

Remote Sensing of Earth's Atmosphere

Spring 2025: PHYS 722 - Credit Hours 3.0

Tuesday and Thursday 10:30 – 11:45 AM

Sherman Hall 151

Instructor's Contact Information: Dr. Belay Demoz, bdemoz@umbc.edu or 410-455-2715. Physics bldg. Rm 426;

Office Hours: Thursday 10am – 11pm; other hours arranged by email.

Prerequisite: *PHYS721: [Atmospheric Radiative Transfer](#)*, or instructor's authorization

PHYS 722 description [Course Catalog]: Techniques for the passive and active remote sensing of the state and composition of the Earth's atmosphere. Fundamentals of radiative transfer as applied to remote sensing. Introduction to measuring radiation and designing passive and active instruments, theoretical background, and algorithmic considerations for the passive and active sensing of aerosol and cloud properties, atmospheric profiles of temperature, humidity and trace gas concentration and the state and composition of the surface.

Suggested Text:

- Rick Chapman, Richard Gasparovic (2022): [Remote Sensing Physics: An Introduction to Observing Earth from Space](#); ISBN: 978-1-119-66907-4
- John R. Schott, 2009; *Fundamentals of Polarimetric Remote Sensing*, SPIE Tutorial Text Vol. TT81
- G. L. Stephens, Remote Sensing of the Lower Atmosphere, 1994, Oxford University Press.
- W. G. Rees, Physical Principles of Remote Sensing, 2001, 2nd. Edition, Cambridge University Press.
- Lecture resources: shared presentations and lectures in [UMBC box](#) and/or handouts.

Course Objective: The course will explore the underlying physical principles and techniques used to make remote measurements of the Earth's Atmosphere and discuss algorithms used to extract geophysical information from those measurements. These will primarily include ground and space-based passive and active remote sensing techniques that are commonly in use today as tools of the research world. Highlights of key instruments, platforms (ground, aircraft, and space) and techniques as well as (dis)advantages in deriving atmospheric properties will be discussed. Students will apply their radiative transfer background from previous courses to simulate and/or explain and interpret remote sensing measurements of the atmosphere and surface. At the end of this course, students will be expected and be able to

- a) Distinguish and describe the designs of passive and active remote sensing instruments
- b) Identify and explain theoretical principles of ground- and satellite-based radiation measurements
- c) Develop and evaluate retrieval methods for sensing aerosols, clouds, precipitation, and atmospheric profiles of temperature, humidity and/or trace gas concentration

Draft of topics to be covered (subject to adjustment after the 1st class meeting).

<u>Topic</u>	<u>time</u>	<u>Comment</u>
AMS annual meeting (No Class)	Week-1	<i>2 Make-up classes: TBD @ 1st class</i>
Introduction to Remote Sensing	Week-2	
Satellite Orbits and Platforms	Week-3	<i>Data and instrument discussion</i>
Infrared Sensing	Week 4	
Microwave Radiometry	Week-5	
Lidar Principles and application	Week-6	
Radar Principles and application	Week-7	
SPRING RECESS	Week 8	<i>16-23 March</i>
Class Project discussion	Week-9	1 st discussion of the class project
Precip. From Space (Mehta)	Week-10	<i>4-apr; deadline to withdraw</i>
	Week11	

Optical Sensing – Ocean Color	Week 12	
Optical Sensing – Land Surfaces	Week-13	
Altimeters	Week-14	
Scatterometry	Week-15	
Synthetic Aperture Radar	Week 16	<i>13-May; Last day of classes</i>
Final exam	TBD	

Course Grading: Student grades will be based on their performance in the following activities or examinations:

Research Project	40%	Each student (as part of a group and/or individually) will (1) justify & select a remote sensing topic (2) provide a written brief report (3pages max) with a box link to supplementary work (3) present the work in class.
Class assignments and discussion	20%	Periodic homework and take-home projects of equal weight will be assigned that will be averaged to 30% of total grade points
Final Exam	40%	A summative final exam; take home and/or in-class will be decided by instructor

Attendance: Students are required to attend all class sessions and field excursions, unless illness or emergency prevents it (in which case the student must provide a written explanation to the instructor upon next class attendance, or by telephone or e-mail in case of extended absence).

Academic Honesty Policy: By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community, in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, See here <http://www.umbc.edu/gradschool/procedures/integrity.html>

Accessibility and Disability Accommodations, Guidance and Resources: Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in university courses, programs, or activities. If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures. ***SDS email: disAbility@umbc.edu SDS phone: (410) 455-2459*** ***If you will be using SDS approved accommodations in this class, please contact me to discuss implementation of the accommodations.***

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination: UMBC's Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination and Federal Title IX law prohibit discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment or retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources: ***Mikhel A. Kushner, Title IX Coordinator (she/they); 410-455-1250 (direct line), kushner@umbc.edu***

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has several Confidential Resources available to support you:

- The Counseling Center: 410-455-2472
- University Health Services: 410-455-2542
- Pastoral Counseling via Interfaith Center: 410-455-3657; interfaith@umbc.edu
- Other Resources: Women's Center: 410-455-2714; womenscenter@umbc.edu.

Pregnancy: UMBC's Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination expressly prohibits all forms of Discrimination and Harassment on the basis of sex, including pregnancy. Resources for pregnant students are available through the University's Office of Equity and Inclusion. Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and assure ongoing access to their academic program with respect to a leave of absence or return following leave related to pregnancy, delivery, or the early months of parenting.

In addition, students who are pregnant may be entitled to accommodations under the ADA through the Student Disability Service Office, and/or under Title IX through the Office of Equity and Inclusion.

Religious Observances & Accommodations: UMBC Policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance, and as early as possible. For questions or guidance or to request an accommodation, ***please contact the Office of Equity and Inclusion at oei@umbc.edu.***

Hate, Bias, Discrimination and Harassment: UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, UMBC Policy prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate or bias or who have such matters reported to them should use the online reporting/referral form to report discrimination, hate or bias incidents; reporting may be anonymous.

Useful links

- Book - remote sensing: <https://read.wiley.com/books/9781119669159/page/8/section/head-2-29>
- A good book - ask the library to buy: <https://www.wiley.com/en-us/Remote+Sensing+Physics%3A+An+Introduction+to+Observing+Earth+from+Space-p-9781119669159>
- Online Training: Satellite-based tools for investigating aquatic ecosystems: <https://www.youtube.com/@trevorfoundation>
- Nice modules for simulating atmospheric things: <https://learningweather.psu.edu/>
- Radar from space:
chromeextension://efaidnbmnribpcajpcglclefindmkaj/<https://kiss.caltech.edu/workshops/biodiversity/presentations/McDonald.pdf>
- Public Health application of TROPOMI (NO2):
<https://gwu.app.box.com/s/8dedogu80in6roy0aerdbtbnyvdk4woy>
- <https://tropomino2.us/>
- A good recent paper – Gambacorta:
<https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10107761>
- Precipitation - Amita/ARSET floods: http://learningcenter.obt.inpe.br/lib/exe/fetch.php?media=e-learning:webinar3_part_2_floods_a_prados_a_mehta.pdf