SUMA K4147: Water Resources and Climate

Scheduled Class Times:
R 6:10-8:00 pm

Instructor Information:
Drs. Neil Pederson and Laia Andreu-Hayles

Email: Neil <adk@ldeo.columbia.edu>, Laia <lah@ldeo.columbia.edu>
Office: Tree Ring Lab of LDEO
Office hours: The hour before class or by appointment in Sustainability Management conference room, 2929 Broadway 5th floor.
Emails will be responded to within 12 hours during the workweek. Emails sent on Saturday will not likely receive a response until Monday.

Course Overview:
Water security may become one of the defining issues of the coming century, and it will almost certainly be affected by changes in climate. In the past decade, our understanding of the interactions between climate and hydrology has advanced rapidly, with a better understanding of how changes in the mean, variability, and extremes of the hydrologic cycle may occur. Given how precious freshwater is as a resource, incorporating this knowledge into planning for water resources is critical for the future.

This course will cover the science needed to understand hydrology, the link between hydrology and climate, and why climate change will affect the hydrologic cycle. It will then look at what changes have occurred in the past, and what changes are projected for the future and how these changes may affect other sectors, such as agriculture. The final module of the course will look at adaptation measures to adapt to climate change. The course will be formatted to be a mixture of lectures and seminars, with the lecture portion used to introduce scientific concepts and the seminar portion to discuss and evaluate the readings assigned.

This course satisfies the elective requirement for the Certificate in Sustainable Water Management. This course satisfies the physical dimensions requirement for the M.S. in Sustainability Management.

Learning Objectives
1. Understand the hydrologic cycle and its connection to climate
2. Understand how changes in climate have affected/will affect how much water is available on land
3. Understand how water impacts ecosystem services
4. Learn how to critically evaluate a scientific article
5. Diagnose the cause of a climate-related water problem and develop solutions to address it

-- The syllabus is a guide for our semester. It is subject to change as discoveries are made!! --
**Text/Readings:**
There is no assigned text for this class. Readings will be taken from reports and scientific articles. Readings may be supplemented with news articles depending on current events as the class progresses.

**Resources:**
Courseworks will be used to distribute reading materials, lecture slides, and to turn in assignments unless specified otherwise.

**Course Requirements and Grading:**

The course will consist of readings, homework assignments, one mid-term exam, and a final project, consisting of a paper and presentation to the class.

*Attendance & participation* (5% of final grade)
Students are expected to attend class. Most classes will be divided in two parts. During the first part a theoretical basis will be given by the instructor, while the second part will be seminars based on reading material. Students will be evaluated (5%) based on their rate of attendance and participation in the classes.

*Reading seminars (10 sessions)* (50% of final grade)
The degree of knowledge of the assigned readings will be graded through a continuous evaluation. A group of students will be presenting the readings assigned for every class. Presentation should include background and main results and it should last no more than 20 minutes and will make up 20% of the student’s total grade. The rest of the class will be devoted to discussing the readings in terms of the topics covered, the strengths and weaknesses of the articles, and critical aspects of the research presented. The students presenting and the instructors will moderate the general discussion. The instructors and the classmates will grade the performance of the students presenting.

For students not presenting, a written critique is due via email or Courseworks the day before class. This will make up 30% of the student’s total grade. The critique must include:

1. A short essay giving an overview of the reading (250-300 words +/-).
2. Three strengths and three weaknesses of the investigation/reading
3. Two critical questions that can be used as a part of the class discussion

*Mid-term exam* (15% of final grade)
There will be one in-class two-hour written midterm exam that will evaluate concepts, ideas, themes and issues of what we have covered as a group to date. It will be composed of short-answer essay questions.

*Final project* (30% of final grade)
The final project for this course will be a paper on an issue of the student’s choice related to a water/climate change issue. A project proposal will be due by **October 10**th for topic approval. The student will be responsible for reading primary source material on the issue,
evaluating the scientific certainty/uncertainty behind the issue, and recommending an adaptation strategy. The student also would be responsible to make the appropriate links and associations with the relevant theoretical material taught during the course.

The grade for the final project grade will be based 50% on the written paper and 50% on the presentation. The proposal will not be graded; it is to ensure an appropriate topic. The written portion will be evaluated based on: 1) demonstrating a critical understanding of the scientific literature that addresses the selected topic and 2) proposing a creative, but feasible adaptation strategy to the issue. A quantitative approach to solve the problem is welcome, but not compulsory, and so it would be a student choice that needed to be well justified. The presentation will be evaluated for the ability to clearly present the problem and solution so their peers understand it (40%) and addressing any questions and defending the proposed solution (10%).

Policies and Expectations: Attendance, Late Papers, Missed Tests, Class Behaviors and Civility
Students are expected to arrive on time, attend all classes, and to stay until the end of class unless they have notified the instructor otherwise. Students are responsible for completing assigned readings and homework. Late assignments will be marked down a grade for each day it is late, unless an extension was granted. We ask that mobile devices be turned off during class.

Course Schedule:

*Module 1: Climate & the hydrologic cycle*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Readings</th>
<th>Assignment</th>
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<td><strong>Seminar 1</strong>: Example seminar given by instructor</td>
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| Week 4 | Changes in seasonality Climate, populations & the geography of water  
2. How humans & ecosystems use water  
3. Where humans are; where the water is |
| Week 5 | Variability vs. trends  
4. Decadal variability of long-term climate |
| Week 6 | Neo-Paleo  
5. Regional differences  
6. Extreme events |
| Week 7 | Abrupt climate shifts & the fall of civilizations  
Deeper Paleo changes in hydrology |

### Module 2: Historical climate change & variability

| Week 5 | Seminar 2 Additional Readings  
Pederson et al., 2011 Science  
Held & Soden, 2006 Climate Woodhouse, 2003 Climate and Water, Chapter 1 |
| Week 6 | Seminar 4 Additional Readings  
Climate and Water, Chapters 2 & 3  
Milly et al., Nature, 2002 |
| Week 7 | Seminar 6 Additional Readings |

| Week 4 | Seminar 3 Additional Readings  
Hoekstra, PNAS, 2012  
Bonan Science 2008  
Postel, Science, 1996 |
| Week 5 | Seminar 4 Additional Readings  
Climate and Water, Chapters 2 & 3  
Milly et al., Nature, 2002 |
| Week 6 | Seminar 5 Additional Readings  
Cook et al., 2010  
Pederson et al., 2013  
Mantonse & Frei, 2013 |
| Week 7 | Seminar 6 Additional Readings |

| Week 4 | Critique 3 due  
Allen et al., PNAS 1998 |
| Week 5 | Critique 4 due  
Trenberth et al, Clim Res, 2011 |
| Week 6 | Critique 5 due  
Cook et al., 2004; |
| Week 7 | Critique 6 due  
Buckley, PNAS, 2010; |

| Week 4 | Reading:  
Trenberth et al, Clim Res, 2011 |
| Week 5 | Reading:  
Cook et al, Science, 2004 |
| Week 6 | Reading:  
Buckley et al, Science, 2010  
Final Project Proposal |
| Week 7 | Reading:  
Gleick et al, PNAS, 2010 |
### Module 3: Future climate change & water management

<table>
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<tr>
<th>Week 8</th>
<th>Oct 24</th>
<th>Projected changes in mean states regionally</th>
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<td>7.</td>
<td></td>
<td>Ice ages, droughts &amp; floods</td>
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<td>8.</td>
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<td>Global circulation models &amp; future scenarios</td>
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<td>9.</td>
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<td>Uncertainty</td>
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<td>10.</td>
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<td>Changes in extremes</td>
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<td>11.</td>
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<td>Impacts on sectors</td>
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<td></td>
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<td>Population, its changes &amp; human water demands</td>
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**Critique 7 due**
Gleick, *PNAS*, 2010

**Seminar 7 Additional Readings**
*Climate and Water*, Chapters 4 & 5
Vorosmarty et al., *Science*, 2000
Rogers, *Scientific American*, 2008

**Reading**:
Milly et al., *Science*, 2008

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<tr>
<th>Week 9</th>
<th>Oct 31</th>
<th>Using climate projections for water management</th>
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<td></td>
<td></td>
<td>Critique 8 due</td>
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<td>Milly et al., <em>Science</em>, 2008;</td>
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**Seminar 8 Additional Readings**
Rajagopalan et al., *Water Resources Management*, 2009
Barnett et al., *PNAS*, 2009

**Study!**

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<th>Week 10</th>
<th>Nov 7</th>
<th>Midterm exam</th>
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**Reading**:

### Module 4: Adaptation & management strategies

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<th>Week 11</th>
<th>Nov 14</th>
<th>Traditional engineering options</th>
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<td></td>
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<td>Critique 9 due</td>
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**Seminar 9 Additional**

**Reading**:
Choo 2009
| Week 12     | Two Case Studies: Water use in New York and Singapore | **Readings**  
*Climate Change Handbook for Regional Water Planning*  
Brown and Lall, *Natural Resources Forum*, 2006 |
|-------------|------------------------------------------------------|--------------------------------------------------|
| Nov 21      |                                                      | **Critique 10 due**  
Choo *Water Resources Development and Management*, 2009 |
|             |                                                      | **Seminar 10 Additional Readings**  
Pires, *Land Use Policy*, 2004  
Tortajada *Water Resources Development*, 2006 |
| Week 13     | Final project presentations                          | None                                             |
| Dec 5       |                                                      |                                                  |
| Week 14     | AGU – no class!                                      | None                                             |
| Dec 19      |                                                      |                                                  |
| Week 15     | Final project presentations                          | None                                             |
| Dec 19      |                                                      |                                                  |
APPENDIX A

Student Information Page

Please complete this information page and post to the Courseworks site before the first class meeting. I will use this information to plan the semester, to get to know you, and to contact you by email or phone if the need arises. I will not share this information with anyone without your consent.

Name_______________________________ Student ID# ______________

Contact me by phone at:  Home:_______________________
                           Work:_______________________
                           Other:_______________________

My UNI email address: ________________________________

Identify the degree program or certificate program you are in:

Explain why you are you taking this course and how it fits into your degree or certificate program.

What are your expectations for the course?

Briefly describe related experiences or courses that are relevant to this course:

If you require special accommodations, please indicate that below and be sure to discuss them with me soon.
Appendix B

Policies and Expectations:

Academic Integrity

The School of Continuing Education does not tolerate cheating and/or plagiarism in any form. Those students who violate the Code of Academic and Professional Conduct will be subject to the Dean’s Disciplinary Procedures. The Code of Academic and Professional Conduct can be viewed online:
http://ce.columbia.edu/node/217

Please familiarize yourself with the proper methods of citation and attribution. The School provides some useful resources online; we strongly encourage you to familiarize yourself with these various styles before conducting your research:
http://library.columbia.edu/help/howto/endnote.html

Violations of the Code of Academic and Professional Conduct will be reported to the Associate Dean for Student Affairs.

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/services/ods/support