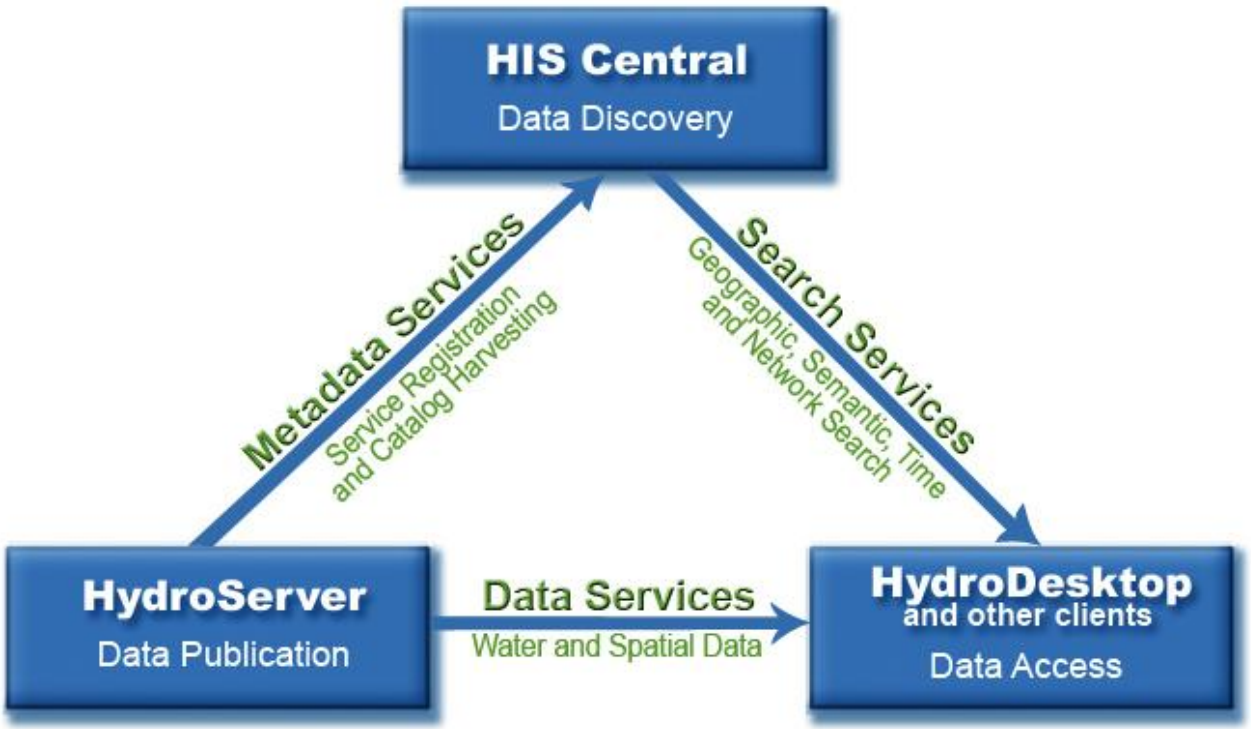
# Component-based Modeling using the HydroModeler Plug-in

Jonathan L. Goodall  Anthony M. Castronova

Civil and Environmental Engineering
University of South Carolina

CUAHSI HIS Webinar Series
November 7, 2011

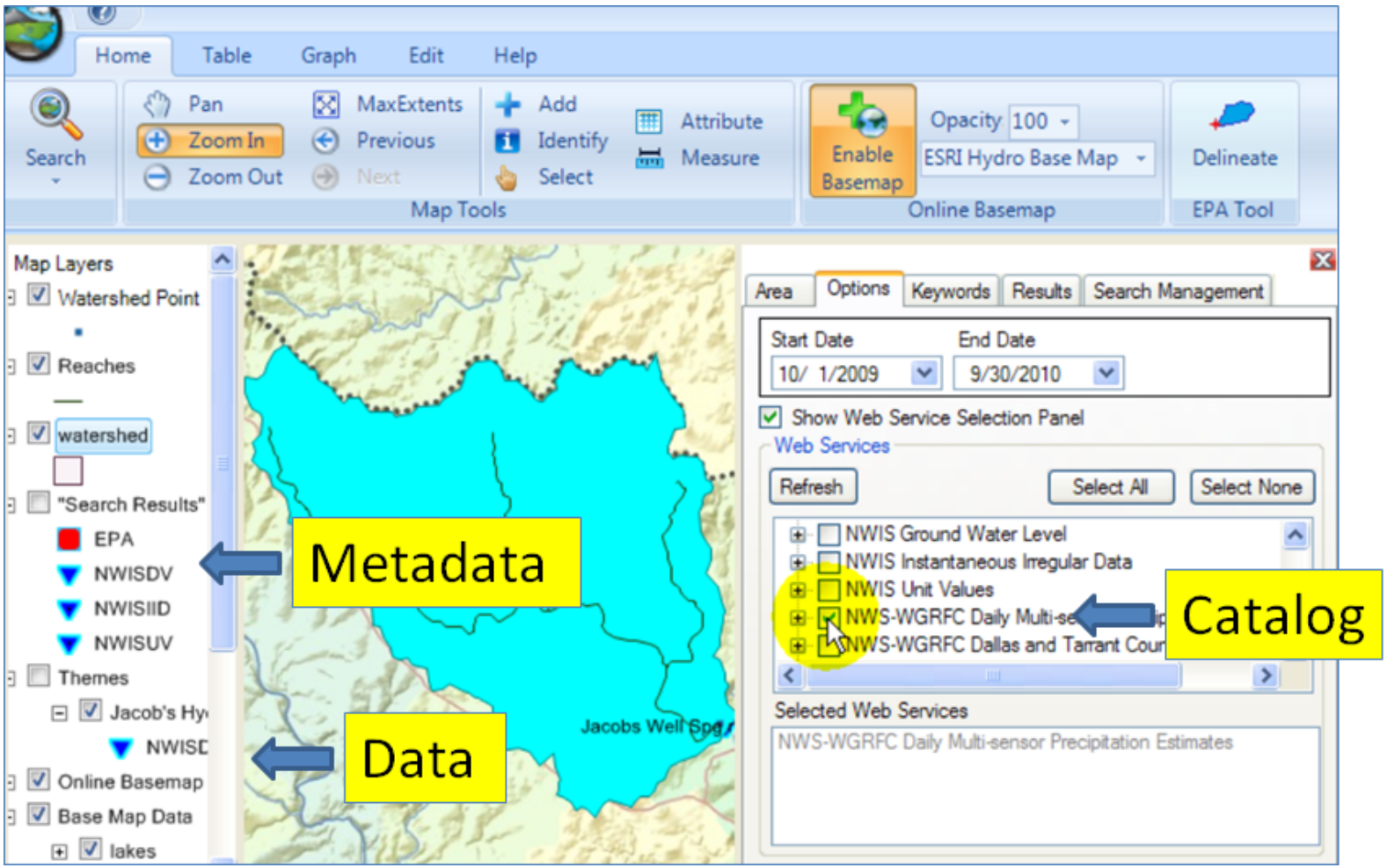
# HIS Overview






*Source: his.cuahsi.org*

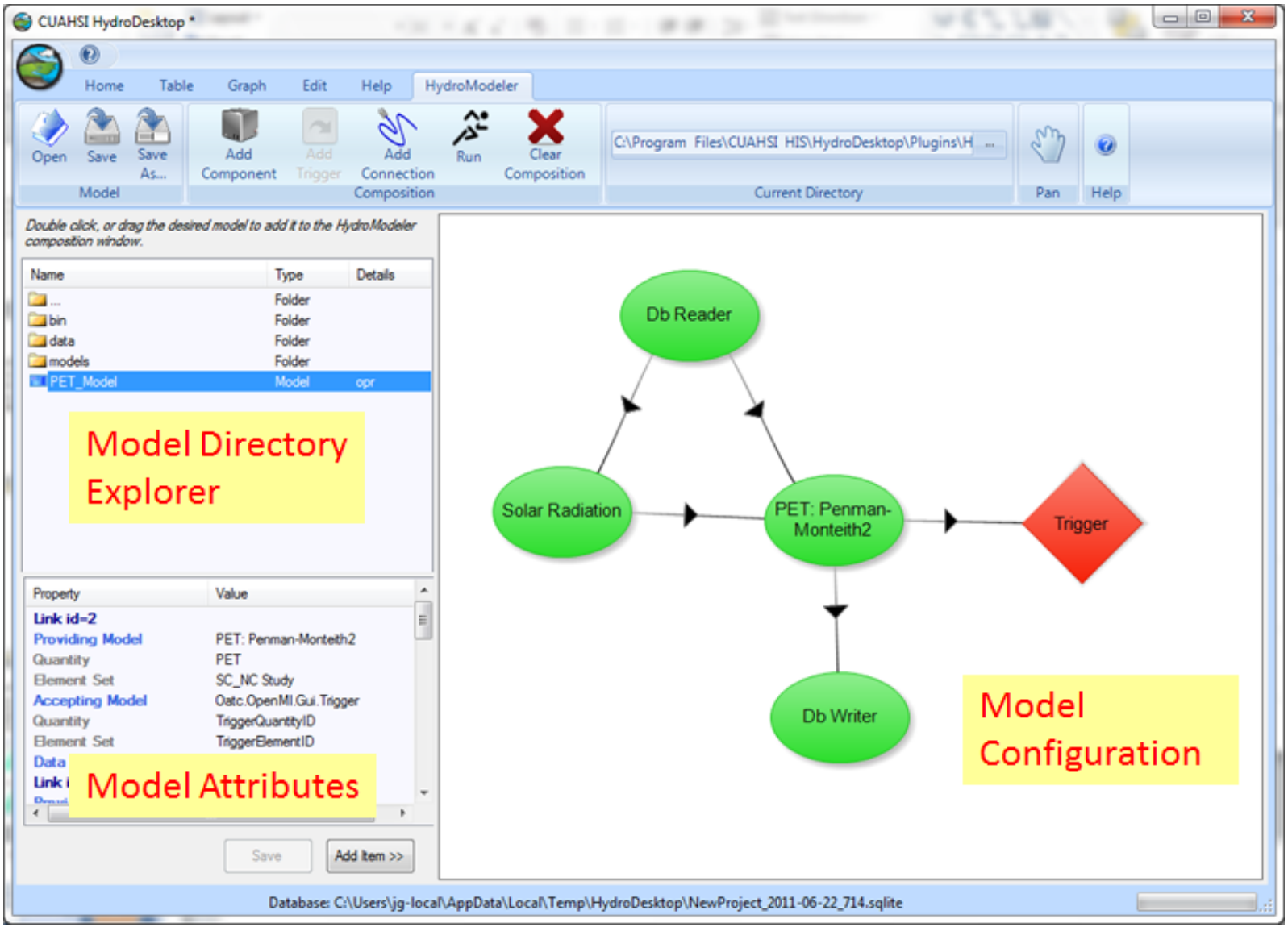
# HydroDesktop





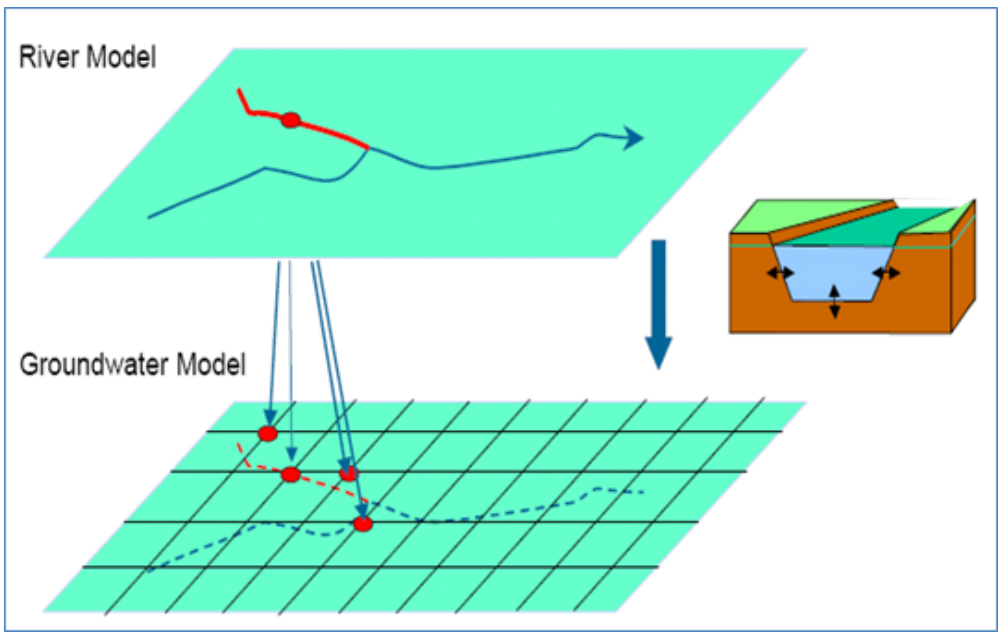

*Source: hydrodesktop.org*

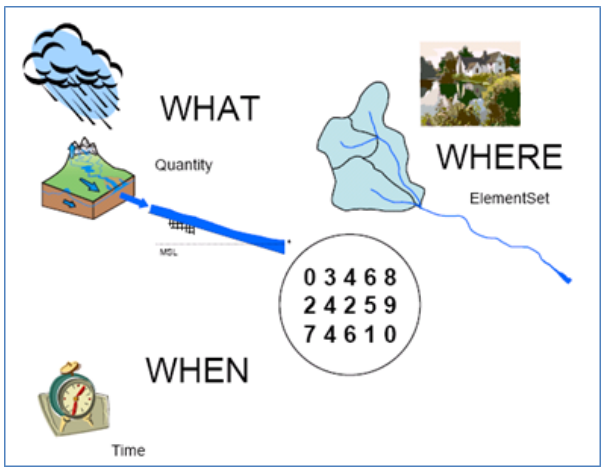
# HydroModeler



# Open Modeling Interface (OpenMI)

Standard for Model Coupling





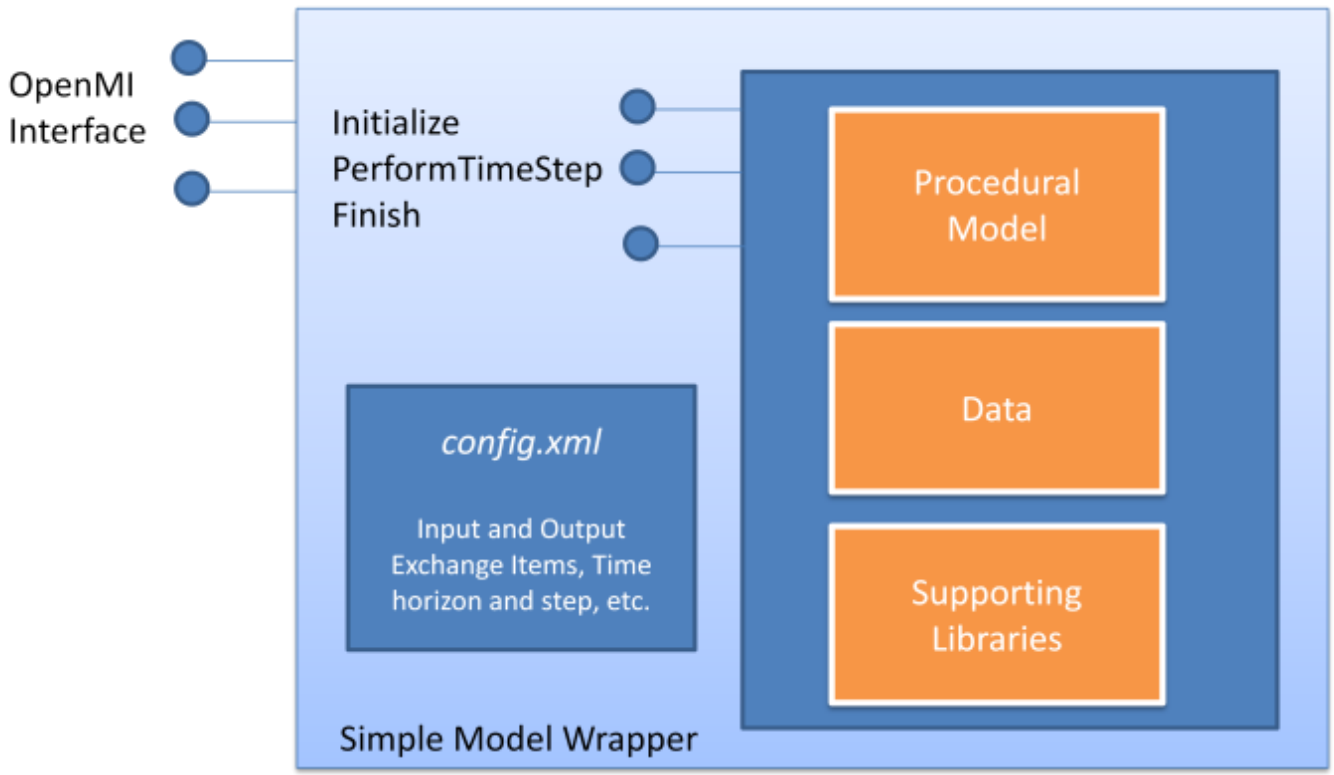

*Source: openmi.org*

# Advantages of Componentization

- Specialization
- Avoid duplication of effort
- Software maintenance

# Simple Model Wrapper (SMW)

## Using OpenMI for Process-Level Model Coupling






*Source: Castronova and Goodall, Environmental Modelling & Software, 2010.*

# Library of OpenMI Process-Level Components

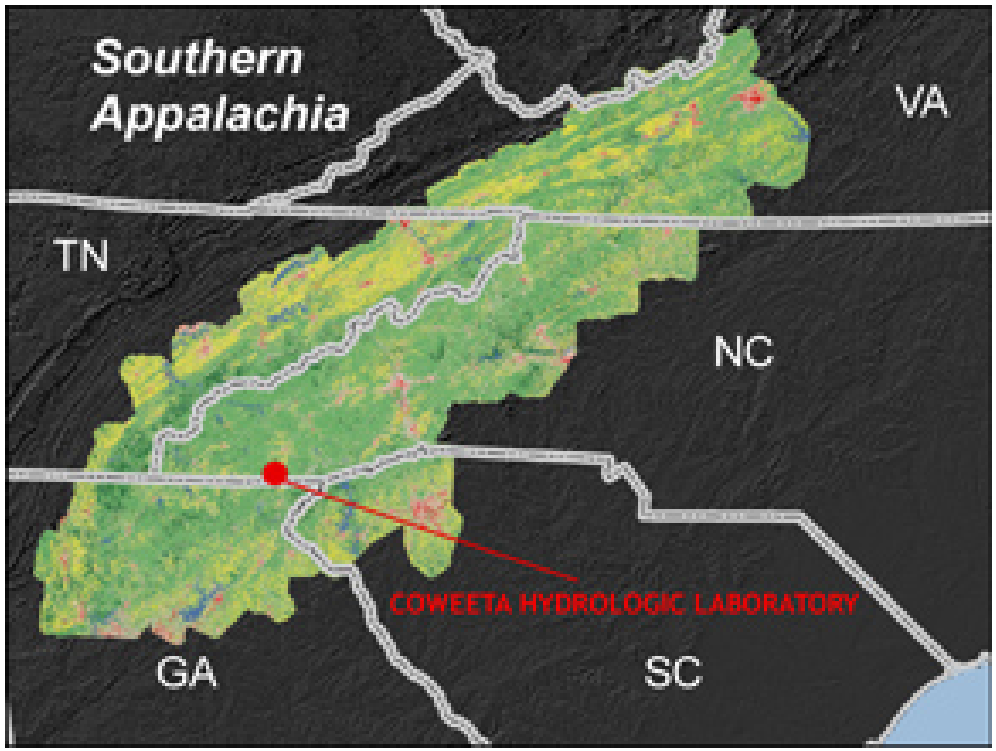
Open Source Library of Components for Hydrologic Modeling

- TopModel
- Phillip's Equation
- Penman-Montheith
- PriestleyTaylor
- GreenAmptMethod
- Hargreaves
- SolarRadiation
- SCSAbstractionMethod
- SCSUnitHydrographMethod
- ...

Available in the HydroDestkop source code repository (Source/HydroModeler/Components)

# Coweeta Hydrologic Laboratory

Long Term Ecological Research (LTER) Network Site

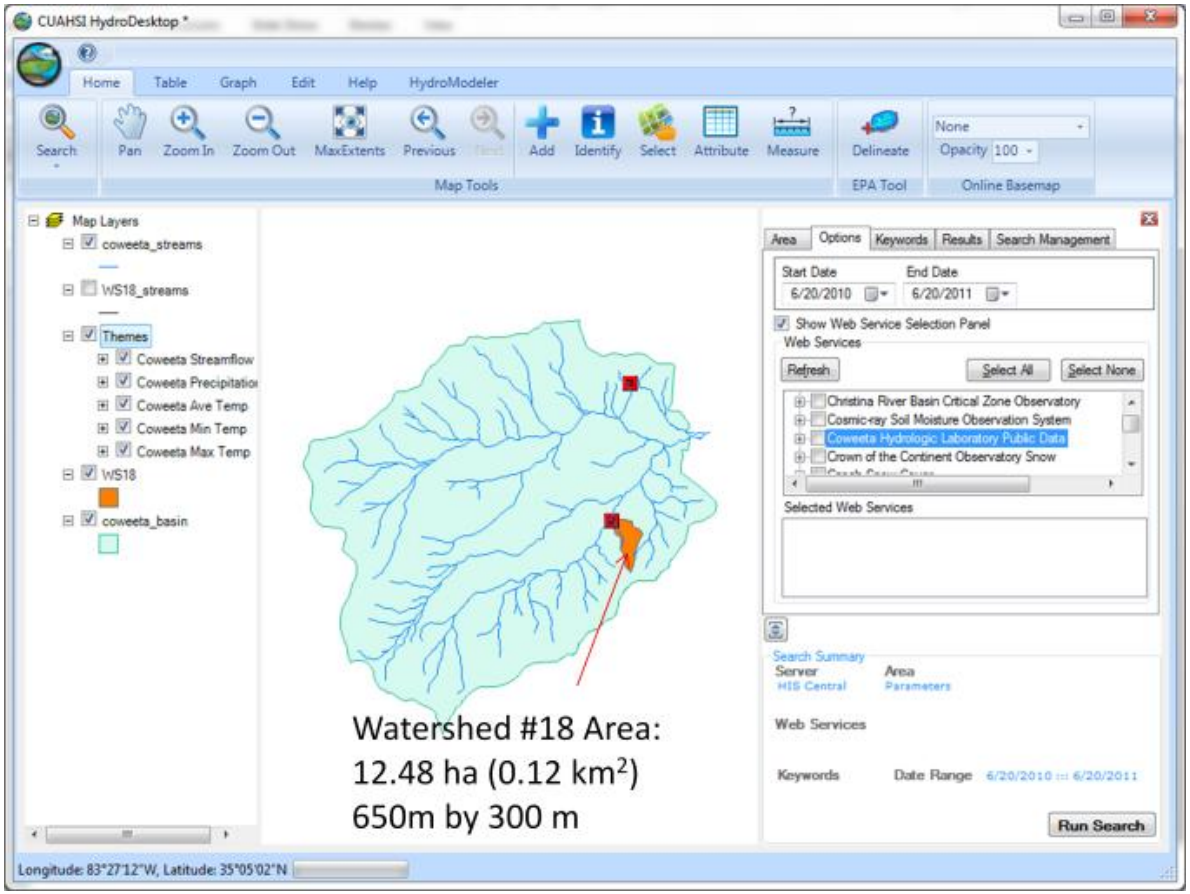




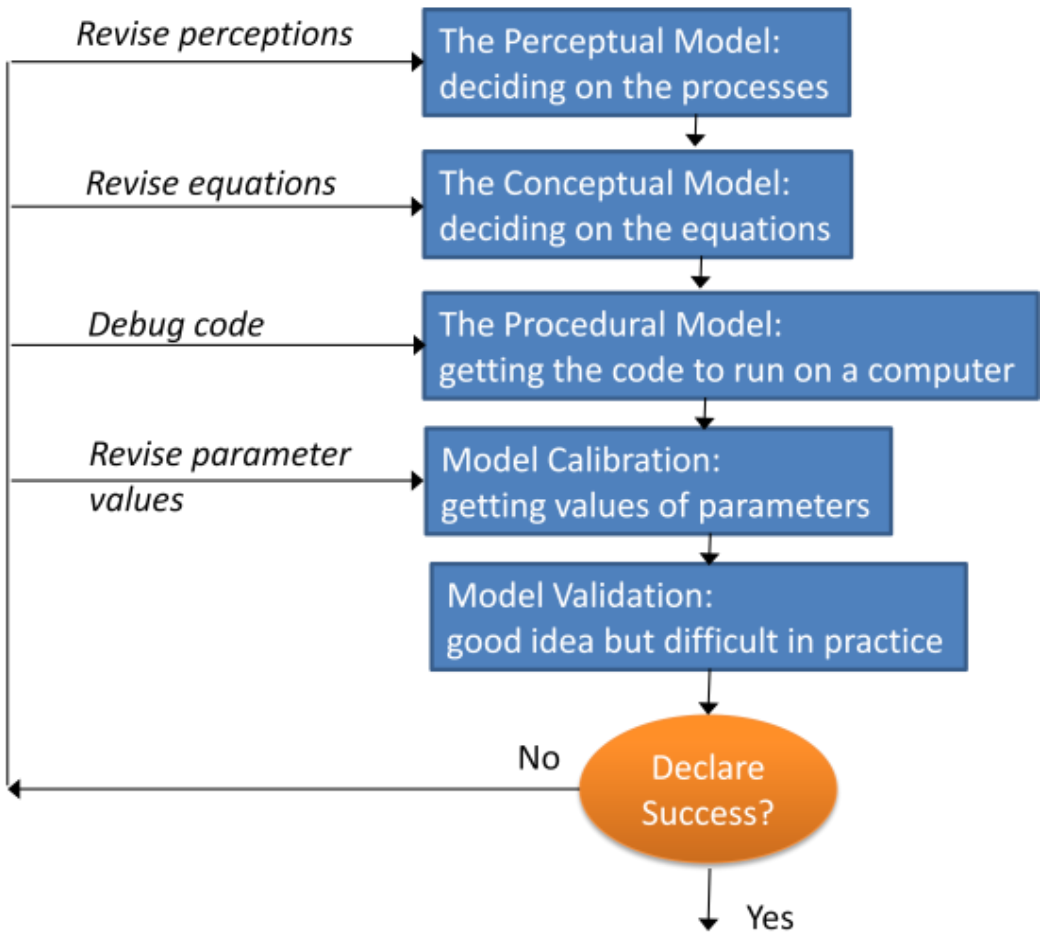

*Source: http://coweeta.uga.edu/*

# Coweeta Hydrologic Laboratory

Watershed #18 in HydroDesktop



# Hydrologic Modeling Workflow






*Source: Beven, Rainfall-Runoff Modeling: The Primer, 2001.*

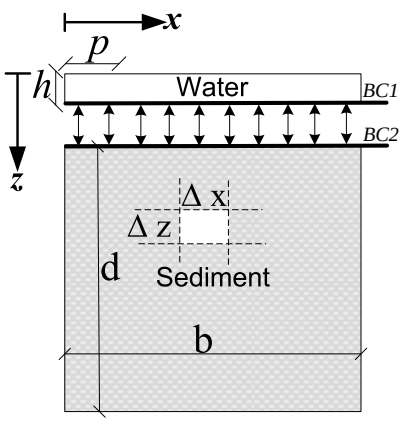
HydroModeler Demo for Coweeta Watershed #18...

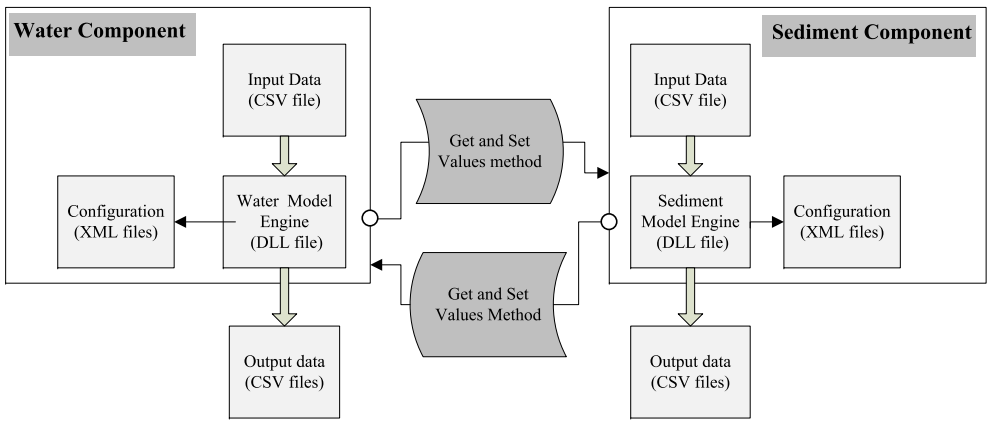
# Challenges with Component-based Modeling

- Lowering the bar to entry
- Data transfer issues
  - Spatial and/or temporal rescaling
  - Semantic mismatches
  - Feedback loops
  - Unit conversions
- Computation scaling as models become more complicated
- Interoperability across component-based modeling frameworks
- Model metadata and system decomposition (granularity issues)

# Feedback-loops using Component-based Modeling

Simulate advection-diffusion across a water/sediment interface using component-based modeling

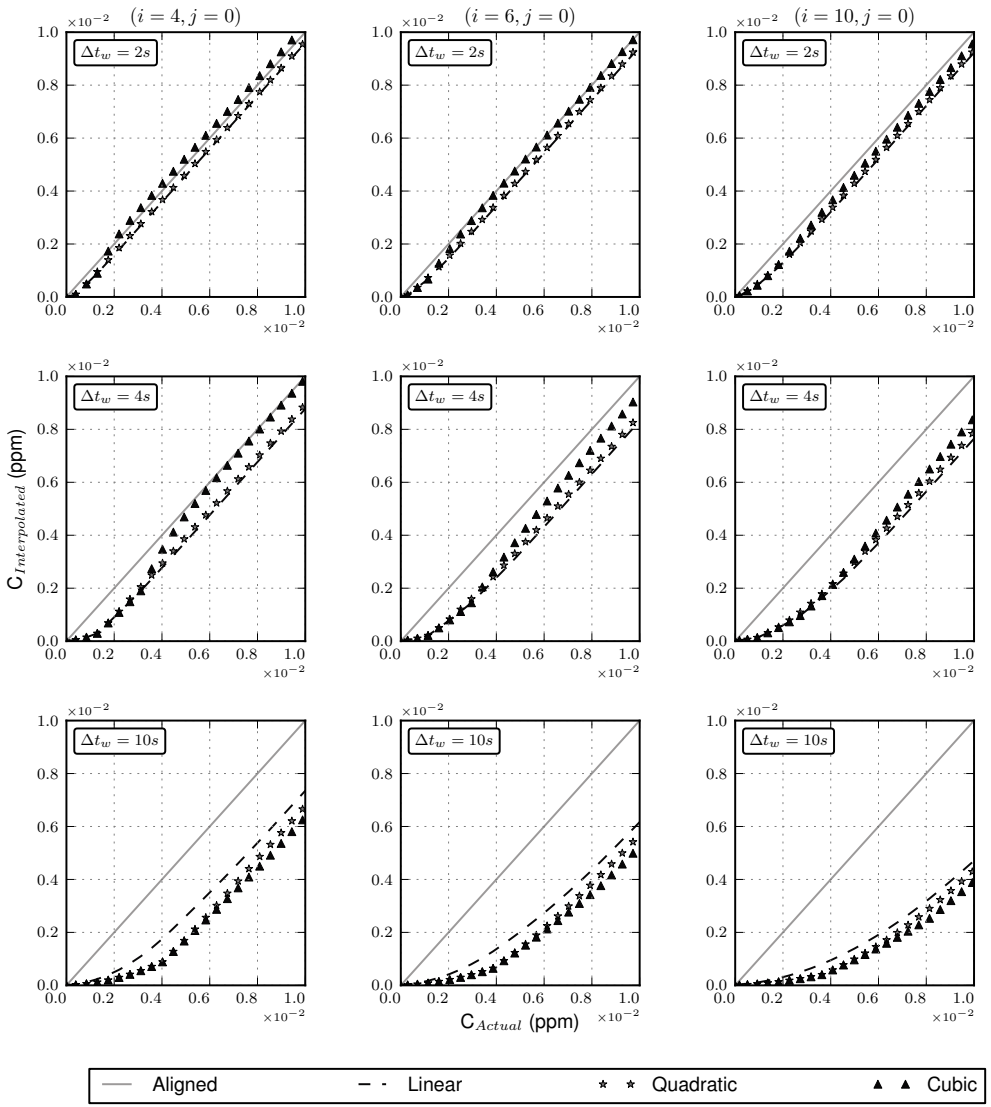





*Source: Elag and Goodall, In Press, WRR*

# Impact of Time-step Mismatch on Overall System Mass Balance in Component-based Modeling






*Source: Elag and Goodall, In Press, WRR*

# Summary

- HydroModeler is a component-based modeling environment built on the OpenMI SDK and integrated into the CUAHSI HydroDesktop application.
- HydroModeler is free and open source (included in the HydroDesktop repository) and we welcome the input of other developers
- Componentization of hydrologic models offers many potential benefits, but research is needed to address challenges (some of which I briefly mentioned)

Feel free to contact me with questions, comments, etc.

Jon Goodall, University of South Carolina (goodall@cec.sc.edu)