HAZADR

Strengthening common reaction capacity to fight sea pollution of oil, toxic and hazardous substances in Adriatic Sea

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A CROSS-BORDER INITIATIVE TO PROTECT THE ADRIATIC COASTS FROM THE OIL SPILL

THE RESULTS OF THE HAZADR PROJECT AND NEW PERSPECTIVES

Protezione Civile
REGIONE PUGLIA

A CROSS-BORDER INITIATIVE TO PROTECT THE ADRIATIC COASTS FROM THE OIL SPILL

The results of the HAZADR project and new perspectives

Edited by Marco Meggiolaro,
EURIS s.r.l. on behalf of Apulia Region,
Civil Protection Department

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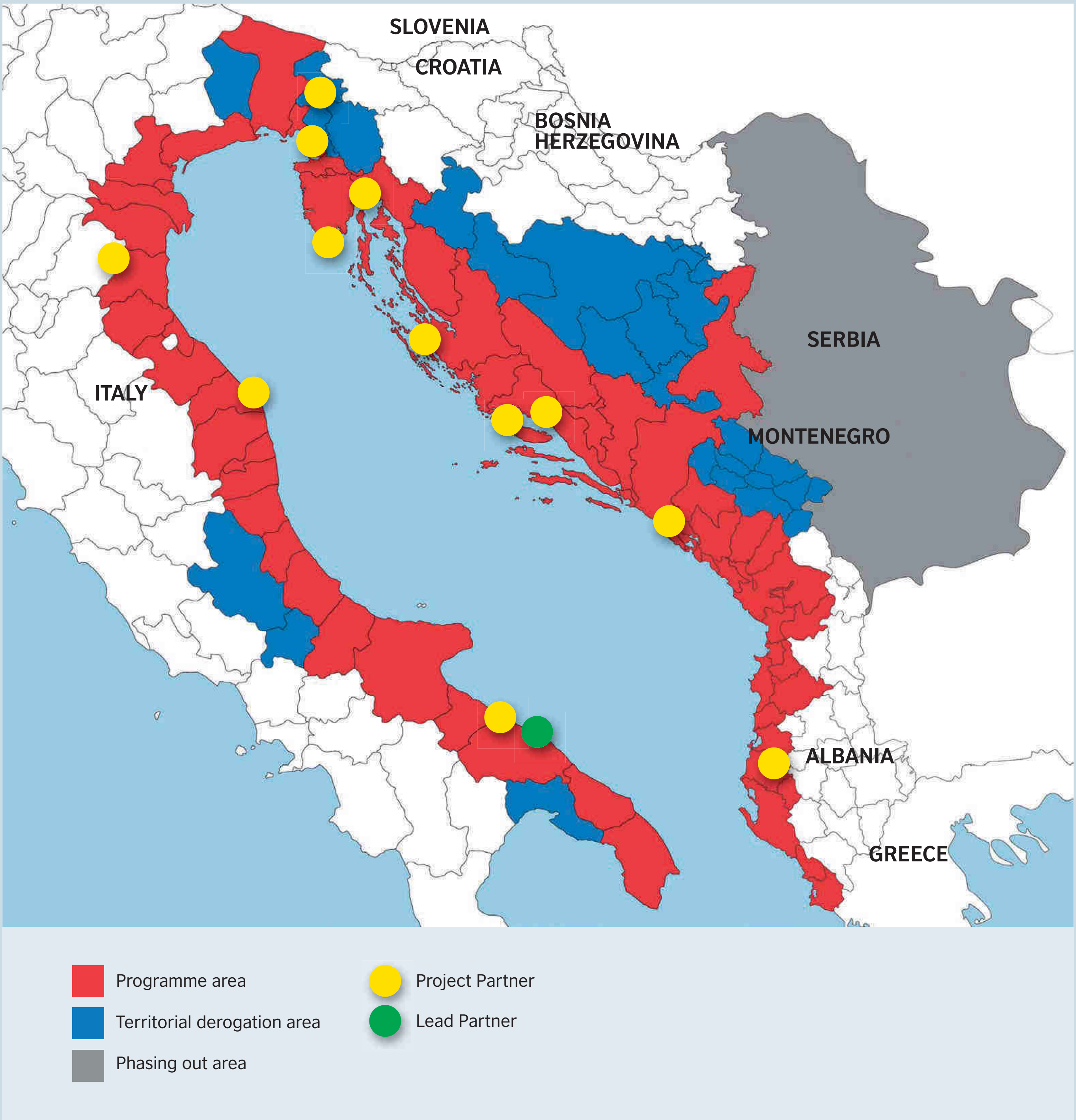
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FORWARD

The Adriatic macro-region includes a wide transnational area with more than 60 million inhabitants and has distinct physical, environmental, socio-economic and cultural characteristics. It has an extraordinary environmental ecosystem, which is extremely delicate, and is subject to a range of pressures associated with maritime traffic, maritime industries and port activities. In particular, the intense and yearly-increasing maritime transport activities and hydrocarbon exploration and exploitation could result in oil spills, including large scale and catastrophic pollution events. Owing to its semi-enclosed and relatively shallow nature, the Adriatic is highly vulnerable to anthropogenic pressures, whilst the coastal zone are highly exposed to possible large damage to the environment and local economies.

The EU Strategy for the Adriatic and Ionian Region (EUSAIR), a macro-regional strategy adopted by the European Commission and endorsed by the European Council in 2014 to address common challenges among all territories in the Adriatic-Ionian Region, encourages the implementation of measures to enable joint and harmonized contingency planning and coordinated emergency response as well as the empowerment of prevention, protection and clean-up programs against human-induced pollution threats.

HAZADR, conceptualized immediately after the UND ADRIYATIK accident that took place in 2008 and implemented from October 2012 thanks to the EU financing by the IPA Adriatic CBC Programme, anticipates and embeds the pivotal environmental priorities of the EUSAIR: the safety of the sea and its coastal zones. But pursuing such goal requires international synergies and coordination.

The project represents a concrete answer to prevent and protect the Adriatic coasts from the oil spill as it has been supporting cross-border applications, joint educational programmes and the testing of innovative technologies to be progressively introduced in the local practices of the local administration and maritime authorities.

HAZADR is a crucial step towards a stable trans-boundary collaboration and stakeholder cooperation across different coastal and maritime sector activities in Adriatic. Still much has to be done, but the way forward over the next years is already marked.

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EXECUTIVE SUMMARY

Marco Meggiolaro

The Mediterranean is one of the most crowded seas in the world in terms of traffic. Even if it covers only 0.7% of the total sea-water surface in the world, it hosts 30% of the overall international maritime traffic. Sea pollution by oil, hazardous and noxious substances can happen at any time and in any place, especially along the main maritime routes due to technological and natural hazards and during the loading and unloading vessels' operation in the sea-terminals, where the likelihood of marine environment pollution is the highest.

On average, there are annually 60 accidents on the Mediterranean, out of which 15 result from maritime accidents of tankers transporting petroleum or chemicals. In this context, the Adriatic Sea is no exception, especially since it represents a narrow and shallow basin across which petroleum transport is directed towards transit ports mainly situated in the northern part of the Adriatic. According to statistical data, tankers sail into the Adriatic Sea almost 5.000 times per year, out of which 3.500 times into the port of Trieste alone, where more than half of the total petroleum cargo designated for the Adriatic maritime route is unloaded yearly. To date, numerous studies shows the exposure of the Adriatic Sea to accidents: they show that the pressure from the merchant navy is higher here than in areas with heavy maritime traffic.

Over the past 15 years, a total of 174 accidents has been recorded on the Adriatic, none of which was of catastrophic proportions, but nevertheless some of the accidents have made a mark on the maritime traffic & served as a warning that a joint cooperation at all levels is necessary for a prompt and efficient response.

One of those accidents took place in 2008 and involved a Turkish vessel UND ADRIYATIK that took fire 13 miles offshore the coasts of Rovinj, in Northern Croatia, with a very serious threat for the environment. Luckily, it ended without dramatic consequences for the coasts, but this was more due to a series of fortunate circumstances than the successful performance of the Adriatic response teams.

But this accident was, in a certain sense, useful to lights up the gaps in the cross-border coordination. A weak preparedness of regions and counties on the Adriatic was evident not only in the insufficient equipment and poorly trained personnel to deal with the emergencies in a cross-border area, but also in the delayed deployment to the site of the accident. This can be attributed to the poor coordination protocols between the competent bodies involved in the implementation of contingency plans on the Adriatic, which in turn stems from the fact that response procedures within contingency plans both at the national and regional level are not harmonized. The basic problems in the cross-border area lie in the facts that the general and specific regulations are not harmonized and that response teams for contingencies are not adequately trained nor prepared.

The UND ADRIYATIK's case has basically unveiled the vulnerability of the Adriatic coasts to the oil spill risk exposure and has put the harmonization of strategies, practices and facilities on the top of the political agenda of many national and regional authorities across the Adriatic space.

HAZADR was born upon these premises, when some Italian Regions and Croatian Counties, coordinated by Apulia Region, launched the proposal of a big project to improve the organization and ability of the Administrations on both sides of the Adriatic to deal with such incidents at sea and better organize the contingency action on the coasts.

The main objective of the HAZADR project, running from October 2012 to September 2015, is the establishment of a cross-border network for the prevention of risks and for the early management of emergencies, in order to reduce the risk of pollution and contamination of the Adriatic coasts. Therefore, HAZADR aims at strengthening a common reaction capacity of the communities belonging to the Adriatic Region against environmental and technological hazards due to collisions, shipwrecking and spillage of oil and toxic material into the sea that could seriously pollute the marine environment and damage the socio-economic activities of the Adriatic coastal communities.

HAZADR, that focuses all its actions to improve the seashore and coastal mechanisms of prediction, protection and mitigation against the oil spill, basically helps the Adriatic regions:

- to upgrade the knowledge framework over the estimated environmental and socio-economic risks in the most vulnerable Adriatic areas due both to natural and human-induced factors, as well as the harmonization of the practices governing the protection of the coasts from pollution;
- to provide the Adriatic emergency corps with a standardized decision support system (called: ATLAS) that warns about the real-time potential risk factors for the coastal areas associated to the presence of dangerous ship (such as oil-tankers) and weather conditions in the Adriatic. This system offers a coastal early warning facility able to activate a cross-border dispatching and oil-forecast system addressed to the qualified emergency operators to accelerate, both across the coasts and in the open sea, the single, interregional or cross-border procedures to combat the pollution and reduce the environmental damages;
- to set up a common database on the state of readiness and spatial distribution of pollution preventing equipment along the Adriatic coasts as well as the improvement of the operational instruments and oil spill mitigation programmes to cope with the environmental and technological hazards;
- to enhance the prevention structures in some of the most sensitive economic and ecologic poles of Adriatic through a joint meteorological radar monitoring program (based on a set of radar systems and VHF devices) and innovative oil-spill detection programmes;
- to harmonize, improve and shorten the deployment time of the cross-border reaction capacity in the event of oil, toxic and hazardous substances spill through the organization of three joint oil-spill simulations and exercises in the Adriatic;
- to reinforce – through the establishment of one Adriatic Training and Research Centre based in Rijeka and the cooperation with the European and International Organizations – a cross-border emergency capacity: the ATRAC has delivered training to command personnel, operational staff and other actors involved in contingency plan and pollution prevention from all over the Adriatic.

13 project partners from Italy, Croatia, Slovenia, Montenegro and Albania, plus many other emergency corps and decision makers, are currently testing new early warning and predictive applications to monitor the risky factors caused by technological hazards in Adriatic, related to the quality of the ships that every day sails in the Adriatic. Radars systems monitor the sea in some very vulnerable areas. Response simulations, implemented through macro-regional intervention protocols, are focused nearby the coastal zones. Civil protections and local administrations get equipped with brand new ocean booms and detergent to face potential oil and toxic waves approaching the coasts. Education at all level is rolled out.

HAZADR, as shown, embeds in a single initiative more and more sides of the coastal Adriatic protection and joint warning. It capitalizes from previous European projects, such as SECURSEA and SHAPE. It experiments new technological Early Warning System. And it wants to be a platform of discussion for all key-stakeholders that are in charge of protecting the fragile Adriatic environment.

The present publication, written with the contribution of all project partners, offers a privileged showcase of the deliverables achieved through a joint European cooperation and paves the ways towards new initiatives to make the Adriatic safer.


CMA CGM CORNEILLE

1. THE ADRIATIC LEGAL SETTING. WAYS TO ENHANCE THE JOINT COOPERATION TO PROTECT THE ADRIATIC COASTS

One of the key objectives of HAZADR aims at analysing national regulations addressing protection of the marine environment against marine pollution incidents of the five Adriatic coastal States which participate in the project actions, namely Albania, Croatia, Italy, Montenegro and Slovenia. Besides that, the analysis outlines the most important provisions of the relevant, global and regional, international Conventions and Protocols, deepening the existing national, area (regional) and local contingency plans in the five countries concerned, as well as the Sub-Regional Contingency Plan and recommending effective and realistic measures for improving the cooperation of national and in particular area (regional) and local authorities in spill preparedness and response.
The outcomes of the comparative legal analysis has represented the ground to address the possible range of applications of the ATLAS together with its costal vulnerability joint dispatching system. Furthermore, the oil spill exercises and the educational packages delivered through the project were also inspired and guided by the recommendations towards harmonization and cooperation streamlined by the legal analysis.

1.1 THE COMPARATIVE LEGAL ANALYSIS: MAIN OUTCOME AND PERSPECTIVES

Tomislav Kandžija

The present analysis refers principally to regulations dealing with accidental marine pollution from ships and does not cover those dealing with operational pollution from ships (regulated globally by the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 – hereinafter referred to as MARPOL) and pollution from land based sources, including rivers. It is understood that as far as preparedness and response to accidental marine pollution is concerned the term „contingency plan" covers plans for dealing with accidental pollution at sea and on shore.

A detailed national regulation analysis demonstrates that practically all documents dealing with maritime and environmental issues regularly address matters of importance primarily for the prevention of marine oil or HNS pollution in general, and for what is known as operational marine pollution in particular. These rarely address accidental marine pollution, and only sporadically major marine pollution incidents that may have grave consequences for economic activities at sea and in the coastal area, or severely affect marine environment. In particular, these documents rarely distinguish clearly between operational pollution, which to a cer-

Figure 1. Involvement of Italian national authorities in the project activities.

tain extent includes also minor incidents which may occur during loading and unloading ships and during their routine operations in or near the ports, and on the other hand the "real" accidental pollution (i.e. "pollution incidents" in terms of OPRC 1990) which occurs as the consequence of serious maritime incidents including collisions, groundings, explosions on board in particular oil tankers, etc.

On the other hand, the national legislations of the Adriatic coastal States, with minor exemptions, provide a sound basis for the development of cooperation in the field of prevention of, preparedness for and response to marine pollution incidents. It was found that all five Adriatic coastal States have set up their respective national preparedness and response systems, comprising at least basic elements underlined in the OPRC 1990 Convention. Such national systems allow the countries concerned to cooperate, if a need be, in responding to major marine pollution incidents that might affect one or several countries in the Adriatic region.

Seven international treaties providing, global and regional framework for dealing with marine pollution incidents, and addressing in particular preparedness for and response to accidental marine pollution and cooperation among the countries in case of emergency, as well as four international Conventions and Protocols forming the basis of the international regime for compensation of damage caused by pollution by oil or other hazardous and noxious substances, show a very high level of accession or ratification of these international treaties by the countries in the Adriatic region.

Similarly, various contingency plans that were analyzed also prove to adequately cover the response to pollution incidents at the national and lower levels, but also at the level of the Adriatic as a sub-region of the Mediterranean.

In all National Contingency Plans (hereinafter referred to as NCPs) waste management is covered only in general terms, and the procedures for dealing with waste generated during pollution operations at sea, and in particular on shore, should be addresses more specifically.

Although all five Adriatic coastal States have set up their respective national preparedness and response systems, a clear reference to the obligations stemming from the relevant international Conventions, Protocols and other instruments to which the Adriatic coastal States are parties is not always present, and this particular aspect which provides the basis for international cooperation among the countries in case of marine pollution emergency needs to be more emphasized and improved.

It is generally accepted that the key to prompt and effective response to marine pollution accidents, or to incidents likely to cause marine pollution by oil and other harmful or noxious substances, is the establishment of a proper national preparedness and response systems. As stipulated in Article 6 of the OPRC 1990 Convention, the basic elements of such system are (a) the designation of the competent national authorities responsible for oil and/or HNS pollution preparedness and response, the national contact point or points responsible for the receipt and transmission of oil pollution reports, an authority which is entitled to act on behalf of the State to request assistance or to decide to render the requested assistance, and (b) a national contingency plan for preparedness and response which defines organizational relationships of various bodies, either public or private, involved in dealing with marine pollution incidents or consequences thereof.

OPRC 1990 further requires each Party (i.e. State) to establish a minimum level of pre-positioned spill response equipment, commensurate with the risk involved, a programme of exercises and training for the personnel involved, and detailed plans and communication capabilities for responding to pollution incidents, as well as some other components.

It is noted that the term „national preparedness and response systems" itself was not found in any of the analyzed contingency plans.

Table 1. Summary status of ratifications by the Adriatic coastal States of the relevant international Conventions and Protocols* (as at 9 January 2014).

Convention or Protocol*	ALB	HRV	ITA	MNE	SVN
OPRC 1990	acceded or ratified	acceded or ratified	acceded or ratified	not acceded or not ratified	acceded or ratified
OPRC-HNS 2000	** acceded or ratified	not acceded or not ratified	not acceded or not ratified	not acceded or not ratified	acceded or ratified
INTERVENTION 69	not acceded or not ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
INTERVENTION PROTOCOL 1973	not acceded or not ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
SALVAGE 1989	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
CLC 92	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
FUND 92	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
BUNKERS 2001	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
HNS PROTOCOL 2010	not acceded or not ratified	not acceded or not ratified	not acceded or not ratified	not acceded or not ratified	not acceded or not ratified
Barcelona Convention	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified
Prevention and Emergency Protocol	not acceded or not ratified	acceded or ratified	acceded or ratified	acceded or ratified	acceded or ratified

■ acceded or ratified ■ not acceded or not ratified

* All international Conventions and Protocols appearing in this table are globally applicable instruments adopted under the auspices of the International Maritime organization (IMO), with the exception of the Barcelona Convention and its Prevention and Emergency Protocol 2002, which are regional international treaties adopted under the auspices of the United Nations Environment Programme (UNEP).

** In the list of ratifications kept by the International Maritime Organization and regularly updated (the version used for the preparation of the present document was published on 9 January 2014) Albania does not appear among the countries that are Parties to OPRC-HNS 2000 Protocol, despite the publication in the Albanian Official Gazette No. 135 dated 17 October 2012 of the Law No. 89/2012 "For the Accession of the Republic of Albania to Protocol [...] OPRC-HNS 2000". The reason for not appearance of Albania in the above mentioned list might be that the instrument of accession was not as yet deposited with the Secretary General of IMO.

Figure 2. VIREX 2014 – exercise for accidental marine pollution.

Issues that should be given more prominence in the national contingency plans are wildlife rescue, health and safety and especially training and exercises. However a clear indication of the type of training and exercises that need to be organized as part of „preparedness" activities and their periodicity would improve the situation in the field of preparedness for response.

Recognizing the importance of addressing issue of training by the national policy makers, is of particular importance for the future work of Adriatic Training and Research Centre, which was established in Rijeka under the present HAZADR project.

Finally, another extremely important issue is the issue of procedures for the use of dispersants, including approval procedures for use of specific products in each country, and the authorization to use these "approved" products in case of emergency. Such procedures, prepared on the basis of work carried out by IMO, REMPEC and other relevant organizations and institutions, should be discussed and agreed upon in each country individually, and once adopted should be clearly referred to in the national contingency plans.

It is also strongly recommended to establish proper national criteria for testing and approval of oil spill dispersants, and to prepare the list of dispersants approved for use in Croatia, and to replace the long "list of dispersants approved for use in the EU" which at present appears in the NCP since criteria used by different EU Member States do not necessarily correspond to the environmental and other conditions in the Croatian internal sea area and the territorial sea.

So far only Croatia and Italy among the Adriatic coastal States have elaborated contingency plans for dealing with marine pollution emergencies at levels lower than the national one, and provided examples of their respective area or local contingency plans. Italian national regulations envisage preparation of three levels (tiers) of contingency plans while Croatian national regulations distinguish only between response at the national level which is managed by the National Headquarters in accordance with the National Contingency Plan (representing a Tier 3 plan) and includes both actions at sea and on shore, and response at the county level, including even minor local emergencies, which is conducted by County Operations Centres according to their respective County Contingency Plans (thus representing Tier 1-2 plans). The most significant shortcoming of all these plans is that they either completely neglect the issue of waste management or address it in more or less general terms. It is emphasized once again that the parts of County plans dealing with waste management should be revised and carefully elaborated, so that in case of a major spill the accumulation of waste generated during response operations does not jeopardize the entire response.

It is strongly recommended to complete the process of complementing national contingency plans with the adequate and effective area (regional) and local plans, in all Adriatic coastal States and in particular in those which declared that Tier 1 contingency plans do not exist (Albania, Montenegro) or did not provide any details on them (Slovenia).

Within the same context, it is strongly recommended to Albania and Montenegro to accede to the Sub-regional Agreement on Sub regional contingency plans, to Albania to accede to the Intervention Convention 1969, its Intervention Protocol of 1973, and to the 2002 Prevention and Emergency Protocol to the Barcelona Convention, and to Montenegro to accede to OPRC 1990 Convention and its OPRC-HNS 2000 Protocol.

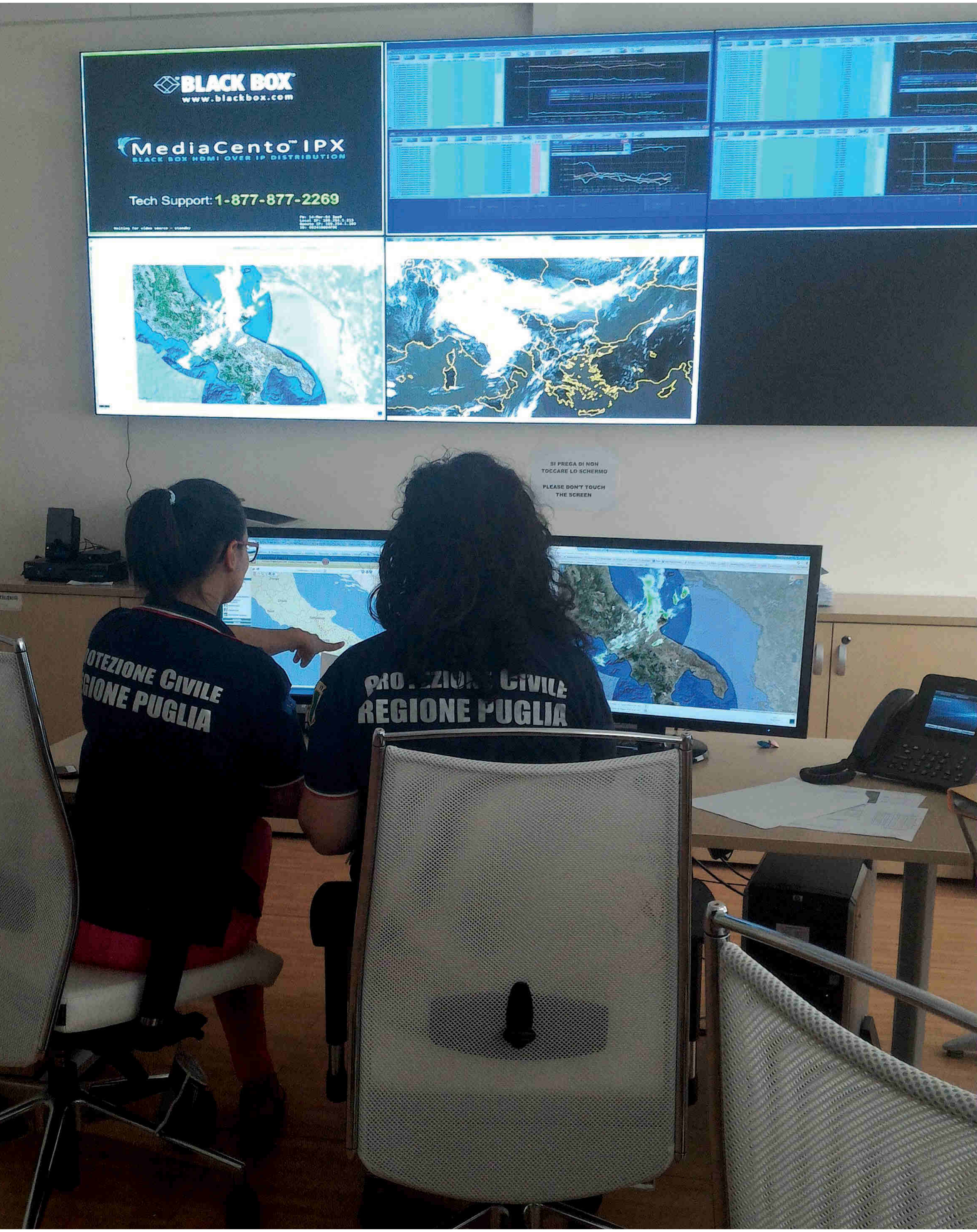
Consequently, it is strongly recommended to Croatia, Italy and Slovenia to officially invite Albania and Montenegro to join the Agreement on the Sub-Regional Contingency Plan for the Adriatic, and to Italy to ratify in accordance with its national legislation the Agreement thus enabling the Sub-Regional Contingency Plan to officially enter into force.

It is also strongly recommended to streamline the setting up of "national preparedness and response systems" by promoting on the national level the adoption of specific legal instruments / regulations, reflecting the commitments of the individual States as Parties to OPRC 1990 and to Prevention and Emergency Protocol 2002. Such new legislation would serve as a basis for adoption of any new contingency plans at area/region and local levels.

Finally, it is recommended to consider under the possibility to assigning to the Adriatic Training and Research Centre which is set up in Rijeka, also the function of a permanent Secretariat for the Sub-Regional Contingency Plan. This would allow for the continuous coordination of all activities related to spill prevention, preparedness and response by all Parties, i.e. all Adriatic coastal States. It is considered that, by adopting these simple but efficient and non-expensive measures, the cooperation in the Adriatic region in the field of prevention of, preparedness for and response to marine pollution incidents would significantly improve and enable taking some of the measures suggested and/or recommended.

The existence of a reliable national system for preparedness and response, including administrative organization, contingency plans for combating marine pollution incidents, trained personnel and basic equipment, is considered to be the single most important factor which determines the effectiveness and the success of response to marine pollution incidents, by public authorities in charge of dealing with them.

Figure3. Recent incident happened in Adriatic, luckily without serious environmental damages.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2. MONITORING THE SAFETY OF THE ADRIATIC COASTS AND SPEEDING UP INTERVENTIONS: THE ATLAS SYSTEM

During the last few years we have witnessed several disasters due to oil spill happened all around the world. Maritime incidents represent a complex problem to solve because there are many factors that can lead to their occurrence, while several consequences can result from such happenings: the risk and threat of sea pollution by oil, hazardous and noxious substances may have equally disastrous consequences for the delicate environment and important sea-based economic activities.

In case of incident with consequent oil-spill, shortening the time to intervention and the coordination of the emergency corps, event at cross-border level, is crucial to protect the sea and the coasts from the pollution.

Worldwide, there are already some early warning and decision support systems in use by the emergency corps to implement the contingency plan, but they are mostly focused on the pollution and intervention at sea. There is a lack of facilities, elaborated and shared at cross-border level, that evaluate the risk exposure of the coastal areas due to the ship presence, in particular those carrying hazardous substances and with low security standards.

In HAZADR, a pioneering system called ATLAS was developed to protect the Adriatic coasts from the oil spill, monitor in real time the possible human-induced environmental threats and forecast the oil spill grounding in case of incident at the sea. The availability of such system for a so narrow, environmentally fragile and international basin sea like the Adriatic represents a fundamental asset to make the Adriatic sea safer than ever.

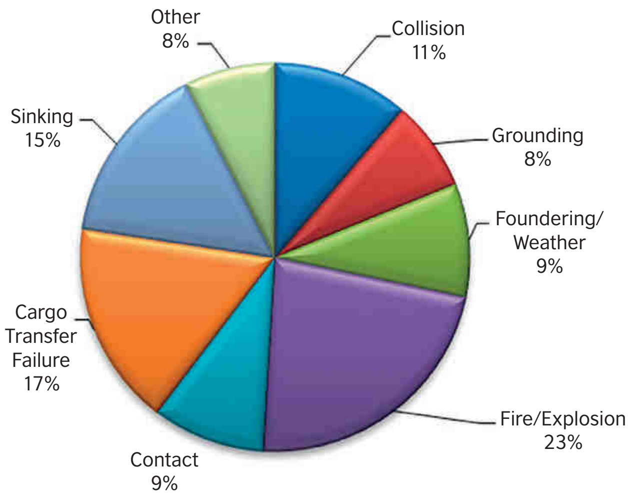
2.1 REVIEW OF THE ACCIDENTS ON ADRIATIC SEA. THE ATLAS AND ITS CONCEPTUAL MODEL

Raffaella Matarrese / Michele Vurro

The Adriatic Sea is one of the most endangered areas in the Mediterranean area, facing serious environmental challenges, especially taking into consideration that it constitutes an important oil transport route to the North-Adriatic ports of Trieste, Venice, Koper and Omišalj. From an economic point of view, the Adriatic region plays an important role in tourism and recreation, whilst it is heavily characterized by the presence of important maritime-based industries and activities, including fishery. As already mentioned in the executive summary, this area has been affected by numerous maritime incidents which luckily caused no significant damage to the environment. The first most notably case was «Brigitta Montanari», which on November 16th, 1984, during a storm in the upper Adriatic sea, with sea force 7, sank in the Croatian waters; the ship became a serious ecological threat as carrying a load of highly polluting vinyl chloride monomer (1,300 tons), which fortunately did not cause damage to the environment. In addition, the 2008 incident with the Turkish ship «UND ADRIYATIK» revealed the lack of organization and ability of regions and counties on both sides of the Adriatic to deal with such incidents at sea. The event had no consequences, but this was mostly due to luck rather than to the level of preparedness of response teams.

The design of the ATLAS, the HAZADR decision support system to protect the coasts from the oil spill that will be explained in this chapter, requires an initial statistical analysis of maritime incidents, from 1970 to 2014, considering all the events recorded in the international database of REMPEC (www.rempec.org), CEDRE (www.cedre.fr) and ITOPF (www.itopf.com). This analysis reveals that the majority of the maritime incidents in the Adriatic sea (45% of the total) is due to human errors, grouping cargo transfer failures, collisions, grounding and contact with other vessels or other objects. A significant proportion is also represented by fire or explosion on board that recurs in almost a quarter of the episodes recorded. Notice how the adverse weather conditions have influenced the 9% of the incidents. The remaining causes of accidents are due to random circumstances, unchangeable and not predictable. The same statistical analysis shows that the 50% of the incidents had involved oil and chemical tankers and gas carriers. Furthermore, the 76% of the vessels were older than 12 years [▶Figure 1].

Figure 1. Percentage distribution of maritime incidents in Adriatic sea from 1970 to 2014.



It appears, thus, evident that is not possible to predict an accident with any certainty. Nevertheless, it is possible to associate an hazard to maritime traffic and to the weather conditions in order to compute the likelihood of a spill occurring. On the other hand, it is also possible to evaluate the vulnerability of a coastal area to oil spill risk in order to understand the consequences or the effects of the spill. Their combination gives the basis to a necessary risk assessment that underpins all preparation and planning for marine oil spill response.

The ATLAS developed in the HAZADR project represents a complete 'e-tool' for managing marine pollution events caused by oil spill. It is a real time early-warning system that allows the simultaneous view, by each partners and all authorized final users, of

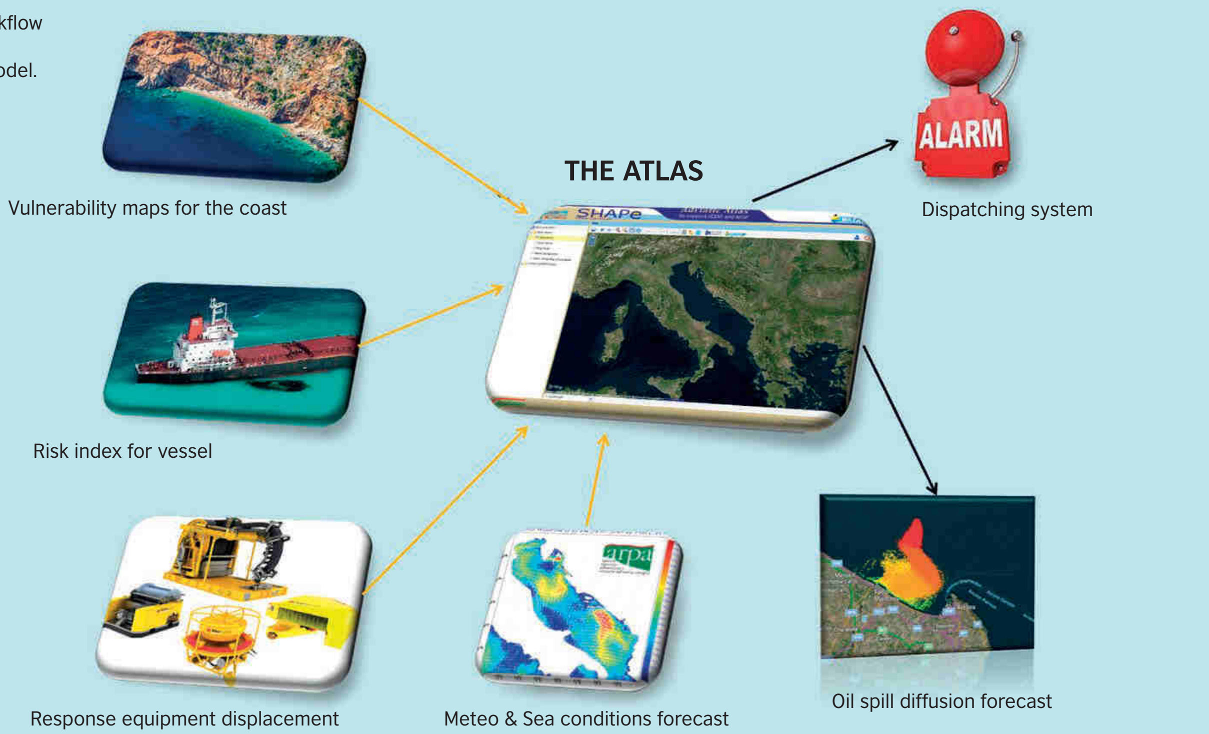


Figure 2. Workflow of the ATLAS conceptual model.

several information related to the risk propagation in the Adriatic and the potential coastal threats.

The ATLAS interpolates information about the Adriatic most sensitive and vulnerable areas and the intrinsic risky index of the sailing vessels, whilst one oceanographic model covering all the Adriatic basin can predict the oil spill dynamic and the first costal zones / marine areas affected by the pollution in case of hazard. The ATLAS provides also information on the available response equipment to combat the oil spill pollution at coasts and their locations in Adriatic, with the purpose of sharing information across the emergency corps, even at cross-border level, and facilitate the quick cooperation when a real emergency shows up.

The conceptual model architecture is well explained in the figure 2.

In particular, as will be described hereafter, the real time risk prevention system consists in the interpolation of 5 informative layers:

- Coastal vulnerability maps;
- Forecast for weather and sea;
- Real time position of vessels in Adriatic sea associated to their risk index;
- Oil spill diffusion simulation from GNOME model;
- All the response equipment dispaced along the coast.

All these informative layers, both static and dynamic, automatically interact each other and fuel one Adriatic-scale early warning system that estimates the potential coastal risks associated to the presence of dangerous ship (such as oil-tankers) and dispatches in automatic a warning (via SMS and email) addressed to the qualified emergency operators when an high risk vessel represent a possible threats for the coasts.

Furthermore, in case of real accident, the emergency managers can query the ATLAS system to predict the oil spill propagation directly on the webgis: being this simulation elaborated hours before the oil spill grounding, the emergency corps could know in advance the impact location, get organized in time, alert the concerned costal communities and mobilize equipment and volunteers to protect the endangered coasts. The organization of one common database on the response equipment available in the HAZADR participating regions represents a further asset: indeed, it is the first time that this equipment screening is conducted at cross-border scale: in the future, this database shall be integrated with the missing information and constantly updated.

The ATLAS is a novelty for the Adriatic and it could represent a strategic asset for the Adriatic macro-region, but it needs to be promoted: from now on, the emergency corps, civil protection and coastguards of Adriatic counties and regions should get in confidence with the use of ATLAS. The purpose is not to replace monitoring instruments already in use by these corps (or overlap they responsibilities/missions) but to provide them with a powerful decision support system that helps understanding where the oil spill moves in case of risky conditions or real accidents and thus accelerate the single, interregional or cross-border procedures to minimize the coastal pollution.

In the next pages, the structure of the ATLAS is deeply explained.

2.2 VULNERABILITY OF THE ADRIATIC COASTS AND THE INTEGRATION WITH THE SHAPE PROJECT

Raffaella Matarrese / Michele Vurro

The coastal vulnerability maps are an outstanding element in an oil spill contingency plan. These maps provide the oil spill responders with essential information on where ecologically vulnerable areas and economically important resources are located, as well as crucial drivers about the protection and clean-up priority areas. To this aim, a method of PSCM (Point Count System Models) or Parameter Weighting and Rating Method has been used to design the vulnerability maps in HAZADR. This method is able to implement a very flexible procedure for selecting areas, and it is based on few guidelines for establishing parameters, exclusion criteria, ratings and weights. The PCSM is the most suitable method for handling the available data in the national agencies and organizations in charge of the national territory management and survey. The PSCM is a very simply, clear and understandable method, also for people not having familiarity with oil spill risk.

Based on the New Zealand approach described in Stevens et al, in 2005, each partner of HAZADR project was asked to provide significant layer related to all the groups listed in the Table1.

Considering the big amount of requested data and the difficulty to obtained them, and also in order to capitalize the results of another European project funded under the IPA CBC Adriatic Programme, in July 2014 an agreement was signed between HAZADR and SHAPE (**S**haping an **H**olistic **A**pproach to **P**rotect the Adriatic **E**nvironment between coast and sea) projects.

SHAPE (www.shape-ipaproject.eu) aims at the development of a multilevel and cross-sector governance system, based on an holistic approach and on an integrated management of the natural resources, risk prevention and conflicts resolution among uses and users of the Adriatic coast and sea. One of its main outputs is a common GIS Atlas of Adriatic sea.

Table 1. Resource categories and groups in the risk assessment.

Resources type	Resource category	Resource group	
ENVIRONMENT	**Shoreline character**	Exposed rocky headlands; Eroding wave-cut platforms; Fine-grained sand beaches; Course-grained beaches; Exposed compacted tidal flats;	Mixed sand & gravel beaches Gravel beaches Sheltered rocky coasts Sheltered tidal flats Salt marshes
	Plants & Animals	Plants – terrestrial, wetland and marine plants and algae Birds / Fishes Invertebrates Reptiles Mammals	
	Protected sites	International; Marine protected areas; Marine reserves; Wildlife Sanctuaries;	Scientific/nature reserve Wildlife refuge Wildlife Management reserves Scenic Reserves
HUMAN	**Economic**	Shipping/ports; Aquaculture; Tourism	Fishing Infrastructure/Coastal
	Cultural	Cultural, traditional Archeology	
	Social, Amenity & Recreation	Fishing; Diving; Shellfish harvesting	Boating Bathing waters

HAZADR builts on the SHAPE experience, capitalizing its main results. This cooperation agreement between the two projects was very important for two major issues. On one hand, it allowed to integrate the HAZADR data, collected by the partners and organized by the CNR, within an already existing Web-GIS; on the other hand, it was possible to combine SHAPE project data with the vulnerability maps requirements, thus bypassing the lack of information for certain Adriatic coastal areas.

With an almost-complete dataset covering the whole Adriatic coast, it was then possible to assign a weight of vulnerability to each group listed in table 1. For each category, the criterion to rank it is described as follow.

Mapping the morphology of the coast

For the various types of shoreline (and riverine or lacustrine ecosystems), the widely accepted Environmental Sensitivity Index (ESI)[1],[3] has been adapted for each county/region. The ESI, ranging from 1 (low sensitivity) to 10 (very high sensitivity), integrates:

- the shoreline type (grain size, slope) which determines the capacity of oil penetration and/or burial on the shore, and movement;
- the exposure to wave (and tidal energy) which determines the natural persistence time of oil on the shoreline;
- the general biological productivity and sensitivity.

Table 2. Associated values applied to each coastal types considered.

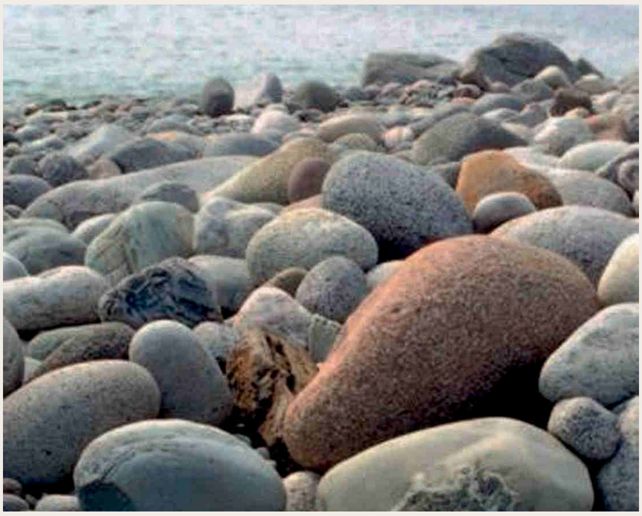
Exposed rocky headlands	1
Eroding wave-cut platforms	2
Fine-grained sand beaches	3
Course-grained beaches	4
Exposed compacted tidal flats	5
Mixed sand & gravel beaches	6
Gravel beaches	7
Sheltered rocky coasts	8
Sheltered tidal flats	9
Salt marshes	10

As result, a map of shoreline features, ranging from 1 to 10, was generated [Figure 3].

Figure 3. Examples of coast type in Adriatic.

Sandy beach

Cobble beach



Rochy shoreline

Wave-cut platform

Cliffs

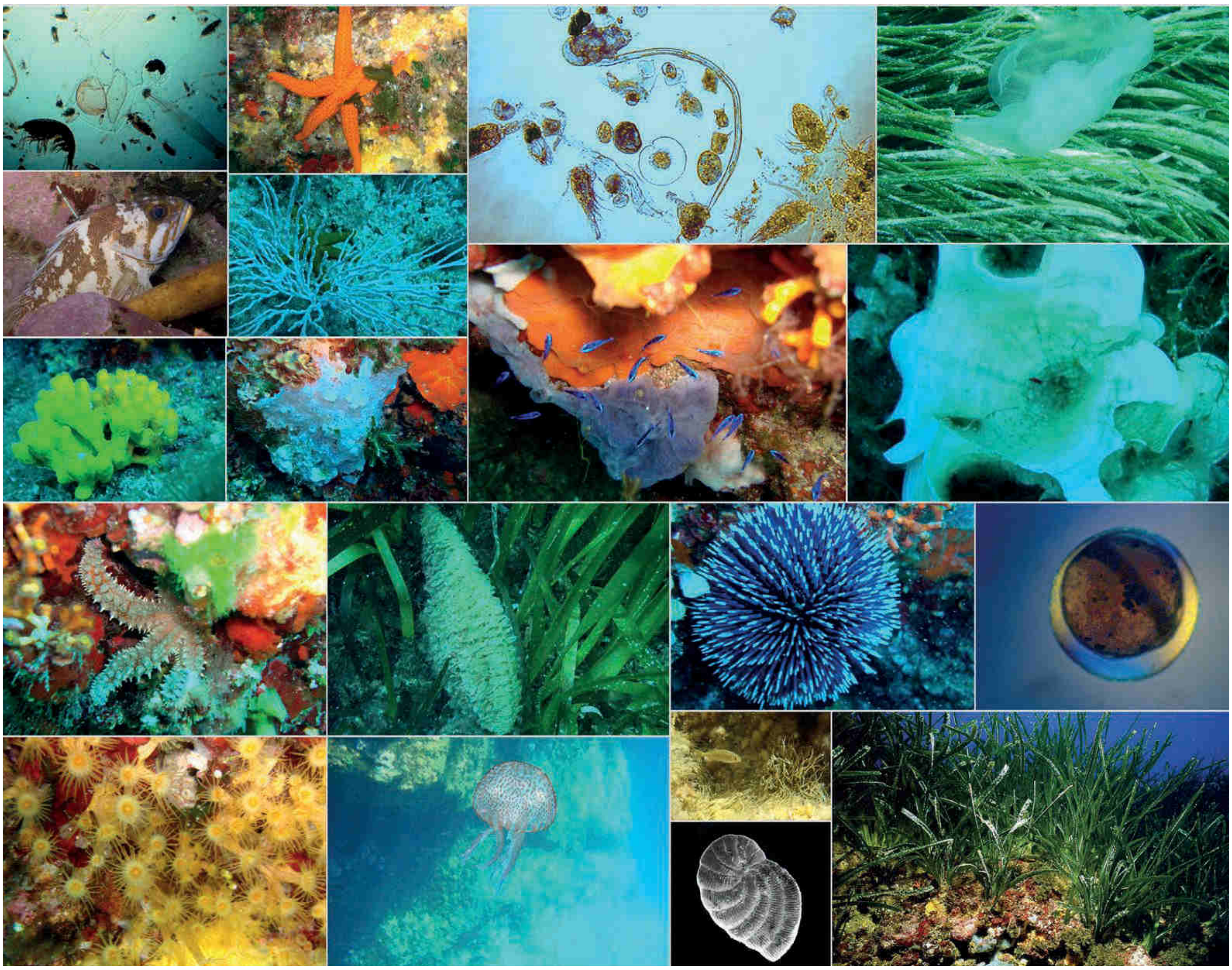


Figure 4. Examples of marine ecosystems.

Mapping the biodiversity vulnerable elements of the areas

Mapping both protected areas and the areas of biodiversity importance includes the coastal species, habitats and natural resources that could be affected by accidental oil pollution. In particular, this includes:

- protected areas and important areas of biodiversity;
- different types of coastal habitats/ecosystems;
- endangered species.

For the protected areas the associated values are shown in table 3.

As result, a map of protected sites intersecting the coastline, ranging from 0 to 10, was produced.

It has to be noticed that the EU legislation protects most of the sites, classified in table 3, based on their specific environment, except for *Posidonia oceanica* meadows. *Posidonia oceanica*[2] is a species that grows in a narrow coastal strip, at depths of up to 40 meters, only in the Mediterranean sea. *Posidonia oceanica* mead-

Table 3: Associated values applied to each protected area type.

International	10
Marine protected areas	9
Marine reserves	8
Wildlife Sanctuaries	8
Scientific/nature reserve	7
Wildlife refuge	6
Wildlife Management reserves	4
Scenic Reserves	2

ows serve as sanctuaries for numerous species for annual reproduction and as a year round refuge and food source for others, that is the reason of their crucial importance for the ecosystem. Since they are extremely sensitive to poor water clarity caused by pollution, nutrient loading or mechanical disturbance, they were ranked in "Plants & Animals" category, with the highest value of sensitivity.

As results, associating the value 10 to the coastline within 1 km^2 from *Posidonia oceanica meadows*, a map of biocenosis with 0 or 10 value, was generated.

Mapping the vulnerability of socio-economic features

Sensitive socio-economic features have been mapped including: non-living resources that may be directly injured by oiling; managed areas that may suffer economically, e.g. through interruption of use if oiled; and areas that may be valuable in the event of a spill for access or staging activities. These features can be grouped into various categories:

- subsistence, artisanal and commercial fishing, and fishing villages;
- aquaculture;
- water intakes (salt marsh plant, desalinization plant, aquaculture and salt production, industrial use);
- tourism and recreation areas (hotels, restaurants, marinas, beaches, recreational fishing, diving, etc.);
- port (including the activities and infrastructures);
- industrial activities (relying on maritime transport);
- infrastructures related to oil exploration, production and transport activities; and
- cultural sites (archaeological, historical, religious, etc.).

The ranking of these categories has been the most delicate phase in the whole PSCM approach. Indeed, the information provided by all partners and by SHAPE database had to be harmonized in terms of spatial references, typology of shape files (points, lines and polygons) and – above all – values to assign. An extensive study has been conducted: starting from what available in literature[4,5,6,7], several experts in economy and ecology have been interviewed ending with the evaluation shown in table 4 and table 5.

Table 4. Associated values applied to commercial fisheries type.

Commercial fisheries	
Offshore fish stokes	2
Fish breeding / nursery area	7
Nearshore shellfish resources and fishing gear	9
Intertidal shellfish resources and aquaculture	10

As result, two maps of shoreline human features, ranging from 1 to 10, were generated.

In case of overlapping, the highest value has been considered.

Table 5. Associated values applied to human use available data.

Human Use	
Seaports	3
Build-up areas	4
Marinas	6
Sand and salt exploitation	7
Tourism	8
Bathing water	8
Archeological sites	10

Build vulnerability maps

For each of the five categories (Shoreline type, Biological resource, Protected sites, Commercial fisheries and Human Use), a weight was associated, based on the scheme in Stevens et al, 2005, in table 6:

Table 6. Associated weights per categories.

Resource Type	Category	Weighting
Environment	Shoreline type	1.5
	Biological resource	1.75
	Protected sites	1.5
Human	Commercial fisheries	2
	Human Use	2

Following an area score being given for each Resource Category, the sum of the combined scores were generated for 'environmental' and 'human' categories [▶Figure 5].

According to the described approach, three different vulnerability maps were ingested in the ATLAS, in order to provide the decision-maker with the most accurate knowledge of the area that might be impacted by the spill: (1) a total vulnerability map, that is the combination of (2) one environmental and (3) one human vulnerability maps.

Entering the ATLAS it will be possible, for the authorized and public users, to choose in the left panel (Topic categories), the folder n.8, Geoscientific Information, and then Vulnerability of coastal environment, and visualize the preferred vulnerability map. Figure 5 is an example of "Environmental vulnerability to oil spill" for the Apulia Region, Albania and part of Montenegro.

As another example, figure 6 represents the total coastal vulnerability for the Slovenia and the northern part of Croatia [▶ Figure 6].

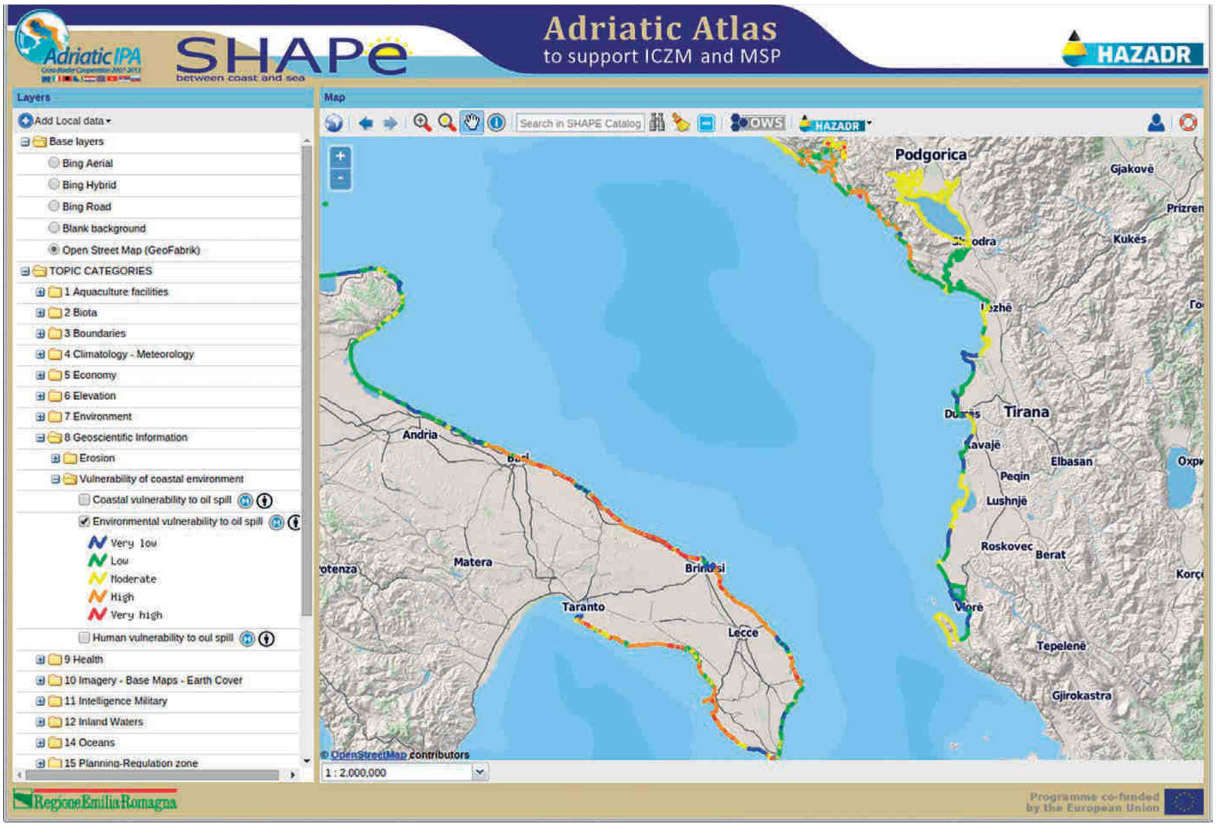


Figure 5. Environmental vulnerability to oil spill for the Apulia Region, Albania and part of Montenegro.

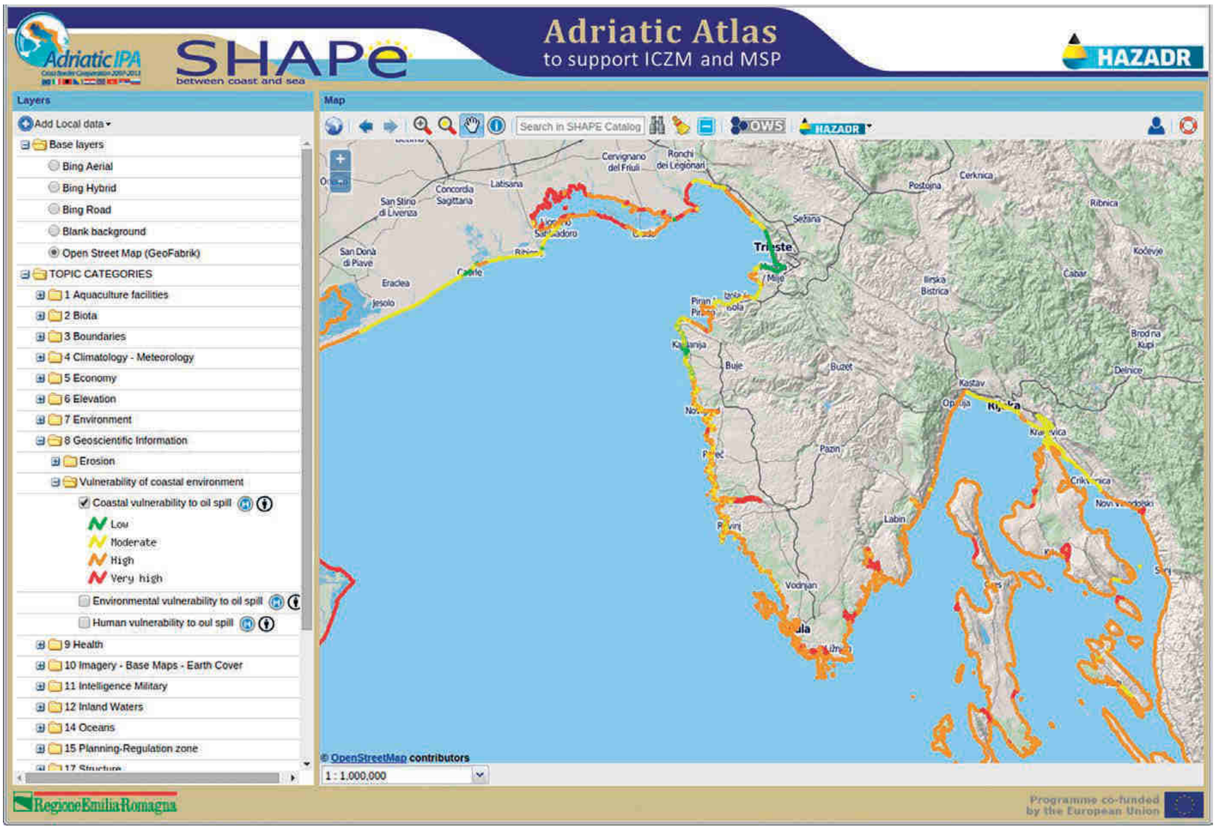


Figure 6. Environmental vulnerability to oil spill in the North Adriatic.

2.3 SIZING THE COASTAL EXPOSITION TO THE RISK AND THE DISPATCHING MECHANISMS

Leonardo Balestra / Alberto Cecconi / Roberto Cingolani / Gabriella Gigli / Giorgio Severini / Alessandro Coluccelli / Andrea Valentini / Aniello Russo

The Adriatic sea can be defined as an environmental risky area, basically for two reasons: high anthropic pressure along the coastal areas (human activity) and the intensive maritime traffic in both directions north-south, south-north.

Particularly, the aspect of coastal exposure and its risk of pollutants linked to marine traffic is, until now, under-estimated. We also have to consider that 50% of products transported by sea consist in substances classified as hazardous.

Usually the problems linked to sea transport are handled by Maritime Authority, (Coast Guards, Port Authorities, etc.) whereas land government authorities such as Municipalities, Regions, Counties are not involved. These authorities could be involved dramatically in case of accidents, when and if the oil spillage approaches the coastal areas.

Thus, coastal areas are terribly and passively exposed to risks of ship presence, in particular those carrying hazardous substances and with low security standards.

Index of dangerousness exposure

The Adriatic is always under pressure, being endangered by the presence of potential risky vessels. To respond to this challenge, the HAZADR project has developed a system able to estimate the potential coastal risks associated to the presence of dangerous ship (such as oil-tankers) in the Adriatic. This system is part of the ATLAS and offers a coastal early warning facility able to activate a cross-border dispatching mechanism addressed to the qualified emergency operators.

The innovation performed by HAZADR project has a paramount importance. Indeed, when providing the Adriatic administrations concerned by the project with an unique “vocabulary” to recognize the coastal risk exposure born at sea, there are two immediate benefits: firstly, a cross-border and shared understanding of what the risk (real or potential) is, how serious it might be for the Adriatic coastal communities and what could happen if the potential factor of risk escalades in a real emergency; secondly, to detect the potential sources of risk, get ready for emergencies and improve a joint fast coastal response mechanism.

The system is based on the AIS (Automatic Identification System), which permits the identification of all ships in the Adriatic area. A software uses the AIS data to link each ship’s ID number

Figure 7. Oil spillage. A prompt reaction depends on a functional dispatching system and one effective oil spill forecast model.

to the database of “The Lloyd’s Register of Ships Online”, and analyzes the main characteristics of the ships and obtain the ships profile with the evaluation of each risk level.

According to the principles of the Paris Memorandum of Understanding (Paris Mou), the Marche Region – on behalf of the partnership – has identified several elements of the ships, that may represent a risk to the coastal environmental areas in the Adriatic sea.

The vessel’s intrinsic risk profile increases or decreases depending on the vessel’s relative position in the Adriatic. Indeed, the risk profile of a ship shall be assessed by a combination of some parameters, evaluated and weighed in relation to the peculiar characteristics of the basin where the ship is located (i.e. vicinity to marine reserves, protected areas, touristic or industrial installation etc..). Considering some factors such as the Adriatic basin size (132.000 Km2 , length 800 Km, width 150 km – average data -, depth 300 m -average data-) and the high levels of human activity on the sea and along the coast, we can consider the Adriatic an extremely vulnerable area. For this reason, every ship navigating across the basin is analyzed with specific assessment criteria. These parameters were processed in the ATLAS, as deeply explained in the previous paragraph “Vulnerability of the Adriatic coasts and the integration with the SHAPE project”.

The HAZADR dispatching system scans the ship risk profile using similar (but not identical) criteria to Paris MoU standards and lets to highlight those situations that are source of risks for the Adriatic coastal zones, as expressed by an index. This index, based on a prototypal version proposed by Marche Region and enhanced by the partnership, considers all those parameters that significantly increase the environmental risks due to the sea traffic in the Adriatic basin.

At present, the index of vessel’s dangerousness is based on the evaluation of *five plus two* parameters 1) Type ship 2) Gross Tonnage 3) Launched 4) Flag 5) Register 6) Wind conditions -Beaufort scale- 7) Sea-state condidions -Douglas scale-.

When choosing the most suitable index to estimate the vessel’s dangerousness inside the project, a common criteria was shared among partners. The ship profile is synthesized by an index named COMADEX (COastal MArche region Dangerousness EXposure). It is obtained from the analysis and the evaluation some parameters. The index is based on the same or similar version of the Paris MoU. The Paris Memorandum strategic plan aims at the elimination of substandard merchant ships in the waters of the European coastal States and the North Atlantic basin from North America to Europe. Each ship, in the information system, will be attributed a ship risk profile, in accordance with Annex 7 of the Paris MoU text. This ship risk profile will determine the ships’ priority for inspection.

To obtain COMADEX, five parameters are analyzed:

1. Type ship: different type of ships have different levels of dangerousness related to coastal areas. From this point of view, passenger ships are considered low environmental risk, gas carriers are considered of medium risk and oil and chemical tankers, are considered as posing an higher risk. This is because in case of accident, pollutants, in particular oil, may be dispersed into the sea and reach coastal areas.

2. Gross Tonnage: it is based on the consideration that the bigger the ship is (and the bigger the amount of load dispersed is), the higher the dangerousness for the coastal areas in case of accident is. Furthermore the Adriatic is a small and shallow sea. For this reason we consider big ship as a relative statement. Ships with gross tonnage above 50.000 and above 90.000 tons shall be considered at high risk.

3. Launched: Paris MoU considers ships older than 12 years as real risk. In COMADEX we consider medium risk ships those vessels aged between six and twenty years, whilst the 20 years older ships shall be considered at high risk.

4. Flag: according to Paris Mou, ships flying the flag of a State for which an audit has been completed and, where relevant, a corrective action plan submitted, both in accordance with the Framework and procedures for the Voluntary IMO Member State Audit Scheme, shall be considered as posing a lower risk. Ships flying the flag of a State with a low detention rate within the Community and the Paris MoU areas shall be considered as posing a lower risk. Ships flying the flag of a State with a high detention rate within the Community and the Paris MoU region shall be considered as posing a higher risk.

5. Register: ships are recognized by organizations that have different performance levels in relation with their detention rates within the Community and the Paris MoU region. Considering this parameter, according with Paris MoU classification, we distinguish four ships performance levels. Ships certificated by recognized organisations as having an high performance level in relation with their detention rates within the Community and the Paris MoU region shall be considered as posing a lower risk. Ships certificated by recognized organizations as having a low or very low performance level in relation with their detention rates within the Community and the Paris MOU region shall be considered as posing a higher risk.

In addition to the COMADEX parameters mentioned above, 2 additional parameters have been considered by HAZADR partners to design the index of dangerousness exposure. Indeed, the sea and weather conditions can definitely affect the ship maneuvers and can favor collision. In the history of oil tanker shipwrecks (i.e. Haven, Erika etc.) the main cause of the accident is to be found in structural failure. Storm conditions can create high stress factor over the structure of the ship. For this reason, with the increasing of waves and/or wind (throughout the evaluation of the forecasts of the intensity of the wind and the height of the waves, considering respectively the Beaufort and Douglas scales), an exponential increase of risk condition has been assigned [▶Table 6].

Upon these 7 parameters, in HAZADR, the partnership has identified three score-triggering levels: [▶Table 7].

The combination created from COMADEX index, Douglas and Beaufort scales, allows the system to process the ranking of the

Table 7. In HAZADR, the sea and weather condition are evaluate according to the Beaufort and Douglas scales.

Limit of the scales

Scala Douglas (Stato del Mare*)

Stato del mare	Termine descrizione	Altezza media delle onde	State of the sea	État de la mer
0	Calmo	–	Calm (glassy)	Calme
1	Quasi calmo	0-0,10 mt.	Calm (rippled)	Calme (ridée)
2	Poco mosso	0,10-0,50 mt.	Smooth	Belle
3	Mosso	0,50-1,25 mt.	Slight	Peu agitée
4	Molto mosso	1,25-2,50 mt.	Moderate	Agitée
5	Agitato	2,50-4 mt.	Rough	Forte
6	Molto agitato	4-6 mt.	Very rough	Très forte
7	Grosso	6-9 mt.	High	Grosse
8	Molto grosso	9-14 mt.	Very high	Très grosse
9	Tempestoso	oltre 14 mt.	Phenomenal	Énorme

* Waves generated by wind action.

Scala Beaufort

Beaufort*	Avg Miles per Hour	Knots	Surroundings
0 calm		0 -1	Smoke rises vertically and the sea is mirror smooth
1 light air	1.2 - 3-0	1 -3	Smoke moves slightly with breeze and shows direction of wind
2 light breeze	3.7 - 7.5	4 - 6	You can feel the breeze on your face and hear the leaves start to rustle
3 gentle breeze	8.0 - 12.5	7 - 10	Smoke will move horizontally and small branches start to sway. Wind extends a light flag
4 moderate	13.0 - 18.6	11 - 16	Loose dust or sand on the ground will move and larger branches will sway, loose paper blows
5 fresh breeze	19.3 - 25.0	17 - 21	Surface waves form of water and small trees sway
6 strong breeze	25.5 - 31.0	22 - 27	Trees begin to bend with the force of the wind and causes whistling in telephone wires. Some spray on the sea surface
7 moderate gale	32.0 - 38.0	28 - 33	Large trees sway. Moderate sea spray
8 fresh gale	39.0 - 46.0	34 - 40	Twigs break from trees, and long streaks of foam appear on the ocean
9 strong gale	47.0 - 55-0	41 - 47	Branches break from trees
10 whole gale	56.0 - 64.0	48 - 55	Trees are uprooted and the sea takes on a white appearance
11 storm	65.0 - 74.0	56 - 63	Widespread damage
12 hurricane	75+	64+	Structural damage on land, and storm waves at sea

Table 8. The HAZADR cross-border code to recognize the coastal risk exposure born at sea.

TRIAL	COMADEX index	Color
Safe ship	total score ≤ 35	green
Partly safe ship	total score > 35 - ≤ 45	yellow
Potentially hazardous ship	total score > 45	red

ships. If a ship has a COMADEX index > 45, on the screen it is always red; if COMADEX score is > 35 – ≤ 45 and, in the same times, Douglas score is ≥ 7 and Beaufort score is ≥ 9, the ship appears red . In the other cases the ship appears yellow or green. [▶Table 8].

In short, the system conceptualized in HAZADR leads to estimate the vessel's dangerousness taking into account the vessel's conditions (through COMADEX index) and the sea and weather condition (through Douglas and Beaufort scales). On the screen, the different hazardousness levels are displayed with three different colors of the ships: green, yellow and red. When the system reports the presence of red ships there is (or there are) a situation of potentially hazardousness in a certain area of the Adriatic basin. Beside the risky score, it is also possible to visualize the route of the vessel during the last previous hour. Furthermore, the ATLAS stores the positions (and the associated risk) of the vessels for the last 72 hours, enabling the user to better understand the causes and the actions to undertake [▶Figure 9].

Table 9. Combination of COMADEX, Douglas and Beaufort scales to determine a potentially hazardous ship for the coastal areas.

The dispatching system

Within the HAZADR project a potential risk threshold is fixed and shared by the partners. In case of exceeding the limit, the system is able to send automatically a warning message: (via e-mail and an SMS) addressed to few and well identified emergency operators. The SMS contains basic information: start of the alert, time, MMSI code, name of the ship, position (link to Google map). The email contains extra information such as the IMO number, ship type.

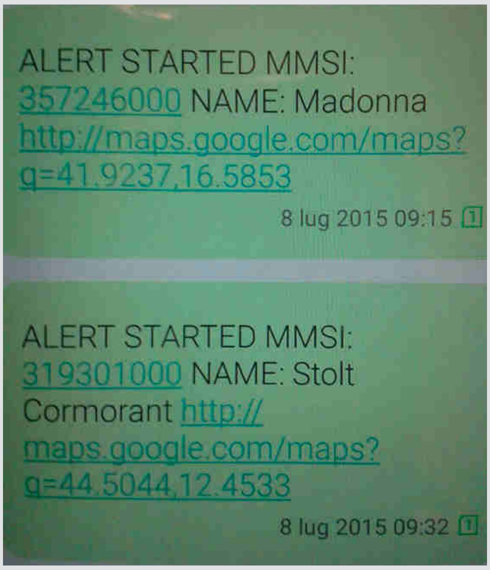
This dispatch is sent from ACCRA, (Adriatic Coastal Control Room Ancona), that manages the system, to a list of authorized subjects (the users) that can benefit from the information.

Basically, the meaning of the alert is: "Be careful! The system has detected a ship potentially hazardous for your coastal areas. Pay attention"!

Once received the warning, delivered by SMS and email, the emergency operators, beside keeping the ship under control in the monitoring area, have to make several considerations. In particular, they are supposed to estimate if the ship could represent a real threat for its own coastal areas and if its position – against the current weather and sea conditions – could be really dangerous [▶Figure 8].

After the dispatch, each emergency unit in operation in any area of the Adriatic can follow the red-ship route and evaluate, minute by minute, the position of the ship in relation to the con-

Figure 8. The ATLAS system reports ships sailing in the Adriatic sea showing their potential risk and their route during the last hour.



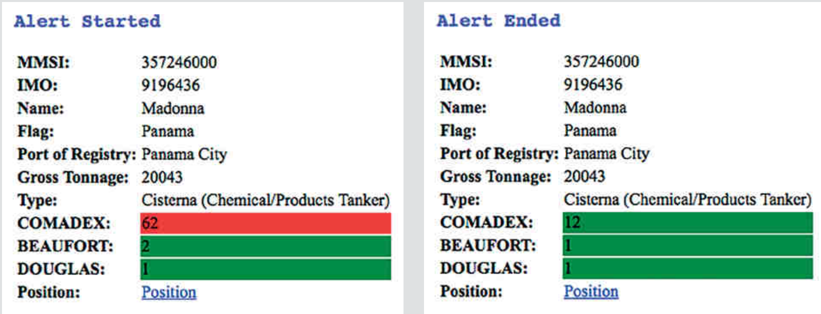


Figure 9. Example of warning message delivered by the ATLAS dispatching system. From left: alert notified by SMS; start of alert notified by email; end of alert notified by email.

trolling operator's coast. They can also observe the trajectories of currents close to the ship (wind and wave). If their intensity and direction are unfavorable (the stream heads to the coast) and the distance from the coast gets closer, a combination of elements exposing the coast to a potentially risk rises up, hence demanding a specific attention by the coastal authorities.

In this case, the user that considers the situation potentially dangerous to his area can ask the support of the Oil Spill Forecast Supporting System (Oil spil FSS), as explained in the next paragraph.

The Oil Spill Forecast Supporting System (Oil spill FSS)

The Oil Spill FSS is composed by a hierarchy of operational models that run in sequence: every day, outputs of the atmospheric model are used by the hydrodynamic and wave models, while the oil spill model, that is run on demand, is forced by outputs from the previously cited models [▶Figure 10].

Atop the hierarchy there is COSMO-I7, a non-hydrostatic limited-area atmospheric model (7 km of horizontal resolution), developed by the Consortium for Small-scale Modelling (COSMO, www.cosmo-model.org). COSMO-I7 is managed by the Italian COSMO partners: Meteo Service (USAM) of the Italian Air Force, the Hydro-MeteoClimate service of ARPA Emilia-Romagna (ARPA-SIMC) and the Environment Protection Agency of Piemonte Region.

The model grid covers the whole Italian domain, it runs twice a day at ARPA-SIMC and it supplies a 72-hours forecast with hourly outputs.

AdriaCOAWST is the system of coupled models used to predict the physical state of the sea and it is a specific application built on top of the COAWST system, developed at the Woods Hole Oceanographic Institution (http://woodshole.er.usgs.gov/operations/modeling/COAWST/). The AdriaCOAWST operational forecasting system has been specifically developed for HAZADR by the Department of Life and Environmental Science of the Polytechnic University of upon agreement with the Marche Region. The core of the system is made of a regional marine circulation model (ROMS) fully coupled with a wave model (SWAN). The domain of the model is the whole Adriatic Sea, with 1 km horizontal resolution and 30 vertical levels.

This model is forced by: the output provided by COSMO-I7 and the sea-state forecasting system MEDITARE of ARPA-SIMC; the Po river discharge and temperature measured by ARPA Emilia Romagna; the output of the Mediterranean Forecasting System (http://gnoo.bo.ingv.it/mfs/dailysys_des.htm) that provides the sea parameters at the open boundary near the Otranto channel.

The AdriaCOAWST forecasting system runs autonomously every day and produces a 72-hours forecast with hourly output.

The oil-spill model used to predict the oil dynamics (direction, speed, impact) on the sea surface and its possible stranding is GNOME (General NOAA Operational Modeling Environment). It is the modeling tool used by the General NOAA Oil Modeling Environment (http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/gnome.html). Additionally AdriaCOAWST produces output ready to be used by the MEDSLIK-II oil-spill model (http://medslikii.bo.ingv.it).

GNOME provides till 72 hours of forecast "on demand" and it is

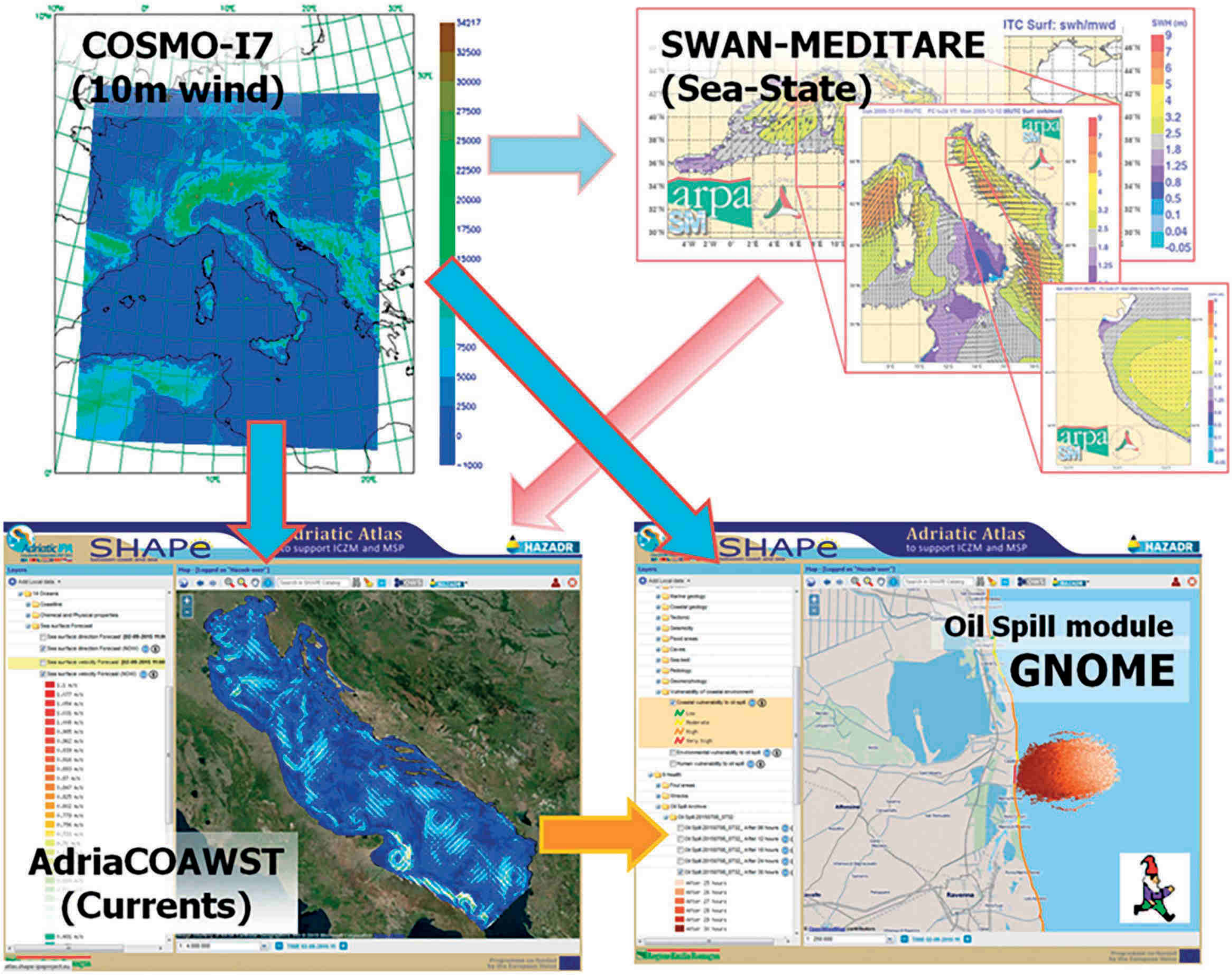


Figure 10. Operational numerical models part of the Oil Spill Forecast Supporting System; arrows indicate the output flow.

driven by the 10m wind from COSMO-I7 and surface currents from AdriaCOAWST .

Moreover, wind, surface currents and wave forecast data have been integrated as map layers inside the Adriatic Atlas and they are freely available every day. Oil-spill simulations and maps are produced only if requested by accredited users that can use this data for the assessment of environmental and technological risk. This information is addressed at setting the degree of sensibility to oil dispersion in the area. This forecast can also improve the capacity of response with a better allocation of equipment and intervention teams. If the users are interested to obtain the forecast they must require them to ACCRA.

To obtain these information the applicant (for instance, a port authority of a civil protection department) has to fill in a form available on the HAZARD website, by providing the most outstanding inputs such as the spillage initiation area, the quantity and the type of oil (in case of lack or partial information, the applicants can enter provisional estimations) [▶Figure 11].

In case of accident the operator in ACCRA, after having received the form, activates the dispatching system and provides the oil spill forecast using the mathematical model with the real data. When the forecast is already on the HAZADR site, one SMS and one email inform all users. In this case the data is not an estimation but are real information provided for Coastal Guard or other subjects.

The system takes about 30' to elaborate all data and produce a forecast. When is the forecast is ready, one SMS followed by one e-mail notifies the applicant that the forecast is available on

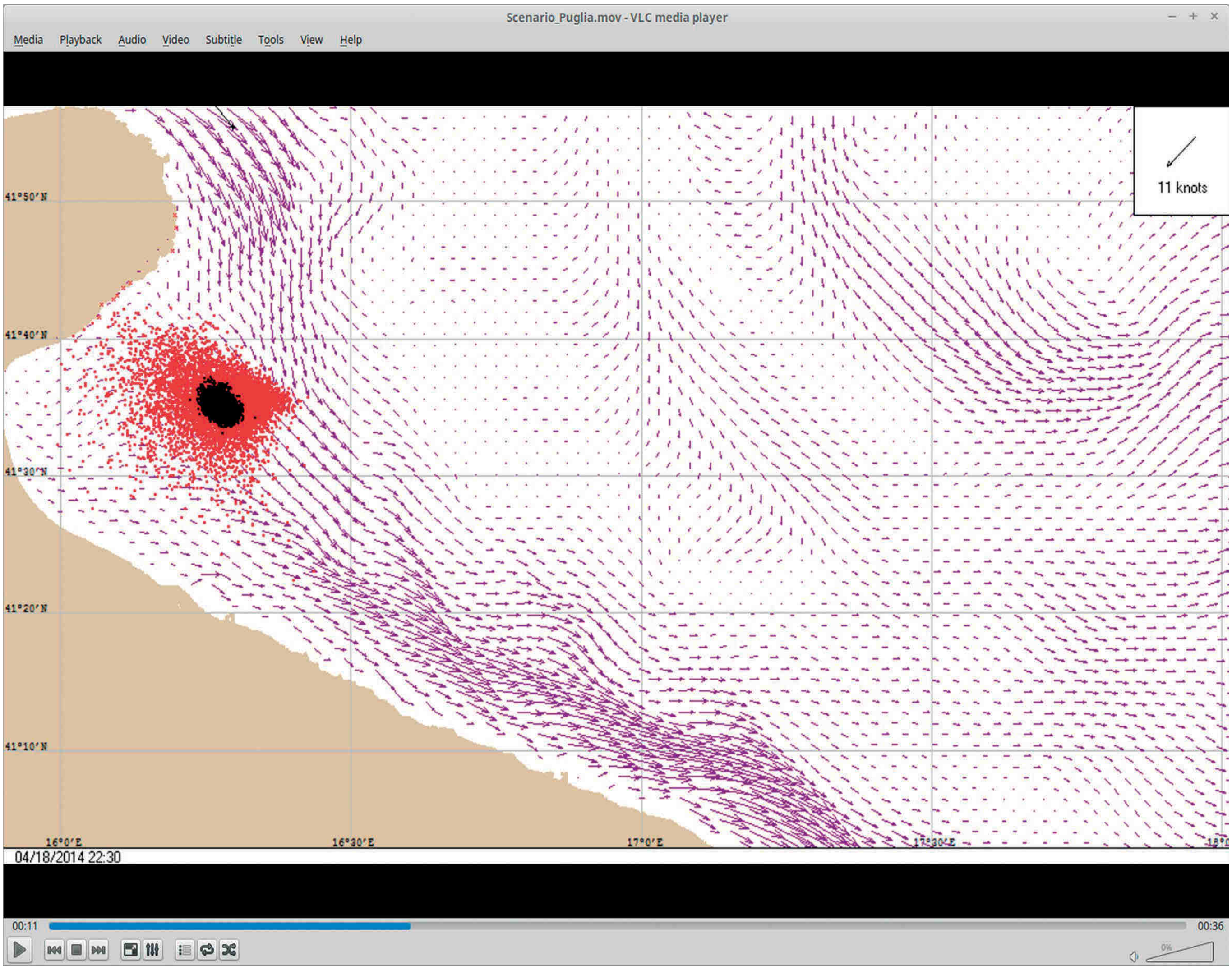


Figure 11. Screenshot of an oil-spill simulation provided by the ACCRA in the frame of HAZADR project

HAZADR site. On the way round, when the potentially dangerous situation is over, another SMS /e-mail advises the users that the monitoring system does not report any dangerous ship in the area.).

Final considerations

The system helps estimating the sizing of sea and coastal risks associated to the vessels' traffic in different Adriatic areas and in various sea and weather conditions. The AdriaCOAWST system provides a very fine description of the Adriatic sea currents and therefore a more accurate prediction of the oil spill dynamics, especially in the coastal areas. The knowledge of the type and of the position of the potentially hazardous situation and its seriousness would improve the response capacity of the Civil Protection and optimize clean-up activities on the shoreline. The information provided can generate meaningful benefits in the assessment of environmental damage, limiting the effects of environmental disasters caused by oil spills. Indeed the system contribute to the control of sea and coast and improves the ability to take the wisest decision in case of emergency.

However, the system has a flexible setting: it is possible to change the thresholds, the level of the limits, the considered parameters, etc. Upon the progressive experience and the feedbacks, it will be possible, if necessary, to recalibrate the sizing of the different parameters. It is also possible to add extra information that were not considered before.

2.4 EMERGENCY EQUIPMENT DISPLACEMENT IN THE ADRIATIC

Raffaella Matarrese / Michele Vurro

An important aspect for a contingency plans is the knowledge of the availability and the readiness of the response equipment that can be used. Beside the awareness and exhaustive knowledge of its own response equipment for catastrophic by each Adriatic Region, the creation of a global Adriatic-scale database of the ready-to-use oil spill response equipment displaced across the Adriatic coastal lines represent an essential asset to accelerate the oil-spill mitigation procedures in case of incidents. That is the

Figure 12. Response equipment's tutorial in Pula, Croatia.

Figure 13. Some of response equipment used during ERCOLE 2014 exercise.

reason why the ATLAS reserves a part of its GIS database to these equipment.

To this aim, the ATLAS can provide essential information about the availability, the quantity and the ownership of the necessary equipment to deal with costal pollution crises.

To implement the common database for the entire Adriatic area gathering data on the state of readiness of response equipment, each partner was asked to fill a questionnaire to collect data on the state of readiness and the spatial distribution of their spill response equipment. The provided data, entered into a joint digital database, is accessible from the project website only for authorized users.

In the overall HAZADR project concept, the result of this activity contributes at completing the picture over the most endangered Adriatic vulnerable zones, the response procedures applied in every country and partner's region and the locations where the response equipment is stored and ready-to-use across the whole Adriatic area.

A survey has been carried out focused only on land response equipment, analyzing the results of other EU projects and using best practices and suggestions published by National and International Centers, as CEDRE, assuming that the open-sea response equipment will be surveyed during the framework analysis conducted by the EU – MED project MEDESS-4MS (www.medess4ms.eu).

The first step, before starting the survey, included the study of the most important oil clean-up techniques and the relative equipment to be used.

CEDRE, REMPEC, IMO and ITOPF were the principal sources of information analyzed. As result, the survey was divided in six parts:

1. Personnel involved (administrations, fire brigades, municipalities, army, NGOs, private contractors, volunteers) and their location;
2. Preventative measures: for each technique that can be applied, the quantity and the owner of a list of response equipment available;
3. Initial clean-up: for each technique that can be applied, the quantity and the owner of a list of response equipment available;
4. Final clean-up: for each technique that can be applied, the quantity and the owner of a list of response equipment available;

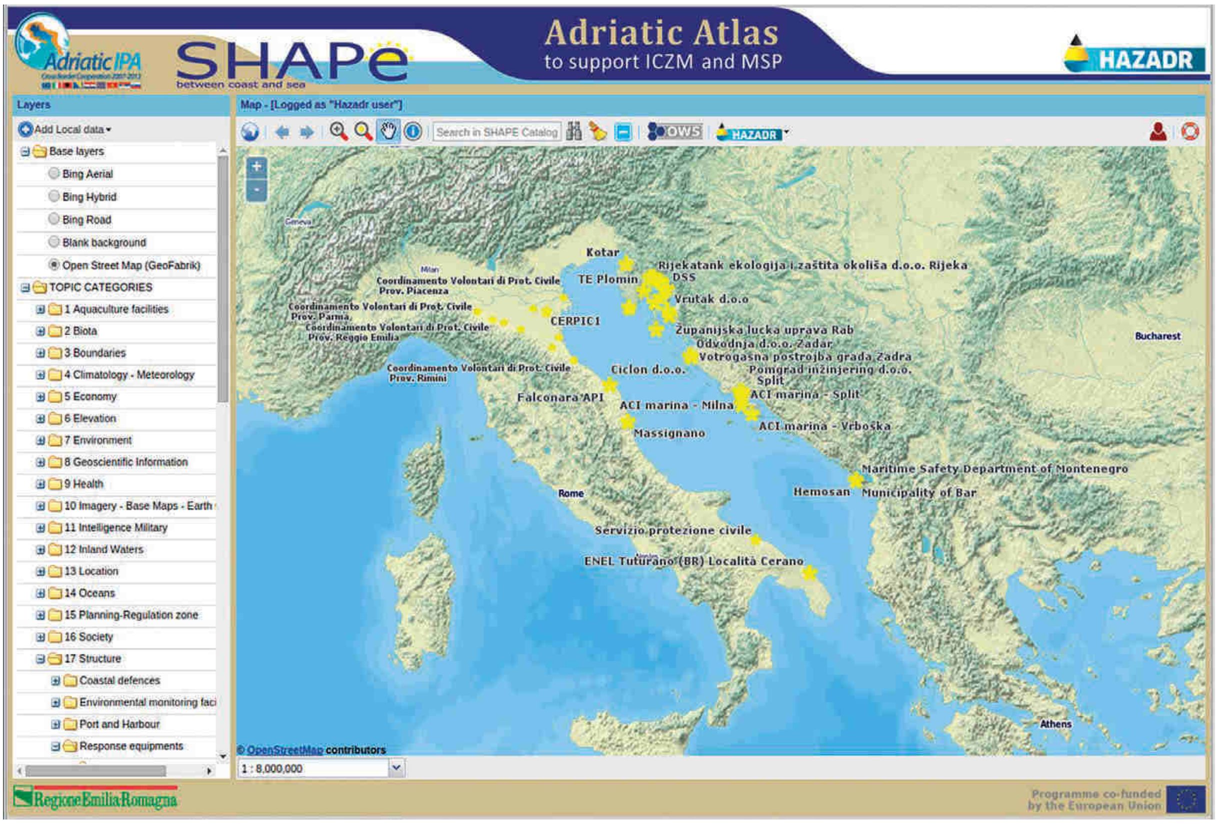


Figure 14. Displacement of floating booms in Adriatic sea.

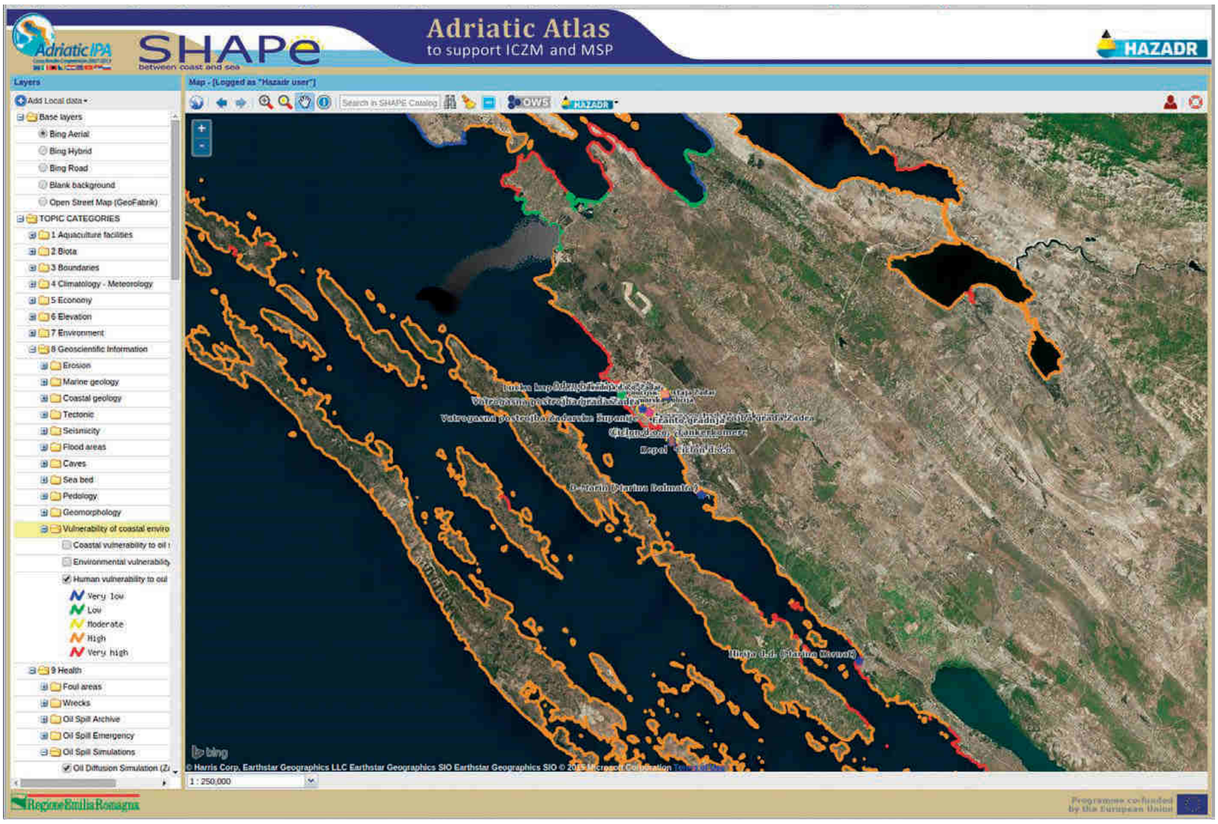


Figure 15. VIREX 2014 exercise. Human vulnerability map intersect the oil spill diffusion simulation (in grey scale in the upper part of the image). Several equipment available are shown with the name of their owner.

5. Pollution response products: quantity and owner of dispersants, washing agents, demulsifiers and bioremediation agents;
6. Personnel equipment: quantity and owner of personal protective equipment and personnel decontamination equipment.

One document explaining the possible techniques, associated to pictures of equipment to facilitate the comprehension of the questionnaire, was furnished to each partner in charge to collect the information about the response equipment in his area of competence.

Within the ATLAS, 61 different typologies of equipment were counted and grouped in categories like dispersant, containers, work tools, machinery and others. Additionally, the ATLAS reports and display each equipment's location and the name of the place where to find it. Asking info on the record, it is even possible to know the quantity of what requested. In the Fig. 14, i.e. you can see where floating booms are located in the Adriatic area.

Summarizing, in case of emergency, the ATLAS can show simultaneously the vulnerability of the coast, the displacement of response equipment and the prediction of the oil spill. The Fig. 15 is an example based on the VIREX 2014 exercise in front of Zadar County coast.

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3. THE HAZARD RADAR INFRASTRUCTURE SYSTEM

The High-frequency (HF) oceanographic radars are remote sensing instruments that measure surface currents in an area. The radars can measure currents over a large region of the coastal ocean, from a few kilometres offshore up to 200 km, and are the only sensors that can measure currents over a large area of the ocean. The scattered radar electromagnetic waves emitted to all directions over the sea coherently return, resulting in a strong peak of energy at a very precise wavelength, known as Bragg scattering frequency.
A meaningful part of the HAZADR project concerns the enhancement of the sea and weather surveillance capacity through the implementation of a joint radar monitoring program in two of the most trafficked areas of the Adriatic: the gulf of Trieste, covering a cross-border area between Italy and Slovenia, and the Dalmatian archipelagos, in the central Croatia.
That data will bring new insights into water flows in the Gulf of Trieste and in the middle Adriatic and, by providing inputs about the critical weather conditions and waves forecast, enable more effective reactions and wise decisions to potential accidents and spills.
At this regard, the information processed by the radar joint monitoring programme are ingested into the ATLAS, enhancing the whole system.
This chapter describes the two HAZADR radar infrastructure systems located in the North Adriatic Node (upon the cooperation of the OGS – National Institute of Oceanography and Experimental Geophysics of Trieste and the NIB – National Institute of Biology of Piran) and in the Central Adriatic Node (by the IOF – Institute of Oceanography and Fisheries of Split).

3.1 THE HAZADR RADAR INFRASTRUCTURE SYSTEM – THE NORTH ADRIATIC NODE

Simone Cosoli / Branko Cermelj

The High Frequency (HF) radar infrastructure in the Gulf of Trieste provides high-resolution maps of current, waves and winds in the region for the HAZADR project. It constitutes the observing node for the north Adriatic region, is part of a wider observing network that comprises a second observing node in the Split region, and is also part of a great number of HF radar networks being developed world wide for coastal ocean monitoring. HF radars measure surface currents in the first top meter of the water column, can provide directional wave measurements and maps of winds at the ocean surface. At the time of writing only surface current data are provided in near-real time in the form of standard format files and maps. Those data and, additionally, directional wave and wind are being available on a dedicated server.

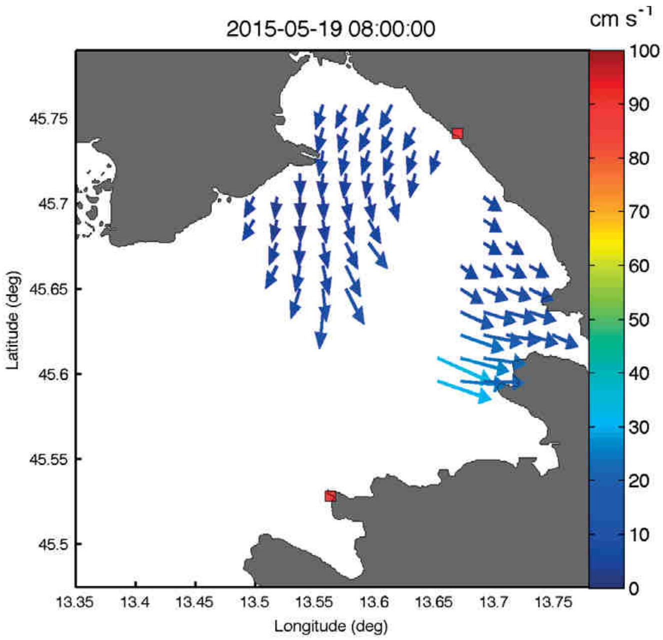
Since the earlier experimental studies that interpreted propagation and reflection of the electromagnetic radiation over a rough sea in terms of the Bragg scattering effect [1], technology evolved to the point that High-Frequency (HF) radars are products deemed essential in multi-platform ocean observing systems at a regional, national and global level [2]. HF radars can map sea surface currents well beyond the horizon over a wide variety of spatial and temporal scales (03-3 km; 3-10 minutes to 1-3 hours), using limited amount of transmit power, in all weather conditions and environments, while some limitations to their capabilities may occur due to external interferences.

Geographical settings, oceanographic background and characteristics of the HF radars installations

The Gulf of Trieste is located in the northeastern corner of the Adriatic Sea, a semi-enclosed and elongated basin located in the northernmost part of the Mediterranean. Waves are low and surface currents are generally weak, and their typical magnitudes are comparable the uncertainty levels of a typical HF radar. However, they are important as they present large variability especially under the passage of meteorological fronts that enhance or invert the local circulation patterns, or quickly build up significant waves following the wind pulses, they present significant vertical stratification from either from the seasonal stratification or from increased freshwater discharges from the major rivers in the region.

A HF radar network composed of two German WERA radars has been installed as part of the HAZADR project in the Gulf of Trieste. It, is composed of two stations with a FMCW modulation 4 antenna transmitter, and a receive array of either 12 antennas (as in Piran), or a shorter 8-element RX array as in Trieste (Aurisina). Surface current maps in the Gulf are derived on a measurement grid common to the two radar stations, however sectors where some geometrical constraints are not satisfied are flagged and removed due to the high Geometric Dilution Of Precision (GDOP) errors. An example of the surface current maps is given in Figure 1, showing the radar network geometry (red squares in the map), and where surface currents are depicted as vectors showing direction and magnitude (the latter, color-coded accordingly to the speed).

Figure 1. Example of surface current map and radar installation sites marked as red squares.



The setup

Due to scarce space available in the urban area around the Gulf of Trieste, both system are setup in a non-standard way, making use of the best out of the municipal infrastructure available, however satisfying all technical demands. The Piran radar is located on the top of the steep cliff on the northern side of the city of Piran, close to the St. George cathedral. This is an area of high archeological importance, but it is also one of the few areas along the Slovenian coast that offers a view over the whole Gulf of Trieste. The cliff itself is a natural barrier dividing the small Bay of Piran from the rest of the Gulf. The receiving antennas are hidden within the fence situated on top of the cliff (Figure 2) that was specially reconstructed for this purpose.

A special arrangement for the transmitter was made to ensure measurements both in the small Piran Bay and in the Trieste Gulf. One pair of the transmitting antennas is settled bellow the vaults of the St. George Cathedral facing northward. This pair transmits the signal northward. The second pair of transmitting antennas is placed on the roof of the Piran city theatre and is transmitting the signal toward south, over the Bay of Piran. The receiving antennas alternately receive both backscattered signal and discriminate one from the other. A small container placed aside the fence contains the radar electronics.

The receive antennas for the Trieste (Aurisina) radar system is setup on the roof of the OGS headquarter in Santa Croce, close to the coast, while the 4-antennas transmitter is located 300 m to the northwest of the receiver, within an area protected from public access to reduce vandalisms. Special arrangements were taken during the setup of the transmitter element, so to maximize its directivity and minimize impacts. The radar electronics is hosted within a dedicated room in the building.

Figure 2. The receiving antennas are masked within the protecting fence on the top of the clif.

Radar data production and visualization

Surface current maps are created at 30 minutes temporal resolution both in Piran and in Trieste. The standard procedure is followed in Piran using the radar manufacturer software, which derives the surface current maps in near-real time mode converts them in a standard netcdf format and provides quality-control flags. In Trieste, a set of MATLAB scripts that performs a preliminary quality-control based on signal-to-noise ratio, geometrical

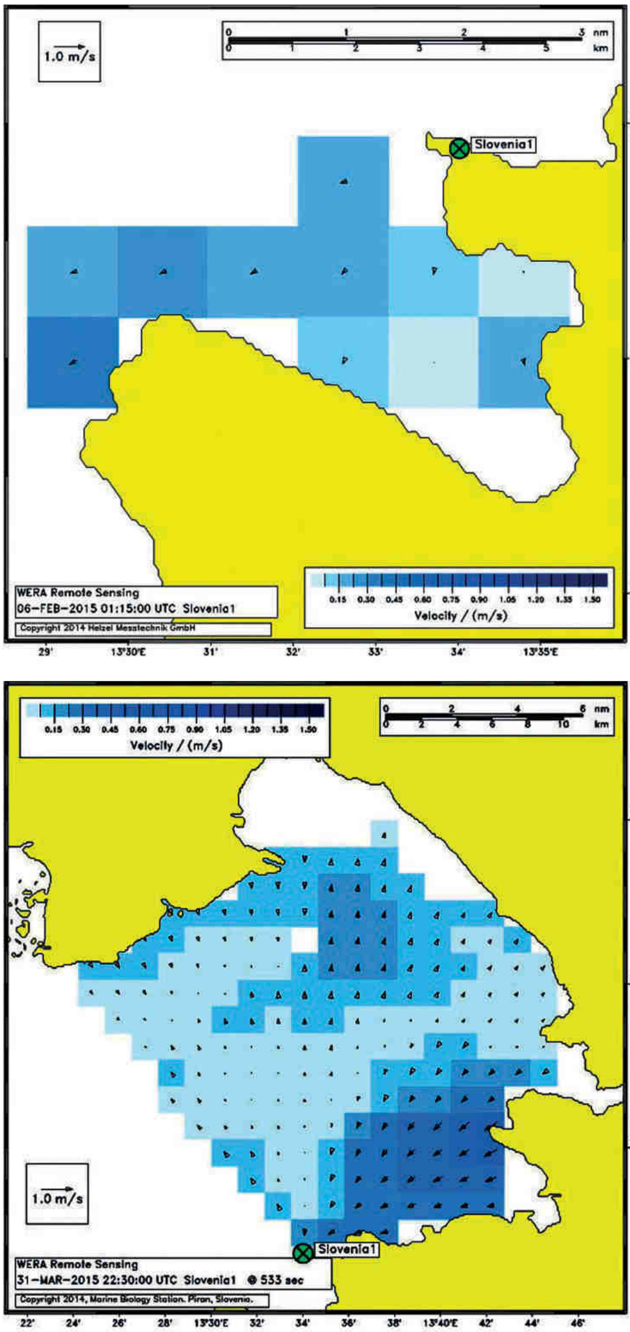


Figure 3. Both areas, the Gulf of Trieste (left) and the Bay of Piran (right) are thus covered by the radar signal (shown are the radial components).

Figure 4. The biochemistry and biology laboratories within the Oceanography Section are located at the Santa Croce headquarters.

constraints and velocity thresholds on radial currents from each station, is responsible for the creation of the vector maps and their archiving on a local server at OGS, and the conversion in standard netcdf format for further publication on a THREDDS server, which will be accessible in a near future as part of the HAZADR project.

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3.2 THE HAZADR RADAR INFRASTRUCTURE SYSTEM – THE CENTRAL ADRIATIC NODE

Vlado Dadic

A pair of HF radars have been installed in the middle Adriatic within the frame of the HAZADR project, at Cape Ražanj, island of Brač, and Cape Stončica, island of Vis. The HF radars are of WERA type, manufactured by Helzel GmbH (http://www.helzel.com), operating on 27 MHz frequency and covering the area of about 40x40 km with spatial resolution set to 1.5 km (Fig. 1). The installation was carried out during early months of 2014, when the Institute of Oceanography and Fisheries (IOF) team did the installation of the equipment at both sites (Fig. 2), with the help of research vessel Bios Dva.

The spatial operational coverage of the data availability between March 2014 and June 2015 is also displayed in Fig. 1. The HF radars have been working almost continuously till today, except for a few months in early 2015, when the libeccio storm of the decade broke the installation at the coast near Cape Ražanj, pulling multi-tonnes boulders along the beach and HF radar installations. However, the repair of the equipment was done quickly as the IOF team was quite skilled and trained for such kind of hazards.

Figure 1. Operational coverage of the HF radar systems achieved in the middle Adriatic area between March 2014 and June 2015.

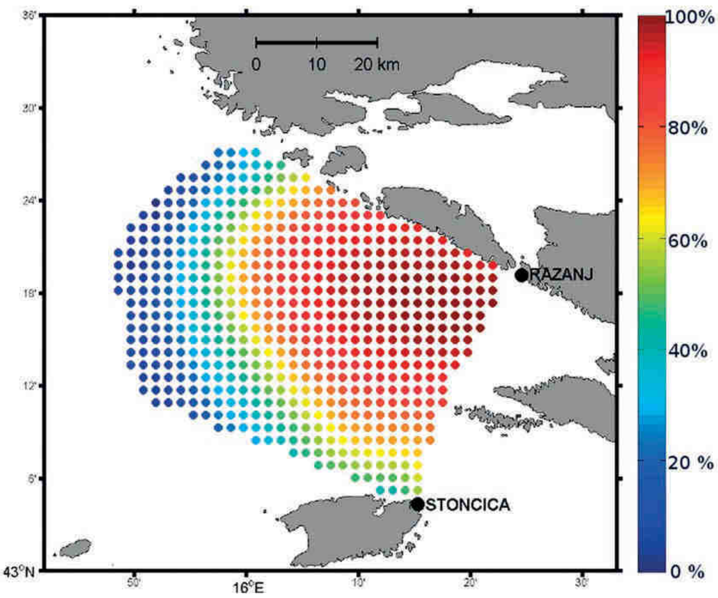

Figure 2. Installation of HF radar antenna at Cape Stončica, island of Vis.

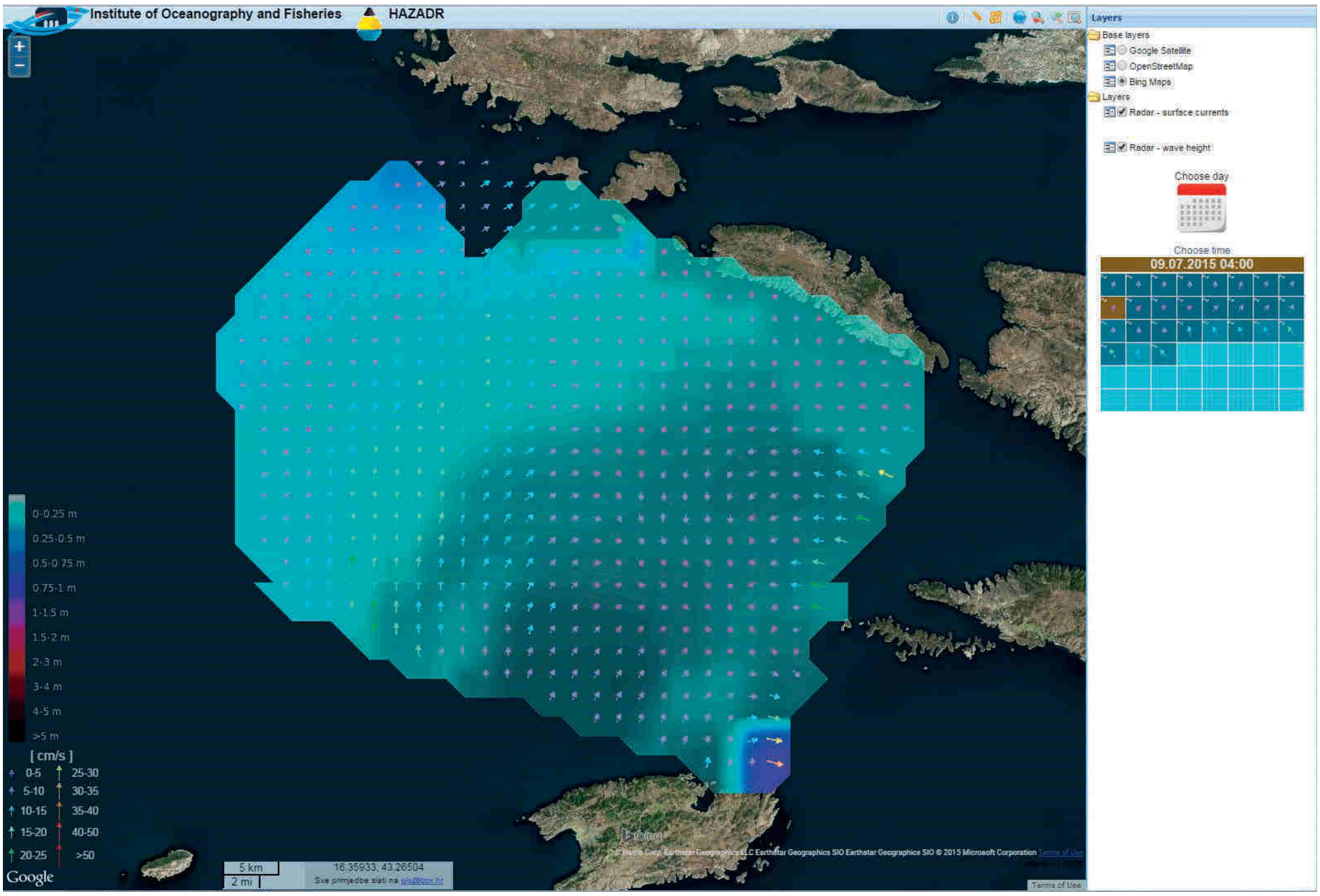

Figure 3. A snapshot on the surface current and wave field at the HAZADR webpage.

A snapshot of the measurements from the HAZARD webpage is presented in Fig. 3.

The WERA HF radars also measure ocean surface waves (height and direction), all of them available for the area of middle Adriatic.

The radar system is operated from the operational centre located at the IOF, where the HF radar data are being acquired, processed and archived. The acquisition of the data is performed in real-time through GPRS connection, every 30 minutes, followed by automatic quality check and processing of the data to get surface current fields, which are visualized at the HAZADR website (http://jadran.izor.hr/hazadr/index_eng.htm). The data have been stored in the MEDAS database of the Institute of Oceanography and Fisheries, available for a variety of users, including research analyses and operational purposes as demanded from the disaster managing services and others.

The acquired data are a necessary compound of the NEURAL project (www.izor.hr/neural), which has an aim of creating operational forecasting surface current forecast based on measurements of HF radar data, forecasts of surface winds by the operational weather prediction mesoscale model, altogether processed by a kind of neural networks, Self-Organizing Maps (SOM). The NEURAL project, executed in parallel with HAZADR project, provides an innovative use of HF radar data and ends with an operative product which may be of help for decision makers and hazard mitigation agencies for a number of applications, like safety of navigation, rescue missions at sea, oil spill tracking and modelling, verification of ocean numerical models, etc. The example of 16 characteristic currents patterns derived by training the SOM using low-passed currents (33 h low-pass filter, to eliminate high frequency oscillations in current field) can be seen in Fig. 4. Temporal evolution of patterns enables deeper insight in different current regimes in the area (Fig. 5).

In particular, HF radar data have been found useful for tuning numerical ocean models to obtain better performance and reliability. Ocean numerical models are essential in assessment of any dynamical phenomena in the ocean, therefore serving as a crucial ingredient to the operational oceanography services. Moreover, the dynamics is an essential component for investigations of biogeochemical properties and processes in the ocean. For that reason, the importance of HF radar measurements is being raised in a number of applications and investigations relevant to the ocean and ocean issues.

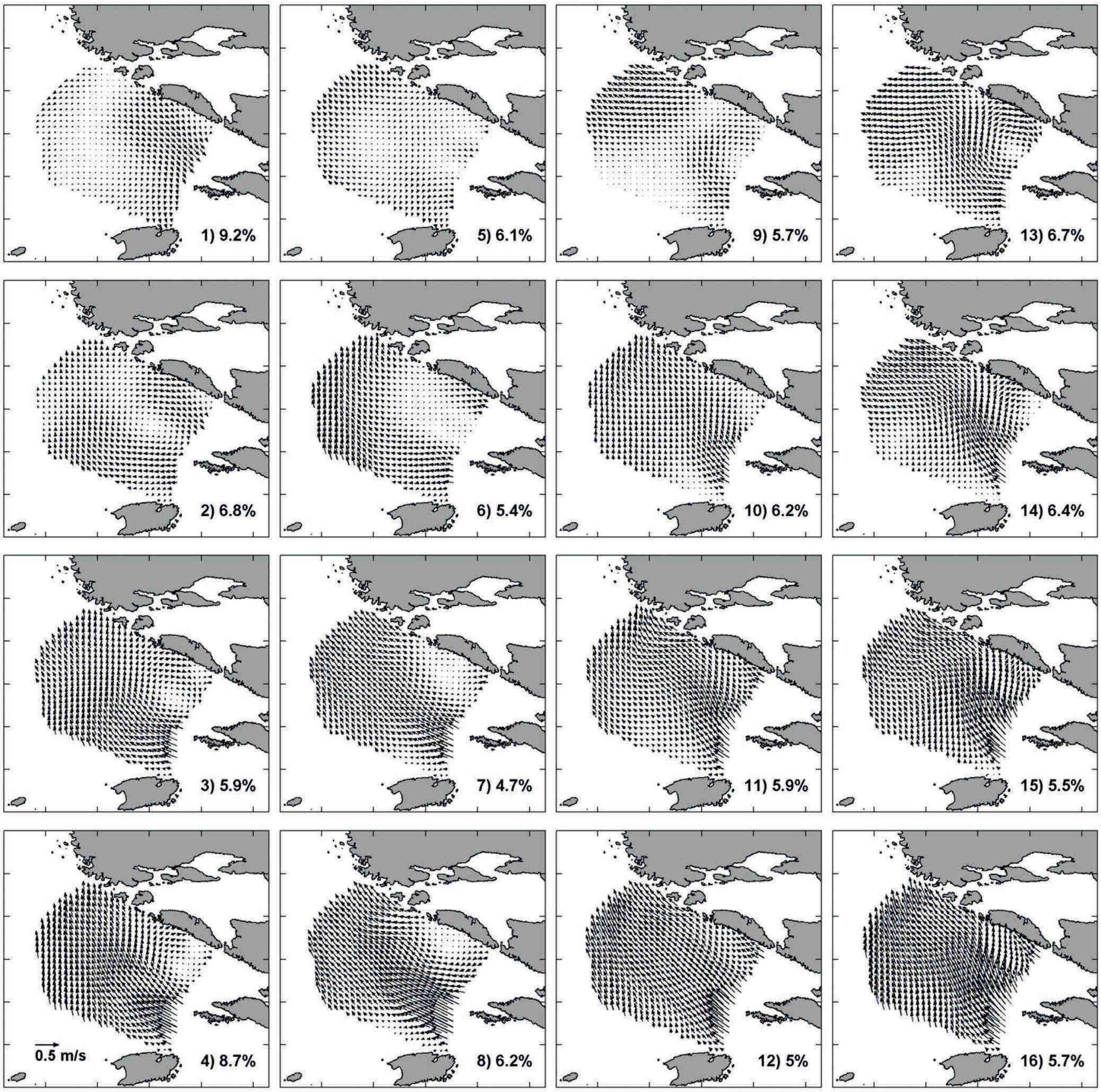

Figure 4. Sixteen characteristic patterns extracted by the SOM using low-pass filtered current data from 1 March 2014 to 15 June 2015.

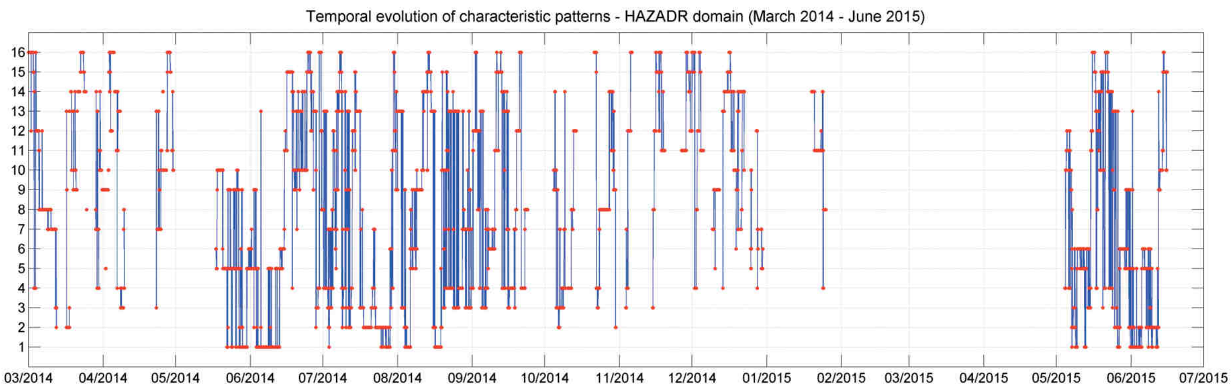

Figure 5. Temporal evolution of characteristic SOM patterns. Temporal coverage of the radar measurements till 15 June 2015 is also visible here, with the largest gap between January and April 2015.

4. ENHANCING THE OIL SPILL JOINT RESPONSE CAPACITY AT COAST

Three interregional and cross-border incident management exercises were implemented under the umbrella of the HAZADR project between May 2014 and May 2015 in three different Adriatic zones (Zadar, Falconara, Brindisi-Durres).

The purpose of this central part of the HAZADR project is to provide common guidance on the planning and conducting of exercises designed to evaluate a wide range of oil spill contingency plans and to train the personnel involved.

In specific, VIREX, ERCOLE and PAM-EX aimed to demonstrate the effective achievement of the main objective of the project HAZADR: the creation of a cross-border network for the prevention of risk and emergency management, with the strengthening of a common reaction capacity of the Adriatic Regions and Counties against environmental and technological risks arising from collisions, wrecks and accidental releases of oil or toxic material at sea. All this in order to reduce the risk of pollution and contamination of the Adriatic Sea and accelerate the deployment time of interventions at coasts.

Furthermore, the exercises represented a privileged opportunity to validate the potential of the ATLAS system associated to the oil spill forecast system (Oil spill FSS) as facility to support the management response in case of coastal pollution. It was also an opportunity to test the purchased equipment such as skimmer and booms to contain and remove pollutants and to test the preparedness of the staff.

Each exercise consisted in four steps: designing, developing, conducting and joint reviewing.

The benefits of exercises are many. Response teams are provided with the opportunity to practice skills that will be required in an emergency, to work together closely, and with foreign colleagues, and develop relationships, and to make complex decisions under stressful circumstances. Plans, equipment and systems were tested and, with proper feedback, recommendations made for their improvement. Furthermore, one environmental monitoring protocol related to site samplings in case of oil spill beaching was conducted by an international team. VIREX, ERCOLE and PAM-EX also allowed the public, media and key local organizations to observe and participate, while the national, regional and local policymakers could demonstrate their commitment to managing the risk of oil spills and protecting the environment across the Adriatic coastal zones.

4. VIREX 2014. THE FIRST CROSS-BORDER RESPONSE EXERCISE

Darko Domovič

Introduction

Zadar County was responsible for organizing the first cross-border oil spill response exercise in the Northern Adriatic): a crucial phase for the HAZADR project, since the simulation has represented a technical baseline of the human and organizative capacities in case of oil-spillage at coasts. An overall goal of the exercise was to test the operational preparedness and to improve cooperation and to adjust and harmonize the work of operational personnel, and especially the response of teams included in the implementation of national and regional contingency plans. Moreover, the first calibration of the Oil Spill Forecast Supporting System (Oil spil FSS) developed in the frame of the ATLAS.

For preparing the scenario for the envisaged oil spill response exercise in the Northern Adriatic and for organizing and conducting the exercise Zadar County engaged OSEC d.o.o., a company specialized in training and consultancy in the field of accidental marine pollution preparedness and response. The contract for the execution of these tasks was signed in December 2013, the preparatory activities for the Exercise started in January 2014 and were finalized in May 2014 with the conducting of the exercise at sea and on shore near Zadar.

The exercise, which was named VIREX 2014 in order to reflect the fact that it was planned to start with a fictitious shipping incident in the Sea of Vir (*Virsko more* in Croatian), was conceived as a comprehensive (alerting, incident management, use of equipment at sea and on shore) exercise designed to check response preparedness in the event of accidental marine pollution. In consultation with the relevant authorities in Zadar County responsible for the implementation of the County Contingency Plan (CPC), the competent national authorities responsible for the implementation of the National Contingency Plan (NCP) and the envisaged participants in the exercise, it was agreed to organized VIREX 2014 at sea around Vir (*Virsko more*) and on shore in the area near Zadar between 14 to 16 May 2014.

Following the agreement between the Croatian participants in HAZADR project and the Ministry of Maritime Affairs, Transport and Infrastructure, Republic of Croatia, and with the consent of the Project Steering Committee, it was decided that VIREX 2014 exercise would also serve to check the functioning of the Croatian national response preparedness system in case of accidental marine pollution by oil.

The programme of activities for VIREX 2014 was prepared jointly by the Exercise organizers OSEC d.o.o. and the staff of Zadar County in charge of HAZADR project implementation.

Purpose of the Exercise

The purpose of the Exercise was to check the mechanisms for alerting, information verification, deciding on response measures and management of oil clean-up operations at sea and on shore, the capacities for joint operations of response teams from multiple counties, as well as the use during the decision making process of data obtained from tools developed within HAZADR project. An additional purpose was to determine the need for additional oil spill response equipment which could be obtained through the HAZADR project funding.

Objectives of the Exercise

In consultation with all parties involved, the following general objectives were set for VIREX 2014 [▸Figure 1]:

- to check the possibility of cooperation between Croatian counties and Italian regions in the event of marine pollution;
- to improve the cooperation and coordination of operational staff, especially response teams;
- to check the command structure of Zadar County and the national contingency plans;
- to achieve adequate flow of information, especially between response teams taking part in joint response operations;
- to check the equipment and acquire experience in handling the equipment, products and other tools used in the containment and removal of pollution at sea and on shore;

Figure 1. Response teams on site: vulnerable seashore area protected with floating booms and booms positioned in J-formation for collecting oil with skimmer.

- to train command personnel (members of COC and the Headquarters) in the process of situation assessment, forecasting its development, making decisions concerning response and commanding clean-up operations;
- to analyse procedures in case of activation of County and National Contingency Plans.

A series of special objectives were also defined and these reflected the need to check certain practical aspects of decision making process and response management in case of major marine pollution emergency e.g. functioning of the communications system, setting up an Operational Centre, verifying information, assessing the situation, reporting, anticipating the development of the situation, assessing the impact of pollution, assessing the cost of response, checking cooperation between public and private sector, and between the competent regional departments in the neighbouring countries, etc.

With a view to achieving these objectives OSEC d.o.o. prepared and elaborated a draft Exercise scenario, which was subsequently discussed and agreed upon with the competent departments of the Ministry of Maritime Affairs, Transport and Infrastructure of the Republic of Croatia and coordinated with the County Operations Centre (COC) of Zadar County.

Outline of the Exercise scenario

VIREX 2014 was based on a fictitious incident of MV Marko Polo (a passenger/Ro-Ro ferry) running aground at 12.00 on 14 May 2014 on Sajta shoal (lat: 44°11’00’’ N; long 015°02’00’’ E), with a loss of some 250 m^3 of bunker fuel, polluting the sea in the area and subsequently the shore in Zadar county.

After receiving and confirming the information on the incident the Zadar Harbour Master calls County Operations Centres (COC) and starts managing the pollution response. COC sets up the Operations/Control Room in the Zadar County (ZC) building, and subsequently notifies and alerts into the state of readiness locally available spill response resources.

After receiving a report from the Zadar HMO patrol boat’s COC assesses the situation and dispatches to the spill site a fast spill response boat equipped with floating booms and a skimmer, an auxiliary vessel and a PFD Zadar fireboat, which start containment and recovery operation using a boom in U-formation and a skimmer.

Upon receipt of the weather report and forecast and additional data on spilled oil characteristics and quantity COC addresses by the relevant Oil Spill Information form a formal request to the Adriatic Coast Control Room of Marche Region for the forecast of

Figure 2. Press conference led by Croatian National Operational Centre's Commander; presentation of oil spill movement predicted by oceanographic model made by Marche Region

oil spill movement and behaviour derived from the Oil Spill Forecast Support System in Ancona (Italy). The requested forecasts is subsequently received, indicating that the following day a part of the oil spill would reach the coast around the village of Zaton, NNW of Zadar.

Due to a slow progress of recovery operation COC orders anti-pollution boat on scene to prepare for dispersant application in order to reduce the amount of oil which is expected to hit the shore, and after assessing the received reports (a) requests the authorization to use dispersants, which is subsequently granted, (b) informs MRCC Rijeka that the size of the spill exceeds the response capacities of Zadar County, and (c) requests from the COCs of the neighbouring Counties assistance in the form of vessels, equipment and manpower.

After receiving the authorization the application of dispersants starts in the late afternoon and continues until all available dispersant on board is used.

Following the request of COC the Civil Protection Department of Apulia Region in Bari provides (a) an assessment of the sensitivity of the coastal area expected to be affected by the spill and (b) information on the type and quantity of equipment available in the neighbouring counties, using the ATLAS developed under HAZADR project.

MRCC Rijeka informs COC that the following morning Primorje-Gorski Kotar County, Šibenik-Knin County and Split-Dalmatia County will provide the requested assistance in the form of cleaning vessels, equipment and trained personnel.

After all dispersant has been used, COC instructs all response vessels to return to their bases and prepare to resume clean-up operations at sea the next day.

In the evening COC draws a plan for response operations at sea and on shore for the following day, which is based on the forecasts received from Marche Region, sensitivity assessments received from Apulia Region and information on equipment available as assistance from the neighbouring counties [▶Figure 2].

In the morning of Thursday, 15 May 2014, the air surveillance report confirms the predicted arrival of oil on shore. COC continues directing response operations. Due to the lack of dispersants, the mechanical recovery of oil at sea resumes in the vicinity of the polluted shores, as well as protection and clean-up of already affected shoreline. Operations are carried out using the equipment and personnel received from the neighbouring countries.

Exercise activities at sea and on shore are terminated at around 12.00 hours, when COC confirms that response operations at sea and on shore have reached a routine stage.

COC continues its work by estimating the envisaged duration of clean-up operations at sea and on shore, and estimating the total cost of the overall operation. It requests the competent authorities to make an urgent decision on the location of temporary storage of oily materials collected during clean-up operations on the shore.

Participants, Observers and Control Team

The entities that were envisaged to actively participate in the Exercise included: Zadar County COC, Croatian National Maritime Rescue Coordination Centre in Rijeka (MRCC) *(if so requested)*, Primorje-Gorski Kotar County COC *(if so requested)*, the Headquarters for the implementation of the (national) Contingency Plan of the Republic of Croatia *(if so requested)*, Response teams from specialized companies and public services of Zadar, Primorje-Gorski Kotar, Šibenik-Knin and Split-Dalmatia Counties (Ciklon, Zadar; Dezinsekcija, Rijeka; Cian, Split; Harbour Master's Office, Zadar; Maritime Police Station, Zadar; Public Fire Department, Zadar; Public Fire Department, Šibenik; National Protection and Rescue Directorate, Regional Office Zadar, General Purposes Unit Nin; Croatian Coast Guard; the Croatian Air force), and the personnel from specialized institutions from Italian regions of Apulia and Marche *(via telecommunications links)* [▶Figure 3].

In addition to the active participants the following Observers were invited and actually attended VIREX 2014 exercise: the representatives of HAZADR project participants from Istria, Primorje-Gorski Kotar, Zadar and Split-Dalmatia Counties, Italian regions of Apulia, Marche and Emiglia-Romagna, as well as the Albanian and Slovenian partners, the representatives of administrative bodies of Zadar County in charge of environment protection, protection and rescue, and internal affairs; the representatives of local self-government bodies, and the journalists from the local and national press, radio and television.

The entire VIREX 2014 exercise was conducted and controlled by a Control Team composed of two OSEC d.o.o. staff members and four external consultants engaged by the company.

Instructions for the Exercise

With a view to informing the active participants in VIREX 2014 and the observers on all important aspects of the Exercise the organizers prepared an "Exercise Handbook" containing relevant information for properly conducting and following the exercise, and a more comprehensive "Control Team Manual", which in addition to the information contained in the Exercise Handbook also contained additional information that the Control Team periodical-

Figure 3. Response teams performing clean-up techniques at sea

Figure 4. Response teams performing clean-up techniques on shore.

ly distributed to the COC Zadar to ensure as realistic as possible proceeding of the Exercise. OSEC also prepared an introductory PowerPoint presentation, outlining the key information relevant for properly starting, conducting and following the Exercise, which was presented to all participants and observers before the start of the Exercise [▶Figure 4].

Exercise duration

The total foreseen duration of VIREX 2014 exercise was 3 days, from Wednesday, 14 May 2014 until Friday, 16 May 2014. The active part of the Exercise (starting with the report on the fictitious pollution incident, and ending with the completion of the initial response operations by COC and operational teams) comprised two days, starting at 12.00 hours on Wednesday, 14 May 2014, and ending at approximately 13.30 hours on Thursday, 15 May, 2014 with the debriefing and the press conference [▶Figure 5].

VIREX 2014 concluded with the final debriefing session, held on Friday, 16 May 2014 in the Assembly Hall of Zadar County and moderated by the members of OSEC Control Team. The representatives of Zadar County COC presented a summary report on various aspects of the Exercise as well as their personal observations, which were commented by the representatives of MRCC Rijeka, Rijeka Harbour Master's Office, Primorje-Gorski Kotar County, Istria County, Split-Dalmatia County and the Croatian Coast Guard.

Figure 5. Presentation of the exercise to the Croatian national and regional Authorities.

4.2 ERCOLE 2014. THE SECOND CROSS-BORDER RESPONSE EXERCISE

Leonardo Balestra / Alberto Cecconi / Roberto Cingolani / Gabriella Gigli / Giorgio Severini

Introduction

ERCOLE, acronym of “**E**mergency **R**esponse to **C**oastal **O**i**L** spill **E**xercise” is a manifold exercise needed to test the current models and oil spill forecasts (Oil spil FSS), the coastal management response mechanisms, the use of equipment and the application of different cleanup techniques on shoreline. The exercise, implemented in the framework of HAZADR, was organized by the Marche Region through the “Protection of the Sea Unit” and by Civil Protection Department of Emilia-Romagna region, with the participation of some international partners as “observers”. The exercise is designed to check the cross-regional response preparedness of coastal authorities in case of coastal pollution.

Presentation of the exercise and media /press conference

A press conference was organized to present the exercise, on Monday September 22nd, at 12.00 am. MEDIA were invited to the presentation of ERCOLE. The press conference allowed the press to address direct questions to the participants involved in the exercise.

The day after, on the 23rd September 2014 at 05:30 pm, the technical presentation of ERCOLE took place. The scenario was illustrated to all partners during an informative meeting in the hall of Li Madou Palac, during which the officers of the “Protection of the Sea Unit” of Marche Region and those of the Civil Protection Department of Emilia-Romagna region illustrated all details concerning ERCOLE.

On the 24th September, the MEDIA were invited to report the response operations at sea and on shore at 10.30 am hours in front of Villanova’s beach, where a control room was organized to show the particular technological instruments to be used during the exercise.

Purpose of the Exercise

The exercise was designed to check the alert response and preparedness mechanisms in case of accidental coastal pollution and to test the capacity of the special instruments to support the decision makers and to guide the beach teams on the field.

Figure 1. The work area of Villanova .

Objectives of the Exercise

In consultation with all parties involved, the following general objectives were set for ERCOLE 2014:

- to check the efficiency of the coastal response system in case of oil spill along the coast;
- to check the coastal monitoring system IMSA (Integrated Monitoring System Adriatic) in the Marche region area;
- to improve the coordination between ACCRA (Adriatic Coastal Control Room Ancona) and the response teams along the coastal areas;
- to check the equipment and acquire experience in handling it

as well as the products and other tools used in the containment and removal of pollution on shore;

- to verify the capacity of coordination between different regions (in particular with Emilia-Romagna) in the perspective of larger hazards that might require intervention by civil protections from neighboring regions or countries;
- to improve knowledge of technology which can be used along the Adriatic coast;
- to share assessment principles and methodology among partners of the entire Adriatic Region.

Furthermore, the ERCOLE 2014 was extremely useful to address guidelines and technical recommendations for all partners involved in HAZADR, as it helped assessing:

1. the oil spill forecast system (Oil spil FSS) as facility to support the management response in case of coastal pollution;
2. the speed and appropriateness of response teams' interventions on shore;
3. the cleanup operation processes;
4. the potentially weak points in the response strategy;
5. the type and quantity of equipment that should be stocked for adequate response on shore.

Outline of the Exercise scenario

On the evening of 23rd September 2014, a fictitious accident took place at sea, at approximately five miles off the coast of Falconara Marittima. So, the exercise began with the report of an oil spill at sea at approximately 06:00 pm. The notification consisted in a dispatch launched by the Coast Guard to ACCRA: *"a relatively large quantity of crude oil has leaked into the sea"*. Maritime Authorities put in place all appropriate actions to control the pollutant at sea. The vessels and the task force rushed to the area to collect as much oil as possible. After that phase, the Marine Authorities announced that 500 cubic meters of crude oil were still dispersed and, pushed by the currents, they were about to reach the coastline. The information provided by Marine authorities about the coordinates of the spillage point were:

Lat. 43° 40' 06" N Long. 13° 31' 21" E

They also sent information about the appearance and the concentration of oil at sea.

ERCOLE can be distinguished into two parts: the response preparation (monitoring activities, oil spill forecast support system) and the operational activities. About the latter, the operational activities – that started with the decision to organize the work area till the declaration of end of alter and closure of the operations – took approximately 9 hours (from 06:00 am to 02:00 pm 24th September 2014). The cleanup activities related to the accident included the mobilization and deployment of real equipment including skimmers, booms, high pressure pumps, concrete mixers etc. [▶Figure from 2 to 5].

After having received the information, the Marche Region activated the IMSA (Integrated Monitoring System Adriatic) and, in particular, one of its components: the ATLAS carried out by HAZADR and available at www.atlas.shape-ipaproject.eu. As knows, this instrument is a DSS (Decision Support System) useful to support land government authorities, such as Municipalities, Regions, Counties, to recognize coastal risk exposure and improve the fast coastal responses. Therefore, the ATLAS was test whilst ERCOLE was running to assess its functionality. In particular, the oil spill Forecast Support system (Oill spill FSS) was put in operation to obtain the trajectory of the spillage and the impact point along the coastal areas.

This mathematical model was able to predict the stranding of the crude oil along Villanova's shoreline (area of Falconara Marittima – Ancona) at approximately 10:30 am of the 24th September. On the basis of this information the Unit "Protection of the sea" decided to organize an immediate response along the coast. This consisted in the preparation of a work area at the site identified by the mathematical model. The oil was thus beaching al Villanova beach on the morning of September 24th.

Before beginning the shoreline cleanup activities, a survey team carried out a ground check. The data, collected by the shoreline survey team, were noted in the SCAT assessment form (Shoreline Cleaning Assessment Technique). This data is of primary importance as they are useful to define the scale of the oiling, to establish shoreline protection priorities, to develop treatment objectives, to define priorities of intervention, to provide specific instructions to cleanup teams and to provide overviews of the spill response status. After the survey activities, the OSC (On Scene Commander) based on data analysis activated the response which consisted in carrying out shoreline clean-up techniques. The technology adopted was going to be different according to the characteristics of different polluted substrates presented on Villanova's beach: such as sand, granules, pebbles, and riprap barriers. Four different teams applied the appropriate clean-up techniques and the related procedures in each substrate's context. The techniques and procedures implemented were naturally suitable to the characteristics of the polluted area. The first team worked on a sandy beach, the second on a granule beach, the third on pebbles, the fourth on riprap barrier.

The clean-up activities aimed to limit the spreading of pollution and ecological impact through reducing the duration of oil contact with the environment. During this exercise a fifth team deployed the floating booms to catch the clean-up effluents and used a skimmer (a four drums separator) to recover hydrocarbons on the water surface. This tool is very important to handle oil spills along coastal areas, in particular behind artificial protective barriers (riprap). In these areas the floating booms trapped the effluents and the skimmers recuperated hydrocarbons on the water surface.

The decontamination phase was well prepared to emphasize this aspect. At the end of the operational cycle the operators had to pass through the decontamination station to clean up all equipment used and to wash themselves. The area was isolated from

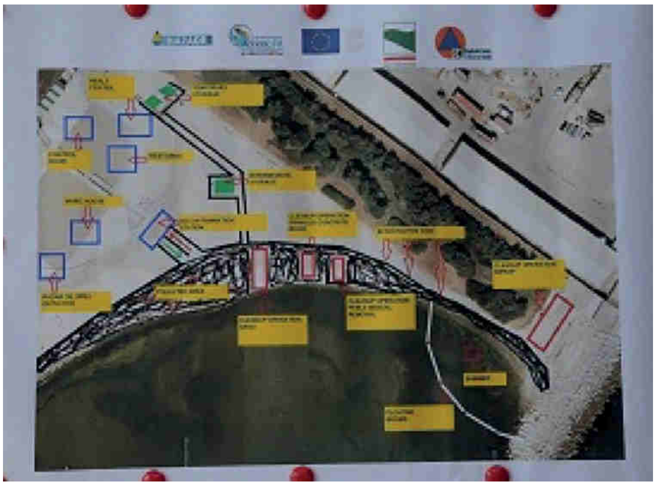

Figure 2. Organization scheme of the exercise beach.

Figure 3. Manual cleanup of pebbles.

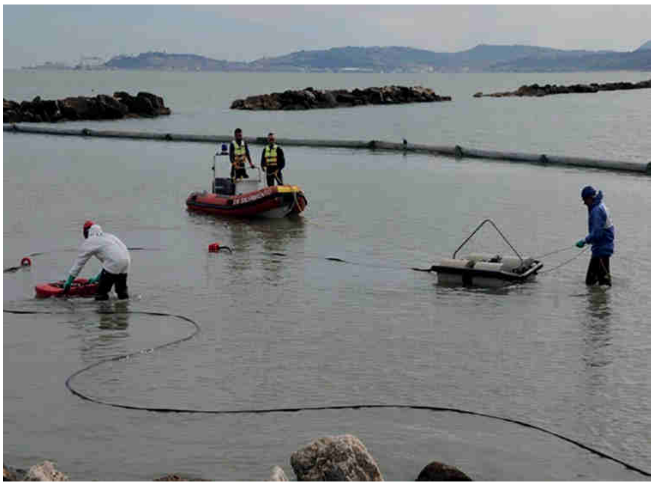

Figure 4. Containment boom and skimmer used to recover hydrocarbons on water surface.

Figure 5. High pressure cleanup of riprap barrier.

the soil with a plastic film. Another team provided to decontaminate all operators by using two tanks filled with solvent and detergent liquid, and with the aid of pressured water.

The technological support to the teams was guaranteed by an information system in the area. All coastal operations in fact were supported by IMSA, a combined and integrated system which uses different technologies. In particular IMSA is composed by a set of cameras that provide images of the shoreline, and some mobile devices that provides images of the oil spill (MAR.M.MO system). An “oil spill detection” radar surveyed the spillage. The FSS had predicted the oil spill’s movement and the AIS (Automatic Identification System) surveyed the position and the environmental reliability of ships in the Adriatic Basin. A control screen was set up close to the working area, to view all data and control all processes and verify the performance of the entire system.

The access to the exercise area during on-field activities was restrained. Due to spatial constraints and in order to avoid any unnecessary disturbance during the exercise, the number of persons allowed into the working area was limited. The police department of the Municipality of Falconara Marittima ensured this aspect.

Personal safety during the ERCOLE exercise is of paramount importance. All people involved in the exercise were equipped with the appropriate PPE (Personal Protective Equipment) according to operations and movement of personnel during the exercise regulations. The environmental care is always a priority in this exercise. During the organization and the implementation of ERCOLE, all necessary actions and precautions are used in order to protect the area and to reinstate the shore to its original condition prior to the exercise. After the conclusion of the trial all polluted material was sent to special treatment facilities.

The documentation and the recording of ERCOLE is guaranteed by an operator. All stages of exercises were filmed and photographed to obtain a collection of images and movies aimed to gather information held on the coast line. This aspect is particularly relevant to emphasize the methodological approach adopted on the beach.

Participants-observers

The exercise was organized by the Marche Region through the “Protection of the Sea Unit” and by Civil Protection Department of Emilia-Romagna region.

Stakeholders were invited to observe the exercise on order to display the organization of activities and to share different points of view on coastal response. There were:

- representatives of HAZADR project participants;
- representatives of administrative bodies of the Marche Region, in charge of environment protection and civil protection;
- representatives of local bodies such as representatives of administrative bodies of Falconara Municipality in charge of civil protection and rescue;
- representatives of the Coast Guard;
- representatives of National Italian bodies in charge of environmental protection (CNR-ISPRA).

Exercise duration

In total, the exercise took 20 hours from Monday 23rd September 2014 till Wednesday 24th September 2014. The exercise started on Monday 23^{tr} at 06:00 pm and ended around 02:00 pm of the next day [▶Figure 6].

Debriefing

A final meeting and analysis was organized to focus of the main organizative and operational aspects of the exercise. Following the conclusion of the exercise, on the September 24th at 03:00 pm, the Control Team of ERCOLE held a short debriefing at Villanuova’s control room. All the observers and the participants of the HAZADR project and other guests, answered questions. During the debriefing, the results of the day and the details of the activities carried on throughout the exercise were analyzed. Compared to the ERCOLE’s initial scenario, all main objectives were achieved. Nevertheless some interesting aspects arose from the observations of the participants [▶Figure 7].

A. Difficulty in managing the waste. After the examination of the data collected by the shoreline survey team, some specific procedures to set up cleanup activities were adopted. The waste resulting from the application of these techniques is extremely big, making the waste disposal a challenging task.

B. Language barriers between teams of different countries. During the exercise it was tested the response capacity and the coordination capacity of an interregional group (the Marche Region and the Emilia Romagna Region). The coordination of groups of the different regions has been addressed with the constitution of a unique command and control center. However, larger hazards in the Adriatic basin this might require the interventions of civil protections from neighboring regions or countries with the necessity of an enhanced coordination and perhaps an unified command of operations. In this case, the proper understanding among international response teams has to be assured to get an efficient collaboration.

C. Lack of trained volunteers. During the ERCOLE implementation phase, some shoreline clean up techniques were put in place in the pilot site. All techniques and procedures implemented depended on the characteristics of the polluted area. Five intervention teams, four volunteers each, coordinated by a group leader, applied the appropriate cleanup techniques and the related procedures. This means that also the work of the volunteers needs important technical skills. In case of disaster, the involvement of hundreds of trained volunteers should be foreseen, but at present there is a poor availability of an adequate number of trained staff.

D. The coastal response along the Adriatic coast is not well organized. The presence of skimmers able to recover hydrocarbons on the water surface, is jeopardized. For this reason the skimmers must be considered one of the main instruments that should be made available on all coastal areas at all times.

Figure 6. Team involved in the ERCOLE exercise 2014.

Figure 7. The control room of Villanova.

4.3 PAM-EX 2015. THE THIRD CROSS-BORDER RESPONSE EXERCISE

Lucia Di Lauro / Maria Trabace / Elson Thana / Ana Castelli / Nicola Ungaro / Antonietta Porfido

introduction

The exercise PAM-EX (Puglia Albania Montenegro – EXercise) was organized from 11th to 15th May 2015 in the Apulia region (Italy), on a stretch of the beach in the Apani area on the southern border of the protected area 'Natural Reserve of Torre Guaceto (near Brindisi), and in Albania, along the Durres coasts. Three partners, namely the Civil Protection Service of the Apulia Region, the Ministry of Public Works and Transport of Albania and the Institute of Marine Biology, University of Montenegro) were responsible for the organization of this cross border exercise. Alongside the clean-up phase of the exercises, some demonstrative intervention procedures for environmental monitoring in case of pollution at the sea and at coasts were implemented by the environmentalist teams.

The description of the different phases of the PAM-EX are reported in this chapter.

PART 1. PAMEX ON THE APULIAN COASTS

The first part of Pam-ex was organized by the Civil Protection Service of the Apulia Region and was presented at the Palace of the Brindisi Province on 11th May 2015 at 15:00 p.m.

Figure 1. Simulation of the polluted area on the exercise area.

The exercise was done on the morning of 12th May 2015.

The activities involved in particular the local authorities which have territorial jurisdiction and the volunteers of the Civil Protection teams, all together in a simulation of intervention deriving from an oil spill reaching the coast of the Municipality of Brindisi.

The scenario considered an accident involving a vessel offshore the coast of Brindisi, with prohibitive sea and weather conditions. In this scenario, despite the prompt interventions of the dedicated emergency corps, it was not possible to contain the spill at sea and the oily surface that moves slowly, expanding, dividing and taking two directions: one towards Apulia Region and the other towards Albania.

Accordingly, after the simulation of the Apulian's oil spill grounding, the second part of the exercise was held in Durres (Albania) on 15th May 2015: this part of the exercise was organized by the Ministry of Transport of Albania, as coordinator of the Inter-ministerial Operational Unit Albanian, and the University of Montenegro for what concerned the ecological monitoring.

Objectives of the exercise

The objective of the PAMEX on the Apulia coasts was not to carry out an exercise including the offshore activities, which by its nature would see the involvement of the competent structures of the national level. Rather, PAM-EX was thought to assess the synergies built throughout the HAZADR initiative and test the ability of reaction, the use and availability of specific equipment and the ability to act as neighboring organizations whose territory is surrounded by the sea, where a possible oil spill is almost never a problem of one but, more likely, a problem of many.

The exercise on the 12th May 2015 starts directly from the operation on the coast in Apani area: this with the purpose of focusing energies and resources on aspects closely related to the defense and safety of the coast from pollution of hydrocarbons.

It was important to test the operational synergy with ARPA (Regional Agency for Prevention and Environmental Protection) of Apulia Region that applies a specific sampling protocol, developed within the project and the collaboration with the Office of Civil Protection of the Province of Brindisi, the Municipality of Brindisi and the Consortium Management of the Reserve of Torre Guaceto. The large participation of the HAZADR partners was, finally, extremely useful to exchange very practical experiences on the beach clean-up techniques.

Outline of the exercise scenario in PAMEX on the Apulia coasts

PAME-EX was based on a fictitious incident, in particular in the afternoon of 11th May 2015, about at 16:00 pm, a large ship-type "Oil/Chemical Tanker" while sailing to the Ancona Harbor about 20 miles North from the Brindisi coast, had an accident (unspecified) and released a spill of pollutants in the sea [▶Figure 1].

The weather conditions were prohibitive for the containment of the oil spill at sea and therefore the pollution kept expanding to finally split in two main directions according to the sea currents.

The Harbor Authority, which first received the alarm directly from the vessel, activated the Local Operating Plan (POL).

Looking forward to having more precise information and due to the weather condition, in order to prepare in time any preventive measures on the coast, the Civil Protection of Apulia Region, through the use of the ATLAS system acquired more information on the characteristics of the accident area (distance from the coast, wind conditions, wave, current direction, wave height, territorial jurisdiction of the nearest coasts etc.) and on the nearest coasts to be potentially impacted by the polluted waves [▶Figure 2].

At the same time, the Civil Protection of Apulia Region triggered the oil spill forecast system (Oil spil FSS), a mathematical model integrated in the ATLAS, which allows to predict the trajectories of the spilled pollutants in a known point in the sea and indicates the range of costs which might be affected by the oil spill, estimating the time arrival of the ''black wave".

The model, after few minutes, provided a series of useful information to understand the event, including a map of the estimated oil spill trajectories with its projected in hours/days, the coastal area to be primary affected by the crises and the countdown to the beaching. These data are overlapped to the other information layers in the Atlas including the vulnerability of the coastline affected from the spill, its geomorphology, bathymetry, roads to reach the coast and the response equipment stored nearby (and ready to be used).

This is important to give the priority to intervention along the high vulnerability cost, to organize the working area, the dislocation of equipment, staff, means.

The ATLAS then indicated the displacement of oil spill reaching the coast of Brindisi in the area near Torre Guaceto-Apani on the early morning of Tuesday, 12th May 2015, with a possible second oil spill, according to the currents, in the direction of Albania and expecting to reach the Albanian coast in the early hours of Friday, 15th May 2015.

In the morning of Tuesday, 12th May 2015, all the teams arrived on the identified site of the coast (Region, Province, Municipality, volunteers, ARPA, ISPRA, Harbor Master, fire brigades...) bringing the necessary oil spill response stocks.

A survey team, before the beginning of the shoreline cleanup activities, carried out a ground check. The survey team's collected data were recorded in the assessment form **SCAT** (**S**horeline **C**leaning **A**ssessment **T**echnique). Then a preliminary meeting was organized to evaluate the quantity of pollution, to decide the different techniques to use and to organize different teams on the work area [▶Figure 3].

Then the operational activities were kicked off.

Figure 2. Thirty volunteers were divided in groups, each coordinated by a leader group, applying different shoreline clean-up techniques.

Figure 3. A survey team during the ground check. The data collected by shoreline survey team, were noted in the assessment form SCAT (Shoreline Cleaning Assessment Technique).

Figure 4. Technique for the clean-up of the pebbles.

Figure 5. Decontamination station.

Figure 6. Technique for the clean-up of the rocks.

Operational activities on the Apulian coasts

The operational activities started with the decision to organize the work area and ended with the operations carried out by the work/operational teams. The operational activities lasted about 10 hours (from 06:00 am to 15:00 pm on 12th May 2015).

The activities related to accident management included the mobilization and deployment of real equipment such as a skimmer, booms, sorbent booms, high pressure pump, etc..

30 volunteers, divided in groups, were employed, each one coordinated by a leader group, applying different shoreline clean-up techniques for sand, stones, rocks... preventing the spreading of pollution on land, limiting the ecological impact of clean up adopted techniques, using the appropriate techniques aimed to limit the quantity of generated waste. Each staff member has been equipped with PPE. Walking outside the defined paths was forbidden to prevent secondary contamination [▶Figure 4].

According to the program, at the end of the operations the operators were treated within the decontamination station to clean the equipment and to wash themselves [▶Figure 5].

Sampling of the water and the land to check the level of pollution and the effectiveness of implemented interventions were held by ARPA Puglia that drafted a report of the situation to Control Team (see more at part 3 of the present chapter).

Participants, Observers and Control Team on the Apulian coasts

The entities that were envisaged to actively participate in the PAM-EX exercise included: Civil Protection Service of Apulia Region, ARPA-Regional Agency for Prevention and Environment Protection, Brindisi Prefecture, Brindisi Province Civil Protection Service, Brindisi Municipality Civil Protection Service, Consortium of the protected area R.N.S. of Torre Guaceto, Civil Protection volunteers, Fire Brigades, the Brindisi Municipality.

The following Observers were invited and attended Pam-ex exercise: the representatives of HAZADR project participants from Croatia, Albania, Montenegro, the National Department of Civil Protection, the Italian HAZADR partners, namely Marche Region, CNR-ISPRA (Institute for the Protection and Environmental Research), the 'Direzione Marittima' of Bari, the Harbor Master.

The PAM-EX exercise was conducted and controlled by a Control Team composed staff members of Apulia Region [▶Figure 6].

Exercise duration on the Apulian coasts

The total duration of the PAM-EX exercise on the Apulian coasts took 2 days, from Monday, 11th May 2015 until Tuesday, 12th May 2015. The active part of the exercise, starting with the report on the fictitious pollution incident and ending with the completion of the initial response, comprised two days, starting at 16.00 hours on Monday, 11th May 2015 and ending at approximately 15.00 hours on Tuesday, 12th May 2015 (with the debriefing moderated by the staff members of Apulia Region Control Team). The representatives of Apulia Region presented a summary report on various aspects of the exercise as well as their personal remarks.

Communications, instructions and press for PAM-EX exercise on the Apulian coasts

The Operations Centre, located outside the polluted area, was responsible for managing and ensuring the connection of the radio communications between the operational area and other operational staff in situ.

With a view to informing the active participants in PAM-EX and the observers on all important aspects of the exercise the organizers prepared an “PAM-EX Exercise Handbook” containing all the relevant information for properly conducting and following the exercise.

Particular importance was given to press release and MEDIA. Journalists were invited to the presentation of the exercise on 11th May and on the operational area on the 12th May.

Then all the phases of the Exercise have been filmed and photographed from the ground and with a drone.

PART 2: PAMEX ON THE ALBANIAN COASTS

Given the fact that, on the 11th and 12th of May 2015, the pollution initially arrived to the coast of Apani near Brindisi, the Civil protection of Apulia Region took the necessary measures to protect the environment from the pollution. Later on, on the 14th and 15th of May 2015, a part of the spill headed towards the bay of Durres. After the notification by Apulia Region, in this side of the Adriatic the necessary measures were taken according to the Albanian National Contingency Plan.

For the organization of this exercise a working group was set up with representatives from each institution responsible for the response to pollution in implementation of DCM no. 480, dated 25.07.2012. This working group, under the coordination of the Ministry of Transport and Infrastructure, Ministry responsible for the Project, defined the tasks, participants, duration of training, as well as any other technical specification that will enable the implementation of the exercise.

The proposed exercise was created as a simulation of an emergency situation that may occur in the southern Adriatic coast with the conclusion of a large quantity of oil leaking into the sea and with the inclusion of one or more countries of the Adriatic Sea coast.

Figure 7. Oil spill exercise nearby Durres, Albania.

This exercise had as its main objective: verification of the current situation of the response capacities of the institutions that have the obligation to take reactive measures on this ground in the southern Adriatic coast (Region of Durres); identification and exposing the gaps in the coordination of activities and cooperation with the participating national institutions during the implementation of the National Response Plan; strengthening of cooperation and coordination with the neighbouring countries of the region to take more effective response operations within a shorter time [▸Figure 7].

This exercise was carried out pursuant to:

1. OPRC 1990
2. MARPOL 73/78
3. Barcelona Convention;
4. Albanian National Response Plan;
5. Regional Response Plan of Durrës District.

In this exercise they were committed troops and resources from:

- Ministry of Transport and Infrastructure;
- IMOC;
- Durrës Port Authority;
- Albanian Navy;
- Romano Port;
- Durrës City Mayor;
- Police Forces;
- Firefighters;
- Regional Environmental Directory;
- Civil Emergency Forces of Durrës;
- National Inspectorate of Environment;
- Volunteer Centre;
- Public Health Institute.

The chain of command on the Albanian coasts

The chain of command was conducted in full compliance with the Contingency Plan.

- National Commander was appointed the representative of the Ministry of Environment in IMOC. IMOC premises also served as meeting place for monitoring and information collection, processing and provision of the necessary commands.
- On Scene Commander of the operation at sea was appointed the captain of the military navy "Erzeni" who continuously was reporting to the National Commander of the exercise.
- On Scene Commander for the coastline response operations was the representative of Civil Emergencies at Durres District Prefect, who maintained constant communications with the Commander General of the Exercise.
- The representatives of other ministries played the role of collaborator throughout the operation.

Implementation of the Exercise on the Albanian coasts

The exercise was conducted in two directions: response operation at sea and ashore.

a. Response at sea on the Albanian coasts

It was conducted by the Coast Guard ship with "Erzeni" which had on board a boomer with a length of 300 m. For the opening was assisted by a private company ship "Pastrimi Detar". The two ships coordinated the work for the manoeuvring of the boom towards "pollution".

The response at sea was conducted very well, because the Navy effectives already have experience in this field because of trainings and exercises previously developed within the country and with foreign partners [▸Figure 8].

b. Shoreline operations on the Albanian coasts

The shoreline operation was conducted by the forces of the Durres Port Authorities, Albanian Navy, the private company "Pastrimi Detar", as well as the volunteer teams by the Volunteers Centre. It was implemented the determination of qualified commanders, the limitation of the region polluted from the pollution.

Response operation on shore, despite the fact that for them was the first time acting in this type of exercise and had no previous experience, in general was good implemented, following the guidelines and rules laid down in such a case [▸Figure 9].

The exercise time on the Albanian coasts

The exercise started on 15th May 2015 at 07:00 and ended at 17:00 after thorough cleaning and removal of waste.

Conclusions on the Albanian coasts

The exercise reached the planned objectives. The participating national institutions managed to establish the idea and understand what can happen in such situations and how to act in pollution response operations. Representatives of the responsible institutions clearly realise that without the full cooperation between institutions and without an information and evaluation system of previously prepared, cannot successively implement the reaction operation in case of pollution by oil.

Cooperation with other countries was satisfactory. The announcement by the Apulia Region was within required standards and in a proper timely manner. Also, communications with representatives of Montenegro have been very effective.

Figure 8. Involvement of the Coast Guard during the exercise.

Figure 9. Shoreline operations with the presence of experts and volunteers.

PART 3: A JOINT ENVIRONMENTAL MONITORING PROTOCOL ADOPTED DURING THE EXERCISES

Introduction

Environmental protection needs cooperation and exchange of know-how. In order to achieve this aim, one of the action within the project HAZADR is to harmonize response procedure at sea and along the coast in the case of accidental marine pollution. In the light of the joint exercises, foreseen in the project HAZADR, the three project partners from Apulia, Albania and Montenegro – acting within the same exercise test area, the south Adriatic sea basin – have adopted an unique protocol for environmental monitoring in the case of oil spill event. In the case of such a pollution, the environmental monitoring is needed in order to provide technical support for the decisions of the competent Authorities in the planning of emergency response.

The adopted protocol derived from the document "Monitoring planning for environmental emergencies at sea and along the coast in the Apulia Region: the case of an oil spill event", developed by the Apulian Regional Agency for Environmental Prevention and Protection (ARPA Puglia) within the HAZADR project. This document describes the intervention procedures for environmental monitoring in case of pollution at the sea.

This shared protocol was applied during the joint exercise PAM-EX 2015 (11-15th May 2015), in specific in the pilot areas of Apani (Brindisi, Apulia Region, IT) and at the Southern Montenegrin coast, within the Ulcinj Bay, near the border between Albania and Montenegro.

During the PAME-EX exercise, observers from Italy, Albania and Montenegro took part to the implementation of the common protocol for the environmental monitoring, comparing and identifying at the same time the strengths and weaknesses in the monitoring capacities of their respective Countries in the case of oil spill pollution.

Description of the monitoring procedures for environmental emergencies at sea and along the coast – the case of an oil spill event

The monitoring plan gives instructions about the intervention activities that are needed for the environmental monitoring in case of an oil spill event, at sea and along the coast. Following that, the plan is developed according three topics:

- **A.** Spatial delimitation of the impacted area
- **B.** Monitoring activities at the sea
- **C.** Monitoring activities at the shore

The initial activity includes an immediate inspection and sampling at sea and along the beach; both the inspection and sampling are in charge of the expert teams of the local responsible institutions for the environmental monitoring and control (ARPA Puglia in the case of Italy). The aim is to assess the degree of impact at the sea and on the coast, the presence of critical / sensitive areas to environmental purposes, the main characteristics of the hydrocarbons and their distribution in the sea and along the shore [▶Figure 10].

Figure 10. Monitoring of the wind direction and intensity.

During the sampling activities the operators are equipped with the Personal Protective Equipment (PPE):

- Tyvek coverall type covering the entire body;
- Boots or safety shoes with toe and rubber antistatic sole, anti-slip, oil-resistant;
- Protective gloves to chemical hazards;
- Cover shoes to wear in sampling sites sprayed with oil.

A. Spatial delimitation of the impacted area

The spatial delimitation and environmental characterization of the impacted area require the following standard procedures:

- identification of the geographical area in which the pollution occurred, locating any critical and / or sensitive areas (waters identified for specific uses, including any protected areas, priority habitats, aquaculture and mussel plants, etc.);

- geo-morphological classification of the area (bathymetry, seabed structure, morphology of the coast, etc.).
- monitoring of meteorological parameters that can affect the distribution of any pollutants in the sea water (wind direction and intensity, waves, air temperature, relative humidity, etc.), using portable weather stations.
- monitoring of the main hydrological parameters (direction and intensity of the surface currents, water temperature, salinity, pH, dissolved oxygen, concentration of chlorophyll “a”, turbidity, redox potential, transparency), using the current-meter, the multiparameter probe and the “Secchi” disk.

B. Monitoring activities at the sea

The monitoring at sea is carried out according to a site-specific sampling plan, applying several standard procedures, taking into account all the environmental matrices potentially affected by pollution.

In particular, the “water” sampling scheme takes into account both the boundary conditions (extent of the influenced area, weather-marine conditions, hydrology, etc..) and the characteristics of pollutants (chemical and physical properties, quantity, persistence, behavior in the water, etc.). For example, according to the density of the substance, it could be considered to sample at different depths of the water column, as well as in the prevailing direction of the sea currents. If necessary, the sediments are sampled too; indeed, the sediments, particularly those with a medium-fine granulometry, are considered to be traps for pollutants.

In addition, when there is a reasonable doubt that the pollutant may have reached critical and / or sensitive areas (waters identified for specific uses, including any protected areas, priority habitats, aquaculture plants/mussel farms, bathing areas, etc.), it is necessary to sample the “biota” (mussels or other organism potentially subject to phenomena of bioaccumulation).

Regarding the waters, in the collected samples the main analytical parameters (i.e. suspended solids, total nitrogen, ammonia, nitrite, nitrate, total phosphorus, ortho phosphate phosphorus) are determined as well as other parameters related to the specific type of pollution – i.e. hydrocarbons – (the same chemicals should be determined, if necessary, also in sediments and biota).

The measurement of chemical and physical parameters must be replicated at short time intervals (at least daily) in view of the fact that the oil substances, such as hydrocarbons, undergo transformation processes (weathering) that determine changes in characteristics, behavior and fate of these substances in the sea. The main characteristics to be measured are viscosity and density; tests to determine the dispersion tendency of the oil product should be also performed with the same frequency.

The sampling procedure and the instruments to be used depend on the characteristics of the oil product (solid, liquid, sinking, floating, etc.) and the matrix to be sampled (water emulsions, solid product deposited on the seabed or on the coast, etc.) [▶Figures 11-12].

The knowledge of the local characteristics of the impacted area and the results gained by the initial monitoring give the possibility to predict whether, when and in what way any pollutants will be distributed (i.e. it will remain on the surface, it will sink, it will follow preferential directions, etc.). Moreover, the support from hydraulic modeling, if available, may be important for the forecast scenarios. Following the prediction made, it is possible to modulate the next phase of monitoring.

Figures 11-12. Simulation of surface oil slick sampling from the beach (using a telescopic rod with sampling bottle).

C. Monitoring activities at the shore

The sampling at the shore is carried out at the outer fringe of the coast – beach affected by the oil stranding, at different points within the same, so to consider the size and limits of the area influenced by the spill. The collection of oil residues deposited on the sandy coast require the use of binders (spatulas or spoons), preferably Teflon or PET made, or even stainless steel. Particular attention should be paid to avoid contamination of the sample with sediment, sand or other types of marine debris [▶Figure 13].

The sampling of sandy coast also considers sub-surface samples; the sub-surface samples are obtained, for each chosen point, digging up to the level of outcrop water, which, in case of contamination by hydrocarbons, will produce iridescence due to the leaching of the sand. The observation of the vertical section of the excavation will identify any stratifications of hydrocarbons, which is properly sampled with the aid of the specific tools (binders). The sampled material is stored in borosilicate glass bottles, if possible amber, with a large opening that facilitates the storage of the material, screw plastic caps with secure cap Teflon ® made. The depth of the excavation for the sampling is evaluated according to the sedimentary regime of the beach.

The activity at the shore could also be targeted to the sampling of tar balls (tarry clusters) and stranded marine debris and vegetation (plants, algae, shells, small pieces of wood or debris) if smeared with oil, and if deemed relevant for the analytical investigations. The tarry clusters represent preferential points of sampling, as in the semi-solid outer crust the oil product should be well preserved and less influenced by the weathering effects.

For the sampling on rocky shore, oil residues deposited on the rock surface are picked. The tarry residues are particularly difficult to remove from the rocks, so it is suggested to use disposable tools, designed for other purposes but equally effective, such as wooden pallets depressor.

Figure 13. Simulation of hydrocarbons sampling on the sandy coast.

The collected samples should be placed into wide mouth containers and stored at 4° C protected from light.

During all the monitoring activities, synoptic field sheets need to be used in order to take notes of environmental parameters, samples coding and other useful information (an example of synoptic field sheet is reported as annex at the shared protocol).

Conclusions

During the PAM-EX exercise, the monitoring activities described in the shared and common protocol were performed. In any case, the environmental monitoring was carried out according to the best available equipment and professional capacities of the partners participating in the project.

Observers from the partners' representatives participate also to the PAM-EX exercise, and the experience was transferred in their own Countries to gather the implementation of the respective national contingency plans.

The PAM-EX exercise remarked the need for the cooperation between Countries sharing the Adriatic Sea in the case of pollution at the sea, in order to prevent the damage and minimize the environmental impact. The oil spill simulation exercise performed in the two locations across the Adriatic Sea demonstrated the fundamental role of the flow and sharing of information, for a fast and cross-border reaction to the sea pollution event.

The cross-border cooperation during PAM-EX exercise highlighted the importance of the further harmonization of procedures for the establishment of a single, common management plan for the Adriatic sea, to realize the best environmental monitoring at the sea and on the shoreline in the event of oil, toxic and hazardous substances spill.

4.4 USEFUL GUIDELINES FOR IMPLEMENTING OIL SPILL MITIGATION MEASURES ON THE ADRIATIC COASTS

Darko Domovic / Leonardo Balestra

Between May 2014 and May 2015 three international spill response exercises have been organized under HAZADR project. Their outcomes, as discussed during the final debriefings of the exercises, indicated that certain measures could or should be implemented with a view to improving the level of cross-border cooperation and effectiveness of cross-border coordination, reducing the deployment time in case of joint response operations, and increasing the adequacy of equipment and clean-up techniques. In general, these goals could be achieved by (as much as practical) introducing certain notions into the existing relevant regional/area Contingency Plans. In this regard the following proposed Guidelines could be considered:

1. In case when different contingency plans exist for operations at sea and on shore respectively, clearly define responsibilities for various aspects of shoreline clean-up operations and operational modalities and techniques to be used, taking into consideration the specific characteristics of the coastline in each region/area.

2. Introduce a compulsory testing of regional/area Contingency Plans at defined intervals, through spill response exercises of different levels and inviting the representatives of other Adriatic regions to participate in such spill response exercises, with a view to transferring knowledge and sharing experience among the Adriatic regions.

3. Define the exact standard location of the Operations Room(s) to be used by the Response Management Team (RMT) during oil spill response operations (and/or exercises), specifying also the necessary means of communication (including in particular VHF radio communications) to be available in the Operations Room for directly following communication of all units (at sea and on shore) taking part in the operations. The use of real time video communications for monitoring response operations should also be considered.

4. Specify duties of each individual member of RMT, in order to relieve its Commander from duties related to logistics, finances, procurement, etc. The introduction into RMT of independent professionals (experts), without decision making powers, should be considered.

5. Envisage the possibility to use tools developed/improved under HAZADR project, i.e. the Oil Spill **Forecast Support system (**Oil Spill FSS) and **IMSA** system available in Marche Region and **Atlas** available in Apulia Region, and define conditions/procedures for accessing the forecasts and data sets available from these.

6. Emphasize in the CP the importance and modalities of co-operation among Adriatic regions in response to oil spills and in conducting spill response exercises.

7. Envisage the possibility (or even obligation) to invite the representatives of other Adriatic regions to send observers to spill response operations in case of marine pollution incidents, with a view to sharing knowledge and experience.

8. Clearly define „Tiered response system" and define responsibilities at each of the three envisaged „tiers" without defining these in terms of quantity of spilled oil/pollutant.

9. Clearly define locations for temporary storage of oily wastes collected during recovery operations at sea and shoreline clean-up operations, and methods for final disposal of such wastes. It should be done in close cooperation with the competent national authorities responsible for waste management, taking into consideration that standard waste storage and management procedures are usually not applicable in marine pollution incidents.

10. Introduce a clear notion that if a need for external assistance has been identified such assistance has to be requested immediately, and define appropriate channels for requesting/offering such assistance.

11. Define the official language *(possibly English)* to use when requesting/offering assistance in case of emergency, during the joint spill response operations and in exercises, and identify/ appoint a liaison officer in each area/region, who is fully proficient in such official language as well as in national language(s) of the participating countries.

12. Define the modalities of including professional and spontaneous volunteers in shoreline clean-up operations at local, regional/area and national levels, comprising the volunteers from other countries in the Adriatic region, and minimum requirements for training volunteers envisaged to be involved in oil spill response *(making use of e.g. POSOW training package and ATRAC Rijeka).*

13. Improve response on shore by training volunteers (but also

Figure 1. Clean up techniques during PAM-EX exercise.

professionals), designated to take part in pollution response, by creating an Adriatic training network coordinated by ATRAC Rijeka. Other teaching centres of the network may be, in the western part of the basin Ancona, which is already operational, and Durres for the eastern part. The mission of the network is continuous training of teaching staff, *inter alia* through specifically prepared e-learning programs, which would train the relevant personnel locally. The network promotes and coordinates the activities of trainers on both sides of the Adriatic with shared training programs (ATRAC), and operational techniques homogeneous throughout the basin.

14. List qualified and trained personnel in the field of marine pollution emergency response, including their contact details, and define standard training requirements (in cooperation with ATRAC) for “qualified” personnel.

15. Define equipment and material which is in short supply in each Adriatic region (e.g. skimmers, booms, dispersants, shoreline clean-up tools and chemicals, etc.) and a medium/long term plan for procurement of such equipment and material.

16. Define sampling procedures to be applied in case of marine oil pollution (e.g. those developed under HAZADR project by the Regional Agency for Prevention and Environmental Protection – ARPA of Apulia Region).

17. Define (quantify) funds to be used for procurement of materials, equipment and for training of personnel.

18. Improve the control of the Adriatic through the implementation of the mobile monitoring system **MAR.M.MO** (Maritime Mobile Monitoring), already applied in Marche Region. The system is based on GPRS technology and involves professional fishermen and yachtsmen who, on a voluntary basis, undertake to notify potentially dangerous situations by sending geo-referenced data to ACCRA (Adratic Coastal Control Room Ancona).

19. Improve the capacity for coordination and exchange of information among the different control rooms playing a role in case of a marine pollution incident, by reducing the number of command centres and international and regional intervention coordination centres.

20. Consider creating an integrated and coordinated system of “coastal intervention stations” along the Adriatic coasts for a timely response in case of arrival of on shore, which are able to intervene along the coast in short time (3/5 hours). The nodal points of the network could be Bari/Brindisi, Ancona, Rijeka, Split and Durres. Permanent coordination of the stations’ activities and enhancing their equipment should be promoted with a view to optimizing results while reducing costs within a perspective of mutual assistance in the Adriatic.

5. THE ADRIATIC TRAINING AND RESEARCH CENTRE FOR ACCIDENTAL MARINE POLLUTION PREPAREDNESS AND RESPONSE

Effective oil spill preparedness requires personnel who understand, and can perform, a variety of emergency response and incident management functions. The harmonization of practices and procedures, along with the mutual knowledge of what the neighboring Countries and Regions would do in case of an oil spill crisis, has a capital importance in the Adriatic, where even a minor spillage may affect various coastal areas ruled by different administrations. Although this risk is well-known and the demand of common standards is high there were no cross-border entities providing education and training focused on the Adriatic peculiarities before the HAZADR project.

The purpose of the Adriatic Training and Research Centre, hosted at the premises of the County of Primorje and Gorski Kotar, Croatia, and kicked off in 2015, is to ensure that the personnel dealing with oil spill emergencies from Italy, Croatia, Albania, Slovenia and Montenegro are given appropriate opportunities to exchange practices, learn and enhance relevant knowledge and skills about managerial or supervisory capabilities, general logistical, procurement or administrative knowledge and oil spill risk assessment.

The ATRAC offers an unique environment to improve the global capacity of the Adriatic coastal managers to respond to emergencies both at sea and coast. It represents a concrete step to meet the challenges posed by the EU Strategy for the Adriatic and Ionian Region (EUSAIR) towards more coordinated emergency response as well as the empowerment of prevention, protection and clean-up programs against human-induced pollution threats.

5.1 THE EDUCATIONAL TRAININGS DELIVERED BY THE ATRAC

Vedran Martinić

One of the objectives of Adriatic Training and Research Centre for accidental marine pollution preparedness and response is training of persons included in national and area/regional systems for preparedness and response to marine pollution incidents involving oil and other HNS. The Centre's key role is considered to be providing training in matters related to accidental marine pollution preparedness and response, to the personnel from the Adriatic countries.

As agreed by the Fifth Steering Committee Meeting (Tirana, 9-10 December 2014) the training programme proposed to be organized and conducted by the Adriatic Training and Research Centre was based on the standard IMO OPRC and POSOW Model training courses complemented with addition of certain topics of specific interest identified and proposed by the partners in HAZADR project.

According to that conclusion the Centre had a duty to prepare, organize and deliver eight (8) training courses among which four (4) IMO OPRC model courses and four (4) courses based on POSOW training material. Although the basis of IMO OPRC and POSOW courses were already defined, the program of individual courses was prepared taking into consideration specific references and characteristics of the Adriatic region.

Having analysed the suggestions provided by the Project partners, it appeared that they in general agreed that the international training courses (IMO OPRC Level 1 and 2) should be organized in Rijeka and POSOW based courses in the seats of the partners or elsewhere in their regions/areas.

POSOW courses

The EU financed project Preparedness for Oil-polluted Shoreline cleanup and Oiled Wildlife interventions – POSOW, aimed at improving all aspects of response following an oil spill reaching the shoreline and to strengthening regional cooperation through the enhancement of knowledge and capacities of operators (professionals and volunteers) in the field of response to marine pollution. By providing training courses and material to civil protection professionals and volunteers, in cooperation with local competent authorities, the project aimed at improving the effectiveness of emergency response to shoreline pollution following an oil spill in the Mediterranean region. The main target groups for which the training package was developed were operators (professionals and volunteers) working in the national civil protection services, in municipalities (local community) and in well-established Non-Governmental Organisations (NGOs) active in the coastal regions of the Mediterranean. POSOW model courses were designed for personnel involved in on shore response who have very little or no previous knowledge of shoreline morphology and description, properties and behaviour of spilled oil and the way of describing the oiling of shorelines respectively.

The 2 days duration of such training course have been a very good option for all partners who needed training for a relatively large group of trainees in their domicile localities.

The Project partners – Zadar County, Region Marche, the National Institute of Biology in Piran and the Ministry of transport and infrastructure of Albania, in agreement with the other Project partners, have offered to host POSOW training courses. The Centre, in cooperation with these project partners, prepared and organized all the four planned POSOW courses.

The first such course was held in Zadar, 19 – 20 May 2015 and was attended by twenty participants from Istarska county, Montenegro, Split county and Zadar county.

The second POSOW course, 22-23 May 2015, was organized in Ancona and it assembled 34 participants from Apulia region, Emilia-Romagna region and Marche region [▶Figure 1].

The National Institute of Biology in Piran was the host of the POSOW training course in Piran, 25-26 May 2015. This course was attended by the biggest number of participants: 43 participants from Slovenia

In cooperation with the Ministry of transportation and infrastructure of Albania, the Adriatic Training and Research Centre organized the fourth and the last POSOW training course in this cycle, in Durres, 23-24 June 2015.

Total of 87 participants from various voluntary organizations

Figure 1. Open air training during the Italian POSOW.

Figure 2. IMO OPRC training course in Rijeka.

dealing with the protection of the fauna and of the marine environment, as well as the personnel of civil protection units, port authorities and specialized response companies, attended the four delivered POSOW courses. All of these were held in a very positive working atmosphere with exchange of experiences of all the participants and speakers at the training courses.

IMO OPRC training courses

The International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC) calls for the International Maritime Organization, along with the relevant international and regional organisations, oil and shipping industries, to develop a comprehensive training programme in the field of oil pollution preparedness and response including the availability of expertise for the development and implementation of training programmes. In this regard, IMO decided to develop three model training courses as follows:

Operational staff (Level 1),
Supervisors and on-scene commanders (Level 2); and
Senior management personnel (Level 3) [▶Figure 2].

The objective of IMO OPRC Level 1 Model training course is to provide operating level personnel responsible for undertaking on-site clean-up operations (First Responders), with a complete overview of the various techniques available for recovering spilled oil and cleaning polluted shorelines so that they may become effective members of an oil spill response team and are aware of other issues that occur during a spill.

The Level 1 courses (Response to Marine Oil Spills Course for First Responders) were organized in Rijeka in two terms – 10-12 June and 16-18 June 2015 respectively. The duration of the courses has been adjusted to 3 (three) working days. Each course was comprised of 16 classroom lectures, videos, spill response equipment demonstrations, hands-on practical exercises, an introductory presentation and the course evaluation. The static demonstration of various types of booms, skimmers and other spill response equipment, including pollution response vessels, as well as of maintenance and storage of spill response equipment and products was arranged with one of the local clean-up contractors [▶Figure 3].

The two IMO OPRC level 1 courses were attended by a total of the 28 participants from Albania, Croatia, Italy, Montenegro and Slovenia. According to evaluation questionnaires, a major part of participants indicated that the course had a great value for them, particularly regarding to their expected tasks and workplace [▶Figure 4].

The objective of the Level 2 course (Response to Marine Oil Spills Course for Supervisors and On-Scene Commanders) is to prepare Supervisors and On-Scene Commanders to coordinate / manage the response to an oil spill. The course therefore aims at informing senior officials, designated to act as Supervisors/

Figure 3. Practical exercises at IMO OPRC level 1 course.

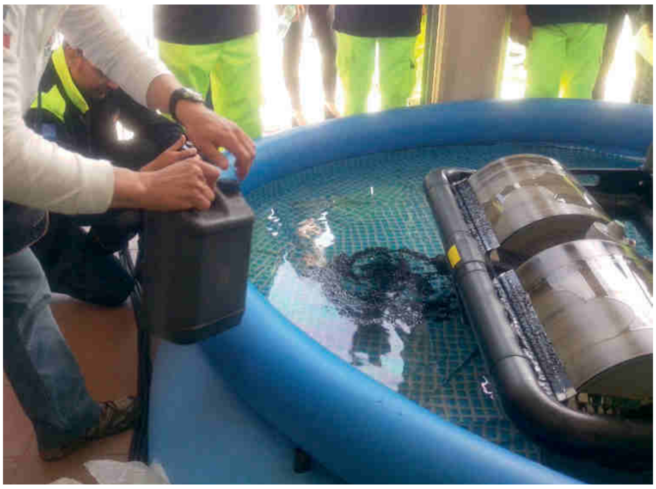

Figure 4. Practical exercises in the use of the skimmer.

On-scene Commanders during spill response operations, on the responsibilities of the members of an oil spill response organisation and on how to effectively respond to an oil spill through the deployment of equipment and resources at regional (area) or national levels.

Two IMO OPRC Level 2 courses of four days duration each were organized in Rijeka. The first edition of the course started on the 30 June and finished on 3 July 2015, and was followed by the final

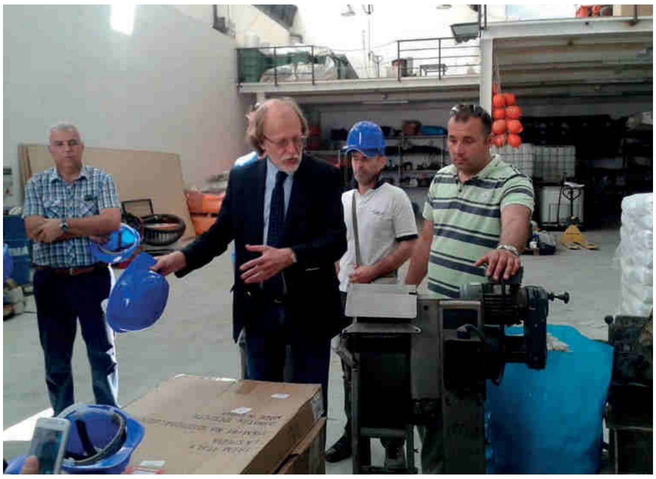

Figure 5. Equipment tutorial at IMO OPRC level 2 course.

Figure 6. International working table during the training courses.

course organized by the Centre during this training cycle between 7 and 10 July 2015.

The respective courses comprised 27 classroom lectures, videos, a table-top exercise, an introductory presentation and the course evaluation. The goal of the exercise was to place the students in a situation similar to a real oil spill incident and to test their understanding of various elements of response planning and management. The participants evaluated the exercise as the most interesting part of the course.

The description of an incident based on a hypothetical event at sea in Primorje-Gorski Kotar county and the characteristics of the specified area were given to the students, divided into 2-3 groups (teams) of 6-7 participants each. Each team was instructed to act as an Incident Management Team and requested to: assess the situation, establish command structure and responsibilities within the group, determine the location of the spill and its likely trajectory, consider possible response options, chose response strategy, mobilize personnel, equipment and other necessary resources; establish relations with media and provide them with relevant information and press notices and consider financial aspects of response activities.

In the beginning and at various stages of the exercise each team (group of participants) was provided with the identical original spill notification (type of accident, information on the ship, her cargo, the reported loss of oil, etc.), set of nautical charts of the area in which the accident occurred, weather report(s), information on available equipment and other resources, information on sensitive areas in the zone that could be affected by the spill, any additional information on development of the situation, etc. Throughout the exercise the Control Team, composed of the Course Director and other instructors, introduced appropriate new injects with a view to amending and complementing the initial information [▶Figure 5].

The beneficiaries of the training courses were representatives of the Port authorities, Harbour Masters' offices, national and local authorities, specialized spill response companies, scientific institutions, Firefighting departments, public ports, Coast Guard, Civil protection organizations and Voluntary organizations.

Instructors have been graded with a high rate and most of the participants were very satisfied with the delivered presentations. During the courses the instructors answered all questions and assisted participants in attaining the knowledge and skills.

All the participant were awarded with the ATRAC certificate for participation at the respective course [▶Figure 6].

Certainly, one of the additional values of the training courses is a database of trainees who attended training activities. This database will be useful tool for efficient exchange of relevant information and for distribution of knowledge. Within this cycle of training courses Adriatic Training and Research Centre educated 202 persons. Participants from Albania, Croatia, Italy, Montenegro and Slovenia were delegated by all relevant HAZADR project partners.

With this result the Centre has fulfilled the major aim which was to strengthen the capacities of the Adriatic coastal areas/regions and the respective States, and to develop, facilitate and foster co-operation among them in the field of preparedness for and response to pollution incidents which require emergency actions or other immediate response.

About the future. The Adriatic Training and Research Centre will develop the educational programme adjusted to the regional characteristics and needs. That training programme will be created in line with International oil spill response training standards and should be recognized by the all relevant authorities in the Region.

Finally, the Adriatic Training and Research Centre may have a great role to harmonization of national regulations within the Region, particularly for the continuous coordination of all activities related to spill prevention, preparedness and response by all Parties, i.e. all Adriatic Ionian coastal States.


NIB


HAZADR
SURVEY TEAM

CONCLUSIONS

This book is an useful aid for informing those Adriatic stakeholders having a role in preventing pollution and responding to crises to select appropriate cross-border response options to minimize adverse environmental impacts of a marine oil spill at coasts.

Traditionally, the oil spill prevention and intervention mechanisms focus on marine response issues and activities performed at sea typically engage national coast guard agencies, maritime administrations and organisations with sea based oil recovery resources and vessels. Obviously, international and regional cooperation protocols are already existing at this regards. Most oil spill accidents, however, can also result in shoreline contamination and the risk of pollution turns higher when the sea basin is narrow.

Such complexity increases in the international sea basin, like the Adriatic. The large number of organisations and the different duties they have in different countries make cross-border cooperation much more complex for the shoreline response than for offshore response.

In particular, for potential large scale spills, shoreline contamination may occur along hundreds of kilometers of beaches and shorelines. Such events are also likely to include cross-border pollution and situations when the national preparedness resources and organisations cannot cope with the response needs only by their own resources.

Hence, coasts are vulnerable not only because exposed to the risk of ships collisions, shipwrecks and – in general – man-induced or nature-induced incidents but also because many players dealing with the emergency at different levels and from different Countries could basically delay the response if the coordination mechanism is not well tuned.

For these scenarios it is essential that effective mechanisms for cross-border international cooperation are well established, supported by reliable and mutually-recognized technological facilities and ready to operate together efficiently.

HAZADR has initially identified a need for a cross-border oil spill response coordination specifically dedicated for shoreline operations and land-based organisations. Then, the project set up a complex mechanism providing a pioneering group of Operational Rooms with an early warning communications and , the ATLAS, which is a web-based alert and notification application enabling real time exchange of information between the Adriatic Countries and Regions.

In the meantime, to improve a solid coordination and operation in the field, it was necessary to conduct common shoreline exercises, which have represented the privileged way to train the head of operations, the civil protection teams and the volunteers. By exchanging best practices and learning, teams have increased their ability and effectiveness in responding to disasters. In the final project phase, the Adriatic Training and Research Centre has supported and complemented the prevention and preparedness efforts of the participating partners, focusing on areas where a joint Adriatic approach is more effective than separate national or regional response actions. These include the improvement of the quality and accessibility to information, clean up techniques and case studies, also encouraging the diffusion of early warning tools.

However, most of the findings and applications carried out by HAZADR require further implementation and diffusion at Adriatic scale to be a recognized by the policy makers as standardized practices. In this sense, the mainstreaming and the large scale uptake of the HAZADR results within the recently approved Adriatic and Ionian Macro-regional Strategy represents the challenge ahead.

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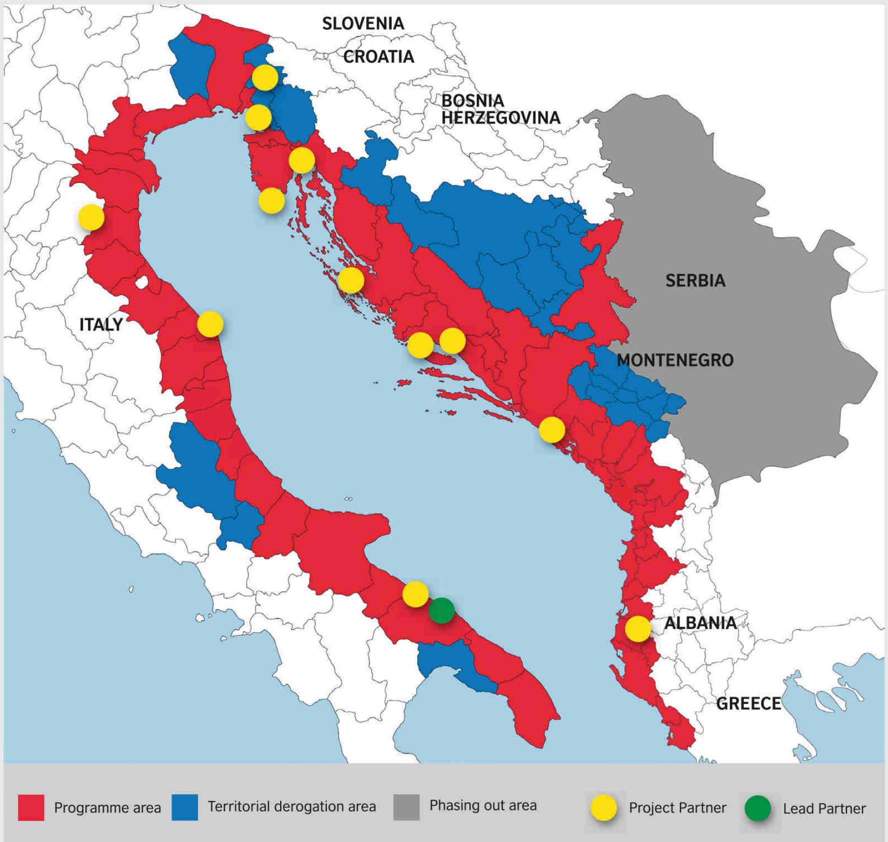

The IPA Adriatic Cross-border Cooperation Programme is the result of joint programming work carried out by the relevant participating countries and is part of the cooperation process in the Adriatic area through the financial support of the European Union. Many factors make cooperation in the Adriatic area important today, particularly from a political and economic point of view, in order to guarantee harmonious growth, sustainable development and unity among people. The areas of interventions are the socio-economic development, natural, cultural and environmental risk protection, energy efficiency and renewables, accessibility, networks and transports.

The Programme eligible area consists of 4 Member States (Italy, Greece, Slovenia, Croatia), and Potential Candidate Countries (Albania, Montenegro, Bosnia and Herzegovina) on the Adriatic sea.

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