COURSE SYLLABUS
AT737 Satellite Observations of the Atmosphere and Earth

Instructor Information

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Office Hours: Wednesdays 1-2 PM , or by appointment
Communication Policy: Responses to emails will be provided within 48 hr

Class Meets: ACRC Room 212B M/W 11:00 AM - 12:15 PM

Prerequisites for Course

Graduate-level Atmospheric Radiation (e.g., ATS 622), Graduate-level Atmospheric Remote Sensing (e.g., ATS 652), or the express consent of Instructor. Any graduate student in physical sciences, engineering or mathematics is qualified to take the course. Students are expected to have a basic familiarity with scientific programming languages. Students are free to use their language of choice (e.g., Matlab, IDL, FORTRAN-90/95, R, Python) for assignments. However, the instructor / class support team can provide minor assistance in FORTRAN-90, IDL and Python.

Credits: 3

Course Description & Objectives

This course delves into the exciting topic of meteorological satellites, beginning with the basic theory and laws that govern satellite orbits, and reviewing the underpinning principles of radiative transfer that enable remote sensing of the earth/atmosphere system. We explore different kinds of satellite instrumentation and their unique abilities to sense key properties of this system, and hone our interpretation of satellite imagery as related to various meteorological and environmental phenomena. The course takes a historical perspective on the field (which is still relatively new) and extends into the modern-era of operational and research-grade systems, and consider the role of the satellite platform in addressing the pressing questions of weather/climate observation and prediction.

LEARNING OUTCOMES (See Course Schedule for Alignment)

Upon the completion of this course, students will be able to:

1. Recount the history of meteorological satellites
2. Describe basic satellite orbits and compute them from first principles of Newton's Laws and Keplerian Theory
3. Relate fundamental principles of radiative transfer theory to the application of satellite remote sensing
4. Understand how satellite instruments measure electromagnetic radiation to infer the composition of various constituents of the earth/atmosphere system, including:

   a. Imagery interpretation and physically based enhancements
   b. Temperature and Moisture
   c. Winds
   d. Clouds and Aerosols
   e. Precipitation
   f. Earth's radiation budget and climate
   g. As a tool in supporting various research topics (class projects)
5. Understand how satellites are used in operational forecasting
6. Design a satellite observing system to meet a specific science objective
7. Anticipate the future of meteorological satellites vis-à-vis priorities of our field

In addition to lectures on the core topics of satellite meteorology, experts from the field will be invited provide additional background and examples of specific research and operational pursuits leveraging satellite observations—providing students with a well-rounded, multi-dimensional perspective.

Assignments' Description & Alignment with Course Objectives

The main assignments will involve an exercise to apply the basic orbital theory learned in the first part of the course to a practical problem, review of selected scientific papers or book chapter updates, and a Class Project.

Each student will develop their own Class Project topic idea. Topics must deal with some aspect of meteorological satellite remote sensing of Earth's environment. Topics related to a student's ongoing thesis or dissertation work are allowed in some cases and where applicable, but must demonstrate a significant, self-contained effort. Project proposals are due in February and will be reviewed by the instructor to ensure project criteria are met. Students will make oral and written presentations of their project near the end of the semester. Further guidelines be discussed in class.

Course Schedule – Alignment of Course Topics, Learning Outcomes, and Assignments/Assessments

DATE	TOPIC/SUB-TOPIC	LEARNING OUTCOMES ALIGNMENT (see list above)	ASSIGNMENTS/ ASSESSMENTS
F 20 Jan	Welcome, Scope, and Introductions	--	
M 23 Jan	Satellite History GUEST: Tom Vonder Haar	1	K&V Ch 1
W 25 Jan	Satellite Orbits 1: Basic Theory	2	K&V Ch 2
M 30 Jan	Satellite Orbits 2: Types of Orbits	2	
W 1 Feb	Satellite Orbits 3: Navigation	2	
M 6 Feb	Sat Orbits Workshop GUEST: Stan Kidder	2	Orbital Assignment
W 8 Feb	Radiative Transfer 1: Basic Laws, RTE	3	K&V Ch 3
M 13 Feb	Radiative Transfer 2: Scattering & Absorption	3	Orbital Assignment Due
W 15 Feb	Class Project Discussions (Students, Resources)	4,5	Class Project Proposals

M 20 Feb	Satellite Instrumentation 1: Resolution & Calibration	4	K&V Ch 4
W 22 Feb	Satellite Instrumentation 2: NOAA Operational Programs	4	
M 27 Feb	Satellite Imagery Interpretation	4a	K&V Ch 5 Bader
W 1 Mar	Severe Weather GUEST: Dan Bikos	4	
M 6 Mar	Atmospheric Composition 1: Temperature Soundings	4b	K&V Ch 6
W 8 Mar	Atmospheric Composition 2: Moisture/Gas Soundings	4b	
13-17 Mar	CSU Spring Break	--	--
M 20 Mar	Winds	4c	K&V Ch 7
W 22 Mar	Atmos Motion: Optical Flow GUEST: Jason Apke	4c	
M 27 Mar	Clouds	4d	K&V Ch 8
W 29 Mar	Tropical Cyclones GUEST: Mark DeMaria	4d, 5	
M 3 Apr	Aerosols	4d	
W 5 Apr	Precipitation	4e	K&V Ch 9
M 10 Apr	Earth's Radiation Budget	4f	K&V Ch10
W 12 Apr	Surface Properties	4a	
M 17 Apr	NWS Usage of Satellites GUEST: Bill Line	5	
W 19 Apr	Field Trip: Cheyenne WFO CONFIRMED date TBF	5	
M 24 Apr	*The Future:* NextGen Programs and Decadal Survey Priorities	6,7	K&V Ch 11
W 26 Apr	*Science of the Night*: Low-Light Visible Sensing	6,7	
M 1 May	Field Trip: Lockheed Martin	6,7	
W 3 May	Class Project Presentations Poster Reception	--	--
W 10 May (Finals Week)	No Class Class Project Reports Due	--	--

Textbook / Course Readings

Required Text:

Satellite Meteorology, an Introduction (Kidder and Vonder Haar (K&V), Academic Press)
https://www.amazon.com/Satellite-Meteorology-Introduction-Stanley-Kidder/dp/0124064302

https://www.elsevier.com/books/satellite-meteorology/kidder/978-0-08-057200-0

Optional Text:

Images in Weather Forecasting (Bader et al., Cambridge)
https://www.amazon.com/Images-Weather-Forecasting-Practical-Interpreting/dp/0521451116

https://www.abebooks.co.uk/book-search/title/images-in-weather-forecasting/author/bader/

Other Topical Readings (Suggested or Assigned):

To be provided

Course Materials & Equipment

N/A

Participation/Behavioral Expectations

This course will be taught in-person, but in the event of unanticipated hybrid format delivery modes, please review the core rules of netiquette for some guidelines and expectations on conduct expectations in an online learning environment.

Course Policies (late assignments, make-up exams, etc.)

As a student enrolled in this course, one of your responsibilities is to submit course work by the due dates listed. With that said, I take my role as your instructor very seriously. I care about how well you do in this course and that you have a satisfying, rewarding experience. As such, it is my commitment to you to respond individually to the work you submit in this class and to return your work in a timely manner. Smaller assignments will be returned within 1 week and major assignments will be returned within 2 weeks. If, due to unforeseeable circumstances, the grading of your work takes longer than the times I have listed here, I will keep you informed of my progress and make every effort to return your work with feedback as soon as I can.

Grading Policy

GRADE	RANGE
A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

ASSIGNMENT	GRADE POINTS	GRADE PERCENTAGE
Attendance, Discussion and Participation		10%
Wx Briefings and/or Literature / Book Chapter Reviews		15%
Assignments		25%
Class Project: Oral Presentation + Poster		25%
Class Project: Final Report		25%

ASSIGNMENT	GRADE POINTS	GRADE PERCENTAGE
Total:		**100 %**

Academic Integrity & CSU Honor Pledge

This course will adhere to the CSU Academic Integrity/Misconduct policy as found in the General Catalog and the Student Conduct Code.

Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, I will ask that you please affirm the CSU Honor Pledge as part of completing your work in this course. Any violations will result in a grading penalty for this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Important Semester Dates!

Spring Semester - 2023

Date	Event
January 2	Monday Holiday - University Offices Closed
January 12-13	Thursday-Friday Orientation, Advising and Registration for New Students
January 16	Monday Holiday - University Offices Closed
January 17	Tuesday Classes Begin (ATS-737 First Class on Wednesday!)
January 20	Friday End Restricted Drop
January 22	Sunday End Add Without Override
February 1	Wednesday Registration Closes - end of period for adding courses - last day for dropping courses without record entry, changes in grade option, and tuition and fee adjustment
February 11	Founder's Day - CSU's 151st birthday
March 11	Saturday Spring Break Begins - No Classes Next Week
March 20	Monday End Course Withdrawal ("W") Period, Repeat/Delete Deadline
March 20	Monday Classes Resume
May 5	Friday Last Day of Classes; University Withdrawal Deadline
May 8-12	Monday-Friday Final Examinations
May 12-14	Friday - Sunday Commencement
May 16	Tuesday Grades Due
Calendar	