

## Summer 2018

**Instructor:** Carlo Barbante, Ca' Foscari University

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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, 3<sup>rd</sup> Edition.

#### **Recommended Readings**

IPCC 5th ASSESSMENT REPORT - 2013

(downloadable from [www.ipcc.ch](http://www.ipcc.ch))

#### **Grading**

Participation	20%	<i>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.</i>
Presentations	30%	<i>All the students will be asked to prepare and present a 15 minute presentation on a subject treated during the course</i>
Final Examination	50%	<i>Written exam with open questions</i>

**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](mailto: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://hvard.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://hvard.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	<b>Overview of Climate Sciences;</b> 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	<b>Mon 25 June</b>
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2001. Chapters 1-2. Downloadable from the editor web site</i>	
2	<b>Climate archives, data and models;</b> dating climate records; climate resolution; climate data; climate models; General Circulation Models; Tectonic-scale climate change; greanhouse worlds; chemical weathering; the Gaia hypothesis.	Wed 27 June
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. New York. 2007, 2<sup>nd</sup> Edition. Chapters 3-4</i>	
3	<b>Plate tectonic and climate;</b> glaciations and continental positions since 500 Myr ago; the super-continent Pangea; tectonic control of CO <sub>2</sub> input; greanhouse Earth; sea level changes and climate	<b>Mon 2 July</b>
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 5-6</i>	
4	<b>Global climate change since 55 Myr ago;</b> 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;	Wed 4 July
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 7-8</i>	
5	<b>Insolation control of monsoons;</b> evidences of global scale changes in summer monsoons; insolation control of ice sheets; modelling the behavior of ice sheets;; the northern hemisphere ice sheet;	<b>Mon 9 July</b>

Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 9-10</i>	
<b>6</b>	<b>Orbital scale changes in CO<sub>2</sub> and CH<sub>4</sub></b> ; Orbital scale interactions in the climate system; ice-driven climate responses; CO <sub>2</sub> level and ice volume; the mystery of the 100 kyr cycle	Wed 11 July
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 11-12</i>	
	<b>Visit to the Ca' Foscari Science Campus in Via Torino</b>	<b>Fri 13 July</b>
<b>7</b>	<b>Deglacial and millennial climate changes</b> ; 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;	<b>Mon 16 July</b>
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 13-14</i>	
<b>8</b>	<b>Millennial oscillations in climate</b> ; detecting millennial oscillations; millennial oscillations during the last 8000 yr; causes of millennial-scale oscillations;	Wed 18 July
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 15-16</i>	
<b>9</b>	<b>Historical changes in climate</b> ; 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;	<b>Mon 23 July</b>
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 17-18; IPCC 2007 Full Report (downloadable from <a href="http://www.ipcc.ch">www.ipcc.ch</a>)</i>	
<b>10</b>	<b>Climate changes in the future</b> ; predicting climate changes; natural variations on climate; future human impact on climate; future climate changes caused by CO <sub>2</sub> ; monitoring greenhouse warming; the impact of future increase of greenhouse gases on humans	Wed 25 July
Readings	<i>Earth's Climate: Past and Future. W.H. Freeman and Company, New York. 2007, 2<sup>nd</sup> Edition. Chapters 19; IPCC 2007 Full Report (downloadable from <a href="http://www.ipcc.ch">www.ipcc.ch</a>)</i>	
<b>11</b>	<b>Preparation for the final exam</b>	<b>Mon 30 July</b>
<b>12</b>	<b>Final Exam</b>	Wed 1 August