WATERLOO
ENVIRONMENT
DEPARTMENT OF GEOGRAPHY AND
ENVIRONMENTAL MANAGEMENT

GEOG 471
Remote Sensing Project

Lecture: 08:30-11:20 M EV3-1408
Lab 101: 08:30-10:20 Th EV2 1002A
Lab 102: 13:30-15:20 M EV2 1002A
Lab 103: 11:30-13:20 M EV2 1002A

Remote Sensing Project: Course Outline

Instructor
Dr. Richard Kelly
Room: EV1-119, ext 35451
E-mail: rejkelly@uwaterloo.ca
Office Hours: Thurs 12:00 - 2:00pm

Course Assistant
Mike Lackner (MAD)
Mapping Analysis and Design
E-mail: mlackner@uwaterloo.ca
Office Hours: by appointment

Teaching Assistants
John McLean
jsmclean@edu.uwaterloo.ca
Duo Zhang
d265zhan@uwaterloo.ca
Office Hours: TBA

Overview

This course has a very strong application focus in the form of ***remote sensing observations for climate and land cover change studies***. The aim of this course is to develop students' theoretical and practical understanding of remote sensing through project-based work using a variety of image analysis software to address a substantive aspect of climate change. It builds on courses GEOG271, GEOG371 and GEOG293/294. Working in a group and individually, students identify and develop a research study that uses remote sensing data sets to address a substantive issue related to environmental change.

The objectives of this course:

1. To design, plan, and execute a science-based resource management project focusing on the application of remote sensing and digital information extraction. The project will be expected to be responsive to one of the 17 United Nation's Sustainable Development Goals (SDGs);
2. To conduct a literature synthesis of your topic from the remote sensing research literature, perform a series of image processing tasks related to that topic, and place your work in context of what others have done
3. To communicate the results of your efforts to the instructor through a project report paper and to your peers through a class group presentation;
4. To be competent in a range of geographical skills, particularly those relating to problem identification, research methodology definition, remote sensing data analysis and interpretation, and research communication;
5. To be aware of some of the inter-linkages within and between the remote sensing information content and knowledge in human and/or physical and human geography;
6. To develop further your range of personal transferable skills, including the ability to present material orally and in report form and to work effectively both as an individual and as a member of a group;
7. To be aware more keenly of your own range of personal transferable skills and be able to assess, critically and constructively, the contribution of team members, including yourself, to the group in which you work.

Text and Readings

There is no single text for this course. As you will be focusing on producing a remote sensing research project, you are not required to purchase a textbook for this course. The textbook *Introductory Digital Image Processing: A Remote Sensing Perspective* (Jensen, 2015) is highly recommended but does not cover everything. In addition, you will be expected to make use of remote sensing journal periodicals and other material in the university libraries, in addition to web-based information.

Textbooks:

Jensen, J.R., 2015. *Introductory Digital Image Processing: A Remote Sensing Perspective*. Fourth Edition. Prentice Hall, Toronto, Canada. (Available in the Library – 3 hour short loan). Earlier versions are also good, especially 3rd Edition)

Jensen, J.R. 2007. *Remote Sensing of Environment: and Earth Resources Perspective*, Second Edition, Prentice Hall, Toronto, Canada.

Lillesand, T.M., and Kiefer, R.W., 2003, *Remote Sensing and Image Interpretation* (Fifth Edition), John Wiley & Sons, Canada, 784pp.

Mather, P.M. 2004 *Computer Processing of Remotely-sensed Images*, (3rd Ed.). John Wiley & Sons Canada, 442pp.

Campbell, J.B., 2002 *Introduction to Remote Sensing* (Third Edition), The Guilford Press, 621pp.

Richards J.A. 2010, *Remote Sensing Digital Image Analysis: An Introduction*, 4th Edition. SpringerLink (**Online through UW library**)

Richards, J.A. (2009) Remote Sensing with Imaging Radar, Springer Link. (Online through UW)

Project definition and research design

Montello D.R. and P.C. Sutton (2013) *An Introduction to Scientific Research Methods in Geography and Environmental Studies (2nd Edition)*, London: Sage Publications, pp314. (Highly Recommended)

Parsons, A.J. and P. Knight (2005) *How to do your dissertation in geography and related disciplines (2nd ed.)*. New York: Routledge, 168pp. (Online edition available).

Hay, I. and Giles, P. (2010) *Communicating in Geography and the Environmental Sciences: Canadian Edition*, Oxford: Oxford University Press, 312pp Great for knowledge communication.

Selected course notes and lecture presentations will be available on the course web site which will be maintained as part of the UW LEARN system.

Evaluation

All course activity will be focused on a major term project. The final mark is broken up into specific activities the requirements for which will be explained in detail at the start of the course and by Requirements documents posted on Learn:

Lab Tasks (individual)	6%
Project Proposal (Group submission)	10%
Project Literature Review (Individual submission)	24%
Project Presentation (Group Presentation)	10%
Project Report (Group Submission)	50%

Group and Individual contributions will be assessed for specific parts of the evaluation process. See course website for details of each element. Peer evaluation forms part of the final mark to ensure that there is equity of contribution.

Schedule

The course is organized around a weekly 3 hour lecture / discussion held on Mondays from 8:30-11:20 am in **EV3-1408** and labs held in **EV2 1002A (Geddes Lab)**. ***Attendance is mandatory for each lecture/discussion and for each lab. You will be graded by your group peers on your contribution to the proposal and the final project report.***

Lecture Date	Topic
Jan 7	***Lecture: Introductions - course overview. Project selections, establishment and design. Course expectations (GEOG271 and GEOG371 foundations).*** Lab Discussion: group selection, project definition. Lab Task 1: Useful procedures in RS – *read TM and run simple ROI analysis*.
Jan 14	***Lecture: Exploring instruments and data sets available for project work. Data formats.*** Lab Discussion: Project analysis approach and data needs – assign member roles Lab Task 2: Useful procedures in RS – *read MODIS MOD09 and polar project*
Jan 21	***Lecture: Google Earth Engine and change analysis*** Lab Discussion: Project analysis approach and data needs – finalize data acquisition Lab Task 3: Using Google Earth Engine for change analysis.
Jan 28	***Lecture: Multiple data set analysis*** Lab Discussion: using Planet data with other data sources Lab Task 4: Useful procedures in RS – *estimating TOA albedo and mosaicking data*.
Feb 4	Group presentations on proposed projects (5 minutes each) ***Proposals due 4 Feb 2019*** Lab Discussion: Group editing of Lab Task 5: Useful procedures in RS - *processing SAR backscatter data*.
Feb 11	***Lecture: Verification and testing*** Lab Discussion: estimating errors and uncertainty from RS analyses Lab Task 6: Useful procedures in RS – *running an accuracy assessment in ENVI*
Feb 18	**UW READING WEEK**
Feb 25	***Lecture: Application example of remote sensing.*** ***Literature Review Due in class on 18 February 2019*** Lab Discussion: project work
Mar 4	**Lecture:** ***Project reporting – expectations.*** Lab Discussion: project work
Mar 11	Lecture: mandatory update from each group on progress, problems and plans Lab Discussion: Project Work.
Mar 18	Lecture: group discussions with TAs and instructors Lab Discussion: Project Work
Mar 25	Lecture: mandatory update from each group on progress, problems and plans Lab Discussion: Project Work
Apr 1	***Lecture: Final Presentations (EV3 Foyer)*** ***Final Project Report Due (5 April, 2019)***

A Note on Correspondence.

Please use email for any correspondence with the instructor and the TAs outside of class and lab time. There is usually ample time to interact with both during these periods. If you need to send an email, it will be responded to within 3 business days.

When corresponding with the course instructor, please use only a **uwaterloo.ca** email account and ensure that the subject line begins with [GEOG 471 - Winter 2019:].This will help us manage requests efficiently.

Resources

Geddes Lab (EV2-1002A) Lab Code: 1 4 3 2

The Geddes Lab will be used for all practical work in this course. You can access this for allocated lab hours. The Magellan Lab is available (mostly) for 24 hours a day, 7 days a week. The Lab may occasionally be unavailable while maintenance operations are performed.
Note: No food or drink is allowed in the labs. Failure to abide by this rule may result in your computer accounts being suspended.

Course Website

A website for this course has been created as part of the UW-LEARN system. Students registered in the course can access the course website by going to the UW-LEARN homepage and entering their UW_Dir userid and password in the logon form displayed on this page. Once you are logged on to UW-LEARN, you will see a list of courses that you are registered in and that are using UW-LEARN. Click on GEOG 471 to select this course.

The course website provides access to lecture presentations, course notes on selected topics, and assignment scripts. These documents can be opened or downloaded by clicking on the appropriate link. In addition, the course website supports announcements, discussion groups and e-mail. Please use the discussion groups and/or UW-LEARN e-mail for messages related to this course. I will monitor course discussion groups and UW-LEARN e-mail more frequently than my regular e-mail. I will reply to e-mail messages, but where appropriate, I will post a response to questions or problems raised in e-mails to the course discussion group or I will add an announcement to the course home page.

Disk storage space

Students are encouraged to use university-allocated storage space to work with their data and share their work with group members. Students are allocated 1 Tb of space (backed up and 'shareable') as part of the new student email system so please use this space for your project work. Typically, groups also use their own solutions for data storage and collaboration (e.g. dropbox, portable drives, Google docs, etc.). If groups would prefer ENV-allocated space (<200Gb) then please discuss your needs with Mike Lackner.

NB You are strongly advised to backup your work frequently.

Getting Help

Students are expected to get into the habit of using the on-line files as the first source of help. I will be available in my office for consultation during regular office hours or by appointment. I will also check UW-LEARN course-related e-mail and discussion groups on a daily basis. Additional help is available from the MAD help desk and the TA. Mike Lackner will also be available to answer questions related to lab assignments in this course. A LEARN bulletin board is also available for posing questions to the wider group.

Course Conduct

- GEOG 471 is a double weighted course. This means that there is significantly more expectation on students than on a single weighted course. It is in your interests, therefore, to attend lectures and seminars with your group and contribute strongly to the group project. In the past, students who have not been engaged in the group, have missed meetings and have not contributed strongly have lost marks in this course.
- Lectures are there for your benefit. Please come prepared to engage in the material and be ready to ask questions. Open laptops will not be allowed during lectures unless expressly requested for note taking.
- Labs are mandatory and are there for you to engage with group members and to ask for advice and assistance from TA, the instructor and Mike Lackner. Lab time is an essential core time to enable groups to work together on individual or common issues. 6% of the overall course grade comes from the six lab tasks.
- Students will choose their own groups. If you are unable to find a group, please let the instructor know so steps can be taken to find a home for you.

From the Associate Dean, Undergraduate Studies

♦ **Intellectual Property:**

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:
-Lecture content, spoken and written (and any audio/video recording thereof);
-Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
-Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
-Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

♦ **Academic Integrity:**

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. The University's guiding principles on academic integrity can be found here: **http://uwaterloo.ca/academicintegrity**. ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office specifically for students: **http://uwaterloo.ca/academicintegrity/Students/index.html**

Students are also expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offense, or who need help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. Students may also complete the following tutorial: **https://uwaterloo.ca/library/get-assignment-and-research-help/academic-integrity/academic-integrity-tutorial**

When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline: **https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-71**. Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance: **https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-70**

♦ **Note for students with disabilities:** AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

♦ **Mental Health:** The University of Waterloo, the Faculty of Environment and our Departments/Schools consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. **Please note that help is available**. Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services www.uwaterloo.ca/counselling-services is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential

counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

♦ **Religious Observances:** Students need to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

♦ **Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. See Policy 70 - Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please contact your Undergraduate Advisor for details.

♦ **Appeals:** A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 – (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

♦ **Unclaimed assignments:**
Unclaimed assignments will be retained for … [period of time*; or: "until one month after term grades become official in quest"]. After that time, they will be destroyed in compliance with UW's confidential shredding procedures.

♦ **Communications with Instructor and Teaching Assistants:**
All communication with students must be through either the student's University of Waterloo email account or via Learn. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

♦ **Turnitin:** Text matching software (Turnitin®) will be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, and are subject to the USA PATRIOT ACT, 2001; therefore, students will be given an alternative (e.g., scaffolded assignment or annotated bibliography) if they are concerned about their privacy and/or security. Students will be due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course.

Associate Dean, Undergraduate Studies, 5 January, 2018