



Enhancing HNS preparedness
through training and exercising

MARINER-

Task_C1_5_Model_Comparison

Task C: HNS modelling and
environmental impact

Action C.1.5: Model Comparison

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1. Summary

The objective of this work is to compare Mariner Modelling tools (using MOHID model) for air dispersion with well known and widely used tools (as ALOHA model).

The comparisons show that Mariner modelling tools are able to represent similar level of concern areas, lengths and directions, consisting in a state-of-the-art tools for chemical incidents preparedness and response.

2. Real Case Comparison

A performance comparison between ALOHA[®] software and Mariner Modelling tools were carried out in two scenarios: The Cason accident happened in Galician coast in 1987 and a training exercise at Vilagarcia harbor.

ALOHA[®] (Areal Locations of Hazardous Atmospheres) is a computer program designed to model chemical releases for emergency responders and planners. It can estimate how a toxic cloud might disperse after a chemical release—as well as several fires and explosions scenarios.

ALOHA is part of the CAMEO[®] software suite, which is developed jointly by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA).

ALOHA will display up to three threat zones. A threat zone is an area where a hazard (such as toxicity or thermal radiation) has exceeded a user-specified Level of Concern (LOC). ALOHA will display up to three threat zones overlaid on a single picture. The red threat zone represents the worst hazard.

2.1. Cason Accident

On 5th December 1987, the general cargo vessel “Cason” reported a fire on board while sailing off the coast of Spain. The fire spread and the ship lost control, it eventually ran aground despite the towing attempts. Frightened by the violent reactions the crew abandoned ship. 23 crew-members died due to breaking their neck by the lifejacket when jumping into the sea as well as the low temperatures of the sea.

The Panamian cargo “Cason” holds transported close to 1000 tonnes of chemicals stored in barrels. According to the manifest, the main HNSs were listed in the next table:

	Products on board	Amount	Risks	SEBC
Cargo	n-Butanol	228 t	3.3 flammable, irritating...	D
	Xylenes	254 t	3.3 flammable, irritating, aq. tox.	FE
	Sodium metal	12.6 t	4.3 dangerous when wet, harmful	D
	Aniline oil	110 t	6.1 toxic, irritating, aq. tox.	FD
	ortho Cresol	110 t	6.1 toxic, corrosive	FE
	Formaldehyde	86 t	3.3 flammable,corrosive, ...	D
	Phosphoric acid	50 t	8.0 corrosive	D
	Cyclohexanone,...	8.6 t	3.3 flammable, irritating,...	FE

Table 1: Main HNS transported by Cargo Cason, when the accident at night 5th December 1987.

The cargo “Cason” drifted towards the coast of Finesterre where it ran aground at Punta do Castelo, near Praia do Rostro. The wreck of “Cason” was situated close to the coast where it was grounded on the rocky seabed approximately 100 m from the coast. The ship’s bottom was damaged and water was in the different holds. Operations began to unload the deck cargo. At night of 10 December, a series of explosions happened due to reaction between sodium and seawater due to the bad weather. The surrounding communities were panic-stricken and 15,000 people were evacuated.

In order to simulate this case, the worst scenario was chosen: The release of the all amount of Xylene in the atmosphere, 254 Tm, on 6th December, when the ship ran ground. This case is highly improbable, but it would be the first scenario that responders had simulated.

The inputs for both models, ALOHA and Mariner Modelling tools, were: 254 Tm M-Xylene, instantly released at 00:00, 6th December 1987, at Punta del Castelo.

As input weather conditions, wind was obtained of ERA-20C, the ECMWF's first atmospheric reanalysis of the 20th century, from 1900-2010. In the next figure, the surface wind at the NW of Iberian Peninsula was shown, at 00:00 UTC 6th December 1987. The presence of low pressures

at N of Galicia caused strong winds from SW in Galician coast. The module and direction of wind were 7 m/s and 215° at 43°N 9°W.

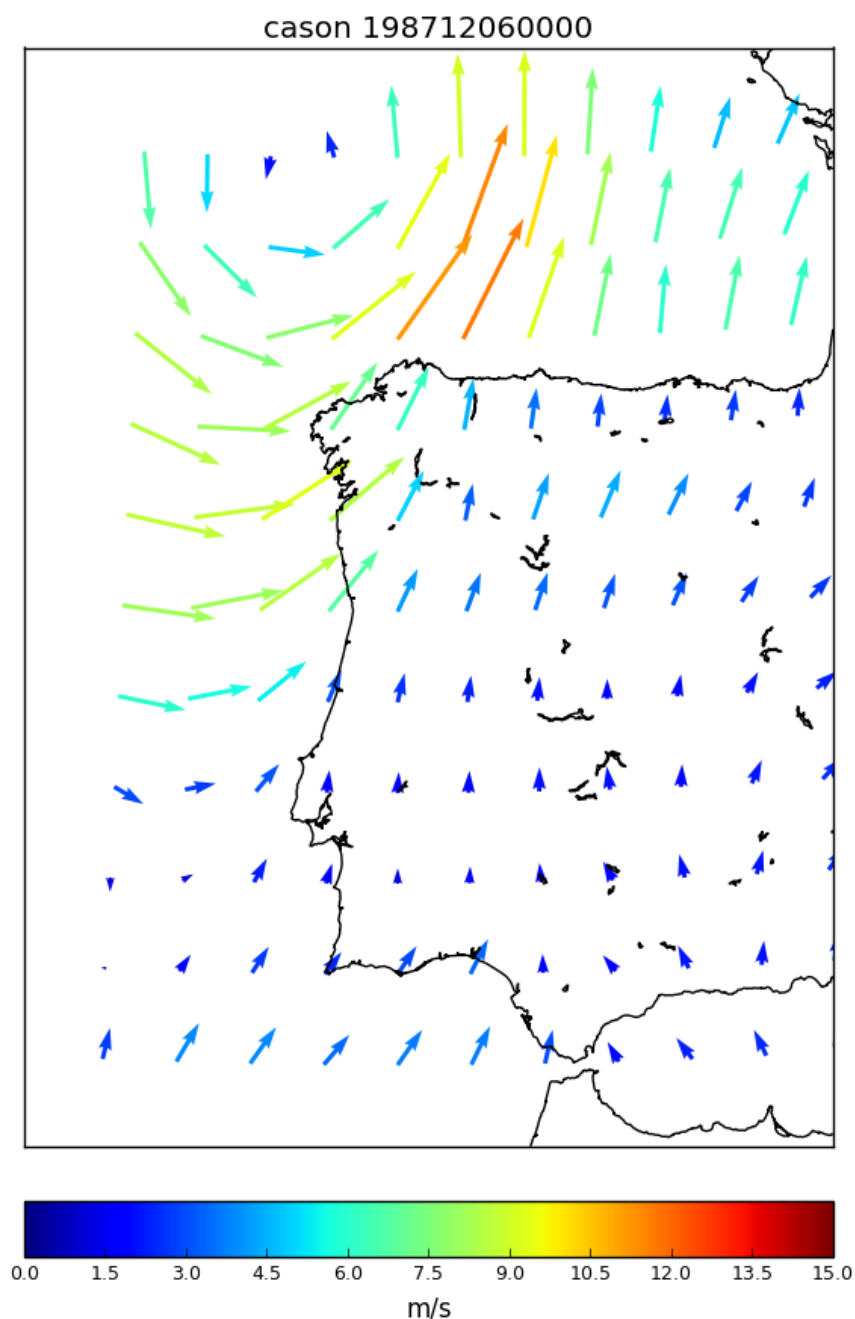


Figure 1. Surface winds at 00:00 UTC on 6th December 1987 from the ECMWF's ERA-20C Reanalysis.

Both modelling tools were tested in these conditions. The main output of the Mariner Modelling tools is a field of HNS distribution in water and air during the period of the accident. With these outputs, other information can be inferred as exclusion areas determined by public exposure

guidelines. Public exposure guidelines are intended to predict how members of the general public would be affected (that is, the severity of the hazard) if they are exposed to a particular hazardous chemical in an emergency response situation. The most common public exposure guidelines are: AEGLs (Acute Exposure Guideline Levels), ERPGs (Emergency Response Planning Guidelines), TEELs (Temporary Emergency Exposure Limits) and PAC (Protective Action Criteria). In order to compare the outputs of them, the PAC zones were calculated using Mariner Modelling Tool's outputs, since these zones are the output of ALOHA model.

The next figures show the threat zones using PAC levels calculated by both models:

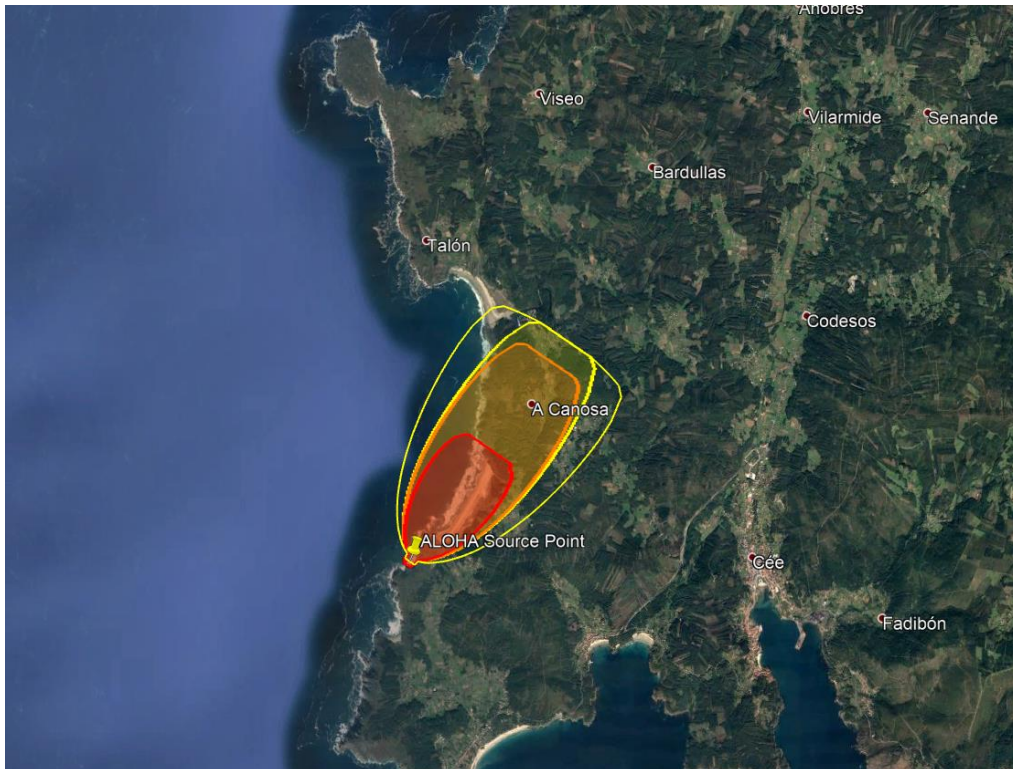


Figure 2. ALOHA PAC zones forecasted for Cason worst scenario, on 6th December 1987, displayed as a KML file on GoogleEarth®.

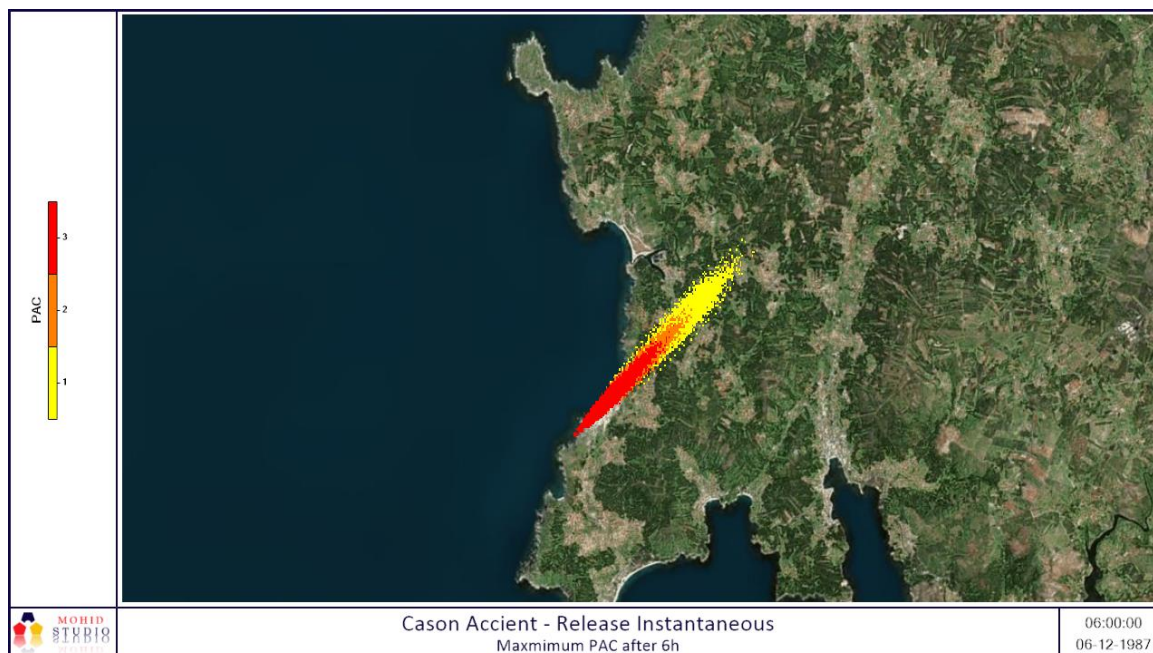


Figure 3. Mariner Modelling Tool PAC zones forecasted for Cason worst scenario, on 6th December 1987, displayed by MohidStudio®.

In the figures above, original output displays were presented, Google Earth KML for ALOHA and Mariner COP using MOHID Studio for Mariner Modelling Tool.

As can be seen in the figures, both forecasted PAC areas have similar NE direction and the order of the PAC extensions is also comparable, with minor differences in total length of PAC1. ALOHA PAC areas are wider than MOHID. While both have the same atmosphere turbulence scheme and parameters they represent different dispersion implementation (MOHID is lagrangian approach and ALOHA is Gaussian) that can be the cause of the differences. However, in terms of preparedness and response, Mariner Modelling tools seem capable of estimating similar impacts as ALOHA reference model.

2.2. Vilagarcía Exercise

On 23rd November 2017, Vilagarcía Harbor Authority organized a HNS Response exercise. Mariner Project's partners were invited to test several tools developed during the project. Among them, Mariner Modelling Tool was used to simulate the pollution plume forecast and determine the threat area. This simulation was compared with the ALOHA simulation for the same conditions.

To face a drill accident near Vilagarcia Harbor (Galicia), it was necessary to determine an exclusion area due to the likely release of 100 Tm of ammonia. As meteorologic and oceanographic conditions, MeteoGalicia numerical forecast was used. MeteoGalicia is the Galician Meteorological Service, and it performs a daily numerical prediction based WRF meteorological model and MOHID hydrodynamic model.

The release is considered instantaneous at 8:00 UTC on 23rd November 2017. Both simulation outputs were displayed as PAC Zones on Plan CAMGAL web viewer. Plan Camgal is the Galician contingency plan for marine accidents, and its web viewer is based on Arcopol Web Viewer. Results are shown in the next figures:

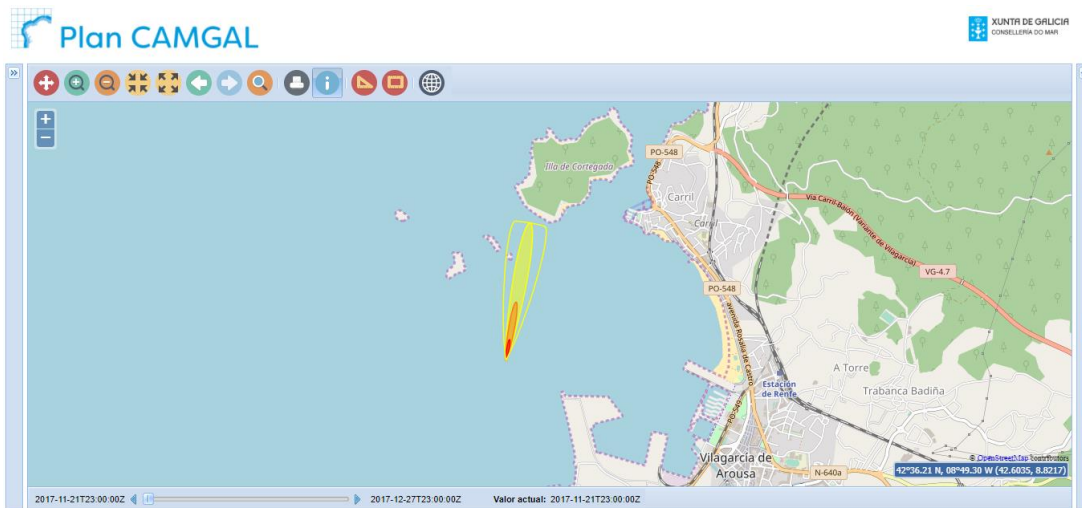


Figure 4. ALOHA PAC zones forecasted for Vilagarcia Harbor Exercise scenario, on 23rd November 2017, displayed by Arcopol Web Viewer of Plan Camgal.

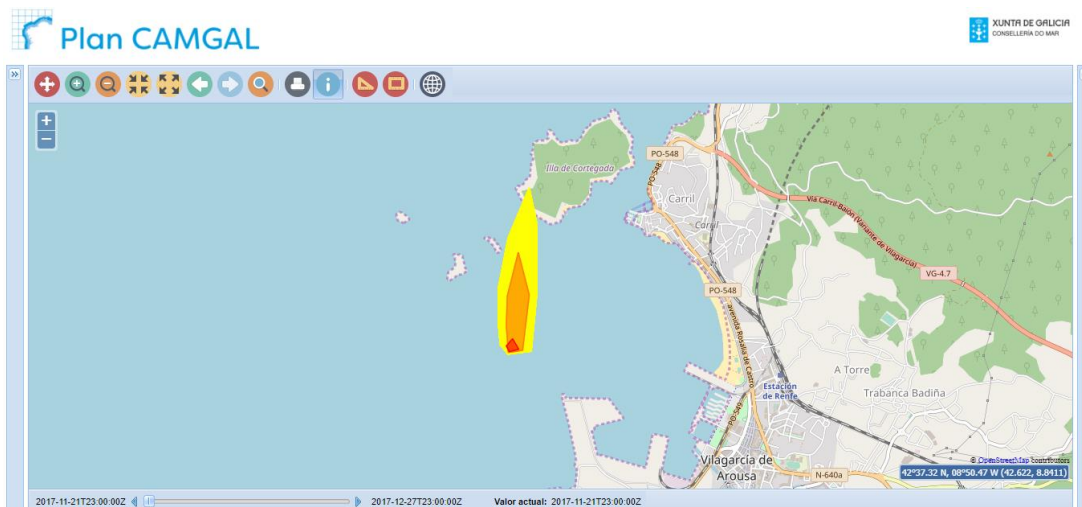


Figure 5. Mariner Modelling Tool PAC zones forecasted for Vilagarcia Harbor Exercise scenario, on 23rd November 2017, displayed by Arcopol Web Viewer of Plan Camgal.

Again both threat zones predicted by the models are very comparable with similar PAC lengths, direction and widths. What reinforces that the Mariner Modelling tools are able to predict human health impact as a state-of-the-art model. Within Mariner these state-of-the-art tools are put in the hands of the responders where this kind of simulations can be requested in an online fashion, in a very simple and straightforward wizard, and results displayed in a matter of minutes, contributing as another source of information for most probable impact areas to aid in decision making.

3. Bibliography and references

CEDRE: "Cason". <https://wwz.cedre.fr/en/Resources/Spills/Spills/Cason>. Last visited: 29th January 1987.

NOAA, Office of Response and Restoration. ALOHA web page.
<https://response.restoration.noaa.gov/aloha> . Last visited: 29th January 1987.

Wikipedia: Cason (Galician versión). <https://gl.wikipedia.org/wiki/Cason> . Last visited: 29th January 1987.