# Hydrology (ENVP U6116) – SYLLABUS, Summer 2016

## Instructor Information

Dr. Michael J. Puma
Email: mjp38@columbia.edu
Phone: 212-678-5667
Office Hours: Mondays from 11-1 pm in the SIPA Cafe
Accessibility: Please contact me via e-mail. I will typically respond to you within 24 hours (with a delay on weekends). If you don't hear from me, then please resend or ask the TAs to get in touch with me.

### Teaching Assistants (TAs):

Andrew Budsock: ab3998@columbia.edu
Kari Patel: kvp2108@columbia.edu

## Course Overview

The sustainability of freshwater resources is a critical issue facing society over the coming decades. To manage our precious water resources effectively, practitioners need to understand the fundamentals of the water cycle. I have therefore designed this course to introduce you to *hydrology*, the science that encompasses the occurrence, distribution, movement, and properties of Earth's water and its relationship with people and the environment. Multiple case studies will be highlighted throughout to illustrate contemporary threats to water sustainability. As part of the course, you will apply the knowledge that you gain to policy and management challenges related to the water resources.

## Learning Objectives

You are expected to understand the key components of the water cycle (including precipitation, evapotranspiration, groundwater, and surface water) and the basics of water quality. Sustainability issues in water management will be explored for various regions – including those in developing and developed countries – and at various scales (local to global). You should be prepared to apply your understanding of hydrology to specific cases studies.

## Course Content

The course consists of four 3-hour lectures, one 1.5-hour lecture, a field trip, and four labs. The course content is listed below:

### 1. The Science of Hydrology (July 26, 2016)

I. Why policy students should care about hydrology?
II. What is the water cycle, and how is it linked to the climate system?
III. How to prepare a *water* budget?

*Readings that you should complete before this lecture:*

- Davie: Chapter 1, pp. 1 – 13
- Pearce: *The Crops Fail* & *We Mine Our Children's Water*, pp. 1 – 63

### 2. Precipitation and Evapotranspiration (August 1, 2016)

I. How is water exchanged between the atmosphere and land?
II. What happens to water once it infiltrates the soil?
III. How does agricultural water use affect the water cycle?

*Readings that you should complete before this lecture:*

- Davie: Chapter 2, pp. 14 – 35, Chapter 3 pp. 36 – 55
- Pearce: *The Wet Places Die* & *Floods May Not Be Far Behind, pp. 67 – 127*

### 3. Field trip: Water Quality (*Morning*, Aug. 2, 2016)

*Field trip to the Stamford Water Pollution Control Facility*
***Abbreviated lecture upon return to campus (No LAB)***

I. What are the major water pollutants in rivers, lakes, and aquifers?
II. How do we treat contaminated water?

### Lecture: Soil Moisture & Groundwater (*Afternoon*, Aug. 2, 2016)

III. What are the characteristics of groundwater flow?
IV. What is the unsaturated zone of the subsurface?

*Readings that you should complete before this lecture:*

- Davie: Chapter 7, pp. 125 – 150 (*Water Quality*)
- Davie: Chapter 4, pp. 56 – 77 (*Soil Moisture & Groundwater*)
- Pearce: *Engineers Pour Concrete* & *Men Go To War Over Water*, pp. 131 – 181

### 4. Surface Water and Probability in Hydrology (August 9, 2016)

I. What are the characteristics of water flow in rivers, and how do we measure and model this flow?
II. How do we deal with probabilities in hydrology?
III. How do we quantify risk and uncertainty for hydrologic systems?

*Readings that you should complete before this lecture:*

- Davie: Chapters 5 and 6, pp. 78 – 124
- Pearce: *Civilizations Fall & We Go Looking For New Water*, pp. 185 – 255
- Chow: Chapter 11 *only* pp. 350-355, Chapter 12 *only* pp. 380-385, Chapter 13 *only* pp. 416-420

### 5. Water Sustainability in a Changing World (August 16, 2016)

I. What are the main challenges facing future water resource managers?
II. Which regions of the world are facing the greatest water-related challenges?
III. How can we prepare for future water-related hazards and vulnerabilities?

***IN-CLASS QUIZ, STARTING AT 9AM***

*Readings that you should complete before this lecture:*

- Davie: Chapter 8, pp. 151 – 174
- Pearce: *We Try To Catch The Rain & We Go With The Flow*, pp. 259 – 311

### 6. Term Project Presentations (August 18, 2016)

## Textbook and Readings

All readings will be posted on Courseworks on the 'Calendar'. You should read this material before each class (i.e. the readings should be done by start of lecture that it is associated with).

*Required books:*

1. Fundamentals of Hydrology, Tim Davie, 2008 (2nd Edition)
2. When the rivers run dry: water, the defining crisis of the twenty-first century, Fred Pearce. 2006;

Other readings are posted on Courseworks.

## Course Requirements

The major assignments of the course will include *four lab assignments,* an *in-class quiz,* and a *final term project* (paper + presentation). Students are also expected to attend and participate in class.

**Lab Assignments**

The lab assignments are designed to reinforce the basic concepts presented in class and to ensure that you master them. The labs will be available for the Lab Session on Tuesday morning and are due the Friday of that week (11:55 pm on Courseworks).

**40 minute, In-Class Quiz**

The written in-class quiz will cover the basic concepts of the course. It will be a mix of short answer and multiple-choice questions based on the lecture material and the assigned readings. To do well, be sure to complete the assigned readings, both in Davie and Pearce. *Grading*: The quiz will be graded on a numerical grade scale from 0 to 100.

**Term Project**

The term project is your opportunity to apply hydrologic concepts from class to a water-related case study. The case study should be on a water-related issue that you and your colleagues find both interesting and important. In particular, you should include an analysis of hydrological data (e.g., precipitation, streamflow, groundwater, evapotranspiration) using methods introduced in class. Importantly, your data analysis should be used to answer a specific research question that your team identifies. Evaluation of the project will be based on how well you incorporate hydrologic concepts covered in the course into your analyses, the quality of your research question, and how effectively you communicate your findings in both your presentation and written report.

The final **project paper** should include analyses and discussions that build on ideas discussed in the course. You will prepare a paper that is about 10 pages (*double spaced not including figures and references*). **You should aim to form a *group of three students.* Groups of two are acceptable but not preferred; group size should not exceed three students and should be larger than one.** Details on topics will be discussed in class. For full credit, the paper *must* contain the following sections (or equivalent):

A. Abstract (150 word limit)
B. Introduction (problem statement, stakeholders ID, etc.)

C. Methodology (analysis approach, data description, etc.)
D. Results & Discussion
E. Conclusions & Recommendations

NOTE: As part of your term project, you should include an abstract of 150 words (maximum). This is a required component of your project, so you should make sure that you are familiar with how to write a proper one. An abstract is essentially a very condensed version of your term paper. It should highlight the major points of your paper, as part of a concise description of your report's content and scope.

Guidance on how to prepare a proper abstract can be found at:
http://writing.wisc.edu/Handbook/presentations_abstracts.html
AND http://writingcenter.unc.edu/handouts/abstracts/

Each group is asked to prepare a 5-7 minute **PowerPoint (or equivalent) presentation** based on the research paper. (I am imposing a 5-slide limit not including the title slide; you should be concise and not go over the time limit to receive full credit.) *The presentations will be on August 18, 2016 and the papers will be due the following day on August 19, 2016 by 11:55pm.*

** Make sure to check Courseworks for any updates or changes to these course requirements. **

## Evaluation/Grading

The relative contribution of each of the assignments to a student's total grade for the course is as follows:

| | |
|---|---|
| 4 hydrology labs | = 30% |
| Term paper and presentation | = 30% |
| In-class quiz | = 30% |
| Attendance & participation | = 10% |

Labs are graded on a scale ranging from 0 to 100. The project (including the presentation) will be graded on a letter grade scale from A+ to F. The final course grade will be computed using a weighted average of these scores.

## Resources and Software Packages

Courseworks will be used for communication of assignments, exams, course material, and other information throughout the course. You should be familiar with Microsoft Excel or equivalent software. Research material for your term projects can be obtained through Columbia University Libraries.

## Policies and Expectations

### Attendance, Late Assignments, and Missed Exam

You are expected to attend and participate in class. Assignments should be submitted in a timely manner, so that you will be able to understand and benefit from course content. *Late assignments will be penalized 10% per day of lateness.* A missed quiz will result in no credit for the quiz. Extenuating circumstances should be brought to my attention and will be handled on a case-by-case basis.

### Academic Integrity and Community Standards

You are required to comply with SIPA's Code of Academic and Professional Conduct. Please read the information provided at:
http://bulletin.columbia.edu/sipa/academic-policies/.

# APPENDIX A: Accessibility Statement

Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process.

For more information regarding this service, please visit the University's Health Services website:
http://health.columbia.edu/disability-services