Lagrangian simulations of drifting floating objects from the Toconao pellet spill

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Abstract

The use of Lagrangian models for the simulation of drifting objects in the ocean is very interesting for simulating different situations that occur in the oceans (search and rescue, pollution events, larval and plankton dispersion...). The Lagrangian particle dispersion model implemented in the open source state-of-the-art OpenDrift model (https://opendrift.github.io/) allows offline simulations to be carried out using available stored output of hydrodynamic and atmospheric model runs as forcing. In this way, a reanalysis of events of interest with the Lagrangian model can be performed. In this contribution we will present Lagrangian simulations to study the dispersion of pellet bags spilled from the Toconao merchant ship in December 2023. Due to the uncertainty about their buoyancy characteristics and their state (whether they were bags or pellets drifting by their own), the pellet bags were simulated as passive particles and as drifting objects with different properties that have a floating surface on which the effect of wind drag must be added. Sensitivity analysis of the results of the simulated dispersion to the type of floating object will be presented.

On the other hand, since it is well known that Lagrangian particle simulations are highly sensitive to the choice of hydrodynamic and atmospheric models (see [1]), we performed simulations forcing the Lagrangian model with different available hydrodynamical and atmospheric forcing, coming from Copernicus Marine Environment Monitoring Service (CMEMS) and the regional Galician agency MeteoGalicia. Comparing the trajectories of the forced particles with the output of CMEMS and MeteoGalicia models yields markedly different results (see figure 1) in terms of particle deposition (probability of pellets reaching the coast) and particle dispersion. We have evaluated qualitatively the differences in the description of the currents in the two models, induced by the wind variability and by the presence of freshwater. Additionally, we have analysed hydrodynamical model output with numerical techniques to characterise Lagrangian barriers, trying to assess the impact of existing fronts at the time of the spill, especially freshwater fronts.

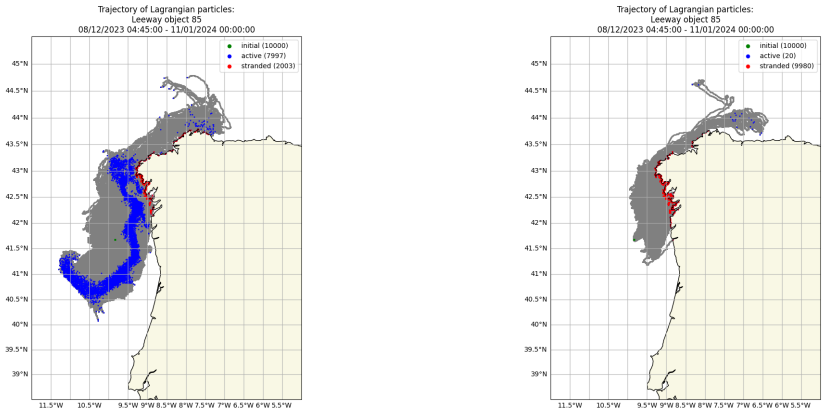

Figure 1: Simulation of pellets dispersion forced by CMEMS (left figure) and MeteoGalicia (right figure) hydrodynamical and atmospheric models

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References

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