Quantitative Geomorphology

Instructor: Bodo Bookhagen (bodo@eri.ucsb.edu)
Teaching Assistant: Taylor Smith (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 (km²) 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 (4th 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 (4th 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

   **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 (4th 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 (4th 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 (4th 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 (4th 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 (4th edition)

    **Lab 5 continued**

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 (4th 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