

PREVENT / PREPARE / RESPOND / RESTORE





THE SCIENTIFIC RESPONSE TO SUPPORT THE ENVIRONMENTAL EMERGENCY CAUSED BY THE PLASTIC PELLETS FROM THE TOCONAO SHIP SPILL

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INTRODUCTION

Plastic pellet spill from the Toconao ship

8/Dec/2023	13/Dec/2023	5/Jan/2024	9/Jan/2024	9 – 12 Jan/2024
Accident report, about 100 km off the Portuguese coast.	Arrival of the first pellets on Galician shores	Galicia activates emergency level 1	Cantabria, Asturias and Galicia activates level 2 of the emergency	First simulations in Galicia, Cantabria and Basque Country

Northern Spain on alert as plastic pellets from cargo spill wash up on beaches





: IH cantabria

Source: Noia Limpia

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OBJECTIVES

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This work presents the **scientific actions** carried out along the North coast of Spain (Galicia, Cantabria and Basque Country) to support the emergency response.

Modelling for response

(Mid-term) Probabilistic modelling for planning

Drifters and Field Exercises



HIDROM

Laboratory experiments

KEY INFORMATION

- WHEN: Date: 8/12/2023
- WHERE: Portuguese Waters: 80 Km distance from coast (Viana) 41-40.5 N / 009-50.4 W
- WHAT: 6 lashed / fixed together containers:
 - plastic pellets (26 TM of pellets in bags of 25 Kg, 1050 bags)

UNCERTAINTY

- Number of sacks left in the containers
- How many of the sacks were broken (and when), or how many were not broken
- Amount of pellets spilled
- Location of the pellets in the open sea: they are not detected in the sea





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THE TRACK AT THE FIRST

FIRST MODELIZATIONS

- On December 8th, 2023, the ship TOCONAO lost 6 containers 40 miles from Viana, one of them loaded with 1050 bags of pellets.
- On December 13th, more than 50 of these bags arrived in Corrubedo. After that there were no more sightings.
- On January 3rd and following, pellets and sacks begin to appear on the coasts of Muros, Arousa Norte and then in Fisterra and beaches in northern Galicia



RESPONSE

KEY INFORMATION ON THE RESPONSE

- Surveys to locate pellet accumulations
- Pellet sampling and analysis
- Mapping of survey results
- Trajectory forecast with different models and different metocean data (webGNOME, MOHID, IHTESEO)
- Information on oceanographic and meteorological predictions
- Drifters exercises
- Demo of pellet collection at sea
- Daily bulletins
- Development/setting up of protocols:
 - Cleanup by professional staff
 - Clean up by volunteers
- Others....







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TUALIZACIÓN SITUACIÓN METEOROLÓXICA DÍAS 14 AO 17 XANEIRO

Luns 15 - Xaneiro Durante esta sormada as baixas presións continuarian ao oeste da emisual biérica, subegando massa de aire húmido emor cara a Galíal. Logo das chuvias intensas da madrugada agardamos agora unha xormada de chuvias máis débles e intermitentes, con ventos do surceste que non soparária non moita intensidade. A altura das ondas quedará en mar aberto no entorno dos 2 metros de atura.



itos e correntes previstas para o mediodía do luns 15 de xanei



ntecma



HIDROMOD

RESPONSE



- Since it was not known where the pellets were located, different modeling strategies were established
- Different models and tools were applied (webGNOME, MOHID, TESEO)
- Elaboration of daily bulletins





EXCEL, LON

RESPONSE

KEY INFORMATION ON THE RESPONSE: SIMULATIONS

- First simulation: 9/01/2025
- Last simulation: February 2025
- Several simulations everyday in Galicia, Cantabria, Basque Country
- More than 60 simulations
- All the outputs were included as part of the Emergency Plans to be used by the response teams.







- Where are the pellets likely to go?
- Will they reach the coast of Cantabria and Basque Country?, When?
- How long it will take for the spill to reach a location?
- Is it expected a massive arrival?



We have to answer to these questions in terms of PROBABILITY

TESEO: Transport and Evolution of Substances and Elements in Oceanic and coastal environments



Simulation of the pellet's trajectories for: 1 month, 2 months and 3 months for 200 met-ocean scenarios

















1°W

2°W

12° W

11° W

Is expected a massive arrival of pellets?

PROBABILITY OF CONTAMINATION (1 particle/m²) PROBABILITY OF CONTAMINATION (20 particle/m²)

PROBABILITY OF CONTAMINATION (200 particle/m²)







2 months simulation considering different thresholds for pellet's concentration (particle/m²)

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Initial location Starting month: December





When will the pellets arrive to Cantabria?

ARRIVAL TIME (1 particle/m²)



It will take at least 40 days to arrive to Cantabria in a low concentration

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ARRIVAL TIME (200 particle/m²)



In 2 months there is not a massive arrival of pellets

2 months simulation considering different thresholds for pellet's concentration (particle/m²)



DRIFTERS AND EXERCISES

VALIDATION OF MODELS

- ✤ 6 drifters designed by AZTI and Université du Littoral Côte d'Opale.
- Type A: mainly transported by currents
- Type B: mainly transported by wind
- Deployment in 3 points (1 drifter A, 1 drifter B)



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VALIDATION OF MODELS



BUOY 5





Euskalmet

AGENCIA VASCA DE METEOROLOGÍA

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LA MAR CA SPILL

CONFERENCE & EXHIBITION

IN

EXCEL, LONDON 8-10 APRIL 2025

AGENCIA Estatal de

INVESTIGACIÓN

EXERCISE - SACK OF PELLETS

The Spanish Civil Guard provides a sack of pellets

23 Jan

14 Feb

19 Jan

Sack of pellets – floatability test in a small basin

Exercise at sea with the sack to test the trajectory



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CALIBRATION

Corrientes (CMEMS-IBI) + viento (CD= 2%) (CMEMS - WIND_GLO_PHY_L4_NRT_012_004



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ENCIA VASCA DE METEOROLO

LABORATORY TESTS







Qualitative dispersion of pellets in a flume under 6 different conditions defined by level (η), Flow rate (Q) and wind (W).







CONCLUSIONS



- The scientific response to the pellet spill from the *Toconao* ship demonstrated that a holistic approach integrating different models, tools and methods (short-term predictions, mid-term predictions, drifter and field exercises) provides valuable information to support decision-making.
- Probabilistic mid-term predictions provide information about the potential pollution, amount of pellets expected and arrival time in coastal areas located far away from the spill point, providing valuable information for planning the response in the mid-term.
- Lessons learnt from the emergency also showed that further research is required to better understand the behaviour of the pellets in the sea and the accumulation in the coastal areas and to incorporate this knowledge in models and tools specifically designed for pellet spills.



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I+D+i para un desarrollo sostenible THANKS

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