Instructor: Joel Carr  
E-mail: jcarr31@jhu.edu (I will typically respond to your email within 24-48 hours of receipt).

Office Hours: By appointment

Course Description
This course provides an overview and introduction to the hydrological cycle. We will explore the influence of geography, geology, climate and build towards understanding human impacts and influences on the cycle. We will examine the major components of hydrology covering precipitation, evapotranspiration, surface and ground water flows, storage and reservoirs. Concurrently we will examine how these processes affect our understanding of water resources and human water use issues, including the nexus of population, energy, and food. Discussion of these topics using the primary literature will highlight applications and areas of current hydrological research.

Course Objectives
Following the completion of this course, students should understand the key conceptual processes in the hydrologic cycle and different factors driving a change in these processes. They should also have a broad understanding of how these processes are connected. Lastly, they should understand how to approach water quality and quantity issues, and some of the methods and tools available to address these issues.

Textbooks

https://jhupbooks.press.jhu.edu/content/elements-physical-hydrology

JHU Code of Conduct
All students are to abide by the Code of Conduct, which is available at http://advanced.jhu.edu/wp-content/uploads/2013/01/AAP1101_CodeofConduct.pdf. The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor. Please read and adhere to JHU’s policy: http://advanced.jhu.edu/students/plagiarism/
JHU Disability Service
The Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students in Advanced Academic Programs (AAP) who are in need of accommodations should visit http://advanced.jhu.edu/current-students/current-students-resources/disability-accommodations/ for the appropriate steps and documentation needed. Requesting accommodations before the semester is preferable, but not required. The student should submit the Request for Accommodation Form prior to the beginning of each semester (s) he is registered to ensure that accommodations continue for that semester. Depending on the accommodation, there may be a time delay before accommodations can be implemented. For any AAP disability matters please use the following email alias: aapdisability@jhu.edu.

Dropping the Course
You are responsible for understanding the university’s policies and procedures regarding withdrawing from courses. You should also be aware of the current deadlines and penalties for dropping classes.

Course Requirements
The format of this class will typically consist of a longer lecture period in which small sample problems will be given. Throughout the course we will be exploring the concepts of hydrology using real world data sets. Most of this data exploration will be done in the programing language R, a widely used free programming language. This lecture period will be followed by a ~15 minute break. After the break, we will typically have a paper discussion/talk pertaining to the topics presented that week in lecture.

During the semester, students are expected to contribute to discussions of primary source literature. Participation in this discussion period will count towards a discussion grade. A journal article that is relevant to that week’s lecture will be sent to the class by 11:59 PM EST the Friday prior to our class meeting.

Two problem sets will be assigned for the semester. Problem sets will be due approximately three weeks after they have been assigned in class. If there is any remaining time at the end of class, the remainder of the class period will be used to work on the problem set. With the exception of emergency situations, late assignments (i.e., problem sets, presentations and reports) will be penalized at 5% per day. Please submit assignments in hard copy during class on the day they are due. Students are encouraged to attempt the problem sets individually as there will be an in-class closed-book midterm and final that will incorporate material from the problem sets and key concepts presented during lectures and discussions.

Field Trip
We will be exploring and applying some of the principles learned in class in the field (weather permitting). This will likely occur on a Saturday, and expect to be gone for most of the day. We will try to schedule this mid-course, such that some concepts already covered from course can be immediately explored the field.
Grading
Problem sets 30%
Midterm 20%
Final exam 25%
Discussion participation 10%
In class problem participation 10%
Field report/data analysis 5%

Final grades
Final grades will be assigned based on JHU-AAP’s scale:
A+ 98-100%
A 93-97%
A- 90-92%
B+ 87-89%
B 83-86%
B- 80-82%
C 70-79%
F <70%
<table>
<thead>
<tr>
<th>Dates</th>
<th>Topic(s)</th>
<th>Assignments/Activities</th>
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| Week1  | Course overview and expectations  
Conservation of Matter, Energy  
The hydrological cycle  
Water budgets at catchment to global scales  
Basic Math review (applications in R) | Reading Assignment                |
| Week2  | Basic Statistic review (applications in R)  
General Planetary Atmosphere Overview  
Spatial and temporal aspects of precipitation  
Measuring Precipitation | Problem set #1 given              |
| Week3  | Evapotranspiration -Energy balance  
Carbon stocks |                                |
| Week4  | Fluid dynamics and the Bernoulli equation  
Laminar and turbulent flows (pipe flow) |                                |
| Week5  | Open channel flow |                                |
| Week6  | Rivers, dams, reservoirs and sediment | Problem set #1 Due                |
| Week7  | Review for midterm |                                |
| Week8  | In class MIDTERM |                                |
|        | **Spring break** | **NO CLASS**                     |
| Week9  | Groundwater flow  
Aquifer characterization  
Land subsidence | Problem set #2 given              |
| Week10 | Soil moisture dynamics  
Flow in the unsaturated zone |                                |
| Week11 | Runoff |                                |
| Week12 | Hydrologic controls on vegetation  
Unintended consequences paper discussion  
Biotic controls on hydrological processes  
The water-food-energy nexus  
The globalization of water  
Impacts of changing climate part I | Problem set #2 Due                |
| Week13 | The water-food-energy nexus  
The globalization of water  
Impacts of changing climate part II  
Review for Final |                                |
| Week14 | FINAL |                                |