‘Environmental Change 4’ (**GEOGM1110**) / ‘An introduction to Earth system modelling’ (**GEOGM1404**)

Overview

This Unit provides an introduction to and practical hands-on learning in Earth system modelling. It will provide a chance to explore the dynamics of the Earth’s climate system as well as of global carbon cycling and the biogeochemical impacts of fossil fuel CO_2 emissions. The Unit will foster a critical appreciation of the nature and limitations of climate and Earth system models in trying to understand and predicting global change. But you will also see how numerical models can be utilized to address scientific questions, test hypotheses, and quantify the past and future relationship between global carbon cycling and climate and associated feedbacks. You will learn new computer skills and gain experience with data analysis and visualization software and techniques. The cumulating objectives of the Unit are to develop a deeper understanding of the role and nature of feedbacks in the Earth system and provide context to the impacts of current human activities and also and importantly, foster a critical appreciation of the nature and limitations of climate and Earth system modelling in understanding and predicting global change.

Format

Learning will be facilitated by a series of interactive seminars (whatever that means, e.g. questions/answer & discussion but also lecturing on topics that should be new to all) … with personal research and literature review, but with the main emphasis being on practical work in the form of computer model based classes using a research-grade Earth system model:
5 weeks x 1-ish hour seminar/lecture sessions, plus
5 weeks x 3 hour computer practical classes.
The 5 time-tabled seminar plus practical weeks are on consecutive weeks (1-5).

Seminar/lecture sessions will take place at **12 noon** (for about an hour) for both **GEOGM1110** and **GEOGM1404** – in seminar room **SR1** in Geography (G.11N).
Practical (lab) sessions with me in the small computer room in Geography – **1.4N**. For **GEOGM1110** this will start at **9 am** (until 12 noon) and for **GEOGM1404** at **2 pm** (until 5 pm).

Assessment

(1) A group oral presentation of a computer modelling practical exercise on 'snowball Earth' (and ice-albedo feedback) == 20% overall Unit marks [**GEOGM1110 ONLY**]

(2) Model investigation report: 3000 words max (Nature Article format) for GEOGM1110 [**2000 word limit for GEOGM1404**] write-up of a computer model based research exercise (subject to be determined, but may be ‘ocean acidification’) == 80% overall Unit marks (20 credit points) for GEOGM1110 [**100% or 10 credit points for GEOGM1404**]

Detailed timetable

- **Week 1 [Fri 4th Oct.]** – Lecture 1 (12 noon) + Lab session #1 (9-12 or 2-5 pm)
  [*cGENIE modelling basics + experiments in climate hysteresis*]
- **Week 2 [Fri 11th Oct.]** – Lecture 2 (12 noon) + Lab session #2 (9-12 or 2-5 pm)
  [*cGENIE modelling basics + experiments in climate hysteresis – CONTINUED*]
- **Week 3 [Fri 18th Oct.]** – Lecture 3 (12 noon) + Lab session #3 (9-12 or 2-5 pm)
  [*Ocean circulation and overturning stability*]
- **Week 4 [Fri 25th Oct.]** – Lecture 4 (12 noon) + Lab session #4 (9-12 or 2-5 pm)
  [*Fossil fuel CO2 release and 'ocean acidification'*]
- **Week 5 [Fri 1st Nov.]** – Lecture 5 (12 noon) + Lab session #5 (9-12 or 2-5 pm)
  [*Ocean biogeochemical cycles and Engineering the carbon cycle*]
- **Week 6 [Fri 8th Nov.]** – Group presentations (10 am I SR1)
  [*'snowball Earth' and ice-albedo feedback*]
- …
- …
- **[Thurs 23th Jan???]** – Written assessment hand-in

Readings

Suggested initial (GENIE) model and background sciences references will be given with each Lab session handout.

For a more general introduction/background to Earth system science/modelling, the following all cover a broadly similar range of topics and may be helpful to varying degrees:

- Surface Ocean--Lower Atmospheres Processes, Eds. C. Le Quéré and E. S. Saltzman, AGU Geophysical Monograph Series, Volume 187 (2009).
- Ocean Biogeochemical Dynamics, J. L. Sarmiento and N. Gruber, Princeton University Press, ISBN: 978-0691017075 (2006).
- Ocean Dynamics and the Carbon Cycle, R. G. Williams and M. J. Follows, Cambridge University Press, ISBN: 978-0-521-84369-0 (2011).
- The Earth System, L. Kump *et al.*., Prentice Hall, ISBN-13: 978-0321597793 (2009).

Course resources

Lab instructions and model resources will appear week-by-week on my website:
http://www.seao2.info/mycgenie.html
Lectures, communications, and other non-model specific information/resources via Blackboard as usual.