FOREST AND WETLAND HYDROLOGY — 2020

NRC 528 (3 credits)
SPIRE #: 64277
Remote Instruction (*Zoom*)
MWF, 11:15-12:05 pm
Course website on *Moodle*

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Summary

This graduate-level course focuses on water movement through forest and wetland ecosystems. The water balance and the energy balance are used as the analytical frameworks for the exploration of hydrologic processes. The effects of land and natural resource use on the quantity, timing, and quality of water flow—and consequent watershed management challenges and opportunities—are also presented and discussed.

Required Book – de la Crétaz, A.L., and P.K. Barten., 2007. *Land Use Effects on Streamflow and Water Quality in the Northeastern United States.* Taylor & Francis/CRC Press, Boca Raton, FL, 319 pp. (Electronic copy in the UMass Library Collection)

Intended Audience

Seniors and graduate students in the Department of Environmental Conservation are the primary intended audience for this course. Other qualified students may enroll with my permission and assistance, if space is available. The enrollment capacity is 20; this reflects the substantial amount of one-on-one mentoring, review and grading needed to effectively deliver this course without a graduate teaching assistant.

Preparation and Expectations

Hydrology and watershed management build upon interdisciplinary training in plant biology, ecology, geology, general physics, and soil science. Part 1 (Chapters 1-5) of de la Crétaz and Barten (2007) provides background information on hydrology, environmental chemistry, aquatic ecosystems, and riparian areas that will be helpful to students who have a strong interest in this course but lack some of the background and core scientific training. Reading assignments, lectures, discussions, and the term project are based on the expectation that students have successfully completed college-level mathematics (pre-calculus), basic statistics, biology, chemistry, and ecology and are proficient with Microsoft Excel (…or can, with my help, quickly reach an intermediate level of proficiency for detailed calculations and scientific graphics). I am reluctant to add a long list of prerequisites in SPIRE that would automatically exclude some highly motivated prospective students. If, however, you are concerned about your preparation for NRC 528 please contact me before the end of the ADD/DROP period. As the semester progresses please be proactive in conservatively budgeting time and seeking my help with the term project. Simply put, do not you wait until a few days before the due date.

Here is a symbolic and visual representation of the entire course[1]

Law of Conservation of Mass and Energy: ΣInflows - ΣOutflows $\pm\Delta$ Storage = 0

Water Balance Equation: P - ET - Q $\pm\Delta$ S = 0

P = precipitation, ET = evapotranspiration, Q = water yield, S = storage

$$P - (E + T + I) - (Q_{OF} + Q_{SSF} + Q_{GW}) \pm\Delta (S_{SNOW} + S_{SOIL} + S_{WETLANDS} + S_{LAKES} + S_{STREAMS} + S_{BIOMASS}) = 0$$

Water Balance = *f* (Energy Balance, time, terrain, land use, legacy effects, climate, etc., etc.)

[1] A "water year" (beginning and ending in March) starting from the upper left and proceeding, typewriter fashion, to the lower right, 365 days later — looking from forested uplands across a wetland to an open field about 200 meters away.

NRC 528: Forest and Wetland Hydrology – Fall 2020 Schedule

Week	Day	Date	Session Topic	READ	Project Report DUE
1	M	24 Aug	Introduction, overview, course design, professional development goals	Ch. 1	
	W	26 Aug	Key concepts: variability and probability of occurrence		
	F	28 Aug	The water balance, water year, and annual hydrograph (and climatograph)		
2	M	31 Aug	*Term Project Part 1 (Unit conversions and precipitation classification)*		
	W	2 Sep	The energy balance and energy exchange processes		
	F	4 Sep	• Solar radiation		
3	M	7 Sep	• Latent heat flux, advection, convection, conduction		
	W	9 Sep	Precipitation: storm types, intensity, hydrologic effects		
	F	**11 Sep**	Snow		**Part 1**
4	M	14 Sep	*Term Project Part 2 (modeling snow accumulation and melt)*	Ch. 2	
	W	16 Sep	Snow		
	F	18 Sep	Water movement through soils—physical and hydraulic properties		
5	M	21 Sep	• Soil water potential [energy] and hydraulic gradients		
	W	23 Sep	• Permeability and Darcy's Law		
	F	25 Sep	• Infiltration, soil compaction, heat flow		
6	M	28 Sep	Interception		
	W	**30 Sep**	Soil-Plant-Atmosphere Continuum and evapotranspiration		**Part 2**
	F	2 Oct	*Term Project Part 3 (Estimating potential evapotranspiration and AET)*	Ch. 3	
7	M	5 Oct	Streamflow generation – pathways and relative rates of flow		
	W	7 Oct	Variable source area concept – old water/new water		
	F	9 Oct	Wetland hydrology – unique features and functions		
8	M	12 Oct	Wetland hydrology – inflow-storage-outflow regime, stormflow routing		
	W	14 Oct	Wetland hydrology – vernal pools and ephemeral ecosystems		
	F	16 Oct	Riparian areas	Ch. 5	
9	M	19 Oct	Aquatic ecosystems and the River Continuum Concept	Ch. 4	
	W	21 Oct	Open channel hydraulics (the physics of flowing water)		
	F	**23 Oct**	Manning's equation for open channel flow		**Part 3**
10	M	26 Oct	*Term Project Part 4 (Climatograph, water year narrative, HRV of streamflow)*		
	W	28 Oct	Forest management and natural disturbance effects	Ch. 6	
	F	30 Oct	Forest/wetland conversion to agriculture effects	Ch. 7	
11	M	2 Nov	Forest/wetland conversion to suburban and urban land uses	Ch. 8	
	W	4 Nov	Mixed land use and cumulative effects	Ch. 9	
	F	6 Nov	Land use effects workshop – Part 1		
12	M	**9 Nov**	Land use effects workshop – Part 2		**Part 4**
	W	11 Nov	*Term Project Part 5 (Final report preparation)*		
	F	13 Nov	NASEM 2004 Atlantic Salmon in Maine	Summary	NASEM reports, Moodle
13	M	16 Nov	NASEM 2008 Hydrologic Effects of the Changing Forest Landscape	Summary	
	W	18 Nov	NASEM 2020 Review of New York City Watershed Protection Program	Summary	
	F	20 Nov	Conclusions and watershed management implications	Ch. 10	
26 Nov (Thanksgiving Day) — 27-28 Nov (Reading Days) — 30 Nov to 4 Dec (Final Exams)					
On or before, W 2 Dec			Early submission of Term Project final report (10% extra credit)		**Part 5**
Not later than W 9 Dec			**Final due date** of Term Project final report. (Grades are due by NLT 14 Dec)		

Term Project Hydrometeorological Analysis and Interpretation	**Due date**
Part 1: Set-up, temperature and precipitation calculations …scientific graphing	**11 Sep**
Part 2: Snow accumulation and melt, streamflow, and hydrologic response ratio	**30 Sep**
Part 3: Evapotranspiration calculations (PET and est. AET)	**23 Oct**
Part 4: Climatograph and comparison to other water years (driest, wettest, and another mean year of record)	**9 Nov**
Part 5: Final figures and table, revised discussion and interpretation + xls file	**NLT 9 Dec**

What former students have to share with you about the term project…

"Many aspects of your time at UMass are intended to prepare you to become a member of the professional workforce. While leaving school with a high GPA is obviously helpful in indicating your qualifications and preparedness to a potential employer, even more so is leaving with a concrete example of the quality and breadth of technical work and professional writing you are able to do. Immediately after graduation, I started a job as a Park Ranger with the MA Department of Conservation and Recreation. I had little relevant work experience, but with my application I attached my term project report for Forest and Wetland Hydrology. It demonstrated to the people hiring me that I was able to produce high quality, well-researched, thorough work, beyond what the other candidates had provided. It was instrumental in landing the job. The format and timeline of this project is an accurate and useful representation of the type of work that will be expected of any student interested in entering the field of environmental science and management, and the inclusion of it in the Forest and Wetland Hydrology course was invaluable for preparing me to become a professional in the field."
Charlotte Axthlem, BS Psychology (with NRC minor), MS (July 2019) in wetlands, hydrology, and soil science

"Even as a student outside of the Department of Environmental Conservation, Forest and Wetland Hydrology was one of the most useful classes I took at UMass. The report is worth the hours of work for the Excel practice alone – hardly a day goes by at my job when I don't open up the program. After graduation, I accepted a position as a landscape architect with an engineering firm specializing in water and transportation. Along with my portfolio and resume, I brought a bound copy of my report for this class and my interviewers were beyond impressed. Without even reading it, the report *looks* impressive (so make sure you spend time on your graphics!) and it proves to your potential employer that UMass has taught you skills that you will actually be using in your day-to-day life as a professional."
Rachel Guilfoil, BLA (with NRC minor), May 2018 …Landscape Designer, Water Services Group, CDM Smith, Boston (https://www.cdmsmith.com/en)

"I have referred back to this project and report several times throughout the past year to complete work for other classes. It also landed me the interview and an internship with MassDEP. They asked for a writing sample with the application packet. The exact words of the Section Chief who conducted the interview were …"Very impressive, it's why you're here. I honestly can't say enough good things about that NRC 528 term project. It was challenging and I had a love/hate relationship with it at times. However, I can definitely say it's one of the most valuable experiences I've had in grad school."
Dorothy Lawrence, Master of Regional Planning and MS3, May 2019

"I cannot recall the last time I updated you on my post-graduation life, but I have spent the last year and half working with the U.S. EPA down in Florida at the Gulf Ecosystem Measurement and Modeling Division. I am a research assistant, working primarily on projects related to characterizing social environments, with the team that developed EPA's Human Well-Being Index. My supervisor loves a good excel document and I really cannot express enough how important the lessons in Excel best practices from your Forest Hydrology course have been for me in this job."
David Ferguson, BS Environmental Science, Minors in NRC and Geography, NAIS Certificate

Attendance Policy: Reasonable, case-by-case exceptions will be made for illnesses, family emergencies, or UMass athletic team members. The Health Center, Office of Student Affairs, or Athletic Department can provide documentation for excused absences. **I take attendance at the beginning of every class.** You are responsible for keeping me informed, in advance if possible, about absences and to complete required work by watching the recorded sessions and taking the initiative to follow up with me as needed.

Course Grade = ((# sessions - # unexcused absences)/# sessions)*100) * 0.1)
+ (Term Project final grade * 0.9)

Letter grade	Point total
A	>92.5
A-	90 – 92.4
B+	87.5 – 89.9
B	82.5 – 87.4
B-	80 – 82.4
C+	77.5 – 79.9
C	72.5 – 77.4
C-	70 – 72.4
D	60 – 69.9
F	<60

Incomplete Policy – An incomplete (INC) will be submitted if, *and only if*, the student has a documented medical absence (Health Plan) or family emergency (Dean of Student Affairs) during the semester as described in the UMass Amherst attendance policy. In all other cases, the course grade will be calculated as noted above from the work that has been submitted by the last due date (17 Dec).
For 64 pages of detail go to: http://www.umass.edu/registrar/sites/default/files/academicregs.pdf

Statement on Academic Honesty – It is expected that all students will abide by the UMass Amherst Academic Honesty Policy (available online at www.umass.edu/dean_students/codeofconduct/acadhonesty) . Sanctions for acts of dishonesty range from receiving a grade of F on the paper/exam/assignment or in the course, loss of funding, being placed on probation or suspension for a period of time, or being dismissed from the University. All students have the right of appeal through the Academic Honesty Board.

This is not a prohibition on working and learning together with fellow students. It is simply a reminder that all submitted work must ultimately be your own, with appropriate attribution of reference material and data sources. Specifically, **you must develop your own spreadsheet for the term project**, including all of its component parts (data, formulae, and graphs), as well as the four interim reports and the final term project report.