# Demo Stochastic Oil Spill Modelling Report - Fictional Winter Well Blowout Scenario

Prepared For: Demonstration Purposes

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## EXECUTIVE SUMMARY

A scenario was modeled for DEMO as part of the development of an Oil Spill Contingency Plan (OSCP) for exploration activities in The English Channel. This was:

- **Mancha-1 Scenario:** Fictional Well Blowout with **~ 265 000 BBLs / day** of oil at the coordinates Lat: 50°57' 5.76'“ N, Long: 1° 17" 46.20”' W, during 60 days of release and 40 additional days of simulation, between January and April. We refer to this event as **Mancha-1.**

A scenario was developed to assess potential oil spill risks and inform response strategies in The English Channel.

A summary of the results is presented in the table below:

| | Mancha-1 Scenario |
|---|---|
| Surface | |
| Fastest oil to maritime boundary | France<br>< 1 days |
| Surface waters with >75% probability impact | France (≈ 95 %), Belgium (≈ 91 %), Netherlands (≈ 87 %), United Kingdom (≈ 86 %) |
| Predominant direction of travel | E-NE |
| Shoreline | |
| Fastest shoreline oiling | France<br>< 3 days |
| Shoreline with > 50% probability impact | France (≈ 94 %), Belgium (≈ 94 %), United Kingdom (≈ 82 %), Netherlands (≈ 82 %), Germany (≈ 63 %), Denmark (≈ 61 %) |

**Table 1 Summary of model results**

**Mancha-1 Blowout**

The release predominantly spreads **East–Northeast**, with surface oil potentially reaching up to **633 km** from the release site, as far as the waters of Denmark. The majority of the surface oil is **rainbow sheen (0.3 – 5 µm)**, with **discontinuous true-colour oil (50 – 200 µm)** oil primarily affecting the surface waters of **France, Belgium, Netherlands, and the United Kingdom.**

Shorelines of **7 countries** are predicted to be impacted. **France, Belgium, United Kingdom, Netherlands** are expected to experience **heavy** oiling, as per ITOPF classification. The shoreline of **Guernsey** is predicted to experience **light** oiling. Meanwhile, **Denmark and Germany** are expected to receive **very-light** shoreline oiling.

The most oil ashore trajectory occurred in **March**, with **11 000 MT** of oil and up to **163 500 BBL** of emulsion expected to impact shorelines.

The fastest oil ashore trajectory occurred in **January**, with oil reaching the **coastline of France** in **< 3 days** after the release. Oil reaches the **France maritime boundary < 1 day** after the release.

*Disclaimer:*

**Modelling results are to be used for guidance purposes only**, and response strategies should not be based solely on these results.
• The **resolution and quality of wind and current data vary between regions and models**. As with any model, the quality and reliability of the results depend on the quality of the input data.

Considering the above, all advice, modelling, and other information provided are **generic and illustrative only** and are not intended to be relied upon in any specific instance. The recipient of any advice, modelling, or other information from, or on behalf of, **DES** acknowledges and agrees that a variety of variables may impact an oil spill and, as such, each case should be assessed individually.

**DES assumes no liability** in relation to such advice, modelling, or other information, and the recipient hereby fully **indemnifies and holds harmless DES, its officers, employees, shareholders, agents, contractors, and subcontractors** against any costs, losses, claims, or liabilities arising in connection with such advice, modelling, training, or other information.

# INTRODUCTION

## 1.1 Background

Digital Earth Solutions S.L. (DES) conducted oil spill modelling on behalf of DEMO to provide SPOT Oil spill modelling services in preparation for upcoming offshore activities in The English Channel (Figure 1). The findings of this analysis will contribute to the development of an Oil Spill Contingency Plan (OSCP) for the area.

A spill scenario was simulated, as summarized in Table 1:

• **Mancha-1 Scenario**: A well blowout releasing **265 000 barrels per day (BBLs / day)** of oil over a **100 day period (January – April)**.

The modelling was performed using SPOT Oil's advanced 3D simulation tool, which predicts the movement and fate of oil on the sea surface and throughout the water column. Further details on the modelling methodology can be found in **Appendix B**.

## 1.2 Aims

The objective of this report is to assess the potential impact of an oil spill on the sea surface and shoreline by generating spatial maps that illustrate:

1. **Probability** – Estimating the likelihood of an area being affected.

2. **Arrival Time** – Determining how quickly oil could reach a given location.

3. **Emulsion Thickness** – Evaluating the severity of the impact based on oil concentration.

These data-driven analyses help address key questions, including:

- How quickly could oil reach nearby shorelines, and in what quantity?
- Which countries are most at risk from a spill originating from the Mancha-1 scenario?

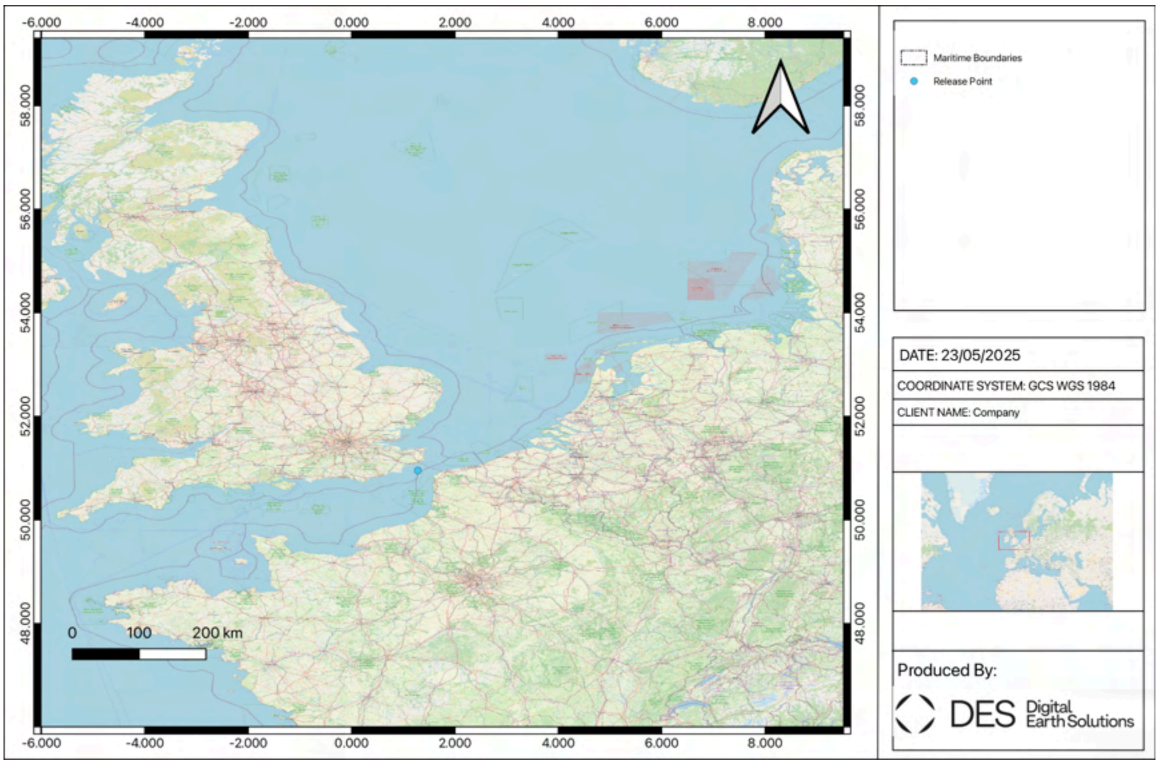



Figure 1 Map showing the release location

## 2 SCENARIO SETUP

### 2.1 Modelling Setup

Three stochastic simulations will be conducted for the **Mancha-1**. This simulation will involve a total of **240 individual trajectories**, which will be post-processed to generate stochastic results. Each trajectory will begin on a different start date to ensure that the oil spill is modeled under varying wind and current conditions, providing a comprehensive assessment of potential spill behavior.

| Scenario Reference | Mancha-1 Scenario |
|---|---|
| Description | A well blowout in the English Channel |

| | |
|---|---|
| **Location** | Lat: 50° 57’ 5.69’’ N, Long: 1° 17’ 46.20’’ W |
| **Timeframe** | January - April |
| **Depth of Release** | 50 m |
| **Release Rate** | ~ 265 000 BBLs / day |
| **Duration of Release** | 60 days |
| **Total Volume Released** | 15 900 000 BBL |
| **Total Run Duration** | 100 days |
| **Diameter of Release at 24 hours** | ~ 2 km |
| **Total Number of Trajectories** | 240 |
| **Time Between Trajectories** | 1 day |
| **Nearest Shoreline** | 16.3 km, in the waters of United Kingdom |

Table 2 Summary of stochastic setup for spill scenarios

### 2.1.1 Metocean Data

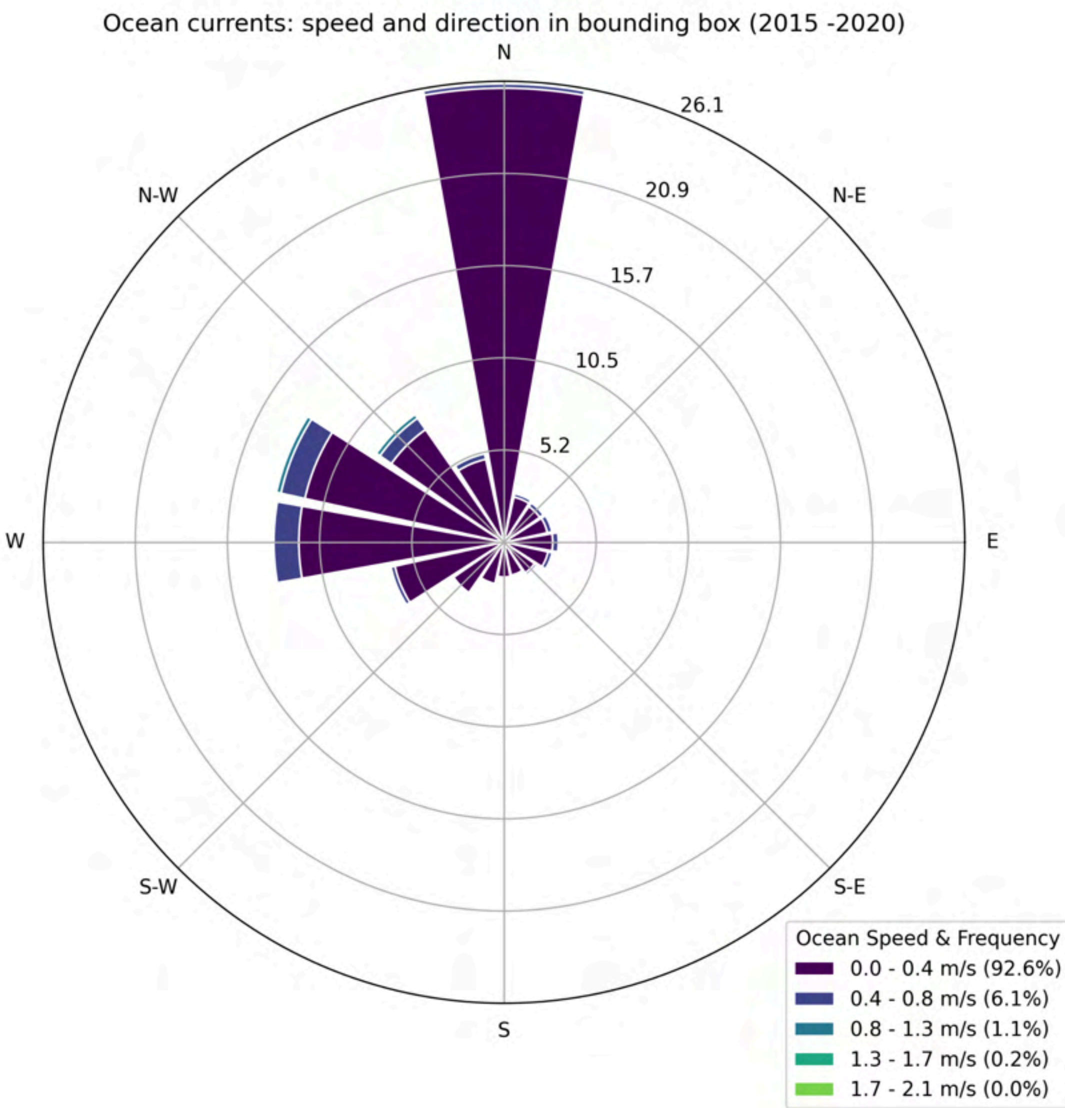
Six years of hydrodynamic data were used as model inputs. Wind and current data were available for the model domain. **SPOT OIL** requires these data as model inputs to accurately predict the movement of the release (see **APPENDIX B** for more information).

For ocean currents, the **CMEMS Global Reanalysis** dataset was used, while wind conditions were obtained from the **ERA5** dataset.

This area has been highlighted on all map output images, as well as in the **Location Map (Figure 1)**, and any oil crossing into this area has been excluded from statistics and other analyses.

| Metocean Data | | |
|---|---|---|
| **Dataset** | Current- CMEMS | Wind – ERA5 |
| **Spatial Resolution** | 8 km | 27 km |
| **Temporal Resolution** | Daily | Hourly |
| **Date Period** | 2015-2020 | 2015-2020 |
| **Number of vertical layers** | 50 | 1 |

Table 3 Metocean data


Ocean currents: speed and direction in bounding box (2015 -2020)
N
N-E
E
S-E
S
S-W
W
N-W
26.1
20.9
15.7
10.5
5.2
Ocean Speed & Frequency
0.0 - 0.4 m/s (92.6%)
0.4 - 0.8 m/s (6.1%)
0.8 - 1.3 m/s (1.1%)
1.3 - 1.7 m/s (0.2%)
1.7 - 2.1 m/s (0.0%)

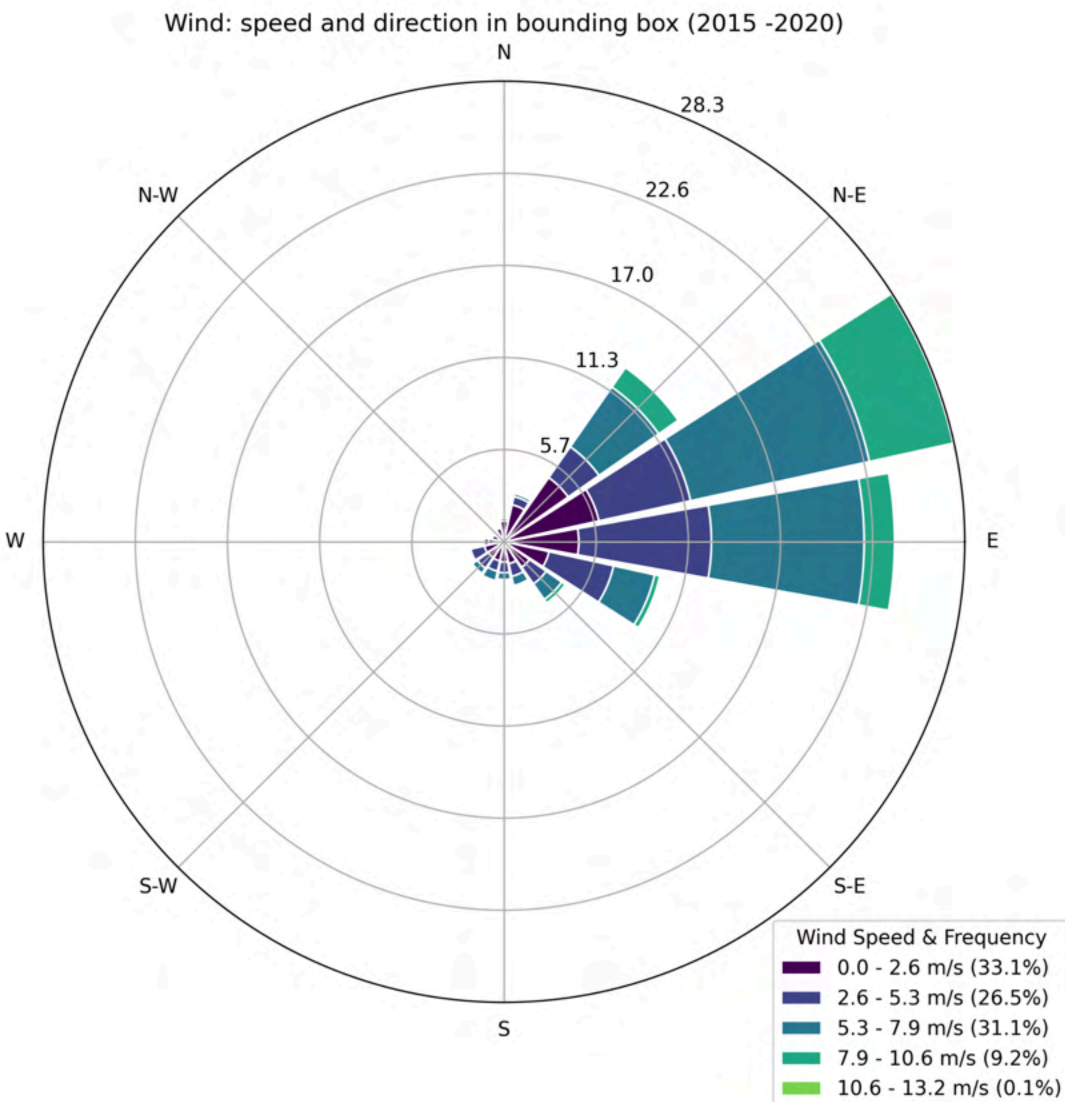



**Figure 2 Rose of winds and currents for the study area**

For further details on the model setup, refer to **APPENDIX A**.

### 2.1.2 Model Extent

SPOT OIL requires the user to set up a habitat grid that contains the oil spill. Habitat grids define the model domain; if oil travels outside this domain, it will be classified as "outside" and not included in any further calculations. As such, oil "outside" the domain will not be considered in shoreline statistics or other analyses. There are a maximum of 1 000 x 1 000 spatial grid cells. So, if the oil covers a 4 060 km x 2 460 km area, the smallest spatial resolution (or surface grid cell) is

4.06 km x 2.46 km. Habitat grids that cover large areas will typically provide coarser results than habitat grids that cover smaller areas.

| Domain Extent | | | |
|---|---|---|---|
| Number of Cells | | Cell Resolution | |
| East to West | North to South | East to West | North to South |
| 1 000 | 1 000 | 4.06 km | 2.46 km |
| Domain Size | | | |
| East to West | | North to South | |
| 4 060 km | | 2 460 km | |

Table 4 Model extent

## 2.2 Oil Characteristics

Laboratory-tested oils were selected for this modelling study based on the data provided by **PSEPBV**. The properties of the modelled oil for the **Mancha-1 Scenario** is detailed in **Table 5**

| Name | API | Specific Gravity | Viscosity (cP) | Pour Point | Wax Content | Asphaltenes |
|---|---|---|---|---|---|---|
| Modelled Oil | 35 | 0.85 | 14 @ 13ºC | -9ºC | 3.40% | 0.36% |

Table 5 Properties of the modeled oil

## 2.3 Thresholds

Thresholds define the point below which data are no longer considered informative. For instance, when surface emulsion thickness falls below **0.04 µm**, the oil becomes invisible to the naked eye and may be deemed insignificant for response actions. The thresholds applied in this study are presented in **Table 6**.

| Threshold | Value | Description |
|---|---|---|
| Surface | 0.04 µm | The **Bonn Agreement Oil Appearance Code (BAOAC)** classifies oil slicks into five categories based on their visual characteristics and actual color variations. The thinnest detectable layer, |

| | | |
|---|---|---|
| | | visible to the naked eye, is **0.04 µm** thick. |
| Shoreline | 0.1 **L/m²** | The **minimum threshold for light oiling** is based on the guidelines outlined in the ITOPF document *"Recognition of Oil on Shorelines."* |

**Table 6 Thresholds used in the model**

The **thickness key** used in the **surface emulsion thickness maps** throughout this document is based on the **Bonn Agreement Oil Appearance Code**.

The **thickness key** applied in the **shoreline maps** follows the guidelines outlined in the **ITOPF Technical Information Paper (TIP) No. 6: "Recognition of Oil on Shorelines" (ITOPF, 2011b)**. According to **ITOPF**, **very light oiling** is considered insignificant, requiring no practical response other than monitoring the affected shoreline.

# 3 RESULTS

## 3.1 Mancha-1 Scenario: A well blowout

The **stochastic results** for the **Mancha-1** scenario were derived from **240 simulated trajectories**. This scenario models the release of **15 900 000 BBLs of oil** over **60 days** during **January to April**, with the oil's movement tracked for an additional **40 days**. This is a total simulation of **100 days.**

The following results are presented:

Sea Surface

- Figure 3: Probability that a surface cell could be impacted.
- Figure 5: Minimum arrival time of surface oil.
- Figure 7: Maximum emulsion thickness of surface oil.

Shoreline

- Figure 4: Probability that a shoreline cell could be impacted.
- Figure 6: Minimum arrival time of shoreline oil.
- Figure 8: Shoreline contamination based on emulsion mass.

### 3.1.1 Stochastic Maps

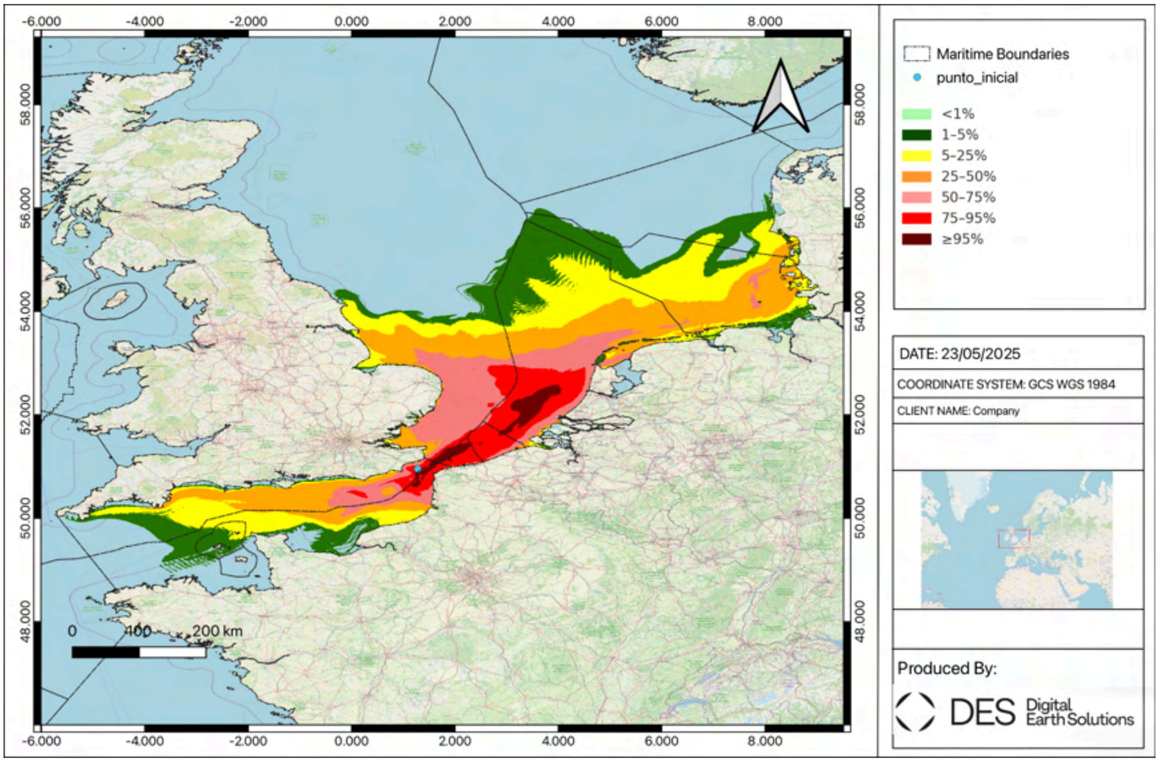



**Figure 3 Probability that a surface cell could be impacted.**

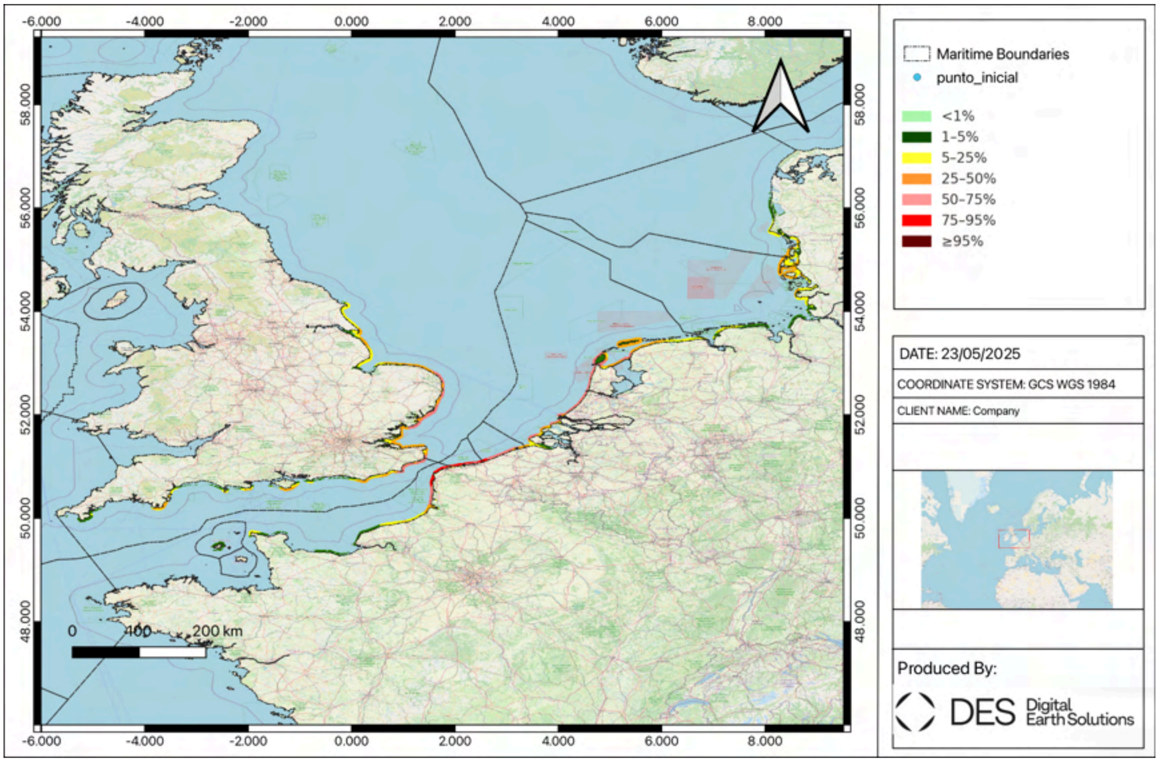



**Figure 4 Probability that a shoreline cell could be impacted.**

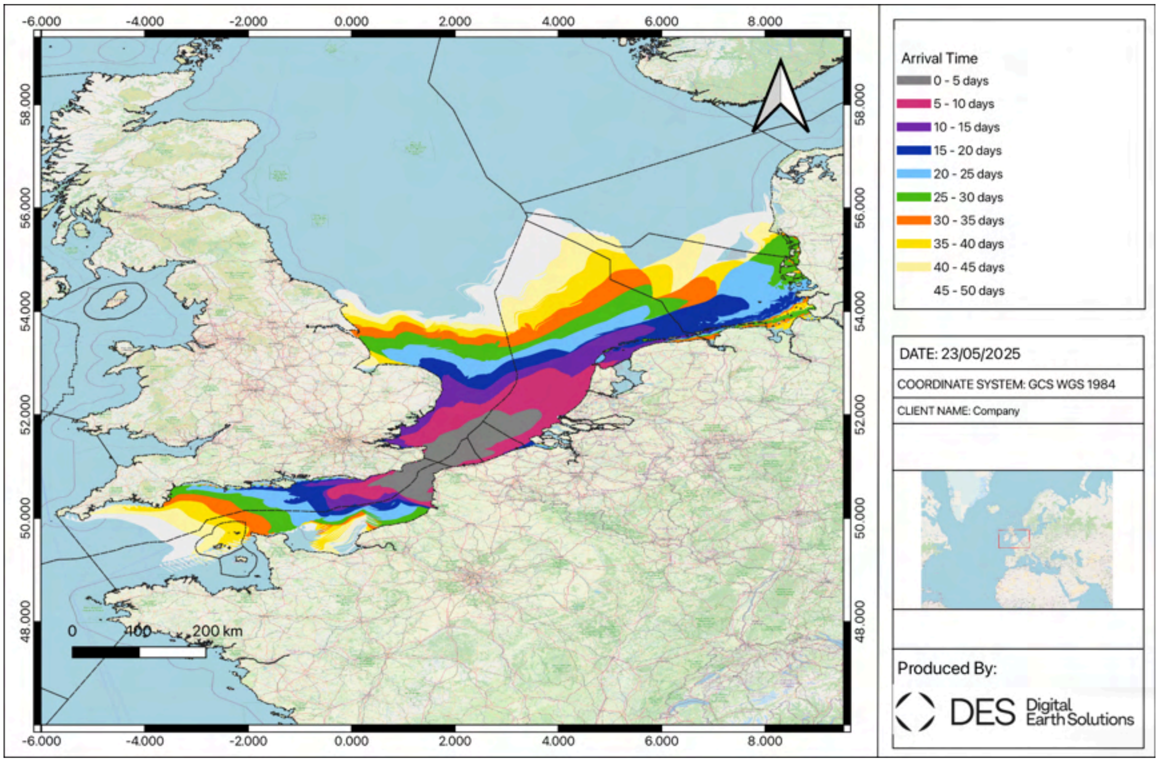



Figure 5 Minimum arrival time of surface oil

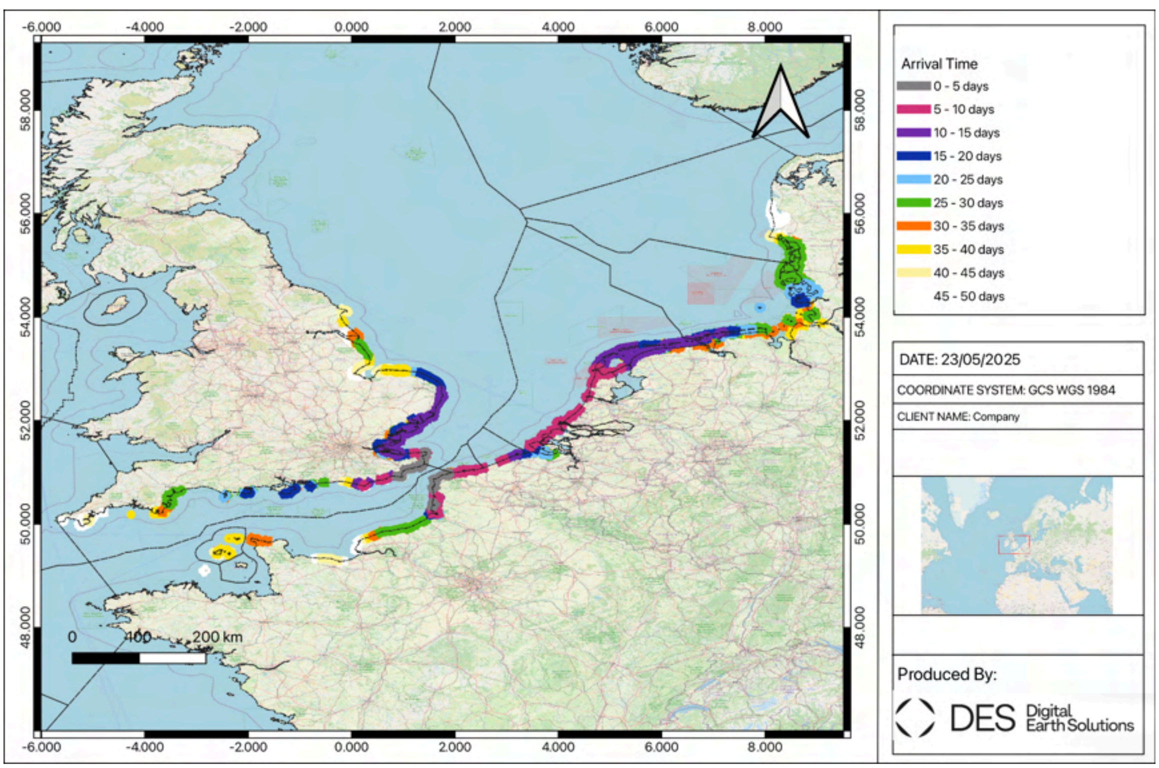



Figure 6 Minimum arrival time of shoreline oil

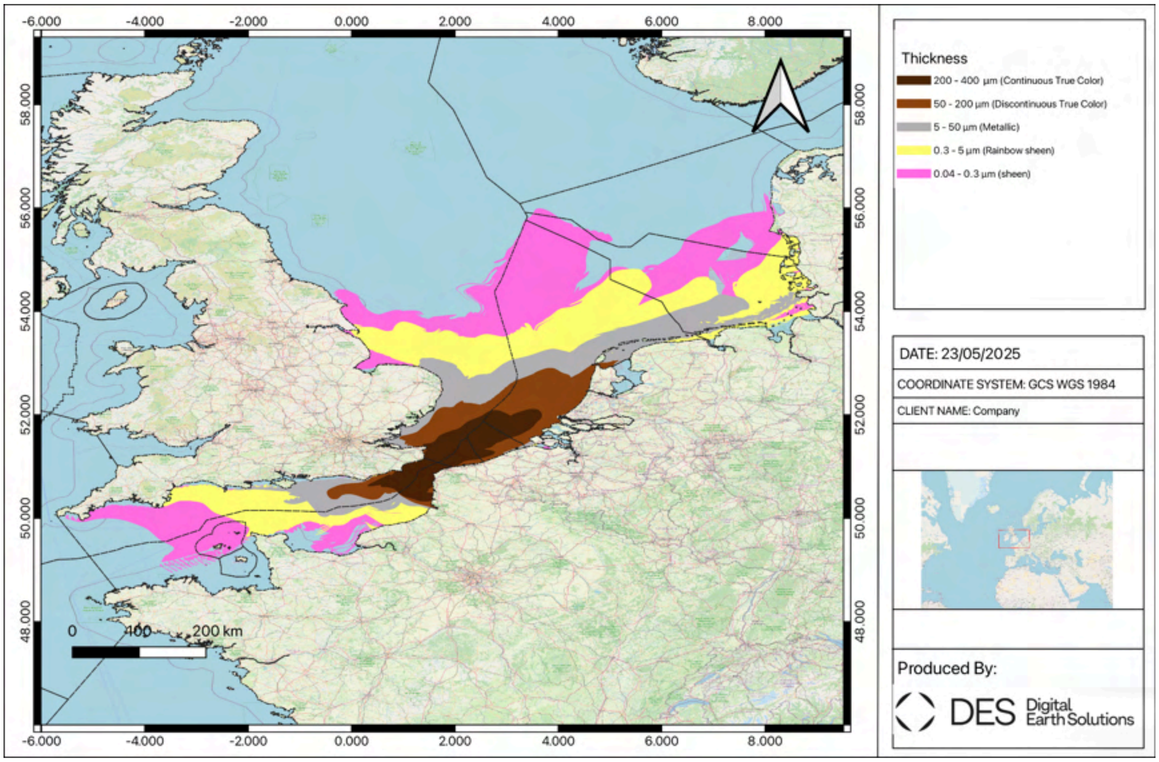



**Figure 7 Maximum emulsion thickness of surface oil**

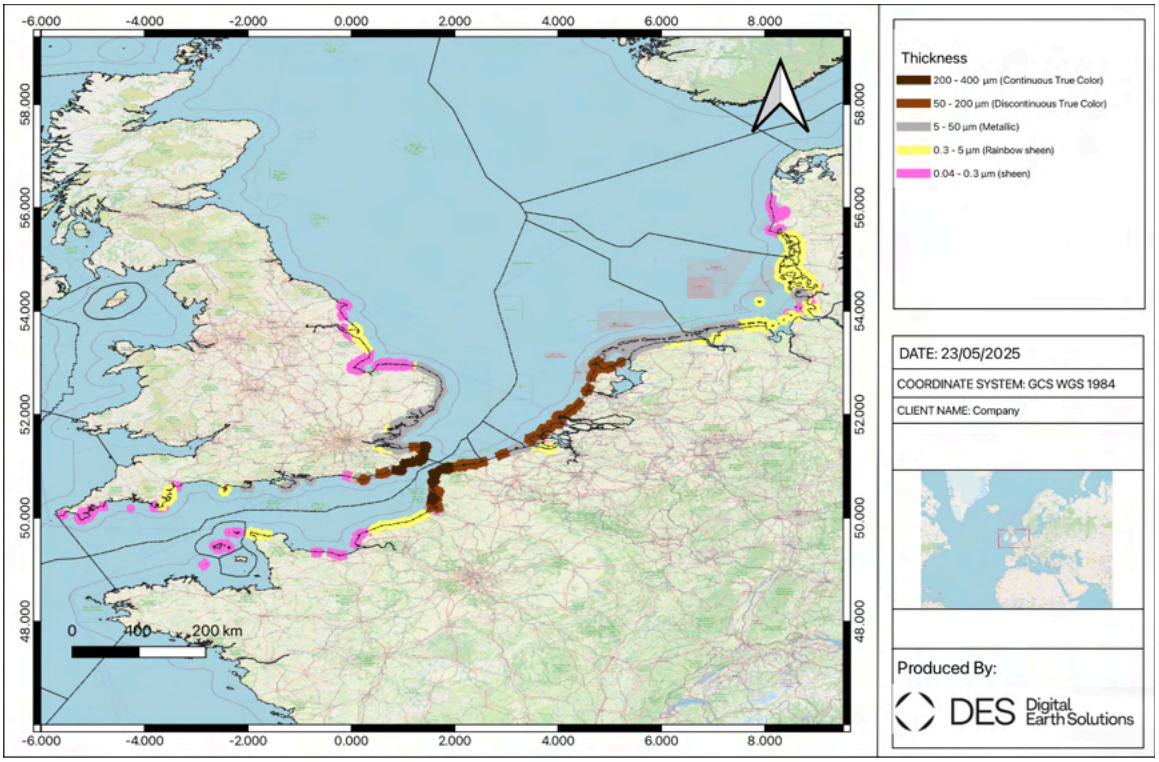



Figure 8  Maximum emulsion thickness of shoreline  oil

### 3.1.2 Statistical Analysis

| Oil Spill Modelling Summary | | |
|---|---|---|
| Spill Scenario/Description | Mancha-1 Scenario | S01 |
| Median Crossing | | |
| Identified Median Lines | Probability and Shortest Time to Reach Median Line | |
| | January - April | |
| France | 94.81 %<br>2 day | |
| Belgium | 91.34 %<br>8 days | |
| Netherlands | 87.45 %<br>8 days | |
| U.K. of Great Britain and Northern Ireland | 85.71 %<br>2 days | |
| Germany | 73.70 %<br>18 days | |
| Denmark | 61.60 %<br>28 days | |
| Guernsey | 29.34 % | |

| | |
|---|---|
| | 38 days |

Table 7 Statistical Analysis – Surface

| Oil Spill Modelling Summary | | |
|---|---|---|
| Spill Scenario/Description | Mancha-1 Scenario | S01 |
| Median Crossing | | |
| Identified Median Lines | Probability and Shortest Time to Reach Median Line | |
| | January - April | |
| France | 94.81 %<br>2 days | |
| Belgium | 91.34 %<br>8 days | |
| Netherlands | 87.45 %<br>8 days | |
| U.K. of Great Britain and Northern Ireland | 85.71 %<br>2 days | |
| Germany | 63.20 %<br>18 days | |
| Denmark | 61.60 %<br>28 days | |
| Guernsey | 29.34 %<br>38 days | |

Table 8 Statistical Analysis - Shoreline

### 3.1.3 Trajectory Results

Trajectory results are generated by simulating a **single spill scenario** under specific conditions on a particular date. **Worst-case trajectories** were selected from each set of simulations that contribute to the stochastic results, allowing for a more detailed analysis of the **fate and behavior of oil** throughout the simulation period.

For this scenario, the **worst-case trajectories** are defined as:

• The trajectory that results in the **greatest volume of oil reaching the shoreline**

• The trajectory that results in the **fastest arrival of oil onshore**

• The trajectory that results in the **fastest impact on the United Kingdom maritime boundary**

The **selected trajectories** for the **credible-case well blowout** are presented in **Table 9**, with the **key results summarized in Table 10**

| Scenario | Worst-case | Trajectory Number | Simulation Start Data (UTC) |
|---|---|---|---|
| Mancha-1 Scenario | Most Oil Ashore | 172 | 2019-01-01 |
| | Fastest Oil Ashore | 25 | 2015-02-01 |
| | Fastest Impact to United Kingdom Maritime Boundary | 7 | 2015-02-01 |

**Table 9 Worst-case trajectories following Mancha-1 Scenario**

| Trajectory 25/240 | Most Oil Ashore |
|---|---|
| Release Location | 50° 57′ 05.69″ N<br>1° 17′ 46.20″ E |
| Maximum Mass of Oil Ashore | 11 000 MT |
| Maximum Volume of Oil Ashore | 81 800 BBL |
| Water Content | 50 % |
| Volume of Emulsion Ashore | 163 500 BBL |
| Trajectory 25/240 | Fastest Oil Ashore |
| First Shoreline Impact | < 3 days after release |
| Site of Impact | France |
| First Impact to Maritime Boundary | France, < 1 day |

**Table 10 Key results from Mancha-1 Scenario**

Worst-case trajectories provide a deeper insight into the **fate and behavior of the spilled oil**. They enable a more detailed examination of **mass balance**, helping to assess the **probability and likelihood of oil impact** with greater accuracy.

## 4 SUMMARY

A scenario was modeled for **DEMO** as part of the development of an **Oil Spill Contingency Plan (OSCP)** for exploration activities in **The English Channel**. This was:

• **Scenario 1**: A *fictional well blowout* of **265 000 BBLs / day** of oil at Lat: 50°57' 5.76'" N Long: 1° 17" 46.20"' W, for **60 days**, during **January – April**.

A summary of the results is presented in **Table 11** below.

| | Mancha-1 Scenario |
|---|---|
| Surface | |
| Fastest oil to maritime boundary | France, < 1 day |

| | |
|---|---|
| Surface waters with >75% probability impact | France ≈ 95 %, Belgium ≈ 91 %, Netherlands ≈ 87 %, United Kingdom ≈ 86 % |
| Predominant direction of travel | East-north-east (E-NE) |
| Shoreline | |
| Fastest shoreline oiling | France, < 3 days |
| Shoreline with > 50% probability impact | France ≈ 94 %, Belgium ≈ 94 %, United Kingdom ≈ 82 %, Netherlands ≈ 82 %, Germany ≈ 63 %, Denmark ≈ 61 % |

**Table 11 Key results from Mancha-1 Scenario**

**Mancha-1 Scenario**

The release predominantly spreads E-NE, with surface oil being found up to 633 km from the release site, extending to the waters of Denmark. There is **moderate** eastward spread of oil from the release site, extending approximately **120 km E-SE**. The majority of the surface oil is **rainbow sheen (0.3 – 5 µm)**, with **discontinuous true-colour oil (50 – 200 µm)** primarily impacting the surface waters of **France, Belgium, the Netherlands, and the United Kingdom**. A **narrow (~15 km-wide) strip of continuous true-colour oil (200 – 1 000 µm)** is expected up to **80 km** from the release site, with the majority impacting the **southern North Sea and eastern English Channel**.

The shorelines of **France, Belgium, the United Kingdom, and the Netherlands** are primarily impacted by **heavy oiling**, as defined by ITOPF. **Guernsey** primarily experiences **light** shoreline oiling. The shorelines of **Germany and Denmark** are expected to experience **very-light oiling**. The shorelines of **seven** countries are predicted to be impacted, with **57 %** of these having a greater than 50 % probability of oiling. The highest probability of shoreline impact is for **the Belgian and Dutch coasts**, with **84 %** of coastline affected. The majority of shoreline impact (**68 %**) has a probability of less than 20 %.

The worst-case trajectories selected for this scenario examined the situations that resulted in:

• The most oil ashore
• The fastest oil reaching the shore
• The fastest oil reaching the United Kingdom maritime boundary

The **most-oil-ashore** trajectory delivered **11 000 MT** of oil and up to 163 500 BBL of emulsion to the shoreline. All oil types defined by the Bonn Agreement Oil Appearance Code were present: rainbow sheen (0.3 – 5 µm thickness) extended east-northeast up to 270 km from the release point, while continuous true-colour oil (200 – 1 000 µm thickness) formed a narrow belt **impacting the coastal waters of France, Belgium, and the southern North Se**a, reaching approximately **120 km offshore**.

The **fastest oil-ashore** trajectory impacted the **French coast** (Normandy) in under three days. The initial surface expression was rainbow sheen (0.3 – 5 µm thickness) observed up to 85 km east-northeast of the origin, followed by discontinuous true-colour oil (50 – 200 µm thickness) reaching the shoreline near Cherbourg, approximately 95 km from the release point.

The **fastest trajectory to the United Kingdom maritime boundary** occurred **within 24 hours** of release. While isolated patches of silvery sheen (0.04 – 0.3 µm thickness) advanced up to 310 km north-northwest, the predominant surface-oil manifestation was rainbow sheen (0.3 – 5 µm thickness), forming a continuous front approaching the UK boundary at approximately 325 km from the spill origin. Under these conditions, secondary scattered true-colour oil (200 – 1 000 µm thickness) remained confined to near-field waters north of the release.

## APPENDIX A. METOCEAN DATA

Three-dimensional ocean current data are used to track the movement of oil both on the sea surface and throughout the water column.

| | |
|---|---|
| Dataset Name | **GLORYS12V1** |
| Reference | DOI: https://doi.org/10.48670/moi-00021 |
| Description | The **GLORYS12V1** product is the **CMEMS global ocean eddy-resolving reanalysis**, featuring a **1/12° horizontal resolution** and **50 vertical levels**, covering the satellite altimetry era (1993 onward).<br><br>It is primarily based on the **CMEMS real-time global forecasting system**. The model component is built on the **NEMO platform**, with surface forcing from **ECMWF ERA-Interim** and, for recent years, **ERA5 reanalysis**. Observational data are assimilated using a **reduced-order Kalman filter**, integrating: |

| | |
|---|---|
| | • **Along-track altimeter data (Sea Level Anomaly)**<br>• **Satellite-derived Sea Surface Temperature**<br>• **Sea Ice Concentration**<br>• **In situ Temperature and Salinity vertical profiles**<br><br>Additionally, a **3D-VAR scheme** is applied to correct **slowly-evolving large-scale biases** in temperature and salinity, enhancing the accuracy of the reanalysis. |
| Start Time | March 2015 |
| End Time | July 2020 |
| Spatial Resolution | 8 km |
| Temporal Resolution | Daily |
| Depth Levels | 50 |

Table 12 Glorys12v1  Metocean Data

Two-dimensional wind data help refine the prediction of oil movement on the sea surface, estimate wave height, contribute to evaporation rates, and account for mixing in the upper water column.

| | |
|---|---|
| Dataset Name | **ERA5** |
| Reference | DOI: 10.24381/cds.adbb2d47 |
| Description | **ERA5** is the fifth-generation reanalysis produced by ECMWF, providing global climate and weather data for the past eight decades, with coverage starting from 1940. It replaces the ERA-Interim reanalysis.<br><br>Reanalysis integrates model simulations with observations from across the globe, creating a complete and consistent dataset based on the laws of physics. This process, known as data assimilation, is similar to the approach used in numerical weather prediction (NWP). At ECMWF, for example, every 12 hours, a previous forecast is optimally merged with newly available observations to generate an updated estimate of the atmospheric state, known as the analysis, which serves as the basis for improved forecasts. |

| | |
|---|---|
| | In reanalysis, this method operates at a lower resolution to accommodate the need for long-term historical datasets. Unlike operational forecasts, reanalysis is not constrained by real-time demands, allowing for the collection of additional observations and the incorporation of improved versions of past measurements. This process enhances the accuracy and reliability of the ERA5 reanalysis product over extended timescales. |
| Start Time | March 2015 |
| End Time | July 2020 |
| Spatial Resolution | 27 km |
| Temporal Resolution | Hourly |

Table 13 ERA5 Metocean Data

## APPENDIX B. OIL SPILL MODELLING SOFTWARE AND METHODOLOGY

**SPOT Oil** has been developed based on over 20 years of ocean dynamics research at the Spanish National Research Council (CSIC). Its reliability has been extensively validated through real-world hydrocarbon spill cases in collaboration with global partners. Unlike traditional particle-based models, SPOT Oil employs a more precise contour-based methodology, optimizing the representation of oil dispersion and degradation at sea.

This innovation enhances the resolution of key processes such as evaporation, emulsification, and sedimentation, which are essential for characterizing spill evolution under varying environmental conditions.

**Advanced Modeling Capabilities**

SPOT Oil integrates cutting-edge invariant dynamic structures to refine the characterization of uncertainty in spill trajectories. Unlike conventional models requiring extensive manual calibration, SPOT Oil optimizes this process through:

- A database of over 1,000 hydrocarbons with predefined physical properties.
- Three-dimensional modeling for deep-sea spill scenarios.
- Detailed simulation of key physical processes such as dispersion, emulsification, density, thickness, biodegradation, and coastal impact.
- Uncertainty analysis and validation with satellite data, ensuring model robustness across diverse environments.

**Scientific Accuracy and Real Data Validation**

SPOT Oil has been validated against real spill data and controlled experiments. Its development is rooted in benchmark studies of spill dynamics in the Atlantic and Mediterranean, including incidents like the OS35 spill in Gibraltar (2022) and the Puerto de la Luz spill in Gran Canaria (2024). These validations confirm that SPOT Oil's modelling aligns with observed realities with over high accuracy, outperforming conventional approaches in predicting hydrocarbon drift and its impact on coastal zones and sensitive ecosystems.

**Key Innovations Enhancing Accuracy**

- **Use of Lagrangian Coherent Structures (LCS):** Instead of modeling oil dispersion as individual particles, SPOT Oil identifies invariant ocean flow structures that govern spill transport and dispersion, enabling more precise predictions.
- **Improved Uncertainty Management:** Advanced techniques have been developed to quantify modeling uncertainties by integrating dispersion metrics and unstable flow structures that dictate spill evolution.
- **Multi-Source Data Validation:** The accuracy of SPOT Oil has been corroborated through comparisons with satellite data and real-world observations, including drifting buoy measurements and high-frequency coastal radar data. This reinforces its reliability against models that struggle with uncertainty-prone scenarios.

**Outputs and GIS System Integration**

One of SPOT Oil's fundamental advantages is its ability to generate user-accessible results in multiple formats:

- **Technical reports** featuring detailed maps of affected areas, time estimates for spill arrival at sensitive zones, total spill coverage, and precise volume evolution (evaporated vs. stranded oil).
- **Georeferenced animations** illustrating spill evolution over time.
- **KML, GeoJSON, and Shapefiles** for direct integration into GIS analysis platforms.
- **Comprehensive tables and graphs** detailing the physicochemical degradation of the spill, tracking key parameters over time with step and cumulative evolution insights.

**SPOT Oil - the right choice for Stochastic Modelling in Contingency Planning**

SPOT Oil stands out as an ideal solution for stochastic oil spill modeling, offering a robust and scientifically grounded framework to assess risk and uncertainty in complex marine environments. Its capabilities go **beyond deterministic forecasting**, integrating a full suite of stochastic deliverables to inform **risk-based decision-making in spill contingency planning**.

Through the generation of probability maps, Estimated Time of Arrival (ETA) maps, and thickness distribution visualizations, SPOT Oil allows responders to anticipate not only the likely trajectory of a spill but also its spatial variability and temporal evolution.

The ability to simulate **hundreds of spill scenarios, combined with real-time and historical environmental data**, results in a comprehensive probabilistic assessment that identifies high-risk zones and informs worst-case scenario planning. For users requiring advanced and visually interpretable stochastic outputs, SPOT Oil offers unmatched precision, customizable data layers, and detailed reports that synthesize complex insights into actionable intelligence.

## APPENDIX C. GLOSSARY OF TERMS, ACRONYMS AND ABBREVIATIONS

| Term/Acronym | Definition |
|---|---|
| °C | Degrees Celsius (1.0°C = 33.8° Fahrenheit) |
| µm | Micrometre (1.0 µm = 10^-6 m) |
| API | American Petroleum Institute |
| API Gravity | A ratio between the densities of oil and water used to characterize oil types.<br>. Light - API > 31.1,<br>. Medium - API between 22.3 and 31.1,<br>. Heavy - API < 22.3, Extra Heavy - API < 10.0.<br><br>Formula: API gravity = (141.5/Specific Gravity) – 131.5.<br>API > 10 floats on water; API < 10 sinks. |
| Asphaltenes | Crude oil components insoluble in n-heptane but re-dissolvable in toluene. Highest in molecular weight, polarity, and aromaticity. |
| BBLs | Barrels of oil (1.0 BBL = 0.15899 $m^3$, 1.0 $m^3$ = 6.2898 BBLs). Conversion requires oil density. |
| BBLs / day | Barrels of oil per day (rate). |
| BONN Agreement | An international agreement on pollution response, originally for the North Sea but internationally recognized. |
| GOR | Gas to Oil Ratio - volumetric ratio of produced gas to oil. Changes with temperature and pressure. |
| ITOPF | International Tanker Owners Pollution Federation. |
| km | Kilometres (1.0 km = 1 000 m). |
| $m^3$ | Cubic Meters. |
| MT | Metric Tonnes (1.0 MT = 1,000 kg). Conversion requires API or Specific Gravity:<br>Barrels per metric ton = 1/[(141.5/(API + 131.5) x 0.159]. |
| ERA5 | **ERA5** is the **fifth-generation global climate and weather reanalysis dataset** produced by the **European Centre for Medium-Range Weather Forecasts (ECMWF)** as part of the **Copernicus Climate Change Service (C3S)**. It provides **hourly atmospheric, land, and oceanic data** from **1940 to the present**, replacing the previous **ERA-Interim** reanalysis. |
| CMEMS | **CMEMS (Copernicus Marine Environment Monitoring Service)** is a **European Union-funded service** that provides **high-quality oceanographic data** for **marine and climate applications**. It is part of the **Copernicus Earth Observation Program**, which delivers free and open-access environmental data. |

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|---|---|
| SPOT OIL | Oil spill model developed by DES. |
| DES | Digital Earth Solutions |
| Pour Point | Lowest temperature at which a liquid flows. Below this, it solidifies. |
| Specific Gravity | Density ratio of a substance to a reference (usually water). Used to calculate API Gravity. |
| Stochastic | Probabilistic results showing likelihood and statistical risk of an event. Used to assess worst-case scenarios. |
| Trajectory | Deterministic results showing the impact of a single spill event over time. Can assess response strategies. |
| UTC | Coordinated Universal Time. |
| Wax Content | Crude oil components soluble in high-molecular-weight alkanes but insoluble in lower-weight alkanes. |

**Table 14 Glossary of terms**