Drawing conclusions from drunk fish in dynamic environments

Nicholas Keeney
Department of Oceanography and Coastal Sciences
Louisiana State University

Spatially-explicit models of fish behavior and movement have become an increasingly popular tool in assessing ecological risk in aquatic systems, and understanding the root of emergent population-level patterns. The Eulerian-Lagrangian-agent framework couples a mesh-based hydrodynamic model of water flow with particle representations of individual fish, which interpret and react to varying physical and environmental parameters. In my research I use an unstructured three-dimensional grid representation, the Finite-Volume Coastal Ocean Model (FVCOM), of Breton Sound estuary, Louisiana. The estuary is seasonally flushed by the Caernarvon Freshwater Diversion Structure, which releases Mississippi River water into the upper estuary to alleviate flood risk, as well as control salinity and increase fisheries production. These rare perturbations dramatically alter the environment, and the behavioral response by virtual fish will allow better understanding of the mechanisms leading to observed *in situ* ecosystem changes.

In this talk I will address the selection and parameterization of individual behavioral algorithms, and the effect on the overall population for idealized systems and Breton Sound. The area is also susceptible to blooms of cyanobacteria, which may be toxic and are connected with water quality issues potentially mediated by Caernarvon. Acute exposure can kill fish, with a clear outcome. However, chronic exposure to these and other algal toxins causes subtle changes in the fitness and cognition of intoxicated individuals. These effects are poorly understood outside the laboratory, and have not been incorporated into agent-based models of fish. To this end, I will also discuss options for interpreting the movement of modelled individuals, short of traditional population-level mortality and production.