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GEO 460.01: Process Geomorphology

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Geosciences 460: Process Geomorphology

Spring 2015
University of Montana
4 credits

Instructors:
Sharon Bywater-Reyes Office: CHCB 316
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Office Hours: TR 4-5 PM, or by appointment

Rebecca Manners Office: CHCB 355
email: rebecca.manners@umontana.edu
Office Hours: TW 2-3 PM (during RM lecture weeks), or by appointment

Class Meetings: TR 9:10 –11 AM, CHCB 348

Process Geomorphology will provide an in-depth investigation of the processes that determine the form and evolution of landscapes, starting with tectonic geomorphology and then focusing on hillslopes, rivers, and glaciers. The course will combine lectures, discussions, field data collection, calculations, and other activities. Active learning and student participation will be an essential component.

Course Objectives:
To provide students with

- a strong understanding of the linkages between landscape form and process
- familiarity and experience applying fundamental concepts in physical systems
- experience collecting and analyzing field data
- opportunities for developing scientific writing skills
- opportunities to develop and apply skills in physics and mathematics
- experience in interpreting and analyzing literature from both secondary and primary sources
- practice in using models, data, and logical reasoning to critically evaluate and connect information about geomorphic processes
- experience communicating an understanding of the interrelationships among geomorphic concepts and theories to peers and others
- experience working as members of productive, collaborative teams

Course Website:
This course will use Moodle (https://umonline.mrooms3.net/login/index.php). Please check Moodle regularly, especially before class, for course announcements, notes, and assignments. Some of the class lecture notes will be posted.

Course Evaluation:

30% In-class and lab exercises, other homework, class participation, quizzes
40% Field project reports
10% Midterm
20% Final exam

Graduate Student Increment:

To receive graduate credit for this course, graduate students will be required to

1) Answer 1-2 questions on the mid-term and final exam that differ from those provided to the undergraduate students and require graduate students to further synthesize geomorphic concepts.
2) Include a more thorough review of the literature in lab/project write-ups than is expected for undergraduate students. Specific details will be provided with the associated instructions.

Field trips:

The field trips are required. The data collected on these field trips will be the basis for much of your work in this class. See me right away if you have scheduling conflict. You will need a field book, so purchase one now if you don't have one.

- March 14: hillslope processes field trip
- April 12: fluvial processes field trip
- There may be a 3rd field trip

Readings:

We will use the following textbook:

Anderson, R.S. and Anderson, S.P., 2010. *Geomorphology: The Mechanics and Chemistry of Landscapes*. Cambridge University Press, Cambridge, UK, 637 pp.

It is challenging, very good, and essential to your learning in the course, so we encourage you to devote more time and attention to it than you normally might for textbooks. Journal papers and supplemental readings will also be assigned.

Other notes:

1. *Prerequisites*: One semester calculus and one semester physics are firm prerequisites. Calculus and physics will be used in the class. Computer literacy is also expected; assignments will be given involving computations, the use of spreadsheets and retrieval of data over the internet. The most important requirement is to be prepared to devote time and effort to this class (We will too).
2. *Attendance*: Much of the material covered in class will not be in the assigned reading. There will often be in-class activities that contribute to your grade. All exams are open note, so taking good and organized notes will be beneficial.
3. *Email*. Feel free to communicate with us by email, keeping the following in mind: 1) if you are stuck on an assignment question, please come to office hours or ask questions at the beginning of class rather than emailing me; 2) if you miss class, please check Moodle and/or talk to classmates about what you missed; 3) assignments submitted electronically

must be well organized, consolidated into at most two files, and have your name in the file name; 4) use your UM email account and/or email via Moodle.

4. *Late policy*: 1 assignment can be handed in late without penalty, reason, or prior communication. Otherwise 2% of total points are deducted per day late. No credit allowed for assignments handed in > 1 week after due date or after answer key posted, whichever comes first.
5. *Academic Integrity:* All students need to be familiar with and abide by the Student Conduct Code and its definitions of academic misconduct. The Code is available for review online at http://life.umt.edu/vpsa/documents/StudentConductCode1.pdf.
6. *Equal Access*: The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students (DSS). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson 154. We will work with you and DSS to provide an appropriate accommodation.

Course schedule:

- *Class meeting topics are subject to change*
- Readings must be completed before class on the day listed
- Any updates to the syllabus will be announced in class and posted on Moodle
- Supplemental readings from journal papers and other sources will be assigned

Week	Date	Inst.	Class meeting topic	Textbook reading
1	1/27	RM	Introduction	A&A 1
	1/29	RM	Introduction continued; Lab 1: Landscape attributes and metrics	
2	2/3	SBR	Large-scale geomorphology	A&A 2,3
	2/5	SBR	Tectonic geomorphology	
3	2/10	SBR	Tectonics & climate	A&A 4,5 (96-106, 113-117)
	2/12	SBR	Lab2: Intro to ArcGIS	
4	2/17	RM	Glacial processes: intro, mass balance	A&A 8
	2/19	RM	Glacial processes: mass balance, flow mechanics	
5	2/24	RM	Glacial processes: erosion, landforms	A&A 8
	2/26	RM	Glacial processes: glaciers & climate, jokulhlaups, glacial hydrology	
6	3/3	SBR	Weathering	A&A 7
	3/5	SBR	Sediment budgets Lab 3: Surveying, GPS, GIS	
7	3/10	SBR	Landslides & debris flows	A&A 10
	3/12	SBR	Landslide mechanics *Midterm*	
Saturday, March 14: Field trip (hillslope processes)				
8	3/17	SBR	Slope stability	A&A 10
	3/19	SBR	Hillslope processes wrap-up; (maybe) Lab 4	
9	3/24	RM	Water in the landscape; Channel networks and drainage basins	A&A 11
	3/26	RM	Hillslope hydrology	
10	4/7	RM	Fluvial processes: alluvial rivers	A&A 12,14
	4/9	RM	Fluvial processes: flow and sediment transport *Field project 1 reports due*	
Sunday, April 12: Field trip (fluvial processes)				
11	4/14	RM	Fluvial processes: Hydraulic geometry, channel patterns, long profiles	A&A 12,14
	4/16	RM	Fluvial processes: floods, dominant Q, channel adjustments, classification	
12	4/21	RM	Megafloods, Glacial Lake Missoula, Dating methods	A&A 17, 6, 9
	4/23	RM	Climate change & geomorphology	
13	4/28	SBR	Biotic effects on geomorphic processes *Field project 2 reports due*	TBA
	4/30	SBR	Ecogeomorphology, applications	
14	5/5	SBR	Human effects on geomorphic processes	TBA
	5/7	SBR	Course wrap-up	
15	5/12, *8-10 am*		*Final exam*	

Journal papers

Dietrich, W.E., Bellugi, D.G., Sklar, L.S., Stock, J.D., Heimsath, A.M. and Roering, J.J., 2003. Geomorphic transport laws for predicting landscape form and dynamics. In: P.R. Wilcock and R.M. Iverson (Editors), *Prediction in Geomorphology*. American Geophysical Union, Washington D.C., pp. 103-132.

Dietrich, W.E. and Perron, J.T., 2006. The search for a topographic signature of life. *Nature* 439(7075): 411-418.

Egholm, D.L., Nielsen, S.B., Pedersen, V.K. and Lesemann, J.E., 2009. Glacial effects limiting mountain height. *Nature*, 460(7257): 884-887.

Gabet, E. J., and A. Bookter (2008), A morphometric analysis of gullies scoured by post-fire progressively bulked debris flows in southwest Montana, USA, *Geomorphology*, *96*(3-4), 298-309.

Kirchner, J.W. 2002. Subtleties of sand reveal how mountains crumble. *Science* 295: 256-258.

Montgomery, D.R. and J.M. Buffington. 1997. Channel reach morphology in mountain drainage basins. *GSA Bulletin* 109.

Montgomery, D.R. 2007. Is agriculture eroding civilization's foundation? *GSA Today* 17(10): 4-9.

Naylor, S. and Gabet, E.J.. 2007. Valley asymmetry and glacial vs. non-glacial erosion in the Bitterroot Range, Montana, USA. *Geology* 35(4): 375-378.

Pedersen, V.L. and D.K. Egholm. 2013 Glaciations in response to climate variations preconditioned by evolving topography. *Nature* 403: 206-210.
Brocklehurst, S.H. 2013. How glaciers grow. *Nature* 493:173-174. (comment on Pederson & Egholm)

Perron, J.T., Kirchner, J.W. and Dietrich, W.E., 2009. Formation of evenly spaced ridges and valleys. *Nature*, 460(7254): 502-505.

Pinter, N. and M.T. Brandon. 1997. How erosion builds mountains. *Scientific American*. April: 74-79.

Strogatz, S. 2010. Change we can believe in. New York Times. http://opinionator.blogs.nytimes.com/2010/04/11/change-we-can-believe-in/

Trush, W.J., S. M. McBain, and L. B. Leopold. 2000. Attributes of an alluvial river and their relation to water policy and management. *Proceedings of the National Academy of Sciences* 97: 11858-11863.