

Remote Sensing of the Atmosphere and Ocean (MR3522; Winter Quarter 2022)

Instructor: Scott Powell

Meeting times: M, W: 1500–1650 (F 1000–1150 only as needed)

Course webpage: <http://faculty.nps.edu/scott.powell/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 (Jan. 3–7): 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 (Jan. 10–14): 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

Week 3 (Jan. 18–21): Weighting functions, JPSS, Ocean color, Aerosol Optical Depth, Sea surface temperature retrievals, High resolution observations of land surface.

Jan. 17: No class. MLK Day.

Lab 2: Sea-surface temperature retrievals with IR data (due Jan. 28)

YouTube: Modules 2.4–2.7

Week 4 (Jan. 24–28): Lightning detection networks and satellite remote sensing of lightning.

Jan. 24: Quiz on all material covered through Jan. 21.

Lab 3: Visualizing Landsat-8 data

YouTube: Modules 3.1–3.2

Week 5 (Jan. 31–Feb. 4): Fundamentals of microwave radiative transfer, Polarization of radiation. Microwave imagers and sounders.

YouTube: Modules 4.1–4.3

Week 6 (Feb. 7–11): Midterm Review

Feb. 11: Midterm Exam (Covers Lecture Series 1–3).

CALICO Begins. Class may be cancelled at short notice from this point forward.

Week 7 (Feb. 15–18): MW wind speed retrievals, Scatterometry and Altimetry, CYGNSS

Feb. 14: No Class. Presidents' Day.

Lab 4: Introduction to Passive Microwave Data

YouTube: Modules 4.4–4.6

Reading: Will provide text.

Week 8 (Feb. 21–25): 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

Week 9 (Feb. 28–Mar. 4): Radar scan strategies; Challenges, Dual-polarimetric radar observations, Anomalous echoes: Surface clutter; second and third trip echo; side lobes

Feb. 28: Quiz on all material through Feb. 25.

YouTube: Modules 5.4–5.6

Reading: Rauber and Nesbitt: Chapters 7–9, 14

Week 10 (Mar. 7–11): 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

Week 11: (Mar. 14–18): Cover remaining material if needed.

Date 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 (10%)
Class Worksheets (20%)
Midterm exam (25%)
Final exam on all material (45%)

Course Structure:

1. This course may be conducted through an online, hybrid or entirely in-person instruction format, pending conditions. 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 is "NPS Remote Sensing". Remote participation in class will be enabled through Microsoft Teams.
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. The Navy does not provide funding for instructors to hold office hours. Therefore, please make your best effort to ask questions about course material during class.
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 30–45 minutes to complete and will be administered at 1500 on the day listed in the syllabus (or if class remains in remote format, an agreed upon time).
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. Each student may create a private channel with the instructor in the MR3522 Team and the channel name should be your last name.
10. Labs: All labs will be completed on a remote JupyterHub. The link to the JupyterHub and instructions on how to get started will be posted once the Hub is fully operational. Please review this as soon as possible once directed so that any problems with access or running labs can be remedied.
11. Submitting lab assignments: Labs will not be graded, and answer keys will be provided on the course website. 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.
12. Quizzes and Exams: Format (in-person or at-home) will be determined in the days prior to each quiz/exam, and instructions will be provided at that time. Depending on the needs for exam review in class, exams may need to be scheduled during the otherwise unused Friday lab period.
13. 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.