Applied Climatology (GEOG 8902)

Spring 2020

Instructor: Dr. Steven M. Quiring
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Office Hours: T & TR 4:00–5:00 p.m. and by appointment
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Class Meeting Time and Place: T and TR 2:20–3:40 p.m., 1116 Derby

Online Course Information: http://carmen.osu.edu/

Course Objective:
The objective of this course is to provide you with experience utilizing climate data and methods to address environmental problems. These skills will be acquired through a real-world semester-long project. The class will be divided up into teams and each team will work on a collaborative research project that develops a tool or model for a client. The final product of this course will be an applied climate tool/model that is delivered to the client. In addition, a project report (co-authored by all team members) that summarizes the data, methods and model/tool development and applications will be submitted to the client. This report should be of sufficient quality to be submitted to *Journal of Applied Meteorology and Climatology* or another appropriate peer-reviewed journal.

Course Description:
Applied climatology involves the application of climatic data and techniques to solve a wide range of environmental problems. Therefore, applied climatology involves many other disciplines (e.g., Anthropology to Zoology). Applied climatology seeks to identify the relationships between climate and environmental or social systems and utilize these relationships to develop practical applications, models, or tools that facilitate decision making, adaptation, or mitigation.

This course introduces a number of data sets and methodologies that are commonly used by climatologists. These methodologies will be introduced through a problem-based learning approach. Problem-based learning (PBL) is a collaborative learning approach that puts the students' engagement with a real-world, complex problem at the center of the learning process. Curricular content is organized around a series of real life problems (i.e., relevant to professional practice in the discipline), rather than topics or chapters in a textbook. The course content objectives are integrated with the problems and require students to build upon their existing knowledge and skills (i.e., scaffolding). The selected problems that will be addressed this semester are open-ended and complex to encourage critical thinking, creativity, and group discussion and collaboration. Students will work in small groups to identify what they know, and more importantly, what they do not know and must learn (i.e., learning issues) to solve the problem. My primary role as the instructor is to facilitate group process and to guide students to answers by questioning

and offering resources. Problem-based learning encourages students to assume a greater responsibility for their learning by emphasizing critical thinking skills, understanding, learning how to learn (metacognition), and cooperative work. You will gain knowledge and skills through an in-depth analysis of a real-world problem.

This research project will provide you with an opportunity to analyze climate data and utilize a number of analytical tools that will be introduced during the semester. It is expected that students will have a basic understanding of climatology and statistics prior to taking this class. You will be able to select the software that is most appropriate for analyzing and visualizing climate data.

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 applied climatology and discuss why it is an important science
- Summarize the current state of knowledge about (topic to be defined during the class)
- Critique published research on applied climatology 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, radar data)
- Describe the strengths and weaknesses of commonly used applied climate (and statistical) methods (e.g., regression, principal components analysis, compositing, clustering)

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 renanalysis data, TRMM precipitation (or other satellite data), paleoclimate data (e.g., IODP, tree rings), GCM data from IPCC models (CMIP5), 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 trends in climate data
- Calculate correlations 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

Course Outline:

Since this may be your first experience participating in a PBL course, I will begin by introducing the basics of PBL and describing how this course will operate. The first 2 weeks of the course will provide an overview of applied climatology and it will also introduce the clients and projects that we will be working on this semester. In addition, I will introduce best practices for project management, data sharing, code development and versioning, and other skills that are relevant to your project. Students will then be divided into teams and the remainder of the course will be organized around developing an applied climate model/tool for your client.

WEEK	DATE	TOPIC
1	January 7 & 9	Introduction to PBL What is applied climatology? Examples of applied climate applications
2	January 14 & 16	Overview of client projects Introduction to project management
3	January 21 & 23	Determine research groups & projects; chose a group leader; **Initial meeting with client**; develop a list of tasks and a schedule
4	January 28 & 30	Literature review & background (group presentations) -Draft proposal, timeline and task list are due
5	February 4 & 6	Communication and Visualization (group presentations) -Revised proposal is due -Mock-up of user interface for tool/model
6	February 11 & 13	Data (group presentations) -selection of best datasets for project

		-define study area, time period, spatial and temporal resolution -treatment of missing data; data scrubbing and QC
7	February 18 & 20	Methods (group presentations) -selection of methods for modeling/tool development -strengths and weaknesses -model validation plan
8	February 25 & 27	Methods #2 (group presentations) -continued…
9	March 3 & 5	**Mid-term meeting with client** -present user interface, data, methods and functionality -get feedback from client -revise tasks and timeline based on client feedback
	March 10 & 12	Spring Break- NO CLASS
10	March 17 & 19	Research & development #1 (group presentations)
11	March 24 & 26	Research & development #2 (group presentations)
12	March 31 & Apr. 2	Research & development #3 (group presentations); **First draft of project report is due**
13	April 7& 9	AAG- No CLASS
14	April 14 & 16	Presentation of beta version of model/tool -refine model based on feedback from the class -practice presentation is a dry run for the final presentation given to the client
15	April 21	**Final presentation to client** -Times TBD based on client availability

Submit model/tool for evaluation [April 21]

Final project report due [April 28]

Grading:

Participation (based on peer feedback (50%) and professor (50%))	20%
Evaluation of model/tool (Monday, April 21)	40%
Final project report (Monday, April 28)	40%

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 (20%):
Students will be assigned a participation grade based on **peer-evaluations**. In order for this class to be successful, students need to be able to rely on their fellow group members to carry out the assigned tasks. Therefore, each student will be evaluated by their peers (50%) and the course instructor (50%). Participation grades will be based on your level of participation in all aspects of the research project including the weekly task assignments, developing the model/tool and writing/presenting the final report.

Model/tool Evaluation (40%):
There are two deliverables for the research project. Half of your grade is based on an evaluation of the software model/tool that you developed for the client. The evaluation will be based on my assessment as well as input from the client. The evaluation will be based on whether the tool meets the requirements specified by the client and the functionality/usability of the tool (Is the tool easy to use? Are the results communicated effectively? Can it be used operationally? Is it well-designed and visually appealing? Is it accurate?). I will distribute a rubric that provides more detail on how the tool will be assessed. This is a group project, so all members of your team will receive the same grade. You must either provide me with a copy of the code (if it is stand-alone code (e.g., R, python, etc.) or access to the tool (if it is web-based). You must submit the code by 4 pm on April 21.

Final Report (40%):
The second deliverable for the research project is a final report. The project report (co-authored by all team members) will summarize the data, methods and model/tool development. It will also provide an overview of the model validation results (if applicable). In addition, the report will include instructions for installing and operating

the software. Both the software and the project report will be submitted to the client. This report should be of sufficient quality to be submitted to *Journal of Applied Meteorology and Climatology* or another appropriate peer-reviewed journal. I except that all team members will participate in researching, writing, editing, and presenting the final report. All students in your team will receive the same grade on the final report based on the quality and completeness of the final product. You must submit to me both a digital and hard copy of your final report by 4 pm on Monday, April 28.

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.