Applied Weather Modification (AtSc 252)
Course Syllabus: Spring 2023

Overview

This syllabus describes the requirements and procedures for ATSC 252 Applied Weather Modification. You are responsible for knowing this material, so please read carefully. Any changes will be announced through email to your UND email account. You will be responsible for any changes. Your continued enrollment in this course is your implicit agreement to abide by the requirements of this class.

Course Information

AtSc 252: Applied Weather Modification (3 credits)
Prerequisite: ATSC 110
Class Meeting Time: Tuesday/Thursday 4:00 –5:15 p.m.
Class Meeting Location: Odegard Hall, Room 106
Class Format: Hybrid (Zoom Link)

Contact Information

Professor: David Delene
Office: Clifford Hall 420
Office Hours: Tuesday/Thursday 3:00 – 4:00 p.m. or by Arrangement
Phone Number: 701-777-4847 (Office), 507-533-5363 (Cell/Text)
Email: **delene@aero.und.edu**
Zoom: 947 2496 5587 Meeting ID

Graduate Teaching Assistant: Lucas Castro
Office Hours: 1:30-3:00 p.m. on Tuesday in Aerospace Learning Center
Email: lucas.castro@und.edu

Welcome

I would like to welcome you to ATSC 252 Applied Weather Modification for the Spring 2023 semester. It is my first priority to offer a great in person classroom experience. I feel that this is a better learning environment than online and you are welcome to attend in person as often as possible. To accommodate those who are not always able to attend, the course will be delivered in a hybrid mode. This means that course material will be posted online, including video recordings of classroom lectures. If at any time you have questions or concerns, please do not hesitate to contact me.

Policies and Procedures

Attendance

Attendance is important for this class; however, student attendance will not be used in calculating grades. There class will be available via a Zoom session so if you can't make the class in-person, please login to the Zoom Session. Additionally, there will be Zoom recordings, unless there a technical issues, that you can review. Please try hard to make it to class on time; however, if this is not possible, please come in late if necessary, without disturbing the class. Students are responsible for finding out what material they missed if they do not attend class. This includes class handouts and assignments. Additionally, if you have to miss an in-person exam, please contract me ahead of the exam to make arrangements.

Student Resources

Information on the student resources (UND's Notice of Nondiscrimination; Disability Access Statement; Reporting Sexual Violence; and Faculty Reporting Obligations Regarding Sexual Violence) is located on the Atmospheric Sciences Wiki page at http://wiki.atmos.und.edu/lib/exe/fetch.php?media=atmos:student_resources.doc. Also included is information on the UND Cares Program, as well as how to seek help when in distress, and how to recognize when students are in distress.

Missed Exams or Assignments

Exams or Assignments can only be made up if students make arrangements before hand. Students are responsible to find out about assignments and upcoming exams if they cannot attend a class. **No late assignments will be accepted!**

Scholastic Dishonesty

Please refer to the code of student life for information on cheating and plagiarism. Each student is expected to complete assignments and exams individually. Students are encouraged to work together to learn the material but must complete work individually. Turning in identical assignments will result in zeros for both assignments and may result in failure of the course.

Grading

Class grades are determined from assignments (50 %), quizzes (10 %) and exams (40 %). Course grading scale is as follows: 90% A, 80% B, 70% C, 60% D. Grades will be based on quizzes (20 %), exams (60 %) and the final exam(20 %). Exams and the final will be comprehensive of the class material covered.

Class Participation

Active student participation is expected during class and may be considered if a student's grade is borderline. Please ask questions during class and I will try to address the question. However, if the question requires a long explanation, we may have to wait until after class to talk about it. I will research questions that I don't know the answer to and address the question during the next class meeting. Please let me know of topics that interest you that are not being covered.

Class Format

A typical class meeting will be broken up between short quizzes, discussions, and lectures. The beginning and middle will be used to discuss current new topics related to weather modification or showing of short videos. The class will cover several different major topics in applied weather modification. Quizzes will be given to build upon classroom work and assess understanding of the material. Concepts and tools will be introduced in a problematic fashion, which means that things will be presented when and to such an extent that they are necessary to address the topic.

Course Objectives

Provides a comprehensive introduction to basic concepts of weather modification as currently practiced around the world. Topcis include a study of cloud physics, seeding theory, a review of past and current programs, and a discussion of related legal, societal, economic, and environmental issues. The class provides students exposure to the practical aspects of weather modification operations, including operational program design and evaluation, care

and use of seeding materials and equipment, identification of seeding opportunities, and methods of airborne delivery of seeding materials.

Goals

- To learn the theoretical basis for weather modification.
- To learn how cloud weather modification projects are established and conducted.
- To learn how to effectively participate in operational programs.

Learning Outcomes

By the end of this course each student should be able to:

- State why and where weather modification operations are conducted.
- Recognize the overall context and external factors affecting application of this technology.
- Explain the theoretical basis for weather modification by cloud seeding, including underlying assumptions.
- Explain what constitutes a seeding opportunity.
- Identify cloud seeding opportunities and select appropriate conditions for treatment.
- Describe how cloud seeding equipment works and what are its operational limitations.
- Conduct cloud seeding operations in a safe and effective manner.
- Distinguish between valid and false claims of cloud seeding success.

Reference Material

This course makes use of open educational resources (OER). Open educational resources are freely accessible, openly licensed documents and media that are useful for teaching and learning. These required resources are available to students at no cost and will be used in place of physical textbooks.

Course Outline

1. Block 1
    - Introduction and Internship Experience
    - History of Weather Modification
    - Critical Thinking and Legal Aspects
    - Environmental Concerns and Sociological Issues
    - Economic Impacts
    - Unintended Weather Modification
    - Statistical Evaluations
2. Block 2
    - Atmospheric Aerosols
    - Atmospheric Water Vapor
    - Particle Nucleation
    - Droplet Growth
    - Basic Clouds and Cloud Formation
3. Block 3
    - Precipitation Processes
    - Cloud Dynamics
    - Conceptual Models
    - Precipitation Conceptual Models
    - Hail Suppression Conceptual Models
    - North Dakota Cloud Modification Project (NDCMP) Model

4. Block 4
    - Seeding Materials
    - Dry Ice as Seeding Agent
    - Seeding Agent Dispersal
    - Seeding Equipment and Methods
    - Radar for Weather Modification
    - Record Keeping and iPARS
    - Weather Forecasting and SkewT Bascis
    - Daily Operations and Opportunity Recognition
    - Flight Safety
    - Case Example: Put All Together