Term Information

Effective Term	Autumn 2026
Previous Value	*Autumn 2022*

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

Course name; course description, and course content and structure. Content and structure changes include a title change to Twisters and Tempests: Exploring Extreme Weather and Climate, course topic changes, restructuring and refocusing of classroom time, and revamping nearly all lab exercises, though majority of content is retained. Course will be added as a major requirement for ATMOSSC major in new proposed major proposal in addition to retaining current GE Foundation: Natural Sciences.

What is the rationale for the proposed change(s)?

Course is reconceptualized to serve both as the main introductory meteorological course as a prerequisite/ corequisite for Atmospheric Sciences majors and a GE Foundations: Natural Sciences course.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

Course change for GEOG 1900 is in concert with a revision proposal submission for the Atmospheric Sciences major (planned effective for Autumn 2026).

Is approval of the requrest contingent upon the approval of other course or curricular program request? Yes

Please identify the pending request and explain its relationship to the proposed changes(s) for this course (e.g. cross listed courses, new or revised program)

This course will replace GEOG 5900 or ATMOSSC 2940 as the principle introductory course in the revised program request for ATMOSSC-BS program (effective term planned for AU26). ATMOSSC 2940 will be removed from departmental offering when new version of the major is approved and term implemented.

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Geography
Fiscal Unit/Academic Org	Geography - D0733
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1900
Course Title	Twisters and Tempests: Extreme Weather and Climate
Previous Value	*Extreme Weather and Climate*
Transcript Abbreviation	Weather & Climate
Course Description	This course introduces a range of natural disasters and extreme weather as we survey characteristics and processes of Earth's atmosphere and how it interacts with the planet's surface, oceans, and human activity. The course focuses on how these interactions work to produce extreme weather events and climate extremes and how they affect people and our communities.
Previous Value	*Surveys characteristics and processes of Earth's atmosphere and how it interacts with the planet's surface, oceans, and human activity. The course focuses on how these interactions work to produce extreme weather events and climate extremes and how they affect people.*
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture
Grade Roster Component	Laboratory
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites	
Exclusions	Not open to students with credit for 1900H, 2960, 5900, or ATMOSSC 2940.
Previous Value	Not open to students with credit for 1900H (120H), 2960 (220), 5900 (520), 120, or AtmosSc 2940 (230).
Electronically Enforced	No

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	40.0401
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore

Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors
General Education course:
Physical Science; Natural Sciences

Previous Value

General Education course:
Physical Science; Natural Sciences

Course Details

Course goals or learning objectives/outcomes

- Describe the main components of the atmosphere and understand the physical processes that generate the seasons, winds, clouds, lightning and precipitation.
- Explain the processes that produce - and the most important societal impacts of - extreme weather and climate events, including thunderstorms, tornadoes, hurricanes, straight-line winds, firestorms, floods, droughts, heat and cold waves.
- Understand the basic principles behind natural and anthropogenic climate change; describe and critically evaluate existing predictions of how anthropogenic climate change is likely to impact extreme weather events in the future.
- Understand how weather and climate forecasts are made and critically evaluate their strengths and weaknesses.
- Understand the most widely adopted methods and instruments used for atmospheric observations and apply some of these to generate and analyze atmospheric data.

Previous Value

Content Topic List

- Processes of the Earth's atmosphere
- Meteorology
- Global energy balance and transfer
- Atmospheric circulation
- Precipitation processes
- Weather systems
- Severe weather

Sought Concurrence

No

Previous Value

Attachments

- GEOG 1900_Course Change Submission Cover Letter.pdf: GEOG 1900_Cover Letter

  (Cover Letter. Owner: Godfrey,Ryan B)
- GEOG1900_Syllabus_9.17.2025.pdf: GEOG 1900_Syllabus

  (Syllabus. Owner: Godfrey,Ryan B)
- Geog1900_GE_NatSci_Comp_Stmt.pdf: GEOG_1900_Comp_Stmt

  (GEC Model Curriculum Compliance Stmt. Owner: Godfrey,Ryan B)
- AU25_GEOG_1900_Columbus_Montenegro_Syllabus.pdf: old version of syllabus for comparative purposes

  (Syllabus. Owner: Vankeerbergen,Bernadette Chantal)

Comments

- Natural Science General Education form revised / completed by DUS now uploaded. *(by Godfrey,Ryan B on 09/24/2025 02:29 PM)*
- Please remove the last file (where the GE questions are answered on an adjusted Themes form) & use the university form for GE Foundation courses. The Natural Science section starts on PDF p. 21 and goes through PDF p. 24. That way the subcommittee will not be confused with erroneous references to the Health and Wellbeing theme and also some questions for the Natural Science Foundation are further explained on the correct form. The form is here https://ugeducation.osu.edu/sites/default/files/documents/ge-foundations-submission.pdf *(by Vankeerbergen,Bernadette Chantal on 09/22/2025 10:39 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Godfrey,Ryan B	09/17/2025 07:58 PM	Submitted for Approval
Approved	Houser,Jana Bryn	09/17/2025 09:17 PM	Unit Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	09/22/2025 10:39 AM	College Approval
Submitted	Godfrey,Ryan B	09/24/2025 02:29 PM	Submitted for Approval
Approved	Houser,Jana Bryn	09/24/2025 05:07 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	10/21/2025 09:28 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	10/21/2025 09:28 AM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

Department of Geography
College of Arts and Sciences

1036 Derby Hall
154 North Oval Mall
Columbus, Ohio 43210
www.geography.osu.edu

Curriculum and Assessment Services
College of Arts and Sciences

September 16, 2025

Subject: GEOG 1900 Course Change Submission

Dear Arts and Sciences Curriculum Committee,

The Department of Geography is proposing changes to the content and structure of GEOG 1900.

These changes include a title change to Twisters and Tempests: Exploring Extreme Weather and Climate, course topic changes, restructuring and refocusing of classroom time, and revamping nearly all lab exercises. While these changes are substantial, we do not believe that they warrant the development of a new course that is independent from the original content of 1900, as there is still substantial overlap in the fundamental concepts currently being taught in 1900 and the proposed version.

We additionally wish to retain the GE Natural Sciences designation of the course.

We look forward to your feedback and any suggestions the curriculum committee might have for improvement.
Sincerely,

Dr. Jana Houser
Associate Professor of Meteorology
Director of Undergraduate Studies
Department of Geography
The Ohio State University
houser.262@osu.edu

THE OHIO STATE UNIVERSITY

College of Arts and Sciences
Department of Geography

SYLLABUS

GEOG 1900

Twisters and Tempests: Exploring Extreme Weather and Climate
Fall26 – Course # XXX

COURSE OVERVIEW

Course information

1. Class periods: Monday, Wednesday and Fridays, 11:10 am -12:05 pm

2. Labs: One 80-minute meeting per week
   - Credit hours: 4
   - Prerequisites: None
   - Classroom:
3. Mode of delivery: In Person Lecture and Lab
4. General Education: Natural Sciences Foundation Course
5. Recommended Textbook:
   - Aguado, E. and J. E. Burt, 2012. *Understanding Weather and Climate*, 7th edition. Pearson Education, Inc. Upper Saddle River, NJ. (ISBN: 9780321769633) IPCC
6. Required Lab Manual available on Carmen
7. Required Readings available on Carmen
8. Worksheets available on Carmen
   - Instructor: Alvaro Montenegro
   - Email address: montenegro.8@osu.edu
9. Office hours: Tuesdays 1:00 to 3:00 PM

10. Office location: Derby Hall 1152

11. Graduate Assistant contact: TBD

Course description

This course serves as an introduction to the study of the atmosphere with an emphasis on high-impact weather and climate events. The primary objective is to provide students with a comprehensive understanding of the atmosphere and the processes that govern its behavior, with a focus on events that have a large impact on human activity such as tornadoes, hurricanes, hailstorms, floods, severe droughts and long-term climate events. The course is organized around case studies of extreme weather and climate events that are used as points of entry into the subject. It also serves as prologue to historical overviews describing the development of our understanding of how the atmosphere works. One unique feature of the course is the watching and discussion of a series of documentaries and movies that are directly related to different types of weather and climate events. Students engage with the harmful effects of these extreme events on natural and human systems, as well as their interactions. In particular, the course discusses not only the impact of natural disasters on our society, but also the potential role of humans in altering weather and climate. Will anthropogenic greenhouse gas emissions increase hurricane intensity or frequency? How does urbanization change flood risk? Will a warmer Ohio also mean a drier Ohio and what might this mean for the agricultural sector in the state? How far into the future will Earth experience the effects of current human alterations to the climate system? These are some of the questions directly addressed by the course.

Course-specific goals and Expected Learning Outcomes

This course fulfills requirements as a **Natural Sciences Foundation** course within the University's **General Education (GE)** program. Lectures provide students with theoretical knowledge of the basic physical, chemical and biological principles that underpin our current understanding of climate and weather phenomena. During laboratories, experiments and demonstrations students will engage with methods and modes of inquiry broadly used in the natural sciences. In addition, a series of documentaries and movies are discussed to demonstrate not only the events, but their impacts on our society. Besides understanding the theories to explain atmospheric phenomena, particularly those categorized as "extreme weather events", successful students will be capable of describing the historical evolution of our understanding of these phenomena, including the evolution of efforts aimed at generating weather and climate forecasts, allowing students to discern the relationship between the theoretical and applied sciences while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

Course-specific ELOs

By the end of the semester, students will successfully:

1. Describe the main components of the atmosphere and understand the physical processes that generate the seasons, winds, clouds, lightning and precipitation.
2. Explain the processes that produce - and the most important societal impacts of - phenomena labelled “extreme weather and climate events”, including thunderstorms, tornadoes, hurricanes, straight-line winds, firestorms, floods, droughts, heat and cold waves.
3. Understand the basic principles behind natural and anthropogenic climate change; describe and critically evaluate existing predictions of how anthropogenic climate change is likely to impact extreme weather events in the future.
4. Understand how weather and climate forecasts are made and critically evaluate their strengths and weaknesses.
5. Understand the most widely adopted methods and instruments used for atmospheric observations and apply some of these to generate and analyze atmospheric data.

Natural Sciences GE goals ELOs:

Goal 1 Successful students will engage in theoretical and empirical study within the natural sciences while gaining an appreciation of the modern principles, theories, methods, and modes of inquiry used generally across the natural sciences.

1.1 Explain basic facts, principles, theories, and methods of modern natural sciences, and describe and analyze the process of scientific inquiry: The course provides an overview of the basic understanding of a large number of atmospheric phenomena with a focus on extreme weather events a. Coursework during lecture focuses on providing the foundational building blocks needed to understand the science including atmospheric composition, forces, and physical processes. This means every lecture, at some point, addresses ELO 1.1 by explaining a basic fact or theory related to atmospheric science. Labs 1, 7 and 8 guide students through the standard hypothesis generation, testing and conclusion standard to the scientific method.

1.2 Identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods. There are several instances in which the course provides brief descriptions of how our understanding of the phenomenon being presented has changed over time. All lectures dealing with forecasts (Lecs. 2 for weather and 14 for climate) discuss how better theory

or observations improved forecasts over time. The historical overview of our understanding of glacial and interglacial cycles is provided in Lec 13. Lecture 12 describes the history of cloud seeding, from the 1950s to the present day, including social political issues associated with the practice.

1.3 Employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data: Labs 1, 7 and 8 consist of experiments in which students, in a group, use scientific equipment to make measurements and analyzed the collected data to test hypothesis. At the start of all but labs 9 and 11 students start by, based on existing theory, generating a hypothesis about the experiment or demonstration to be performed and then finish with them testing their original hypothesis against observations or data collected during the lab.

Goal 2. Successful students will discern the relationship between the theoretical and applied sciences while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

2.1. Analyze the inter-dependence and potential impacts of scientific and technological developments. The course addresses in several instances (Lecs. 2; 3; 4; 10; 11; 14), how our understanding of climate and weather was improved by the advent of new technologies. These technologies include both observational systems such as satellite, radar, and upper-air monitoring, as well as computational technology that has enabled numerical weather prediction. This includes: The critical role played by computers in weather and climate forecasts; how satellite observations provided the first quasi-synoptic views of the climate system, the importance of weather station observations in improving forecasts.

2.2. Evaluate social and ethical implications of natural scientific discoveries. Students will be presented with and discuss in group activities how different social groups are unevenly impacted by weather and climate disasters. Lecture 14 engages with the complex social, economic and geopolitical aspects of our response to anthropogenic climate change. How social, economic and other inequities can cause unequal distribution of the negative impacts of extreme weather events is addressed by Lectures 4, 10 and 14 and by lab 9.

2.3. Critically evaluate and responsibly use information from the natural sciences. During laboratories, when testing the validity of their original hypothesis, students are asked to describe potential observational errors and also to describe how these could

have influenced results and conclusions. Lecture content related to weather and climate forecasts (2, 11, 14) emphasizes their many limitations, this includes the differentiation of those related to lack of data from those caused by lack of theory.

HOW THIS COURSE WORKS

Mode of delivery: In-person, lecture-based with lab.

Credit hours and work expectations: This is a **4-credit-hour course**. According to Ohio State policy, students should expect around 4 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 8 hours of homework (assignments and the final project) to receive a passing grade of C. Higher grades will require more time dedicated to the course.

COURSE MATERIALS AND TECHNOLOGIES

Textbooks and other course materials

Required text: Aguado and Burt 2012 (see front page for details)

1. Older editions (down to 5th) editions of the suggested course textbook would be useful for those who choose to purchase it.
2. The Lab Manual will be available on Carmen.
3. A copy of slides used during lectures will be available on Carmen

Technologies

REQUIRED SOFTWARE

- **A web browser (e.g., Google Chrome, Apple's Safari):**
  This is needed for most of the Group Activities and also to view/download some of the course's materials (PDFs), and access CarmenCanvas.

OPTIONAL EQUIPMENT & SOFTWARE

- **Any spreadsheet software:** While not required, it can be helpful for some of the labs

Carmen: Accessibility, Help, Skills & Multi-Factor Authentication

ACCESSIBILITY OF CARMEN

This course requires use of Carmen (Ohio State's learning management system) and a web browser. If you need additional services to use these technologies, please request accommodations with your instructor.

- CarmenCanvas accessibility
- CarmenZoom accessibility

HELP WITH CARMEN (OR OTHER IT ISSUES)

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Basic computer and web-browsing skills are expected, and navigating Carmen is an essential skill for this course. For questions about specific functionality, see the Canvas Student Guide.

REQUIRED TECHNOLOGY SKILLS SPECIFIC TO THIS COURSE

- Accessing course information on CarmenCanvas
- Uploading assignments on CarmenCanvas
- Using web browsers

CARMEN MULTI-FACTOR AUTHENTICATION

You will need to use BuckeyePass multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated (% breakdown)

ASSIGNMENT CATEGORY*	% POINTS
In-class Participation – Individual	10
In-class Participation – Group	15
Labs	30
Worksheets	20
Exam 1	10
Exam 2 (final)	15
Total	**100**

*All grade generating events other than in-class Group Participation activities are individual efforts

Assignment descriptions:

In-class Participation (25% of course grade):

There are two forms of class participation: individual and group. Both will be recorded using TopHat. It is the student's responsibility to make sure the electronic device they choose to use during class is communicating correctly with TopHat.

Individual Ungraded Questions (10%). The goal of these questions is to check student understanding of the material that is being presented in the current lecture. Full points are earned for simply sending in a response independent of the response being correct or not. Incorrect responses, as long as they are recorded by TopHat, will be awarded full credit. Time allotted to these questions will depend on response rate and will be controlled by the instructor on a case-by-case basis.

Group Questions (15%). The goal of these questions is to check student understanding of the material presented in previous lectures and also to engender debate. At the start of the semester, students will have the opportunity to self-arrange into groups of three or four (3 or 4) individuals. Students not associated with any group after the first three lectures will be randomly grouped. Students will be able to change groups before the end of the third week but in order to do so must inform AND receive permission from the instructor. Each group should discuss and come to a consensus about the question before submitting a response. 50% of the points comes from the submission by itself - irrespective of correctness. The other 50% will depend on the answer being correct or not. Groups will have at least 2 minutes to respond to each question. During this period, students can check their notes and other sources. Communication between group members is expected, and communication between members of different groups is allowed.

Labs (30% of course grade): Laboratory exercises will be conducted during recitations. Lab recitations have a duration of 80 minutes and attendance is required. Students should read through each lab and be prepared **PRIOR** to the lab session. It is the responsibility of each student to turn in the required laboratory exercise at the beginning of the lab class on the due date. All lab exercises must be completed **INDIVIDUALLY**, although working in groups is encouraged. (In other words, you may discuss the exercises with your peers, but you must do your own work.) Teaching Assistants execute and grade the Labs.

While the instructor will be happy to help with particular lab questions, different TA's might grade things differently depending on what took place during a particular lab. It is always safer to settle lab doubts with TAs. Students should also approach the TA's when it comes to arrangements on late or missed labs.

Worksheets (20% of course grade):
Students will complete 10 worksheets on their own, outside of class time, based on assigned readings or videos. In addition to questions related to information present in the assigned material, worksheets will ask students to relate content on the material to information being presented and discussed in class. Several worksheets also have a discussion component,

where students will post on Carmen their views and opinions on aspects of the worksheet.

Exams (25% of course grade): There will be two exams taking place on the following dates:
Midterm - Tuesday, Sep 16
Final – XXX Dec YY (Could not find final dates for AU25)
Exams are mostly non-cumulative but questions about some important themes/concepts will be present in both exams. These themes/concepts will be clearly communicated to the class by a study guide prior to exams.

Both will be administered outside of the class via the online Carmen platform, and they are open book, but the use of AI search is not allowed. All exams have identical length and format: 50 questions with 35 being multiple choice and 15 true or false. Exam duration is 90 minutes, meaning students will have on average 1.8 minutes, or 108 seconds to answer each question. The time limit refers to the whole exam, there will be no time limit on individual questions.

Students will be able to start taking these exams at any time during the periods described above, but once they start, they will have only 90 minutes to finish. To make use of all 90 minutes, students need to start taking the exams at or before 10:29 PM of the day the exam is due. Reinforcing with an example: If a student starts to take Midterm at 11:54 PM on October 2, they will only have five (5) minutes to answer all 50 questions before they get locked out of the exam by Carmen. If this takes place students will not have a second chance to answer any questions left blank.

Regular lectures and labs will take place on exam days.

Make-up exams are only allowed in the case of university sanctioned absences, a documented emergency or through **PRIOR** consent of the instructor.

EXTRA CREDIT

Four distinct activities will provide students with the opportunity of earning up to 4.5 extra points on their final course grade. There will be zero tolerance for late, incomplete, or incorrectly formatted extra credit submissions.

Late extra credit submissions = 0 points

Incomplete extra credit submissions = 0 points

Incorrectly formatted extra credit submissions = 0 points

Syllabus test: There is the potential for 0.5 extra credit point on the final course grade (i.e. a 0.5% increase to the student's final grade) for those who turn in a perfect syllabus test. The test is available on Carmen and should be submitted online via Carmen by the end of the day (11:59 PM) on Tuesday, Sep 2. There will be no partial grades. To get the 0.5 extra credit point all responses must be correct. One error = no extra credit.

Citizen science cloud observations (max percentage points = 2): In this individual effort, up to 2 extra credit points (i.e. +2%) on the final course grade will be awarded to students who act as observers for the "Student Cloud Observations Online (S'COOL)" project. This is a NASA led citizen science initiative aimed at collecting cloud cover data in order to improve satellite-based observations. The amount of extra credit received will be determined by the total number of reports handed in. Each report is worth 0.08 % points. These are accumulated until 2 extra credit points are obtained (25 reports). Students are encouraged to perform more than 25 observations, but those who do will still receive the maximum 2 extra credit points. To be valid, reports must be based on observations performed between August 26 and Dec 1. For full credit reports must be submitted to Carmen by 11:59 PM on Dec 1. More details on how to perform observations and complete reports are found on the Extra Credit section in Carmen.

***The 1900 Weather Creative (max points = 1.5)*:** Create and submit a piece of art in some way related to weather and climate or other content discussed in class for up to 1.5 extra credit points on the final course grade. The effort can be individual or shared by up to two

students. A variety of forms will be accepted, including but not limited to: poetry, music, short text, photography, painting/drawing, sculpture, animation, film, dance, short theatrical sketch and video games.

Important limitations:

1. All submissions should be original efforts.
2. Submissions are due on Tuesday, Dec 2
3. A representation of the piece must be uploaded to Carmen. This is simple for text or static images, but those who opt for performance (dance, theater), film, animation, song, etc… will have to record their work in some electronic format that can be uploaded.
4. All submissions should have a maximum duration of two and a half minutes, or 150 seconds. This includes poetry and text (the average person talks at about 125-150 words per minute).

While connections might be somewhat indirect, submissions must be related to the subject of the course. You are required to attach a short (max 100 words) legend explaining the connection.

The instructor will reject submissions deemed not sufficiently related to the themes discussed in class. Submissions will be curated and ,if there is sufficient quantity and quality, we will hold a show with the best entries during our next-to-last lecture on Tuesday ,Dec 9 .At this time the class will vote on their favorite submission. There will be prizes for the top submission

Class Lecture Topics and associated labs*

Subject to change. Students will be advised of updates to the schedule on Carmen

Date	#	Theme + associated readings and worksheets	Lec	Lecture	Labs
	1	**Tornadoes, hurricanes, bomb cyclones, flash floods, mega droughts and more!**			No lab
8/26		No readings	1.1	Introductory lecture consist of a rapid description of several types of hazardous and inclement weather and climate phenomena	
8/28		No readings	1.2	Uplift, condensation, pressure gradient force, latent heat	
8/31		No readings	1.3	Distinct impacts of tornadoes, hurricanes, thunderstorms, floods and droughts; focus on mortality and economic losses. **Case study:** this lecture is organized so that each event is introduced as a case study	
	2	**Weather forecasts**			No lab
9/02		No readings	2.1	What do they show and how they are made. **Case study:** Difference in fatality between the 1900 and 2008 Galveston hurricanes	
9/04		No readings	2.2	Climatology and statistics, weather models	
9/09		Forecast worksheet (3 pages)	2.3	How to make better use of your local forecast. **Activity-worksheet:** Verifying our local forecast	

	3	**Ballons, satellites and lasers: how we observe the atmosphere**			**Lab 1**: Blimp over the Oval. Vertical atmospheric profile
9/11		No readings	3.1	Types of measurements and platforms. **Case study**: Meteorologists flying into hurricanes	
9/14 9/16		No readings video (4 minutes) Ice core worksheet (5 pages including 2 –page reading)	3.2 3.3	Temperature and volume, blackbody radiation, atmosphere-radiation interactions. Different ways of displaying and analyzing measurements. **Activity (video+worksheet)**: Sampling the past: tropical ice cores at the Byrd Polar and Climate Research Center.	
	4	**Tornadoes**			**Lab 2a:** Movie: Twister **Lab 2b:** Home grown tornado: Shear, vorticity and pressure.
9/18		No readings	4.1	Description, associated weather features, geographical distribution	
9/21		No readings	4.2	Pressure gradient force and wind intensity. **Guest Lecturer:** Dr. Jana Houser. How do Tornadoes Start?	
9/23		Reading (1775 words) Worksheet (1 page)	4.3	Forecasting, impacts of climate change. **Case study;** The unusually active 2024 tornado season in central Ohio. **Activity (Reading+worksheet+discussion):** Change of address: Is climate change making storms move out of Tornado Alley?	
	5	**Mid-latitude cyclones: Driving our weather**			**Lab 3:** Counterintuitive effects of Earth's spinning: Currents in a rotating tank
9/25			5.1	Description, geographical distribution, seasonality	

9/28		Worksheet (2 pages)	5.2	Fronts, the Coriolis effect, atmospheric stability, precipitation types **Activity (movie+worksheet+discussion):** Bombogenesis in the movies: "The Perfect Storm".	
9/30		No readings	5.3	Wind and precipitation impacts, focus on freezing rain **Case study:** The 2016 blizzard in Ohio	
	6	**Thunderstorms**			**Lab 4**: Buoyancy, convection and thunderstorm formation
10/2 10/5 10/7		No readings No readings Worksheet (3 pages, includes 2-page reading)	6.1 6.2 6.3	Lightning , storm life cycle, single and multicell systems Lightening formation, uplift of air and cloud formation, latent heat of condensation Wind and precipitation impacts, focus on hail. Forecasting and preparedness. **Case study:** Pluvial flooding in Columbus. **Activity:(worksheet + discussion)**: Hail, a low intensity but more frequent and costly thunderstorm impact.	
	7	**Multicell thunderstorm systems and straight winds**			**Lab 5:** Tabletop haboob! Density, inertia and gust fronts.
10/9 10/12		No readings Worksheet (3 pages, includes 1-page reading)	7.1 7.2	Squall lines, mesoscale convective processes, associated atmospheric conditions and seasonality Frictional drag of precipitation, gust fronts, uplift by convergence. **Activity (videos + worksheet)**: haboobs in the American Southwest	
10/14		No readings	7.3	Wind and precipitation impacts, focus on precipitation intensity vs duration. **Case study:** the 2012 derecho in Central Ohio	
	8	**Low temperature threats: Blizzards and cold waves**			**Lab 6**: The science behind “The Perfect Storm”.

10/19 10/21		No readings Worksheet (3 pages, includes 2-page reading)	8.1 8.2	Definition and occurrence, associated weather conditions Thermal sensation, global scale winds, the polar vortex. **Activity (worksheet+discussion)**; Will global warming make cold waves worst?	
10/23		No readings	8.3	Human impacts, focus on hypothermia. **Case studies:** Great Blizzard of 1978, North American Blizzard of 2008	
	9	**High temperature threats: Heat waves and firestorms**			**Lab 7**: Adiabatic temperature change and wildfires
10/26 10/28		No readings Worksheet (3 pages, includes 2-page reading)	9.1 9.2	Definition, distribution, associated weather conditions Adiabatic temperature change and katabatic winds, fire creating its own weather, the role of the land surface on wildfires. **Activity (videos+worksheet):** firestorms in the 2025 California wildfires	
10/30		No readings	9.3	Human impacts focus on cardiovascular, individual and collective coping strategies, response to climate change. **Case studies:** The 2023 US heat wave, the 2023 Canadian wildfires.	
	10	**Hurricanes**			**Lab 8a**: movie "When the levees broke" **Lab 8b:** Pressure gradient force: diver of motion in the atmosphere
11/2 11/4		No readings No readings	10.1 10.2	Description, stages, spatial distribution, formation and intensification Vertical pressure gradient and temperature, wind-induced currents and storm surge	

11/6		No readings	10.3	Impacts, focus on storm surge and inland precipitation, response to climate change. **Case study:** Hurricane Sandy, when a hurricanes and mid-latitude cyclones meet.	
	11	**Preparing for and responding to weather disasters**			**Lab 9**: Documentary "Landfall". The long-term impacts of Hurricane Maria
11/9		No readings	11.1	Operation of emergency agencies from local to national level, building codes, property insurance. **Case studiy:** The Ohio Emergency Management Agency	
11/13		2-page worksheet	11.2	Quantifying and communicating uncertainty. **Activity (video+ worksheet + discussion)**: Recorded interviews with OSU atmospheric alumni working in operational forecast or emergency management	
11/16		No readings	11.3	Failues and successes in preparing and and responding to disasters. **Case Study:** Hurricane Bhola a weather disaster with large geopolitical consequences.	
	12	**Water unbalance: Floods and droughts**			**Lab 10a**: Doc: "Dust Bowl". **Lab 10b**: Evaporation transporting energy to the atmosphere
11/18		No readings	12.1	Description, types, US and world temporal and spatial distribution	
		No readings	12.2	Surface water and energy budget, concept of climatological means and anomalies	
11/20		No readings	12.3	Human impacts, focus on Ohio agriculture and response to climate change.	

				Case studies: The record breaking Ohio drought of 2024, The Columbus Great Flood of 1913 and the Guadalupe River flash flood of 2025	
	13	**Past Climate Catastrophes: Climate change and mass extinction events**			**Lab 11a:** Movie "The day after tomorrow". **Lab 11b**: Visit to the Byrd and Polar Climate Research Center (group 1)
11/23		No readings	13.1	Definition of climate and climate change, glacial-interglacial cycles, definition of mass extinction events and when they took place.	
11/25		No readings	13.2	Global radiative balance, the greenhouse effect, positive temperature feedbacks	
11/30		No readings	13.3	Wow glaciation and rapid warming cause extinctions **Case studies**: Huronian and Permian mass extinction events	
	14	**Anthropogenic Climate Change**			**Lab 12a:** Doc: "Canary". **Lab 12b**: Visit to the Byrd and Polar Climate Research Center (group 2)
12/2		No readings	14.1	D and P: recent observed warming and atmospheric CO2 increase, past CO2 and temperature reconstructions,	
12/4		No readings	14.2	S: climate proxies, climate models, atmospheric and oceanic heat transport	
12/7		Worksheet (5 pages, includes 3-page reading)	14.3	Future projections and impacts, focus on temperature and precipitation changes in the US Midwest **Case studies:** Warming and Lake Eire harmful algal blooms **Worksheet**: impact of climate change on sports	
12/9		Review+Catching up	15		

OTHER COURSE POLICIES

Commented [GR1]: Please delete and replace with the required elements (updated text statements from the university) for standard syllabus statements. Please note the following will be required to get through revisions: "All syllabi must have either a link to the statements below **or** these statements written out in their entirety within the syllabus. Syllabi should link to the Office of Undergraduate Education's Syllabus Policies & Statements webpage and/or copy-and-paste the below statements from the Office of Undergraduate Education's website.
Academic Misconduct
Student Life - Disability Services
Religious Accommodations
Intellectual Diversity"

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Units**! Yup, they are important and should be present whenever a physical quantity is described or calculated.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably***.***

Academic integrity policy

- **Labs**: Working with other students is permitted, but ***every student must submit their own work.***
- **AI tools:** use of AI tools is permitted as long as the student indicates that they have used them in their submission.
- **Reusing past work**: In general, students are prohibited in university courses from turning in work from a past class, even if modified. Students should discuss the situation with instructors in advance if there is any doubt.

ACADEMIC MISCONDUCT

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The Ohio State University's Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: Any activity that tends to compromise the academic integrity of the University or subvert the educational process. Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another

student, and possession of unauthorized materials during an examination. Ignorance of the University's Code of Student Conduct is never considered an excuse for academic misconduct, so please review the Code of Student Conduct and, specifically, the sections dealing with academic misconduct.

If an instructor suspects that a student has committed academic misconduct in this course, the instructor is obligated by University Rules to report those suspicions to the Committee on Academic Misconduct. If COAM determines that a student violated the University's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University.

If students have questions about the above policy or what constitutes academic misconduct in this course, they should contact the instructor.

Disability Statement (with Accommodations for Illness)

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If students anticipate or experience academic barriers based on a disability (including mental health and medical conditions, whether chronic or temporary), they should let their instructor know immediately so that they can privately discuss options. Students do not need to disclose specific information about a disability to faculty. To establish reasonable accommodations, students may be asked to register with Student Life Disability Services (see below for campus-specific contact information). After registration, students should make arrangements with their instructors as soon as possible to discuss your accommodations so that accommodations may be implemented in a timely fashion.
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Columbus Campus:

slds@osu.edu
https://slds.osu.edu/
098 Baker Hall, 113 W. 12th Ave
614-292-3307 phone

Religious Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual

belief system in reviewing such requests and shall keep requests for accommodations confidential.

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A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement **and** the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Civil Rights Compliance Office.

Policy: Religious Holidays, Holy Days and Observances

Counseling and Consultation Services / Mental Health Statement

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting

ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th floor of the Younkin Success Center and 10th floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24-hour emergency help is also available through the 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Intellectual Diversity

Ohio State is committed to fostering a culture of open inquiry and intellectual diversity within the classroom. This course will cover a range of information and may include discussions or debates about controversial issues, beliefs, or policies. Any such discussions and debates are intended to support understanding of the approved curriculum and relevant course objectives rather than promote any specific point of view. Students will be assessed on principles applicable to the field of study and the content covered in the course. Preparing students for citizenship includes helping them develop critical thinking skills that will allow them to reach their own conclusions regarding complex or controversial matters.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a welcoming community. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Civil Rights Compliance Office (CRCO):

Online reporting form: http://civilrights.osu.edu/

Call 614-247-5838 or TTY 614-688-8605

civilrights@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Civil Rights Compliance Office to ensure the university can take appropriate action:

All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.

The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member.

GEOGRAPHY 1900

Extreme Weather and Climate

Autumn Semester 2025

Instructor:

Alvaro Montenegro
Office: 1152 Derby Hall (DB)
Email: montenegro.8@osu.edu
Office Hours: By appointment.

Teaching Assistant:

Brian Rakoczy
Email: rakoczy.4@buckeyemail.osu.edu
Office: DB 1031
Office Hours, Mondays and Wednesdays from 4:00 to 5:00 PM; OR by appointment

Course Details

Lecture: Monday, Wednesday and Friday, 12:40 to 1:35 PM – Pomerene Hall 160

Labs:

Mondays, 10:20– 11:15 AM in Derby Hall (DB) 0070 –

Mondays, 3:00 – 3:55 PM in Derby Hall (DB) 0070 –

Wednesdays, 10:20– 11:15 AM in Derby Hall (DB) 0070 –

Wednesdays, 3:00 – 3:55 PM in Derby Hall (DB) 0070 –

Course Materials

Suggested Text: Aguado, E. and J. E. Burt, 2012. *Understanding Weather and Climate*, 7th edition. Pearson Education, Inc. Upper Saddle River, NJ. (ISBN: 9780321769633)

Required Lab Manual: A pdf file of the Manual is also available on Carmen.

Website: The Carmen course management system http://carmen.osu.edu

Course Description

This course will serve as an introduction to the study of the atmosphere. The primary objective is to provide students with a comprehensive understanding of the atmosphere and the processes that govern its behavior. In this course students will be exposed to various aspects of meteorology, including the structure and behavior of the atmosphere, global energy balance and transfer, atmospheric circulation, precipitation processes, weather systems and severe weather. This course will emphasize the inter-relationship existing between the atmosphere, hydrosphere, biosphere and lithosphere and will illustrate how the movement of matter and energy between

these spheres is responsible for the weather, climate and environments we experience on Earth.

Science GEC Course

Natural Science coursework fosters students' understanding of the principles, theories, and methods of modern science, the relationship between science and technology, the implications of scientific discoveries and the potential of science and technology to address problems of the contemporary world. Below are the four general Natural Science GE outcomes and how each will be addressed by the course.

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. Lectures, textbook and exams for basic facts, principles and theories
    b. Labs will demonstrate and give hands on experience with basic methods, and reinforce understanding of principles with experiments.
2. Students learn key events in the history of science.
    a. Progressive understanding of atmospheric dynamics will be explained using key examples like mid-latitude cyclones.
    b. Basic history of meteorology and history of our understanding of anthropogenic climate change is explicitly covered by lectures.
3. Students provide examples of the inter-dependence of scientific and technological developments.
    a. Lab exercises will reinforce how technology infuses understanding, and how instrumentation to measure atmospheric phenomena has changed over time.
    b. Measurements of the atmosphere, its qualities and motions are key to atmospheric science, and lectures and readings will highlight specific examples of how technology has enhanced theoretical understanding, and vice versa.
4. Students discuss social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. In lectures and readings about climate change, ozone destruction, and atmospheric pollution students will engage with the social implications of science discoveries and how these both mold and are molded by worldviews and political perspectives.

Student Evaluation

***Participation (20% of course grade)*:**

Attendance. 5 of the total 20 participation grade points will be based on lecture attendance. Each student is entitled to one unjustified absence during the semester. Participation will be recorded using TopHat. It is the student's responsibility to make sure their device is communicating correctly with TopHat.

TopHat Multiple Choice Questions. 15 of the total 20 participation grade points will be based on student response to multiple choice questions presented to the class via TopHat. Just answering the question, even if incorrectly, is all that is required for full participation points. It is the student's responsibility to make sure their device is communicating correctly with TopHat.

Note that to give students time work out any problems with TopHat, tracking of attendance and TopHat for participation will only start on Monday, Sep 8.

***Labs (30% of course grade)*:** Laboratory exercises will be conducted during recitations. Attendance is required. Students should read through each lab and be prepared **PRIOR** to the lab session. It is the responsibility of each student to turn in the required laboratory exercise at the beginning of the lab class on the due date. All lab exercises must be completed **INDIVIDUALLY**, although working in groups is encouraged. Teaching Assistants are the ones responsible for the Labs.

While the instructor will be happy to help with particular lab questions, the TA might grade things differently depending on what took place during a particular lab. It is always safer to settle lab doubts with your TA. Students should also approach the TA when it comes to arrangements on late or missed labs.

***Exams (50% of course grade)*:** There will be three exams, all to be completed online (Carmen) and open book. All exams have identical length and format: 50 questions with 35 being multiple choice and 15 true or false. Exams duration is 80 minutes, meaning students will have on average 1.6 minutes, or 96 seconds to answer each question. The time limit refers to the whole exam, there will be no time limit on individual questions.

Regular lectures and labs will take place on exam days.

Exams are mostly non-cumulative but questions about some important themes/concepts will be present in both exams. These themes/concepts will be clearly communicated to the class by a study guide prior to exams.

All exams will be available on Carmen.

- Exam 1 will have to be completed on Carmen sometime between 6:00 AM and 11:59 PM on Sep 26.
- Exam 2 will have to be completed on Carmen sometime between 6:00 AM and 11:59 PM on Oct 27.
- Exam 3 will have to be completed on Carmen sometime between 6:00 AM Dec 10 and 11:59 PM Dec 11. The longer open period for Exam 3 is related to the relatively busy schedule of students at the end of the semester. It is not different from the previous two in length, format, or approximate amount of content covered.

Students will be able to start taking these exams at any time during the periods described above, but once they start, they will have only 80 minutes to finish. To make use of all 80 minutes, students need to start taking the exams at or before 10:39 PM of the day the exam is due. Reinforcing with an example: If a student starts to take Midterm Exam 1 at 11:54 PM on Sep 26, they will only have five (5) minutes to answer all 50 questions before they get locked out of the exam by Carmen. If this takes place students will not have a second chance to answer any questions left blank.

Make-up exams are only allowed in the case of university sanctioned absences, a documented emergency or through **PRIOR** consent of the instructor.

Final Grade Break Up

Participation - Attendance	5%	
Participation - TopHat MC	15%	
Labs	30%	
Exam 1	15%	Sep 26
Exam 2	17.5%	Oct 27
Exam 3	17.5%	Dec 10

A note on final course grades:

The course adopts the following numerical to letter grade conversion:

Numerical Final Course Grade	Letter Final Course Grade
92.5-100	A
89.5-92.4	A-
86.5-89.4	B+
82.5-86.4	B
79.5-82.4	B-
76.5-79.4	C+
72.5-76.4	C
69.5-72.4	C-
66.5-69.4	D+
59.5-66.4	D
0-59.4	E

Final course numerical grades will be rounded to the closest decimal value prior to conversion to a letter grade. Note that, compared to the standard OSU numerical to letter grade conversion, the table above already contains a 0.5 point "round to the higher letter grade bump" at letter grade boundaries. This means that unless an error in grade calculation is noted, no other adjustments will be made.

For example: A student obtaining a final course numerical grade of 89.45 will have their grade rounded to 89.5 and will have earned an A- as final course letter grade. A student obtaining a final course numerical grade of 89.44 will have their grade rounded to 89.4 and will have earned a B+ as final course letter grade.

A note on the overall grades as seen on Carmen:

Due to a lack of connectivity between TopHat and Carmen and complications related to inserting extra credit grades on Carmen *the overall course grade students see on Carmen IS NOT CORRECT* and is usually an overestimate of the correct overall grade. An excel spreadsheet is available on the "Grade Calculation Spreadsheet" module in Carmen to aid students interested in tracking their overall grade during the semester. When adding attendance data to the spreadsheet students should use information obtained directly on TopHat and not the attendance percentages seen on Carmen.

Extra Credit

Three distinct activities will provide students with the opportunity of earning up to 5.5 extra points on their final course grade. There will be zero tolerance for late, incomplete, or incorrectly formatted extra credit submissions.

Late extra credit submissions = 0 points

Incomplete extra credit submissions = 0 points

Incorrectly formatted extra credit submissions = 0 points

Dec 10 in-class urban heat island effect mitigation activity: There is the potential for 1 extra credit point on the final course grade for those who are present in class on December 10 AND actively participate in a group activity related to urban heat island effect mitigation policies. Students will be presented with brief summaries of several available policies and, in groups of up to 5 members, discuss and choose what they believe is the best option for Columbus. At the end of the lecture, each group will turn in a brief (100-200 words) text justifying their choice. The expectation is that the text be completed during class and the submission is due on Dec 10 at 2:30 PM. Both presence in class AND being listed as a member of a group in the written justification is required. Present in class but not being a group member or being listed as a group member but not being present in class will result in no extra credit.

***The 1900 Weather Creative (Art Project)*:** Create and submit a piece of art in some way related to weather and climate or other content discussed in class for up to 2 extra credit points on the final course grade. The effort is individual. A variety of forms will be accepted, including but not limited to: poetry, music, short text, photography, painting/drawing, sculpture, animation, film, dance, short theatrical sketch and video games.

Important limitations:

- All submissions should be original efforts.
- Submissions are due on Monday, Dec 1.
- A representation of the piece must be uploaded to Carmen. This is simple for text or static images, but those who opt for performance (dance, theater), film, animation, song, etc… will have to record their work in some electronic format that can be uploaded.
- All submissions should have a maximum duration of two and a half minutes, or 150 seconds. This includes poetry and text (the average person talks at about 125-150 words per minute).

While connections might be somewhat indirect, submissions must be related to the subject of the course. You are required to attach a short (max 100 words) legend explaining the connection. The instructor will reject submissions deemed not sufficiently related to the themes discussed in class.
Submissions will be curated and, if there is sufficient quantity, quality, and time we will hold a show with the best entries during our next-to-last lecture on Dec 10. At this time the class will vote on their favorite submissions. There will be (simple) prizes for the top submissions!

Citizen science cloud observations: In this individual effort. Up to 2.5 extra credit points on the final course grade will be awarded to students who act as observers for the "Student Cloud Observations Online (S'COOL)" project. This is a NASA led citizen science initiative aimed at collecting cloud cover data in order to improve satellite-based observations. The amount of extra credit received will be determined by the total number of reports handed in. Each report is worth 0.1 points. These are accumulated until 2.5 extra credit points are obtained (25 reports). Students are encouraged to perform more than 25 observations, but those who do will still receive the maximum 2.5 extra credit points. To be valid, reports must be based on observations performed between Aug 27 and Dec 1. For full credit reports must be submitted to Carmen by 11:59 PM on Dec 1. Students can only submit one report per day. More details on how to perform observations and complete reports are found on CloudObs.docx file in the Extra Credit Module in Carmen.

Special Statement Regarding Absences

Based on the Office of the Provost recommendations on the current flu situation, students that feel ill are encouraged to stay home and isolate themselves from others. In addition, the "Explanatory Statement for Absence from Class" self-reporting form available online (https://shs.osu.edu/posts/documents/absence-excuse-form2.pdf) from the Wilce Student Health Center will be accepted as documentation of medical absence and reasonable efforts will be made to provide for make-up work opportunities. All make-ups from documented absences must be **completed within one week** of the original scheduled date.

Academic Misconduct

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of viral infection or fever, they should let their instructor know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations.

Lecture Schedule*

Lecture**	Chapter	Theme
1	1	Atmosphere Composition
2	1/2	Comp. of the Atm./Radiation
3	2	Radiation in the Atmosphere
4	2/3	Seasons/Energy Balance
5	3	Temperature
	Sep 26	**First Exam**
6	4	Pressure and Wind
7	4/5	Pressure and Wind /Moisture
8	5/6	Moisture / Cloud Formation
9	7	Precipitation Processes
10	8	Atmospheric Circulation
11	8/9	Air Masses and Fronts
	Oct 27	**Second Exam**
12	10	Mid Latitude Cyclones
13	11	Tornadoes
14	12	Tropical Cyclones
15	15/16	Climate and Climate Change
16	15/16	Climate and Climate Change
17	14	Atmospheric Pollution
	Dec 10	**Third Exam**

*This is a tentative schedule. While exam dates will not change, the actual material presented in lectures at the time of any exam might not mirror the schedule precisely. The material covered in each exam will be clearly defined on a study guide that will be published on Carmen.

**Lecture means a cohesive presentation covering a whole theme, not a 55-minute class.

GE Theme course submission worksheet: Foundations, Natural Sciences Theme.

GEOG 1900, 4 credits
"Twisters and Tempests: Exploring Extreme Weather and Climate"

Overview

Courses in the GE Themes aim to provide students with opportunities to explore big picture ideas and problems within the specific practice and expertise of a discipline or department. Although many Theme courses serve within disciplinary majors or minors, by requesting inclusion in the General Education, programs are committing to the incorporation of the goals of the focal theme and the success and participation of students from outside of their program.

Each category of the GE has specific learning goals and Expected Learning Outcomes (ELOs) that connect to the big picture goals of the program. ELOs describe the knowledge or skills students should have by the end of the course. Courses in the GE Themes must meet the ELOs common for **all** GE Themes and those specific to the Theme, in addition to any ELOs the instructor has developed specific to that course. All courses in the GE must indicate that they are part of the GE and include the Goals and ELOs of their GE category on their syllabus.

The prompts in this form elicit information about how this course meets the expectations of the GE Themes. The form will be reviewed by a group of content experts (the Theme Advisory) and by a group of curriculum experts (the Theme Panel), with the latter having responsibility for the ELOs and Goals common to all themes (those things that make a course appropriate for the GE Themes) and the former having responsibility for the ELOs and Goals specific to the topic of **this** Theme.

GE Rationale: Foundations: Natural Science (4 credits). Requesting a GE category for a course implies that the course fulfills all expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Natural Sciences, please answer the following questions for each ELO.

A. Foundations Please explain in 50-500 words why or how this course is introductory or foundational in the study of Natural Science.

The course is an introduction to the study of weather and climate with a focus on what are frequently defined as “extreme weather” or “extreme climate” events such tornadoes, floods and heat waves. As these phenomena are presented, basic physical principles important to our current understanding of atmospheric processes are introduced and explained. Extreme weather events tend to have large societal pertinence and are associated with risks to human lives in addition to severe negative economic impacts. Case studies related to specific events are used to ground students’ understanding to facts more related to their lived experiences and to forge a concrete link between the basic physical process and their societal impact. With this in mind, case studies are continuously updated.

Connect this course to the Goals and ELOs shared by *all* Themes

Below are the Goals and ELOs common to all Themes. In the accompanying table, for each ELO, describe the activities (discussions, readings, lectures, assignments) that provide opportunities for students to achieve those outcomes. The answer should be concise and use language accessible to colleagues outside of the submitting department or discipline. The specifics of the activities matter—listing "readings" without a reference to the topic of those readings will not allow the reviewers to understand how the ELO will be met. However, the panel evaluating the fit of the course to the Theme will review this form in conjunction with the syllabus, so if readings, lecture/discussion topics, or other specifics are provided on the syllabus, it is not necessary to reiterate them within this form. The ELOs are expected to vary in their "coverage" in terms of number of activities or emphasis within the course. Examples from successful courses are shared on the next page.

Goal 1: Successful students will engage in theoretical and empirical study within the natural sciences while gaining an appreciation of the modern principles, theories, methods, and modes of inquiry used generally across the natural sciences. *SEE BREAKDOWN OF EACH ELO IN TABLE BELOW

OVERVIEW:

The course provides an introduction to the study of weather and climate with a focus on what are frequently defined as "extreme weather" or "extreme climate" events such tornadoes, floods and heat waves. These phenomena tend to have large societal pertinence and are associated with risks to human lives in addition to severe negative economic impacts. Course content is centered on our present understanding of these events, as well as the impact of these events on human and societal activities. The course also relates these extreme events to the larger scale and longer lasting processes of climate variability and change. The course consists of two major components: lectures and labs. An additional component of extra credit activities is also designed for those interested in more in-depth knowledge. In all the three course components, students will engage with theoretical knowledge of the basic physical principles that underpin our current understanding of weather and climate phenomena. In the lecture portion, each week is dedicated to a particular extreme weather or climate phenomena are surveyed with attention focused on: 1) the description and basic processes related to the phenomena, 2) understanding of scientific or technological concepts pertinent to the phenomenon, and 3) its practical impacts or consequences. Case studies of particular events are then presented and used to synthetize these three perspectives on the phenomenon. Every lecture theme is also associated with an individual activity where worksheets and guided discussions provide students with the opportunity to actively interact with the content. The labs are designed so that students engage with methods and modes of inquiry broadly used in the natural sciences. This includes the use of theory to elaborate – prior to observations - hypothesize about how and why the observed variables will behave the way they do. During laboratories, students will use different techniques and instruments to conduct measurements of pertinent parameters in both controlled (laboratory) and uncontrolled (field) settings. In crafting lab reports, students will have to think about and describe potential sources of uncertainty and error in these measurements and then organize results making use of basic but fundamental data processing and visualization techniques. With final results in hand, students will critically analyze their original hypothesis. In order to provide yet another perspective on the course's material, movies - both documentaries and entertainment - are used in several labs and lecture activities.

Goal 2: Successful students will discern the relationship between the theoretical and applied sciences while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

OVERVIEW:

The relationship between understanding and forecasting of extreme events is the most important link between theoretical and applied sciences to be discussed in the course. In addition to understanding the current theories used to explain extreme weather and climate events, successful students will be capable of describing the

historical evolution of our understanding of these phenomena; including the evolution of efforts aimed at generating weather and climate forecasts, and how the quality of forecasts is highly dependent on technological development of the observation and computational systems adopted to generate them. These improvements in forecast skill will be presented in terms of how they have changed preparedness and helped better mitigate the societal impacts of extreme weather and climate events.

The preparedness for, response to and communication of extreme weather events is another component of the course related to application takes place in week 11 (here and henceforth, "week" refers to three, 55-minute lectures). In these lectures, students will have the opportunity to hear directly from professionals working on the operational forecast and emergency management fields.

Historical extreme events are presented and discussed as case studies and are an integral part of all lectures and will be used to further deepen students' understanding of the links between theory and application of weather and climate knowledge. Students will watch and complete worksheets on three full length documentaries on hurricane Katrina, the US 1930's "dustbowl", and anthropogenic climate change; as well as additional movies about bomb cyclogenesis, abrupt climate events and global warming. Worksheets are designed so that students engage with the dynamic relationship between understanding, forecast, communication and technology from a more human-centered perspective.

Below are the ELOs unique to Foundations Natural Sciences

	Course activities and assignments to meet these ELOs
ELO 1.1 Explain basic facts, principles, theories, and methods of modern natural sciences, and describe and analyze the process of scientific inquiry	The focus of the course is on extreme weather and climate events and their impacts. This requires an overview of the basic understanding of a large number of atmospheric phenomena. Every lecture and associated activity contain the description and analysis of foundational building blocks at the base of our current understanding of the extreme event being evaluated. With this in mind, all lectures and associated activities address ELO 1.1 by having, as one of their main focuses, the explanation and analysis of basic facts and theories related to atmospheric science. The central scientific/technological concepts of each lecture are explicitly listed in the "Class Lecture Topics" portion of the syllabus. Two examples: in the "Tornadoes" lecture, the main scientific concept being presented is the relationship between pressure gradient force and wind strength and in the "Floods and droughts" these are the surface water and energy budget and concepts of climatological means and anomalies. The process of scientific inquiry is explicitly present in all labs. Completion of reports require students to go through the standard scientific methods of hypothesis generation, hypothesis testing and conclusion elaboration. Every lab also has space for a critical analysis of the whole process, including how conclusions might have been impacted by potential errors in data generation and analysis.
ELO 1.2 Identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods.	The historical perspective of how our understanding of the phenomenon being presented is an important aspect of lectures. There are several instances in which the course provides descriptions of how our understanding of the phenomenon being presented has changed over time. The historical approach is especially important for lectures and worksheets dealing with forecasts (lectures in weeks 2 for weather and 14 for climate) where much space is dedicated to the discussion of how better theory or observations improved forecasts over time. The historical overview of our understanding of glacial interglacial cycles is also provided in lectures for week 13. Week 12, that deals with droughts, describes the history of cloud seeding, from the 1950s to the present day, including ethical and political

	issues associated with the practice. The choice of case studies prioritizes recent events as these should be more relatable to students' lived experience, but some cases refer to earlier events. These include the history of pluvial and fluvial floods in Columbus (Weeks 6 and 12) and the Great Blizzard of 1978 (Week 8). Current understanding of the phenomena and response to their impacts will be compared to knowledge and standard practices at the time of the case being analyzed.
ELO 1.3 Employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data.	All labs will allow students to engage with phenomena using methods and tools commonly used in scientific inquiry (as discussed in ELO 1.1 above). Tools used in labs include a series of standard atmospheric science instruments like barometers and hygrometers as well as more generic instruments such as different thermometers, chronometers and compasses. For example, in Lab 10 (Surface Energy Fluxes) students will measure the temperature of a sand surface with a radiometer to evaluate how evaporation impacts surface energy fluxes and temperature. Chronometers will be used in Lab 8 (Pressure Gradient Force) to estimate the speed of flowing water and how these are related to pressure gradients. Evaluation of lab results steer students toward the use of standard data analysis and plotting techniques. Students perform experiments and record data from these in a group, and while lab results must be reported individually, collaboration during analysis of these results is encouraged. Students interact directly with the natural world, and outside a structured lab environment. For examples, they use instruments suspended by a blimp flying over the oval to generate and evaluate a vertical atmospheric profile of temperature, humidity, particulate concentration and wind velocity (Lab 1, Vertical Profile of the Atmosphere); students interested in extra credit will have the opportunity to make and report on a series of 25 daily observations of cloud cover and land surface parameters important to weather and remote sensing techniques.
ELO 2.1 Analyze the inter-dependence and potential impacts of scientific and technological developments.	The course addresses how our understanding of climate and weather was improved by the advent of new technologies in several instances (Weeks 2, 3, 4, 10, 11, 14; Weather Forecasts, Observations, Tornadoes, Hurricanes, Preparedness and Climate Change, respectively). These technologies include both observational systems such as satellite, radar, and upper-air monitoring, as well as computational technology that has enabled numerical weather prediction. These lectures address the critical role played by computers in weather and climate forecasts; how satellite observations provided the first quasi-synoptic views of the climate system, how weather station networks and weather-balloon-derived vertical profiles play a fundamental role in forecasts. The interconnection between observations and understanding is also evaluated by the worksheets of Week 4 (Tornadoes) and 12 (Floods and Droughts), where students are asked to imagine/propose improvements to observational capabilities that could contribute to our better understanding of tornadoes and droughts, respectively.

ELO 2.2 Evaluate social and ethical implications of natural scientific discoveries.	Students will be presented with and discuss in group activities how different social groups are unevenly impacted by weather and climate disasters. Differences might arise from the quality of the forecast, with more affluent countries/areas being capable of generating better forecasts due to better observational network and modeling infrastructure or the ability of social entities and individuals to divulge, understand and respond to warmings as well as recover from negative impacts. These questions will be addressed explicitly by lecture and worksheets content of Weeks 2, 4, 8, 9 10 and 11 and Lab 9. Week 14 engages with the complex social, ethical, economic and geopolitical aspects of our response to anthropogenic climate change.
ELO 2.3 Critically evaluate and responsibly use information from the natural sciences.	During laboratories, when testing the validity of their original hypothesis, students are asked to describe potential observational errors and also to describe how these could have influenced results and conclusions. Lecture content related to weather and climate forecasts (Weeks 2, 11, 14; Weather Forecast, Preparedness and Climate Change, respectively) emphasizes their many limitations, this includes the differentiation of those related to lack of data from those caused by lack of theory. The Week 11 (Preparedness worksheet will ask students to assume the role of an emergency manager that, with a set of projections in hand, must decide whether to issue or not an evacuation order for a particular location. The goal of the exercise is to provide students with a concrete example of the complexities and risks associated with using scientific information to justify and support real world interventions that have large impacts on people's lives.