

# Quantitative Geomorphology

---

*Instructor: Bodo Bookhagen ([bodo@eri.ucsb.edu](mailto:bodo@eri.ucsb.edu))*

*Teaching Assistant: Taylor Smith ([ttsmith@geog.ucsb.edu](mailto:ttsmith@geog.ucsb.edu))*

GEOG and EARTH 137 / 237 Quantitative Geomorphology, M, W 9:30-10:45am, ELLSN 2609

Lab: M 3:00-6:50, ELLSN 2610

Office hours (Bodo Bookhagen): W 11:00am-12 pm (or by appointment), ELLSN 4816

Office hours (Taylor Smith): TU 12:00-1:00pm (or by appointment), ELLSN 4812

Class Webpage: <http://www.geog.ucsb.edu/~bodo/classes.php?pg=classes#qg>

## Syllabus

1. Sep 30 (M) Introduction to Geomorphology (Overview and History)

**Lab 1: Introduction to Matlab, 'Mega geomorphology', viewing digital elevation models, the importance of scale, creating hypsometric curves of continents, area (km<sup>2</sup>) of each continent, mean, maximum elevation, slope, using global precipitation and temperature data to identify potential relations between climatic parameters and landscape shape.**

2. Oct 2 (W) Concepts of equilibrium, Internal and External Forces, Tectonic Forces (Tectonic Geomorphology), Climatic Forces (Climatic Geomorphology)  
*Required Reading: Chapter 1 (Introduction to the study of surface processes), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 2 (Internal Forces and Climate) of Process Geomorphology (4<sup>th</sup> edition)*

3. Oct 7 (M) Introduction to Digital Elevation Models (DEMs), Morphology of planets, large-scale topography and mantle response times  
*Required Reading: Chapter 2+3 (Whole Earth morphology, Large-scale topography), Geomorphology by R.S. and S.P. Anderson*

### Lab 1 continued

4. Oct 9 (W) Tectonic Geomorphology  
*Required Reading: Chapter 4 (Tectonic Geomorphology), Geomorphology by R.S. and S.P. Anderson*

5. Oct 14 (M) Physical and Chemical Weathering (principles and types)  
*Required Reading: Chapter 7 (Weathering), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 4 (Physical Weathering, Mass Movement, and Slopes) of Process Geomorphology (4<sup>th</sup> edition)*

**Lab 2: Using Mars MOLA topographic data to compare Earth and Mars' surface characteristics**

6. Oct 16 (W) Atmospheric processes and geomorphology, orographic rainfall processes

Required Reading: Chapter 5 (Atmospheric processes and geomorphology), Geomorphology by R.S. and S.P. Anderson

7. Oct 21 (M) no class

**Lab 3a: Earth's Surface Temperature and functions in Matlab; Lab3b: Chemical weathering and increase in land-surface area**

8. Oct 23 (W) No class

9. Oct 28 (M) Hillslope Processes I (mass continuity, diffusion processes, landslides)

Required Reading: Chapter 10 (Hillslopes), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 4 (Physical Weathering, Mass Movement, and Slopes) of Process Geomorphology (4<sup>th</sup> edition)

**Lab 4: Hillslope transport and diffusion, using Matlab to solve scarp diffusion analytically and numerically, including Taylor-series approximation and numerical diffusion schemes.**

10. Oct 30 (W) Hillslope Processes II (mass continuity, diffusion processes, landslides)

Required Reading: Chapter 10 (Hillslopes), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 4 (Physical Weathering, Mass Movement, and Slopes) of Process Geomorphology (4<sup>th</sup> edition)

11. Nov 4 (M) Glaciers, Ice deformation, glacial erosion, periglacial processes

Required Reading: Chapter 8 (Glaciers and Glacial geology), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 9 (Glaciers and Glacial Mechanics), Chapter 10 (Glacial Erosion, Deposition, and Landforms), and Chapter 11 (Periglacial Processes and Landforms) of Process Geomorphology (4<sup>th</sup> edition)

**Lab 5: Flow-routing algorithms (D8 and Infinity) in Matlab and applying to two different scales DEMs for the Santa Barbara area (10 vs. 30 m). Channel definition, channel-slope calculation, specific stream power calculation.**

12. Nov 6 (W) Fluvial Processes (hydrographs, flow velocity and dimensionless flow parameters, sediment transport)

Required Reading: Chapter 11+12 (Water in the landscape, Rivers), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 6 (Fluvial Processes) and Chapter 7 (Fluvial Landforms) of Process Geomorphology (4<sup>th</sup> edition)

Nov 11 (M) Veteran's day – no lecture

13. Nov 13 (W) **midterm exams**

14. Nov 18 (M) Sediment transport mechanics

Required Reading: Chapter 14 (Sediment transport mechanics), Geomorphology by R.S. and S.P. Anderson; Suggested Reading: Chapter 6 (Fluvial Processes) and Chapter 7 (Fluvial Landforms) of Process Geomorphology (4<sup>th</sup> edition)

**Lab 5 continued**

15. Nov 20 (W) Drainage Basins, Initiation of channels, Drainage Basin Sediment budgets

Required Reading: Chapter 11+12 (*Water in the landscape, Rivers*), *Geomorphology* by R.S. and S.P. Anderson; Suggested Reading: Chapter 5 (The Drainage Basin – Development, Morphometry, and Hydrology) of *Process Geomorphology* (4<sup>th</sup> edition)

16. Nov 25 (M) Eolian landforms

Required Reading: Chapter 15 (*Eolian forms and deposits*), *Geomorphology* by R.S. and S.P. Anderson; Suggested Reading: Chapter 8 (Wind Processes and Landforms) of *Process Geomorphology* (4<sup>th</sup> edition)

**Lab 6: Stability and shallow landslide mapping of the Santa Barbara foothills using a lidar DEM**

17. Nov 27 (M) Extreme events in Geomorphology

Required Reading: Chapter 17 (*The geomorphology of big floods*), *Geomorphology* by R.S. and S.P. Anderson;

18. Dec 2 (M) Review session

**Lab 6 continued (Lab due Friday, Dec 6)**

19. Dec 4 (W) no lecture

Dec 8-14 finals week

**Dec 9 (Monday): Finals, 9-11am**