36.14% of the total amount, while 63.86% was evaporated, during the 72 hours of the simulation.

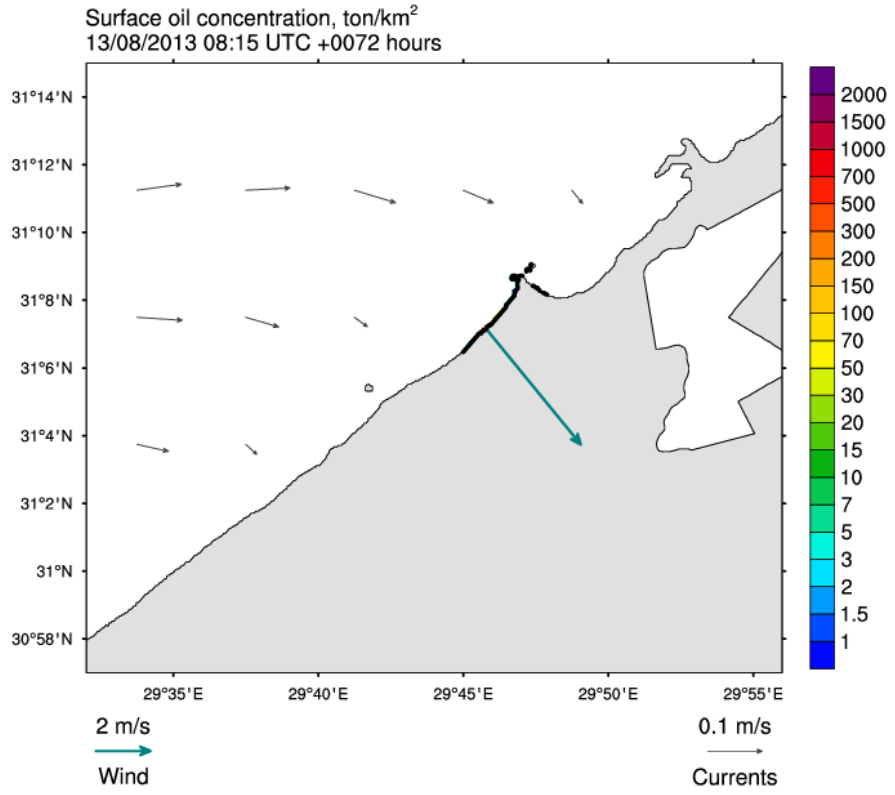

Figure 7: **SCENARIO 1 -** oil at the surface and on the coast in tons/km after 72 hours.

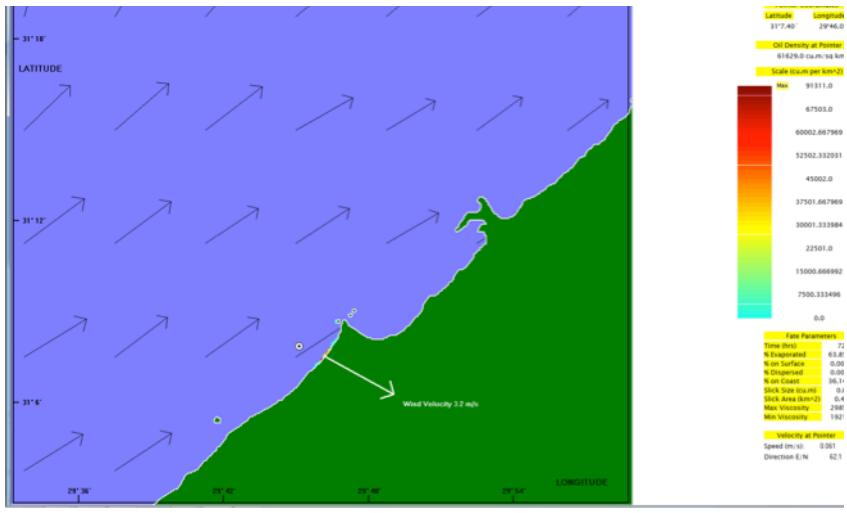

Figure 8: **SCENARIO 2** - Position of the oil slick at 08:15 of 16/08/2013, oil concentration is given in units of cu.m.

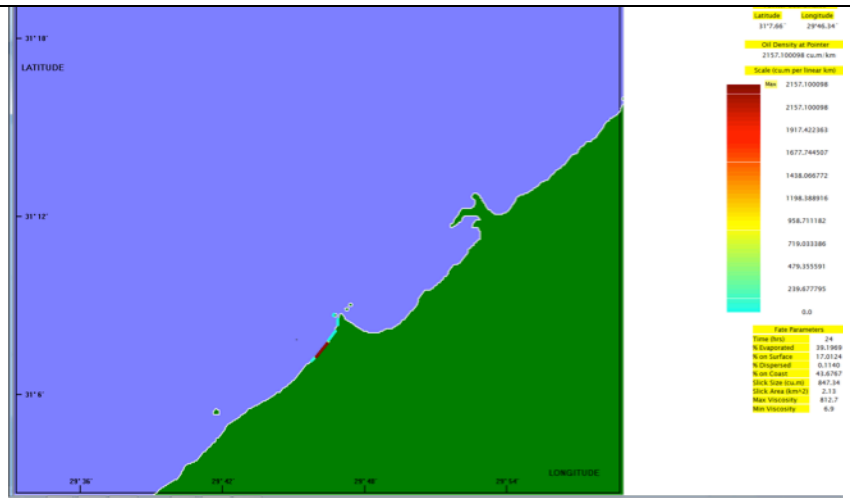

Figure 9: **SCENARIO 2 -** oil on the coast in cu.m after 72 hours.

Final discussion

Figure 10 illustrates the area average percentage of oil in four categories, evaporated, at the sea surface, dispersed in the water column and at the coasts for SCENARIO 1 and 2.

The results of both SCENARIOS showed that after 30-40 hours almost all the released, non-evaporated oil (Figure 10 red line) arrived on coast, mainly due to the persistent northwesterly winds and currents. The high percentage of the free oil on coast (potentially capable to return back to the sea) shown by both SCENARIOS is an indication of possible prolonged and extended coastal impacts up to 72 hours.

In **SCENARIO 1** about 30% of the oil evaporated in the first 8 hours and after 30 hours more than 50% of the oil evaporated. In **SCENARIO 2** the evaporated oil reaches 40 % in the first 8 hours of simulation and progressively increases up to 60% after 72 hours.

Furthermore Figure 11 presents the estimate of the **oil impact on coast** from SCENARIO 2. The estimated coastal strip impacted by the oil leak is 3.55 km long after 40 hours.

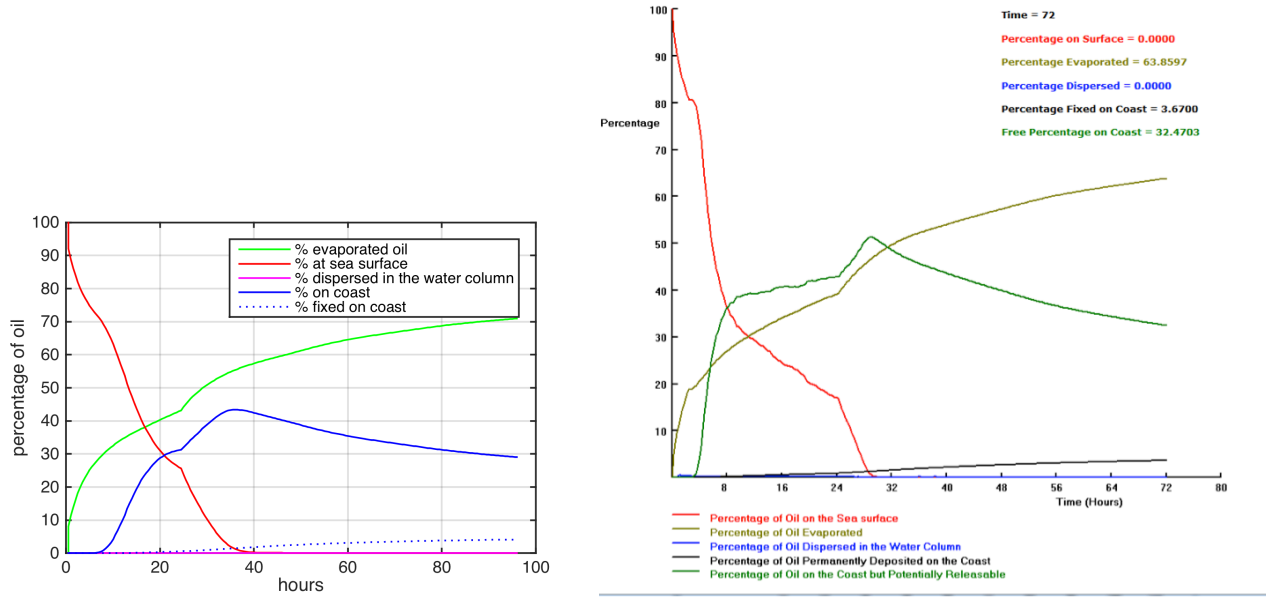

Figure 10: Percentage of the oil on four compartments: at the surface, dispersed in the water column, evaporated and at the coasts as a function of simulation time: (left) SCENARIO 1; (right) SCENARIO 2.

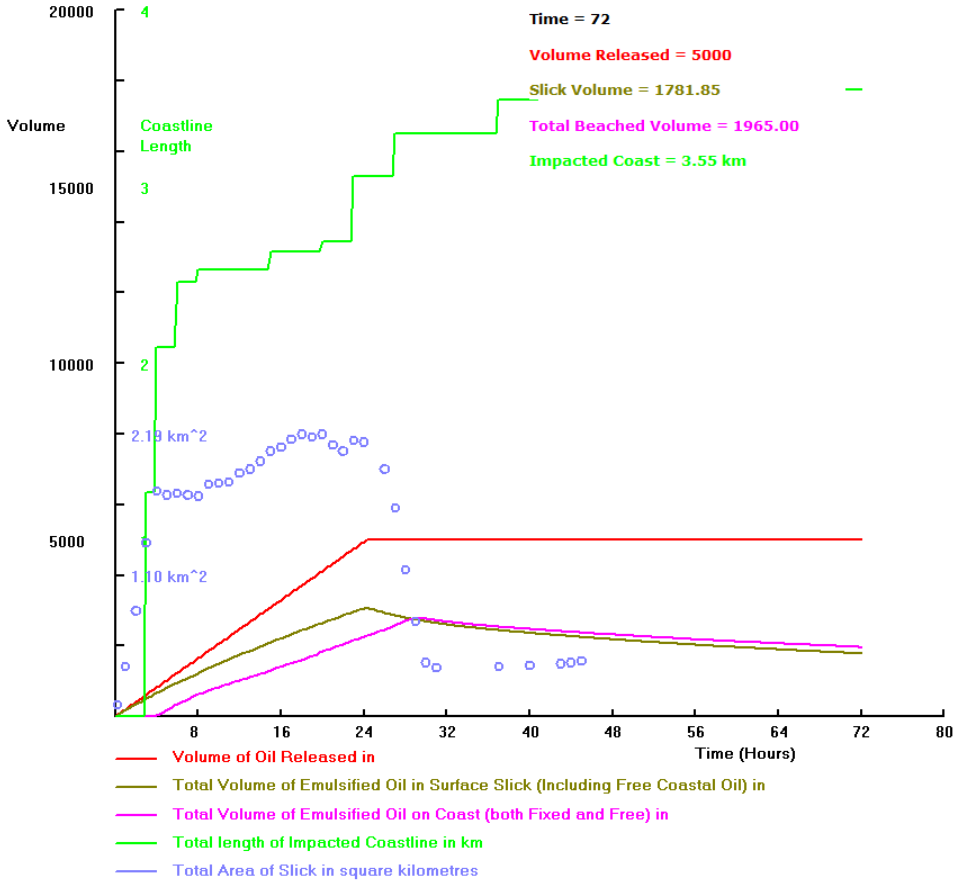

Figure 11 - SCENARIO 2 estimates of the oil impact on coast

Potential Impact on environmental and human activities

The assessment of potential impacts on the coastal environment and human activities needs additional data sets about key characteristics:

- Bathymetry and Elevation
- Coastal geomorphology
- Seabed substrate
- Marine and coastal infrastructures
- Mariculture
- MPAs
- Transport routes
- Use of coastal areas

The availability of this information has been first analyzed on the EMODNET tematic portals.

Bathymetry/elevation and coastal geomorphology

Information has been retrieved from the EMODnet Bathymetry web portal http://portal.emodnet-bathymetry.eu/, selecting the incident area and the interesting layers. The result is shown in Figure 12. The initial oil leak happened on the continental shelf, very close to the coast largely influenced by the Nile river delta. The bathymetry of the incident area is shallower than 50 meters.

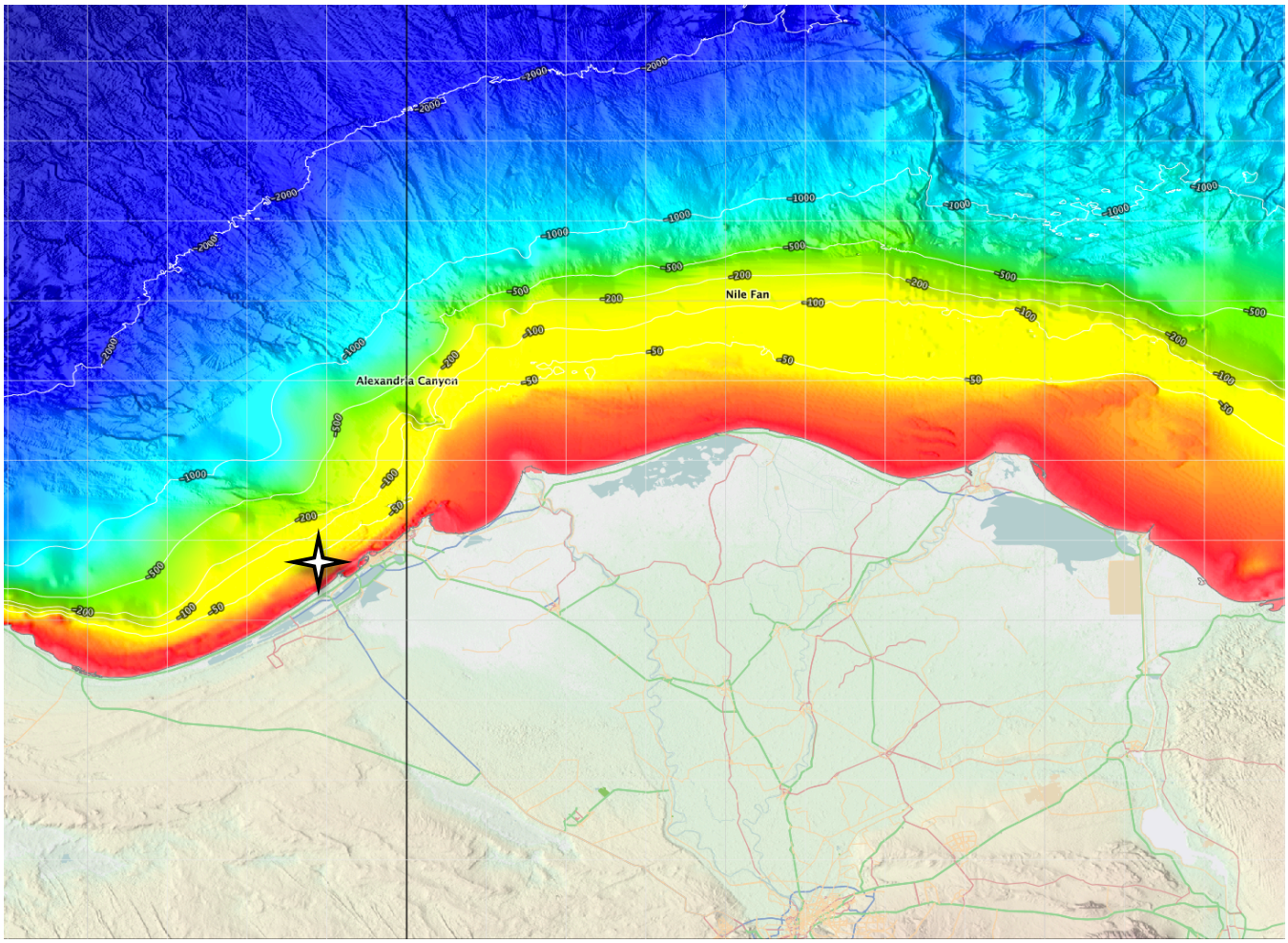

Figure 12 - Map of the Incident area containing layer information on: bathymetry, coastline depth contours, land geography and topography, coastal areas with high-resolution bathymetry, mean depth full coverage.

SeaBed Habitats

Information has been retrieved from EMODnet Seabed Habitat regarding modeled maps of specific habitats from MEDISEH EU Project:

- Figure 13 shows a very low probability (<10%) of having **coralligenous habitat** in the impacted area, being a river influenced area.
- Figure 14 shows high to very high (50-90%) probabilities to find **maerl habitat** in the impacted area, being a river-influenced area.
- Figure 15 shows high to very high (>50%) probabilities of finding **Posidonia Oceanica** nearshore area, with the exception of the Alexandria harbor.

Due to the high probability of having Posidonia Oceanica on the nearshore area impacted by the oil leak, the effects on the Seabed habitat and the ecosystem might be disastrous.

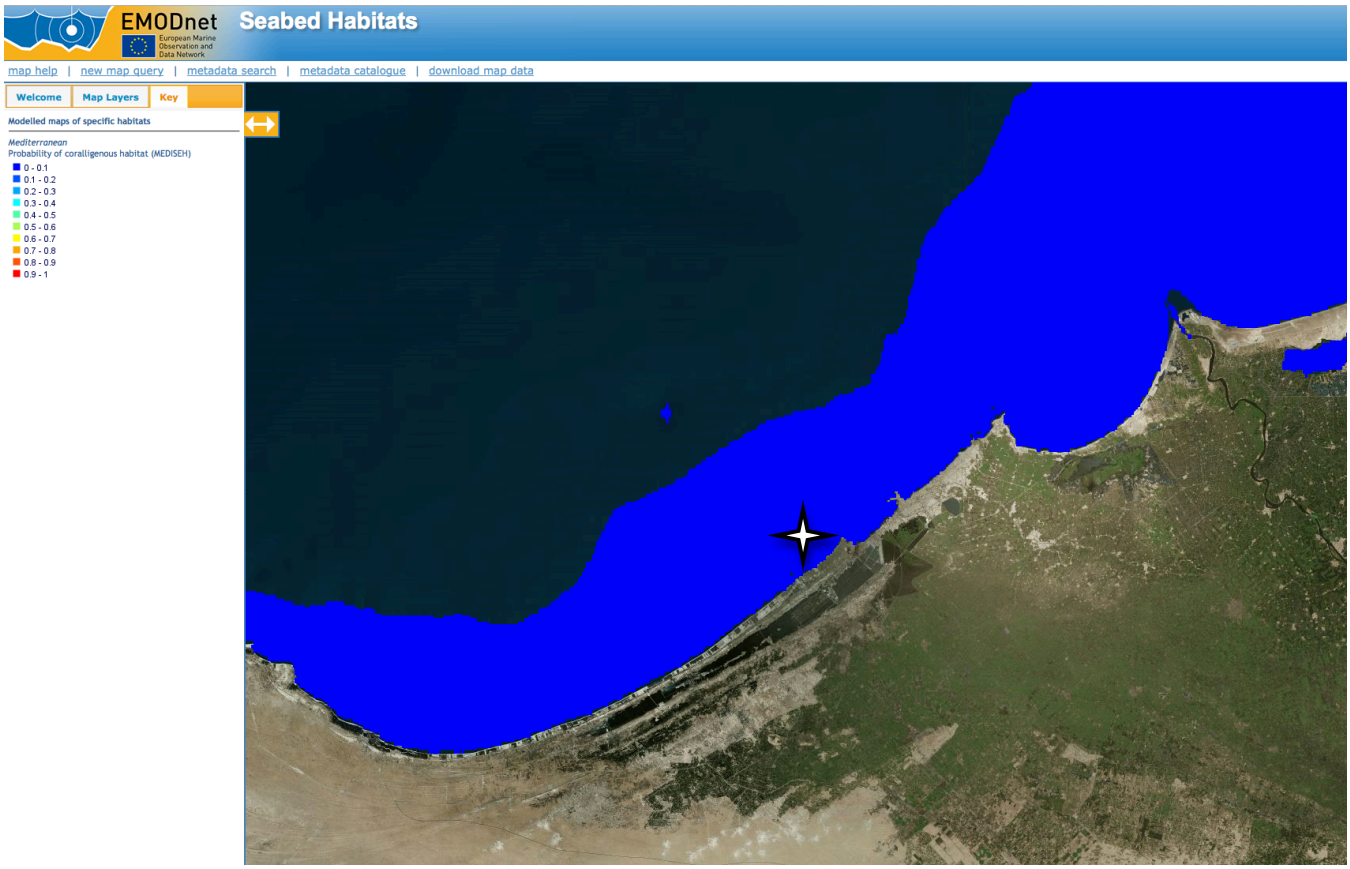

Figure 13 Modeled map of probability of Coralligenous habitat (from MEDISEH Project) retrieved by EMODnet Seabed Habitat web portal:
http://www.emodnet-seabedhabitats.eu/default.aspx?page=1974

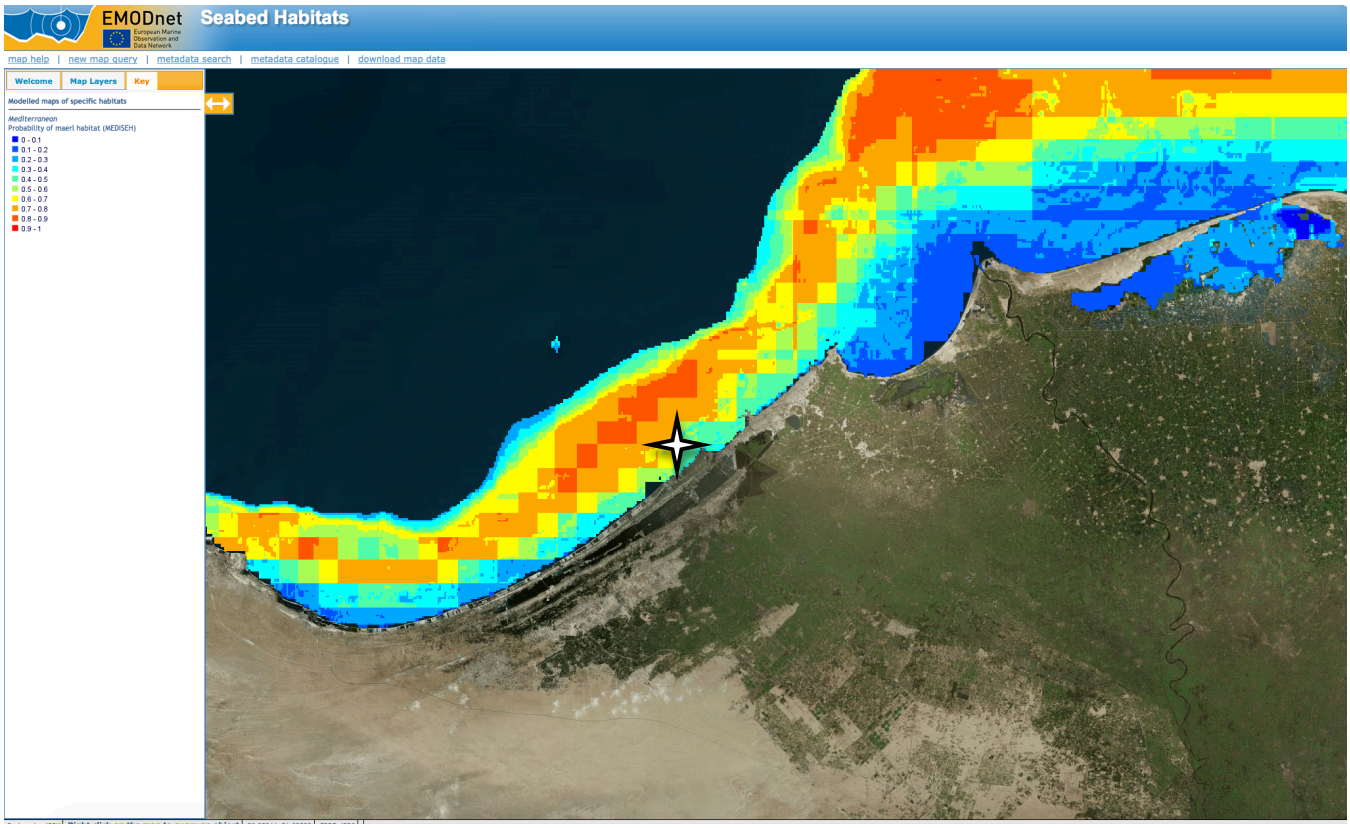

Figure 14 - Modeled map of probability of maerl habitat (from MEDISEH Project) retrieved by EMODnet Seabed Habitat web portal: http://www.emodnet-seabedhabitats.eu/default.aspx?page=1974

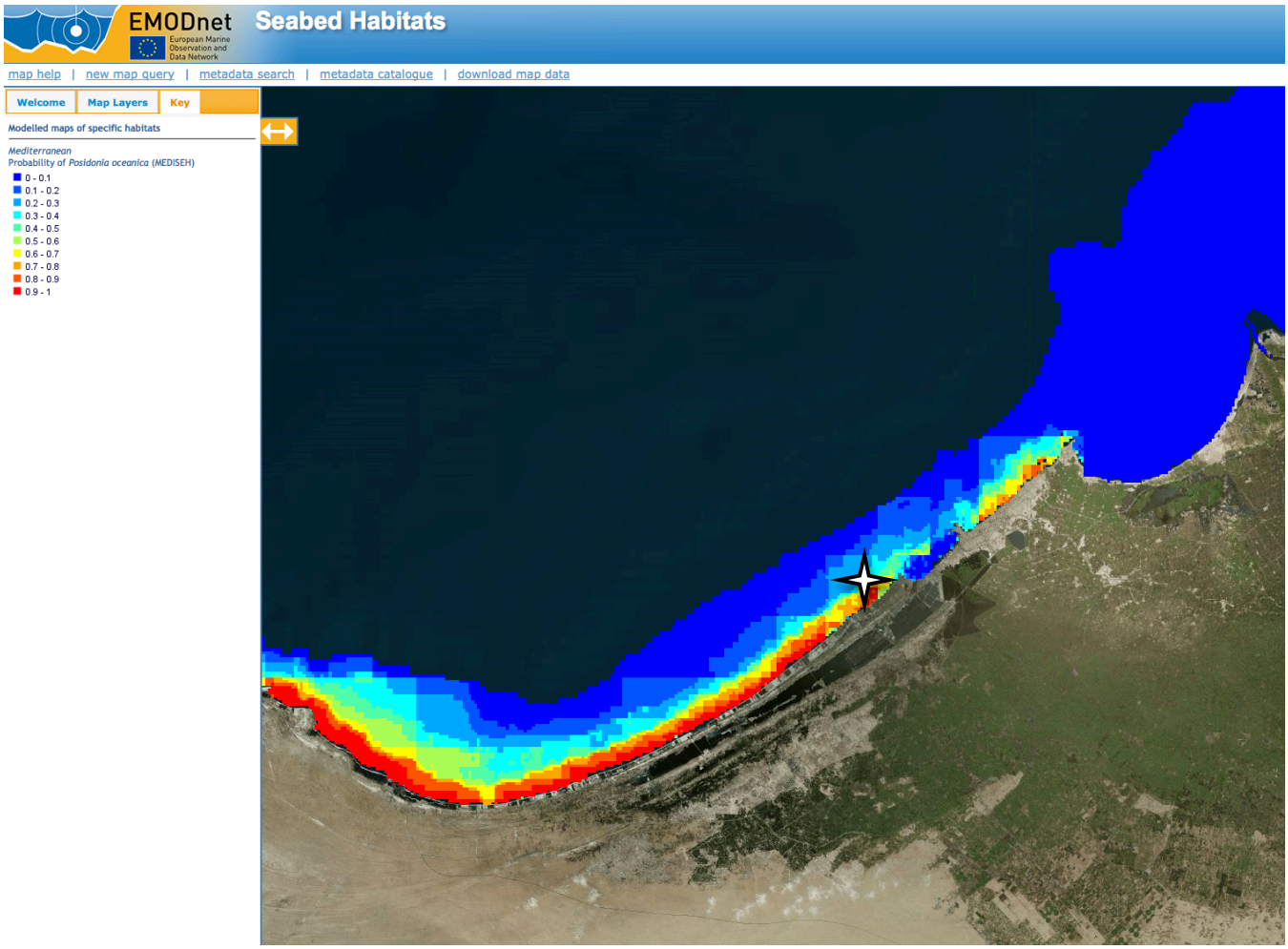

Figure 15 - Modeled map of probability of Posidonia Oceanica (from MEDISEH Project) retrieved by EMODnet Seabed Habitat web portal:
http://www.emodnet-seabedhabitats.eu/default.aspx?page=1974

Marine Protected Areas and Biological zones

Information about Med conservation areas and biological zones has been retrieved by MedSea Checkpoint Challenge 2 targeted product (MEDSEA_CH2_Product_2). The produced shape file contains layers with the Med protection initiatives (management and conservation areas), MPA extension areas and different protection levels for each of them together with biological depth zones. http://www.emodnet-mediterranean.eu/medsea-challenge-2-product-1/
Circalittoral and Infralittoral biological zones would be highly damaged as shown in Figure 16.

Two Marine Protected Areas are located nearby the accident zone:

1. International MPA close to El-Alamain, south-west the impacted area;
2. National MPA enclosing a wetland area close to Baltim, northeast the impacted area.

Considering the seasonal prevailing circulation in the impacted coastal area the second MPA could potentially be affected by the coastal ecosystem damages.

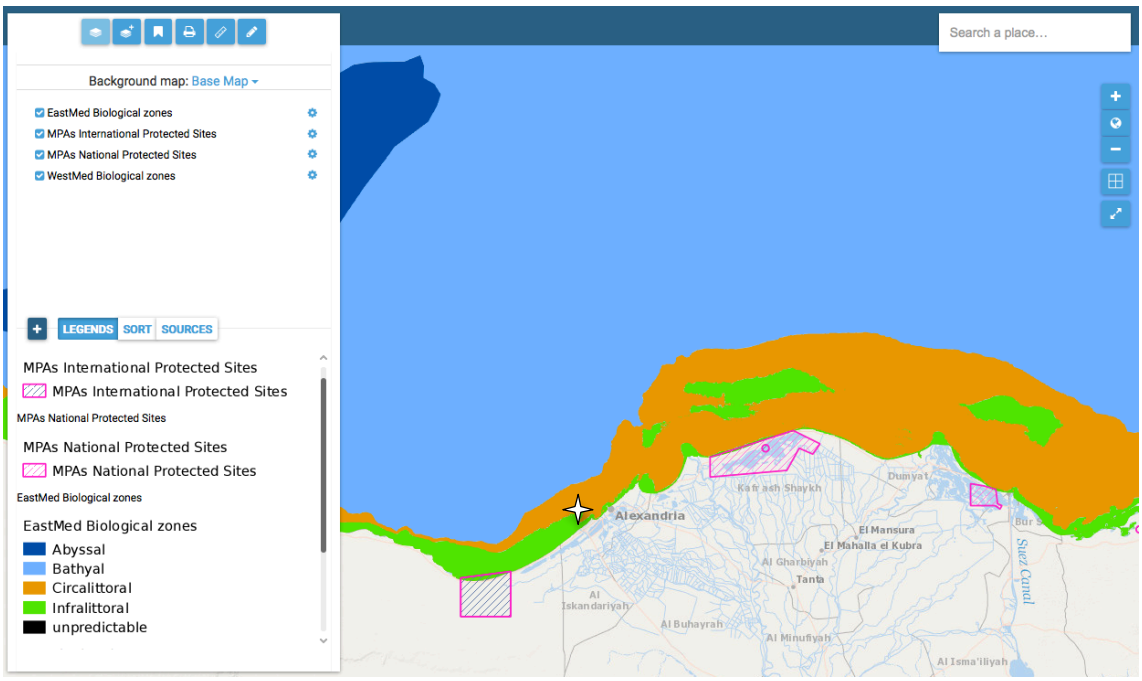

Figure 16 - MEDSEA_CH2_Product_2 developed by MedSea Checkpoint Challenge 2: Med conservation areas and biological zones. Shape file with the layers containing the Med protection initiatives (management and conservation areas), MPA extension areas and different protection levels for each of them and depth zones. http://www.emodnet-mediterranean.eu/medsea-challenge-2-product-1/

Transport route and use of coastal areas

Human Activities web portal (http://www.emodnet-humanactivities.eu/view-data.php) has been considered to retrieve information, but we noted gaps of information along the African coast. None MPA or harbor are displayed on the graphic interface.
The initial leak area is close to the entrance of the Alexandria Harbor, which is the main port in Egypt. Alexandria is also considered the second most important city in Egypt and its coastal strip is densely populated. The economical impact of the incident on touristic and maritime transport activities has to be estimated.

The main factors which have strong influence on the outcomes of the fate and expected impact

The production of the OPL-Bulletin relies on the availability of meteo-oceanographic forecasts and analyses for the Mediterranean Sea. In this specific case, it is particularly important to note that CMEMS (Copernicus Marine Environment Monitoring Service) is the only service that provides historical current products to produce the simulations. However time resolution is daily instead of hourly and this has an impact on the oil spill transport, as shown in the literature. Thus the EMODnet OPL has a degraded quality due to the lack of time resolution in the CMEMS historical.

In the particular case examined here and having only CMEMS low resolution products, the accuracy of the forecast will be strongly affected by small displacements of the source point because currents will be stronger far offshore and the displaced source could intercept the boundary current running mainly at the shelf break. This additional SCENARIO might present a wider impact on the coastal area allowing the advection of the oil further along the coastline.

Weaknesses of the assessment methodology

The weaknesses to be pointed out are:

1. the assessment of the coastal impact: this is dependent on the specific transformation and beaching processes included in the oil spill model that is normally the weakest part of the model itself.
2. the assessment of the environmental impact from EMODnet Human Activities GIS layers: this information is absent for the African coasts and the test area.
3. the priority to be given in the assessment: this should be done in close collaboration with the interested stakeholders in order to present a customized report on the possible impacts.

Recommendations

First recommendation is to include all Med Sea protected areas in the human activity portal, since the complete dataset id available from the MedSea Checkpoint (challenge 2 targeted product):
MEDSEA_CH2_Product_1: Med protection initiatives, management and conservation areas, excel file containing information on MPA extension areas and different protection levels for each of them.

Another recommendation, helpful from a user perspective, is to have the possibility to insert on EMODnet thematic portals GIS maps a pointer or a polygon to highlight the interested area, or eventually, to query the available information around a selected point.