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

Ana J. Abascal[1], Germán Aragón[1], César Antonio Pérez[1], Paula Núñez[1], Irene Ruiz[2], Anna Rubio[2], Carmen M. Magaña[3], Pedro Montero[4], Garbiñe Ayensa[4], Paulo Chambel[5], Andrés García[1], Raúl Medina[1]

[1]IHCantabria - Instituto de Hidráulica Ambiental de la Universidad de Cantabria, Avda. Isabel Torres, 15, Parque Científico y Tecnológico de Cantabria, 39011, Santander, Spain, e-mail: abascalaj@unican.es

[2]AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, 20110, Spain

[3]Emergency Service of Civil Protection, Consejería de Presidencia, Justicia, Seguridad y Simplificación Administrativa del Gobierno de Cantabria, C. Peña Herbosa, 29, 30003, Santander, Spain.

[4]Intecmar*,* Technological Institute for the Control of the Marine Environment of Galicia, Peirao de Vilaxoán, s/n, 36611 Vilagarcía de Arousa, Pontevedra, Spain.

[5]Hidromod, Rua Rui Teles Palhinha, nº 8, 3º D, 2740-278, Porto Salvo, Portugal

On December 8, 2023, the cargo ship Toconao lost six containers off the north Portuguese coast, one of which was carrying about one thousand sacks of plastic pellets. As a result of the accident, millions of pellets were released into the sea and transported into the Bay of Biscay threatening the north coast of Spain and France. In the weeks following the spill, pellets began to arrive on the beaches of northwest Spain, especially in Galicia, Asturias and Cantabria (Bay of Biscay). The environmental spill emergency resulted in the activation of different emergency plans along the Spanish coast, which required scientific actions, mainly based on numerical modelling, to develop proper response strategies. The scientific actions carried out along the North coast of Spain (Galicia, Cantabria and Basque Country) to support the emergency response are described below.

<u>i) Drifters' deployment and numerical modelling validation:</u> Six drifting buoys, designed by AZTI and Université du Littoral Côte d'Opale, were deployed in the Bay of Biscay and used for model validation (see Figure 1). Two types were deployed: Type A (current-driven, pellets) and Type B (wind-influenced, sacks). Surface current data came from the IBI model by Copernicus Marine Systems and the HF radar station at the EusKOOs coastal observatory. Surface wind data was provided by Tecnalia. The GNOME model, developed by NOAA's OR&R, was configured for validation. The validation exercise showed that buoys are suitable for tracking floating objects with minimal wind exposure (pellets), but there's more uncertainty for those with larger exposed surfaces (sacks).

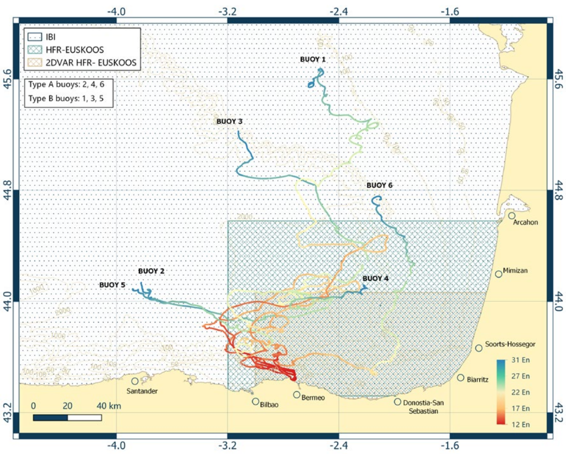


Figure 1. Trajectories between January 12 and January 31 of the 6 buoys released off the coast of the Basque Country.

ii) Operational system for short-term trajectory prediction: The Near Observation Unit of the Territorial Contingencies Plan for Accidental Marine Spills in Galicia (Plan Camgal) used the Mohid Lagrangian model for the prediction of the pellet trajectories using as inputs the wind and current predictions of the MeteoGalicia operational models. Results were distributed in real-time through the Common Operational Picture of the Plan Camgal. On January 9, drift simulations began to be carried out to find out the possible trajectories of bags and granules. From this day on, several daily simulations were carried out, the results of which were distributed to the actors involved. This operation was maintained until February 1, carrying out a total of more than 60 drift simulations.

iii) Mid-term probabilistic simulations: Mid-term (1 to 3 months) probabilistic simulations of the pellet trajectories were carried out to plan the potential arrival in the communities located far away (Cantabrian coast and Northeast of the Bay of Biscay) of the spill's initial release. A database of trajectories was simulated for 3 months under different met ocean conditions (200 scenarios) randomly selected from historical data provided by Copernicus Marine Service. The simulations were carried out using the Lagrangian transport model, named TESEO, developed by IHCantabria. As result, the following information was provided: 1) probability maps showing the potential pollution (see Figure 2) and 2) the time taken from the pellets to reach the impacted area.

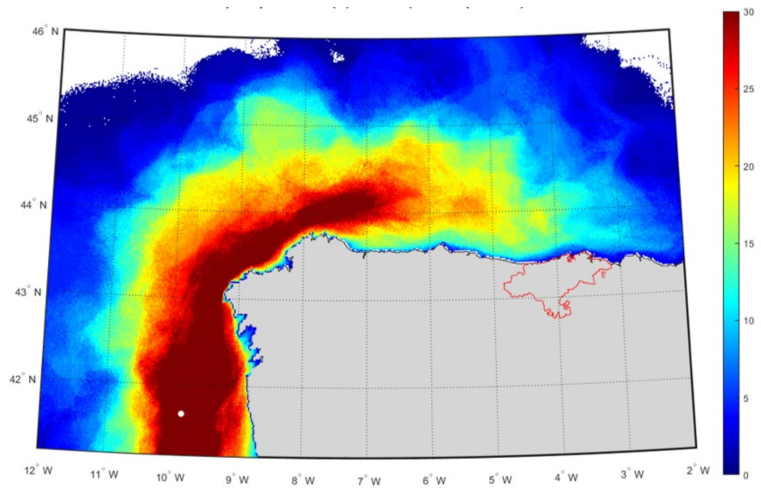


Figure 2. Probability of pollution over a 2-month period following the beginning of the release (white circle).

iv) Laboratory experiments: The laboratory experiments on pellet dispersion aimed to understand their transport under different hydrodynamic and wind conditions. The behaviour of pellets from the Toconao spill was evaluated in a laboratory flume under different hydrodynamic conditions, combining one water level with three flow rates and different wind conditions. Results revealed varying dispersion and transport velocities, aiding the calibration of numerical models for improved predictive accuracy in future emergencies.

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