MARINER

AN EU PROJECT TO ENHANCE COOPERATION AND PREPAREDNESS TO RESPOND TO CHEMICAL SPILLS AT SEA

Funded by European Union Civil Protection and Humanitarian Aid

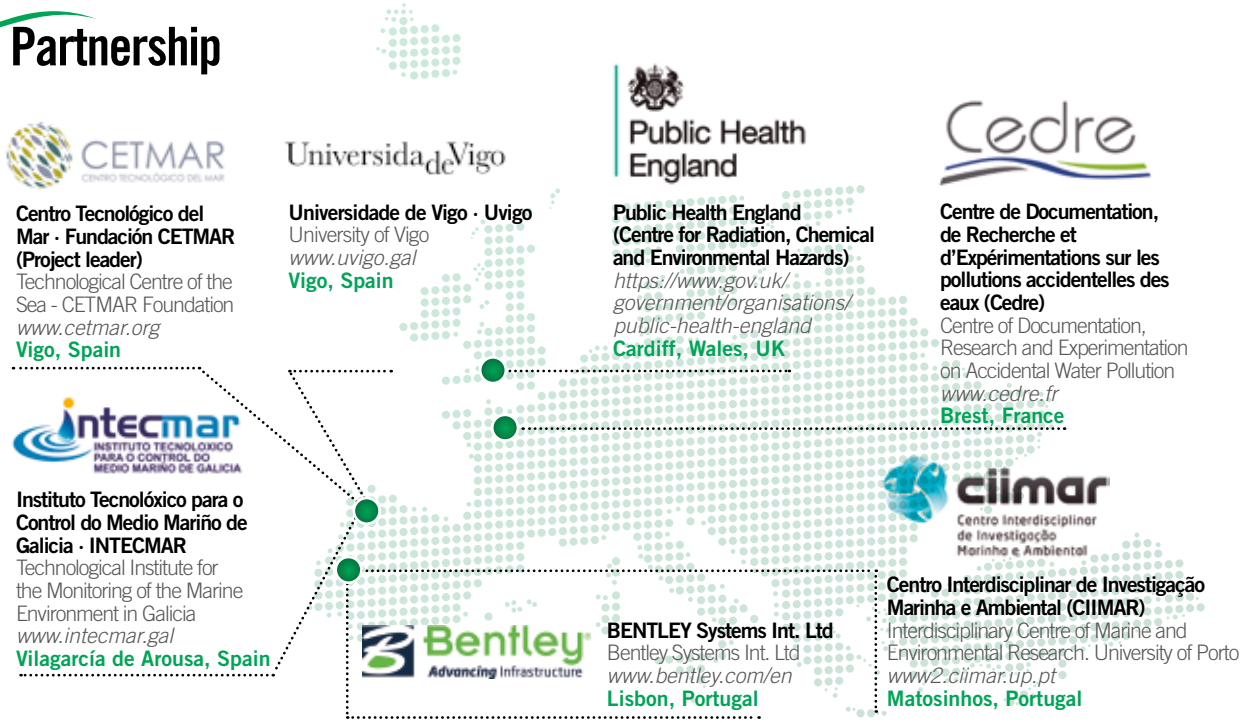
MARINER is co-financed by the European Union in the framework of the Union Civil Protection Mechanism. DG-ECHO

MARINER AT A GLANCE

Acronym: MARINER
Title: Enhancing HNS preparedness through training and exercising
Website: www.mariner-project.eu
Duration: 2 years (January 2016-January 2018)
Budget: 998,547€ (75% from EU)

Financing: Co-financed by the EU in the framework of the Union Civil Protection Mechanism, DG-ECHO.
MARINER goal: Improve preparedness and response to maritime spills of chemicals in Europe.

Partnership



Centro Tecnológico del Mar · Fundación CETMAR (Project leader)
Technological Centre of the Sea - CETMAR Foundation
www.cetmar.org
Vigo, Spain

Universidade de Vigo · Uvigo
University of Vigo
www.uvigo.gal
Vigo, Spain

Public Health England (Centre for Radiation, Chemical and Environmental Hazards)
https://www.gov.uk/government/organisations/public-health-england
Cardiff, Wales, UK

Centre de Documentation, de Recherche et d'Expérimentations sur les pollutions accidentelles des eaux (Cedre)
Centre of Documentation, Research and Experimentation on Accidental Water Pollution
www.cedre.fr
Brest, France

Instituto Tecnolóxico para o Control do Medio Mariño de Galicia · INTECMAR
Technological Institute for the Monitoring of the Marine Environment in Galicia
www.intecmar.gal
Vilagarcía de Arousa, Spain

BENTLEY Systems Int. Ltd
Bentley Systems Int. Ltd
www.bentley.com/en
Lisbon, Portugal

Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR)
Interdisciplinary Centre of Marine and Environmental Research. University of Porto
www2.ciimar.up.pt
Matosinhos, Portugal

Advisory Board

Spain (Madrid)

- **Salvamento Marítimo - Sasemar**
- **Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. División para la Protección del Mar.**
- **Ministerio de Fomento. Dirección General de Marina Mercante.**
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Portugal (Lisbon)

- **Direcção-Geral da Autoridade Marítima. Direcção de Combate à Poluição do Mar.**

United Kingdom (Southampton)

- **Maritime & Coastguard Agency**

France (Paris)

- **Ministère de la Transition Ecologique et Solidaire**

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CHEMICAL SPILLS?

WHAT'S THAT? DO YOU MEAN OIL SPILLS?

Over 90% of the world's trade is carried by sea. Besides oil, maritime transport carries around the world numerous goods and commodities, including chemicals, both in bulk and packaged form.

Potentially harmful chemicals transported by sea are commonly termed **Hazardous and Noxious Substances (HNS)**. HNS are defined by international pollution conventions as **any substance other than oil which, if introduced into the marine environment is likely to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.**

More than 2,000 different HNS are regularly transported by sea.

The transportation of chemicals has grown considerably in recent years (the International Maritime Organization estimated over 200 Million tonnes traded annually by tankers).

HNS incidents can pose major risks to health and the environment as well as economic and social implications.

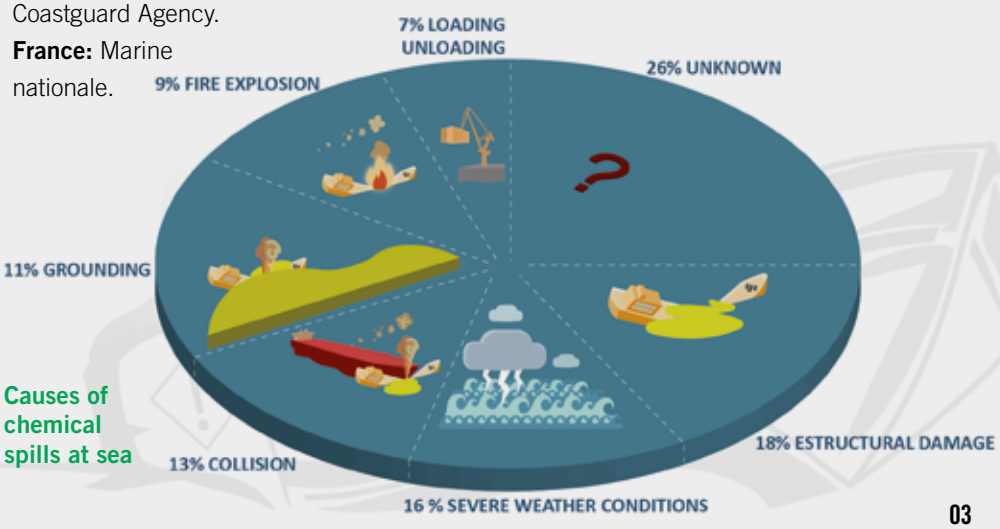
Around the world, 126 ship-source HNS incidents over 10,000 L were recorded for the period from 1998 to 2013 (Cedre).

WHO IS IN CHARGE OF RESPONDING IF A CHEMICAL SPILL HAPPENS IN EUROPEAN WATERS?

Member States have contingency plans in which responsibilities and actions to take are clearly set out. They provide a tiered approach in which responding organisations can range from the local to the international level depending on the severity (scale and danger) of the incident and its location. This collaboration within and among Member States ensures that all the needs in terms of equipment, personnel and expertise will be satisfied.

Some of the national organisations in charge of implementing and/or managing the response to maritime incidents are:
Spain: Dirección General de Marina Mercante.
Portugal: Direcção-Geral da Autoridade Marítima.
United Kingdom: Maritime & Coastguard Agency.
France: Marine nationale.

At the European level, the European Maritime Safety Agency (EMSA) provides a major source of support to Member States, which can be requested via the Emergency Response Coordination Centre (ERCC) in the European Commission, DG ECHO.



Causes of chemical spills at sea

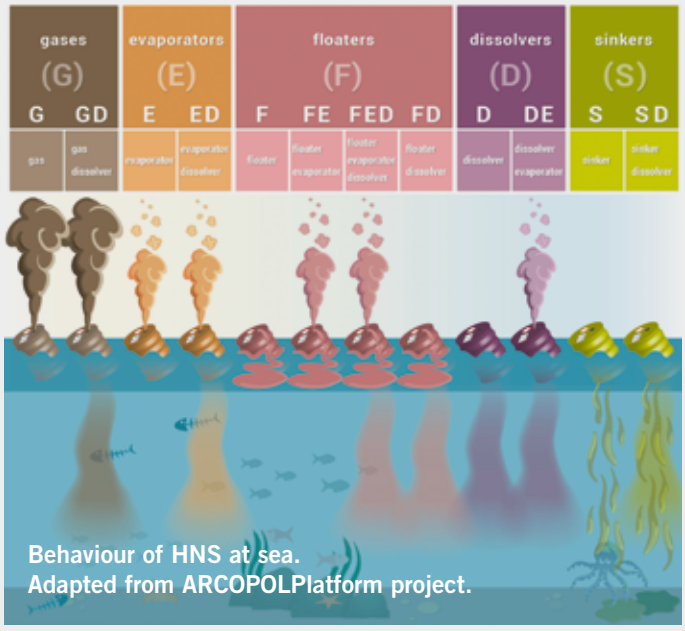
CHEMICAL SPILLS?

Photo: Cedre

OK... SO EVERYTHING SEEMS UNDER CONTROL, DOESN'T IT?

Maritime spills involving HNS are always tricky situations to deal with...

- The identification and assessment of the cargo and associated risks and hazards may be challenging.
- Depending on the weather and sea conditions, and on the chemical(s) involved, HNS spilled at sea can evaporate, float, dissolve, sink, or do all three –e.g. 50% of the chemical may evaporate, 25% dissolve and the 25% left may float.
- Furthermore, some chemicals can react in contact with seawater or air causing explosions or forming more dangerous products (corrosive, toxic or flammable). Additionally, when the spill involves different HNS, besides their own particular characteristics, the potential interactions between them need to be considered too.
- Thus, due to the great complexity and variety of chemicals transported by sea (their behaviour, toxicity, etc.), HNS preparedness and response is less straightforward than that for oil spills.



Behaviour of HNS at sea. Adapted from ARCOPOLPlatform project.

THEN... ARE WE DOOMED???

No, we are not. Fortunately there has been lots of work to study and assess how to respond to such incidents, for example:

- In close cooperation with the European Chemical Industry Council (Cefic) and our partner Cedre, EMSA established a network of experts (MAR-ICE Network) who provide upon request information and specialist advice on chemicals involved in maritime emergencies, their associated risks, and possible response options. Besides, EU Member States have access to EMSA Marine Chemical Information Sheets (MAR-CIS), which gather relevant information for the initial stage of response operations to incidents involving HNS.
- At different territorial levels, competent organisations are continuously improving their contingency plans to include protocols to respond to potential incidents involving HNS spills, and provide the right equipment and trained personnel.
- Certain national and international organisations launch calls to spur and support innovation, research and cooperation among key organisations to improve our preparedness to deal with maritime spills. For instance, every year, the DG-ECHO (Directorate-General for European Civil Protection and Humanitarian Aid Operations) publishes a call for prevention and preparedness projects in the field of civil protection and marine pollution. And this is how this all started, we took on the challenge of improving our capabilities to respond to HNS in Europe and DG-ECHO selected our proposal, the MARINER project.

MARINER PROJECT

LINES OF ACTION

MAKING THE MOST OF THE EXISTENT KNOWLEDGE

We identified and classified relevant resources produced by previous projects or related organisations in this field to foster their accessibility and transfer to contingency planners and responders.

PREDICTING THE FATE AND IMPACT OF THE SPILL TO SUPPORT RESPONSE OPERATIONS

We upgraded and improved tools to support decision-making and response during the emergency.

DRAWING UP BESPOKE RESPONSE PROTOCOLS

We encouraged information exchange among key actors coming from different fields of expertise (coastguards, firemen, chemists, public health specialists, etc.) to adapt chemical incidents response protocols and equipment to the maritime context.

REINFORCING PREPAREDNESS

We developed training packages and a web tool for exercising to support response teams and their managers in reinforcing their preparedness.

AWARENESS RAISING AND DISSEMINATION

We produced dissemination materials and organised public events to make the maritime sectors and the general public aware of the risks spills of HNS may pose to the environment and human health.

LINE OF ACTION

MAKING THE MOST OF THE EXISTENT KNOWLEDGE

RESPONSIBLE PARTNER

Marisa Fernández, Patricia Pérez, Raquel Diez, and Belén Pungín
MARINER Coordination Team. CETMAR

What was missing in terms of knowledge on HNS?

We were fully aware that MARINER was not the first project addressing HNS spills, and that different organisation had already produced different materials on this subject. But we also knew that, especially for project results, all this knowledge was dispersed among different websites often with access limited to the duration of the project itself. So, the conclusion was that there was much knowledge already but it was not readily available for the end users to make the most of it.

What did MARINER deliver to cover this need?

We carried out an extensive search on EU-funded programmes repositories to compile information on HNS related resources -guides, reports, videos, manuals, software, etc.- delivered in the frame of research and cooperation projects, as well as on the websites of relevant organisations that work on maritime issues and health or environmental protection. Then all the information compiled was systematically classified and made into a user-friendly database that we named "HNS Knowledge Tool" which is publicly available online.

In addition to that, we prepared booklets that illustrate the type of information available on the database. They are fact sheets presenting the most relevant resources we have found in our searches.

Lastly, to achieve a real impact on the preparedness to deal with HNS spills in Europe, information about the HNS Knowledge Tool and the booklets has been communicated to end users in UK, France, Spain and Portugal and beyond.

MAIN RESULTS *http://mariner-project.eu/results/category/2*

HNS KNOWLEDGE TOOL [CETMAR]

Database publicly accessible through a user-friendly online browser that enables users to perform advanced and basic searches on resources relevant for different areas of HNS preparedness and response.

E-BOOKLETS [CETMAR and Universidade de Vigo]

Short catalogues presenting key features of the most relevant resources included in the HNS Knowledge Tool. The booklets were organised based on thematic areas such as: Contingency planning and response; Risk analysis; Environmental monitoring, impact, and recovery; Training and exercising; HNS Characterisation; and Modelling.

Photo: MARINER Project

LINE OF ACTION

PREDICTING THE FATE AND IMPACT OF THE SPILL TO SUPPORT RESPONSE OPERATIONS

RESPONSIBLE PARTNERS

Rodrigo Fernandes, David Brito, and Frank Braunschweig
Bentley Systems International Ltd.

Pedro Montero and Begoña Vila
INTECMAR

Miguel Santos, Joana Soares, and Helena Oliveira
CIIMAR

What was the need that the MARINER project wanted to address to reinforce response operations?

When we are right in the middle of a crisis involving the spill of HNS, response managers have to make important decisions on how, when and where to act. For this they have to consider varied information such as the location of the incident, weather conditions, properties of the HNS spilled, vessel conditions, people and environments that may be affected, etc. While this information helps assess immediate hazards and actions, managers also rely upon modellers and scientists for predictions on how the incident could evolve in the following hours or days and on its potential impact on the environment. Under such crisis conditions, the information required should be as accurate as possible, but also in a format that can be understood easily by all response stakeholders. So that is why we wanted to work on the models used to predict the fate of HNS at sea and on environmental impact assessment, in order to make the tools and guidelines available more operational and readily usable by response managers and/or the members of their teams.

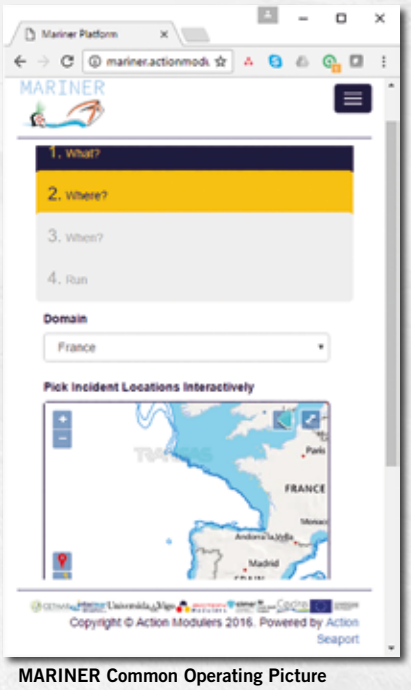
What did MARINER deliver to cover this need?

We basically worked on three complementary areas:

Modelling: we optimized the speed and performance of the current MOHID 3D HNS spill model, which predicts the fate of HNS at sea, to be suitable for use in emergency response operations. Additionally, the HNS spill model was updated to include an environmental risk module. This module can predict and display the areas that may be negatively affected by the spill, and calculates a hazard index. The predictions are based on the concentration of the HNS that the model estimates will be reached in the environment and compares this with the toxicity thresholds of marine organisms available from the CIIMAR online database -which was updated thanks to MARINER. Then we built it into a Common Operating Picture (i.e. a user interface) simple enough that the model could be run by anyone regardless of their knowledge on modelling or environmental impact assessment, but also set up to prevent its misuse to give false forecasts.

Information exchange during the crisis. For efficient communication during the crisis, use of the same schemes (digital files templates that are used to exchange information between emergency services) is fundamental. In MARINER we wanted to deliver standard templates to share this information, and also a standard set of symbols and styles to display HNS-spill related graphic information on maps.

Environmental impact assessment. Considering that the potential environmental hazards posed by HNS spills are much less understood than oils, we wanted to develop guidelines and protocols that could support competent organisations on environmental monitoring and HNS impact assessment in the marine and coastal environment.



MARINER Common Operating Picture

Photo: MARINER Project

MAIN RESULTS *http://mariner-project.eu/results/category/3*

MARINER MODELLING PLATFORM
[Bentley Systems International Ltd. (Former Action Modulers) and CIIMAR]

Software (3D HNS spill model) and interface (Common Operating Picture - COP) for predicting the fate, behaviour and environmental / public health risks from a chemical spilled in the European Atlantic area and whether it may potentially affect the marine or coastal environment.

MODELLING OF HNS HAZARDS TO THE ENVIRONMENT [CIIMAR]

Two reports were produced.
The first explains the choice of toxicological parameters selected and their application to evaluate the environmental hazard and risk following a maritime spill. The second report explains the rationale of the environmental-impact module developed and coupled to the 3D HNS-spill model and includes a description of the model developed to predict the effects of a HNS spill on a population of representative marine crustaceans (amphipods).

OGC GML SCHEMA FOR HNS SPILLS [INTECMAR]

In order to assure the interoperability between different agencies when they share information about HNS spill events, a Geography Markup Language GML schema is proposed. This format has the capability to share data about the location of the incident, the involved substances, levels of concern, modelling outputs and threat zones. Since it is based on Open Geospatial Consortium GML standard, it is a suitable format to share geographic data and to be used by GIS Software and Common Operating Pictures.
In addition to the schema, an API (Application Programming Interface) to deal with these types of files (coded in Python) as well as some examples are also provided.

GUIDELINES AND PROTOCOLS FOR ENVIRONMENTAL IMPACT ASSESSMENT [CIIMAR]

A systematic compilation and validation of existing chemical, biological and ecological information to produce guidelines and protocols for HNS environmental monitoring and impact assessment.

STANDARD SYMBOLS AND STYLES FOR MAPPING [INTECMAR]

This report presents the state-of-the-art in the use of different symbols for hazard and warning situations. It also includes a description and the ready-to-use files of a set of symbols (to mark single location) and styles (to mark areas) proposed for marine HNS and oil spill incident maps. These symbols and styles are based on the symbology used in other hazard mapping systems.

COMPARING MARINER SYSTEM WITH OTHER SYSTEMS [Bentley Systems International Ltd.]

A report that analyses the results of tests carried out to check the performance of the 3D-HNS MOHID model with other models currently in use. It also presents the outputs provided by the model when using real past incident scenarios, comparing the model with what actually happened during the incident.

Photo: MARINER Project

LINE OF ACTION

DRAWING UP BESPOKE RESPONSE PROTOCOLS

RESPONSIBLE PARTNERS

Garbiñe Ayensa and Silvia Allen-Perkins. **INTECMAR**
William Giraud. **Cedre**
Luis Navarro and Iván Rodríguez. **Universidade de Vigo**

What was the knowledge gap that the MARINER project identified regarding the response to maritime HNS incidents?

Dealing with spills of hazardous substances is always tricky, but in a maritime context the difficulty can be even more challenging. Considerable expertise exists on how to respond to such incidents but this mainly relates to spills on land. The aim of this line was therefore to transfer these skills to a maritime response.

What did MARINER deliver to cover this need?

In MARINER we identified key expertise, knowledge and relevant protocols used by the chemical industry, civil defence, military special units, and fire brigades. Through numerous visits to their facilities and interviews all this knowledge was closely assessed and used as a basis for developing protocols adapted to the maritime environment. Specifically, as a case study, these protocols were tailored to the resources available on the response vessels used by the Galician Coastguards.

The Galician Coastguards provide sea surveillance, search and rescue, and protection services in Galician waters, a region located in the NW corner of Spain. Galicia is the only region in Spain that has its own coastguard service and they have always been a useful collaborator in our work to enhance HNS response. During MARINER the Galician Coastguards incorporated knowledge gathered by the project and, with advice from INTECMAR, used this to reinforce their response resources to fight HNS spills. Once those resources were improved, adapted protocols were tested during field exercises.

MAIN RESULTS *http://mariner-project.eu/results/category/4*

PROTOCOLS FOR RESPONDING TO HNS SPILLS AT SEA
[INTECMAR, Cedre, and Universidade de Vigo]

This guide for responders includes adapted protocols to deal with HNS spills in the marine environment. Different land-based operations and protocols were analysed and adapted for the different steps: pre-planning considerations, communication and operational procedures, and technical considerations. Protocols covering different behaviours of HNS (evaporators, floaters, sinkers and dissolvers) were evaluated, as well as recommendations to better deal with HNS spills at sea.

VIDEO: DEALING WITH HNS SPILLS AT SEA
[Universidade de Vigo and INTECMAR]

This video highlights the main aspects to consider when dealing with HNS spills at sea. It shows in an entertaining way different techniques that can be used when a HNS spill takes place. The video contains animated frames combined with real images from the field exercises organised in the frame of MARINER project and also during the international exercise SCOPE 2017 and the Spanish national exercise HUELVA 2017. It is available in English and Spanish.

Photo: MARINER Project

LINE OF ACTION

REINFORCING PREPAREDNESS

RESPONSIBLE PARTNERS

Andrew Kibble, Paul Harold, and David Russell. Centre for Radiation, Chemical and Environmental Hazards. **Public Health England**

William Giraud, Romain Dietschi, and Arnaud Guéna. **Cedre**

Rodrigo Fernandes, David Brito, and Frank Braunschweig. **Bentley Systems International Ltd.**

Miguel Santos, Helena Oliveira, and Joana Soares. **CIIMAR**

What was the need that the MARINER project wanted to address?

We knew that the best way to reduce the impact of maritime spills is to have robust and regularly tested contingency plans. Thankfully real incidents are not common but it is very important to facilitate regular training and exercising of plans instead; this maintains preparedness and makes teams "battle-ready". However, knowledge on chemical spills in the maritime sector is scarce and specific training and exercising is not common. So in MARINER we wanted to produce some materials and tools that could support training activities, improve preparedness and fill this gap in knowledge.

What did MARINER deliver to cover this need?

To support response teams and their managers in reinforcing their preparedness to such events, we developed training packages addressing different aspects of HNS maritime spills (management, environmental impact, modelling, and implications on International Health Regulations) and combined these with a web tool capable of producing classroom exercises around HNS spill response.

MAIN RESULTS *http://mariner-project.eu/results/category/5*

EXERCISE WEB TOOL AND MANUAL ALLOWING PREPARATION OF BESPOKE LOCAL AND REGIONAL DESK-TOP MARITIME HNS EXERCISES [Centre for Radiation, Chemical and Environmental Hazards. PHE]

A free to access web tool and manual allowing preparation of bespoke local and regional desk-top maritime HNS exercises. The tool combines key information on HNS types, an interface to input regional weather and sea conditions to model chemical spill behaviour, a mapping system to load coastal sensitivity data and a library of typical exercise scenarios with supporting materials. The tool allows those involved in planning and providing technical response advice to be trained to respond to realistic incident scenarios for their area. The exercise tool is available in English only but the manuals are in Spanish too.

TRAINING PACKAGE ON HNS MODELLING AND ENVIRONMENTAL IMPACT [Bentley Systems International Ltd. and CIIMAR]

A Mediawiki webpage covering different aspects of HNS modelling and environmental impact assessment. The main contents are completed with slide presentations, interviews, articles, manuals, etc.

E-LEARNING: INTERNATIONAL HEALTH REGULATIONS AND HNS MARITIME INCIDENTS [Centre for Radiation, Chemical and Environmental Hazards. PHE]

An interactive e-learning course aimed to train response agencies about WHO International Health Regulations, which relate to major cross-border health emergencies, and how they may apply to large scale maritime HNS incidents.

TRAINING PACKAGE ON HNS SPILL MANAGEMENT [Cedre and Universidade de Vigo]

Powerpoint presentations and posters in pdf format covering training for responders on general aspects of HNS, incident prevention and preparedness, incident response and post-crisis actions. Topics covered include maritime transport, regulations, accident causes, chemical behaviour, marine and shoreline response techniques for the different vessels transporting HNS, responder protection, environmental monitoring, communications and compensation funds.

Photo: MARINER Project

LINE OF ACTION

AWARENESS RAISING AND DISSEMINATION

RESPONSIBLE PARTNERS

Marisa Fernández, Patricia Pérez, Raquel Diez, and Belén Pungín
MARINER Coordination Team. CETMAR
Luis Navarro and Iván Rodríguez.
Universidade de Vigo

Who is the MARINER target audience?

When we were developing this project proposal we were all concerned about the lack of awareness the general public have regarding HNS.

For example if we say "maritime pollution" people typically picture oil spills or "black tides". Furthermore, if someone hears about containers washing up on a beach instead of being alarmed they are as likely to go there to see if there is anything valuable.

So for the benefit of all, we agreed that we should work to raise awareness on the benefits and risks of shipping and how our governments are working on this.

Likewise, while the maritime sector is aware of the problem in general they have limited access to the resources that could increase their knowledge and reinforce preparedness.

What did MARINER do to reach its target audience?

As an EU funded project, we wanted all project results to be freely available online, so we set up the project website and disseminated MARINER outputs via this and through our social media accounts and project newsletters. Specifically for the maritime sector, we held workshops in the 4 countries participating in the project (UK, France, Spain, and Portugal) for maritime and response professionals to have a closer look at the project results and give us feedback that could help us improve the final products.

In addition, partners participated in external events dealing with maritime or environmental issues to further disseminate MARINER work internationally.

We feel it is important that the public are also aware of the work of MARINER and so we have produced a number of videos available via a range of social media outlets and also this layman's report. All of these individual actions were aimed at disseminating MARINER results and raising awareness on HNS to a wide audience.

MAIN RESULTS *http://mariner-project.eu/results/category/6*

PROJECT WEBSITE [CETMAR]

Website hosting all the information about the project and the results produced by the partnership.

MARINER PROJECT: INTRODUCTORY VIDEO [Universidade de Vigo]

This 10-minute video features the goals and activities included in the MARINER project. Starring: all MARINER partners.

AWARENESS RAISING VIDEO [Universidade de Vigo]

This 6-minute animation video highlights the importance of the role authorities and experts play when facing maritime chemical incidents and how this role helps to reduce environmental and human impacts. The characters are inspired by the MARINER partners.

MARINER EVENTS: WORKSHOPS AND FINAL CONFERENCE [CIIMAR, PHE, Cedre, CETMAR]

During the second year of implementation of the project, partners organised events in 4 different countries to showcase the MARINER project and its results to end users. Workshops were held at

- Matosinhos, Portugal. April 2017
- Cardiff, Wales. June 2017
- Brest, France. September 2017
- Vigo, Spain. November 2017.

The agendas included presentations and live demonstrations of MARINER tools and opportunity for stakeholders to discuss and help evolve aims and outputs.

Photo: MARINER Project

SO WHAT HAS MARINER ACHIEVED?

OVER THE TWO YEARS OF ITS COMPLETION, THE MARINER PROJECT HAS DELIVERED A COMPREHENSIVE SET OF MATERIALS AND TOOLS TO REINFORCE PREPAREDNESS AND RESPONSE TO MARITIME CHEMICAL SPILLS BOTH IN EUROPE AND BEYOND. KEY ACHIEVEMENTS INCLUDE:

HNS Knowledge Tool

An online database housing more than 400 resources on the scope of HNS preparedness and response.

Exercise Web Tool

A web tool for producing desk-top exercises adapted to local conditions.

New Protocols

For responding to HNS incidents at sea using knowledge from land and inland waters.

Training packages and e-learning on

- Modelling and environmental impact assessment,
- Response to chemical spills,
- International Health Regulations and HNS maritime incidents.

Models

Models that can predict the fate and impact of chemical spills.

Videos

Videos to raise awareness and share the knowledge gathered after two years of intense liaison with experts on chemical emergencies from different sectors.

As recognised by the project Advisory Board, comprising those organisations discussed earlier with key roles in responding to maritime spills, one of our most important achievements has been to deliver fully-transferable operational products that address actual needs in the response approaches of the participant countries. Furthermore, when our coasts have not been subjected to chemical spills recently, MARINER has kept the potential threat of HNS high on the agenda, and provided an arena to foster cooperation between EU countries reinforcing our preparedness and response should such threats become a reality.
Lastly but still very importantly, MARINER has provided a stepping stone for all the organisations working on the project to continue collaborating and improving EU capabilities to deal with maritime spills.

CONTACT DATA

Project website: http://mariner-project.eu/
Social networks:

Twitter:
@MARINER_HNS

Permanent contact: Marisa Fernández:
mfernandez@cetmar.org · mariner@cetmar.org
CENTRO TECNOLÓGICO DEL MAR - FUNDACIÓN CETMAR
Eduardo Cabello s/n · 36208 Vigo · Spain

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THE MARINER TEAM

- **Partnership:** CETMAR, INTECMAR, Universidade de Vigo, PHE, Cedre, CIIMAR, Bentley Systems Int. Ltd.
- **Advisory Board: ES:** SASEMAR, MAPAMA, Gardacostas de Galicia, DG Marina Mercante, Protección Civil. **PT:** Direcção-Geral da Autoridade Marítima. **UK:** MCA. **FR:** Ministère de la Transition Ecologique et Solidaire.