ATS 770: Satellite Remote Sensing II

Professor: Sundar A. Christopher, Ph.D.

1. **Disability Statement.** The University of Alabama in Huntsville will make reasonable accommodations for students with documented disabilities. If you need support or assistance because of a disability, you may be eligible for academic accommodations. Students should contact Disability Support Services Office (256.824.1997 or 317 Wilson Hall) as soon as possible to coordinate accommodations.

2. **Contact Information**

   Email Address: christs@uah.edu ; Availability, Office Hours: By email. Please use CANVAS for all class-related communication.

3. **Course Information**

   Depending on the semester being taught this course will either be in traditional person format or as an asynchronous online course which means that students will work through the material based on the syllabus. In the asynchronous format all lectures will be provided in prerecorded format.

   Course Name: Satellite Remote Sensing II – ATS 770
   Credit Hours: 3
   Meeting day, time, and location: TBD
   Prerequisites: ATS 670 (Satellite Remote Sensing I)

4. **Course Description**

   4.1 Catalog Description: Using various satellite data sets and radiative transfer models, this course will train students to calculate and study cloud, aerosol, ocean and land surface properties to assess the radiative energy budget of the earth-atmosphere system. Prerequisites: ATS 670

   4.2 List of topics.

   Separating clouds and aerosols from other features in satellite imagery
   The Discrete Ordinate Radiative Transfer Model
   Cloud property retrieval
   Aerosol property retrieval
   Cloud and aerosol forcing
   Validation of geophysical products

4.3 Course Learning Objectives. Students will:

a) Understand and apply principles of spectral, spatial, angular, and polarization information to separate clouds and aerosols in satellite imagery.
b) Understand and use radiative transfer algorithms to calculate radiances and fluxes
c) Retrieve cloud and aerosol properties from satellite imagery using radiative transfer algorithms
d) Calculate radiative forcing of clouds and aerosols
e) Validate and assess geophysical products.

4.3.1 Course Outcomes.

By the end of the course students will be able to:

a) Explain how spectral, spatial. Angular, and polarization features can help separate clouds and aerosols from satellite imagery
b) Use radiative transfer code to calculate and interpret radiances and fluxes.
c) Use satellite data to retrieve cloud and aerosol properties
d) Use satellite data to separate clouds and aerosols from other features in the image

4.4 Course Materials

Various journal papers and algorithm theoretical basis documents will be assigned.

4.5 Recommended Text Books:

1) Computer processing of Remotely Sensed Images, An Introduction by Paul Mather, John Wiley and Sons
2) Satellite Meteorology, An Introduction, Kidder and Vonder Haar, Academic Press.
3) Remote Sensing of the Lower Atmosphere, An Introduction, Graeme Stephens, Oxford press.

4.7 Organization of Course/Instructional Methods. Depending on the semester this will be either in online format or in person.

4.8 Course Communication. In this class the official mode of communication is through Canvas. All communication between student and instructor and between student and student should be respectful and professional. Each student is responsible for course information communicated via Canvas. Students can expect responses from the instructor to Canvas messages and emails, within a 48-hour timeframe.

4.9 Course-specific resources. Check out the module “Student Technology and Resource Tool Box - Course Specific”. In this module there are numerous resources ranging from sample programs and how to access relevant data bases for your work. This module is at the top of the module list.

5 **Attendance Policy.** This online course is accessible completely online and active participation will greatly improve your success in this course. You are expected to log into the course at least 2 to 3 times a week to complete course assignments/quizzes, participate in discussions, and to check updates related to the course. Please make sure that you check your email regularly for course updates.

5.1 Missed Assignments/Make-Ups/Extra Credit. To ensure fairness to all students, **late assignments are not accepted** and will be given a grade of zero. Since the entire course is released at the beginning of the semester students are expected to work at their own pace and complete the assignments on time.

Evaluation and Grading. The following grading scale will apply to all work:

A = 90%–100%
B = 80%–89%
C = 70%–79%
D = 60%–69%
F = 0%–59%

Grading Elements
Four class projects: 40 %
One final project: 25 %
Four paper presentations and one final project presentation: 35 %
TOTAL : 100%

This advanced level remote sensing course is designed to foster interaction among students and with instructor. Therefore, the format will be flexible with lectures by instructor, presentations by students, and discussions during classes.

5. **Data Sets and programming issues.** We will use current data sets such as the MODIS, VIIRS, GOES-ABI, Planetscope, and CERES for this class. We will focus primarily on radiance level data for classification, retrievals and validation although coarser resolution products may be used for comparison purposes. We will use other satellite data sets as needed. You can use IDL/Python for the course and you can use any and all libraries available as part of the package. You must write your own code to perform analysis and plotting.

6. **Radiative transfer models and other dat**a. We will primarily use the Discrete Ordinate Radiative Transfer Model (SBDART) for this course. You will download this code from the web yourself, compile, read instructions and run the program to suit your projects. We may use other data bases as needed. Example the OPAC cloud and aerosol data base.

Codes : https://atmos.washington.edu/~qfu/links.php (Links to an external site.)

References for RT models

1. Paul Ricchiazzi, Shiren Yang, Catherine Gautier and David Sowle. 1998: **SBDART: A Research and Teaching Software Tool for Plane-Parallel Radiative Transfer in the Earth's Atmosphere.** *Bulletin of the American Meteorological Society*: Vol. 79, No. 10, pp. 2101–2114.
2. M. Hess, P. Koepke and I.Schult. 1998: **Optical Properties of Aerosols and Clouds: The Software Package OPAC.** *Bulletin of the American Meteorological Society*: Vol. 79, No. 5, pp. 831–844

7. **Projects**

You will be doing four major projects in this class and one final project. Each project will require a written report that should follow the Journal of Geophysical of Research guidelines. Times Roman 12 pitch font, double-spaced with figures at the end of the paper. See the web page for an example. The four projects are:

1. **Classification**. Separating various classes such as clouds, aerosols, land and ocean in satellite imagery. You must multi-spectral/multi-angle satellite data and perform your classification using both land and ocean imagery involving aerosols, clouds, land and ocean. Perform validation/intercomparison.
2. **Cloud retrieval**. For the clouds that you identified in the first project, you must retrieve cloud optical depth, cloud particle size and cloud liquid water path. You can restrict your analysis to water clouds only. Also perform validation/intercomparisons.
3. **Aerosol retrieval**. For aerosols that you identified perform retrievals of aerosol optical depth and perform validation and intercomparison.
4. **Radiative forcing**. Using radiation budget data such as CERES to calculate radiative forcing for the cloud, atmospheric and aerosol conditions. Perform validation/intercomparison.

8. **Important notes**: Choose your areas of study and images judiciously at the beginning of the semester so you can use your time effectively. Look for areas where ground measurements are available and well defined aerosol plumes and low level water clouds are present.
9. **Oral presentation**. You will be making four oral presentations as part of this course.

As part of your oral presentation, I want you to discuss the satellite sensor and the corresponding ATBD and present this in class. The instructor will assign the satellite sensor. You will be given 45-50 minutes for your presentation. Your presentation must summarize the results of your ATBD and present the results of the ATBD that you selected. The presentation topics include

1. Cloud and aerosol identification from satellite imagery
2. Cloud optical property retrieval
3. Aerosol optical property retrievals
4. Radiative forcing of clouds and aerosols

All presentations must be prepared using PPT and recorded using the Record Slide show feature. Then convert the recorded presentation to MP4 format.

Students must upload

1) the recorded seminar in mp4 format
2) PPT slides.

Note that the students will give a live seminar in class. The recorded seminar is simply a way to for the student to get used to technology, rehearse the seminar in the allotted time and as a means of practice before the actual live seminar.

9. **Final project**.

The final project must use satellite data and well conceived research plan. You can either perform geophysical retrievals yourself or use existing products. You can leverage some of your existing research but it must include comprehensive data analysis. The topic must be approved by the instructor. In the past some students have directly submitted this into journal papers.

On or before deadline, I need a one-page summary of your final project including the goal of your project. What scientific questions you are setting out to examine, the data sets you will use, the area of study, how much data you will process, a time line of how you will complete your project and a list if key references for the project.

10. **Important dates**. All projects are due before start of class on the date specified. You must upload the PDF versions of all projects. No exceptions and late projects are automatically assigned a grade of zero. For presentations a MP4 recorded file and slides are required.

6 **Course Conduct.** Students are expected to show respect for the instructor and other students.

7 **Academic Honesty.** Your written assignments and examinations must be your own work. Academic misconduct will not be tolerated. To insure that you are aware of what is considered academic misconduct, you should review carefully the definition and examples provided in the Student Handbook, p. 139. If you have questions in this regard, please contact me without delay.

8 **Use of Prior Work.** You may not submit in fulfillment of requirements in this course any work submitted, presented, or used by you in any other course.

9 **Copyright.** All federal and state copyrights in my lectures and course materials are reserved by the instructor. You are authorized to use course material for your own personal use and for no other purpose. You are not authorized to record the instructor's lectures or to make any commercial use of them or to provide them to anyone else other than students currently enrolled in this course, without the instructor's prior written permission. In addition to legal

sanctions for violations of copyright law, students found in violation of these prohibitions may be subject to University disciplinary action under the Code of Student Conduct. This course may also contain copyright protected materials such as audio or video clips, images, text materials, etc. These items are being used with regard to the Fair Use doctrine in order to enhance the learning environment. Please do not copy, duplicate, download or distribute these items. The use of these materials is strictly reserved for this course and your use only. All copyright materials are credited to the copyright holder.

10 **Privacy Statement.** During this course, you might have the opportunity to use public online services and/or software applications sometimes called third-party software such as a blog or wiki. While some of these could be required assignments, you need **not** make any personally identifying information on a public site. Do not post or provide any private information about yourself or your classmates. Where appropriate you may use a pseudonym or nickname. Some written assignments posted publicly may require personal reflection/comments, but the assignments will not require you to disclose any personally identity-sensitive information. If you have any concerns about this, please contact your instructor.

11 **Technology Statement.** This course will use UAH's learning management system, Canvas, as well as other technology tools. Students will be expected to have access to a computer with internet capabilities in order to fully participate in this course. Students are encouraged to reference accessibility information regarding specific technologies.

If you encounter technical difficulties with Canvas, report the behavior to Canvas Support. Canvas Support is available 24/7 for all faculty and students. In order to get immediate help:

1. Call the Canvas Support at 844-219-5802
2. Click on the "Help" icon on the left panel navigation in Canvas and select "Chat with Canvas Support"

When submitting a support ticket include your name, your class, the element/assignment being affected, and a detailed description of the issue. Providing a screenshot is often very helpful in diagnosing an issue.

Only under extraordinary circumstances would technical difficulties be considered as a mitigating factor in late or missed assignments (e.g., Canvas is down for two days, which is a highly unlikely event). In other words, if technology fails when a student waits until the last hour or two to complete an assignment, that situation does not qualify as an extraordinary circumstance. In the event that deadline extensions are indeed allowed, you must show documentation that you have first followed the above procedures. Canvas support will email you a ticket number. You can forward the email to the instructor as documentation.

Access to and use of certain software tools will be helpful in the completion of course requirements. Students will be expected to have access to a computer frequently, as all writing assignments used will be typed out and not handwritten. The software you use to write your assignments is irrelevant, as long as you follow my writing guidelines outlined later in my syllabus. It is recommended that you have access to a computer weekly. You will be expected to have access to the internet and email since the instructor will be emailing you about assignment updates, additions and changes.

12 **Student Resources.** The University of Alabama in Huntsville offers a range of student services to enhance the experience of students.

- Student Support Services—Counseling Center, Disability Support Services, Student Health Services, Office of International Services, Multicultural Affairs, etc.
- Academic Support Services—Student Success Center, Tutoring, PASS, Academic Support Centers by College
- M. Louis Salmon Library—Printed and Online Resources, Reference Services, Group Study Rooms, AV Resources, Printing
- Canvas Support—Call 844-219-5802 to report an issue with Canvas.
- OIT Help Desk—For technical support, contact the OIT Help Desk (helpdesk@uah.edu; 256.824.3333)

13. Elasticity Statement. The instructor will make every effort to follow the guidelines of this syllabus as listed; however, the instructor reserves the right to amend this document as the need arises. In such instances, the instructor will notify students via email and will endeavor to provide reasonable time for students to adjust to any changes.

14. Netiquette. Every student is expected to follow these guidelines when interacting with your instructor and classmates online in our class. Failure to do so will result in a warning. Ignoring the warning will result in zero (0) points on assignments.

- Be respectful of your instructor and fellow students. Be careful with your language.
- Spell out words - e.g. "you" instead of "u"
- Do not share inappropriate material or material not related to the topic
- DO NOT TYPE IN ALL CAPS! It looks like you are screaming.
- Be careful with the use of emojis - they are a friendly and informal style of communication that is easily misinterpreted
- Sarcasm does not work when typed on the screen. Do not use it. (I am not being sarcastic!)
- Be forgiving - assume initially others are not trying to disobey the rules or offend

15. **Complaint Procedure**. If you have difficulties or complaints related to this course, your first action should be to discuss them with your instructor. If such a discussion would be

uncomfortable for you, or fails to resolve your difficulties, you should contact the Chair of the Department at aes-chair@uah.edu. If you are still unsatisfied, you should discuss the matter with the Associate Dean of the College of Science, adeancos@uah.edu.

16. **Academic Continuity Plan**. If for some reason I am not able to be *present in this online course*, please contact the chair of the department (aes-chair@uah.edu) . The chair of the department is my supervisor and will step in to assess the situation and provide contingency plans. If for some reason we are not able to utilize Canvas, you can email christs@uah.edu and if that network is down you can reach me at sundar@nsstc.uah.edu for non-Canvas-related communication.