

# Ocean Warming: The New Bluff in Climate Alarmism

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## Summary for Policymakers

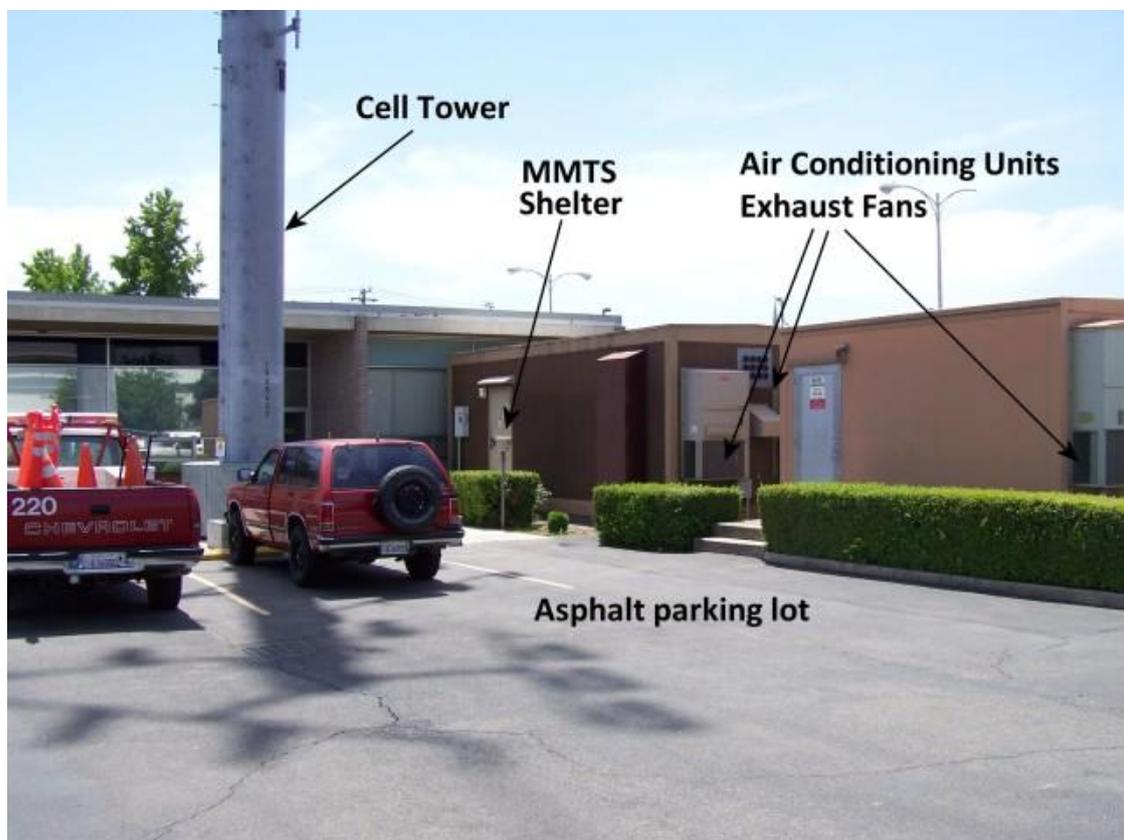
- *Air temperatures have been falling for years.* Satellites show that 1998 was the warmest recent year and that a cooling trend started in 2002. The land-based thermometer data is corrupted by artificial heating sources close to 89% of its thermometers, and is heavily “corrected”. But even it now shows a cooling trend developing from 2006.
- *The alarmists recently switched to ocean temperature* to measure global warming.
- *The alarmists claim the world is still warming, that heat is building up in the oceans, and that the ocean temperature is rising and rising fast.* These claims implicitly depend on a time period to say what a “trend” is, because temperatures fluctuate. The alarmists provide the context by showing trends of 20 to 50 years. This is a clever trick to reframe the debate, and essential to their case.
- *Ocean temperatures have only been measured properly from mid 2003,* when the Argo network became operational. Over 3,000 Argo floats cover all the world’s oceans. They dive down to measure temperatures, then resurface to radio back the information. The previous XBT system did not monitor huge areas of ocean, did not go as deep, and was much less accurate.
- *Ocean temperatures are dropping slightly.* The Argo data shows that the oceans have been cooling slightly since mid 2003.
- *Short-term trends contradict the alarmist claims.* Our best data, from satellites and Argo, shows that the air and oceans have not warmed for at least five years. The world is now cooling slightly, so there is no heat accumulating. Some natural cooling force is currently stronger than the warming due to human emissions.
- *Long-term trends contradict the alarmist claims.* The world has been recovering from the little ice age, warming at a steady trend rate since 1750 with alternate warming and cooling oscillations of about 30 years. The pattern suggests we have just finished the last warming, and have entered a cooling period until about 2030.
- *The latest alarmist claims are a bluff.* The alarmist claims only appear credible if trends shorter than 10 years or longer than 50 years are ignored. But it will take time to inform the public and politicians that the alarmist’s claims are baseless. With the US climate bill now being debated and the Copenhagen climate conference coming up in December 2009, *they only need to make the public believe their schtick for a few months.*
- *Problems with alarmist graphs of ocean heat.* They omit Argo data by stopping in 2003, or contradict it by showing ocean warming continuing through 2006.

## Air Temperatures Have Been Falling For Years

All four global temperature records now agree that (surface) air temperatures are falling. It's important to understand the difference between satellite data and land-based thermometer data, because the alarmists ignore satellite data and use the land-based thermometer data to “spin” the results.

Satellites are best at measuring air temperatures, because they work 24/7 measuring broad swathes of air over both land and ocean, across the whole world except the poles. But satellite data only goes back to 1979.

Land-based thermometers are still used to measure temperatures, but that data is compromised by the *urban heat island* effect—the microclimate around a land-based thermometer can change due to urban encroachment, such as nearby asphalt, concrete, buildings, air conditioners, cars, electrical appliances, or changes in vegetation.



*Figure 1: The land-based thermometer site at Marysville California, used to gather official temperature data. The thermometer is in the “MMTS Shelter”; it gets extra warming from several micro-site effects. [Source](#).*

Anthony Watts, a 25-year broadcast meteorology veteran, recruited 650 volunteers to inspect and document the 1,221 land-based thermometers overseen by the National Oceanic and Atmospheric Administration (NOAA) in the US. Of the 860 thermometers inspected to date, **89% fail** to meet NOAA’s siting requirements that they be more than 30 meters from an artificial heating or radiating/reflecting heat source. NOAA call their network “high quality”. [[Watts 2009](#), [NOAA 2008](#)]

The global GISS land data comes from 1,079 land-based thermometers, 134 of them in the USA from the NOAA network above. More than half, 554 of them, are at airports—typically near tarmac, and often in the exhaust of planes. [Goetz 2009]



Figure A2: [Ciampino Airport](#) in Rome, Italy. The three thermometers shown get affected by planes, the tarmac, and the truck parking lot.

Let's look at each of the four global air temperature records record, noting whether they use satellites and/or land-based thermometers, and focus on the warmest year and the major trends. (The following four graphs are formatted the same, except that the temperature-change scale can vary slightly due to auto-scaling and they have different zero-temperatures.)

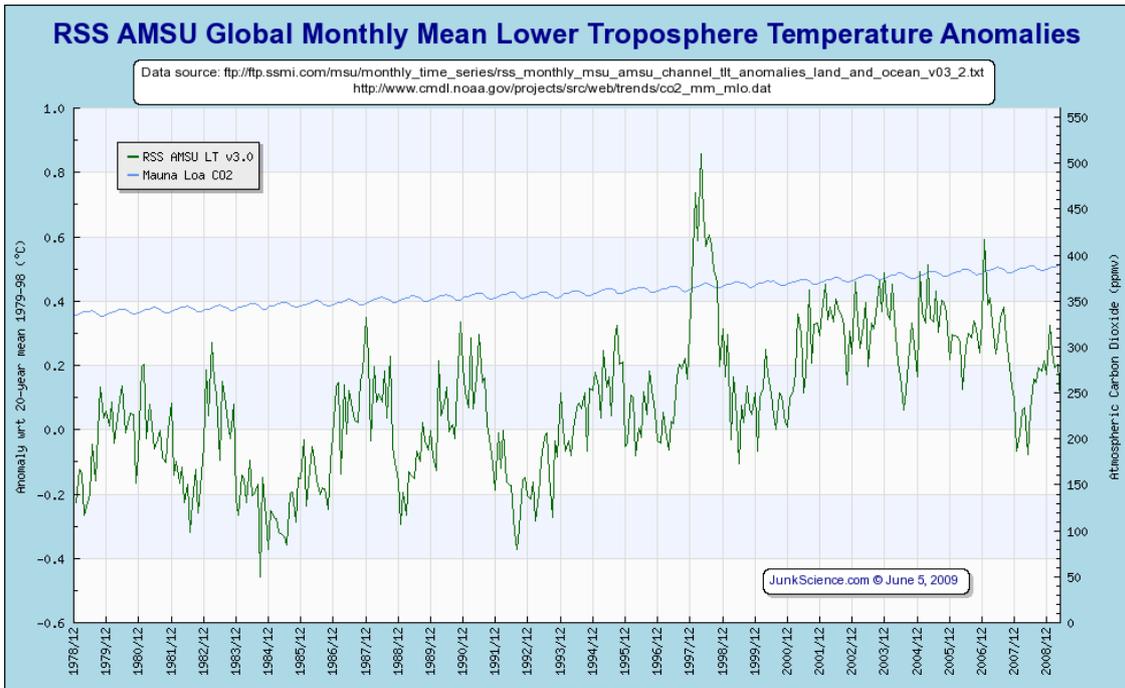


Figure 2: From Remote Sensing Systems in California. Satellite data only. [Source](#).

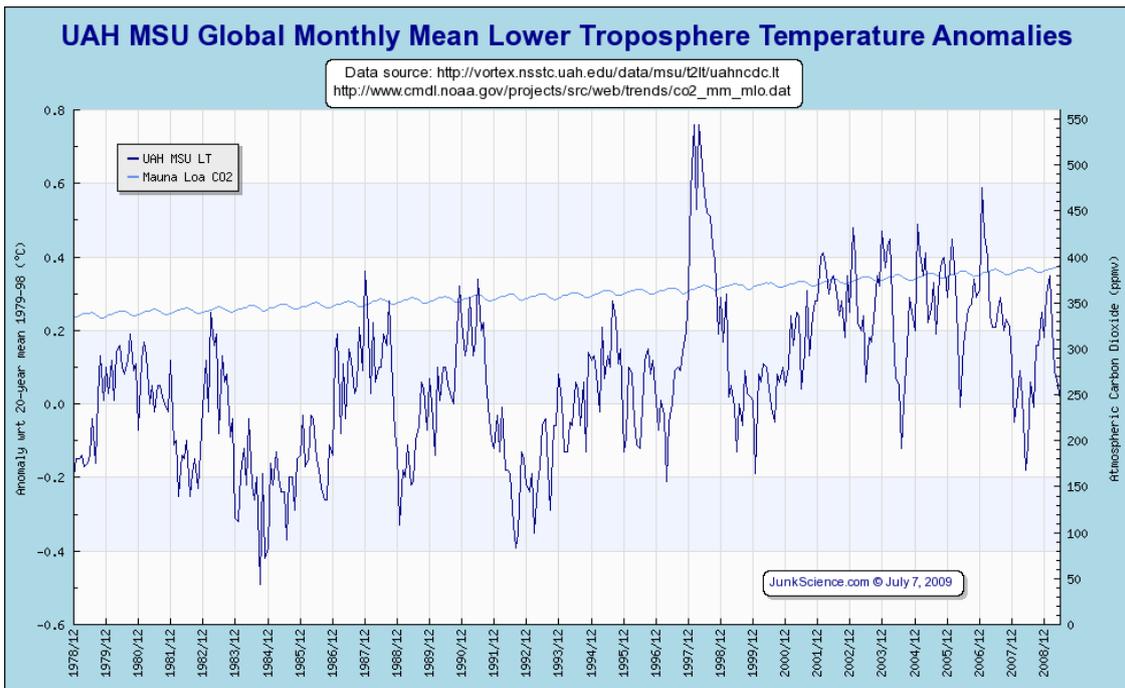


Figure 3: From the University of Alabama in Huntsville, using the NASA Aqua satellite. Satellite data only. [Source](#).

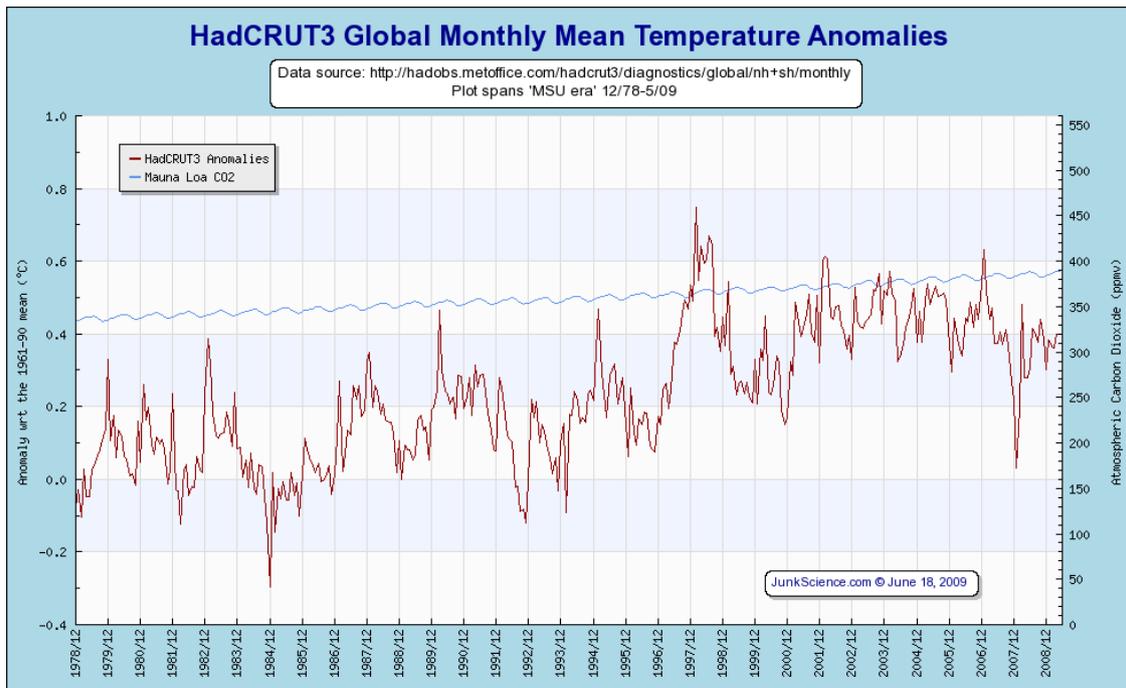


Figure 4: From the Hadley Centre in the UK. Mix of satellite data and land-based thermometers. Although Hadley use the same land-based thermometer raw data as GISS (next figure), they process it differently. [Source](#).

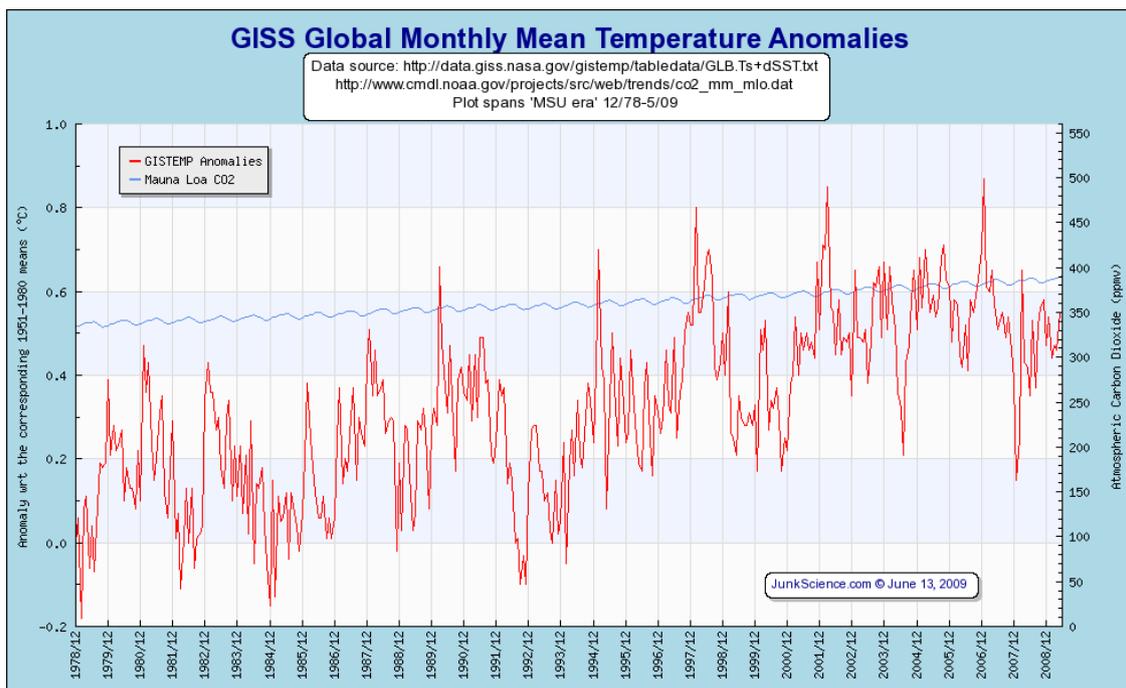


Figure 5: From the Goddard Institute for Space Studies (GISS) at NASA, run by Jim Hansen. Land-based thermometers and a few ocean thermometers, but no satellite data (despite the “Space” in GISS). [Source](#).

In the three records that use satellite data:

- The warmest recent year is 1998 (the temperature spike that year coincided with an exceptionally large El Nino event).
- The warming trend continues until about 2001.

- There is a cooling trend from 2002.

*The GISS data (the only record not to use satellite data) is quite different:*

- The warmest recent year is 2006.
- The warming trend continues until 2006.
- There might be a cooling trend developing from 2006 but it is too short to be called a trend yet.

The more extreme alarmists only ever quote the GISS data, and simply ignore the superior satellite data. (The IPCC almost exclusively use the Hadley Centre data.) GISS claim that the land-based thermometers records have been “corrected” to take the urban heat island effect and other problems into account. But the correction methods are not all made public, and the rises in the GISS temperature data over the last century are substantially due to the “corrections” rather than due to the underlying raw data:

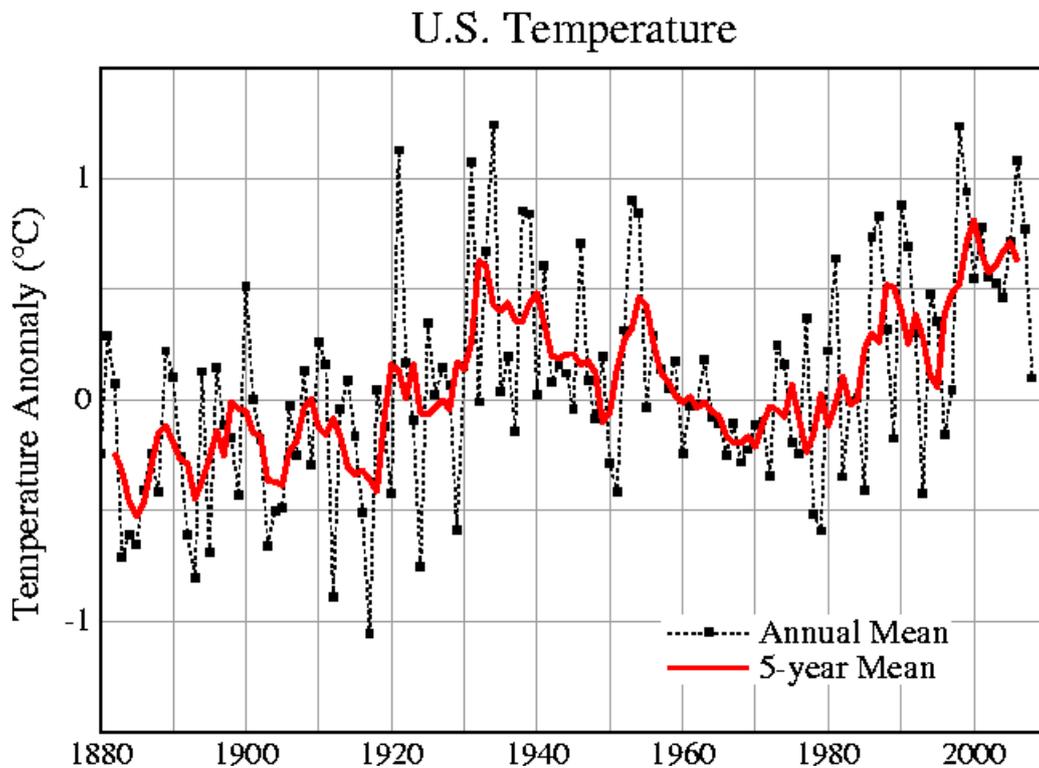


Figure 6: US temperatures reported by GISS, based on NOAA’s land-based thermometers.  
[Source.](#)

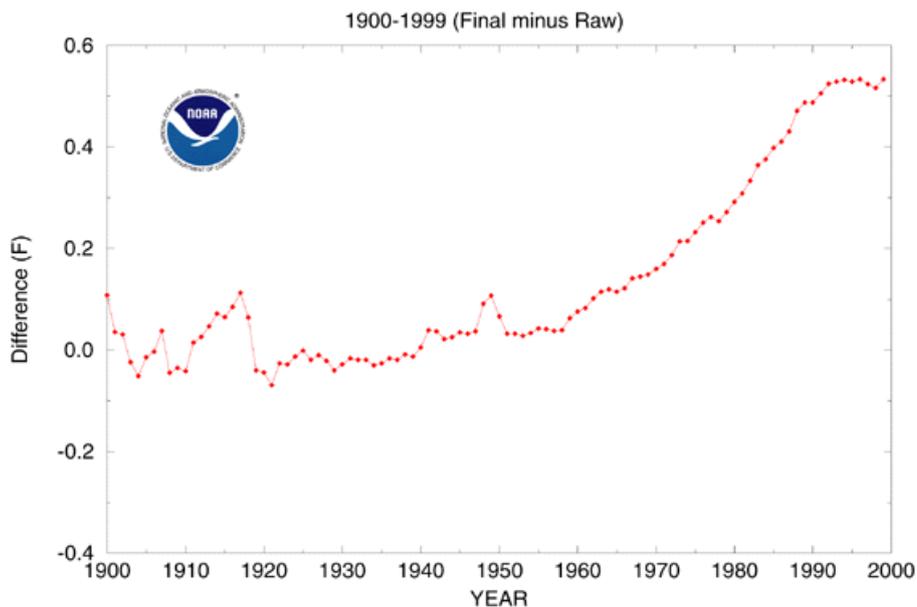


Figure 7: The corrections made to the raw US land-thermometer data by NOAA, in degrees Fahrenheit. These corrections were added to the raw data, boosting the temperatures reported by GISS from 1960, especially in the 1990s. [Source](#).

The corrections to the raw data in 1934 were minimal, but by 2000 the raw data was “corrected” upward by about 0.3°C. Yet the smoothed US temperature reported by GISS was only 0.2°C higher in 2000 than in it was in 1934. So the smoothed raw temperature was 0.1°C higher in 1934 than it was in 2000. ***Without the “corrections”, the GISS picture of rising temperatures over the century largely vanishes.***

The document showing these corrections was published in 2008, yet it only shows the corrections to 2000. What has happened since 2000, when the satellites show cooling yet GISS is the world’s only temperature record showing rising temperatures?

In science, data should be verifiable and open. The satellite data is taken from multiple sources, and they all agree. The land-based temperature is corrupted by the urban heat island effect and other problems, but the all-important corrections are kept from public scrutiny.

Because it comes from sites with individual histories and problems, land-based thermometer data is endlessly “correctable”. Indeed, there have been a long series of revisions and corrections made to this data, each of which make the recent warming appear more serious compared to past rises. The problems discussed here are just those in the US: reported problems elsewhere appear worse, especially in Siberia and China.

To conclude on air temperatures:

- Satellite data is superior. It shows 1998 was the warmest recent year, and that a cooling trend has been in place since 2002.
- Even the GISS data is now showing a cooling trend developing, from 2006.
- The GISS data is the only global temperature record not to use satellite data. Its land-based thermometer data is obviously corrupted, and it has been endlessly “corrected” in an opaque fashion to exaggerate recent warming. The recent

cooling in the GISS data suggests that GISS have come to the end of the road in being able to credibly make the air temperature data look like it's rising.

## The Alarmists Switch to Ocean Temperatures

There has been a change in direction by the climate alarmists, as shown by their new "[Synthesis Report](#)" ([June 2009](#)). They now emphasise ocean temperatures and ocean heat content, and pay scant attention to air temperature.

Their new argument is that most of the heat in the climate system (water, air, ice, and snow) is stored in the oceans, so the ocean temperature is "a better indicator of change in the climate" than the air temperature. (This argument is correct. The problem is that ocean temperatures have only been measured adequately since mid 2003.) The leading temperature diagram in the Synthesis Report is:

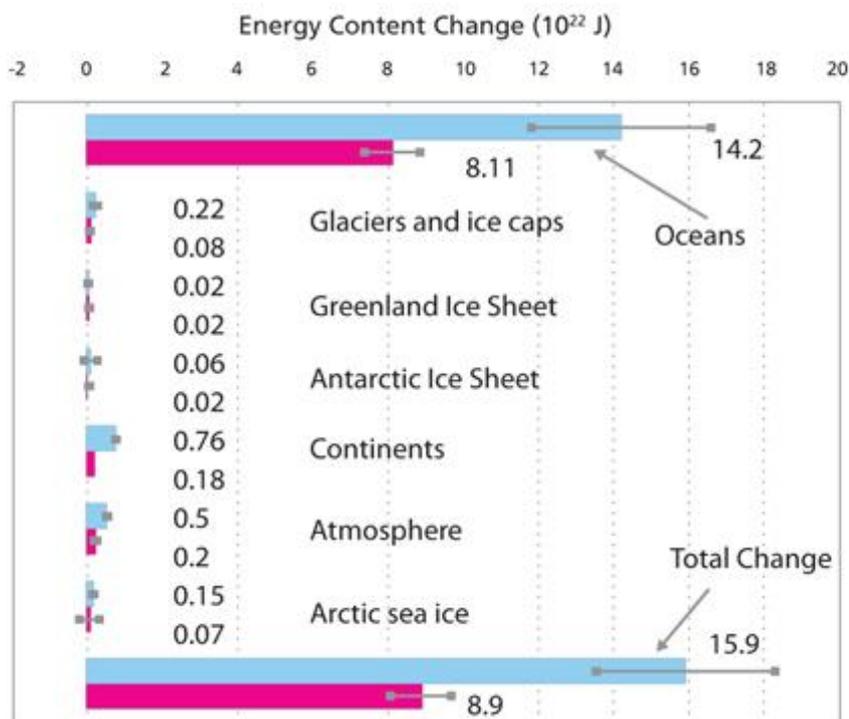


Figure 8: The most prominent temperature picture in the [Synthesis Report](#), showing heat accumulation for 1961-2003 (blue bars, 42 years) and 1993-2003 (pink bars, 10 years). In a warming climate system, most of the heat accumulates in the oceans. The pink bars are more than half the blue bars, so warming is accelerating.

In the formal reply to an Australian Senator's query about climate change (June 2009), the first graph used by Australian Climate Change Minister Penny Wong was:

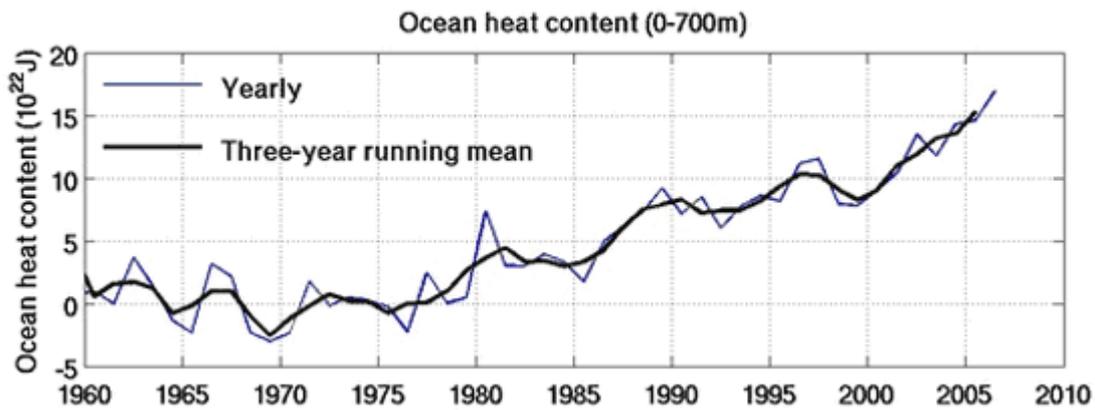


Figure 9: The [first diagram](#) in the reply by Australian Climate Change Minister Penny Wong to whether rising human emissions could be responsible for global warming, given that air temperatures are dropping. Essentially her reply was to ignore air temperatures and focus on ocean temperatures instead. The reply was written by one of the Synthesis Report's authors, Will Steffen. The unit of the vertical axis,  $10^{22}$  Joules, corresponds to about  $0.01^{\circ}\text{C}$ .

## The Alarmist Claims

The alarmists claim:

- The world is still warming, and the evidence for this is in the oceans.
- The ocean temperature is rising and rising fast.
- Even though the air temperature is falling, the heat build-up continues in the ocean.

They do not always make these claims explicitly, in so many words, but they certainly leave these unmistakable impressions on any but the most lawyer-like. Less formal writings frequently make these claims explicitly.

The crucial point to notice is that each claim depends on an implied time period: “still warming”, “is rising”, “build up continues”. All the quantities involved go up and down a little on a daily basis, so it is really only the trends we are concerned with. The meanings of the words “still”, “is”, and “continues” implicitly depend on context to say how much time they refer to: a change is only “relevant” if it is “long enough”.

The alarmists accompany their claims with data showing trends of 20 to 50 years, thereby implicitly claiming that shorter or longer periods of time are not relevant. We shall see later why this time period is essential to the alarmist position. This is a clever lawyer's trick to frame the debate, but the climate system ignores human words.

Also bear in mind that almost any trend you want can be created from a long enough series of data: just choose the length and endpoint to suit your case. More important than the trends are the turning points, the critical parts of timing, because they contain information about cause and effect.

Before we examine the latest alarmist position, let's review ocean temperatures.

## Ocean Temperatures Have Only Been Measured Properly From Mid-2003

Measuring ocean temperature globally is harder than it sounds. The [Argo network](#) finally overcomes many of the problems, but only became operational in mid-2003.

Before Argo, starting in the early 1960s, ocean temperatures were measured with bathythermographs (XBTs). They are expendable probes fired into the water by a gun, that transmit data back along a thin wire. They were nearly all launched from ships along the main commercial shipping lanes, so geographical coverage of the world's oceans was poor—for example the huge southern oceans were not monitored. XBTs do not go as deep as Argo floats, and their data is much less accurate. [[Met Office](#), [Argo](#), [GizMag](#)]

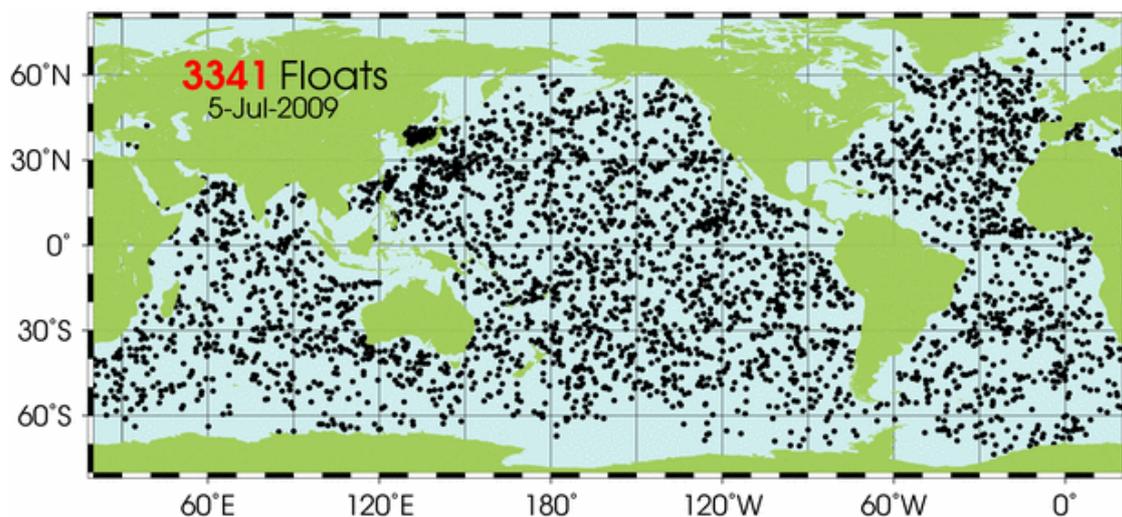


Figure 10: The Argo network has floats measuring temperature in all of the oceans. [Source](#).

The Argo network consists of over 3,000 small, drifting oceanic robot probes, floating around all of the world's oceans. Argo floats duck dive down to 1,000 meters or more, record temperatures, then come up and radio back the results.

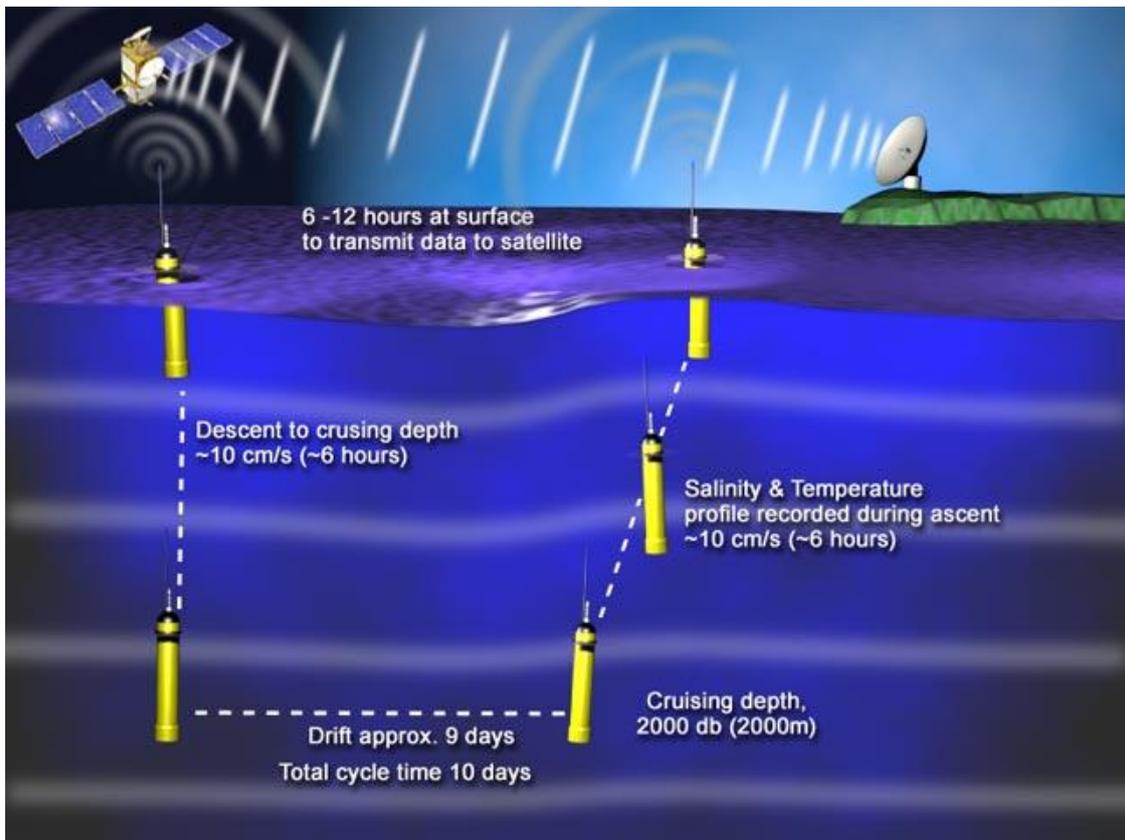


Figure 11: An Argo float descends to cruising depth, drifts for a few days, ascends while recording temperatures, then transmits data to satellites. [Source](#).

## Ocean Temperatures Are Dropping

The Argo data shows that the oceans have been in a slight cooling trend since at least late-2004, and possibly as far back as mid-2003 when the Argo network started:

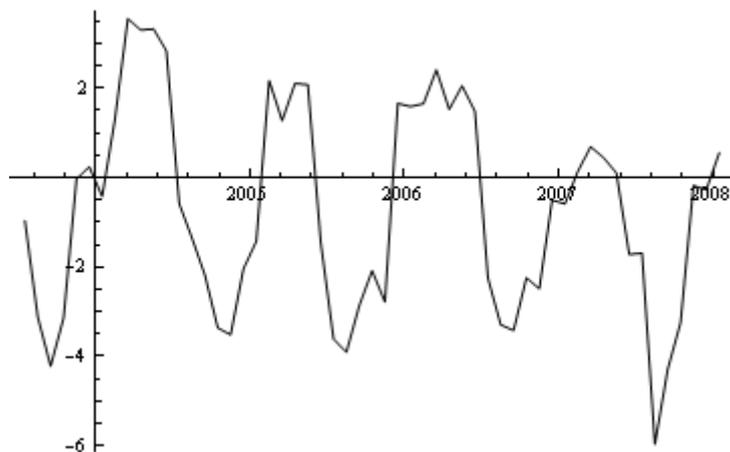


Figure 12: The ocean heat content from mid 2003 to early 2008, as measured by the Argo network, for 0 – 700 meters. The unit of the vertical axis is  $10^{22}$  Joules (about  $0.01^{\circ}\text{C}$ ). This shows the recalibrated data, **after** the data from certain instruments with a cool bias were removed (initial Argo results showing strong cooling). [Source](#) (Figure 1a), plus private correspondence with the author on the depth and the smoothing.

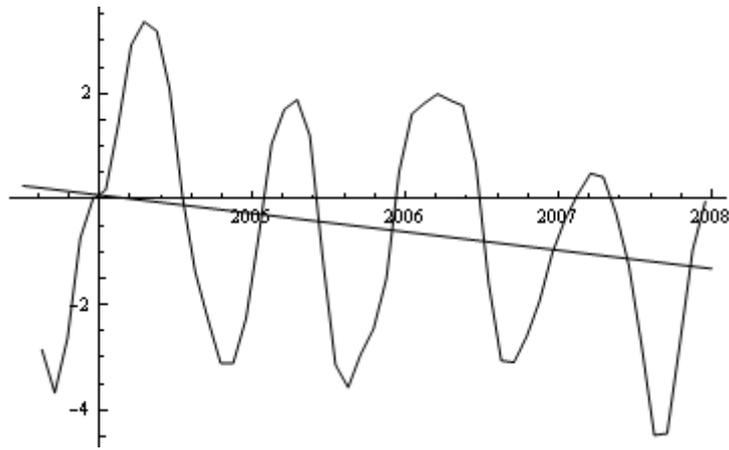


Figure 13: The Argo data of Figure 12, smoothed, with a line of best fit. The line is dropping at  $-0.35 \times 10^{22}$  Joules per year (about  $0.035^{\circ}\text{C}$  per decade). [Source](#) (Figure 1c).

Josh Willis of NASA’s Jet Propulsion Laboratory, in charge of the Argo data, said in March 2008 on [NPR](#): “There has been a very slight cooling, but not anything really significant”.

By the way, the ocean temperature shows seasonal fluctuations with peak warming around January because the oceans are mainly in the southern hemisphere.

The ocean data that the alarmists are relying on to establish their warming trends is all pre-Argo; it all comes from the old, less accurate XBTs. Now that we are measuring ocean temperatures properly, the warming trend has disappeared. And by coincidence, it disappeared just when we started measuring it properly! There is a large ocean temperature rise reported in the two years before Argo became available—might there have been a calibration problem between the old data and the Argo data? Could the old ocean temperature data have been subject to “corrections”, like the GISS air temperature data?

The Argo data originally showed a strong cooling trend. Josh Willis was [surprised](#) at the results: “every body was telling me I was wrong”, because it didn’t agree with the climate models or satellite observations of net radiation flux. (By the way, Willis, who has written a paper with the father of alarmism James Hansen, had an “eye-opening” [brush](#) with Rush Limbaugh over the original data.) Willis decided to recalibrate the Argo data by omitting readings from some floats that seemed to be giving readings that were too cold. The Argo results shown above (Figures 12 and 13) are for the new, current data, *after* those recalibrations were made.

There is a problem with data in the politicized world of climate science: alarmists have all the authority positions in climate science and own (manage) all the datasets. Datasets that contradict the alarmist theory have a habit of being recalibrated or otherwise adjusted for technical reasons, and the changes to the datasets always make them more supportive of the alarmist theory. It has happened several times now—but by chance alone you would expect technical adjustments to make the data less supportive of any given position about half the time. Don’t be surprised if the Argo data for the last few years is “revised” at some stage to show warming instead of slight cooling.

Finally, the Argo data is extraordinarily difficult to find on the Internet: there is no official or unofficial website showing the latest global ocean temperature. (It is easy to find some *raw* Argo data on the Internet, but the computations to move from there to the global temperature are complex.) Basically the only way to get the data is to ask Josh Willis (above). The graphs above come from Craig Loehle, who got the data from Willis, analyzed it, and put the results in a peer reviewed paper available on the Internet. Given the importance of the ocean temperatures, don't you think this is extraordinary? If the Argo data showed a warming trend, don't you suppose it would be publicized endlessly?

## Short Term Trends Contradict Alarmist Claims

The Argo data proves that the oceans aren't warming, and haven't been warming for at least five years.

Our best data, from satellites and Argo, says that both the air and oceans have not warmed for at least five years now. If there is a heat build-up, where else could the heat be hiding? There isn't nearly enough melting ice to hide the heat, because the heat used to melt ice is less than 7% of the heat absorbed by the oceans (or see Figure 8). Continents (that is, rocks) have little interaction with the climate system (Figure 8). Therefore:

- The climate system has been cooling for at least the last five years.
- There is no recent accumulation of heat.
- There is no "pipeline", and no unstoppable temperature rises on the way.
- There has been no radiative imbalance heating the earth for the last few years.

A turning point in the earth's temperature was passed a few years ago. The short-term trend changed; we are now cooling (slightly).

Clearly there is some cooling force that for the last five or more years has been overpowering the warming due to human emissions. Strong candidates would be ocean oscillations (particularly the Pacific Decadal Oscillation), and the modulation of cloud formation by the sun's magnetic field via cosmic rays. Both of these causes have stronger correlations with air temperature than the CO<sub>2</sub> level, and in both cases their turning points match the turning points of air temperatures much better.

The IPCC's [mandate](#) is to study the risk of human-induced climate change. The alarmists dismiss any natural forces as "natural variability" and, apart from solar irradiance, omit them from their models. However, despite the dire predictions of warming from all the climate models in 2001, the alarmists are now forced to excuse the recent lack of warming on "natural variability".

## Long Term Trends Contradict Alarmist Claims

The *medieval warm period* around AD 1000 – 1300 was a little warmer than now: crops grew in Greenland, and there are many signs around the world of extra warmth during that period.

That gave way to the bitter cold of the *little ice age* from 1400 to 1800: animals in Europe died from cold even inside barns, and the River Thames in London would freeze over every winter (it last froze over in 1804).

Global air temperatures have been rising at a steady trend rate of 0.5°C per century since about 1750, as the world recovers from the little ice age:

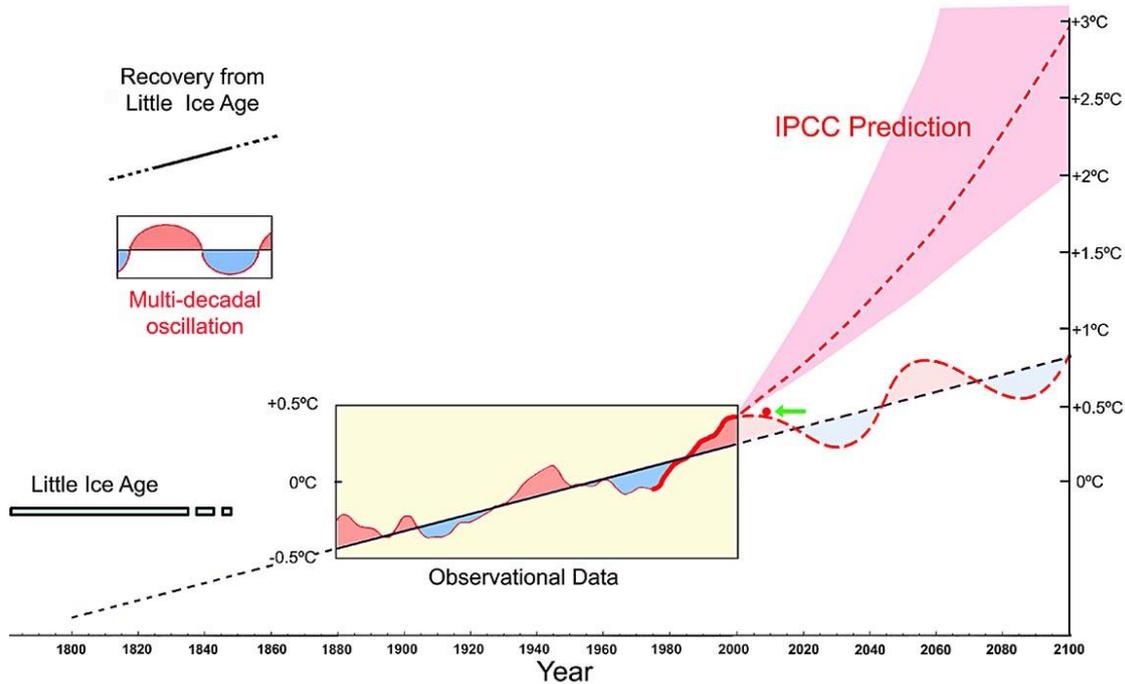


Figure 14: Reasonable global air temperature data only goes back to 1880. This analysis into a steady rising trend and oscillations is simply an empirical observation, by [Dr Syun Akasofu](#). The IPCC predictions are their widely publicised 2001 predictions

On top of that trend are oscillations that last about thirty years in each direction:

- 1882 – 1910 Cooling
- 1910 – 1944 Warming
- 1944 – 1975 Cooling
- 1975 – 2001 Warming

In 2009 we are where the green arrow points in Figure 14, with temperature leveling off and beginning to fall slightly (which fits in with the observed short-term trend and the recent turning point from warming to cooling). The pattern suggests that the world has entered a period of cooling until about 2030.

The long-term trend suggests that:

- Temperatures are simply following the pattern of the last two centuries.
- The last warming period (1975 – 2001) is like the previous warming period (1910 – 1944).
- Once the effects of the little ice age have finally passed, the temperature will get back to where it was in the medieval warm period (which is also where it was during the Roman Optimum, and in the Holocene optimum before that).

What about human influence? Human emissions of CO<sub>2</sub> were virtually non-existent before 1850, and were insignificant compared to current levels until after 1945 (see for example Figures 2 and 3 [here](#)).

The alarmists *assume* that nearly all the global warming since 1750 is due to rising CO<sub>2</sub> levels. This is a brave assumption. Oddly enough, this assumption is the foundation of climate alarmism: the climate models are calibrated so that the rise in CO<sub>2</sub> from 1750 to the present causes nearly all the warming from 1750 to the present *in their climate models*. Therefore if there were in fact any other warming forces between 1750 and the present, then the *climate models are too sensitive to CO<sub>2</sub> rises and their predicted temperature rises are too high*.

The alarmists insist that they know all the forces on climate from 1750 to the present, so there could not have been any unknown warming forces or natural variability. Yet when it comes to the cooling trend of the last five years, they claim that some unknown force, some natural variability, is overpowering the warming due to human emissions. They cannot have it both ways, so the alarmists are then forced to argue that natural variability can only cause short-term fluctuations (like the last five years), but not long term fluctuations (anything with a net effect on the temperature rise from 1750 to the present).

So here's the thing. What force shifted the global climate over the centuries from the medieval warm period to the little ice age? Obviously the passing of this force may have caused much (or all) of the warming since 1750. And clearly this force wasn't human-induced. At this point climate alarmism is so bereft of logic it disintegrates—to which the alarmist's response was to rewrite history by erasing the medieval warm period and the little ice age, in what is known as the “hockey stick graph.” This graph appeared prominently six times in the 2001 IPCC Assessment Report and was adopted for the IPCC logo. It was uncovered as a fraud by 2004, it has since disappeared from the IPCC logo, and it did not appear in the 2007 IPCC Assessment Report.

The long term trends are very unkind to climate alarmism.

## The Latest Alarmist Claims are a Bluff

The claims of the alarmists about rising ocean temperatures and accumulating heat are wrong in the short term and wrong in the long term. They appear credible only if you ignore trends shorter than 10 years and trends longer than 50 years. They crumble under analysis.

But it will take time to inform the public and politicians that the alarmist's claims are baseless. With the US climate bill now being debated and the Copenhagen climate conference coming up in December 2009, *they only need to make the public believe their schtick for a few months*.

This is a bluff.

The alarmists have a weak hand, and are relying on focusing the public and politicians on trends of just the right length, between 10 and 50 years. Anyone who strays outside

that zone will notice that their claims aren't true. The alarmists have framed the debate so as to implicitly define a "trend" as between 10 and 50 years, and with the help of their massive public-relations machine may keep enough people believing through to the Copenhagen Conference in December.

The climate alarmists had to switch from air temperatures to ocean temperatures because by 2009 too many people are aware that air temperatures have been dropping since 2002 and that the warmest recent year was 1998. This latest position is possibly the last roll of the dice in the alarmist's grab for political power and results, because if the long term pattern holds then the next decade or two will show cooling.

## Problems With The Alarmist's Graphs

We are now in a position to notice and understand some problems with the alarmist's graphs.

Figure 8, which shows heat accumulation in the climate system from 1961, stops at 2003. But the data up to 2008 is available: why not continue the diagram until 2008? Perhaps because the new Argo ocean data started becoming available in mid-2003, and it shows mild cooling? Make what you will of their decision not to mention what happened from 2003 to 2008, but it is the sort of decision that belongs in politics—*it has no place in science*. Also, Figure 8 relies on the old XBT ocean data.

Figure 9, which shows ocean heat content from 1960, stops in 2006 and shows steep rises in ocean temperature from 2000 to the end of the graph in 2006. Again, the Argo data on ocean heat content is available through 2008, so why not show it? Again, *the decision not to show it reeks of politics and has no place in science*. But the bigger problem is that it shows ocean heat content rising strongly from 2003 to 2006—but we know that the superior Argo data shows slight cooling over that period (Figure 12). Their graph directly contradicts the best known data—*did they hope we wouldn't notice?* This is dangerous territory they are moving into. If the US Senate and the Copenhagen Conference take action based on information that is *known to be misleading and inadequate* then the repercussions could get ugly. The alarmists may have some wild and imaginative excuse, but it is not at all obvious how their Figure 9 can be reconciled with the Argo data in Figure 12.

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## Appendix A: Conversion between Ocean Heat Content and Temperature

Ocean warming is usually measured by changes in heat content, but it is sometimes interesting to know the corresponding temperature change. Calculations for an order-of-magnitude conversion for the upper 700 meters of the ocean:

- Surface area of Earth =  $5.1 \times 10^8 \text{ km}^2$
- Fraction of Earth's surface that is water = 71%

- Volume of upper 700m of ocean =  $5.1 \times 10^8 \text{ km}^2 \times 71\% \times 0.7 \text{ km} = 2.5 \times 10^8 \text{ km}^3 = 2.5 \times 10^{23} \text{ cm}^3$  (overestimate, assumes all the ocean is  $\geq 700\text{m}$  deep)
- Density of water =  $1 \text{ g/cm}^3$  (underestimate, deeper water is compressed)
- Mass of upper 700m of ocean =  $2.5 \times 10^{23} \text{ cm}^3 \times 1 \text{ g/cm}^3 = 2.5 \times 10^{23} \text{ g}$
- Specific heat of water = heat to raise 1 gram of water by  $1^\circ\text{C} = 4.186 \text{ J/(g }^\circ\text{C)}$
- Heat to raise upper 700m of ocean per  $1^\circ\text{C} = 2.5 \times 10^{23} \text{ g} \times 4.186 \text{ J/(g }^\circ\text{C)} = 10.5 \times 10^{23} \text{ J/}^\circ\text{C}$
- Temperature rise for a rise in heat content of  $10^{22}$  Joules in the upper 700m of ocean =  $10^{22} / (10.5 \times 10^{23} \text{ J/}^\circ\text{C}) = 0.01 \text{ }^\circ\text{C}$ .

So, for the upper 700 meters of ocean,  $10^{22}$  Joules corresponds to about  $0.01^\circ\text{C}$ .

## Appendix B: Organizations That Audit the IPCC

There aren't any.

The only auditing is by a grassroots movement of unpaid volunteers, mainly retired scientists. For their efforts they are abused and mocked, and the alarmists fuel ad hominem attacks on them from well-funded specialist attack websites like [desmog](#) (run by PR company [Hoggan and Associates](#)) or [ExxonSecrets](#) (run by [Greenpeace](#)).

Do our politicians really want to rearrange the world's energy sector, and cast economically marginal people into energy poverty, on the basis of reports from an unaudited organization with obvious self interests? Well yes, apparently. And the media think it's pretty cool too.

## Appendix C: Author and Acknowledgements

Dr David Evans worked for the Australian Greenhouse Office (now the Department of Climate Change) from 1999 to 2005, building FullCAM, a leading carbon accounting model that estimates carbon in plants, debris, mulch, soils, and forestry and agricultural products. Evans is a mathematician and engineer, with six university degrees including a PhD from Stanford University in electrical engineering. The evidence supporting the idea that  $\text{CO}_2$  emissions were the main cause of global warming dropped away from 1998 to 2003, and by 2007 had reversed itself, causing Evans to move from being an alarmist to a skeptic.

Thank you to William Kininmonth for advice and proof reading. Kininmonth was head of Australia's National Climate Centre for 12 years until 1998. He is a consulting climatologist with more than 45 years professional experience, including 38 years with the Australian Bureau of Meteorology. He is author of the book, *Climate Change: A Natural Hazard* (2004, Multi-Science Publishing Co, UK).