# SUMA K4147: Water Resources and Climate
# Spring 2018

## Class Syllabus

**Scheduled class times:**

Wednesdays, 6:10-8:00 pm

**Office hours:**

By appointment; place TBD

**Instructors information:**

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Emails will be responded within 12 hours during the workweek. Emails sent on Saturday will not likely receive a response until Monday.

**Course Overview:**

The fragility of water resources under a changing climate has received increasing awareness amongst policy makers, planning and environmental agencies, stakeholders and beyond; driven by exciting developments in climate science and bolstered by a surge in media coverage.

An important driver of water resource availability is the interaction between the hydrologic cycle and the climate system. With climate models projecting a future of an increasingly variable and extreme climate system, the resulting impacts on the water cycle are of key relevance to the sustainable management of water resources.

This course will cover the science needed to understand the main features of the global water/hydrologic cycle, the link between science of water and climate, and how climate variability and change is affecting the water cycle, and by association the natural and human systems. Using this knowledge, students will use case studies and review scientific literature to critically evaluate real-world water security issues and develop sustainable solutions to address them.

The interaction between water and climate plays and integral role on the coupling between natural and human systems, and the experiences gained in this course are a valuable complement to other courses in the Sustainability Management Program.

**Learning Objectives:**

1. Understand the water/hydrological cycle and its connection to climate.
2. Understand how variability and changes in the climate affect/will affect water supply and availability on land.
3. Understand how water impacts ecosystems.
4. Learn how to critically evaluate a scientific article and write a review.
5. Diagnose the cause of a climate-related water problem and develop solutions to address it.

*-- This syllabus is a guide for our semester and is subject to further changes. --*

**Text/Readings:**

There is no assigned textbook for this class. Readings will be taken from reports and scientific articles, and may be supplemented with news articles, depending on current events as the class progresses.

**Resources and Communication Channels:**

Courseworks/Canvas will be used to distribute reading materials, lecture slides, and to turn in assignments unless specified otherwise. Students are expected to check email on a daily basis during weekdays to stay current with course-related communications.

**Course Requirements and Grading:**

The course will consist of readings, homework assignments, one exam, and a final project, consisting of a paper and a presentation in class. The final grade will be calculated as follows:

- 5% - Attendance
- 35% - Written critiques
- 10% - Participation
- 20% - Exam
- 30% - Final Project (15% written paper + 15% presentation)

Most classes will be divided in two sections. During the first part the instructor will deliver a theoretical basis, while on the second part a reading discussion will be held.

**<u>Final grade letter equivalent</u>**

| | | | |
|---|---|---|---|
| **A+** | **100% to 98%** | **C+** | **< 80% to 77%** |
| **A** | **< 98% to 93%** | **C** | **< 77% to 74%** |
| **A-** | **< 93% to 90%** | **C-** | **< 74% to 70%** |
| **B+** | **< 90% to 87%** | **D** | **< 70% to 66%** |
| **B** | **< 87% to 84%** | **F** | **< 66% to 0%** |
| **B-** | **< 84% to 80%** | | |

***Attendance*** *(5% of final grade)*

Students are expected to attend class. The attendance grade will be proportional to the number of classes attended. Missing classes without justification may imply losing the complete attendance grade.

***Written critiques*** *(35% of final grade)*

Written assignments will be requested for 9 scientific papers discussed in class. For all students, these written critiques are due via Courseworks/Canvas at **2PM** on the day of class.

The grades of the 9 written critiques will make up 35% of the student's total grade.

Each critique must include:

- A short essay giving an overview of the reading (not less than 200 and no more than 300 words)
- Two strengths and two weaknesses of the investigation/reading
- Two critical questions that can be used as a part of the class discussion

The critique should discuss the readings in terms of the topics covered, the strengths and weaknesses of the articles, and critical aspects of the research presented. We have included the following list to act as a guideline for preparing your critique. Not all points need to be included in every critique.

- Provide a general overview
- Explain the main ideas
- Explain important numbers/facts
- Incorporate original thought
- Tie the paper into the overarching theme of the course

Late Submission

Written critiques are due before ***2PM on the day of class.*** Please let us know of any extenuating circumstances that may prevent you from meeting this deadline as soon as possible. We considered that it is crucial that all the students have read and wrote a thoughtful review before the discussion in class. For this reason, critiques received after 2PM will be subject to deductions:

- 2:01 PM to 6:00 PM (day of class) – 5 point deduction
- 6:01 PM to Midnight on day of class – 10 point deduction
- Day after class – 15 point deduction

Later than day after class– maximum grade possible will be **80**. Feedback from the instructor is not guaranteed.

***Participation*** *(10% of final grade)*

Participation on the topics of discussion of the course will account for 7% of the final grade, while the 3% will be based on the student's participation in the online discussions and forums in CANVAS. This grade will be an average from the individual evaluation of the instructors.

This participation grading will be elaborated based on the participation of the students on the discussions of the readings during class, and on these and other topics proposed through Courseworks/Canvas. The students are expected to show critical thinking, respectful interactions with classmates and a positive attitude towards learning and freely discussing the topics proposed. Students are encouraged to share the critical questions from their assignments with their peers.

***Exam*** *(20% of final grade)*

There will be one in-class two-hour written exam that will evaluate concepts, ideas, themes and issues that were covered in class until the evaluation date. It will be composed of short-answer essay questions. The specific point value of each question will be detailed at the time of the exam.

***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 **water resources and climate**. The total grade for the final project (30%) will be based on the written paper (15%) and the presentation (15%).

A mandatory **project proposal** will be due on **February 26th** for topic approval. The proposal will not be graded; it is meant to ensure an appropriate topic and it is a pre-requisite for the acceptance of the final project. For the **proposal** we request the submission of a document of less than one page describing the project and how you plan to approach your paper. Failing to turn the proposal on a timely manner will forfeit the submission of the final project or points removal from the final written project.

The student will be responsible for reading primary source material on the topic, evaluating the scientific uncertainty behind the issue, and recommending adaptation solutions, management approaches and/or strategies as appropriate depending on the topic discussed. The student will also be responsible for making the appropriate links and associations with the relevant theoretical material covered during the course. On **March 21st**, the students will present their reviewed proposal in class. This is meant to help students acquiring constructive feedback from classmates.

The **written paper** will be due on **April 23rd**. This paper 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 solution/management/adaptation strategy to the issue. The written paper grades will be an average from the individual evaluation of the instructors.

The **presentations** will take place on **April 25th**. The presentation will be evaluated by the ability to clearly present the problem and potential solutions to your peers, to address any questions and to defend the proposed adaptation strategy on a timely manner (TBD before the presentation). Presentation grades will be an average from the individual evaluations of the instructors and classmates.

More complete **final project guidelines** will be circulated through Courseworks/Canvas in advance of the deadlines.

**Policies and expectations: Attendance, late papers, missed tests, class behavior 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 unless an extension was granted. **We ask that mobile devices be turned off and stored properly during class**.

## Course Schedule

| | LECTURE/EVENTS | ASSIGNMENTS | ADDITIONAL MATERIAL |
|---|---|---|---|
| **Jan 17th** | **CLASS 1**<br>**The water cycle: an introduction** | | Dingman (2015)-<br>Chapter 2, 8 & Appendix B |
| **Jan 24th** | **CLASS 2**<br>**Connections between climate and water** | **- Written critique 1 due**<br>Oki and Kanae (2006) | Bates et al. (2008) Chapter 1<br>Gleick and Palanappian (2010) |
| **Jan 31st** | **CLASS 3**<br>**The impact of climate change on the hydrological cycle** | **- Written critique 2 due**<br>Trenberth (2011) | Held and Soden(2006)<br>Bates et al. (2008)- Chapter 2&3<br>Hegerl et al.(2015) |
| **Feb 7th** | **CLASS 4**<br>**The role of ecosystems to changes in the hydrological cycle** | **- Written critique 3 due**<br>Allen and Breshears (1998) | Williams et al. (2012)<br>Bonan (2008)<br>Aragão (2012) |
| **Feb 14th** | **CLASS 5**<br>**Paleo-perspectives on hydroclimate variability** | **- Written critique 4 due**<br>Cook et al. (2010) | Cobb et al. (2003) |
| **Feb 21th** | **CLASS 6**<br>**The coupling of hydroclimate variability with human systems** | **- Written critique 5 due**<br>Buckley et al. (2010) | Pederson et al. (2014)<br>DeMenocal (2011)<br>Cook et al. (2010)<br>Gemenne et al. (2011) |
| **Feb 26th** | | **FINAL PROJECT PROPOSAL DUE** | |

| | LECTURE/EVENTS | ASSIGNMENTS | ADDITIONAL MATERIAL |
|---|---|---|---|
| **Feb 28th** | **CLASS 7**<br>**Climate change projections** | **- Written critique 6 due**<br>Sedlácek and Knutti (2014) | Bates et al. (2008)- Chapter 4&5<br>Hawkins (2011) |
| **Mar 7th** | **CLASS 8**<br>**Climate variability and change (climate modes)** | **- Written critique 7 due**<br>Fyfe et al. (2016) | Greene et al. (2011)<br>Trenberth (2015) |
| **Mar 21th** | **CLASS 9**<br>**Good practices of scientific research and reporting** | Students presentation of final project **proposal** | Fisher at al. (2016)<br>Appendix A (plagiarism and citation management) |
| **Mar 28th** | **CLASS 10**<br>**Climate Information and Applications** | **- Written critique 8 due**<br>Wilby and Dessai (2010) | Milly (2008)<br>Winkler et al. (2011) |
| **Apr 4th** | **CLASS 11**<br>**EXAM** | **STUDY!** | |
| **Apr 11th** | **CLASS 12**<br>**WORKSHOP**<br>**Tools for climate analyses** | | |
| **Apr 18th** | **CLASS 13**<br>**Water management approaches to climate variability and change** | **- Written critique 9 due**<br>Heikkila et al. (2012) | Moss et al. (2017)<br>Khoo (2009)<br>Thomson et al. (2011)<br>Sweeney et al. (2014)<br>Schwarz et al. (2011) |
| **Apr 23rd** | | **FINAL PROJECT:**<br>**WRITTEN REPORT DUE** | |
| **Apr 25th** | **CLASS 14**<br>**FINAL PROJECT PRESENTATIONS** | | |

## Reading Material References


Allen, Craig D., and David D. Breshears. "Drought-induced shift of a forest–woodland ecotone: rapid landscape response to climate variation." *Proceedings of the National Academy of Sciences* 95.25 (1998): 14839-14842.

Aragão, Luiz EOC. "Environmental science: The rainforest's water pump." *Nature* 489.7415 (2012): 217-218.

Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.

Bonan, Gordon B. "Forests and climate change: forcings, feedbacks, and the climate benefits of forests." *science* 320.5882 (2008): 1444-1449.

Buckley, Brendan M., et al. "Climate as a contributing factor in the demise of Angkor, Cambodia." *Proceedings of the National Academy of Sciences* 107.15 (2010): 6748-6752.

Cobb, Kim M., et al. "El Nino/Southern Oscillation and tropical Pacific climate during the last millennium." *Nature* 424.6946 (2003): 271-276.

Cook, Edward R., et al. "Asian monsoon failure and megadrought during the last millennium." *Science* 328.5977 (2010): 486-489.

Cook, Edward R., et al. "Megadroughts in North America: Placing IPCC projections of hydroclimatic change in a long-term palaeoclimate context." *Journal of Quaternary Science* 25.1 (2010): 48-61.

deMenocal, Peter B. "Climate and human evolution." *Science* 331 (2011): 540.

Dingman, S. Lawrence. *Physical hydrology*. Waveland press, 2015.

Fisher JP, Jansen JA, Johnson PC, Mikos AG. Guidelines for writing a research paper for publication. Mary Ann Liebert, Inc. Accessed on:18-10-2016.

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Gleick, Peter H., and Meena Palaniappan. "Peak water limits to freshwater withdrawal and use." *Proceedings of the National Academy of Sciences* 107.25 (2010): 11155-11162.

Greene, Arthur M., Lisa Goddard, and Rémi Cousin. "Web tool deconstructs variability in twentieth-century climate." *Eos, Transactions American Geophysical Union* 92.45 (2011): 397-398.

Hawkins, Ed. "Our evolving climate: communicating the effects of climate variability." *Weather* 66.7 (2011): 175-179.

Hegerl, Gabriele C., et al. "Challenges in quantifying changes in the global water cycle." *Bulletin of the American Meteorological Society* 96.7 (2015): 1097-1115.

Heikkila, Tanya, et al. "Designing Sustainable and Scalable Rural Water Supply Systems: Evidence and Lessons from Northeast Brazil." (2012).

Held, Isaac M., and Brian J. Soden. "Robust responses of the hydrological cycle to global warming." *Journal of Climate* 19.21 (2006): 5686-5699.

Khoo, Teng Chye. "Singapore water: yesterday, today and tomorrow." *Water Management in 2020 and Beyond*. Springer Berlin Heidelberg, 2009. 237-250.

Milly, P.C.D, et al. Stationarity is Dead: Whither Water Management? *Science* 319 (2008).

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Oki, Taikan, and Shinjiro Kanae. "Global hydrological cycles and world water resources." *science* 313.5790 (2006): 1068-1072.

Pederson, Neil, et al. "Pluvials, droughts, the Mongol Empire, and modern Mongolia." *Proceedings of the National Academy of Sciences* 111.12 (2014): 4375-4379.

Schwarz, Andrew, et al. "Climate change handbook for regional water planning." (2011).

Sedlácek, Jan, and Reto Knutti. "Half of the world's population experience robust changes in the water cycle for a 2° C warmer world." *Environmental Research Letters* 9.4 (2014): 4008.

Sweeney, Alexandra, et al. "Utilizing remote sensing to explore environmental factors of visceral leishmaniasis in South Sudan." *EO Heal* (2014).

Thomson, Madeleine C., et al. "Africa needs climate data to fight disease." *Nature* 471.7339 (2011): 440-442.

Trenberth, Kevin E. "Changes in precipitation with climate change." *Climate Research* 47.1-2 (2011): 123-138.

Trenberth, Kevin E. "Has there been a hiatus?." *Science* 349.6249 (2015): 691-692.

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## APPENDIX A

**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/locations/undergraduate/citationguide.html

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

You can find **reference and citation management** tools at:

http://library.columbia.edu/research/citation-management.html
http://www.chicagomanualofstyle.org/tools_citationguide.html

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http://health.columbia.edu/services/ods/support