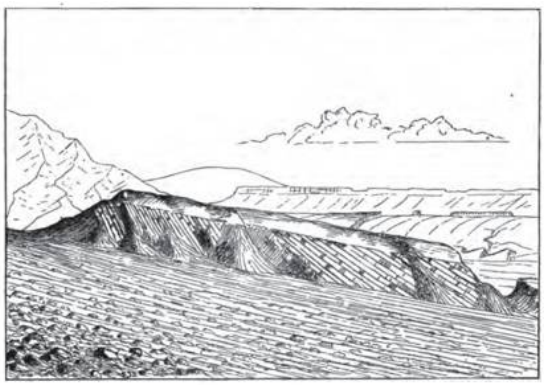
EAS 4205/6325: Geomorphology (4 credits)

Lecture
Wednesday + Friday 11:00 AM to 12:15 PM
Ford ES&T L1116

Lab
Friday 12:30 PM to 3:15 PM
Meet in Ford ES&T L1116

EAS 8001 GEO Surface Processes Seminar
(optional reading seminar on related topics)
Wednesday 2:00 PM to 3:00 PM
Ford ES&T 1221



A hill of planation
Report on the Geology of the Henry Mountains
G.K. Gilbert, 1877

Instructor
Dr. Karl A. Lang (Assistant Professor, he/him)
Office hour: Wednesday 12:30 PM to 1:30 PM
Please message via Canvas, not via email

Teaching Assistant
Srinanda Nath (PhD student, she/her)
Office hour: Thursday 10:00 AM to 11:00 AM

Description
A quantitative study of the processes shaping topography, including a survey of modern methods for measuring landscape change and an introduction to landscape evolution modelling. Study covers surface processes spanning more than 8 orders of magnitude in spatial and temporal scales, acting in tectonically active and inactive regions of Earth and other planets.

Goals
The goals for this course are to provide both an *intuitive* understanding of landscape evolution as well as the *quantitative* background to predict and measure landscape change. Quantitative aspects of this course also develop *practical* skills manipulating, interpreting, and modeling Digital Elevation Models (DEMs) in Matlab. The course includes opportunities for *field study* including geomorphic observation, measurement, interpretation, and peer-instruction. For students enrolled in EAS 6325, this course also serves as a robust introduction to the academic literature.

Prerequisites
A familiarity with calculus (including differential equations and vector calculus), physics (mechanics and thermodynamics), chemistry (introductory level with some analytical chemistry), and geology (EAS 2600, Structure, Earth History, Field Methods) will be helpful in this class – but are not strictly required. Prior experience with Matlab is desirable, but also not required. To gain additional computing and math background, consider co-enrolling with: EAS 8802 *Practical Computing and Math* with Prof. Robel and Prof. Ito. If you have questions or concerns about your preparation for this course, please reach out early in the semester.

Readings
Our textbook is *Geomorphology: The Mechanics and Chemistry of Landscapes* (2010) by Robert S. Anderson and Suzanne P. Anderson, published by Cambridge University Press (1st edition). All students should complete the assigned textbook readings prior to class. Students enrolled in EAS 6325 are also asked to read selections from the academic literature.

Final grading rubric
Your final grade will be evaluated based on lab exercises, field trips, and the Flat Earth Debate. I will use the following scale to calculate a final average grade: A = >90, B = 80-89, C = 70-79, D = 60-69, F = <60. I do not plan to offer opportunities for extra credit.

Lab exercises (60%, 10x 6% each)
Laboratory periods are designed to be instructor-assisted opportunities for you to work through exercises in Matlab at your own pace. Many exercises use TopoToolbox (https://topotoolbox.wordpress.com/). Some exercises will be outside (see schedule for details). Lab exercises are due one week from their assignment date, at the beginning of the lab period – except in the case of multi-week labs (4 and 5) which are due two weeks from the initial assignment date. Please see the lab exercise grading rubric for the late submission policy and further details. If you are struggling, *please* ask for help!

Required for EAS 6325: summary haikus of academic papers
An important part of graduate school is an introduction to the academic literature. To facilitate this, students enrolled in EAS 6325 as asked to read one academic paper each week (see schedule for list of papers). Please read the paper *prior* to it's assigned date. We will briefly discuss the paper at the beginning of each lab period, then you will write a haiku capturing the essence of the paper and submit the haiku *by the end of lab*. As a reminder, haikus have five syllables in the first line, seven syllables in the second line, and five syllables in the third line. Summaries will be anonymized and the class will vote on their favorite before the following lab period. The author of the most popular haiku will receive a rare and priceless prize. All students may submit haikus (even if enrolled in EAS 4205).

Field trips (20%, 10% each)
Two, Saturday field trips are required for this course. Each field trip includes a low-stakes, peer-reviewed assignment. Assignment rubrics are available on Canvas.

South River surveying (10/5, backup date 10/6)
During the fieldtrip you will collect data necessary to calculate river discharge. Your peers will review your notes and calculations.

Tallulah Falls field trip (10/19, backup date 10/26)
During the fieldtrip, you will each present on a bedrock erosion process. You will be provided with a medium-sized dry-erase board and colored dry-erase markers for illustration. Your peers will review your presentation.

Flat Earth Debate (20%)
In lieu of a final exam, we will have an Oxford-style debate contesting the biggest question in Geomorphology: *Is the Earth Flat?* To receive credit, you will read papers and summarize the main arguments from the proponent and opponent sides in a two-page document, then join the debate in a professional manner. The winner of the debate will receive a rare and priceless prize.

Course materials
Grades, labs, lecture slides and other course materials will be available on the Canvas course website. Please check the site regularly for announcements and schedule updates. Lab solutions will not be provided, but students can check individual answers with the instructor or TA.

How many years can a mountain exist, before it is washed to the sea?
Bob Dylan, 1963

Policies

Academic integrity
Instructors and students should follow the Georgia Tech Academic Honor Code: https://policylibrary.gatech.edu/student-affairs/academic-honor-code. You are encouraged to work together on lab exercises, but you must submit your own final version. Any violation of the honor code (e.g. plagiarism, cheating) will automatically earn a zero for the assignment.

Absences and Accommodations
Please obtain approval and provide documentation at least a week in advance of any absence. The Institute's absence policy is available here: www.catalog.gatech.edu/rules/4/. If you are a student with a documented short-term or permanent disability seeking accommodations in this course, please contact The Office of Disability Services: disabilityservices.gatech.edu (or by phone at 404-894-2563) for guidance and additional resources without disclosing your private information. Please provide as much advance notice as possible in requesting accommodations.

Mutual respect
It is my goal to foster an inclusive and collegial atmosphere that encourages intellectual discourse. To this end, I expect that you will behave in a professional, mature manner treating your peers with *the same respect you would expect from them*. This includes: addressing people with the name and pronoun of their choice, avoiding interruptions and overtalking, and apologizing when mistakes happen. Intentionally disrespectful behavior of any kind will not be tolerated. Please reach out to me, or another faculty member if you are uncomfortable with any part of the course. Remember that faculty are also considered mandatory reporters of any event that constitutes discrimination under the scope of Title IX (https://titleix.gatech.edu/). You may also report evidence for discrimination through the Ethics Reporting Hotline: 866-384-4277.

Additional Resources for academic and personal support

Center for Academic Success http://success.gatech.edu. 1-to-1 tutoring, peer-Led Undergraduate Study (PLUS) and academic coaching.OMED Educational Services http://omed.gatech.edu/programs/academic-support. Group study sessions and tutoring programs. The Office of the Dean of Students http://studentlife.gatech.edu/content/services or 404-894-6367, Smithgall Student Services Building 2nd floor. Counseling Center: http://counseling.gatech.edu or 404-894-2575, Smithgall Student Services Building 2nd floor. Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources. Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2204. Students' Temporary Assistance and Resources (STAR): http://studentlife.gatech.edu/content/need-help can assist with interview clothing, food, and housing needs. Stamps Health Services: https://health.gatech.edu; 404-894-1420 for primary care, pharmacy, women's health, psychiatry, immunization and allergy. OMED: Educational Services: http://www.omed.gatech.edu, Women's resources: http://www.womenscenter.gatech.edu; 404-385-0230. LGBTQIA resources: http://lgbtqia.gatech.edu/, 404-385-2679, Veteran's resources: http://veterans.gatech.edu/; 404-385-2067 and Georgia Tech police: https://police.gatech.edu/; 404-894-2500

And if you see my reflection in the snow-covered hills, well, the landslide will bring it down.
Stevie Nicks, 1975

DAY	DATE	TOPIC	TEXT	PAPERS
W	8/21	Introduction, climate drivers	Chp. 1, Chp. 5 (read later)	
F	8/23	Tectonic drivers: continental isostasy	Chp. 2, Chp. 3 to p. 43	
		Lab 1: Introducton to Matlab, DEMs, and TopoToolbox		**TopoToolbox cheat sheet**
W	8/28	Tectonic drivers: flexural isostasy	Remainder of Chp. 3, Chp. 4 from p. 86 to end	
F	8/30	Tectonic drivers: faulting and orogenesis	Chp. 4 to p. 86	
		Lab 2: Lithospheric flexure		**England and Molnar, 1990**
W	9/4	Chemical Weathering (recording)	Chp. 7 from p. 183 to end	
F	9/6	Physical Weathering (Dr. Reynolds)	Chp. 7 to p. 182	
		Lab 3: Diffusion (Dr. Reynolds)		**Anderson, 1998**
W	9/11	Hillslope processes	Chp. 10 to p. 330	
F	9/13	Mass wasting	Remainder of Chp. 10	
		Lab 4a: Sandbox diffusion (lab is outdoors)		**Heimsath et al., 1997**
W	9/18	Alluvial channels	Chp. 12 p. 395 to p. 409	
F	9/20	Flow Mechanics: open channel flow	Chp. 12 to p. 390	
		Lab 4b: Structure from Motion photogrammetry		**Westoby et al., 2012**
W	9/25	Flow Mechanics: boundary effects	Reread 9/20 if necessary	
F	9/27	Flow Mechanics: flow around a bend	Chp. 12 p. 391 to 395	
		Lab 5a: Optical surveying (lab is outdoors)		**Harrelson, 1994 (parts 5 and 6)**
W	10/2	Sediment transport: Initiation of motion	Chp. 14 to p. 461	
F	10/4	Sediment transport: transport modes	Remainder of Chp. 14	
		Lab 5b: GPS surveying (lab is outdoors)		**Harrelson, 1994 (part 10, skim the rest)**
S	*10/5*	*Surveying fieldtrip: South River*	*Harrelson, 1994 (parts 5, 6, and 10)*	
W	10/9	Floods	Chp. 17	
F	10/11	Bedrock erosion	Chp. 13 to p. 435	
		Lab 6: Bedrock channel profiles		**Hancock et al., 1998**
W	10/16	Knickpoints (remote or recording)	Remainder of Chp. 13	
F	10/18	Channel networks	Chp. 11 to p. 351	
		Lab 7: Slope/Area analysis		**Whipple and Tucker, 1999**
S	*10/19*	*Tallulah Falls fieldtrip*	*Hancock et al., 1998*	
W	10/23	Glacial erosion	Chp. 8 p. 245 to 257	
F	10/25	Glacial deposition	Chp. 8 p. 257 to end	
		Lab 8: Glacier goo		**Hallet et al., 1996**
W	10/30	Landscape evolution models: concepts	*Read for Flat Earth Debate PRO: Willenbring, 2013*	
F	11/1	Landscape evolution models: simulation	*Read for Flat Earth Debate PRO: Kirchner and Ferrier, 2013*	
		Lab 9: Landscape evolution modeling		**Tucker and Bras, 1998**
W	11/6	Measuring time in landscape evolution	*Read for Flat Earth Debate OPP: Warrick, 2014*	
F	11/8	Luminesence dating	*Read for Flat Earth Debate OPP: Larsen, 2014*	
		Lab 10: Radiometric dating		**Kirchner et al., 2001**
W	11/13	Cosmogenic radionuclides		
F	11/15	Low-temperature thermochronology (Dru-Ann Harris)		
		Laboratory tour (no exercise)		**Reiners et al., 2017 (your choice)**
W	11/20	*No lecture: time reserved for pre-debate prep + Q&A*		
F	11/22	**Flat Earth Debate + Award Ceremony**		
W	11/27	*No Class - Thanksgiving Holiday*		
F	11/29			