Multidisciplinary Simulation, Estimation, and Assimilation Systems
Seminar Series

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Coupled 4D-variational physical and biological data assimilation in the California Current System

Abstract: Coupled physical and biological data assimilation is performed within the California Current System. The initial condition of physical and biological variables is estimated using the four-dimensional variational (4DVar) method under the Gaussian and lognormal error distributions assumption, respectively. Errors are assumed to be independent, yet variables are coupled by assimilation through adjoint model dynamics. Using a nutrient-phytoplankton-zooplankton-detritus (NPZD) model coupled to an ocean circulation model (the Regional Ocean Modeling System, ROMS), the coupled data assimilation procedure is evaluated in a twin experiment setting and compared to two related experiments, assimilating physical data only and biological data only. Independent assimilation of physical (biological) data reduces the root-mean-squared error of physical (biological) state variables by more than 56% (43%) on average. However, the improvement in biological (physical) state variables is less than 7% (13%). In contrast, the coupled data assimilation shows improvement in both physical and biological components by 57% and 49%, respectively, illustrating the superior performance of the coupled assimilation approach. The coupled data assimilation also recovers the coupled modes between surface physical-biological variables, while other two assimilation runs do not.

Friday, Jan. 18, 2013
11:30AM; Rm. 5-314

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