

# The Missing Hotspot

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*Web address: <http://sciencespeak.com/MissingSignature.pdf>*

*An easy two-page version of this paper is at [sciencespeak.com/SimpleHotspot.pdf](http://sciencespeak.com/SimpleHotspot.pdf).*

## Summary

Each cause of global warming heats up the atmosphere in a distinctive pattern—its “signature”. According to IPCC climate theory, the signature of carbon emissions and the signature of warming due to all causes during the recent global warming both include a prominent “hotspot” at about 10 – 12 km in the air over the tropics. But the warming pattern observed by radiosondes during the recent global warming contains no trace of any such hotspot. Therefore:

1. IPCC climate theory is fundamentally wrong.
2. To the extent that IPCC climate theory is correct in predicting a hotspot due to extra carbon dioxide, we know that carbon emissions did not cause the recent global warming.

The hotspot is not incidental to IPCC climate theory—it lies at its heart, because the same water vapor feedback that produces the hotspot in IPCC climate theory also doubles or triples the temperature increases predicted by the IPCC climate models. If the IPCC climate modellers just turn down the water vapor feedback in their models enough so their theoretical signatures match the observed warming patterns, then the predicted temperature increases due to projected carbon emissions are greatly reduced and are no longer of much concern.

The radiosonde data shocked the alarmists, who expected a hotspot to confirm their theory. Alarmists now dispute the radiosonde data, saying it is so poor that it cannot show any pattern. But radiosondes can reliably detect temperature differences of 0.1°C, and the hotspot would be at least 0.6°C warmer. And there were hundreds of radiosondes—they cannot all have missed it. Alarmists now distract people away from the hotspot issue, and often give the *impression* that they found the hotspot without actually claiming they have.

Scarcely anyone knows about the missing hotspot and its significance. (Which proves that alarmists do *not* tell us when they find evidence *against* their idea that carbon emissions are the main cause of global warming.)

## Causes Leave Signatures

Each cause of global warming heats up the atmosphere in a distinctive pattern. The pattern of areas that heat up fastest during a warming is the “signature” of the cause.

The situation is analogous to a house fire. If the initial warming is in the living room in front of the fireplace, then this would point to a burning log rolling out of the fireplace. Initial heating in the kitchen is the signature of a fire on the stove. The signature of a cigarette left burning in a bed would be initial heating in a bedroom. Fire investigators use the pattern of initial heating and the spread of the fire to narrow down the cause of the fire.

Signatures are like fingerprints: telltale marks that tell you something about who done it.

Unfortunately we cannot use signatures to prove that a particular cause *was* the main cause of global warming, because the signatures of some leading suspects are unknown. But we can use signatures to rule out those causes whose signatures were definitely not observed.

## Signatures are Important

Signatures are second only to the temperatures themselves in the debate about the causes of global warming, because they can immediately and definitively:

1. Confirm or falsify the IPCC climate theory models.
2. Rule out some causes of global warming.

Temperatures are of course the other observations that can prove that the IPCC climate theory is false, but they will take decades to play out. It will take at least another decade or two of non-rising temperatures to convince the IPCC climate theorists they are wrong: as of March 2009, some alarmist scientists were acknowledging that the planet is in a cooling phase that could last another thirty years.

Most global warming debating points do not matter much. For example, some say the receding snowline on Mt Kilimanjaro is due to global warming, while others say it is due to local deforestation reducing the snowfall. But this debate has never converted anyone between alarmism and skepticism, and has no bearing on the causes of global warming or whether we should have a carbon tax. On the other hand, signatures can confirm or disprove the IPCC climate theory, and thereby indicate whether or not we should reduce carbon emissions.

Evidence about the causes of global warming is fairly rare. There is lots of evidence that global warming has been taking place, and the media are eager to report it. However this is not evidence about what *causes* global warming—because it says nothing about whether, say, the earth is heating because of rising carbon dioxide levels, the sun is getting hotter, or aliens are warming the planet with ray guns. Unfortunately this logical difference is often overlooked in the media’s fear and

alarmism. In the public's mind, the evidence that global warming is happening has been conflated with evidence that it is due to carbon emissions.

## **No One Knows About Signatures**

Alarmists keep very quiet about signatures. Hardly anyone in the public or government realises the observed warming data exists or its significance. The “news” services aren't exactly falling over themselves to tell you about it. There has been near complete official silence on the topic: ever notice that, outside highly technical circles, the IPCC or alarmists never mention the idea that warming patterns are evidence of causes, or talk about signatures or hotspots?

Definitive data on the last warming period was collected by 1999 (thereby including the big El Nino warming peak of 1998), but the earliest technical publications did not appear until 2003 and the first public outing of signatures did not occur until 2007 (as far as I am aware). The observed warming pattern and the comparisons with signatures below in this document have never appeared anywhere in the mainstream media as of March 2009 (again, as far as I know).

Unless you are a climate scientist or closely involved with the global warming debate, you almost certainly did not hear of the idea that atmospheric warming patterns contain telltale clues of their causes before 2008. And almost no one outside a small group knew of the observed warming pattern data until skeptics tried to draw attention to it, in plain language, starting in 2007.

Of course, if the signature of increased greenhouse warming truly had been observed then we would have heard ALL about it. Every two-bit science reporter would be an expert on signatures, and the media would be screaming from the rooftops that signatures were vital evidence that confirmed the IPCC climate theory.

## **The Observed Warming Pattern**

To observe the warming pattern we need to measure the temperature at each height and latitude around the world during a warming. (The longitude does not matter much, because the climate is pretty much the same all around the world at a given latitude.)

Satellites cannot measure temperatures at specific heights in the atmosphere, so we need to use radiosondes—lighter-than-air balloons that ascend through the atmosphere with a thermometer, radioing the temperatures back to a ground station. Fortunately people have been using radiosondes to observe atmospheric temperatures since the 1960s, so we have a reasonably good picture of the pattern of variations in atmospheric temperatures during the recent period of global warming from 1977 to 2001.

Despite the importance of the observed warming pattern, it was a long while before it was published in any document accessible to the public. Finally in 2006 the US Climate Change Science Program (CCSP) published it in a small diagram buried near the back of a report in among some theoretical diagrams: part E of Figure 5.7 in section 5.5 on page 116:

It is reproduced here:

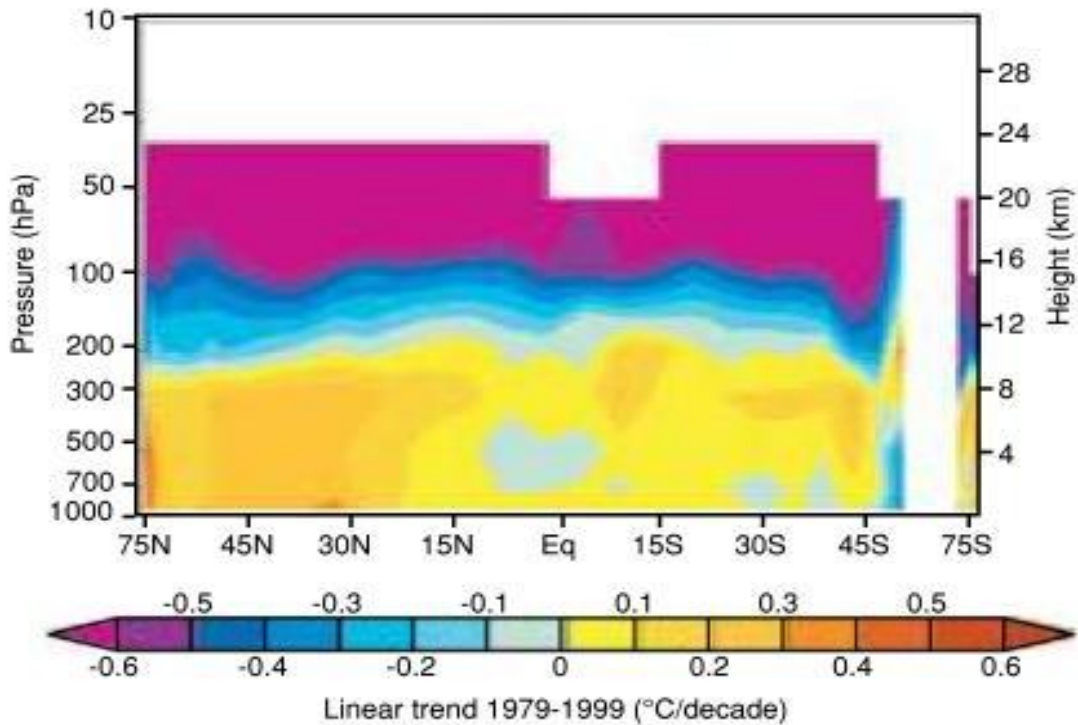


Figure 1: The observed pattern of atmospheric warming, 1979 – 1999, as per the US CCSP of 2006, part E of Figure 5.7 in section 5.5 on page 116. (Axes deblurred.)

This is the pattern of atmospheric warming for the period 1979 to 1999, which covers nearly all the recent period of global warming. All the radiosonde data in that period is combined into a single picture, showing temperature variation over the 20 year period by latitude and by height in the atmosphere (for each latitude and height, the results at different longitudes are averaged into a single number or point in the diagram).

The horizontal axis is the latitude, from 75 degrees north through the equator in the middle to 75 degrees south. There is no data around 60 degrees south because there is little data from that region (there is no inhabited land around that latitude). The vertical axis is the height in the atmosphere, marked on the right hand side as 0 – 28 km (and on the left hand side as the corresponding air pressures in hPa). The colors in the diagram shows the temperature changes on a per-decade basis.

What warming pattern do we see? There was broad stratospheric cooling and broad tropospheric warming, and a little more warming in the northern hemisphere than the south.

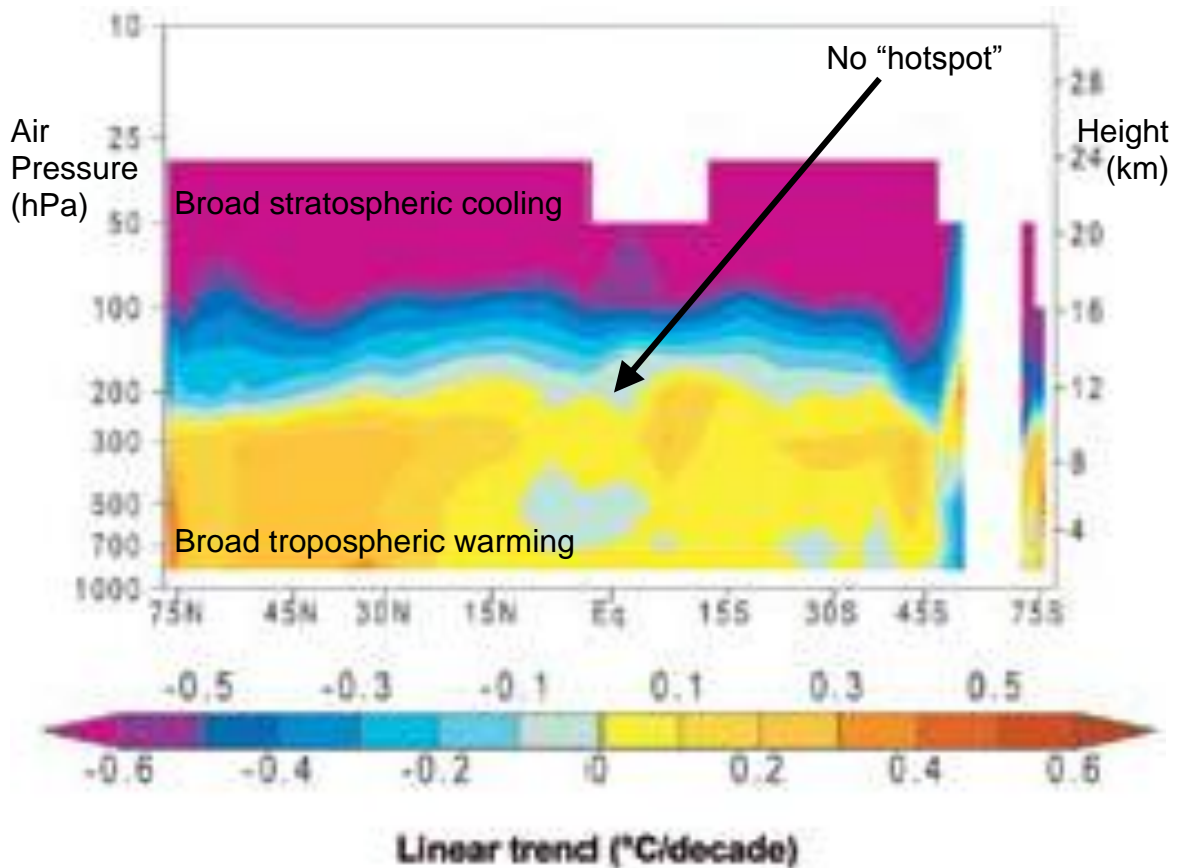


Figure 2: The observed pattern of atmospheric warming, 1979 – 1999, annotated.

What we *don't* see is a hotspot at the top of the tropical troposphere. There is no hotspot at all at 10 – 12 km up, from 23°N to 23°S: indeed, much or most of the troposphere warmed by more than the region where the hotspot would be.

This is all the data we will ever have about that warming period, because we cannot go back in time and take more or better measurements. Furthermore, the world has not been warming since 2001, so we haven't been able to take more measurements since then (we are only interested in the atmospheric pattern when there is warming). This particular view of the data is known as the “HadAT2 temperature data”. The raw data from the radiosondes can be processed in slightly different ways, so there are some small variations on this picture, but basically this is it.

Radiosondes reliably detect temperature differences of 0.1°C when correctly calibrated and operated. There were variations in equipment and procedures over those 20 years, not all operators were equally skilful, and some radiosonde data was contaminated by radiosondes passing through cold clouds and getting iced up (the data from these radiosondes was discarded). Nonetheless, most of the radiosondes were definitely sensitive enough to notice temperature variations of a small fraction of a degree.

## Signatures From the IPCC, for 1958 – 1999

The published theoretical signatures produced by the IPCC climate theory that best matches the period of the observed warming pattern (1979 – 1999) appeared in the US Climate Change Science Program, 2006, Chapter 1,

[www.climatechange.gov/Library/sap/sap1-1/finalreport/sap1-1-final-chap1.pdf](http://www.climatechange.gov/Library/sap/sap1-1/finalreport/sap1-1-final-chap1.pdf).

It shows six signature diagrams in Figure 1.3, in Section 1.5 on page 25, for the period 1958 – 1999, which are reproduced here:

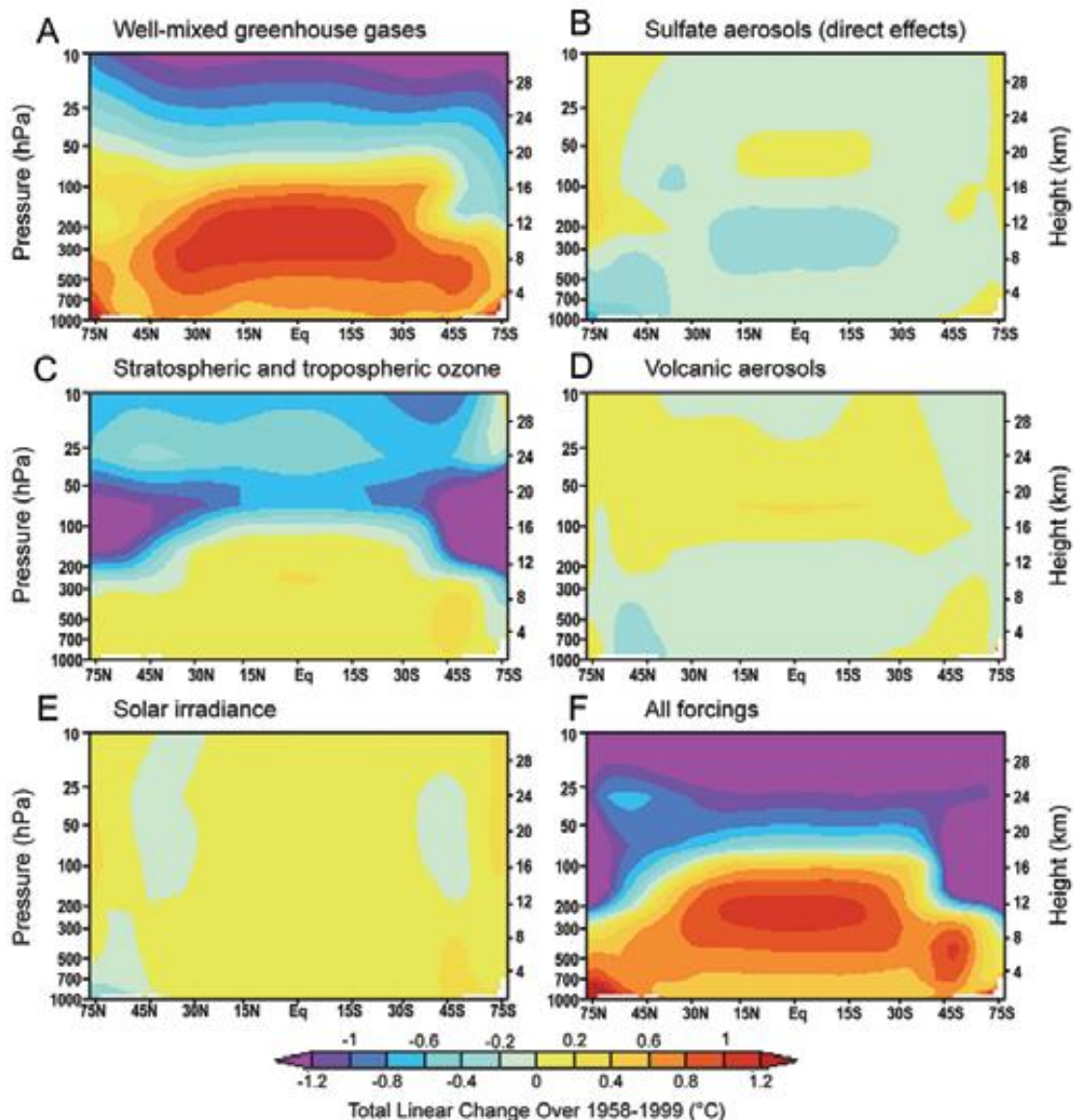


Figure 3: The theoretical warming patterns calculated by the IPCC climate models for 1958 to 1999, in °C per 42 years. From the US CCSP of 2006, Figure 1.3 in section 1.5 on page 25.

These diagrams show what the IPCC say occurred, according to their climate models. In particular, diagram A is the signature of warming due to an increase in greenhouse gases other than water vapor, that is, from carbon emissions. And diagram F is the warming pattern expected from the sum of all the five signatures A – E in the

proportions the IPCC believe those causes contributed to global temperature changes; it is dominated by signature A because the IPCC's theory is that the warming was mainly due to carbon emissions.

These signatures are for 1958 – 1999. But since there was little warming or cooling from 1958 to 1978, they are fairly directly comparable to the observed warming pattern for 1979 – 1999.

Notice that the signature A for increased greenhouse warming has two main features:

1. A hotspot over the tropics at about 10 – 12 kms.
2. Broad stratospheric cooling and broad tropospheric warming.

That second feature is also present in signature C for ozone depletion.

## **Signatures From the IPCC, for 1890 – 1999**

The most authoritative source of signatures based on the IPCC theory is the latest assessment report from the IPCC itself. The IPCC Assessment Report 4 (AR4), 2007, Chapter 9,

[ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_Ch09.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch09.pdf)

shows six signature diagrams in Figure 9.1, in Section 9.2.2.1 on page 675, which are reproduced here:

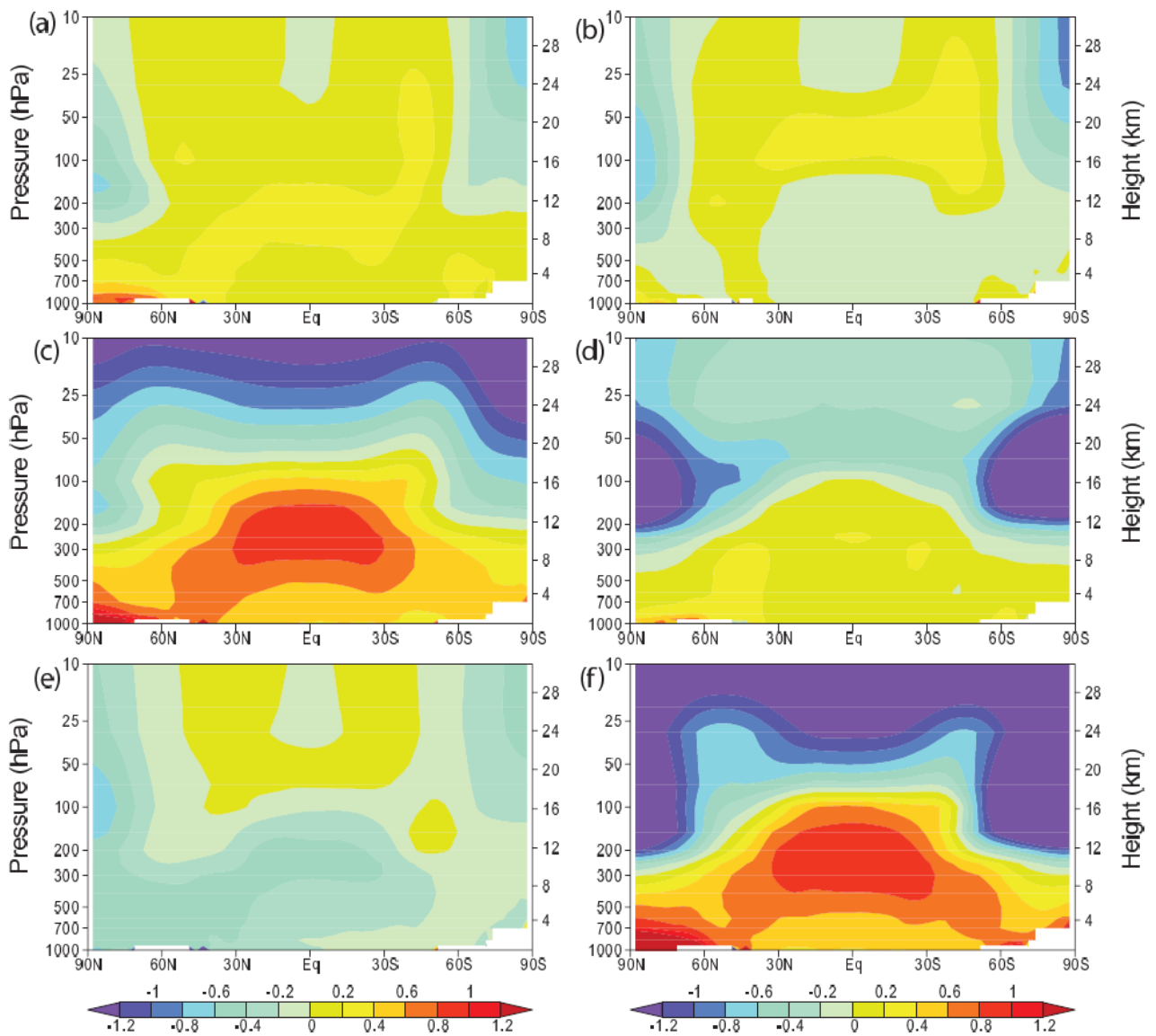


Figure 4: The theoretical warming patterns calculated by the IPCC climate models for 1890 to 1999, in °C per century. They show the theoretical warming signatures from (a) the sun getting hotter, (b) volcanoes, (c) an increase in non-water-vapor greenhouse gases, (d) ozone depletion, (e) aerosol emissions, and (f) the sum of all these five factors in the proportions the IPCC believe those causes contributed to global temperature changes. From the IPCC 2007, Figure 9.1, in Section 9.2.2.1 on page 675.

These signatures are for a time period that includes global cooling from 1890 to 1910, then warming to 1944, then cooling to 1977, then warming again to 1999. However there was net warming over the entire period and the IPCC climate theory is that the overall warming was for the same reasons as the 1979 – 1999 warming. As a result the signatures have very similar features (though different magnitudes of temperature changes) to the ones for 1958 – 1999, and are thus also directly comparable to the observed warming pattern of 1979 – 1999.



## Conclusion 1: IPCC Climate theory is wrong

Compare the observed warming for 1979 – 1999 in Figure 1 to what the IPCC climate models say happened for 1958 – 1999 in Figure 3F:

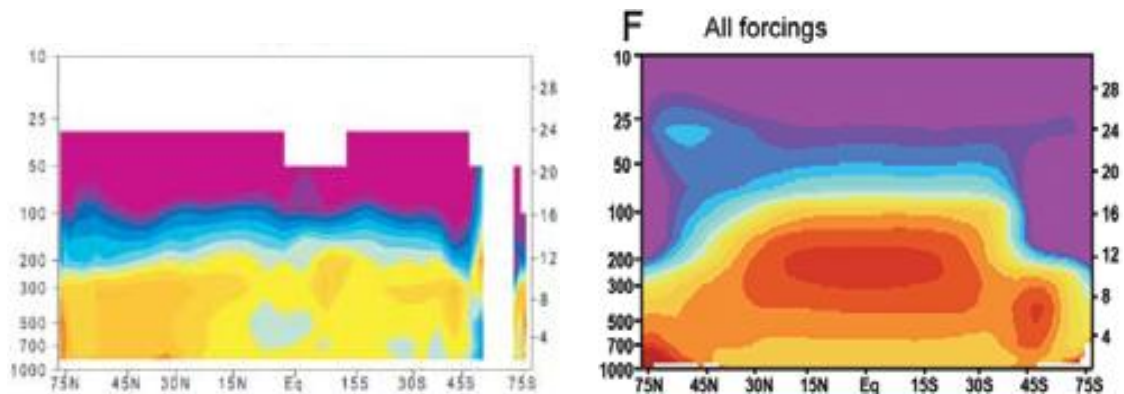


Figure 5: Observed warming (left) versus IPCC theory (right).

- The IPCC climate theory predicts a hotspot.
  - There was no hotspot.
- ⇒ IPCC climate theory is wrong.

Below we examine the role of water vapor feedback in IPCC climate theory. That feedback both creates the hotspot and is responsible for a half to two-thirds of the temperature rises predicted by the IPCC climate models. So the hotspot is not an incidental or optional part of the IPCC's climate theory—it is an integral part. Thus the missing hotspot shows that IPCC climate theory is *fundamentally* wrong.

## Conclusion 2: CO<sub>2</sub> is Innocent

Compare the observed warming for 1979 – 1999 in Figure 1 to the IPCC's signature for warming due to increased (non-water-vapor) greenhouse gases for 1958 – 1999 in Figure 3A:

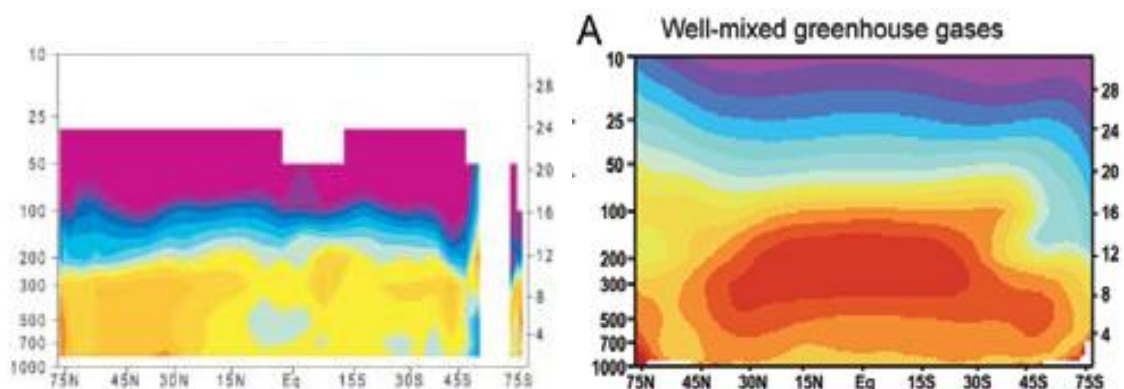


Figure 6: Observed warming (left) versus the IPCC's signature due to increased (non-water vapor) greenhouse gases (right).

- The IPCC's signature for warming due to an increase in (non-water-vapor) greenhouse gases includes a hotspot.

- There was no hotspot.
- ⇒ To the extent that IPCC's greenhouse signature is correct, we know that carbon emissions did not cause the recent global warming.

It comes down to *how* correct the IPCC's climate theory is. Their theory might be so broken that the real signature of increased non-water vapor greenhouse gases does not have a hotspot, in which case:

- We cannot draw the conclusion that CO<sub>2</sub> is innocent (though it may well be).
- The predicted temperature increases due to rising carbon levels must be a lot smaller (so they cannot be much of a problem). We will examine this issue below, when looking at the water vapor feedback.

## The IPCC Attacks the Observations

The missing hotspot is an enormous problem for the IPCC, because it:

1. Proves that IPCC climate theory is false.
2. Undermines the theory that carbon emissions cause global warming.

The usual practice when observations and theory disagree is that the theory must yield to the observations. However in this case the IPCC choose instead to attack the observations, and to preserve their theory and models without modification.

Next we look at their two objections and conclude that they are obviously feeble. Perhaps there was too much power and money and too many good science jobs at stake to admit any problems in the IPCC climate theory.

## Santer's Objection

Ben Santer, the IPCC's foremost expert on the observed warming pattern, emphasized the uncertainties in the data from the radiosonde thermometers—he stretched the error bars. On the basis of a complex statistical argument he argued that it was possible that the hotspot might be present and yet went undetected:

[https://publicaffairs.llnl.gov/news/news\\_releases/2008/NR-08-10-05-article.pdf](https://publicaffairs.llnl.gov/news/news_releases/2008/NR-08-10-05-article.pdf)

But while the uncertainties in temperature measurements from a radiosonde are indeed large enough for a single radiosonde to maybe miss the hotspot, hundreds of radiosondes have given the same answers—so statistically it is extremely unlikely that they collectively failed to notice the hotspot. Statistical counter arguments to Santer's analysis are aired at

[www.climateaudit.org/?p=4101](http://www.climateaudit.org/?p=4101)

Radiosondes are calibrated to detect temperature differences of 0.1°C, and Figure 3 shows that the hotspot should be at least 0.6°C and probably around 1°C. Simple scrutiny of the observed data in Figure 1 shows how hard it is to credibly claim that the hotspot might be there. Santer is essentially claiming that the hotspot could be present in Figure 1, but we just cannot see it due to the noise.

Santer tortured the radiosonde data looking for a hotspot for years, from 2000 to 2008, but the best he came up with was a tendentious claim that the hotspot could possibly be there but went undetected.

## Sherwood's Objection

Steven Sherwood, another leading IPCC scientist, combined the data from the thermometers in the radiosondes with wind data from the same radiosondes, and a theory about windshear, and processed it on his computer:

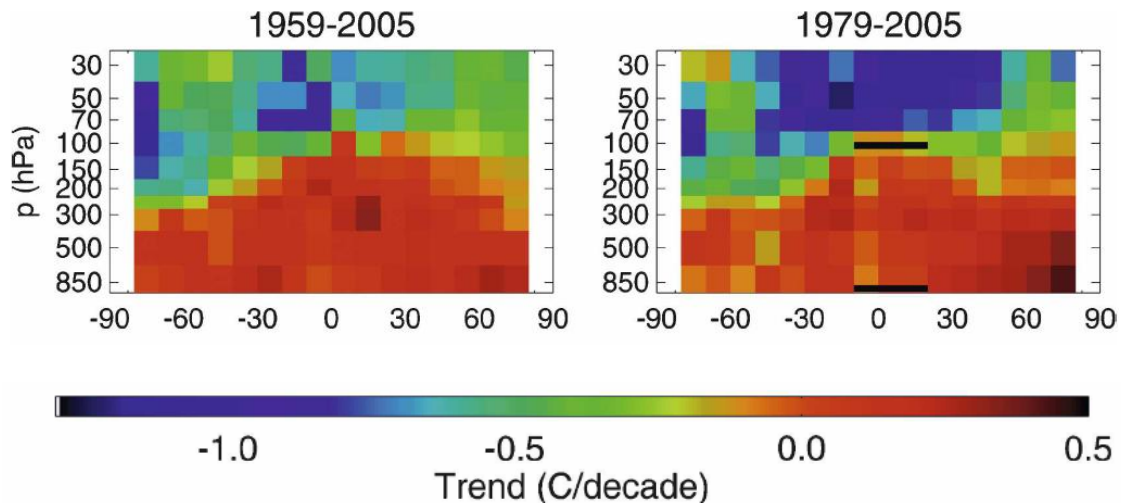


Figure 7: The warming pattern as calculated by Sherwood from the radiosonde wind data as well as the temperature data shown in Figure 1. From Fig. 6 of Sherwood 2008, [camels.metoffice.gov.uk/quarc/Sherwood08\\_JClimate.pdf](http://camels.metoffice.gov.uk/quarc/Sherwood08_JClimate.pdf). It appears he “found” the hotspot, but look at the scale closely!

Looks like a hotspot, right? But look closely at the scale and note the color of zero change—it’s red! So if the atmosphere stayed at exactly the same temperature everywhere, Sherwood’s interpretation would be an all-red graph! The reds blend together and it is impossible to see where his “hotspot” might be—but his “hotspot” is too faint anyway, because the hotspot in the climate models is at least  $0.6^{\circ}\text{C}$  over two decades. And why should wind data be accidentally better at measuring temperature than thermometers, which are designed to measure temperature? Why would a leading climate scientist present a graph with such a deceptive color scale?

## The Objections Are Plainly Weak

It is important to note that the IPCC scientists never claimed to have found the hotspot, only that we might have missed it. This is an important distinction. They wrote several densely worded papers that suggested, to a casual reader, that the hotspot had indeed been found. But on careful scrutiny those papers always stop just short of claiming to have found the hotspot.

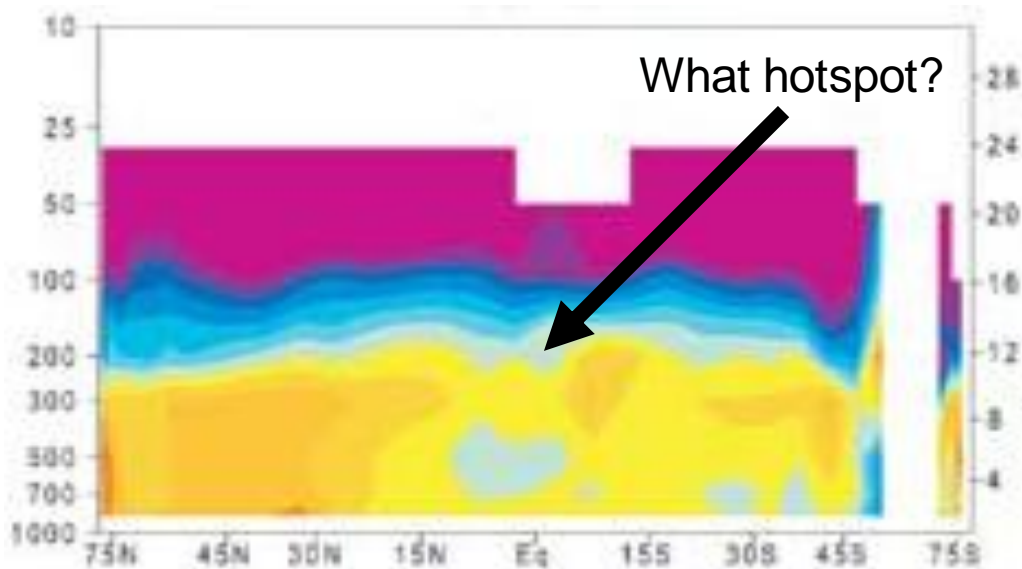


Figure 8: The observed warming pattern. If the hotspot is there, where is it?

The objections by the IPCC scientists are fair enough, because we need to see the best possible arguments from both sides. But their attempts to say the hotspot might not be missing are plainly weak.

The AGW theory makes very few claims that are falsifiable within a reasonable timeframe (say a decade or two). The development of a hotspot in the warming pattern is one of them. If we had found a hotspot, it would have been a major confirmation of AGW. However we measured the atmosphere during a global warming period and there was no hotspot. AGW is falsified.

## Water Vapor Feedback

According to IPCC climate theory, a hotspot is present to some degree in the signature of any cause of global warming that heats the earth's surface due to the water vapor feedback. This is the heart of IPCC climate theory and where it went wrong.

A little background on the atmosphere: The part of the atmosphere that contains water vapor is called the *troposphere*. Water vapor is a greenhouse gas, each molecule absorbing radiation and later reradiating it in a random direction at a water vapor absorption frequency. Thus the troposphere is effectively a blanket at the water vapor absorption frequencies. The troposphere is partitioned into the *lower* and *upper* troposphere by the *characteristic emissions level* (CEL), which is one optical depth below the top of the troposphere. Above the CEL radiation at the water vapor absorption frequencies effectively radiate straight into space, but below the CEL it effectively does not. Thus the lower troposphere is "in" the warming blanket and is warmer, while the upper troposphere is increasingly "out" of the blanket and gets colder as you go higher. The CEL tends to be at a constant temperature fixed by the radiation balance to and from space.

Theoretically, according to IPCC climate theory:

- Any increase in surface temperature increases ocean evaporation, which increases water vapor in the atmosphere.
- The extra water vapor adds to the existing water vapor, thereby enlarging the lower troposphere (and pushing the CEL higher).
- This extends the warmer lower troposphere into volume previously occupied by the colder upper troposphere. That volume was previously partly outside the water vapor warming blanket and above the CEL, but is now inside the warming blanket and below the CEL—so that volume is now warmer, and it constitutes the hotspot.
- This occurs mainly in the tropics, which are much moister than the temperate and polar areas. So a hotspot develops at the top of the tropical lower troposphere.
- Water vapor is a greenhouse gas that traps heat. Enlarging the lower troposphere traps more heat and thus causes the world to warm further. This temperature rise is in addition to the initial temperature rise that caused the extra water vapor in the first place.

More details:

- The increased water vapor decreases the moist-adiabatic lapse rate of the lower troposphere—that is, there is a drop in the rate at which temperature decreases with height between the ground and the top of the lower troposphere.
- So if the lapse rate drops then the top of the lower troposphere must rise to compensate. This rise creates the hotspot.

The extra water vapor is the result of the initial temperature rise, and feeds back into a further rise in temperature. This is why the effect is called the “water vapor feedback”. The water vapor feedback amplifies any temperature rise *and* creates a hotspot. The hotspot is an intrinsic part of the process: you cannot get the temperature amplification without also getting the hotspot.

We stress that the preceding description of the water vapor feedback in this section is purely theoretical, and comes from IPCC climate theory. In fact it is wrong, as demonstrated by the lack of a hotspot during the last warming period 1979 –1999. In reality any extra water vapor due to that warming did *not* form a hotspot, and presumably therefore did not amplify the initial temperature increase and will not amplify any future temperature increases due to rising carbon dioxide levels—so the IPCC’s temperature predictions are much too high.

To illustrate that a hotspot forms due to any surface heating in IPCC climate theory, consider these two theoretical signatures published by the *Real Climate* website at

[www.realclimate.org/index.php/archives/2007/12/tropical-troposphere-trends](http://www.realclimate.org/index.php/archives/2007/12/tropical-troposphere-trends)

Both are dominated by a hotspot, yet they are due to quite different causes.

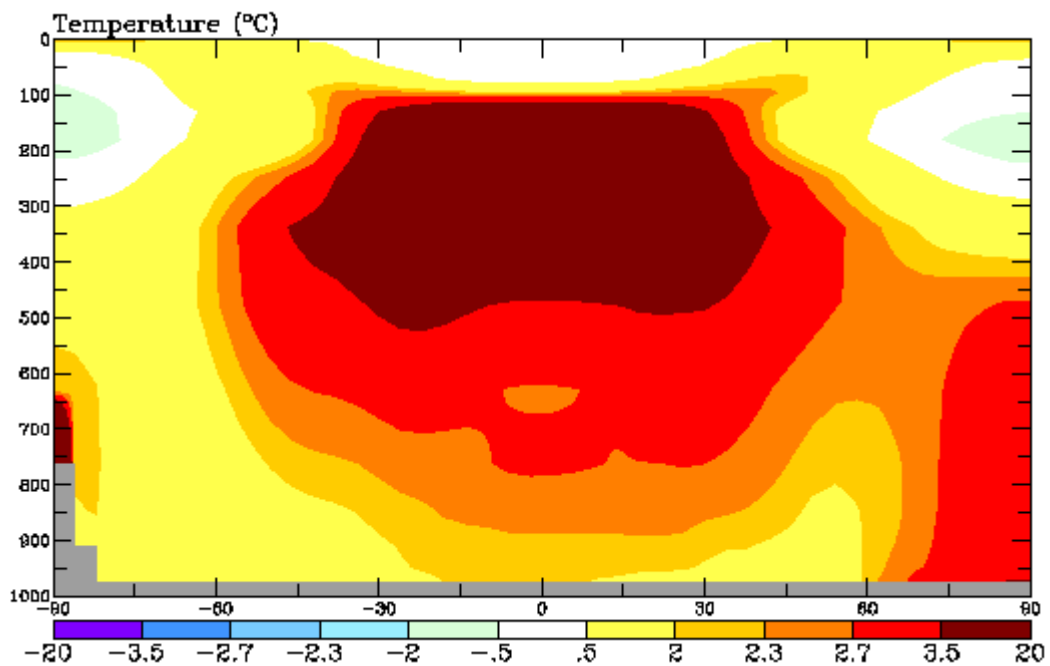
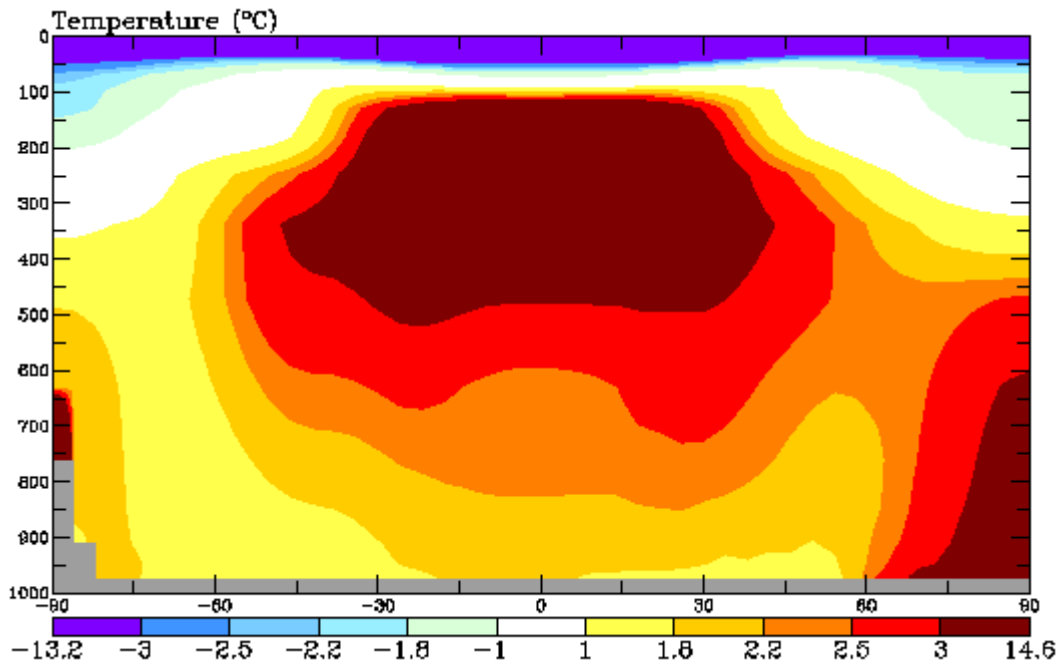


Figure 9: Signatures of a doubling of CO<sub>2</sub> (top) and a 2% increase in radiation from the sun (bottom), according to the GISS model. Each is dominated by a hotspot.

## Water Vapor Feedback is Responsible For Most of the Temperature Rises Predicted By the IPCC Climate Models

We will now quantify the effect of the theoretical water vapor feedback in the IPCC's climate models, to show how important it is to their predictions. We will show that turning down the water vapor feedback in IPCC models to a level consistent with the

observation of a missing or faint hotspot, and making no other changes, reduces their predicted temperature rises by over a half.

The IPCC does not explicitly understand the atmosphere in terms of system diagrams with feedbacks, because it relies primarily on its climate models. However it does provide enough data in its assessment reports to show how it thinks the climate system works in terms of systems and feedbacks. This is fortunate for us because it means we do not need a supercomputer running their climate models to calculate what happens if we turn down their theoretical water vapor feedback—just the system diagram and a small calculation.

Christopher Monckton, a journalist who has delved deeply into the IPCC claims, has pieced together the most recent opinions of the IPCC into a single feedback diagram, which he presents in Figure 3 at

[www.aps.org/units/fps/newsletters/200807/monckton.cfm](http://www.aps.org/units/fps/newsletters/200807/monckton.cfm)

That diagram is reproduced here:

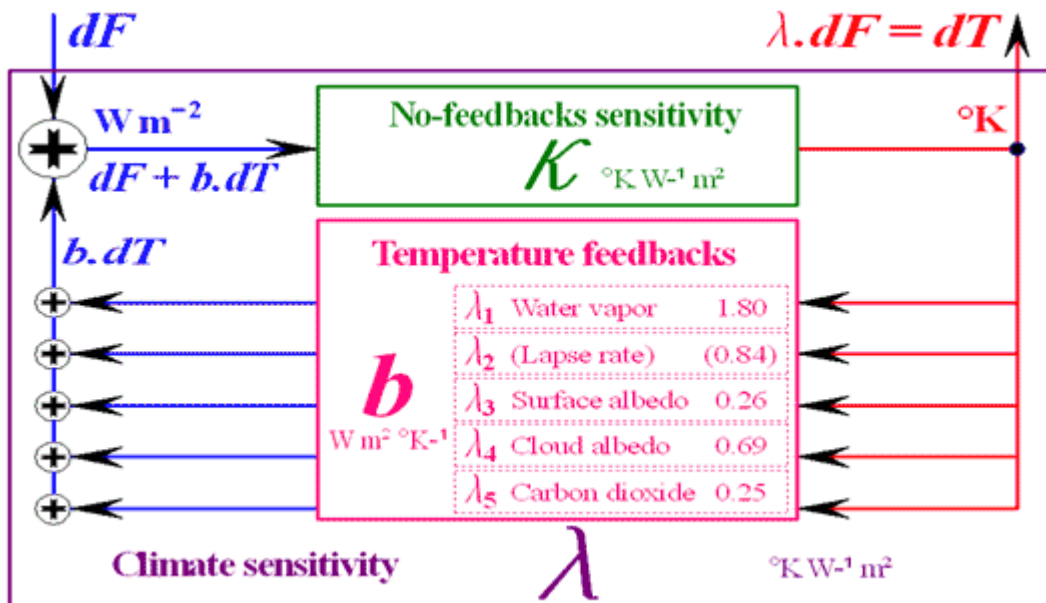


Figure 10: A perturbation  $dF$  in the incoming solar radiation (or “forcing”) is input to the earth’s climate system (purple box). It is multiplied by  $\kappa$  by the no-feedbacks climate system (green box), to produce an initial temperature perturbation  $dT$ . But  $dT$  also causes temperature feedbacks (red box) which add a further  $b dT$  to the input of the no-feedbacks climate system! After sorting out the simultaneous effects, the final temperature perturbation due to  $dF$  is  $dT = \kappa dF / (1 - b\kappa)$ .

The system diagram in Figure 10 is a bit rough and ready because the feedbacks aren’t really independent of one another, and the subsystems aren’t really linear and passive, and transients are ignored. However it has sufficient explanatory power for an approximate quantitative understanding of the IPCC climate models.

According to the IPCC, the total temperature feedback is  $b = 1.80 - 0.84 + 0.26 + 0.69 + 0.25 = 2.16 \text{ W m}^{-2} \text{ K}^{-1}$  and the no-feedbacks sensitivity is  $\kappa = 0.313 \text{ W}^{-1} \text{ m}^2 \text{ K}$ .

The IPCC reckons that a doubling of CO<sub>2</sub> levels from pre-industrial times (due around 2070 on current trends) is equivalent to a forcing perturbation of  $dF = 3.4 \text{ Wm}^{-2}$ . Their predicted temperature increase for a doubling of CO<sub>2</sub> is thus

$$dT = \kappa dF / (1 - b\kappa) = 0.313 * 3.4 / (1 - 2.16 * 0.313) = 3.3 \text{ }^\circ\text{C},$$

which agrees with the published predictions from the IPCC's climate models. This gives us confidence that the system model above mimics the IPCC climate models.

According to the IPCC, the water vapor feedback is  $1.80 \text{ Wm}^{-2}\text{K}^{-1}$ . This is a quantification of the IPCC's theoretical hotspot-creating water vapor feedback mechanism that we described above: for every temperature rise of  $1^\circ\text{C}$ , the consequent extra water vapor heats the earth by an amount equivalent to an increase in solar radiation of 1.80 Watts per square meter. (By way of comparison, the average incoming solar radiation falling on each square meter of Earth is a much larger 342 Watts.)

But we know from the observed warming pattern in Figure 1 that during the recent warming of 1979–1999 there was in fact no hotspot (or at most, a faint one). This suggests that in reality there was no water vapor feedback, for whatever reason. So what is the impact of removing the water vapor feedback on the IPCC temperature predictions?

If the water vapor feedback is zero and the other feedbacks remain the same then  $b = 0 - 0.84 + 0.26 + 0.69 + 0.25 = 0.36 \text{ Wm}^{-2}\text{K}^{-1}$  and the temperature increase for a doubling of CO<sub>2</sub> is

$$dT = \kappa dF / (1 - b\kappa) = 0.313 * 3.4 / (1 - 0.36 * 0.313) = 1.2 \text{ }^\circ\text{C}.$$

More generously: the hotspot might merely be faint, so there was still some water vapor feedback, and the magnitude of the lapse rate feedback would be smaller if the water vapor feedback was smaller. So let's have a small positive water vapor feedback of  $0.20 \text{ Wm}^{-2}\text{K}^{-1}$  and halve the lapse rate feedback to  $-0.42 \text{ Wm}^{-2}\text{K}^{-1}$ , for a total feedback of  $b = 0.20 - 0.42 + 0.26 + 0.69 + 0.25 = 0.98 \text{ Wm}^{-2}\text{K}^{-1}$ . The temperature increase for a doubling of CO<sub>2</sub> is then

$$dT = \kappa dF / (1 - b\kappa) = 0.313 * 3.4 / (1 - 0.98 * 0.313) = 1.5 \text{ }^\circ\text{C}.$$

Perhaps more realistically: some observers of clouds outside the IPCC camp reckon that the water vapor feedback is in fact negative. A small negative water vapor feedback of  $-0.20 \text{ Wm}^{-2}\text{K}^{-1}$  and a halved lapse rate feedback of  $-0.42 \text{ Wm}^{-2}\text{K}^{-1}$  give a total feedback of  $b = -0.20 - 0.42 + 0.26 + 0.69 + 0.25 = 0.58 \text{ Wm}^{-2}\text{K}^{-1}$ . The temperature increase for a doubling of CO<sub>2</sub> is then

$$dT = \kappa dF / (1 - b\kappa) = 0.313 * 3.4 / (1 - 0.58 * 0.313) = 1.3 \text{ }^\circ\text{C}.$$

**Conclusion:** Between a half and two thirds of the temperature increases predicted by the IPCC are due to their assumed theoretical water vapor feedback, which is also responsible for the hotspot. Reducing the water vapor feedback in the climate models in line with the faint or absent hotspot in the observed warming pattern, while leaving



the rest of their climate model unchanged, cuts the temperature increases projected by the IPCC by more than half.

## The Water Vapor Feedback is Responsible For the Instability in the Climate Models

The climate system shown in Figure 10 becomes unstable and goes into runaway warming if the *loop gain*, the total amplification in going once around the loop through the “no-feedbacks” climate system (green box,  $\kappa$ ) then the temperature feedbacks (red box,  $b$ ), exceeds one. The loop gain is the amplification a forcing or temperature perturbation receives in going once around the feedback loop and back to where it started. So if the loop gain, which is equal to  $b\kappa$ , exceeds one then the perturbation gets bigger each time it goes around the loop—and so it “runs away to infinity”. In climate terms, this means runaway warming—the world would get much hotter (until something about the system changed to bring the loop gain back below one).

Electrical and electronic engineers have used feedback systems very extensively for decades, and nearly every electrical and electronic device you encounter deliberately has some feedback built into it. A large body of knowledge about such systems has grown up, called *control theory*.

The values of the various factors in the climate system in Figure 9 are always evolving and changing by small amounts. For example, human emissions of carbon dioxide are increasing the “no-feedbacks” amplification factor  $\kappa$ , though it is not known by how much. Also, there are a myriad of small factors of the real climate not portrayed in the diagram. And finally, the climate system cannot truly be analysed in terms of independent linear systems, so the diagram is only an approximation of the climate system. As a result of these factors, engineers know that this system would be prone to instability if the loop gain is anywhere near one in a logarithmic sense. Technically the tipping point would be if the loop gain  $b\kappa$  exceeds one, but more realistically the system might be prone to occasional instability if the loop gain exceeded 0.1, or maybe even a lower amount.

According to the IPCC, the total temperature feedback is  $b = 2.16 \text{ Wm}^{-2}\text{K}^{-1}$  and the no-feedbacks sensitivity is  $\kappa = 0.313 \text{ W}^{-1}\text{m}^2\text{K}$ , for a loop gain of  $b\kappa = 0.68$ . This suggests a climate system that is very prone to instability. It also suggests that the IPCC has tuned their climate models to be as close as possible to instability (and the dreaded tipping point!) without already being too obviously unstable.

But, unlike Venus, the earth has never gone into runaway greenhouse warming—despite asteroid strikes, carbon dioxide levels up to twenty times today’s level, continents drifting around, volcanoes, and so on. The earth’s climate system has in practice been quite stable, surviving some large perturbations and billions of years of evolving parameters in the system diagram. This historical stability is a solid clue that the IPCC climate models are wrongly set way too close to the tipping point, and that the loop gain  $b\kappa$  is in reality a lot lower.

Simply turning down the water vapor feedback to say zero (it might even be negative) in line with the observations of a missing or faint hotspot, and halving the magnitude of the lapse rate feedback, reduces the total feedback to  $b = 0 - 0.42 + 0.26 + 0.69 + 0.25 = 0.78 \text{ Wm}^{-2}\text{K}^{-1}$  and the loop gain to  $b\kappa = 0.24$ . This is much more stable, though still unrealistically high.

**Conclusion:** The IPCC climate models are currently set unrealistically close to the tipping point of runaway warming. Reducing the water vapor feedback in the climate models in line with the faint or absent hotspot in the observed warming pattern, while leaving the rest of their climate model unchanged, makes the climate models much more stable—and more consistent with the earth’s historic climate stability.

## Unknown Signatures

Signatures are always theoretical. To be empirically derived, a signature would have to be observed during a period of global warming that was somehow known to be due solely to one cause, and that has never occurred.

There are many possible causes of global warming whose signatures are unknown (as far as I know), including the signatures of:

1. The Pacific Decadal Oscillation. Global temperature changes for the last century can be largely explained by a long-term fluctuations of the Pacific Ocean. See [www.drroyspencer.com/research-articles/global-warming-as-a-natural-response](http://www.drroyspencer.com/research-articles/global-warming-as-a-natural-response).
2. Cosmic rays. This theory, championed by Henrik Svensmark in his book *The Chilling Stars: The New Theory of Climate Change*, notes that cosmic rays impacting on the earth cause showers of particles that provide the nuclei for water droplets to form clouds from water vapor. The sun’s magnetic field (but not the earth’s, because it is too weak) shields us from cosmic rays, so when the sun is more active we get fewer cosmic rays, fewer low clouds, and the earth heats up. The sun has been unusually active for the last century and especially the last couple of decades. The correlations of global temperatures with cosmic rays on all time scales, from decades to millions of years, are very good—far better than the correlations with carbon dioxide levels.

These possible causes are not necessarily mutually exclusive—they may influence each other.

A reason more signatures aren’t known is because the IPCC scientists produce most of the signatures, but the IPCC’s mandate is to investigate the effect of *human emissions* on global temperature—and they vigorously ignore other possible causes.

Logically, because some likely causes have unknown signatures, the observed pattern cannot definitely prove what caused global warming, because it might be wholly or partly due to the causes whose signatures are unknown. The observed warming pattern can only rule causes out.

## Can the Observed Pattern of Warming Tell Us What *Did* Cause Global Warming?

If we definitely knew all the signatures of all the possible causes, and they were all sufficiently distinct, then we could probably figure out from the observed warming pattern in Figure 1 what caused the recent global warming.

But we don't know the signatures of some leading candidates. We don't even reliably know the signatures of increased CO<sub>2</sub> or increased solar radiation, because their theoretical signatures as published by the IPCC have large hotspots due to the water vapor feedback assumed by the IPCC—and the absence of a hotspot in the last warming period tells us that the IPCC's theory of water vapor feedback is wrong. Perhaps the signatures of increased CO<sub>2</sub> or increased solar radiation are as per Figures 3 and 4, but without the hotspot. Who knows?

So we cannot tell much about what *did* cause the global warming. We can however note the broad similarities between Figures 1 and Figures 3C and 4 (d), from which we can conclude that maybe ozone depletion was a significant cause of warming from 1979 to 1999.

To the extent that the signature of increased greenhouse warming includes a hotspot, then carbon emissions were not a significant cause of the warming. However, if the IPCC's climate theory is so broken that the true signature of increased non-water-vapor greenhouse gases does not include a hotspot, then carbon emissions might have had a significant role in the recent global warming—but if so then the IPCC's theoretical water vapor feedback is wrong and the IPCC's predictions for future temperatures due to rising CO<sub>2</sub> levels should be reduced by at least a half.

## Further Discussion

To go deeper into the missing hotspot issue, perhaps look at these articles and comments on leading alarmist and skeptical websites:

[www.climateaudit.org/?p=3161](http://www.climateaudit.org/?p=3161)

[www.climateaudit.org/?p=4101](http://www.climateaudit.org/?p=4101)

[www.realclimate.org/index.php/archives/2007/12/tropical-troposphere-trends](http://www.realclimate.org/index.php/archives/2007/12/tropical-troposphere-trends)

[global-warming.accuweather.com/2008/05/climate\\_models\\_get\\_a\\_boost\\_fro\\_1.html](http://global-warming.accuweather.com/2008/05/climate_models_get_a_boost_fro_1.html)

[clubtrotppo.com.au/2008/12/19/david-evans-greenhouse-sceptic-debates-his-views-on-trotppo/#more-6780](http://clubtrotppo.com.au/2008/12/19/david-evans-greenhouse-sceptic-debates-his-views-on-trotppo/#more-6780)

[joannenova.com.au/2008/10/30/not-found-the-hot-spot](http://joannenova.com.au/2008/10/30/not-found-the-hot-spot)

[joannenova.com.au/2010/07/sherwood-2008-where-you-can-find-a-hot-spot-at-zero-degrees](http://joannenova.com.au/2010/07/sherwood-2008-where-you-can-find-a-hot-spot-at-zero-degrees)

[www.skepticalscience.com/How-Jo-Nova-doesnt-get-the-tropospheric-hot-spot.html](http://www.skepticalscience.com/How-Jo-Nova-doesnt-get-the-tropospheric-hot-spot.html)  
[joannenova.com.au/2010/06/how-john-cook-unskeptically-believes-in-a-hotspot-that-thermometers-cant-find](http://joannenova.com.au/2010/06/how-john-cook-unskeptically-believes-in-a-hotspot-that-thermometers-cant-find)

These papers have the latest statistical arguments.

Douglas 2007: [www.icecap.us/images/uploads/DOUGLASPAPER.pdf](http://www.icecap.us/images/uploads/DOUGLASPAPER.pdf)

Santer 2008: [https://publicaffairs.llnl.gov/news/news\\_releases/2008/NR-08-10-05-article.pdf](https://publicaffairs.llnl.gov/news/news_releases/2008/NR-08-10-05-article.pdf)

Santer 2008: [camels.metoffice.gov.uk/quarc/Sherwood08\\_JClimate.pdf](http://camels.metoffice.gov.uk/quarc/Sherwood08_JClimate.pdf)

MacIntyre 2009: [arxiv.org/abs/0905.0445v1](http://arxiv.org/abs/0905.0445v1)

Douglass and Christy 2009 (article about process, ClimateGate emails):  
[www.americanthinker.com/2009/12/a\\_climatology\\_conspiracy.html](http://www.americanthinker.com/2009/12/a_climatology_conspiracy.html)

McKittrick 2010:  
[rossmckitrick.weebly.com/uploads/4/8/0/8/4808045/mmh\\_asl2010.pdf](http://rossmckitrick.weebly.com/uploads/4/8/0/8/4808045/mmh_asl2010.pdf)

David Stockwell 2010: [landshape.org/enm/how-bad-are-climate-models](http://landshape.org/enm/how-bad-are-climate-models)

Christy 2010: [www.mdpi.com/2072-4292/2/9/2148/pdf](http://www.mdpi.com/2072-4292/2/9/2148/pdf)

## Some Political Observations

### *What Else Can They Say?*

The IPCC scientists do not claim that the hotspot was found, only that we might have missed it. Consider the alternatives for the IPCC scientists—what else can they say?

Suppose the IPCC agreed that the hotspot was not present in the observed data at a strength consistent with an increased greenhouse effect as a significant cause of the recent warming. Then the IPCC has much less reason to exist and would lose much of its status and influence. Santer and his colleagues would get less funding and some would lose their jobs, while future carbon emission trading profits would disappear. See any vested interests there? Of course Santer and company are going to put forward the strongest case that the hotspot is there—but what is striking is the weakness of their case.

Fortunately for them, Santer and his colleagues only have to convince politicians and sympathetic journalists. A couple of impressive-looking papers from authority figures with dense language usually does the trick!

### What If the Hotspot Had Been Found

Consider what would have happened if the hotspot was present in the observed warming pattern. The IPCC would have triumphantly told the world that they had finally found evidence that carbon emissions were causing global warming—and they would have been entitled to. They obviously really want to claim they have found the hotspot, but they always stop just short of making that claim.

### Theory Versus Evidence

The missing hotspot is a case where the evidence does not support the theory. We skeptics demand theory yield to evidence. That's the usual practice. But so far the IPCC is still demanding that the evidence yield to its theory. The IPCC has had a few years to torture the radiosonde data, but it hasn't admitted to a hotspot—so exonerate carbon! Or at least admit that the IPCC predictions of temperature rises are way too high because they have the water vapor feedback all wrong!

### What is Really Going On

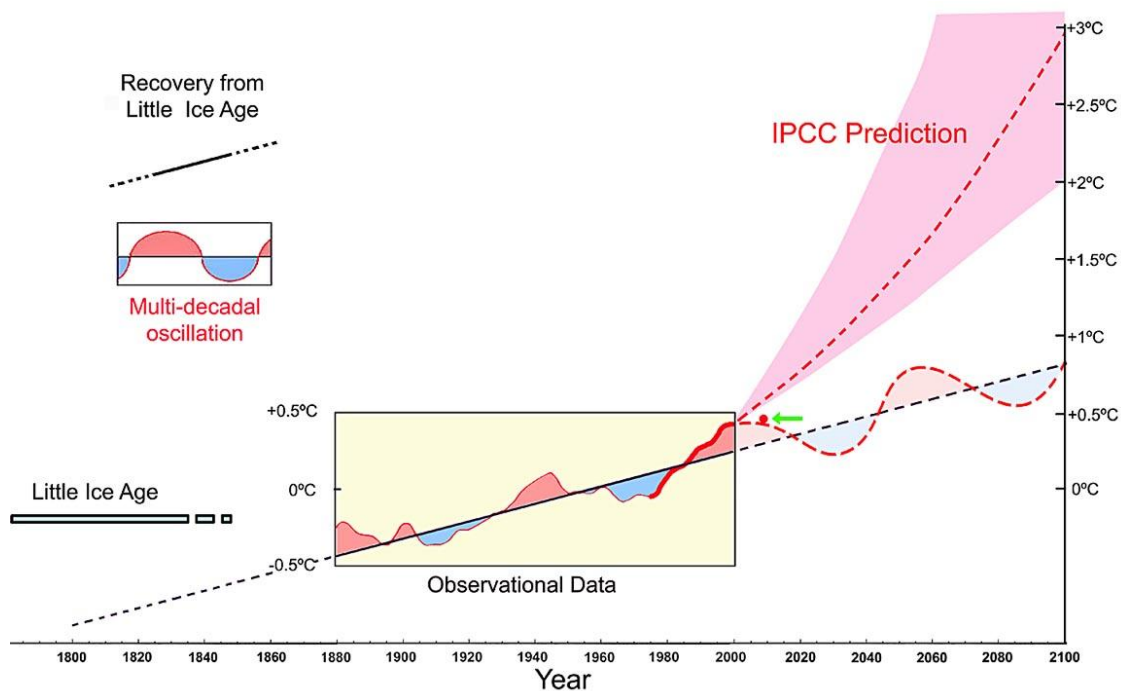


Figure 10: The big temperature picture. Excellent graph and insight from Dr Syun Akasofu (2009 International Conference on Climate Change, New York, March 2009).

The global temperature has been rising at a steady trend rate of 0.5°C per century since the end of the little ice age in the 1700s (when the Thames River would freeze over every winter). On top of the 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, with temperature levelling off. The pattern suggests that the world has entered a period of slight cooling until about 2030.

There was a cooling scare in the early 1970s at the end of the last cooling phase. The current global warming alarm is based on the last warming oscillation, from 1975 to 2001. The IPCC predictions simply extrapolated the last warming as if it would last forever, a textbook case of alarmism. However the last warming period ended after the usual thirty years or so, and the global temperature is now definitely tracking below the IPCC predictions.

The IPCC blames human emissions of carbon dioxide for the last warming. But by general consensus human emissions of carbon dioxide have only been large enough to be significant since 1940—yet the warming trend was in place for well over a century before that. And there was a cooling period from 1940 to 1975, despite human emissions of carbon dioxide. And there has been no warming since 2001, despite record human emissions of carbon dioxide.

There is no actual evidence that carbon dioxide emissions are causing global warming. Note that models are just concatenations of calculations you could do on a hand-held calculator, so they are theoretical and cannot be part of any evidence. Although the models contain some well-established science, they also contain a myriad of implicit and explicit assumptions, guesses, and gross approximations (such as the assumption of water vapor feedback), and mistakes in any of them can invalidate the model outputs.

No one knows for sure what caused the little ice age or for how many more centuries the slow warming trend will continue. It has been warmer than the present for much of the 10 thousand years since the last big ice age: it was a little warmer for a few centuries in the medieval warm period around 1100 (when Greenland was settled for grazing) and also during the Roman-Climate Optimum at the time of the Roman Empire (when grapes grew in Scotland), and at least 1°C warmer for much of the Holocene Climate Optimum (4 to 8 thousand years ago).

(By the way: Measuring the global temperature is only reliably done by satellites, which circle the world 24/7 measuring the temperature over large swathes of land and ocean. But satellite temperature records only go back to 1979. Before that, the further back you go the more unreliable the temperature record gets. We have decent land thermometer records back to 1880, and some thermometer records back to the middle of the 1700s. Prior to that we rely on *temperature proxies*, such as ice cores, tree rings, ocean sediments, or snow lines.)

### **What Next?**

Probably nothing.

The IPCC have known that the missing hotspot has been a problem since the mid 1990s, and said so publicly on occasion. Positions have hardened in the last few years, and now they are quiet about it. A couple of IPCC scientists, Santer and Sherwood, have quite properly tried to explain the missing hotspot—the only time the IPCC mentions the missing hotspot is each time it is explained away!

However there is plainly a problem and the IPCC knows it: the hotspot should have been detectable by the radiosondes if the IPCC climate theory was correct. Still, the IPCC scientists live in a world of few close critics and of well paid science jobs whose existence depends on government belief in the carbon dioxide scare.

Why should the IPCC just give up? Maybe they will find a hotspot next time there is a warming period, using better technology. They cannot just announce their climate theory is wrong and give up their jobs and funding: “Sorry folks, looks like we might have been wrong, no problem after all. Emit all the carbon you like.” However they should at least now level with the public and say that maybe their climate theory isn’t right: they should start turning down the water vapor feedback in their models, and lower their temperature predictions. Remember, even the IPCC in its 2007 Assessment Report only said it was 90% sure that carbon emissions caused global warming, so they have left themselves wiggle room for a backdown.

Some climate scientists such as Fred Singer have been talking about the missing signature since 1995. No one much has listened: there is too much bureaucratic momentum, government money, and carbon trading money behind AGW for anything to stop it now except a plunge in temperatures so sharp or so long that the public simply disbelieves all the hype that carbon emissions are causing the world to heat up. In the climate science world, that the hotspot is missing or too faint is neither new nor a secret. But in the wider world no one knows or cares.

The missing hotspot is a difficult topic to make accessible to the public. Alarmists can confuse the issue with talk about other signatures. Or they simply claim the hotspot has been found—very few people know to contradict them, and Santer and Sherwood give them some cover by providing authoritative and dense papers that give the impression that the hotspot has been found, while not actually claiming it has been found.

### ***The Money Connection***

So what is going on here? In time-honored journalistic fashion, follow the money:

- The amount of money spent on anti-AGW activity by organizations is around US\$2 million per year, primarily from Heartland.
- The amount of money spent by pro-AGW organisations on research is about US\$3 billion per year, about 1,000 times larger. It mainly comes from big government spending on pro-AGW climate research and on promoting the AGW message, and from the Greens.
- Emissions trading by the finance industry was US\$120 billion in 2008. This will grow to over US\$1 trillion by 2012, and carbon emission permit trading will be the largest “commodity” market in the world—larger than oil, steel, rice, wheat etc. Typically the finance industry might pocket 1% – 5% of the turnover, so ***even now their financial interest matches the spending on pro-AGW activities and soon it will vastly exceed it.***

Presumably therefore it is the finance industry that is driving the carbon emission permits agenda. Notice that a carbon tax, which would be simpler and fairer, would ***not*** benefit the traders and is ***not*** being put forward by governments. It is not that the

“science is settled” (a fine piece of anti-science propaganda!), but that the science is simply irrelevant now because big money interests are in control.

Who benefits? Emission permits are created by government fiat, out of thin air, yet have value. Trading favors the well-informed and those who can move the market, so big financial firms will routinely plunder the pockets of smaller market participants. The rest of us, one way or another, will pay for both the government-issued emission permits and the trading profits of the finance industry.

A former Chief IMF economist explains that the finance industry is now so powerful that it can sweep aside objections to its profit-making activities, no matter how ruinous they will be in the long term. From [www.theatlantic.com/doc/print/200905/imf-advice](http://www.theatlantic.com/doc/print/200905/imf-advice) (and see also [www.321gold.com/editorials/wilson/wilson050509.html](http://www.321gold.com/editorials/wilson/wilson050509.html)):

*“But these various policies—lightweight regulation, cheap money, the unwritten Chinese-American economic alliance, the promotion of homeownership—had something in common. Even though some are traditionally associated with Democrats and some with Republicans, they all benefited the financial sector. Policy changes that might have forestalled the crisis but would have limited the financial sector’s profits—such as Brooksley Born’s now-famous attempts to regulate credit-default swaps at the Commodity Futures Trading Commission, in 1998—were ignored or swept aside.”*

I have met carbon emissions traders who say that they are well aware that carbon emissions almost certainly do not cause global warming. But that they are riding the trading for all it is worth while it lasts, because it is good business. They told me that that view seems to be widespread among carbon traders.

All of which suggests that the Greens and the politically-correct are acting in the interests of big money. Laughably, they are not even acting in their own professed interests:

- Carbon emission restrictions will make energy more expensive. Much of the third world and the poor in the developed world can barely afford energy now, even without restrictions on cheap energy from hydrocarbons. So carbon emission restrictions will cause widespread poverty and death in the third world and greater poverty in the developed world.
- As the missing hotspot shows, carbon emissions restrictions will make little or no difference to the world’s temperature.

In unwittingly supporting big money interests against their own professed ideals, uninformed leftists are following in the steps of tradition. For example, the creation of the fourth and current central bank in the United States in 1913 was by a leftist university professor plucked out of obscurity and propelled into the presidency by big money interests, Woodrow Wilson. He later bitterly regretted what he had done.

Leftists in particular think they are saving the planet. But in reality science now damns their case. They are striving to make life harder or impossible for most of the world’s population, and they are the unwitting tools of big money. Wake up!



## ***The World Needs a Science Debate***

In a courtroom trial, two sides argue their best cases and out of that argument some sort of truth emerges. The same happens in science, when it is healthy.

However in the global warming debate, one side has vastly more resources than the other—so only one side of the argument is heard. How did this come about? Since World War II, government has funded most science research. So if one paradigm captures government science funding, only that paradigm will get government funding. In climate science there is almost no industry research, so climate science research spending comes entirely from government. All western governments were long since captured by AGW forces, and no funding goes to competing ideas. (On the non-western side the alignments are often very different. For example the Russian government has always said that AGW is rubbish, while the Indian and Chinese governments have never supported AGW.) The solution might be for science funding bodies to cultivate diversity, to routinely and deliberately fund opposing paradigms in order to prevent the bad policy that results from unfair contests where only one voice is adequately resourced and heard.

Ever noticed that there have been no debates on the science in global warming? Formal televised debates where scientists outlay their cases and rebut each other? We skeptics constantly ask for debates, but are swept aside and ignored by the pro-AGW forces because their position could not get any better.

- A trial without a defence is a *sham*.
- Business without competition is a *monopoly*.
- Science without debate is *propaganda*.

## **Alarmist Propaganda**

Until now this document has dealt with reasonable arguments made by honourable scientists in the debate. Now we will deal with some of the unreasonable claims and arguments made by less scrupulous alarmists. Alarmists are fighting a rearguard action of media blackout, misinformation, confusion, and outright lies on the signature issue.

### ***Claim: The Signature of Increased Greenhouse Warming Has Been Found***

This claim is sometimes made because part of the signature of increased greenhouse warming, the combination of broad stratospheric cooling and broad tropospheric warming, is indeed present in the observed warming pattern. But the other feature of that signature, the hotspot at the top of the tropical troposphere, is missing from the only data we have (Figures 1, 2, and 7). Therefore the signature of increased greenhouse warming has not been found.

It could be argued by alarmists (but never is) that the missing hotspot merely shows that the climate models are wrong about the hotspot, so the signature of increased greenhouse warming might just be the combination of broad stratospheric cooling and broad tropospheric warming without the hotspot. But if this were the case, then the water vapor feedback predicted by climate theory cannot be present (because there is

no hotspot), so the predictions of future warming due to rising CO<sub>2</sub> levels must be reduced by at least half. Also, that combination of broad stratospheric cooling and broad tropospheric warming is at least partially due to ozone depletion, whose signature also has that feature and is known to have occurred during 1979–1999. Finally, there is still no proof that the observed warming pattern isn't due to causes whose signatures are unknown, such as cosmic rays.

The less sophisticated argument is simply to claim that the climate models are correct *and* that the signature of increased greenhouse warming was found. This is obviously nonsense, as the comparisons above show. Even if Santer or Sherwood turn out to be correct that the hotspot might be present in Figure 1 but we just cannot see it, the claim that the signature of increased greenhouse warming was found is still wrong—because Santer and Sherwood only claim that the hotspot could be present in the observed data, not that it definitely is present. It is, at most, faint.

Finally there are even less sophisticated claims, which can be challenged with:

- Is there some other data? If so, climate scientists would be very interested in it.
- You can see the signature of an increased greenhouse effect, and thus the hotspot at 10 – 12 kms in the tropics, in the data in Figure 2? Really? Where?
- How do you distinguish the signature of an increased greenhouse effect from the signature of ozone depletion, which we know *was* occurring?
- Do you acknowledge that the signature of an increased greenhouse effect includes a hotspot at the top of the tropical troposphere? If not, do you acknowledge that the water vapor feedback must therefore be much diminished—so the IPCC model's predictions of temperature rises due to rising CO<sub>2</sub> must also be much reduced?

***Argument: More than One Possible Cause of Global Warming Has a Hotspot, So the Signature of Increased Greenhouse Warming Does Not Include the Hotspot***

This argument is made whilst also claiming that IPCC climate theory is correct. Obviously the signature of an increased greenhouse effect does include a hotspot at 10 – 12 kms in the tropics (Figures 3 or 4). This argument is illogical and silly, relying at best on confusing semantics while omitting the whole truth, but it was made prominently and seriously at

[scienceblogs.com/deltoid/2008/07/the\\_australians\\_war\\_on\\_science\\_16.php](http://scienceblogs.com/deltoid/2008/07/the_australians_war_on_science_16.php)

and no alarmists seems to have bothered to inform Tim that it doesn't make sense.