

Seminar: Problems in Climatology (GEOG 8901)
Hydroclimatology
Spring 2022

Instructor: Dr. Steven M. Quiring
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Class day/time: Tuesday/Thursday 2:20-3:40, 1116 Derby Hall
Online Course Information: <http://carmen.osu.edu>

Course Description:

Hydroclimatology is defined by Mather (1991) as the “study of the influence of climate upon the waters of the land”, while Hirschboeck (1988) offered that it is “an approach to studying hydrologic events within their climatological context”. In this seminar, a more holistic definition is used; hydroclimatology is defined as the study of atmospheric moisture and surface water. Hydroclimatology utilizes climatic data and land surface models to understand the global hydrologic cycle and to investigate a wide range of environmental problems, including droughts and floods.

This seminar will cover the fundamental theories that are necessary to understand hydroclimatology and evaluate contemporary research and debates. This class will be taught using a mixture of lecture and discussion (seminar style). Each topic will be introduced through a lecture given by the instructor that will cover core concepts and relevant theories. This introduction will be followed by student-led discussions of relevant peer-reviewed papers. The research project will provide students with an opportunity to apply the knowledge that they have gained over the semester to focus on a topic of their choosing. It is expected that students will have a basic understanding of climatology (such as GEOG 5900) prior to taking this class.

Course Objectives:

The objectives of this course are to:

- (1) Develop a conceptual understanding of hydroclimatology including the relevant theory and commonly used data and methods
 - (2) Read, critically evaluate and discuss key publications and contemporary research in the field of hydroclimatology
 - (3) Apply this knowledge in an individual research project. The topic of this project should be relevant to your graduate research and must be approved by the instructor. The background, data & methods, and results of your project will be summarized in paper written in the format of *Journal of Hydrometeorology* (e.g., American Meteorological Society format).
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Learning Objectives:

As a result of taking this course you should know (knowledge objectives) and be able to do certain things (skill objectives).

Knowledge objectives (Things you should know by the end of the course):

- Define climatology and hydroclimatology and discuss its role in climate science
- Summarize the current state of knowledge regarding hydroclimatology and selected sub-components thereof
- Critique published research on hydroclimatology and be able to describe the strengths and weaknesses of the data and methodology utilized by the authors
- Describe the limitations and biases of commonly used climatic data sets (e.g., station data, reanalysis data)
- Describe the strengths and weaknesses of commonly used methods in hydroclimatology

Skill objectives (Things you should be able to do by the end of the course):

- Interpret formulas, graphs, tables, and schematics, and draw inferences from them
 - Locate and analyze climate data sources (including NCDC climate division and station data, NCEP/NCAR reanalysis data, TRMM precipitation (or other satellite data), paleoclimate data (e.g., IODP, tree rings), GCM data from IPCC AR4 models, and teleconnection data)
 - Create graphics (line graphs, pie graphs, box plots, etc.) that effectively communicate information and support your arguments
 - Represent climate information symbolically, visually, numerically, and verbally
 - Import, summarize, and analyze climate data
 - Calculate and interpret statistics
 - Analyze variability and trends in climate data
 - Complete hydroclimatic analyses and explain the results
 - Analyze climate data using a variety of tools/methods (for example: scientific programming, statistical methods (regression, multiple regression (including step-wise), data reduction (PCA, EOF), model evaluation and cross validation, compositing, clustering and self-organized maps, time series analysis, CCA, trend, bootstrapping and Monte Carlo simulation), and modeling (statistical models, dynamical models)
 - Perform library research
 - Write a literature review (synthesis of the literature)
 - Critically evaluate the published research
 - Proof-read and edit your own work
 - Critically evaluate your own writing and the writing of your peers
 - Write a scientific research paper that conforms to the accepted standard for publication in a peer-reviewed journal
 - Deliver clear and concise oral presentations
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Course Outline:

Tentative schedule of topics to be covered (subject to change).

Part I: What is hydroclimatology? January 11 and January 13

Part II: Global hydrologic cycle January 18 to January 20
Importance, primary processes, spatial and temporal variability

Part III: Precipitation variability and processes January 25 to February 8
Mechanisms; global precipitation climatology; primary factors responsible for spatial and temporal variability; influence of climate change

Part IV: Evapotranspiration February 10 to February 22
Mechanisms; methods for estimating/modeling ET and PET; global patterns; primary factors responsible for spatial and temporal variability; influence of climate change

Part V: Soil Moisture and Streamflow February 24 to March 22
Mechanisms; methods for modeling; primary factors responsible for spatial and temporal variability; anthropogenic influences; land-atmosphere interactions

Part VI: Hydroclimatology: methods and applications March 24 to April 14
Topics will be selected based on the interests of the students. They could include topics such as: satellite, radar and gage data; precipitation bias adjustment; land surface models; droughts monitoring and prediction; flood forecasting; seasonal climate prediction

Part VII: Student presentations April 19 & April 21

Grading:

Participation: class discussions and paper presentations	30%
Exams (2 x 15%; March 1 and April 27)	30%
Project presentation (April 19 or 21)	10%
Research Paper (Monday, April 18)	30%

The grading scale is:

A	= 93 to 100%
A-	= 90 to 92%
B+	= 87 to 89%
B	= 83 to 86%
B-	= 80 to 82%
C+	= 77 to 79%
C	= 73 to 76%
C-	= 70 to 72%
D+	= 67 to 69%
D	= 63 to 66%
D-	= 60 to 62%
E	= <59%

Participation (30%):

Participation is worth 30% of your final grade and it will be determined based on three components:

- (1) Article reviews (10%)
- (2) Paper presentations (10%)
- (3) Class discussions (10%)

(1) Article reviews: Students are expected to carefully and critically read all of the assigned journal articles. For each class meeting, all students will read the assigned material and bring to class a summary with critique notes and discussion questions in response to the readings (up to about one page). These exercises will be turned in as part of the participation grade, and they will enable informed in-class discussion.

(2) Paper presentations: Each student will be responsible for presenting and leading a number of discussions on the papers that are covered in class. The schedule will be arranged in consultation with the instructor. The student leader(s) for each discussion will give a short presentation summarizing the article(s) and lead the subsequent discussion. Lead students are expected to obtain and read additional articles where appropriate and synthesize all the relevant information in their presentation and discussion. Students are required to prepare formal presentations following the guidelines that will be discussed in class.

(3) Class discussions: True participation during each class meeting, as well as diligence on assignments and readings before and after each class, are essential. Simply attending class and/or attempting to participate by making ad-hoc comments will result in a low participation grade, as will poor or incomplete weekly assignments.

Exams (30%):

There will be two exams in this course. A mid-term exam worth 15% of your final grade (March 1) and a final exam (Wednesday, April 27; 2-345 pm) worth 15% of your final grade. The exams will be essay-based exams and will require students to synthesize the material covered in readings, discussions and lectures.

Research Paper (30%):

The research paper will summarize the background, data & methods, and results of your project will be summarized in paper written in the format of *Journal of Hydrometeorology* (e.g., American Meteorological Society format). The topic of the research paper will be selected by the student in consultation with the instructor. The paper should be approximately 15 double-spaced pages excluding references, figures and tables. Papers are due on Monday, April 18.

Research Presentation (10%):

Each student will be required to give an AMS-style presentation of their results on April 19 or 21. Each presentation will be 15 minutes with 5 minutes for questions at the end. A presentation rubric will be handed out in class.

Required textbook: none

Required readings: Readings for this class will be assigned by the professor. These readings will be drawn from peer-reviewed articles in climatology, atmospheric science and geography journals that are relevant to the problem-based learning projects that the students decide to pursue. Because the PBL projects are selected by the student and vary from semester to semester the reading list will be developed each semester based on the research projects.

Statement on Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct at <http://studentlife.osu.edu/csc/>.

Disability Services

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.
