University of British Columbia
Department of Geography
Geob 405: Fluvial Geomorphology (Credits: 3.0)

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Office Hours: W - 10:00-11:00, GEOG 253 or GEOG 221

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Prerequisite:
GEOG 206 or EOSC 330 (GEOG 305 recommended)

Times:
Lecture: W- 11:00-13:00 and F - 11:00-12:00 -- Rm 229
Laboratory: F - 12:00-13:00 -- Rm 229

Course Objectives:
1. To introduce the morphology of rivers and of the fluvial landscape.
2. To introduce the main processes that occur in rivers, and means for observing them.
3. To familiarise the student with some of the techniques for analysis of river morphology and processes.
4. To introduce geomorphological literature that is relevant to the subject.

It will be assumed that the student may be interested in applying material from the course, either in graduate studies, or in employment. **Hence, the course will be analytical rather than descriptive**. The same orientation will be expected in class work.

Programme:

1. **Lecture**: Regular attendance is required (course outline attached)
2. **Laboratories**: There will be **five (5)** laboratories to be handed in for marking, consisting of computational and interpretative exercises. Collaborative effort in working out the problems is encouraged. However, individual reports must be handed in.
3. **Reading**: There will be a reading assignment associated with each major topic of the course. You are formally responsible for learning this material.
4. **Discussion**: There will be **four class discussion assignments**. Readings associated with each discussion will be decided in class.
5. **Field trips**: There will be a one-day trip to East Creek, UBC Forest. **It will occur on Saturday, October 4 and Sunday, October 5 (to be decided in class).** The trip is required as part of the course. A field report is not required; however, the trip will yield material used in **lab 3**.
6. **Analytical project**: Students will carry out a project to observe and measure fluvial processes in the field or laboratory. A report is required.
7. **Examination**: There will be a formal examination scheduled by the Registrar for some time during the period **December 2-17**. You will be responsible for attendance: other arrangements cannot be entertained. The examination will be open book and you will need to integrate materials from lectures, laboratories, readings and your term project. It is not usually practical to use textbooks effectively during an examination. You may wish to keep this in mind when you prepare your notes.

Course Evaluation:

Laboratories	(5x7)	35
Project		15
Discussion		10
Final Exam		40
		100

Late Assignments:
Assignments may be handed in during class to the instructor or to the geography main office. Ten percent per day will be subtracted from the grades of laboratory assignments and analytical projects that are turned in late.

Required Textbook
Knighton, D. 1998. Fluvial Forms and Processes. Arnold, New York, 383 p.

Reference Texts
Allen, J.R.L. 1985. Principles of Physical Sedimentology. Allan and Unwin, London, 227 p.

*Bridge, J.S. 2003. Rivers and Floodplains. Blackwell Publishing, Malden MA, 491 p.

Henderson, F.M. 1966. Open Channel Flow. Macmillian, New York, 522 p.

Leopold, L.B., Wolman, M.G., and Miller, J.P. 1964. Fluvial Processes in Geomorphology. Dover, New York, 522 p.

Middleton, G.V. and Southard, J.B. 1984. Mechanics of Sediment Movement. Society of Economic Paleontologists and Mineralogists, Short Course (2nd edition), 40 p.

Petts, G. and Foster, I. 1985. Rivers and Landscape. Arnold, London, 274 p.

*Robert, A. 2003. River Processes. Oxford University Press, New York, 214 p.

Richards, K. 1982. Rivers: Form and Process in Alluvial Channels. Methuen, London, 358 p.

Yalin, S.M. 1992. River Mechanics. Pergamon Press, New York, 220 p.

*These are good and up to date reference texts.

Journal Papers
Ashmore PE, Church M. 1998. Sediment transport and river morphology: a paradigm for study. In *Gravel-Bed Rivers in the Environment*, ed. PC Klingeman, RL Beschta, PD Komar, JB Bradley, pp. 115–48. Highland Ranch, CO:Water Resour. Publ. 642 pp.

Blum, M. D. & Roberts, H. H. 2009. Drowning of the Mississippi delta due to insufficient sediment supply and global sea-level rise. *Nature Geosci.* **2**, 488–491.

Brardinoni, F. and Hassan, M. A., 2006. Glacial erosion, evolution of river long profiles, and the organization of process domains in mountain drainage basins of coastal British Columbia. *Journal of Geophysical Research*, Vol. 111, F01013, doi: 10.1029/2005JF000358.

Church, M., 2006. Bed material transport and the morphology of alluvial river channels. Annual Review of Earth and Planetary Sciences, 34, 325-354

Church, M. and Slaymaker, O., 1989. Holocene disequilibrium of sediment yield in British Columbia. *Nature* 327, 452–454.

Hassan, M. A., Church, M., Lisle, T. E., Brardinoni, F., Benda L., and Grant, G. E., 2005. Sediment transport and channel morphology of small, forested streams. *Journal of the American Water Resources Association,* 41, 853-876.

Hassan, M. A., Gottesfeld, A. S., Montgomery, D. R., Tunnicliffe, J. F., Clarke, G. K. C., Wynn, G. Jones-Cox, H., Poirier, R., MacIsaac, E., Herunter, H., and Mcdonald, S. J., 2008a. Salmon-driven bedload transport and bed morphology in mountain streams. *Geophysical Research Letters*, Volume 35, L04405, doi:10.1029/2007GL032997.

Hassan, M. A., Church, M., Xu, X., and Yan, Y., 2008b. Spatial and temporal variation of sediment yield in the landscape: the example of Huanghe (Yellow River). *Geophysical Research Letters*, 35, L06401, doi:10.1029/2008GL033428.

Montgomery, D.R., and Buffington, J.M., 1997. Channel reach morphology in mountain drainage basins. Geological Society of America, Bulletin, 109, 596-611.

Nittrouer, J.A., and Viparelli, E., 2014. Sand as a stable and sustainable resource for nourishing the Mississippi River delta. *Nature Geoscience*, **7**, 350–354.

Syvitski, J. P. M. *et al*. 2009. Sinking deltas due to human activities. *Nature Geosci.* **2**, 681–686.

Tal, M. and Paola, C., 2007. Dynamic single-thread channels maintained by the interaction of flow and vegetation. Geology, 35, 347-350.

Lecture Outline:

1. Introduction: The Fluvial System

Readings: Knighton pp. 1-8
Church, 2006.

2. Flow in River Channels

Readings: Knighton 65-80 (skim); 96-107
Roberts 2003

3. Sediment Transport Processes

Readings: Knighton 107-150
Church, 2006.
Hassan et al., 2005.

4. Bed material transport and River Morphology

Readings: Knighton 126-136
Ashmore and Church, 1998.

5. Hydraulic Geometry

Readings: Knighton 151-187.

6. Channel Pattern and Gradient

Readings: Knighton 205-241

7. River Profile

Readings: Knighton Ch. 5 pp. 242-260

8. Alluvial Channel Morphology

Reading: Church, 2006.

9. Small Channel Morphology and Dynamics

Reading: Montgomery and Buffington, 1997.
Hassan et al., 2005
Brardinoni and Hassan, 2006

10. Depositional Landforms (Alluvial Fans, Deltas and Estuaries)

Readings: Knighton 141-150
Nittrouer and Viparelli, 2014

11. Drainage Basin Sediment Yield

Readings: Church and Slaymaker, 1989
Hassan et al., 2008b

12. Human modification of Rivers

Readings: Knighton 307-335

Project:
The purpose of the project is to carry out a small field or laboratory study related to fluvial geomorphology. The project must involve data collection and may be supplemented by laboratory analysis or information obtained from maps, airphotos, and aerial photographs.

The work can be done individually, or preferably, in pairs. In the latter case, a single report will be submitted. The results will be presented in the form of a scientific research paper and be no longer than **12 pages** (double-spaced) including the diagrams. References and the cover page are not included in this page limit. Your literature review should consist of primary sources (i.e. journal articles) rather than secondary sources (i.e. textbooks).

It is important that you select a topic that allows you to follow the scientific method (i.e. you must be testing a model or hypothesis). You should be able to find many topics in your textbook. A short list of possible topics is given below. You must discuss your project with me by **Oct 10** (just before Thanksgiving).

Field projects:
1. Flow in a meander bend or step-pool system
2. Velocity profiles
3. Channel morphology and sediment composition
4. Channel network composition
5. Testing hydraulic geometry equations
6. Surface armouring on gravel bars

Flume projects:
1. Test of sediment transport models
2. Bedform stability fields
3. Velocity profiles
4. Fall column experiment

The final report is due **November 28** and should follow the outline below strictly.

Abstract
-Outlines purpose, location and conclusions of study
Introduction
-Outline model or hypothesis to be tested
Setting (for field studies)
-Discuss relevant aspects of environment, study area
Methods
-Describe field and /or laboratory equipment and measurement programme
Results
-Describe the research results using figures and tables
Discussion
-Discuss possible sources of error in results
-Compare results with hypothesis or model and discuss differences (if any)
-Compare results with other, similar studies
Conclusions
-Enumerate (e.g. 1, 2, 3) main findings
References
-Use format in Canadian Journal of Earth Sciences