Remote Sensing, Geographical Information Systems and Analysis: Theory and Application

United Nations University (UNU-IAS)

Spring 2025

Location: UNU-IAS, Tokyo
Time: 09:30 – 13:00

Lecturer: Dr. Eng Martiwi Diah Setiawati
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Office Hours: 09.30-17.30(time, or by appointment)

Course Description

This course introduces the ideas and practices of remote sensing (RS) and geographic information systems (GIS) and how they apply to social-ecological research, management planning, and decision-making. There are two sections to this course. The first section will cover basic GIS principles and some significant and often used geoprocessing and spatial analysis tools and techniques, including vector-raster conversion, proximity, surface interpolation, reclassification, map algebra, and zonal analysis. The second section will primarily focus on processing RS satellite data, including developing many spectral indices and particular applications of satellite image classification methods. A sequence of talks and supervised practical training sessions will accomplish these goals. QGIS software will be used in training.

Course Objectives and Learning Goals

This course's main objective is to give students a basic understanding of the ideas and concepts behind GIS and RS and how to apply them to decision-making, management planning, and social-ecological research. Students will be able to process RS data and use many essential GIS tools and techniques at the end of the course. They will be able to utilize GIS and RS to conduct at least a fundamental spatial analysis and recognize a few vital social-ecological issues that can be supported by spatial analysis. Ultimately, they will be able to relate their study findings to management planning, decision-making, and current knowledge through GIS/RS-based analysis.

Requirements and Grading Policy

The course requirements include active class participation, exercise and assignment, final report, and oral presentation.

Attendance and class participation   : 20 %
(More than 80% attendance is required)

Exercises and assignments : 20 %
Final Report : 35%
Oral presentation : 25 %

<u>*Class Participation*</u>

The course requires students to attend all classes, arrive on time, complete the readings, and participate actively in class discussions. At the discretion of the instructor, frequent late arrivals or absences may result in a lower grade. Please note that the first session is particularly important and cannot be missed.

<u>*Exercises and assignment*</u>

*In order to develop a thorough understanding of the basic concepts of GIS and RS, the students need to do exercises on how to conduct spatial analysis by using the open-source software QGIS. Therefore, there will be two assignments: 1) processing the vector data set and 2) processing the raster (RS) dataset with some case studies. Assignments should be no more than five written pages, **not** including a works cited page. Quality visualizations of mapping are strongly encouraged.*

<u>*Final Report :*</u>

The final report should be a case study on applying GIS and RS to respond to societal and environmental issues/problems. The report could be their own analysis of the RS/GIS data set or through a literature review. Moreover, it should consist of a set of recommendations on how to overcome particular societal and environmental issues/problems. Each student is expected to write a final chapter of 5-6 pages in length. The document must be in MS format and single-spaced, 12-point Times New Roman font. The papers must have a title, a proper introduction, and a conclusion section, and all material that is used to support the student's argument must be clearly cited. For the in-text citations and the bibliography, we suggest that students use APA-style citations. For a reference for APA style citations, see https://www.umuc.edu/library/libhow/apa_examples.cfm.

<u>*Final Presentation:*</u>

This presentation will be formal. Students will have 10 minutes to present a case study on applying GIS and RS to respond to societal and environmental issues/problems using a PowerPoint or similar presentation platform style. Style and speaking tips will be shared with the students during the course of the class.

Course Outline

Lecture No.	Frame work	Title	Date	Instructors/Invited Speakers if any
1	Basic GIS	Introduction to GIS and Applications of GIS	Tuesday, April 8th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
2		Hands-on-training: installing QGIS and Overview of QGIS interface	Tuesday, April 8th, 2025~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati

3		Lecture: Data sources and software packages	Tuesday , April 15th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
4		Hands-on-training: Vector data handling: Geo-referencing, digitizing, and editing	Tuesday, April 15th, 2025 ~ 11: 20-13:00	Dr. Eng Martiwi Diah Setiawati
5		Hands-on-training: Database handling: Create tabular data, convert data from other sources	Tuesday, April 22 th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
6		Hands-on-training: Data Representation and Layout	Tuesday, April 22th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati
7	Basic Remote Sensing	Lecture: Introduction to RS and applications of RS	Tuesday, April 29 th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
8		Hands-on-training: Satellite image downloading, Satellite image acquisition	Tuesday, April 29 th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati
9		Hands-on-training: RS data processing: Image classification and calculates the accuracy	Tuesday, May 13th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
10		Hands-on-training: Spatial analysis (1) Vector-raster conversion, proximity, surface interpolation	Tuesday, May 13th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati
11		Hands-on-training: Spatial analysis (2) Reclassification, map algebra, zonal analysis	Tuesday, May 27th, 2025 ~ 09:30-11:10	Dr. Eng Martiwi Diah Setiawati
12	GIS and RS Application	Hands-on-training: Study case: Advanced spatial analysis and modeling with GIS and RS	Tuesday, May 27th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati
13		GIS science and RS for the society	Tuesday, June 3th, 2025 ~ 09.30-11:10	Dr. Eng Martiwi Diah Setiawati
14		Consultation for the final report and oral presentation	Tuesday, June 3th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati
15		Oral presentation	Tuesday, June 10th, 2025 ~ 11:20-13:00	Dr. Eng Martiwi Diah Setiawati

Course Readings

Essential Reading
• https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf
• https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesRemoteSensing.pdf

Useful Links

- *https://docs.qgis.org/3.28/en/docs/training_manual/vector_classification/index.html*
- *https://earthdata.nasa.gov/learn/remote-sensing*

Scientific Journals
• Annals of GIS, International Journal of Geographical Information Science, Transactions in GIS, Applied Geography, GIScience & Remote Sensing, Remote Sensing of Environment, ISPRS Journal of Photogrammetry and Remote Sensing, etc.

Important Information
Class Conduct & Etiquette
Students are expected to arrive on time and not to engage in disruptive behavior during class. This includes, among other things, private side conversations, the use of cell phones and other electronic devices, or the reading of newspapers. Cell phones should be switched off and stored in the bag. We wish to create an atmosphere of open and tolerant discussion in the classroom and request students to recognize every individual's right to have an opinion. The lecturer and other students should be treated with dignity and respect, particularly in discussions on contentious political issues where a diversity of opinion is likely to arise. However, we also recognize that there are limits to tolerance, and the lecturer reserves the right to request disciplinary action against any student who violates this policy or repeatedly shows disruptive behavior in class.

Computer Use in Class
The use of computers (including tablets) in the classroom is restricted to taking notes, reading the course material, doing exercises on GIS and RS, or searching for course-related information on the Internet. Any disruption of the class by cell phones, instant messaging programs, or other communication devices will not be tolerated. The lecturer reserves the right to revoke this permission if a student is found using a computer for any non-course-related activities.

Plagiarism & Academic Misconduct
Please be aware that the consequences of plagiarism are severe, and students found guilty of academic misconduct will be punished in accordance with UNU's academic honesty policies. The lecturer reserves the right to run all assignments through anti-plagiarism software provided by the UNU. If evidence of academic misconduct on the assigned presentations, the mid-term exam or the final essay should be found, the assignment will receive a failing grade. In case of repeated violations of academic conduct, the student may receive a failing grade for the entire course and will be reported to the appropriate authorities for disciplinary action.