

# A New Framework for Environmental Impact Assessment of HNS: Combining HNS Databases, Population Modelling and Dispersion models

MARINER

**CIIMAR**

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Workshop - Using technology towards a better preparedness to HNS Spills  
**28<sup>th</sup> April 2017 Porto - CIIMAR**



## Hazardous and Noxious Substances Spill Incidents



### Advanced Search

Ship name

HNS spill

Year

Incident location

Search

### Spill Incidents

Ship name	Incident date	Incident location	
Ena II	2004	Germany	
Bahamas	1998	Brazil	
Weissborn	1994	Spain	
Co-op Venture	2002	Japan	
Ece	2006	France	
Scaieni	1991	Italy	



## Hazardous and Noxious Substances Spill Incidents

### Advanced Search

Ship name

HNS spill

Year

Incident location

Search

On this database it is collected information on the fate and weathering of hazardous and noxious substances (HNS) accidentally spilled at the sea around the world. It gathers and systematizes existing information to assist stakeholders involved in spill preparedness and response, and builds return of experience datasheets for the chemicals involved. It will facilitate the incorporation of lessons from past incidents on the decision process to improve preparedness.

### Carla

1997  
Portugal - Azores  
Europe  
Packaged

### HNS Spill

Wine alcohol Liquid		Amount Spill (T) Unknown		CAS Number -	
D	-	3	-		IV
Physical Behaviour (SEBC code)	Pollution Category (HARPOL Annex 2)	Class according to IMDG code	Subsidiary Risk Class according to IMDG code	Classification as Marine Pollutant	HNS Classification (2010 HNS Convention)

### Fate and weathering facts observed/reported

74 containers were lost, sinking in waters 3000 m deep. Fourteen containers carried products classified as marine pollutants. One contained carried 3 laboratory irradiators with their radioactive sources. The Caesium protective cells, designed to resist a pressure of 20 atm, would have exploded during container sinking. The French Institute of Protection and Nuclear Security (IPSN) carried out assessments of the possible impact on human beings and on fauna of the area, concluding that because of the great depth, a high dilution capacity limited the exposure. The risk to human consumers was considered minimal, as trawling in the zone is carried out at a depth of less than 2000 m.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

## Material Safety Data Sheet Xylenes MSDS

### Section 1: Chemical Product and Company Identification

<b>Product Name:</b> Xylenes	<b>Contact Information:</b>
<b>Catalog Codes:</b> SLX1075, SLX1129, SLX1042, SLX1096	<b>ScienceLab.com, Inc.</b>
<b>CAS#:</b> 1330-20-7	14025 Smith Rd.
<b>RTECS:</b> ZE2100000	Houston, Texas 77396
<b>TSCA:</b> TSCA 8(b) inventory: Xylenes	US Sales: <b>1-800-901-7247</b>
<b>CI#:</b> Not available.	International Sales: <b>1-281-441-4400</b>
<b>Synonym:</b> Xylenes, Dimethylbenzene, xylol, methyltoluene	Order Online: <a href="http://ScienceLab.com">ScienceLab.com</a>
<b>Chemical Name:</b> Xylenes (o-, m-, p- isomers)	<b>CHEMTREC (24HR Emergency Telephone), call:</b>
<b>Chemical Formula:</b> C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	1-800-424-9300
	<b>International CHEMTREC, call:</b> 1-703-527-3887
	<b>For non-emergency assistance, call:</b> 1-281-441-4400

### Section 2: Composition and Information on Ingredients

Composition:		
Name	CAS #	% by Weight
Xylenes	1330-20-7	100
<b>Toxicological Data on Ingredients:</b> Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].		

### Section 3: Hazards Identification



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# Actions: Action C.2.3

## C.2.3 Tools for modelling impact (toxicology)

Fate, weathering,  
behaviour and toxicity  
of priority Hazardous  
and Noxious  
Substances



### Physicochemical properties/Characteristics

E	78.114	0.88	12.64
Physical behaviour (GESAMP, 2016)	Molecular Weight (g/mol)	Density (kg/L)	Vapour pressure (KPa; 25°C)
1, 2	2	2	2
5.5	80.1	23.3	
Melting point (°C)	Boiling point (°C)	Volatilization half- life (days)	
2	2	4	

### Substances

Substance name	CAS number	Formulae	Behaviour
1-Dodecanol	112-53-8	C <sub>12</sub> H <sub>26</sub> O	Fp
1-Nonanol	143-08-8	C <sub>9</sub> H <sub>20</sub> O	Fp
1-Nonene	124-11-8	C <sub>9</sub> H <sub>18</sub>	FE
4-Nonylphenol	104-40-5	C <sub>15</sub> H <sub>24</sub> O	Fp
Acrylonitrile	107-13-1	C <sub>3</sub> H <sub>3</sub> N	DE
Aniline	62-53-3	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub>	FD
Benzene	71-43-2	C <sub>6</sub> H <sub>6</sub>	E
Butyl acrylate	141-32-2	C <sub>7</sub> H <sub>12</sub> O <sub>2</sub>	FED
Cyclohexane	110-82-7	C <sub>6</sub> H <sub>12</sub>	E
Cyclohexylbenzene	827-52-1	C <sub>12</sub> H <sub>16</sub>	F
Decanoic acid	334-48-5	C <sub>10</sub> H <sub>20</sub> O <sub>2</sub>	Fp
Di-2-ethylhexyl adipate	103-23-1	C <sub>22</sub> H <sub>42</sub> O <sub>4</sub>	Fp
Heptane	142-82-5	C <sub>7</sub> H <sub>16</sub>	E
Hexane	110-54-3	C <sub>6</sub> H <sub>14</sub>	E
Isononanol	27458-94-2	C <sub>9</sub> H <sub>20</sub> O	Fp



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# Actions: Action C.2.3

## C.2.3 Tools for modelling impact (toxicology)

Algae			13	LC50	18.4	Water flea - <i>Ceriodaphnia dubia</i>
			Parameter	Concentration (mg/L)	Species	
Invertebrates			7	Mortality		Freshwater; Static; 25 °C; 24h-exposure; < 24h age
6	EC50	18	Water flea - <i>Daphnia magna</i>	Endpoint	Observations	
			Parameter	Concentration (mg/L)	Species	
Intoxication, immobilization			Endpoint	Observations		Freshwater; Static; 20 24h age
7	EC50	10	Water flea - <i>Daphnia magna</i>	Mortality		Saltwater; Static; 16 °C; 96h-exposure; Mature organism(s)
			Parameter	Concentration (mg/L)	Species	
Intoxication, immobilization			Endpoint	Observations		Freshwater; Static; 20 exposure; Juvenile(s)
8	EC50	10.15	Water flea - <i>Ceriodaphnia dubia</i>	Mortality		Saltwater; Static; 21 °C; 96h-exposure
			Parameter	Concentration (mg/L)	Species	
			Endpoint	Observations		
			14	LC50	20	Bay shrimp - <i>Crangon franciscorum</i>
			Parameter	Concentration (mg/L)	Species	
			Endpoint	Observations		
			15	LC50	27	Daggerblade grass shrimp - <i>Palaemonetes pugio</i>
			Parameter	Concentration (mg/L)	Species	
			Endpoint	Observations		



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## Fate, behaviour and weathering of priority HNS in the marine environment: An online tool

Isabel Cunha <sup>a,1</sup>, Helena Oliveira <sup>a,\*,1</sup>, Teresa Neuparth <sup>a</sup>, Tiago Torres <sup>a</sup>, Miguel Machado Santos <sup>a,b,\*,\*\*</sup>

**ciimar** Fate, weathering, behaviour and toxicity of priority Hazardous and Noxious Substances

**Advanced Search**

Substance name

Behavior at the sea

Search

On this database it is collected information on weathering, behaviour and toxicity of priority Hazardous and Noxious Substances (HNS) from different sources. These systematized information is a useful tool to predict the behaviour of priority HNS in accidental spills and support spill preparedness and effective decision-making process response. This database also provides an important support to risk assessment, environmental impact assessment and monitoring actions.

**Physicochemical properties/Characteristics**

EF	126.2	0.74	0.72	1.12	0.64
Behavior (GHS/SGH, 2016)	Relative Vaporization Press.	Density (kg/L)	Vapor pressure (kPa)	Water solubility (mg/L)	Dynamic viscosity (mPa.s)
1.2	2	2	2	2.2	2.2
-81.3	146.9	58.1			
Melting point (°C)	Boiling point (°C)	Vaporization heat (kJ/kg)			
2	2	4			

1. G: Gas; E: Evaporator; F: Floater; H: Heavier (than water); D: Dissolver; S: Sinker;  
 2. Values collected from the literature and public databases e.g. PubChem;  
 3. "-" corresponds to values not found in the literature or in available databases;  
 4. Values estimated with models of the EPI suite<sup>®</sup>.



Home Maps Charts **Simulation** Operational Models [rodrigo.fernandes](#)

1. What?

2. Where?

3. When?

4. Run

### Incident Name

2016-10-14 15:27:31 Sim Name

### Substance Type

HNS Spill

### Chemical Spill Options

1-nonanot (Floater)

Chlorine gas (Gas)  
 Ammonia (Gas-Dissolver)  
 Benzene (Evaporator)  
 Styrene (Evaporator-Floater)  
 Di-n-butylamine (Evaporator-Dissolver-Floater)  
 Methanol (Evaporator-Dissolver)

1-nonanot (Floater)

Aniline (Floater-Dissolver)  
 Ethanolamine (Dissolver)  
 Perchloroethylene (Sinker)

Previous

Next



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# CIIMAR HNS database was integrated in MARINER interface.


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[Maps](#)
[Charts](#)
[Simulation](#)
[Operational Models](#)

	Name	Behaviour	CAS	Density [kg/m3]	Viscosity [mPa.s]	Solubility [mg/L]	Vapour Pressure [Pa]	Molecular Weight [g/mol]	Log Kow	Source
<input type="checkbox"/>	1-Dodecanol	Floaters (Persistent)	112-53-8	830	18.80 at 20°C	4 at 25°C	0.1 at 25°C	186.339	5.13	MARINER (CIIMAR)
<input type="checkbox"/>	1-Nonanol	Floaters (Persistent)	143-08-8	830	11.70 at 20°C	140 at 25°C	3 at 25°C	144.258	3.77	MARINER (CIIMAR)
<input type="checkbox"/>	1-Nonene	Evaporator, Floaters	124-11-8	740	0.64 at N/D°C	1.12 at 25°C	720 at 25°C	126.243	5.15	MARINER (CIIMAR)
<input type="checkbox"/>	4-Nonylphenol	Floaters (Persistent)	104-40-5	950	0.00 at N/D°C	7 at 25°C	0.1 at 25°C	220.356	5.76	MARINER (CIIMAR)



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## Environmental risk assessment

### PNEC

Predicted no-effect concentration

Is the concentration of a substance below which no adverse effects of exposure in an ecosystem are expected to occur, during long-term or short-term exposures.



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## Ecotoxicological dose descriptors

Chronic toxicity **NOEC** or equivalent **Ec<sub>x</sub>**

- ✓ **Algae** (primary producers): **72/96h EC<sub>50</sub>** (reproduction/growth);
- ✓ **Invertebrates** (primary consumers): **48h EC<sub>50</sub>** (immobility) *Daphnia* *sp.* and **96h LC<sub>50</sub>** other crustaceans;
- ✓ **Fish** (higher level consumers): **96h LC<sub>50</sub>** (mortality).

The lowest of the availability toxicity values between and within the different trophic levels is used as a toxicological dose descriptor.



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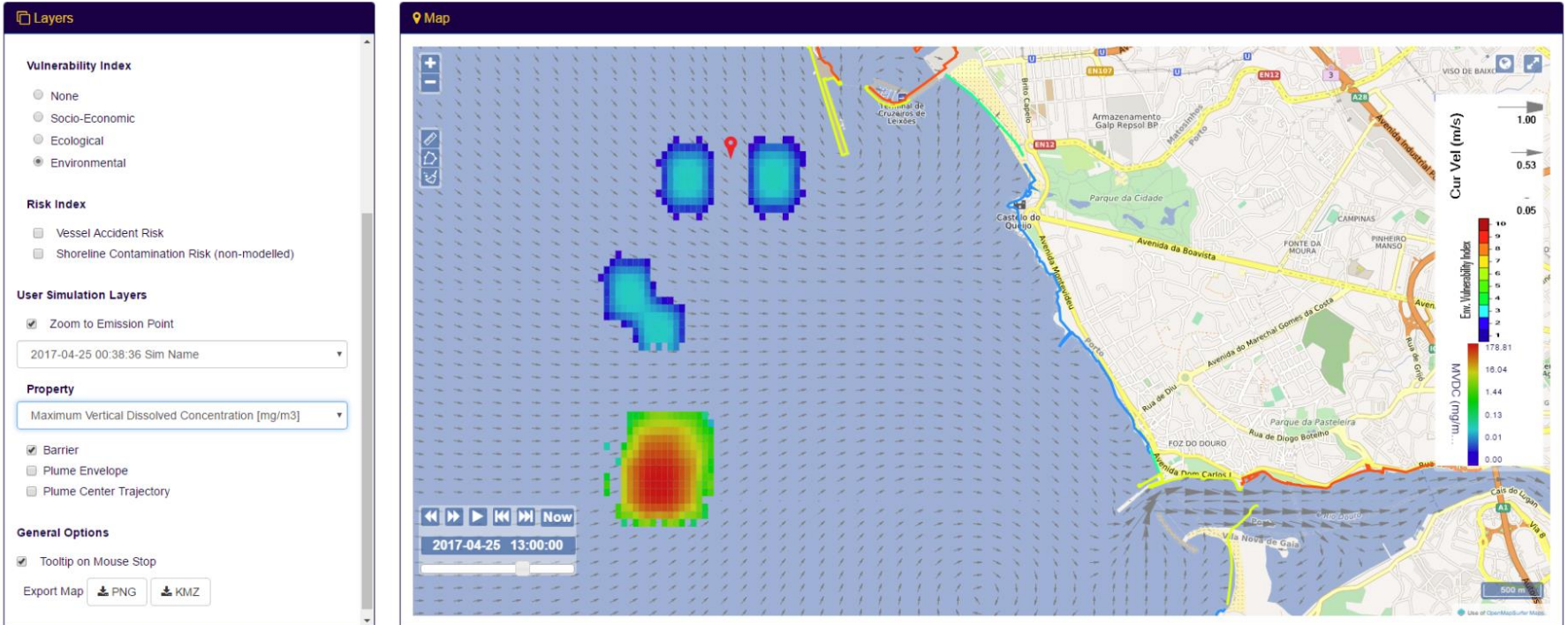
## PNEC<sub>seawater</sub>

Data set	Assessment factor
Lowest short-term L(E)C50 from freshwater or saltwater representatives of three taxonomic groups (algae, crustaceans and fish) of three trophic levels	10,000 <sup>a)</sup>
Lowest short-term L(E)C50 from freshwater or saltwater representatives of three taxonomic groups (algae, crustaceans and fish) of three trophic levels, + two additional marine taxonomic groups (e.g. echinoderms, molluscs)	1000 <sup>b)</sup>
One long-term result (e.g. EC10 or NOEC) (from freshwater or saltwater crustacean reproduction or fish growth studies)	1000 <sup>b)</sup>
Two long-term results (e.g. EC10 or NOEC) from freshwater or saltwater species representing two trophic levels (algae and/or crustaceans and/or fish)	500 <sup>c)</sup>
Lowest long-term results (e.g. EC10 or NOEC) from three freshwater or saltwater species (normally algae and/or crustaceans and/or fish) representing three trophic levels	100 <sup>d)</sup>
Two long-term results (e.g. EC10 or NOEC) from freshwater or saltwater species representing two trophic levels (algae and/or crustaceans and/or fish) + one long-term result from an additional marine taxonomic group (e.g. echinoderms, molluscs)	50
Lowest long-term results (e.g. EC10 or NOEC) from three freshwater or saltwater species (normally algae and/or crustaceans and/or fish) representing three trophic levels + two long-term results from additional marine taxonomic groups (e.g. echinoderms, molluscs)	10

European Chemicals Agency

**PNEC<sub>water, intermittent</sub>: LC(E)50 divided by 100**







## Layers

### Domain

Portugal (Cont.)

### WMS Layers

- ☐ Vessels
- ☐ Monitoring Stations

### Model Results

Hydro MOHID AM Douro 50m

- ☒ Current Velocity [m/s]
- ☐ Current Velocity Modulus [m/s]

### Vulnerability Index

- ☐ None
- ☐ Socio-Economic
- ☐ Ecological
- ☒ Environmental

### Risk Index

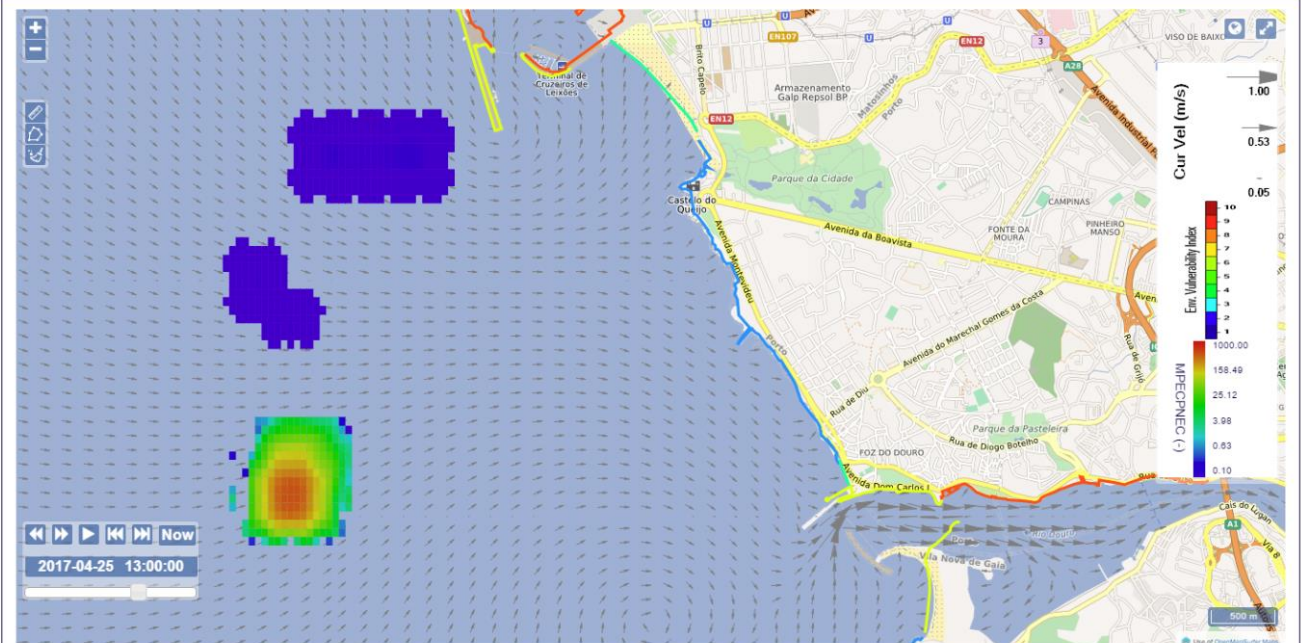
- ☐ Vessel Accident Risk
- ☐ Shoreline Contamination Risk (non-modelled)

### User Simulation Layers

- ☒ Zoom to Emission Point

2017-04-25 00:38:36 Sim Name

## Map



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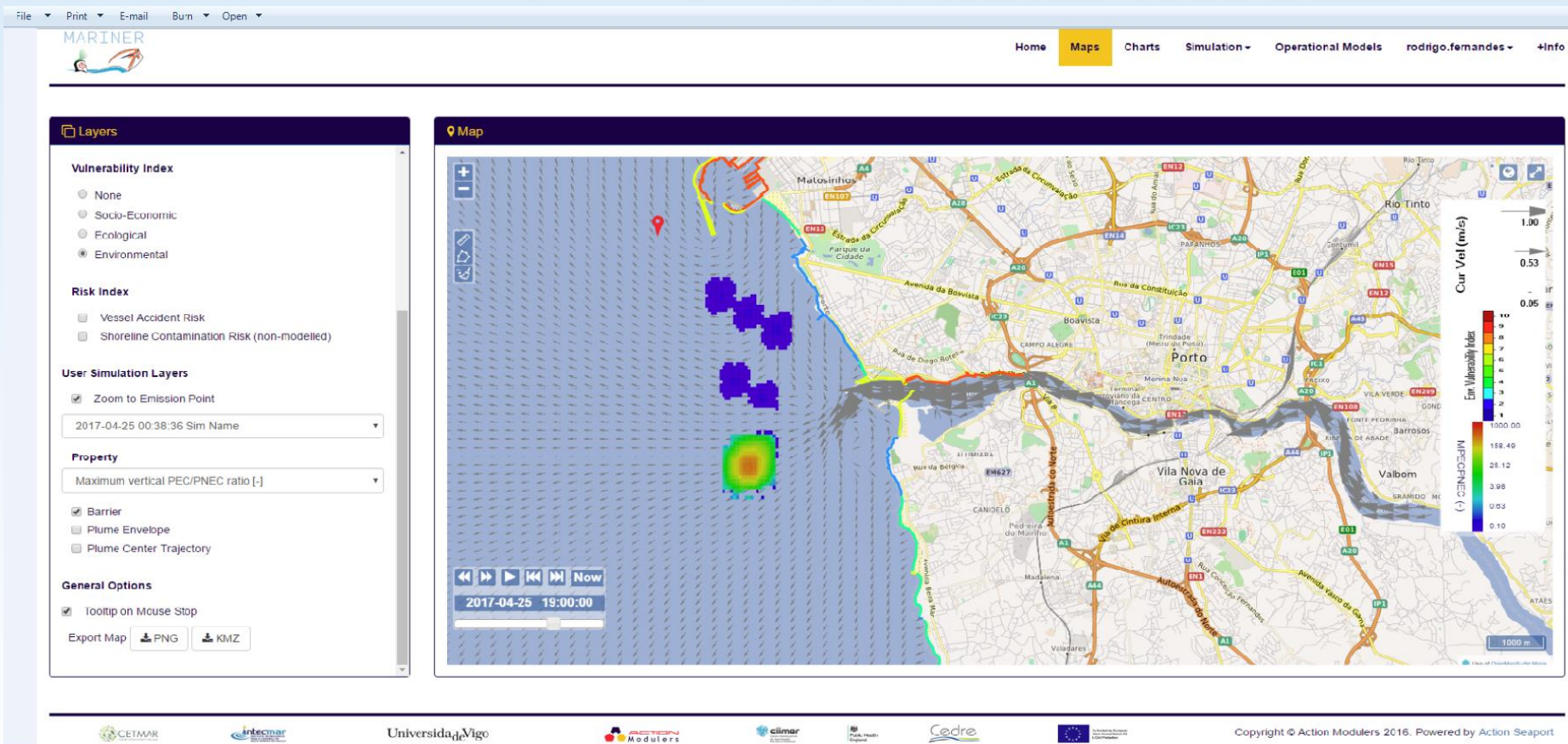


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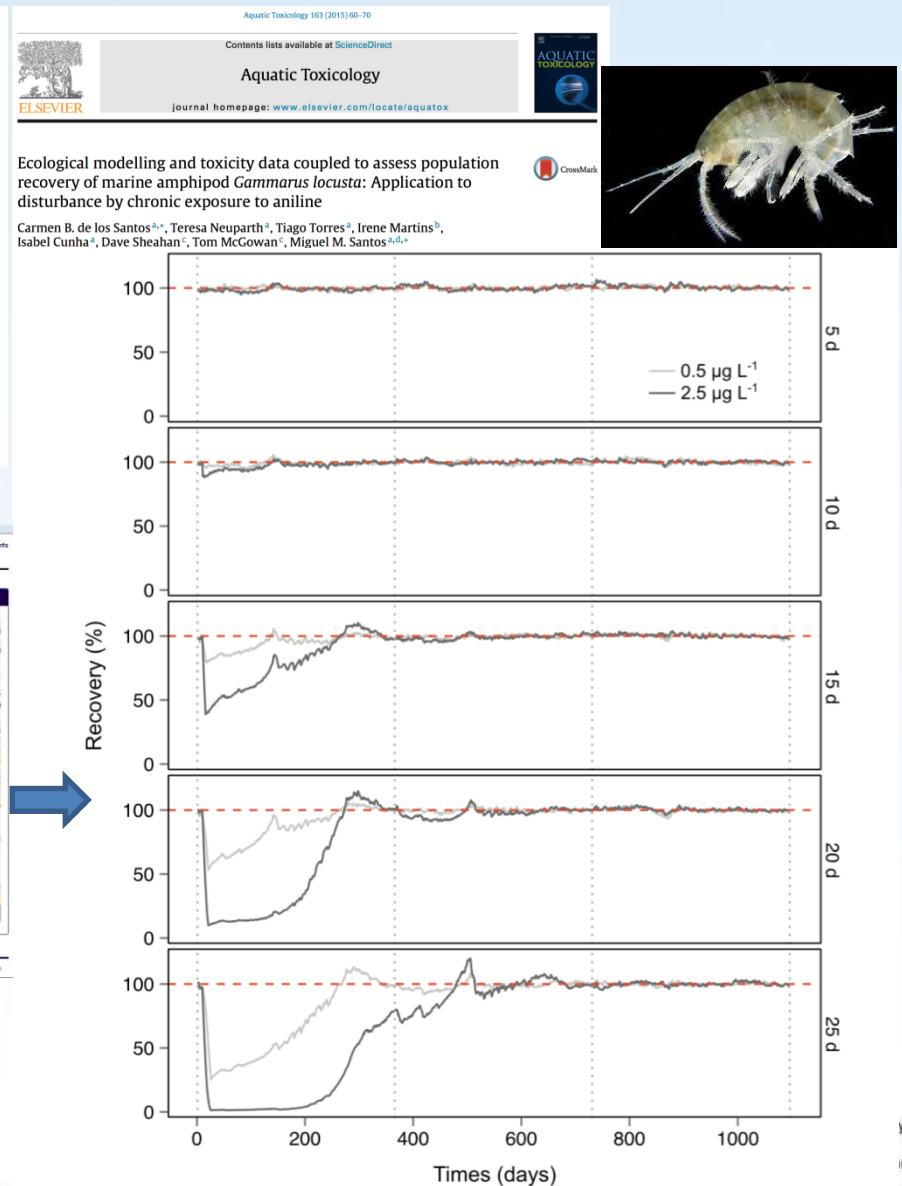
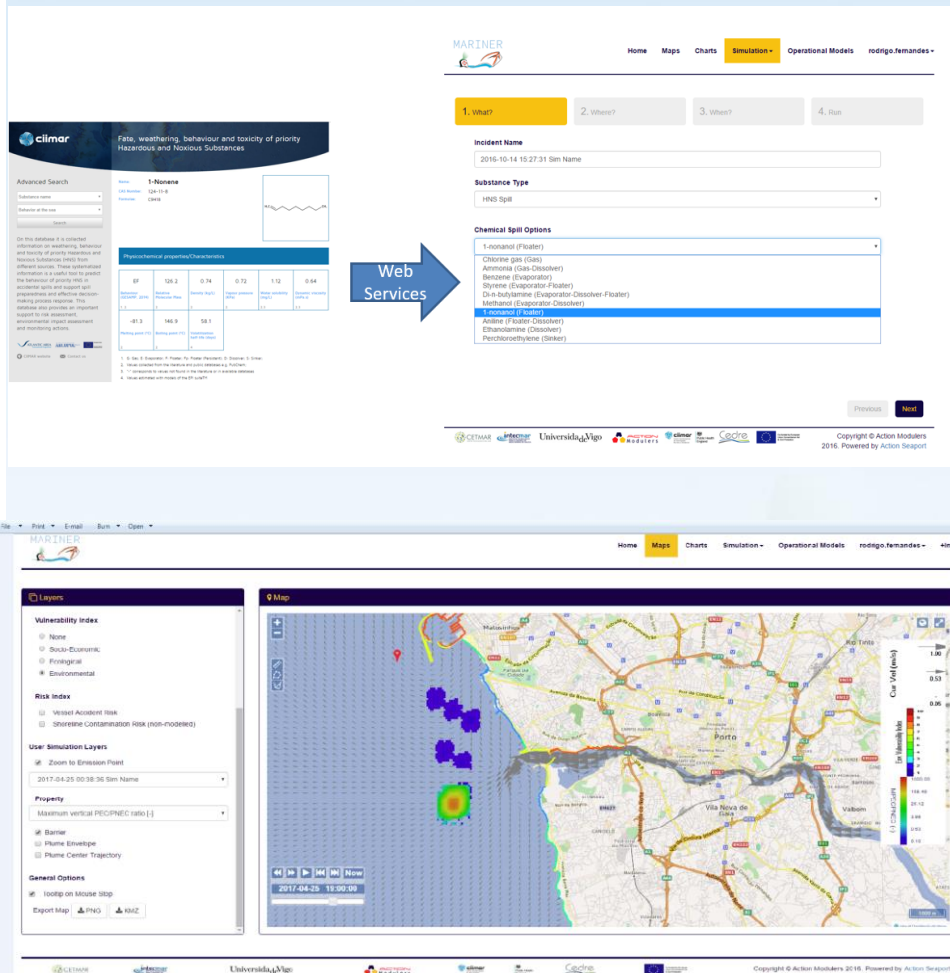


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Thank you

Merci

Gracias

Muito obrigada

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