

Hydrology (ENVP U6116)

SYLLABUS, Summer 2023

Instructor Information

Prof. Beizhan Yan

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Office Hours: Tuesdays afternoon

Accessibility: Please contact me via e-mail. If you don't hear from me, then please don't hesitate to resend or ask the TAs to get in touch with me.

Teaching Assistants (TAs):

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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. This course will 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 pollution and sustainability. As part of the course, you will apply the knowledge that you gain to policy and management challenges related to the water resources. Also this year, we will explore how globalization and new technologies has fundamentally transformed hydrologic systems.

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

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

The course consists of five 2.5 hour lectures, and four labs. The course content is listed below:

1. The Science of Hydrology (July 11, 2023)
 - 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?
- IV. Lab 1 in the afternoon

Readings that you should complete before this lecture:

- Davie: Edition 3 - Chapter 1, pp. 1 – 18.

Recommended readings: Pearce: The Crops Fail & We Mine Our Children's Water, pp. 1 – 63

2. Precipitation and Evapotranspiration (July 18, 2023)

- 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?
- IV. Lab 2 in the afternoon

Readings that you should complete before this lecture:

Davie: E3, Ch 2, pp. 19 – 48, Ch3 pp. 49 – 68. Ch6 pp. 107-132

Recommended readings: Pearce: The Wet Places Die & Floods May Not Be Far Behind, pp. 67 – 127

3. Surface Water and Probability in Hydrology (July 25, 2023)

- 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?
- IV. Lab 3 in the afternoon
- V. Quiz 1 in the morning (covering the first two lectures)

Readings that you should complete before this lecture:

- Davie: E3, Chs 8, 9, 10, pp. 133-232,

Recommended readings: Pearce: Civilizations Fall & We Go Looking For New Water, pp. 185 – 255

4. Water Pollution, Quality, and Management (Aug. 1, 2023)

- I. Watch pre-recorded videos talking water pollution, quality, and management.
- II. Field trip to Newtown Creek Visiting Center (the Digester Egg Tour)
- III. Lab session: the preparation of term projects (by your own group)

Readings that you should complete before this lecture:

- NYC DEP, 2018 One Water NYC: 2018 Water Demand Management Plan
- Davie: E3, Ch10, 207-232; Chs 5, 6, pp 86-132

Recommended readings: Pearce: Engineers Pour Concrete & Men Go To War Over Water, pp. 131 – 181

5. Glacial Hydrology, Dam and Associated issues, Ground Water (August 8, 2023)

- I. The largest freshwater resource.
- II. Dam and associated issues.
- III. What are the characteristics of groundwater flow?
- IV. What is the unsaturated zone of the subsurface?
- V. Lab 4 in the afternoon

Readings that you should complete before this lecture:

- Davie: E3 Ch11; pp 233-256, or
Recommended readings: Pearce: *We Try To Catch The Rain & We Go With The Flow*, pp. pp. 131 – 181 and 259 – 311

6. Groundwater Environmental Issues & Global Burden of Disease (August 15, 2023)

- I. Groundwater environmental issues
- II. Quiz 2 in the morning
- III. Guest Lecture (tentatively):
How NYC manages drinking water and wastewater?
What are the main challenges for NYC water management and environmental Protection?

7. Term Project Presentation (August 17, 2023)

Textbook and Readings

All readings will be posted on Courseworks. 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 book: Fundamentals of Hydrology, Tim Davie, 2019 (3rd Edition)

You can have access to this book from Columbia Library Ebook website:

<https://clio.columbia.edu/catalog/14248993?counter=1>

Recommended book: When the rivers run dry: water, the defining crisis of the twenty-first century, Fred Pearce. 2006;

Other readings will be posted on Courseworks.

Course Requirements

The major assignments of the course will include *four lab assignments*, *two in-class quizzes*, 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. Students will be working in groups of 4 or 5. These will be your groups for both the lab assignments and the term project. The labs will be available for the Lab Session on Tuesday morning and are due the coming Sunday (11:55 pm on Courseworks).

In-Class Quizzes

Two in-class quizzes will cover the basic concepts of the course and encourage everyone to read the assignments. The quizzes will be short (about 7 to 8 multiple-choice questions each) based on the lecture material and the assigned readings. To do well, be sure to complete the

assigned readings and lab questions. *Grading:* The quizzes 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.

See the “Hydrology Term Project Guide” for details.

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 | = 40% |
| Term paper and presentation | = 40% |
| In-class quizzes | = 15% |
| Attendance/participation | = 5% |

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/Canvas 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.

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>