CIVE/WR 524 Modeling Watershed Hydrology

Meeting times
Lecture: MW 12:00-12:50 pm in Shepardson 102
Lab: W 1:00-2:40 pm in Engineering C205

Instructors
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Introduction and course objectives
Models can be powerful tools for exploring watershed hydrologic processes, and they are widely used both in research and in professional practice. This course introduces major concepts and skills in hydrologic modeling with an emphasis on the conceptual foundation of existing models. Specific course objectives are to develop: 1) ability to select and/or develop appropriate watershed models; 2) familiarity with a range of commonly used modeling approaches; and 3) skills in model configuration, calibration, and evaluation. Class projects will require use of spreadsheets, basic programming logic, spatial analysis software (RiverTools, ArcGIS), and the HEC-HMS hydrologic model. Supporting references will include the HEC-HMS manual, book chapters, and journal articles, including both classic texts on model concept development and new reviews of the latest advances in watershed modeling.

Website
RamCT (ramct.colostate.edu)

Textbook
No textbook is required. Readings will be provided through RamCT.
If you need to brush up on hydrology as we go through the class, good references are:

- Physical Hydrology, by Dingman
- Handbook of Hydrology, edited by Maidment
- Encyclopedia of Hydrological Sciences, edited by Anderson

Prerequisites
An introductory hydrology class: CIVE/ENVE 322 or WR416
An introductory statistics class: CIVE 202, STAT 301, or STAT 315
Familiarity with differential equations, fluid mechanics, groundwater, and ArcGIS

Grading

Modeling Projects	80%
Class Participation	20%

Modeling projects

Approximately four assignments
Due before class begins on due date
Late submissions will not be accepted
Every cell, every line of code, and every word must be your own work
Sending files to other students is not allowed, but discussion with others is encouraged
Show your work, explain your results, and include appropriate units where appropriate

Class participation

We expect all students to participate actively in class discussions of journal articles and to complete all lab activities.

Academic integrity

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog - 1.6, pages 7-9. (http://www.catalog.colostate.edu/Content/files/2012/FrontPDF/1.6POLICIES.pdf) and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Schedule (subject to change)

Subject	Class	Topic	Reading
Introduction	Jan 23	Modeling introduction	Singh and Woolhiser, 2002
	Jan 23 lab	*Design a model*	
	Jan 28	Hydrology review	
	Jan 30	Scale and spatial variability	Seyfried and Wilcox, 1995
	Jan 30, lab	*Introduction to matlab*	
Physical representations	Feb 4	Upward and downward modeling	Klemes, 1983
	Feb 6	Catchment scale modeling	Kirchner, 2009
	Feb 6, lab	*Linear reservoir model*	
	Feb 11	Conservation equations	Beckie, 2005
	Feb 13	Conservation equations	
	Feb 13, lab	*Data management in matlab*	
	Feb 18	Subsurface flow	Freeze and Harlan, 1969
	Feb 20	Surface flow	Bates, 2005
	Feb 20, lab	*Input files for distributed models*	*Project 1 due*
	Feb 25	Distributed models	Kampf and Burges, 2007
	Feb 27	Introduction to TopoFlow	Peckham, 2007
	Feb 27, lab	*TopoFlow event simulation*	
	Mar 4	Radiation and energy budget	Wigmosta et al., 1994
	Mar 6	Snow	Ferguson, 1999
	Mar 6, lab	*Energy budget simulation*	
	Mar 11	Case study	
	Mar 13	Guest speaker, George Leavesley	
	Mar 13, lab	*TBD*	*Project 2 due*
		Spring Break	
Structure Selection	Mar 25	Loss Methods	Ch 5, Feldman (2000)
	Mar 27	Transform Methods	Ch 6, Feldman (2000)
	Mar 27 Lab	*Introduction to HEC-HMS*	
	Apr 1	Baseflow Methods	Ch 7, Feldman (2000)
	Apr 3	Routing Methods	Ch 8, Feldman (2000)
	Apr 3 Lab	*ArcHydro & HEC-GeoHMS*	
	Apr 8	Forcing Methods	Ch11, Sharffenberg and Fleming (2010)
Parameter Screening	Apr 10	Global Sensitivity Analysis	Saltelli et al. (2008)
	Apr 10 Lab	*Elementary Effects*	Saltelli et al. (2004)
Parameter Calibration	Apr 15	Choosing to Calibrate	Klemes (1997)
	Apr 17	Model Performance	James and Burges (1982)
	Apr 17 Lab	*Performance Measures*	
	Apr 22	Optimization Methods	Ch. 6-7 Xu (2006)
	Apr 24	Calibration Strategies	Refsgaard (1997)
	Apr 24 Lab	*Calibration in HEC-HMS*	
Model Evaluation	Apr 29	Model Validation	Oreskes et al. (1994)
	May 1	Parameter Identifiability	Beven (2001)
	May 1 Lab	*GLUE Analysis*	
Model Application	May 6	Case Study	
	May 8	Ensemble Forecasting	McIntyre et al. (2005)
	May 8 Lab	*Monte Carlo Simulation*	