GEOL4700/5700-003 Sediment Transport Mechanics
Spring semester 2011
T-Th 11:00-12:30 Benson Earth Sciences, Room 355
Instructor: Greg Tucker
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This course introduces beginning graduate students and upper-level undergraduates to the basic physical principles governing the motion of fluids (air and water) and sediment. The first half of the course will be devoted to understanding the physics of fluid motion, properties of fluids, and variations on the equations governing fluid motion and its interaction with rough surfaces. We will also work toward developing skills in using mathematics to describe geological systems, using the basic concepts of mass, momentum and energy balance. The second half of the course emphasizes the movement of sediment and fluid-sediment mixtures.

COURSE OBJECTIVES:

- Understand fundamental aspects of fluid dynamics that relate to sediment transport
- Understand the mechanics of sediment entrainment, transport, and deposition, from the grain scale to models of heterogeneous size-density sediment flux
- Develop an improved ability to frame geological problems mathematically
- Gain practice solving sediment-transport equations numerically
- Recognize and understand fluid flow and sediment transport equations in the literature

REQUIRED WORK:

- Problem sets (weekly to bi-weekly)
- Final project: research proposal relating to sediment transport

COURSE OUTLINE (subject to modification as the course evolves):

I. Introduction and basics
   a. Review of useful mathematical tools and Newton's second law
   b. Properties of fluids (air and water) and sediment
   c. Setting up problems with mass and momentum balance
   d. Introduction to dimensional analysis
II. Physics of fluids
   a. Continuity of mass and momentum for a viscous fluid in 3 dimensions
   b. Invicid fluids and the Bernoulli equation
   c. Turbulence
   d. Open channel flow
III. Sediment entrainment and transport
   a. Particle settling in still fluid
   b. Sediment entrainment
   c. Bedforms
   d. Bedload and suspended load
   e. Examples of transport formulas
IV. Applications and special topics
   a. Landscape evolution
   b. Mass transport on hillslopes
   c. Debris-flow dynamics

RECOMMENDED READINGS:
(Note: copies of most of these are on the shelf outside my office in room 262. Feel free to come by and peruse them, but please don't take them out of the office except to photocopy.)

Furbish, D.J. (1997) *Fluid physics in geology: An introduction to fluid motions on Earth's surface and within its crust*. New York: Oxford University Press, 476 pp.

Julien, P. (1998) *Erosion and Sedimentation*. Cambridge University Press.

Hornberger, G., and Wiberg, P. (2005) *Numerical Methods in the Hydrological Sciences*. AGU, eBook.

Middleton, G.V., and Southard, J. (1984) *Mechanics of Sediment Movement*, S.E.P.M. Short Course No. 3., 401 pp.

Middleton, G.V., and Wilcock, P.R. (1994) *Mechanics in Earth and Environmental Sciences*. Cambridge University Press.

Slingerland, R.L., Harbaugh, J., and Furlong, K.P. (1994) *Simulating Clastic Sedimentary Basins*. Prentice Hall (out of print).

Southard, J. (1996) *Lecture Notes on Sediment Transport*. Unpublished illustrated lecture notes.

Tritton, D.J. (1988) *Physical Fluid Dynamics*, 2nd ed. Oxford University Press.

Also see:

Sediment Transport in Motion – DVD compilation by Mark Schmeeckle of Arizona State University (and CU PhD alumnus).

DISABILITIES: Students with disabilities who qualify for academic accommodations should provide a letter from Disability Services (DS) and discuss specific needs with the professor. DS determines accommodations based on documented disabilities (303-492-8671, Willard 322, www.colorado.edu/sacs/disabilityservices).

RELIGIOUS OBLIGATIONS: Students with conflicts between religious observance dates and course exams or assignments must notify the professor via email at least two weeks in advance of the event so that reasonable and appropriate accommodations can be arranged.