University of Wyoming, Department of Atmospheric Science
ATSC 5880
Airborne Instrumentation (for Atmospheric Measurements)
Spring 2020
Course Syllabus, Policies and Outline

1 Instructor

Jeffrey (Jeff) R. French, PhD
Office: EN6065
Phone: 307-766-4143
Email: jfrench@uwyo.edu
Office Hours:
Mon & Wed 1:30 – 3:00 PM (or by appointment)
Course Materials Website:
http://www.atmos.uwyo.edu/~jfrench/teaching.html

2 Course Description, Goals and Objectives

Description: An introduction to instrumentation used on research aircraft to measure properties of the atmosphere. Topics include measuring atmospheric state, atmospheric particles, and other constituents (ie trace gases) from aircraft. Principles of measurement techniques are described, complexities due to clouds are presented, and resulting uncertainties and limitations are explored.

Goal: The goal of this course is for students to gain an advanced understanding of complexities associated with atmospheric measurements from airborne platforms. After completing this course, students should understand basic theoretical considerations of how fast moving platforms influence atmospheric measurements including the effects of airflow passed sensors, changing static pressure, sensor response time, and influences of changing aircraft orientation. Students will have opportunities to work with and manipulate data collected from the UW King Air. Students will be introduced to a variety of sensors used to obtain measurements from research aircraft, including atmospheric state, thermodynamics, dynamics, aerosol, cloud and precipitation, and atmospheric gases.

Objectives: Specific objectives of this course are as follows: Students shall--

- Gain an advanced understanding of basic atmospheric measurements from aircraft,
- Gain an understanding of instrument calibration specific to airborne measurements,

- Prepare and deliver lectures on specific topics relevant to airborne measurements, and
- Work with data sets from aircraft-based instruments to evaluate quality of measurements.

3 Course Prerequisites

Graduate student in atmospheric science and/or consent of instructor

The target student audience for this course is advanced graduate students (2^{nd} year MS and PhD students). It is assumed that students taking this course are familiar with basic atmospheric structure, including thermodynamics of the atmosphere, composition of clouds, etc. Students should be comfortable working in programming languages such as idl, matlab, python, or similar; to read, manipulate, and display data. Example procedures in idl will be provided.

4 Course Structure

Material for this course is taught through lecture sessions, 1 hr 15 min, 2 days a week. Early in the semester, the instructor will lead lectures. These will focus on the basics of atmospheric measurements from aircraft. Through the middle of the semester lectures will discuss specific topics such as cloud measurements, aerosol, and trace gases. We will seek to mix in special guest lecturers. Towards the end of the semester, lectures will be led student teams focusing on specific topics/instrument/measurement types for airborne platforms. Student lectures constitue the semester project discussed below.

5 Grading

a. Breakdown of graded events

Grading will be based on prepared lectures, projects, and class participation.

	WEIGHT
Class Participation	10%
Student-Led Lectures	45%
Semester Project	45%
TOTAL	100%

b. Class Participation

Students will be expected to participate in all classes. This is an advanced graduate course and as such, I seek to teach the course with a mix of lectures and class discussion. Students' comments and own curiosity should help guide the discussion through class periods. Participation of all students is required.

c. Early Semester Project

During the first half of the semester, each student will be required to complete and provide a short write-up on a specific topic utilizing airborne measurments. Topics will be decided in consultation with the instructor and should focus on a specific measurement or measurement class utilizing real data either from the UWKA or other airborne platform. The development of the project should include a basic research question that the student will address through analysis of data. Results of the project will be presented in a short paper due at mid-term.

d. Student-Led Lectures

Students will be divided into teams of two persons. Each team will present a single lecture on a topic of specific interest to them. The instructor will provide some reference material available in the refereed literature on the topic and the student teams will be responsible for presenting the material to the class. Prior to the lecture, the team will review their material with the instructor. Students will be expected to organize the material into a *teaching lecture* (not just a ‘seminar’) with expected learning outcomes. The instructor will provide written critiques and comments to each team.

e. Grading Scale

Letter Grade	**Percentage Range (%)**	**Equivalent GPA (4.0 scale)**
A	90 – 100	4.00
B	80 – 89	3.00
C	70 – 79	2.00
D	60 – 69	1.00
F	Below 60	0.00

Note: the university mandates that graduate students maintain a cumulative GPA of 3.00 or better. Failure to do so will result in academic probation and could lead to expulsion from the program.

6 Textbook and supplementary material

No textbooks are required. Reading specific to material being covered in lectures will be made available on the class webpage. Much of the overview material will be drawn from the text: *Airborne Measurements for Environmental Research* ed. Wendisch and Brenguier. Relevant chapters from this text will be available on the class webpage.

Other material, typically available in the refereed literature, will be posted on the class webpage.

7 Overview of Policies

a. Turn-in Policy

To obtain credit for your work, projects must be completed on time. In extenuating circumstances, students may receive extensions to due dates, but these should be arranged in advance if at all possible. Projects not turned in on time may receive a zero.

b. Attendance

If students know they will miss class (Dr. appointment, conference, etc) they **must** contact the instructor ahead of time. Unexcused absences will result in reduced grade for class participation.

Students are <u>encouraged</u> to take advantage of opportunities offered by the department: flying on the UWKA, attending conferences, participating in field program. However—make sure you arrange ahead of time with your instructor if you will miss class.

c. Collaboration Policy

'Science and learning rarely occurs in a vacuum.' Student-led presentations require collaboration amongst team members. The homework assignments should lead to discussion, both inside and outside of class, which also encourages collaboration. However, collaboration does not mean that it is OK to misrepresent work that is not your own (See Academic Dishonesty statement below).

Semester projects are student specific, thus these projects and the accompanying presentations should be the student's own work.

d. Academic Honesty

"The University of Wyoming is built upon a strong foundation of integrity, respect and trust. All members of the University community have a responsibility to be honest and have the right to expect honesty from others. Any form of academic dishonesty is unacceptable to our community and will not be tolerated." [excerpted from the UW General Bulletin] All persons should report suspected violations of standards of academic honesty to the instructor, department head, or dean. See UW Regulation 6-802, "Procedures and Authorized University Actions in Cases of Student Academic Dishonesty." You can read this and all other University regulations at: http://www.uwyo.edu/generalcounsel/index.html

e. Disability Statement

If you have a physical, learning, or psychological disability and require accommodations, please let the instructor know as soon as possible. You must register with, and provide documentation of your disability, to University Disability Support Services (UDSS) in SEO, room 330 Knight Hall.

f. Duty to Report

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at http://www.uwyo.edu/reportit

You do not have to go through the experience alone. Assistance and resources are available, and you are not required to make a formal complaint or participate in an investigation to access them.

8 Course Topics *(Subject to Change)*

<u>Basic atmospheric state and dynamics measurements</u>

Measurement of static and dynamic pressure, airspeed and flow angle

Incompressible vs compressible, flow distortion, upwash

Measurement of static (air) temperature

Total temperature vs static, calibration techniques

Measurement of humidity/water vapor

Techniques for making vapor measurements

Determination of position and attitude and measurement of ground speed, transforming between air-relative and ground-relative components

IRS vs. GPS, when rates are important

Calculation of 3-Dimensional Wind Vector

Basic steps of computation, sources of air, in-flight calibration (Lenschow, Rodi, Friehe & Khelif)

<u>Complexities due to presence of cloud (liquid)</u>

Measuring temperature in cloud

Measurement of bulk cloud properties

Bulk liquid (and ice) water, extinction

<u>Introduction to measurement of atmospheric particles</u>

Measurement techniques

Scattering, extinction, absorption, mass

In-cabin measurements (typical aerosols)

Inlet considerations and size sorting, complications due to cloud

Cloud Hydrometeor Measurements

Forward/back scattering, optical array probes, holography

<u>Atmospheric gases and constituents</u>

<u>Airborne measurements of atmosphere/surface flux</u>

<u>Remote Sensing from Aircraft</u>