GEOG 483
WATERSHED ANALYSIS
Dr Trent Biggs
MWF 11-1150am

Office hours:
WF 12-2pm
Office: 317 Storm
Spring 2009

Course description:

Humans and ecosystems depend on and affect watershed processes that move water, sediment, and chemicals through a landscape. Watershed analysis describes and quantifies connections between natural landscape properties, human activities, and ecosystem services related to soil, water resources, and aquatic ecosystems. In this course students will learn procedures for watershed analysis with a focus on understanding the main processes that control water quantity, water quality, sediment transport, and aquatic habitat. A particular focus will be given to the effects of urbanization and fire on watershed processes in semi-arid climates. Field projects on campus and in Los Penasquitos Watershed will familiarize students with methods for measuring landscape properties, and the class project involves analysis of a watershed problem of interest to the student. While some technical skills will be covered, *emphasis will be placed on critical understanding of conceptual underpinnings of the most widely used techniques and models*. A major emphasis is placed on the critical use of simple calculations and observations to test working hypotheses about water, sediment, and nutrient flows though watersheds.

Learning Goals:

By the end of the course, students will be able to:

1) WATERSHED PROCESSES:
Articulate the main watershed processes controlling the fluxes of water, sediment, and chemicals, and how those processes are affected by human activities.

2) QUANTITATIVE ANALYSIS:
Use mathematical models to identify important watershed processes and to critically estimate their approximate magnitudes.

3) TECHNICAL APPLICATIONS:
Critically use GIS and geospatial data in watershed analysis.

4) WRITING AND RESEARCH
a. Articulate and address a clear research question
b. Find and summarize scientific literature.
c. Write insightful, clear summaries using scientific writing style.
d. Present the results of a watershed analysis in a classroom.

Activities and Grading:

Problem sets	40%
In-class participation	15%
Final Presentation	10%
Research project	
Proposal (1 page)	5%
First draft	13%
Peer review	2%
Final report	15%

Homework assignments: The will be five homework assignments designed to familiarize the student with tools for watershed analysis. Some HW will require use of GIS and computing facilities. All students will have a student account.

Field trips: there will be at least two required field trips to Los Penasquitos Watershed. Times and dates TBA depending on student schedules.

Computer labs: Some assignments will require use of the computer labs.
Fridays are reserved for computer-based exercises in the Spatial Analysis Laboratory (SAL, Storm Hall Room 338). These lab days will be announced in class.

In-class participation: This includes both participation in-class and student-led discussions of the readings for each week. Each student will be responsible for facilitating discussions of the readings twice during the semester.

Final report: The culminating activity of the course is a comprehensive analysis of a problem in a watershed of the student's choosing. The paper will pose and address a question of interest to the student related to watershed analysis. Key data gaps and uncertainties will be identified, along with prescriptions for constraining remaining uncertainties. At least ten references from the peer-reviewed literature must be included in the report to provide context for the study, no more than three from the class reading list. Examples of term projects could include:

"Pathogen contamination in southern California watersheds"
"Storm runoff from urbanization in southern California"
"Channel condition and fish habitat in a San Diego watershed"
"303d-listed watersheds in San Diego"
"Effects of fire on runoff and water quality: Modeling and uncertainty"
"Sediment production from urbanized surfaces: San Diego and Tijuana"

For more ideas, see the list of class projects from another course at:
http://www.ce.utexas.edu/prof/maidment/tmpaper/spring97/project.html

Plagiarism and cheating: Copying from either printed material or another student's work without proper citation, for either term papers or homework assignments, will be considered plagiarism, and will result in a zero for the assignment. Any doubts about what constitutes plagiarism can be clarified through the instructor.

TENTATIVE SCHEDULE AND READINGS

Wk	Date	Topic	Readings
0	Jan 23	Introduction to course; the sprit of WA	
1	Jan 26-30	Watershed structure and delineation	Montgomery et al (1995) pp 371-384 Reid (1998) pp. 476-485 LPW pp 1-5
2	Feb 2-6	HYDROL 1: Precipitation	EH pp. 29-51
3	Feb 9-13	HYDROL 2: Runoff processes, infiltration, SCS	**HW #1 DUE 2/11** EH55-73, 119-123,132-5, 303-4 Onda (2008); White (2006)
4	Feb 16-20	HYDROL 3: Evaporation, soil moisture, vegetation and water yield	LPW 74-77 EW 83-90, 304-305 Hibbert (1983)
5	Feb 23-27	HYDROL 4: Stream discharge, floods	**HW #2 DUE 2/25** EH 125-131, 135-149, 152, (GRADS 207-212)
6	Mar 2-6	SED 1: Erosion; USLE	EH 255-270 Trimble (2000) Inman (1999) LPW pp 77-78
7	Mar 9-13	SED 2: Sediment budgets; urbanization and sediment production	**HW #3 DUE 3/11** EH 272-289 Trimble (1997); Wolman (1967)
8	Mar 16-20	SED 3: Channels, Stream restoration	**PROPOSAL DUE** EH 161-7, 170-4, 177-206 Kondolf (2001)
9	Mar 23-27	WATER QUALITY 1: Dissolved oxygen and nutrients	**HW #4 DUE 3/25** Novotny pp 1-22, 34-41 LPW pp 66-78 McPherson (2002)
	Mar30-Ap3	SPRING BREAK	
10	Apr 6-10	WATER QUALITY 2: Heavy metals, toxics, pathogens	Dwight (2002) Curriero (2001) **PROJECT DRAFT 4/10**
11	Apr 13-17	WATER QUALITY 3 : TMDLs	
12	Apr 20-24	HABITAT 1	**HW #5 DUE 4/22** EH 167-9; LPW 29-48 Greer and Stow (2003)
13	Apr27-May1	HABITAT 2	LPW Appendix B Riley et al (2005) Callaway (2004)
14	May 4-8	HABITAT 3	Nordby and Zedler (1991)
15	May 11-13	Presentations	**HW #6 DUE 5/18** **FINAL DRAFT MAY 20**

* HMW = Enviromental Hydrology; LPW = Los Penasquitos Watershed Management Plan

Readings (additional readings will be handed out in class):

TEXT: Environmental Hydrology, 2^{nd} Ed. Ward and Trimble. 2004, CRC Press.

Recommended but not required: Dunne and Leopold, 1978, Water in Environmental Planning.

ARTICLES, IN ORDER OF APPEARANCE: (all will be posted on Blackboard):

Montgomery, D.R., Grant, G.E., Sullivan, K., 1995. Watershed analysis as a framework for implementing ecosystem management. Water Resources Bulletin 31, 369-386.

Reid, L. M. (1998), Chapter 19. Cumulative watershed effects and watershed analysis, in *River Ecology and Management: Lessons from the Pacific Coastal Ecoregion*, edited by R. J. Naiman and R. E. Bilby, pp. 476-501, Springer-Verlag, N.Y.

Onda, Y., W. E. Dietrich, and F. Booker (2008), Evolution of overland flow after a severe forest fire, Point Reyes, California, *Catena*, *72*(1), 13-20.

White, M.D. and Greer, K.A., 2006. The effects of watershed urbanization on the stream hydrology and riparian vegetation of Los Peñasquitos Creek, California. Landscape and Urban Planning, 74: 125-138.

Hibbert, A. R. (1983), Water yield improvement potential by vegetation management on western rangelands, *Journal of the American Water Resources Association*, *19*(3), 375-381.

Trimble SW & Crosson P (2000) U.S. Soil Erosion Rates--Myth and Reality. Science 289: 248-250.

Inman, D., and S. Jenkins (1999), Climate Change and the Episodicity of Sediment Flux of Small California Rivers, *The Journal of Geology*, *107*.

Trimble, S.W., 1997. Contribution of Stream Channel Erosion to Sediment Yield from an Urbanizing Watershed, *Science*, 278(5342): 1442-1444.

Wolman, M. G. (1967), A cycle of sedimentation and erosion in urban river channels, *Geografiska Annaler*, *49A*, 385–395.

Kondolf, G. M., M. W. Smeltzer, and S. F. Railsback (2001), Design and Performance of a Channel Reconstruction Project in a Coastal California Gravel-Bed Stream, *Environmental Management*, *28*(6), 761-776.

McPherson, T., S. Burian, H. Turin, M. Stenstrom, and I. Suffet (2002), Comparison of the pollutant loads in dry and wet weather runoff in a southern California urban watershed *Water Science & Technology 45*, 255-261.

Dwight, R. H., J. C. Semenza, D. B. Baker, and B. H. Olson (2002), Association of Urban Runoff with Coastal Water Quality in Orange County, California, *Water Environment Research*, *74*, 82-90.

Curriero, F. C., J. A. Patz, J. B. Rose, and S. Lele (2001), The Association Between Extreme Precipitation and Waterborne Disease Outbreaks in the United States, 1948-1994, *Am J Public Health*, *91*(8), 1194-1199.

Riley, S. P. D., G. T. Busteed, L. B. Kats, T. L. Vandergon, L. F. S. Lee, R. G. Dagit, J. L. Kerby, R. N. Fisher, and R. M. Sauvajot (2005), Effects of Urbanization on the Distribution and Abundance of Amphibians and Invasive Species in Southern California Streams, *Conservation Biology*, *19*(6), 1894-1907.

Callaway, J. C., and J. B. Zedler (2004), Restoration of urban salt marshes: Lessons from southern California, *Urban Ecosystems*, *7*(2), 107-124.

Other article possibilities:

Finkenbine, J.K., Atwater, J.W., Mavinic, D.S., 2000. STREAM HEALTH AFTER URBANIZATION. Journal of the American Water Resources Association 36, 1149-1160.

Nordby, C. and Zedler, J., 1991. Responses of fish and macrobenthic assemblages to hydrologic disturbances in Tijuana Estuary and Los Peñasquitos Lagoon, California. Estuaries and Coasts, 14(1): 80-93.

Barnett, Potential impacts of climate change on water resources in snow-dominated regions, Science.