Course Change Request

New Course Proposal

Date Submitted: 03/03/20 9:33 am

Viewing: CLIM 401 : Midlatitude Synoptic Meteorology

Last edit: 03/24/20 10:12 am

Changes proposed by: bhuang

In Workflow

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

Approval Path

1. 03/24/20 9:48 am Jim Kinter (ikinter): Approved for AOES Chair

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

No

Effective Term: Spring 2021

Subject Code: CLIM - Climate Dynamics

Course Number: 401

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Midlatitude Synoptic Meteorology

Banner Title: Synoptic Meteorology

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 2.5

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

Max Allowable Credits:

6

Default Grade Mode: Undergraduate Regular

Recommended Prerequisite(s):

Weather Analysis and Forecasting (CLIM301)

Recommended Corequisite(s):

Atmospheric Dynamics (CLIM411)

Required Prerequisite(s) / Corequisite(s) (Updates only):

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):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

This course teaches students how to apply dynamical concepts and methods in weather analysis and map interpretation. We first introduce the essential dynamical tools for synoptic meteorology, the quasigeostrophic theory, isentropic analysis and potential vorticity framework. Using these tools, we examine the midlatitude weather systems and phenomena, including extratropical cyclone, front, cold-air damming and winter storm. The concept of baroclinic instability is also introduced. Finally, basic procedure of numerical weather prediction and human forecasting processes are discussed.

Justification:

Synoptic meteorology is an essential component of meteorological education and professional training for weather forecasters. Therefore, many major meteorological and atmospheric programs have courses of synoptic meteorology at senior undergraduate level and graduate level, in addition to the more basic and qualitative weather analysis courses for students at sophomore or senior years. Meteorologist positions in the federal civil service requires 6 semester hours in analysis and prediction of weather systems (synoptic/mesoscale). For graduate students in climate science, this course will provide fundamental knowledge of synoptic meteorology that deals with the day-to-day weather phenomena, an essential part of the atmosphere.

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

Learning Outcomes:

Upon completion of this course, students will be able to

1. Bringing together the observational and theoretical meteorology to understand the mid-latitude synoptic weather systems comprehensively.
2. Be familiar with various synoptic methods and techniques in weather analysis and forecasts.
3. Apply dynamical principles and conceptual models in the map interpretation of the real-time weather phenomena.

Attach Syllabus

Syllabus.pdf

Additional Attachments

Staffing:

One faculty member is required to teach this course.

Relationship to Existing Programs:

This course is designed for seniors in the undergraduate program of the Atmospheric Sciences. It will fill a gap in the current curriculum of the Atmospheric Science undergraduate Program because it provides an advanced-level synoptic meteorology course that examines realistic large-scale weather systems on a vigorous dynamical basis. This course may also be useful for graduate students of the Climate Science MS Program and Climate Dynamics PhD Program, especially those from non-meteorological background.

Relationship to Existing Courses:

This course will be offered in the spring semester as a follow-up elective course to CLIM301 (Weather Analysis and Forecast), which is currently taught every fall semester. Undergraduate students to take this new course are recommended to first take CLIM301. Graduate students should get permission from the instructor. In CLIM301, students have learnt some basic knowledge of synoptic meteorology to use standard weather maps and charts and make predictions. This course is a higher-level synthesis that enriches and brings together the observational knowledge they have learned from the previous class with deeper physical understanding on a solid dynamical foundation. In the practical side, the students taking both courses in two semesters get to see a whole year of weather through real-time weather discussion and other hands-on activities.

An advanced-level synoptic meteorology course requires knowledge of atmospheric dynamics. Students taking this course are recommended to take the Introduction to Atmospheric Dynamics (CLIM 411) if they have not taken a similar dynamical course previously. Since CLIM411 is offered in the spring semester, students can take both courses in the same time. Similarly, graduate students are recommended to CLIM511 or an equivalent course of atmospheric dynamics previously or simultaneously.

This course discusses briefly the practical aspects of the numerical weather prediction (NWP). It will concentrate on the operational NWP procedure and the usage of its products. Therefore, it will not cause a overlap with the major topics covered in CLIM 470.

Additional Comments:

Reviewer Comments

Gregory Craft (gcraft) (03/24/20 10:12 am): updated the max allowable credits to 6 per Mason's policies

Key: 16796

Syllabus

Midlatitude Synoptic Meteorology (CLIM401/601)

Course type: elective
Semester: spring
Class Day/Time: TBD (two classes weekly)

Catalog description

This course teaches students how to apply dynamical concepts and methods in weather analysis and map interpretation. We first introduce the essential dynamical tools for synoptic meteorology, the quasigeostrophic theory, isentropic analysis and potential vorticity framework. Using these tools, we examine the midlatitude weather systems and phenomena, including extratropical cyclone, front, cold-air damming and winter storm. The concept of baroclinic instability is also introduced. Finally, basic procedure of numerical weather prediction and human forecasting processes are discussed.

Course credits: 3

Prerequisites: CLIM301 or instructor's approval
A atmospheric dynamics course (CLIM411, 511 or 711, can be taken simultaneously with this class)

Learning Outcomes:

Upon completion of this course, students will be able to
1. Bringing together the observational and theoretical meteorology to understand the mid-latitude large-scale weather systems comprehensively.
2. Be familiar with various synoptic analysis methods and techniques in weather analysis and forecasts.
3. Apply dynamical principles and conceptual models in the map interpretation of the real-time weather phenomena.

Textbook

Garry M. Lackmann, 2015: Midlatitude synoptic meteorology: dynamics, analysis and forecasting, pp345, American Meteorological Society, ISBN 978-1-878220-10-3.

Gary M. Lackmann, Brian E. Mapes and Kelvin R. Tyle, 2017: Synoptic-dynamic meteorology lab manual, visual exercises to complement Midlatitude Synoptic Meteorology, pp120, American Meteorological Society, ISBN 978-1-878220-26-4.

Supplemental reading: Toby N. Carlson, 1998: Mid-latitude weather systems, pp507, American Meteorological Society, ISBN 978-1-878220-30-1.

Requirements:

The lectures will be accompanied with homework assignments on a weekly basis. A 15-min discussion of current weather, lead by a student, will be conducted at the beginning of each class. In addition, some lab exercises (projects) will be assigned and some classes will be devoted to lab projects.

The syllabi for the upper/lower level course are similar. However, graduate students will get extra homework and project assignments not required of the undergrads. Furthermore, a paper or project is graded with different criteria for the undergraduate and graduate courses.

Course Structure and Grading Criteria:

20% mid-terms
20% final
50% homeworks and lab exercises
10% participation in weather discussion

Week I **Background, a weather map view of basic dynamics** (Chapter 1)
1.1 Scale of motions and governing equations, a review
1.2 Geopotential, thickness and thermal wind relation
1.3 Temperature advection, frictional veering
1.4 Vorticity (Shear, curvature and planetary vorticity; vorticity equation)

Week 2 **Quasigeostrophy (QG) 1** (Chapter 2)
2.1 QG approximation
2.2 QG omega equation
(Trenberth approximation, Q-vector formulation etc)

Week 3 **Quasigeostrophy (QG) 2** (Chapter 2)
2.3 Height tendency equation (map application)
2.4 QG Energetics

Week 4 **Isentropic analysis** (Chapter 3)
3.1 Basics
3.2 Construction and interpretation of isentropic charts
3.3 Representation of vertical motion on an isentropic surface

Week 5 **Review and exam1**

Week 6 **Potential vorticity** (Chapter 4)
4.1 Definition and PV tendency equation

4.2 PV distribution and dynamic tropopause
4.3 examples of PV inversion

Week 7 **Extratropical cyclones** (Chapter 5)
5.1 Climatology of cyclones
5.2 An historical review
5.3 Cyclogenesis (QG interpretation, Sutcliffe-Patterssen formulation)

Week 8 **Fronts** (Chapter 6)
6.1 Frontal properties and types
6.2 Kinematic frontogenesis
6.3 Dynamic frontogenesis

Week 9 **Baroclinic instability** (Chapter 7)
7.1 Concept of baroclinic instability
7.3 Energetics
7.4 Diagnosing ageostrophic motion

Week 10 **Review and exam 2**

Week 11 **Cold-air damming (CAD)** (Chapter 8)
8.1 CAD in the southeastern US
8.2 CAD as a geostrophic adjustment
8.3 Thermal advection and diabatic processes
8.4 Synoptic settings

Week 12 **Winter storms** (Chapter 9)
9.1 General forecasting considerations
9.2 Physical processes
9.3 Precipitation-type forecasting techniques
9.4 Lake-effect precipitation

Week 13 **Basics of Numerical Weather Prediction (NWP)** (Chapter 10)
10.1 Historical perspective and a simple example
10.2 Dynamical core and subscale parameterization
10.3 Data assimilation and ensemble forecasting
10.4 Model output

Week 14 **Weather forecasting procedure** (Chapter 11)
11.1 The forecast process
11.2 Use of automated guidance
11.3 Specific forecast parameters

Week 15 **Course review and final exam**

Some Important Mason Policies

Students with Disabilities:
If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474, http://ods.gmu.edu. All academic accommodations must be arranged through the ODS.

GMU Email:
All George Mason students are issued an e-mail account. Students must use their MasonLive email account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

HONOR CODE:
Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The AOES Department strongly enforces the GMU Honor Code. Students are expected to read and adhere to the George Mason University Honor Code. Ignorance of the Honor Code is no excuse for infractions thereof. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind), please ask for guidance and clarification.

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.

WHERE TO GET HELP

If you encounter any difficulties in this course, first contact your research advisor immediately! Do not wait until the end of the semester to ask for help in understanding the material in order to improve your grade - by then, it may be too late. Do not be afraid to ask for help - that is our job!

The Counseling Center is committed to improving academic and personal skills, and offers many workshops and counseling groups throughout the semester.

Make use of the many rich academic and personal opportunities available at Mason!