UNITED NATIONS

EP

United Nations Environment Programme

Distr. LIMITED

UNEP (DEPI)/CAR IG.33/INF.7

5 July 2012
Original: ENGLISH

Fifteenth Intergovernmental Meeting on the Action Plan
for the Caribbean Environment Programme and Twelfth Meeting of the
Contracting Parties to the Convention for the Protection and
Development of the Marine Environment of the Wider Caribbean Region

Punta Cana, Dominican Republic, 25-27 October, 2012

RAC-REMPEITC
Activity Report: Development of a GIS-based database for Maritime Traffic in the Wider Caribbean Region

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REGIONAL ACTIVITY CENTER/REGIONAL MARINE POLLUTION EMERGENCY, INFORMATION and TRAINING CENTER (RAC/REMPEITC-Caribe)

Ref: Strategic Plan 10-11/ Activity 4.6.b.2 **July 4, 2012**

Development of a GIS-based database for Maritime Traffic in the Wider Caribbean Region

Activity Report

Submitted by Véronique Morinière and Anne Réglain

Summary: RAC/REMPEITC-Caribe provided oversight, technical instruction and management for the development of a GIS-based database for Maritime Traffic in the Wider Caribbean Region. The data were purchased from LMIU by the UNEP in 2009. The development of the project was funded by the IMO, effectively starting in January 2011, for a final release in July 2012.

Contents

1. Background and definition of the project

1.1. Background

In 2007, RAC/REMPEITC-Caribe (Regional Activity Center, Regional Marine Pollution Emergency Information and Training Center in the Wider Caribbean Region) identified a lack of relevant data on maritime traffic in the Wider Caribbean and the risks posed by it, as a significant impediment, both at the national and regional levels, to new prevention/response preparedness initiatives. The Wider Caribbean Region is one of the areas in the world with the largest maritime traffic; the Caribbean Sea is of tremendous economic significance to the population that relies on its resources. The possible social impact of ineffective prevention/response planning could be huge should an incident occurs.

The issue was also raised during a co-chair meeting organized by the White Water to Blue Water committee (WW2BW – http://www.ww2bw.org).

A project proposal was established by the REMPEITC in February 2009.

The Regional Coordination Unit of UNEP's Caribbean Environmental Project (UNEP CAR/RCU www.cep.unep.org), based in Jamaica, purchased data on the maritime movements in the region, from Lloyd's Marine Intelligence Unit (LMIU).

The International Maritime Organization (IMO) mandated the REMPEITC to carry out this project in 2010-2011, under the Activity 3 of the Technical Cooperation Programme No. TC/0202.

1.2. Objective of the project

To evaluate the maritime traffic in the Wider Caribbean Region in order to possess a basis for addressing the following:

- Risk analysis (evaluation of the Tanker traffic, HNS[1] traffic, Cruise traffic, etc.), especially regarding Oil and HNS spills;
- Implementation of the Special Area under MARPOL[2] Annex V: since May 2011, it is prohibited for any ship to discharge garbage into the sea, other than organic materials under certain conditions such as distance from shore and particle size.
- Supporting initiatives for the definition of vessel lane management schemes, of Particularly Sensitive Seas Areas, etc;
- Supporting the United Nations Declaration of the Caribbean Sea as a Special Area for Sustainable Development.
- Etc.

[1] Hazardous and Noxious Substances

[2] International Convention for the Prevention of Pollution From Ships

The project will help to develop a complete assessment of the maritime traffic in the Wider Caribbean to facilitate and strengthen national and regional prevention/preparedness in maritime environmental issues by compiling the information needed for a relevant risk analysis.

1.3. Brief description of the project

The project developed a GIS[3]-based database for use of the countries of the Wider Caribbean region. This database displays the maritime traffic, in a well-designed GIS format, available on-line, with the possibility to perform queries and apply filters on the display of the traffic flow (types or sizes of the ships, time period, crossings…) for specific analysis and/or risk assessments.

1.4. Wider Caribbean Region definition

The Wider Caribbean Region (WCR) is defined as the Gulf of Mexico and the Caribbean Sea proper including the bays and seas therein and that portion of the Atlantic Ocean within the boundary constituted by the 30° N parallel from Florida eastward to 77° 30' W meridian, thence a thumb line to the intersection of 20° N parallel and 59° W meridian, thence a thumb line to the intersection of 7° 20 N' parallel and 50° W meridian, thence a thumb line drawn southwesterly to the eastern boundary of French Guiana.

1.5. Phases of the project

The project comprised three main phases:

- collection of data;
- design of a computer model of shipping routes;
- creation of a web-mapping system allowing visualization, analysis and sharing of the data online.

1.6. Contractor Company

REMPEITC hired as Contractor the French company Makina Corpus to design the computer model and create the web-mapping system.

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www.makina-corpus.com

[3] Geographic Information System

2. Data

2.1. Data for the maritime traffic

a. Traffic flow: database on vessels' movements from LMIU

In 2009, UNEP CAR/RCU purchased a database containing historical data on the movements of all merchant vessels over 100 GT for the year 2007-2008, in Microsoft Access format from Lloyds Marine Intelligence (LMIU), for the following vessel movements:

1) From a port within the WCR to another port within the WCR;
2) From a port outside the WCR to a port inside the WCR and vice versa;
3) From a port outside the WCR to another port outside the WCR where the WCR was used as a transit route

The data included in this database from the LMIU were the following:

Vessel:

- IMO Number
- Vessel Type
- Double Hull Indicator (DB: Double Bottom, DH: Double Hull, DS: Double Sides)
- Vessel Name
- Vessel Flag
- Year of built (YOB)
- Gross Tonnage (GT): refers to the total internal volume of a vessel (corresponding tonnage if filled with fresh water)
- Deadweight Tonnage (DWT): measure of how much a ship can safely carry (including crew, passengers, fuel…), i.e. the actual weight of the vessel minus the lightship weight

Port of origin:

- Place ID and Name, Country, Coordinates, Departure Date

Panama Canal indication: Indicator (crossing or not), Direction (West or East) and Arrival Date

Port of destination:

- Place ID and Name, Country, Coordinates, Arrival Date

These data do not give information on the actual routes.

The model created for this project excluded all data for ships that had no IMO numbers. Also, the IMO number, the vessel flag, the year of built and the vessel name were not included in the database.

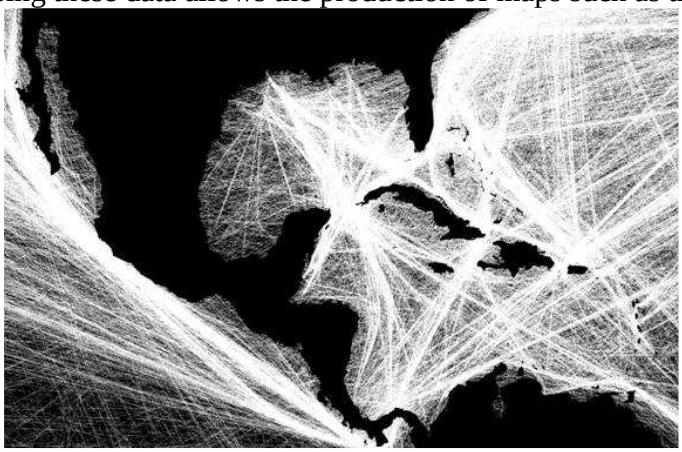
b. Data of the Commercial shipping lanes from the WMO VOS

The Voluntary Observing Ship (VOS) Scheme is an international program comprising member countries of the World Meteorological Organization (WMO) that recruit ships to take, record and transmit weather observations whilst at sea. When transmitting meteorological data, ships also transmit their geographic positions: by compiling these spatial data, a global view of the shipping lanes can be obtained. Because it's a voluntary program, not all ships participate (around 10%), thus the data cannot be used for maritime traffic flow analysis. However, they can be used to determine common waypoints.

Two international programs related to marine pollution prevention have been using and processing these data, and they made them available online for free in a GIS format:

- Halpern et. Al, *Global Map of Human Impacts on the Marine ecosystems*: http://www.nceas.ucsb.edu/globalmarine/impacts
- World Resources Institute (WRI), *Reefs at Risk Revisited*: http://www.wri.org/publication/reefs-at-risk-revisited

Processing these data allows the production of maps such as the following one*:



And by applying a filter extracting pixels representing the 5% highest intensity, we can obtain the following map*:

* Source: Jean-Nicolas Poussart, Grida, Jean-Nicolas.Poussart@grida.no

Therefore, even if these data do not give actual information on the traffic, they can be used to identify the main maritime routes.

c. Note on the AIS data

The Automatic Identification System (AIS) is an automated system used on ships and by Vessel Traffic Services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships and VTS stations. AIS information supplements marine radar, which continues to be the primary method of collision avoidance for water transport.

The International Maritime Organization's (IMO) International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be fitted aboard international voyaging ships with gross tonnage (GT) of 300 or more tons, and all passenger ships regardless the size.

By compiling data of ships positions from a VTS station, it is theoretically possible to know and display the maritime traffic within the area covered by this VTS station, though limited to a coastal range. But most of these VTS stations are privately owned (even when used by port authorities), and the REMPEITC was not successful in getting any AIS data records, and this idea was left aside.

2.2. Additional data

a. Previous spills

Though the REMPEITC does not maintain a database on oil spills or on accidents likely to cause spillages of oil in the WCR, a short list of major incidents was developed to be included in the tool.

b. Oil infrastructures

In association with ARPEL, the Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean, the Petroleum Economist Ltd. produced in August 2009 the “Energy map of Latin America & the Caribbean”.

The relevant data for risk assessments have been extracted from this map:

- Oil refineries: country, location (place name), company and capacity (b/d)
- Tanker terminals: country, location.

The additional data description is included in **Annex 2**.

2.3. Filters and corrections to LMIU database

LMIU's database included a number of irrelevant datasets, and filters were applied by Makina Corpus to put them aside. Some corrections were applied to the database to decrease the number of datasets put aside (see table 1).

This led to the following percentage of invalid datasets:

Total valid datasets: 235921
Total datasets: 247800
% of invalid datasets after corrections: 4.8 %

Nature of the problem	Corrections to the database	# of invalid datasets after corrections
Arrival date out of bounds (before 2007/1/1**)**	None	187
Departure date out of bounds (after 2008/12/31)	None	354
Arrival before departure	When the difference in dates was less than 5 days, arrival and departure dates were inverted	3767
No IMO number	None	3162
No destination coordinates	Port coordinates were manually included when the number of journeys to the port was higher than 7	2187
No origin coordinates	Port coordinates were manually included when the number of journeys from the port was higher than 7	2204
Inaccurate ports coordinates (wrong locations or ports located in the sea)	Port coordinates were manually corrected or datasets were put aside when the port coordinates could not be found	17

Table 1: Datasets filters and corrections

Note: in some cases, the name of the ports were changed for relevancy (e.g. the Netherlands Antilles were replaced by the names of the islands), and ports in five islands were grouped together because some datasets without coordinated did not mention the specific port (Antigua & Barbuda, Aruba, Curaçao, Dominica and St Lucia).

The list of corrections in port coordinates and names is included in **Annex 3**.

3. Computer model of shipping routes

The LMIU database of vessel movements is the most complete of its kind, allowing conducting many analyses. However, regarding spatial analysis, only ports have a known location, and the actual route followed by a vessel is not recorded. Therefore, an artificial model to characterize the movements between ports needed to be built. Makina Corpus designed a computer model of shipping routes which could be used to theoretically predict routes used by various ships.

Route computation is an active field of GIS, it is commonly used by SatNav devices or to make step-by-step itineraries. Car routing, pedestrian routing or even multi-modal routing is now accessible to everyone. On land, routing is easy, since existing infrastructures (roads, rails, paths, etc...) can be used to build a routing network. Many algorithms and tools are available for graph-based route computing.

On sea, however, there is no road network, and the usual routing tools do not work. Two options were tested by Makina Corpus to build estimated routes for the maritime traffic:

- to develop open space routing tools;
- to develop a graph-based model of maritime routes.

3.1. Open space routing

This was the first approach tested. Open space route computation uses a polygon representing safe navigation waters. A routing algorithm is created, to calculate the shortest line between two points without crossing any obstacle (coastline, islands). This approach did not prove to be satisfactory for this specific project for several reasons:

- it is extremely expensive with regard to computer resources (CPU[4], memory) and is not adapted to large datasets,
- it cannot easily handle routing constraints.

3.2. Graph-based routing

The second option tested and adopted was to develop a plausible maritime route network, where the traffic is artificially guided. This approach has the following drawbacks:

- if the maritime route network do not serve an area, this can lead to bias in analysis;
- a graph produces routes with angles (shortest on the graph but not in the real space).

But this approach also offers an interesting opportunity for movement aggregation. Using the same tools and techniques, it is easy to know how many movements matching a given condition travelled on a specific network segment. This matched the final goal of the project (traffic distribution analysis).

[4] Central Processing Unit

The actual network built for this project is a refined version of a maritime route model from the Canadian Transport Authority. The following changes were made to this existing network:
- to fix unconnected network edges;
- to connect LMIU ports;
- to redraw edges crossing the land.

In addition, adjustments were made with the VOS data, which were used to identify common waypoints and to correct the network manually.

3.3. Improvements needed

This approach and the network built will need some improvements in the future.

One of the main drawbacks of this approach is that the vessels have to follow the network, which may in some cases lead them to follow a route that is not the shortest route.

The current model will also need to be refined to take maritime constraints into account:
- to refine handling of tonnage constraints (only Panama canal has constraints so far)
- to include maritime knowledge: currents, prevailing winds, dangerous areas...
- to add the traffic separation schemes

4. Web-mapping system

4.1. Access to the online SIG

The URL of the web-GIS is http://www.caribbeanmaritimetraffic.org/. The application is hosted by Makina Corpus on its servers. It is required to log in with a username and a password, which will be provided by REMPEITC to its focal points and upon request.

Makina Corpus built the web-mapping system, allowing the user to apply filters on the traffic movements, to choose the preferred representation and options for the traffic flow, to generate reports and to export data.

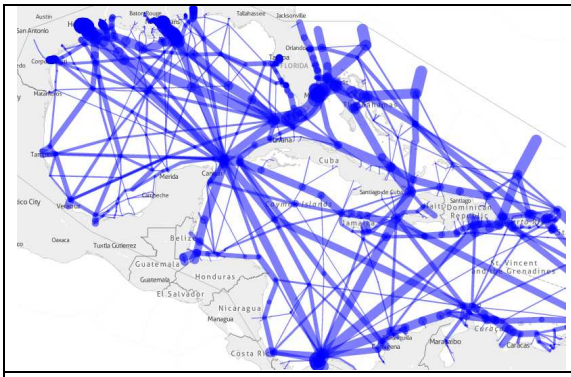
4.2. Criteria to calculate the traffic flow

There are two possible criteria to calculate and represent the traffic flow, and the user can choose which option he prefers:

- Number of vessel movements: the traffic flow is reflected by the total number of vessel movements (e.g. if 3 vessel movements are counted, the criteria will be 3);
- Total GT[5]: the traffic flow is reflected by the total GT (e.g. if 3 vessel movements are counted, the respective GT of the 3 vessels being 1313, 1731 and 437 tons, the criteria will be 1313+1731+437=3481 tons).

4.3. Display options

The maritime traffic can either be represented as routes or as heatmaps (**Figure 2**).



Routes: the thicker a route is, the higher the density on this route is	**Heatmaps**: the density in each square is color-coded

Figure 2. Maritime Traffic display options

[5] Gross Tonnage

4.4. Data layers

Data were divided in layers. The map layer (base layer) and the maritime traffic layer (routes or density) are always displayed. The following layers are optional, and the user has the choice to display them or not by checking the corresponding boxes:

- Ports: circle with a diameter related to the traffic flow;
- Major accidents: icon;
- Tanker terminals: icon;
- Oil refineries: icon.

Hovering over an arc (maritime routes) or a square (heatmaps), shows the corresponding traffic value (number of movements or total GT, depending on the traffic representation option chosen).

Hovering over a port, an oil refinery, a tanker terminal, or a major incident, shows information on the selected item.

4.5. Transit representation

To represent the transit traffic, i.e. movements of ships coming in and out of the WCR, a single artificial point was created for the Pacific side (Panama canal), and 8 points were artificially created in the Atlantic for the eastern boundaries of the Wider Caribbean Region.

4.6. Filters

The user has the option to apply filters on the vessel movements he wants to consider for his specific analysis. These queries apply on the maritime traffic layer and the port layer. The filters can be used simultaneously and the effects of the filters are combined.

a. Types of ships

The user can choose the types of ships for which the vessel movements are considered and displayed. The following categories and sub-categories are considered:

Category	Sub category
Tanker	Crude Tanker
	Product Tanker
	Chemical Tanker
	Combined Chemical and Oil
	Oil/Bulk/Ore
	Gas Tanker
	Other Tanker
General cargo	Container Ship
	Vehicle carrier

	Other General cargo
Tug & Supply	
Dry-bulk carrier	
Passenger	
Other	Drill vessel
	Barge
	Tank barge
	Heavy lift
	Yacht
	Salvage
	Research
	Fishing
	Training
	Other

The concordance between this list and the vessel types given in the LMIU's database is included in **Annex 4**.

b. Size of ships

The user can apply a filter on the size of ships for which the vessel movements are considered and displayed. He can choose between applying a filter on the size in DWT[6] or in GT, and then he can choose the range. This allows to show, for instance, journeys made by the largest boats.

c. Time interval

The user can select only data within a specific time frame (month & year of departure, for now, only data for 2007 and 2008 are available). By default, the entire period is displayed.

d. Ports of departure/destination

The user has the option to consider only the traffic flow for vessels passing through specific ports or countries. It is possible to select several ports or countries. When a country is selected, all ports from this country are automatically selected. By default, the selected ports are considered as places of departures and arrival, but the user has the possibility to consider them only as departure or arrival places.

e. Arcs

By clicking on one specific arc on the map, this arc is highlighted, and only journeys passing through this arc are displayed.

[6] Dead Weight Tonnage

4.7. Exportation of data

The data can be exported to a CSV file, so that the user can use the data in its own GIS systems for analysis purpose for example. The selected filters are applied to the data exported. It is not possible to export the full set of data, the exportation will only work if filters are applied.

4.8. Chart view

The data, considering the filters applied, can be displayed as bar charts, representing the total traffic flow (total GT or number of vessel movements) monthly. This facilitates the comparison of different time periods. Hovering over a bar shows the corresponding total traffic value.

4.9. Generation of reports

A report can be generated, including the filters and display options, the chart view and a view of the map (as represented on the screen).

4.10. Resolution of problems

Makina Corpus created the following interface: https://mantis-nonopenid.makina-corpus.net, to report bugs and potential mistakes. The consultant in charge of this project will be responsible for gathering and transmitting information to this interface.

5. Future developments and recommendations

5.1. Dissemination of the tool

REMPEITC will be responsible for the dissemination of the tool to insure its best use in the region, and for the evaluation of its performance, notably by collecting feedbacks from users.

A link was created on REMPEITC's website, with the terms and conditions of the tool and an explanation of the procedure to get a username and a password:
http://cep.unep.org/racrempeitc/maritime-traffic

The tool will be presented in REMPEITC's quarterly newsletter, and will be proposed to be included in regional partners' newsletters and communication means as well (UNEP, IMO, Regional Maritime Advisor, COCATRAM[7], CCA[8], ARPEL, etc...).

Whenever the centre organises or participates in an activity (workshop, training program, international conference, national meeting, etc.), its consultants will make sure to present the tool. In particular, it is recommended that the tool be presented during the 15th IGM in October 2012, in Dominican Republic, where all the Contracting Parties of the Cartagena Convention will be attending.

5.2. Maintenance agreements with Makina Corpus

A five-year warranty for applicative maintenance was contracted with Makina Corpus, in order to keep the website running smoothly and to make sure the service remains available and responsive (in particular to correct bugs if they appear).

Regarding the evolutionary maintenance, when new developments and improvements will be requested (additional data, adjustment of the network, new options, etc.), a new contract will have to be develop with Makina Corpus.

5.3. Future developments on data

For now, only data for 2007 and 2008 are represented in the GIS. More recent data should be found to improve the relevance of the tool in the future.

REMPEITC never maintained a database on oil spills in the region, and only 7 major accidents are displayed in the GIS so far. A research is needed for REMPEITC to extend this database to make it more complete (possible sources of data: ITOPF, IPIECA).

[7] Central American Maritime Transport Commission
[8] Clean Caribbean and Americas

At the moment, the tool only includes commercial vessels of 100 GT or more, which do have an IMO number. It would be interesting to study the feasibility of including also smaller vessels, which are often more likely to create incidents than bigger vessels, even if the consequences of the incidents would be less important. However, the main difficulty would probably be the lack of data on non-registered vessels, and the consistency/homogeneity of such data.

5.4. Ideas for the improvement of the tool

Here are few ideas that came up during the development of the tool, and that could be included in future improvements of the GIS, once feedbacks from the users are collected:

a) Possibility for the user to save its selection: for now, when the user chooses filters and display options, he cannot save its selection and if he closes the webpage (intentionally or not).

b) Comparison of different selections (for example to analyze the changes in the traffic at different periods of time, which for now can only be done by doing the two selections one at a time, and comparing the reports and/or exported data).

c) Selection a polygonal zone on the map to analyze the traffic within this specific zone only.

d) Smart zoom displays (the display of routes/ports changes with different levels of zoom): this was technically not feasible at that stage, but could be included in future versions of the tool.

e) Addition of more data (TSS, previous oil spills, ESI maps etc.)

Annexes

Annex 1 – Contact List
Annex 2 – Additional data
Annex 3 – Port coordinates corrections
Annex 4 - Types of ships

Annex 1 – Contacts' List

This Annex gives a list of contacts that were involved in the organization and development of this project (collection of data, specifications of the project, etc).

Name	Function	Organisation	Email	Tel
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Claire Wright		LMIU	claire.wright@lloydsmiu.com	

Annex 2 – Additional data

Oil infrastructures

Source: Energy Map, ARPEL & Petroleum Economist

Tanker terminals

Country	Location
Aruba	San Nicolas Bay
Belize	Belize City
Colombia	Covenas
Colombia	Mamonal
Colombia	Cartagena
Colombia	Barranquilla
Colombia	Pozos Colorados Terminal
Colombia	Puerto Bolivar
Costa Rica	Puerto Limon
Cuba	Moa
Cuba	Santiago de Cuba
Cuba	La Habana
Cuba	Cienfuegos
Cuba	Nueva Gerona
Cuba	Matanzas
Cuba	Nuevitas
Curaçao	St Michiel's Bay
Curaçao	Bullen Bay
Dominican Republic	Andres
French Guiana	Cayenne
French Guiana	Degrad des Cannes
Guyana	Georgetown
Guyana	New Amsterdam
Honduras	Puerto Cortes
Martinique	Fort de France
Mexico	Tampico
Mexico	Tuxpan
Mexico	Veracruz
Mexico	Dos Bocas
Panama	Chiriqui Grande
Panama	Las Minas
Puerto Rico	Yabucoa
St Lucia	Castries
Suriname	Nieuw Nickerie
Suriname	Paramaribo
Trinidad & Tobago	Brighton
Trinidad & Tobago	Point Lisas
Trinidad & Tobago	Pointe-à-Pierre
Trinidad & Tobago	Galeota Point Terminal
Trinidad & Tobago	Scarborough
US Virgin Is	St Croix
Venezuela	Maracaibo
Venezuela	Punta Palmas
Venezuela	La Solita
Venezuela	La Salina
Venezuela	Puerto Miranda
Venezuela	Punta Cardon
Venezuela	Las Piedras
Venezuela	Amuay Bay
Venezuela	El Palito
Venezuela	Caripito

Oil refineries

Country	**Location**	**Company**	**Capacity (b/d)**
Aruba	San Nicolas Bay	Aruba Refining Co.	315 000
Colombia	Cartagena	Ecopetrol	75 000
Costa Rica	Puerto Limon	Refinadora Costarricense de Petroleo SA	24 000
Cuba	La Habana	Cuba Petroleos	121 800
Cuba	Cienfuegos	Cuba Petroleos	76 000
Cuba	Santiago de Cuba	Cuba Petroleos	101 500
Curaçao	Bullen Bay	Refineria Isla Curazao	320 000
Jamaica	Kingston	Petrojam	36 000
Martinique	Fort de France	Société Anonyme de la Rafinerie des Antilles	17 000
Mexico	Ciudad Madero	Pemex	195 000
Mexico	Minatitlan	Pemex	200 000
Nicaragua	Managua	Esso Caribbean & C. America	20 000
Puerto Rico	Yabucoa	Shell	73 000
Trinidad & Tobago	Pointe-à-Pierre	Petrotrin	165 000
US Virgin Is	St Croix	Hovensa LLC	500 000
Venezuela	El Palito	PdVSA	126 900

Major Accidents

Place	Coordinates	Name	Month	Year	Accident	metric tons	Product spilled	Comments
10 miles off Tobago	11° 18'N 60°21'W	MV Atlantic Empress - MV Aegean Captain	July-August	1979	Collision during a rainstorm	287000	Crude oil	world largest ship-based spill
Gulf of Mexico	28°53'N 94°14'W	Megaborg	June	1990	Explosion	16500	Angolan crude oil	
Nevis island	17° 17.00' N 62° 18.00' W	Vista Bella	March	1991	Oil tanker sinking	2000	Heavy no. 6 fuel oil	5 islands contaminated
Puerto Rico	18° 28.30' N 66° 5.40' W	Morris J Berman	January	1994	Barge grounding	2600	Heavy no. 6 fuel oil	
New Orleans	29° 54.75' N 90° 5.50' W	New Orleans oil spill	July	2008	Collision tanker/barge	8800	Heavy no. 6 fuel oil	Spill into the Missisipi river
Gulf of Mexico	28°44′12.01″N 88°23′13.78″W	Deepwater Horizon	April-August	2010	Oil well blowout	585000	Light crude oil	4th world largest spill
Bay of Campeche, Gulf of Mexico	19°24′30″N 92°19′30″W	Ixtoc I	June - March	1979-1980	Exploratory oil well blowout	480000	Crude oil	5th world largest spill

<u>Annex 3</u> – Port corrections (coordinates and/or names)

LMIU country name	LMIU port name	New country name	New port name	New Coordinates							
					°	'	"		°	'	"
Aruba	Oranjestad	Aruba	Aruba	N	12	31	17	W	70	2	33
Aruba	San Nicolas Bay	Aruba	Aruba	N	12	31	17	W	70	2	33
Dominica	Portsmouth(DMA)	Dominica	Dominica	N	15	17	55	W	61	23	13
Dominica	Roseau	Dominica	Dominica	N	15	17	55	W	61	23	13
St. Lucia	Castries	St. Lucia	St. Lucia	N	14	1	3	W	60	59	22
St. Lucia	Cul de Sac	St. Lucia	St. Lucia	N	14	1	3	W	60	59	22
St. Lucia	Vieux Fort	St. Lucia	St. Lucia	N	14	1	3	W	60	59	22
Algeria	Algeria	Algeria	Algeria	N	36	46	14	E	3	3	11
American Virgin Islands	St. Croix	US Virgin Islands	Christiansted	N	17	44	49	W	64	41	52
American Virgin Islands	Christiansted	US Virgin Islands	Christiansted	N	17	44	49	W	64	41	52
American Virgin Islands	Frederiksted	US Virgin Islands	Frederiksted	N	17	42	50	W	64	52	59
American Virgin Islands	Hovensa	US Virgin Islands	Hovensa	N	17	42	11	W	64	45	1
American Virgin Islands	Limetree Bay	US Virgin Islands	Limetree Bay	N	17	41	54	W	64	45	22
American Virgin Islands	Port Alucroix	US Virgin Islands	Port Alucroix	N	17	42	24	W	64	46	24
American Virgin Islands	St. John(VIR)	US Virgin Islands	St. John(VIR)	N	18	21		W	64	40	
American Virgin Islands	St. Thomas	US Virgin Islands	St. Thomas	N	18	23		W	64	56	
Angola	Kizomba Field	Angola	Kizomba	S	6	19		E	11	3	
Antigua & Barbuda	Antigua	Antigua & Barbuda	St. John's	N	17	7	5	W	61	50	40
Antigua & Barbuda	St. John's(ATG)	Antigua & Barbuda	St. John's	N	17	7	5	W	61	50	40
Aruba	Aruba	Aruba	Aruba	N	12	31	17	W	70	2	33
Bahamas	Inagua	Bahamas	Inagua	N	21	3	24	W	73	25	27
Bahamas	Coco Cay	Bahamas	Coco Cay	N	25	49	5	W	77	56	19
Bahamas	Princess Cays	Bahamas	Princess Cays	N	24	38	30	W	76	10	13
Barbados	Barbados	Barbados	Bridgetown	N	13	6	11	W	59	37	26

Bermuda	Bermuda	Bermuda	Hamilton(BMU)	N	32	18		W	64	47	
Bonaire	Kralendijk	Bonaire	Kralendijk	N	12	8	59	W	68	16	38
Brazil	Campos Field	Brazil	Rio de Janeiro	S	22	55		W	43	12	
Brazil	Brazil	Brazil	Brazil	S	22	55		W	43	12	
Canada	Vancouver Anch.(CAN)	Canada	Vancouver(CAN)	N	49	17	5	W	123	6	43
Canary Islands	Palma(Canary Is)	Canary Islands	Canary Islands	N	28	7	59	W	15	25	55
Cayman Islands	Grand Cayman	Cayman Islands	George Town(CYM)	N	19	18		W	81	23	
Cayman Islands	Cayman Brac	Cayman Islands	Creek(CYM)	N	19	44		W	79	47	
Colombia	San Andres	Colombia	San Andres	N	12	34	19	W	81	42	7
Colombia	Covenas	Colombia	Covenas	N	9	24	39	W	75	41	31
Colombia	Pozos Colorados Trem.	Colombia	Pozos Colorados Trem.	N	11	10	3	W	74	13	34
Cuba	Baracoa	Cuba	Baracoa	N	20	21	5	W	74	30	4
Cuba	Nueva Gerona	Cuba	Nueva Gerona	N	21	54	20	W	82	48	6
Dominica	Dominica	Dominica	Dominica	N	15	17	55	W	61	23	13
Dominican Republic	Ocoa Bay	Dominican Republic	Azua	N	18	25		W	70	40	
Dominican Republic	Azua	Dominican Republic	Azua	N	18	20	52	W	70	50	9
Dominican Republic	Puerto Viejo de Azua	Dominican Republic	Puerto Viejo de Azua	N	18	20	50	W	70	50	12
Dominican Republic	Barahona	Dominican Republic	Barahona	N	18	12	26	W	71	5	29
Dominican Republic	Manzanillo	Dominican Republic	Manzanillo	N	19	42	25	W	71	44	35
Dominican Republic	Puerto Plata	Dominican Republic	Puerto Plata	N	19	47	53	W	70	41	57
Gabon	Gabon	Gabon	Gabon	S	0	38		E	8	42	
Grenada	Grenada	Grenada	St. George's(GRD)	N	12	2	54	W	61	44	54
Guadeloupe	Marigot	St. Martin	Marigot	N	18	4		W	63	6	
Guadeloupe	St. Barthelemy	St. Barthelemy	Gustavia	N	17	55		W	62	50	
Guadeloupe	St. Martin	St. Martin	Marigot	N	18	4		W	63	6	
Guyana	Guyana	Guyana	Georgetown(GUY)	N	6	49		W	58	11	
Haiti	Miragoane	Haiti	Miragoane	N	18	26	58	W	73	6	28

Honduras	Omoa	Honduras	Omoa	N	15	46	40	W	88	2	47
Honduras	Puerto Castilla	Honduras	Puerto Castilla	N	16		20	W	85	58	12
Honduras	Roatan Is.	Honduras	Roatan Is.	N	16	18	47	W	86	32	41
Iceland	Reydharfjordur	Iceland	Iceland	N	64	4		W	21	55	
Martinique	St Pierre MTQ	Martinique	St Pierre MTQ	N	14	44	31	W	61	10	35
Mexico	Yucalpeten	Mexico	Yucalpeten	N	21	16	6	W	89	42	10
Mexico	Playa del Carmen	Mexico	Playa del Carmen	N	20	37	41	W	87	4	1
Mexico	Calica	Mexico	Calica	N	20	37	15	W	87	4	30
Mexico	Punta Venado	Mexico	Punta Venado	N	20	34	19	W	87	7	43
Mexico	Puerto Costa Maya	Mexico	Puerto Costa Maya	N	18	43	58	W	87	41	32
Netherlands	Everingen	Netherlands	Netherlands	N	51	15	21	E	4	23	25
Netherlands Antilles	Curacao	Curaçao	Curaçao	N	12	6	54	W	68	56	2
Netherlands Antilles	Bonaire	Bonaire	Kralendijk	N	12	9		W	68	17	
Netherlands Antilles	Bullen Bay	Curaçao	Curaçao	N	12	6	54	W	68	56	2
Netherlands Antilles	Kralendijk	Bonaire	Kralendijk	N	12	9		W	68	17	
Netherlands Antilles	Philipsburg	St. Maarten	Philipsburg	N	18	2		W	63	3	
Netherlands Antilles	Saba	Saba	Fort Bay	N	17	38		W	62	14	
Netherlands Antilles	St. Anna Bay	Curaçao	Curaçao	N	12	6	54	W	68	56	2
Netherlands Antilles	St. Eustatius	St. Eustatius	Oranjestad	N	17	29	53	W	62	59	51
Netherlands Antilles	Willemstad(ANT)	Curaçao	Curaçao	N	12	6	54	W	68	56	2
Nicaragua	El Bluff	Nicaragua	El Bluff	N	11	59	30	W	83	41	28
Nigeria	Nigeria	Nigeria	Nigeria	N	6	26	18	E	3	23	19
Panama	Chiriqui Grande	Panama	Chiriqui Grande	N	8	57	8	W	82	6	60
Panama	Panama	Panama	Panama	N	9	21	42	W	79	52	50
People's Republic of China	China	People's Republic of China	China	N	31	15		E	121	30	
Puerto Rico	Puerto Rico	Puerto Rico	Puerto Rico	N	18	27	58	W	66	6	59
Republic of Ireland	Shannon Estuary	Republic of Ireland	Foynes	N	52	36	43	W	9	6	8

St. Bathelemy	Gustavia	St. Bathelemy	Gustavia	N	17	53	44	W	62	50	57
St. Lucia	St. Lucia	St. Lucia	St. Lucia	N	14	1	3	W	60	59	22
Suriname	Suriname	Suriname	Paramaribo	N	5	50		W	55	10	
Trinidad & Tobago	Trinidad	Trinidad & Tobago	Trinidad	N	10	39	9	W	61	31	1
Trinidad & Tobago	Trinidad & Tobago	Trinidad & Tobago	Trinidad & Tobago	N	10	39	9	W	61	31	1
Trinidad & Tobago	Guayaguayare	Trinidad & Tobago	Guayaguayare	N	10	8	20	W	61		1
Trinidad & Tobago	Galeota Point Term.	Trinidad & Tobago	Galeota Point Term.	N	10	8	31	W	60	59	45
Turkey	Ceyhan BTC	Turkey	Mersin	N	36	48	17	E	34	38	29
Turkey	Ceyhan Botas	Turkey	Mersin	N	36	48	17	E	34	38	29
Turks & Caicos Islands	Turks & Caicos Islands	Turks & Caicos Islands	Turks & Caicos Islands	N	21	44		W	72	17	
Turks & Caicos Islands	Providenciales	Turks & Caicos Islands	Providenciales	N	21	44	25	W	72	16	49
United Arab Emirates	Fujairah Anch.	United Arab Emirates	Fujairah	N	25	10		E	56	22	
United Kingdom	Scapa Flow	United Kingdom	Sullom Voe	N	60	26	28	W	1	16	21
United Kingdom	Southend Anch.	United Kingdom	London	N	51	30		W	0	4	
United States of America	Galveston light. area	United States of America	Galveston	N	29	18		W	94	48	
United States of America	Delaware Bay	United States of America	Delaware City	N	39	34		W	75	35	
United States of America	S. Sabine Point light. area	United States of America	Sabine	N	29	43		W	93	52	
United States of America	Annapolis Anch.	United States of America	Baltimore	N	39	16	55	W	76	36	51
United States of America	Long Island(NY USA)	United States of America	New York	N	40	42	23	W	74	0	42
United States of America	Texas	United States of America	Texas	N	29	45		W	95	20	
United States of America	Hampton Roads	United States of America	Richmond(VA USA)	N	37	32		W	77	26	
United States of America	Alabama	United States of America	Mobile	N	30	42	19	W	88	2	47
United States of America	Boca Grande	United States of America	Boca Grande	N	26	43	7	W	82	15	32
United States of America	Gulfport	United States of America	Gulfport	N	30	21	2	W	89	5	27
Venezuela	Margarita Is.	Venezuela	Margarita Is.	N	10	52		W	64	4	
Venezuela	Amuay Bay	Venezuela	Amuay Bay	N	11	44	50	W	70	12	38
Venezuela	Punta Cardon	Venezuela	Punta Cardon	N	11	37	26	W	70	13	47

Venezuela	Cumarebo	Venezuela	Cumarebo	N	11	29	19	W	69	21	26
Venezuela	Borburata	Venezuela	Borburata	N	10	29	6	W	67	58	58
	West Africa	West Africa	West Africa	N	4	14		E	8	3	
	San Juan	Puerto Rico	San Juan(PRI)	N	18	27	58	W	66	6	59
	Tripoli	Lebanon	Tripoli(LBN)	N	34	28		E	35	50	

<u>Annex 4</u> - Types of ships
Correlation between the REMPEITC list and the LMIU vessel types

Vessel Type Decode (LMIU DB)	Category	Subclass
anchor handling fire fighting tug/supply	Tug & Supply	
anchor handling salvage tug	Tug & Supply	
anchor handling tug	Tug & Supply	
anchor handling tug/supply	Tug & Supply	
asphalt tanker	Tanker	
barge	Barge	
barge carrier	General cargo	
bulk carrier	Dry-bulk carrier	
bulk carrier with container capacity	Dry-bulk carrier	
bulk cement carrier	Dry-bulk carrier	
bulk ore carrier	Dry-bulk carrier	
bunkering tanker	Tanker	
buoy ship	Other	
cable ship	Other	
cargo/training	General cargo	
catamaran tug	Tug & Supply	
chemical tanker	Tanker	Chemical Tanker
combined bulk and oil carrier	Tanker	Oil/Bulk/Ore
combined chemical and oil tanker	Tanker	Combined Chemical and Oil
combined LNG and LPG Gas Carrier	Tanker	Gas Tanker
combined ore and oil carrier	Tanker	Oil/Bulk/Ore
crane barge	Barge	
crane ship	Other	
crude oil tanker	Tanker	Crude Tanker
cutter suction dredger	Other	
diving support	Other	
dredger	Other	
drill platform	Drill vessel	
drill ship	Drill vessel	
edible oil tanker	Tanker	
exhibition ship	Other	
ferry	Passenger	
fire fighting tractor tug	Tug & Supply	
fire fighting tug	Tug & Supply	
fire fighting tug/supply	Tug & Supply	
fish carrier	Other	
fish factory	Other	

fishery protection	Other	
fishing (general)	Fishing	
floating gas storage	Tank barge	
floating production tanker	Tanker	
fruit juice tanker	Tanker	
fully cellular containership	General cargo	Container Ship
fully cellular refrigerated	General cargo	Container Ship
general cargo	General cargo	
general cargo with container capacity	General cargo	
hopper barge	Barge	
hopper dredger	Other	
hydrographic research	Research	
icebreaker	Other	
icebreaker/supply	Tug & Supply	
landing craft	Other	
lighthouse/tender	Other	
Liquid Natural Gas Carrier	Tanker	Gas Tanker
Liquid Petroleum Gas Carrier	Tanker	Gas Tanker
livestock	Other	
maintenance	Other	
molasses tanker	Tanker	
naval auxiliary tanker	Tanker	
Naval Auxiliary Vessel	Other	
Naval Vessel	Other	
oceanographic research	Research	
offshore safety	Other	
passenger (cruise)	Passenger	
passenger ro/ro	Passenger	
patrol ship	Other	
pipe layer	Other	
pontoon	Other	
product tanker	Tanker	Product Tanker
pusher tug	Tug & Supply	
reefer	General cargo	
research	Research	
research/supply ship	Tug & Supply	
Roll On Roll Off	General cargo	
Roll On Roll Off with container capacity	General cargo	
salvage	Salvage	
salvage tug	Tug & Supply	
seismographic research	Research	
semi-sub HL vessel	Heavy lift	

semi-sub HL/tank	Heavy lift	
standby safety vessel	Other	
suction hopper dredger	Other	
supply	Tug & Supply	
support	Other	
tank barge	Tank barge	
Tanker (unspecified)	Tanker	
tractor tug	Tug & Supply	
trailing suction hopper dredger	Other	
training	Training	
trawler (All types)	Fishing	
tug	Tug & Supply	
tug/supply	Tug & Supply	
vehicle carrier	General cargo	Vehicle carrier
waste ship	Other	
wood-chip carrier	Dry-bulk carrier	
work ship	Other	
yacht	Yacht	