GEOL 437
Global Climate Change
Spring 2018

• Introduction
• Course structure
• About the instructor
• About you
• The nature of climate science

Class web page: http://one.geol.umd.edu/cc/
user name: geol437 (case sensitive)
password: spring2018 (case sensitive)
Late 20th Century: The World at Night

The Earth at Night, NASA Earth Observatory (http://earthobservatory.nasa.gov/Study/Lights/), accessed 8/18/07
Greenhouse gas concentrations are increasing

Figure 6.4 from the IPCC Working Group I, Fourth Assessment (2007), http://www.ipcc.ch/, accessed 8/29/07
Is the climate changing?
How?
How much?
How quickly?
How do current changes compare to past changes?
What is the record of past climate change?

The last century

Global Mean Estimates based on Land and Ocean Data

- Annual Mean
- Lowess Smoothing

What is the record of past climate change?

The last millennium

Agreement between 1-SE Northern Hemisphere temperature reconstruction uncertainties for 11 published reconstructions; from Fig. 6.10 from the IPCC AR4 WGI Report (http://ipcc-wg1.ucar.edu/wg1/), accessed 1/26/2009
What is the record of past climate change?

The Pleistocene

Antarctic ice core-derived greenhouse gas concentrations and deuterium isotope record, and globally-averaged benthic marine isotopic record, from Fig. 6.3 from the IPCC AR4 WGI Report (http://ipcc-wg1.ucar.edu/wg1/), accessed 1/26/09
What is the record of past climate change?

The mid Pliocene

Fig. 2. Surface air temperature anomalies of (top) the late 21st century and (bottom) the mid-Pliocene.

Comparison of simulations of 21st century and mid-Pliocene climate, from Robinson et al. (EOS, V.89 (49), 2 Dec. 2008)
What is the record of past climate change?

The Neoproterozoic

Reliable paleomagnetic measurements from the Elatina glacial marine deposits in South Australia place them at paleolatitudes <10 degrees at the time of sedimentation (Embleton & Williams, 1996; Schmidt et al, 1991; Schmidt & Williams, 1995; Sohl et al., 1999). Primary remnant magnetization due to detrital hematite has yielded positive syn-sedimentary fold tests and magnetic reversal tests. It is the most reliable result from a Precambrian sediment.
What are predictions of future climate change?

**Climate predictions for 2100**

Fig. 10.4, Meehl et al., 2007, “Global Climate Projections”, Ch. 10 in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC (S. Solomon et al., eds.). Cambridge: Cambridge Univ. Press.
What is the sensitivity of climate to forcing?

The climate sensitivity (change in surface temperature for a doubling in CO2) for a suite of CLIMBER-2 runs (an EMIC) plotted vs. the LGM SST cooling in the tropical Atlantic in those experiments. The proxy-observed range limits the inferred climate sensitivity based on the model results (green and purple lines). From von Deimling et al. (2006).
Meet EdGCM

Course structure

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About the instructor

- Geology & ESSIC (affiliate: AOSC, AMSC); specialty: Paleoclimatology

Ocean2k working group (2011-2015)

Queensland, Australia (2010)
Aitutaki, S. Cook Islands (2013)
Switzerland (2013); Spain/France (2017)

Want to learn more about what I do? See http://one.geol.umd.edu/
About you
About you (Part 2)
The nature of climate science

Fig 1 (left) from Stott et al (2000)
Summary and questions for the semester

• Climate science relies on testing and disproof, but because we are unable to perform experiments on the actual system, we rely on inferences from naturally occurring “experiments” and from comparison with simulations.

• Questions for the semester:
  • What are the mechanisms by which the climate may change?
  • How is projected climate change similar to and different from past climate changes?
  • What is the sensitivity of climate to perturbations (forcings)?

• Next:
  • Radiation balance and the greenhouse effect (1/30, 2/1)

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