FACULTY OF SCIENCE

SCHOOL OF BEES

GEOS3811

Advanced Techniques in Remote Sensing

S1, 2016

Faculty of Science - Course Outline - 2016

Contents:

Faculty of Science - Course Outline - 2016

1. Information about the course

NB: Some of this information is available on the UNSW Virtual Handbook[1]

Year of Delivery	2016
Course Codes	GEOS3811
Course Name	Advanced Techniques in Remote Sensing
Academic Unit	School of BEES
Level of Course	3rd year
Units of Credit	6UOC
Session(s) Offered	S1
Assumed Knowledge	None
Hours per Week	3
Number of Weeks	12
Dates	Weeks 2-13, session 1, 2016

Summary of Course Structure (for details see 'Course Schedule')

Component	Hours	Time	Day	Location
Lectures	24	13:00– 15:00	Tuesdays	TBC
Labs	22	10:00-12:00	Tuesdays	The Red Centre, School of Mathematics and Statistics, H13, Lab M020 (Labs Wks 2,3,4,5,6,7) Biosciences G11 (Wks 8,9,10,11,12)

2. Staff involved

Staff	Name	Contact Details	Consultation Times
Course Convener and Lecturer Lecturer	Prof Graciela Metternicht Prof Richard Lucas A/Prof Jason Evans Dr Mirela Tulbure Dr Mark Broich Dr Adrian Fisher	g.metternicht@unsw.edu.au richard.lucas@unsw.edu.au jason.evans@unsw.edu.au mirela.tulbure@unsw.edu.au mark.broich@gmail.com adrian.fisher@unsw.edu.au	By appointment outside scheduled contact times
Laboratory Tutors	Dr Leonardo Hardtke Dr Mitchell Lyons	leonardtke@gmail.com mitchell.lyons@unsw.edu.au	

[1] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au/current/index.html

3. Course details

Course Description[2]

The course is designed to introduce the concepts and applications of remote sensing, and to introduce some basic and advanced techniques for data processing with a focus on land surface dynamics.

Course Aims

The main objective of this course is to provide you with an introduction to remote sensing data and its environment-related applications. Through this approach, you will be better equipped to deal with the enormous variety of different applications you will encounter in the workforce.

Course Learning Outcomes (CLO)

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Understand various sensor systems for collection of remotely sensed data and its potential and limitations for environmental applications
2. Test and compare advanced methods of digital image processing and enhancement; including image classification, and change detection
3. Perform image based environmental modelling, extracting trends and seasonal cycles to understand land surface dynamics
4. Interpret, synthesise and apply that knowledge to formulate new applications addressing complex environmental issues of the 21st century.
5. Pursue guided research of a topic involving remote sensing data analysis and interpretation
6. Communicate the results of that investigation in a variety of written formats, catering for diverse audiences.

[2] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au/current/index.html

Graduate Attributes Developed in this Course

Science Graduate Attributes	FOCUS 0 = NO FOCUS 1 = MINIMAL 2 = MINOR 3 = MAJOR	Activities / Assessment
1. Research, inquiry and analytical thinking abilities	3	All will be achieved through the assessment tasks
2. Capability and motivation for intellectual development	3	
3. Ethical, social and professional understanding	1	
4. Communication	2	
5. Teamwork, collaborative and management skills	3	
6. Information literacy	3	

Major Topics (Syllabus Outline)	See course schedule
Relationship to Other Courses within the Program	This course forms part of the BSc major in Spatial Information, as well as contributing and complementing other programs in the geosciences, biosciences and related disciplines.

4. Rationale and strategies underpinning the course

Rationale for learning and teaching in this course – How this course is taught

Remote sensing is technical in nature, in that one needs to use software to achieve one's aims. However, this course is not about teaching software. It is about the principles and applications of remote sensing (software changes rapidly while principles do not).

There are three elements that you should use for learning in the course. Lecture notes and resource material provide an overview of the subject, and are a key reference source. In the case of the software, there are detailed online manuals that should be referred to. These include both command references and tutorials. Finally, there are your colleagues in the course. You are all working on similar problems, and you should be learning together. As described above, you are expected to do much of the learning both by yourself and with your colleagues.

Teaching Strategies

The UNSW encourages a student-centered learning approach. This is the modality of teaching and learning to be applied in this course, through regular lectures, discussions, and practical sessions. This teaching strategy fosters graduates that are able to apply their knowledge and skills to solving problems.

How the assessment supports and assists the learning

A variety of class activities have been devised to address the set learning outcomes, and to foster graduates that understand their discipline in an interdisciplinary context, are capable of independent and collaborative inquiry, are rigorous in their analysis, critique and reflect, are able to apply their knowledge and skills to solving problems, are capable of effective communication, teamwork, and capable of applying their discipline in local, national and international contexts, and are environmentally responsible.

Access to the lecturer

By appointment.

5. Course schedule

The schedule below might change a little, but still gives a good indication of what to expect in this course.
Lectures and lab notes will go up in Moodle, in the corresponding section of Moodle, week by week.

Wk	Date	Lecture	Lecturer	Lab
1	1 Mar	NO CLASS		
2	8 Mar	• Course overview • Overview of remote sensing platforms and sensors; • Methods for analysing multi-temporal remote sensing data: time series analysis and change detection • Earth Observation sensors for time series analysis	Graciela Metternicht	Intro GRASS L Hardtke
3	15 Mar	Multi-temporal RS: Time series Analysis (I) • Remote sensing time series variables • Variables used in time series analysis • Decomposition of series: trends and seasonal effect estimation • Time series analysis examples • Handling of remotely sensed time series data: assumptions and challenges.	Graciela Metternicht	Intro GRASS and Time series – MODIS L Hardtke
4	22 Mar	Multi-temporal RS: Time series analysis and change detection • Phenological extraction: Enhanced Vegetation Index (EVI – MODIS) • Example of land surface phenology extraction for land use, land cover and fire. • Types of change detection techniques o Post-classification comparison	Graciela Metternicht	Time Series – MODIS L Hardtke
5	29 Mar	EASTER BREAK		
6	05 Apr	Multi-temporal RS: change detection analysis (continued) • Univariate image algebra: difference / ratio • Image transformation: tasselled cap, PCA Multi-sensor/ multi-temporal change detection: Landsat ETM+ and MODIS for mapping and monitoring tropical forest cover loss (Dr Mark Broich) • Landsat ETM+ and MODIS pre-processing, including radiometric normalisation; • Creation of annual composite sets of Landsat images • Landsat time series metrics • MODIS classification using a decision tree algorithm; • Method for estimating spatio-temporal variation in forest cover loss.	Graciela Metternicht (1 hour) Mark Broich (1 hour)	Change detection L Hardtke
7	12 Apr	Change detection analysis • Image regression: AVHRR-NDVI time series. Example: “Discrimination between climate and human induced land degradation • Change vector Analysis	Jason Evans / G Metternicht	Change Detection L Hardtke
8	19 Apr	Multi-temporal RS: change detection • Seasonal fractional cover analysis. • Monitoring tree cover: comparing satellite and LiDAR vegetation metrics • The Veg-Machine platform and applications	Adrian Fisher	Classification of time series L Hardtke
9	26 Apr	Very high spatial resolution satellite imagery (Quickbird) for mapping invasive species. • Quickbird image pre-processing • Unsupervised classification	Mirela Tulbure	Completion of labs

		• Accuracy assessment of classified imagery		
10	03 May	Advanced active remote sensors: • Principles of radar imaging • Understanding microwave interaction through modelling • Understanding radar imagery through applications	Richard Lucas	Richard Lucas
11	10 May	Unmanned Aerial Vehicles and LiDAR platforms and sensors • Principles of UAV optical imaging • UAV Applications • Theory behind LIDAR remote sensing • Applications of LIDAR, with focus on vegetation	Richard Lucas	Mitch Lyons
12	17 May	Hyper-spectral remote sensing (G Metternicht) • Principles of hyperspectral data and sensors • Steps to Extract Information from Hyperspectral Data • Selected Indices Useful for Hyperspectral Data Analysis • Applications of hyperspectral remote sensing.	G Metternicht	ASD FieldSpec® 4 Spectrometer Mitch Lyons
13	24 May	Landsat time series for mapping of surface water dynamics Lecturer: • Landsat image normalisation • Supervised classification of multi-temporal Landsat data sets • Accuracy assessment of classified imagery.	Mirela Tulbure	Blog lab (G Metternicht)
14	31 May	Course overview	G Metternicht	

6. Additional resources and support

Text Books

There is no set text for this course. However, there are book chapters, peer reviewed journal articles and other relevant resources that will be made available in Moodle**.**

Some general texts that might be useful are (available at UNSW Library):

Introductory Digital Image Processing. ISBN: 9780134058160. Jensen, J.R., Prentice Hall 4th ed., 2015

Remote Sensing Time Series: Revealing Land Surface Dynamics. Kuenzer, Claudia; Dech, Stefan; Wagner, Wolfgang. Springer Science & Business Media B.V., 2015

Remote sensing digital image analysis: an introduction. J. A. Richards (John Alan), 5th ed., Berlin ; London : Springer, 2013

Course Materials

Course materials will be provided on Moodle for online viewing and/or download. This will require a browser such as Firefox (15 and above), Safari (6 and above), Internet Explorer (9.0 and above) or Chrome (22 and above).

To login to Moodle, go to: https://moodle.telt.unsw.edu.au

Once in Moodle, you will also need your z number and z pass to access some of the readings via the UNSW library website. Lab instructions and lecture notes (Lectures) will be available through Moodle, in the corresponding section (Practicals: Labs) and week.

Required Readings

These will be advised as the course progresses.

Additional Readings

Useful Journals:

International Journal of Remote Sensing
Remote Sensing of Environment
IEEE Transactions in Geoscience and Remote Sensing
Photogrammetric Engineering and Remote Sensing
Remote Sensing Reviews
Geocarto International
Journal of Applied Remote Sensing
Remote Sensing

You should also become familiar with the use of citation tracking in the Scopus and Web of Science databases. These are available via sirius.library.unsw.edu.au. Citation tracking allows you to see who has been citing articles, and who is cited in articles. It is a very good way of seeing if an idea or method has been critiqued or further developed by subsequent researchers.

Recommended Internet Sites

http://earth.eo.esa.int/satelliteimages/
http://visibleearth.nasa.gov/
http://earthobservatory.nasa.gov
http://neo.sci.gsfc.nasa.gov/Search.html

Computer Laboratories or Study Spaces

Biosciences G11 and 640

7. Required Equipment, Training and Enabling Skills

Required equipment Provided in the computer labs.

Enabling skills - training which may be required to complete this course Working knowledge of Windows.

8. Assessment Tasks and Feedback

Task	CLOs assessed	% of total mark	Date		Feedback	
			Release	Due		
Lab work & reports	CLO2, CLO3,CLO5	20	2	Weekly; week following the Lab.	LH and other tutors	weekly
Research report and blog	CLO4, CLO5, CLO6	40	2	Week 13	GM	Week 15
Final Exam	CLO1, CL2	40		Central exams	GM	Exam period

8.1 Assessment Criteria

Lab Reports (20% of final course mark)

- These reports are to be completed for each lab, and submitted via Moodle within one week
- Answer the lab questions, and include images/screenshots of your results
- **Save the document as a .pdf** and upload to the corresponding assignment submission.
- These are not meant to be detailed and polished reports - they just need to be readable and demonstrate that you have put reasonable effort into attempting and completing the lab exercises - there are (almost) no wrong answers

Research Report and Blog (40% of final course mark)

Due date: end week 13 (optional proposal due Tuesday of week 8)

The aim of this report is to investigate an environmental remote sensing application, synthesising knowledge acquired through Labs and systematic literature review of a 'theme' of your choice (e.g. geology, ecology, land use change, surface hydrology, land degradation, etc). The report is to be complemented with a blog, as a way of summarising the report findings for a more general audience and provoking debate in the style of The Conversation (ie. following the style and specifications of that website). Specific instructions and rubric will be uploaded in Moodle, under Assessments.

If you submit a proposal, it should be a brief, well thought out skeleton of the report, detailing the key points to be covered in each section – it should be no more than 2 pages. This will provide you an opportunity to get feedback on your ideas and adjust accordingly, if necessary.

Format: 12pt times new roman font, double spaced (reference list can be single spaced), 2.5cm margin on all sides, no more than 15 pages, from title to end of references. **Save your document as a .pdf** and upload via Moodle. Upload your final report to the assignment submission below.

A dedicated space will be created in Moodle for your blog.

The report is worth 40%, and there are 2 main tasks, so do the math and write your report and related blog accordingly.

Final exam (40%)

Due date: centrally scheduled, most likely to be multiple choice.

Weighting: 40% of final course mark

9. Administrative Matters

Expectations of Students	You are expected to attend all lectures and laboratories. All assessable items are compulsory.
Assignment Submissions	Assignments are to be submitted via the BEES assignment box. Extensions will not be granted unless supported by documentation (eg doctor's certificate) or through UNSW Student Central (see https://my.unsw.edu.au/student/atoz/SpecialConsideration.html).
Occupational Health and Safety[3]	Information on relevant Occupational Health and Safety policies and expectations can be found at http://www.ohs.unsw.edu.au/ (UNSW) and http://www.bees.unsw.edu.au/ohs/indexohs.html (BEES).
Examination Procedures	The final exam will be held during the course.
Equity and Diversity	Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or www.studentequity.unsw.edu.au). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Grievance Policy[4]

School Contact	**Faculty Contact**	**University Contact**
Dr Jes Sammut Room 509, Phone: 9385 8281 j.sammut@unsw.edu.au	Dr Scott Mooney Associate Dean (Undergraduate Programs) s.mooney@unsw.edu.au Tel: 9385 6127	University Counselling Services Tel: 9385 5418

[3] UNSW Occupational Health and Safety: http://www.ohs.unsw.edu.au/

[4] UNSW Grievance Policy: https://my.unsw.edu.au/student/atoz/Complaints.html

10. UNSW Academic Honesty and Plagiarism

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.
*Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle
† Adapted with kind permission from the University of Melbourne.

BEES Academic Honesty and Plagiarism

Please note:

In addition to the UNSW Policy on Academic Honesty and Plagiarism, the School of Biological, Earth and Environmental Sciences (BEES), also considers any work submitted that has been produced outside of a given course in a given year to be plagiarism i.e:

- Work produced for a third party e.g. your place of employment, is considered intellectual property of the third party, and as such if such work is submitted in place of a required course work, it is deemed plagiarism.

- All work submitted for assessment must be created specifically for the given assessment task in the given year. Work produced in previous years or for other assessments is not acceptable.