

# Answers to Climate Change Questions

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This handout addresses some of the key questions on climate change and includes citations for follow-up.

## I) Do scientists agree that humans are causing recent changes in climate?

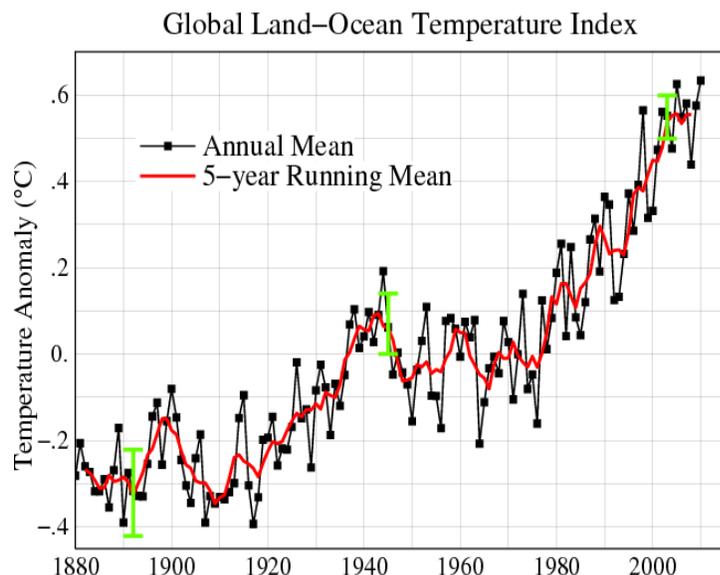
As to the suggestion that the scientists are not settled, here is journal article reporting on a survey to address that question: [http://tiger.uic.edu/~pdoran/012009\\_Doran\\_final.pdf](http://tiger.uic.edu/~pdoran/012009_Doran_final.pdf) To summarize the report, the survey was sent to every US geoscientist (academic, state government, federal government) in an extensive database. The survey was simple to aid in getting a large number of responses. To the question about believing that "...human activity is a significant contributing factor in change mean global temperatures" the percent agreement was high for all subgroups (>75%) with increasing numbers of those who study climate and those who are publishing authors. For professional climatologists who publish peer-reviewed papers, 72 of 75 agree with the statement. As you can judge for yourself, that is about as clear a consensus as can be reached among scientists who are incredibly independent and cautious about agreeing to something so general.

Also in this vein, the presidents of 17 major scientific societies, including the largest (ACS) and the primary broad-based (AAAS) presented testimony to Congress in October confirming the consensus. Here is the text of the letter: [http://www.aaas.org/news/releases/2009/media/1021climate\\_letter.pdf](http://www.aaas.org/news/releases/2009/media/1021climate_letter.pdf)

## II) What data do we have on global temperatures?

The data trend is clearly positive since 1880 when reasonably reliable direct temperature measurements were first possible. The official data from NASA is at: <http://data.giss.nasa.gov/gistemp/graphs/>

The data from the other two the groups in the world (NOAA and the British agency) track very similarly. The recent "cooling" issue is also not real. According to NASA data 2005 has been the hottest year in modern times, so any year after that is "cooler", but it is not surprising that there is variability in the annual averages. 2008 was cooler, but 2009 tied for the second warmest year according to modern records – and 2010 tied for the warmest, matching 2005!

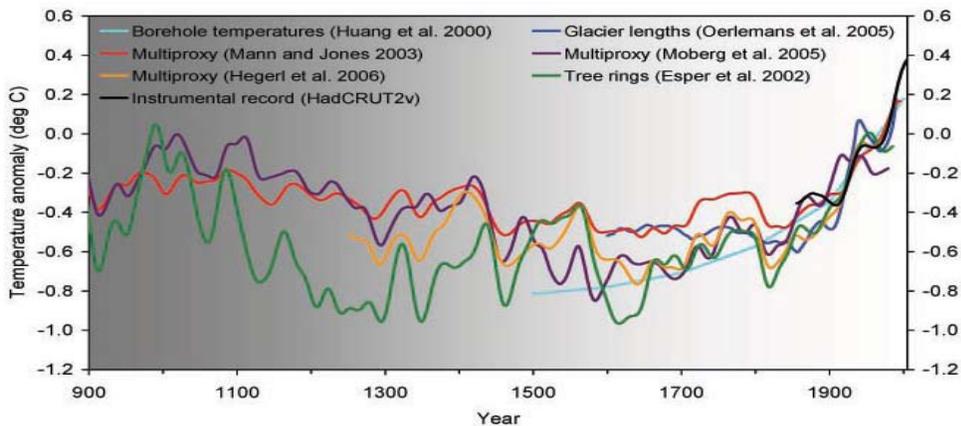


Line plot of global land-ocean temperature index, 1880 to present, with the base period 1951-1980. The dotted black line is the annual mean and the solid red line is the five-year mean. The green bars show uncertainty estimates. (Last modified 1/12/2011) NASA

Here is a posting on medium-long trends and predictions from these:

<http://tamino.wordpress.com/2009/12/07/riddle-me-this/>

This is a National Academy of Sciences figure that shows a longer historical perspective:



This is what the most prestigious science organization in this country states about the data shown above:

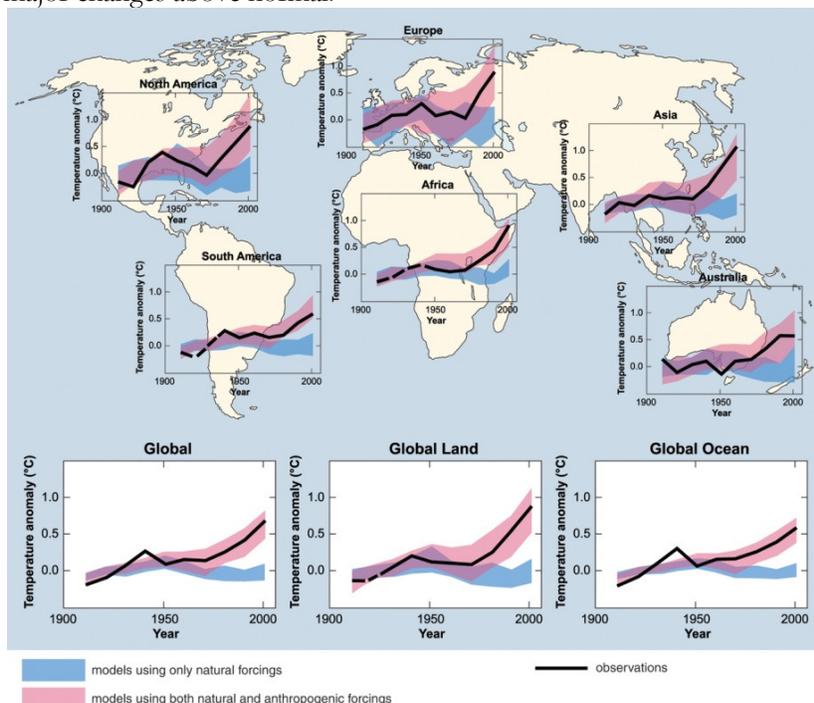
“It can be stated with a high level of confidence that global mean surface temperature was higher during the last few decades of the 20<sup>th</sup> century than during any comparable period during the previous four centuries.” The full report can be found here: <http://dels.nas.edu/climatechange/understanding-climate-change.shtml>

### III) But predictions are just models, right?

This answer and the next use figures from the IPCC 4<sup>th</sup> Assessment Report which can be found at:

[http://www.ipcc.ch/publications\\_and\\_data/publications\\_ipcc\\_fourth\\_assessment\\_report\\_synthesis\\_report.htm](http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm)

The earth is warming - but, of course, why is a separate question. A key question is how good is the modeling at predicting temperature change? This figure shows the results of modeling calculations for various regions. The solid line is actual data, the light blue models without humans and the purple with the models indication of human impacts. Obviously the models do reproduce the effect of humans, indicating that it is humans are responsible for major changes above normal.

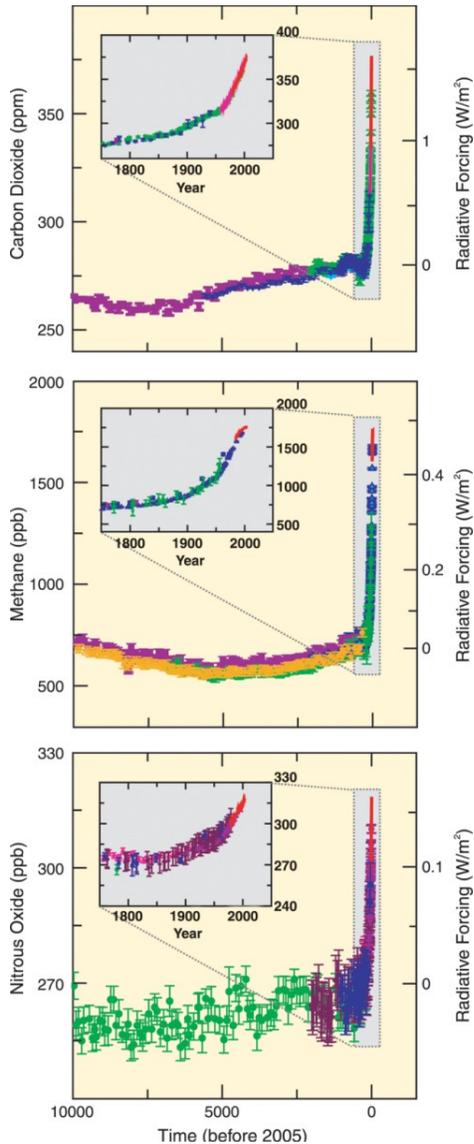


#### IPCC 4<sup>th</sup> Synthesis Report

**Figure 2.5.** Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using either natural or both natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906-2005 (black line) plotted against the centre of the decade and relative to the corresponding average for the 1901-1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5 to 95% range for 19 simulations from five climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5 to 95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings. (WGI Figure SPM.4)

#### IV) Do we have data on carbon dioxide levels?

This is a figure from the IPCC Report showing green house gas concentrations since pre-history to the present. The major changes since humans started to produce these gases are quite apparent.

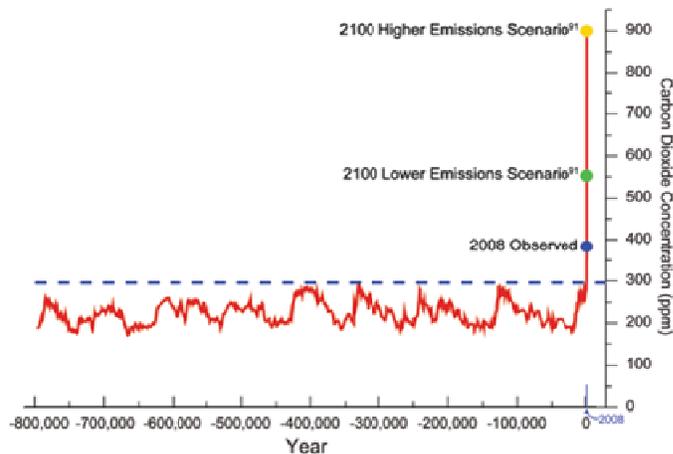


#### IPCC 4<sup>th</sup> Synthesis Report

**Figure 2.3.** Atmospheric concentrations of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines). The corresponding radiative forcings relative to 1750 are shown on the right hand axes of the large panels. {WGI Figure SPM.1}

This does not prove that the gases came from humans, but the analysis of the carbon-14 level indicates that the sources of the carbon-based gases are very old and therefore indicative of being from fossil fuels.

On the next page you will find a longer time frame from the 2009 Global Climate Change Impacts in the United States. The full report can be found at: <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts>



As you can see, we are already at a level of carbon dioxide 30% higher than the record indicates for 800,000 years. And even the lowest level projection for 2100 is almost twice as great as the historical high.

#### V) Isn't this a problem of the world, not just the US?

Yes, the atmosphere knows no country boundary. But until recently the US was the emitter of more carbon dioxide than any other country of the world. China has displaced us in this distinction, but they have 4 times the population that we have. The average annual carbon dioxide emissions per person in the world equal 4.6 tons while that of China is 4.9 tons. While emissions for other developed countries emit about 10 tons per person (e.g., 9.8 tons for Germany and 10 tons for Japan), the US average is 19 tons! Clearly this is a situation that demands action in the US to prevent problems in other countries that are caused by our actions

#### VI) Why don't we wait until we are absolutely sure of the impacts of climate change?

That would be too late to prevent very serious damage. In fact there many scientists believe that we have little time to respond to this problem. And since many responses will actually save us money, reduce our dependence on foreign oil and reduce air pollution it is prudent to make changes.

A parallel circumstance is your physician telling that you need to make major adjustments to our behavior, such as quit smoking or the consequences could be grave. If you ask if there is a guarantee that you would get cancer if you keep smoking or if there is a guarantee that you would not get cancer if you stopped smoking, the answer is that there are no guarantees – but the change would surely improve your odds of surviving. It is time to make the changes that will increase our odds of getting past this problem.

#### General References:

- A presentation by Dr. John Holdren of Harvard and now science advisor to the president:  
<http://www.ncseonline.org/Conference/Chafee08final.pdf>
- This is a high-quality blog that is updated frequently and includes important links. One of the authors is a key climate scientist at NASA. <http://realclimate.com/>
- A general source for information on climate change: <http://www.newscientist.com/article/dn11462-climate-change-a-guide-for-the-perplexed.html>
- An editorial in The Guardian and 55 other newspapers from around the world:  
<http://www.guardian.co.uk/commentisfree/2009/dec/06/copenhagen-editorial>
- You can get many references on the sheet that is available for downloading from my webpage:  
<http://www.utoledo.edu/as/chemistry/people/Webpages/Jorgensen.html>
- For a broad overview you can read this article by the environmental report of the Toledo Blade:  
<http://www.toledoblade.com/apps/pbcs.dll/article?AID=/20091213/NEWS16/912130304>