

Climate Systems Science: CLIM3001

Schedule and timetable: See pages 4-5

School of BEES, Faculty of Science

~~Session 2, 2019~~ Term 2 2020

UOC: 6

Prerequisites: CLIM2001 or PHYS2801 or GEOS2711 or MATH2241

Course Coordinators: Prof Matthew England and A/Prof Lisa Alexander

Climate Change Research Centre

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Course material will be posted in Moodle

<https://moodle.telt.unsw.edu.au/login/index.php>

All classes held online – zoom links appear on page 4 below.

Course summary:

Climate science incorporates aspects of atmospheric science, oceanography, hydrology, biology, chemistry and physics. An understanding of the observations of and interactions between the Earth's carbon cycle, hydrological cycle and key chemical species is key to understanding the mechanisms that underpin climate and in particular climate change. This course will build on students existing understanding of these separate disciplines and present an integrative multi-disciplinary approach to understanding the key drivers of the Earth's climate as well as how these drivers are measured and incorporated into mathematical models of climate. Theoretical understanding gained in lectures will be explored in practical sessions using a range of simplified statistical and climate models that will allow students to appreciate the strengths and weaknesses of the assumptions inherent in each modelling approach. By allowing students to understand the myriad of feedbacks and complex interactions between components of the climate system, this course provides the foundation for interpreting climate model projections and understanding the key sources of uncertainty in climate prediction. These are essential prerequisites for research in this area and invaluable skills for graduates looking to apply their knowledge in the university sector, government or private business.

Course aims:

This course aims to give students an understanding of the key systems that control the Earth's climate, how they interact, as well the uncertainties associated with direct climate observation and future climate modelling. Students will have an appreciation of the range of observational data products that allow us to understand climate processes, including uncertainties associated with sampling and representativeness. Students will also develop an understanding of how climate models are built, executed and evaluated against observations. Through this, students will gain the skills required to critically interpret climate model projections and understand key aspects of the uncertainties associated with those projections.

Student learning outcomes:

Learning outcomes are the skills and capabilities we hope this course will help you to attain i.e. what we have in mind while we're teaching. They include the ability to:

1. Identify the limits of inference for a given observed climate data product e.g. spatial or temporal scales, sampling uncertainty and representativeness, or noise levels.
2. Describe primary pathways of the carbon cycle, including photosynthesis, autotrophic and heterotrophic respiration and ocean solubility, as well as the conditions that enhance or restrict them and climate feedback mechanisms that may affect these.
3. Detail a range of key climate feedback mechanisms, as well as how these are likely to have affected the Earth's palaeoclimate.
4. Identify common representations of atmospheric, oceanic and terrestrial processes within current generation state-of-the-art climate models.
5. Identify aspects of future climate projections that deserve higher or lower confidence and recognise the sources of uncertainty in such projections including downscaling techniques.
6. Perform experiments using simple and complex models of the climate system and present results

Reading material

"Introduction to Climate Dynamics and Climate Modelling". By Goosse H., P.Y. Barriat, W. Lefebvre, M.F. Loutre and V. Zunz. Online textbook available at <http://www.climate.be/textbook>. Further reading material may be prescribed for each week on Moodle, predominantly from online material. Please check Moodle regularly as updates to the reading list may be posted throughout the course.

There is a list of useful general references below.

http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

<http://www.csiro.au/resources/Climate-Change-Book.html>

<http://www.science.org.au/reports/climatechange2010.pdf>

Lecture slides and recordings: We will make lecture slides and recordings available ASAP after each lecture. Lecture slides are not intended as a comprehensive representation of material covered in lectures and therefore are in no way a substitute for lecture attendance and effective note taking. They are made available simply to help structure and supplement students' notes.

Assessment

Assessment grading is as shown in the table below. Full details of assessments, including assessment criteria submission and details of feedback, will be made available on Moodle.

Activity	Contribution
First 7 tutorials	30%
Last 5 tutorials (including presentation)	20%
Final Exam	50%

More information about the assessable tasks above:

- Tutorials will mostly be computer-based but will also include some theoretical problems. It is expected that you will not be able to complete the tutorials tests within class time and will therefore be expected to spend some additional time completing assignments outside of class time. You should hand in your tutorial assignments by the beginning of the following week's tutorial. Assignments will be marked and handed back to you by the Thursday tutorial of the following week.
- The last 4-5 weeks of tutorials involve learning how to run a low resolution fully coupled climate model. Each person will be given a different 'experiment' to run and in the last tutorial you will be expected to give a 10 minute presentation on the results to the rest of the class and the lecturers. You will be marked on your understanding of the problem and how you contextualise your topic and the clarity and delivery of your presentation.
- The final examination will contain short and longer answer questions, to test your ability to synthesise several aspects of the course material.

Academic misconduct will not be tolerated in any form in this course.

Substantiated instances of cheating or plagiarism may result in a failure grade. Please investigate <http://www.lc.unsw.edu.au/plagiarism/> if you are in any way unsure of what constitutes plagiarism.

Help

The learning centre can offer personalised, confidential help with writing and a range of other academic skills. Contact them at <http://www.lc.unsw.edu.au/student.html> or call 9385 2060. UNSW Counselling offers a free and confidential service to students. Find out more at <https://www.counselling.unsw.edu.au/> or call 9385 5418.

Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or <http://www.studentequity.unsw.edu.au/content/default.cfm?ss=0>). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Grievance policy

Should you wish make a complaint regarding this course, the UNSW Grievance Policy can be found at <http://www.gs.unsw.edu.au/policy/documents/studentcomplaintproc.pdf> and the procedure for the resolution of complaints about student experiences at the University can be found at <https://my.unsw.edu.au/student/atoz/Complaints.html>. In all cases you should first try to resolve any issues with the course coordinator (contact details above). If this is unsatisfactory, you should contact the Director of the Climate Change Research Centre (Prof. Katrin Meissner K.Meissner@unsw.edu.au). If this in turn is not satisfactory, you can contact the Associate Dean (Education). The University Counselling Services can also offer advice on any grievances (9385 5418 or counselling@unsw.edu.au).

Climate Systems Science: CLIM3001

CLASSES:

Lectures: Tuesdays 1:00pm – 3:00pm

Lecture / Lab: Thursdays 1:00pm – 3:00pm

Lecture / Lab: Fridays 10:00am – 12 noon

All classes will be online on zoom: connect here: <https://unsw.zoom.us/j/93111392611>

Password = 784597

			Lecture / Tute / Lab Topic
Week 1	Tuesday 2 nd June 1 – 3pm	Matt England	Course introduction & Ocean's Role in Climate
	Thursday 4 th June 1 – 3pm	Lisa Alexander	Point-based measurement systems, scaling issues and statistics of climate
	Friday 5 th June 10am-12	Lisa Alexander	In situ observations and scaling issues (lab)
Week 2	Tuesday 9 th June 1 – 3pm	Laurie Menviel	Palaeoclimate, climate forcings, Milankovitch theory and palaeo proxies
	Thursday 11 th June 1 – 3pm	Laurie Menviel	Palaeoclimate Ice sheets (lab)
	Friday 12 th June 10am-12	Jason Evans	Principles of remote sensing applications
Week 3	Tuesday 16 th June 1 – 3pm	Stefan Contractor	Remote sensing (lab)
	Thursday 18 th June 1 – 3pm	Ryan Holmes	Planetary energy budget; radiation, fluxes
	Friday 19 th June 10am-12	Stefan Contractor	Energy balance modelling (lab)
Week 4	Tuesday 23 rd June 1 – 3pm	Steve Sherwood	Idealised models to study particular phenomena, chaos and initial conditions, ocean applications
	Thursday 25 th June 1 – 3pm	Ryan Holmes	Idealised ENSO modelling (lab)
	Friday 26 th June 10am-12		No class
Week 6	Tuesday 30 th June 1 – 3pm	Nina Ridder	The carbon cycle, ocean chemistry and acidification, feedbacks and tipping points
	Thursday 2 nd July 1 – 3pm	Nina Ridder	Carbon cycle modelling (lab)
	Friday 3 rd July 10am-12	Veronique Lago	Coupled modelling with MK3L – 1. Intro (lab)

Week 5	Mon 6 th July – Fri 10 th July	No classes	Mid-session break
Week 7	Tuesday 14 th July 1 – 3pm	Martin de Kauwe	Terrestrial carbon and water cycles
	Thursday 16 th July 1 – 3pm	Martin de Kauwe	Modelling the photosynthetic response to environmental conditions (lab)
	Friday 17 th July 10am-12	Veronique Lago	Coupled modelling with MK3L – 2. Expts (lab)
Week 8	Tuesday 21 st July 1 – 3pm	Jason Evans	Global Climate Models: History and hierarchies of climate models, atmosphere and land- surface models
	Thursday 23 rd July 1 – 3pm	Matt England	Global Climate Models: Ocean and cryosphere
	Friday 24 th July 10am-12	Veronique Lago	Coupled modelling with MK3L – 3. Expts (lab)
Week 9	Tuesday 28 th July 1 – 3pm	Sarah Perkins- Kirkpatrick	Regional climate modelling, statistical and dynamical downscaling
	Thursday 30 th July 1 – 3pm	Veronique Lago	Coupled modelling MK3L – 4. Synthesis (lab)
	Friday 31 st July 10am-12	No lab	
Week 10	Tuesday 4 th Aug 1 – 3pm	Gab Abramowitz	Model evaluation metrics & uncertainty estimation
	Thursday 6 th Aug 1 – 3pm	Veronique Lago / Matt England	Student presentations (lab) Coupled modelling with MK3L
	Friday 7 th Aug 10am-12	No lab	
Week 11	Tuesday 11 th Aug. 12 - 2pm	No classes	Study leave
Exam period	X – Y Aug TBC Time TBC	Exams	Exams