ENVE340

Environmental Change

S1 Day 2015

Dept of Environmental Sciences

Contents

General Information	2
Learning Outcomes	3
Assessment Tasks	4
Delivery and Resources	7
Unit Schedule	28
Learning and Teaching Activities	30
Policies and Procedures	31
Graduate Capabilities	33
Background to the unit	41
Fieldwork	42
Grading of assessed tasks	45

General Information

Unit convenor and teaching staff
Unit Convenor
Kira Westaway
kira.westaway@mq.edu.au
Contact via kira.westaway@mq.edu.au
E7A632
Office hours - send an email to book

Lecturer
Paul Hesse
paul.hesse@mq.edu.au
Contact via 9850 8384
E7A633
Office hours - send an email to book

Credit points
3

Prerequisites
39cp including (ENVE214(Cr) or ENVE266(P) or GEOS214(Cr) or GEOS266(P))

Corequisites

Co-badged status

Unit description
This unit requires you to piece together lines of evidence to reconstruct the climatic and environmental changes over the last 2.6 million years. This period saw dramatic changes as the environment swung in and out of huge glacials, where large sections of the planet were covered in ice, to interglacials, where the climate recovered and the environment flourished. We will use this evidence to understand how landscapes, vegetation, fauna and humans respond to large-scale climate and environmental change and use this as a baseline to comment on how they will respond to future changes. This unit considers how the environmental response from cave and fluvial sediment, tree rings, pollen, ice cores, marine cores and landforms can be used to reconstruct past environments to gain an understanding of how the earth system evolves. This understanding is then related to evidence of environmental change seen in the local Australian landscape, and investigated during field excursions, including a week-long field trip during the mid-semester break. Case studies include: the extent of glaciation in Kosciuszko; how environmental change in Africa and Asia shaped the evolution of early humans; human-environmental interactions such as the mega fauna debate; and how climatic change during the past hundred thousand years affected sediment transport and drainage systems in the Murray Darling basin.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships

Demonstrate critical thinking in your reading of the literature and interpretation of your own data

Design a field research project including data gathering and interpret your own data

Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses

Data collection is to be undertaken in a manner that is rigorous, reliable and replicable.

Data collection should be structured in a manner to address a clearly-specified question.

The data themselves should be irrefutable, whereas our interpretations are not.

Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
Communicate scientific information and concepts through oral, visual and written formats
Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment Tasks

Name	Weighting	Due
Assessment 1	10%	1 pm 2/3/15
Assessment 2	25%	9 am 4/5/15
Assessment 3	25%	1 pm 1/6/15
Assessment 4	40%	Semester 1 exam period

Assessment 1

Due: **1 pm 2/3/15**
Weighting: **10%**

Conduct the proxies practical and then submit a handout with the final interpretation (4%)

Then argue in 500 words that a chosen proxy provides the best evidence for reconstructing GLOBAL environmental change compared to other proxies (5%). A further 1% can be gained from peer review scores - see your prac book for further details. This assessment is submitted electronically via the Turnitin link and the Workshop link both in ilearn and marked using Grademark (further details in *Delivery and Resources*)

On successful completion you will be able to:

- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Communicate scientific information and concepts through oral, visual and written formats
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment 2

Due: **9 am 4/5/15**
Weighting: **25%**

Write a 2000 word field report (plus figures and references) on your research conducted at Kosciuszko and Nerrandera

You will be required to develop your own question which you must address in your report, tailoring the presentation and discussion of your results to answer the question and placing them within a context revealed by your readings and the work conducted in the field. The research and thought which go into each report are an important part of your learning in this unit. We expect that you will deepen your understanding of the topic and your field experience by discovering the links between your observations and previous published research in the scientific literature. It should be presented in the format of scientific reports, with a high standard of presentation (clarity and accuracy, not necessarily 'pretty'), with diagrams, maps, graphs and tables (as appropriate) and standard scientific citation and referencing. You will be provided with some essential and useful readings for these reports but you should also undertake your own research of the primary scientific literature.

This assessment must be submitted electronically via Turnitin (follow links in ilearn) and will be marked using Grademark

On successful completion you will be able to:

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment 3

Due: **1 pm 1/6/15**
Weighting: **25%**

An oral group presentation on the results of your field research including your fieldwork and

susequent laboratory analysis (weeks 8-12). This will be presented in groups in the prac during week 13 (23%) - every student will be given 5 mins presentation time. A further 2% can be gained from peer assessment of your presentations

On successful completion you will be able to:

- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Communicate scientific information and concepts through oral, visual and written formats
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment 4

Due: **Semester 1 exam period**
Weighting: **40%**

Mid year exam based on lecture and practical content

The **EXAM** will be scheduled in the regular University examination period. The exam is 3 hours in length and will cover all subjects covered in the lectures, practicals and fieldtrips. There is a combination of short answer and longer (short essay) style questions. Past exam papers for this unit are available, but we will also provide a few example questions in the final lecture.

The University examination period in First Semester 2014 is from 9/6/15-26/6/15. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in draft form approximately eight weeks before the commencement of the examinations and in final form approximately four weeks before the commencement of the examinations. (http://www.reg.mq.edu.au/Forms/APSCon.pdf)

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. Information about unavoidable disruption and the special consideration process is available at (http://www.reg.mq.edu.au/Forms/APSCon.pdf)

If a supplementary examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period. You are

advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is the final day of the official examination period.

On successful completion you will be able to:

- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Communicate scientific information and concepts through oral, visual and written formats
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Delivery and Resources

LECTURES

Two one hour lectures are held on most Fridays from 11-1 pm. Lectures are designed to provide you with a framework with which to focus your study of the subject and are an essential and important component of the unit. They are by no means exhaustive on each and every topic, and you are expected to supplement them by reading especially from the textbook but also from the current journals, where the most up-to-date information can be found. There is a reading list for you to use as a starting point later in this document, and additional material will be referred to during the lecture program. Lecture slides are available on-line through https://ilearn.mq.edu.au/login/MQ for viewing and/or printing. **llectures are not available for this course, audio will not be recorded**. It is your responsibility to keep up to date with lecture content. **DO NOT MISS LECTURES!!**

PRACTICALS

Practicals are held most weeks on Mondays at 1 pm for 3-4 hours. Each student **must attend** all practical sessions, held in E5A240. Most practicals will have no take-home component but students must demonstrate understanding of the topics and mastery of the skills introduced before being allowed to leave. Practical classes comprise a practical exercise, including numerical analysis, examination of rocks and sediments or local fieldwork. Practicals provide greater depth to the related lecture materials and are designed to assist learning by encouraging your active participation. The venue of the practical classes varies (see Unit schedule). Important material for the practical classes is included in the practical book. Additional material may be posted on ilearn for download. Each student must bring the appropriate equipment to the practical session and pre-read the practical description. Equipment may include; overhead transparencies, permanent FINE overhead pen (red or green preferably), drawing pencils (2B, HB, 2H), coloured pencils, ruler, sharpener, eraser, protractor, calculator, field note book. You should also wear appropriate clothes for the laboratory and field: closed shoes, sun protection etc.

FIELDWORK

There are two compulsory fieldtrips for all students: 9th March and 7-12th April. Fieldwork forms an essential component of this unit and therefore all students must attend. These trips include one day/half day long field trip to Narrabeen Lagoon in Week 3, and a mid-semester field trip from 7-12th April to Kosciuszko. The assignments and fieldtrips are described in detail elsewhere in this unit guide. Equipment and safety issues for field work are described in the fieldwork section.

ASSESSMENTS

There are 4 assessments overall with different percentage weightings. The first two assessments (Proxies and Field report) must be submitted electronically using Turnitin (follow links in ilearn for submission) - **there will be no hard copy submissions** - see assessments section for further details

PROBLEM SOLVING QUEST

A private or team study quest to practice problem solving skills and create environmental detectives. At the end of each lecture series an environmental problem will be presented that needs to be solved, the answers can be entered into ilearn at home producing a clue - these clues can be combined to form the location of the quest - further details will be provided in the first lecture.

LIGHTENING PRESENTATIONS

Each student will be expected to present a 1 minute presentation (with no notes) to their peers on an important topic in Quaternary Science. The presentations will not be graded but will be helpful for developing essential communication skills and undertanding of topic areas.

PEER REVIEW

All students will be given the opportunity to mark fellow student assignments (for assignment 1), and assess the final presentations (assignment 3) this will contribute a small proportion to the final grades. You will be assessed on your scores provided by your peers.

ESSENTIAL READINGS

There is no specific essential reading for this topic – but you will need to read widely in order to have the background necessary to achieve a good understanding of the topic. However, the following texts are suggested as being valuable reading and will be referred to during lectures. You are not required to purchase them, but may find them useful. There are some copies in the library, which have been placed in special reserve so everyone can have access:

- **Global Environments through the Quaternary**, Anderson, D., Goudie A.S., Parker, A.G., 2007. Oxford University Press
- **Reconstructing Quaternary Environments**, JJ Lowe Walker, MJC. 2nd Edition.

- **Quaternary Environments**. Martin Williams, David Dunkerley, Patrick De Deckker, Peter Kershaw, John Chappell. 1998. Arnold.
- **Quaternary Geochronology,** Noller, JS., Sowers JS Lettis WR 2000. American Geophysical Union, Washington DC
- **Encyclopaedia of Quaternary Science**, Elias, S.A. (Ed.), 2007. Elsevier, London (Electronic resources in MQ library – each article can be downloaded)
- **Tectonic Geomorphology** Burbank DW, Anderson RS. 2001. Blackwell Scientific: Oxford

If you have not already done so, you should invest in a Dictionary of Physical Geography, available in the bookshop.

To keep up with lecture materials and also some of the practical classes and the fieldtrips you should read all '***essential text***' BEFORE the lectures each week. Start with these chapters as a foundation then supplement your reading with the listed journal references when you have some spare time. MORE READING = BETTER UNDERSTANDING. Key journals for this course include:

Quaternary Science Reviews

Journal of Quaternary Science

Quaternary International

Quaternary Research

Palaeogeography, Palaeoclimatology, Palaeoecology

Nature Geoscience

Journal of Human Evolution

TECHNOLOGY USED AND REQUIRED - iLearn and ON-LINE MATERIALS

You will require access to a computer for parts of this unit. The university has now changed its online system to iLearn – you will need to make yourself familiar with this system – student guides can be found at **http://mq.edu.au/iLearn/studentinfo.htm**. You can gain access to the Powerpoint slides used for each lecture by visiting the iLearn page for ENVE 340 **(https://ilearn.mq.edu.au/login/MQ/ -** login with your Macquarie OneID username and password**)**. Please note: Audio lecture recordings in ilecture will not be available for this unit – it is your responsibility to come to the lectures or catch up on material missed. This iLearn site will be used by staff to outline course content week by week, to post video clips, to send reminders and notices concerning fieldtrips, practical classes and lectures, and to keep in contact with students. **You should check the site regularly**, especially the day before lectures/pracs. There is also capacity for discussion between students; please feel free to use this to discuss issues relating to any aspect of the unit and environmental change in general. For specific questions on the lecturers, either post them on iLearn or email them directly (see front cover).

In addition to iLearn we will be trialling a new student and teacher 'clicker' (Socrative – m.socrative.com) to facilitate rapid student responses during the lecture. Everyone is encouraged to participate – all it requires is a SMART phone, laptop, tablet or ipad with a connection to the internet (all web enabled devices can be used) – if everyone has a device then a short 'exit'quizz will used at the end of most lectures to test understanding.

The first assessment will be submitted through Turnitin that can be accessed through a link in iLearn.Turnitin is a paperless grading system whereby your assignments will be submitted online and marked by staff online, and feedback will be given online via electronic comments, custom marks and even by voice comments. The staff marking will be provided with the exact time and date of submission, an overlay of the assignment, and access to the originality checker (via the Turnitin software – please read notes on plagiarism very carefully). Your resulting grades and feedback can be found at the Turnitin site (linked to ilearn).

WORKLOAD

ENVE 340 is a 3 credit point unit and, according to University guidelines, you should spend at least 9 hours on the unit each week, or 135 hours over the 15 week semester. The following is a guideline as to how that time should be spent:

22 Lectures	**22 hours**
7 days of excursions	**49 hours**
8 Practicals	**24 hours***
Assignment 1	**4 hours**
Field trip report	**10 hours**
Presentation preparation	**6 hours**

* Although the online University Timetable indicates the practical will run for 4 hours, the average will be ~3 hours

Your own study time for ENVE340 should therefore be a **minimum** of an **additional 1.5 hours per week (for 13 weeks)**. Simply attending lectures and practical classes is not enough to guarantee a good grade.

LIBRARY RESEARCH RESOURCES

The Library provides a range of learning opportunities aimed at developing student capabilities in research and information technology. Topics covered include:

computer essentials

navigating the Macquarie University website

getting started in your online unit

using the library catalogue and e-readings to locate key references

using research databases to find journal articles

locating scholarly information on the Internet

effective searching of the Internet

You can choose to learn online or at face-to-face session in the library.

More information is available at: (http://www.lib.mq.edu.au/training/). Follow the links to Training

FINDING RELEVANT SCIENTIFIC JOURNALS

While you should begin with the readings listed below, wander through the GB, S590 and QE sections of the library (in particular). You are especially encouraged to keep an eye on the current journals, where the most up-to-date information can be found. Particular attention should be placed on the journals *Earth Surface Processes and Landforms* and *Geomorphology*. Don't be scared to bring journal articles to our attention – we are always ready to chat about such things!

Additional journals that you are encouraged to 'keep your eye on' are listed below. Recent years of many of these titles are available on-line. Go to 'Journal Search' on the Library web page and follow directions. Usually, papers can be downloaded and printed freely.

American Journal of Science.	Q1.A5	Journal of Sedimentary Research.	QE420.J84
Annals of the Association of American Geographers	G3.A7	Nature.	Q1.N202
Applied Geography.	G1.A7	Palaeogeography, Palaeoclimatology, Palaeoecology.	QE500.P25
Australian Geographer.	G1.A9	Progress in Physical Geography.	G1.P685
Australian Geographical Studies.	G51.A9	Quaternary Research.	QE696.Q33
Australian Journal of Earth Science.	QE1.G3	Science.	Q1.S35
Australian Journal of Soil Research.	S590.A78	Sedimentary Geology.	QE581.A1.S42
Catena.	S590.C3	Sedimentology.	QE581.A1.S4
Earth and Planetary Science Letters.	QE1.E12	Zeitschrift fur Geomorphologie.	G1.Z472

Earth Surface Processes & Landforms.	GB400.E3		

FINDING RELEVANT SCIENTIFIC PAPERS

In addition to the journal papers we have listed below, there are many more papers, especially recent and overseas papers, which you may find have valuable information for your reports. To find relevant papers you should become familiar with the searchable databases available through the library web page. From the main Library page, go to 'Databases' and try these:

- Science Direct
- Web of Science (also called ISI Web of Science)
- SCOPUS
- INGENTA
- GEORef

And enter search terms (e.g. ice cores, speleothems). There are many other environmental and biological databases as well. For example, Google Scholar (see the Google search page) is also a good search engine for scientific papers.

All databases are slightly different and it's often worth trying more than one. Once you have found the details (often including the abstract) you will probably need to go back to the journal (use 'journal search' on the library page) to find and download the paper.

Note: Many of the readings (scientific papers) are available online from the library's e-reserve page for ENVE340 (http://www.lib.mq.edu/borrowing/ereserve.php)

Recommended reading:

Week 1: Introduction to past global environmental changes/Proxies (ice and marine cores, speleothems),

Essential texts:

Lowe, JJ Walker MJC – Ch 1, 3 (p85-86, 127-135, 148-158) Ch 6

Williams et al., 1998 – Ch 1,2,5 -3, 7

Anderson et al., 2007 – Ch 2, Ch 1and 9

Noller et al., 2000 – p1-10 427

Lowe et al., 2007

- Elias, S.A., 2007. History of Quaternary Science. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 10-18.
- Lowe, JJ, Walker MJC, Porter SC 2007. Understanding Quaternary Climatic Change.In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 28-39

- *Zachos, J., Pagani, M., Sloan, L., Thomas, E. and Billups, K., 2001. Trends, Rhythms, and Aberrations in Global Climate 65 Ma to Present. Science 292, 686-693.
- Siddal et al., 2003. Sea-level fluctuations during the last glacial cycle, Nature, 423, 853-858.
- Fleming, K., Johnston, P., Zwartz, D., Yokoyama, Y., Lambeck, K. and Chappell, J., 1998. Refining the eustatic sea-level curve since the Last Glacial Maximum using far- and intermediate-field sites. Earth and Planetary Science Letters 163, 327-342.
- *Lambeck, K., Chappell, J. 2001. Sea level change through the last glacial cycle. Science 292, 679-686.
- *Chapell J, Shackleton NJ., 1986. Oxygen isotopes and sea level. Nature 324, 137-140.
- CLIMAP Project, 1976. The surface of the ice-age Earth. Science 191, 1131-1136. *This is a seminal paper, and while now well out of date was a spur for a considerable amount of research.*
- Waelbroeck, C., Paul, A., Kucera, M., Rosell-Melé, A., Weinelt, M., Schneider, R., Mix, A.C., Turon, J.-L. 2009. Constraints on the magnitude and patterns of ocean cooling at the Last Glacial Maximum. Nature Geoscience 2, 127-132.
- Chappell, J. 1983. Thresholds and lags in geomorphologic changes. Australian Geographer 15, 357-366.
- Christl, M., Mangini, A., Holzkamper, S., Spotl, C., 2004. Evidence for a link between the flux of galactic cosmic rays and Earth's climate during the past 200,000 years. Journal of Atmospheric and Solar-Terrestrial Physics 66, 313-322.
- Bassinot, FC., 2007. Oxygen Isotope Stratigraphy of the Oceans In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 1740-1748
- Jouzel, J Masson-Delmotte, V, 2007. Antarctic Stable Isotopes In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 1242-1250
- Brook, EJ, 2007. Correlations between Greenland and Antarctica. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 1258-1266
- Bond, G., Broeker, W. et al., Correlations between climate records from North Atlantic sediments and Greenland ice. 1993, Nature, 365, 143-147.
- Hellstrom, J.C., McCulloch, M.T., Stone, J., 1998. A detailed 31,000-year record of climate and vegetation change, from the isotope geochemistry of two New Zealand speleothems. Quaternary Research 50, 167-178.
- Wang, Y.J., Cheng, H., Edwards, R.L., An, Z.S., Wu, J.Y., Shen, C.C., Dorale, J.A., 2001. A High Resolution Absolute Dated Late Pleistocene Monsoon Record from Hulu Cave, China. Science 294, 2345-2348.

- Johnson, R.G., Lauritzen, S.E., 1995. Hudson Bay-Hudson Strait jokulhlaups and Heinrich events: a hypothesis. Palaeogeography, Palaeoclimatology, Palaeoecology 117, 123-137.
- Gronvold, K., Oskarsson, N., Johnsen, S.J., Clausen, H.B., Hammer, C.U., Bond, G., Bard, E., 1995. Ash layers from Iceland in the Greenland GRIP ice core correlated with oceanic and land sediments. Earth and Planetary Science Letters 135, 149-155.
- Gardiner V, Dackombe R. 1983. Geomorphological Field Manual. George Allen & Unwin: London
- NGRIP, 2004. High-resolution record of northern hemisphere climate extending into the last interglacial period. Nature 431, 147-151.
- Dykoski, C.A., Edwards, R.L., Cheng, H., Yuan, D., Cai, Y., Zhang, M., Lin, Y., Qing, J., An, Z.S., Revenaugh, J., 2005. A high-resolution, absolute-dated Holocene and deglacial Asian monsoon record from Dongge cave, China. Earth and Planetary Science Letters 233, 71-86.
- Kershaw, A.P., van der Kaars, S., Moss, P.T., 2003. Late Quaternary Milankovitch-scale climatic change and variability and its impact on monsoonal Australasia. Marine Geology 201, 81-95.

Week 2: Sources of Evidence -Sedimentology and Stratigraphy/ Reconstructing the ice age

Essential texts:

Lowe, JJ Walker MJC – Ch1 and 2-6 (skim) – Ch 7 (but very northern hemisphere bias)

Williams et al. – Ch 4

Lowe and Walker

- Bond, G., Broeker, W. et al., 1993. Correlations between climate records from North Atlantic sediments and Greenland ice. Nature, 365, 143-147.
- Yin, Q. Z. and Berger A., 2010. Insolation and CO_2 contribution to the interglacial climate before and after the Mid-Brunhes Event. Nature Geoscience 3, 243 – 246.
- Weaver, A.J. and Hillaire-Marcel, C., 2004. Global Warming and the Next Ice Age. Science 304, 400 – 402.
- Loutre, M.F. Berger, A., 2003. Marine Isotope Stage 11 as an analogue for the present interglacial. Global and Planetary Change 36, 209–217.
- EPICA Community members 2004. Eight glacial cycles from an Antarctic ice core.

Nature 429, 623-628.

Week 3: Field excursion

Essential texts:

Flack and Erskine, 1996

Roy et al., 1980 (see below for full refs)

- Blong, RJ, Riley, SJ, Crozier, PJ., 1982. Sediment yield from runoff plots following bushfire near Narrabeen Lagoon, NSW. Search, 13, pp. 36-38.
- Hennecke, W.G., Greve, C.A., Cowell, P.J., Thom, B.G. 2004. GIS-based coastal behaviour modelling and simulation of potential land and property loss: Implications of sea-level rise at Collaroy/Narrabeen Beach, Sydney (Australia). Coastal Managemen t 32, 449-470.
- Flack, K.A., Erskine, W.D. 1996. Development of the Middle Creek delta plain, Narrabeen Lagoon, NSW.Australian Geographer 27, 235-248
- Johnston, D., Gerstle, B. 1986. The urbanisation of Narrabeen Lagoon catchment - a case study. Journal of Soil Conservation, New South Wales 42, 18-21
- Roy, PS, Thom, BG, Wright, LD, 1980. Holocene sequences on an embayed, high-energy coast: an evolutionary model. Sedimentary. Geology 26, 1-19.

Week 3: Luminescence dating/Dating the Australian landscape

Essential texts:

Lowe and Walker – Ch 5

Anderson et al., 2007 – Ch 2

Noller et al., 2000 p157-176

Turney et al., 2001

Lian, 2007

- Duller, G.A.T., 2004. Luminescence dating of Quaternary sediments: recent advances. Journal of Quaternary Science. 19, 183-192.
- Duller, G.A.T., 2000. Dating methods: geochronology and landscape evolution. Progress in Physical Geography 24, 111-116.
- Jull,A.J.T. 2007. Dating techniques. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary

Science, Elsevier, London, pp 453-459.

- Nanson, G.C., Price, D.M., Jones, B.G., Maroulis, J.C., Coleman, M., Bowman, H., Cohen, T.J., Larsen, J.R. 2008. Alluvial evidence for major climate and flow regime changes during the middle and late Quaternary in eastern central Australia. Geomorphology 101, 109-129
- Pietsch, T.J., Olley, J.M., Nanson, G.C. 2008. Fluvial transport as a natural luminescence sensitiser of quartz Quaternary Geochronology 3, 365-376.
- Smith, D. and Lewis D., 2007. Dendrochronology, In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 459-465.
- Cook G.T. and van der Plicht, J., 2007. Conventional Method. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 2899-2911.
- Jull, A.J.T., 2007. AMS Methods. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, pp 2911-2918.
- Bird, M.I., 2007. Charcoal. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 2950-2958.
- Thompson, W.G., 2007. U-Series Dating. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp Pages 3099-3104.
- Lian, O.B., 2007. Optically-Stimulated Luminescence. In: Elias, S.A. (Ed.), Encyclopaedia of Quaternary Science, Elsevier, London, pp 1491-1505
- Roberts, R.G., Bird, M., Olley, J.M., Galbraith, R.F., Lawson, E., Laslett, G.M., Yoshida, H., Jones, R., Fullagar, R.L.K., Jacobson, G. and Hua, Q., 1998. Optical and radiocarbon dating at Jinmium rock shelter in northern Australia. Nature 393, 358-362.
- Turney, C.S.M., Bird, M.I., Fifield, L.K., Roberts, R.G., Smith, M.A., Dortch, C.E., Grun, R., Lawson, E., Ayliffe, L.K. and Miller, G.H., 2001. Early Human Occupation at Devil's Lair, Southwestern Australia 50,000 Years Ago. Quaternary Research 55, 3-13.
- Roberts, R.G., Jones, R. and Smith, M.A., 1990. Thermoluminescence dating of a 50, 000-year-old human occupation site in Northern Australia. Nature 345, 153-156.
- Roberts, R.G., Jones, R., Spooner, N.A., Head, M.J., Murray, A.S. and Smith, M.A., 1994. The human colonisation of Australia: Optical dates of 53,000 and 60,000 years bracket human arrival at Deaf Adder Gorge, Northern Territory. Quaternary Geochronology 13, 575-583.
- Roberts, R.G. and Jones, R., 1994. Luminescence dating of sediments: new light on the human colonisation of Australia. Australian Aboriginal Studies 2, 2-16.

Week 4: Human landscape interactions/Caves

Roberts et al., 2001

Roberts and Brook, 2010

Field et al., 2008

Wroe and Field, 2006

Demeter et al., 2012

Morwood et al., 2004

Ibrahim et al., 2013

Duringer, et al., 2012

- Roberts, R.G., Flannery, T.F., Ayliffe, L.K., Yoshida, H., Olley, J.M., Prideaux, G.J., Laslett, G.M., Baynes, A., Smith, M.A., Jones, R. and Smith, B.L., 2001. New Ages for the Last Australian Megafauna: Continent-Wide Extinction About 46,000 Years Ago. Science 292, 1888-1892.
- Bowler, J.M., Johnson, H., Olley, J.M., Prescott, J.R., Roberts, R.G., Shawcross, W., Spooner, N.A., 2003. New ages for human occupation and climatic change at Lake Mungo, Australia. Nature 421, 837-840.
- Roberts, R., Brook, B., 2010. And Then There Were None? Science, 327, 420-422.
- The Future Eaters, Tim Flannery, 2002, Grove Press, 432 pages.
- Judith Field, Melanie Fillios, Stephen Wroe, 2008. Chronological overlap between humans and megafauna in Sahul (Pleistocene Australia–New Guinea): A review of the evidence. Earth-Science Reviews 89, 97-115.
- Prideaux, G.J., Roberts, R.G., Megirian, D., Westaway, K.E., Olley, J., 2007. Effects of Pleistocene climate change on southeastern Australian mammal fauna and implications for causes of megafaunal extinctions. Geology 35, 33-36.
- Price, G.J., Zhao, J.-x., Feng, Y.-x., Hocknull, S.A., 2009. New U/Th ages for Pleistocene megafauna deposits of southeastern Queensland, Australia. Journal of Asian Earth Sciences 34, 190-197.
- Grün, R., Eggins, S., Wells, R.T., Rhodes, E., Bestland, E., Spooner, N., Ayling, M., Forbes, M., McCulloch, M., 2006. A cautionary tale from down under: Dating the Black Creek Swamp megafauna site on Kangaroo Island, South Australia. Quaternary Geochronology 1, 142-150.
- Grün, R., Eggins, S., Aubert, M., Spooner, N., Pike, A.W.G., Müller, W., 2010. ESR and U-series analyses of faunal material from Cuddie Springs, NSW, Australia: implications for the timing of the extinction of the Australian megafauna. Quaternary Science Reviews

29, 596-610.

- Ayliffe, L.K., Prideaux, G.J., Bird, M.I., Grün, R., Roberts, R.G., Gully, G.A., Jones, R., Fifield, L.K., Cresswell, R.G., 2008. Age constraints on Pleistocene megafauna at Tight Entrance Cave in southwestern Australia. Quaternary Science Reviews 27, 1784-1788.
- Roberts, R.G., Brook, B.W., 2010. Turning back the clock on the extinction of megafauna in Australia. Quaternary Science Reviews 29, 593-595.
- Johnson, C.N., 2005. What can the data on late survival of Australian megafauna tell us about the cause of their extinction? Quaternary Science Reviews 24, 2167-2172.
- Wroe, S., Field, J., 2006. A review of the evidence for a human role in the extinction of Australian megafauna and an alternative interpretation. Quaternary Science Reviews 25, 2692-2703.
- Fillios, M., Field, J., Charles, B., 2010. Investigating human and megafauna co-occurrence in Australian prehistory: Mode and causality in fossil accumulations at Cuddie Springs. Quaternary International 211, 123-143.
- Cosgrove, R., Field, J., Garvey, J., Brenner-Coltrain, J., Goede, A., Charles, B., Wroe, S., Pike-Tay, A., Grün, R., Aubert, M., Lees, W., O'Connell, J., 2010. Overdone overkill - the archaeological perspective on Tasmanian megafaunal extinctions. Journal of Archaeological Science 37, 2486-2503.
- Demeter, F., Shackelford, L., Bacon, A.M, Duringer, P., Westaway, K.E., Sayavongkhamdy, T., Braga, J., Sichanthongtip, P., Khamdalavong, P., Ponche, J-L, Lundstrom, C, Patole-Edoumba, E, Karpoff, A-M, 2012. Anatomically modern human in Southeast Asia (Laos) by 46 ka. PNAS 109, 14375-1438.
- Morwood, M.J., Soejono, R.P., Roberts, R.G., Sutikna, T., Turney, C.S.M., Westaway, K.E., Rink, W.J., Zhao, J.-x., van den Bergh, G.D., Awe Due, R., Hobbs, D.R., Moore, M.W., Bird, M.I. and Fifield, L.K., 2004. Archaeology and age of a new hominin from Flores in eastern Indonesia. *Nature* 431, 1087–1091.
- Ibrahim, Y., Tshen, L.T, Westaway, K.E., Earl of Cranbrook, Peng, L.C., Muhammad , R.F. , Humphrey. L. 2013. First records of fossils of Orangutan Pongo Sp. of Quaternary age from Peninsular Malaysia. Journal of Human Evolution 65, 770-797.
- Duringer P., Bacon, AM, Sayavongkhamdyc,T., Nguyen TKT., 2012. Karst development, breccias history, and mammalian assemblages in Southeast Asia: A brief review. Comptes Rendus Palevol 11, 133–157.

Week 5: Rapid Environmental Change/Introduction to Field Area

Essential texts:

Burbank and Anderson, 2001

Westaway, et al 2010.

Summerfield 1991 Ch 15 (see below for full refs)

- Burbank DW, Anderson RS. 2001. Tectonic Geomorphology. Blackwell Scientific: Oxford.
- Westaway, K.E., Morwood, M.J., Sutikna, T., Zhao, J.-x., 2010. The rate of landscape evolution in the tropics using river terraces: an environmental context for an archaeological site in western Flores, Indonesia. Journal of Quaternary Science 25, 1018–1037
- Summerfield MA., 1991. Global Geomorphology: An introduction to the study of landforms. Longmans, London. Ch 15 p 371-402.
- Gascoyne M, Ford DC, Schwarcz HP. 1983. Rates of cave and landform development in the Yorkshire Dales from speleothem age data. Earth Surface Processes and Landforms 8, 557–568.
- Leland J, Reid MR, Burbank DW, Finkel R, Caffee M. 1998. Incision and differential bedrock uplift along the Indus River near Nanga Parbat, Pakistan Himalaya, from ^{10}Be and ^{26}Al exposure agedating of bedrock straths. Earth and Planetary Science Letters 154, 93–107.
- Piccini L, Drysdale R, Heijnis H. 2003. Karst morphology and cave sediments as indicators of the uplift history in the Alpi Apuane (Tuscany, Italy). Quaternary International 101-102, 219–227.
- Stock, G.M., Anderson, R.S., Finkel, R.C., 2004. Pace of landscape evolution in the Sierra Nevada, California. Geology 32, 193-196.
- Burbank DW, Leland J, Fielding E. 1996. Bedrock incision: rock uplift and threshold hillslopes in the northwestern Himalayas. Nature 379, 505–510.
- Chaplot V, Coadou le Brozec E, Silvera N, Valentin C. 2005. Spatial and temporal assessment of linear erosion in catchments under sloping lands of northern Laos. Catena 63, 167–184.
- Droppa A. 1966. The correlation of some horizontal caves with river terraces. Studies in Speleology 1, 186–192.
- Fei, W., Hongchun, L., Rixiang, Z., Feizhou, Q., 2004. Late Quaternary downcutting rates of the Qianyou River from U/Th speleothem dates, Qinling mountains, China. Quaternary Research 62, 194-200.
- Ford, D.C., Scharcz, H.P., Drake, J.J., Gascoyne, M., Harmon, R.S., Latham, A.G., 1981. Estimates of the age of the existing relief within the southern Rocky mountains of Canada. Arctic and Alpine Research 13, 1-10.

- Ford, T.D., Gascoyne, M., Beck, J.S., 1983. Speleothem dates and Pleistocene chronology in the Peak District of Derbyshire. Transactions of the British Cave Research Association 10, 103-115.

Kosciuszko

- Barrows, T. T., J. O. Stone, et al. (2001). "Late Pleistocene glaciation of the Kosciuszko Massif, Snowy Mountains, Australia." Quaternary Research 55: 179-189.
- Barrows, T. T., J. O. Stone, et al. (2002). "The timing of the Last Glacial Maximum in Australia." Quaternary Science Reviews21: 159-173.
- Barrows, T. T., J. O. Stone, et al. (2004). "Exposure ages for Pleistocene periglacial deposits in Australia." Quaternary Science Reviews23: 697-708.
- Galloway, R. W. (1965). "Late Quaternary climates in Australia." Journal of Geology73: 603-618.

Nerrandera

Murrumbidgee Dunes

- Page, K.J., Dare-Edwards, A.J., Owens, J.W., Frazier, P.S., Kellett, J.,Price, D.M., 2001. TL chronology and stratigraphy of riverine source bordering sand dunes near Wagga Wagga, New South Wales, Australia. Quaternary International 83-85, 187-194.
- Spooner, N.A., Olley, J.M., Questiaux, D.G.,Chen, X.Y., 2001. Optical dating of an aeolian deposit on the Murrumbidgee floodplain. Quaternary Science Reviews 20, 835-840.

Lake Urana

- Page, K., A. Dare-Edwards, et al. (1994). "Late Quaternary evolution of Lake Urana, New South Wales, Australia." Journal of Quaternary Science9: 47-57.

Murrumbidgee Palaeochannels

- Dosseto, A., P. P. Hesse, et al. (2010). "Climatic and vegetation control on sediment dynamics during the last glacial cycle." Geology**38**: 395-398.
- Page, K., G. Nanson, et al. (1996). "Chronology of Murrumbidgee River palaeochannels on the Riverine Plain, southeastern Australia." Journal of Quaternary Science11(4): 311-326.
- Page, K. J., A. J. Dare-Edwards, et al. (2001). "TL chronology and stratigraphy of riverine source bordering sand dunes near Wagga Wagga, New South Wales, Australia." Quaternary International83-85: 187-194.
- Page, K. J. and G. C. Nanson (1996). "Stratigraphic architecture resulting from Late

Quaternary evolution of the Riverine Plain, south-eastern Australia." Sedimentology43: 927-945.

- Schumm, S.A., 1968. River adjustment to altered hydrologic regimen - Murrumbidgee River and palaeochannels, Australia. Geological Society Professional Paper 598, 1-63.

Dunes and dust

- Hesse, P. P. (1994). "The record of continental dust from Australia in Tasman Sea Sediments." Quaternary Science Reviews**13**(3): 257-272.
- Hesse, P.P., 2010. The Australian desert dunefields: formation and evolution in an old, flat, dry continent. In: P. Bishop and B. Pillans (Editors), Australian Landscapes. Special Publication, 346. Geological Society, London, London, pp. 141-163.
- Hesse, P. P. and G. H. McTainsh (1999). "Last Glacial Maximum to Early Holocene wind strength in the mid-latitudes of the Southern Hemisphere from aeolian dust in the Tasman Sea." Quaternary Research**52**: 343-349.
- Hesse, P. P. and R. L. Simpson (2006). "Variable vegetation cover and episodic sand movement on longitudinal desert sand dunes." Geomorphology**81**: 276-291.
- Marx, S.K., Kamber, B., McGowan, H.A.,Denholm, J., 2011. Holocene dust deposition rates in Australia's Murray-Darling Basin record the interplay between aridity and the position of the mid-latitude westerlies. Quaternary Science Reviews 2011, 3290-3305.

General

- Fujioka, T., Chappell, J., Honda, M., Yatsevich, I., Fifield, K., Fabel, D., 2005. Global cooling initiated stony deserts in central Australia 2-4 Ma, dated by cosmogenic ^{21}Ne-^{10}Be. Geology 33, 993-996.
- Fitzsimmons, K.E., Rhodes, E.J., Magee, J.W., Barrows, T.T., 2007, The timing of linear dune activity in the Strzelecki and Tirari Deserts, Australia . Quaternary Science Reviews 26, 2598-2616
- Turney, C.S.M., et al., 2006. Integration of ice-core, marine and terrestrial records for the Australian last glacial maximum and termination: A contribution from the OZ INTIMATE group, Journal of Quaternary Science 21, 751-761
- Nanson, G.C., Price, D.M., Jones, B.G., Maroulis, J.C., Coleman, M., Bowman, H., Cohen, T.J., Larsen, J.R. 2008. Alluvial evidence for major climate and flow regime changes during the middle and late Quaternary in eastern central Australia. Geomorphology 101, 109-129.
- Page, K., Nanson, G., Price, D. 1996. Chronology of Murrumbidgee river palaeochannels on the Riverine Plain, southeastern Australia. Journal of Quaternary Science 11,

311-326 .

- Page, K.J., Nanson, G.C., Price, D.M. 1991. Thermoluminescence chronology of late Quaternary deposition on the Riverine Plain of south-eastern Australia. Australian Geographer 22, 14-23
- Nanson, G.C., Price, D.M., Short, S.A. 1992. Wetting and drying of Australia over the past 300 ka Geology 20, 791-794
- Kershaw, A.P., Nanson, G.C. 1993. The last full glacial cycle in the Australian region. Global and Planetary Change 7, 1-9.
- Barrows, T.T., Juggins, S., De Deckker, P., Calvo, E., Pelejero, C. 2007. Long-term sea surface temperature and climate change in the Australian-New Zealand region Paleoceanography 22 (2), art. no. PA2215
- Barrows, T.T., Stone, J.O., Fifield, L.K., Cresswell, R.G. 2002. The timing of the last glacial maximum in Australia. Quaternary Science Reviews 21, 159-173
- Shulmeister, J., Goodwin, I., Renwick, J., Harle, K., Armand, L., McGlone, M.S., Cook, E., Curran, M. 2004. The Southern Hemisphere westerlies in the Australasian sector over the last glacial cycle: A synthesis. Quaternary International 118-119, 23-53.
- Hesse, P.P., McTainsh, G.H. 2003. Australian dust deposits: Modern processes and the Quaternary record Quaternary Science Reviews 22, 2007-2035.

Week 7: Environmental change influencing human dispersal: Africa to Australia/ Palaeoenvironments and palaeoclimates

Essential texts:

Anderson et al., 2007 – Ch 8

Elias, 2007 Humans in the Quaternary

Williams et al., Ch 11

Dennell, 2004 (see below)

Dennell and Petraglia 2012

deMenocal, 2011 (see below)

- deMenocal, P., 2011. Climate and human evolution. Science 331, 540-542.
- Bowler, J.M., Johnson, H., Olley, J.M., Prescott, J.R., Roberts, R.G., Shawcross, W., Spooner, N.A., 2003. New ages for human occupation and climatic change at Lake Mungo, Australia. Nature 421, 837-840.
- Storm, P., 2001. The evolution of humans in Australasia from an environmental

perspective. Palaeogeography, Palaeoclimatology, Palaeoecology 171, 363-383.

- Bettis, I., E. A., Zaim, Y., Larick, R.R., Ciochon, R.L., Suminto, Rizal, Y., Reagan, M.K., Heizler, M., 2004. Landscape development preceding *Homo erectus* immigration into Central Java, Indonesia: the Sangiran Formation lower lahar. Palaeogeography, Palaeoclimatology, Palaeoecology 206, 115-131.
- Dennell RW. 2004. Hominid dispersals and Asian biogeography during the Lower and Middle Pleistocene, c. 2.0-0.5 Mya. Asian Perspectives 43, 205–226.
- Dennell, R., Petraglia, M.D., 2012. The dispersal of Homo sapiens across southern Asia: how early, how often, how complex? Quaternary Science Reviews 47, 15-22.
- Turney, CSM, Scourse, J Rodbell D, Caseldine C, 2007. Quaternary climatic, environmental and archaeological change in Australasia. Journal of Quaternary Science 22, 421–422.

- Anderson B , Mackintosh A Geology 2006;34:121-124
- Dosseto, A., Hesse, P.P., Maher, K., Fryirs, K.,Turner, S.P., 2010. Climatic and vegetation control on sediment dynamics during the last glacial cycle. Geology 38, 395-398.
- Hesse, P.P., Magee, J.W.,van der Kaars, S., 2004. Late Quaternary climates of the Australian arid zone: A review. Quaternary International 118-119, 87-102.
- Page, K., Nanson, G.,Price, D., 1996. Chronology of Murrumbidgee River palaeochannels on the Riverine Plain, southeastern Australia. Journal of Quaternary Science 11(4), 311-326.
- Schumm, S.A., 1968. River adjustment to altered hydrologic regimen - Murrumbidgee River and palaeochannels, Australia. Geological Society Professional Paper 598, 1-63

- Barrows et al 2007. Science.
- Bond et al. 1999, in Mechanisms of Global Climate Change at Millennial Time Scales. AGU
- Broecker W. S., *GSA Today* 9(1):1-7 (January 1999)
- Denton G. H. et al., Science 328, 1652-1656 (2010)
- EPICA community members, 2006, Nature 444
- Hays J. D., Imbrie John and Shackleton N. J., Variations in the Earth's Orbit: Pacemaker of the Ice Ages. Science 10 December 1976: 1121-1132.
- Lambeck, K.,Chappell, J., 2001. Sea level change through the last glacial cycle. Science 292, 679-686.
- Martinson, D.G., Pisias, N.G., Hays, J.D., Imbrie, J., Moore, T.C.,Shackleton, N.J., 1987. Age dating and the orbital theory of the ice ages: Development of a high resolution 0 to

300 000 year chronostratigraphy. Quaternary Research 27, 1-29.

- Roche et al., 2004 Nature
- Wang Y. J., Cheng H., Edwards R. L., An Z. S., Wu J. Y., Shen C.-C., and Dorale J. A. A High-Resolution Absolute-Dated Late Pleistocene Monsoon Record from Hulu Cave, China. Science 14 December 2001: 2345-2348. [DOI:10.1126/science.1064618]Wilson et al. 2000 Ice sheet collapse

Week 8: Rivers and Lakes/ particle size analysis

Essential texts:

Lowe, JJ Walker MJC – Ch2

Williams et al., 1998 – Ch 3, 4, 5, 6, 12

- Bagnold, R.A.,Barndorff-Nielsen, O., 1980. The pattern of natural size distributions. Sedimentology 27, 199-207.
- Fieller, N.R.J., Gilbertson, D.D.,Olbricht, W., 1984. A new method for environmental analysis of particle size distribution data from shoreline sediments. Nature 311, 648-651.
- Folk, R.L., 1974. Petrology of Sedimentary Rocks. Hemphill, Austin, 182 pp.
- Yonge, D.,Hesse, P.P., 2009. Geomorphic environments, drainage breakdown and channel and floodplain evolution on the Lower Macquarie River, central-western New South Wales. Australian Journal of Earth Sciences 56, S35-S53.
- Cohen, T.J., Jansen, J.D., Gliganic, L.A., Larsen, J.R., Nanson, G.C., May, J.H., Jones, B.G., Price, D.M., 2015. Hydrological transformation coincided with megafaunal extinction in central Australia. Geology doi: 10.1130/G36346.1.
- Harrison, S.P., 1993. Late Quaternary lake-level changes and climates of Australia. Quaternary Science Reviews 12, 211-231.
- Selby M., 1993. Hillslope materials & processes. Oxford University Press. p150

Week 9: Dunes and dust/ Weathering

Essential texts:

Williams et al., 1998 – Ch 9, 13

Lowe, JJ Walker MJC – Ch3

- Bostock, H.C., Opdyke, B.N., Gagan, M.K., Kiss, A.E.,Fifield, L.K., 2006. Glacial/ interglacial changes in the East Australian current. Climate Dynamics 26, 645-659.
- Brookfield, M., 1970. Dune trends and wind regime in Central Australia. Zeitschrift fur Geomorphologie, Suppl.Bd 10, 121-135.
- Fitzsimmons, K.E., Rhodes, E.J., Magee, J.W.,Barrows, T.T., 2007. The timing of linear

dune activity in the Strzelecki and Tirari Deserts, Australia. Quaternary Science Reviews 26, 2598-2616.

- Hesse, P.P., 1994. The record of continental dust from Australia in Tasman Sea Sediments. Quaternary Science Reviews 13(3), 257-272.
- Hesse, P.P., 2010. The Australian desert dunefields: formation and evolution in an old, flat, dry continent. In: P. Bishop and B. Pillans (Editors), Australian Landscapes. Special Publication, 346. Geological Society, London, London, pp. 141-163.
- Hesse, P.P., 2011. Sticky dunes in a wet desert: formation, stabilisation and modification of the Australian desert dunefields. Geomorphology 134, 309-325.
- Hesse, P.P.,McTainsh, G.H., 1999. Last Glacial Maximum to Early Holocene wind strength in the mid-latitudes of the Southern Hemisphere from aeolian dust in the Tasman Sea. Quaternary Research 52, 343-349.
- Hesse, P.P.,Simpson, R.L., 2006. Variable vegetation cover and episodic sand movement on longitudinal desert sand dunes. Geomorphology 81, 276-291.
- Hesse, P.P., Humphreys, G.S., Smith, B.L., Campbell, J.,Peterson, E.K., 2003. Age of loess deposits in the Central Highlands of New South Wales. Australian Journal of Soil Research 41, 1115-1131.
- IPCC AR4, 2007
- Kalma, J.D., Speight, J.G.,Wasson, R.J., 1988. Potential wind erosion in Australia: A continental perspective. Journal of Climatology 8, 411-428.
- Mahowald, N., Kohfeld, K.E., Hansson, M., Balkanski, Y., Harrison, S.P., Prentice, I.C., Schulz, M.,Rodhe, H., 1999. Dust sources and deposition during the last glacial maximum and current climate: A comparison of model results with paleodata from ice cores and marine sediments. Journal of Geophysical Research 104(D13), 15,895-15,916.
- Maher, B.A., Prospero, J.M., Mackie, D., Gaiero, D., Hesse, P.P.,Balkanski, Y., 2010. Global connections between aeolian dust, climate and ocean biogeochemistry at the present day and at the last glacial maximum. Earth-Science Reviews 99, 61-97.
- Markgraf, V., Dodson, J.R., Kershaw, A.P., McGlone, M.S.,Nicholls, N., 1992. Evolution of late Pleistocene and Holocene climates in the circum-South Pacific land areas. Climate Dynamics 6, 193-211.
- Masson, Delmonte et al 2005 Science 309
- Nanson, G.C., Chen, X.Y.,Price, D.M., 1995. Aeolian and fluvial evidence of changing climate and wind patterns during the past 100 ka in the western Simpson Desert, Australia. Palaeogeography, Palaeoclimatology, Palaeoecology 113, 87-102.

- Seidel et al 2008 Nature Geoscience
- Shao et al. 2011, Aeolian Research v2
- Sprigg, R.C., 1982. Alternating wind cycles of the Quaternary era and their influences on aeolian sedimentation in and around the dune deserts of south-eastern Australia. In: R.J. Wasson (Editor), Quaternary Dust Mantles of China, New Zealand and Australia. A.N.U., Canberra, pp. 211-240.
- Wasson, R.J.,Hyde, R., 1983. Factors determining desert dune type. Nature 304, 337-339.
- Williams et al. 2006 J Quat. Sci.
- Doner H. & Lynn W., 1989. In 'Minerals in Soil Environments', 2nd edition (J. Dixon and S. Weed, eds) Soil Sci. Soc. Am., Wisconsin, p 300
- Froelich, P.N., Klinkhammer, G.P., Bender, M.L., Luedtke, N.A., Heath, G.R., Cullen, D., Dauphin, P., Hammond, D., Hartman, B.,Maynard, V., 1979. Early oxidation of organic matter in pelagic sediments of the eastern equatorial Atlantic: suboxic diagenesis. Geochimica et Cosmochimica Acta 43, 1075-1090.
- Gile et al., 1966. Soil Science 101: 347-360
- Hesse, P.P., 1994. Evidence for bacterial palaeoecological origin of mineral magnetic cycles in oxic and sub-oxic Tasman Sea sediments. Marine Geology 117, 1-17.
- Hingston, F.J.,Gailitis, V., 1976. The geographic variation of salt precipitated over Western Australia. Australian Journal of Soil Research 14, 319-335.
- Milnes, A.R.,Hutton, J.T., 1983. Calcretes in Australia, Soils: an Australian viewpoint. CSIRO/Academic Press, Melbourne, pp. 119-162.
- Phillips, S.E.,Milnes, A.R., 1988. The Pleistocene terrestrial carbonate mantle on the southeastern margin of the St Vincent Basin, South Australia. Australian Journal of Earth Sciences 35, 463-481.
- Quade, J., Chivas, A.R.,McCulloch, M.T., 1995. Strontium and carbon isotope tracers and the origins of soil carbonates in South Australia and Victoria. Palaeogeography, Palaeoclimatology, Palaeoecology 113, 103-117.
- Veproskas M et al. 1994. In A Ringrose-Voase & G Humphreys (eds) Soil Micromorphology: Studies in Management & Genesis. Elsevier, Amsterdam. p117-131

Week 10: Biological indicators of environmental change/ecosystems

Essential texts:

Lowe, JJ Walker MJC – Ch4

Williams et al., 1998 – Ch 7, 10

- Barrows, T.T.,Juggins, S., 2005. Sea-surface temperatures around the Australian margin and Indian Ocean during the Last Glacial Maximum. Quaternary Science Reviews 24, 1017-1047.
- Bradley, 1985 Quaternary Palaeoclimatology
- Cerling, T.E., Ehleringer, J.R.,Harris, J.M., 1998. Carbon dioxide starvation, the development of C4 ecosystems, and mammalian evolution. Philosophical Transactions of the Royal Society of London, Series B 353, 159-171.
- Cook et al., 2000. Climate Dynamics 16
- Cupper, M.L., 2005. Last glacial to Holocene evolution of semi-arid rangelands in southeastern Australia. The Holocene 15, 541-553.
- Dietrich and Perron, 2006. Nature 439: 411
- Dodson, J.R.,Wright, R.V.S., 1989. Humid to arid to subhumid vegetation shift on Pilliga Sandstone, Ulungra Springs, New South Wales. Quaternary Research 32, 182-192.
- Kershaw, A. P., McKenzie, G. M., Porch, N., Roberts, R. G., Brown, J., Heijnis, H., Orr, M. L., Jacobsen, G. and Newall, P. R. 2007. A high-resolution record of vegetation and climate through the last glacial cycle from Caledonia Fen, southeastern highlands of Australia. *J. Quaternary Sci*., **Vol. 22** pp. 481–500. ISSN 0267-8179.
- Kershaw, A.P., 1986. Climatic change and Aboriginal burning in north-east Australia during the last two glacial/interglacial cycles. Nature 322, 47-49.
- Kershaw & Nix 1987 CLIMANZ 3, CSIRO
- Hope, G., 1987. Climatic implications of timberline changes in Australasia from 30 000 yr bp to present. In: T.H. Donnelly and R.J. Wasson (Editors), CLIMANZ 3. CSIRO, Division of Water Resources, Melbourne, pp. 91-99.
- Hope 1976, Journal of Ecology 64
- McGlone, M.S., Turney, C.S.M., Wilmshurst, J.M., Renwick, J., Pahnke, K., 2010. Divergent trends in land and ocean temperature in the Southern Ocean over the past 18,000 years. Nature Geosci 3(9), 622-626.
- Miller, G.H., Magee, J.W.,Jull, A.J.T., 1997. Low-latitude glacial cooling in the Southern Hemisphere from amino-acid racemization in emu eggshells. Nature 385, 241-244.
- Miller, G.H., Fogel, M.L., Magee, J.W., Gagan, M.K., Clarke, S.J.,Johnson, B.J., 2005. Ecosystem collapse in Pleistocene Australia and a human role in megafaunal extinction. Science 309, 287-290.
- Turney C S et al. Geology 2003;31:223-226

Week 11: Fire/desertification

Essential texts:

Williams et al., 1998 – Ch 9, 13

TBA

Week 12: Anthropocene/global climate system

Essential texts:

TBA

Unit Schedule

Week	Date	Lecture Title	Practical Class	Essential reading
1 **KW**	27/2	1 **- Introduction** to global environmental change, course overview and expectations 2 –- **Proxies** for global environmental change (prep for assessment 1)	23/2 No prac class this week	Lowe, JJ Walker MJC – Ch1, 3 (p85-86, 127-135, 148-158), 6 Williams et al., 1998 – Ch 1,2,5 -3, 7 Anderson et al., 2007 – Ch 1, 9 - Ch 2 Noller et al., 2000 p1-10 p 427 Lowe et al., 2007
2 **KW**	6/3	3 - **Sources of evidence and methods** - sedimentology and stratigraphy: field trip preparation 4 - Reconstructing the 'Ice age'	2/3 Correlating between proxies for global environmental change (**Assessment 1**). E5A 240.	Lowe, JJ Walker MJC – Ch2-6 (skim) Burbank and Anderson, 2001 Williams et al. – Ch 4 Lowe and Walker – Ch 7
3 **KW**	13/3	5 - Luminescence as a tool for reconstructing environmental change 6 – Numbers everywhere: dating the Australian landscape	9/3 FIELD DAY: Deep Creek Delta, Narrabeen Lagoon	Roy et al., 1980 Flack and Erskine, 1996 Lowe and Walker – Ch 5 Anderson et al., 2007 – Ch 2 Noller et al., 2000 p157-176 Turney et al., 2001

4 **KW**	20/3	7 - Pre-European human-landscape interactions in Australia 8 Caves – natural sediment and fossil traps	16/3 Analysis of sediment cores from Narrabeen Lagoon. E5A 240.	Roberts et al., 2001 Roberts and Brook, 2010 Field et al., 2008 Wroe and Field, 2006
5 **KW** **PH**	27/3	9 - Rapid environmental change: case study Flores, Indonesia 10 - Introduction to the field area	23/3 Luminescence dating and archaeology. E5A 240.	Westaway, et al 2010. Summerfield 1991 Ch 1 Barrows et al., 2001, 2002 Hesse et al., 2004
6 **KW** **PH**	3/4	NO LECTURE – PUBLIC HOLIDAY	30/3 Preparation for field trip. E5A 240.	
MID SEMESTER BREAK (2 weeks) MAJOR FIELD TRIP 7-12th APRIL - Kosciuszko and Narrandera				
7 **PH**	24/4	11 – The influence of environmental change on human dispersal - Part 1: from Africa to Asia - Part 2: from Asia to Australia 12 – Palaeoenvironments and Palaeoclimates: reading past landscapes and climates from proxy records	20/4 Post fieldtrip debrief – field report discussion; initial sample preparation	Anderson et al., 2007 – Ch 8 Elias, 2007 Humans in the Quaternary Williams et al., Ch 11 Dennell, 2004, Petraglia and Dennell, 2012 **deMenocal, 2011**
8 **PH**	1/5	13 – Rivers and lakes: palaeohydrology 14 – Particle Size analysis and interpretation in environmental reconstruction	27/4 Laboratory project I – Field report due (**Assessment 2**)	Lowe, JJ Walker MJC – Ch2 Williams et al., 1998 – Ch 3, 4, 5, 6, 12
9 **PH**	8/5	15 – Dunes and dust: records from the deserts 16 – Weathering in surface materials: past climate or modern overprint?	4/5 Lab Project II. E5A 240.	Lowe, JJ Walker MJC – Ch3

10 **PH**	15/5	17- Biological indicators of past climates: palaeoecology 18 – How did Australian ecosystems respond to climate change?	11/5 Lab Project III. E5A 240.	Lowe, JJ Walker MJC – Ch4 Williams et al., 1998 – Ch 7, 10
11 **PH**	22/5	19 – Fire in the Australian landscape: people v climate 20- Past and future desertification: natural and anthropogenic	18/5 Lab Project IV E5A 240	Williams et al., 1998 – Ch 9, 13
12 **PH**	29/5	21- The anthropocene and the Australian environment 22- The global climate system and the Australian environment	25/5 No prac – informal presentation preparation	
13 **KW**	5/6	23 – Unit summary: The missing pieces of the past – what do we still need to understand and how do past changes inform future management? 24 – Exam preparation	1/6 ENVE 340 conference – presentation of lab data. E5A 240. (**Assessment 3**)	

Learning and Teaching Activities

Lectures

Two one hour lectures are held on most Fridays from 11-1 pm.

Practicals

Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.

Fieldwork

Two compulsory fieldtrips for all students: 9th March and 7-12th April.

Problem-solving quest

A private or team quest to practice problem solving skills and become environmental detectives.

Lightening presentations

1 minute presentation to peers on a topic in Quaternary Science.

Peer Review and Assessment

Students will mark fellow student assignments to develop an greater understanding

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

PENALTY FOR LATE ASSIGNMENTS & PLAGIARISM

Overdue assignments attract a penalty of 10 % per day i.e. the mark out of which they are assessed will be reduced by 10% for every day that they are late! ALL assignments must be submitted, however late, otherwise you will be excluded from the unit. **Late assignments must be submitted online via the Grademark system.**

If you wish to seek an **extension** on the grounds of illness or misadventure, you MUST submit a copy of the UNIVERSITY'S form as well as a medical certificate or other appropriate proof which shows you were incapacitated. **These must be submitted through the Student Office, not directly to unit staff**, however you should advise us of your situation as early as possible. Regular work commitments are not a reasonable excuse for lateness; plan your time. However, having said that, please DO NOT hesitate to discuss with the unit staff any circumstances which may be preventing you from completing assignments on time or hindering your study in any other way. From experience, we know that early action is best!

Plagarism will not be tolerated and will be checked via the Turnitin software. Quotations should be avoided and only really used if the point being made is vital to your argument and if you could not express it better yourself. If you paraphrase, you must acknowledge your authority as you

would when quoting directly - after the paraphrased section or quotation, i.e., (Merali and Skinner, 2009, p. 293). Make sure you document this reference in your list of References. Remember, if you copy any sections of text word-for-word without denoting a quote this is plagiarism – even if you include a reference - **PLAGIARISM IS CHEATING! Therefore you either directly quote or paraphrase both with references.**

An example of a direct quote: **Brown *et al*. (1990 p. 12) conclude that 'the depth to the Moho under the oceans is less than under the continents'.** Note that for a direct quote the page must be cited.

An example of a general acknowledgement of the source of information: **As explained by Laing (1991) the mid ocean ridges are etc.**

An example of a more specific reference but not a direct quote: **The distribution of Tertiary volcanism in eastern Australia (Johnson 1990) can be used to infer etc.** From this the reader would conclude that Johnson (1990) provided information on the distribution of...

An example of a more general reference to sources: **Most older textbooks in geology (e.g. Rastal 1941; Stamp 1938) either ignored the deep ocean basin deposition or etc.**

Only those sources referred to in the text of the essay should be listed in the reference list at the end of the essay.

This is always a difficult topic when conducting group assignments, and data sharing is required. Unless otherwise stated, the ***results of group work are group contributions*** and can be disseminated amongst the group members. ***However, each student is required to produce their own interpretations of this data***. Drawing up your own diagrams is an important skill, so we require that each group member present their **own** diagrams, graphs etc. The only exception to this is data that is collected as part of a group effort – e.g. an airphoto interpretation that is collectively drawn. In this case ensure that when you present this piece of work that each author is acknowledged, and if possible define who completed which part of the output. ***If uncertain, ask before submission!***

APPEALS

Students have the right to appeal their final grade in this unit. Prior to initiating a formal appeal the student is required by the Division of Environmental and Life Science to have preliminary discussions with the staff member responsible for the unit. This discussion is to be undertaken in the context of unit requirements as set out in the unit outline. A full statement on appeals procedure is available in the Division Office or in the student centre.

FEEDBACK

At all stages in this unit we will try to give you critical feedback on your understanding and performance. The unit has been structured so that assessable practicals and field reports allow us to monitor your progress and understanding throughout the unit. This includes both conceptual and practical (such as field skills) components.

We will do our best to return assessment items to you within 2 weeks of submission (sometimes faster). Feedback will be given you as individual comments on each piece of work and also some comments delivered to the group in class. The assessed practicals concentrate on

specific practical skills where feedback is detailed but usually short. The field reports will normally carry longer comments addressing both specific skills and generic skills.

If at any stage you wish to receive guidance on the content of the unit or your performance then we encourage you to approach one of the staff and arrange a meeting. Likewise, if you would like more detailed feedback or explanation of the feedback you have received then please approach the staff member who gave this feedback to arrange a meeting.

Finally, we appreciate your (constructive) feedback too. This is especially the case given that this is only the fourth time we are running this unit. Our goal is to improve our teaching (and your learning) continuously. We ask for your feedback at the end of semester and value your specific comments via the **TEDS** survey (please attend the final lecture so that you can contribute). We are also happy to receive your comments throughout the semester.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be

imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Design a field research project including data gathering and interpret your own data
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment tasks

- Assessment 2
- Assessment 3

Learning and teaching activities

- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil

and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Communicate scientific information and concepts through oral, visual and written formats

Assessment tasks

- Assessment 2
- Assessment 3

Learning and teaching activities

- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- Students will mark fellow student assignments to develop an greater understanding

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of

geomorphic events

- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment tasks

- Assessment 1
- Assessment 2
- Assessment 3
- Assessment 4

Learning and teaching activities

- Two one hour lectures are held on most Fridays from 11-1 pm.
- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.
- 1 minute presentation to peers on a topic in Quaternary Science.
- Students will mark fellow student assignments to develop an greater understanding

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description

and analyses
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events

Assessment tasks

- Assessment 1
- Assessment 2
- Assessment 4

Learning and teaching activities

- Two one hour lectures are held on most Fridays from 11-1 pm.
- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.
- 1 minute presentation to peers on a topic in Quaternary Science.

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Demonstrate critical thinking in your reading of the literature and interpretation of your own data
- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable.

Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.

- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment tasks

- Assessment 1
- Assessment 2
- Assessment 3

Learning and teaching activities

- Two one hour lectures are held on most Fridays from 11-1 pm.
- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.
- 1 minute presentation to peers on a topic in Quaternary Science.
- Students will mark fellow student assignments to develop an greater understanding

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Demonstrate critical thinking in your reading of the literature and interpretation of your own data

- Design a field research project including data gathering and interpret your own data
- Demonstrate your ability to 'Read the landscape' through morphodynamic description and analyses
- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Demonstrate your ability to apply your knowledge and understanding to problems in Quaternary Science

Assessment tasks

- Assessment 2
- Assessment 3

Learning and teaching activities

- Two one hour lectures are held on most Fridays from 11-1 pm.
- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Communicate scientific information and concepts through oral, visual and written formats

Assessment tasks

- Assessment 1
- Assessment 2

- Assessment 3
- Assessment 4

Learning and teaching activities

- Practicals are held most weeks on Mondays from 1 pm for 3-4 hours.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.
- A private or team quest to practice problem solving skills and become environmental detectives.
- 1 minute presentation to peers on a topic in Quaternary Science.
- Students will mark fellow student assignments to develop an greater understanding

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Data collection is to be undertaken in a manner that is rigorous, reliable and replicable. Data collection should be structured in a manner to address a clearly-specified question. The data themselves should be irrefutable, whereas our interpretations are not.
- Understand how to apply a range of dating techniques to constrain the timing of geomorphic events
- Communicate scientific information and concepts through oral, visual and written formats

Assessment tasks

- Assessment 1
- Assessment 2
- Assessment 3

Learning and teaching activities

- Two one hour lectures are held on most Fridays from 11-1 pm.

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active

participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Demonstrate field skills including: a) make clear, accurate field descriptions of geomorphology, soil profiles, sediment sections b) interpret landforms and make a geomorphic map from your interpretation of air photographs, maps or other sources c) survey topography (tape and clino), compute and plot data d) describe and sketch soil and sediment sections in the field using standard methods e) draw and interpret stratigraphic sections, correlate profiles and interpret temporal and process relationships
- Design a field research project including data gathering and interpret your own data

Assessment task

- Assessment 2

Learning and teaching activity

- Two one hour lectures are held on most Fridays from 11-1 pm.
- Two compulsory fieldtrips for all students: 9th March and 7-12th April.

Background to the unit

ENVE340 AND THE EARTH SURFACE SCIENCE PROGRAM AT MACQUARIE

ENVE 340 is one of the core 300-level unit in Earth Surface Science (formerly Geoecology), and alongside ENVE 334 (Fluvial Geomorphology and River Management), ENVE 336 (Environmental Quality, capstone), ENVE 335 (Advanced Environmental Earth Science) make up the requirements for a major in Environmental Earth Science. Other units that are suggested as part of an Environmental Earth Science program include ENVE 361 (Environmental Management) and ENVE 382 (Environmental Analysis Using GIS), ENVE 382 (Coastal and Marine Biophysical Modelling) and ENVE 389 (Special interest seminar).

Earth Surface Science aims to describe the diverse physical processes found at the earth's surface and the connections between them. This area lies at the nexus between earth systems and biological systems – it is often concerned with landscapes and the landforms, sediments and soils within them but also, and crucially, the interaction of plants and animals in directing processes and shaping habitat. Earth Surface Science combines aspects of Geomorphology, Soil Science, Natural Hazards, Environmental Management and Ecology. As a consequence, graduates gain skills essential for management of natural resources, including rural rivers and lands, and highly altered landscapes, including urban environments and mining areas.

Graduates of the Earth Surface Science major are in a wide range of workplaces including: environmental and geotechnical consultancies, local government (environmental officers), state government departments (Infrastructure, Planning and Natural Resources; Environment and Conservation), National Parks and Wildlife Service, Sydney Water, mining companies

(environmental officers), teaching (primary and secondary) and research.

This major is offered within the Bachelor programs of Science and Environment. It is highly compatible with a double major in Environmental Management, SIS, Climate Science, Ecology, Environmental Geology, Marine Science and Museum Studies. Depending on your own goals you may decide to combine EES units with other fields e.g. geology, atmospheric science, biology, Geographic Information Science (GIS).

CHANGES TO THIS UNIT IN 2015

In 2010 this unit changed from a 4cp to a 3cp, as well as changing code from GEOS337 to ENVE377 and in 2011 changed to ENVE340 due to curriculum changes. In order to meet the workload requirements of the reduced credit point load, we have changed the unit by reducing the number of lectures, the number of practical classes and the time demands of the field trip assignment. However we feel that we are still trying to get the balance right – and that is partly because we need to get more information on how long each of the assessment tasks takes to complete. We will seek your feedback to try and make sure this is manageable. In response to feedback last year the first assignment has reduced percentages for peer review assessment. In addition the practicals are now completed in class rather than requiring extra work at home, but the hand-in sheet allows you to still be assessed for this work.

Fieldwork

FIELDWORK

Weather: We **never** cancel fieldtrips for bad weather! You must be prepared to work in the rain with the appropriate clothing and waterproof notebooks. Likewise you should always protect yourself from the sun and dehydration.

Transport: You will need to arrange your own transport for the Narrabeen field day in Week 3. Ideally you should arrange to drive to each site with several other students from your practical class. We will provide a bus for the mid-semester field trip.

Arrival: Narrabeen day trip: We will meet at the parking area at a time to be announced on the northern side of the Wakehurst Parkway, to the east of the bridge across Deep Creek.

Kosciuszko and Nerrandera: We will meet in the compound behind E5A, at 7 am on the 7th of April. We will arrange accommodation bookings.

Cost: You must cover your own food and accommodation, the University will cover the transport costs. We have booked accommodation on behalf of the group, and you will need to use the payment slips at the rear of the book **before the trip** – amount is to be advised.

Accommodation: Field accommodation is in a backpackers in Snowy Mountains and a caravan Park in Nerrandera. There will be communal kitchens, dining, bathroom/toilet and work areas with limited power. You should bring (apart from the gear listed below) a sleeping bag, pillow and towel. The cost is the same no matter what accommodation option you choose (amount to be advised).

Departure: Narrabeen day trip: we aim to depart Narrabeen lakes no later than 4pm.

Mid semester field trip: we will aim to depart in time to return to the University by 6 pm on Sunday night. However, given the distance involved this time should be considered an aim rather than an absolute.

PERSONAL FIELD EQUIPMENT

We will be working in a remote environment – both remote from help and in a regional part of Australia, so you will not be able to buy any equipment after departing Sydney.

What we will provide:

- tape measures, augers, spades, soil kits, GPS, geological hammer, grain size card, safety equipment.

Personal field equipment required (i.e. you will need to buy and bring it)

- sturdy shoes ('no visible skin below the ankles')- sandals, thongs, or high heels are for après-field activities
- water bottle (full, of course!)
- wet weather gear - we go whatever the weather! If it rains at Kosi it will get very, very muddy, so at least two sets of old clothes are recommended.
- hat (with a wide brim, front and back) and sunscreen
- field note book and pencils (see note below)
- calculator, hand lens
- camera
- your lunch, drinks & snacks for the day - we do not stop at shops!!!
- a back pack to store it all in

If you have a laptop computer you may find it useful for compiling data while in the field. It is not essential that everyone bring a laptop, but at least one per group is suggested. At least two will be available for loan from Environmental Science (but competition for them might be high).

Other personal items for the mid-semester field trip

sleeping bag and sheet – may be necessary for the shearers quarters – we will inform you closer to the departure date.

cooking/eating – no utensils necessary; but we will cook in the cabins.

towel/toiletries – bring these

food – there will be limited opportunities to purchase food, but the accommodation should have fridges. Expect to stock up on the drive to Wirroona. However, it is feasible that the local

supermarket at Dubbo might not have the exact brand of exotic spice/unusual vegetable/vegan expresso chocolate that you covet, so if you can't go without for the week bring it along with you. Be a bit sensible here though as it's a long drive in a small minibus…

FIELD NOTE BOOK: Each student MUST purchase a small hardcover notebook for use in the field. It should be bound down the spine on the left side, or across the top (but NOT spiral bound). Use only ball-point pen, felt tip pen will run in wet weather and pencil will smudge or rip wet paper. The best, and most expensive, option is a waterproof 'rite-in-the-rain' notebook. Write your personal details on the first page, and a table of contents inside the front cover. On each field day, write the date and project title, the site details, and all observations and measurements, including details of methodology.

It is important that you get into the habit of writing thorough, accurate and legible notes at the outset - after all, if you are an expert witness for some environmental issue, your notebook can be tendered as evidence in legal proceedings, either in the Land and Environment court or at a Commission of Inquiry. Get into the practice of structuring your notebook at the start of each exercise and continually taking notes. Do not depend on others, unless prescribed roles are allocated and this is one of the designated tasks.

SAFETY IN THE FIELD AND LABORATORY

Any student who has a disability that may limit their participation in field work or that could result in a medical emergency in the field should notify the unit convenor immediately. As a general guide to the level of physical fitness required, you should be able to walk 10 km over open undulating terrain in 3 hours.

Each student must ensure his/her own safety at all times during field excursions.

•Do not undertake fieldwork alone. You must work with at least one other person.

•You must be adequately equipped to undertake fieldwork, including wet weather clothing, warm clothing, hat and sun protection, protective footware (closed toe boots or shoes).

•You should bring a first aid kit if you have one (they will be provided to each group).

•Do not undertake any activity you feel to be unsafe. Discuss with the fieldtrip leader any concerns you have about particular tasks.

•Be watchful of the safety of your fellow students, if they become separated from the group or are at some other risk. Tell the fieldtrip leader as soon as you notice a potentially dangerous situation.

Laboratory work in this unit does not involve hazardous chemicals. Nevertheless, in the laboratory you must wear safe (closed) footwear and generally follow safe practice. Where items of equipment are to be used, do not use them until you have received adequate training.

Grading of assessed tasks

All assessment tasks will be assessed according to the following criteria:

- level of accuracy and detail in description.
- use of terminology
- presentation
- use of resources
- use of theoretical concepts to support your evaluation

Other specific criteria are given with each Practical and Assignment description elsewhere in this book.

Each assessment item will be returned to you with a letter grade (HD, D, Cr, P, PC, F) determined by the marker according to the University's guidelines.

Academic Senate has a set of guidelines on the distribution of grades across the range from fail to high distinction. Your final result will include one of these grades plus a standardised numerical grade (SNG). On occasion your raw mark for a unit (i.e. the total of your marks for each assessment item) may not be the same as the SNG which you receive. Under the Senate guidelines, results may be scaled to ensure that there is a degree of comparability across the university, so that units with the same past performances of their students should achieve similar results. It is important that you realise that the policy does not require that a minimum number of students are to be failed in any unit. In fact it does something like the opposite, in requiring examiners to explain their actions if more than 20% of students fail in a unit. The process of scaling does not change the order of marks among students. A student who receives a higher raw mark than another will also receive a higher final scaled mark. For an explanation of the policy see: http://www.mq.edu.au/senate/MQUonly/Issues/Guidelines2003.doc or http://www.mq.edu.au/senate/MQUonly/Issues/detailedguidelines.doc

Grades for each assessment item and for the unit as a whole will be awarded according to the following general criteria:

	Developing	***Functional***	***Proficient***	***Advanced***
General description of the level of attainment	Has not yet reached the desired standard. Limited understanding of required concepts and knowledge. A fail grade (or under some circumstances, a conceded pass) would be given.	Has reached basic academic standards. Work has limited translation of concepts and procedures to new contexts unless aided. A pass grade would be awarded.	Has completely reached the standards expected. Can work independently in new contexts, adapting procedures to meet the context. Demonstrates awareness of own limitations. A credit grade would be awarded.	Has gone beyond the expected standards. Exhibits high levels of independence and can use concepts to generate new ways of completing procedures. Can engage in productive critical reflection. A grade of distinction or high distinction would be awarded.

Penalty for Late Submission. There is no room for lateness! However, if you should hand in some component late you will be penalised 10% each day. Come and see us **before** handing in late to discuss options

Extensions. There is no room for extensions either. However, if something comes up you must discuss an extension with a staff member **before** the deadline.

What is required to complete this unit satisfactorily?

· **Attendance**: make the most of the opportunities available to you: attend lectures and practicals and the two fieldtrips. You may only submit assessment items based on practicals and fieldwork if you attended those sessions.

· Assignments: you must hand in/complete ALL the assessment tasks to complete the unit

· **Attitude**: look, read, ask, discuss, debate, enjoy

· Quality: your assessment items will be graded according to your achievement of the learning outcomes. We are looking for deep understanding as well as competence in particular skills of data collection, analysis, interpretation and presentation.

· Honesty and sharing: you will often work in groups in the field and the laboratory but all the assessment tasks are individual. Group data must be shared freely but presentation, writing up and interpretation are to be the efforts of each individual. Macquarie's procedures relating to **plagiarism** can be found at http://www.student.mq.edu.au/plagiarism/

· Macquarie University has a range of policies that relate to learning and teaching, including

o - assessment

o - unit guide

o - special consideration

o They can be found at Policy Central (http://www.mq.edu.au/policy/).

1. Assessment: 1 (15%)

- During the practical in week 2 you will be provided with three data sets; a terrestrial, an ice record and a marine record.

Further information on this assessment is provided in the practical

Assessment rubric

Developing	***Functional***	***Proficient***	***Advanced***
Results are poorly organised and displayed do not address the main point; are not supported by suitable illustrations/data/ references; rely on a single and/or outdated source.	A clear description and explanation giving the important points with supporting illustrations, data and/or references. Demonstrates research effort by use of suitable, current literature.	A very clear description and explanation giving the critical points with well chosen supporting illustrations, data and references. Demonstrates research effort by use of suitable, current literature.	Insightful description and explanation showing original interpretation of the critical points, including uncertainties and gaps. Well chosen supporting illustrations, data and references. Use of several sources of suitable, current literature.

2. Field Report (25%)

This report is based on the mid-semester fieldtrip, the preparatory practical sessions, post-fieldwork data analysis and your own reading and research on the topic. You will develop your own question that you must address in your report, tailoring the presentation and discussion of your results to answer the question and placing them within a context revealed by your readings. The report should be presented in the format of scientific report, with a high standard of presentation (clarity and accuracy, not necessarily 'pretty'), with diagrams, maps, graphs and tables (as appropriate) and standard scientific citation and referencing. You will be provided with some essential and useful readings for these reports but you should also undertake your own research of the primary scientific literature. This report will be broken up into two parts: group results and individual interpretations. It is expected that you will share results between members of your group (and others where applicable). However, you should produce your own interpretations based on this data. This includes generating your own diagrams, graphs etc. Further details on how to prepare this field report will be provided during the field trip.

Developing	*Functional*	*Proficient*	*Advanced*
Lacks a clear explanation of research question, hypothesis or research strategy. Results may not be presented completely or accurately and may not support interpretations. May lack support from suitable literature.	able to explain the research question clearly; explain the hypothesis and show a clear and suitable research strategy; show appropriate results clearly and with accuracy; draw main conclusions from data and outstanding limitations. Supported by reference to appropriate literature.	as for Functional level but with greater insight into question, results and interpretations. Includes acknowledgement and/or discussion of limitations of data/interpretations.	as for Proficient but with originality in approach and/or interpretation of results.

3. Oral Presentation (20%)

Each group will present oral presentation on their topic that compiles the results and that your group has gathered and the conclusions reached. You are welcome to use a variety of resources (e.g. props such as examples of sediments, powerpoint slides) to present your material. The primary emphasis of the presentations should be the laboratory examinations, but the presentation should refer to field sites and data to provide a context for these results, and to broaden their meaning and interpretation. Each group member is required to present for 5 minutes. The quality of your portion of the presentation – i.e. how well communicated the material delivered to your audience (coherence, audibility, use of resources, ability to answer questions) and your scientific insight into the material presented will form 50% of your grade for this presentation. A further 40% will be allocated for your group as a whole. This will be based on the accuracy and relevance of your group's results and how well the talks from your group are integrated to tell the overall story. 10% will be awarded for the quality of questions you ask of the other groups.

Assessment Rubric (individual)

Developing	*Functional*	*Proficient*	*Advanced*

Jumbled or unclear explanation; may not be audible; resources may be poorly presented or irrelevant to your presentation; may not be well supported by resources. May struggle to answer questions.	A clear, coherent explanation which is audible and supported by your prepared resources. Prepared resources provide support your presentation. Able to answer questions.	A very clear, coherent explanation which is audible and supported by your prepared resources. Prepared resources are accurate, legible and support your presentation. Able to answer questions, including acknowledging limitations of understanding.	Clear explanation, audible and well supported by resources; may show insightful interpretation or originality. Prepared resources are of excellent quality, and enhance the delivery of your presentation. Able to answer questions with additional detail and/or acknowledging limitations of understanding.

Assessment Rubric (group)

Developing	***Functional***	***Proficient***	***Advanced***
Results are poorly collected or irrelevant. Little or no connection and structure between the group presentation	Presentations explain the research question and hypothesis, show appropriate results clearly and with accuracy. Group presentation is structured so audience can follow from question -> data -> conclusions	As for functional level but with greater insight into question, results and interpretations. Includes acknowledgement and/or discussion of limitations of data/interpretations. Group presentation is highly coherent and well structured.	As for proficient but with originality in approach and/or interpretation of results. Group presentation may draw on the strengths of individual members to improve the quality of the overall result.

4. Examination (40%)

The exam will be scheduled in the regular University examination period. The exam is 3 hours in length and will cover all subjects covered in the lectures, practicals and fieldtrips. There is a combination of short answer and longer (short essay) style questions. As this is only the second time this unit has run, only last years exam papers are available but example questions will be discussed during the final lecture.

Developing	***Functional***	***Proficient***	***Advanced***
Unable to explain basic terms and concepts clearly or accurately. Unable to illustrate terms and concepts with specific examples or conceptual diagrams. Unable to extrapolate concepts to new situations.	able to explain terms and concepts clearly and accurately; can illustrate terms and concepts with specific examples and conceptual diagrams. Can apply knowledge to new situations with some competence.	as for Functional level but with greater critical insight. Includes acknowledgement and/or discussion of limitations or drawbacks of own knowledge.	as for Proficient but with originality in approach and/or interpretation.