# ERIKA VS PRESTIGE : TWO SIMILAR ACCIDENTS, TWO DIFFERENT RESPONSES. THE FRENCH CASE

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## ABSTRACT

*The aim of this paper is to make a comparison between two major accidents involving Heavy Fuel Oil (HFO) that affected the French coastline: the ERIKA spill in 1999 and Prestige in 2002.*

*The authors will analyse response techniques, strategies and organizational frameworks.*

*When the ERIKA sank in December 1999, 70 km off the French western coast, spilling 20,000 tons of heavy fuel oil, the French government had to face an unexpected major event that changed our way of dealing with a Tier 3 incident. As a technical adviser, Cedre knew that accidents occurring abroad (NAKHODKA, SEA EMPRESS,...) underlined the possibilities of recovering oil at sea not only as an argument or as a pretence of explaining expenses to the public, but as an efficient tool. Means and results were modest but significant when taking into account the sea conditions. Drifting predictions, organization of the recovery on the shore line and communication also had to be adapted when the crisis calmed down.*

*PRESTIGE sank three years later with the same persistent product but a larger amount of HFO (70,000 tons). In the ERIKA lessons conference in Brest in 2002, «What if the ERIKA has sunk off the coast of Galicia » a similar scenario has already been considered.*

*Our paper describes the various steps of the response to these two incidents in terms of early response, response at sea by specialized vessels and by fishing vessels, aerial surveillance (specialized aircraft, satellites), analysis of drifting models results, communication, data management of the recovery (at sea and on the shore line) use of GIS, international relationships, state organizations, R&D...*

## INTRODUCTION

Large pollutions by Heavy Fuel Oil (HFO) do not constitute a new type of oil spill in France. Three major incidents involving these type of hydrocarbons have already affected the French coasts before 1999:

- TANIO (1980) spilled 6,500 tons of HFO on the northern coast of Brittany,
- AMAZZONE (1988) spilled most 2,100 tons of paraffinic oil when sailing 50 miles offshore the coast of Brittany, 450 km of which were polluted.

The aim of this paper is to make a comparison between two major HFO accidents that affected the coasts of France: the ERIKA spill in 1999 and the PRESTIGE one in 2002.

### Accident circumstances

It must be noted that the two incidents occurred in the north-south shipping lane leading to the English Channel, in two different locations well known amongst mariners for their crossed seas and long oceanic swells meeting the continental slope (figure 1).

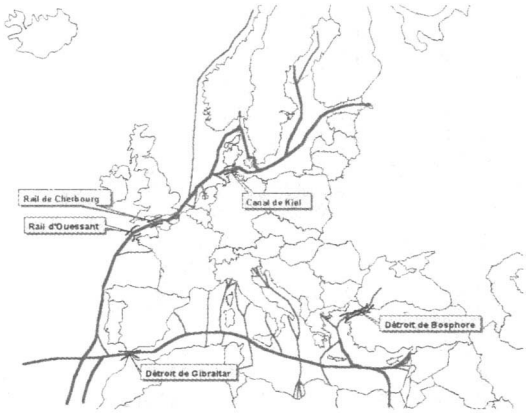



FIGURE 1 : MARITIME SHIPPING LANES IN EUROPE

The ERIKA and the PRESTIGE were both single hull tankers, transporting heavy fuel oils (37,283 tons for the ERIKA, 81,557 tons for the PRESTIGE) and respectively 24 and 26 years old. These two tankers sank in severe sea conditions in similar circumstances, creating massive pollution of the coast in Spain and in France.

### Incidents description

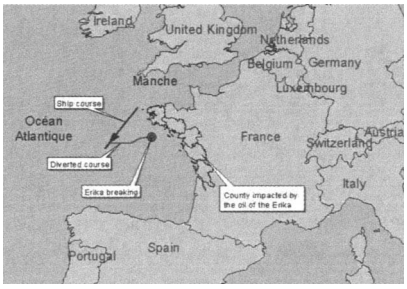



FIGURE 2 : ERIKA COURSE

| | ERIKA | PRESTIGE |
|---|---|---|
| Date of the event (first mayday) | 11th of December 1999 | 13th of November 2002 |
| Circumstances | Western winds force 8-9 ; Waves 6 m ; Fist mayday at 15:00 on Dec 11th | Western winds force 7 ; Waves 5 m ; Starboard list of 30° on Nov 13th in the afternoon. About 30 miles from the Cape Finisterre, propulsion failure, and first spillage noted. |
| | En route to St Nazaire harbour for shelter. | 24 crew men evacuated by Sasemar helicopters. |
| | On Dec 12th , Mayday. Crew evacuated by French and British helicopters. | On Nov.14th, ship towed in rough seas, towards the north-west, then south, and finally SW when she breaks into two parts (19/11). |
| | Ship breaks at 08:15 LT 30 miles south of Brittany. | On Nov 19th, vessel breaks in two parts, which sink 133 nautical miles off Galicia. |
| | Bow sinks in the night Dec 12-13th, 30 nautical miles from the coast of Brittany. | |
| Estimation of the quantity spilled after the breakage | 7,000 to 10,000 tons | 15,000 to 20,000 tons |
| Real quantity released (checked after pumping the wrecks) | 20,000 tons | 64,000 tons |
| Towing operations | Stern is towed away from the coast during 24 H. | The ship is towed away from the coast during 6 days. |
| Wrecks | Lay at a depth of 120 m. 10 km each from the other. | Lay at 3,750 m depth. |

**Table 1 : Circumstances of the incidents and events following the first "Mayday"**

The ERIKA launched her "Mayday", while she was en route for the harbour of Saint Nazaire to look for shelter, despite the reluctance of the ports authorities (figure 2). When she was allowed by her owner to make for the port of Donges (Saint Nazaire), she was 300 km from Ushant, 350 km from Donges and 300 km from La Coruña, quite in the middle of the Biscaye Bay. Cape 210, she received the 6 m waves at 20-30 degrees starboard and 6 meter residual swells.

When the tug boat "Abeille Flandres" arrived on location the ERIKA was already broken and the bow had disappeared. The stern of the ERIKA, drifting at 3 knots towards the south of Brittany and the intention was to tow the aft section away from the coastline. In the event, the stern sank, 24 hours after being hooked up to the tug.

The scenario for the early phase of the Prestige was quite different. The PRESTIGE was towed for 5 days before breaking and sinking. The orders given to the tug were obviously to take PRESTIGE away from the Spanish coastline (figure 3).

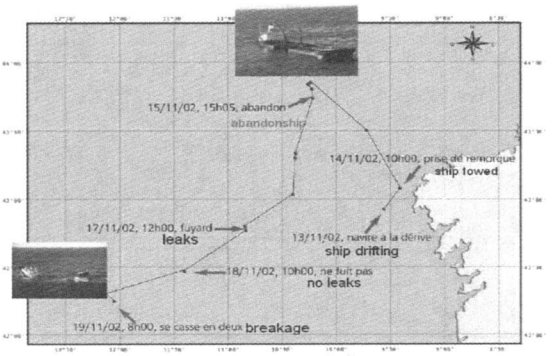



FIGURE 3: ROUTE OF PRESTIGE DURING THE TOWING OPERATIONS

The progression of the towed ship still seems to be erratic (NW, S, SW) but is not. This apparently erratic progression is due to several reasons:

- the necessity to adapt permanently the course of the injured vessel to the bad weather conditions,
- the fact that the salvage plan suggested by SMIT was adapted two days after the initial incident,
- the reactions of the French and then the Portuguese authorities, which were sceptical about the towage course decided by the Spanish authority.

## POLLUTANT PROPERTIES

The physical and chemical properties of the two fuels differ on parameters described in table2. A slightly higher density for the ERIKA one and a thicker one for the PRESTIGE.

| Parameter | ERIKA | PRESTIGE |
|---|---|---|
| Density | 1.0025 | 0.993 |
| Pour Point | +3°C | +6°C |
| Viscosity (50°C) | 555mm_/s | 615mm_/s |
| (10°C) | 20,000mm_/s | 50,000mm_/s |
| Asphaltenes | 3.78% | 12.4% |
| Aluminium | 36ppm | - |
| Nickel | 45ppm | 12ppm |
| Sulphur | 10.8ppm | - |
| Vanadium | 82.7ppm | 76ppm |

**Table 2: characteristics of the two fuels.**

Pour point is a parameter that needs to be well understood. The PRESTIGE cargo has a pour point of + 6°C. If one considers the temperature of the sea bottom at 3,800 m (+ 2.5 °C), even as soon as the entire cargo cools and reaches the bottom temperature (that normally takes a few months for the all cargo), the cargo would be still pasty and would be still able to seep up to the surface through the vents holes and the small gaps of the damaged hull. The misunderstanding of this parameter lead to wrong assessments during the ERIKA incident as it was said that the remaining fuel would solidify in the wrecks after cooling.

### Polycyclic Aromatic Hydrocarbons

It was said that the French Government and TOTAL hid the fact that the fuel was carcinogen and the only explanation given by the media was that this was due to the fact that the cargo was not a HFO but an industrial waste. After crossing the analyses from many laboratories (French Institute of Petroleum, University of Bordeaux, Ifremer) it appeared that the PAH amount was typical of that contained in a "normal" HFO, based on the analysis of the 16 PAH defined by the Environmental Protection Agency taken as references to evaluate the hazards in case of exposure. Medical experts issued reports on the toxicity of the fuel on the 21st of December 1999, 9 days after the sinking of the ERIKA.

For the PRESTIGE, the experience gained during the ERIKA was beneficial and clear notices were sent to mayors and to relevant administrations before the stranding of the oil. Volunteers were warned by the mayors and encouraged to stay at home.

### Behaviour of the fuels at sea

The two heavy fuel oils are close in their composition. Evaporation, solubility, amount of water in the emulsion (65% maximum) and stability, density increase and degradation (20% of the compounds are said to be biodegradable) are generally the parameters that are taken into consideration when an hydrocarbon is released at sea.

With a viscosity of 50,000 cSt at 10°C it is obvious that it was impossible to use dispersants. With 50% water content, the viscosity of the emulsion, reached 200,000 cSt and the pollutants resembled a heavy sticky paste, that was difficult to recover with skimmers. Whereas the fuel from the ERIKA remained two or three weeks at sea as thick patches of 10 to 100 metres diameter or more, the PRESTIGE oil stayed a very long time drifting at sea (six months and more), leading to the adaptation of response recovery techniques at sea: fishing nets handled by fishing boats, and hand-made recovery devices specially designed for drifting "pancakes" (after 4 months at sea). Small pieces(a few centimetre diameter) and droplets were almost impossible to detect and to recover at sea after a 6 months drift.

### Oil sinking

The evolution of the density of the oil spilled at sea is a result of the evaporation of the lighter fractions and of the incorporation of seawater as well as the absorption of sediments in coastal zones and estuaries (with lower water densities). It can be considered that 5 to 10% of the mass of HFO disappear by evaporation.

Operations to remove sunken oil were difficult to undertake. Divers were involved on the heavy spots of Belle-Île and dredgers in the entrance of the "Traict du Croisic" (contaminated sediment).

Another question still without clear answer is the dolphin behaviour of some slicks. Observers at both incidents reported that slicks drifting at the sea surface in the afternoon were impossible to locate in the morning. Is that phenomenon due to air bubbles trapped inside the sticky emulsion and expanding when exposed to the sun or variation of the sea surface layer density? Experiments should be carried out to explain this behaviour.

## DRIFTING OF SLICKS AT SEA (Table 3)

Since 1998, the software MOTHY, handled by Meteo France, has been used by *Cedre* in order to predict the drifting of floating oil for the account of the French authorities. An engineer of Meteo France is on duty 24 hours a day, to give weather forecasts and to activate MOTHY, when required.

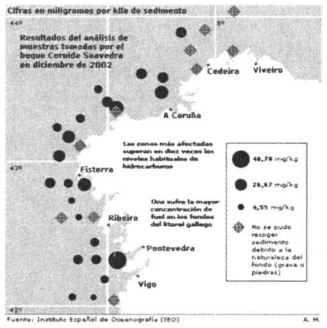
### ERIKA

The first aerial observations (French Navy and Customs aircraft) revealed several slicks, among them one of 15 km length, the volume of which was estimated at 3,000 tons, drifting to the East at a speed of 1.2 knots. During the following days, other aerial observations showed two strings of patches elongated in the set of the wind and located to the east of the wreck probably resulting from the first release of oil when the hull was broken. Two other slicks surfaced above each part of the wreck, the one above the bow being very diffuse and thin. The thick patches (5 to 8 cm) forming strings drifting along the coast broke up into smaller ones. On December 16th, small slicks 100 meters in diameter gathered in a 25 x 5 km area. As from December 17th, these patches and slicks began to sink a few centimeters below the sea surface.

### An unexpected stranding

The first stranding on the shore occurred on December 23rd, on Day 11 on the south-west coast of Brittany, followed on December 26th by more severe impact on the eastern coast of Brittany, in Groix island, Belle-Île, Le Croisic and Le Pouliguen (figure 4).

This scenario was not forecast by Meteo Fance, who had said that the first impact would reach shores 200 km more South. Figure 4 clearly shows this sudden nooorthward change on December 21-22.



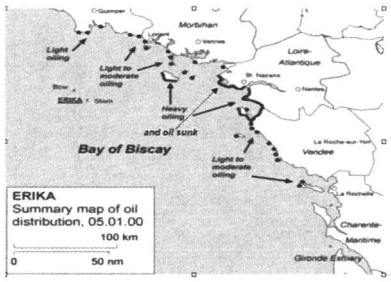




FIGURE 4

FIGURE 5: ERIKA: SUMMARY MAP OF OIL DISTRIBUTION AND OIL SUNK (ADAPTED FROM ITOPF)

Although, simulations are based on daily aerial observations, the problem is that in case of massive pollution and especially with heavy fuels and rough sea conditions, not all the oil patches can be spotted from the air. In other words, lacks and gaps do exist in the aerial coverage and mapping of a given zone in such conditions.

This could explain the unexpected arrivals on December 23rd on the shore of the South West of Brittany. Leaks during the ERIKA course towards the South (e.g. before the "Mayday" when she turned east towards the harbor of Donges-Saint-Nazaire) could be the source of those arrivals. These slicks were not detected and the simulations were made on the slicks appearing after the" Mayday" message when the ERIKA broke into two parts.

**Table 3: Summary of the drifting simulations and satellite evolutions between the ERIKA and the PRESTIGE spillage.**

| | ERIKA | PRESTIGE |
|---|---|---|
| SLICKS OBSERVATIONS | Incomplete | Incomplete |
| Route of the ship | Not taken into account | Taken into account |
| Choice of the starting points of the simulations | *Cedre* | Drifting committee |
| Old observations at sea | Not taken into account | Long term simulations using true winds |
| Satellite observations | No picture | Pictures but late and difficult to interpret. |

## PRESTIGE

One of the consequences of the ERIKA accident was to integrate Meteo France in the Crisis Management Centre as technical expert. This prerogative was written officially in a Prime Ministerial circular in 2001.

On Day 5, by decision of the Secretary General of the Sea, acting on behalf of the Prime Minister, a "drifting committee" was established and located in *Cedre* (Brest). All the French national institutes related to oceanography and surface drift prognosis were invited to participate in the committee activities: Meteo France, Ifremer, National Hydrographic Service, *Cedre*, Maritime Prefecture.

This committee met daily during 4 1/2 months and based its recommendations on the daily surveys, drifting buoys trajectory analysis, and oceanographic data. A chart was issued every day and made available to the authorities and to the public and posted within 24 hours the *Cedre* web site.

The trajectories of the various slicks were very complicated to follow in what we called in our Committee, "the washing machine" (covering thousands of km$^2$ in a zone where the currents were poorly known) (figure 6).

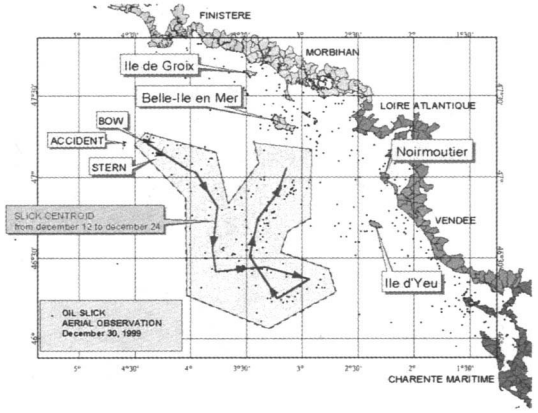



FIGURE 6: MAIN TRAJECTORIES OF THE ERIKA SLICKS

In order to remove the element of surprise from the slicks predictions, long term simulations were performed by taking into account the towing trajectory for the tanker and wreck locations. These simulations, cross-referenced with the drift buoy data (figure 7), helped the authorities in dealing with inquiries from the public, the media or elected persons.

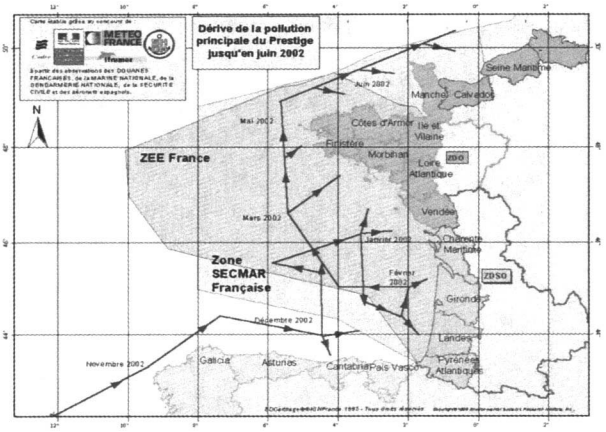



FIGURE 7: MAIN TRAJECTORIES OF THE SLICKS SPILLED FROM THE PRESTIGE IN THE BAY OF BISCAY AND THE CHANNEL

### Map presentations

Figures 8 and 9 show the evolution between the ERIKA and the PRESTIGE as far as cartography is concerned. *Cedre* and the drifting committee tried to improve the comprehension of the maps, and to avoid the counter-productive depiction of figure 7, which were considered as confusing and alarmist. The size of these heavy black spots showing the reported oil slicks could be out of all proportion to actual size of the slicks. For this reason the slicks reported during the PRESTIGE incident were represented by symbols so as not to confuse public opinion.

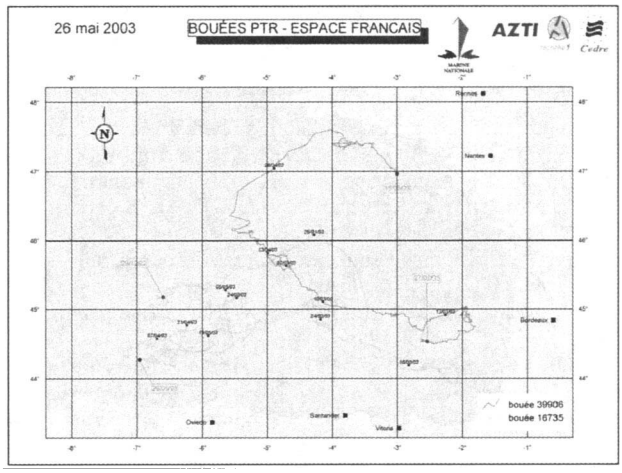



FIGURE 8: DRIFTING ROUTES GIVEN BY TWO SURFACE BUOYS

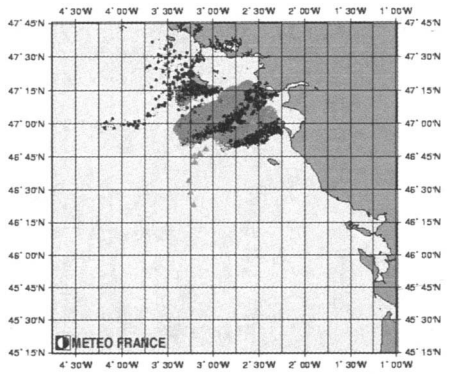



FIGURE 9: WORKING CHART PRESENTING 48 HOURS OPERATIONAL FORECASTS FOR DECEMBER 26, 2000 UTC. RED STARS FIGURE THE INITIAL POSITION OF THE SPILLS. BLACK DISKS SHOW THE FINAL POSITION OF THE SLICKS MODELIZED BY MOTHY. THE TRAJECTORIES OF THE DROPLETS ARE IN GREY. BLUE DISKS SHOW THE POSITION OF THE OIL RELEASED FROM THE WRECK. GREEN TRIANGLES ARE POSITIONS OF A DRIFTING BUOY.

During the PRESTIGE, we took the ERIKA experience and after a three weeks trial on our daily charts, we finally agreed on the type of map proposed in figure 10.

Simulation for 3 days have been shown and surveyed zones, aerial observations are noted in a GIS (Geographic Information System) format.

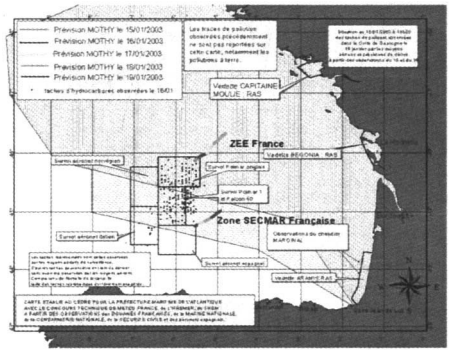



FIGURE 10: CHARTS ISSUED BY THE "DRIFTING COMMITTEE" DURING THE PRESTIGE (OBSERVATIONS AND SIMULATIONS)

### Satellite imagery

During the ERIKA spill, there were not any satellites observation available showing the drifting slick. Such imagery during the PRESTIGE spill was not always available or analysed in time and if it was the case, they still remain unanalyzed or poorly analyzed in due time, with the exception of a few images, such as that one showed in figure 11.

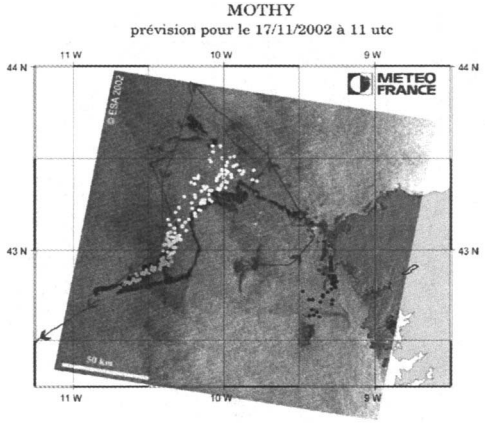



FIGURE 11: SATELLITE IMAGERY (ENVISAT), SHOWING THE SLICKS COMING OUT OF THE PRESTIGE DURING THE TOWING OPERATIONS AND UP TO DECEMBER 17TH, TWO DAYS BEFORE THE BREAKAGE OF THE SHIP (IN BLACK), TOGETHER WITH MOTHY SIMULATIONS (COLOURED DOTS) AND THE DRAWING OF THE PRESTIGE ROUTE (IN RED).

In 2004, this gap is on the way to be solved and algorithms are in progress to interpret these pictures in order to say whether the black zones can be considered as oil or not.

## FRENCH NATIONAL CONTINGENCY PLAN FOR MARINE POLLUTION FROM SHIPPING

Counter pollution at sea, even in case of a threat, is placed in France under the responsibility of the Port Admiral who is also the Navy officer in command for the Atlantic area. Thus the Port Admiral has access to naval resources. When pollution occurs at sea, he is in charge of pollution response and, in case of a Tier 3 incident, can active the national contingency plan for marine pollution from shipping called POLMAR Plan.

### ERIKA: at sea operations

On December 12th 1999, the Port Admiral implemented Polmar Plan (Sea) at 06.00 h.; 10 hours after ERIKA broke in two parts.

First French oil recovery vessel on site was "Ailette" on December 13th. But during the night waves reached more than 6 m (force 8 to 9), W NW, which made deployment of equipment dangerous.

First recovery attempts started on December 15th (Day 4) and were interrupted by very poor weather conditions, and the first attempt of boom deployment led to its rupture. The oil recovery devices were not adapted to this type of oil: sticky and viscous oil. The length of the hoses (70 metres) and their diameter (5 inches) didn't allow an effective and quick recovery. It turned out that the sweeping arm systems gave the best results thanks to their pumping arrangement.

On December 19th four oil recovery vessels were on location (French vessel, British vessel, German Vessel, Dutch Vessel), waiting for a slack period in the rough weather to work.

After a total of 24 hours pumping, on December 23rd recovery operations were interrupted due to the arrival of the pollution onshore, the non detection of floating slicks by aerial surveys and the forecast of gale force (force 10 to 11).

The total volume of emulsion pumped by the four boats was 1.100 $m^3$. Fishing vessels or vessels of opportunity were not much used during the ERIKA spill, mainly because there was no prior preparation to be on site in such a short period of time.

### PRESTIGE: at sea operations

A massive pollution reached the coasts of Galicia a few days after the first "mayday" and up to November 29th when the slicks entered the Biscay Bay. This phase is similar to the ERIKA spill in France: large patches of thick and pasty emulsion invading the coastal bays and beaches. In this phase, recovery operation by specialised vessels (a total of about 15 were working) helped in the sheltered areas by fishermen recovering oil with fully improvised tools including hands.

Oil patches and pancakes along the southern part of the Biscay Bay, polluted the northern coast of Spain (Asturia, Cantabrico, Euskadi) and the South West of France over a long period of time (December 5th to March 2003). Local authorities and fishermen had time to organise themselves and choose the best manual techniques to deal with the drifting oil. Their performance matched those of the specialised vessels. Basque fishermen took the lead in this party and some days, more than 200 Basque fishing vessels recovered up to 2,000 tons of emulsion and spoiled debris (figure 12). The organisation of the recovery at sea guided by AZTI helicopters together with the waste management in harbours was impressing.

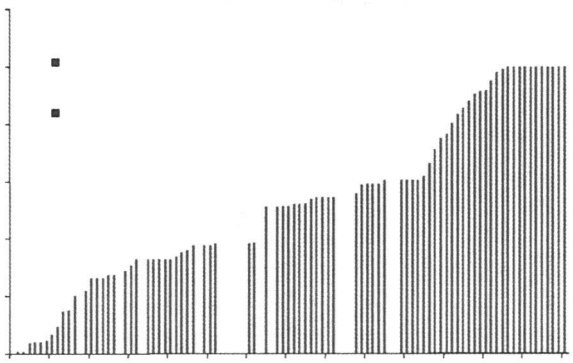


FIGURE 12: CUMULATIVE GRAPH OF THE RECOVERY AT SEA DURING THE PRESTIGE

**Table 4: Mass balance and efficiency of the recovery operations at sea during the ERIKA and PRESTIGE spill (in tons)**

| | PRESTIGE | PRESTIGE | ERIKA | ERIKA |
|---|---|---|---|---|
| | Wastes & emulsion | Fuel | Wastes & emulsion | Fuel |
| Specialised Vessels unloading in Spain | 14. 946 | 5.381 | – | – |
| Specialised vessels unloading in France | 1.081 | 350 | 1.100 | 600 |
| Specialised vessels unloading in Portugal | 160 | 60 | – | – |
| **Total Specialised vessels** | **16,187** | **5,791** | **1,100** | **600** |
| Fishing boats unloading in Spain | 34.924 | 15.737 | – | – |
| Fishing boats unloading in France | 1363 | 500 | – | – |
| **Total Fishing vessels** | **36,287** | **22,031** | – | – |
| Total unloaded in Spain | 49.908 | 21.122 | – | – |
| Total unloaded in France | 2.444 | 850 | – | – |
| Total Portugal | 160 | 60 | – | – |
| **Total recovered at sea** | **52,512** | **22,031** | **1,100** | **600** |
| Total recovered on land Spain | 90.149 | – | – | – |
| Total recovered on land France | 25.470 | 4.075 | – | – |
| **Total recovered on land (oil and oily wastes)** | **115,619** | **44,592** | 230.000 | – |
| **Total recovered (Oil and oily wastes)** | **168,132** | **44,592** | **230,000** | **1,100** |
| Total naturally lost | - | 4725 | – | - |
| In wreck or recovered from the wreck | - | 13.800 | – | 11.000 |

By the end of January 2003, the pollution drifted up in the Biscay Bay. Performance of the fishermen decreased due to the difficulty to locate the small pancakes and droplets.

## CONCLUSION

### Technical considerations

Beyond the behaviour of the pollutants, very similar for the ERIKA and the PRESTIGE, as far as France is concerned, impacts along the French coast line were very different: 400 kilometres of coast impacted among them 150 kilometres heavily impacted, for the ERIKA, and about 3,500 kilometres from the Spanish border up to the coasts of the North Sea impacted by moderate to light pollution, for the PRESTIGE.

If we consider the impact on the Spanish Coasts, it can be said that the Galician coast has been as polluted as the south of Brittany was during the ERIKA.

From the response point of view, each major crisis was a booster for R&D programmes and modified response schemes .Following the ERIKA wreckage, the government increased research funding under the authorities of various ministries: Industry, Research, Environment. Many of these programs are still in progress in relation with the French Navy and the State Acton at Sea. About 35 projects were financed, following the ERIKA spill. The PRESTIGE response benefit from these projects.

Vessels of opportunities and fishermen clearly have a role to play, specially in using nets, although these are only suitable for sticky and agglomerated pollutants.

**Table 5: Summary of the comparison of the ERIKA and PRESTIGE operations**

| | ERIKA | PRESTIGE |
|---|---|---|
| DRIFTING PREVISION | During 2weeks | During 6 months |
| DRIFTING MANAGEMENT | Cedre and Meteo France | Drifting committee<br>Drifting buoys |
| SHORE CLEANING | Particularly efficient | Efficient, slight tendency to beach over cleaning |
| WASTE MANAGEMENT | Poor<br>25000 tons of waste | Fair<br>well organized |
| AT SEA RECOVERY | Poor but significant in terms of possibilities | Excellent<br>Good management of fishermen |
| COMMUNICATION | Poor at the beginning, no website | Daily situation charts on Cedre website |

Among the points to be improved after the Prestige case, we note:

- management of aerial observation and transmission of the data.
- a correct reading of satellite observations and their transmission in due time to experts.
- interactive situation charts available to experts and authorities
- foreign participation to expert committees has to be encouraged.

**On the organisation point of view**

Among the various expert committees (wreck handling, public health, environmental impacts...), by decision of the Secretariat General of the Sea, the follow-up of the spill was achieved by an expert group gathering scientists from national institutes competent in oceanography, (Ifremer, Navy Oceanographic Service), meteorology (Meteo France), response at Sea (Navy) and pollution experts (*Cedre*). This group gathered every day during four months and produced daily forecast drifting charts and recommendation, after observing the results of aerial observation. The existence of this committee is now registered in the POLMAR Mer Plan. The authority of these experts effectively countered any opinion in the media.

Transboundary spills need an international response within national organizations. Scientific and experts go further than politics and it can be said that they open the way. This is one of the major lessons of these two spills. Experts meet each other in "peace time" and share information during the conferences organized everywhere in the world. The applicable rules are known and each pollution case is discussed in these meetings. It doesn't mean that all the experts agree on everything. Many approaches are different; but all of them show an interest in a well done job.

Experts work on a consultancy base; they give advice to authorities who are under the pressure of the politicians, the citizens, the local representatives and the media.

In France, The PRESTIGE didn't lead to a major public scandal or a general outrage as the ERIKA conveyed (over cleaning of beaches and cliffs, cancer phobia...).This could be explained by the way the authorities handled and framed the problem together with a different approach given by the experts, showing less certitude but assuring a continual presence at the sites.

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