Course Change Request

New Course Proposal

Date Submitted: 04/01/19 5:24 pm

Viewing: **CLIM 761 : Advanced Atmospheric Predictability and Prediction**

Last edit: 04/01/19 5:24 pm

Changes proposed by: bklinger

Are you completing this form on someone else's behalf?

No

Effective Term: Fall 2019

Subject Code: CLIM - Climate Dynamics

Course Number: 761

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Advanced Atmospheric Predictability and Prediction

Banner Title: Advanced Predictability

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May only be taken once for credit, limited to 2 attempts (N2)

Max Allowable Credits: 3

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only): CLIM 711 (minimum grade B-), CLIM 751

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

In Workflow

1. **AOES Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 04/03/19 3:43 am Jim Kinter (ikinter): Approved for AOES Chair

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description: Covers the theory and practice of predicting atmospheric circulation from daily weather to subseasonal weather regimes to seasonal climate. Discusses atmospheric data assimilation, the dynamics of rapidly amplifying modes, the role of large- scale instability and weather regime dynamics, and the role of boundary conditions. Students will design and carry out ensemble forecasts using a range of numerical models.

Justification: There is no graduate course in the curriculum of the PhD Program in Climate Dynamics that gives the students the detailed conceptual and mathematical foundation to understand how forecasts (from daily to seasonal time scales) are actually produced, and to understand the barriers in improving these forecasts. This course will give the students the ability to better understand and probe the journal literature in this area. Additionally, carrying out predictability projects with several models will give the students a better grasp of the concepts, and will prepare them more fully for PhD research.

Does this course cover material which crosses into another department? No

Learning Outcomes:

- Acquire knowledge of the basic concepts of prediction and predictability from daily to seasonal time scales.
- Understand the roles of errors in initial conditions and errors in models in limiting predictability.
- Understand the role of boundary forcing in seasonal predictability
- Be able to articulate the relationship between the large-scale atmospheric state and predictability.
- Become familiar with the application of the mathematical theories to growth of forecast errors.
- Acquire basic skills for carrying out original research on weather predictability using models.
- Develop the ability to read current journal papers on the subject, and report the main findings.

Attach Syllabus clim761syll1.pdf

Additional Attachments

Staffing: Dr. David Straus, Dr. Katherine Pegion

Relationship to Existing Programs: Elective credit for Climate Dynamics PhD.

Relationship to Existing Courses: Sequel to CLIM 751 Predictability and Prediction of Weather and Climate, which deals more broadly with the concepts in weather and climate predictability.

Additional Comments:

Reviewer Comments

Key: 16449

CLIM 761: Advanced Predictability and Prediction of the Atmosphere
Course Syllabus

<u>Catalog Description</u>: Covers the theory and practice of predicting atmospheric circulation from daily weather to subseasonal weather regimes to seasonal climate. Discusses atmospheric data assimilation, the dynamics of rapidly amplifying modes, the role of large- scale instability and weather regime dynamics, and the role of boundary conditions. Students will design and carry out ensemble forecasts using a range of numerical models.

<u>Course Prerequisites</u>: CLIM 711, CLIM 751

<u>Proposed Instructors</u>:
David Straus, Kathleen Pegion

Course Goals and Student Learning Outcomes

- Acquire knowledge of the basic concepts of prediction and predictability from daily to seasonal time scales.
- Understand the roles of errors in initial conditions and errors in models in limiting predictability.
- Understand the role of boundary forcing in seasonal predictability
- Be able to articulate the relationship between the large-scale atmospheric state and predictability.
- Become familiar with the application of the mathematical theories to growth of forecast errors.
- Acquire basic skills for carrying out original research on weather predictability using models.
- Develop the ability to read current journal papers on the subject, and report the main findings.

Student Work Components

1. Four Homework Sets = 50% percent of grade
2. Original Research Projects* = 50% of grade
   *Exploring predictability of weather and seasonal means using both the two-level quasi-geostrophic model and a fuller multi-level primitive equation model.

Course Schedule

Week 1:
Time scales of atmospheric circulation. Introduction to predictability and chaos: sensitivity to initial conditions. Introduction to analysis-forecast cycle.

Week 2:
Variability of error growth: determination of most rapidly growing errors in a simple model (Lorenz, 1965).

Week 3:
Reduction of Weather Models to Low Dimensions: Spectral two-level quasi-geostrophic model (Lorenz, 1963). Tutorial on running the model to explore growth of small errors.

Week 4:
Physical instability mechanisms in the atmosphere: Barotropic instability of realistic basic states. Baroclinic instability and life cycles.

Week 5:
Linear and Nonlinear error growth in realistic models. Inner products and Adjoint Operators. Energy and Enstrophy Inner Products. Optimal Modes vs. normal modes.

Week 6:
Introduction to multi-level spherical primitive-equation atmospheric model ("SPEEDY"). Tutorials on setting up initial and boundary conditions and running forecasts.

Week 7:
Two-dimensional turbulence. Quasi-geostrophic turbulence. Role of the energy spectrum in error growth

Week 8:
Examples of operational forecasting.

Week 9:
Forecast errors in operational forecast systems: Roles of analysis error, model error and chaos.

Week 10:
Introduction to Data Assimilation: Overview and Fundamental Ideas

Week 11:
Statistical-Dynamical forecasting. Forecasting Moments of the Probability Distribution Function

Week 12:
Predictability of low-frequency intra-seasonal fluctuations. Blocking formation. Role of tropical SST in probabilistic forecasting of blocking

Week 13:
Sources of extended subseasonal predictability in the tropics: Madden-Julian Oscillation.

Week 14:
Introduction to seasonal predictability: Role of El-Niño Southern Oscillation. Methods for extracting the forced signal: Maximum Covariance Analysis, Predictable Component Analysis.

Week 15: Presentation of student projects using spectral two-level quasi-geostrophic model and SPEEDY

Some Important Mason Policies

Updated Spring 2016

Electronic Communications

Students must use their MasonLive email account to receive important University information, including communications related to this class.

Disability Accommodations

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with **Office of Disability Services** to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Office of Disability Services: http://ods.gmu.edu

Academic Integrity

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using MLA or APA format. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

Office of Academic Integrity: http://oai.gmu.edu/
Honor Code: http://oai.gmu.edu/the-mason-honor-code-2/

Mason Diversity Statement

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.