Environmental Change 4
(An introduction to Earth system modelling)

GEOGM1110 + GEOGM1404

Overview

This Unit will provide hands-on learning in, and 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. Learning will be facilitated through a mix of interactive seminars, with personal research and literature review, plus practical work, with a strong emphasis on computer model based practical classes using a genuine research-grade Earth system model.

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

The format is of lecturer-led seminars with student input (whatever that means) together with computing modelling tuition: 5 x 1-ish hour seminar/lecture sessions, plus computer practical classes in 5 x 3 hour sessions. The 5 time-tabled seminar plus practical weeks will be grouped into 2 clusters – the first of 2 consecutive weeks, which will take place during weeks 1-5, and a second cluster of 3 consecutive weeks. The taught weeks are clustered to dovetail with the assessment and hence provide time in between them for completing assessed research.

Seminar/lecture sessions will take place at **10 am** (until ~11) in the **MSci (computing) room**.
Practical sessions will take place in the **MSci (computing) room** [code: 5-4-2], **2-5 pm**.

Assessment

(1) 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 [**1500 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 12th Oct.]** – Lecture 1 (11 am) + Lab session 1 (2-5 pm)
- **Week 2 [Fri 19th Oct.]** – Lecture 2 (10 am) + Lab session 2 (2-5 pm)
- **Week 3** – 'Free' for assessment work
- **Week 4 [Fri 2nd Nov.]** – Group presentations (10 am) (*no Lab session*)
- **Week 5 [Fri 9th Nov.]** – Lecture 3 (10 am) + Lab session 3 (2-5 pm)
- **Week 6 [Fri 16th Nov.]** – Lecture 4 (10 am) + Lab session 4 (2-5 pm)
- **Week 7 [Fri 23rd Nov.]** – Lecture 5 (10 am) + Lab session 5 (2-5 pm)
- **Week 8** – 'Free' for assessment work
- **Week 9** – 'Free' for assessment work
- **Week 10** – 'Free' for assessment work
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- **Week 11** – 'Free' for assessment work
- **Week 12 [Thurs 24th 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).