Quantifying Uncertainty in Nearshore Currents: Applications Using Fuzzy Mathematics

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Predicting how floating objects around the ocean surface is challenging but there is significant interest in this prediction for marine emergency responses to oil spills, search and rescue, etc.. The movement of surface objects is governed by currents, winds, and waves at the surface but can also depend on the geometry if solid, floating objects are being investigated. The sheer range of uncertainty introduction can become intractable for a modeler unless several assumptions are made. This presentation will provide insights from research being conducted by collaborators at the University of Victoria and the Department of Fisheries and Oceans Canada that explores the use of fuzzy mathematics to quantify uncertainty in predicting particle or object movement (drift). Uncertainty can be quantified as fuzzy numbers representing a portion of instrument observations of currents and winds. This uncertainty can be propagated through time-series simulations of particle trajectories where geometry is accounted for deterministically. An application to buoys in the northeast Pacific shows how fuzzy mathematics is able to correctly identify the area where a buoy is expected to be found for targeted simulations. Furthermore, the impact of uncertainty in variable velocity fields on particle movement is explored numerically in a simple domain where steady uncertainty is described as a fuzzy number. The modelling shows that adequate results can be produced with reasonable computational effort.

Keywords

Uncertainty, near shore modelling, ocean environments, particle tracking