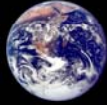


The Case for Anthropogenic Warming, I

Richard McGehee



Seminar on the Mathematics of Climate Change
School of Mathematics
September 8, 2010



The Case for Anthropogenic Warming

What's at stake?

Where is Public Opinion?

Is the globe warming?

What determines the Earth's temperature?

Did human activity cause the problem?

How big is the problem?



The Case for Anthropogenic Warming

What's at stake?

- No ice fishing in Minnesota
- No polar bears in the Arctic
 - No ice in Antarctica
 - No Florida

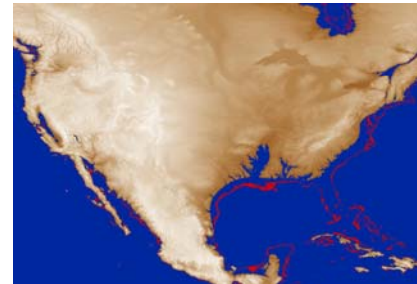


The Case for Anthropogenic Warming

What's at stake?

The USA in the Ice Free Earth

Computer Simulation, Clarence Lehman, Univ. Mn. 2006

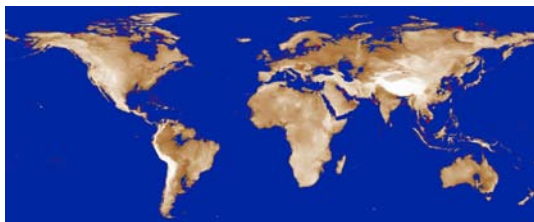


The Case for Anthropogenic Warming

What's at stake?

The Modern Ice Free Earth

Computer Simulation, Clarence Lehman, Univ. Mn. 2006



Sea level rises 63 meters.



The Case for Anthropogenic Warming

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The Case for Anthropogenic Warming Is the Globe Warming?

Public Perception

Opinions about Global Warming 2006-2009				
Is there solid evidence the earth is warming?	Aug 2006	Jan 2007	April 2008	Oct 2009
	%	%	%	%
Yes	77	77	71	57
Because of human activity	47	47	47	36
Because of natural patterns	20	20	18	16
Don't know (Vol.)	10	10	6	6
No	17	16	21	33
Mixed/Don't know (Vol.)	6	7	8	10
	100	100	100	100

Q41 & Q42. Figures may not add to 100% because of rounding.

The Pew Research Center for People and the Press, October 22, 2009
<http://people-press.org/report/556/global-warming>



The Case for Anthropogenic Warming

Public Perception

Across Partisan Lines, Fewer See Solid Evidence of Global Warming


Party	2006	2007	2008	2009
Dem	91	86	83	75
Inc	79	76	75	53
Rep	59	62	49	35

Most Republicans See No Solid Evidence of Global Warming

Group	Aug 2006	Jan 2007	April 2008	Oct 2009
Republicans				
See solid evidence of warming	59	62	49	35
Because of human activity	31	29	27	18
Because of natural patterns	18	17	15	13
Don't know (Vol.)	11	7	8	11
No solid evidence of warming	37	34	42	57
Mixed/Don't know (Vol.)	6	7	8	11
	100	100	100	100
Democrats				
See solid evidence of warming	91	86	83	75
Because of human activity	57	57	57	47
Because of natural patterns	20	20	18	16
Don't know (Vol.)	11	10	6	6
No solid evidence of warming	8	10	17	21
Mixed/Don't know (Vol.)	4	6	8	10
	100	100	100	100
Independents				
See solid evidence of warming	79	77	71	57
Because of human activity	47	47	47	36
Because of natural patterns	20	20	18	16
Don't know (Vol.)	8	13	7	6
No solid evidence of warming	14	14	18	33
Mixed/Don't know (Vol.)	6	11	7	10
	100	100	100	100


Q41 & Q42. Figures may not add to 100% because of rounding.

The Pew Research Center for People and the Press, October 22, 2009
<http://people-press.org/report/556/global-warming>



The Case for Anthropogenic Warming Is the Globe Warming?


Public Perception



Q Do you think it's been proven beyond a reasonable doubt that the Earth is warming because of man-made problems?

Democrats (41 votes)		Republicans (31 votes)			
	(Nov)	(April 2008)		(Nov)	(April 2008)
Yes	95 percent	93 percent	Yes	13 percent	23 percent
No	2 percent	2 percent	No	84 percent	77 percent
Scientific consensus (overruled)	2 percent		Only part of the cause (unanswered)	3 percent	

National Journal, Feb 3, 2007
http://syndication.nationaljournal.com/images/203Insiderspoll_NJlogo.pdf



The Case for Anthropogenic Warming Is the Globe Warming?


Public Perception

How much is Antarctica warming? Officials get firsthand look, Star Tribune, February 23, 2009

Online Comments: 2 favorable, 6 unfavorable


"Global [w]arming [c]annot be proved to be caused by humans. It can't. The earths climate has been constantly changing for billions of years. You global warming believers are nothing more than useful idiots to a bunch of politicians who want more control over our lives." Posted by toddoruno on Feb. 24, 2009.

Star Tribune, Feb 23, 2009
http://comments.startribune.com/comments.php?d=asset_comments&asset_id=40181592§ion=world



The Case for Anthropogenic Warming

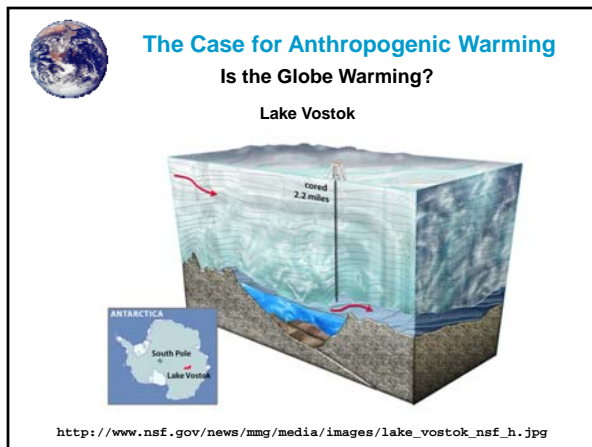
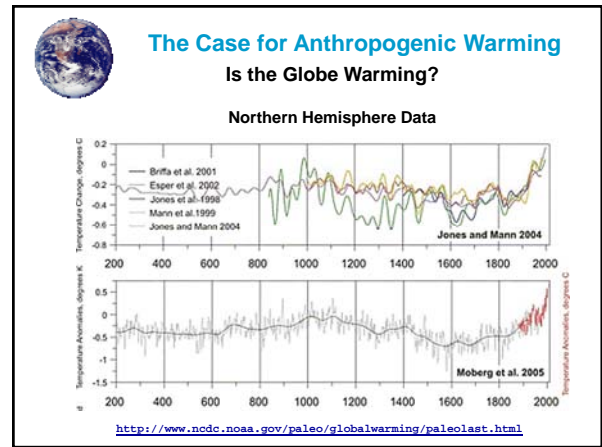
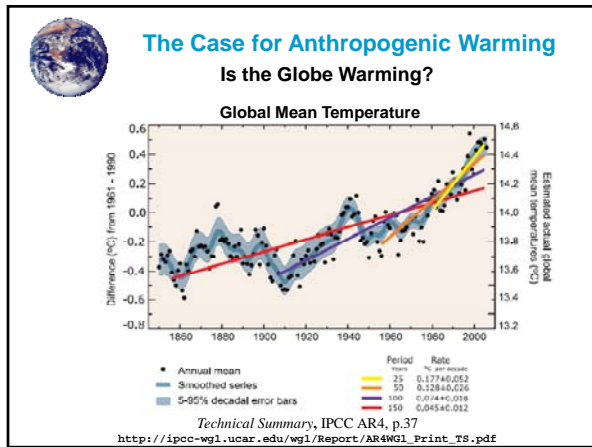
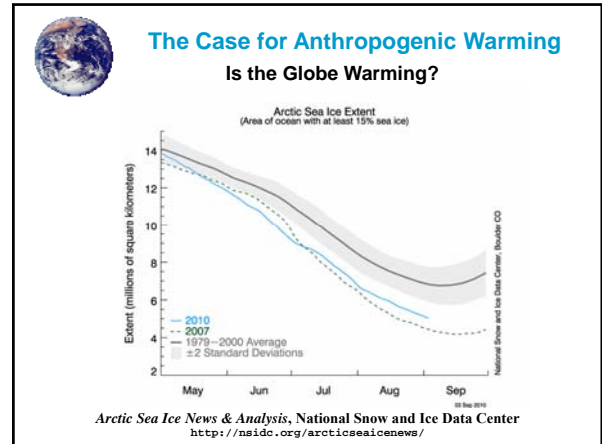
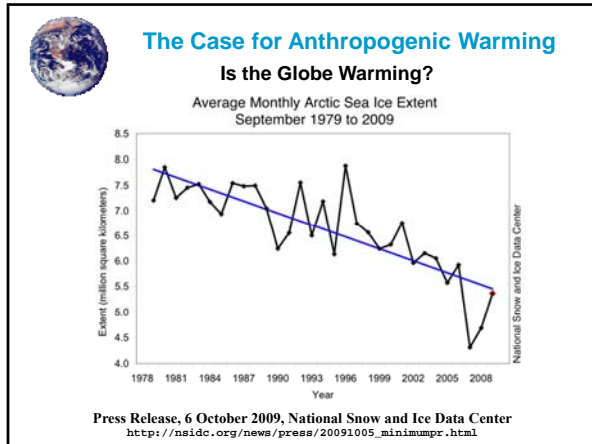
What's at stake?
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The Case for Anthropogenic Warming Is the Globe Warming?

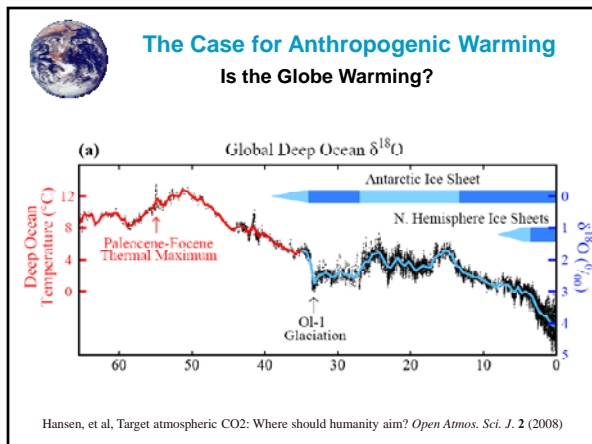
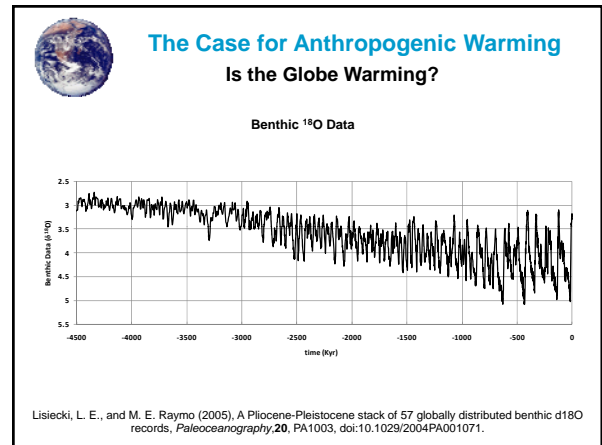
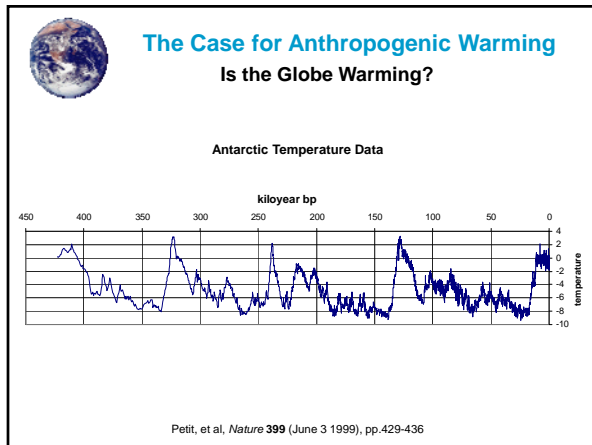
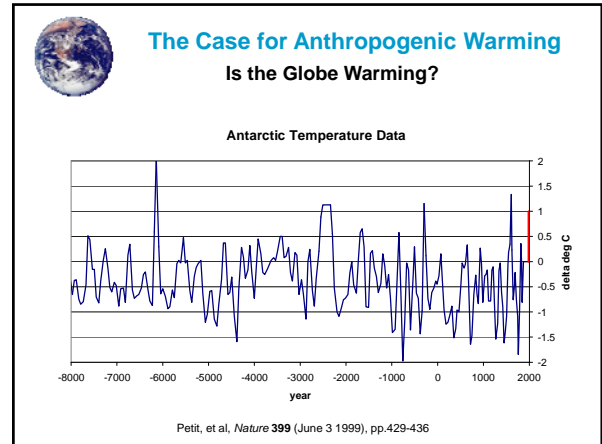
2007 Polar Sea Ice

Press Release, 1 October 2007, National Snow and Ice Data Center
http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html



The Case for Anthropogenic Warming
Is the Globe Warming?

Core Samples
Photographs copyright Reto Stöckli, NASA GSFC



The Case for Anthropogenic Warming

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The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Heat Balance

$$T^4 = kS$$

where T = surface temperature ($^{\circ}\text{K}$)

S = solar influx (W/m^2)

k = constant depending on reflectivity of the surface, emissivity of the surface, and the Stefan-Boltzmann constant.

For the current value of k , $T = 255^{\circ}\text{K} = -18^{\circ}\text{C} = [0^{\circ}\text{F}]$

Why isn't the Earth a Snowball?

C.Lorius, The ice-core record: climate sensitivity and future greenhouse warming, *Nature* 347 (1990), pp.139-145



The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Why isn't the Earth a Snowball?

The Greenhouse Effect!

Joseph Fourier, *Mémoires de l'Académie des Sciences de l'Institut de France*, t. vii. 1827.



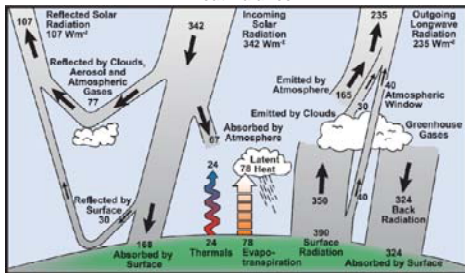
Svante Arrhenius, "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground," *Philosophical Magazine and Journal of Science (Fifth Series)* 41, pp. 237-276, 1896.



The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Heat Balance



Historical Overview of Climate Change Science, IPCC AR4, p.96
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_CH01.pdf

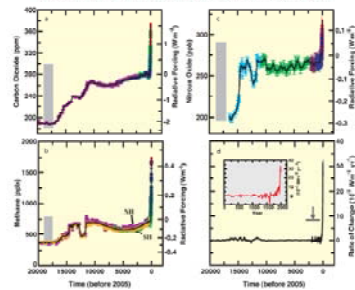


The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Radiative Forcing by Greenhouse Gases

CHANGES IN GREENHOUSE GASES FROM ICE CORE AND MODERN DATA



Technical Summary, IPCC AR4, p.25

http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

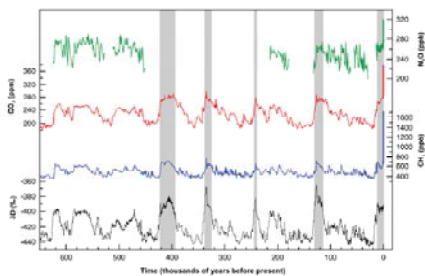


The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Greenhouse Gases

GLACIAL-INTERGLACIAL ICE CORE DATA



Technical Summary, IPCC AR4, p.24

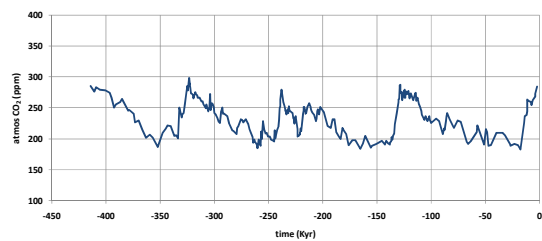
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf



The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Atmospheric CO₂ (Vostok data)

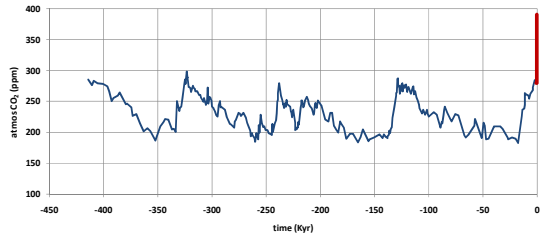




The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

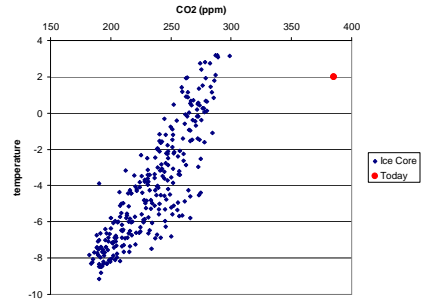
Atmospheric CO₂ (Vostok data)



The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Vostok Data



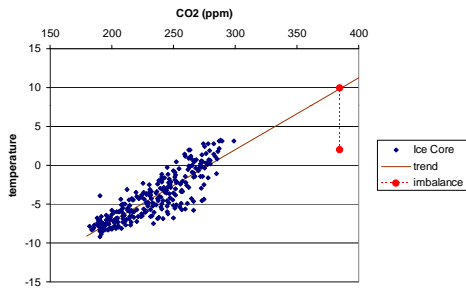
Current conditions are well outside the range recorded in the ice core data.



The Case for Anthropogenic Warming

What Determines the Earth's Temperature?

Vostok Data



The Case for Anthropogenic Warming

to be continued ...