

## A long range weather forecast for my grandchildren

How does the variability of the Sun affect the Earth's climate?

### From the UN International Panel of experts on Climate Change

Increases in atmospheric CO<sub>2</sub> since pre-industrial times are responsible for a radiative forcing of  $+1.66 \pm 0.17 \text{ W m}^{-2}$ ; a contribution which dominates all other radiative forcing agents considered in this report. **2007 report of IPCC technical summary P25 available at:** [http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_TS.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf)

But even without changes in external forcing, the climate may vary naturally, because, in a system of components with very different response times and non-linear interactions, the components are never in equilibrium and are constantly varying. An example of such internal climate variation is the El Niño-Southern Oscillation (ENSO), resulting from the interaction between atmosphere and ocean in the tropical Pacific. **IPCC Climate Change 2001: Working Group I: The Scientific Basis at:** [http://www.grida.no/climate/ipcc\\_tar/wg1/042.htm](http://www.grida.no/climate/ipcc_tar/wg1/042.htm)

*Sorry guys but these statements are just plain wrong. A little observational diligence would establish that the truth is otherwise. What can you have been thinking of? Is there truth in the saying that there is none so blind as those who will not see? Have you signed up to a religious movement? Do you subscribe to the notion that 'belief' is the most comfortable state? Are you annoyed at the activities of your fellow man and would you have him punished? Are you disgruntled with capitalism, the industrial revolution, urban living, freeway congestion and modern life in general?*

**IPCC Technical summary 2007** [http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_TS.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf)

Knowledge of the contribution of past solar changes to radiative forcing on the time scale of centuries is not based upon direct measurements and is hence strongly dependent upon physical understanding.

OK, let's make a start.

This story is dedicated to my grandchildren James, Rosie Jane, Finnegan and Ignatius.

We are always making up stories. It helps us to understand things if we have a story about it. The Aboriginals and the Red Indians had stories to explain where they came from and where they were going and everything in between. So do all the rest of us. However, we should be careful. The stories that people tell are not always based on careful observation.

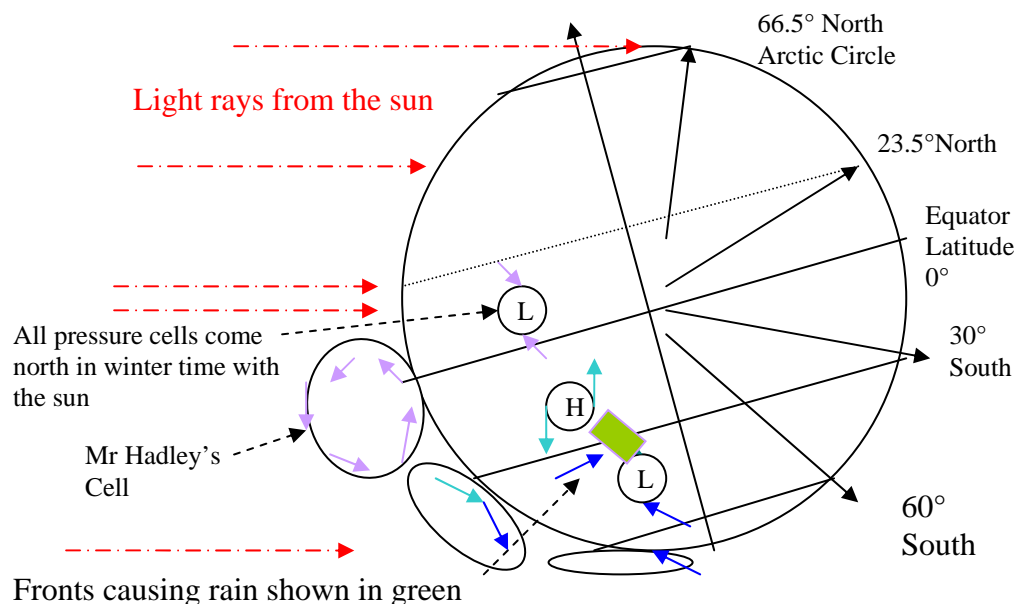
I know that some of the stories that I tell you are what you might call 'fairy stories' but this is not one of them. I'm giving it my best shot and I want you to believe me. I can't pretend that everything that I tell you is 100% accurate but I am going to be as careful as I can. Sometimes of course, I am giving you my best guess.

When I came here to plant this vineyard the big trees had just been pushed over and burnt. Straight away the ground became very wet because there were no trees sucking up the water any more. I was often getting bogged in my tractor and would call on helpful neighbours to come and pull me out with a long chain. I was so keen to get on with the work that I couldn't stand a moments delay. I came to know where the worst wet patches were and would go with a shovel and dig the drains to let the water out.

That is how the big drain in the middle of the vineyard got to be there. What I did not know in 1978, when I planted the vineyard, was that there had been twenty five years of good rain and from that time onwards it was going to get a lot drier. That big drain has been looking very silly for a long time. However, this winter there is water in it.

Our rain comes only in the winter time when the big low pressure systems that normally travel about the world in the region of 60° South Latitude move north slicing under the warm air that is in the tropical regions, cooling it down. It only has to lift that warm wet air a kilometre and the temperature cools by five to ten degrees Celsius. Air that is made colder can not hold its moisture and rain will fall. The fronts move in the zone shown by the green rectangle in Figure 1. In the summer that zone moves south and in the winter it moves north.

**Figure 1**  
**The circulation of the atmosphere in the Southern Hemisphere in winter**



At 33° South Latitude in the south west corner of Australia we have the big high pressure cells sitting right on top of us. These high pressure cells move lazily from west to east with clear skies and dry weather while the wind turns about them in an anticlockwise direction. In the middle of a high pressure cell the air is descending and getting warmer and drier. The high pressure cells are at the southern end of Mr Hadley's cell (he discovered this circulation). That's the one with the mauve arrows rising in the north and falling in the south. In the Hadley cell the tropics get the most direct rays from the sun and this causes the air to heat up greatly. As the air heats it becomes less dense and it is pushed up by denser air moving in from the side. So air rises up in the low pressure cells across the tropics and descends in the high pressure cells that travel at about 30° South latitude. However the Hadley cell moves north of the equator in the winter time and back into the Southern Hemisphere in the summer time. That is why it is dry in the summer time when the low pressure cells are pushed to the south along with their rain bearing fronts shown by the green rectangle.

When the equator warms up during an El Niño event the Hadley cell gets larger because radiation from the sun causes a larger turnover of air in this region. As a result the Hadley cell pushes the rest of the atmosphere towards the pole and the fronts that bring our rain don't reach us so often. Our climate then becomes drier.

**IPPC Technical report 2007 P 38 at:**

[http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_TS.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf)

**There is evidence for long-term changes in the large-scale atmospheric circulation, such as a poleward shift and strengthening of the westerly winds.** Regional climate trends can be very different from the global average, reflecting changes in the circulations and interactions of the atmosphere and ocean and the other components of the climate system. Stronger mid-latitude westerly wind maxima have occurred in both hemispheres in most seasons from at least 1979 to the late 1990s, and poleward displacements of corresponding Atlantic and southern polar front jet streams have been documented. The westerlies in the NH increased from the 1960s to the 1990s but have since returned to values close to the long-term average.

What causes an El Niño event? Why should the Equator warm up? And why should a period of warming last between 1978 and 2007 a period of 29 years?

Let's begin by reminding ourselves that the Earth heats up during the day and cools down at night. That's what we call the daily cycle. Then there is the seasonal cycle between summer and winter. These are two familiar cycles that we all know about and think nothing of. Others cycles are less familiar. The sun is a giant ball of gas that is slowly burning itself up with nuclear reactions. Parts of the sun are more active than others and they will open to our horizon every 27 days as the sun spins slowly on its axis. The effect of changes in the sun's magnetism is felt at the surface of the Earth. When we study the records of magnetometer observations we see peaks occurring at a frequency of about 1.3 to 1.4 years. About every 11 years the sun changes its magnetic poles at the height of its sunspot cycle when there are many poles competing together. It appears that about every thirty years in recent times the intensity of the sun's magnetism changes. There appear to be other cycles that take 100 years, 200, 300, 500, 1000 and 2500 years. There is evidence when we look at the growth of trees and the sediments in the ocean that at each of these intervals the intensity of the energy received at the surface of the Earth changes so as to affect the amount of light and the temperature. This causes plants and animals to grow and reproduce faster or slower. For more on this see:

<http://sait.oat.ts.astro.it/MSAI760405/PDF/2005MmSAI.76.1048T.pdf>

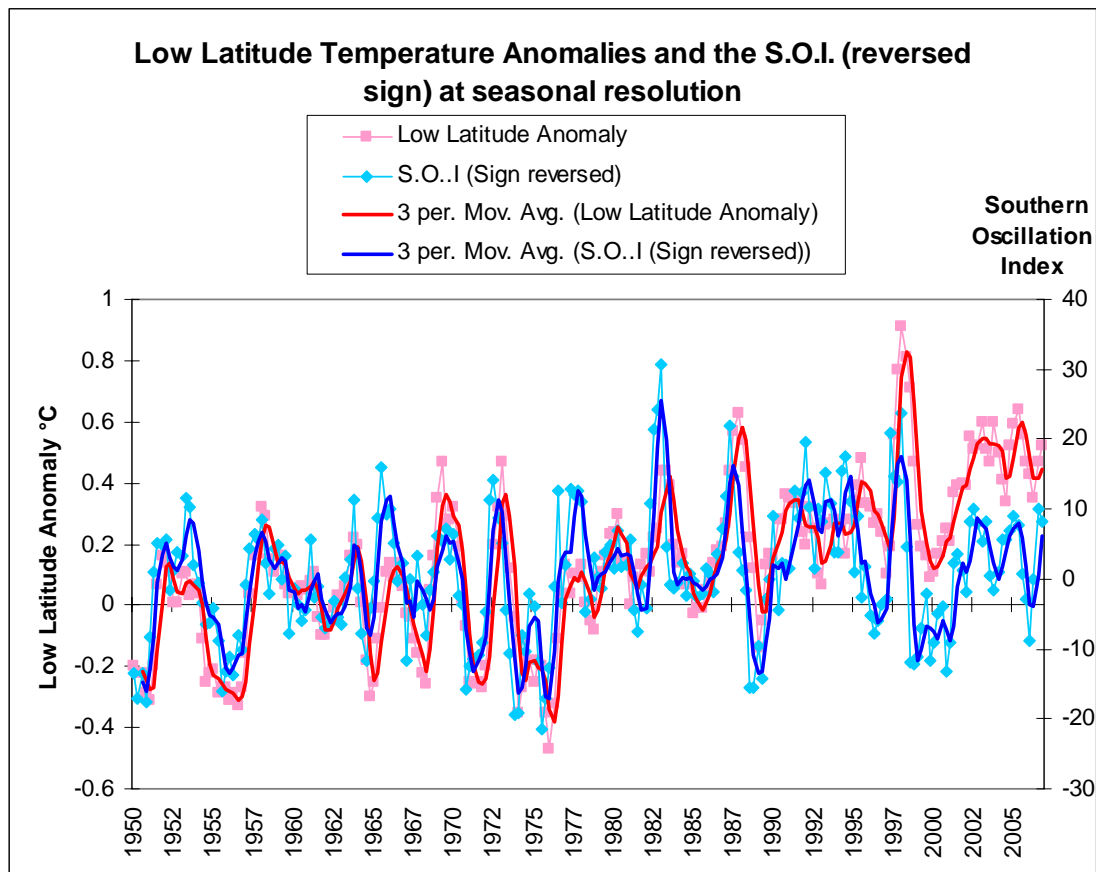
### **El Niño events and the Southern Oscillation Index**

Let us imagine that we could put an umbrella over the Earth so that it filtered out a certain amount of solar radiation. When the umbrella is taken away more light gets to the surface. This causes an El Niño event. That this actually happens can not be disputed. I will explain how I came to that conclusion. Later I will speculate as to how the umbrella factor actually works. But first let me describe how a heating event develops.

The Eastern Pacific Ocean has little cloud because the winds coming from the East are dried in their passage over the Andes Mountains. If the umbrella is taken away the Eastern Pacific warms faster than the west because the west has more cloud. The atmosphere is warmed by contact with land and sea. Air pressure falls in Tahiti in the Eastern Pacific faster than it does in Darwin. This difference in air pressure is

maintained so long as the extra heat is being received because to the west of the Andes there is always less cloud. So, while the tropics continue to warm the air pressure difference is maintained. This difference in air pressure is the basis of the Southern Oscillation Index (S.O.I.). A fall in the S.O.I index represents a warming episode and that is commonly called an El Niño event. When the heat input into low latitudes falls below the average (because the umbrella is in place) the S.O.I. increases and that is known as a La Niña event. It's a pity that this index is not arranged so that a rising S.O.I. signifies warming and a falling S.O.I. signifies cooling but it is easy to change the sign to make it do so. That is what I have done in figure 2.

Figure 2



It is plain that the blue line of the S.O.I. is rising and falling just before the red line of temperature, always being just a whisker ahead. When we have one thing that is so similar to the other we say it is a good 'proxy'. The S.O.I. is obviously a very good proxy for changes of temperature at low latitudes. You can be very sure that a major turning point in one of them will be associated with a similar change in the other within a month or two. This is very useful because we have air pressure measurements for Darwin and Tahiti going back to 1884. The satellite measurements of air temperature in the tropics don't start until 1978. We have been observing the sun for a long time but it is very difficult to link Earth temperature and the sun properly without data for a reasonable period of time. Having an index like the S.O.I. that can be taken to represent temperature movements is therefore a big advantage.

Now you might ask: 'What is the use of knowing what temperature is doing in the tropics if you don't know what is happening in other places?' But we do. Figure 3

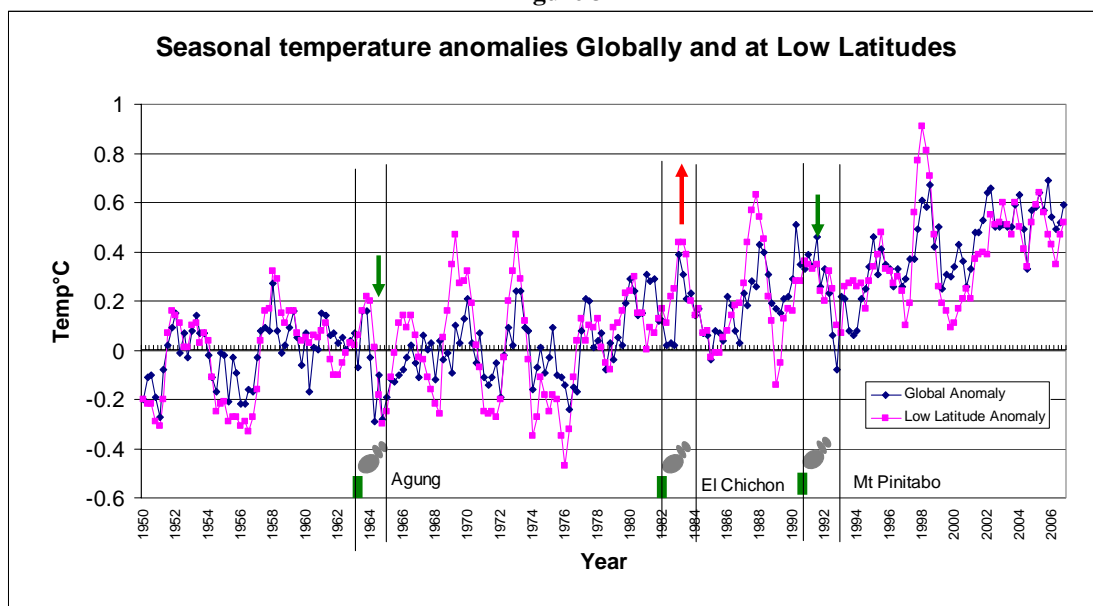
shows that changes in Earth's temperature commence in the tropics. The angle of incidence ensures that radiation travels through less of the atmosphere to reach tropical latitudes. When the temperature rises in the tropics you see the low latitude anomaly exceed the global anomaly and global temperature starts to rise too. When temperature falls in the tropics the Earth cools down. This observation gives you a big clue as to where the extra heat is coming from.

By the way, don't let the word anomaly worry you. It simply records the difference between today's temperature and an average over a chosen period in the past.

Figure 3 shows that temperatures were bumping along with no apparent trend between 1950 and 1976 and then suddenly started to increase. People became very worried about this. The suggestion is that man has caused this problem by burning petroleum and coal to keep him warm, create electricity to drive machines and move himself and his products around in cars, trucks, trains, ships and aircraft. In the process carbon dioxide is added to the atmosphere and this is said to cause the atmosphere to warm up. However, as we shall see the Earth has warmed up by another mechanism entirely.

What led me to identify the mechanism was the observation that the Earth did not cool down after the El Chichon volcanic eruption. The Earth usually cools when dust enters the stratosphere. More solar radiation is then reflected into space. I reasoned that in this instance some powerful countervailing force must have been at work. I asked myself what would cause the tropics to warm up fast. It was a short step to realise that the El Niño and La Niña events are closely connected with a generalised change in the temperature at low latitudes, not just in the Pacific Ocean but right round the world. The task I set myself was to find out the cause of this low latitude warming and cooling. My first discovery was that the meteorologists didn't have a clue.

Figure 3



The S.O.I. is a very convenient statistic that is easy to understand. It depends upon knowing the atmospheric pressure in just two places on the surface of the Earth,

namely Darwin and Tahiti. This is a lot easier than trying to actually measure the temperature right across the tropics. That would demand hundreds or thousands of air temperature measurements across both the land and the sea. There is not much land in the tropics and taking a measurement at sea means having a ship in the right place at the right time. Understandably, before we had satellites to measure temperatures from space we really didn't have much idea of what was happening at all.

In the tropics some radiation heats the sea and the land and in turn the air above it but a lot is used up in evaporating about two metres of water every year. About half of the energy from the sun is not in the form of light but rather infrared energy that we feel directly as heat. Some of this long wave infrared energy passes easily through clouds. As the damp air in the tropics warms it is lifted up and rainfall occurs. As the water vapour in that rising air turns into a liquid (rain), heat is released into the air (the heat that was used to turn water from a liquid into vapour is released when vapour turns back into liquid) and this causes the air to become less dense and to rise further. In the tropics clouds are created in air that is up to 25 kilometres in height by this process. By contrast, in mid latitudes clouds are always within a few kilometres of the surface. This gives you some idea of the difference between the energy received in the tropics by comparison with the mid latitudes (30 to 60 degrees).

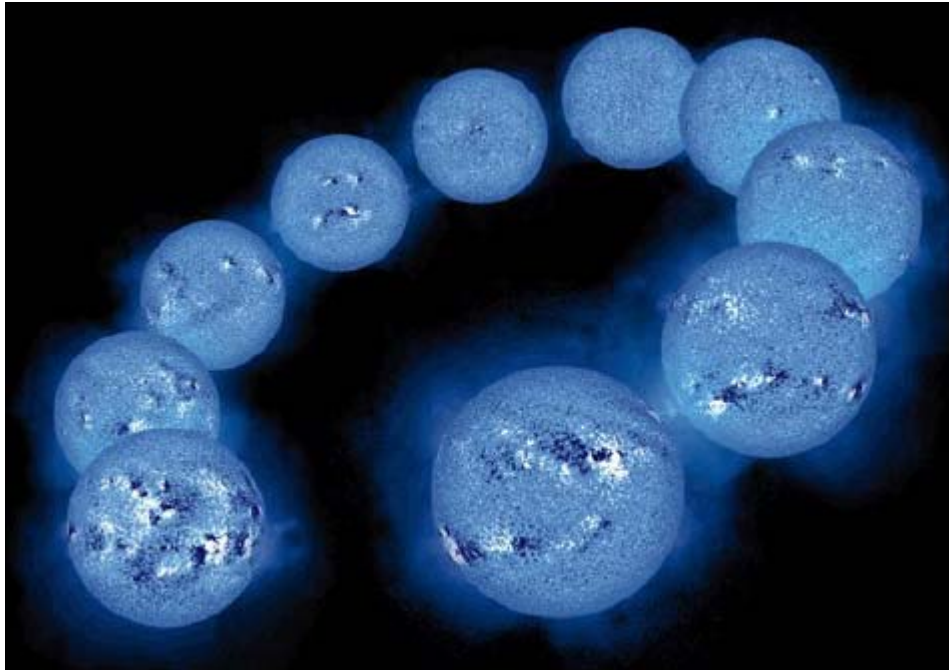
This heating process at the Equator drives the Hadley air cell. The movement of air elsewhere in the atmosphere must accelerate to keep up with the energy delivered by the sun in the tropics. Very cold air can be drawn down from the poles and some places far from the equator can actually cool as the equator is warming.

Ok, pops you told us that before, what about that umbrella in the upper atmosphere? That definitely sounds like a fairy story.

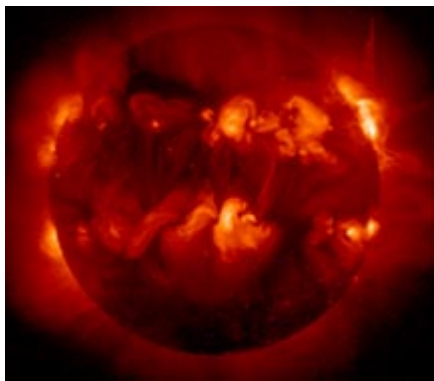
Don't rush me. I will get to that in a minute.

### **Magnetism and the Sun**

For a long time we have known that the Earth's magnetic field is affected by what happens on the sun. A sensitive compass needle that is absolutely stationary at the surface of the Earth will suddenly begin to turn left or right or up or down without apparent cause. At this time we frequently see 'auroras', the shimmering northern and southern lights seen at night. The gyrations in compass needles are recorded in Hartford England and Canberra Australia and used to construct an index called the aa index of geomagnetic activity. geo means EARTH - and in Greek mythology, Gea was the goddess of the earth.



Sunspot maximum in the foreground and minimum in the background



Here is what the Sun looked like in X-rays on April 27th, 2000 at the height of the sunspot cycle 23. This image was taken by the Yokoh satellite. Sunspots are arrayed either side of the sun's equator. Each sunspot has negative and positive magnetic polarities. Sunspots are potent forms of highly energetic x rays.

Figure 4

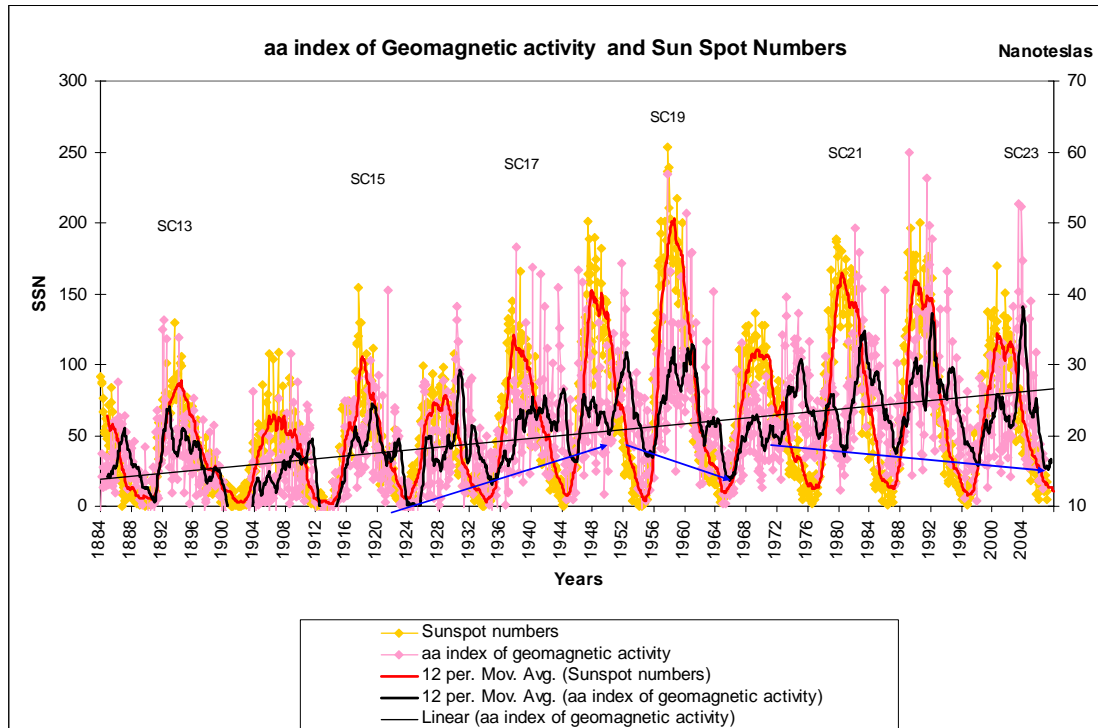
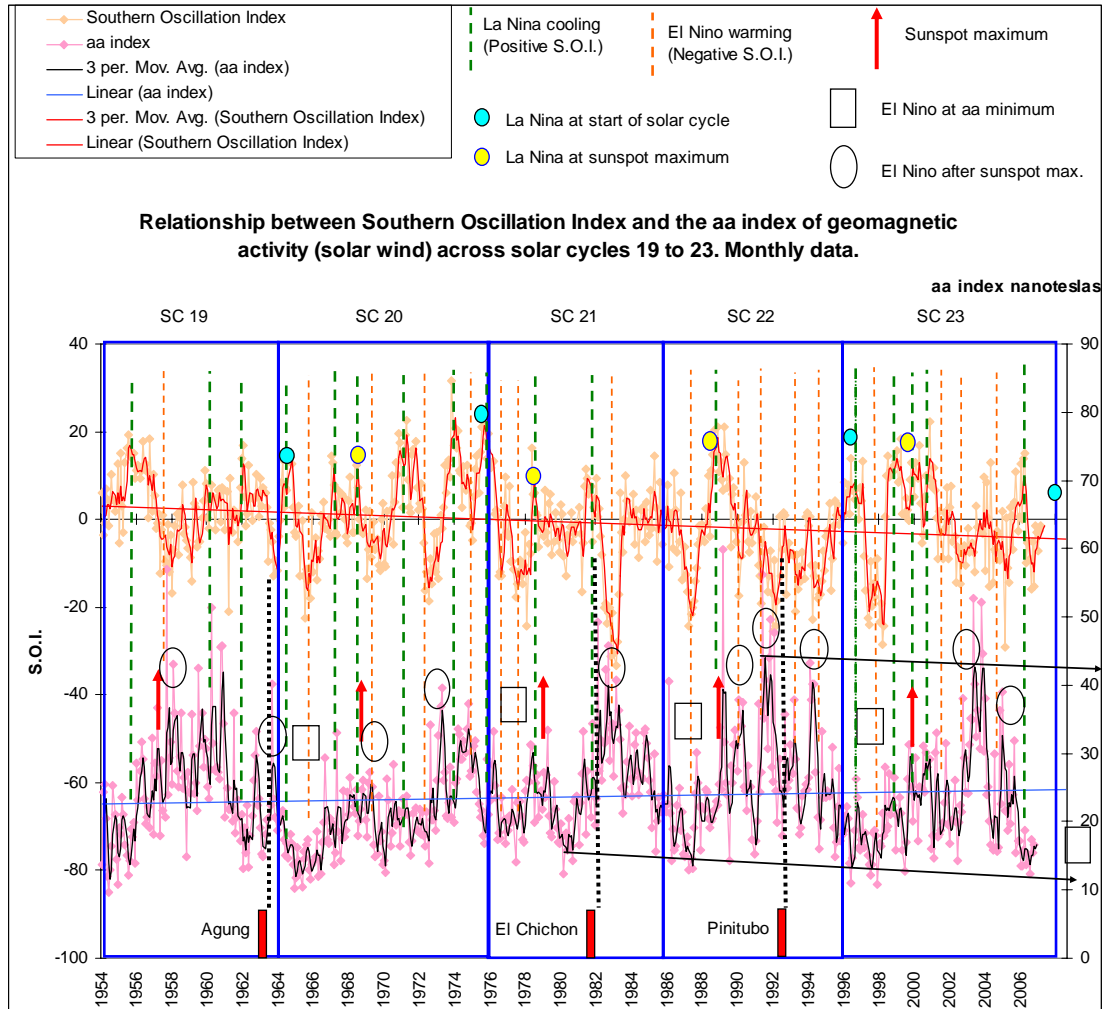


Figure 4 compares the aa index with sunspot numbers. Notice how geomagnetic activity has climbed since sunspot cycle 13. Notice how the minimum level has changed since solar cycle 19. Notice that recent minimums are greater than the maximums in the early sunspot cycles. Notice the jagged peaks of the aa index in recent years. Notice how aa activity falls away at sunspot maximum. Notice how the aa activity minimum is always in the phase where the new sunspot cycle has begun to gather strength.

Figure 5 shows how this aa index of geomagnetic activity compares to the S.O.I. index. You will remember that the S.O.I. index tells us when the Earth is cooling or warming at low latitudes. A fall in the S.O.I. means warming. A rise in the aa index means that contrary magnetic influences from the sun are reaching the surface of the Earth and the magnetic needles are swinging right, left, up down and generally wobbling about.

**Figure 5**



What does figure 5 tell us?

1. The El Niño (heating in the tropics) events that occur in the declining phase of the sunspot cycle are marked with ovals and are clearly associated with an increase in the aa index.
2. Although El Niño's do occur at sunspot maximum as in Solar Cycle 19 this is not the usual pattern. La Niña's (cooling events) are associated with sunspot maximum in Solar cycles 20 and 21 and much more so in 22 and 23. This is probably associated with the weakening of the sun's magnetic field at a time of competing polarities (many sunspots) and the complete reversal of the magnetic poles of the sun at this time.
3. El Niño warming also occurs when the aa index is very low. This coincides with the period of two to three years after the new sunspot cycle has started and the aa index is below its trend line. Interestingly, if the aa index falls below its trend line at other times it is not associated with a fall in the S.O.I. This El Niño occurs in the early stages of the sunspot cycle precisely because the sun has so few sunspots at this time and its magnetism is consequently strong and unified in a directional sense. At sunspot minimum the sun tends towards a single north and a single south pole just like the Earth. At other times each sunspot represents a different pole of magnetic activity. Because the sun's magnetism is strong but very consistent in the early phase of the new solar cycle magnetic needles do not move much on the surface of the Earth.

The aa index does not reflect the strength of magnetism of the sun. Rather, it shows the strength of variations in the magnetic signal from the sun. A low aa index simply reflects consistency and that consistency could be at either a high or a low level of magnetic influence. A strongly varying aa index could be interpreted to be a period where swings in the magnetic influence are frequent implying great magnetic influence at least half of the time.

4. La Niña cooling events frequently occur as the aa index falls dramatically. This happens at sunspot minimum and to a lesser extent at sunspot maximum. There is a good chance that the La Niña developing in late 2007 will intensify in 2008 if the aa index continues to fall. It should give way to a strong El Niño in 2009 and 2010 as sunspot cycle 24 is getting underway. Knowledge of this relationship and pattern of activity could improve long range climate forecasting. Inigo Jones in Australia used this knowledge to predict major droughts.
5. The aa index reflects powerful forces emanating from the sun. Major earthquakes and volcanic eruptions are reported to be associated with high levels of aa activity. For more on this see:  
<http://www.springerlink.com/content/753717276h869880/>

It appears that whether the earth is warming or cooling has a lot to do with whether the suns magnetism is weak or strong. Given the way in which heating in the tropics can occur both at high aa activity and at low activity I think that *the fluctuation in temperature at low latitudes on Earth is a much better indicator of the suns magnetic strength than the aa index*. This may seem to be a strange idea until you consider that the mass of the sun represents 99.8% of the mass of our solar system, its diameter is 1.4 million kilometres and the Earth is only 107 sun diameters removed whereas the suns sphere of magnetic activity stretches beyond Pluto that is more than 4,000 sun diameters removed. Is the Earths magnetic field driven to a large extent by the sun? One can magnetise bodies that have a metal content by passing a strong magnet about them.

### **Climate Prediction**

In figure 5 the linear trend line for the S.O.I. has been falling since 1950 indicating an increased tendency for El Niño warming events. However there is a better way to look at the relative dominance of La Niña and El Niño events over time. Each solar cycle features a different pattern of magnetic activity. If we add the S.O.I. index value for each month within each solar cycle and graph it we have figure 6. Cooling is indicated by green bars and arrows (the arrows for the temperature response) and warming by yellow bars and orange arrows. The arrows represent a seat of the bum expectation of the temperature response based upon the magnitude of the bars. In this way we get a good idea of the changing strength of the suns magnetic field since 1890 as reflected in the tendency for low latitude temperatures to rise or fall within each solar cycle and we also get a good idea of the likely trend in temperatures.

Figure 6

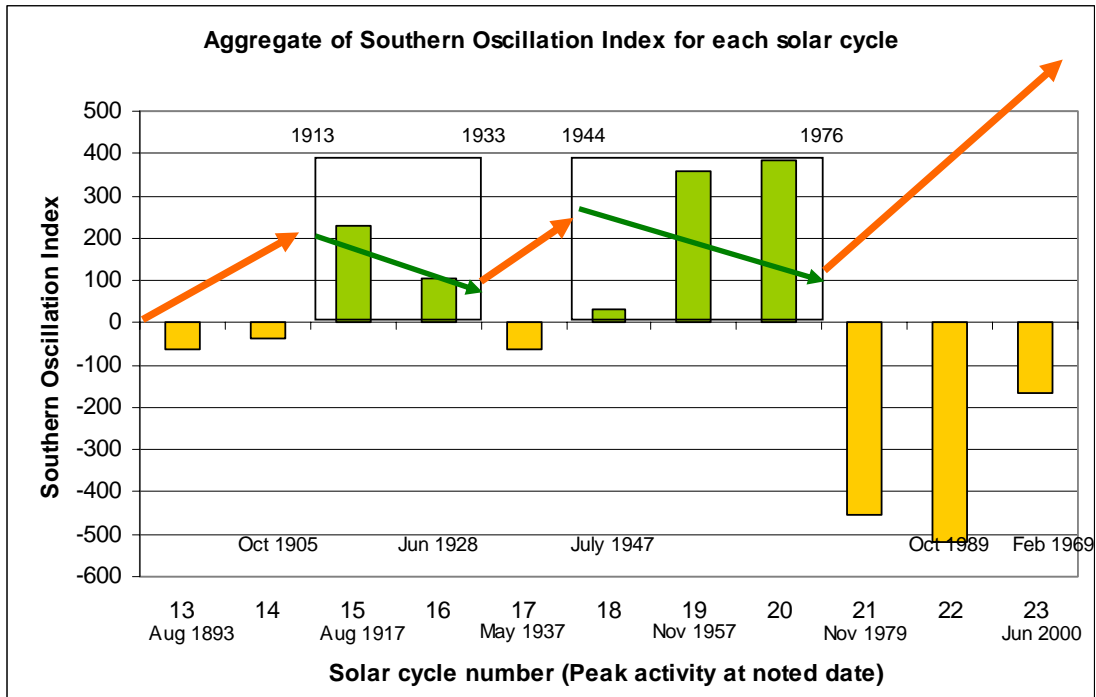
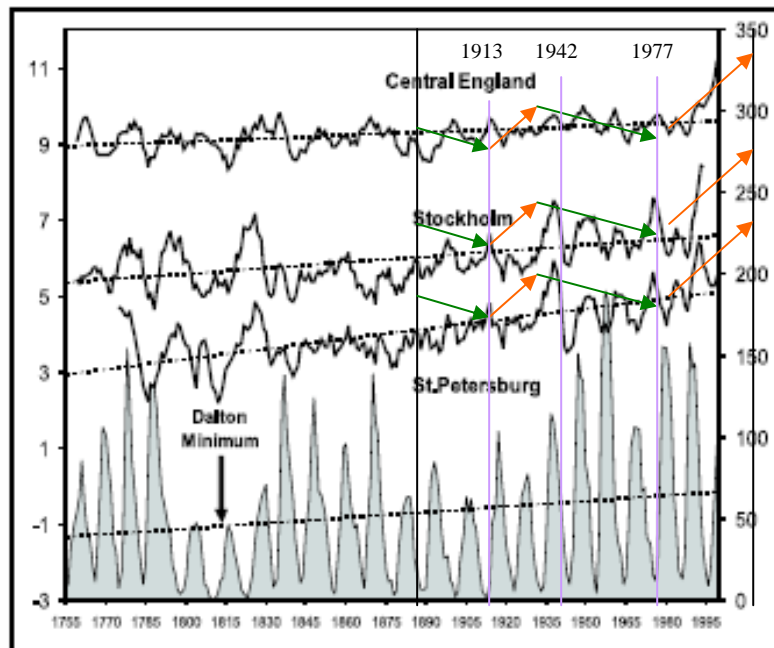


Figure 6 shows us that the Earth warmed slightly in solar cycle 13 and 14, cooled in cycles 15 and 16, warmed in 17, cooled in 18, 19 and 20 and warmed thereafter. How does this compare to what we know of temperatures over the period from 1890 to 2007? Prior to 1950 we don't have temperature measurements for the Earth as a whole and certainly not the tropical regions. So, we have to be content with the temperature of a few cities in Europe. The arrows on figure 6 are applied in figure 7 to cover exactly the same period of time as is covered in figure 6.

Figure 7



**Fig. 1.** Long-term mean annual temperatures (five-year running averages) for CET, Stockholm and St.Petersburg stations, the Wolf sunspot numbers (from the top to bottom).

Data from: <http://sait.oat.ts.astro.it/MSAIt760405/PDF/2005MmSAI..76.1026I.pdf>

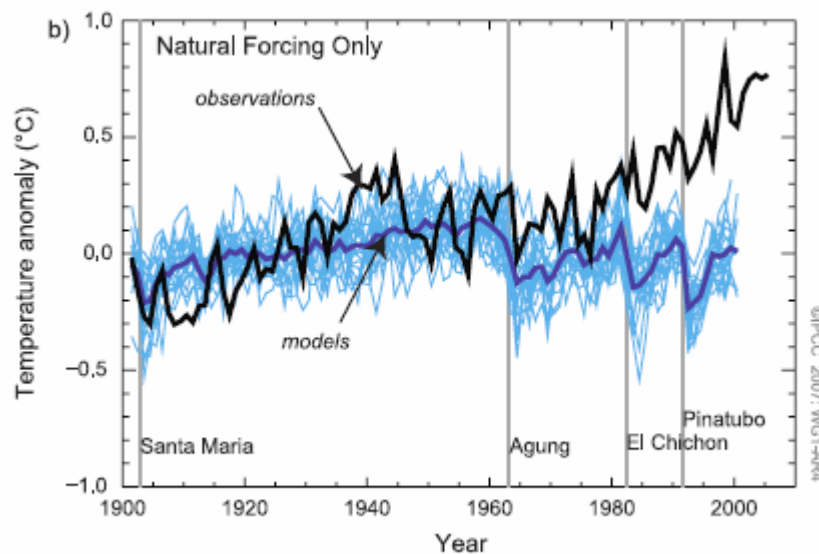
The IPCC 2001 report says at: [http://www.grida.no/climate/ipcc\\_tar/wg1/049.htm](http://www.grida.no/climate/ipcc_tar/wg1/049.htm) Most of this increase (in temperature) has occurred in two periods, from about 1910 to 1945 and since 1976. Yes, that's what we are seeing here.

What does this very interesting series tell us?

1. The aggregate of the S.O.I. index as shown in Figure 5 is a fair guide to the trends in temperature that occur over time in these three major European cities and over the world as a whole.
2. Temperatures have continuously increased since 1765.
3. The temperature fluctuations on the continent of Europe are more severe than in England. The sea has the effect of moderating the rise and fall of temperature in England.
4. Between 1830 and 1930, temperature fluctuations about the trend line were small.
5. Before 1830 and after 1970, temperature fluctuations were very large. This suggests that the magnetic strength of the sun is not constant. It swings more violently in some periods than others. There were strong La Niña and El Niño events at the time of the Dalton Minimum of sunspot activity just as there have been since 1976.
6. St Petersburg is much warmer today than in 1785. The rise of temperature there has been greater than in Copenhagen or in Central England.

7. The number of sunspots is not a good guide to the Earth's temperature. However, the magnetic signal from the sun is very important in accounting for the major warming and cooling events that we have witnessed in recent times.
8. The increase in carbon dioxide in the atmosphere has not stopped the Earth cooling in recent times.
9. Given the shortness of the period of observations of temperature in the context of the life of the Earth it is entirely possible that the recent warming is part of an established pattern of warming and cooling. A pattern of warming that goes on for thirty years can go unnoticed unless we have an accurate method of measuring temperature and take the trouble to record it in many thousands of places all over the Earth. Having a satellite to do it makes the job much easier. It is only very recently that we have had any idea of what happens to temperature in the tropics.
10. Figure 5 shows an expanding corkscrew type spiral that suggests that the Earth is about to cool down.

Figure 5 reflecting the solar influence on climate change should be compared with the IPCC estimate, from the understandings built into climatic models, of the expected forcing from a combination of volcanic and solar sources over the same period. The model prediction appears below.



The IPCC comment in the 2007 technical report is as follows:

**It is extremely unlikely (<5%) that the global pattern of warming observed during the past half century can be explained without external forcing.** These changes took place over a time period when non-anthropogenic forcing factors (i.e., the sum of solar and volcanic forcing) would be *likely* to have produced cooling, not warming

**The data presented here completely contradicts the IPCC view that natural forcing of climate is inconsequential and in decline. On the contrary, the documented warming that has occurred between 1910 and 1944 and since 1976 can be traced to strong warming in the tropics associated with a dominant negative S.O.I. over those warming periods in turn due to the magnetic signal from the sun that is reflected in the aa index of geomagnetic activity.**

### **The Umbrella effect:**

Let's summarise what we know at this point. We have established that the tropics regularly warm up and cool down depending upon the magnetic signal from the sun. As many as four big warming episodes can occur over the space of a single solar cycle that takes about eleven years. One is likely to be in the early ascent phase of the solar cycle and the others in the decline phase. There can also be marked cooling events within that same solar cycle, commonly one as the aa index falls away in the declining phase of the sunspot cycle and another at sunspot maximum when the sun's magnetic poles become most confused. There is a clear relationship between the S.O.I index, an excellent proxy for temperature fluctuation at low latitudes (and globally), and the strength of the sun's magnetic field. However, the aa index is not a good measure of the strength of the sun's magnetic field. Temperature in the tropics is a better index for that. Finally, when the S.O.I. is strongly negative dominant over a solar cycle the Earth warms.

There are allied phenomena that go with warming in the tropics. When the aa index is high, especially in the descending phase of the sunspot cycle we are likely to see auroras, the generation of electric currents in the Earth and in electric power grids, the failure of satellite electronic circuits and G.P.S. communication systems, and there is a report that seismic activity (earthquakes and volcanoes) increases at the same time. For this report see <http://www.springerlink.com/content/753717276h869880/> In addition we know that short wave radio communication is disrupted at times of high aa activity due to apparent disturbances in the ionosphere. It appears that a high aa index in the descending phase of the solar cycle represent the sun giving the Earth a damn good shaking in various ways. In the higher atmosphere it appears that particles are driven away from the equator and towards the poles. Both the evidence of change in radio reception and the movements in the ionosphere that are associated with auroral activity strongly suggest that this is the case.

Satellite measurements of the level of overall energy coming from the sun show that it has been almost constant for the last thirty years. That rules out the simple idea that warming of the Earth is due to changes in the amount of energy generated by the sun. In this I am in complete agreement with the IPCC. However, it leaves quite open the question as to whether there is a fluctuation in the filtering effect of the atmosphere that lets more solar radiation through at times of high solar magnetic activity.

Two things could account for the warming episode at low latitudes that is associated with changes in the sun's magnetism. One is the atmosphere becoming thinner, less dense and more transparent thereby letting more light through. The other is the atmosphere becoming more impervious to outgoing radiation and keeping the heat in. Of these two, only the former makes sense. Half of the radiation that comes from the sun is in the infrared form. If the atmosphere became denser there would be greater absorption of infrared radiation before it reached the Earth and the Earth would cool down, not warm up. There is a great deal more infrared in direct solar radiation than there is radiated by the surface of the Earth.

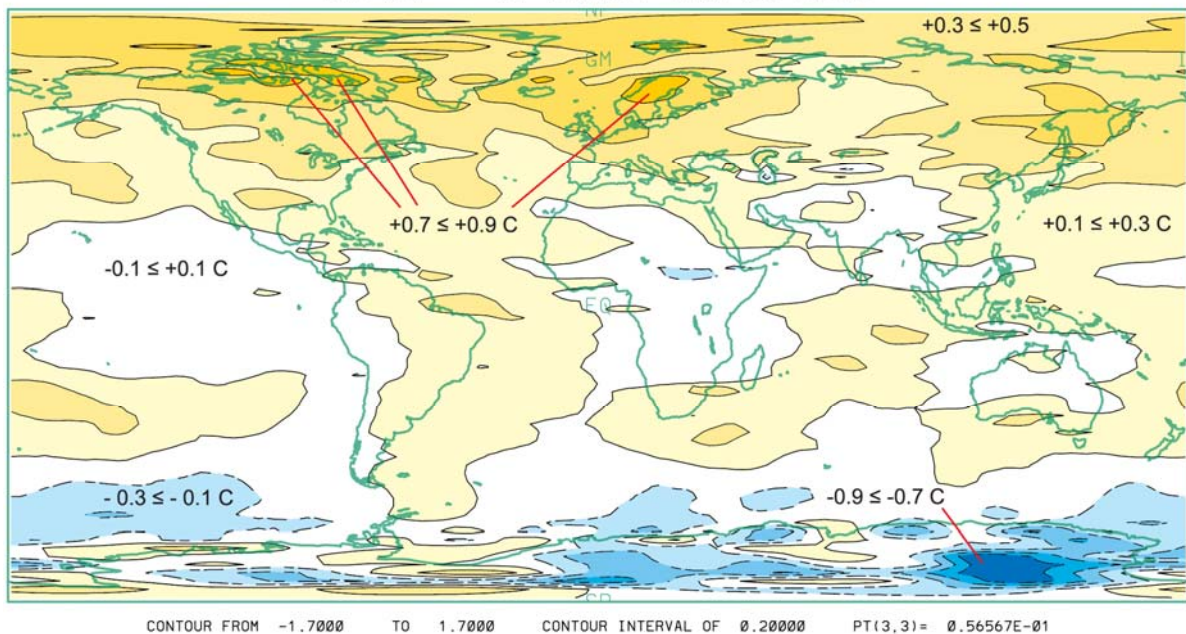
To be effective an increase in the insulating capacity of the Earth's atmosphere would have to occur in the troposphere. The troposphere carries 75% of the atmosphere by weight. This would cause a general increase in the temperature of the troposphere. This would raise air temperatures in both hemispheres and in Antarctica. At the South

Pole there is a base run by the U.S.A. called Amundsen Scott after these two great Antarctic explorers. Temperatures have been falling there since 1957 when records were first kept. Many parts of the Southern Hemisphere have hardly warmed since temperatures were first recorded in the 1880s. By and large the temperature increase that we see has occurred in the mid to high latitudes of the northern hemisphere and it has been balanced to some extent by temperature declines in the Southern ocean and Antarctica. See figure 8. These changes seem to be intuitively more consistent with a pattern of direct surface warming via the interception of more solar radiation rather than an increase in the insulating potential of the troposphere.

**Figure 8**

**University of Alabama Global Temperature Report: December 2006 based on satellite observation of microwaves emitted by oxygen molecules in the lower troposphere**

TREND DEG/DECADE : 197812 - 200611  
LAYER = LT LOWER TROPOSPHERE



Source <http://climate.uah.edu/25yearbig.jpg>

Study of the ionosphere reveals that it is very responsive to changes in very short wave Gamma, X Ray and Ultraviolet radiation that varies strongly over the solar cycle. The solar wind very much affects the distribution of material in the ionosphere. Furthermore, it is known that satellites travelling in the ionosphere can experience quite dramatic increases in drag that will bring them back to Earth prematurely. Consequently an error of 10% in the prediction of the life of satellites is common.

Is it possible that the magnetic influence from the sun is indirectly thinning the molecular atmosphere above the tropics at the same time as it is sweeping electrons towards the poles and creating auroras? The atmosphere above the tropics is already thin because of its temperature. When it is further thinned by heating, more radiation could penetrate to the surface. The energy arriving in the infrared form has a wide spectrum of wave lengths some of which are intercepted within the atmosphere and some not. Even those very short wave lengths that are heavily absorbed by gaseous

particles in their path will be affected by changes in the mass of material through which they must pass. Any heating effect will be self reinforcing.

Thinking of the sun's effect on the atmosphere, it is as if the inter tropical convergence, actually made up of a series of low pressure cells, were in fact a chain of camera irises opening up in response to the magnetic influence of the sun and permitting more of its energy to reach the surface.

The atmosphere is variously transparent to different wave lengths that make up the electromagnetic spectrum of solar energy. The diagrams below should therefore be seen as a snapshot at a moment in time in a situation that is by no means stable. The atmosphere has to be seen as a dynamic medium responding directly to solar forces in ways that we are only just coming to grips with. Figure 9 provides an artist's impression of the depth to which various wavelengths penetrate the atmosphere under average circumstances.

Figure 9

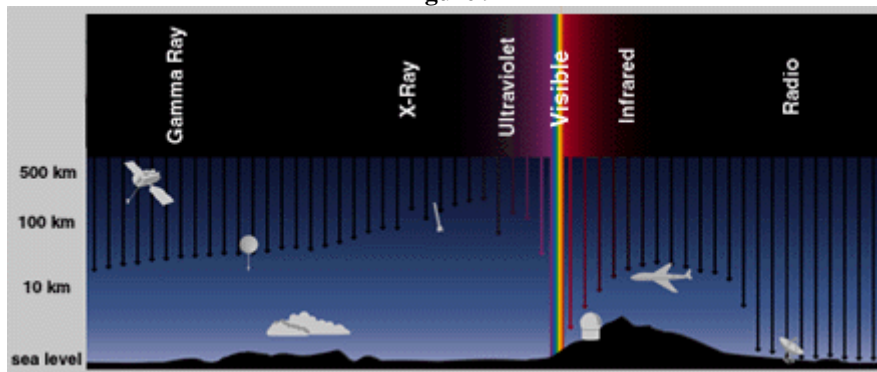
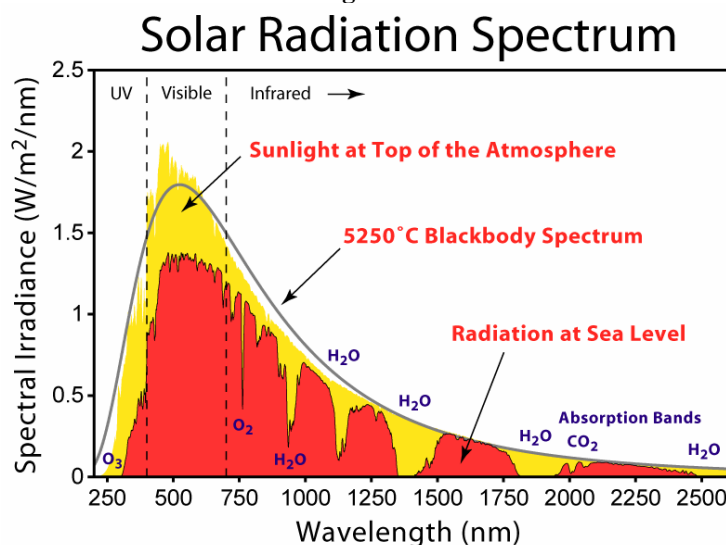


Figure 10 shows the solar radiation spectrum according to wave length above the atmosphere (yellow) and at the surface (red).

Figure 10



Source: [http://upload.wikimedia.org/wikipedia/commons/4/4c/Solar\\_Spectrum.png](http://upload.wikimedia.org/wikipedia/commons/4/4c/Solar_Spectrum.png)

The accuracy of aspects of this diagram is contestable, for instance in its emphasis on the role of ozone as the sole interceptor of UV radiation. All atmospheric gases are broken down in the process of creating the ionosphere and it is the very short wave radiation smaller in wavelength than visible light that is responsible. However, the average filtration effect of the atmosphere at different wave lengths is here documented. Much less radiation is received at the surface than arrives at the margins of the atmosphere and this observation applies across the whole width of the electromagnetic spectrum. The prime agents of interception are gaseous molecules and atoms including nitrogen, oxygen, ozone, water vapour, carbon dioxide and particulate matter. The degree of interception varies with wave length, latitude and time of day and is partly a function of the molecular weight of the gaseous particle by comparison with the wave length of the radiant energy. *It should be noted that the effect is to create a radiation shield that is the very antithesis of a greenhouse effect.* This is the 'umbrella' of which I speak.

It appears that, in terms of the energy potential of the full spectrum of solar radiation something like just over one half actually reaches the surface of the Earth. The loss of energy can be gauged by the area of red in relation to area that lies beneath the top of the yellow. Any change in the mass of the atmosphere in the path of solar radiation in a particular place will affect the degree of interception at that place. We know that the angle of incidence of the sun at different latitudes affects the amount of atmosphere that radiation must travel through to reach the surface and that this affects surface temperature. To that important factor we must add another vital factor, the stage of the solar cycle as it influences the composition and distribution of the upper atmosphere.

The spectral distribution of solar energy at sea level is reported to be 3%, 44%, and 53% in the UV, visible and infrared wave lengths, respectively but it is notable that the proportions vary with time of day, latitude and season. It is certain that the proportions change too with the variations in the strength of radiation that is received at different wave lengths and the redistributive effect of the solar wind as these two elements vary within and between solar cycles.

To fully understand how the atmosphere can change during the solar cycle we need to understand its structure, how the structure changes over time, the manner in which it intercepts solar energy and also the way it very efficiently conveys heat away from the surface of the Earth. But, that is a story for another day.

### **Implications of this study**

The following statements are revealed to be at best confused and at worst misleading.

**2007 IPCC Report at [http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1\\_Print\\_TS.pdf](http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf)**

Greenhouse gas forcing has *very likely* caused most of the observed global warming over the last 50 years. Greenhouse gas forcing alone during the past half century would *likely* have resulted in greater than the observed warming if there had not been an offsetting cooling effect from aerosol and other forcings. {9.4}

It is *extremely unlikely* (<5%) that the global pattern of warming during the past half century can be explained without external forcing, and *very unlikely* that it is due to known natural external causes alone. The warming occurred in both the ocean and the atmosphere and took

place at a time when natural external forcing factors would *likely* have produced cooling. {9.4, 9.7}

**The Media Worldwide** The world is warming mainly because of mans burning of fossil fuels. We can control the warming only by reducing our carbon dioxide emissions.

**IPPC Climate Change 2001: Working Group I: The Scientific Basis at:**

[http://www.grida.no/climate/ipcc\\_tar/wg1/042.htm](http://www.grida.no/climate/ipcc_tar/wg1/042.htm)

But even without changes in external forcing, the climate may vary naturally, because, in a system of components with very different response times and non-linear interactions, the components are never in equilibrium and are constantly varying. An example of such internal climate variation is the El Niño-Southern Oscillation (ENSO), resulting from the interaction between atmosphere and ocean in the tropical Pacific.

**From the US NOAA :** El Niño and La Niña are naturally occurring phenomena that result from interactions between the ocean surface and the atmosphere over the tropical Pacific. Changes in the ocean surface temperatures affect tropical rainfall patterns and atmospheric winds over the Pacific ocean, which in turn impact the ocean temperatures and currents. The El Nino and La Niña related patterns of tropical rainfall cause changes in the weather patterns around the globe.

[http://www.grida.no/climate/ipcc\\_tar/wg1/050.htm](http://www.grida.no/climate/ipcc_tar/wg1/050.htm)

The frequency and intensity of ENSO has been unusual since the mid-1970s compared with the previous 100 years. Warm phase ENSO episodes have been relatively more frequent, persistent, or intense than the opposite cold phase during this period.

This recent behaviour of ENSO is related to variations in precipitation and temperature over much of the global tropics and sub-tropics and some mid-latitude areas. The overall effect is likely to have made a small contribution to the increase in global surface temperature during the last few decades.

**And here is a red herring from:** [http://www.grida.no/climate/ipcc\\_tar/wg1/053.htm](http://www.grida.no/climate/ipcc_tar/wg1/053.htm) the warming influence of El Niño on global temperature is empirically well attested (e.g., Jones, 1994) and the physical causes are starting to be uncovered (Meehl et al., 1998)

**IPPC Technical summary 2007** It is *very likely* that anthropogenic greenhouse gas increases caused most of the observed increase in global average temperatures since the mid-20<sup>th</sup> century. Without the cooling effect of atmospheric aerosols, it is *likely* that greenhouse gases alone would have caused a greater global mean temperature rise than that observed during the last 50 years.

**Robust Findings:** From new estimates of the combined anthropogenic forcing due to greenhouse gases, aerosols and land surface changes, it is *extremely likely* that human activities have exerted a substantial net warming influence on climate since 1750. {2.9}

Solar irradiance contributions to global average radiative forcing are considerably smaller than the contribution of increases in greenhouse gases over the industrial period. {2.5, 2.7}

Climate models are based on well-established physical principles and have been demonstrated to reproduce observed features of recent climate and past climate changes. There is considerable confidence that AOGCMs provide credible quantitative estimates of future climate change, particularly at continental scales and above. Confidence in these estimates is higher for some climate variables (e.g., temperature) than for others (e.g., precipitation). {FAQ 8.1}

### **The way forward**

Models are only as good as our understanding and quantification of the relationship between cause and effect. An understanding of the major variables that influence whether the Earth is going to warm up or cool down must begin with a study of the Sun, solar radiation, the Earth's atmosphere and its variability as these things combine to influence radiation reception at the surface of the Earth and therefore local and global temperatures.

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