Summer 2017

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Earth's Climate: Present, Past and Future
ENVR S-133

Course description
This course deals with past present and future climate changes as evinced from the most recent studies on palaeoclimate archives, such as marine sediments and ice cores. The techniques available for the study of climate will be carefully reviewed and the most recent results will be presented. Climate changes involve multiple interactions among different components of the climate system, such as the atmosphere, the ocean, the earth, the biosphere and the ice sheet. One way to make sense of this complex system is to understand the inherent rate at which each of its components respond both to the primary causes of climate change and as part of a web of interactions within the system. Testing of hypothesis by means of climate models strongly supports the experimental data presented in the course.

Prerequisites
None

Required readings
- William F. Ruddiman, Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2013, 3rd Edition.

Recommended Readings
IPCC 5th ASSESSMENT REPORT - 2013
(downloadable from www.ipcc.ch)

Grading

Participation	20%	*This part of the grading will be evaluated based on the demonstration of having done the readings, willingness to answer questions, and attention and response to classmates.*
Presentations	30%	*All the students will be asked to prepare and present a 15 minute presentation on a subject treated during the course*
Final Examination	50%	*Written exam with open questions*

NB: Master's students (studenti a livello magistrale) and all other students at graduate level will be given extra work for grading purposes.

Policies and procedures

Attendance is required and considered as part of the grading. *Any absence must be registered by the CFHSS office (email cafoscari-harvard@unive.it). All work submitted for this course must be the student's own and must follow proper citation procedures. All students are required to read in advance the policies on* ***"Plagiarism and Collaboration"*** *in the Handbook for Students at http://hvrd.me/iXiaLD. Please familiarize yourself with the* ***Guidelines for Using Sources****: http://bit.ly/cQK9A3*

Other guides to reading, writing, and research are available on the course website: http://hvrd.me/yYGeJy

Students can usually find me in my office during working hours, however it is also possible to make an appointment by phone or email.

Seminars

Lesson	Title and Description	Date
1	**Overview of Climate Sciences;** climate and climate change; tools for climate studies; climate forcings and responses; Earth's climate system today; climate interactions and feedbacks; atmospheric and oceanic circulation	**Tue 27 June**
Readings	*Textbook Chapters 1-2.*	
2	**Climate archives, data and models;** dating climate records; climate resolution; climate data; climate models; General Circulation Models; Tectonic-scale climate change; greanhouse worlds; chemical weathering; the Gaia hypothesis. **Plate tectonic and climate;** glaciations and continental positions since 500 Myr ago; the super-continent Pangea;	**Thu 29 June** (early lesson, 8:45)
Readings	*Textbook Chapters 3-5*	
3	**Plate tectonic and climate;** tectonic control of CO_2 input; greenhouse Earth; sea level changes and climate **Global climate change since 55 Myr ago;** oxygen isotope data; a cooling climate; understanding and predicting tectonic climate change; Astronomical control of solar radiation; long term changes in Earth's orbit; eccentricity; obliquity, precession;	**Fri 30 June**
Readings	*Textbook Chapters 6-8*	

4	**Insolation control of monsoons;** evidences of global scale changes in summer monsoons; insolation control of ice sheets; modelling the behavior of ice sheets;; the northern hemisphere ice sheet;	**Tue 4 July**
Readings	*Textbook Chapters 9-10*	
5	**Orbital scale changes in CO_2 and CH_4;** Orbital scale interactions in the climate system; ice-driven climate responses; CO_2 level and ice volume; the mystery of the 100 kyr cycle	**Thu 6 July**
Readings	*Textbook Chapters 11-12*	
6	**Deglacial and millennial climate changes;** the last glacial maximum; testing model simulations; climate changes in the northern hemisphere; the climate in the tropics; climate during and since the last deglaciation; fading memories of melting ice;	**Tue 11 July**
Readings	*Textbook Chapters 13-14*	
7	**Millennial oscillations in climate;** detecting millennial oscillations; millennial oscillations during the last 8000 yr; causes of millennial-scale oscillations;	**Thu 13 July** (early lesson, 8:45)
Readings	*Textbook Chapters 15-16*	
8	**Historical changes in climate;** proxies for detecting historical climate changes; the little ice age; ice cores from mountain glaciers; the three rings instrumental observations; humans and climate change; the impact of climate on human evolution; ; the impact of humans on climate; climate in the twentieth century; Earth's sensitivity to greenhouse gases; causes of global warming in the twentieth century;	**Tue 18 July**
Readings	*Textbook Chapters 17-18; IPCC 2007 Full Report (downloadable from www.ipcc.ch)*	
9	**Climate changes in the future;** predicting climate changes; natural variations on climate; future human impact on climate; future climate changes caused by CO_2; monitoring greenhouse warming; the impact of future increase of greenhouse gases on humans	**Thu 20 July**
Readings	*Textbook Chapter 19; IPCC 2007 Full Report (downloadable from www.ipcc.ch)*	
10	**Exam preparation**	**Tue 25 July**
11	**Final Exam**	**Thu 27 July**