

Spring 2007: WR524 Modeling Watershed Hydrology

Times: Tuesday, Thursday lecture 12:10-1:25
Tuesday, Thursday recitation 1:26-1:50

Location: NR108 Natural Resources

Instructor: Stephanie Kampf, Dept. of Forest, Rangeland, and Watershed Stewardship
skampf@warnercnr.colostate.edu
Office: NR 214
Phone: 491-0931
Office hours: 2-3 Tuesday, Thursday, or by appointment

Website: http://www.warnercnr.colostate.edu/class_info/wr524/

Prerequisites: Required: Introductory hydrology (CE 322/EV 322, WR 416, or other hydrology course) and statistics (ST 304 or STCC 309). Strongly recommended: differential equations, fluid mechanics, groundwater, and soil physics.

Course Description: 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 (e.g. GIS), and the MODHMS and HEC-HMS hydrologic models. Supporting references will include the MODHMS and HEC-HMS manuals, book chapters, and journal articles, including both classic texts on model concept development and new reviews of the latest advances in watershed modeling.

Grading: This is a project-based course with a series of major modeling assignments. 70% of the course grade will be based on these modeling projects. A take-home final designed to synthesize the major modeling projects introduced in the course will constitute 20% of the course grade. The remaining 10% of the course grade will be based on participation in class discussions and activities.

Text: The course has no required text. You will be provided with electronic or hard copies of required readings. As a supporting text for hydrologic process understanding, I recommend you purchase your own copy of *Physical Hydrology* 2nd Edition by S. Lawrence Dingman.

Schedule (draft):

Week	Class topic	Readings	Assignment
16 Jan	History of watershed modeling	Todini, 1988; Singh & Woolhiser, 2002	Black box model
23 Jan	Hydrologic process review: conservation equations	Excerpts from Dingman, Brutsaert	Transfer function model
30 Jan	physics of subsurface and surface flow	Freeze & Harlan, 1969; Freeze, 1974	
6 Feb	physics of energy transfer: snow, ET	Excerpts from Dingman	
13 Feb	Representing flow physics: boundary value problems	Panday & Huyakorn, 2004	MODHMS, surface-subsurface model
20 Feb	numerical solutions, coupling schemes, analytical solutions	Wigmosta et al., 1994,2002	
27 Feb	Overview of watershed models: classifications	Clarke, 1973; Singh, 1995	
6 Mar	survey of existing models	Excerpts from Dingman, Singh	
SPRING BREAK			
20 Mar	Data for modeling: point & spatial	Seyfried & Wilcox, 1995;	HEC-HMS model
27 Mar	Parameterization	Excerpts from Xu, UNESCO Beven, 2006	
3 Apr	Calibration, Performance evaluation	Excerpts from Xu, UNESCO James & Burges, 1982	
10 Apr	Statistics in watershed modeling	Helsel & Hirsch, USGS manual	Forecasting and uncertainty
17 Apr	Stochastic modeling	Excerpts from Xu, UNESCO	
24 Apr	Special topics, student choice	TBA	
1 May	Review	Oreskes et al., 1994; Loague et al., 2006	Take home final

References:

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- Loague, K., C.S. Heppner, B.B. Mirus, B.A. Ebel, Q. Ran, A.E. Carr, S.H. BeVile, J.E. VanderKwaak. 2006. Physics-based hydrologic-response simulation: Foundation for hydroecology and hydrogeomorphology. *Hydrological Processes* 20:1231-1237.
- Loucks, D.P., E. van Beek, 2005. *Water Resources Systems Planning and Management: An Introduction to Methods, Models & Applications*. UNESCO.
- Oreskes, N., K. Shrader-Frechette, K. Belitz. 1994. Verification, validation, and confirmation of numerical models in the earth sciences. *Science* 263:641-646.
- Panday, S., P. S. Huyakorn. 2004. A fully coupled physically-based spatially-distributed model for evaluating surface/subsurface flow. *Advances in Water Resources* 27:361-382.
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- Singh, V.P., 1995. *Computer Models of Watershed Hydrology*. Water Resources Publications, Highlands Ranch, CO.
- Singh, V. P., D.A. Woolhiser. 2002. Mathematical modeling of watershed hydrology. *Journal of Hydrologic Engineering* 7:270-292.
- Todini, E. 1988. Rainfall-runoff modeling - past, present and future. *Journal of Hydrology* 100:341-352.
- Wigmosta, M. S., L.W. Vail, D.P. Lettenmaier. 1994. A distributed hydrology-vegetation model for complex terrain. *Water Resources Research* 30:1665-1679.
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- Xu, C., 2006. *Hydrologic Models*. University of Oslo.