# EDS 296 - A Climate Modeling Perspective on Big Data Techniques Spring 2025

**Instructor**: Samantha Stevenson
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**Course Lecture Times:** Mondays 12:30-1:45pm

**Overview**: As climate change becomes a more and more urgent concern, there is a pressing need for trained professionals able to understand and work with data generated from global climate models, across a wide range of industries. However, the datasets involved can be enormous - on the order of many terabytes. This makes climate data an excellent way to learn 'big data' techniques while also gaining highly marketable skills in analyzing and visualizing information from future projections generated with climate models. Students in this course will learn how to access large datasets via cloud computing services (Amazon Web Services), and become familiar with using network Common Data Format (netCDF) data and the terminology associated with the Coupled Model Intercomparison Project (CMIP). Students will also gain skills in dimension reduction techniques for data visualization and multivariate geospatial statistics including regression and covariance maps and principal component analysis.

**Course Objectives**

During this course, students will:

- Gain familiarity with file formats and naming conventions used in climate science
- Learn how to access and manipulate large datasets via the Amazon Web Services cloud computing facility
- Perform statistical analyses on large climate datasets, including both one- and multi-dimensional techniques
- Create data visualization products based on climate data (time series, spatial maps)
- Customize analyses for a climate application of their choosing, and develop written materials describing the results of these analyses

**Course Content Areas**

Network Common Data Format (netCDF) file structures and syntax
Climate modeling fundamentals: what are they and how do they work?
The Coupled Model Intercomparison Project (CMIP) and the Intergovernmental Panel on Climate Change (IPCC)
Organization of climate “big data”
Cloud computing access and best practices
Linear regression for single- and multi-dimensional datasets
Principal component analysis (PCA)/empirical orthogonal function (EOF) analysis

**Before The First Class**
Before the first week of class, you need to install Jupyter on your personal laptop. You should also make sure that you have a functioning Github account and profile, as well as having Git configured on your local machine.

**Course Assessment**
Your performance in this course will depend on:

- Two homework assignments (30% each)
- Participation in class coding sessions (10%)
- A final project adapting tools from the notebooks we use in class to an application (region, climate variable) of your choice and discussing the results (30%)

**Course Schedule (subject to change)**
See course Canvas site for specific lecture topics each week, reading materials/slides, assignments, and due dates. All assignments will be due via Canvas.

**Week 1**: Introduction to Climate Models
**Week 2**: Working with netCDF Files
**Week 3**: CMIP and the IPCC
**Week 4**: Cloud Computing Data Access
**Week 5**: More on Data Access
**Week 6**: Data Visualization: Linear Regression
**Week 7**: Data Visualization: Regression Maps
**Week 8**: Data Visualization: PCA/EOF
**Week 9:** NO CLASS - MEMORIAL DAY
**Week 10:** Final project practicum

**Code of Conduct:**
All students are expected to read and comply with the UCSB code of conduct. We expect cooperation from all members to help ensure a welcoming and inclusive environment for everybody. We are determined to make our courses welcoming, inclusive and harassment-free for everyone regardless of gender, gender identity and expression, race, age, sexual orientation, disability, physical appearance, or religion (or lack thereof). We do not tolerate harassment of class participants, teaching assistants, or instructors in any form. Derogatory, abusive, or demeaning language or imagery will not be tolerated.

**Student Support:**
We understand that ongoing crises impact students differently based on experiences, identities, living situations and resources, family responsibilities, and unforeseen challenges. We

encourage you to prioritize your well-being. We are here to help you reach your learning and career goals. You are always welcome to reach out to our teaching team so that we can best support you. Please see the UCSB Campus Resource Guide for campus student support and services.

**Disabled Students Program:**
Students with disabilities and/or alternative learning needs are encouraged to work with the Disabled Students Program at UCSB to ensure we can best support your learning and success.