**ES 520 – Modes of Climate Variability**

Syllabus – Spring 2018

**Instructor: Diane Thompson**

Office: [CAS](http://www.bu.edu/maps/?id=30) 141E Office Hours: W 11:30-12:30 PM / F 2-3 PM

Email: [thompsod@bu.edu](mailto:cregalla@bu.edu) Office Phone: (617) 353-9678

Class Meeting: Section A1 TR 3:30-4:45 pm [CAS](http://www.bu.edu/maps/?id=30) 220

**Course Description:**

Natural variability in the Earth’s climate system is generated by complex physical processes that govern the redistribution of energy and moisture over a rotating sphere with heterogeneous boundary conditions. Despite this complexity, much of the variability in the Earth’s climate system on interannual to decadal time scales can be explained by a few major modes (“patterns”) of climate variability. In this course, we will discuss these major modes of climate variability, including: El Nino-Southern Oscillation, Pacific Decadal Oscillation, Atlantic Multidecadal Oscillation, Monsoons, and Annular Modes. We will assess the dynamics/physical mechanisms driving these modes of variability and their impact on weather, climate and society. We will also investigate the evolution of each mode through time, using paleoclimatic evidence to assess how they have changed in the past and climate model simulations to project how they are expected to change in the future. By assessing the evolution of these modes of variability and the physical mechanisms behind them, we gain an improved understanding of how changes in climate forcing (e.g., greenhouse gases, solar radiation, volcanic eruptions) affect global and regional climate. The class will be a mixture of lectures, discussions, and student presentations.

**Learning objectives:**

Given a random example, students by the end of this course will be able to identify and interpret the main mode of climate variability influencing that system/record, explain the basic mechanisms and climate dynamics underlying that mode of variability, discuss how it has changed in the past and predict how it may change in the future.

To achieve this overarching goal, students will:

1. Synthesize, discuss and critique the scientific literature on each mode of variability in oral and written forms
2. Apply basic spatio-temporal analysis techniques to observed and simulated climate data sets to investigate these modes of variability

**Prerequisites:** None required

**Class structure**

Most Thursday class sessions will be student led discussions of two or three papers that go into more depth or expand on some aspect of the climate mode that we are focusing on that week. Each topic will be led by an individual (graduate) or small group of (2 undergraduate) students, and the papers and discussion will be summarized by an independent group of students. Students will sign up for topics the second week of class.

**Leading Discussion Session (20%)**

Each group will be responsible for:

1. ***Selecting the papers***. Students should work with the instructor to select appropriate papers for discussion. Presenters are encouraged to select papers that they are particularly interested in, but the papers should be of interest to the whole class. Papers that provide different approaches or contrasting evidence for variability in the mode are encouraged.
2. ***Creating a short (<1 page) list of focus questions*** to guide the group’s reading towards the critical points addressed by the papers.
3. ***Distributing the papers and focus questions to the class by the Friday*** preceding the Thursday discussion session
4. ***Presenting and leading a discussion on the papers***. Group members should lead/ co-lead a powerpoint presentation to guide a discussion on the main findings of the papers. The presentation should not be designed as a lecture, but rather to engage the class and facilitate discussion.

Students will be graded on these four elements and the overall effectiveness of leading a discussion on their topic following a grading rubric (available on the class website). Discussion leaders will also receive feedback from their peers.

**Discussion summary (10%)**

Each student will write a short (<1 page) summary of one of the student-led discussions that they do not lead. Each student must write their summary on their own. These summaries will be posted as a resource on the class website.

**Data exercises (30%)**

There will be several data analysis exercises throughout the semester designed to familiarize students with obtaining, manipulating and interpreting climate data using common spatio-temporal analysis tools and techniques. These data exercises will utilize data and analytical tools in IRI/LDEA Climate Data Library, a fantastic resource for climate data analysis that students can apply to their own research projects (<http://iridl.ledeo.columbia.edu/>). In the final exercise, students will synthesize what they learned throughout the semester by applying these tools to their own region of interest.

**Midterm and Final Exams (20% each)**

* Tests will consist of multiple choice, true/false, diagrams and short answer questions
* Anything covered in lectures, in-class discussions or the assigned readings is fair game for the test; however, tests will focus on major concepts, not details of individual papers

Partial credit: For all assignments and exams, partial credit will be given based on the level of completion and correctness. For problems that require calculations, *full credit will not be given if the appropriate supporting work and units are not clearly shown.*

Late Policy:

* Assignments are due at the beginning of class unless otherwise stated.
* Late penalty: 10% deduction per day late. If extenuating circumstances arise and you need an extension, you must arrange this prior to the original due date. Otherwise the full deduction will be taken.
* Assignments cannot be turned in for credit after the exercise has been graded and returned to the class.
* *No incomplete grades will be given for this course. Students are expected to complete the course material during the semester.*

Grades will be based on the following points/ percentages:

|  |  |  |
| --- | --- | --- |
| **Percentage** | **Letter** | **GPA** |
| 93-100 | A | 4.0 |
| 90-93 | A- | 3.7 |
| 87-90 | B+ | 3.3 |
| 83-87 | B | 3.0 |
| 80-83 | B- | 2.7 |
| 77-80 | C+ | 2.3 |
| 73-77 | C | 2.0 |
| 70-73 | C- | 1.7 |
| 60-69 | D | 1.0 |
| < 60 | F | 0.00 |

**Course Policies:**

Students are expected to:

* Attend class and participate in discussions
* Closely read the assigned readings. If you don’t read the papers, the rest of us will know!
* Begin data exercises, readings and other class preparations early enough that you have time to get help from peers or the instructor when you need it

**Readings and Required Text:** No textbook is required. We will discuss relevant papers for each topic.

**Course Outline** *(Tentative, subject to change)*

The following is an outline for the course. The details of the schedule may change, but the updated version (including the readings for each class period and data exercises) will be available on the course webpage.

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Date | Topic | Notes |
| 1 | 01-23-2018  01-25-2018 | Introduction to atmospheric dynamics  Introduction to ocean dynamics |  |
| 2 | 01-30-2018  02-01-2018 | Intro to Climate data, reanalysis & climate modeling  Timescales of variability & uncertainty discussion |  |
| 3 | 02-06-2018  02-08-2018 | Identifying modes of variability &  IRI climate database tutorial  No class: IRI database work time | DE1 assigned |
| 4 | 02-13-2018  02-15-2018 | El Niño-Southern Oscillation (ENSO) I  ENSO paper discussion I | DE2 assigned  DE 1 due |
| 5 | 02-20-2018  02-22-2018 | Monday Classes; ENSO discussion II  ENSO paper discussion (student led) | DE3 assigned  DE2 due |
| 6 | 02-27-2018  03-01-2018 | Monsoons  Monsoons paper discussion (student led) | DE4 assigned  DE3 due |
| 7 | 03-06-2018 | Spring Recess—no classes |  |
| 8 | 03-13-2018  03-15-2018 | Snow day  Indian Ocean Dipole (IOD) | DE4 due |
| 9 | 03-20-2018  03-22-2018 | IOD paper discussion (student led)  Midterm |  |
| 10 | 03-27-2018  03-29-2018 | Annular Modes I & II  Annular Modes paper discussion (student led) | DE5 assigned |
| 11 | 04-03-2018  04-05-2018 | Atlantic Multi-decadal Oscillation (AMO)  AMO paper discussion (student led) | DE5 due |
| 12 | 04-10-2018  04-12-2018 | Pacific Decadal Oscillation (PDO) I  PDO paper discussion I | DE6 assigned |
| 13 | 04-17-2018  04-19-2018 | PDO II  Project (DE6) work; No class |  |
| 14 | 04-24-2018  04-26-2018 | PDO paper discussion II (student led)  Future modes discussion (student led) |  |
| 15 | 05-01-2018  05-03-2018 | Future modes / Wrap-up/ Review    Take home exam administered | DE6 due |
| 16 | 05-09-2018 | Take-home exam due (by 5PM) |  |

**BU Policies:**

The College of Arts and Sciences policies on incomplete grades and academic conduct will be followed. For details refer to the BU undergraduate or graduate bulletins and the CAS Academic Conduct Code, at www.bu.edu/academics/policies/academic-conduct-code/. All written work must be your own.

**Classroom conduct:**

**Attendance Policy:** Students are expected to attend each scheduled class, to be on time, and to be prepared for each class session*. There will be no make-ups for in-class discussions or activities.*

**Cell Phones and Laptops:** Please respect the learning environment of your classmates and turn your cell phones off or on silent during class. In addition, please respect the time dedicated to you in the classroom by not texting or accessing the internet / social media during class. Some modules in this class utilize laptop computers– please restrict your use of these to the assignment.

**Communication – Blackboard**

I will rely on Blackboard to send course email announcements, updates to assignments, data etc. Please be sure you check Blackboard regularly or set up notifications. If you are having any problems receiving and sending communications though Blackboard, or having difficulty accessing course materials, please let me know. Information about Blackboard at BU can be obtained here:

<http://www.bu.edu/tech/services/teaching/lms/blackboard/students/>

|  |  |  |
| --- | --- | --- |
|  |  |  |

**Academic integrity:**

* The College of Arts and Sciences policies on incomplete grades and academic conduct will be followed. For details refer to the BU undergraduate or graduate bulletins and the CAS Academic Conduct Code, at:

<http://www.bu.edu/academics/policies/academic-conduct-code/>.

* Many activities and labs will include collaborating in groups; however, unless explicitly stated otherwise, each group member must submit their own unique work. Duplication of other group members’ work will be considered cheating.
* For written assignments, any information presented from an outside source (books, news papers, online sources) must be cited appropriately. Paraphrasing without citation will be considered plagiarism.
* Infractions will be handled in accordance with university policy, and can result in a zero for the assignment, or reduction in course grade.

**Disability Accommodations:** Accommodations for students with disabilities will be provided in accordance with the policies of Boston University.

**BU resources:**

1. BU Academic Conduct Code: <http://www.bu.edu/academics/policies/academic-conduct-code/>

2. BU Policy on Religious Observance: <http://www.bu.edu/chapel/religion/>

3. Multifaith Calendar: <http://www.interfaithcalendar.org/>

**ES 520 – Modes of Climate Variability**

Professor Thompson

Spring 2018

**Confirmation**

To receive a grade for this course and to ensure that you have read the entire syllabus and

understand the course policies, please sign this form and return it in person at the end of the class by ***Tues Jan 30, 2018***

*I have read the syllabus for ES 520. I understand and agree to adhere to the policies*

*explained in this syllabus.*

**Signature**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Date**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Name**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(print full name)

**Nam**e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(print preferred name / knick name)

**Preferred pronouns** (circle): (she/her/hers), (he/him/his), (they, them, theirs), (Ze, hir)

**E-mail Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What you’re excited to learn about in this class:**

**Picture:**