**Earth Sciences 33 / Geography 17.01: Earth Surface Processes and Landforms**

Spring 2022

**VERSION 1.0 – last updated 03/21/2022 – check for updates beyond this date**

**Instructor:** Joanmarie Del Vecchio, 204 Fairchild Hall, 646-2666

Email joanmarie@dartmouth.edu

Office hours: X hours or by appointment on <https://calendly.com/joanmarie_delvecchio>

**Teaching assistant:** Victoria Halvorson, 221 Fairchild Hall

Email: victoria.e.halvorson.gr@dartmouth.edu

Office hours: Mondays 2:00-3:30

**Class meeting time: Lectures**: Monday and Wednesday 3:30-5:20pm Fairchild 213

**X Hour**: Monday 5:30-6:20pm (used for office hours and *make up lectures – please keep available*)

**Labs**: Tuesday 3:30 – 5:20 pm Fairchild 217

**Class website:** <https://canvas.dartmouth.edu/courses/51725>

**Prerequisites:** Any Earth Sciences course numbered 1-9 (except 7); or Geography 3;

or permission of instructor.

**Textbook:** None – weekly readings from different texts, book, and journal articles

**Course description and objectives:**

This course provides an introduction to *earth surface processes and landforms* or *geomorphology* – the study of the processes that shape the Earth’s surface and the landforms and deposits that these processes produce. Geomorphologists must make observations of landscapes and then interpret those landscapes to understand how different processes work, determine a region’s history, and recognize the impacts that different processes can have societally. In this course, students will examine a range of geomorphic processes, including fluvial, glacial, hillslope, and eolian processes, as well as the resulting geomorphic landforms. In addition to the morphologic characteristics of landforms and landscapes, we will also address their sedimentological and stratigraphic characteristics. The processes we discuss are not confined to the Earth, and as such, we will also touch on surface processes on other planetary bodies as well.

This course is included among the *Core Methods* group of courses in the Earth Sciences curriculum.

Expected learning outcomes from this course include the following:

(1) List mechanisms of physical and chemical weathering; describe examples of weathering-induced landforms at small and large scales.

(2) Give examples of diffusive versus advective processes and how they affect hillslope morphology.

(3) Explain why understanding channels and their behavior is fundamental to geomorphology.

(5) Identify features, landforms, and deposits associated with different geomorphic processes (e.g., glacial, periglacial, aeolian, volcanic, tectonic, fluvial)

(6) Practice extracting key takeaways and outstanding knowledge gaps from scientific journal articles, and communicating those concepts in written and oral form to a nonspecialized audience

(7) Practice acquiring, analyzing and plotting landscape data from computer models and databases

**Course requirements and grading:**

*Labs (40%):* There will be six labs, where students will become familiar with geomorphic principles and processes; this will be done though analyzing field, digital topography and environmental data analysis, and using what we learn in the lectures to interpret the data. Attendance is mandatory for all labs (you will not receive outside help if you do not attend lab) and lab reports are due the following week before the start of your next laboratory period. If you have to miss lab, please email Victoria to make arrangements. Instructions for remote access to lab computers with necessary software will be made available on Canvas.

*Final projects (40%):* Each student will pick a topic of interest that broadly falls into “earth and planetary surface processes,” grounded in a recent journal article. This topic will be the foundation of three distinct projects that will allow you to release your curiosity and creativity:

1. A short (500-700 word) summary of the article for a broad audience in the style of [Geobites](https://geobites.org/)
2. A 10-minute lecture on the topic aimed at the undergraduate level with time for questions
3. A Jupyter/Colab Notebook-based data activity exploring the topic using equations or datasets

At the end of the term, you will be given a choice of designating one of the three activities as counting for 20% of your grade, and the others will be 10% each. The presentation will be graded in class and will include your participation as an audience member. The deadlines for the Geobites article and data activity will be staggered at the end of the term (tentatively second week of May).

*Weekly assignments* (*20%*): Quizzes and in-class activities that will help solidify the concepts discussed in class and in the readings, and provide feedback for me and you. **Monday** class will begin with a short quiz based on the assigned reading and act as a check on attendance and reading assignments. You will also receive **a homework assignment on Monday**, which would be **due the following Monday** and will check your understanding of quantitative concepts in the course. **Wednesday** will involve a coding-based data tutorial that will conclude with reflection questions, **due the next Friday**.

*Late Policy:* Please contact me or the teaching assistant *in advance* if you have circumstances that will make it difficult to turn in an assignment/lab report on time. Without this advance permission, assignments and lab reports handed in late will have their grades reduced by 20% per day.

*Regrade Policy*: If there is a math error or we tallied points incorrectly, let us know immediately and we will correct your grade. If you feel a question on the exam has not been correctly graded, I am willing to discuss it with you, but will not make a decision in real time. If you choose, you can submit your exam to me for re-grading. I will regrade all questions on the exam and your new grade will be final.

*Grading*: While subject to change, the tentative grade scale is as follows:

> 95 = A

91-94 = A-

87-90 = B+

82-86 = B

78-81 = B-

73-77 = C+

68-71 = C

63-67 = C-

60-62 = D+  
<60 = D/E

**Accommodations for students with disabilities:**

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS;[*Apply for Services webpage*](https://students.dartmouth.edu/student-accessibility/students/where-start/apply-services); [*student.accessibility.services@dartmouth.edu*](mailto:student.accessibility.services@dartmouth.edu); [*1-603-646-9900*](tel:16036469900)) and to request that an accommodation email be sent to me in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with me to determine relevant details such as what role SAS or its [*Testing Center*](https://students.dartmouth.edu/student-accessibility/services/testing-center) may play in accommodation implementation. This process works best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

**Wellness:**

We recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: your undergraduate dean (<http://www.dartmouth.edu/~upperde/>), Counseling and Human Development (<http://www.dartmouth.edu/~chd/>), and the Student Wellness Center (<http://www.dartmouth.edu/~healthed/>). In addition to these resources, please don’t hesitate to come speak with me if something comes up throughout the term – your health and wellness come first.

**Religious observances:**

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me as soon as possible, or before the end of the second week of the term—at the latest, to discuss appropriate adjustments. Dartmouth has a deep commitment to support students’ religious observances and diverse faith practices.

**Academic honor principle:**

You should be aware of, and follow, the Dartmouth Honor Code as expressed in the ORC. In this course, some implications of the academic honor principle are as follows:

* You are encouraged to discuss lab assignments and data tutorials with others, but all work handed in must be your own. Your written reports should be expressed in your own words, and any quotations, figures, graphs, or other materials based on another’s work must be explicitly acknowledged.
* In your term projects, any materials (graphics or text) that are based on work from others must be explicitly acknowledged. For the data activity, include URLs that you used to craft your code.

If you have questions about how the honor principle applies to this course, please contact me.

**Course Schedule**

**Week 1: Introduction to Geomorphology and its Tools**

What is geomorphology?

Geomorphologist’s Toolkit: Dating methods, measuring rates of processes, experiments, proxy records

Introduce course structure, final projects overview

*No lab this week*

*Data tutorial #1: Introduction to Python, Pandas, and Notebooks*

**Week 2: Weathering and Soils**

Physical, chemical, and biological weathering

Soils

*Lab #1: Introduction to ArcGIS*

*Data tutorial #2: Soil production function*

**Week 3: Geomorphic Hydrology and Hydroclimate**

Ground and surface water hydrology

Hydroclimate influence on landscape morphology

Geomorphic records of hydroclimate change

*Lab #2: Tombstone Weathering*

*Data tutorial #3: USGS stream gage data*

**Week 4: Hillslope Processes**

Diffusive hillslope processes

Mass movements

Slope stability

Hillslope morphology

*Lab #3: Hillslope Diffusion*

*Data tutorial #4: Diffusion coefficients by rock type*

**Week 5: Fluvial Processes and Sediment Transport**

Fluvial processes

Sediment transport

Channel patterns

Channel reach morphology

*Lab #4: Slope stability and landslide mapping*

*No Data tutorial*

**Week 6: Drainage Basins and Channel Networks**

Channel networks (drainage patterns, channel order)

What sets the long profile of a river?

*Lab #5: Mink Brook*

*Data tutorial #5: Multispectral imagery*

**Week 7: Aeolian and Volcanic Processes**

Wind-driven processes, aeolian features, landforms and deposits

Volcanism, volcanic landscapes and their evolution

*Lab #6: Bedrock channels and morphology of mountain ranges*

*No Data tutorial*

**Week 8: Landscape Evolution**

Models of landscape evolution

Rates of processes

*No new lab, catchup week.*

*Data tutorial #6: Landscape evolution models*

**Week 9: Cold-climate geomorphology**

Quaternary climate and geomorphology

Glacial features, mass budgets and flow processes, and mechanics of erosion

Permafrost and periglacial features

*Potential filed trip!! around campus.*

*Troubleshooting data projects*

**Week 10: Final presentations**

*No classes on Memorial Day.*

*Lab time Tuesday afternoon MEETS for final project presentations.*

**Selected sources:**

Anderson, R. S., & Anderson, S. P., 2010, Geomorphology: the mechanics and chemistry of landscapes. Cambridge University Press.

Bierman, P.R., & Montgomery, D., 2014, Key Concepts in Geomorphology, W.H. Freeman and Company Publishers, 41 Madison Ave, New York City, NY.

Easterbrook, D.J., 1999, Surface Processes and Landforms, 2nd Edition, Prentice Hall, Upper Saddle River, NJ, 546 p.

Knighton, D., 2014, Fluvial forms and processes: a new perspective. Routledge.

Burbank D.W. and Anderson R.S. (2001), Tectonic Geomorphology, Blackwell, ISBN 0-632-04386-5.  
Carson M.A. and Kirkby M.J. (1972). Hillslope form and process, Cambridge Univ. Press, ISBN 0-521-08234-X.  
Tinkler K.J. and Wohl E.E. (1998), Rivers over rock, AGU Geophysical monograph 107, ISBN 0-87590-090-0.  
Willett S.D., Hovius N., Brandon M.T. and Fisher D.M. (2006), Tectonics, Climate and Landscape Evolution, GSA special paper 398, ISBN 0-8137-2398-1.  
  
Particularly useful Journals include Journal of Geophysical Research, Geology, Nature, Nature Geoscience, Science, Earth Surface Processes and Landforms, Geomorphology, Water Resources Research and Geophysical Research Letters