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David Swayne

Markiyan Sloboda

Simon Hood

Vimal Sharma

William Booty

See next page for additional authors

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Presenter/Author Information

David Swayne, Markiyan Sloboda, Simon Hood, Vimal Sharma, William Booty, and David Lam

Lessons Learned from Experiments in Auto-Calibration of Large Scale Environmental and Hydrological Models

David A. Swayne, Markiyan Sloboda, Simon Hood, Vimal Sharma, William Booty,

David Lam

Computing Research Laboratory for the Environment

Department of Computing and Information Science, University of Guelph,

Guelph, Ontario, Canada

E-mail: dswayne@cis.uoguelph.ca

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Recent work by the authors has identified the need to efficiently auto-calibrate models of considerable complexity, in order to investigate future water quality and quality concerns in the Great Lakes' Basin. Initial results in the use of standard models such as AGNPS and SWAT have yielded somewhat disappointing results. The calibration process has been cumbersome, and predictions based on outputs from, say, a watershed model input to a lake circulation model have generally proven problematic: If the flows are correct, the loadings are not, and so forth.

With the use of a supercomputer it is possible to generate a large number of model runs in a very short time, but the inherent sequential nature of a search for a suitable parameter set is at cross-purposes with parallel search strategies. We are, therefore, investigating the incorporation of tools borrowed from the artificial intelligence community for knowledge discovery and uncertainty management. Our experiments have included: genetic algorithm approaches, data mining, and modeling the models themselves with Bayesian Belief Network approximations.

The models we consider consist of: 1) AGNPS and SWAT; 2) lake circulation models of varying complexity; 3) several choices of hydrological drivers of varying complexity. Rainfall and sediment loads, nutrients and phytoplankton are the major measured parameters against which calibration progress is measured. For lake circulation models, long-term simulations require calibration involving wind, temperature observations and solar radiation.

Counterintuitive strategies such as joint calibration of hydrological, erosion / sediment and biological variables (rather than step-wise starting with hydrological) might indicate sources of uncertainty to explain less-than-perfect agreement.

Using the SHARCNet super computer clusters we are conducting series of experiments with the available models to see if we can improve upon results obtained "by the book" which are, to date, disappointing. We will present our findings and conclusions at the workshop.