Bacon, John; Kershaw, Simon

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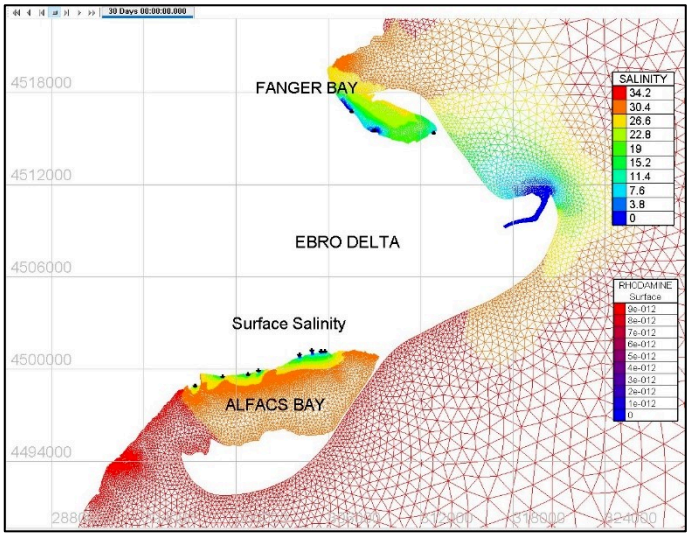
Developing and validating a Telemac3D model for *E. coli* and norovirus dispersal through aquaculture systems

John Bacon, Simon Kershaw
Centre for Fisheries and Aquaculture Science, Pakefield Road, Lowestoft, NR33 0HT, UK

john.bacon@cefas.co.uk

The expansion and development of shellfish aquaculture has resulted in National regulatory bodies for water quality, turning to the use of numerical modelling to monitor the potential exceedance of thresholds of many pollutants or waterborne viruses. In shallow coastal or estuarine environments, locations of aquaculture developments near to wastewater discharges including storm overflows and other sources of contamination, are vulnerable to episodically high concentrations of substances with potentially harmful impacts on marine and human health.

Cefas has developed a series of Telemac3D models to monitor pollutant levels and effluent dispersion in several coastal locations in UK, France, Ireland and Spain. The example used in this paper, at Alfacs Bay in Eastern Spain, provides a microtidal environment and a temperate, shallow, seasonally stratified, coastal lagoon influenced by freshwater input of land drainage from the highly productive Ebro Delta region. Circulation and mixing in the bay are limited for much of the year giving the potential for nutrients and waste products related to the extensive bivalve farming systems located within a few hundred metres from the shoreline, to build up when conditions for the dispersal of these potential contaminants are poor.



The focus of the paper centres upon validating model simulations of the transmission of potentially harmful bacteria into areas of aquaculture production, comparing the modelled circulation of passive tracer release in Telemac3D, against a field experiment utilising a 12.4 h release of rhodamine dye tracer into the discharge at one of the coastal sewage treatment works (STW) outfalls. The validation of the model to simulate the dispersal of the rhodamine was used to calibrate the release of *E. coli* in the model. The Sant Carles de la Ràpita sewage treatment works discharges treated effluent into a drainage channel approximately 400 m north of the aquaculture sites. The *E. coli* released in the model acts as a faecal indicator for the degree of contamination in the water and degrades as a function of temperature, salinity and insolation. Analysis of residence times for these parameters in the bivalve production areas is an important step to understanding how the transmission of bacteria and virus such as Vibrio spp. and Herpes OsHV-1 can be controlled. These potentially harmful microbes can present a human health risk in shellfish consumed raw or subject to insufficient treatment post harvesting or impact commercial production of Blue Mussel and Pacific Oyster.

Further work using particle techniques was carried out to investigate the transmission of another common waterborne human pathogen, norovirus (NoV). The behaviour of norovirus particles was matched as closely as possible to their physical parameters, the Lagrangian motion being more appropriate to their transmission than a diffuse tracer.

The results give confidence to regulators that the use of relatively inexpensive field experiments coupled with modelled simulations, microbiological transmission can be assessed and contaminant concentrations predicted under varying environmental conditions. These in turn can inform regulatory decisions for the management of aquaculture production.

Proposed session: Water quality, biodiversity, ecology and environmental pollution
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