Remote Sensing

GEOG 372
Fall 2019

Learning Outcomes

This course is intended to provide an introduction to remote sensing of the environment, with particular focus on interaction of electromagnetic radiation with the Earth's surface and atmosphere, and systems used to monitor the Earth's land and oceans. It will introduce the basic principles of remote sensing, methods and techniques for data acquisition, interpretation and processing in relation to optical, thermal and microwave remote sensing systems. Examples of remote sensing applications will be presented along with methods for obtaining quantitative information from remotely sensed images. The lab sessions will focus on introducing techniques used in the analysis of remotely sensed data (e.g., digital image processing), with an emphasis on the study of spatial and environmental relationships.

This course is intended either as an overview for a general academic program or as preparation for further remote sensing technology courses. It is a gateway for majors in Geography and to 400-level classes in Geography.

After successfully completing this course you will be able to:

- Understand the general principles of electromagnetic energy interaction with the Earth's surface and atmosphere, which enable and limit successful applications of remote sensing methods.
- Understand the basis of operations for active and passive air- and satellite-born instruments in the optical, thermal, and microwave range of the electromagnetic spectrum.
- Describe the major properties of remotely sensed imagery, including resolution(s), instruments and platform-dependent distortions and data limitations.
- Perform qualitative and quantitative analysis of remotely sensed data, extract spectral information, and perform image classification using standard and emerging techniques.
- Acquire freely-available satellite data and geoinformation products and competently handle simple image processing routines using commercial (PCI Geomatica) and open source (QGIS) image analysis software.

Dr. Sergii Skakun
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Class Meets
Tuesdays & Thursdays
9:30 am – 10:45 am
SQH # 1120

Office Hours
LeFrak Hall #1153
Tue & Thu 1:00-3:00 pm
and by appointment

Teaching Assistants
Matthew Cooper
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Prerequisites
This course has as prerequisites GEOG201 and GEOG306.

Course Communication
All announcements will be posted on ELMS. Instructors can be contacted via ELMS or email. Please, include GEOG372 into the subject, when contacting by email. A guidance on writing professional emails available at ter.ps/email.

Required Resources

Course website: **elms.umd.edu**, where all announcements, lectures, reading materials, and grades will be posted.

The course does not have a required textbook. In this course text books are used as **reference material**. A list of books is provided, so the student can select the one that adapts better to their needs.

- Campbell, J.B. and Wynne, R. H. 2011. Introduction to Remote Sensing. Guildford Press, New York. 5th Edition. ISBN 978-1-60918-176-5.

- Richards, J. A. 2013. Remote Sensing Digital Image Analysis. An Introduction. Springer-Verlag, Berlin, Heidelberg. Fifth Edition. ISBN 978-3-642-30061-5.
- Jensen, J.R., Remote Sensing of the Environment - An Earth Resource Perspective, 592 pp., Prentice Hall, Upper Saddle River, NJ, 2007. ISBN: 0131889508, Second Edition.
- Chuvieco, E. and Huete, A. 2010. Fundamentals of Remote Sensing. CRC Press (Taylor & Francis Group), Boca Raton (Florida). ISBN 978-0-415-31084-0.

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies and follow up with me if you have questions.

Activities, Learning Assessments, & Expectations for Students

Lectures. This class will consist of 19 lectures/discussions. The purposes of the lectures are to present and discuss remote sensing concepts, Earth observation data collection and analysis methods, and application examples. Topic exams will be based on information from the lectures. Attendance to lectures, as well as active participation in discussion, is strongly encouraged.

Tests. There will be two tests in the course, which would cover the material studied in the preceding lectures and required additional reading materials. Although tests are non-cumulative, understanding of the principles acquired in earlier parts of the course will be necessary to answer questions in the later parts of the course. Tests are multiple choice exams with factual and conceptual questions. There is no final exam in this class. The final grade will be assigned based on the total number of points earned during the class (see Grading).

Labs. The course includes 10 lab classes, and one lab intro class. The lab classes are an essential part of this course, so attendance at all lab classes is mandatory. During the lab exercises the students will work individually to produce a lab report which will be graded by the TA. Each completed lab report is worth 10 points maximum. Some lab assignments will include additional tasks for "extra" points. These tasks are optional, and the points earned will be added to the total score. Lab report should be submitted to Canvas/ELMS within a week after the lab. Delayed reports will be downgraded by 50%. Reports will not be graded if submitted three weeks or more after the lab class.

Homework assignments. There will be two homework assignments, which will be performed in groups. First assignment ("Time machine") will be on researching and understanding socio-economic impacts of land cover land use changes (LCLUC) on the Earth. Each group of students will select a study region, and will analyze 30+ years of satellite images using Google Earth Timelapse (https://earthengine.google.com/timelapse/). Using ancillary information, students will connect LCLUC with socio-economic information, and write a 3-4 pages report. The second assignment will be a research paper analysis, results of which will be presented during seminars. The list of research papers will be provided. Each group is expected to give a presentation on that paper in front of the class during the last three weeks of the course. The presentation will be followed by a discussion, during which students

from other groups are expected to ask questions and engage. Each student will be required to read every summary before the day, during which it is presented. The presentations will be limited to 8 minutes and Q&A will be limited to 5 minutes. Students will be graded both as presenters and for participation in discussion.

Attendance.
Lectures: Following Campus policy, attendance at lectures is not mandatory BUT important information (including review and preparation to the tests) will be presented.

Labs: The lab classes are an essential part of this course, so attendance at all lab classes is mandatory. Absences excused according to the University Policy. During the lab exercises the students will work individually to produce a lab report which will be graded by the TA. All deliverables as described in each lab assignment should be submitted to Canvas/ELMS.

Course-Specific Policies

No computers, phones or tablet devices are permitted during our class meetings. I understand and have considered arguments for permitting laptop and tablet computers in the classroom. However, in my experience (and based on the research evidence) the reality is that they present an irresistible distraction and detract from the cooperative learning environment. Researchers have found that these distractions do in fact interfere with learning and active participation. For that reason, the use of computers and phones will not be permitted during class meetings (except when required for ADS accommodations, and during the seminars). If a computer is needed to accomplish a class objective for the day I will provide it or give you advanced notice to bring one with you.

I expect you to make the responsible and respectful decision to refrain from using your cellphone in class. If you have critical communication to attend to, please excuse yourself and return when you are ready. For more information about the science behind the policy watch: youtu.be/WwPaw3Fx5Hk.

Get Some Help!

Taking personal responsibility for you own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit tutoring.umd.edu to learn more about the wide range of campus resources available to you. In particular, everyone can use some help sharpen their communication skills (and improving their grade) by visiting ter.ps/writing and schedule an appointment with the campus Writing Center. You should also know there are a wide range of resources to support you with whatever you might need (see go.umd.edu/assistance), and if you just need someone to talk to, visit counseling.umd.edu or one of the many other resources on campus.

Most services are free because you have already paid for it, and **everyone needs help**… all you have to do is ask for it.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live and believe this may affect your performance in this course, please visit go.umd.edu/basic-needs for information about resources the campus offers you and let me know if I can help in any way.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Grades

Grades are not given, but earned. Your grade is determined by your performance on the learning assessments in the course and is assigned individually (not curved). If earning a particular grade is important to you, please speak with me at the beginning of the semester, so that I can offer some helpful suggestions for achieving your goal.

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet in my office.

Late work will not be accepted for homework assignments, so please plan to have it submitted well before the scheduled deadline. Lab due dates are explicitly stated. Lab reports must be submitted within one week after the lab. Delayed lab reports will be downgraded by 50%. Lab reports will not be graded, if submitted three weeks or more after the lab class. If you are sick or physically indisposed and cannot submit your assignment on time, you must notify the instructor before the class and provide a written doctor's note when you return for you to have a chance to make up the assignment. Any non-verifiable excuses may be denied. This policy may seem strict, but this class will move rapidly, and it is in your best interest to turn in everything on time to avoid falling irrecoverably behind.

I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Learning Assessments	#	Points Each	Category Total	Weight
Tests	2	40	80	40%
Labs	10	10	100	40%
Assignments	2	10	20	20%
		Total Points:	**200**	**100%**

Final letter grades are assigned based on the percentage of total assessment points earned.

Final Grade Cutoffs										
+	97.00%	+	87.00%	+	77.00%	+	67.00%			
A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	<60.0%	
-	90.00%	-	80.00%	-	70.00%	-	60.00%			

Course Schedule

Lecture, tests and seminars

Week	Date	Topic	Due dates
1	27-Aug-Tue	Introduction	
	29-Aug-Thu	Basic concepts in remote sensing (RS)	
2	3-Sep-Tue	Principles of electromagnetic radiation	
	5-Sep-Thu	Interaction of the radiation with the atmosphere	
3	10-Sep-Tue	Missions and sensors. Part 1	
	12-Sep-Thu	Missions and sensors. Part 2	
	13-Sep-Fri		Group forming
4	17-Sep-Tue	LIDAR	
	19-Sep-Thu	Thermal remote sensing	
5	24-Sep-Tue	Synthetic Aperture Radar (SAR). Part 1	
	26-Sep-Thu	Synthetic Aperture Radar (SAR). Part 2	
6	1-Oct-Tue	Review	
	3-Oct-Thu	TEST #1	
7	8-Oct-Tue	Analysis of RS data: spatial, spectral and temporal domains. Part 1	
	10-Oct-Thu	Analysis of RS data: spatial, spectral and temporal domains. Part 2	
8	15-Oct-Tue	Processing of RS data: regression and classification	
	17-Oct-Thu	Advanced methods for RS image processing	
	18-Oct-Fri		1st homework assignment
9	22-Oct-Tue	Accuracy assessment	
	24-Oct-Thu	Land area estimation	
	25-Oct-Fri		Research paper selection (2nd homework assignment)
10	29-Oct-Tue	Vegetation parameters retrieval with RS	
	31-Oct-Thu	Agricultural monitoring with RS	
11	5-Nov-Tue	Land cover land use change	
	7-Nov-Thu	Natural hazards monitoring with RS	
12	12-Nov-Tue	Review	
	14-Nov-Thu	TEST #2	
13	19-Nov-Tue	Seminar #1	2nd homework assignment
	21-Nov-Thu	Seminar #2	
14	26-Nov-Tue	Seminar #3	
	28-Nov-Thu	No class – Thanksgiving	
15	3-Dec-Tue	Seminar #4	
	5-Dec-Thu	Seminar #5	

Labs
Lecture, tests and seminars

Week	Date	Lab
1	29-Aug-Thu	Introduction: working with RS data
	30-Aug-Fri	
2	5-Sep-Thu	Lab1. Introduction to data visualization and analysis
	6-Sep-Fri	
3	12-Sep-Thu	Lab 2. Satellite data from different sensors
	13-Sep-Fri	
4	19-Sep-Thu	Lab 3. Landsat 8 data analysis and interpretation
	20-Sep-Fri	
5	26-Sep-Thu	Lab 4. Thermal remote sensing
	27-Sep-Fri	
6	3-Oct-Thu	Break
	4-Oct-Fri	
7	10-Oct-Thu	Lab 5. Analyzing Images in QGIS
	11-Oct-Fri	
8	17-Oct-Thu	Lab 6. Spectral indices and spatial filters
	18-Oct-Fri	
9	24-Oct-Thu	Lab 7. Supervised and unsupervised image classification
	25-Oct-Fri	
10	31-Oct-Thu	Lab 8. Decision tree supervised classification and accuracy assessment
	1-Nov-Fri	
11	7-Nov-Thu	Lab 9. Change detection
	8-Nov-Fri	
12	14-Nov-Thu	Lab 10. Working with remote sensing data catalogues
	15-Nov-Fri	

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.