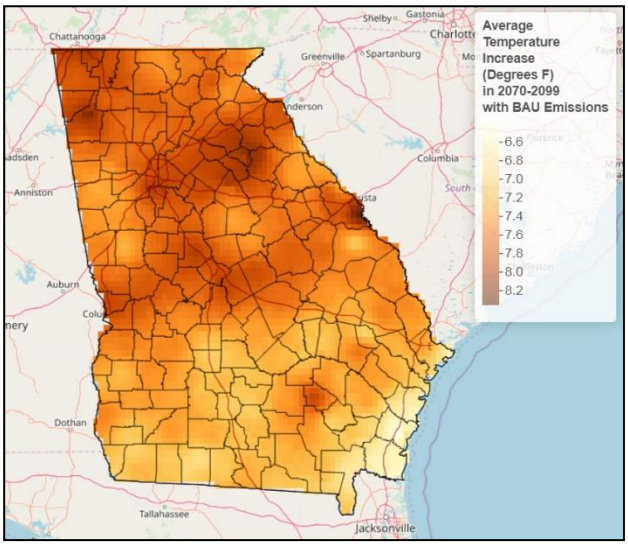
CP 4545 & CP 6545
Climate Change Analytics
William J. Drummond
Fall 2026



Course Syllabus

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Course Description

This is a course for students who want to confront the global problem of climate change using powerful, recently-developed tools from the fields of data science and geospatial analytics. The course's primary software environment is the R language and a suite of specialized R-based packages, but previous knowledge of R is not required or assumed.

Climate change analytics is especially challenging because the time horizons addressed can extend backward and forward for centuries, and any analysis of future climate change must deal with a broad range of unknowns while still applying scientific rigor. In addition, the rapid pace of climate change means that the past conditions are no longer a reliable guide for predicting future conditions. Instead, we must be guided by the output of climate models when we decide what actions we must take today to try to forestall or adapt to the worst effects of climate change in the future.

The course will address the major ways in which data analytics can help answer three major questions:

- What are the primary **causes** of climate change?
- What are the major **impacts** of climate change?
- What are the available **solutions** for climate change?

The course will, at many points, touch on climate change policy. However, climate change data and analysis methods, not policy, are the major foci of the course. Students who are also interested in climate change policy should consider these courses:

- CP 4190/6190: Introduction to Climate Change Planning
- CP 6217: Climate Change and the City
- PubP 6360: Sustainable Energy and Environmental Management
- PubP 6354: Climate Policy
- PubP 6701: Energy Technology and Policy

Learning Objectives

Students successfully completing this course will be able to:

- Create R scripts to import and format a variety of data related to climate change
- Utilize R to analyze climate change data to generate useful information
- Import and format relevant vector climate change spatial data
- Import and format relevant raster climate change spatial data
- Visualize climate change data through charting and mapping

Teaching Methods

The teaching methods for this class include a wide variety of methods, including lectures, in-class labs, class discussions, homework, required readings, LinkedInLearning videos, two tests, a final exam, and a class project. Students are expected to attend all classes. See below in the Grading section for class attendance details.

Course Materials

There are no required textbooks for this course. Additional materials or links to those materials will be posted on Canvas.

Course Software

The primary software environment will be the open-source R package and RStudio, supplemented with specialized R libraries for data wrangling and spatial analysis. However, prior experience with R or any other programming language is not a course pre-requisite. Students may use College of Design virtual machines with R, RStudio, and a pre-installed set of R libraries. But R, RStudio, and the necessary R libraries are all open-source software that students may download and install on personal computers.

Course Project

For undergraduate students: Your task is to compare (a) the energy sources of Georgia's

electricity generation and electricity CO_2 emissions to (b) the electricity sources and emissions of the United States as a whole.

For graduate students: Your task is to compare (a) the energy sources of Georgia's electricity generation and electricity CO_2 emissions to (b) the electricity sources and emissions of three other states, and to (c) the electricity sources and emissions of the United States as a whole. One of your states must be in the southeastern US (Alabama, Florida, South Carolina, North Carolina, Virginia, and Tennessee) and the other two must be elsewhere in the United States.

For everyone: Your primary data source should be the complete SEDS dataset. Use your R coding skills to identify all the electricity generation energy sources and produce at least one main table comparing your areas.

Write a brief memo explaining your findings and highlighting the major differences and similarities in comparing Georgia to the other four areas. Place your R code in an Appendix to your memo. For undergraduate students, the memo should be 600-900 words in length. For graduate students the memo should be 900-1,500 words in length. Include appropriate ggplot charts and tmap maps to support your memo.

You are encouraged to work together in debugging each other's existing code and discussing R commands and strategies, but you need to write your own code, and you cannot share your code with others.

Alternative project option: If you wish, you can substitute a custom climate change class project rather than the default project. A custom project should require a substantial amount of R coding and produce a similar 600-900 (for undergrads) or 900-1,500 (for graduate students) word memo and R code in an appendix. If you would like to do a custom project, I'm happy to discuss your possible project idea.
If you wish to do a custom project, please turn in a proposal in class on September 24. The proposal should include a single-sentence research question or topic, a 100-150 word description of what you aim to accomplish, and a listing of the major datasets you will use in the project.

Grading

See the Georgia Tech Student-Faculty Expectations Agreement in the Georgia Tech catalog for Institute-wide expectations for both students and faculty.

The Georgia Tech Honor Code is in effect throughout this course**.** You should review this code and make sure you understand your responsibilities. If you have any questions, please contact the instructor.

Test, exam, and project grades may be curved upward or downward depending on the actual distribution of grades in a particular test, exam, or project.

Homework sheets will be distributed on several Wednesdays and will be turned in during class the following Wednesdays. Homework will be checked for completion but not graded.

The two tests and final exam will take place during the designated classes and the GT-defined final exam period. Except in truly extraordinary circumstances as determined by the course instructor, you must take the tests and final exam on the scheduled days and times. **Plan now** to be in class for both tests and the final exam. See the course schedule below for details. Tests and the final will be held in the normal course classroom. They will have two components: short answer questions that are closed book, closed note, and closed computer, and hands-on questions that are open book, open note, and open computer.

All students are expected to attend every class and roll will be taken in most classes. Each student is allowed four absences during the semester, with no explanation to the professor necessary. For a fifth absence students will lose 2½ of the 5 points for class participation, and students with a sixth absence will lose all 5 class participation points. This policy is effective beginning in week 2 of the semester. Students who must miss class for Georgia Tech sports teams or other official Georgia Tech activities will not have those absences count against the four allowed absences.

Each student's final grade in the course will be based upon these components:

Homework	5 percent
Class participation	5 percent
Test 1	20 percent
Test 2	20 percent
Final exam	30 percent
Class project	20 percent
Total	100 percent

Course grades are assigned by the traditional grading scale:

90-100	-	A
80-90	-	B
70-80	-	C
60-70	-	D
Below 60	-	F

Throughout the course, work from undergraduate students and graduate students will be graded according to separate and appropriate standards.

Use of Generative AI and Large Language Models (LLMs)

This course treats AI-based assistance, such as Copilot or ChatGPT, the same way it treats collaboration with other people: you are welcome to talk about your ideas and work with other

people, both inside and outside the class, as well as with AI-based assistants. However, all work you submit must be your own. You should never include in your assignment anything that was not written directly by you without proper citation including quotation marks and in-line citation for direct quotes.

Including anything you did not write in an assignment without proper citation will be considered as an academic misconduct case. If you are unsure where the line is between collaborating with AI and copying AI, here are several heuristics:

Heuristic 1: Never hit "Copy" within your conversation with an AI assistant. You can copy your own work into your own conversation, but do not copy anything from the conversation back into your assignment. Instead, use your interaction with the AI assistant as a learning experience, then let your assignment reflect your improved understanding.

Heuristic 2: Do not have your assignment and the AI agent open at the same time. Similar to the above, use your conversation with the AI as a learning experience, then close the interaction down, open your assignment, and let your assignment reflect your revised knowledge. This heuristic includes avoiding using AI directly integrated into your composition environment: just as you should not let a classmate write content or code directly into your submission, so also you should avoid using tools that directly add content to your submission. (Thanks to David Joyner in the Georgia Tech College of Computing for developing and sharing the original text that is the basis for the above sections of this policy.)

Heuristic 3: In assignments for this course, you **may** use Copilot or other LLMs for

- Research, search, and search summaries,
- Tutoring, concept explanations, and concept exploration, and
- Brainstorming and generation of ideas

Heuristic 4: In assignments for this course, you **may not** use Copilot or other LLMs for

- Generation of charts, figures, or analyses,
- Generation of outlines or lists of topics, and
- Generation of text.

Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at 404.894.2563 or their website, as soon as possible, to discuss your needs and to obtain an accommodations letter. Then, make an appointment with me as soon as possible to discuss your learning needs.