PURDUE UNIVERSITY | Ecological Sciences and Engineering
OFFICE OF INTERDISCIPLINARY GRADUATE PROGRAMS

Evaluating Impacts of Remote Sensing Soil Moisture Products on Water Quality Model Predictions in Mixed Land Use Basins

Dissertation Defense - May 23rd, 2019

1 PM   Lilly 2-425

Garett Pignotti

BIO

Garett is originally from Florida, where he completed his B.S. in Environmental Engineering from the University of Florida. Garett came to Purdue to earn an M.S.E. and pursue a Ph.D., but mostly to perpetually answer the question why he would leave Florida to come to Indiana. He has been an active participant over his (long) time at Purdue in the ABE and ESE graduate student organizations, Global Engineering Program, and helped to establish the inaugural ABE Graduate Student Symposium. During his free time, Garett enjoys feeling guilty about not working, being mediocre at intramural sports, and growing a terrible "beard."

Ecological Sciences & Engineering Interdisciplinary Graduate Program

ABSTRACT

A critical repercussion of agriculturally managed lands is the transport of nutrients and sediment to fresh water systems, which is responsible for a range of adverse impacts on human and environmental health. In the U.S. alone, over half of streams and rivers are classified as impaired, with agriculture as the primary contributor. To address deterioration of water quality, there is a need for reliable tools and mathematical models to monitor and predict impacts to water quantity and quality. Soil water content is a key variable in representing environmental systems, linking and driving hydrologic, climate, and biogeochemical cycles; however, the influence of soil water simulations on model predictions is not well characterized, particularly for water quality. Moreover, while soil moisture is routinely measured by remote sensing systems, defining its potential for use in water quality models remains an open question. Therefore, the goal of this research is to test if updating soil water process representation or predictions can provide better overall model predictive confidence. A widely-used ecohydrologic model, the Soil and Water Assessment Tool, was used to evaluate four objectives: 1) investigate the potential of gridded version of the Soil and Water Assessment Tool for use with similarly gridded, remote sensing data products, 2) determine the sensitivity of model predictions to changes in soil water content, 3) implement and test a more physically representative soil water percolation algorithm, and 4) perform practical data assimilation experiments using remote sensing data products, focusing on the effects of soil water updates on water quality predictions. Results indicate that a range of model predictions are sensitive to changes in soil water content. Further experiments demonstrated the ability to refine these predictions via model structural changes or corrections to soil moisture directly. While the findings illustrate the potential to improve predictions, continued future efforts to refine soil water process representation and optimize data assimilation efficiency are needed. The dependence of ecohydrologic model predictions on soil moisture highlighted by this research underscores the importance and challenge of effectively representing a complex, physically-based process. As essential decision support systems rely on modeling analyses, improving prediction accuracy is vital.