AMPERA

Enhancing European Cooperation on Accidental Marine Pollution Research

Results of the AMPERA Transnational Call

AMPERA
Publication Nr. 3

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on Accidental Marine Pollution Research

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Contents

2 **Foreword**

3 **Steps towards the coordination of national/regional programmes**

3 Analysis of barriers that hinder transnational cooperation

5 Identification of transnational R&D priorities

5 Implementation of the transnational Call

7 **Overview of funded research projects**

8 OILDEBEACH
Buried fuel in the intertidal beach zone: coupling between beach morphodynamic, natural degradation, forcing mechanisms and biological activity

10 DEOSOM
Detection and Evaluation of Oil Spills by Optical Methods

12 ECORAID
Ecological Risk Assessment Information Data-mining and Comparison

14 DRIFTER
HNS, Oil and Inert Pollution: Trajectory Modelling and Monitoring

16 RAMOCS
Implementation of Risk Assessment Methodologies for Oil and Chemical Spills in the European Marine Environment

18 TOXPROF
Toxicity profiling of the major EU transported HNS and oil types

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Foreword

One of the aims of AMPERA is to formulate and implement a series of strategic activities aimed at identifying synergies and complementarities that may be the key for sustainable cooperation among partners in the field of accidental marine pollution research.

The present brochure, the third in the series of publications outreached from the AMPERA Project, outlines the research projects funded through the Call for proposals on accidental marine pollution (AMP), for enhancing the effective and efficient use of existing European R&D capacities for preventing and better responding to accidental contingencies.

This outcome is the result of a process of strategic analysis and decisions, implemented within the bottom-up 'ERA-Net' initiative, launched to improve the coordination of national and regional research activities and programmes.

The analysis procedure encompassed a comprehensive thematic classification of AMP R&D projects initiated by national programs, the assessment of existing complementarities and gaps among national programmes, and a comparison of research priorities between the partner countries, allowing the identification of prospective trends of applied research and a suite of potential specific clusters (regional and thematic).

Based on this complete analysis three R&D themes were selected for the Call that was formulated under the basis of a joint evaluation but national funding:

- Risk assessment studies.
- Clean-up and response techniques and related environmental considerations, restoration methodologies.
- Instruments and technologies for detection and forecasting of AMP.

For all three themes, studies were in particular encouraged on heavy products (oils) and/or hazardous noxious substances (HNS).

At the end of the process, a significant number of scientists from 77 research Institutions participated, reflecting the potential of the European knowledge in the field. The accepted projects outlined in the brochure, account for an overall budget of about 2.25 million EUR.

Despite being a Pilot exercise, the Call is a contribution to transnational collaboration to effectively address issues of common concern. In this case improving the links between accidental marine contamination research with prevention and mitigation activities, underpinning the role of sound knowledge in decision making, and ultimately constituting a step forward in the drive towards the creation of the European Research Area (ERA).

Joan Albáiges
MICINN, Spain
AMPERA Coordinator

Steps towards the coordination of national/regional programmes

In May 2007, the AMPERA Consortium (national/regional[1] R&D funding agencies) launched a joint transnational Call for Proposals on Accidental Marine Pollution (AMP) with the aim of enhancing sustainable cooperation between partners and foster Europe's competitiveness in this field of research. The definition and implementation of a joint transnational programme in AMP was the final result of an extensive process of strategic analysis and decisions to improve the coordination of national/regional programmes on AMP that included the following major steps: analysis of barriers that hinder transnational cooperation, identification of transnational R&D priorities, and implementation of the joint call.

Analysis of barriers that hinder transnational cooperation

An important step towards the coordination of national/regional programmes is the study of the current practices in national RTD programmes management in the partner organizations in order to analyse potential administrative and legal barriers to an effective transnational cooperation (Box 1)[2]. This includes the analysis of issues related with:

- Definition of a programme and a call (e.g. theme selection, cycle programme, type of research, type of participants, funding of foreign researchers/organizations).
- Implementation of a call (e.g. call publication, proposal submission, language of the proposal, grant-aid level, eligible costs).
- Evaluation procedures for project proposals (e.g. foreign and national referees, number of evaluators, standard evaluation form, anonymity of evaluators, evaluator fee, time schedule).
- Other issues (e.g. ownership rights, publication of results, conflict of interest, gender and environmental policy).

Several models for joint research programmes representing various levels of transnational cooperation can be considered in the light of the administrative and legal barriers identified. Suggestions for the effective removal or circumvention of these barriers were put forward leading to the definition of best practices for common call and evaluation procedures and transnational programme management. The model for the joint research programme adopted by the Consortium was the model of a *joint call and evaluation but national funding* (Box 2).

Box 1. Most common administrative and legal barriers identified for the main steps of a transnational programme.

Programme initiation:

› Joint themes hindered due to different partner scopes.
› Different cycles/lengths of national programmes.
› Transnational networking limited due to financial difficulties.
› Problem of joint funding.

Programme implementation:

› Joint calls hindered due to differences in call procedures.
› Joint calls hindered due to differences in evaluation procedures.
› Major differences in time schedules.

Programme management:

› In the case of joint funding: lack of control on procedures, need for common steering, problem of unused joint funds, lack of staff/budget for transnational management.

Box 2. Main features of the model for joint research programme adopted by AMPERA.

Joint call and evaluation, but national funding:

› The AMPERA partners agree on an overall common research theme.
› Together, they launch a joint Call for a common research programme. An international expert committee then evaluates the incoming proposals according to the evaluation criteria set by all involved partners.
› Then, each funding organization will make the final funding decision at a national level. Each partner will fund its national researchers.

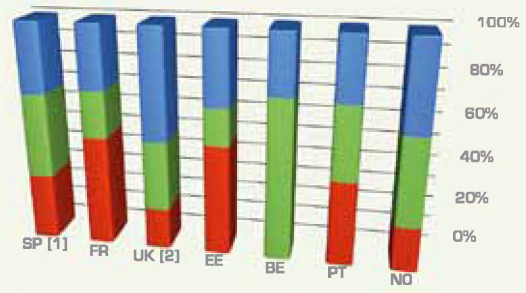
[1] Regional funding organizations: organizations of political regions, i.e. political level just under the national level.

[2] AMPERA Deliverable 2.2.1 and Deliverable 2.2.2

Steps towards the coordination of national/regional programmes

Box 3. Results of the analysis of national RTD programmes (2000-2004) and thematic classification of existing AMP R&D projects within the AMPERA Partner countries.

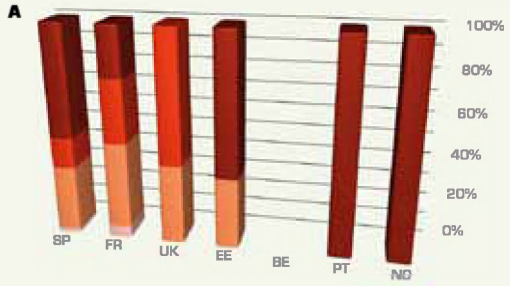
Figure 1. Indicative percentages of RTD projects per field in AMP within the AMPERA Partners.
[1] Data not including the programmes from Xunta de Galicia; [2] Data not including the projects developed in the SEA EMPRESS Oil Spill Programme (SEEC); Disparity in the data: the duration is not similar, some projects cover several fields in AMP.



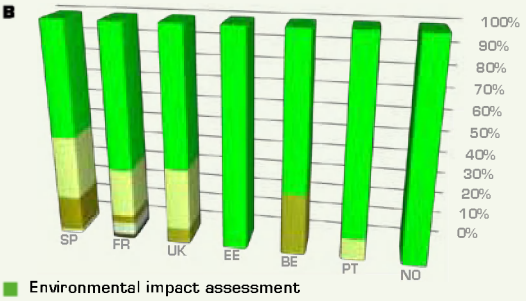
Response preparedness
Impacts
Pollution countermeasures

All the AMPERA partners developed RTD projects in the three defined AMP fields *(Pollution countermeasures, Impacts* and *Response preparedness)*, except Belgium who mainly developed projects related with *Response preparedness*. Portugal, Spain and Norway presented a relative balance between the three AMP fields. France and Estonia mainly developed RTD projects in the field *Pollution countermeasures* whereas UK had more funded projects in the field of *Response preparedness* during the studied period.

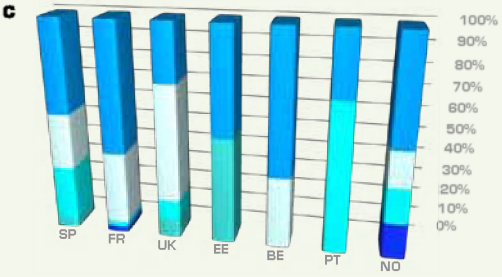
Figure 2. Indicative percentages of RTD projects per theme in the field of Pollution countermeasures (A), Impacts (B) and Response preparedness (C) in AMP within the AMPERA Partners.



Detection and monitoring technologies
Technologies for combating marine spills
Technologies for shore protection and rehabilitation
Waste management



Environmental impact assessment
Impact on fisheries and resources
Impact on natural resources
Socio-economic impacts
Human health impact
Impact of clean-up



Contingency planning
Pollutants characterization
Environmental data
Resource mapping
Exercises/scenario testing

For all partners, most of the RTD projects developed in the field *Pollution countermeasures* were related with *Detection and monitoring technologies*, except in France and UK who mainly developed projects related with respectively *Technologies for shore protection and rehabilitation* and *Technologies for combating marine spills*. There was a clear gap of projects related with *Waste management*.

Concerning the field *Impacts*, most of RTD projects were concerned with *Environmental impact assessment*. Only Spain and France presented projects related with *Socio-economic impacts* and *Human health impact*. There was also a clear gap of projects concerned the *Impact of clean-up*.

All partners funded RTD projects concerning *Contingency planning*. France, Spain and UK also presented a significant percentage of projects related with *Pollutant characterization*. There was also a clear gap of projects in *Resource mapping* and *Exercises/scenario testing*.

Identification of transnational R&D priorities

The second step towards the coordination of national/regional programmes was a comprehensive analysis of national RTD programmes and thematic classification of past and existing AMP R&D projects in the AMPERA partner countries[3] (Box 3). The results allowed the identification of complementaries and gaps among national programmes and the comparison of national research priorities, leading to the identification of prospective trends of applied research and the drafting of potential R&D themes for the Pilot Call. A step by step clustering procedure (Box 4) was also followed to formulate a set of potential clusters of AMP R&D (thematic and regional) aiming at fostering of transnational and interdisciplinary cooperation, avoiding redundancy and filling in the research gaps[4]. The research needs in the field identified by the Spreex Project[5] were also taken into consideration.

Consequently, the Consortium agreed to develop a thematic approach for this Pilot Call, instead of a regional approach. The R&D themes selected for the Pilot Call (Box 5) were:

1. Risk assessment studies.
2. Clean-up and response techniques and related environmental considerations, restoration methodologies.
3. Instruments and technologies for detection and forecasting of AMP.

For all of the three themes, studies were particularly encouraged on heavy products (oils) and/or hazardous noxious substances (HNS). An important objective of this funding initiative was to stimulate European R&D networking and multidisciplinary research, with possibility of funding not only the typical research projects like desktop studies and laboratory work, but also wider types of action such as field trials, workshops, policy-oriented projects, and projects integrating or combining former research results.

Implementation of the transnational Call

A Memorandum of Understanding establishing all the procedures for the implementation of the Joint Call for proposals (e.g. funding model, Joint Management Committee, definition of the themes, dissemination of the call, submission and evaluation procedures, funding procedures and follow up of the funded projects) was signed by the following funding partners:

1. MICINN – Ministry of Education and Science, Spain
2. IFREMER – French Research Institute for the Exploitation of the Sea, France [French funding by the National Research Agency]
3. Defra – Department for Environment Food and Rural Affairs, UK
4. EstSF – Estonian Science Foundation, Estonia
5. BELSPO – Belgian Federal Public Planning Service Science Policy, Belgium
6. FCT – Science and Technology Foundation, Portugal
7. RCN – Research Council of Norway, Norway
8. Xunta de Galicia – Conselleria de Innovación e Industria, Spain

Following the launch of the Pilot Call, a total of 24 research project pre-proposals were received from the different research communities within the countries/regions of the AMPERA Partners, with a total requested contribution of 8.2 M EUR. From these pre-proposals, 19 were considered eligible and, after an international expert review, 9 of them were selected for full submission, with a total requested funding of 3.6 M EUR. The submission and evaluation procedure of full proposals was finished within 4 months, followed by a meeting of the Joint Management Committee (JMC) to rank the proposals and suggest changes in the work programmes and budgets. At the end of the process, 6 collaborative research projects were accepted for a total funding of 2.25 M EUR.

A common kick-off meeting of the funded projects was organized in September 2008, gathering Principal Investigators and AMPERA Executive Board members. A short overview of the funded research projects is given in the following pages.

Box 4. Steps of the procedure used for clustering of AMP R&D projects.

1. Definition of the aim for clustering of R&D projects.
2. Selection of the main driver (e.g. scientific interest, end-user requirements, policy needs, industry demand, availability of funds).
3. Selection of the basic principle for clustering (e.g. thematic, regional).
4. Formulation of the thematic groups (if the thematic principle was not followed in the previous step).
5. Definition of internal (e.g. scientific competence, available research potential) and external (e.g. administrative and legal issues) factors.
6. Formulation and analysis of the combination of the factors and themes.
7. Determination of the clusters.

[3] AMPERA Deliverable 1.1.1 and Deliverable 2.1.1

[4] AMPERA Deliverable 2.1.2

[5] Spreex – Spill Response Experience (FP 6, EU): General Conclusions and Research Needs, http://spreex.net/

Steps towards the coordination of national/regional programmes

Box 5. Description of the R&D themes selected for the Pilot Call.

Theme 1.
Risk assessment studies

Project proposals under this theme had to address current policy needs, priorities, and research gaps. Key topic areas for consideration could include:

› Identification of sensitive coastal areas (receptor identification), e.g. sensitive ecosystems, habitats, communities, species, resources, activities, and the sensitivity mapping.
› Studies related to the transport of dangerous goods in the marine environment (hazard identification), e.g. quantities and routes, ecotoxicological characteristics and effects, likely behaviour after spillage, and possibilities for remediation.
› Risk assessment methodologies in order to integrate the different aspects of risk posed by spillages of both oil and chemicals.
› Studies relating to biomarkers, key species, sensitive species, 'first alert' species, and studies relating to ecosystem functioning, e.g. ecosystem impacts, impacts on the food chain; or to socio-economic impact risks.

Theme 2.
Clean-up and response techniques and related environmental considerations, restoration methodologies

This theme aimed to improve the technological response capacities and the associated expertise. The accent was placed on the protection of the coast, in particular the protection of sensitive areas and the marine resources. Innovation in response and the protection of response teams (safety aspects) were also included. Key topic areas for consideration could include:

› Technologies for the detection of the pollutant on the response area, for safety reasons: detection unmanned systems and methods for oil and chemicals in sea water, under pressure, in sand, etc.
› Technologies for the treatment and (or) the recovery of the pollutant at the coast, including mechanical containment and recovery: booms, nets, collect devices, sorbents, clean-up products, and the evaluation of their impact on the environment.
› Technologies and methodologies for the improvement of the rehabilitation of the ecosystem (biodegradation, photochemical and chemical techniques), and for the associated monitoring of the pollutant and of the degradation products.
› Waste disposal, treatment and management in relation to the pollutant nature.

Theme 3.
Instruments and technologies for detection and forecasting AMP

Emphasis was given to projects dealing with high resolution numerical models of marine transport of oil and other hazardous substances. Key topic areas for consideration could include:

› Advances in the modelling of relevant hydrodynamic processes including wave and current interaction, baroclinic flow, flooding and drying of flooded areas in estuaries and bays, and role of turbulence.
› Advances in the development of marine pollution tracking methods including 3D transport and weathering models, evolution of oil spills and HNS spills in the surf zone, vertical dispersion modeling, Lagrangian vs. Eulerian modelling techniques, and development of probabilistic tools for risk assessment of HNS pollution in coastal and transition waters.
› Networking activities towards the intercomparison and intercalibration of HNS tracking and weathering models.

Figure 1. Participants of the kick-off meeting held in Oslo on 30th September 2008.

Overview of funded research projects

OILDEBEACH

Buried fuel in the intertidal beach zone: coupling between beach morphodynamic, natural degradation, forcing mechanisms and biological activity

The surveys after the Prestige oil spill (POS) in November 2002 have revealed that subsurface oil is able to reach depths well beyond the estimations currently used in clean-up design, up to several meters. In this case, the beach morphodynamics is the key factor that control burial process and oil appearance resultant of the evolution of buried oil, from tar-balls to coatings on the sediment grains. This information allowed developing a conceptual model of oil evolution in the sedimentary column. This model was conceived as the first step in the proposal of a ground tool for shoreline assessment immediately after an oil spill occurred. However, in order to improve the model applicability to support the decision-making in the clean-up design, it is necessary to have a significantly better knowledge of the main processes and factors involved in the natural and forcing processes (bioremediation, mechanical cleaning techniques) of degradation of buried oil.

Coordination
University of Vigo, Marine and Environmental Geology Group, Spain

Partners
CIIMAR – Centre of Marine and Environmental Research, Portugal
GLADYS / University of Montpellier II, France
ICBAS, University of Porto, Portugal

Duration
36 months

Budget
200000 EUR

Funding agencies
MICINN – Ministry of Science and Innovation, Spain
FCT – Science and Technology Foundation, Portugal
ANR – Agence Nationale de la Recherche, France

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OBJECTIVES

The main scientific objective of this project is the study of the fate of the buried oil in the intertidal zone of beaches, in order to improve the applicability of morphodynamic driven oil burial models to support decision-making in the clean-up design. This objective is structured in three major aspects:

1. Improvement of response to recent oil spills, firstly determining the burial mechanism, burial depth and sand volume movement under storm conditions and analyzing forcing degradation methods as bioremediation.
2. Re-evaluation and clean-up strategies against ancient oil spills. The advances from modeling of the subsurface oil burial and temporal evolution will be used to re-evaluate the situation of ancient oil spills, estimating the remaining subsurface oil and the affected sand depth and studying the effectiveness of these degradation methods.
3. Acquisition of new lab and field data to increase the knowledge of the evolution and persistence of subsurface oil.

WORKPACKAGES

The project is organized in four workpackages.

WP1. Field data acquisition.

It includes the organization of a documentary base. Based on the compiled information, the field work strategy will be designed with the objective of widening the temporal scale to the results of the present project.

WP2. Laboratory experimentation and analysis.

It comprises the sample analysis and the lab experimentation. Each core will be sampled and saved for different laboratory analysis: a) visual inspection to detect subsurface oil; b) textural analysis; c) total and inorganic carbon content; d) mineralogical analysis by X-ray diffraction; e) scanning electron microscopy; f) hydrocarbon analysis; g) identification and quantification of the natural microbial prokaryotic populations, including bacteria, present on sediment. The study of the influence of different experimental conditions on the degradation (natural, biostimulation, bioaugmentation) of hydrocarbons will be carried out in a microcosm in the laboratory.

WP3. Modeling.

It comprises the numerical modeling of wave climate (SWAN, REFDIF, SHORECIRC), the data analysis to characterize the beach morphodynamic response to storm and oil spills events, and the modeling of groundwater in the intertidal zone of beaches.

WP4. Establishment of protocol of clean-up.

This WP is the integration of all data and the development of a protocol of response against an oil spill in the intertidal zone of potentially oiled beaches.

Figure 2.
Segment of core from the low tidal zone of *O Rostro* beach, collected in 2006, almost 4 years after the Prestige oil spill. A tar ball of several centimeters was located at 0.76 meters of sand depth.

Figure 3.
Tar balls stranded on intertidal zone of *Nemiña* beach, on October 2004.

EXPECTED RESULTS AND IMPACT

After an oil spill, the use of models of wave climate and morphodynamic beach behavior will improve the reliability and rapidity of collecting initial information. Then, this modeling allows obtaining fast information about the oil burial depth or the probability of oil exhumation in the first steps of the monitoring. Furthermore, the determination of the beach morphodynamic as a controlling factor in the oil burial and its last evolution should be a key in the clean-up decisions and contribute to better evaluate the environmental impact of marine pollution. The results of the bioremediation on the subsurface oil will give a clean-up tool to act when an oil spill arrive to the coast. In last term, the final results of this project could modify some directives on impacts and be incorporated in the manuals or protocols of shoreline assessment and clean-up designs. The application of these results will be useful not only in a future oil spills but to re-evaluate past oil spills.

Overview of funded research projects

DEOSOM

Detection and Evaluation of Oil Spills by Optical Methods

Due to the increasing traffic of cargo ships in European navigable rivers, channels and coastal waters, the risk of water pollution by accidental or criminal oil spillage is increasingly high. The same situation occurs in the more than 1100 ports in the EU.

Protection against oil spillage includes three levels of surveillance: the first level is satellite-borne (range about 50 to 200 km); the second level consists of airborne inspection by visual analysis and IR/UV sensors (range about 100 to 500 m); the third level of surveillance is waterborne.

During the last 25 years, the attention of scientists and engineers concentrated mainly on the development of detection methods and equipment for the first and second levels of surveillance. Almost no techniques suitable for the 3rd level of surveillance (one of the most important, due to its flexibility and lower cost) are available in this moment. In particular, there is a need for lightweight, low-cost detectors that can be widely used for watercraft borne.

In the present project, we intend to develop a low cost, efficient system for the third level of surveillance, which may be installed on watercraft and small aircraft and used for intensive surveillance of harborages, rivers, channels, and coastal waters.

OBJECTIVES

Specific objectives of the project are:

- Characterising the spectral signatures of crude oils and other hydrocarbons from various sources using laser induced fluorescence and passive imaging spectroscopy;
- Developing a low cost nanometre-spectral-range fluorescence lidar for early detection of oil spills in river and coastal waters and measurement of the hydrocarbon film thickness;
- Creating artificial intelligence algorithms for automatic oil identification and tracing using this instrument;
- Developing a dedicated low-cost direct geo-referencing system (GPS/GNSS+IMU) adequate to oil spillage mapping. This will foster the applicability of the oil spill detection system by allowing the organisation of acquired data for direct use in a GIS environment;
- Testing and optimising of the inspection system in laboratory and field tests carried out in Tagus river estuary and Atlantic Ocean coastal waters;
- Benchmarking of the fluorescence lidar developed in the project against more sophisticated well established techniques, in particular a 308 nm fluorescence lidar FLS-A previously developed by Parter 2 and the on-line Spectral Fluorescence Signatures (SFS) analyzer made available by Parter 2.
- Development of calibration and verification procedures of the lidar findings based on the SFS technology in order to achieve more reliable detection, characterisation and mapping of oil spills.

WORKPACKAGES

WP1. Definition of requirements, market survey and specification of LIF/LIDAR prototype.
Water and atmospheric conditions in the field test sites and up-to-dating of the literature survey will be carried out. Market survey will be made in order to identify suitable components that can be applied in the construction of the detector prototype.

WP2. Development and testing of the LIF/LIDAR prototype.
A laser-induced fluorescence lidar (LIF/LIDAR) laboratory prototype will be designed and built. Software for instrument control and preliminary signal processing will be developed.

WP3. Laboratory experiments.
A laboratory experimental set-up will be installed. Laboratory experiments will be developed.

WP4. Construction of algorithms for automatic oil spill detection and mapping.
Algorithms for automatic oil spill detection based on LIF/LIDAR will be developed. Georeferencing algorithms for oil spill mapping will be developed.

Coordination
INOV-INESC-Inovação, Portugal

Partners
Laser Diagnostic Instruments AS, Estonia
CIIMAR – Centre of Marine and Environmental Research, Portugal
University of Vigo, Spain

Duration
36 months

Budget
377126 EUR

Funding agencies
FCT – Science and Technology Foundation, Portugal
EstSF – Estonian Science Foundation, Estonia
Environmental Investment Centre, Estonia
Xunta de Galicia – Conselleria de Innovación e Industria, Spain

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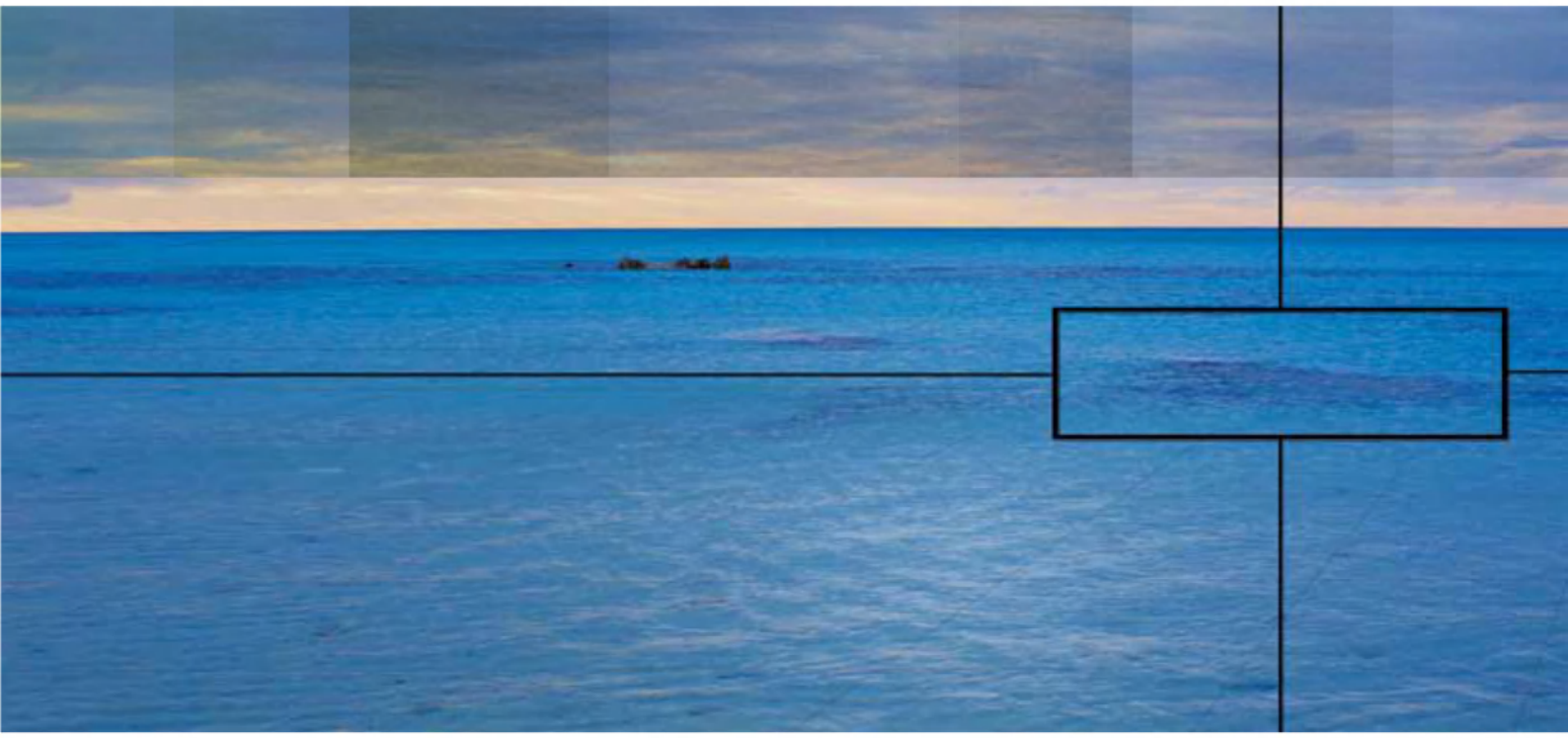

WP5. Field tests.

Field test will be prepared and carried out. Processing and analysis of the experimental data will be passed.

WP6. Specification and conceptual design of an automatic oil spill detection system prototype.

A prototype version of the LIF/LIDAR oil spill automatic detection system will be specified.

WP7. Project management.

EXPECTED RESULTS AND IMPACT

The project will develop a portable and modular oil spill detection system by means of shipborne or airborne surveillance. The detection system will be based on an advanced, low-cost LIF lidar detector, combined with GNSS/GPS/IMU geo-referencing for accurate oil spill mapping and tracking. Due to its lower cost and high performance, this detector will allow intensifying surveillance in riverine and sea coastal waters thus enabling prompts intervention to limit the ecological impact of the hydrocarbon pollution. After the end of the project, the partners expect to continue their collaboration on further development of this prototype towards a commercial detection system that will be commercialized as well as used by the partners for oil ship surveillance services.

The partners have extensive experience in communicating important scientific and technical results to other researchers and technologists through scientific papers and presentations in journals and conferences. Since DEOSOM is an interdisciplinary project, special precaution will be taken to ensure communication between scientific and industrial communities, by ensuring joint publication of the results through media accessible to individuals in all professional.

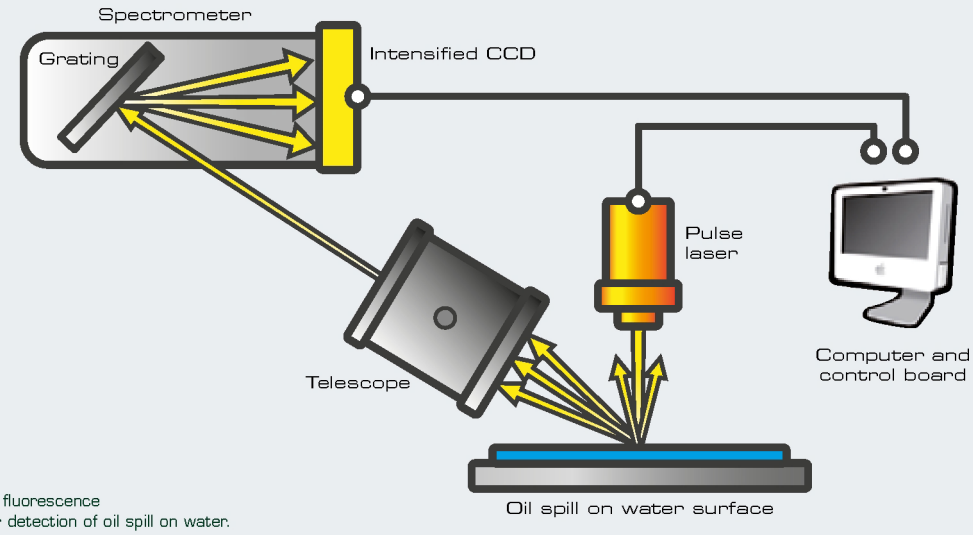

Figura 4.
Laser induced fluorescence (LIF) LIDAR for detection of oil spill on water.

ECORAID

Ecological Risk Assessment Information Data-mining and Comparison

ECORAID addresses the question, how do we best incorporate new and existing biotools into risk assessment methodologies for chemical spills?

Marine and freshwater ecosystems continue to be threatened by large scale pollution disasters, often caused by oil-related activities. Pollution nature, magnitude and site of occurrence can all be very different, with an unpredictable outcome on the responses of individual organisms, the biodiversity and the functioning of the aquatic ecosystem. Rapid, cost-effective and fit-for-purpose methods are therefore needed to permit the environmental impact of oil and chemical spills and to predict the longer term ecological consequences. To meet this need, a diverse range of biological tools is emerging to monitor the relationship between pollutant exposure and sublethal effects in exposed biota. These include both well-established and novel biotools that can potentially be used together with chemical and ecological analysis to quantify pollutant exposure and effect across different temporal and spatial scales, in diverse habitats and across different levels of biological organisation (molecular, cellular, organismal, population, community). If the full potential of these advances in methodology is to be realised, clearly established guidelines are required, based on sound scientific evidence (Anderson and Lee, 2006; Erocips, 2007). This was also the main conclusion of a recent EU workshop held at CEDRE, Brest, 'Pollutant monitoring and ecological assessment following accidental oil and chemical spills at sea', 9-11 October, 2007, attended by scientists and responders from across Europe in charge of emergency response after spill events.

Coordination
University of Exeter, UK

Partners
IRIS – International Research Institute of Stavanger, Norway
CEDRE, France

Duration
12 months

Budget
105000 EUR

Funding agencies
Defra – Department for Environment Food and Rural Affairs, UK
RCN – Research Council of Norway, Norway
ANR – Agence Nationale de la Recherche, France

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OBJECTIVES

We have identified complementary research activities from across member states in the form of three EU funded projects, FACE-iT, PRAGMA, RESPILL which represent aspects of the development, testing and field validation of new, innovative biotools and the integration of well-established biomarkers into current EU guidelines for disaster management strategies (oil, hazardous and noxious substances). In ECORAID, the aim is to perform a desk top in which:

1. The technical performance and suitability of different methods (e.g. biosensors, multibiomarkers, community analyses) from the 3 projects and from the wider literature will be reviewed.
2. The concept of generating easy-to-visualise environmental quality indices based on these different methodologies will be discussed in the context of impact assessment and policy relevance.
3. A document will be produced providing guidelines on the incorporation of biotools with chemical and ecological measurements into integrated environmental assessments suitable for pollution disaster response. Research needs and gaps in knowledge will be identified to allow the prioritisation of community research effort.

The document will be disseminated to scientists, responders and decision makers through the network of contacts of the partners and through a website intended to inform policy makers of the utility and cost-benefit of incorporating such an approach into current EU risk assessment methodologies for chemical spills.

WORKPACKAGES

We shall conduct a desk top study to review current best practice in the application of biotools, using selected data from within each project and with reference to the wider literature. The work will be informed and guided by the policy knowledge of the CEDRE team and e.g. by the findings of previous large scale programmes in which the partners have been involved, BEQUALM, BEEP, BECPELAG, and official guidance documents from e.g. OSPAR, ICES, WKIMON. The work will also be supported by the findings of a complementary RCN funded project, Biomarker Bridges, which is generating data to support the linkages of biomonitoring and risk assessment in relation to the environmental management of produced waters in the Norwegian sector.

Data will be summarised to describe, for selected biotools:

1. Performance characteristics (sensitivity, specificity, fitness-for-purpose and usefulness in predicting ecosystem change) of selected biotools based on the results of laboratory exposures and integrated field sites which have incorporated biotools alongside chemical and ecological surveys with different types of contamination (recent spills of oils, hazardous and noxious substances, shore-line and sediment contamination, recovering sites).
2. Suitability of methods for different spill situations (oils, hazardous and noxious substances, habitats, monitoring of recovery and remediation, suitability for environmental liability and marine resource damage assessment).
3. Suitability of biotools for inclusion in classification systems for grading environmental quality. This will consider issues that may restrict or enhance the incorporation of different biotools with chemical and ecological classifications and their potential suitability for following the spatial and temporal evolution of spills: e.g. baseline and reference values, confidence levels, ability to combine results generated using test methodologies of varying levels of sophistication and across different levels of biological organisation.
4. Feedback and opinion of end users on the relevance of the proposed framework.

Wide dissemination of the resulting document to project partners, responders, expert advisory groups (already assembled for each project) and the wider scientific community will aim to enhance the guidelines available for risk assessment of spill situations. The overall aim is that the guidelines generated by the project will support better integration of research activity into spill response mechanisms and decision-making systems will support the adoption of best operational practice across the member nations and inform future EU policy. Distribution of results at different levels (scientific publications, website, and public engagement activities) will underscore the importance of adopting the guidelines for society in general.

EXPECTED RESULTS AND IMPACT

Guidelines to aid the integration of biotest results into the decision making process would be of huge benefit for responders and directly addresses the policy need of improved risk assessment methodologies. The project partners have extensive experience in assessing accidental marine pollution and strong interactions with spill response organisations for their respective countries. This project therefore provides a great added value to AMPERA in meeting its aims to develop trans-national networks and to enhance European competitiveness through the development and integration of new and emerging technologies into current best practice.

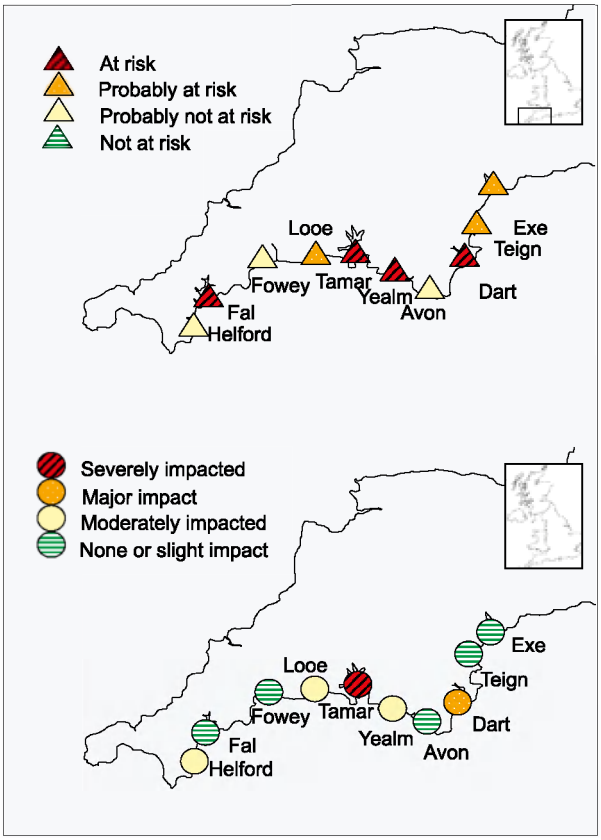

Figure 5.
Classification of estuaries in South-west England: Point source pollution classification (top); biomarker classification (bottom).

Overview of funded research projects

DRIFTER

HNS, Oil and Inert Pollution: Trajectory Modelling and Monitoring

The success in the management of a marine pollution accident that involves a spill depends on several factors such as the ability to detect the spills, the capabilities to follow the movement of the slicks, and the capabilities to predict the fate and behaviour of the pollutant over time. Different approaches and technologies can be applied for those purposes that will support the decision making process in terms of equipment deployment and protection of sensitive areas. The use of tracers (buoys and dyes) is common to follow the location of spills on a continuous way. However, their behaviour is not exactly the same of the followed product being necessary to know the difference of the drift between the real spill and the tracer. Modelling tools allow for analyzing and forecasting the motion of pollutants but calibration and validation studies are needed to improve their reliability. In the other hand, Synthetic Aperture Radar (SAR) has demonstrated to be a suitable tool for the monitoring of oil spills at sea. Nevertheless, the discrimination of oil spill in SAR images can be complicated by other phenomena which resembles oil spill.

Although the effectiveness of all these technologies that contribute to a better localization and follow up of slicks has been demonstrated during recent spill events, limitations and gaps still remain and deserve additional efforts. DRIFTER approaches these gaps and focuses on the development and improvement of detections and forecasting technologies.

Coordination
CETMAR – Centro Tecnologico del Mar, Spain

Partners
METEOGALICIA, Spain
INTECMAR – Instituto Tecnológico para el Control del Medio Marino de Galicia, Spain
University of Vigo, Spain
CEDRE, France
IST – Instituto Superior Técnico, Portugal

Duration
24 months

Budget
408038 EUR

Funding agencies
Xunta de Galicia – Consellería de Innovación e Industria, Spain
ANR – Agence Nationale de la Recherche, France
FCT – Science and Technology Foundation, Portugal

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OBJECTIVES

The specific objectives are the following:

1. Improvement of the capability to follow up spills by:
   i) Identification of the most suitable drifting buoys to be used for the different types of spills.
   ii) Exploration of application of dyes to mark a colourless slick of chemical.
   iii) Application of satellite and remote sensing technologies.
2. Improvement of the capability to forecast drifts of oil, hazardous noxious substances (HNS) and inert.
3. Review, identification and adaptation of oil spill monitoring and forecasting technologies to predict the behaviour and drifts of HNS and inert.
4. Elaboration of protocols for data exchange and management.
5. Wide dissemination of results to stakeholders and end-users.

WORKPACKAGES

WP1. Drifters field testing.

WP1 is addressed to test and improve different systems to follow the position of a spill. Existing drifting buoys and dyes will be investigated and discussed and drifter performance during past accidents will be analyzed. Field exercises and technological improvements will be carried out. The most suitable drifting buoys and dyes to be used for the different types of spills will be identified and guidelines for their application will be issued.

WP2. Modelling tools.

WP2 will assembly the operational oceanographic and meteorological models that feed the Lagrangian dispersion models at the coast. Lagrangian model will be calibrated under different conditions and a semi-operational system for drift modelling will be performed. The applicability of previous developments in oil spills for chemical and inert spills will be assessed and the coefficients for different kinds of inert pollution will be fixed up.

WP3. Validation of spill drifts using remote-sensing data.

WP3 is addressed to identify the most suitable automated or semi-automated oil spill detection systems applying spectral studies on contaminant hydrocarbons in oceanic waters using field spectro-radiometer operating in the UV-Vis spectral region and SAR imagery. Lagrangian dispersion models will be validated using the SAR images taking into account the meteorological and oceanographic conditions provided by modelling and observational systems available in the area.

WP4. Protocols for usage of drifters in HNS, oil and inert pollution.

Diverse protocols addressed to stakeholders for the use of tracking technologies for the spill monitoring (HNS,

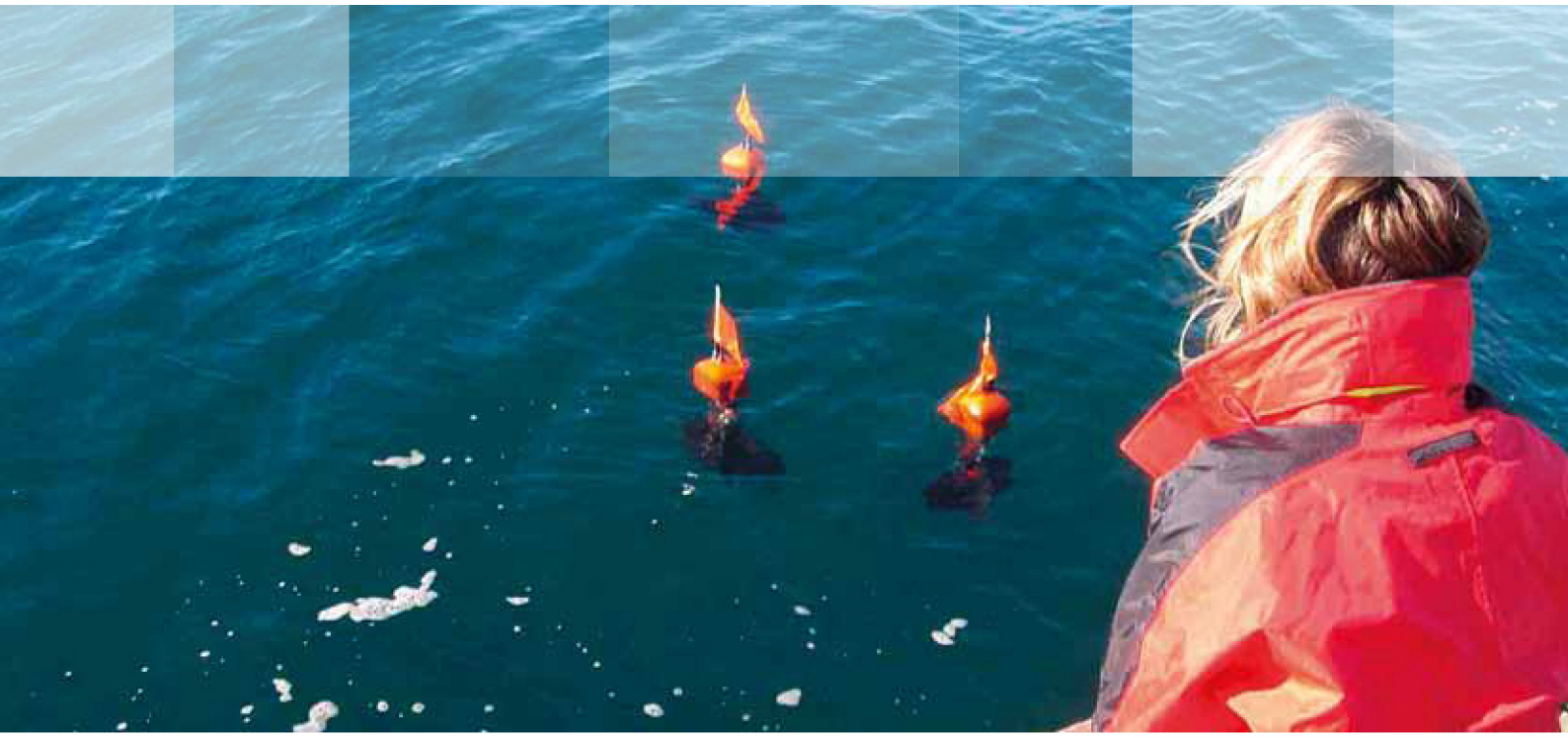

Figure 5. Drifting buoys for field testing.

oil and inerts) during a crisis will be elaborated. The protocols will take into account how information must be shared between operating groups and how crisis managers must be informed.

WP5. Coordination and results dissemination.

WP5 will put in place means and mechanisms to widely disseminate the project results and will ensure that the project is developed as committed within the time and with the resources planned.

EXPECTED RESULTS AND IMPACT

The expected outcomes of the project are of high applicability and include among others guidelines for drifters and dyes application, wind and wave coefficients, operational models, good practices protocols for communication and data exchange, new algorithms for segmentation, characterization and discrimination of oil spills, spectral studies of the different pollutants and information on the most adequate bands for their detection. They will be transferred to key stakeholders and organizations in charge of spill response by using different channels of communication: partner web sites, participation in conferences and congresses, publication of scientific articles and organization of a Workshop at the end of the project. Moreover, a site of reference will be created on INTECMAR web site that will include field measurement observation data obtained with the different drifters, the simulations obtained with the different models as well as the coefficients and their technical features. Data will be downloaded from this website to be used by other researchers working on this field. This site will be kept operational after the project lifetime.

The project approaches are of immediate relevance for other coastal areas. A solid knowledge of trackers behaviour and dyes performance can be useful, no matter where they are used, in order to have the real position of the spill in a continuous way. The expected

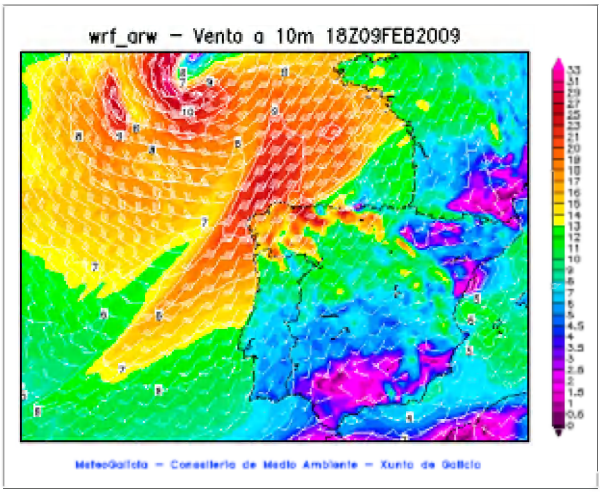

Figure 6.
Surface wind. Operational Meteorological model at MeteoGalicia. Grid 12 Km.
© MeteoGalicia, Xunta de Galicia, Spain.

development and improvement of modelling tools will provide the knowledge and technology required to more easily predict the trajectory and behaviour pollutants in other regions as they are scalable and adaptable to different geographic areas. Information on Drifter outcomes will be distributed to a wide range of policy makers and stakeholders from coastal EU countries.

Overview of funded research projects

RAMOCS

Implementation of Risk Assessment Methodologies for Oil and Chemical Spills in the European Marine Environment

Oil and chemical spills occur in all over the regional seas of Europe particularly in the English Channel and the Galician coast. The number of registered maritime accidents in the EU waters involving chemicals or oil spills since 1957 to present is over 150 encompassing a large variety of oils, chemical products and hazardous noxious substances (HNS). Nevertheless, the impact into the marine environment is largely dependent on the characteristics of the spilled product, volume and the area where the accident happened. Therefore, the assessment of the risk associated with the commonly transported products along the EU waters is an aspect of great importance in order to establish adequate contingency plans and to establish the countermeasures to fight against the originated pollution. In this context, the development of fast and reliable analytical methods for pollutant source identification and early warning standardized bioassays to assess the effects of the chemical spills to the most sensitive species of the different marine ecosystems are important research needs. All these issues will be developed in the RAMOCS project.

Coordination
CSIC – Consejo Superior de Investigaciones Cientificas, Spain

Partners
Plymouth Marine Laboratory, UK
NIVA – Norwegian Institute for Water Research, Norway
University of Vigo, Spain
CIIMAR – Centre of Marine and Environmental Research, Portugal

Duration
36 months

Budget
554597 EUR

Funding agencies
MICINN – Ministry of Science and Innovation, Spain
Defra – Department for Environment Food and Rural Affairs, UK
RCN – Research Council of Norway, Norway
FCT – Science and Technology Foundation, Portugal

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OBJECTIVES

The primary objective of this proposal is to develop fingerprinting tools for heavy oils and new products and to assess their risk in spills in different European regional seas scenarios.

The consortium brings together the expertise in environmental and analytical chemistry, ecotoxicology and marine pollution, and aims at defining a European strategy for risk assessment of accidental marine pollution.

The specific objectives are the following:

1. To improve fingerprinting tools for heavy oil for source recognition in the marine environment.
2. To improve assessment tools for heavy oil weathering in the marine environment.
3. To develop strategies to assess the major weathering processes (dissolution, evaporation, photooxidation, biodegradation) affecting the spillage of hazardous noxious substances.
4. To develop methodologies for identifying the toxic species occurring in the spills by using bioassay-directed analysis.
5. To establish toxicity thresholds of toxic components in sensitive species considering single and combined joint effects.
6. Application of the developed tools to several case studies and define a general strategy to be included in the response/contingency plans, for its use in a European dimension.

WORKPACKAGES

WP1. New fingerprinting tools for source recognition and weathering status assessment of heavy oils and related products.
Conventional fingerprinting techniques based on GC-MS will be intercompared with GCxGC-ToF for source recognition of heavy oils. Moreover, alternative indexes based on molecular markers to assess the contribution of the different processes affecting to the weathering will be developed.

WP2. Methodologies to investigate the contamination following organic and organometallic chemical spillages.
Methodologies and approaches to assess shipping accidents involving the transportation of hazardous and noxious substances will be developed. Chemical products will be prioritised according with guidelines/databases and shipping volumes.

WP3. Chemical characterisation of toxic compounds in oil and its weathered products.
The toxic components of oil and its weathered products will be characterised using bioassay-directed chemical analysis.

WP4. Evaluation of toxicity thresholds for sensitive species. Early warning tools.

The toxic compounds prioritised in WP3 will be tested in different bioassays and sensitive species representative of different marine ecosystems. The risk of the occurrence of toxic components will then be evaluated from the PEC/PNEC ratio considering both single and multi-component exposures.

WP5. Prediction of oil and chemical spill impacts in selected European marine ecosystems.

The vulnerability of different European ecosystems namely Mediterranean, North Atlantic and North Seas in case of oil or chemical spills will be evaluated. Therefore, the risk assessment from PEC/PNEC of sensitive species will be estimated at the different regional seas.

EXPECTED RESULTS AND IMPACT

The RAMOCS project will identify and prioritise the oil products and transported HNS through the EU marine environment. A list of the 10 most dangerous chemicals and the strategies to assess their impact in the marine environment will be issued. Fast fingerprinting tools to assess the source recognition and the weathering processes will be developed. Toxic products originated during the oil weathering will be identified by using a combination of bioassays and chemical analysis. The PNEC of oil products and prioritised HNS will be determined by using a variety of endpoints and sensitive species characteristic of different EU marine ecosystems. Finally, the risk associated to the different oil products and HNS will be estimated from the PEC/PNEC ratios for the different bioassays.

This project is closely aligned to TOXPROF and common standardized methodologies (i.e. water accommodated fraction, oil weathering) will be used. A kickoff meeting held in Oslo (1-2 October, 2008), allowed establishing a consensus approach. Workshops will be carried out in several marine stations where exposure experiments to different bioassays will be performed with the same chemicals and weathered products.

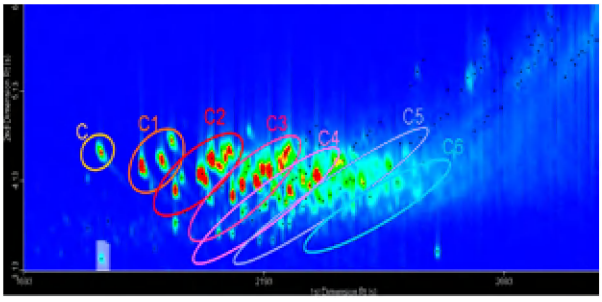

Figure 7.
Bidimensional contour plot of the carbazole fraction from a heavy fuel oil obtained by GCxGC-ToF MS. © IDAEA-CSIC, Nuria Jiménez, Spain.

TOXPROF

Toxicity profiling of the major EU transported HNS and oil types

The Oslo and Paris (OSPAR) Commission in 2006 requested that ICES, through the Working Group on the Biological Effects of Contaminants (WGBEC), consider and assess the long term impact of oil spills on marine and coastal life as requested from OSPAR and provide a guidance document on the use of biological effects techniques for oil spill situations. In addition to providing a background document (ICES WGBEC Report 2006), the working group concluded that research was required on the toxicity profiling of t he major oil types transported in a given region. Toxicological profiling/hazard identification using bioassays should be employed to determine the responses to the given oil types. The importance of undertaking this research is to establish the applicability of biological effects techniques (bioassays and biomarkers) for risk assessment, management and policy purposes after oil spill accidents. The primary objective of this project is therefore to toxicologically profile the major oil types and Hazard ous and Noxious Substances (HNS) transported within EU waters using the suite of bioassays and biomarkers recommended by the ICES WGBEC. The proposal is closely aligned with RAMOCS (Implementation of Risk Assessment Methodologies for Oil and Chemical spills in the European Marine Environment) and will provide data and use the same protocols where necess ary as RAMOCS in order to maximize synergy. TOXPROF and RAMOCS will as far as possible work on the same oils and HNS and all workshops will be common to the two projects. Quality assurance/control of the tests performed will be guaranteed through the testing since both Cefas and NIVA run the BEQUALM QA/QC scheme for biological effects monitoring in the marine environment.

Coordination
NIVA – Norwegian Institute for Water Research, Norway

Partners
Cefas – Centre for Environment, Fisheries & Aquaculture Science, UK
University of Oslo, Norway
IEO – Oceanographic Centre of Murcia, Spain
IFREMER – French Institute for Exploitation of the Sea, France
CSIC – Consejo Superior de Investigaciones Cientificas, Spain

Duration
24 months

Budget
421120 EUR

Funding agencies
RCN – Research Council of Norway, Norway
Defra – Department for Environment Food and Rural Affairs, UK
IFREMER – French Institute for Exploitation of the Sea, France
ANR – Agence Nationale de la Recherche, France
MICINN – Ministry of Science and Innovation, Spain

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www.niva.no/toxprof

OBJECTIVES

The primary objective of this proposal is to toxicologically profile the major oil and HNS types transported within EU waters using a suite of bioassays and biomarkers recommended by the International Council for Exploration of the Seas (ICES) Working Group for Biological Effects of Contaminants (WGBEC).

Toxicological profiling / hazard identification using bioassays is required to determine the responses to the given oil types. The importance of undertaking this research is to establish the applicability of biological effects techniques (bioassays and biomarkers) for risk assessment, management and policy purposes after oil spill accidents.

The specific scientific objectives of the proposal are:

1. Select and chemically characterise the major oil and HNS types being transported within the EU.
2. Toxicity profile the 8 major transported oil/ HNS types (in weathered form) using a suite of bioassays.
3. Toxicity profile 3 of the major transported oil types (in weathered form) using a suite of bivalve and fish biomarkers.
4. Identify the petrogenic components responsible for the observed effects.
5. Publish and disseminate the data along with a guidance document so that they can be used to inform oil spill risk assessments.

WORKPACKAGES

WP1. Oil/HNS selection and physical and chemical characterisation.

An assessment will be made of the major oil types transported within the EU marine area. In the first part of the study an investigation will be performed (all partners) in order to determine the different types of oils that are transported by sea. The results will be expressed as well as in quantities as in quality of oils (types of oils: light, heavy, sulfur rich content, crude oils, refinery products). A typology and classification will be assessed allowing the selection of the oils that will be used for toxicity assessment.

WP2. Bioassay profiling.

In this programme of work bioassays will be selected that have been frequently used in oil spill scenarios and

those recommended for such purposes by OSPAR (ICES 2006) and in addition those that use sensitive life stages and/or species that represent important phyla in the ecosystem. In addition, techniques have been selected that use species that are ubiquitous / common in the European Maritime area.

WP3. Biomarker profiling.

Toxicity profiling of the selected oils will be performed on both dispersed and weathered oils using representative fish and bivalve species for the different European geographic regions. As for bioassays (WP 2), the responses of model organisms (i.e. toxicity profile) will be studied at different concentrations. The methods used in the profiling will be selected according to the list recommended by ICES WGBEC (ICES WGBEC 2006), but also from previous knowledge from monitoring studies (Erika, Prestige, offshore effluents).

WP4. Effects-directed identification of toxic components.

Effects-directed analysis (EDA) can be used to identify the toxic components of complex mixtures through separation procedures directed by bioassays. EDA will be used in TOXPROF following biomarker and bioassay profiling where significant ecotoxicological effects are observed that are not consistent with the known chemical composition. EDA will be used to identify which oil components are responsible for these effects.

WP5. Data evaluation, dissemination and reporting.

As will be evident from the above, different crude oils vary in their composition, but they are all complex mixtures of (mainly organic) substances. Weathering will further serve to modify the composition and increase the range of potentially biologically active compounds in water. It is clearly impossible to be able to directly link all (expected) biological responses to specific components in the oils. This WP will use data from WP1 (characterisation), which will be combined wherever relevant according to chemical/physical properties and biological activity (QSAR assessment). Any relationship between grouped and grouped chemical data with the range of biological responses measured will then be assessed using multivariate techniques (simple PCA and PLS models).

The data generated for each major oil type will be statistically evaluated and compared. From these data and evaluation will be made on the applicability of biological effects techniques (bioassays and biomarkers) for risk assessment, management and policy purposes after oil spill accidents.

The output of the project will be published in peer-reviewed publications submitted to high quality journals (e.g. Environmental Science and Technology and Environmental Toxicology and Chemistry). The recommendations of the project will be made available via the AMPERA and TOXPROF websites and a 1 day open workshop to be held at the end of the project. The workshop will target both policy decision makers and scientists.

EXPECTED RESULTS AND IMPACT

The expected results of the project are bioassay and biomarker data for a selection of oils which represent the most heavily transported in Europe. The bioassays and biomarkers used are those recommended by ICES and are therefore widely used and have appropriate QA/QC in place. In addition the most toxic fractions of the selected oils will have been characterized to identify which oil components are responsible for the effects observed.

The impact of these data is clear. Should oils be spilled in the future there will be a set of reference data available for a number of heavily transported oils that will allow a better understanding of the risks associated with such oils. These data in combination with the risk assessment tools developed in the RAMOCS project will be a significant advancement in our understanding of oil effects post spill.

This publication was produced within Work Package 4, Task 4.1.
– Promoting the exchange of information and diffusion of AMPERA results, under the lead of FCT, Portugal.
Project funded by the European Commission under the Sixth Framework Programme
Contract ERAC-CT 2005-016165

AMPERA

European Concerted Action to foster prevention and best response to Accidental Marine Pollution (2005-2009)

AMPERA, a EU 6th Framework Programme ERA-NET, endeavors to create a platform where governmental policy-makers and scientists from European coastal countries could meet to discuss R&D aspects of accidental marine pollution (AMP), and to provide guidance to implement EU-wide measures as required. By moving towards the coordination – and eventual integration – of national and regional AMP research programmes, the network proposes to maximise the EU's research output and make important contributions to the protection of Europe's coastal ecosystems and economies. This is the first time that European national funding agencies combine efforts to enhance coordination and plan a more efficient use of existing RTD capabilities for preventing and better responding to accidental marine pollution incidents.

The specific objectives of the AMPERA project are to:

1. Set priorities in transdisciplinary AMP research, including policy and socioeconomic aspects, providing incentives for initiating new or strategic areas of innovative research.
2. Improve linking of AMP research with prevention and mitigation activities, to underpin and emphasize the role of sound knowledge in decision making.
3. Improve coordination of national and regional research programmes on AMP.
4. Design strategies to overcome barriers that hinder trans-national co-operation aimed at opening up of national/regional programmes.
5. Launch long-term RTD strategies, by identifying synergies and complementarities that will act as nuclei for sustainable co-operations between partners and improve the use of R&D outputs.
6. Disseminate of knowledge at different levels, underscoring the science-public interface and the importance of adopting this approach for society.

AMPERA partner organizations

The AMPERA consortium is composed of a total of 10 partner organizations from 8 European countries. All these organisations have initiated and managed a national strategic research programme on AMP or have related programmes in different degrees of development.

1. MICINN – Ministry of Education and Science, Spain
2. IFREMER – French Research Institute for the Exploitation of the Sea, France
3. Defra – Department for Environment Food and Rural Affairs, UK
4. EstSF – Estonian Science Foundation, Estonia
5. BELSPO – Belgian Federal Public Planning Service Science Policy, Belgium
6. FCT – Science and Technology Foundation, Portugal
7. RCN – Research Council of Norway, Norway
8. MI – Marine Institute, Ireland
9. Conselleria de Innovación e Industria – Xunta de Galicia, Spain
10. Marine Board – European Science Foundation