Boulder Fluid Dynamics Seminar Series

Tuesday, October 1, 2013
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

Numerical Modeling of Rotating and Pulsed Detonation Engines

Peter Hamlington, *University of Colorado at Boulder*

Propulsion systems based on detonation waves, such as rotating and pulsed detonation engines (RDEs and PDEs), have the potential to substantially improve efficiency and power density compared to traditional gas turbine engines. There are, however, a number of unresolved technical challenges, including obtaining more efficient injection and mixing of air and fuels, more reliable detonation initiation, and better understanding of the flow in the ejection nozzle. Each of these challenges can be addressed using numerical simulations, which can allow low cost, safe, and relatively rapid analysis and optimization of detonation engines. Here we discuss the design and computational details of such simulations, with a specific focus on the modeling required to represent highly unsteady flow fields in the presence of combustion, shock waves, fluid-structure interactions, and turbulence. Results from simulations of RDEs and PDEs are presented and future research directions are outlined. A brief review is also provided of other research performed at the Turbulence and Energy Systems Laboratory (TESLa) at CU.

Ocean Ecosystem Parameter Estimation in a Bayesian Hierarchical Model

Ralph Milliff, *Cooperative Institute for Research in Environmental Sciences*

The Bayesian Hierarchical Model (BHM) methodology is increasingly applied in large state-space geophysical fluid systems. Recent success with a BHM to build surface vector wind ensembles for ocean forecast applications prompted an ambitious effort to identify parameters of a lower-trophic level ocean ecosystem model. Early results were far less encouraging than for the surface wind applications. The ocean ecosystem process model equations are adapted from a Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) model that is a specific formulation of classical predator-prey systems with added source and sink terms. The NPZD ocean ecosystem model is severely undetermined in that the equations involve O(20) parameters that are not constrained by data. Seven parameters were treated as random variables in an NPZD BHM applied to the coastal Gulf of Alaska (CGOA) ecosystem given station data from GLOBEC and surface phytoplankton retrievals from SeaWiFS. The NPZD BHM parameters were not identifiable without the addition of mixing terms in the process model to represent seasonal thermocline formation and shoaling of the upper ocean mixed layer. Given considerable guidance from ensemble forward model calculations, posterior estimations for phytoplankton growth rate (VmNO3) and zooplankton grazing rate (ZooGR) are obtained.