Environmental Impact Assessment of HNS spills: Combining HNS Databases, Dispersion models and population modelling

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21 November 2017, Mariner Final Conference, CETMAR, Vigo

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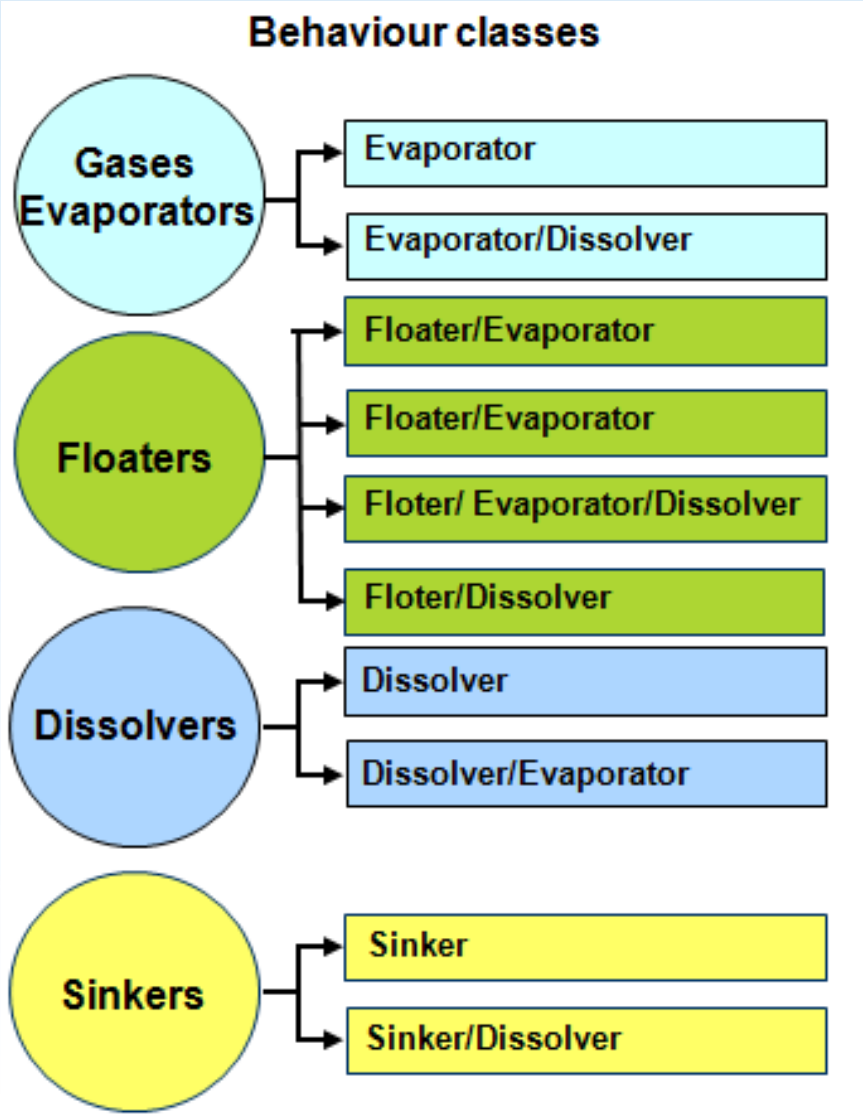

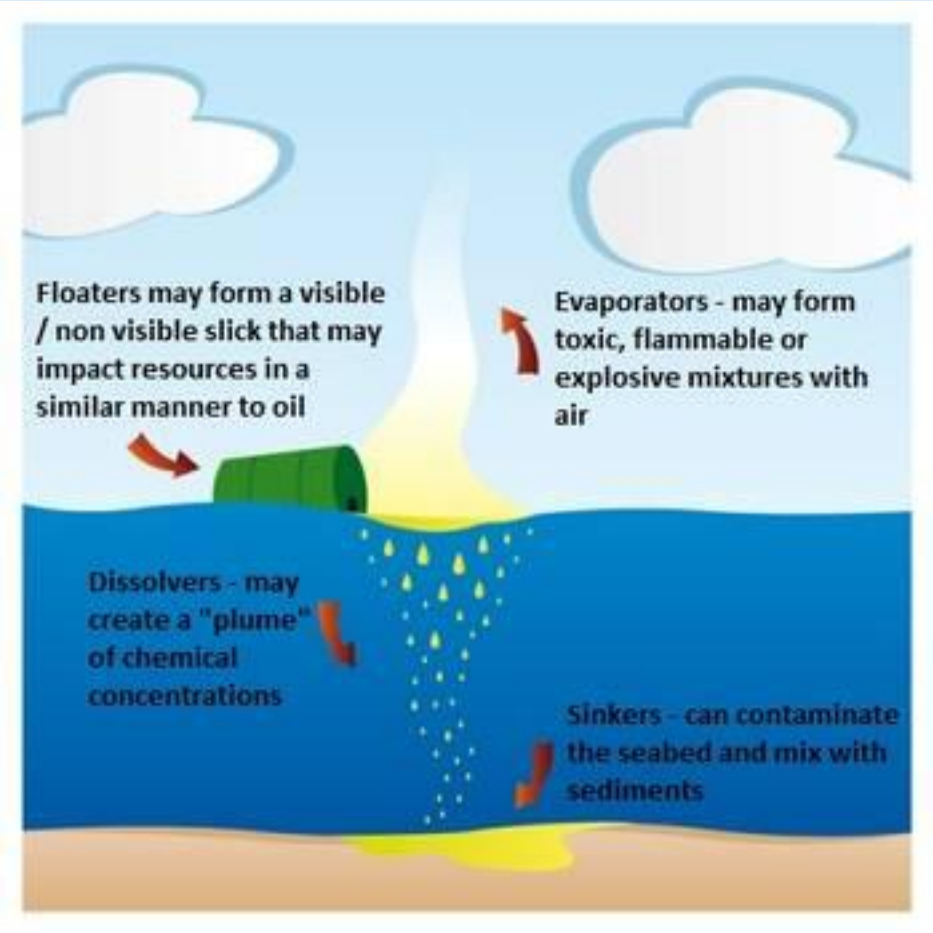

http://www.itopf.com/knowledge-resources/documents-guides/hazardous-and-noxious-substances-hns/chemical-spill-response-strategies/

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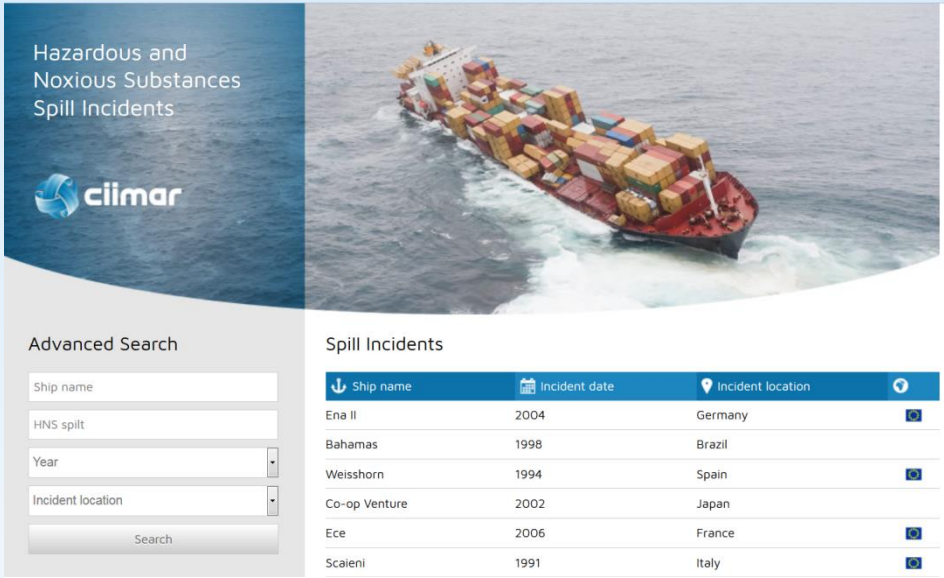

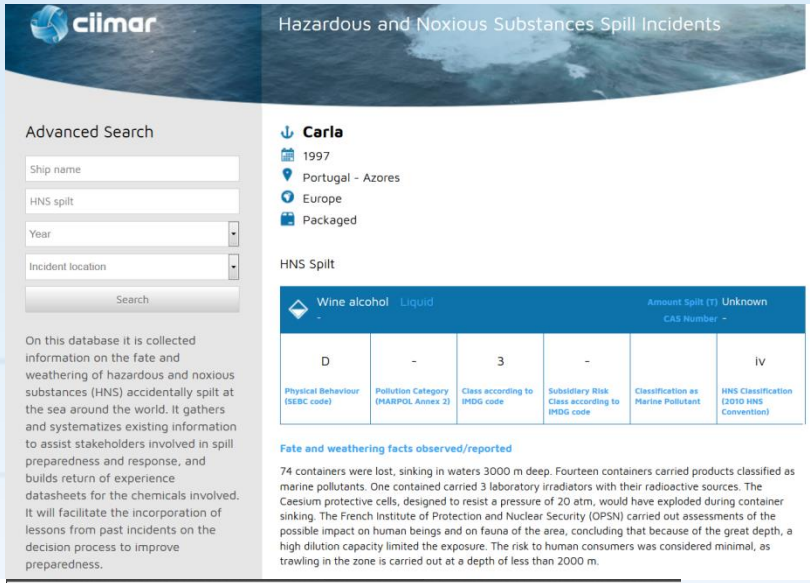

Journal of Hazardous Materials 285 (2015) 509–516

ELSEVIER

Contents lists available at ScienceDirect

Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat

Review

Review on hazardous and noxious substances (HNS) involved in marine spill incidents—An online database

Isabel Cunha [a,*], Susana Moreira [a], Miguel M. Santos [a,b,*]

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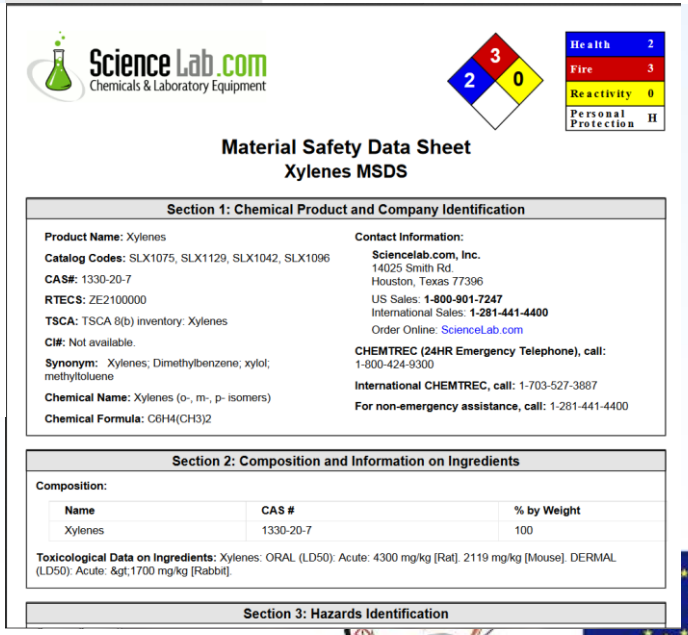

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Actions: Action C.2.3

C.2.3 Tools for modelling environmental impact

Physicochemical properties/Characteristics

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

Substances

Substance name	CAS number	Formulae	Behaviour
1-Dodecanol	112-53-8	C12H26O	Fp
1-Nonanol	143-08-8	C9H20O	Fp
1-Nonene	124-11-8	C9H18	FE
4-Nonylphenol	104-40-5	C15H24O	Fp
Acrylonitrile	107-13-1	C3H3N	DE
Aniline	62-53-3	C6H5NH2	FD
Benzene	71-43-2	C6H6	E
Butyl acrylate	141-32-2	C7H12O2	FED
Cyclohexane	110-82-7	C6H12	E
Cyclohexylbenzene	827-52-1	C12H16	F
Decanoic acid	334-48-5	C10H20O2	Fp
Di-2-ethylhexyl adipate	103-23-1	C22H42O4	Fp
Heptane	142-82-5	C7H16	E
Hexane	110-54-3	C6H14	E
Isononanol	27458-94-2	C9H20O	Fp

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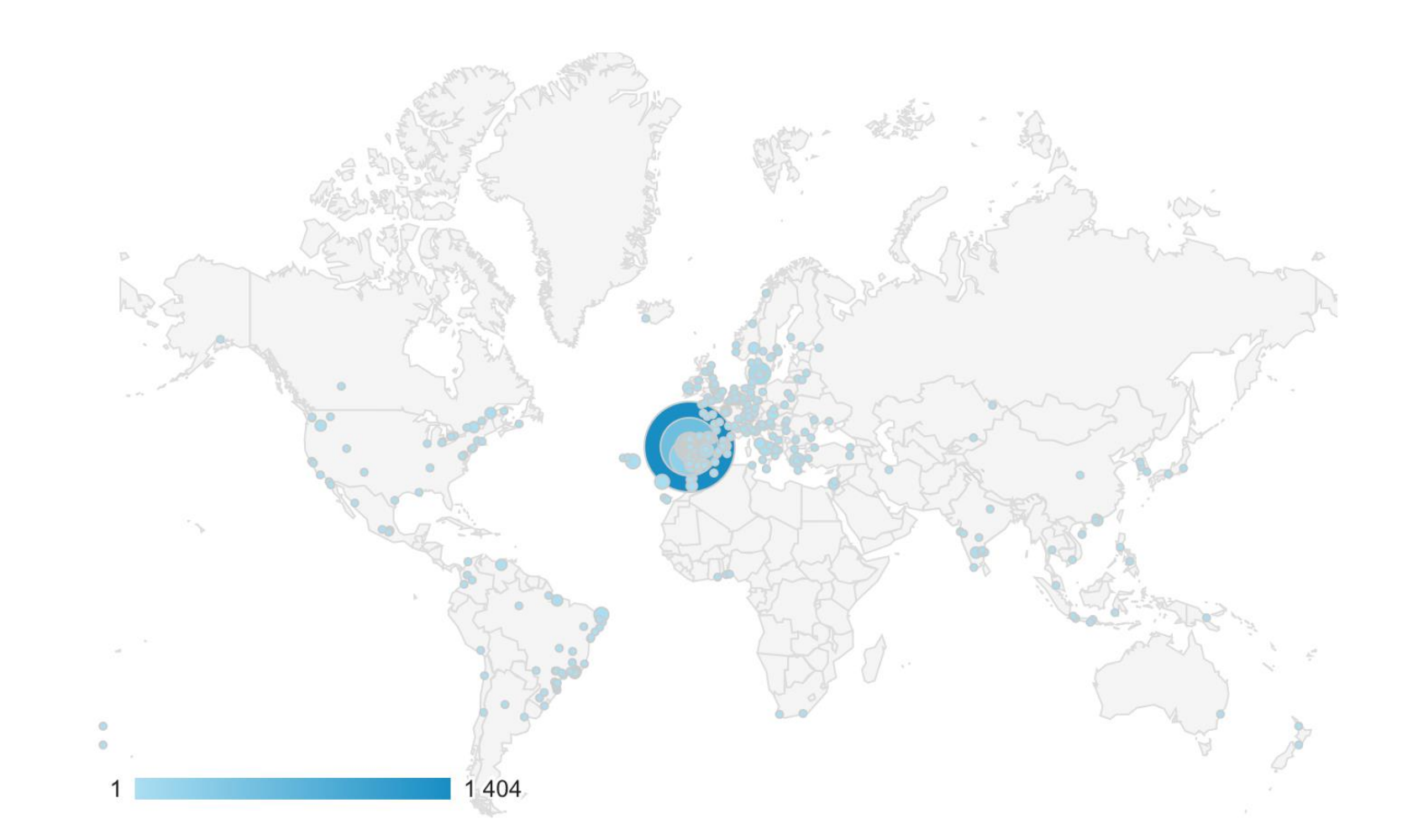

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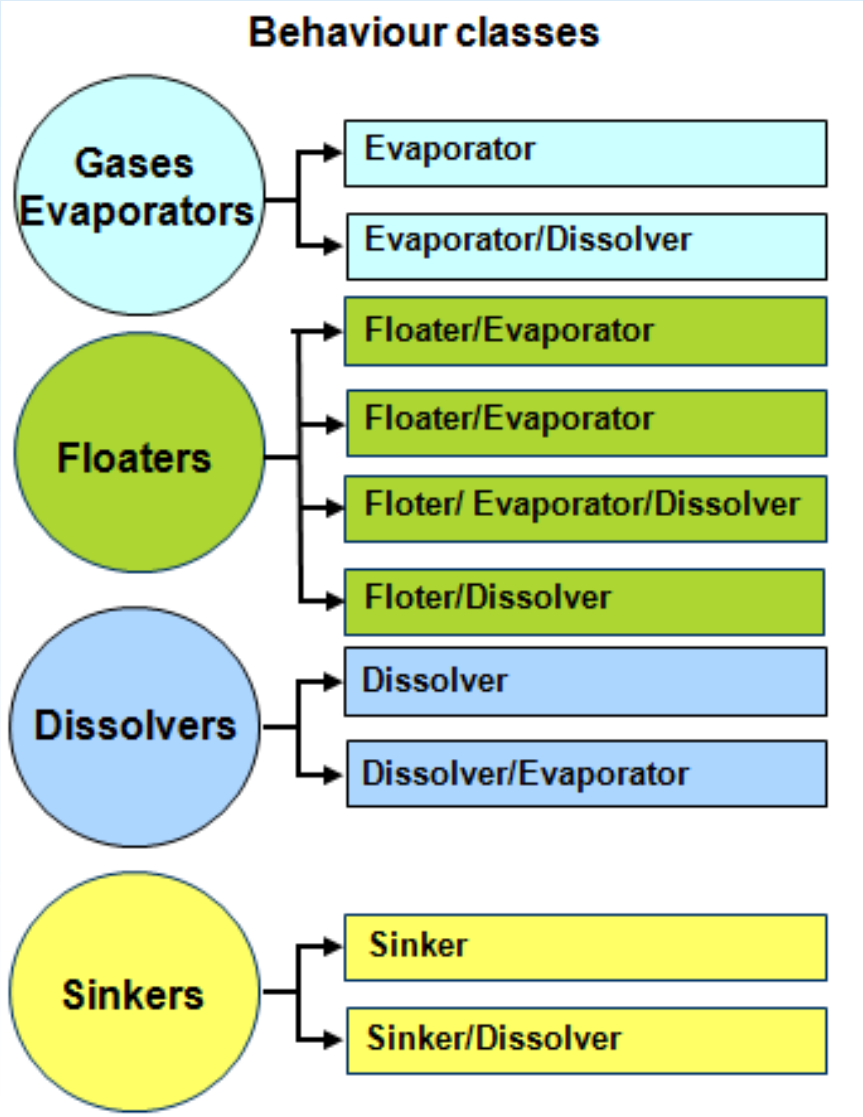

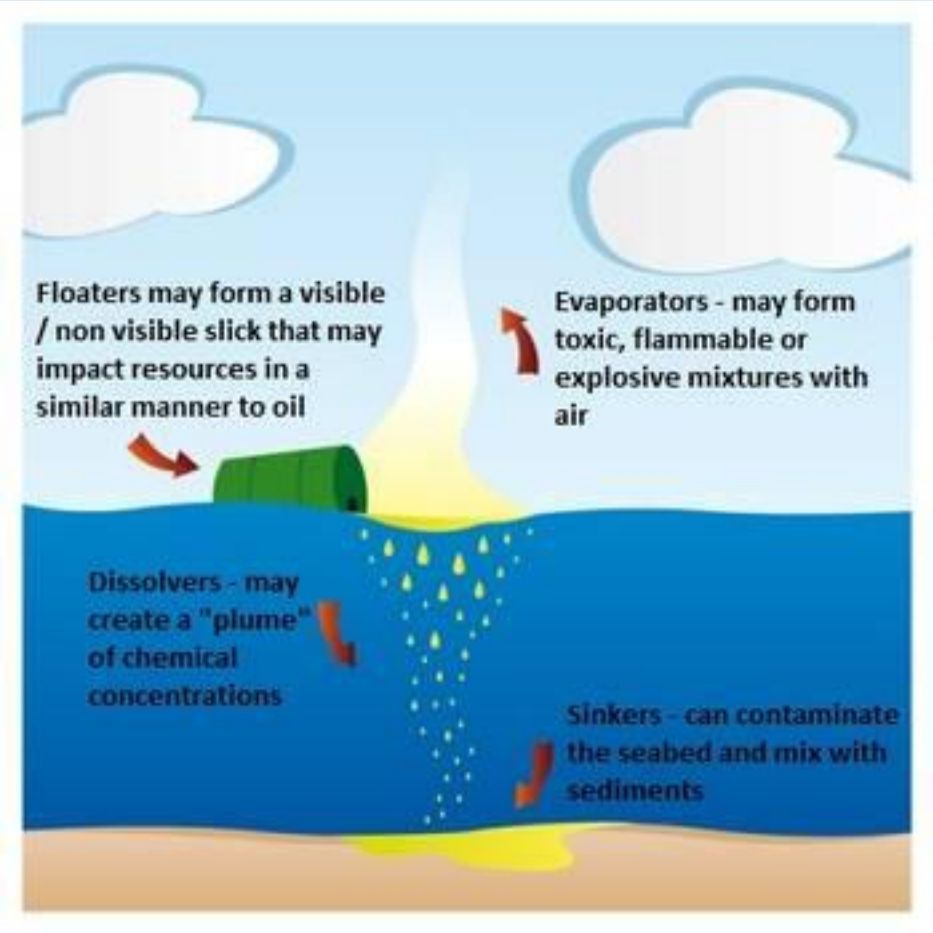

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Marine Pollution Bulletin 111 (2016) 330–338

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

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

Isabel Cunha [a,1], Helena Oliveira [a,*,1], Teresa Neuparth [a], Tiago Torres [a], Miguel Machado Santos [a,b,**]

climar — 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.

Name: 1-Nonene

CAS Number: 124-11-8

Formulae: C_9H_{18}

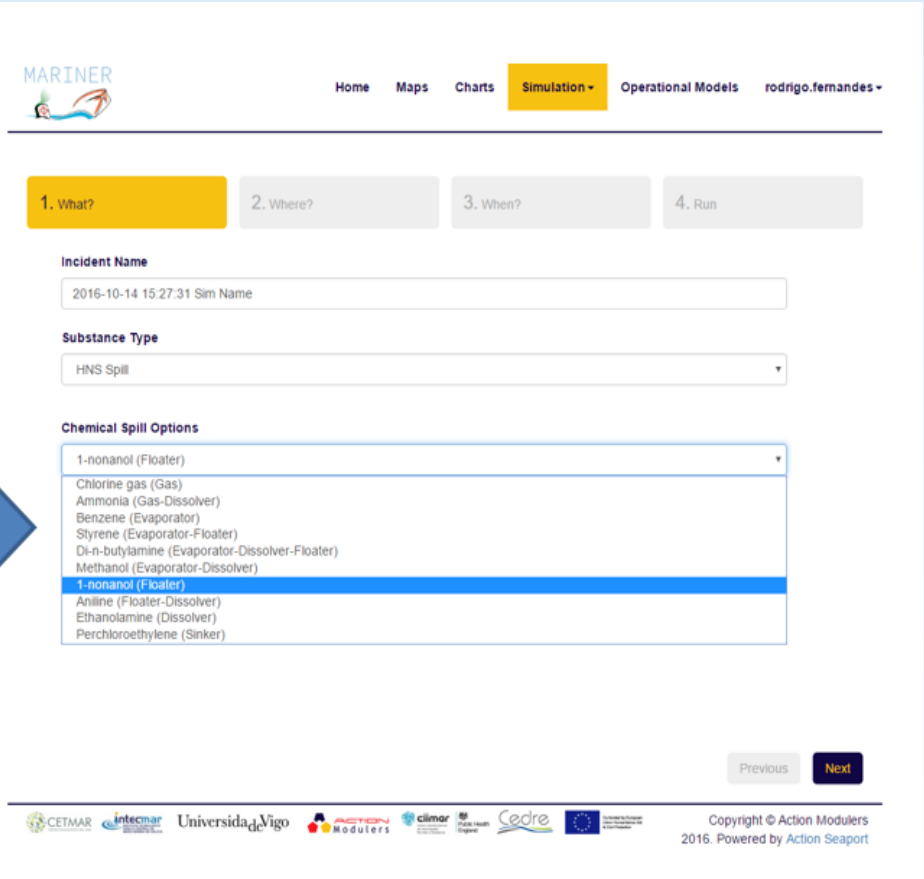
Physicochemical properties/Characteristics

EF	126.2	0.74	0.72	1.12	0.64
Behaviour (GESAMP, 2014) 1, 2	Relative Molecular Mass 2	Density (kg/L) 2	Vapour pressure (KPa) 2	Water solubility (mg/L) 2, 3	Dynamic viscosity (mPa.s) 2, 3

-81.3	146.9	58.1
Melting point (°C) 2	Boiling point (°C) 2	Volatilization half-life (days) 4

1. G: Gas; E: Evaporator; F: Floater; Fp: Floater (Persistent); 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™

Web Services



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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-nonanol (Floater)

- Chlorine gas (Gas)
- Ammonia (Gas-Dissolver)
- Benzene (Evaporator)
- Styrene (Evaporator-Floater)
- Di-n-butylamine (Evaporator-Dissolver-Floater)
- Methanol (Evaporator-Dissolver)
- 1-nonanol (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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	Name	Behaviour	CAS	Density [kg/m3]	Viscosity [mPa.s]	Solubility [mg/L]	Vapour Pressure [Pa]	Molecular Weight [g/mol]	Log Kow	Source
☐	1-Dodecanol	Floater (Persistent)	112-53-8	830	18.80 at 20ºC	4 at 25ºC	0.1 at 25ºC	186.339	5.13	MARINER (CIIMAR)
☐	1-Nonanol	Floater (Persistent)	143-08-8	830	11.70 at 20ºC	140 at 25ºC	3 at 25ºC	144.258	3.77	MARINER (CIIMAR)
☐	1-Nonene	Evaporator, Floater	124-11-8	740	0.64 at N/DºC	1.12 at 25ºC	720 at 25ºC	126.243	5.15	MARINER (CIIMAR)
☐	4-Nonylphenol	Floater (Persistent)	104-40-5	950	0.00 at N/DºC	7 at 25ºC	0.1 at 25ºC	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

Acute toxicity

- ✓ **Algae** (primary producers): **72/96h EC50** (reproduction/growth);
- ✓ **Invertebrates** (primary consumers): 48h **EC50** (immobility) *Daphnia sp*. and **96h LC50** other crustaceans;
- ✓ **Fish** (higher level consumers): **96h LC50** (mortality).

Chronic toxicity **NOEC** or equivalent **Ecx**

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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C.2.3 Tools for modelling environmental impact

Hazard Quotient (HQ)

PEC / PNEC

≥ 1 Potential concern to be considered;

(1-10 lower concern; 10-100 additional data needed; 100-1000 and >1000 major concern, testing or risk reduction measures)

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C.2.3 Tools for modelling environmental impact

Name: **Butyl acrylate** **CAS Number:** 141-32-2 **Formulae:** C7H12O2

Toxicity tests results PNEC$_{seawater}$: 0.21 μg/L PNEC$_{water, intermittent}$: 21 μg/L

Algae

Invertebrates

Fish

Mammals

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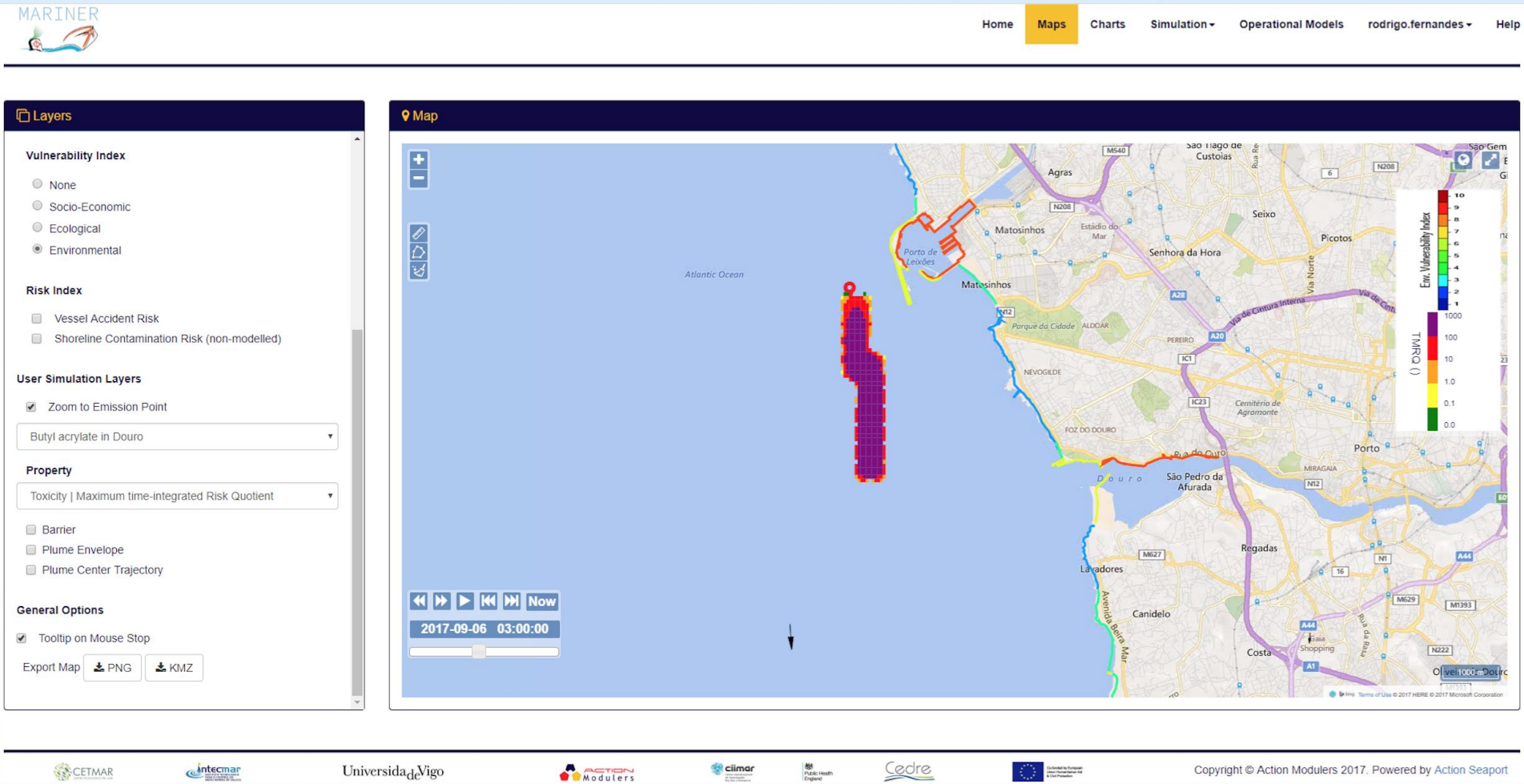

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Layers

Domain

Portugal (Cont.)

WMS Layers

- [ ] Vessels
- [ ] Monitoring Stations

Model Results

Meteo WRF AM Portugal

- [x] Wind Velocity [m/s]
- (•) None
- ( ) Air Temperature [°C]
- ( ) Precipitation [mm/h]

Vulnerability Index

- ( ) None
- ( ) Socio-Economic
- ( ) Ecological
- (•) Environmental

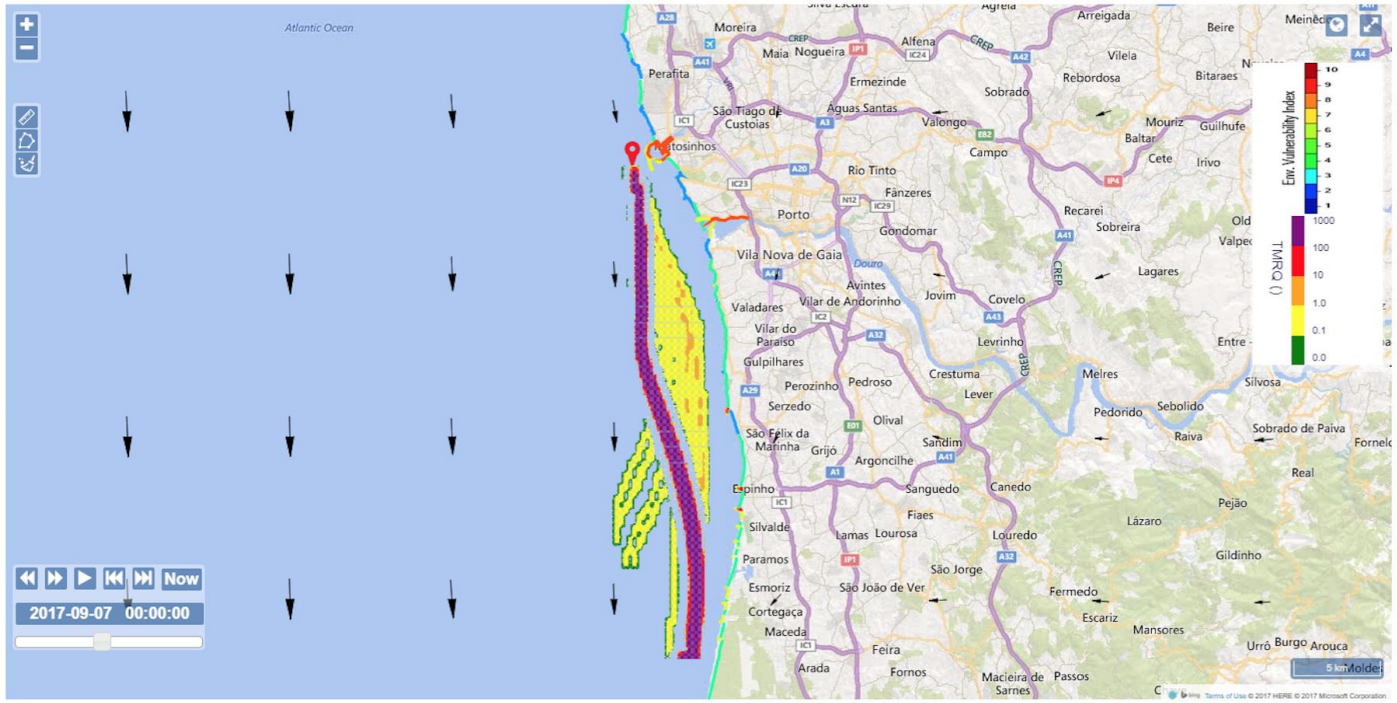
Risk Index

- [ ] Vessel Accident Risk
- [ ] Shoreline Contamination Risk (non-modelled)

User Simulation Layers

- [x] Zoom to Emission Point

Map



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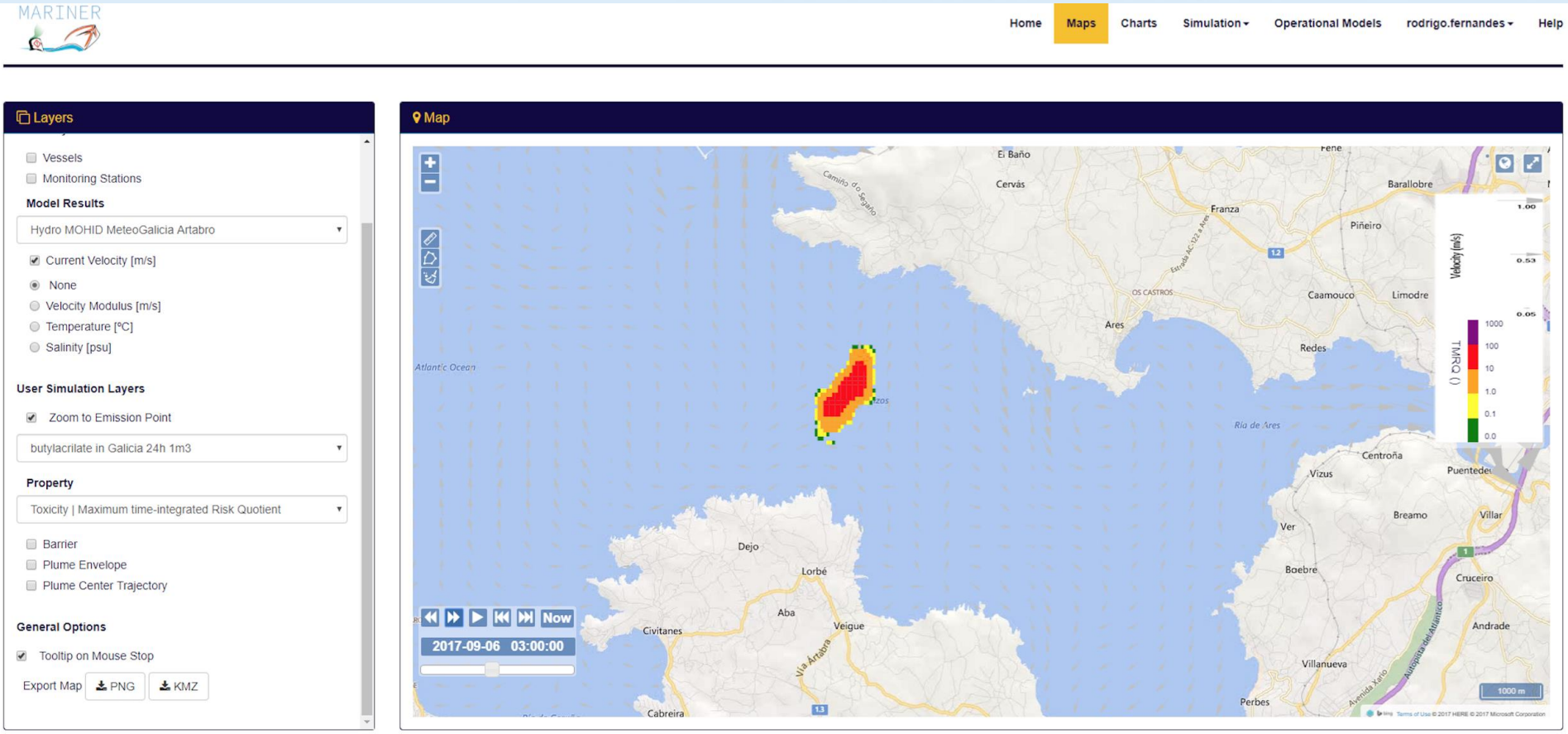

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Layers

Domain

Galiza

WMS Layers

- [ ] Vessels
- [ ] Monitoring Stations

Model Results

Hydro MOHID MeteoGalicia Artabro

- [x] Current Velocity [m/s]
- (•) None
- ( ) Velocity Modulus [m/s]
- ( ) Temperature [ºC]
- ( ) Salinity [psu]

User Simulation Layers

- [x] Zoom to Emission Point

butylacrilate in Galicia 24h 1m3

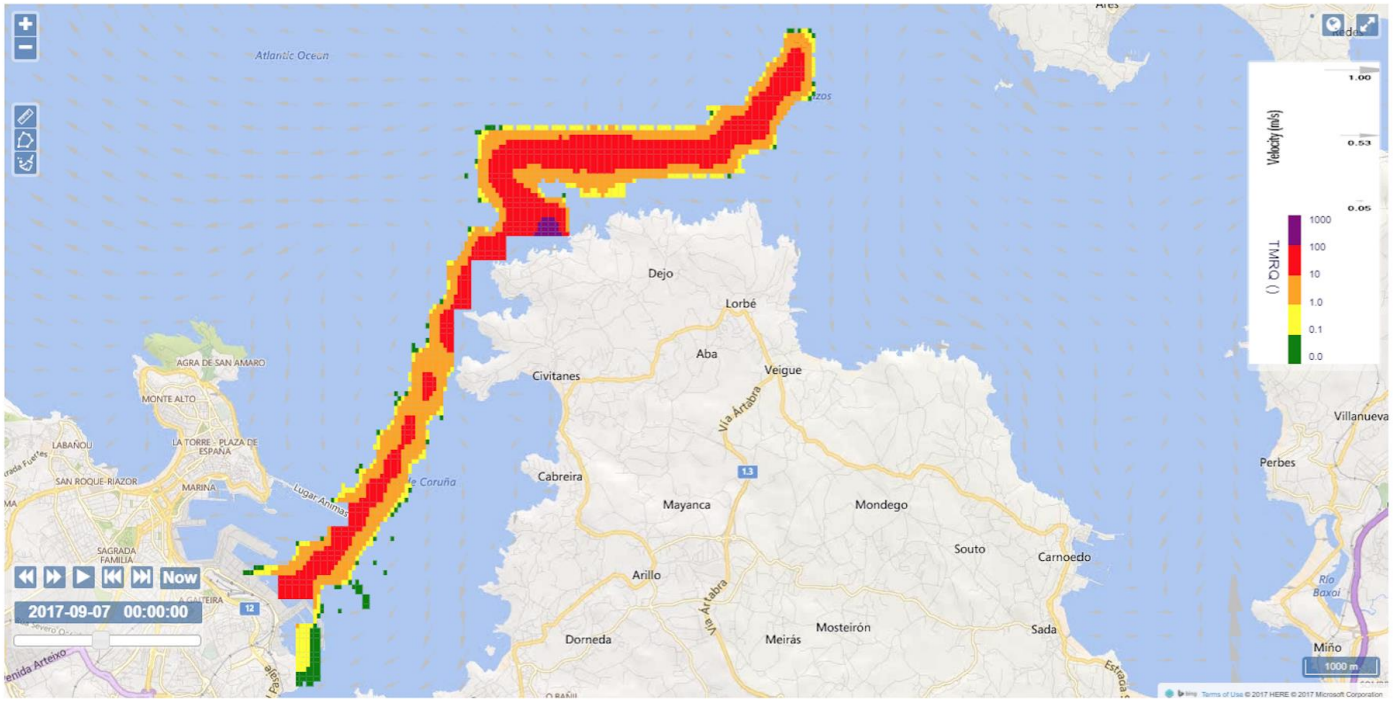
Property

Toxicity | Maximum time-integrated Risk Quotient

- [ ] Barrier
- [ ] Plume Envelope
- [ ] Plume Center Trajectory

General Options

Map



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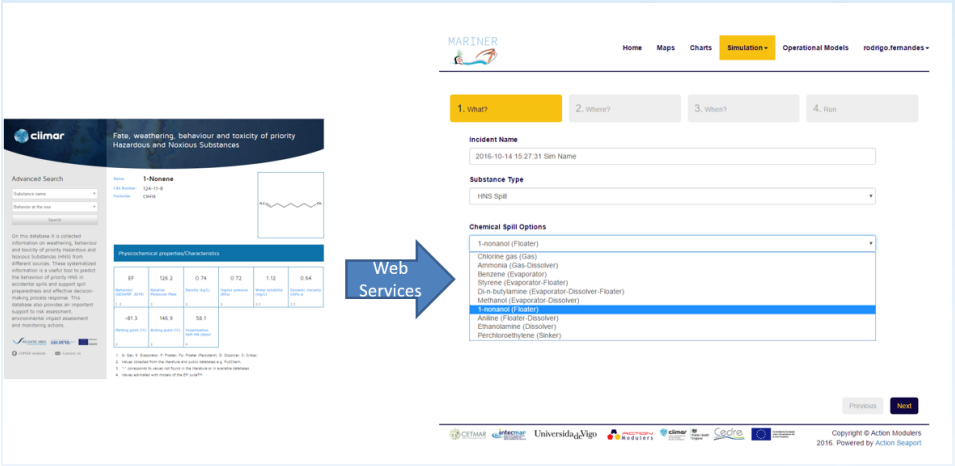

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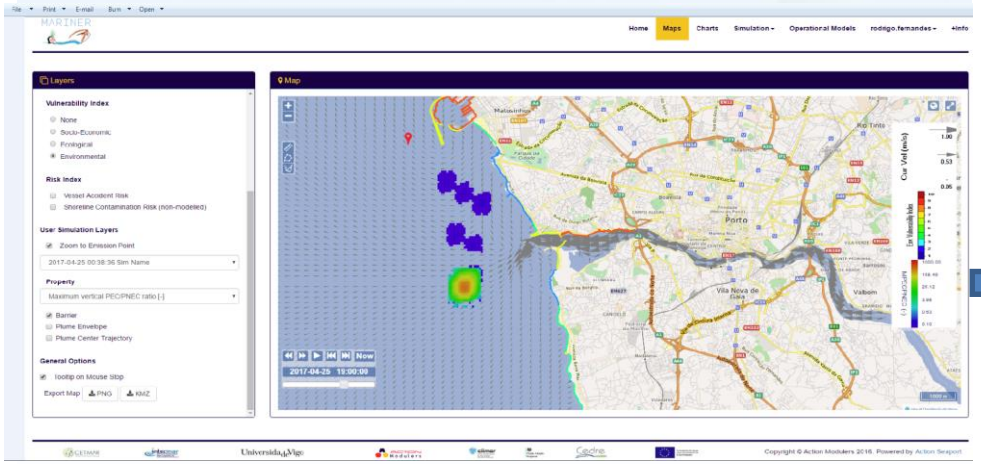
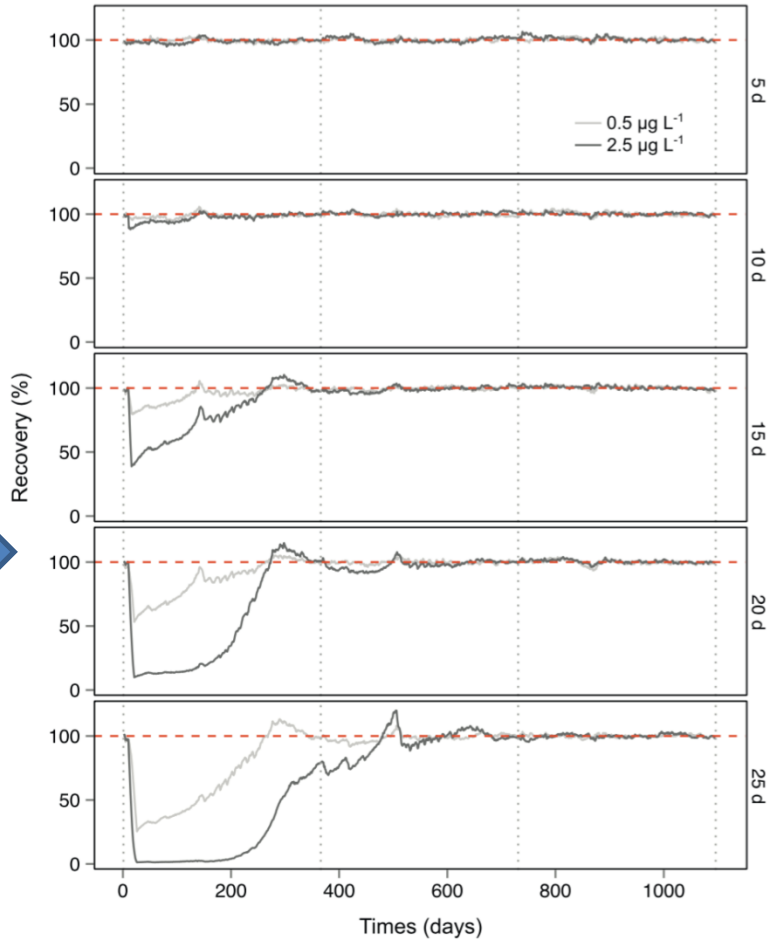


Ecological modelling and toxicity data coupled to assess population recovery of marine amphipod *Gammarus locusta*: Application to disturbance by chronic exposure to aniline

Carmen B. de los Santos[a,*], Teresa Neuparth[a], Tiago Torres[a], Irene Martins[b], Isabel Cunha[a], Dave Sheahan[c], Tom McGowan[c], Miguel M. Santos[a,d,*]



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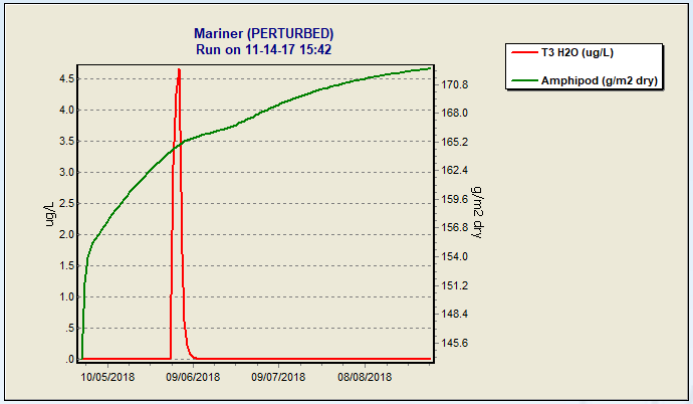
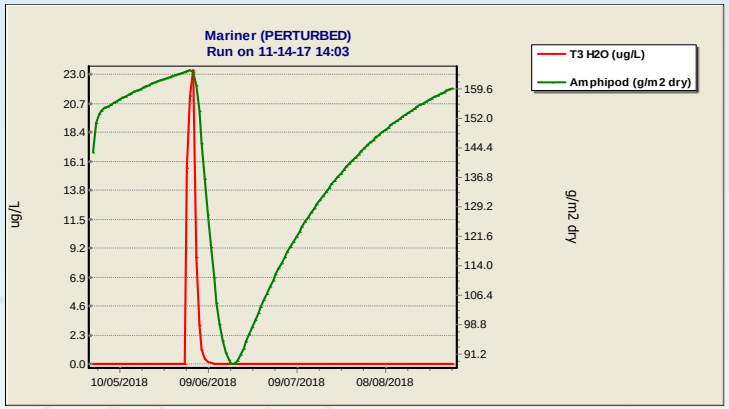
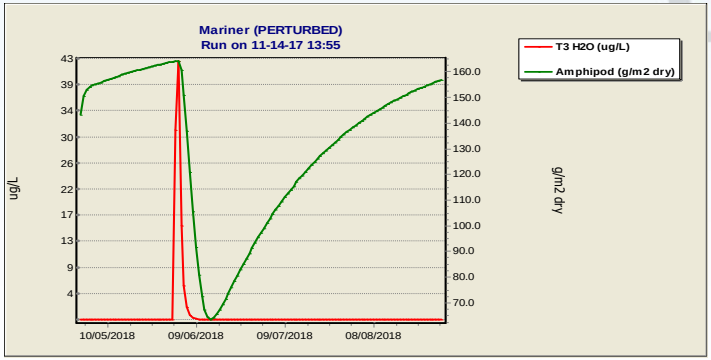
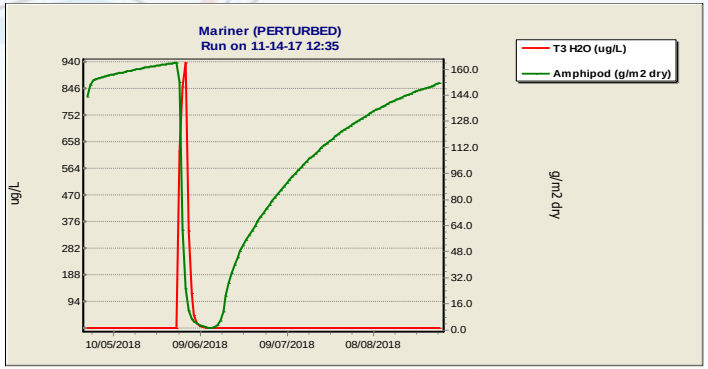
3 days simulations _Nonylphenol









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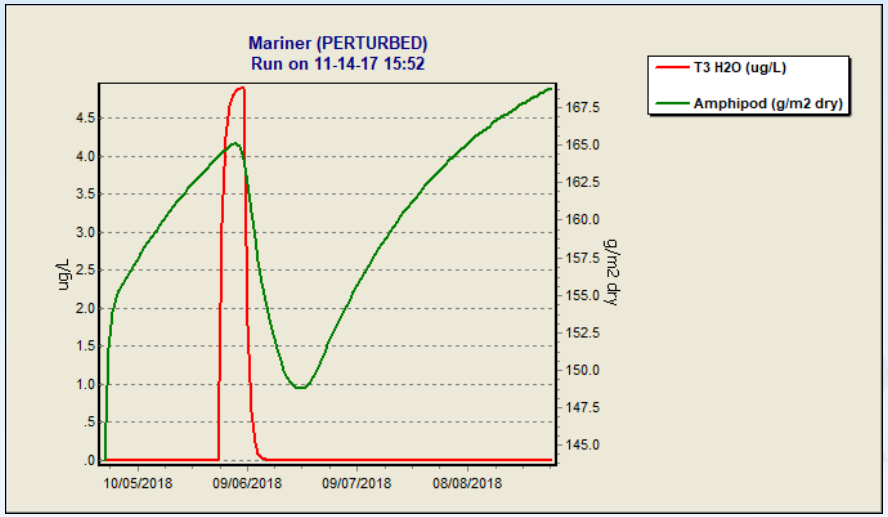
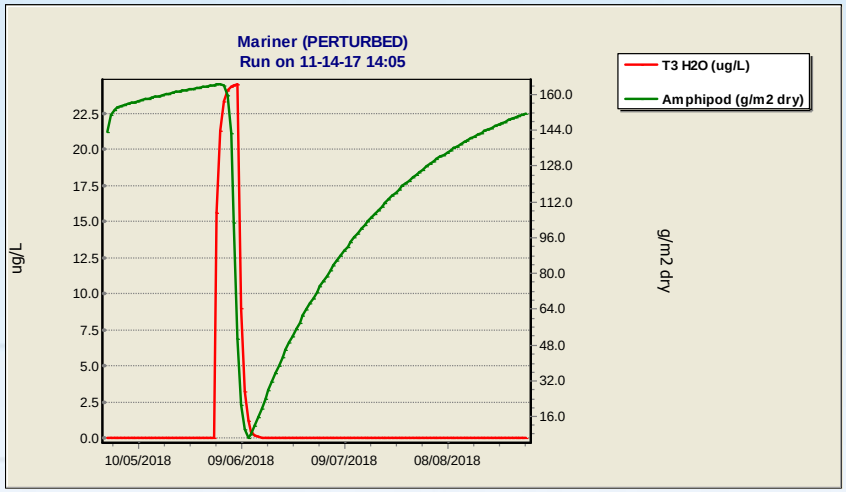
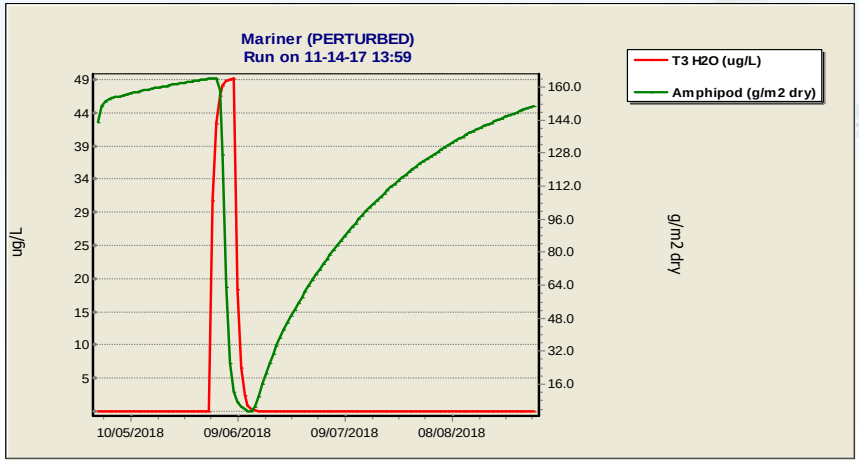
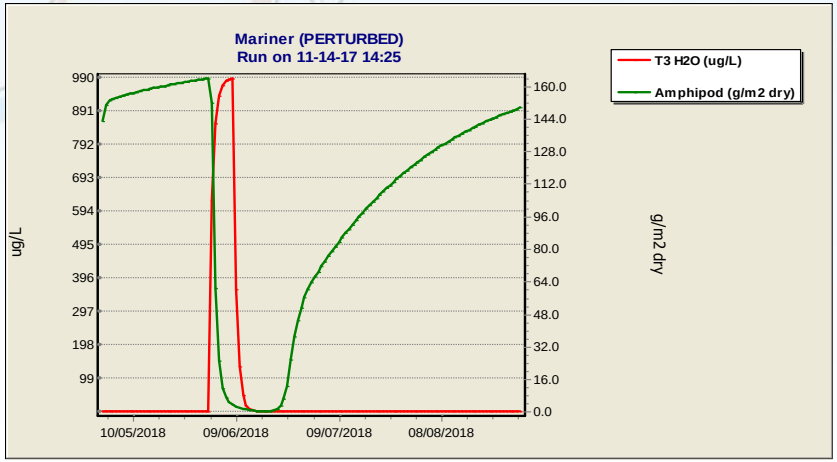
7 days simulations_Nonylphenol









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Development and systematization of guidelines for hazard and Impact Assessment:

- **Chemical monitoring**
- **Biological monitoring:** Bioassays and Biomarkers
- **Ecological monitoring**

Determination of acute lethal toxicity to marine copepods (*Tisbe battagliai*)

Principle of the test

This guideline prescribes a test using a harpacticoide copepod (*Tisbe battagliai*) as test organism to develop data on the acute toxicity of chemicals. Newly hatched larvae (termed nauplii), aged less than 24 hours at the start of the test, are exposed in microwell test chambers to seawater (*i.e.*, control) and to the test chemical added to seawater at a range of concentrations. The test duration is of 48 hours (h). Mortalities are recorded at 24 and 48 h and the concentrations which results in 50 % of copepods mortality (LC50) are determined at 48 h where possible.

Static and renewal microplate tests might not be applicable to materials that have a high oxygen demand, are highly volatile, are rapidly transformed (biologically or chemically) in aqueous solutions, or are removed from test solutions in substantial quantities by the test chambers or organisms during the test.

Test conditions

Equiment

- Oxygen meter (with microelectrode or other suitable equipment for measuring dissolved oxygen in low volume (*e.g.*, ≤ 10-mL) samples);
- pH meter;
- Apparatus for water temperature control;
- Apparatus for water salinity control;
- 125 µm mesh sieve;
- 62 µm nylon mesh;
- Polystyrene 24-well microplates;
- Crystallising dish;
- Pasteur pipettes;
- 500-µL glass syringe;
- Graduated glass capillary pipette;
- Test vessels;
- Dissecting stereomicroscope.

Note: Polystyrene is not well suited to testing with hydrophobic organic chemicals because of non-specific plastic:organic binding, which can reduce chemical bioavailability to copepods. Therefore, microplates with microwells pre-coated with glass or polyacrylamide are better suited for copepod testing of hydrophobic chemicals than microplates with naked polystyrene wells.

Species

Need to integrate modelling tools, i.e., Dispersion models, (eco)toxicity databases, Ecological modelling, Environmental sensitivity index, Risk tools, and implement it at operational level.

Integration with the Marine Strategy Framework Directive

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Obrigado!

santos@ciimar.up.pt

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