Remote Sensing of the Atmosphere and Ocean (MR3522; Spring Quarter 2024)
Instructor: Scott Powell (Root 255)
Meeting times: Thurs: 1300–1450, F 0900–1050
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 (Apr. 1–5): 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 (Apr. 8–12): RT Fundamentals continued; satellite orbits; Geostationary satellites; GOES and Himawari bands

Lab 1: Interpreting Geostationary Satellite Data
YouTube: Modules 1.5–1.7, 2.1–2.3
Reading: Kidder and Vonder Haar, Chapters 1–3
Quiz Friday covering material through Thursday of Week 2.

Week 3 (Apr. 15–19): Weighting functions, JPSS, Ocean color, Aerosol Optical Depth, Sea surface temperature retrievals, High resolution observations of land surface.

Lab 2: Sea-surface temperature retrievals with IR data
YouTube: Modules 2.4–2.7
Quiz Friday covering material through Thursday of Week 3.

Week 4: (Apr. 22–26): *No Class.*

Week 5 (Apr. 29–May 3): *No class and no quiz. However, students will need to follow along with the material listed here:* Lightning detection networks and satellite remote sensing of lightning. Students may want to begin looking through practice exam during this week.

Lab 3: Visualizing Landsat-8 data

YouTube: Modules 3.1–3.2

Week 6 (May 6–10): Review Week 5 material in class (Note: This is only 2 modules). Midterm review on Thursday. May need to use extra hour on Thursday.

May 10: Midterm Exam starts at 0900

Week 7 (May 13–17): Fundamentals of microwave radiative transfer, Polarization of radiation. Microwave imagers and sounders. MW wind speed retrievals, Scatterometry and Altimetry, Bistatic scatterometery. (Some of this material will likely bleed over into Week 8.)

Lab 4: Introduction to Passive Microwave Data

YouTube: Modules 4.1–4.6

Reading: Will provide text on scatterometry for interested students.

Week 8 (May 20–24): Finish Week 7 material as needed; Intro to radar; Radar wavelengths; Reflectivity; Radar Equation; Attenuation; Doppler radar

Lab 5: Interpreting Radar Data

YouTube: Modules 5.1–5.3

Reading: Rauber and Nesbitt: Chapters 2–6

Friday Quiz covering material through Week 7.

Week 9 (May. 28–31): 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

Friday Quiz covering material through Week 8.

Week 10: (Jun. 3–7): Rain-type classification, estimation of precipitation using radar data, satellite-based radars (TRMM, GPM, CloudSat), emulation of radar data using ML.

YouTube: Modules 5.7–5.8

Lab 6: Multi-instrument analysis

Reading: Rauber and Nesbitt: Chapters 13, 17

Friday Quiz covering material through Week 9.

Week 11 (Jun. 10–14): Lidar, Cloud radars, Phased array radars. Synthetic aperture radar. Final exam review.

YouTube: Modules 5.9–5.10

Friday Quiz covering everything except Week 11.

Jun. 18 at 1100: **Final Exam** (Covers all material in course).

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 (15%)
Class Worksheets (15%)
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. If the PDF documents for the slides appear to have blank pages when viewing them in a browser, try downloading the PDF documents to your laptop/tablet, etc. for viewing.

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. However, most students will do best by attending all class meetings possible.

4. Office hours are available by appointment, on Thursday and Fridays. Generally, I will be free 1000–1300 on Thursdays.

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 approximately each Friday starting in Week 2. These quizzes should take no more than 10 minutes to complete; however, since each quiz will be comprehensive (i.e., covering all material up to that point in the course), the questions may become more challenging as the quarter proceeds.

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. You will be able to consult these (and only these) during your exams, so take good notes with them! 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.

10. 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.