

An independent study to assess and validate the shape and size of the Potentially Impacted Areas used in BEAWARE 2 – Qualitative results

Project: BE-AWARE II

Author : Sébastien Legrand

Reference: MFC/2015/SL/BE-AWARE/report_potentially_impacted_areas_v1.1

Document version: 1.1

Date: 2015/08/19

Contents

1	Introduction	3
2	Method.....	4
2.1	OSERIT set-up	4
2.2	Retrieving the potentially impact areas	4
3.	Results and discussion	5
3.1	Zone 1 – Irish Atlantic Approach, West Coast of Scotland, Irish Sea and Celtic Sea ...	6
	THE IRISH ATLANTIC APPROACH	6
	THE CELTIC SEA.....	6
	THE ST GEORGE AND BRISTOL CHANNELS.....	6
	THE IRISH SEA.....	7
	INNER SEAS OFF THE WEST COAST OF SCOTLAND.....	7
	THE NORTHERN PART OF THE ROCKALL TROUGH AND THE FAEROE-SHETLAND CHANNEL.....	7
3.2	Zone 2 – Northern North Sea, East Coast of England and Norwegian trench	8
	SHELF BREAK BETWEEN SHETLAND AND NORWAY.....	8
	NORTHERN NORTH SEA.....	8
	NORWEGIAN TRENCH.....	8
	NORTH EAST COAST OF SCOTLAND	9
	EAST COAST OF ENGLAND	9
3.3	Zone 3 – Danish coast and Skagerrak.....	9
3.4	Zone 4 – Southern North Sea	9
3.5	Zone 5 – English Channel	10
	EASTERN ENGLISH CHANNEL AND DOVER STRAIT	10
	SOUTH WESTERN ENGLISH CHANNEL AND GULF OF SAINT MALO	11
	Conclusion	11
	Reference	11
	Colophon	13

1 Introduction

The BE-WARE I and II projects are projects coordinated by the Bonn Agreement secretariat in order to further develop and coordinate the response capacities to face oil pollution in the greater North Sea. These developments should be based on risk assessments, gap analysis and regional and sub-regional approaches. Therefore it is essential to assess the alternatives to ensure that investments in future response and risk reducing technologies deliver the optimal effect at the regional and sub-regional scale.

The BE-AWARE I project, which ran from 2012-2014, laid the ground for this analysis by assessing the risk of oil pollution both now (2011) and in the future (2020). However in order to assess which methods and technologies will be most effective in reducing and responding to oil pollution further analysis is required.

BE-AWARE II will therefore model the outflow of oil from the spills predicted in BE-AWARE I for ten different response or risk reducing scenarios, taking into consideration the hydrodynamics of the North Sea Region. This will be combined with an analysis of the environmental and socioeconomic sensitivity of the region to assess the impact of the different scenarios. Based upon these and the cost of implementing the measures risk management conclusions will be developed for each of the 5 project sub-regions.

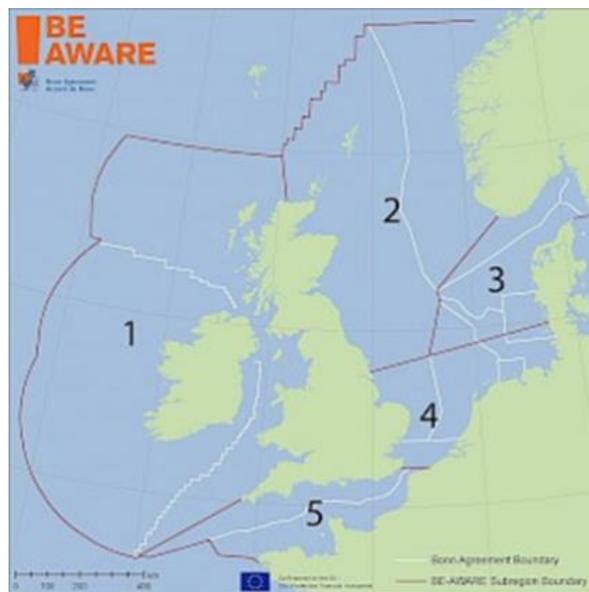


Figure 1 The 5 sub-regions of the BE-AWARE projects

The project is a two year initiative (2013-2015), co-financed by the European Commission (DG ECHO), with participation from the Bonn Agreement Secretariat, Belgium, Denmark, France, the Netherlands, Norway, Sweden and the United Kingdom, and co-financing from Ireland and Germany. COWI has been mandated as main consultant to carry out most of the technical work. RBINS-MUMM is acting as sub-consultant, providing its expertise in the North Sea hydrodynamics.

This report presents some preliminary, qualitative results of an independent modelling work done at RBINS/MUMM in order to assess the variability in size and shape of the potentially impacted areas as a function of the spill location. This work can be used to validate the shape of the potentially impacted areas that is used by COWI in the following of the BEAWARE 2 project.

2 Method

The OSERIT model (Dulière et al, 2012) extended to the whole Bonn Agreement Area has been used to study the variability in size and shape of the potentially impacted areas by oil pollution, as a function of the spill location.

2.1 OSERIT set-up

In this study, the OSERIT model has been set-up to compute 14 days drift trajectories of 1955 oil spills initially evenly distributed on a regular $0.5^\circ \times 0.25^\circ$ lattice (about 30km x 30 km) (Figure 2, left). The lattice covers the entire Bonn Agreement area and its Atlantic approach from 48.5°N to 62°N and from 15°W to 11°E .

In order to keep the computation time reasonable, each slick is represented by a unique Lagrangian particle (the 'centre of mass' of the slick) drifting at the sea surface under the influence of realistic wind and surface current forcing, respectively produced by the UK met office global NWP system and the MyOcean/Copernicus Marine Environment Monitoring Service. No oil weathering processes have been taken into account. In case of beaching, the oil slick can be put again adrift at the next ebb.

The position of each spill is saved every hour, allowing us to retrieve the drift trajectory of each slick (Figure 2, right).



Figure 2 The OSERIT model simulates under realistic met-ocean conditions 14 days drift trajectories of 1955 oil slicks initially distributed on a regular lattice covering the whole Bonn Agreement area.

2.2 Retrieving the potentially impact areas

A unique simulation as shown in Figure 2 only gives for each spill a drift trajectory – i.e. a curved line sometimes called 'spaghetti'. In order to retrieve the potentially impacted areas, a large number of trajectories (and therefore simulations) must be considered. To that purpose, the simulation described in the previous section has been rerun 275 times from the

1st of April 2011 until the end of December 2011. This makes a total of 92400 simulated hours and 180,642,000 saved trajectory locations (275 simulations X 1955 spill locations x 14 days x 24 hours)!

In order to retrieve the potentially impacted areas, all these saved locations have been projected on a 7 km grid (the grid used for the surface currents) so that:

“The potentially impacted area for one release location is defined as the ensemble of the grid cells that have been visited at least once by a spill trajectory.”

The total number of times that a cell has been visited is also an important piece of information in order to assess the probability of an area to be impacted. In the maps presented in the next sections, the color code ranges from dark blue to dark red, meaning that, on the total of the 275 simulations, the grid cell has been visited between 1 and 275 times.

3. Results and discussion

A qualitative, preliminary analysis of the 1955 potentially impacted areas allowed us to subdivide the Bonn Agreement area and its approaches into 15 sub-domains relatively well homogeneous.

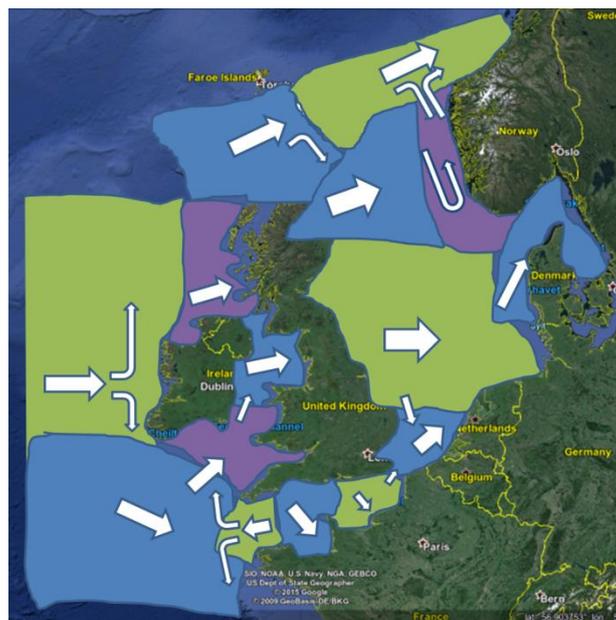


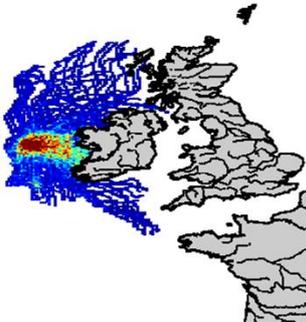
Figure 3: Schematic subdivision of the Bonn Agreement area into 15 sub-domains for which the shape of the impacted areas are relatively well homogeneous. Arrows represent the dominant direction of the surface drift.

All these sub-domains are briefly presented in the next sub-sections and illustrated with a couple of relevant examples of potentially impacted areas.

3.1 Zone 1 – Irish Atlantic Approach, West Coast of Scotland, Irish Sea and Celtic Sea

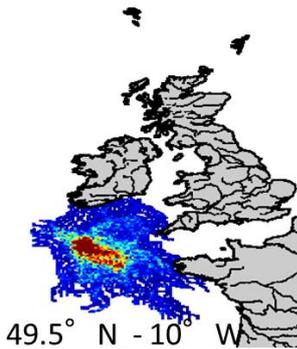
THE IRISH ATLANTIC APPROACH

53.5° N - 13° W



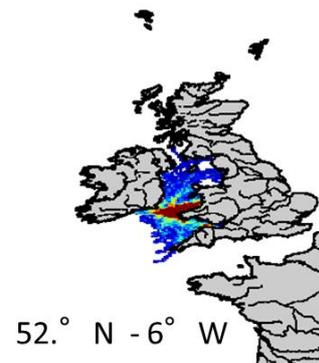
Oil spilt in the Irish Atlantic approach is pushed eastwards potentially impacting all the unsheltered Irish shoreline, northward in the Atlantic Margin Ocean and to a lesser extent, north-eastwards in the Inner Seas off the West Coast of Scotland and south eastwards in the Celtic Sea.

THE CELTIC SEA



Oil spilt in the Celtic Sea mainly drifts south-eastwards following the shelf break and potentially impacting Britany and the north of the Bay of Biscay. However, in case of South wind, the oil slicks can drift towards the southern Irish coast, the Bristol Channel and the St George Channel. Surprisingly, oil slicks do rarely drift towards the English Channel.

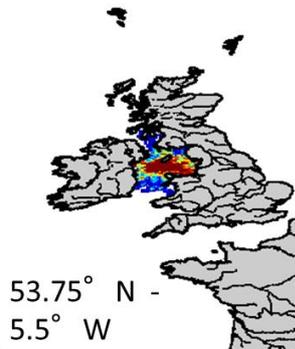
THE ST GEORGE AND BRISTOL CHANNELS



52.° N - 6° W

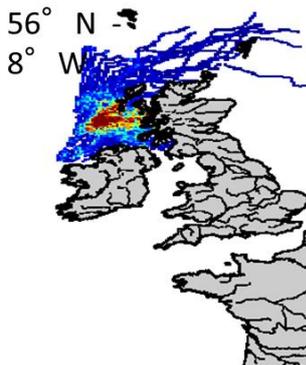
Oil spilt in the St George Channel and the Bristol Channel mainly drifts eastwards, impacting the western coast of Wales and England. If oil slicks can drift towards the Irish Sea there is almost no connection with the Celtic Sea and the English Channel.

THE IRISH SEA



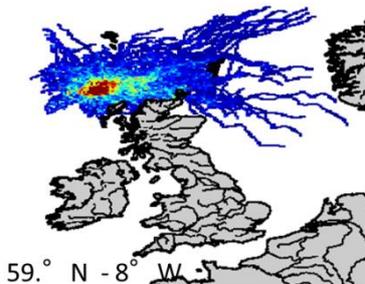
Oil spilt in the Irish Sea mainly drifts eastwards; trapped in the Irish Sea. Wind influence seems limited so that there is no or very little connection with the St George Channel and the Inner Seas off the West Coast of Scotland.

INNER SEAS OFF THE WEST COAST OF SCOTLAND



Most of the oil spilt in the Inner Seas off the West Coast of Scotland beaches along the Scottish shoreline and the northern shoreline of Ireland. There is virtually no connection with the surrounding seas and ocean: the Irish Sea, the Atlantic Margin Ocean and the North Sea.

THE NORTHERN PART OF THE ROCKALL TROUGH AND THE FAEROE-SHETLAND CHANNEL

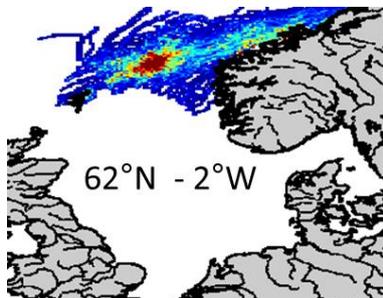


Oil spilt in the Northern part of the Rockall Trough and the Faeroe Shetland Channel tends to drift north-eastwards, following the continental shelf. However, oil spilt at the shelf break

can drift eastwards or enter into the North Sea between the Shetland and the Orkney Islands.

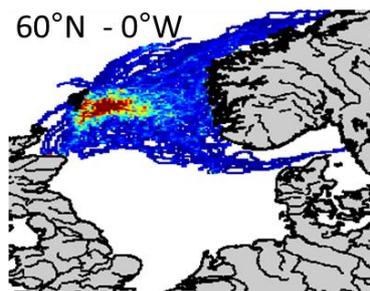
3.2 Zone 2 – Northern North Sea, East Coast of England and Norwegian trench

SHELF BREAK BETWEEN SHETLAND AND NORWAY



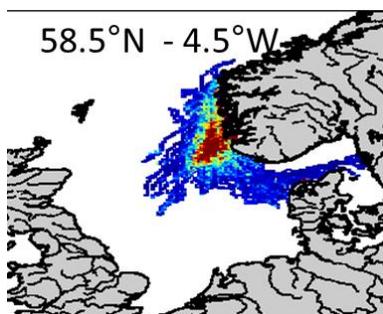
Oil spill at the shelf break drifts north eastwards closely following the slope currents and potentially impacting the Norwegian fjords above 62°N. These drift patterns are very robust. Note that in some case, oil can recirculate in the Norwegian trench.

NORTHERN NORTH SEA



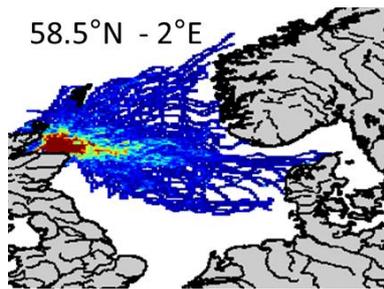
Oil spill in Northern North Sea between the Shetland Islands and Norway tends to mainly drift eastwards, towards Norway and in a lesser extent towards the Skagerrak. There is almost no connection with the southern half of the North Sea.

NORWEGIAN TRENCH



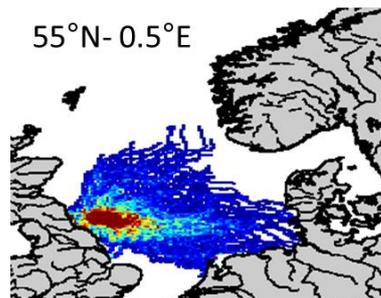
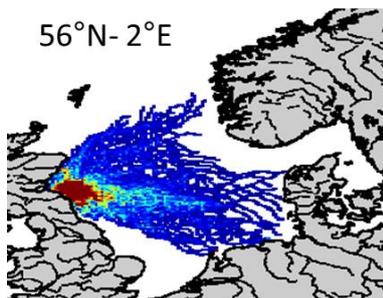
Oil spilt in the Norwegian Trench tends to remain in the Norwegian Trench or drifts towards Skagerrak and the Danish coastline. Surprisingly, if the oil is spilt at the south of 58.5°N, almost no oil recirculates towards the Norwegian Sea.

NORTH EAST COAST OF SCOTLAND



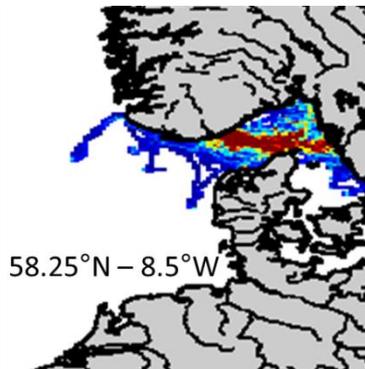
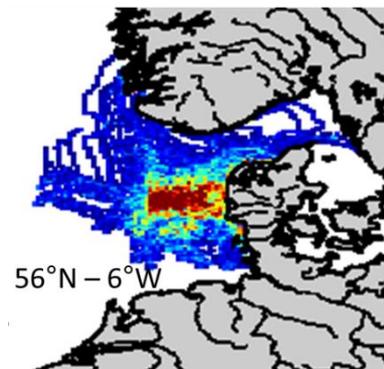
Oil spilt along the North East Coast of Scotland mainly drifts eastwards across the Northern half of the North Sea. Surprisingly, the East Coast of England is protected.

EAST COAST OF ENGLAND



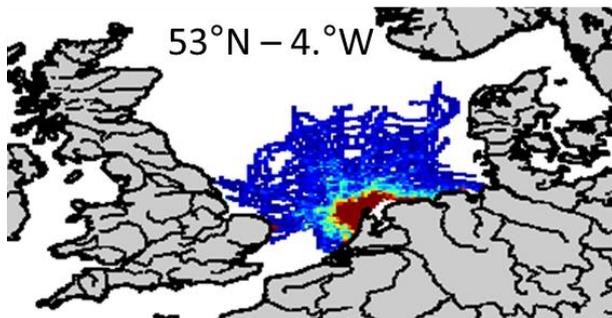
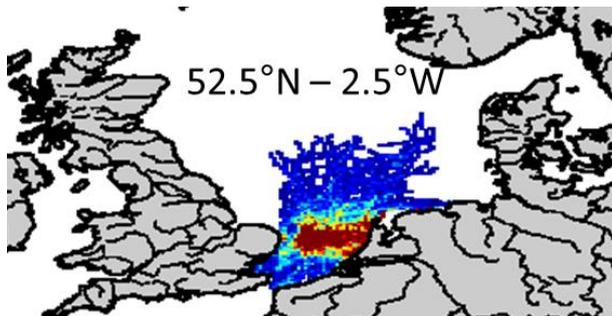
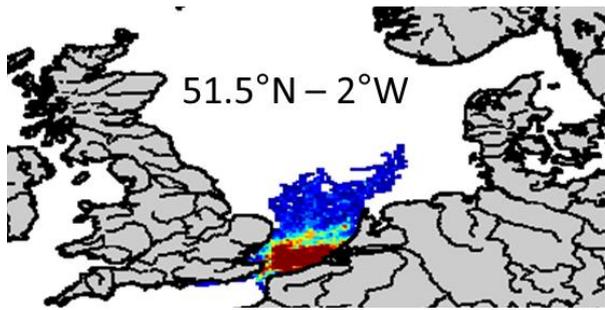
Oil spilt along the North East Coast of England drifts eastwards across the central North Sea towards the German Bight. This oil has no impact on the North East Coast of Scotland, what makes these two adjacent sub-areas of the North Sea totally disconnected!

3.3 Zone 3 – Danish coast and Skagerrak



Oil spilt in the German Bight and the Skagerrak tends to drift eastwards, so that there is almost no connection with the other 4 sub-regions of the BE-AWARE project.

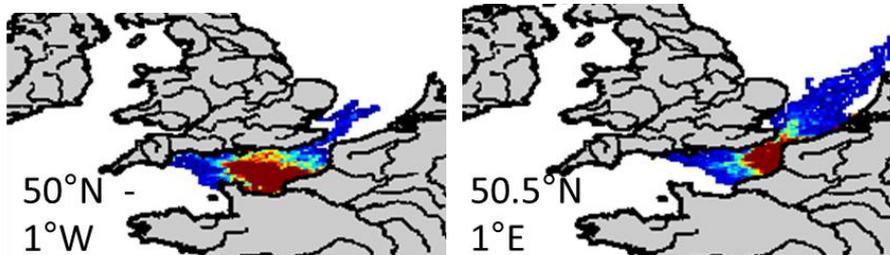
3.4 Zone 4 – Southern North Sea



In the southern North Sea, the shape and the extent of the potentially impacted areas greatly depends on the spill location, the wind regime and the residual circulations. That being said, the potentially impact areas after 14 days usually remains in the southern part of the North Sea.

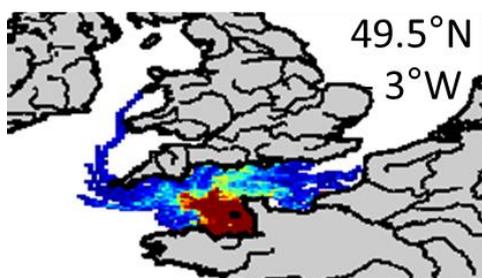
3.5 Zone 5 – English Channel

EASTERN ENGLISH CHANNEL AND DOVER STRAIT



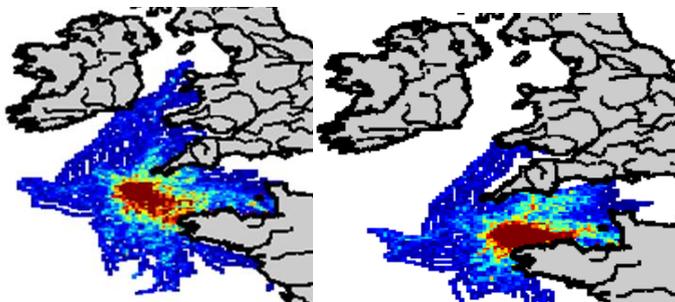
Oil spilt in the eastern English Channel mainly drifts towards the French Shoreline. However, in some conditions, oil can go through Dover Strait and drift in a few days relatively far away in the southern Bight of the North Sea.

SOUTH WESTERN ENGLISH CHANNEL AND GULF OF SAINT MALO



Oil Spilt in the south western English Channel mainly drifts eastwards towards the Gulf of Saint Malo or the eastern English Channel. However in some specific conditions, oil slicks can also drift westwards along the English coast and eventually recirculate towards the Saint George Channel or the Bristol Channel.

WESTERN ENGLISH CHANNEL



The western English Channel has a complex current pattern allowing oil spilt in this area to recirculate eastward in the English Channel but also westwards in the Celtic Sea, the Bristol Channel, the Saint George Channel or even towards Morbihan. As a consequence, the shape of the potentially impacted areas greatly depends on the release location and the wind conditions.

Conclusion

This preliminary qualitative study has shown that the shape and the extent of the potentially impacted areas greatly depend on the release location. In particular 15 sub-areas with relatively homogeneous drift pattern have been identified and should be considered in the rest of the BE-AWARE project.

Reference

Dulière, V., F. Ovidio and S. Legrand (2012) Development of an Integrated Software for Forecasting the Impacts of Accidental Oil Pollution - OSERIT. Final Report. Brussels: Belgian Science Policy, 68 pp. (Research Programme Science for a Sustainable Development)

Colophon

This report was issued by RBINS/OD Nature in August 2015, as a deliverable prepared for COWI in the framework of the project BE-AWARE II.

Status: Draft
 Final version
 Revised version of document
 Confidential

Available in: English
 Dutch
 French

If you have any questions or wish to receive additional copies of this document, please send an e-mail to s.legrand@mumm.ac.be, quoting the reference or write to:

RBINS / OD Nature
100 Gulledele
B-1200 Brussels
Belgium

Phone: +32 2 773 2111
Fax: +32 2 770 6972
<http://www.mumm.ac.be>