A Tool for Identification of Model Structure

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Watershed Models

Hydrologic/water quality modeling to support decision making:

- Flood management
- Nonpoint source pollution
- Impacts of land use change/urbanization

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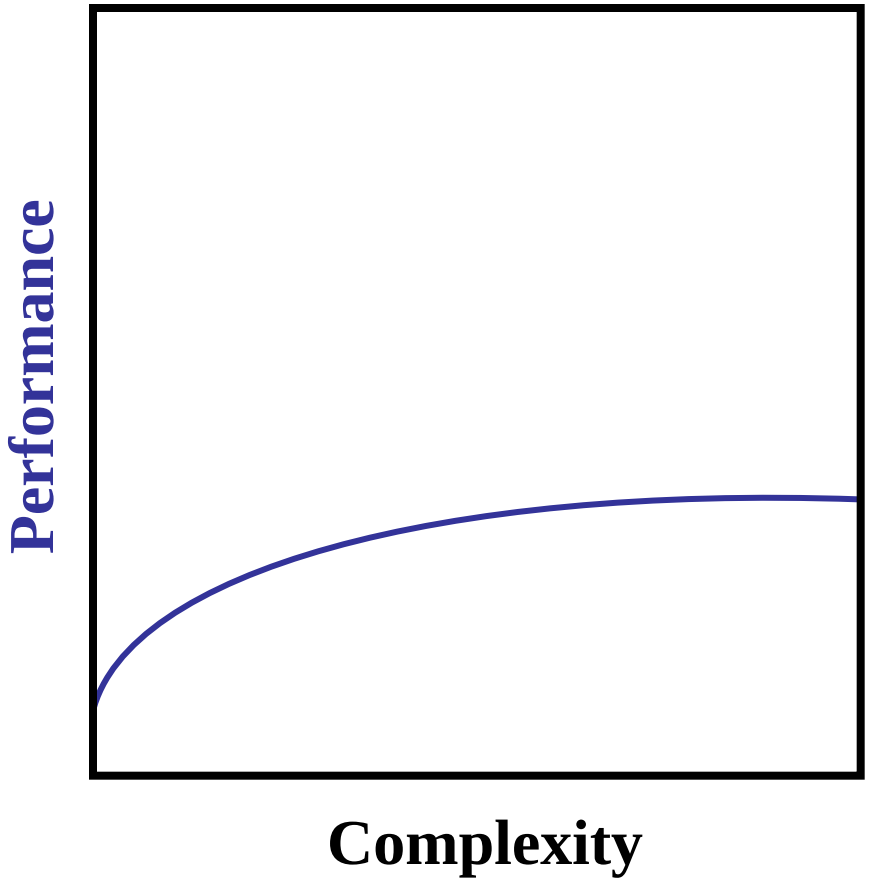
Evolution of watershed models:

- Lumped to distributed
  - Remotely sensed data and GIS
- Finer spatiotemporal resolutions
- Empirical to physically-based
- Incorporation of more input and output variables
- Improving model performance

Model Structure

Tradeoffs between complexity, performance and identifiability:



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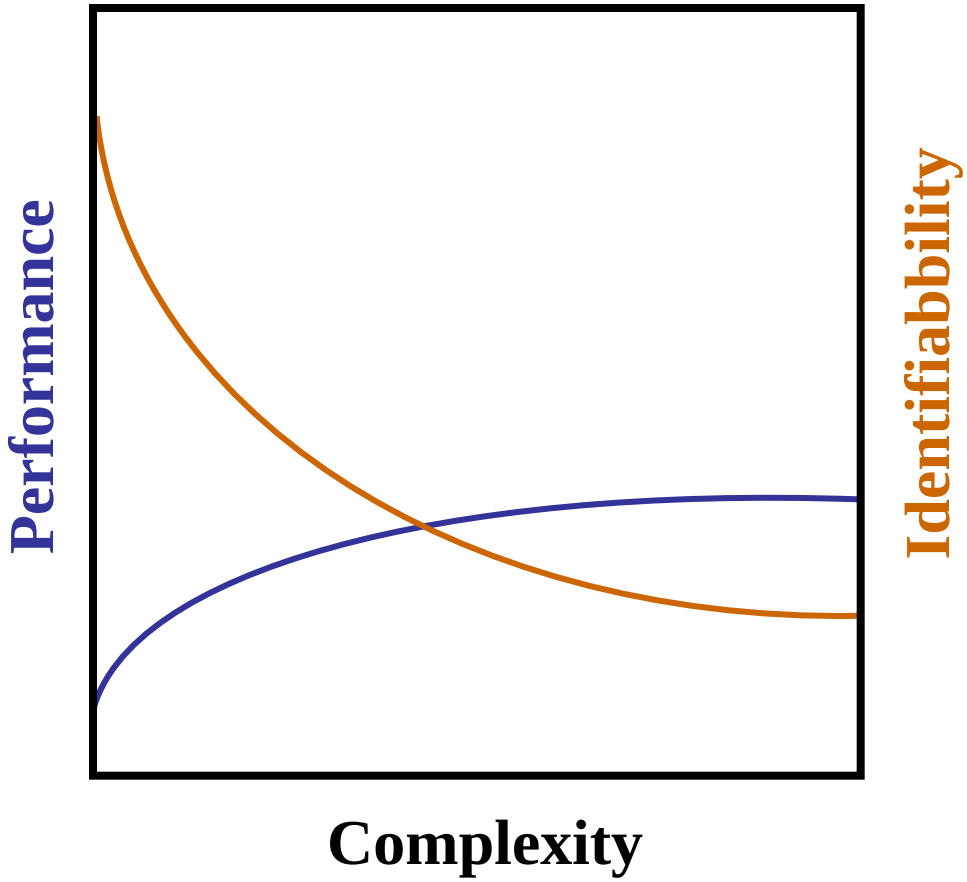

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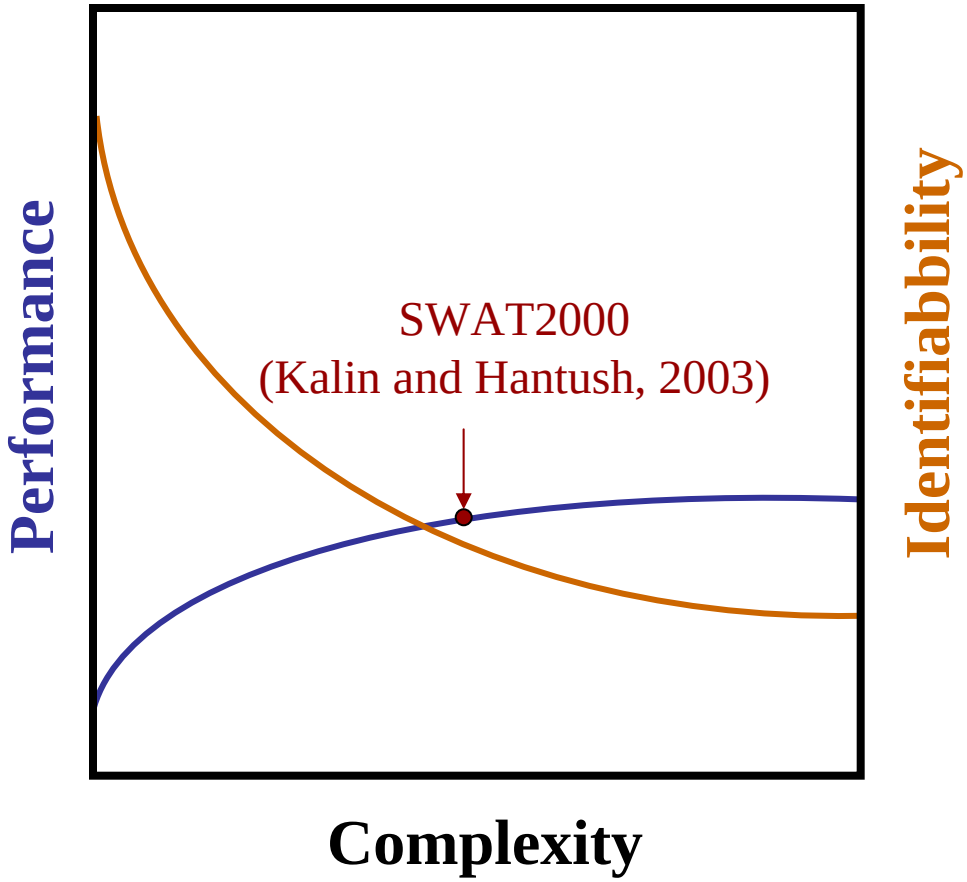

This Presentation

Objective:

- To develop a computational tool for model identification
- To demonstrate the tool in a case study

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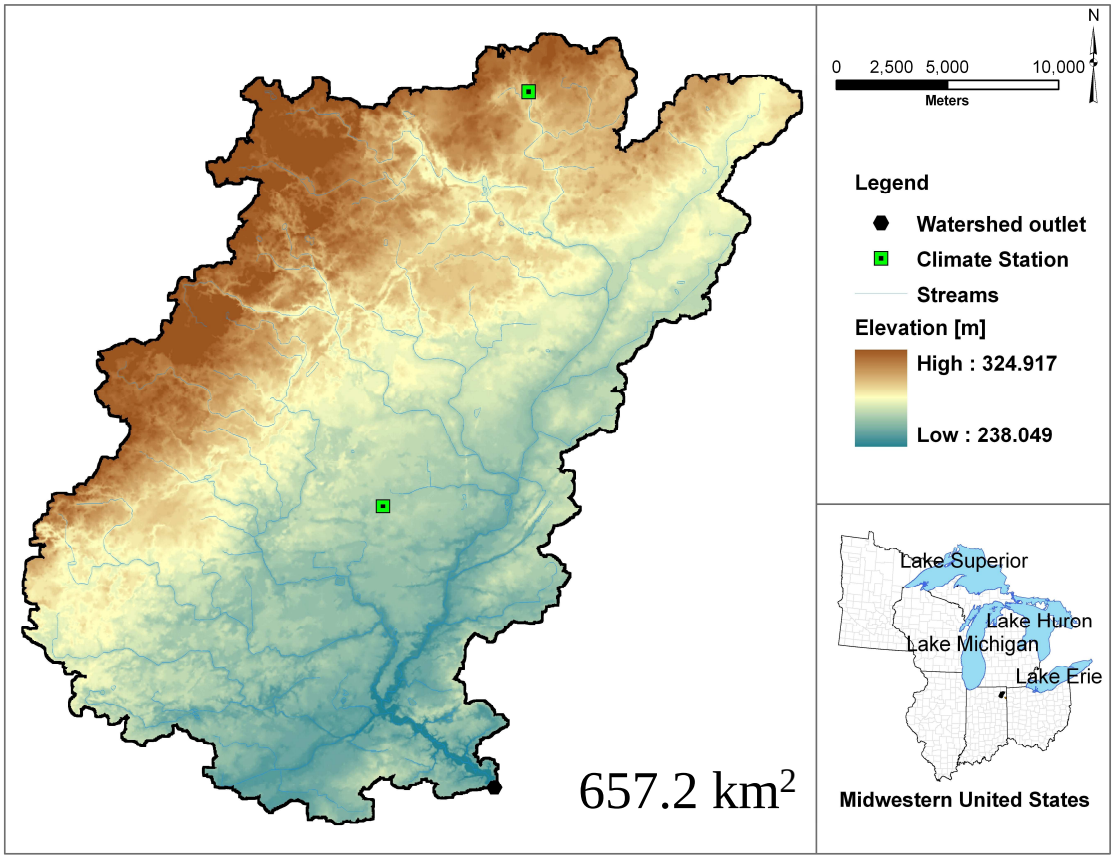
  Fate and transport of ammonia nitrogen in Cedar Creek



In-Stream N Processes in SWAT

Optional in-stream component (QUAL2E):

- It is left to the user to be activated
- It is not activated by default

Comparison of two models

- Model 1: in-stream processes were not activated
- Model 2: in-stream processes were activated

In-Stream N Processes in SWAT

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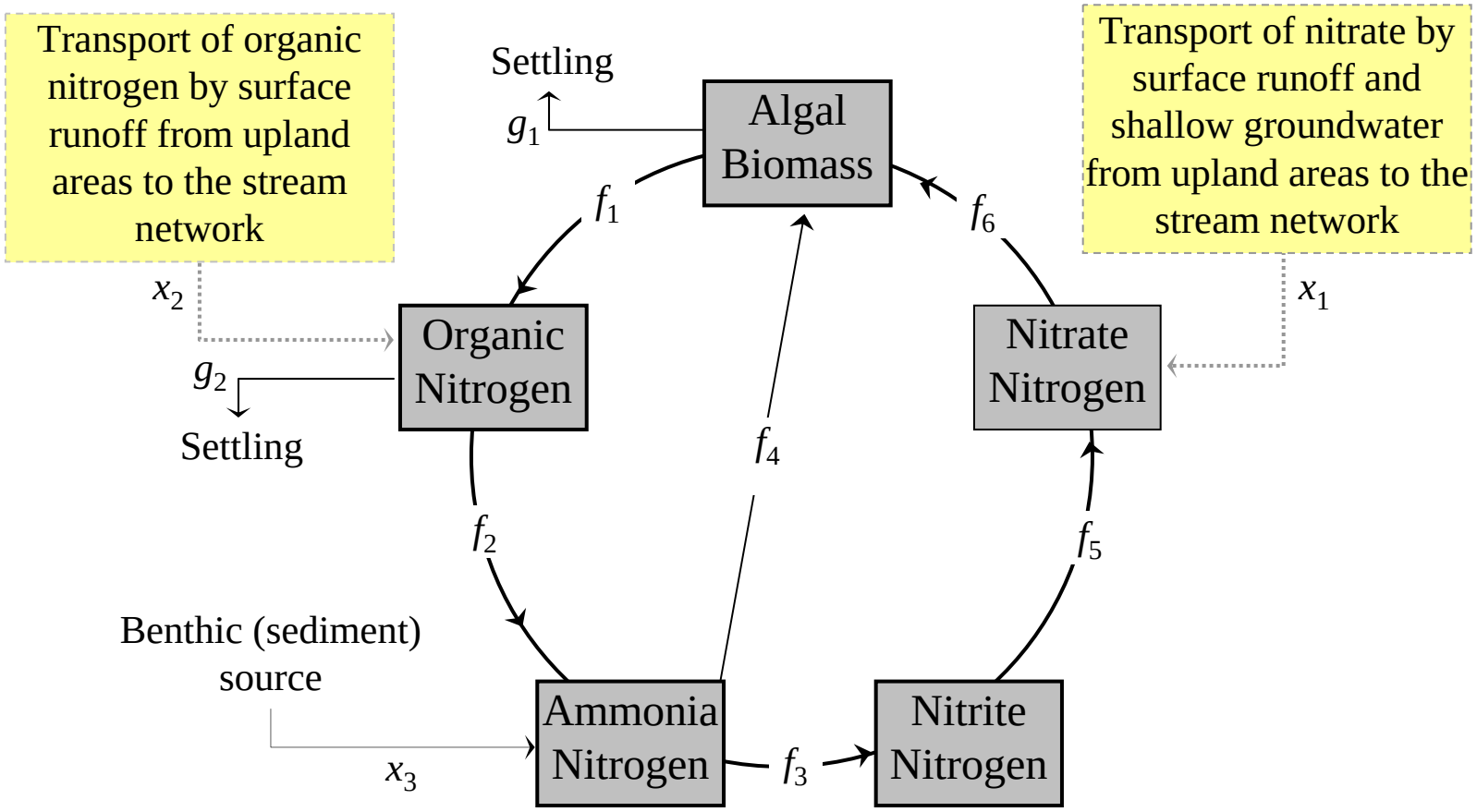

The Approach

Sampling-based approach:

- Structural complexity:
  - Number of input parameters and operations: *Petersen Matrix*
  - Linearity: *Multivariate linear regression analysis*
  - Multivariate interactions: *Tree-Structured Density Estimation*
- Performance:
  - Goodness-of-fit measures (e.g., Nash-Sutcliffe Coefficient)
  - Genetic algorithm optimization engine
- Identifiability:
  - Single parameters
  - Overall identifiability

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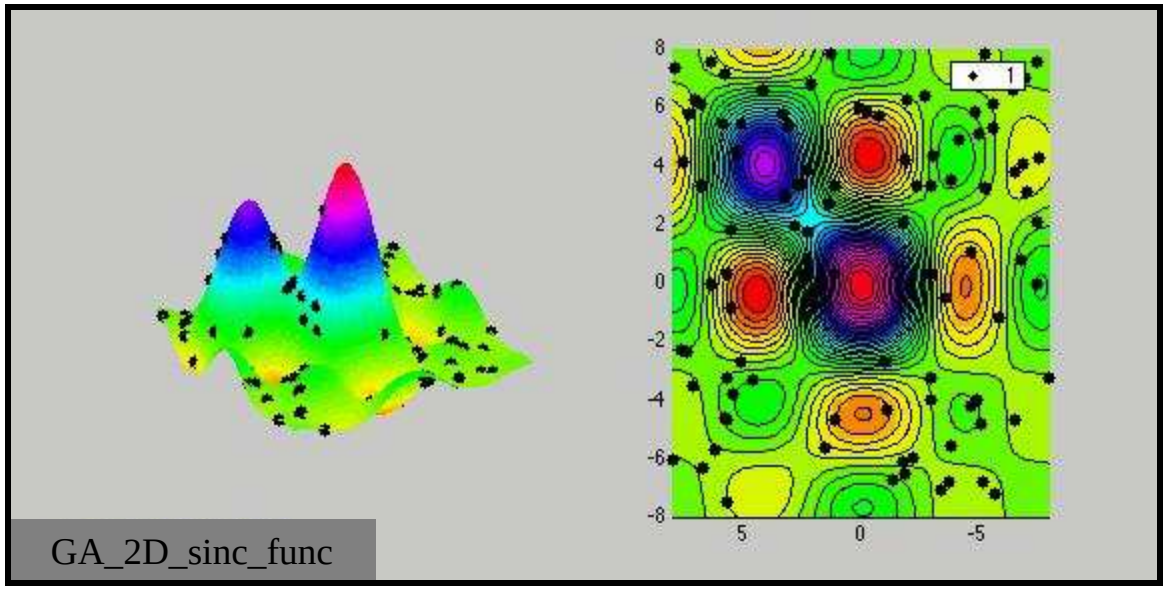
The genetic-algorithm optimization engine:



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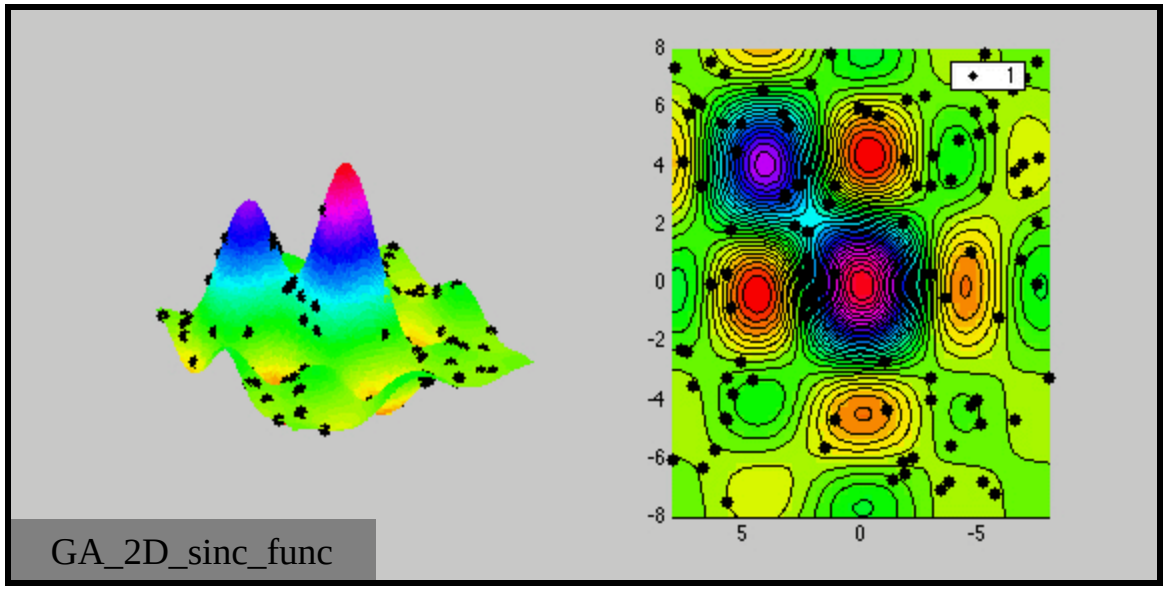
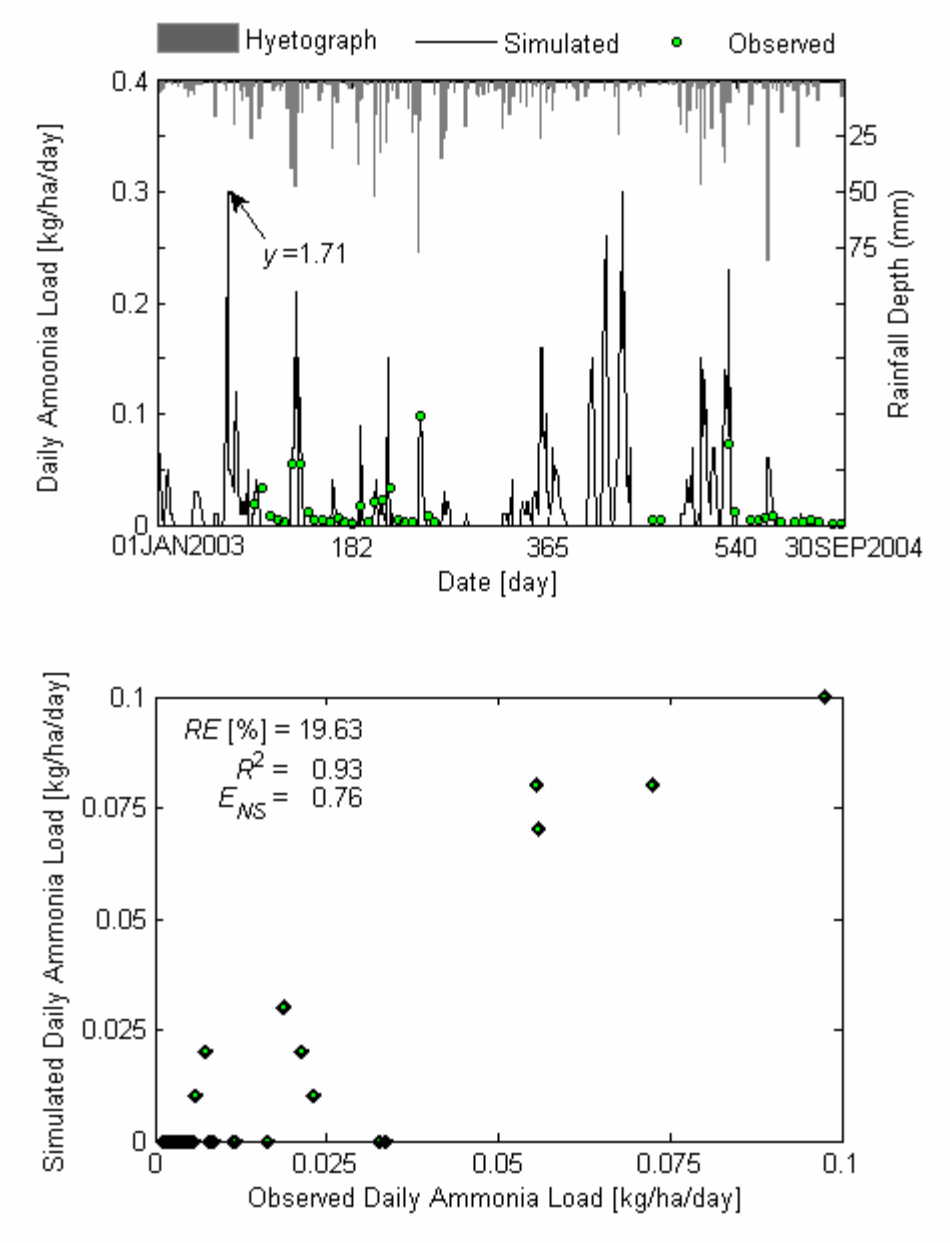


The Case Study

Performance:



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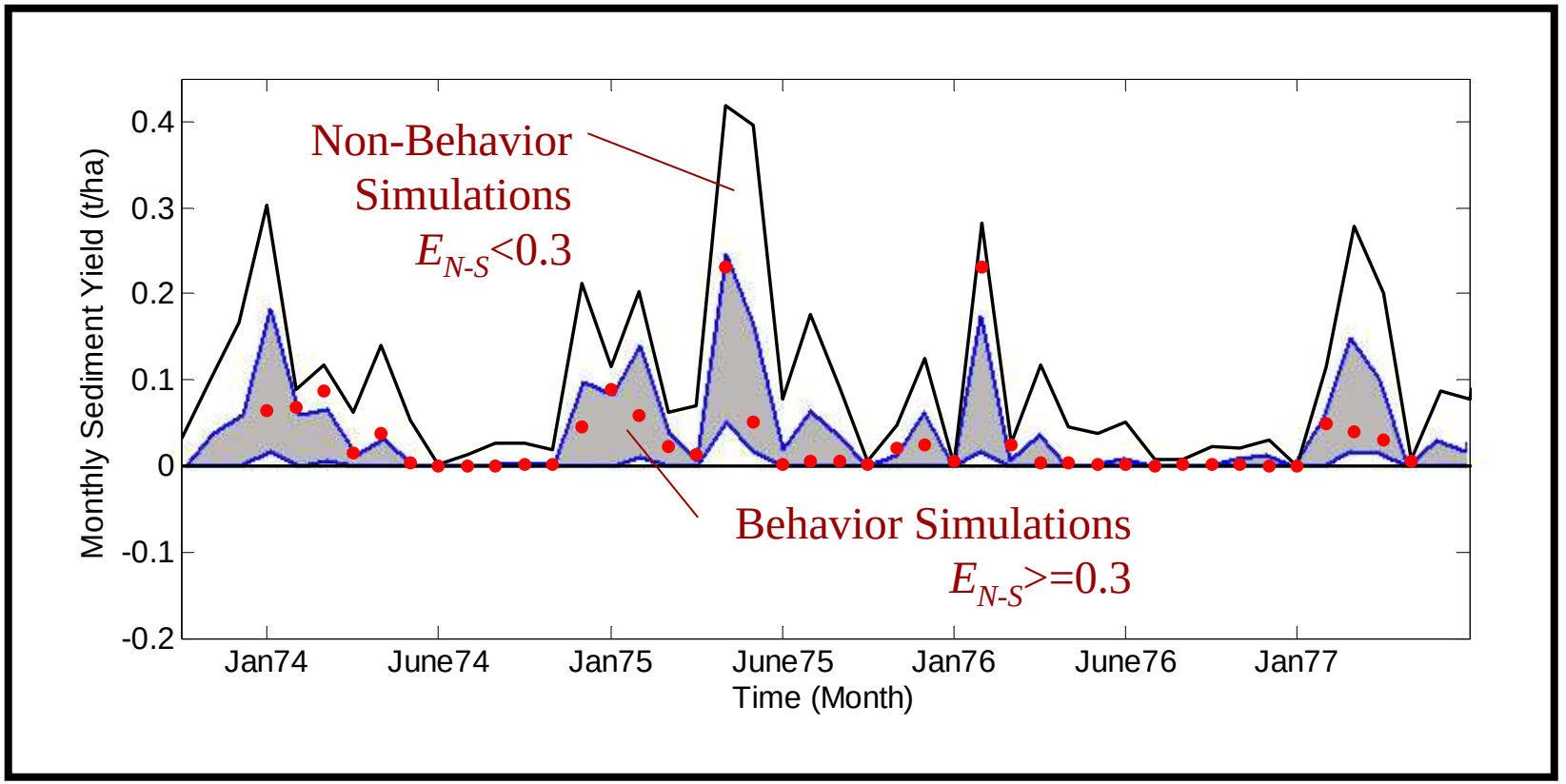
Identifiability:

Single parameters:

Regional Sensitivity

Analysis



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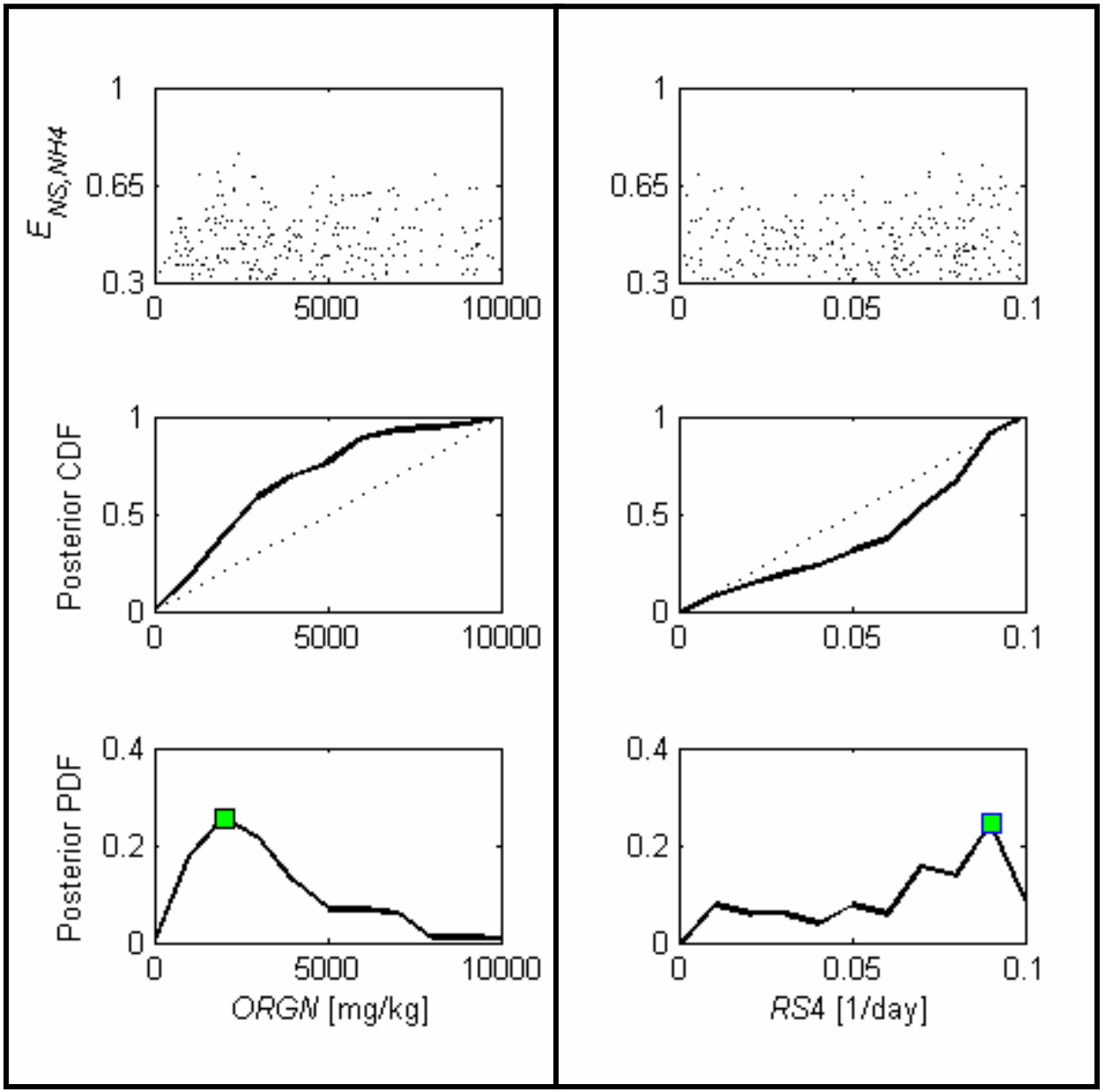
Identifiability:

Single parameters:

Regional Sensitivity Analysis



The Approach

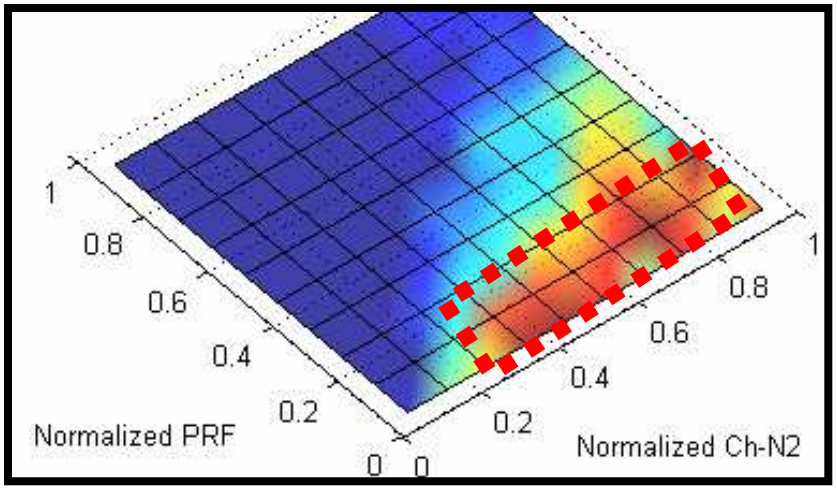
Identifiability:

– Overall model structure:

Tree-structured density estimation

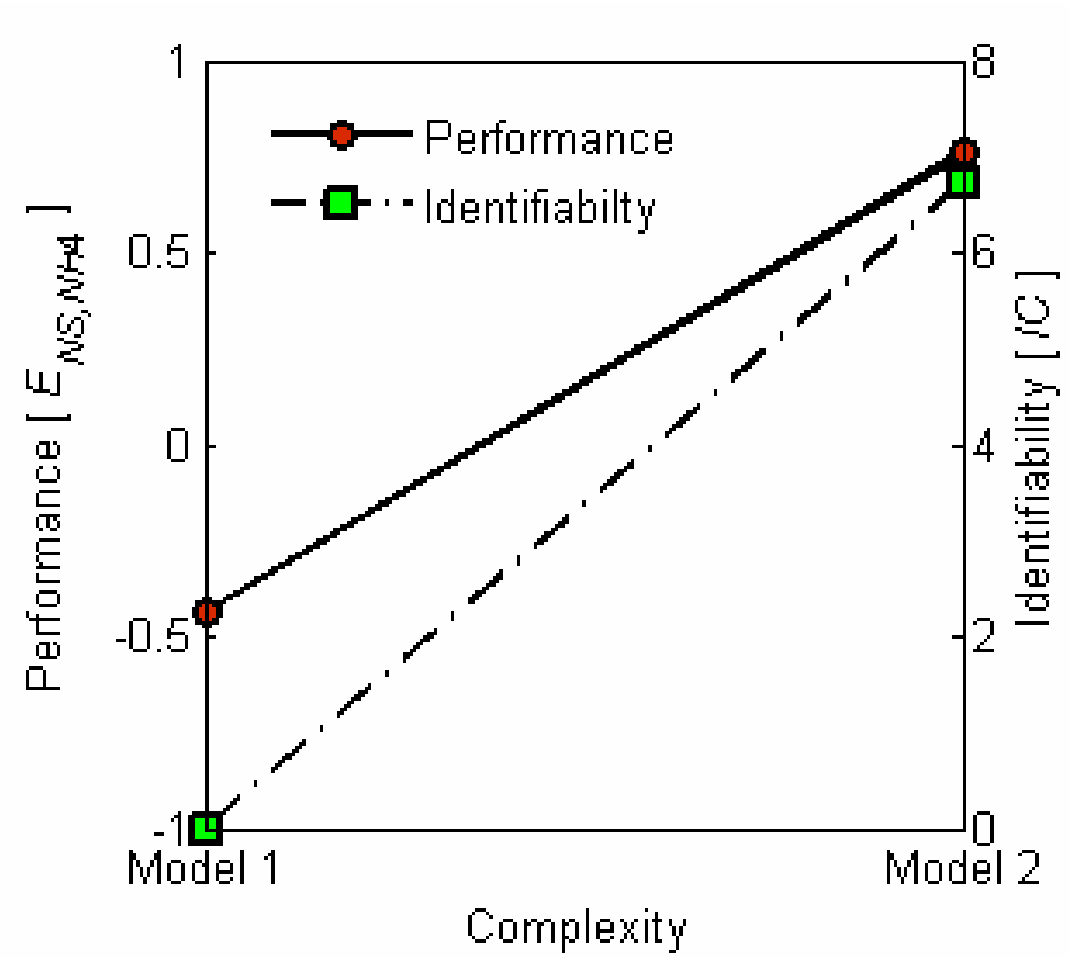
Identifiability Criterion

$$IC = \frac{m_T}{m} \times \frac{1}{V_T}$$



The Case Study

The Tradeoff Plot:



Closing Remarks

Utility of the tool

- Testing new improvements in model structure
- Testing new spatiotemporal discretization schemes

Advantages

- Provides a unified framework for future model enhancements
- Facilitates communication between different research groups working on different aspects of the model
- Can potentially guide integration of models that operate at different spatial/temporal scales

Acknowledgments

Questions?

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