

ARCOPOLplatform. Protecting the Atlantic European coast from maritime pollution

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ABSTRACT: Starting in 2009, ARCOPOL is a family of three consecutive ERDF funded projects framed in the Atlantic Area Transnational Programme aimed at improving the preparedness, response and mitigation capabilities of local and regional authorities to accidental coastal pollution. At present, ARCOPOLplatform is contributing to this objective through the capitalisation of previous projects' outcomes and by developing a sustainable structure of public-private cooperation via "the Atlantic Technological Platform for maritime spills' preparedness and response".

The main topics being addressed are:

- Contingency planning: To assist in the preparation and implementation of contingency plans, Local Authorities have the opportunity to look at pilot actions and adapt ARCOPOL deliverables to their specific needs. Outcomes focus on the response to HNS incident, the singularities of Natural Protected Areas and post-spill environmental monitoring issues.
- Training and awareness raising tools: E-learning courses and videos have been prepared and are being disseminated through road-shows to increase the general public's and potential responders' knowledge.
- Spill modelling and risk analysis: The MOHID desktop oil spill simulator, the Dynamic Risk Analysis, the ARCOPOL web viewer, and the 3D barrier behaviour model are being upgraded and transferred to end users.

Furthermore, and overarching all this work, the Atlantic Technological Platform acts as a meeting forum for public and private organisations dealing with oil and HNS spills. It focuses on the exchange of knowledge, the identification of technological supply and demand, and the development of innovative public-private alliances and partnerships.

The project (www.arcopol.eu) is a partnership between research organisations and regional competent authorities from Ireland, UK, France, Spain and Portugal.

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INTRODUCTION

In 2004, the core group of ARCOPOL partners started working together in the frame of EROCIPS project (Emergency Response to coastal Oil, Chemical and Inert Pollution from

Shipping. INTERREG IIIB, 2004-2007). EROCIPS' achievements ranged from the development of forecasting models, risk assessment and guidance on managing volunteers, to the production of training materials and the establishment of ecological monitoring programmes.

Having EROCIPS as a baseline, the series of ARCOPOL projects started in 2009. The success of the first ARCOPOL (2009-2012) facilitated the continuity of this strategy long term with the approval of the subsequent projects ARCOPOLplus (2012-2014) and ARCOPOLplatform (2014-2015).

All ARCOPOL projects share the same final aim, which is reinforcing the preparedness and response to oil and HNS spills in the Atlantic regions. However, from one project to the next, both the strategy and subject matters were reviewed and adapted to address current gaps and needs identified by the partnership.

ARCOPOL focused on the elaboration of guides and tools to support response operations. During ARCOPOLplus, albeit continuing to update and upgrade ARCOPOL results, partners concentrated on innovation, training and technology transfer. The aim of ARCOPOLplatform consists of establishing a Platform to capitalise on all projects results and facilitate public and private collaboration in relation to the response to maritime pollution. More specifically, the project focuses on five priority topics agreed by the partnership: Contingency planning, HNS, modelling & decisions support systems, environmental monitoring, and training and awareness.

All EROCIPS, ARCOPOL, ARCOPOLplus and ARCOPOLplatform results can be downloaded from www.arcopol.eu.

WORKING STREAMS

Contingency planning

When aiming to improve local authorities' preparedness to respond to accidental maritime pollution, contingency planning is at the essence "*Failing to plan is planning to fail*". Following the work started in ARCOPOL and ARCOPOLplus, ARCOPOLplatform continues to support local authorities to develop their contingency plans through different actions:

- Organising workshops aimed at local stakeholders to assist them in the elaboration of Local Contingency Plans (LCP). This action started in Galicia and Andalusia (Spain) in ARCOPOLplus and continues now in ARCOPOLplatform. The objectives of the workshops are to raise the awareness of accidental maritime pollution amongst local stakeholders, to discuss the content of a Local Contingency Plan, to provide an opportunity for feedback, and to guide them through the process of production and implementation. From previous experiences, these events proved to be the ideal forum to engage with Local Authorities.
- Carrying out pilot actions in municipalities. Building on the experience gained in ARCOPOLplus, there are currently 6 municipalities in Andalusia and 2 in Galicia

that are being closely guided in the preparation and validation of Local Contingency Plans. These plans are being adapted for NPA where required.

- Running exercises to validate LCP approved in the framework of ARCOPOlplus. The objectives of this action are to evaluate the degree of implementation of the LCP delivered in ARCOPOlplus and to test whether they suit the needs of the municipalities/Local Authorities. All feedback will be used to review and improve the LCPs.

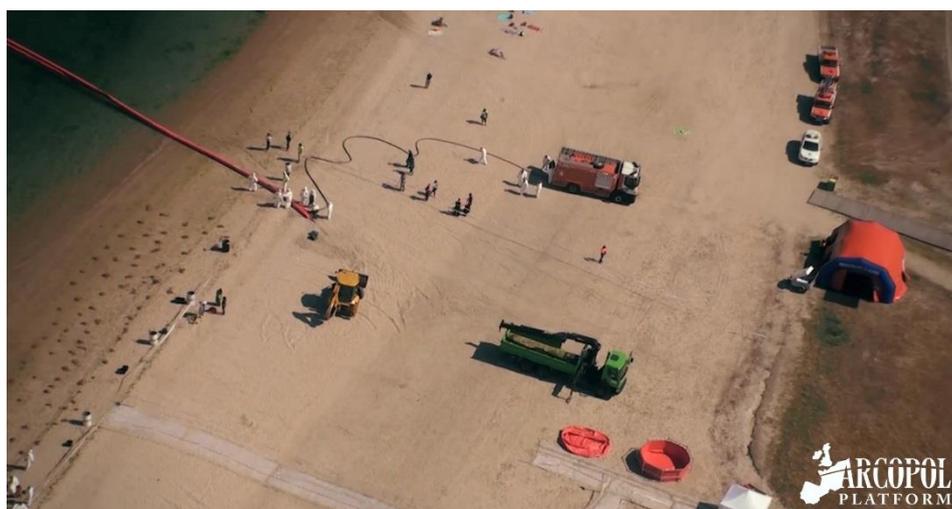


Figure 1 – Exercise in Vilagarcía de Arousa (Galicia-Spain) June 2014. See full video [online](#).

- Promotion of tailored contingency plans for NPA. The LCP for NPA developed in Andalusia will be promoted in international forums, aiming to achieve recognition as recommended best practices by international organisations. Similarly, considering the objective of increasing coastal communities' awareness about the importance of protecting NPA against marine pollution, animation videos are being produced. The first video titled "[The health of our oceans](#) " is available online.
- Establishment of collaboration networks for neighbouring municipalities/Local Authorities. Establishing networks at a local scale can help small municipalities to implement their contingency plans and, consequently, improve the general response to maritime spills on the area. After the selection of potential suitable areas, all the individual LCP concerned will be jointly analysed looking for complementarities and issues for potential collaboration (i.e. sharing response equipment, facilities, etc.).

Hazardous and Noxious Substances - HNS

Data indicate that around 2000 HNS are transported regularly by sea (Purnell, 2009). Hence reinforcing the preparedness of local and regional authorities to face HNS spills

was considered a priority issue for ARCOPOLplatform. Two key actions are being carried out at present on this subject:

- Identification, centralisation and upgrade of information on HNS. This action will gather all existent documentations on HNS (toxicity, fate, weathering and behaviour, guidelines, maps, simulation models, videos, protocols and e-learning courses) and make them available to the public on a dedicated website. In addition, the site will include new products delivered within the framework of the project such as an e-learning course on environmental impact assessment of HNS.
- Transfer of HNS know-how into local contingency plans. Most of the operational documents/tools available are being evaluated by partners in order to assess their suitability and relevance before being adapted and eventually integrated into LCP. Animated videos are being produced to raise awareness among local authorities and the general public.

Modelling & decisions support systems

Despite the work carried out in previous projects on modelling the behaviour of oil and HNS spills and decision support tools (Fernandes, et al., 2013; Fernandes, 2014), room for further improvements in this field was identified. Priority work streams: the capacity of the numerical modelling software, the accuracy and quality of model results for specific regions, the sharing of available modelling tools and data from operational metocean forecast models between participating regions, and finally stakeholders' confidence regarding the application of the developed modelling systems. All these issues are being tackled through the following actions:

- Comparison between different modelling systems in use in the Atlantic Area (Ireland, UK, France, Spain and Portugal). Although determining the best modelling system without real spill data is impossible comparison exercises are being carried out in order to: study similarities and differences between systems; identify important challenges for the future; assess the capability of modelling systems to give a fast, robust and meaningful answer; evaluate ease of use; study the interoperability of outputs, and finally increase the confidence of stakeholders on the performance of modelling systems.
- Improvement and update of ARCOPOL modelling software and decision support systems. This includes the upgrading of the following tools:
 - MOHID: This water numerical modelling system (Neves, 2013; Ascione Kenov, et al., 2014) is fully open-source, meaning that all the developments become immediately available to the scientific community as well as to SME's to use it as it is, or integrate / embed it in other decision support tools. The oil spill lagrangian particle tracking module of MOHID, as well as specifically oil weathering module, has been continuously used and validated in different incidents (Montero, et al., 2003, Juliano et al., 2012), test cases (Janeiro et al., 2008) or exercises, and adapted to multiple decision support systems (Fernandes et al., 2013). Both oil weathering module, and the recently developed chemical

weathering module (Fernandes, 2014a), are being updated to include new researched features and processes, in order to keep this numerical tool as state-of-the-art modelling software. The new developments include air dispersion of oil evaporated components from the sea surface, as well as the modelling of environmental impacts to specific ecosystems (based in biological effects) caused by oil or HNS.

- Dynamic Risk Tool. This tool computes in real time (for monitoring purposes) and in delayed mode (for planning and regulatory purpose) the risk of shoreline contamination based on different data sources: AIS ship information, historic data about past ship accidents, coastal vulnerability indexes, metocean forecasting data (waves, currents and atmosphere), and drift modelling results (simulation of hypothetical spills based on ship positions) (Fernandes, et al., 2014b). The whole system was integrated as a plug-in in a GIS desktop platform (MOHID Studio) and the new functionalities will consist of integration of a new plug-in for simulating fate and behaviour of water pollutants from oil and chemical spills, and for simulating air pollution dispersion from spills at sea. The interaction with booms will also be included (Campbell, et al., 2014). This means that MOHID Studio will become a complete “one-stop-shop” system for management of spills in planning, monitoring and response levels.

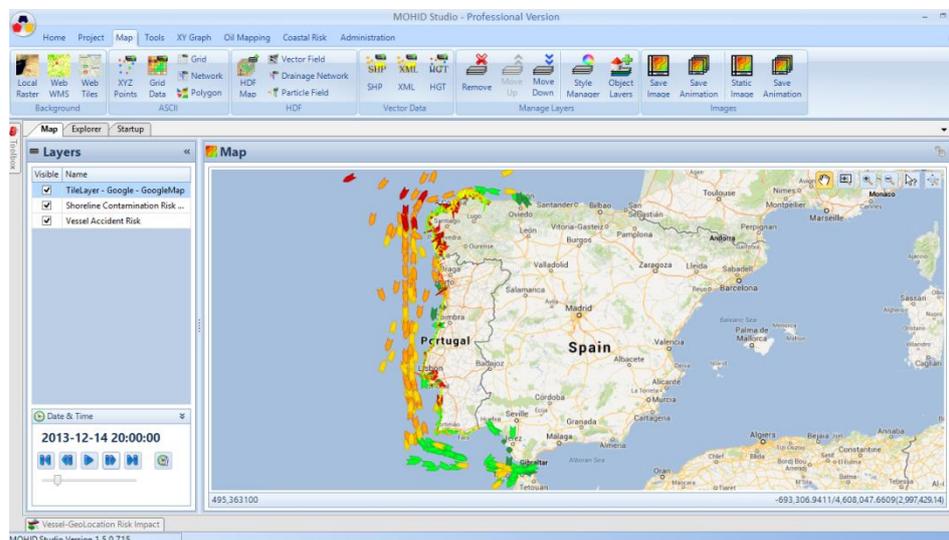


Figure 2 - Dynamic Risk Tool plug-in embedded in MOHID Studio GIS

- Andalusian Oceanography system: [OceanUCA-Maps](#) is a web-based met-ocean data and emergency response simulation system for the Andalusian coast. It consists of a GIS-based user-friendly graphical interface, which integrates met-ocean data layers, a variety of data analysis and visualization tools, oil spill scenarios, and oil spill modelling capabilities. The web-interface allows users and groups to manage, visualise, and analyse a variety of met-ocean data for operational

models, which are required for managing the first states of the response operations to oil spill accidents. Further improvement will focus on the model parallelization and optimisation of the automation processes for the model forecast, and on the assessment of models performance against in-situ field data. These two upgrades will provide faster and more accurate predictions, especially in case of eventual spill accidents. Furthermore, the development of freely available mobile App (with weather forecast and surface current maps) will significantly contribute to increase the number of users of the OceanUCA-Maps.

- ARCOPOL web viewer: ARCOPOL web viewer is a demo web viewer based on an open client built by INTECMAR under ARCOPOL and ARCOPOLplus projects. This viewer is able to display several kinds of data as static data (coastline, ESI line, special protected areas, etc.), model results (winds, currents, spills) and observations (drifter tracks, pictures, spill observations, etc.) to help response managers during emergency situations. This web is fed by several OGC services as WMS and WFS and other as THREDDS or OPeNDAP. On the other hand, these services obtain actual data from different geodata bases and servers of several Galician agencies as INTECMAR or MeteoGalicia. Upgrades will add new services to this tool, the time series of data; report generators, and the atmospheric plume dispersion simulation outputs.
- Test, improve, and demonstrate a sustainable methodology to parameterize turbulent dispersion in lagrangian models supported by existing observational data. Since a good parameterization of turbulence is necessary to effectively simulate pollutant spills with accuracy, exercises will be organised to calibrate turbulence.
- Training on modelling: Based on ARCOPOLplus guidelines (Guide on planning and training exercises for monitoring and forecasting, INTECMAR, 2014), a different set of modelling exercises is to be planned and carried out within the project involving specific end users, mainly those connected with prevention and response activities (e.g., DGAM – Marinha, in Portugal, Galician Coastguards in Spain). This will capitalise on the knowledge of scientific community and increase confidence in the efficiency of ARCOPOL developed tools. The exercises will aim to identify the limitations of the modelling tools and establish improvement requirements. In addition, similar courses will be organised but aimed at the scientific community to increase the number of users and developers.
- Establishing protocols for integrating modelling systems into contingency planning. This action is being carried out in Andalusia, between the Consejería de Medio Ambiente y Ordenación del Territorio and Consejería de Justicia e Interior of the Junta de Andalucía (as the competent authorities in regional and local contingency planning) and the University of Cádiz, developer of the OceanUCA-Maps.
- Implementation of ARCOPOL modelling products in new regions such as La Rochelle (France). In cooperation with [ISDAMP](#) project a local hydrodynamic and

wave forecasting system was implemented in La Rochelle, area with high economic interests in terms of tourism, aquaculture and fisheries. This system was then integrated with operational modelling systems previously developed in ARCO POL and ARCO POL plus - "ARCO POL Oil Spill Simulator" meaning that it is now possible to operationally simulate oil and inert spills in La Rochelle zone, when required.

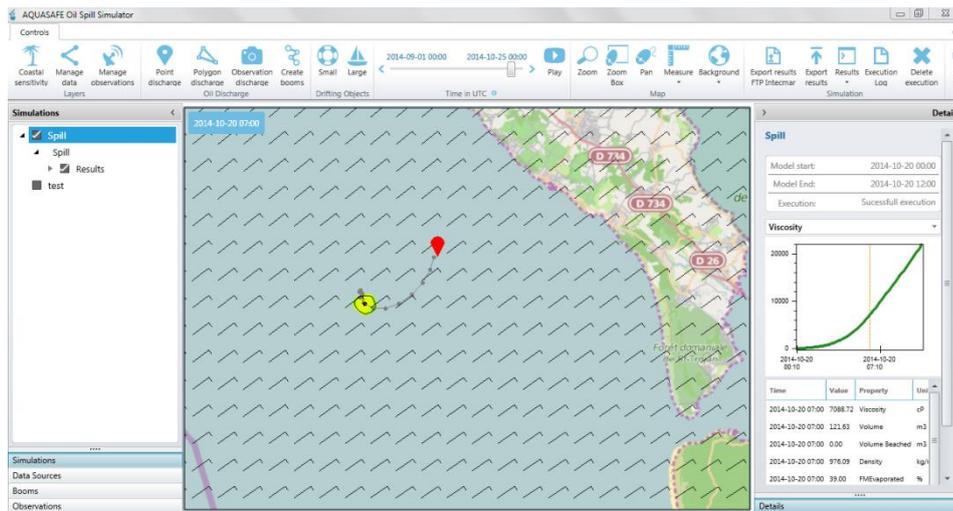


Figure 3 - Simulation of a hypothetical oil spill in La Rochelle with ARCO POL Oil Spill Simulator

- Testing the 3D barrier behaviour model developed in ISDAMP project in ARCO POL platform regions. ISDAMP project produced a software decision aid tool that models the behaviour of booms, considering environmental variables and barrier or curtain characteristics. The outputs of this model help decision makers to protect the coast by optimising the use of the available booms. In the framework of ARCO POL platform, this 3D modelling tool will be applied to other participating regions (i.e. estuary of Palmones River in Algeciras, Andalusia, and in some coastal sites in Galicia) to help prepare LCP scenarios.

Environmental monitoring

This action aims to encapsulate existing knowledge on post spill environmental monitoring through the following tasks:

- Assessment of preparedness and post spill monitoring in the Atlantic area. Building on the guidelines developed by the [PREMIAM](#) project in the UK (Kirby et al., 2014) and on the work initiated in ARCO POL plus to adapt PREMIAM's outputs (Law et al, 2011) to the wider Atlantic Area, the final aim of this action consists of analysing the protocols used in the different countries/regions in the Atlantic Area and

assessing the degree of preparedness of the regions participating in ARCOPOLplatform (from Ireland, UK, France, Spain and Portugal).

- Workshop on post-spill environmental monitoring. Workshops will be organised in Portugal and Ireland to discuss and disseminate the good practices and effectiveness for post-spill monitoring programmes. Competent authorities and experts will participate.
- Impact assessment and compensation of damages. The economic assessment of environmental damages has been previously addressed within the ARCOPOL project. Differences in monitoring protocols when considering different topics (i.e. assessing environmental impacts and assessing the cost of those impacts) were evident. Consequently, the development of standard methodologies for assessing environmental damage suffered by Local Authorities was proposed. Due to the high interest this issue raises for authorities, ARCOPOLplatform will further improve guidelines on monitoring to support the economic evaluation of environmental degradation.
- Establishment of post-spill monitoring protocols for impact assessment. Monitoring protocols and the sentinel species defined during EROCIPS, ARCOPOL, ARCOPOLplus and PREMIAM, as well as the results in this project, will be used to establish post-spill monitoring protocols that will allow the quantification of the impact of a spill incident. In addition, the BACI (Before-After, Control-Impact) sampling framework will be used to structure the monitoring programme. The BACI concept considers the "Before" (pre-spill baseline) and "After" (post-spill) condition of the area, as well as the comparison between a "Control" - reference - site with the "Impact" site - spill site. "Before" and "After" sampling will determine how the spill changed the site through time from its historical condition. "Control" and "Impact" sampling will allow effects of restoration actions to be discerned from natural variability, stochastic events, and underlying trends within the larger area – for example, due to sea level rise or climate change.
- Upgrading the Environmental Sensitivity Index for the Portuguese coast. The upgrading of the Environmental Sensitivity Index produced within the framework of EROCIPS will involve introducing new parameters concerning environmental and socio-economic damages and costs, and enlarging this index to other off-shore ecosystems (i.e. fisheries, off-shore structures, archaeological wrecks, habitats, tourism services -surf, wind surf, diving-). The availability of this type of information would allow improved modelling of the cost of environmental damage. Thus, crisis managers could make use of this information when planning response operations, giving higher priority to those areas where costs are expected to be higher.
- Dissemination of main concepts on environmental monitoring. Key concepts on environmental monitoring (BACI concept, ES Indexes, etc.), will be explained in a video for raising local administrations and general public awareness. Special attention will be paid in using colloquial language understandable to non-expert people in order to raise Local Authorities' awareness of environmental recovery after marine pollution events.

Training and awareness

As for the rest of the work streams, the intended objective here is to further disseminate and upgrade the tools available in the field of training and awareness raising. This general objective can be broken down into the following specific tasks:

- Regional awareness raising road-shows. In order to raise awareness within the response communities of the Atlantic Area, regional “road-shows” are being organised. These aim to provide representatives from key organisations with relevant details of the capabilities and application of materials available via the ARCOPOL Framework. For instance, the tool to prioritise risks to public health from HNS (Harold et al., 2014) has been used to elaborate training materials for shoreline response. The first road-show took place in Bristol under the title “Enhancing public health awareness, preparedness and response to shoreline maritime incidents” in November 2014 (materials are available online after [registration on ARCOPOL Platform](#)).
- Shoreline response forum. This action consists of initiating a web-based forum on which a wide range of professionals can exchange experiences and ideas relevant to maritime shoreline response. This could encourage discussion and provide a means of disseminating information on forthcoming events. The proposed forum will offer an innovative step to enhance shoreline response, being the first such resource in our experience to enable both maritime and land-based professionals across the EU Atlantic region to exchange ideas and expertise in a pro-active manner. This will also provide an innovative platform for organised on-line activities such as webinars enabling users to maintain and increase their knowledge base in a sustainable manner.
- Planning & preparedness and response & recovery actions validation for training course development. This action will, from the outset, have end user participation and act as an important validation of the practical usability of the planning & preparedness and response & recovery actions developed by the project. This validation process will fine tune those actions and help to ensure they are implementable by those working in the frontline services with responsibility for dealing with HNS incidents. The outputs of the validation process, in the form of table top exercises will inform and contribute to training course developments.
- Blended courses and activities for training and awareness raising. E-learning courses and training exercises will be organised to improve the local and regional authorities’ preparedness to face maritime accidents affecting Andalusian shores. They will consist of theory courses and practical activities, encouraging interactions among participants. Two different training strategies will be used to benefit from the advantages of both of these approaches: virtual learning and face-to-face workshops. Considering the interest of broadening the target audience, the convenience of developing the e-learning contents as a Massive Open Online Courses (MOOC) is being assessed. Nowadays, the use of MOOCs platforms such as Coursera, Edx, and Udacity, is widespread among students who want to access quality online courses. In addition, these platforms are accessible worldwide, which is an asset for the future sustainability of the courses.

- Practical exercises with local stakeholders. The organisation of practical drills and simulation exercises at a local scale multiplies training benefits since, apart from reinforcing the knowledge acquired, the engagement of local communities is fostered and all actors realise the importance of working as a team.
- Establishment of a certified training program for regional responders. In order to guarantee the sustainability of training and awareness tools produced in ARCOPOL and ARCOPOLplus, they will be integrated into approved regional training programs for response teams in Andalusia.
- Interregional training. The interest of carrying out common training of personnel from different regions will be assessed. Specific topics of highest relevance in this context will be identified.

Platform

The overarching objective of the ARCOPOLplatform project is the development of the basis for a sustainable Atlantic Technological Platform for oil and HNS spill preparedness, response and mitigation. Building on the ARCOPOL network, this Platform aims to move from an information exchange forum to a more proactive and operational structure that will act as a driver for new collaborative initiatives. More specifically, the objectives of the Platform are as follows:

- To establish a sustainable meeting forum for public and private marine and coastal stakeholders;
- To promote exchange of knowledge and experience among research institutions, governmental agencies, companies and industrial associations dealing with prevention, preparedness, response and mitigation of oil and HNS.
- To collect, update and spread relevant information, resources and documentation relating to oil and HNS marine spills.
- To develop a map of knowledge, experience and capabilities, that facilitates synergies, allows for the efficient mobilisation of human resources, and gives an answer to the needs of the different actors involved in responding to maritime spills.
- To identify gaps, needs and priorities in oil and HNS spill preparedness, response and mitigation.
- To define a Strategic Research Agenda and establish mechanisms to promote R & D projects and technological developments;
- To support the maritime and environmental administrations and make recommendations that inspire future funding programmes;
- To promote the involvement of SMEs on the development of new technologies and services in the fields covered;
- To facilitate the implementation of IMO conventions, EU Directives (Water Framework Directive and Marine Strategy), and national legislation in the field.

Any public and private organisations of the Atlantic Area dealing with oil and HNS spills can join the ARCOPOL Platform ([registration online free of charge](#)) to access resources and information, to promote their capabilities and to interact with key stakeholders.

To promote the interaction among Platform members and achieve the Platform objectives above, five Working Groups (WG) are being set up to address the following specific issues: Contingency planning, HNS, Oil spill modelling and technologies, Environmental monitoring, and Training and awareness.

The WG on Contingency Planning met for the first time in Saint-Malo in October 2014 bringing together ARCOPOLplatform partners and delegates from competent authorities in Ireland, UK, France, Spain and Portugal (i.e Irish Coast Guards, Maritime and Coastguard Agency, Sasemar, Direcção-Geral da Autoridade Marítima). Presentations, minutes and action plan are available online for Platform members. Similarly, the WG on Oil Spill Modelling and Technologies is meeting for the first time in Amsterdam in March 2015 coupled with Interspill2015.

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