

## **Climate Change: A Geological Perspective ERTH2402 (Winter Term 2019)**

**Lectures:** Friday: 11:35AM - 2:25 PM (Rm 103 Steacie)

**Course Material:** Distributed through CULearn

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### **Introduction**

Welcome to Climate Change: A Geological Perspective. I am delighted that you have chosen to take this course and hope that you will enjoy learning about the variety of climates that have characterized the earth over time and what clues they provide for our future. Climate change research is a fascinating and rapidly changing discipline and one that I am excited to be involved in as a climate change researcher here at Carleton University.

This general interest course is designed for the non-major and requires no prerequisites in Earth Sciences. That said there is a lot of material that will be covered and for students with little science background understanding some of the concepts will require additional reading. In short do not consider that this is a **“BIRD COURSE”** or **“GRADE RAISER COURSE”**.

This course explores climate change from the geological perspective, emphasizing the history of earth climates, geological causes of climate change, and impact that rapid climate change has had on the biosphere. At present concerns about these issues are commonly expressed by questions such as:

- 1 How does carbon dioxide influence global temperatures?
- 2 What determines changes in sea level and how do such changes affect the coastal environment?
- 3 How has the atmospheric composition changed with time?
- 4 What are the controls of the oceans, the atmosphere, and the physical geography of the land in setting the regional and temporal patterns of climate?
- 5 How are nature and humans affecting the land?
- 6 What is the role of natural global catastrophes on life in general, and humans in particular?

This course aims to address the issues of both long- and short-term natural and human induced environmental change on a global scale. An understanding of the geologic history of climate change is essential if researchers are to answer the above questions and accurately predict the impact that possible present-day rapid climate change may have on the biosphere. During its history our world has been subject to often dramatic, climatic shifts ranging from near global glaciations, to planetary

greenhouse conditions. These dramatic shifts can be linked to varying factors including development of the planetary biota, plate tectonics and changes in paleoceanographic circulation.

During the past 20 years scarcely a week goes by without some discussion of a climate change related issue on television or in the newspapers. As a secondary goal I have developed the course to help the general public appreciate and better understand the science as well as the social issues associated climate change.

## Course Evaluation

### Grade Breakdown

Optional Midterm (Friday, March 1st, 2019; 11:35AM - 1:25PM). Location to be announced at a later date.	35%
Term paper – Due March 14 <sup>th</sup> at beginning of class	30%
Final Exam – Date, Time, Place TBD	35%
Total	<hr/> 100%

### Textbooks

There are three textbooks that we will be drawing on for the class. Don't panic though one is a free download and the other two, both available from the bookstore, or online, are inexpensive.

**Van Andel, Tjeerd H. 2002. New Views on an Old Planet. Cambridge University Press, 2<sup>nd</sup> Edition. 458 pages.**

“Earth Science is history, and because the earth is changing every day, earth history is being added every moment. Professor van Andel's now famous book on earth history interweaves three main themes: the evolution of the solid earth; the history of oceans and atmospheres; and the evolution of life. In the decade since this award-winning book was first published, much new information has been learned and confirmed, and Dr. van Andel draws on this wealth of knowledge to thoroughly revise and update the text. There is a new chapter on how we can improve our grasp on geological time and, mindful of the current interest in global change, new sections describe the greenhouse effect and address its possible future ramifications. In prose that is both concise and compelling and with a glossary and suggestions for further reading *New Views on an Old Planet: A History of Global Change*, makes earth history appealing to the general reader .”

This book is available as a free chapter by chapter ebook pdf download in the Carleton Library at:

<http://ebooks.cambridge.org.proxy.library.carleton.ca/ebook.jsf?bid=CBO9781139174114>

You can either print the pdf out or load it on a reader such as and iPad. For those of you who prefer a paper copy of the text it is available for purchase at many online vendors for

as little as a dollar including:  
[www.amazon.ca](http://www.amazon.ca)  
<http://www.chapters.indigo.ca>  
[www.abebooks.com](http://www.abebooks.com)

**Be sure and order the 2<sup>nd</sup> edition though!**

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**Peters, E. Kirsten, 2012. The whole story of climate: What science reveals about the nature of endless change. Prometheus Books. 290 p. ISBN-10 185383582X.**

“In the publicity surrounding global warming, climate scientists are usually the experts consulted by the media. We rarely hear from geologists, who for almost two hundred years have been studying the history of Earth's dramatic and repeated climate revolutions, as revealed in the evidence of rocks and landscapes. This book, written by a geologist, describes the important contributions that geology has made to our understanding of climate change. What emerges is a much more complex and nuanced picture than is usually presented.

While the average person often gets the impression that the Earth's climate would be essentially stable if it weren't for the deleterious effects of greenhouse gases, in fact the history of the earth over many millennia reveals a constantly changing climate. As the author explains, several long cold eras have been punctuated by shorter warm periods. The most recent of these warm spells, the one in which we are now living, started ten thousand years ago; based on previous patterns, we should be about due for the return of another frigid epoch. Some scientists even think that the warming of the planet caused by man-made greenhouse gasses tied to agriculture in the past few thousand years may have held off the next ice age. Though this may be possible, much remains uncertain.

But what is clearly known is that major climate shifts can be appallingly rapid--occurring over as little as twenty or thirty years. One danger of dumping greenhouse gases into the atmosphere is that they may increase the chance that this "climate switch" will be thrown, with catastrophic effects on worldwide agriculture.

Besides her discussion of climate, the author includes chapters on how early naturalists pieced together the complicated geological history of Earth, and she teaches the reader how to interpret the evidence of rock formations and landscape patterns all around us.

Accessible and engagingly written, this book is essential reading for anyone looking to understand one of our most important contemporary debates.”

New and used copies of this text can also be obtained from suppliers like Amazon.ca at very reasonable prices. For those of you who prefer a paper copy of the text it is available for purchase at many online vendors for as little as a dollar including:

[www.amazon.ca](http://www.amazon.ca)  
<http://www.chapters.indigo.ca>  
[www.abebooks.com](http://www.abebooks.com)

## **Plagiarism**

The University's Senate defines plagiarism in the regulations on instructional offences as: "to use and pass off as one's own idea or product work of another without expressly giving credit to another". Borrowing someone else's answers, unauthorized possession of tests or answers to tests, or possession of material designed in answering exam questions, are all subject to university policy regarding instructional offences.

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## **Term Paper Guidelines and Grading Scheme**

This document supplements the information provided above in the grade breakdown.

### **Term paper itself: (15%)**

Term paper body is to be single spaced, with 2.5 cm margins all around and paginated. Additional pages may be included for abstract, references, figures and tables as required. Font is to be 12-point Times or Times-Roman.

Electronic version of term paper is to be provided so that submissions can be analyzed for originality. Term paper is due on or before March 15th, 2019 at the beginning of class. There will be 20% deduction in value for each day that the term paper is late.

The layout of the term paper is to follow the outline below:

### **Title and Abstract: (10%)**

Clear and concise. Clearly outlines the contents of the paper in 200-400 words. The Abstract should be on a page by itself.

### **Paper Body: (65%)**

The term paper body is to be 5 pages long. While a complete, in-depth analysis of the topic is not expected (that would be a dissertation or book), a superficial discussion is not sufficient. The term paper should be a thoughtful discussion of your topic. I want to know by reading the paper that you learned some things and thought seriously about the topic. Organize your paper in an organized way. In a survey paper such as you are writing begin with a clear introduction, followed by background and then a discussion of the main points that you wish to cover. It may be useful to subdivide the various parts of the paper with subheadings. Be concise. Wordiness distracts from the points that are being made and wearies the reader. Rephrase or use parenthesis to indicate the work of others. Do not copy text into your document. It is an indication of plagiarism, easily detectable and is a serious academic offence (see section in course outline on plagiarism). Fully cite your sources as you develop your ideas. Class notes do not qualify as citations. Do not use "grandfathered" citations. Go to the original source!

Spelling errors are also distracting. Be sure and spell check the document prior to submission.

**Conclusions: (10%)**

Clearly and briefly summarizes the main points made in the paper.

**References ( 5 % )**

Are all references listed in bibliography cited in text? And are all references cited in text listed in the bibliography? The Internet is a wonderful source of information. However, many non-academic sites are commonly not screened and refereed as are academic journals and publications. If you do cite web pages, give the exact URL address. In the case of online journal articles such as those found in the online peer-reviewed journal *Palaeontologia Electronica*, cite them as though they were in printed form.

**Figures and Tables (10%):**

Earth Science papers are often replete with many figures and data tables. If you include figures from elsewhere clearing reference the source. Figures should be clear with the main points that you wish to make based on them easily distinguishable. It might be useful in some cases to draft your own figure. Figures and Tables require captions that are to be printed on the same page. Figures and Tables are to be placed in order at the end of the paper with one figure and table per page, not interspersed through your manuscript. When you cite figures in the text they should be in order. The progression should be Fig 1, 2, 3, 4, 5 etc. Do not cite Figure 3, then 5, then 1 etc.

**Optional Midterm and Final Exam**

The midterm exam will be held at a venue to be determined on Friday, March 1st, 2019; 11:35AM - 1:25PM. The date of the final exam is fixed by the Office of Registrarial Services. Due to the large number of students in the class I cannot offer alternative dates or times to suit the needs and preferences of individual students. Note that the Midterm exam date and time is published before the start of the course. Students requesting deferred exams must provide a medical note. This is the only accepted reason for an exam to be deferred. For those who are unable to make the midterm for other than medical reasons they may opt to roll the value of the midterm into the final exam. This would make the final worth a whopping 70% of their grade. Putting so many 'grade' eggs into one basket is not recommended.

The midterm and final examination will consist of multiple-choice questions. You will also be required to know and reproduce the simplified geological time scale provided on the WebCT site as part of the midterm. The material examined will reflect what you have been learning throughout the course.

**Topics covered in the course**

**Human Awareness of Climate Change**

A discussion of the impact of rapid and slow climate change on human civilization.

**Climates of the Solar System**

A comparison of the wide variety of climates that have developed on other planets

and moons in the solar system.

### **Utility of Geologic Methods in Assessing Previous Climates**

How geologists interpret the geologic record to determine previous climatic conditions.

### **Atmosphere and Ocean Circulation**

A treatment of the link between oceanic and atmospheric circulation and climate.

### **Impact of El Niño, La Niña and Other Cyclic Phenomena on Climate**

The causes and impact that El Niño and other cyclic climate phenomena may have on climate.

### **Probability of Extreme Weather Events**

What the historical record indicates about the probability of extreme weather events.

### **Impact of Glaciation on Climate**

An overview of the unusually cold conditions that have prevailed on Earth for the last few million years.

### **The Processes Responsible For Climate Change**

A discussion of how climate changes in response to various natural drivers.

### **Climate Cycles and Trends in the Holocene Climate Record**

Discussion on natural cycles and trends in the climate record using research carried out by the Carleton University paleoclimate research group as a case study.

### **Utility of Climate Modeling to Determine Future Climate**

The advantages and disadvantage of the mathematical models that are used to make estimates of previous and future climates.

### **Agents of Catastrophic Climate Change**

The link between climate change and extremely rapid events like meteors, volcanoes, and nuclear weapons exchange.

## **Requests for Academic Accommodations**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

### **For Students with Disabilities:**

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. [carleton.ca/pmc](http://carleton.ca/pmc)

### **For Religious Obligations:**

Students requesting academic accommodation on the basis of religious obligation should make a formal, written request to their instructors for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory event.

Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodations in a way that avoids academic disadvantage to the student. Students who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Equity Services website for a list of holy days and Carleton's Academic Accommodation policies, or may contact an Equity Services Advisor in the Equity Services Department for assistance. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

**Please note:** students who choose to wear head coverings that obscure their facial features will be required to produce a student identity card showing their true likeness, which must be shown to a proctor of the same sex. They will be asked to temporarily remove themselves from the examination room to a private area prior to the beginning of the examination where they will be required to reveal their faces to a proctor of the same sex. The instructor needs to be advised of this requirement at least one week ahead of the examination to ensure that an appropriate proctor can be obtained.

### **Pregnancy obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

### **Medical Certificates:**

Please note that in this course on all occasions that call for a medical certificate you must use (or furnish the information demanded in):

[www1.carleton.ca/registrar/ccms/wp-content/ccms-files/med\\_cert.pdf](http://www1.carleton.ca/registrar/ccms/wp-content/ccms-files/med_cert.pdf)

### **Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)