

Numerical simulations with the ASIMUTH forecast system for understanding and forecasting HAB events in Galicia (NW Spain)

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Summary

Simulations with the model ROMS (hydrodynamical and ecological simulations complemented with Lagrangian particle-tracking simulations) have been performed in the framework of the project ASIMUTH (<http://www.asimuth.eu>) which aims to develop forecasting capabilities to warn of impending harmful algal blooms (HABs) along the European Atlantic coast. In this contribution, we will report on the skill of the ASIMUTH forecast system in predicting transport of HABs and in assessing the area affected by HABs in the upwelling-influenced Galician rias (NW Spain) with the experience gained in years 2013 and 2014.

Introduction

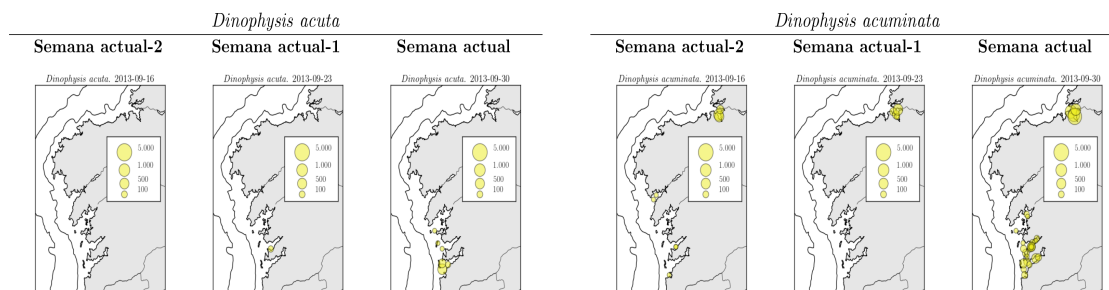
The north-western Iberian coast (Galician rias and shelf) is frequently affected by HABs (Harmful Algal Blooms) associated with dinoflagellates during the upwelling season (spring and summer) and also during the autumn transition from dominance of upwelling-favorable winds to dominance of downwelling-favorable winds. The main dinoflagellates species causing toxic outbreaks on the western Iberian coast are *Dinophysis* spp. (*D. acuminata* and *D. acuta*) and *Gymnodinium catenatum* associated respectively with diarrhetic or paralytic shellfish toxin (DSP or PSP). Hydrodynamical numerical models provide reliable information on the variability of cross-shore and along-shore flows that move HAB populations towards (or away from) harvesting places and contribute to understand how the entrance of HAB populations into coastal embayments like the Galician Rias varies in response to variations in tides and meteorological events. In this contribution, we will report on the experience we have gained during the ASIMUTH project in relating the variability of oceanographic conditions simulated with a numerical model with the occurrence of closures of harvesting areas in Galicia in 2013.

Results and Discussion

There was a bloom of *D. acuminata* in spring 2013 in Galicia, which caused prolonged harvesting closures. Some mussel raft polygons in the rias were closed due to the presence of DSP toxins from early spring (mid March) on. *D. acuminata* is an obligate mixotroph that requires light and live prey (*Mesodinium rubrum*) to grow and *Mesodinium* needs nutrients and live cryptophytes prey (*Teleaulax* spp.) to grow (see a review in Reguera et al. 2012). A bloom of *D. acuminata* requires upwelling for *Mesodinium* to grow and then a process that favors the encounter of *Mesodinium* and *Dinophysis*. It is known that the highest net growth of *D. acuminata* is observed during relaxation and downwelling following upwelling events. Therefore, upwelling events followed by retention in the rias constitute the favorable conditions for *D. acuminata* blooms. The ASIMUTH model can simulate this variability (upwelling-downwelling sequences, tidal cycles). Therefore, some of the observed variability of *D. acuminata* occurrence in Galician Rias can be related to the variability in upwelling-downwelling conditions and to the timing of meteorological events and the spring-neap cycle.

A particularly strong *D. acuta* event took place at the end of September 2013 in the Galician rias, causing the closure of almost 100% of the harvesting polygons in the area from the beginning of October on. The last strong event of *D. acuta* in the rias occurred in autumn 2005, but this year 2013 *D. acuta* appeared together with *D. acuminata*, and contrastingly to 2005, concentrations of *G. catenatum* were not significant. In Figure 1, we plot cell counts of *D. Acuta* and *D. acuminata* measured in the weekly monitoring cruises of the Galician monitoring service INTECMAR for the weeks before the closure. On 30th September 2013, there were concentrations of *D. acuta* and *D. acuminata* in a range that induces closures. On 23rd September, the presence of *D. acuta* was measured in the ria de Pontevedra in low concentration, but the value was already indicative of risk of closures motivated by

this low biomass species. The Portuguese monitoring system measured the presence of *D. acuta* in September on the northern Portuguese shelf.



*Os datos de concentración de especies tóxicas (en células/l) son obtidos do mostreo semanal de INTECMAR (<http://www.intecmar.org/>) feito os luns (data da figura) e os martes

Figure 1: Cell counts of *D. Acuta* and *D. acuminata* on 30 September 2013 and on the monitoring cruises of the two weeks before the autumn closure in Galicia (source Intecmar)

In Figure 2, the results of the ASIMUTH forecast system are presented in the format of a forecast bulletin, although the Galician bulletin was not disseminated routinely at that time. The results of the model on the shelf forecast a northwards flow on the shelf which might transport populations from Portuguese waters. This is clearly seen in cross-sections of along-shore but also in the results from the Lagrangian particle tracking simulations of particles emitted on the shelf for the latitudes of the northernmost Portuguese bivalve monitoring areas.



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1. Modelos: temperatura e correntes superficiais. Circulación na plataforma

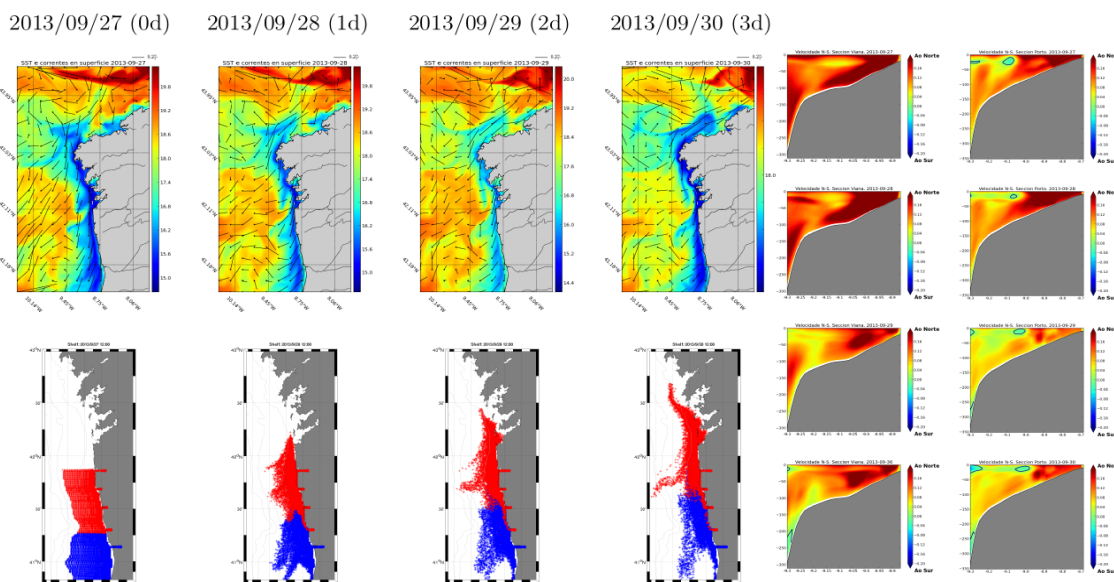


Figure 2: Model results of the Galician ASIMUTH forecast model for Friday 27 September 2013. Top panel: 3-day forecasts of model SST and velocities. Left bottom panel: 3-day evolution of particles released from the two northernmost Portuguese bivalve monitoring areas. Left panel: 3-day forecast of north-south velocities (red and blue respectively) along cross-shore sections at the latitude of the Portuguese monitoring areas (left, Viana, right, Porto)

In this contribution we show how along-shore transport in autumn 2013 is well described and forecasted by the ASIMUTH system. The entrance of HAB populations into coastal embayments, estuaries, rias, beaches, where cultures take place, varies in response to variations in tides and meteorological events. Particularly, downwelling events can introduce Harmful Algae Bloom (HAB) populations present in shelf waters into rias and estuaries. Flows in and out of harvesting place and their variability in spring-summer 2013 can be described and predicted by the ASIMUTH forecast system. However, at this stage it is difficult to forecast the presence of *D. acuminata* in the rias in this period and the closures it induced.

References

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