Spring 2016 Syllabus

WR616: Hillslope Hydrology and Runoff Processes

Class times: Monday 9:00-9:50 am; Wednesday 9:00-10:40 am in NESB A302

Instructor: Stephanie Kampf
Office: Natural and Environmental Sciences Building (NESB), B248
Office Hours: Monday 2:00-3:30 pm; Wednesday 2:00-3:30 pm or by appointment
Phone: 491-0931
Email: Stephanie.Kampf@colostate.edu

Course overview and objectives: This is a reading and discussion-based course on runoff processes at hillslope to catchment scale. The objectives are to (1) develop in-depth understanding of runoff processes, (2) gain familiarity with a broad range of papers in hillslope hydrology, (3) develop skills in peer review of journal articles, and (4) develop skills in synthesizing information from peer-reviewed literature.

Prerequisites: At least one prior course in hydrology (WR416 or equivalent), familiarity with basic concepts and equations in subsurface flow, and familiarity with field measurement techniques in hydrology.

Text: All course readings will be from journal articles provided electronically through Canvas.

Course requirements: During the first half of class, we will read and discuss papers that cover the major concepts and themes in hillslope hydrology and runoff processes. On a rotating basis, each student will be responsible for leading paper discussions and writing paper reviews. As an ongoing class project, each student will select a focus topic, prepare an annotated bibliography and research proposal on the topic, present a brief overview of the topic to class, and lead a class discussion related to the focus topic.

Grading and expectations: You should be fully prepared for each class discussion, which means careful reading of the papers in advance of the class. You are also responsible for active, constructive, and positive participation in the class discussions. At graduate level, you should demonstrate self motivation and direction, and you should be actively challenging and questioning ideas to make every class meeting as engaging and thought-provoking as possible. Your grade will be based on:

- 10% Active and constructive participation in class discussions
- 10% Effective leadership of class discussions
- 30% Reviews
- 15% Annotated bibliography
- 10% Presentation on focus topic
- 25% Research proposal

Late assignments will not be accepted, but you will have the opportunity to revise and resubmit your assignments based on comments from the class and instructor.

Academic integrity: You are responsible for adhering to all university policies on academic integrity (http://learning.colostate.edu/integrity/index.cfm) and student conduct (http://www.conflictresolution.colostate.edu/conduct-code#conduct).

Course outline (subject to change)**:**

Jan 20: Introduction and *runoff processes*

- How to read and understand a scientific paper: http://violentmetaphors.com/2013/08/25/how-to-read-and-understand-a-scientific-paper-2/

Jan 25: *Saturation excess overland flow*

- **Dunne** T, Black RD, 1970. An experimental investigation of runoff production in permeable soils. Water Resources Research 6(2), 478-490.

Jan 27: *Subsurface flow*

- **Hewlett** JD, 1961. Soil moisture as a source of base flow from steep mountain watersheds. USDA Forest Service Station Paper No. 132, Southeastern Forest Experiment Station, Asheville, North Carolina, 11pp. AND **Hewlett** JD, Hibbert AR, 1963. Moisture and energy conditions within a sloping soil mass during drainage. Journal of Geophysical Research 68(4), 1081-1087.
- **Whipkey** RZ, 1965. Subsurface stormflow from forested slopes. Bull. Int. Assoc. Sci. Hydrol. 10(2), 74-85.

Feb 1: *Evapotranspiration*

- **Goulden**, M. L., Anderson, R. G., Bales, R. C., Kelly, A. E., Meadows, M., & Winston, G. C. (2012). Evapotranspiration along an elevation gradient in California's Sierra Nevada. Journal of Geophysical Research: Biogeosciences (2005–2012), 117(G3).

Feb 3: *Soil moisture*

- **Blume**, T., Zehe, E., & Bronstert, A. (2009). Use of soil moisture dynamics and patterns at different spatio-temporal scales for the investigation of subsurface flow processes. Hydrology and Earth System Sciences, 13(7), 1215-1233.
- **Harpold**, A. A., Molotch, N. P., Musselman, K. N., Bales, R. C., Kirchner, P. B., Litvak, M., & Brooks, P. D. (2014). Soil moisture response to snowmelt timing in mixed-conifer subalpine forests. Hydrological Processes.

Feb 8: *Channel initiation*

- **Montgomery** DR, Dietrich WE, 1988. Where do channels begin? Letters to Nature 336, 232-234. AND **Montgomery** DR, Dietrich WE, 1989. Source areas, drainage density, and channel initiation. Water Resources Research 25(8), 1907-1918.

Feb 10: *Connectivity*

- **Jencso**, K. G., McGlynn, B. L., Gooseff, M. N., Wondzell, S. M., Bencala, K. E., & Marshall, L. A. (2009). Hydrologic connectivity between landscapes and streams: Transferring reach-and plot-scale understanding to the catchment scale. Water Resources Research, 45(4).
- **Godsey**, S. E., & Kirchner, J. W. (2014). Dynamic, discontinuous stream networks: hydrologically driven variations in active drainage density, flowing channels and stream order. Hydrological Processes, 28(23), 5791-5803.

Feb 15: *Mobile and immobile water*

- **Brooks** JR, Barnard HR, Coulombe R, McDonnell JJ, 2010. Ecohydrologic separation of water between trees and streams in a Mediterranean climate. Nature Geoscience 3, 100-104 + supplemental figures. AND **Phillips** FM, 2010. Hydrology: Soil-water bypass. Nature Geoscience 3, 77-78.

Feb 17: *Old water and new water*

- **Sklash** MG, Farvolden RN, 1979. The role of groundwater in storm runoff. Journal of Hydrology 43, 45-65.
- **McDonnell** JJ, 1990. A rationale for old water discharge through macropores in a steep, humid catchment. Water Resources Research 26(100), 2821-2832.

Feb 22: *Source water*

- **Frisbee**, M. D., Phillips, F. M., Campbell, A. R., Liu, F., & Sanchez, S. A. (2011). Streamflow generation in a large, alpine watershed in the southern Rocky Mountains of Colorado: Is streamflow generation simply the aggregation of hillslope runoff responses?. Water Resources Research, 47(6).

Feb 24: *Transit times*

- **Tetzlaff**, D., Seibert, J., McGuire, K. J., Laudon, H., Burns, D. A., Dunn, S. M., & Soulsby, C. (2009). How does landscape structure influence catchment transit time across different geomorphic provinces?. Hydrological Processes, 23(6), 945-953.
- **Heidbüchel** I., Troch P.A., Lyon S.W. (2013): Separating physical and meteorological controls of variable transit times in zero-order catchments. Water Resources Research 49 (11): 7644–7657. DOI: 10.1002/2012WR0131492

Feb 29: *Tracers*

- **Hinckley**, E. L. S., Ebel, B. A., Barnes, R. T., Anderson, R. S., Williams, M. W., & Anderson, S. P. (2014). Aspect control of water movement on hillslopes near the rain–snow transition of the Colorado Front Range. Hydrological Processes, 28(1), 74-85.

Mar 2: *Snowmelt systems*

- **Kormos**, P. R., Marks, D., McNamara, J. P., Marshall, H. P., Winstral, A., & Flores, A. N. (2014). Snow distribution, melt and surface water inputs to the soil in the mountain rain–snow transition zone. Journal of Hydrology, 519, 190-204.
- **Knowles**, J. F., Harpold, A. A., Cowie, R., Zeliff, M., Barnard, H. R., Burns, S. P., ... & Williams, M. W. (2015). The relative contributions of alpine and subalpine ecosystems to the water balance of a mountainous, headwater catchment. Hydrological Processes.

Mar 7: *Tropical systems*

- **Ogden**, F. L., Crouch, T. D., Stallard, R. F., & Hall, J. S. (2013). Effect of land cover and use on dry season river runoff, runoff efficiency, and peak storm runoff in the seasonal tropics of Central Panama. Water Resources Research, 49(12), 8443-8462.

Mar 9: *Arid, semi-arid, and burned systems*

- **Yair**, A., & Kossovsky, A. (2002). Climate and surface properties: hydrological response of small arid and semi-arid watersheds. Geomorphology, 42(1), 43-57.
- **Ebel**, B. A., Moody, J. A., & Martin, D. A. (2012). Hydrologic conditions controlling runoff generation immediately after wildfire. Water Resources Research, 48(3).

Mar 21 & 23: No class – Hydrology Days

Mar 28 – May 4: Student focus topics