An Alternative Theory of Climate Change

by

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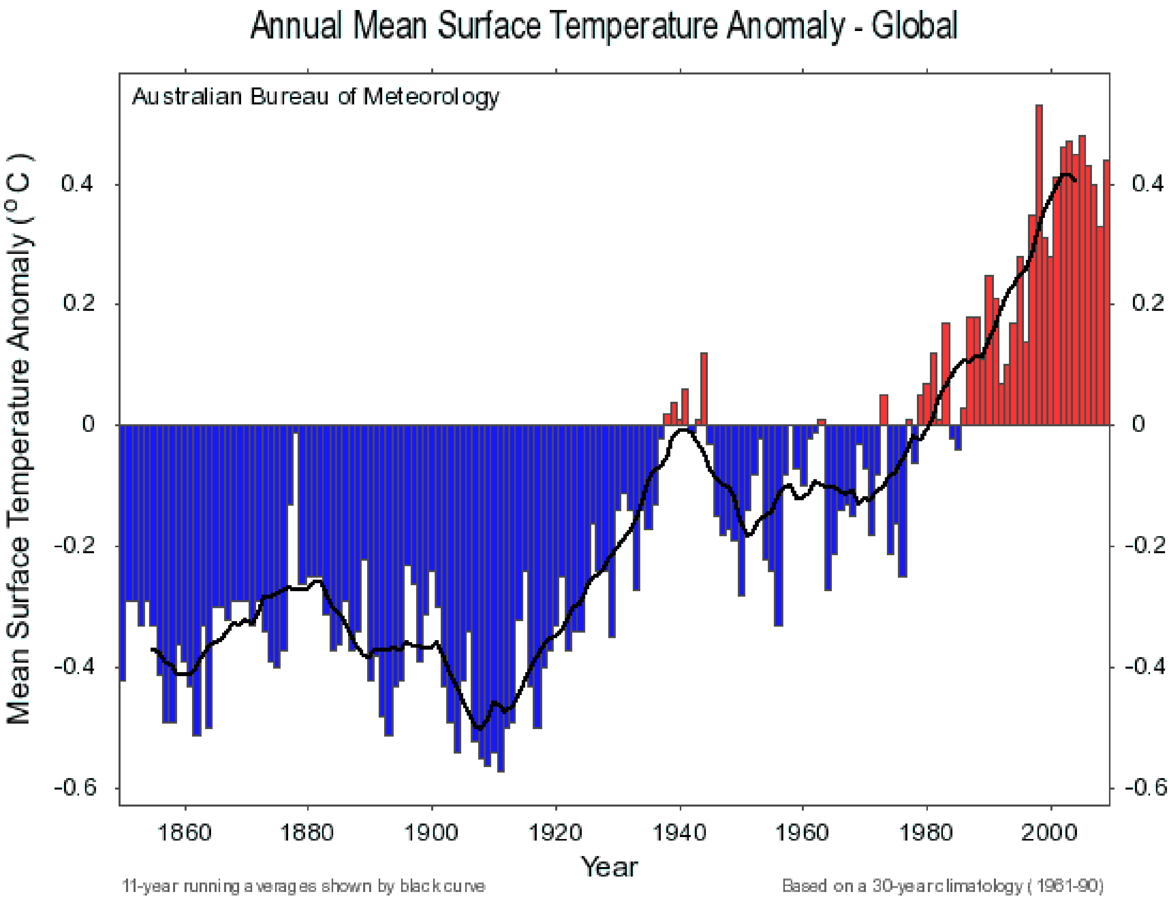
1. Introduction

The UN's Inter Government Panel on Climate Change (IPCC) has made recommendations[1] linking world climate with the emission of carbon dioxide from the burning of fossil fuels. They have predicted a range of global temperature increases are likely unless carbon dioxide emission is curbed. Since fossil fuels are the world's major source of energy, these predictions need to be examined for their accuracy, because measures would need to be carefully calibrated against the threat.

About 10 years ago as [3]one of 80,000 computer users around the world who donated the after-hours use of their computers to the modelling of global climate[2]and as a pioneer in the mathematical modelling of complex systems[3] there was good reason to take part. This so-called 'grid' computing, run by the UK's Hadley centre and Oxford university was because the world's most powerful computers could not do the task. The experience indicated the need for much more research into the basic assumptions and processes on which their climate models were based as well as the need for more powerful computers.

2. The evidence - historical temperature

One would expect the Australian Bureau of Meteorology (BOM) to have an article on current climate science and it has[4]. Furthermore, since BOM has not publicly objected to the UN IPCC's recommendations we can assume their article contains data commonly accepted by the IPCC. So the basic data on which the alternative theory is based comes from their



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1 (3) *Alexander Biggs was a Principal Research Scientist in the DSTO*

web site[4].

The above is the Annual Mean Surface Temperature Anomaly – Global covers 1850-2009. The first thing to note is that the annual mean temperatures fluctuate wildly from year to year, although trends are evident. Obviously there are random factors at work, so to make the trends clearer the data can be smoothed by using a moving average over several years. 11 years is a moving average favourite because the sunspot cycle is 11 years, enabling the cancellation of some of the effects of the cycle on temperature. The BOM has thoughtfully provided such a formula and that is represented by the black line in the diagram and it certainly makes the trends clearer. The disadvantage is that we are always 5.5 years behind knowing the present smoothed temperature.

No notice need be taken of the horizontal centre line marked zero at each end. The IPCC wanted to call the graph an anomaly so they had to have a zero somewhere – red above and blue below. It is purely an arbitrary zero to fit their conclusions and has no physical meaning.

Now study the trends shown by the black line. The averaged mean surface temperature increased uniformly from the 1910 until 1940 – a total of 0.45C. It was not even noticed then: the world was too concerned with one Adolf Hitler. Is it a coincidence that this massive rise coincided with motor vehicles increasing from zero to millions, electricity power generators and factories belching out millions of tons of carbon dioxide? Unlikely. There is no other credible cause other than carbon dioxide for a rise of 0.45C in 30 years. However the zero anomaly line running through the 1940 temperature suggests that temperature was normal. Can you believe it?

Consider the period from 1940 to about 1970, during which the temperature actually fell about 0.1C. That the temperature could actually fall for 30 years during a period of unparalleled increase in carbon dioxide from fossil fuels defies logic. Surely if carbon dioxide concentration in the atmosphere is the main determinate of global temperature, then a steady increase in carbon dioxide concentration should result in a steady increase in global temperature. But perhaps for some reason carbon dioxide has become a less effective contributor to global warming as the concentration increased.

The Spectral Evidence

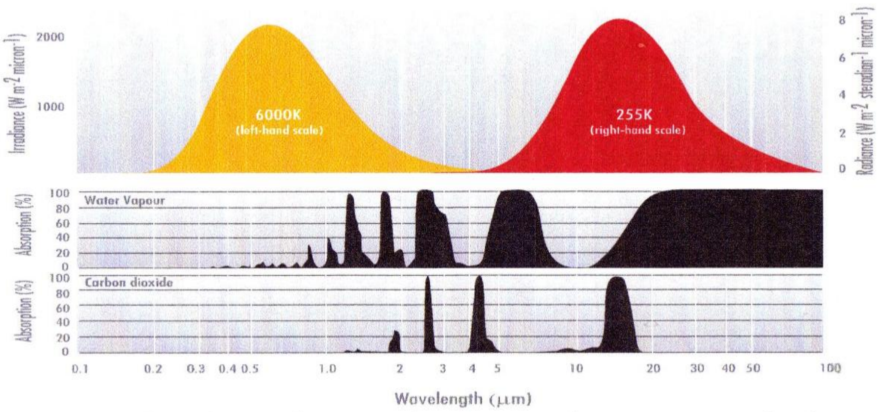

Figure 4. The radiation absorption characteristics of water vapour and carbon dioxide as a function of wavelength. The upper portion of the chart shows the wavelength distribution of radiation emitted from black bodies radiating at 6000K (approximately the solar photosphere) and 255K (approximately the earth's planetary temperature), with the solar irradiance measured at the mean distance of the earth from the sun. The percentage absorption of a vertical beam by representative atmospheric concentrations of water vapour (H_2O) and carbon dioxide (CO_2) are shown in the lower panels.

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Radiation from the sun or any other body consists of many wavelengths or frequencies ranging from x-rays to infra-red heat waves and radio waves. Because different wavelengths of radiation have different heating or cooling effects, we need to explore these effects by their wavelengths. This is called the spectrum of radiation. Figure 4 from the BOM[5] (above) shows the spectra of radiations from both the sun and earth and the absorption spectra by carbon dioxide and water vapour. To avoid huge meaningless numbers the radiation in watts is divided by the size (in square metres) of a disk with the same area as the cross section of the earth through the poles. Thus radiation is expressed as watts per square metre and would be approximately true at the equator. Note that the sun is very hot and peaks at about 2kw per square metre. The horizontal scale of wavelength is in microns (millionths of a metre) and covers the important optical and infra-red wavelengths. Also it is not a linear scale, but logarithmic. As we have satellites circling the earth, it is possible to measure the earth's radiation into space and this is vital to any discussion and prediction of future climate, that is because the earth settles over time to a temperature where there is equilibrium between incoming radiation from the sun and loss of heat from the earth.

The earth's radiation profile is shown in figure 4 by the red shape on the top right. Note that it is a so-called 'bell' curve with a peak at about 14 microns and a temperature of 255 degrees Kelvin (about -18C) and extends from about 4 microns to 100 microns. That is what the earth looks like thermodynamically from space on the average

The bottom two parts of figure 4 show the absorption spectra of the atmospheric gases water vapour and carbon dioxide. An explanation: when heat or light radiation passes through a gas it excites resonances in some of their molecules. The wavelength of radiation that excites the resonance actually identifies molecules and so we have resonance lines in the spectra for carbon dioxide and water vapour. As you can see in the figure, the absorption lines are wider than just lines because the excited molecules excite some motion in adjacent molecules of other gases. For our purposes the important point is that all this shaking of the molecules dissipate energy in the gases raising the temperature and that is crucial to all theories of global warming.

Now the importance of a spectral line in heating the atmosphere depends on where it is situated in the spectrum. The absorption spectral line of carbon dioxide at about 14 microns which, as figure 4 shows, is right near the peak of the earth's radiation spectra (red shape above). The other carbon dioxide lines are way off to the side of the radiation spectra, so are unimportant.

It is important to note that the intensity of the 14 micron line has reached nearly 100% absorption. Obviously the line cannot absorb more than 100% of the energy passing through it. That means that for that particular level of carbon dioxide concentration, an incremental increase in earth's radiation from any cause would have a lesser effect on the rate of increase of temperature. In other words saturation is occurring. The BOM paper does not tell us when that occurred, but probably no one knows, since systematic measurement of carbon dioxide concentration only started in 1961. But it could explain why the rate of increase of global temperature slumped so dramatically in 1940. Another consequence of the saturation of the 14 micron carbon dioxide line is as follows. The bell shaped curve of radiation from the earth is, of course, an average. In general, during the diurnal cycle, the half of the earth in daylight will be warmer than the half in darkness. But because the average absorption of radiated heat is already 100%, the atmosphere cannot absorb the extra daylight radiation Thus on the average the temperature rise due to carbon dioxide will be limited. But this is a complex issue and further attention must be given to that other

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greenhouse gas – water vapour - and the phasing of global temperature increase.

Figure 4 shows that water vapour starts absorbing radiation from the earth at about 5 microns but at that wavelength there is little radiation to absorb. However at 14 microns water vapour would absorb about 40% of the radiation – not as much as carbon dioxide, but still significant. From 20 microns on, water vapour absorbs all the radiation. From the figure an estimate is that water vapour absorbs as much as a third of all the infra-red radiation from the earth. If this is correct then the emphasis on reducing carbon dioxide may have limited effect on global warming. Some climate scientists discount the effect of water vapour, saying it is a feedback whereas carbon dioxide is a forcing function. That misses the point: they both heat the air.

That there is a relation between humidity, air temperature and the extent of cloud cover will surprise no one. But the IPCC has always admitted that they do not understand clouds – neither their production nor their effect on climate. Yet it is obvious that a cloudy day is usually cooler, because cloud reflects the sun's radiation back into space and warmer at night because the clouds prevent the earth's radiation escaping into space, reflecting it back. Actually this makes water vapour and clouds much more complex in their effects on climate than carbon dioxide because clouds provide negative feedback in daylight and positive feedback at night. Carbon dioxide only provides a feedback loop through biological effects. It is also important that the latent heat of evaporation be properly accounted for. Of course latent heat of liquids is basic to refrigeration. When any surface water evaporates it cools both the air and the surface water. When water vapour turns into precipitation, the exact opposite occurs, heating the resulting water and the air. It might be thought that these two effects cancel out, but that is not so, because the latter effect occurs high in the troposphere where it more readily radiates into space. So latent heat provides a natural air conditioner for the earth resisting the heating effect of carbon dioxide

Quantum thermodynamics

The above is an explanation of the theory in classical thermodynamics. To be valid it must also pass the test of quantum thermodynamics. Instead of a continuous rise in temperature, there would be a series of 'steps and stairs' as a quantum of energy became sufficient to ascend or drop to the next degree of freedom of the carbon dioxide molecule. While the author has no table of temperatures at which quanta of radiation are accepted by carbon dioxide, it seems likely that this temperature in the atmosphere was reached in 1940. If so this would allow the subsequent drop in temperature, because no more heat could be absorbed in that state and no higher state was available within the temperature range of the radiation.

The evidence – Ocean phase delay

The oceans cover two thirds of the planet and are kilometres deep. They have a profound effect on both the weather and the climate of the planet. For example, the warmer surface water off he east coast of Australia and the colder water in the central Pacific cause the present La Nina, (2011) dumping floods on eastern Australia. Heating of any fluid can only occcur by one or more of three methods: conduction, convection, radiation. Water is a very poor conductor of heat, so little heating (or cooling) happens by conduction. Radiation from the sun only heats the top 100 metres or so of the oceans. So the huge heat sink that the oceans are, can only be heated by convection, that is to say by the oceans' currents. Ocean surface currents are caused by the prevailing winds, but most currents at depth are caused by varying water density and the Coriolis effect of earth's rotation. In the ocean's depths, water temperature falls to about 4C where the water is most dense. The currants at depth are so slow that it has been calculated that it could take a thousand years for a molecule of water to

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move from the North Atlantic to the central Pacific. In other words there is a huge transport delay in heat moving from the atmosphere into the oceans. Most delays that physicists deal with are inertial, but transport delays can be recognised and allowed for in calculations, otherwise mistakes can occur in attributing the causes of global warming.

The time delay of the atmosphere in responding to any change is about one month, but with the time delay of the oceans being decades at least, how do you decide whether a rising temperature is due to further atmospheric warming, or just the heat from earlier atmospheric warming finally percolating through the oceans? That the global temperature should suddenly start to rise in 1970 after actually falling since 1940 bears all the hallmarks of a transport delay.

3 Conclusions

Lacking a properly validated model of earth's climate, the only way to understand it is to find a model that fits the facts. Such a model is as follows. From 1910 to 1940 the atmospheric average temperature climbed steadily by a total of 0.45C. This was a unique event and highly unlikely to be mere coincidence, with the rise of the motor vehicle and other industry burning fossil fuels. Taken with the spectral information one has to conclude that the rise was due to increased concentration of carbon dioxide during the period. But why did the temperature rise stop in 1940 when carbon dioxide was clearly increasing at an accelerating rate? The spectral information shows the carbon dioxide line had reached 100% absorption, but when? If that happened in 1940 as quantum thermodynamics suggested it might, it would account for the lack of new heat and temperature for the next 30 years, to 1970.

The atmospheric temperature fall post 1910 - 1940 is to be expected as the oceans retained their pre-1910 thermal equilibrium, tending to drag the atmospheric temperature down: due to the long transport delay of the 1910-1940 injection of heat, it had little effect until 1970. After 1970 the permanent injection into the oceans of the extra heat started to raise the atmospheric temperature, a process that continued until at least 2000 resulting in a new equilibrium about 0.5C higher than 1940.

As pointed out above, water vapour would absorb about 40% of earth's infra-red radiation with predictable effects: an increase in humidity and temperature is likely to cause increased cloud cover, which in turn result in increased negative feedback during the day and increased positive at night. Does that matter? Yes it does. Net negative feedback lowers temperature, while positive increases temperature and tends to make the whole system more unstable. It is doubtful that the IPCC understood clouds well enough to resolve this issue. Clearly more research is needed.

The above narrative fits the facts as provided by the Bureau of Meteorology. No such narrative has ever been provided by the IPCC which has many different models and seems unable to decide which, if any, is accurate enough to forecast future climate. So their science lacks the essential clincher evidence to make their story stick. The future? The lack of both another degree of freedom and a new vibration mode for the carbon dioxide molecule suggests either no increase only a very slow increase in global average temperature.

4. References

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