# Remote Sensing

GEOG 49230 | 59230 | 79230 & GEOL 42030 | 52030 | 72030
Spring 2022 | McGilvrey 403 (computer lab) | T/R 12:30-1:45

**Instructor**
Dr. Timothy Assal (he/him/his)
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Phone: 330-672-2046

**Office Hours**
T & R 11-12 pm; 1:45 pm – 2:45 pm in office or Rm 403 (after class)
W 1 – 2:30 pm (online - Zoom Room, password: "geog")

## Course Description

Remote sensing is the retrieval of information about an object without being in contact with that object. The objects we are interested in are all Earth objects and materials: water, rock, vegetation, anthropogenic surfaces, snow and ice. This course is designed to provide students with a working knowledge of the principles and applications of remote sensing. It provides a survey of the concepts and techniques of remote sensing and image analysis for mapping and monitoring a variety of the planet's spheres.

## Course Learning Outcomes and Goals: *Understand…*

- Concepts and principles of remote sensing and electromagnetic energy
- Methods and techniques of remote sensing
- Advantages and limitations of remote sensing
- Applications of remote sensing to resource inventory, monitoring and analysis
- Remote sensing data, analysis approaches, and their relationship to applications
- Interface between remote sensing and other geospatial technologies
- How to plan and develop a remote sensing project
- Computer file management

## Course Materials

**Required Textbook** (available as an eBook through the KSU Main Library):

- James B. Campbell and Randolph H. Wynne*: Introduction to Remote Sensing, 5th Edition* (ISBN 978-1-60918-176-5) (available at the KSU Bookstore and through the KSU Library as an eBook (free access))

**Helpful Textbooks**

- John R. Jensen: *Introductory Digital Image Processing, A remote sensing perspective, 4th Edition* (ISBN 978-0-13-405816-0) (on reserve in the Map Library)
- Hamlyn G. Jones and Robin A. Vaughan: *Remote Sensing of Vegetation; Principles, Techniques, and Applications* (ISBN 9780199207794)

**Canvas**

- The course instructor will deliver course materials and additional materials via Canvas. Links to pdf slides of the lectures will be posted *after* class.

**Software**

- *QGIS* – a free an open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing and analysis of geospatial data, including numerous remote sensing techniques. This software parallels many of the types of analysis that is possible in *ArcGIS Desktop*; however, there are two primary reasons we will use it: 1) it is more powerful and flexible with respect to imagery analysis and 2) it is open source (free!).
- **Students are not required to purchase any software. All software is available in the McGilvrey computer labs.** Additionally, students can download QGIS for free on a personal computer, but it will require some minimal space on your personal computer to be useable.

**Hardware**

- A USB Flash Drive (at least 16 GB size) or external hard drive is highly suggested to store your assignment work if you plan to use the software on your personal computer.
- Success in the lab will depend in large part on managing your data properly. We will discuss this in the lab, but your ability to learn proper data management will be key to your success in this class (and beyond).

**COVID-19 Information**

- This course is being offered as a traditional on-campus class and there is no plan to change the form of delivery at this time. Nevertheless, please see the university website for current COVID information and sign up for Flash Alerts to be notified if the university makes changes to course delivery at any point during the semester. Please let me know if you become ill during the semester and we will make arrangements where appropriate. I will do the same if I become ill. Please follow the Flashes Safety Principles, take care of yourself and each other. I am confident we will have a great semester.
- In the event I am unable to teach the class due to a COVID related reason, I will hold class over Zoom. I will send out more information if that is necessary.

**Course Structure**

Generally, we will have lecture on Tuesday and lab on Thursday (with a few exceptions).

**Lecture Exams:** Two lecture exams will be completed in class and will consist of a mix of multiple choice and short answer questions that reflect the information covered during that period of the course. You must be present in the classroom to take the lecture exam.

**Lab Practical Exam:** One lab exam will be completed in class and will consist of an analysis and subsequent questions. You must be present in the classroom to take the lab practical.

**Labs:** Much of your success in this class will depend on gaining hands on experience with digital analysis of satellite images. The major purpose of these labs is to give you the skills and practice you need to learn the methods and to complete the final project. There will be 9 labs in total (15 points/each). Although one class is set aside for each lab you are expected to complete each lab on your own time. Each lab is due by the start of the next lab (typically one week later,

unless otherwise noted) and must be submitted via Canvas. You can discuss the labs with classmates, but each student must turn in their own lab, with written responses in their own words. Each lab is due by the start of the next lab (typically one week later). You are expected to write in complete sentences using proper grammar/spelling.

**Participation:** Attendance and participation is expected and absences are noted. Be present, be inquisitive, be conscientious. There may be occasional quizzes, in-class reflection assignments, etc. COVID-19 is a challenge to everyone and affects everyone in different ways. If you find yourself struggling this semester, please reach out. Communication with the instructor is key.

**Final Project**

The aim of the final project is to apply remote sensing skills learned in class to a real-world problem or situation. To satisfy the cumulative final exam requirement for the class, you are required to complete a final project using a synthesis of the remote sensing techniques learned in class. ***The project will consist of three parts for 80 points: 1) project proposal (5 pts), 2) project report (60 pts) and 3) project presentation (15 pts).*** The class presentations will take place during the final exam period in Room 403 and reports will be due at that time. ***Undergraduate students will work in teams of 3-4; graduate students will be required to work independently.***

1. Project Proposal: Each group/graduate student will submit a proposal on their topic and approach in the middle of the semester. Before submitting your proposal, you must discuss your project ideas with the instructor. Do not hesitate to consult with your instructor if you have problems choosing a project topic.

   You are responsible for retrieving your own project data (try to stick to EarthExplorer). Be very aware of the nature of the data that you have access to, especially the data quality, time frame, resolution and the scope of the analysis. If you select a project based on data from an instrument not used in class, you will be responsible to figure out how to obtain and processes that data if special techniques are required that were not covered in class. Note that high quality remote sensing image analysis requires pre-processing of data sets. You may need to pre-process the data sets you acquire to be able to extract the signal of interest. This could include removal of stripes and other measurement artifacts, radiometric correction, atmospheric correction, removal of, avoidance of, or identification of clouds, and georectification.

   The proposal should be a concise report of 1-2 pages that includes:
   - the names of all students,
   - project description/objectives (What is the purpose or need for your project? What are you doing, and why?)
   - a brief outline of the data sources and methods
   - an approximate timeline of the study (including explicit responsibilities of each group member),
   - anticipated products/outcomes: What will be your results? Maps, graphs, tables, recommendations, etc.

2. Project Report: the paper for the project should be in the neighborhood of 2000 words for undergraduates (plus images and tables) and 3000 words for graduate students (plus images and tables). It should include the following:
    - Title – Give the paper an appropriate title that adequately describes the content
    - Abstract – write a short abstract that summarizes the content of your paper. (No more than 200 words).
    - Introduction and Objectives– What has been done before on this topic? Use ScienceDirect or Google Scholar to find peer-reviewed papers (scholar.google.com); problem statement – At least one short paragraph should be dedicated to summarizing why the chosen subject deserves investigation; project objectives.
    - Data Sources and Methods– Describe the remote sensing techniques and tools used to investigate.
    - Results – Present your findings in a logical format. Use subheadings if necessary.
    - Discussion – what were your main findings? What do they mean in the context of previous work – for example do your results support or contradict what others have done. Are there any limitations to your project? What are the implications of your results?
    - References – List all sources used in writing the paper; we will discuss format in class.
    - Division of Work - Specify each of the project tasks performed (including report and presentation creation) and which group member did each task.
    - Any figures should be contained within the body of the text and should have clear figure captions. Figures should be referred to in the text as Figure 1, Figure 2, Figure 3 etc. Tables should have descriptive titles. Images and maps should include a scale bar, color bar (where applicable) and a north arrow.

3. Project Presentation: the presentation should be in the form of a 4-5 slide power point presentation that will run about 8-10 minutes per group/graduate student. The presentations will be given during the final exam period for the class.

Writing is a lifelong learning process! Some people are gifted writers, but many of us are not. I encourage all groups to schedule a session at the KSU Writing Commons. This semester you can schedule a video session, chat session, email session or in-person to work with a writing tutor and obtain feedback and pointers on your chronicle. ***Anyone who works with a tutor at the Writing Commons for this report will receive an additional 5 points on the assignment.***

**Course Assessment**

| Category | Points per item | Total Points in Category | Percentage of class grade |
|---|---|---|---|
| Lab Assignments | 15 | 135 | 39% |
| Lecture Exams | 30 | 60 | 17% |
| Lab Practical Exam | 60 | 60 | 17% |
| Final Project | 80 | 80 | 23% |
| Participation | 15 | 15 | 4% |
| **Total** | | **350** | **100%** |

**Final Grade Scale**

| | | | |
|---|---|---|---|
| A 92.5 - 100 | B+ 86.5 - 89.4 | C+ 76.5 - 79.4 | D+ 66.5 - 69.4 |
| A- 89.5 - 92.4 | B 82.5 - 86.4 | C 72.5 - 76.4 | D 59.5 - 66.4 |
| | B- 79.5 - 82.4 | C- 69.5 - 72.4 | F < 59.4 |

**HOW TO SUCCEED IN THIS CLASS -** "*Tell me and I forget, teach me and I may remember, involve me and I learn."* B. Franklin

• ***Time commitment*** –As a rule, for each hour of class, you should be willing to spend an hour of your own time reading and doing class assignments. If you stick with this rule you should not become overwhelmed with material covered in class. **You are expected to complete the assigned readings prior to class.**
• ***Collegiality and professionalism*** – Respect your instructors, peers and colleagues. Communication with the instructor must be conducted in a professional manner. Do not talk in class unless asking or answering class related questions; turn off the ringers on your phones. Do not text or use your phone in class, except for class related purposes. Use your computers only for activities related to class, not social media.
• ***Participation and attendance*** – participating in class discussions will increase your awareness of the material and issues; take notes of key points. Only "legitimate" reasons for an excuse are accepted – let the instructor know if you will miss class.
• ***Always ask questions*** – if there is something that you do not understand do not be afraid to ask questions, even if this means interrupting the class. Engage!
• ***Persevere*** –Technical courses such as this one often have things that go wrong (e.g. software issues, data issues, etc.), let's recognize that. However, with challenges come opportunities ~ *no problem leaves you where you found it!*
• ***Late work*** – Late submissions will be docked 20% of the allocated points. No labs or projects will be accepted after five days past the deadline. All work will be submitted via Canvas. It will be tagged as late, if it comes in after the deadline, and there will be no mechanism to submit after 5 days (to the hour) past the deadline. This deadline is to ensure students do not fall behind.

## University Policies

### Important Dates

The official registration deadline for this course is **January 24th**. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashLine) prior to the deadline indicated. Registration errors must be corrected prior to the deadline. The course withdrawal deadline is **April 4th**.

### Academic Dishonesty

University policy 3-01.8 deals with the problem of academic dishonesty, cheating, and plagiarism. None of these will be tolerated in this class. The sanctions provided in this

policy will be used to deal with any violations. If you have any questions, please read the policy at http://www.kent.edu/policyreg/administrative-policy-regarding-student-cheating-and-plagiarism

**Accommodations & Accessibility**
University policy 3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 330-672-3391 or visit www.kent.edu/sas for more information on registration procedures).

**Survey of Instructor**
The Student Survey of Instruction (SSI) is now online. We will dedicate a portion of a class period later in the semester for students to complete this survey.

## Course Policies

**Respect for Diversity, Equity, and Inclusion**
In this class, we are seriously committed to supporting diversity and inclusion among all classroom community members (our university is too!). We treat one another fairly and honor each other's experiences, beliefs, perspectives, abilities, and backgrounds, regardless of race, religion, language, immigration status, sexual orientation, gender identification, ability status, socio-economic status, national identity, or any other identity markers. It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

**Land Acknowledgment**
We acknowledge that the territory on which Kent State University stands is that of The Kaskaskia and The Erie People. This statement is one small step in acknowledging the history that brought us to reside on the land, and to help us seek understanding of our place within that history. For more information, please visit the Native American Indian Center of Central Ohio.

**Mental Health**
College life can be incredibly stressful, and you may experience a range of issues that can cause barriers to learning and your well-being. Learn more about university sponsored resources to help.

**Course Schedule** (next page)

| Week | Date | Day | Topic | Reading |
|---|---|---|---|---|
| 1 | 18-Jan | T | Course Introduction and History of Remote Sensing | Ch. 1 |
| | 20-Jan | Th | The Electromagnetic Spectrum and Remote Sensing | Ch. 2 |
| 2 | 25-Jan | T | Image Acquisition | Ch. 3 |
| | 27-Jan | Th | Lab 1: Intro to QGIS & Aerial Photos | QGIS Help: Module 2 |
| 3 | 1-Feb | T | Image Interpretation | Ch. 5 |
| | 3-Feb | Th | Lab 2: Visual image interpretation | |
| 4 | 8-Feb | T | Digital Imagery and Color Theory | Ch. 4 |
| | 10-Feb | Th | Lab 3: Data access and download | Ch. 10 |
| 5 | 15-Feb | T | Exam 1 | |
| | 17-Feb | Th | Lab 4: QGIS and map making | QGIS Help: Module 4 |
| 6 | 22-Feb | T | Land Observation Satellites | Ch. 6 |
| | 24-Feb | Th | Lab 5: Georeferencing and data stitching | QGIS Help |
| 7 | 1-Mar | T | **No class** | |
| | 3-Mar | Th | Project Discussion | |
| 8 | 8-Mar | T | Image Classification | Ch. 12-13 |
| | 10-Mar | Th | Lab 6: Supervised classification | Ch. 12-13; QGIS Help |
| 9 | 15-Mar | T | Remote Sensing of Vegetation | Ch. 17 |
| | 17-Mar | Th | Lab 7: Accuracy Assessment | QGIS Plugin Help |
| 10 | 22-Mar | T | Remote Sensing of Rocks, Soil and Water | Ch. 18-19 |
| | 24-Mar | Th | Applications in Archaeology (Lidar & Hyperspectral) | Ch. 8, 15 |
| 11 | 29-Mar | T | Spring Recess - No Class | |
| | 31-Mar | Th | Spring Recess - No Class | |
| 12 | 5-Apr | T | Change Detection | Ch. 16 |
| | 7-Apr | Th | Lab 8: Change Detection | QGIS Plugin Help |
| 13 | 12-Apr | T | Exam 2 | |
| | 14-Apr | Th | Project Work | Literature Review |
| 14 | 19-Apr | T | Applications in Natural Resource Management | Ch. 20 |
| | 21-Apr | Th | Lab 9: Applied Remote Sensing: building algorithms | Ch. 11; QGIS Help |
| 15 | 26-Apr | T | Project Work | Literature Review |
| | 28-Apr | Th | Lab Exam | |
| 16 | 3-May | T | Open Date - Project Work | |
| | 11-May | W | Final Exam Period - Wednesday May 11, 2022 (12:45-3 pm)<br>Final projects due; student presentations at meeting time | |