

**Course Syllabus**  
**ATMO336: Weather, Climate, and Society**  
**Fall 2016 Semester**

### **Course Description**

This course examines basic weather phenomena, climate variability and climate change, and their associated effects on people. The first part of the course is mostly weather topics, while the second part is mostly climate and climate change. Students are challenged to apply basic physical concepts to understand and explain some of the common phenomena in our atmosphere, such as the formation of clouds and thunderstorms. On the issue of human-caused climate change, students will closely examine some of the evidence and arguments both for and against a strong anthropogenic component to recently observed climate changes. Students are then asked to draw their own informed conclusions about the possible influence of human activity on climate change, the type of governmental policies they would support, and personal actions that they may take to reduce their influence on climate change.

### **Web Page / Course Materials**

All required course material is available from the class web pages and links therein.

<http://www.atmo.arizona.edu/courses/fall16/atmo336/home.html>

There will also be a few activities done on the course D2L pages. All students registered for the class should have access to the D2L page for ATMO336, Section 001. There are no required books or special supplies that need to be purchased for this course. Course announcements will be posted on the home page. Due dates for assignments and exam dates are posted on the [Class Calendar](#)

### **Course Hours / Location**

Monday, Wednesday, and Friday, 2:00 – 2:50, McClelland Park, Room 105.

### **Instructor**

Dr. Dale Ward, Dept. of Atmospheric Sciences, PAS Building, Room 566D

Email: [dward@email.arizona.edu](mailto:dward@email.arizona.edu)

Office Hours: Tuesday and Thursday, 10:00 – 11:00 AM

I prefer that you make an appointment if you would like to meet with me outside of the posted office hours. If you come to my office without an appointment, I may or may not have time to meet with you.

## **Teaching Assistants**

Bayu Risanto, PAS Building Room 526

Email: [cbrisanto@email.arizona.edu](mailto:cbrisanto@email.arizona.edu)

Office Hours: Monday and Wednesday, 12:30 – 1:30 PM (or by appointment)

Ryan Dennis, PAS Building Room 526

Email: [radennis@email.arizona.edu](mailto:radennis@email.arizona.edu)

Office Hours: Tuesday and Thursday, 12:30 – 1:30 PM (or by appointment)

## **About your Instructor**

I received a PhD in atmospheric sciences from the University of Arizona in 1998. My research interests are in the area of satellite remote sensing. Currently I am working with a team to develop and implement a new active microwave system to determine the concentrations of water vapor and other trace gases in the atmosphere.

I have been the instructor for Atmospheric Sciences 336 for 15 years. I have also taught a Atmospheric Sciences 170, which is a TIER I natural sciences elective.

I live on the east side of Tucson with my family. In my spare time I enjoy hiking and biking the many trails around Tucson.

## **Course Level Objectives and Expected Learning Outcomes**

This course examines basic weather phenomena, climate variability and climate change, and their associated effects on people. The first part of the course is mostly weather topics, while the second part is mostly climate and climate change. Students are challenged to apply the basic physical concepts that are taught in the reading to understand and explain some of the common phenomena in our atmosphere, such as the formation of clouds and thunderstorms. On the issue of human-caused climate change, students will closely examine some of the evidence and arguments both for and against a strong anthropogenic component to recently observed climate changes. Students are then asked to draw their own informed conclusions about the possible influence of human activity on climate change, the type of governmental policies they would support, and personal actions that they may take to reduce their influence on climate change.

After taking this course you will be able to:

- Read and interpret common weather charts, including 500 mb height maps and skew-t diagrams
- Construct basic, cool season weather forecasts using 500 mb maps

- Explain the limitation of numerical weather forecasting
- Describe the seasonal shift in wind direction that takes place during the North American Monsoon over Tucson and the associated changes in weather
- Discuss the vertical structure of temperature, density, and pressure in the atmosphere, as well as effects of altitude changes on the human body
- Summarize the water cycle on Earth and its important role in Earth's climate
- Explain what clouds are and how and why they form
- Describe the conditions that lead to the formation of thunderstorms, tornadoes, and hurricanes
- Summarize how weather conditions influence human comfort
- Identify the human influence on stratospheric ozone, factors that influence exposure to ultraviolet radiation, and effects of ultraviolet exposure on the human body
- Explain how radiation controls the average surface temperature of the Earth, including the atmospheric greenhouse effect
- Review how human emissions of greenhouse gases have perturbed the system
- Summarize the historical increase in anthropogenic greenhouse gases, which includes the issue of the missing carbon sink
- Discuss the current evidence and arguments both for and against a strong human component to recent climate changes, which includes climate model simulations, uncertainty in simulations, indirect proxy estimates of past climate changes, and recent observations of climate changes
- Make an informed decision about the potential influence of human activity on climate change
- Determine what actions should be taken to reduce the influence of human activity on climate change
- Describe the reason for seasonal changes on Earth as well as the changes that happen at different latitudes
- Explain some of the other factors, beside latitude, that determine regional climate
- Describe some of the optical phenomena that takes place in the atmosphere, such as blue skies, white clouds, and haze.

### **General Education Level Objectives and Learning Outcomes**

This course addresses three of the general education program objectives: Think Critically, Communicate Effectively, and Use Information Effectively. Critical thinking is a component of the global warming opinion essay in which students must argue for their point of view based on the information provided in reading and lecture. Effective written communication is required for all three of the out of class writing assignments. The debate style research paper requires students

to incorporate reference material on both sides of their selected, debatable topic, which tests their ability to use information effectively.

## **Writing Emphasis**

This class is a TIER II Natural Sciences elective for the University's General Education Requirement and thus is writing intensive. There are three diverse out of class writing assignments as well as short answer questions on exams and homework sets.

The Research Paper (4 – 6 Pages) is a discussion-type paper in which you present both sides of a debatable topic or question without personal bias. The focused topic needs to be related to debates about the potential impacts of greenhouse gas emissions or debates about which policies will work best for reducing emissions. This paper requires outside research, a bibliography, and in text citations to material in the bibliography. You are required to submit a topic proposal that will be checked for suitability. You are required to submit a first draft. You are each required to peer review drafts from two fellow students. You are then given time to revise your first draft based on the peer reviews before submitting your final paper.

The 500 mb Project (3 – 4 Pages) is similar to a scientific case study. In this project you will analyze and evaluate 10 day weather forecasts from two different operational weather models. You will look for trends in the forecast accuracy with time and attempt to determine which model made a more accurate forecast.

The Global Warming Essay (2 – 3 Pages) is an opinion essay in which you use material covered in the class to support your opinion on the global warming issue and what you believe should be done.

There will be 3 to 4 short answer questions on each of four in-class exams. Some of the questions require a couple of sentences to answer, while others require complete paragraphs. You will be evaluated both on the correctness of the answers and the writing presentation.

## **Grading**

Your class grade is based on the number of points earned during the semester. There are 1000 possible points:

<b>Grade Item</b>	<b>Points</b>
Homework Set #1	40
Homework Set #2	40
500 mb Project	50
Global Warming Essay	60

Submit first draft of research paper on time (post to D2L Discussion board)	20
Post two thoughtful peer reviews on time (reply to Discussion posts, 2 x 20 points each)	40
Research Paper	150
*Exam 1	150
*Exam 2	150
*Exam 3	150
*Exam 4	150
<b>Total</b>	<b>1000</b>

The final grading scale may be curved depending on overall class performance. However, the grading scale will not be more difficult than A(900 points), B(800 points), C(700 points), D(600 points), E(<600 points). By the eighth week of the semester, grades will be posted for Homework Set #1, Homework Set #2, Exam #1, Exam #2, submission of the research paper first draft, and two peer reviews, which accounts for 440 of the 1000 points for the semester.

### **Final Exam / Missed Exams**

The final exam is optional. If you do not take it, then your grade is fully determined by the grade items in the list. If you decide to take the final exam, at a minimum it will replace the lowest of your three in class exams, even if it is lower. If it is to your benefit, then the final exam score will also be used to replace half of your second lowest in class exam score, but only if this improves your class average. Thus, if you take the final exam, it will count for at least 150 points of your final grade and 300 points if it helps you.

Missed exams can only be made up after presenting documentation for University-approved absences (see absence policy below). Approved reasons for absence include all holidays or special events observed by organized religions for students who show affiliation with that particular religion and absences pre-approved by the UA Dean or Students. In most cases, you are expected to notify the instructor before missing the exam in class at which time a make-up date will be arranged. In general I prefer make-up exams to be taken before the exam is given in class, if possible.

### **Policy on Late Work**

Late written work, which includes homework assignments and the research paper, will be subject to a penalty of 10% per day late. **The first draft of the research paper and the two peer reviews must be turned in on time to get credit. You will not receive any credit for these assignments if you do not submit your first draft on time.**

## **Extra Credit**

There are two extra credit opportunities. 5 points are awarded for completing the class registration form. 10 points are available for submitting an optional research paper topic proposal. No other extra credit opportunities are planned.

## **Incomplete or Withdrawal Grades**

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

## **Description of Grade Items**

Homework Sets: There will be two homework sets given during the semester, which will consist of problem solving and short answer questions that go with the exam 1 and exam 2 material. Your homework submissions will be graded both on the correctness of your answers as well as the quality and clarity of your writing. Homework sets will be posted on the class web pages.

500 mb forecasting assignment: Sometime in late October, after we have covered material on 500 mb maps and cool season weather forecasting, a 500 mb weather forecasting assignment will be made available. The exact dates are not known as we will be using real-time weather forecasts that must be suitable for this class. Detailed instructions for this assignment will be posted on the class web pages. You will be given sufficient time to complete the assignment after it is posted.

Global Warming Essay: The last written assignment is a global warming opinion essay that will be due near the end of the semester. Instructions for writing the paper will be provided on the course web pages.

Exams: Exams count for 60% of your final class grade. Four in-class exams are scheduled. These exams consist of a mixture of multiple choice and short answer questions. Short answer responses will be graded both on the correctness of your answers as well as the quality and clarity of your writing. The in-class exams are not comprehensive in that the questions concentrate on material presented since the previous exam. However, it is expected that you are familiar with some of the basic concepts covered early in the semester. The dates for in-class exams are September 16, October 12, November 4, and December 2.

The in-class exams given during the fall 2015 semester will be available from the class web pages to show you the type of questions asked.

The final exam is optional. If you decide to take it, the final exam grade replaces the lowest of the grades of your previous exams (even if it is lower). Thus, if you do poorly on one exam or miss one exam, you can make up for it by taking the final. Your final exam score will also replace your second lowest exam score (only if higher than your second lowest exam score). Therefore, if you take the final exam it will count for at least 15% of your final grade (by replacing your lowest exam score, 150 points) and 30% of your final grade (if you score higher than your second lowest exam score, 300 points). The final exam is comprehensive in that it covers all of the material presented during the semester.

Final exam is Thursday, December 14 from 1:00 – 3:00 in the regular classroom, McClelland Park, Room 105.

Research Paper: The details of the research paper are described in a link under the homework section of the course web pages. The research paper includes a first draft, peer review, and revision process. The first draft is due to be uploaded to a D2L discussion forum by Wednesday, September 28. Each of you will peer review two drafts from fellow students. These are due by Wednesday, October 5. Based on the reviews, you will then revise your first draft to produce a final research paper. A printed copy of the final paper is due in class on the October 19. In addition, you are required to upload a copy of the paper to an “Assignment Dropbox” on the course D2L pages. An extra credit research paper topic statement, which is basically a statement of your proposed paper topic, is due by September 7 in a D2L assignment dropbox. If you chose to submit a topic proposal, you will be given feedback on your proposed topic.

### Absence and Class Participation Policy:

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>. The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable: <http://policy.arizona.edu/human-resources/religious-accommodation-policy>. Absences preapproved by the UA Dean of Students (or dean's designee) will be honored. See <http://policy.arizona.edu/employmenthuman-resources/attendance>.

You are required to be in class on scheduled exam days and on days when assignments are due. Otherwise attendance will not be used in your grade determination.

### Topics and Tentative Course Schedule

The course material is broken into topics (in bold). The titles of the associated course reading pages are given below each topic. Reading pages are available from the course web pages.

Week / Dates	Topics / Readings	Assignments
<b>1.</b> 8/22 - 8/28	<b>Introduction to 500 mb maps, southwest monsoon, Winds on Weather Maps</b> Introduction to 500 mb height maps Winds at 500 mb ; Southwest Monsoon Season	<i>Read Instructions for Research Paper;</i> <i>Begin Considering Topics for Research Paper</i>
<b>2.</b> 8/29 - 9/4	Winds; Pressure and Winds on Weather Maps <b>Hurricanes</b> Hurricane Introduction and Characteristics Hurricane Movement and Damages	<b>Course Registration Due</b> <i>Continue to Work on Selecting Paper Topic</i>
<b>3.</b> 9/5 - 9/11	Atlantic Hurricane Cycles; Links to Climate Change? <b>Overview of Atmosphere</b> The Atmosphere Some Properties of Gases; Kinetic Model Composition of the Atmosphere	<b>Topic Statement for Research Paper Due</b> <i>Work on Homework Set #1</i>
<b>4.</b> 9/12 – 9/18	<b>Vertical Structure of the Atmosphere</b> Vertical Structure of Temperature, Pressure, Density Human Response to Air Pressure and Density Changes The Skew-T diagram <i>Review for exam #1 (9/14)</i> <i>Exam #1 (9/16)</i>	<b>Homework #1 Due</b> <b>Exam #1</b>  <i>Work on Research Paper</i>
<b>5.</b> 9/19 – 9/25	<b>Water in the Atmosphere</b> Water in the Atmosphere A Closer Look at Evaporation and Condensation Relative Humidity and Dew Point	<i>Work on Research Paper</i>
<b>6.</b> 9/26 – 10/2	<b>Weather Effects on the Human Body</b> Energy Transfer Temperature, Humidity, Wind and Human Comfort <b>Clouds (What They Are and Why They Form)</b> Clouds Why Does Rising Air Cool? Conditions that Force Air to Rise Precipitation	<b>First Draft Research Paper Due (9/28)</b>
<b>7.</b> 10/3 – 10/9	<b>Stability / Introduction to Thunderstorms</b> Moving Parcels Up and Down Stability of the Atmosphere Introduction to Thunderstorms <b>Severe Weather</b> Thunderstorm Lifecycle and Severe Thunderstorms	<b>Peer Reviews (2) of Research Papers Due (10/5)</b> <i>Work on Homework Set #2</i> <i>Work on final draft of Research Paper</i>
<b>8.</b> 10/10 – 10/16	<i>Review for exam #2 (10/10)</i> <i>Exam #2 (10/12)</i>  Tornadoes	<b>Homework Set #2 Due</b> <b>Exam #2</b>

		<i>Work on final draft of Research Paper</i>
<b>9.</b> 10/19 – 10/25	Lightning Hurricane Energetics <b>Impacts / Possible Trends in Severe Weather</b> Impacts of Extreme Weather; Possible Trends <b>Ozone and uv Radiation</b> Ozone and the Ozone Hole Ultraviolet Radiation and its Effects	<b>Final Draft Research Paper Due</b>
<b>10.</b> 10/26 – 11/1	<b>Cool Season Weather Analysis and Forecasting</b> Review 500 mb height maps Review 500 mb winds; Precipitation using 500 mb maps Weather Forecasting Using 500 mb maps The 500 mb Weather Pattern and Common Weather Terminology A Crash Course in Cyclogenesis Numerical Weather Forecasting <b>Introduction to Climate Change</b> Weather vs Climate Introduction to Climate Change	<i>Work on 500 mb Project</i>
<b>11.</b> 10/31 – 11/6	<b>How Radiation Controls Earth's Temperature</b> Solar Radiation and the Earth's Energy Budget I Infrared Radiation, Greenhouse Effect, Energy Budget 2 <i>Review for exam #3 (11/2)</i> <i>Exam #3 (11/4)</i>	<b>Exam #3</b> <i>500 mb Assignment will be due this week or next depending on the date assigned</i>
<b>12.</b> 11/7 – 11/13	<b>Increasing Greenhouse Gases, Carbon Dioxide</b> Increasing Greenhouse Gases Atmospheric Carbon Dioxide and the Carbon Cycle <b>Predictions of Change, Models and Uncertainty</b> Uncertainty in Climate Prediction and Climate Models Climate Models and Their Predictions of Change Potential Impacts of Global Warming	<i>500 mb Assignment may be due this week depending on the date assigned</i>
<b>13.</b> 11/14 – 11/20	<b>Historical Temperature Changes</b> Reconstructing Past Climates The Climate of the Pleistocene Is the Earth Fragile or Robust? The Climate of the Holocene Controversy: Global Average Temperature Reconstruction over the last 2000 Years <b>Recent Temperature Changes and Implications</b> The Present Warming: 20 <sup>th</sup> Century through Today	
<b>14.</b> 11/21 – 11/27	Global Warming: Summary and Discussion <b>Factors that Determine a Region's Climate</b> Seasonal Changes on Earth	Thanksgiving Break <i>Work on global warming essay</i>

<b>15.</b> 11/28 – 12/4	Other Factors that Control Climate <b>Common Optical Phenomena</b> Blue Skies, Red Sunsets, White Clouds, Haze <i>Review for exam #4 (11/30)</i> <i>Exam #4 (12/2)</i>	<b>Global Warming Essay</b> <b>Due</b> <b>Exam #3</b>
<b>16.</b> 12/5 – 12/7	<i>Release pre-final class grades;</i> <i>Discuss how to prepare for final exam</i>	
<b>17.</b> 12/14 – 12/17	<b>Optional Final Exam on Wednesday, December 14</b>	<b>Final Exam</b> <b>December 14</b> <b>1:00 – 3:00 PM</b>

### **Reading Material / Texts**

All of the course reading material is available from the course web page under the lectures link. There are no required outside textbooks for this class.

### **Honors Credit**

Honors students are welcome to take this course for honors credit. Please contact Dr. Ward early in the semester to draw up an honors contract.

### **Classroom Behavior Policy**

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

### **Threatening Behavior Policy**

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

### **Student Code of Academic Integrity**

Students are expected to adhere to the University of Arizona's Code of Academic Integrity as described in <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>. If you commit plagiarism, you could either receive a zero for that assignment, an F grade for the entire course, or even expulsion from the University depending on the severity of the case. If you are unsure what constitutes plagiarism, please see the article on avoiding plagiarism from the University libraries at <http://library.arizona.edu/help/tutorials/plagiarism/index.html>. Thus, when

you use source material in writing your research paper, whether primary or secondary sources, you must make sure that you clearly indicate where you took it from. The Web can be a great search tool, but never copy from the Web without clearly identifying the source.

In addition, do not copy from work completed by your classmates or by students who have taken this course in previous semesters. You can discuss papers and other assignments with fellow students, but your final work needs to consist of your own ideas and words. If you receive help in writing your research paper from the writing center or a tutor, make sure the paper you submit still represents your own work.

### **Help with Writing**

The University has a free writing center where trained consultants are available to work individually with you on your writing at any point in the process, from brainstorming to editing. You can drop in for short sessions, make appointments for longer sessions, or even work with a tutor online. For more information, please see <http://thinktank.arizona.edu/tutoring/writing>.

### **Policies Against Threatening Behavior by Students**

The Arizona Board of Regents (ABOR) Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. Threatening behavior can harm and disrupt the University, its community, and its families. "Threatening behavior" means any statement, communication, conduct, or gesture, including those in written form, directed toward any member of the University community that causes a reasonable apprehension of physical harm to a person or property. A student can be guilty of threatening behavior even if the person who is the object of the threat does not observe or receive it, so long as a reasonable person would interpret the maker's statement, communication, conduct, or gesture as a serious expression of intent to physically harm. Information on prohibited behavior, procedures for reporting threatening behavior, and disciplinary processes can be found at <http://policy.web.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

### **Nondiscrimination and Anti-Harassment Policy**

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. The University encourages anyone who believes he or she has been the subject of discrimination to report the matter immediately. All members of the University community are responsible for participating in creating a campus environment free from all forms of prohibited discrimination and for cooperating with University officials who investigate allegations of policy violations. Information about the University of Arizona's nondiscrimination and anti-harassment

policies can be found at <http://policy.web.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

### **Special Needs and Accommodations**

It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268 or <http://drc.arizona.edu/students/connect>) to establish reasonable accommodations.

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible tables and chairs in the classroom should remain available for student who find that standard classroom seating is not usable.

### **Additional Resources for Students**

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>.

Student Assistance and Advocacy information is available at  
<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

### **Confidentiality of Student Records**

<http://www.registrar.arizona.edu/ferpa/default.htm>

### **Subject to Change Statement**

Information contained in this course syllabus, other than the grade policy, may be subject to change with advance notice, as deemed appropriate by the instructor.