Remote Sensing of the Atmosphere and Ocean (MR3522; Autumn Quarter 2022)
Instructor: Scott Powell
Meeting times: M–R: 1400–1450 (F 1300–1450 only as needed)
Course webpage: https://swpowell.github.io/MR3522.html

Course Objectives

- Understand fundamentals of how satellite-, airborne-, and surface-based instruments provide information about the atmosphere, ocean surface and land surface.
- Visualize and interpret data from a variety of remote sensing instruments, primarily through lab exercises.
- Develop an improved, holistic understanding of how to apply information from various remote sensing platforms, including new state-of-the-art instruments, in research and operational settings.

Textbooks

Satellite Meteorology: An Introduction by Stanley Q. Kidder and Thomas H. Vonder Haar (text needed provided on course webpage)

Radar Meteorology: A First Course by Robert M. Rauber and Stephen L. Nesbitt

Syllabus

Week 1 (Sep. 26–30): Radiative transfer fundamentals; absorption and emission; EM spectrum; atmospheric windows

YouTube: Modules 1.1–1.4
Reading: Kidder and Vonder Haar, Chapters 1–3

Week 2 (Oct. 3–7): Satellite orbits; Geostationary satellites; GOES and Himawari bands, Weighting functions, JPSS

Lab 1: Interpreting Geostationary Satellite Data
YouTube: Modules 1.5–1.7, 2.1–2.4
Reading: Kidder and Vonder Haar, Chapters 1–3

Week 3 (Oct. 11–14): JPSS, Ocean color, Aerosol Optical Depth, Sea surface temperature retrievals, High resolution observations of land surface. Lightning detection networks and satellite remote sensing of lightning.

Oct. 10: No class (Federal Holiday)
Lab 2: Sea-surface temperature retrievals with IR data
YouTube: Modules 2.5–2.7, Modules 3.1–3.2

Week 4 (Oct. 17–21): Fundamentals of microwave radiative transfer, Polarization of radiation. Microwave imagers and sounders.

Oct. 19: Quiz on all material covered through Oct. 14.
Lab 3: Visualizing Landsat-8 data
YouTube: Modules 4.1–4.3
Oct. 20: Midterm Review
Oct. 21: Midterm exam

Week 5 (Oct. 24–27): No class. Instructor on TDY.

Week 6 (Oct. 31 – Nov. 3): No class. Instructor on TDY/leave.

Week 7 (Nov. 7–10): MW wind speed retrievals, Scatterometry and Altimetry, CYGNSS
Lab 4: Introduction to Passive Microwave Data
YouTube: Modules 4.4–4.6
Reading: Will provide text for interested students.

Week 7 (Nov. 14–18): Radar wavelengths; Reflectivity; Radar Equation; Attenuation; Doppler radar
Nov. 15: **Quiz on all material through Nov. 10.**
Lab 5: Interpreting Radar Data
YouTube: Modules 5.1–5.3
Reading: Rauber and Nesbitt: Chapters 2–6

Week 9 (Nov. 21–23): No class.

Week 10 (Dec. 2): No class through Dec. 1. Radar scan strategies; Challenges, Dual-polarimetric radar observations, Anomalous echoes: Surface clutter; second and third trip echo; side lobes
YouTube: Modules 5.4–5.6
Reading: Rauber and Nesbitt: Chapters 7–9, 14

Week 11 (Dec. 5–9): Rain-type classification, estimation of precipitation using radar data, satellite-based radars (TRMM, GPM, CloudSat), emulation of radar data using ML; Lidar, Cloud radars, Phased array radars.
YouTube: Modules 5.7–5.10
Lab 6: Multi-instrument analysis
Reading: Rauber and Nesbitt: Chapters 13, 17

Final Exam: TBD

Grading

All assignments must be completed. An incomplete will be given for a final grade if any assignments are not completed without approval from the instructor.

Quizzes (10%)

Class Worksheets (20%)
Midterm exam (25%)
Final exam on all material (45%)

Course Structure:

1. The majority of material will be initially delivered through short YouTube videos, which are separated into 5 lecture series containing a few videos (modules) each. All YouTube course material will be linked from the course webpage. The YouTube channel for this course in "NPS Remote Sensing". Students should view the videos at least once before class. Class time will be used to reinforce some of the most difficult material covered in the videos.

2. Written transcripts for the videos as well as slides displayed during the videos are available on the course website.

3. There is no required attendance for this course. Students who feel that they understand course material after watching videos should not feel required to attend class; however, all students are encouraged to at least attend exam review, and of course, are required to complete all graded assignments.

4. Office hours are available by appointment.

5. All course material is available online at the start of the course except for the radar textbook. Students may work at their own pace moving through the course material. Students are encouraged to at least keep up with the syllabus and are expected to commit approximately three hours per week to reviewing online material.

6. In order to discourage anyone from getting too far behind, quizzes will be administered about one-quarter and three-quarters of the way through the class. These quizzes should take no more than 30 minutes to complete.

7. Class worksheets will be provided for each lecture series and will be available on the course website. These worksheets contain various questions pertaining to the course material. Students should fill these out as they watch YouTube videos or attend class. Further instructions and due dates will be discussed in class.

8. Reading material: During the first few weeks of the course, students may find the first three book chapters from Kidder and Vonder Haar useful. The text is dated, but still has some useful fundamental concepts. Copies of the text are available at the course webpage. After the midterm, Rauber and Nesbitt will be required. We will cover material in this textbook rapidly. Students can choose to depend only on lecture material for studying, but the textbook is strongly encouraged as a reference.

9. Please use email or Microsoft Teams to communicate with the instructor. A group MR3522 Team has been created for the group, and the instructor will communicate with students primarily through this. Each student may also create a private channel with the instructor inside the MR3522 Team. If you do so, please make the channel name your name.

10. Labs will not be graded, but they can be completed on a remote JupyterHub. The link to the JupyterHub and instructions on how to get started is posted on the course webpage. Please review this as soon as possible once directed so that any problems with access or running labs can be remedied. The server running the JupyterHub may not be running all the time. Please contact the instructor if you have difficulty accessing the labs online. Answer keys will be provided on the course website for the lab questions. Students are strongly encouraged to work through the labs before consulting the answer sheet and keep up with the labs as listed on the syllabus.

11. Quizzes and Exams: Depending on the needs for exam review in class, exams may need to be scheduled during the otherwise unused Friday lab period. At-home quizzes and exams can be arranged on an as-needed basis.

12. If you have any concerns, comments, questions that you do not want to broadcast to the rest of the class, etc., please feel free to email the instructor to discuss or set up a private meeting on Teams.