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GEO 460.01: Process Geomorphology

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Geosciences 460: Process Geomorphology Fall 2018

Course Information

- Instructors: Andrew Wilcox — Luke Fisher (Teaching Assistant)
- Office: CHCB 357 — CHCB 338
- Email: andrew.wilcox@umontana.edu — luke.fisher@umconnect.umt.edu
- Office Hours: M 3-4 pm, or by appointment — W 11–12
- Class meetings: TR 9-10:50, CHCB 348
- Website: Moodle umonline.umt.edu

Overview

Process Geomorphology will provide an in-depth investigation of the processes that determine the form and evolution of landscapes, starting with rivers and then focusing on hillslopes, glaciers, and tectonic geomorphology. 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

Assessment

30% Lab exercises
30% Field project reports
15% In-class exercises and class participation
25% Exam

Course Information, Guidelines and Policies

Field Trips

We will have one required Saturday field trip, October 27 (all day), in addition to in-class field trips and a self-guided, team field project. The data collected on these field trips will be the basis for a substantial amount of your work in this class.

Labs

There is no formal lab for this class, but we will do some lab and field activities during class time; these will provide active-learning opportunities and will often take time beyond the regular class time to

complete. Topics will include GIS and Python analysis of geomorphic processes and high-resolution topography.

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 (I will too).

Attendance

In addition to lab exercises, there will often be short in-class activities that contribute to your grade. All exams are open note, so taking good and organized notes will be beneficial. If you miss class, it is your responsibility to find out what you missed, which should involve consulting the course website and your peers (rather than the instructor).

Readings

There is no *required* textbook. Readings will primarily consist of journal papers. An excellent, challenging textbook that I recommend, if you wish to have a textbook resource to refer to and to develop a deeper understanding of the topics we will treat, is:

Anderson, R.S. and Anderson, S.P., 2010. *Geomorphology: The Mechanics and Chemistry of Landscapes*. Cambridge University Press, Cambridge, UK, 637 pp. (*We will read the first chapter as an introduction to course content and concepts; posted on Moodle*)

A more accessible textbook that I also recommend is:

Bierman, P.R. and D.R. Montgomery, 2014, Key Concepts in Geomorphology. W.H. Freeman and Co.
Cheapest option is e-book rental ($27.99 for semester):
https://store.macmillanlearning.com/us/product/Key-Concepts-in-Geomorphology/p/1429238607
For e-book or paperback purchase, cheapest option is Amazon:
https://www.amazon.com/Key-Concepts-Geomorphology-Paul-Bierman-ebook/dp/B00UY1TEBG/ref=mt_kindle?_encoding=UTF8&me=

Journal papers and supplemental readings will also be assigned each week, *with occasional quizzes on readings*. A partial / example list of journal papers is as follows:

Brown, A.G. et al. 2016. The geomorphology of the Anthropocene: Emergence, status, and implications. Earth Surface Processes & Landforms.

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.

Granger, D.E. and M. Schaller. 2014. Cosmogenic Nuclides and Erosion at the Watershed Scale. Elements 10: 369 – 373.
Greensfelder, L. 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.
Passalacqua, P. et al. 2015. Analyzing high resolution topography for advancing the understanding of mass and energy transfer through landscapes: A review. Earth Science Reviews 148: 174 – 193.
Pinter, N. and M.T. Brandon. 1997. How erosion builds mountains. *Scientific American*. April: 74-79.
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.
von Blanckenburg, F. and J.K. Willenbring. 2014. Cosmogenic Nuclides: Dates and Rates of Earth-Surface Change. Elements 10: 341 – 346.

Course website

Please check Moodle regularly, especially before class, for announcements, notes, readings, assignments, and schedule updates. Some of the class lecture notes will be posted.

Email

Feel free to communicate with me by email, and note that: 1) I'm likely to read your email fairly soon after I receive it but I may not respond immediately; 2) if you have questions that others are also likely to have, please save them for class; 3) if you need to miss class for any reason, please let me know in advance by email; 4) assignments submitted electronically must be well organized, consolidated into at most 2 files, and contain your last name in the file name (often I will have you submit these via Moodle).

Late Policy

Assignments handed in late will have 2% of total points are deducted per day late (starting at the time when the assignment is due). But, for assignments other than the 2 primary field projects, you get 1 "mulligan": 1 assignment can be handed in late without penalty, reason, or prior communication, up to 1 week after due date. No credit allowed for assignments handed in > 1 week after due date or after answer key / grading rubric posted, whichever comes first.

Student Conduct Code

The Student Conduct Code at the University of Montana embodies and promotes honesty, integrity, accountability, rights, and responsibilities associated with constructive citizenship in our academic community. This Code describes expected standards of behavior for all students, including academic conduct and general conduct, and it outlines students' rights, responsibilities, and the campus processes for adjudicating alleged violations. A link to the Code is here: http://www.umt.edu/student-affairs/dean-of-students/default.php

Course Withdrawal

Students may use Cyberbear to drop courses through the first 15 instructional days of the semester. Beginning the 16th instructional day of the semester through the 45th instructional day, students use paper forms to drop, add and make changes of section, grading option or credit. GEO460 may not be taken as credit/no-credit.

Disability Modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Schedule (next page)

- Class meeting topics are subject to change
- The readings listed below are a partial list. Readings will be announced each week (and posted on Moodle) and must be completed before the following class.
- Updates to the syllabus will be announced in class and posted on Moodle

Week	Date	Class meeting topic	Reading
1	28-Aug	Introduction	A&A 1
	30-Aug	Introduction continued; Lab exercise	
2	4-Sep	Fluvial processes: alluvial rivers	Montgomery & Buffington 1997
	6-Sep	Fluvial processes: flow and sediment transport; Lab exercise	
3	11-Sep	Fluvial processes: flow and sediment transport	Dietrich et al. 2003
	13-Sep	Fluvial processes: Hydraulic geometry, channel patterns, long profiles; possible in-class field exercise	
4	18-Sep	Fluvial processes: floods, dominant Q, channel adjustments, classification	Trush et al. 2000
	20-Sep	Fluvial processes wrap-up	
5	25-Sep	Water in the landscape; Channel networks and drainage basins, hillslope hydrology	
	27-Sep	Fluvial processes: flow and sediment transport; Lab exercise	
6	2-Oct	Sediment budgets	Dietrich et al. 2003 Montgomery 2007
	4-Oct	Landslides & debris flows	
7	9-Oct	Landslide mechanics	
	11-Oct	Hillslope erosion / transport laws	
8	16-Oct	Slope stability	
	18-Oct	Slope stability; lab	
9	23-Oct	Hillslope processes wrap-up	Granger and Schaller 2014
	25-Oct	Large-scale geomorphology	
Saturday, October 27: Field trip (hillslope processes)			
10	30-Oct	Tectonic geomorphology	Pinter & Brandon 1997; Kirchner 2002; Molnar & England 1990
	1-Nov	Tectonic geomorphology	
11	6-Nov	Election Day, no class	Naylor & Gabet 2007
	8-Nov	Glacial processes: intro, mass balance, flow mechanics	
12	13-Nov	Glacial processes: erosion, landforms; Student presentations	Egholm et al. 2009
	15-Nov	Glacial processes: glaciers & climate, jokulhlaups, glacial hydrology	
13	20-Nov	Megafloods, Glacial Lake Missoula, Dating methods	
	22-Nov	no class, Thanksgiving	
14	27-Nov	Climate change & geomorphology	Dietrich & Perron 2006
	29-Nov	Ecogeomorphology, restoration	
15	4-Dec	Human effects on geomorphic processes	Brown et al. 2016
	6-Dec	Course wrap-up	
16	12-Dec	Final exam, 10:10-12:10	