Universitat Autònoma de Barcelona

Climate Change

2016/2017

Code: 43056
ECTS Credits: 6

Degree	Type	Year	Semester
4313784 Interdisciplinary Studies in Environmental, Economic and Social Sustainability	OT	0	1

Contact

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Use of languages

Principal working language: english (eng)

Teachers

Graham Mortyn

Prerequisites

There are not prerequisits

Objectives and Contextualisation

We wish to enhance student understanding of the Earth's climate system, considering its many sub-systems (biological, chemical, physical, geologic, etc.) and their complex interactions over a range of temporal (past, present, and future) and spatial (local, regional, global, etc.) scales. Concerted effort will be made to distinguish Climate Change (CC) aspects and patterns from other realms of Global Change. While emphasis is naturally placed on the ocean's role in CC, the course also explores vital terrestrial aspects to CC as well.

Skills

- Analyse how the Earth functions on a global scale in order to understand and interpret environmental changes on the global and local scales.
- Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of Environmental Studies.
- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Communicate orally and in writing in English.
- Continue the learning process, to a large extent autonomously
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise research in environmental sciences.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Work in an international, multidisciplinary context.

Learning outcomes

1. Analyse and interpret climate records and results based on different techniques.

2. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of Environmental Studies.
3. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
4. Communicate orally and in writing in English.
5. Continue the learning process, to a large extent autonomously
6. Evaluate and explain the different facets of climate change and the evidence for these, and their future consequences.
7. Identify the fields in which climate can be applied to the different environmental problem areas.
8. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
9. Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise research in environmental sciences.
10. Show understanding of the concept of climate change from natural or anthropic causes.
11. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
12. Work in an international, multidisciplinary context.

Content

Course contents:

1. **1. Introduction to Climate Change (GM)**

Here we will introduce some of the guiding principles of "change", which are often only superficially understood by the general public. We will also discuss spatial and temporal scales, regional vs. global aspects, global vs. climate change (CC) distinctions, as well as the most important CC concepts. We will also touch on some of the key topic issues to be addressed later in the course. The concept of linkage between global climate change (e.g. recent warming) and the Earth's seasonal monsoon climate system will be explored, especially from the standpoint of SE Asia where it is most dramatic.

1. **2. Archives and Proxies as recording systems and tracing tools (GM)**

Here we will discuss a range of Earth "repository" recording systems of change, considering archives vs. proxies and basic geological and biological guiding principles. We will also get into the actual proxy mechanisms from several important archives (ice cores, marine sediments, corals, trees, and more), considering some geochemical, micropaleontological, physical, and biological "tools" to track change over many temporal and spatial scales.

1. **3. El Niño/Southern Oscillation (ENSO) as a globally relevant case study concept (GM)**

ENSO will serve as a Pacific-born, yet globally relevant phenomenon to consider a plethora of impacts, including climate, marine and terrestrial biology, agriculture, drought, economies, fisheries, water supply, human health, and more.

1. **4. Hurricanes and Atlantic warming of recent decades (GM)**

Recent events (Typhoon Haiyan, Superstorm Sandy, etc.) will be placed into a temporal context of recent decades, especially with Atlantic focus, to try and delineate how global climate change may be impacting storms. We will consider the evidence, knowledge shortfalls, and even paleoceanographic suggestions at the "link".

1. **5. Ocean Acidification (OA) (GM)**

OA will be explored in the context of a "sister" issue to CO2 emissions and anthropogenic climate change. Both broad-based concepts will be considered, including simplified chemistry, as well as newly acquired knowledge of the most vulnerable regions. Particular focus on the Mediterranean Sea and the newly acquired results will be presented. Arenas of impact touch on seawater chemistry, marine ecosystems (both planktic and benthic) and marine ecosystem services (tourism, socioeconomics) and more.

1. **6. Biodiversity and proxies (JB)**

Animals, Plants, Fungi and Bacteria are fundamental elements needed to maintain life on earth and the trophic chains. At the same time they are providers of proxy series to be used in Climate change studies.

1. **7. Pollen and spores (Palynology) (JB)**

Plants and fungi reproduction system through pollen grains and spores provide elements of interest (proxies) for the study of the Climate and Global change processes and impacts. Palynology.

1. **8. Aerobiology (JB)**

Aerobiology is a branch of biology that studies organic particles, such as arthropods, pollen grains, fungal spores, bacteria and viruses, which are passively transported by the air. In this section we will learn about the most common biological airborne particles, which meteorological parameters are involved in their presence and transport and how they affect them. We will consider the positive effects of airborne leaving organisms as well as the negative ones such as human, animal and plant health.

1. **9. Cases studies on pollen, spores, and insects and Climate change (JB)**

Methodology

In-class presentations will be made via Power Point, and detailed class discussions will ensue between the students and teaching staff. We aim to conduct the class sessions in as informal a manner as possible, in order to best facilitate active and inclusive participation, as well as engaged learning. The class discussions will also highlight controversial points, current events, and local phenomena as much as possible to pique the interest of all involved. The course will also engage other researchers (Victor Sarto [applied entomology], Patrizia Ziveri [ocean acidification], Eric Galbraith [biogeochemical cycles and modeling], and others) in conferences outside of the formal class structure.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Students participation in the aula	10	0.4	1, 6, 4, 10, 3, 8, 5
Teaching at the aula	50	2	8, 5, 11, 12
Type: Supervised			
personal working	20	0.8	1, 2, 6, 9, 4, 7, 12
Type: Autonomous			
Exam	5	0.2	1, 6, 4, 10, 7, 3, 8, 5, 11
Study and own work	20	0.8	1, 2, 6, 9, 7, 12

Evaluation

Course assessment

1. A final exam, contributing to 50% of the final mark. The two contributing professors will evaluate the exam together.

2. A research paper (50%). The aim is to conduct detailed literature research on a climate change topic of your choice, guided in part by the subjects covered in class. We want to ensure that students explore topics of significant individual interest. In this vain the class content and structure may serve as a guide, however you should not at all feel restricted by their elements either. To provide further topic guidance, you might look to NASA, NOAA, the International Geosphere-Biosphere Programme (IGBP) (www.igbp.net), or any number of potentially useful web sites and select one of the research questions or initiatives as a poster topic, or at least pique your interest in a particular direction. The paper structure should follow routine procedures and include introduction/background, typical data and methodology used to address the issue, a discussion of the "state of the art" plus continuing controversies, suggestions for future work and research directions, and conclusions. While you are not conducting your own research on this issue and instead basing it on existing literature, the suggested structure reflects this. You should consider all relevant spatial and temporal scales (local, regional, global, past, present, future, etc.) to provide necessary context.

Specifics:

- 10-12 page length, not including figures or references

- 12 pt. font size, 1.5 line spacing

- abstract of </= 500 words

- as many figures and references as you see fit to make your points, embedded into text provided that overall text content is not sacrificed

- topics due by TBA (to graham.mortyn@uab.es by email)

- final papers due TBA

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Exam	50%	25	1	1, 6, 4, 10, 7, 3, 8, 5, 11
personal working	50%	20	0.8	1, 2, 6, 9, 4, 7, 12

Bibliography

Background literature

Sub-Module 1: The Ocean's Role in Global Change

1.1. Introduction to Global Change and Climate Change

- Anderson, D.M, J.T. Overpeck, and A.K. Gupta, Increase in the Asian southwest monsoon during the past four centuries, Science, 297, 596-599, 2002.

- Barker, S., and A. Ridgwell, Ocean acidification, Nature Education Knowledge, 3(10):21, 2012.

- Black, D.E., The rains may be a-comin', Science, 297, 528-529, 2002.

- Broecker, W.S., The great ocean conveyor, Oceanography, 4, 79-89, 1991.

1.2. Archives and Proxies as recording systems and tracing tools

- Cronin, T.M., Principles of Paleoclimatology, Columbia University Press, New York, 1999.

- Mortyn, P.G, and M.A. Martinez-Boti, Planktonic foraminifera and their proxies for the reconstruction of surface-ocean climate parameters, Contributions to Science, 3, 371-383, 2007.

1.3. El Niño/Southern Oscillation (ENSO) as a globally relevant case study concept

- McPhaden, M.J., S.E. Zebiak, and M.H. Glantz, ENSO as an integrating concept in Earth Science, Science, 314, 1740-1745, 2006.

1.4. Hurricanes and Atlantic warming of recent decades

- Elsner, J.B., Evidence in support of the climate change - Atlantic hurricane hypothesis, Geophysical Research Letters, 33, doi:10.1029/2006GL026869, 2006.

- Emanuel, K., Increasing destructiveness of tropical cyclones over the past 30 years, Nature, 436, 686-688, 2005.

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- Witze, Temperatures flare at hurricane meeting, Nature, 441, p. 11, 2006.

- Kerr, R.A., A tempestuous birth for hurricane climatology, Science, 312, 676-678, 2006.

1.5. Ocean Acidification (OA)

- Barker, S., and A. Ridgwell, Ocean acidification, Nature Education Knowledge, 3(10):21, 2012.

1.6 to 1.9

- Calvete, C., Estrada, R., Miranda, M. A., Borrás, D., Calvo, J. H. & Lucientes, J., 2008.- Modelling the distributions and spatial coincidence of bluetongue vectors Culicoides imicola and the Culicoides obsoletus group throughout the Iberian peninsula. Medical and Veterinary Entomology, **22**: 124-134.

- Moreno, J.M., Galante, E., Ramos, M.A., Araujo, R., Baixeras, J., Carranza, J., Daufresne, M. Delibes, M., Enghoff, H., Fernández, J., Gómez, C., Marco, A., Nicieza, A. G., Nogales, M., Papes, M., Roura, N., Sanz, J. J., Sarto i Monteys, V., Seco, V., Soriano, O., Stefanescu, C., 2014. Impacts on Animal Biodiversity: 243-294. In: Moreno, J.M. (ed.) A preliminary general assessment of the impacts in Spain due to the effects of climate change (764 pp). Ministerio de Medio Ambiente. ISBN: 84-8320-303-0. DOI: 10.13140/2.1.4352.7042

- Mullens, B. A., Sarto i Monteys, V. & Przhiboro, A. A., 2008.- Mermithid parasitism in Ceratopogonidae: A literature review and critical assessment of host impact and potential for biological control of Culicoides. Russian Entomological Journal,**17**: 87-113.

- Ortega, M.D., Holbrook, F.R. & Lloyd, J.E., 1999.- Seasonal distribution and relationship to temperature and precipitation of the most abundant species of Culicoides in five provinces of Andalusia, Spain. Journal of the American Mosquito Control Association, **15** (3): 391-399.

- Sarto i Monteys, V., 2002. The discovery, description and taxonomy of Paysandisia archon (Burmeister, 1880), a castniid species recently found in southwestern Europe (Castniidae). Nota lep., **25**(1): 3-15

- Sarto i Monteys, V. & Aguilar, Ll., 2005. The Castniid Palm Borer, Paysandisia archon (Burmeister, 1880) in Europe: Comparative biology, pest status and possible control methods (Lepidoptera: Castniidae). Nachrichten des Entomologischen Vereins Apollo, N.F., **26** (1/2): 61-94.

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