Summer 2015

Interdisciplinary Modeling for Water-Related Issues Graduate Course

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Interdisciplinary Modeling: Water-Related Issues and Changing Climate
GEOS 697 (Summer 2015)

Syllabus (as of 5/19/15)

(3 credits)

Course Dates: June 1 – 13*, 2015, 8 a.m.-5 p.m.; 8 hrs per day, including weekends

*final report is due June 20, 2015 via email

Course Location: Boise State University (Room ERB 1100)

Course Web Page: http://www.cabnr.unr.edu/saito/Classes/geos697/geos697.htm

Course Instructors: Coordinating Instructors:

- **Laurel Saito** (Dept. of Natural Resources and Environmental Science, Univ. of Nevada Reno (UNR); aquatic ecosystem modeling)
- **Dan Cadol** (Dept. of Earth and Environmental Science, New Mexico Institute of Mining and Technology (NMT); ecohydrologic modeling)
- **Alexander Fernald** (Dept. of Animal and Range Sciences, New Mexico State Univ. (NMSU); surface-groundwater interaction modeling)
- **Alejandro Flores** (Dept. of Geosciences, Boise State Univ. (BSU); hydrometeorologic modeling)
- **Timothy Link** (Dept. of Forest Resources, Univ. of Idaho (UI); snowpack energetics modeling)

Co-Instructors:

- **Fred Harris** (Dept. of Computer Science and Engineering, UNR; high performance computation and visualization)
- **James McNamara** (Dept. of Geosciences, BSU; watershed hydrology)

Guest lecturers:

- **Sajjad Ahmad** (Dept. of Civil and Environmental Engineering, Univ. of Nevada Las Vegas (UNLV); water resources systems modeling)
- **Karl Benedict** (University Libraries, Univ. of New Mexico (UNM); data management)
- **Evan Carson** (Dept. of Biology, UNM; fish population modeling)
- **Laura Crossey** (Dept. of Earth and Planetary Sciences, UNM; geochemical modeling)
- **Stephen Crowley** (Dept. of Philosophy, BSU; philosophy of science)
- **Levan Elbakidze** (Dept. of Agricultural Economics and Rural Sociology, UI; economics modeling)
- **Tara Hudiburg** (Dept. of Forest, Rangeland, and Fire Sciences; UI; ecosystem ecology and modeling)
- **Josh Johnston** (Dept. of Vice President for Research; BSU; visualization)
- **Roger Lew** (Virtual Technology Laboratory, College of Art and Architecture, UI; human factors psychology, SES virtualization)
- **Danny Marks** (Agricultural Research Service, Boise; snow modeling)
- **Benjamin Pauli** (Dept. of Biology, BSU; agent-based modeling)
- **Scott Peckham** (Inst. of Arctic and Alpine Research, Univ. of CO; computer science)
- **Aleksey Telyakovskiy** (Dept. of Mathematics and Statistics, UNR; mathematical modeling)

- **Vince Tidwell** (Geohydrology Dept., Sandia National Labs; systems dynamics modeling)
- **Benjamin Turner** (Dept. of Animal and Range Sciences, NMSU; surface-groundwater interaction modeling)
- **Scott Tyler** (Dept. of Geological Sciences and Engineering; UNR; vadose zone modeling)
- **John Wilson** (Dept. of Earth and Environmental Science; NMT; hydrology/mathematical modeling)
- **J.D. Wulfhorst** (Dept. of Ag. Economics & Rural Sociology; UI; rural sociology)

Course Goals: The science and management of many environmental issues including climate change is inherently interdisciplinary. One of the ways to approach the diversity of needs in managing and understanding these issues is to employ mathematical modeling. Models based on available scientific knowledge and theories can be used to bridge the gap between the ability to scientifically predict with reasonable certainty, and the need to make management decisions. This course will address: 1) the advantages and limitations of using models; 2) different spatial and temporal scales that specific disciplines are concerned with; 3) differences in degrees of uncertainty of data and models, 4) interdisciplinary modeling options; 5) communication between disciplines, where different terminology and perspectives can be a barrier to productive discussion of common issues or concerns; 6) education and training of scientists and modelers about applying interdisciplinary approaches; and 7) interaction with stakeholders and the public. The **vision** of this course is *to engage students in interdisciplinary discourse in modeling* by addressing each of these challenges. The **goals** of the course are therefore for students to: A) increase awareness of models used in different disciplines to model water-related issues and climate change; B) increase knowledge of the challenges of applying models in an interdisciplinary context; C) improve skills in working in interdisciplinary teams to address complex issues; D) increase enthusiasm for working with interdisciplinary modeling approaches for addressing water-related issues and climate change; E) increase confidence in doing interdisciplinary modeling; F) increase confidence in working in interdisciplinary teams; and G) increase interest in interdisciplinary modeling (e.g., through taking more courses, pursuing a career, or teaching).

Course Description: Students will be introduced to models that are available in different disciplines and how such models might be applied together to address water-related issues regarding climate change, address issues of variability and uncertainty in implementing interdisciplinary approaches, and gain experience in working in interdisciplinary teams to apply interdisciplinary modeling approaches to increase knowledge about water-related issues regarding climate change. Students will use a common software to do an interdisciplinary modeling project regarding water-related issues in Idaho, Nevada, or New Mexico.

Course Objectives: Successful students will accomplish the following in this course:

1. Discuss the philosophy of modeling
2. Become aware of models in different disciplines used to address water issues related to climate change
3. Work in interdisciplinary teams to explore issues and approaches associated with interdisciplinary modeling

4. Complete an interdisciplinary modeling project that addresses one or more water-related issues related to climate change

Prerequisite: Graduate students in any discipline related to water including, but not limited to: hydrology, engineering, political science, law, economics, geology, atmospheric science, geochemistry, environmental science, chemistry, water resources, etc. Students should have some experience with modeling and/or at least one course in modeling or consent of coordinating instructors.

Required Textbook: None. Students are required to prepare with material posted on the website and wiki.

Grading:

Description	Points
In-class assignments during labs (~12)	400
Interdisciplinary modeling project	500
Class participation and attendance	100
TOTAL	1000

In-class assignments: In-class assignments are designed to promote interdisciplinary discussions and interactions in the context of water-related modeling regarding climate change. Detailed instructions will be provided on the course website and when the assignments are handed out during the course. Topics include introduction to STELLA, data management, visualization, ecological modeling, statistical/mathematical modeling, watershed modeling, water quality modeling, groundwater modeling, weather and climate modeling, economic modeling, and remote sensing/land class evolution modeling.

Interdisciplinary modeling project: The project is designed to promote interaction between students in different disciplines to gain experience with interdisciplinary modeling. Project topics will focus on an interdisciplinary issue pertaining to climate change and water resources in Idaho, Nevada, or New Mexico. Students will be assigned to interdisciplinary teams to work with available data and address issues with interdisciplinary modeling and visualization using STELLA, Excel, and/or modeling software they already are familiar with. Each team will prepare a written report (due June 20) and present the outcomes of their project to the class participants on June 13, 2015 as a 20-minute presentation.

Class participation and attendance: Attendance and participation is a key element to your success in this class. There are no exams associated with this class; rather, the class involves a variety of lectures, discussions and exercises to enhance interdisciplinary interactions. It is essential that students attend the entire course to participate in these activities. You are expected to be at the course each day for all activities. Participation includes completing evaluations of the lectures, exercises, and course, asking questions and providing comments on the issues in class, and contributing actively to group exercises in class.

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Class Schedule (as of 5/19/15)

Monday, June 1, 2015 (Location: ERB 1100)

8:00-8:15	General introduction	Saito
8:15-9:15	Ethics of modeling and why model	Saito
9:15-9:55	Use and misuse of models	Wilson
9:55-10:05	BREAK	
10:05-12:00	Conceptual modeling exercise	Saito/Ahmad/Link/Wilson/others
12:00-1:00	LUNCH	
1:00-2:55	Systems dynamics modeling	Ahmad
2:55-3:05	BREAK	
3:05-5:00	Lab: Introduction to Stella	Ahmad

Tuesday, June 2, 2015 (Location: Student Union Building – Jordan Ballroom)

8:00-5:00	Tri-State meeting	all

Wednesday, June 3, 2015 (Location: ERB 1100)

8:00-9:55	Hydrologic modeling	Saito
9:55-10:05	BREAK	
10:05-12:00	Lab: Hydrologic modeling	Saito
12:00-1:00	LUNCH	
1:00-2:55	Data management	Harris/Benedict
2:55-3:05	BREAK	
3:05-5:00	Adding people to the equation	Wulfhorst
6:00-6:30	Case study: acequia projects	Fernald

Thursday, June 4, 2015 (Location: ERB 1100)

8:00-9:55	Groundwater modeling	Tyler
9:55-10:05	BREAK	
10:05-12:00	Lab: Groundwater modeling	Tyler
12:00-1:00	LUNCH	
1:00-2:55	Remote sensing, land class evolution modeling	Cadol
2:55-3:05	BREAK	
3:05-5:00	Lab: Remote sensing, land class evolution modeling	Cadol

Friday, June 5, 2015 (Location: ERB 1100)

8:00-9:55	Vegetation-atmosphere, canopy interception modeling	Link
9:55-10:05	BREAK	
10:05-12:00	Lab: Vegetation-atmosphere, canopy interception modeling	Link
12:00-1:00	LUNCH	
1:00-2:55	Weather and climate modeling	Flores
2:55-3:05	BREAK	
3:05-5:00	Lab: Weather and climate modeling	Flores

Saturday, June 6, 2015 (Location: ERB 1100)		
8:00-8:15	ASSIGN PROJECTS	Saito
8:15-9:00	Case study - Envision	Flores
9:00-9:45	Case study - acequias	Turner
9:45-10:00	BREAK	
10:00-10:45	Case study – Jemez Canyon	Cadol
10:45-11:30	Case study – Lapwai	Link
11:30-12:00	Preview for Dry Creek Watershed	McNamara
12:00-5:00	LUNCH and field trip to Dry Creek Watershed	McNamara
Sunday, June 7, 2015 (Location: ERB 1100)		
8:00-10:30	Students work on projects with mentors	Cadol, Flores, Link, McNamara, Turner, Volk
10:30-11:15	Issues of scale	Saito
11:15-12:00	Uncertainty and calibration	Saito/Flores
12:00-1:00	LUNCH	
1:00-1:55	CSDMS modeling	Peckham
1:55-2:05	BREAK	
2:05-5:00	Interdisciplinary toolbox exercise	Crowley
Monday, June 8, 2015 (Location: ERB 1100)		
8:00-9:55	Lab: Systems dynamics modeling	Tidwell
9:55-10:05	BREAK	
10:05-12:00	Visualization	Johnston
12:00-1:00	LUNCH	
1:00-1:55	Virtualized SESs	Lew
1:55-2:05	BREAK	
2:05-5:00	Lab: Virtualized SESs	Lew
Tuesday, June 9, 2015 (Location: ERB 1100)		
8:00-9:55	Ecological modeling	Hudiburg
9:55-10:05	BREAK	
10:05-12:00	Snow modeling	Marks/Link
12:00-1:00	LUNCH	
1:00-2:55	Lab: Snow modeling/ecological modeling	Marks/Link/Hudiburg
2:55-3:05	BREAK	
3:05-5:00	Lab: Agent-based modeling	Pauli
Wednesday, June 10, 2015 (Location: ERB 1100)		
8:00-9:55	Mathematical modeling	Telyakovskiy
9:55-10:05	BREAK	
10:05-12:00	Fish modeling	Carson
12:00-1:00	LUNCH	
1:00-2:55	Economics modeling	Elbakidze
2:55-3:05	BREAK	
3:05-5:00	Lab: Economics modeling	Elbakidze

Thursday, June 11, 2015 (Location: ERB 1100)

8:00-9:55	Water quality modeling	Crossey (online)
9:55-10:05	BREAK	
10:05-12:00	Students work on projects	
12:00-1:00	LUNCH	
1:00-5:00	Students work on projects	

Friday, June 12, 2015 (Location: ERB 1100)

8:00-12:00	Students work on projects
12:00-1:00	LUNCH
1:00-5:00	Students work on projects

Saturday, June 13, 2015 (Location: ERB 1100)

8:00-12:00	Students work on projects
12:00-1:00	LUNCH
1:00-3:00	Student presentations of projects
3:00	IN-PERSON CLASS ENDS
5:00-7:00	End of class dinner (location TBD)

Saturday, June 20, 2015

5:00 p.m.	Student reports are due to Laurel Saito by email