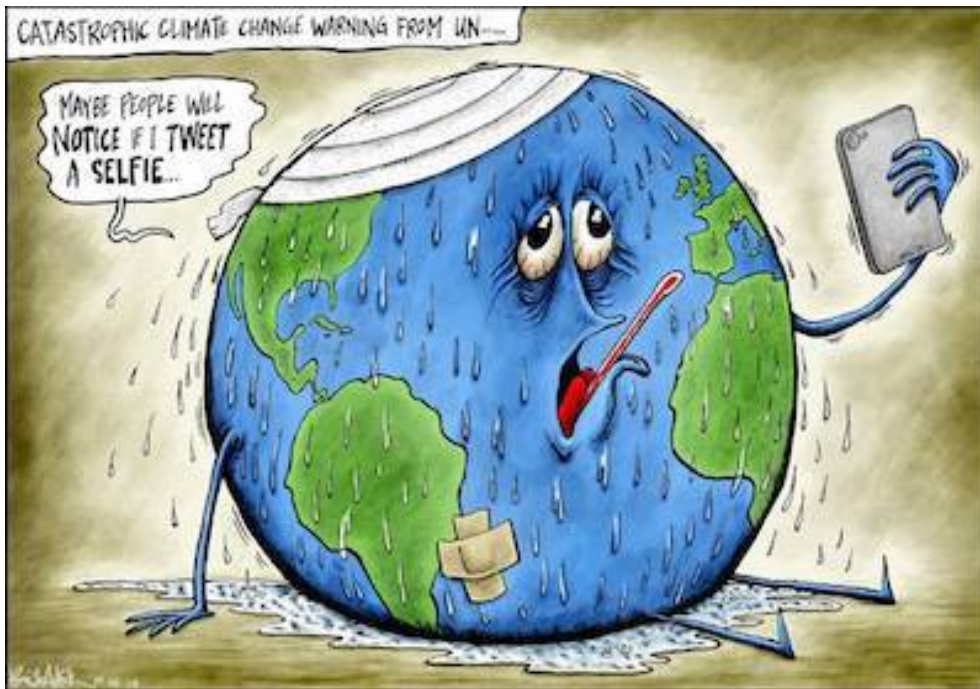


**NEW FOR FALL 2019:
[GEOL/GEOG 095/195]
CLIMATE - PAST, PRESENT, and FUTURE**



Understand how ocean, atmosphere, and land systems regulate Earth's climate while learning how climate has changed over time. Discover how humans have altered Earth's climate and how climate is likely to change in the future. Learn the impact of climate on societies through time.

095 meets three credit/non-lab science requirement. 195 meets four credit/lab requirement.



Class 1: What's happening to our planet and Why it matters so much to all of us

- Brief Introduction to class including 095/195 differences
- Knowledge Survey – work in pairs

Learning Objectives

1. Understand the broad outline of the course and why climate matters
2. Understand difference between 095 and 195
3. Assess your knowledge of climate in the past, present and future

GEOLOGY 095, 195. Climate: past, present, future

Who are we?

- Paul Bierman, Professor of Geology and Natural Resources
- Chris Halsted, Doctoral Candidate, Natural Resources
- Mae Kate Campbell, MS Candidate, Geology



THIS IS A NEW CLASS!

- We all care deeply about this material
- But there will be rough spots
- Please be forgiving of the occasional goof, timing issue, and mid course corrections (we'll do a quick evaluation after each of the exams to get feedback)
- Thanks for your help making this class as good as it can be!
- We are all in this together!

What is this class about?

- **Climate Science – past, present and future**
- **How does Earth's climate work?**
- **What can cause climate to change in one area? A region? Globally?**
- **How has Earth's climate changed in the past?**
- **How are human activities affecting climate?**
- **What could happen to climate in the future?**

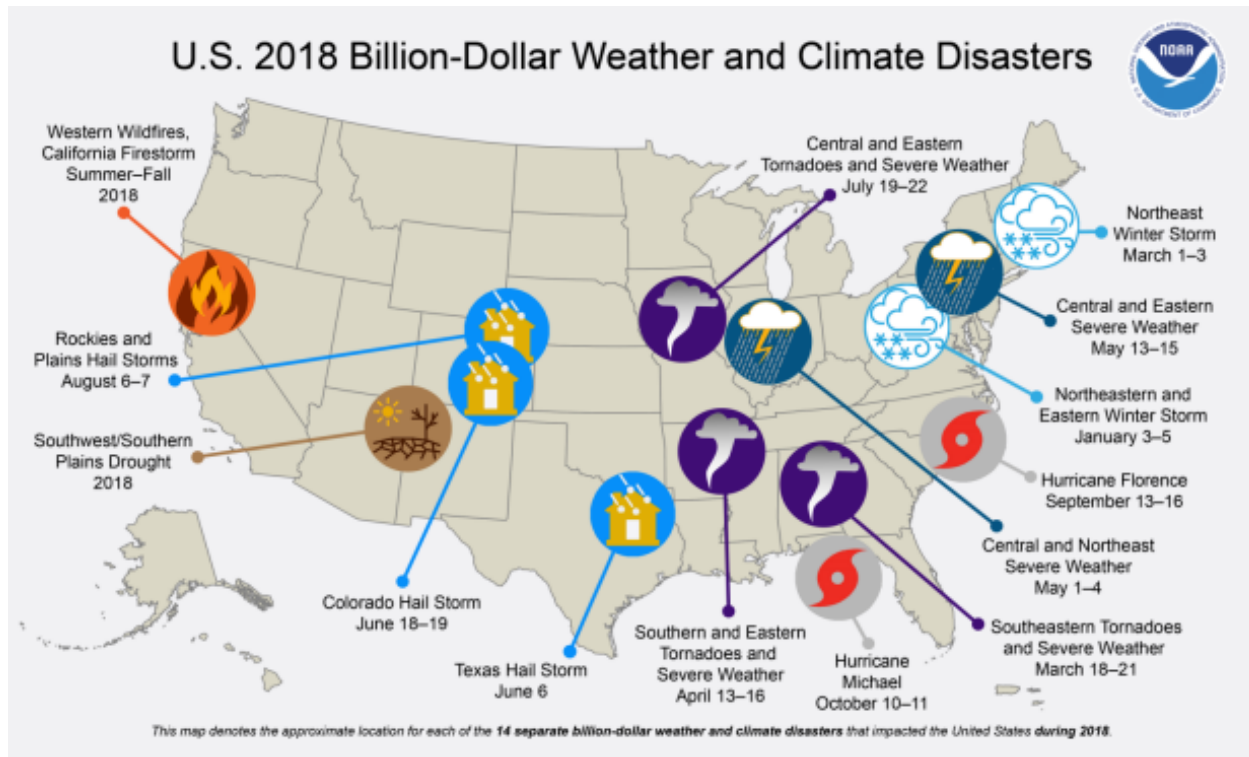


What's the difference between 095 and 195?

- Both class levels will attend lectures on Tuesday and Thursday
- 195 will have an additional lab meeting (in Delehanty Hall) on most Wednesdays and one weekend field trip (Lab does NOT meet this week!)
- 095 for 3 credits (**non-lab science requirement fulfilled**)
- 195 for 4 credits (**lab science requirement fulfilled**)

Why Should I Care?

Attribution science is maturing...we now can estimate the odds that any major weather event is climate change influenced

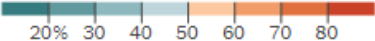


- Climate change is starting to affect everyone
- More changes and damage are expected
- Understanding how this all works is essential to protect against severe future impacts

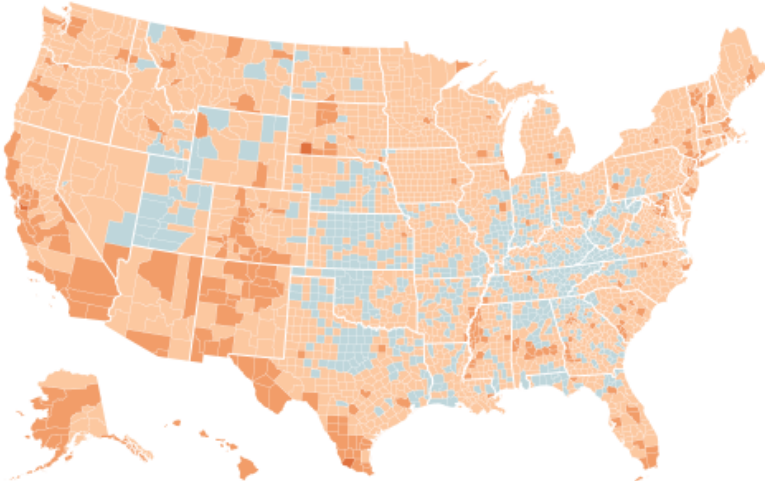
Why Should I Care?

Most people think that climate change will harm Americans, but they don't think it will happen to them.

Percentage of adults per county who think ...



Global warming will harm people in the United States



Global warming will harm me, personally

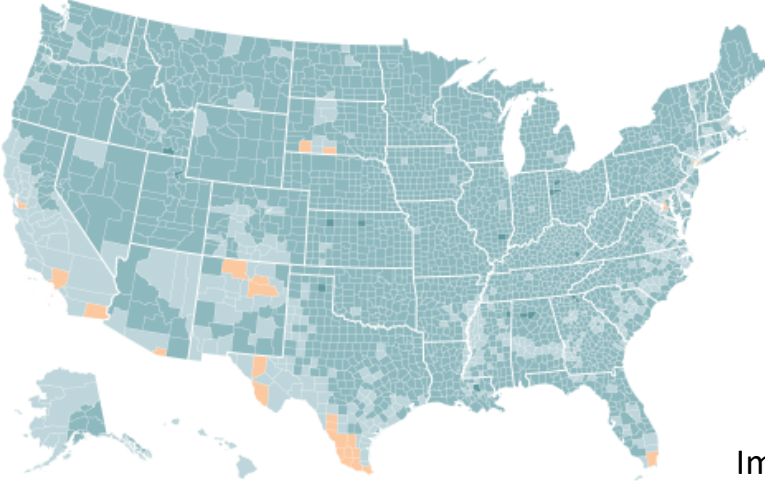


Image from The New York Times

Why Should I Care?

Counties where adults discuss global warming at least occasionally

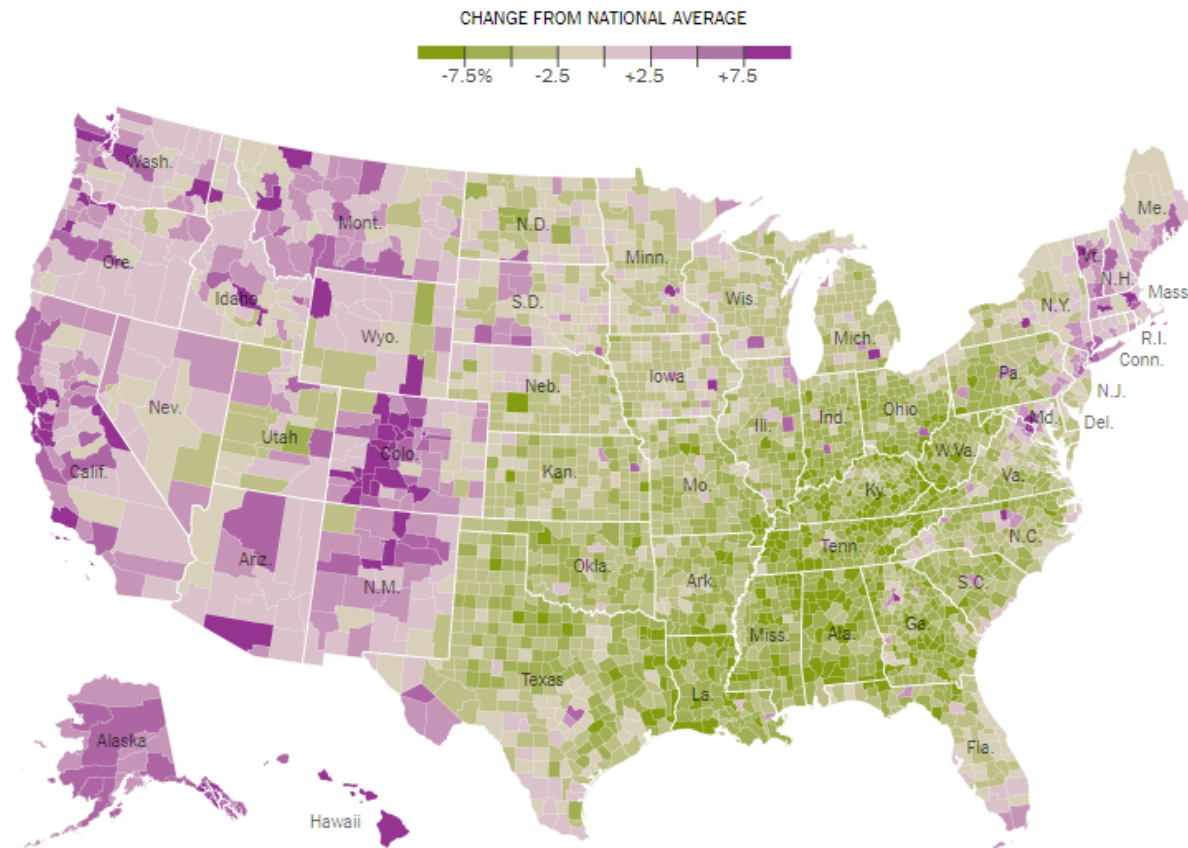


Image from The
New York Times

Why Should I Care?

- **Climate change will affect almost all facets of human society – GLOBALLY!**
- **Whatever career you all choose to pursue, we want you to have this knowledge**
- **Hopefully, you can help your field contribute to efforts to minimize climate change impacts**
- **You need FACTS to make informed decision and see through media spin, hype and “fake news”**

Bill Nye – The Science Guy

<https://www.youtube.com/watch?v=TUdgFOmmQ7U>



It's not magic, it's

SCIENCE!

Science is the process and the body of knowledge that enables us humans to know nature. So far, it's the best idea we've ever had.



Bill Nye the Science Guy, is an American science communicator, television presenter, and mechanical engineer. Nye is now the CEO of the Planetary Society, the leading non-profit space advocacy organization, where the world's citizens work to advance space exploration and science.

Knowledge Survey

- To get us all thinking about the material and talking
- Do in pairs
- Prepare to speak outloud and give the reasoning for your answer!



The
UNIVERSITY
of **VERMONT**



What is the greenhouse effect and how does it work?



How has the global average temperature changed since the Industrial Revolution?



What are the major causes of sea level rise?



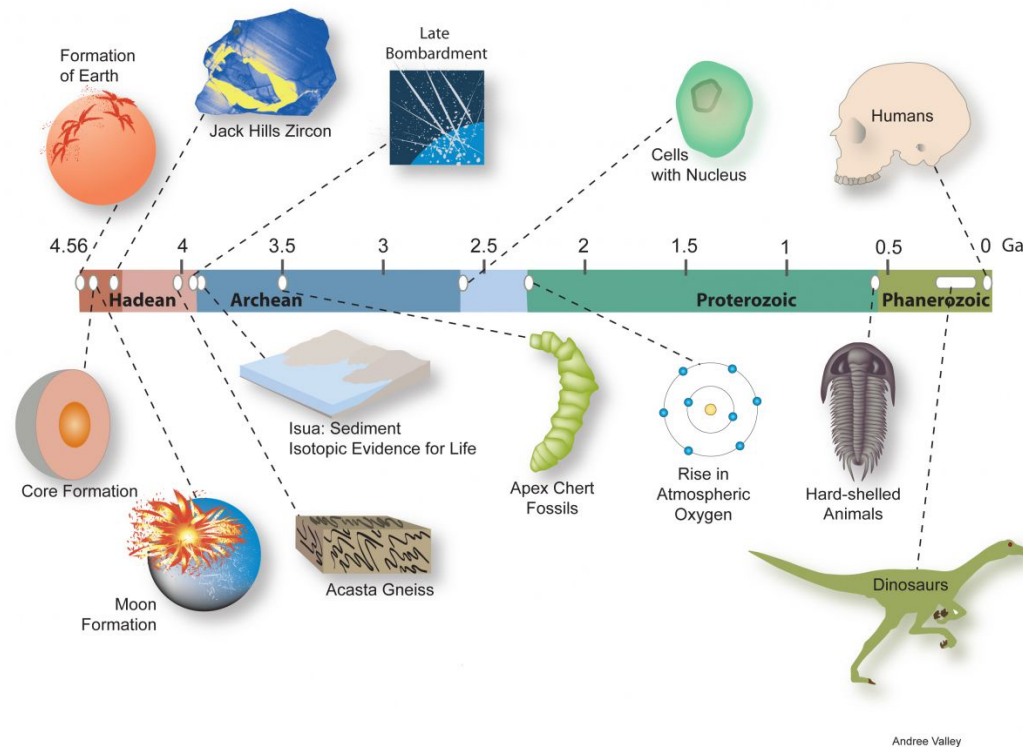
How do we know what greenhouse gas concentrations (and temperature) were in Earth's past?



How does the rate of today's warming compare to previous episodes of rapid climate change on Earth?



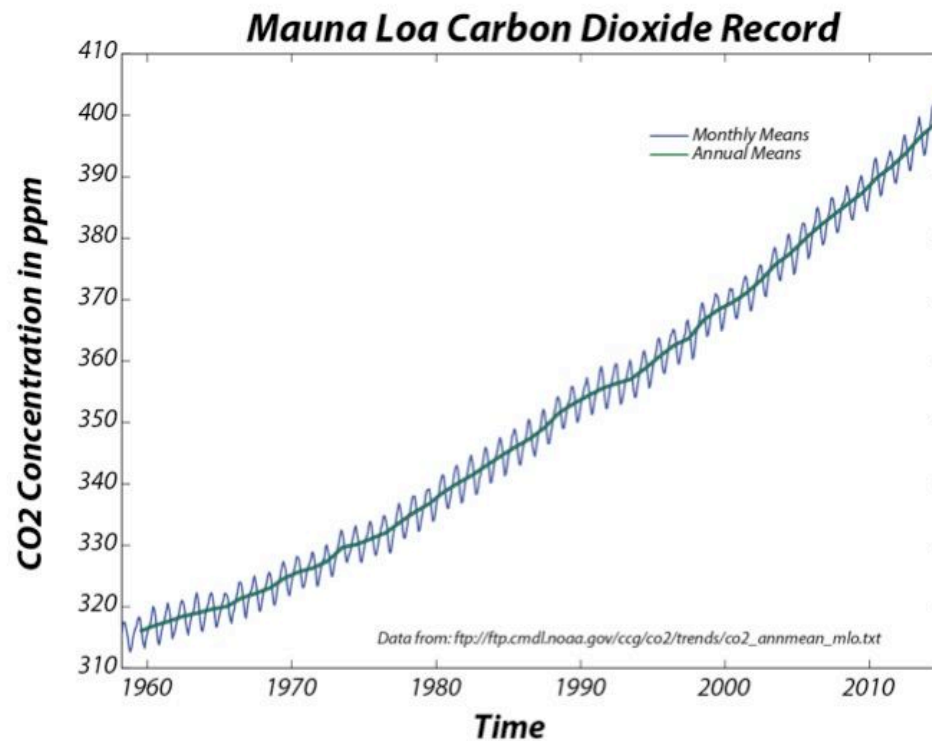
When was the last time in Earth's history that CO₂ was as high as it is now?



If we stopped burning fossil fuels today, what would happen to the climate?



What causes the annual up-and-down fluctuation in CO₂ in the atmosphere?



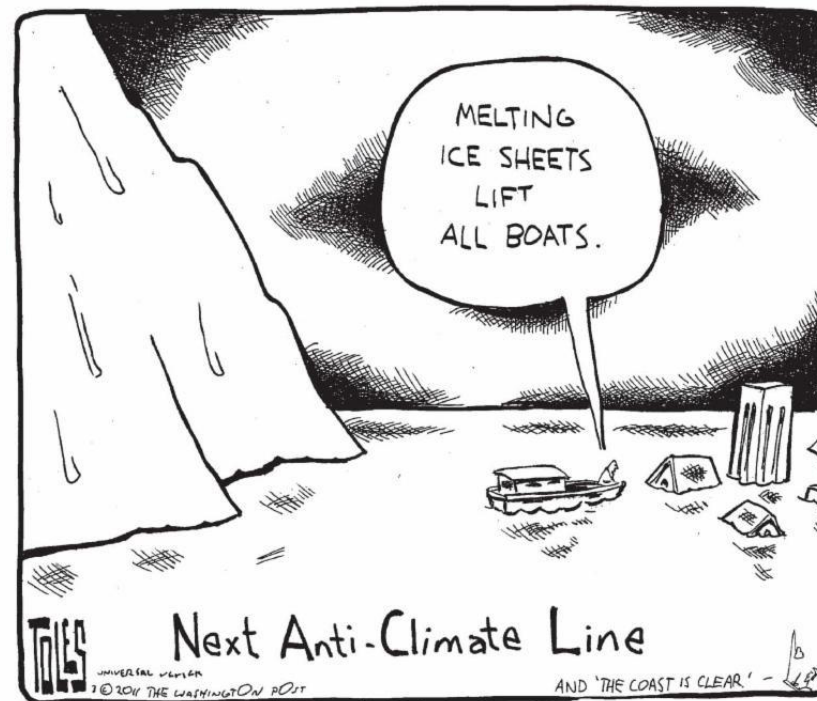
Describe 3 climate change adaptation approaches



Give three examples of Climate Geoengineering




List three of the most common climate change denialist claims and rebut them



Website – no printed material (save trees and energy)

http://www.uvm.edu/~pbierman/classes/climate/fall_2019/



The University of Vermont


APPLY SEARCH INFO



What's GEOL095/195 all about?

In one semester, you will learn the science of climate, climate change, and climate prediction. You will understand how Earth, its rocks, oceans, atmosphere and vegetation influence climate. Then, you will appreciate the impact of people who for thousands of years have altered Earth's climate.

2019 GEOLOGY 095 and 195 CLIMATE: past, present, future (T/Th 10:05-11:20 am, 301 Williams Hall)

2019 GEOL 095 and 195 Climate: past, present, future	<p>Over 16 weeks of fall semester, we will work to understand how the ocean, atmosphere, and land systems regulate Earth's climate, how climate has changed over time, and what it is likely do in the future. We will discover how humans have altered Earth's climate and learn the impact of climate on societies through time.</p> <p> Here is the information for class. Clicking on the links below and reading the PDFs will tell you everything you need to know about the class. To download the syllabus that describes class goals, expectations and grading, click here. For a list of Frequently Asked Questions with answers, click here. Click here to see the class learning goals. For our schedule this semester, click here.</p>
Syllabus	
Class FAQ	
Overall Class Schedule	
Class by Class: reading, goals, ppts	
Books you need and how to get	

Learning Goals

- Be able to explain fundamental controls on Earth's climate including: energy balance, ocean circulation, and atmospheric composition
- Understand how and on what timescales Earth's climate changed in the past
- Describe and provide evidence for human impacts on the climate system
- Predict how climate is likely to change in the future based on human impacts and what we as a global society can do to mitigate those impacts

Syllabus - Schedule

October 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
29	30	1 (Paul) Paleoclimate Proxies & Archives - Climate proxy concept, tree-rings, ice-cores, sediment cores READ: Ruddiman Ch. 3, 16, App 1& 2 QUIZ 3 (on reading)	2	3 (Paul) Paleoclimate I - Industrial & Holocene : The 'hockey stick', climate stability during Holocene, possible pre-industrial anthropogenic signal?	4	5
Week 6						
6	7	8 No Class - double class on Thursday Read: Ruddiman Ch. 17 QUIZ 4 (on reading)	9	10 Michael Mann Guest Lecture in class Michael Mann Burack Lecture in Chapel (4:30 pm, required)	11	12
Week 7						
13	14	15 (Chris) Paleoclimate II - Pleistocene : glacial/interglacial dynamics, Milankovitch theory READ: Ruddiman Ch. 7, 10 QUIZ 5 (on reading)	16	17 (Chris) Paleoclimate III - Greenhouse to icehouse : gradual cooling over last 50 Ma, evidence, hypotheses, Pliocene analogue for future climate	18	19
Week 8						
20	21	22 (Chris) Paleoclimate V - "Deep Time" : Greenhouse climate, Dinosaurs!, evidence hypotheses READ: Ruddiman Ch. 6 QUIZ 6 (on readings)	23	24 Exam - PALEOCLIMATE , based on Weeks 6-9	25	26
Week 9						
27	28	29	30	31	1	2

Iclickers and Reef

- Used for quizzes and for class responses
- Will test on Thursday - get yours before then and register on BB



Office Hours

- Faculty: Paul Bierman, pbierman@uvm.edu
- office hours in 307 Delehanty Hall, TUESDAY 845-945 am

- Chris Halsted, chalsted@uvm.edu
- office hours in 307 Delehanty Hall, WEDNESDAY 900-1100 am

- Mae Kate Campbell
- office hours in 314 Delehanty Hall, MONDAYS 100-300 pm

Grading – grades posted in Blackboard

- **Quizzes 10%.** Weekly 10-minute quizzes will be given starting the second week of the semester. Each quiz will cover the *assignments for the week of the quiz on the syllabus (including reading in the two books, assigned webpages, and assigned podcasts)*. You will be allowed to drop one quiz, either your lowest or the zero that results if you miss a quiz. There will be no make up quizzes. Quizzes will be done only using clicker software. Plan your travel for semester breaks accordingly. Plan to be in your seats when class starts and stay for the entire class period so as to get all the information you might need and so as not to miss the quiz which could come at any time during the class period. *You will be allowed to bring one piece of paper into each quiz on which you can write whatever information you deem pertinent to help you answer the quiz questions. The paper must be your own work and may not be shared.*
- **Class Attendance 10%.** We expect your attendance in all classes. We expect you to stay for the entire class period, not to come in late and not to leave early. Attendance will be determined by clicker questions during class. *You will be excused for at most two missed class or two clicker malfunctions unless there are extenuating circumstances explained to us ahead of the absence.*
- **Exams 60%.** At the end of each third of the course, there will be an exam. It will be taken at class time and will consist of short answer questions and a short essay. Exams will be open book and open notes.
- **Final paper 20%.** There will be a paper at the end of the semester in which you will express yourself creatively; it will incorporate revisions of small paragraph-length essays you will write as part of each of the three exams – you will be expected to revise and meld these paragraphs into a coherent final essay. The paper will be graded both for content and for the clarity of writing. We do not grade on the basis of effort.

Readings

- 1. Earth's Climate Third Edition ©2014 William F. Ruddiman, <https://store.macmillanlearning.com/us/product/Earths-Climate/p/1429255250>
- 2. The Madhouse Effect, How Climate Change Denial Is Threatening Our Planet, Destroying Our Politics, and Driving Us Crazy, Michael E. Mann and Tom Toles, <https://cup.columbia.edu/book/the-madhouse-effect/9780231177863>

WARNING – Be careful ordering books on line – many people in the past have gotten the wrong edition or have had their books delayed by weeks. You are responsible for having the books when the semester begins so you can read and learn.

- Other assignments will be posted to the class web site including webpages and podcasts. *When assigned, these are required and will be included on weekly quizzes.*

Expectations

- We expect you to respect your classmates and faculty at all times when they voice opinions that may differ from yours.
- We expect full attendance at every class; attendance will figure into your grade. We expect you to be in your seat **before 10:05** and not to leave the class until the period is **over at 11:20**. Coming to class late and leaving class early are distracting and interfere with others' ability to learn.
- We expect you to participate in the class by asking questions, doing in-class exercises, and completing clicker questions. We expect you to participate out of class by doing all assignments (web, podcast, book) before the class at which they are due.
- We expect complete academic honesty. We expect that you will neither give nor receive information on the quizzes and that assignments you hand in are your own work. You will sign an honor statement for each quiz, exam and paper
- We expect you to read this class syllabus, the class schedule, and the class FAQ carefully and inform yourself about the class, the assignments, and their due dates. It is your responsibility to know what assignments are due and when.
- We also have high expectations of ourselves as faculty. We will come to class prepared every time with the most interesting and informative slides, videos, and demonstrations we can muster.

See you Thursday – still spaces available

- Class introductions
- Global Climate System (GCS) - Global Energy Balance

