Computational Mathematics Colloquium

Data Assimilation for State and Parameter Estimation in Hurricane Storm Surge Modeling

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Abstract: Numerical hydrodynamic models are frequently used within the coastal science and engineering communities to simulate tides, waves, and hurricane storm surges. The applications of these simulations are vast, and include hindcasts of historical events, forecasts of impending hurricanes, and long-term flood risk assessment. However, like most numerical models, they are subject to epistemic and aleatoric uncertainties, due to factors including the approximation of relevant physical processes by mathematical models, the subsequent numerical discretization, uncertain boundary and initial conditions, and unknown model parameters. Quantifying and reducing these uncertainties is essential for developing reliable and robust hydrodynamic models.
Data assimilation methods can be used to estimate uncertain model states (e.g. water levels) by informing model output with observations. I have developed these methods for hurricane storm surge modeling applications to reduce uncertainties resulting from coarse spatial resolution (i.e. limited computational resources) and uncertain meteorological conditions. While state estimation is beneficial for accurately simulating the storm surge resulting from a single, observed hurricane, broader contributions can be made by estimating uncertain model parameters. To this end, I have also developed these methods for parameter estimation. In this talk, I will discuss applications of data assimilation methods for both state and parameter estimation in hurricane storm surge modeling.

Thursday, January 9, 2020, 1:30 pm
Mathematics and Science Center: MSC W301

Mathematics
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