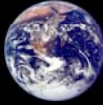



**The Case for Anthropogenic Warming, I**  
 Richard McGehee



Seminar on the Mathematics of Climate Change  
 School of Mathematics  
 September 7, 2011

**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**



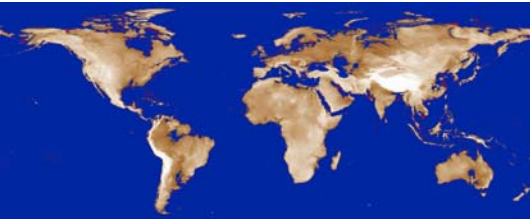
**What's at stake?**  
**The USA in the Ice Free Earth**  
 Computer Simulation, Clarence Lehman, Univ. Mn. 2006



**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: 2006-2010

|  | July 2006 | Jan 2007 | April 2008 | Oct 2009 | Oct 2010 |
|--|-----------|----------|------------|----------|----------|
| <b>Is there solid evidence the earth is warming?</b> | %         | %        | %          | %        | %        |
| Yes  | 79        | 77       | 71         | 57       | 59       |
| Because of human activity                            | 50        | 47       | 47         | 36       | 34       |
| Because of natural patterns                          | 23        | 20       | 18         | 16       | 18       |
| Don't know   | 6         | 10       | 6          | 6        | 6        |
| No   | 17        | 16       | 21         | 33       | 32       |
| Mixed/Don't know                                     | 4         | 7        | 8          | 10       | 9        |
|  | 100       | 100      | 100        | 100      | 100      |

The Pew Research Center for People and the Press, October 27, 2010  
<http://people-press.org/2010/10/27/little-change-in-opinions-about-global-warming/>




## The Case for Anthropogenic Warming Is the Globe Warming?

Public Perception

|   | July 2006 | Jan 2007 | April 2008 | Oct 2009 | Oct 2010 |
|---|-----------|----------|------------|----------|----------|
| <b>Do scientists agree the earth is getting warmer because of human activity?</b> | %         | %        | %          | %        | %        |
| Yes   | 59        | --       | --         | --       | 44       |
| No  | 29        | --       | --         | --       | 44       |
| Don't know  | 12        | --       | --         | --       | 12       |
|   | 100       | --       | --         | --       | 100      |

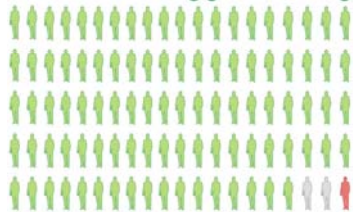
The Pew Research Center for People and the Press, October 27, 2010  
<http://people-press.org/2010/10/27/little-change-in-opinions-about-global-warming/>




## The Case for Anthropogenic Warming Is the Globe Warming?

Scientific Opinion

97 out of 100 climate experts think humans are causing global warming



John Cook, *Skeptical Science*, 11 May 2011  
<http://www.skepticalscience.com/news.php?n=734>



## The Case for Anthropogenic Warming Is the Globe Warming?


Public Perception

Wide Partisan Differences in Views About Global Warming

| Is the solid evidence the earth is warming? | Rep | Dem | Ind |
|---|-----|-----|-----|
|   | %   | %   | %   |
| Yes   | 38  | 79  | 56  |
| Because of human activity                   | 16  | 53  | 32  |
| Because of natural patterns                 | 18  | 18  | 17  |
| Don't know (Vol.)                           | 3   | 8   | 7   |
| No  | 53  | 14  | 31  |
| Mixed/Don't know (Vol.)                     | 9   | 6   | 12  |


| Do scientists agree the earth is getting warmer because of human activity? | Rep | Dem | Ind |
|--|-----|-----|-----|
|  | %   | %   | %   |
| Yes  | 30  | 59  | 41  |
| No   | 58  | 32  | 45  |

The Pew Research Center for People and the Press, October 27, 2010  
<http://people-press.org/2010/10/27/little-change-in-opinions-about-global-warming/>



## The Case for Anthropogenic Warming Is the Globe Warming?


Public Perception



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) |                                       |
|-------------------------------------|------------|------------------------|---------------------------------------|
|                                     | (Now)      | (April 2006)           |                                       |
| Yes                                 | 95 percent | 98 percent             | Yes                                   |
| No                                  | 2 percent  | 2 percent              | No                                    |
| Scientific consensus (voluntarered) | 2 percent  |                        | Only part of the cause (voluntarered) |
|                                     |            |                        | 84 percent                            |
|                                     |            |                        | 77 percent                            |
|                                     |            |                        | 3 percent                             |

National Journal, Feb 3, 2007  
[http://syndication.nationaljournal.com/images/203Insiderspoll\\_NJlogo.pdf](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\\_commentsasset\\_id=40181592&section=world](http://comments.startribune.com/comments.php?d=asset_commentsasset_id=40181592&section=world)



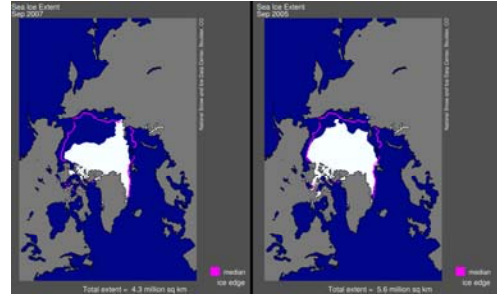
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## The Case for Anthropogenic Warming

**Is the Globe Warming?**  
 2007 Polar Sea Ice

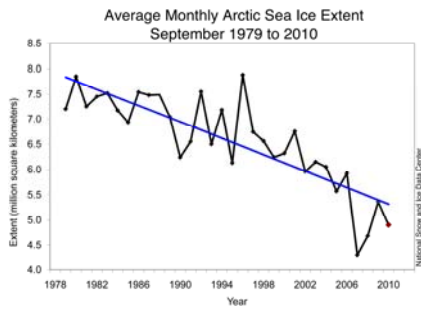


Press Release, 1 October 2007, National Snow and Ice Data Center  
[http://nsidc.org/news/press/2007\\_seaiceminimum/20071001\\_pressrelease.html](http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html)



## The Case for Anthropogenic Warming

**Is the Globe Warming?**

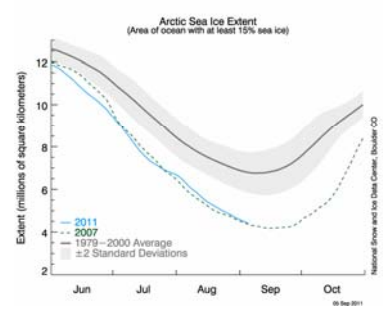


Press Release, 10 October 2010, National Snow and Ice Data Center  
<http://nsidc.org/arcticseaicenews/2010/100410.html>



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**Is the Globe Warming?**

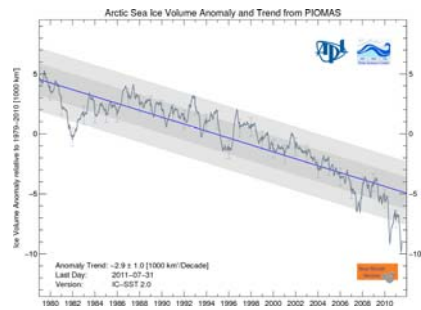


Arctic Sea Ice News & Analysis, National Snow and Ice Data Center  
<http://nsidc.org/arcticseaicenews/>



## The Case for Anthropogenic Warming

**Is the Globe Warming?**

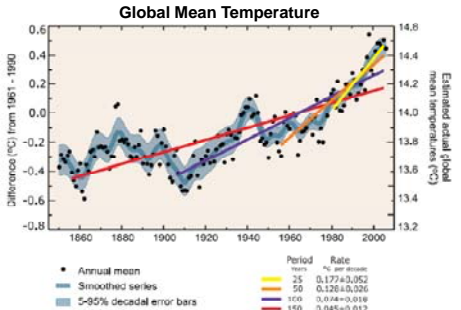


Arctic Sea Ice Volume Anomaly, version 2, Polar Science Center, September, 2011  
<http://psc.ap1.washington.edu/wordpress/research/projects/arctic-sea-ice-volume-anomaly/>

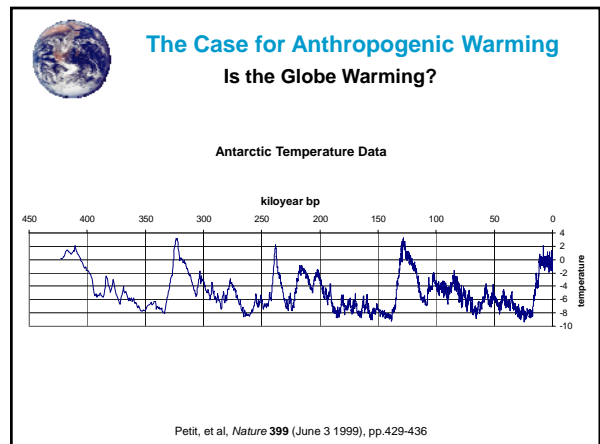
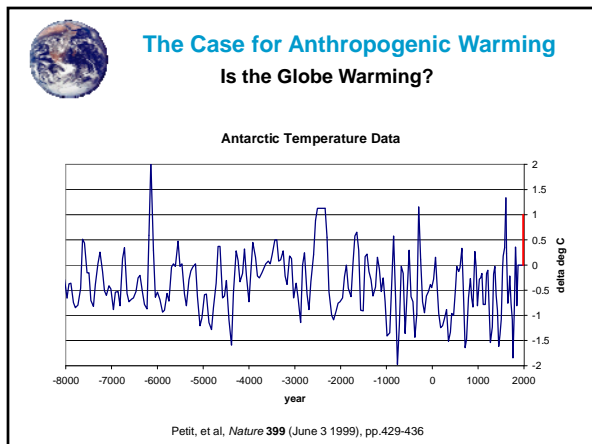
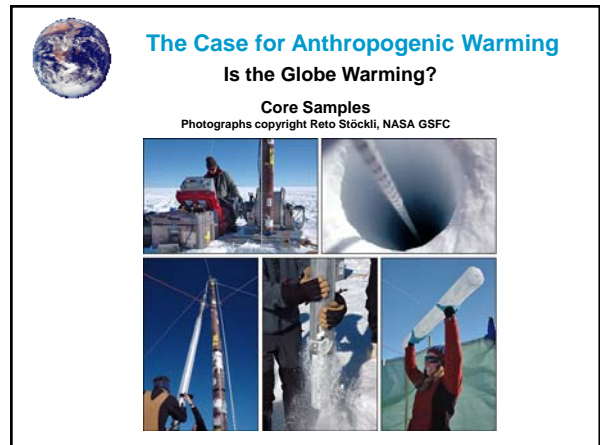
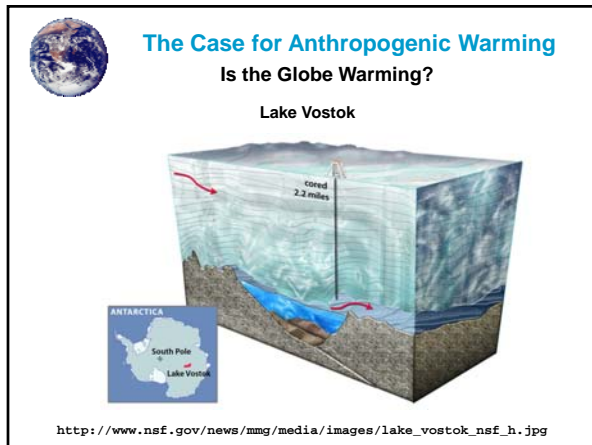
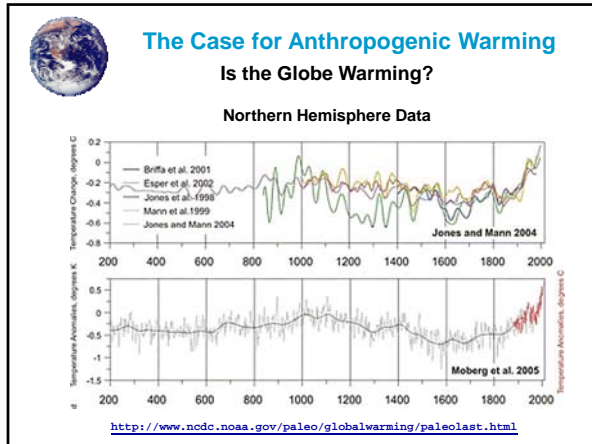


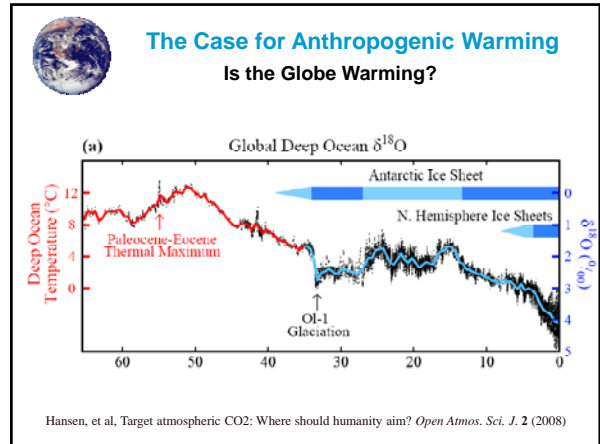
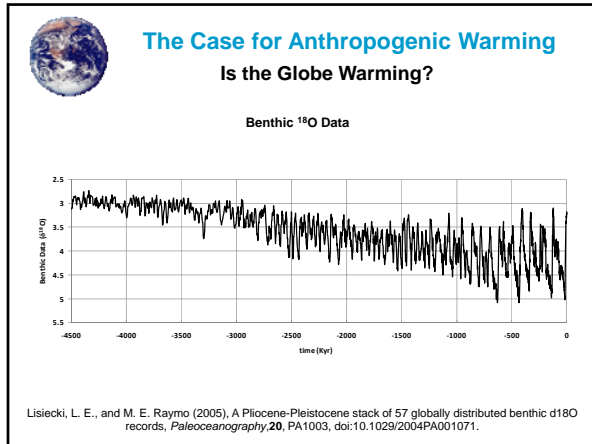
## The Case for Anthropogenic Warming

**Is the Globe Warming?**



Technical Summary, IPCC AR4, p.37  
[http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_TS.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf)





### 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 (°K)  
 $S$  = solar influx (W/m<sup>2</sup>)  
 $k$  = constant depending on reflectivity of the surface, emissivity of the surface, and the Stefan-Boltzmann constant.

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

**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.

