I'm presenting on a paper entitled "SWAT ungauged: Water quality modeling in the Upper Mississippi River basin." It is a collaboration among University of Maryland, University of Melbourne, Texas A&M, the USDA, and the EPA.

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Problem: Current watershed-scale dynamics are simplified in hydrologic and surface water quality models. They require calibration of parameters, which limits their applicability to ungauged basins or those with less available data.

Research justification: Previous research suggests that integrating physical processes instead of simplified numerical relationships can improve uncalibrated modeling at ungauged locations

Research goal: Contribute to the field of continuous model evaluation and improvement, particularly in order to make models more useful in ungauged basins or those lacking enough data for full calibration.

Research application: Improvements made to the SWAT model, tested on the upper Mississippi River basin

This study uses four models, one being the current SWAT model, and three that have been adapted to include two physically-based modules. The first module is the energy balanced soil temperature model, which replaced a more empirical model developed by Neitsch 2011. Instead of parameters to calibrate (point them out), this model uses physical properties to model temperature changes that affect snow and soil processes.

Then, the PAPRAN module was replaced with the CENTURY soil organic matter algorithm. The intention was that this would better simulate nitrogen movement because of the additional coupling of carbon and nitrogen cycling.

None of the four were calibrated, and their performance in comparison to streamflow, sediment, nitrate, and total nitrogen were compared.

They were compared at monthly and annual scales (note that these are pretty large resolutions). Patterns are similar at both, so I'll only show the monthly.

Note, shaded numbers represent r2, NSE, or percent difference parameters that were considered to perform worse than the SWAT 2012 model

CENTURY contributes a lower streamflow bias, energy balance equation allows for more seasonal variability. Both improved in the EC mode. All three also performed better in sediment modeling, in regard to r2 and NSE values. Results were mixed for nitrate and total nitrogen – it was unclear whether one outperformed the other.

Conclusions by the authors:

- Models based more in physical processes reduce bias and improve seasonal variability
- Biogeochemical processes are complex, making it difficult to improve on nitrate and nitrogen using these physical processes
- Improving the integration of physically-based processes in advantageous to developing models for large ungauged basins

Final though (questions) –How may this align or contrast with advantages / disadvantages to modeling simplifications we've discussed in class?

How is computational time affected? Can all of these physical properties be collected for ungauged locations? How does this outweigh the advantages of simplification?