Project	AtlantOS – 633211
Deliverable number	8.4
Deliverable title	Oil spill hazard maps
Description	Release of the Atlantic Oil spill Hazard map Portal for dissemination.
Work Package number	8
Work Package title	Societal benefits from observing/information systems
Lead beneficiary	UNIBO
Lead authors	Antonio Augusto Sepp Neves, Nadia Pinardi University of Bologna
Contributors	Martins, F.,Janeiro, J. University of Algarve Cesarini, C. CLU srl
Submission data	May 25, 2018
Due date	October 31, 2017
Comments	This is the reviewed version of deliverable 8.4. This document is not a technical report but a paper version of the oil spill hazard map portal (https://glamor.sincem.unibo.it), since the actual deliverable was the website release.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 633211.

Last updated: 29 May 2018

Stakeholder engagement relating to this task*

WHO are your most important stakeholders?	☐ Private company If yes, is it an SME ☐ or a large company ☐? ☐ National governmental body x International organization ☐ NGO ☐ others Please give the name(s) of the stakeholder(s): IMO, ITOPF, EMSA
WHERE is/are the company(ies) or organization(s) from?	☐ Your own country x Another country in the EU ☐ Another country outside the EU Please name the country(ies): UK, Portugal
Is this deliverable a success story? If yes, why? **If not, why?**	x Yes, because it is the first time that the actual oil spill hazard due to maritime traffic is mapped in the Atlantic scale and the results are available in an open and free basis. ☐ No, because …..
Will this deliverable be used? **If yes, who will use it?** **If not, why will it not be used?**	x Yes. Once again, this is not the actual deliverable but simply a paper version of the GLAMOR portal. The website is open and free and can be used by anyone. It contains oil spill hazard estimates for the Atlantic basis and decision makers should be interested in it. ☐ No, because …..

NOTE: This information is being collected for the following purposes:

1. To make a list of all companies/organizations with which AtlantOS partners have had contact. This is important to demonstrate the extent of industry and public-sector collaboration in the obs community. Please note that we will only publish one aggregated list of companies and not mention specific partnerships.
2. To better report success stories from the AtlantOS community on how observing delivers concrete value to society.

*For ideas about relations with stakeholders you are invited to consult D10.5 Best Practices in Stakeholder Engagement, Data Dissemination and Exploitation.

Table of Contents

1. Introduction

Recent estimates indicate that over 600,000 tonnes of oil are spilled, every year, in the marine environment (US National Research Council, 2009). Surprisingly, after decades of oil-based economy, we still ignore the impacts those spills may have in the coastal environment. Even more curious is the fact that about 50% of the oil ending up in the sea is not due to large maritime accidents (e.g. vessel explosions, foundering) but to operational on-board activities releasing small volumes of crude in a "frequent" mode (e.g. tank washing, engine leakages). It is therefore clear that both accidental and operational spills do represent a potential threat to our coasts and depicting a global oil spill hazard scenario is the first step towards an effective oil spill risk management at such scales.

According to the AtlantOS grant agreement, the deliverable 8.4 is the "*release of the Atlantic Oil spill Hazard map Portal for dissemination.*" The website, so called GLAMOR, is found online (https://glamor.sincem.unibo.it) and this report is mainly a hard copy of the webpage for the sake of documentation.

2. The GLAMOR Web Portal

All the results provided by GLAMOR can be obtained through an open and free web-based oil spill hazard GIS (https://glamor.sincem.unibo.it) and the website was conceived to be intuitive and give a smooth experience to the end user. The GLAMOR end users will find extra material in the website aimed to support a smooth and profitable use of the available products. The portal is structured as presented in Figure 1 and the content of each page is shown in the coming subsections (extracted from the website).

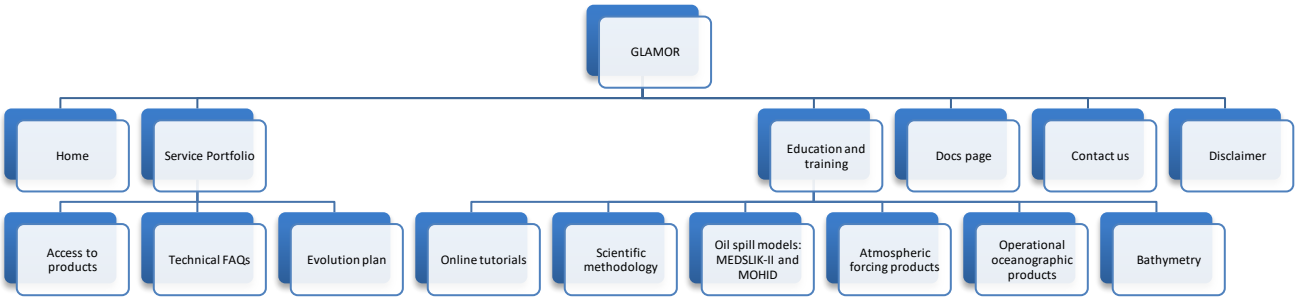

Figure 1 Website structure and its pages

2.1 Home

Welcome! This is the online coastal oil spill hazard mapping webportal, so called GLAMOR, and it has been proposed under the European project AtlantOS (https://www.atlantos-h2020.eu/). It aims at mapping the coastal oil spill hazard associated with the maritime traffic in the Atlantic basin, demonstrating that coordinated international efforts to observe and model the ocean can help us in solving present societal-economic challenges.

The results you will find in GLAMOR were generated using the IT-OSRA oil spill risk assessment methodology and some words on the method itself and its capabilities can be found in our online tutorial, in the scientific methodology or in the papers listed in the references.

All the results provided by GLAMOR can be obtained using our open and free web-GIS and the website was conceived to be intuitive and give a smooth experience to the end user.

2.2 Service portfolio

Access to products

Presentation of the web-GIS.

Oil spill hazard ranking

The literature suggests that the coastal impacts of oil spills depend on both the magnitude (i.e. the volume of oil) of the beaching events and their occurrence rate (i.e. frequency). Using the "Access to Products" tab, the user can readily map the oil spill hazard spatial distribution for the Atlantic countries/states based on the average oil spill concentration found at the coastlines. By simply clicking on the country of interest, one can also see the histogram of all the beaching events in the area of interest. However, we acknowledge that, due to a large number of countries considered in your experiment, comparisons within countries regarding the average oil spill concentration found at the coast, the frequency of beaching events and, of course, uncertainties in the estimates can be challenging. Based on the average concentration of oil found on the coast, here used as a proxy of the oil spill hazard, we ranked the Atlantic nations based on their exposure to oil spills. Further information, namely the uncertainty of the estimates and the number of events observed, were also made available allowing the user to draw more accurate conclusions about the oil spill hazard in the Atlantic and its spatial distribution.

	Name	Average (in tonnes/km)	Standard deviation (in tonnes/km)	Oil spill hazard index	Simulated number of beaching events
1	Guine	197.09	889.48	0.70	369.00
2	Madeira	136.63	666.22	0.66	1,020.00
3	Guine Bissau	62.61	245.75	0.62	570.00
4	Canary	37.49	163.63	0.56	4,839.00
5	Uruguay	35.41	189.96	0.46	1,823.00
6	Portugal	33.84	168.12	0.53	577.00
7	Cabo Verde	30.69	119.90	0.60	13,336.00
8	Spain	25.75	108.50	0.52	2,365.00
9	Mauritania	24.38	109.02	0.50	2,709.00
10	Cameroon	19.31	102.10	0.40	2,533.00
11	Gabon	17.61	76.12	0.46	1,625.00
12	Morocco	17.08	102.24	0.35	281.00
13	Sierra Leone	17.04	70.77	0.48	1,549.00
14	Bahia	16.86	66.03	0.52	4,737.00
15	Senegal	16.53	79.30	0.41	1,304.00

Figure 2 Snapshot of the preliminary ranking found at the GLAMOR portal

Technical FAQs

Still need to contact us?
Send us your comments.

What does RP mean?

RP stands for "Release Point". In the IT-OSRA method we address the widest range of spill scenarios occurred off the coastline of interest and the simulated spills are originated at the pre-set RPs.

What is the unit of measure of the Oil Spill Hazard maps?

In GLAMOR, we opted for employing the average concentration (in tonnes of oil per km of coast) found on the coast as a proxy of the oil spill hazard. The average (and standard deviation) is computed assuming a Weibull distribution using the outputs of the available simulations.

How were the ensemble members defined?

The ensemble members configuration was based on the available literature, trying to cover the uncertainties typically observed in oil spill events (see Sepp Neves et al., 2015 and 2016).

Can I use the GLAMOR results to have a reliable estimate of the hazard at my beach?

No. GLAMOR was thought and executed focused on giving a general picture of the oil spill hazard in the Atlantic basin at the national level. We should always bear in mind that the ocean fields used have a 1/12-degree spatial resolution and do not fully reproduce the circulation in the scale of hundreds of meters (i.e. one beach).

Evolution plan

GLAMOR is a dynamic webpage. Ensemble oil spill experiments are resource demanding and our website will be built in steps. The GIS system/webpage will be updated every six months adding more ensemble members and covering a longer time spam, improving our capability to address the uncertainties inherent to the oil spill hazard in the Atlantic coastlines.

2.3 Education & Training

Online tutorials

Short video on GLAMOR, used methods and its potentialities.

Scientific methodology

The oil spill hazard mapping method applied in GLAMOR is based on the work developed by Sepp Neves et al., (2015) and later improved by Sepp Neves et al., (2016). The methodology, named IT-OSRA, is aligned with modern and standardized concepts of risk (ISO 31000 – Risk management principles) critically adapted to the oil spill case. The user can find the theoretical IT-OSRA basis in Sepp Neves et al., (2015).

The oil spill hazard estimation in IT-OSRA relies on outputs generated by ensemble oil spill modelling experiments. As many as necessary spill scenarios are simulated with different release sites, meteo-oceanographic conditions and oil spill model configurations addressing uncertainties about where, when and how (i.e. spilled volume, type of oil, etc.) a spill might happen. The magnitude and frequency of the beaching events in the simulated spills are evaluated at pre-defined coastal areas (e.g. municipality, country) and used to compute the oil spill hazard.

Some important simplifications were applied to IT-OSRA for the GLAMOR-AtlantOS experiment in order to reduce the computational time involved. To address uncertainties regarding “where” the spill might happen, about 10,000 potential release points were defined covering areas between 30 and 130km away from the coastline. A fixed distance of approximately 25km between release points was defined based on the Lagrangian spatial-decorrelation for surface currents in the Atlantic. To address uncertainties regarding “when” the spill will happen or, in other words, the meteo-oceanographic conditions during the spill event, simulations were repeated for every release point using sampled current and wind fields for the year of 2013. Finally, uncertainties regarding the spill characteristics (i.e. spill volume, oil type, spill duration) were not addressed in the AtlantOS experiment. More on the reasoning behind the ensemble members’ configuration is presented in Sepp Neves et al., (2016), where the user will also find the results obtained with a small-scale case study carried out off the Portuguese coast.

Here the details for the model setup for the oil spill hazard bulletin

—Release Point grid: 1/4deg resolution

—Spatial coverage of RP grid: coastal band (30 – 130 km offshore) covering ice-free areas in the Atlantic

—Number of parcels released in the simulations: 25,000 representing 10,000 tons (accidental scenarios)

— Oil API: 38

— Current fields: CMEMS Global ocean daily analyses (1/12deg spatial resolution)

— Wind fields: ECMWF ERA-Interim Reanalysis 6-hourly wind fields (80km spatial resolution)

— Wave fields: Stokes drift disregarded

— Temporal coverage: only 2013 for now

— Number of simulations to be performed: ~600,000

Further information can also be found in our online tutorial.

Oil spill models: MEDSLIK-II & MOHID

MEDSLIK-II

GLAMOR uses MEDSLIK-II, an open and free oil spill model able to reproduce the transport and weathering processes taking place in spill events (http://medslikii.bo.ingv.it/). A paper on the model equations and structure is found in De Dominicis 2013a. Very useful information on the model calibration using real spill cases can be found in De Dominicis 2013b.

MOHID Oil Spill module

The MOHID water modelling system is a modular system including modules for several processes of the marine environment (physical, chemical and biological), which can communicate in real time during a simulation. MOHID Oil Spill module is used in GLAMOUR as an ensemble member in the oil spill simulations. More details on the Oil module and its implementations can be found in Janeiro et al., (2008) and Janeiro et al., (2017).

Atmospheric forcing products

The atmospheric reanalysis ERA-Interim from the ECMWF was chosen as our wind input to guarantee consistent wind fields for the whole Atlantic and throughout the simulated period. Currently, ERA-Interim 10m winds are available 80km spatial resolution with a 6h interval.

Operational oceanographic products

Oil spill transport is modelled using the daily CMEMS global ocean products, freely available here. GLAMOR uses the CMEMS **daily analysis** current fields at 1/12-degree resolution. The top 150 m currents are used by the oil spill models to drive the Lagrangian movement of oil parcels from the initial release points.

Bathymetry

The bathymetry used in our experiment is based on the open and free GEBCO database. The bathymetry field, originally available with a 30' spatial resolution, was interpolated to the current field grid with a final resolution of 1/12-degree.

2.4 Docs page

De Dominicis M., N. Pinardi, G. Zodiatis, R. Lardner,**2013a.**"MEDSLIK-II, a Lagrangian marine surface oil spill model for short-term forecasting – Part 1: Theory". Geosci. Model Dev., 6, 1851-1869, doi:10.5194/gmd-6-1851-2013

De Dominicis M., N. Pinardi, G. Zodiatis, R. Archetti,**2013b.**"MEDSLIK-II, a Lagrangian marine surface oil spill model for short-term forecasting – Part 2: Numerical simulations and validations". Geosci. Model Dev., 6, 1871-1888, doi:10.5194/gmd-6-1871-2013

Janeiro, J., Fernandes, E., Martins, F., Fernandes, R., 2008.Wind and freshwater influence over hydrocarbon dispersal on Patos lagoon. Brazil. Mar. Pollut. Bull. 56:650
665. http://dx.doi.org/10.1016/j.marpolbul.2008.01.011.

Janeiro, J., Neves, A., Martins, F., Relvas, P., 2017. Integrating technologies for oil spill response in the SW Iberian coast. Journal of Marine Systems, 173, pp. 31-42. http://doi.org/10.1016/j.jmarsys.2017.04.005

Sepp Neves, A.A., Pinardi, N., Martins, F., Janeiro, J., Samaras, A., Zodiatis, G., De Dominicis, M.. **2015.**"Towards a common oil spill risk assessment framework. Adapting ISO 31000 and addressing uncertainties." Journal of Environmental Management, Volume 159, Pages 158-168

Sepp Neves, A. A., Pinardi, N., Martins, F., **2016**. IT-OSRA: applying ensemble simulations to estimate the oil spill risk associated to operational and accidental oil spills. Ocean Dynamics 66 (8), 939–954.

2.5 Contact us

Online form to contact us.

2.6 Disclaimer

UNIBO together with all related data providers informs that timely delivery of data and products from the GLAMOR service through the Internet is not guaranteed.
The information on GLAMOR Web pages may be used for any lawful purpose so long as you do not:

1. claim it is your own,
2. use it in a manner that implies an endorsement or affiliation with the UNIBO,
3. or modify its content and then present it as official GLAMOR material.

The user assumes the entire risk related to the use of information on GLAMOR Web pages.
GLAMOR provides such information "as is", and UNIBO disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose.
In no event will UNIBO be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profit resulting from any use or misuse of this data.
In particular, UNIBO is not liable for any damage or loss to assets or persons deriving from use of the coastal oil spill hazard made available by GLAMOR.

3. Conclusions

The first version of the Atlantic oil spill hazard map portal (GLAMOR) was published online. The site contains preliminary results and it is being updated in so far as more simulations are run. All the information presented is open and free.