Remote Sensing of the Atmosphere and Ocean (MR3522; Spring Quarter 2025)
Instructor: Scott Powell (Root 255)
Meeting times: Mon. – Thurs., 1200–1250
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 (Mar. 31– Apr. 2): Radiative transfer fundamentals; absorption and emission; EM spectrum; atmospheric windows

YouTube: Modules 1.1–1.4
Reading: Kidder and Vonder Haar, Chapters 1–3
No Class Apr. 3.

Week 2 (Apr. 7–10): 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 Thursday covering material through Wednesday of Week 2.

Week 3 (Apr. 14–17): 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 Thursday covering material through Wednesday of Week 3.

Week 4 (Apr. 21–24): Continue from Week 3 as needed. 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
Thursday Quiz covering material through Wednesday of Week 4.

Week 5 (Apr. 28–May 1): Review Week 5 material in class (Note: This is only 2 modules). Midterm review on Thursday.

May 2: Midterm Exam starts at 1300

Week 6 (May 5–8): Fundamentals of microwave radiative transfer, Polarization of radiation. Microwave imagers and sounders. MW wind speed retrievals, Scatterometry and Altimetry, Bistatic scatterometry. (Some of this material will likely bleed over into Week 7.)

Lab 4: Introduction to Passive Microwave Data
YouTube: Modules 4.1–4.6
Reading: Will provide text on scatterometry for interested students.
Thursday Quiz covering material through Wednesday of Week 6.

Week 7 (May 12–15): 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
Thursday Quiz covering material through Wednesday of Week 7.

Week 8 (May 19–22): 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
Thursday Quiz covering material through Wednesday of Week 8.

Week 9: (May 27–29): 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
Thursday Quiz covering material through Wednesday of Week 9.

Week 10 (Jun. 2–5): Lidar, Cloud radars, Phased array radars.

YouTube: Modules 5.9–5.10
Thursday Quiz covering material through Wednesday of Week 10.

Week 11 (Jun. 9–12): Complete material as needed. Synthetic aperture radar, time permitting. Final exam review.

TBD: **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 (25%)
Midterm exam (30%)
Final exam (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. Students should think of the videos as primary "textbook" for the course. Reviewing these videos can be considered homework but is not as a replacement for lecture. In-class time will follow the videos but will particularly emphasize areas where students have questions. 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. The videos for each week are listed above in the week-by-week syllabus.

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. Office hours are available at 1100 Mondays through Thursdays, and other times by appointment.

4. 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 required to at least keep up with the syllabus and are expected to commit approximately six hours per week to reviewing online material. MR3522 is a 4/2-credit core course. **The total estimated average time commitment for this course is 10 hours per week.**

5. In order to discourage anyone from getting too far behind, quizzes will be administered approximately each Thursday 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.

6. 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 and are intended as an additional note-taking aid. 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. These worksheets will not be evaluated or graded.

7. 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.

8. Please use email or Microsoft Teams to communicate with the instructor.

9. 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.