Carbon Dioxide Feeds the World

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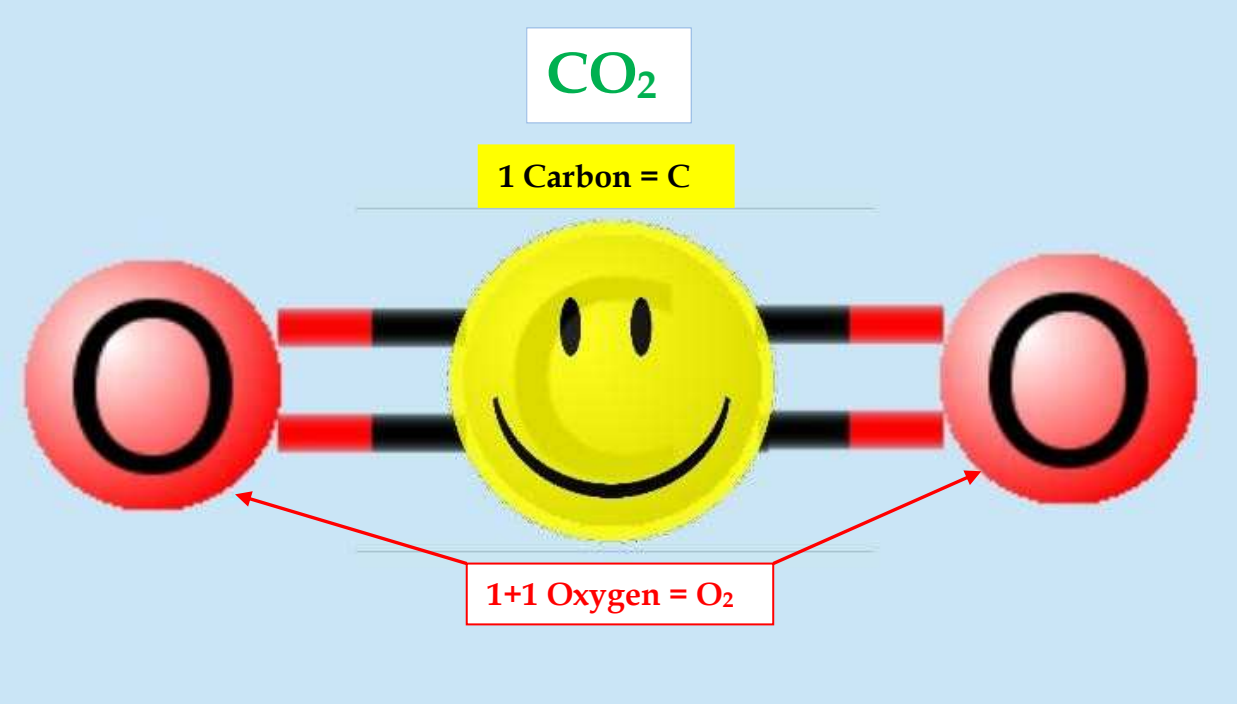
Each email will get a reasoned reply.

Carbon Dioxide Feeds the World

Cuddly Carbon Keeps Koalas And All Animals Alive

CO_2 is essential for life. More CO_2 will do much good and no harm. If we allow it to go on increasing at the current rate CO_2 will feed the World's coming peak population with NO more land, seed, cultivation or water.

Carbon Dioxide
Marvel Molecule
Staff of Life



390 ppmv of CO_2 feeds 6.8 billion people on Earth today. If it rises to 750 ppmv it will feed 50% more – 10.2 billion – which is around the probable peak of human population. It will do so with NO extra land, seed, cultivation or water. If we lay off solving the imaginary 'carbon problem' the world's real food problem will solve itself.

What do we owe to atmospheric CO_2?

We owe our very existence and the existence of every living plant and animal on the planet. CO_2 provides the food for plants like wheat, rice, fruit and vegetables which are human staples plus other plants such as grass which feeds the animals who give us milk and meat or the glorious trees which give us beautiful forests plus timber, paper and many collateral benefits. CO_2 is a most unobtrusive substance being invisible, odorless and non-flammable. It circulates in our blood and passes through our lungs for so long as we live. Plants stop growing below 150 ppmv of CO_2 in the air. If that happens all animals on earth, including humans, will starve to death.

Less than 150 ppmv CO_2 = No Life **More CO_2 = More Life**

Is Carbon Dioxide Pollution?

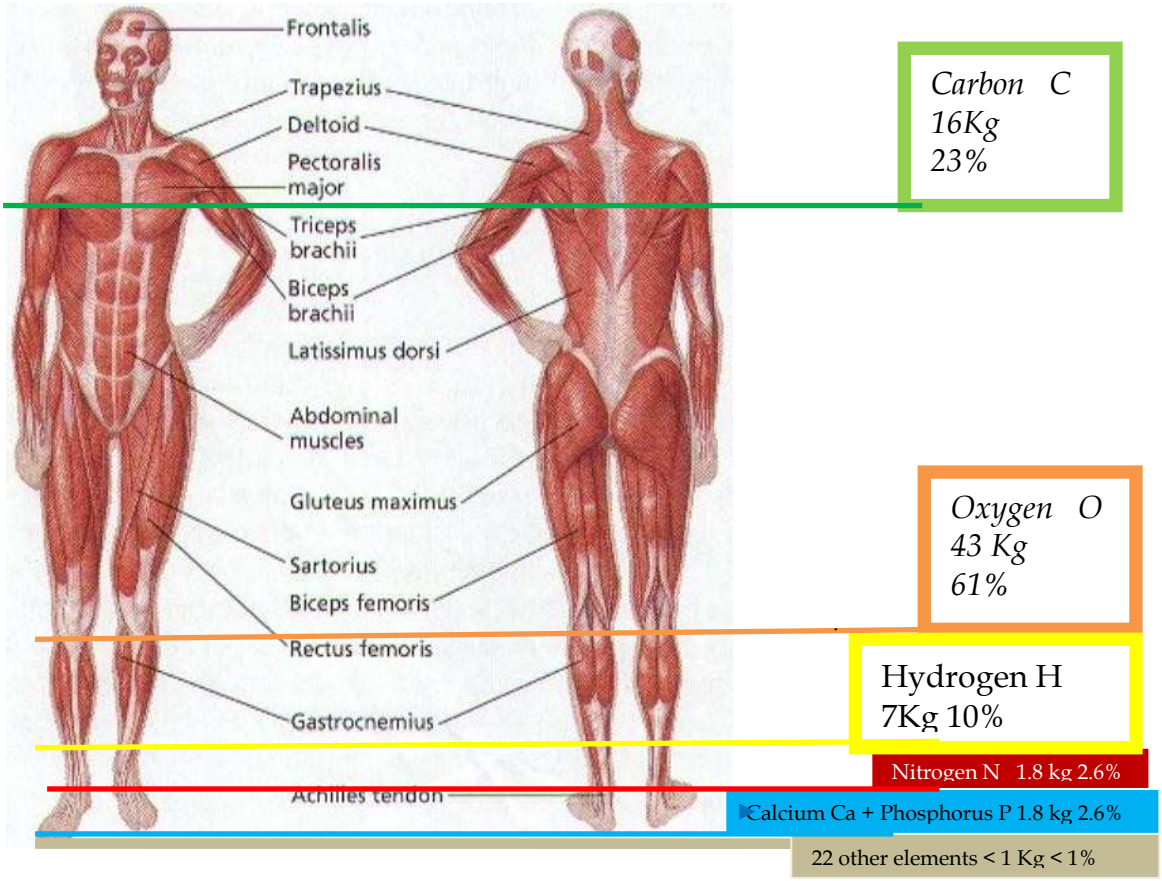
Princes, Presidents, Premiers, Professors, PhDs, Politicians and Pundits condemn carbon as a '*pollutant*' and want to put a price on its head. How can so many prestigious people be so wrong? This note is in praise of carbon dioxide as the World's most important and vital material. Earth's atmosphere used to have much more of it and it will be good to have some of it back. That will help to restore the high plant productivity of those earlier eras.

Carbon Dioxide in the Human Body

A fit person who weighs 70 Kg is made up of 16 kg of carbon, 43 Kg of oxygen, 7 kg of Hydrogen, nearly 2 Kg of nitrogen and about 1 Kg each of calcium and phosphorous. Everything else adds up to less than a kilogram. All the carbon in our bodies comes from atmospheric CO_2.

As it happens, the carbon and oxygen taken together are equivalent to 59 Kg of CO_2.

70 kg human – Constituent Chemical Elements

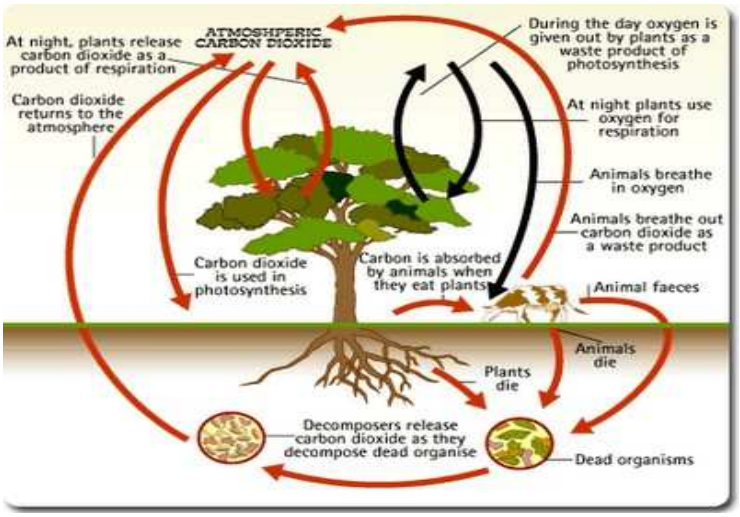


All living animals and plants have a similar chemical composition.

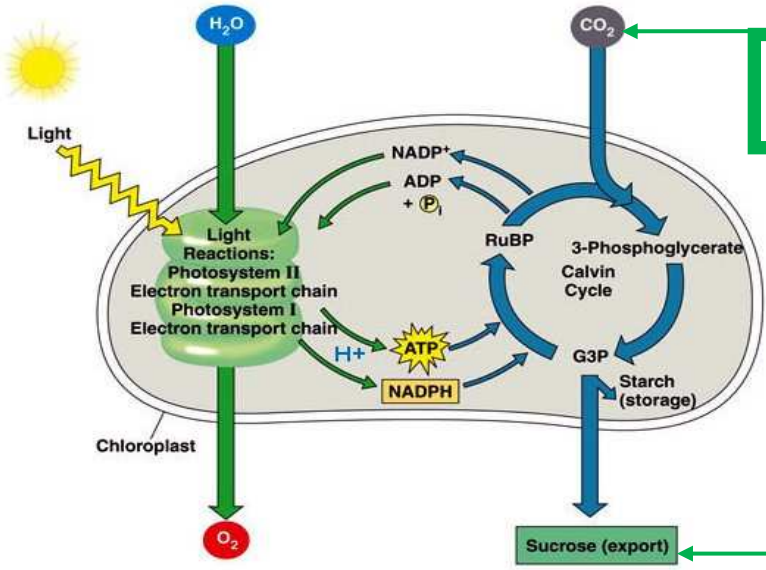
Are We Really a 'Pollutant'?

It is strange indeed that any sensible person could believe that he or she (plus every other human being and animal) is 23% a 'pollutant'. Is some perverse pathology afoot**?**

Carbon, Photosynthesis and Plant Life



$C_6H_{12}O_6$ is glucose – it is the blood sugar for all animals. It is the primary building block and energy source for all plant life. In reality the process is complex, subtle and multi-stage but the role of atmospheric CO_2 as the major plant food is paramount. Without it nothing would happen, plant growth would stop and we would all soon starve to death.

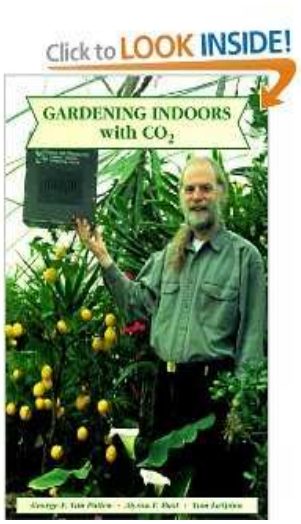


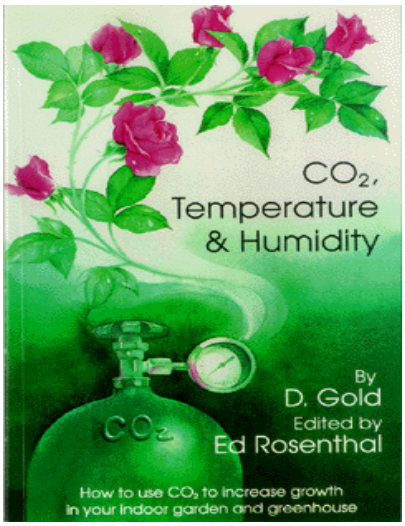
Atmospheric Carbon Dioxide Feeds our Food

Hydrolysis of Sucrose
Sucrose + Water> Glucose + Fructose
$C_{12}H_{22}O_{11} + H_2O > C_6H_{12}O_6 + C_6H_{12}O_6$
Note that glucose and fructose have the same chemical composition but different internal structures.

C3 photosynthetic pathway Image source: http://www.bio.miami.edu

More CO_2 = More Plant Growth Simple chemistry indicates that the greater the concentration of CO_2 the more glucose will be produced and, unsurprisingly, this is so. Numerous trials around the world show that an increase of 100 ppmv (*parts per million by volume*) in atmospheric carbon dioxide increases average crop plant growth by at least 10%. This increased crop production needs no extra land, seed, cultivation or water. Commercial horticultural producers routinely increase the CO_2 content of the air within their glasshouses to improve plant growth. This improved growth with increased carbon dioxide reflects the fact that when land plants evolved about 400 millions year ago in the Devonian period the CO_2 level was around six times higher than it is today. Thus the basic metabolism of plants evolved in and is best suited to that higher level of atmospheric CO_2. Please note that references on third party images to ppm of CO_2 throughout this note are all to ppmv.





Above are just two examples of the hundreds of texts advising on the use of CO_2 to improve crop production. The benefits are so large and so dependable that it is standard practice in commercial horticulture. The extra CO_2 for those growers is expensive, e.g. from cylinders. How much better to have it in the atmosphere where it is free for everyone and every plant?

If CO_2 is allowed to continue rising at about the present rate the world's likely peak population of around 10 billion can be fed comfortably with existing land and water resources. 750 ppmv is an appropriate aim.

Some Products of Carbon Dioxide

National Parks

Forests on Land

Undersea Forests (Kelp)

Wheat

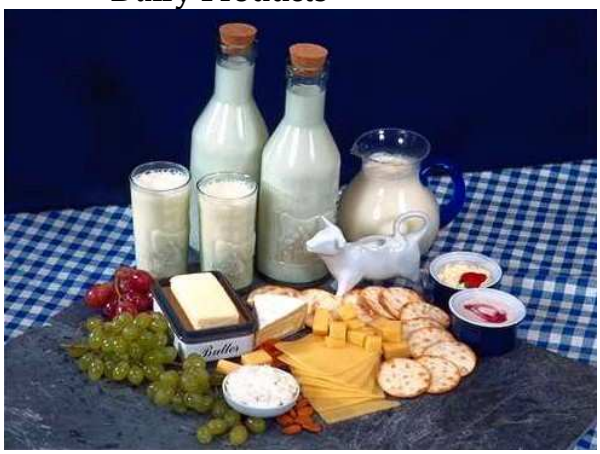
Rice

Milk

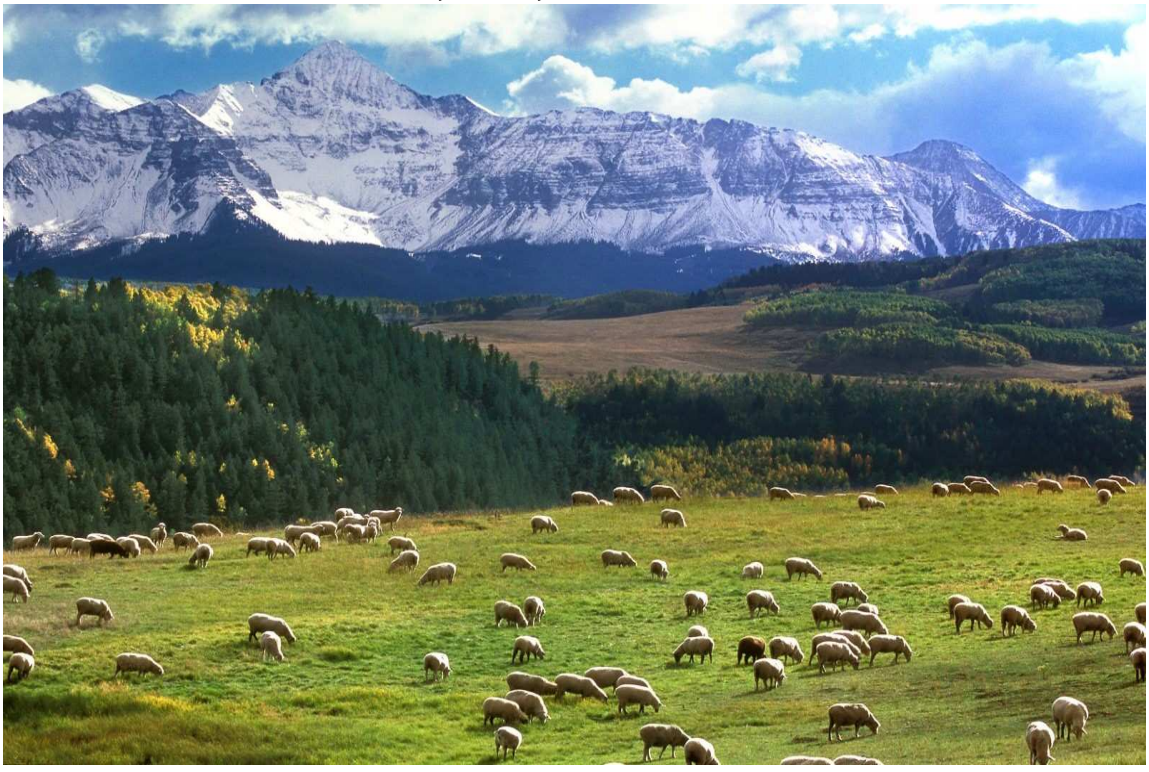
Beef

Fruit and Vegetables

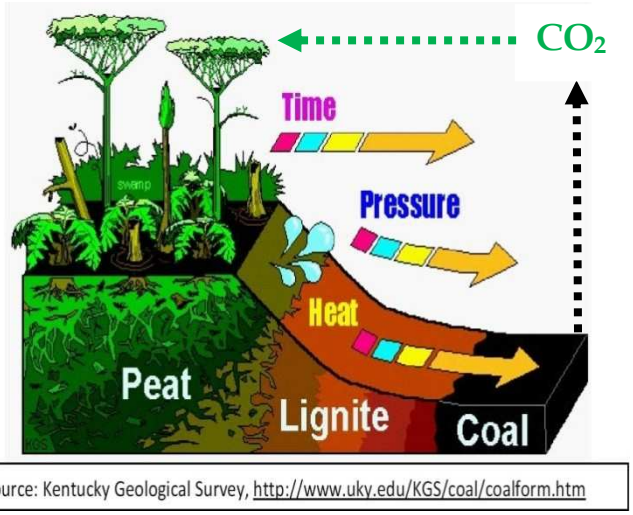
Dairy Products



Trees, Grass, Lamb and Wool



Coal – yes coal all came from atmospheric carbon dioxide via plant growth



Source: Kentucky Geological Survey, http://www.uky.edu/KGS/coal/coalform.htm

Burning coal today merely completes the cycle shown in the diagram above and turns coal, via atmospheric carbon dioxide, back into green, growing plants.

Wild creatures of every size, shape and kind

Free Air Concentration Enrichment (FACE) with CO_2 on a Field Scale with Soybeans

The increased plant growth observed in greenhouses and in open air 'cages' with extra carbon dioxide was sometimes discounted on the grounds that it was the confined conditions and not the additional CO_2 that enhanced the growth. To counter such opinion the *FACE* system was developed during the '90s. As seen above the crop is grown in open fields. Enrichment is achieved by rings of pipes that release carbon dioxide into the wind as it flows across the crop.
A computer continuously measures wind speed and direction and the gas concentration within the ring to determine which pipes should release the gas and how much they should release. The computer feedback results in good control so that the concentration achieved is within 20 percent of the target for 97 percent of the time.

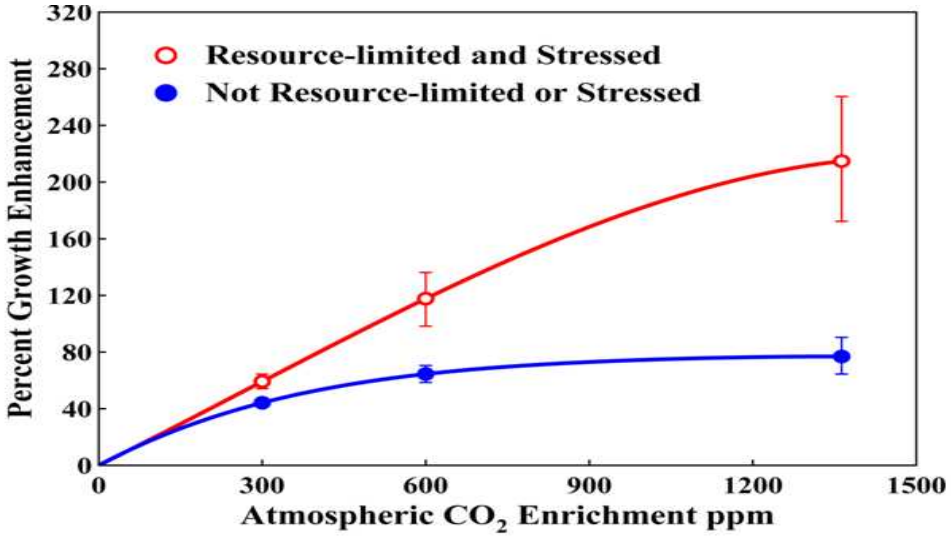
USDA Trials of Field Scale CO_2 Enrichment reported in 2010
"Higher carbon dioxide levels in the atmosphere prompted better water use efficiency in soybean and sorghum plants, regardless of whether the crops were grown with no-till or conventional tillage, according to new ARS research. Natural Resources Conservation Service, USDA, 2010.The first long-term study comparing tillage practices under high CO_2 levels showed that elevated CO_2 caused soybean and sorghum plants to increase photosynthesis while reducing transpiration - the amount of water the plants release. This resulted in increased water use efficiency, whether the crops were grown with no-till or conventional tillage, according to researchers with USDA's Agricultural Research Service (ARS). ARS is the US Department of Agriculture's principal intramural scientific research agency."
"The scientists also compared current ambient CO_2 levels—about 370 parts per million (ppm)—with levels of 720 ppm expected within this century. With the higher level of CO_2, regardless of tillage method, soybean photosynthesis increased by about 50 percent, while sorghum photosynthesis rose by only 15 percent. This was expected because crops like soybean, which have a C_3 photosynthetic pathway, are known to respond better to high CO_2 levels than crops like sorghum and corn that have a C_4 photosynthetic pathway. Most plants worldwide are C_3 plants."

C3 plants are: wheat, rice, fruits, veggies, nuts, legumes, most grasses, eucalypts, pines, etc., etc. C4 photosynthesis evolved only 8 million years when CO_2 was around 400 ppmv.

The USDA trials and many others show that not only does more CO_2 increase the growth of a food crop but it grows more food for a given amount of water. **Improved water efficiency** when growing plants is a most important function of **additional atmospheric CO_2**

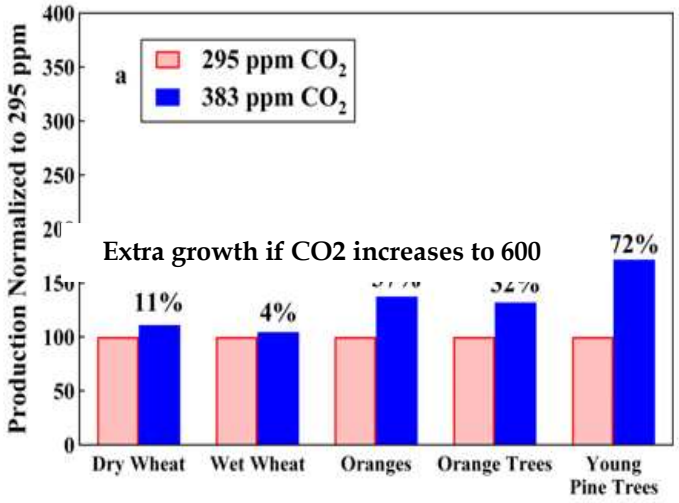
More on growth improvement with extra CO_2

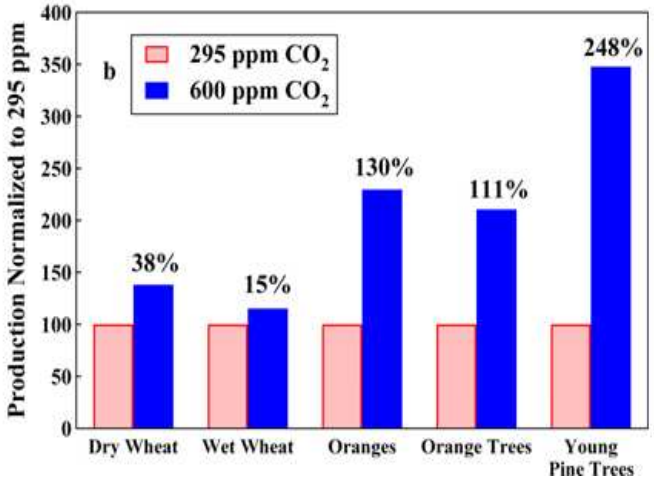
By: Arthur B. Robinson, Noah E. Robinson, and Willie Soon, Oregon Institute of Science and Medicine, 2251 Dick George Road, Cave Junction, Oregon 97523. ***"The graph below summarises data from 279 published experiments in which plants of all types were grown under paired stressed (open red circles) and unstressed (closed blue circles) conditions (114). There were 208, 50, and 21 sets at 300, 600, and an average of about 1350 ppm CO2, respectively. CO2 enrichment also allows plants to grow in drier regions further increasing the response.***



It may be said that plants' *comfort zone* is reached when **CO_2 is over 1,000 ppmv**. At this level they not only grow faster but continue to **grow well in adverse conditions such as drought.**

Extra growth from extra CO_2 already in the atmosphere





Letting CO_2 levels in the atmosphere move steadily upwards holds the key to automatically improving world food output to match its growing population. It will need NO MORE WATER.

This HUGE CARBON BENEFIT is the key message here.

and

MORE CO_2 will do NO HARM.

CO_2 and tree growth in natural conditions right now

Dr Geoff Parker and the Trees He Studies

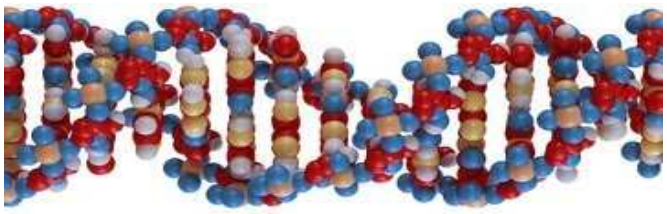
"A study published in Feb. 2010 in the Proceedings of the National Academy of Sciences has found evidence that forests in the Eastern United States are growing faster than they have in the past 225 years. The study offers a rare look at how an ecosystem is responding to climate change. For more than 20 years forest ecologist Geoffrey Parker has tracked the growth of 55 stands of mixed hardwood forest plots in Maryland. The plots range in size and some are as large as 2 acres. Parker is based at the Smithsonian Environmental Research Center, 26 miles east of the nation's capital.

Parker's tree censuses have revealed that the forest is packing on weight at a much faster rate than expected. He and Smithsonian Tropical Research Institute postdoctoral fellow Sean McMahon discovered that, on average, the forest is growing an additional 2 tons per acre annually. That is the equivalent of a tree with a diameter of 2 feet sprouting up over a year. The researchers suspect higher temperatures, longer growing seasons, and more CO_2 (which is nutritious for a plant) as causes.

It was not enough to document the faster growth rate; Parker and McMahon wanted to know why it might be happening. "We made a list of reasons these forests could be growing faster and then ruled half of them out," said Parker. The ones that remained included increased temperature, a longer growing season and increased levels of atmospheric CO_2. During the past 22 years CO_2 levels at SERC have risen 12%, the mean temperature has increased by nearly three-tenths of a degree and the growing season has lengthened by 7.8 days. The trees now have more CO_2 and an extra week to put on weight. Parker and McMahon suggest that a combination of these three factors has caused the forest's accelerated biomass gain."

The average fresh timber production in tons per acre per annum in the forest was about 3.8 tpa/annum at the start of the period so the added 2 tpa/a is a 52% increase. This highlights the very large growth gains which forests are already experiencing due to enhanced atmospheric CO_2. There is much more to come if only we allow it to happen. CO_2 at 750 ppmv will be good news for food production but ***great news*** for those of us who love ***forests***. They will grow at least 100% more – thanks to all those leaves soaking up lovely CO_2.

What else is special about Carbon? Carbon is so important that there is a whole branch of chemistry devoted to carbon compounds alone – organic chemistry. It is called 'organic' because of carbon's crucial role in creating and maintaining life.



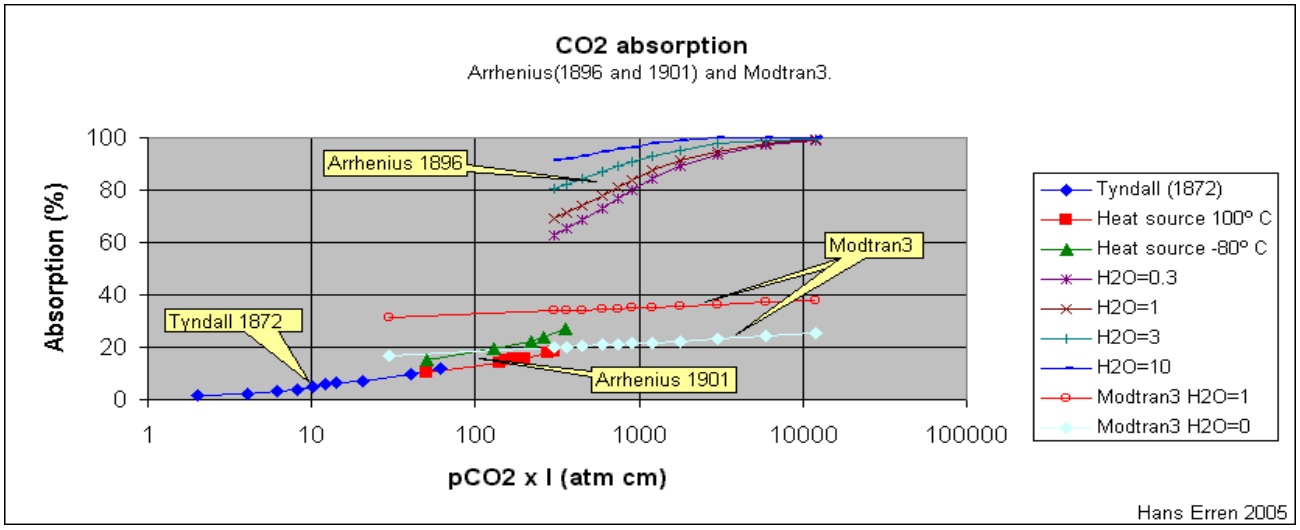
DNA
The famous double-helix molecule is made possible by carbon's ability to form long molecular chains. All the 'clever bits' in any living thing depend vitally on carbon.

The number of compounds which contain carbon is vastly more than the number of compounds of all the other elements put together. Compounds containing carbon total about 10,000,000. The number of compounds made from all the other 105 elements but excluding carbon is about 300,000. Most of the materials around us are organic.

Why do so many people condemn carbon as a 'pollutant'?
Given all the marvelous and vital things carbon does for us and for all life on earth why do so many people now condemn it as a pollutant?
It started with a Swedish scientist ***Svante Arrhenius*** who lived from 1859 to 1927. Among his other achievements he discovered the 'Arrhenius Equation' which accurately predicts how much a chemical reaction speeds up with increasing temperature.
Along the way he noted that carbon dioxide is a 'greenhouse gas'; that is to say it permits short wave radiation (such as incoming sunlight) to pass freely but absorbs much of the longer wave radiation (such as that from the earth's surface) thus warming the air.
Arrhenius believed this would be beneficial in helping to counteract the return of cold conditions which are always a worldwide threat. He was confident that more CO_2 was good.

$$\Delta F = \alpha \ln(C/C_0)$$

Above is the 'greenhouse equation' which Arrhenius developed. It predicts that temperature will rise as the logarithm of the quantity of CO_2 in the atmosphere. That is to say the rate of increase in (absolute) temperature is much less than rate of rise in CO_2.



There was academic debate about Arrhenius' figures but limited interest until 1981. In that year ***Dr James Hansen***, a NASA scientist, published his PhD thesis predicting that man-made carbon dioxide threatened the earth with damaging temperature increases. He became the leading and very articulate advocate for that prediction. He focused it to say that the 'safe' limit for atmospheric CO_2 was 350 ppmv. The present level is 12% above that and rising steadily with no harm evident to date.

Dr James Hansen giving evidence before the US Congress in 1988.

Al Gore – in his film *'An Inconvenient Truth'*.
The biggest influence on the general public in this matter has been Al Gore's film. As a piece of theatre it was magnificent but a more fitting title would be '*Plausible Falsehoods*'.

FEAR = False Evidence Appearing Real

Real Photos Calculated to Mislead
A standard technique of the carbon-antis is to take photographs or film of entirely natural and harmless processes, e.g. polar sea ice melting, icebergs 'calving' or corals dying, and then present them as 'evidence' of the dreadful things that more CO_2 is doing to the planet.

Polar Ice Melt. Page 19 describes how some 23 million Km^2 of polar sea ice naturally melts and freezes, melts and freezes, each and every year. It has been doing so for ages – for almost all that time when the CO_2 level was lower than at present. This routine seasonal event harms no one and does not affect sea level.

Corals, like other living things, are born, grow and die. Some 800 species of warm water corals follow the same life cycle of reproduction, growth, and death. As one colony of corals is dying another is becoming established and yet another is growing vigorously. It has been so for as long as coral has existed. The largest area of coral reefs is in the very warm waters of Indonesia - about 51,000 Km^2. The Great Barrier Reef covers about 30,000 Km^2.
Most corals contain symbiotic algae called zooxanthellae within their cells. The coral provides the algae with a protected environment and the compounds necessary for photosynthesis, in particular, CO_2. The algae supply the coral with the carbon products of photosynthesis which coral needs to survive and grow. CO_2 and sunlight are vital for coral as for every living thing.

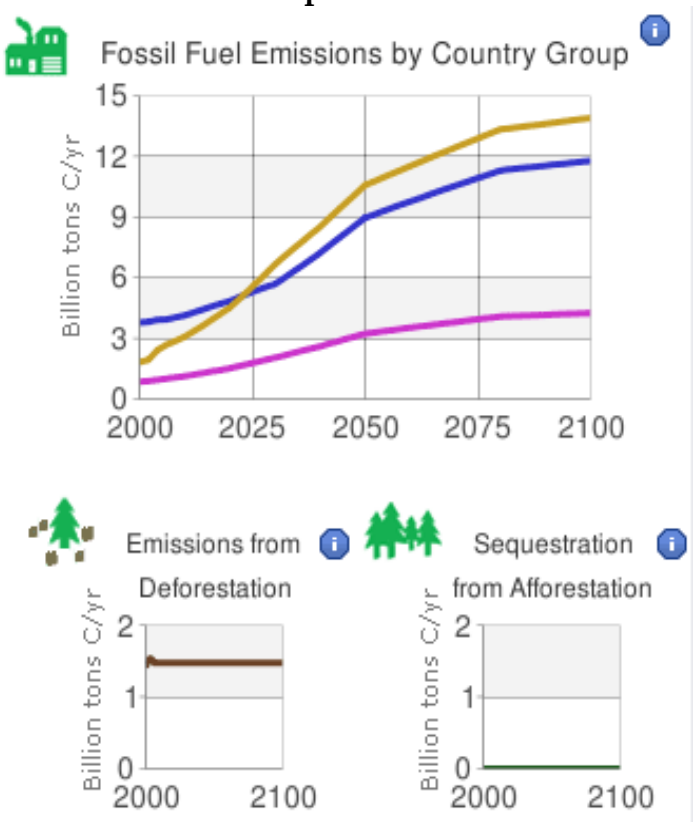
Major coral reef sites are seen as red dots on this world map. Most of the reefs, with a few exceptions, are found in tropical and semitropical waters between 30° north and 30° south latitudes. *From NOAA – CORIS*

Power Station Smoke Stacks
Very understandably many people associate CO_2 with emissions from coal fired power station smoke stacks and believe that is what causes smog and similar nasties. When coal is burned some unpleasant stuff is usually produced, e.g. sulfur dioxide, oxides of nitrogen and smoke. In most countries today a *Clean Air Act* mandates that such material must be removed by 'scrubbing' the stack gas clean before it goes into the atmosphere. This is essential.

The world's biggest coal-fired power station is the 5,780 MW Taichung station in Taiwan. Here it is (left photo) at nearly maximum output using, as always, full stack gas scrubbing. It is producing 5,000 MW, mostly from Australian coal, which is enough to supply Sydney and Brisbane combined. No smoke is visible, 99.8% is trapped by the electrostatic precipitators. 41 million tons of CO_2 are emitted annually.
This really is **'clean coal'** technology. However, the *carbon-antis* want the CO_2 to be removed also. That is technically very difficult and will, if it is ever achieved, be very expensive – over 3 tons of CO_2 are produced for each ton of coal burned. It will also be quite daft. CO_2 going into the air does great good and no harm. In addition to producing an enormous amount of very reliable electrical power the output from this station's stacks helps countless plants worldwide to grow better.

'Smoke' from Cooling Towers
All thermal power stations, be they coal, gas, oil or nuclear, need to condense the used steam emerging from the turbines after generating electricity. This can be done with sea water for coastal units or with fresh water for inland ones. When fresh water is used the inevitable result is that the source river or lake is heated. To avoid this, cooling towers as shown in the photo are often used. They employ evaporative cooling to atmosphere. On a humid day, huge white plumes rise above the towers. The plumes are harmless and consist of air plus a very fine mist of distilled water. It is the same stuff as forms clouds and is entirely innocuous.

Predictions on a Computer



In the 1980s it became ever easier to make sophisticated predictions and graphical presentations on computer. If a PhD thesis was supported by reams of impressive print-outs a doctorate was probably in the bag. But the underlying assumptions were often inadequately understood let alone rigorously scrutinized. None of this denigrates the use of computers in science and engineering where they are of immense value and have become indispensable. But output must be checked continuously against reality.

'Useful' Science Scientific research depends heavily on public funding. Democratic politicians want public money to go towards clearly useful and popular ends; for those who must regularly face election this is entirely proper. Many scientists in the *economic rationalism* of the'80s and '90s feared the loss of their financial support. Enter '*global warming*' aka '*climate change*'. What could be more useful and popular than 'saving the planet'? So many leading scientists (with notable and honorable exceptions) entered a Faustian bargain with the politicians and the public and tacitly agreed to stigmatize carbon dioxide as a 'pollutant' provided the politicians (and the big Foundations) kept the funds flowing. By that test the strategy has been wonderfully successful.
Truth has been the casualty.

A False Faith - Carbon Dioxide as the Devil

In the developed countries belief in God has dimmed in recent times. But many still yearn for something in which they can have faith. So they have cast carbon dioxide as a modern Devil in a secular religion. The over-the-top vehemence with which those who like CO_2 are attacked as 'deniers' (with its Holocaust overtones) shows that, for some, 'climate change' has passed from rational science into the realm of obsession.

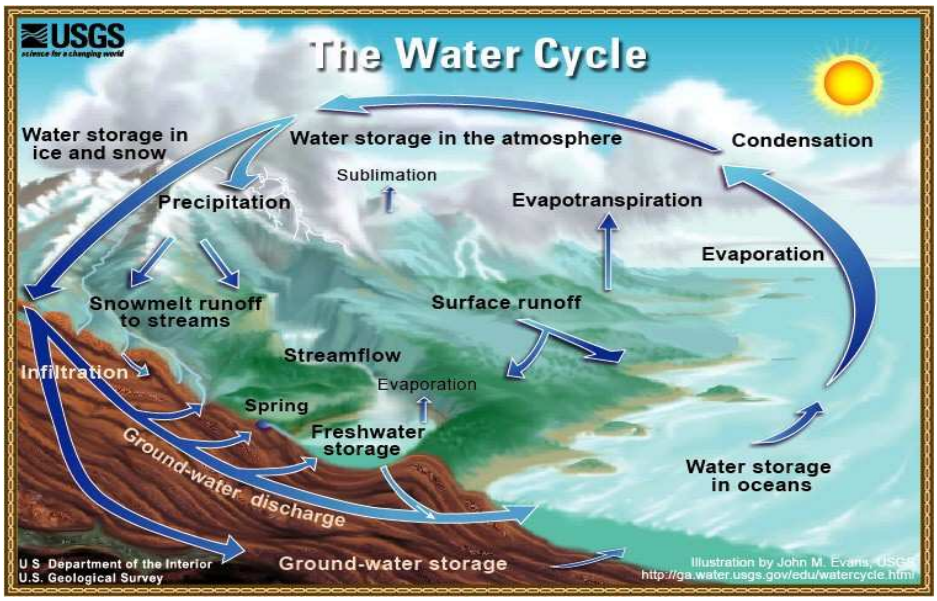
These are a few of the reasons why CO_2 is now wrongly condemned as a pollutant.

What are the Facts?

Several of the vital things CO_2 does to enable life on Earth have been outlined above. CO_2 does very many more good things.

The argument for enhancing atmospheric CO_2 to give a 'free' increase in food production to feed a more populous world and to do so with economy of land and water use is overwhelming.

Will more CO_2 cause more severe droughts?
No; rather the reverse. More CO_2 will cause a small temperature rise and this will result in some more water being evaporated from the sea. A proportion of this extra water will fall as additional rain on land and this will reduce the severity of droughts on average. The other side of this coin is that more severe floods are probable and that is a genuine adverse consequence of extra CO_2 - but more rain is good overall.



What is the Relationship between Evaporation, Rainfall, Floods and Droughts?
As the diagrams above and below show there is a very close relationship between those four factors. Evaporation from the ocean surface is the main way in which moisture enters the atmosphere – about 85% of the moisture in the air comes from the sea. On average, a water molecule spends about 9 days in the atmosphere. Thus it is reasonable to say that precipitation across the globe this week equals the evaporation last week. Most of the water evaporated from the ocean falls back as rain onto the sea but a proportion, about 9%, falls on land. This ocean-derived precipitation amounts to some 45 trillion (45×10^{12}) tons of water annually; 6,500 tons for each person on earth. A similar amount flows back into the ocean as runoff from rivers and streams.

Just where and in what form - snow, hail, gentle rain or torrential downpour - the water arrives over land is determined by local conditions at the time. A good example of dominant local conditions is seen in Australia with *El Nino* and *La Nina.* The former brings drought and the latter flood to Eastern Australia irrespective of total rainfall globally. However, for the earth as a whole, more evaporation means more rain and, on average, a lower probability of drought and a higher probability of flood. Conversely a lower temperature will reduce ocean evaporation and thus increase the global probability of drought and reduce that of flood.

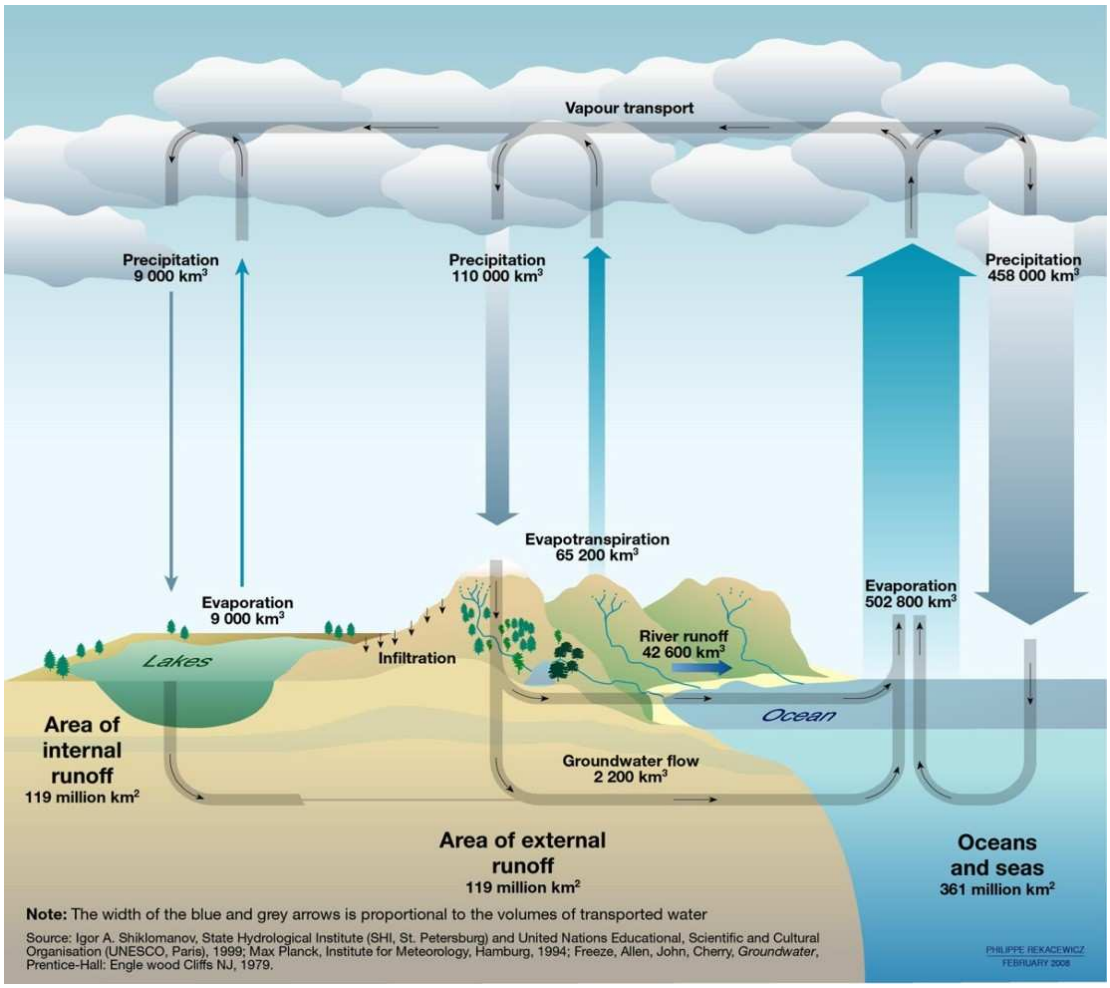
Recent studies by W Yim of Hong Kong University show the frequency with which volcanic events precede and probably cause, extreme local climate events both flood and drought.

The rate of evaporation of water from the ocean surface is controlled by two temperatures, that of the sea itself and of the air in contact with it. Wind also has an effect.

The sea temperature determines the vapor pressure of the water, i.e. its propensity to evaporate. The air temperature determines the capacity of the air to carry away that water vapor. The rate of evaporation is roughly proportional to their sum. The role of the wind is to cause the moist air to rise quickly thus allowing drier air to come in contact with the sea and so absorb more moisture from it.

For a temperature rise from 10°C to 11°C the water vapor pressure rises from 9.209 torr to 9.844 torr, i.e. by 6.9%, and for a rise from 20°C to 21°C from 17.535 to 18.650, i.e. a 6.4% rise.

This gives an approximate rise of 6.5% in water vapour pressure per 1°C of temperature rise. For a given wind speed a 1°C rise in both sea and air temperature will increase the evaporation rate by the sum of the two i.e. by about 6.5 + 6.5 = 13%. Across the globe wind speeds average out.

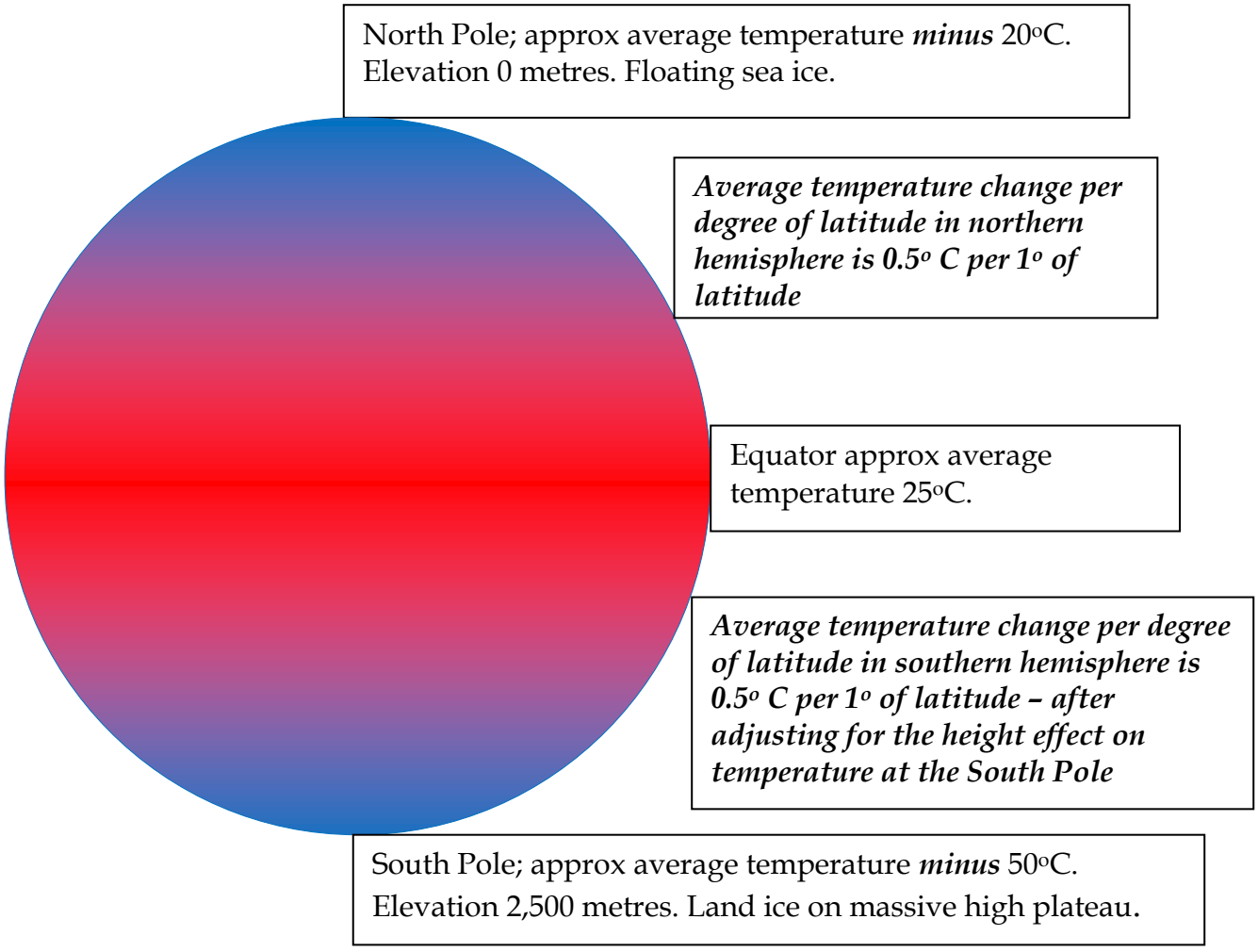


There is an interesting correlation with a 2011 report in the journal 'Nature'. This studied more than 6,000 rain gauge records from the northern hemisphere and found that over the 50 years to date that there had been a 7% increase in severe floods. Over the same period there has been a global temperature rise of about 0.6°C (however caused). Applying the relationship shown above gives a 7.8% increase in rainfall and a similar increase in flooding and decrease in drought. Floods may be both devastating and tragic but for a country as a whole more rain, despite the floods that may come with it, is a major benefit. This is especially true in Australia.

CO_2 and Ocean Life

Every day over 100 million tons of carbon dioxide is drawn from the atmosphere into the ocean by photosynthesis for billions of microscopic ocean plants called phytoplankton. Phytoplankton is the foundation of the ocean food chain so CO_2 is just as important for the growth and survival of fish and other sea creatures as it is for land plants and animals.

How can you try out climate change right now? In the northern hemisphere you can experience a +1°C change by moving a modest distance south and in the southern hemisphere by moving modestly northwards. The move needs to be about 2° of latitude in either case, i.e. about 200 km. If you live on a hill moving 100 metres lower down the slope will have the same effect. In Australia if you move from Sydney to Brisbane (and many people do) you get +3°C of climate change. In the USA, a move from Chicago to Miami gives +8°C of change and people make this choice freely. A temperature rise of itself is no problem. A fall in temperature is something else!



Sea Ice Melting. Every year about 15 million Km² of floating sea ice freezes and later melts in the Antarctic and about 8 million Km² in the Arctic. That means an annual ice melt of 23 million Km² – 3 times the area of Australia; 2.4 times that of China or the USA. No wonder it is easy to get photos of melting polar ice! This has happened every year for centuries and is just the way the world works whatever the amount of CO_2. Sea ice floats and has no effect on global sea level whether it freezes or melts. So melting sea ice is not a problem.

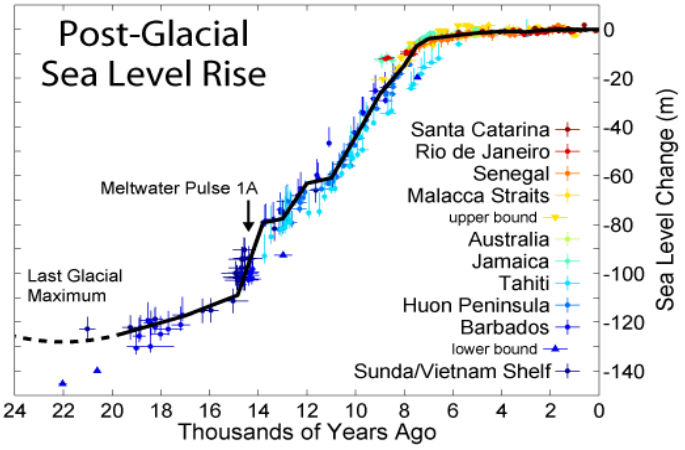
Amundsen-Scott Base near the South Pole.
Ice Cap on Land (14.2 million Km^2) at 2,300 metres average elevation remains largely constant between winter and summer but the surrounding sea ice covers about 18 million Km^2 in winter and 3 million Km^2 in summer.

Submarines surfaced at the North Pole.

Floating Ice at Sea Level.

This covers about 13 million Km^2 in winter and about 5 million Km^2 in summer.

Will more CO_2 make sea level rise faster and inundate our coastal cities and plains?



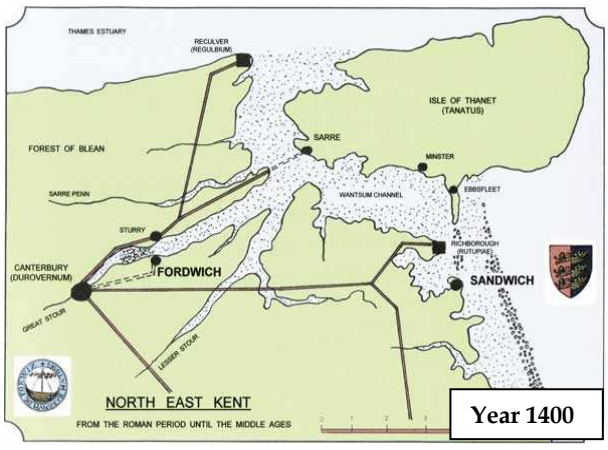
"This figure shows **sea level rise** since the end of the last **glacial episode** based on data from Fleming et al. 1998, Fleming 2000, & Milne et al. 2005. These papers collected data from various reports and *adjusted them for subsequent vertical geologic motions, primarily those associated with post-glacial continental and hydro-isostatic rebound*".

During the past 20,000 years, the blink of an eye in geological time, sea level has risen about 120 metres – an average of 6 mm per year. Throughout that fast sea level rise CO_2 was steady at a very low value. The rise has been much slower recently. The sea level rise inundated huge areas of land which is now 'continental shelf' beneath the ocean. However, it has not all been one-way – especially during the last 5,000 or so years.

Recent and Continuing Land Level Rise

The graph above shows how sea level has risen relative to the centre of the earth (satellites also measure relative to earth's centre as in WGS 84) but the land has also risen in many places and continues to do so. This means that while sea level rises in absolute terms, land may well rise even more. Thus land area can increase despite sea level rise. A good example of such a rise is 'isostatic rebound'. This is where land which was heavily loaded by deep ice and pressed down into the earth's viscous mantle is now unloaded and is gradually 'floating' higher. The process takes thousands of years. It is very active in, for example, the Great Lakes area. Relative to (sea) Lake Michigan, Chicago is now 7 metres higher than it was 5,500 years ago. Other processes such as tectonic movement, volcanic action, crustal expansion, coral growth and sedimentation of bays have a similar effect. It can be seen on the 'raised beaches' (up 40 metres) all around the world, e.g. in places as far apart as Scotland and New Zealand. Thus 'sea level rise' and increasing land area can co-exist happily.

An Example - The Isle of Thanet in Kent – 'The Garden of England'



In 1400 Thanet was an island separated from Kent in England by some miles of sea. Vessels docked at Fordwich near Canterbury. Today the 'Isle of Thanet' and the intervening sea bed have risen to become an integral part of the Kent mainland. What was seabed is now excellent farm land or busy towns. Many former principal ports in the area, the *Cinque Ports,* are today well inland. The now superb grazing land of Romney Marsh was under the sea in 1400. The North Sea has risen but the land has risen faster.

The Coastal Education & Research Foundation, Inc. [CERF] is the official publisher of the Journal of Coastal Research (JCR)

Sea-Level Acceleration Based on U.S. Tide Gauges and Extensions of Previous Global-Gauge Analyses. Report by J. R. Houston and R. G. Dean, March 2011.

Abstract:

"***Without sea-level acceleration, the 20th-century sea-level trend of 1.7 mm/year would produce a rise of only approximately 0.15 m from 2010 to 2100; therefore, sea-level acceleration is a critical component of projected sea-level rise.***

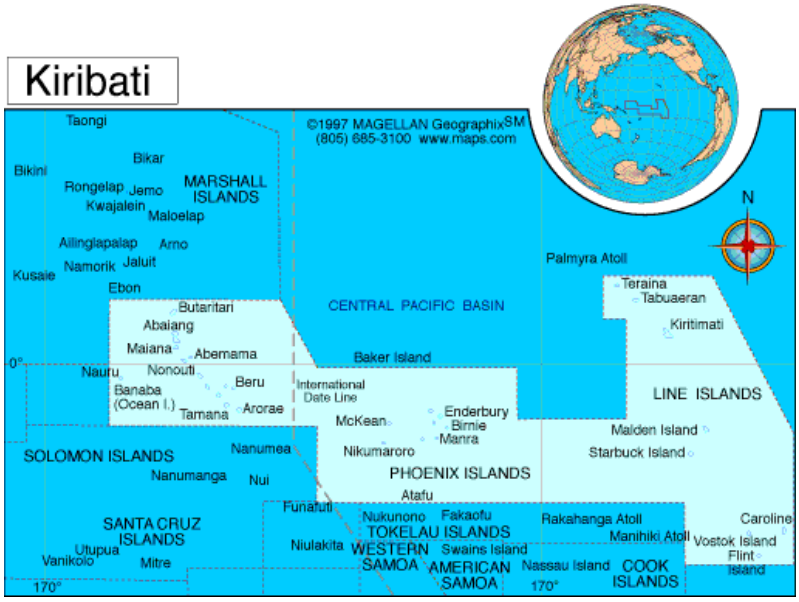
To determine this acceleration, we analyze monthly-averaged records for 57 U.S. tide gauges in the Permanent Service for Mean Sea Level (PSMSL) data base that have lengths of 60–156 years. Least-squares quadratic analysis of each of the 57 records are performed to quantify accelerations, and 25 gauge records having data spanning from 1930 to 2010 are analyzed. In both cases we obtain small average sea-level decelerations. To compare these results with worldwide data, we extend the analysis of Douglas (1992) by an additional 25 years and analyze revised data of Church and White (2006) from 1930 to 2007 and also obtain small sea-level decelerations similar to those we obtain from U.S. gauge records."

The report above shows that "sea level rise", which is already tiny, is reducing still further. We can be confident that iconic Bondi Beach, shown below, will be much the same as today for our great-great-grandchildren in 2100.

Sea Level around the Kiribati Island Chain

Kiribati consists of 33 inhabited coral islands, home to over 100,000 people, spanning 4,000 kilometres from East to West, 2,000 km from North to South, straddling the Equator and in the deep Pacific Ocean.

Initially the *carbon-antis* selected Kiribati as the ideal location to demonstrate their creed. As well as predicting fast rising sea level they also claimed that more carbon dioxide would inhibit coral growth. Thus these islands were, on two counts, forecast soon to disappear beneath the waves.



However, Kiribati had been the subject of regular, high-quality aerial photos from 1950 onwards. Careful measurements by Paul Kench, at the University of Auckland, and Arthur Webb at the South Pacific Applied Geoscience Commission (SOPAC) in Fiji, in a paper published in the journal *Global and Planetary Change* show that during the past 60 years the total land area of the islands of Kiribati has increased by some 3% - a very fast gain in geological terms. The IPCC said they would be inundated but measurement shows the opposite. Other low-lying islands give similar results.
We can all take comfort that more atmospheric CO_2 will <u>not</u> cause us to drown.


Kiribati Parliament House from the air

Floating Sea Ice does not affect Sea Level but what about Ice on Land?
Melting land ice will add more water to the oceans and thus will raise global sea level. By the same token an increase in land ice volume will lower global sea level. This happened dramatically during the last ice age 20,000 years ago. The area of the Earth's oceans is 365 x 10^6 Km^2. Thus 0.365 x 10^6 Km^3 of land ice must melt to raise sea level by 1 metre – all else remaining constant. Today land ice has three main components; Antarctic Ice, Greenland Ice

and Glaciers. Antarctic ice has a massive volume of 30 x 10^6 Km^3. Greenland has 2.6 x 10^6 Km^3. All earth's glaciers added together have a volume of under 0.1 x 10^6 Km^3. See relative volumes below.

Antarctic land ice volume

Greenland land ice

Total glaciers

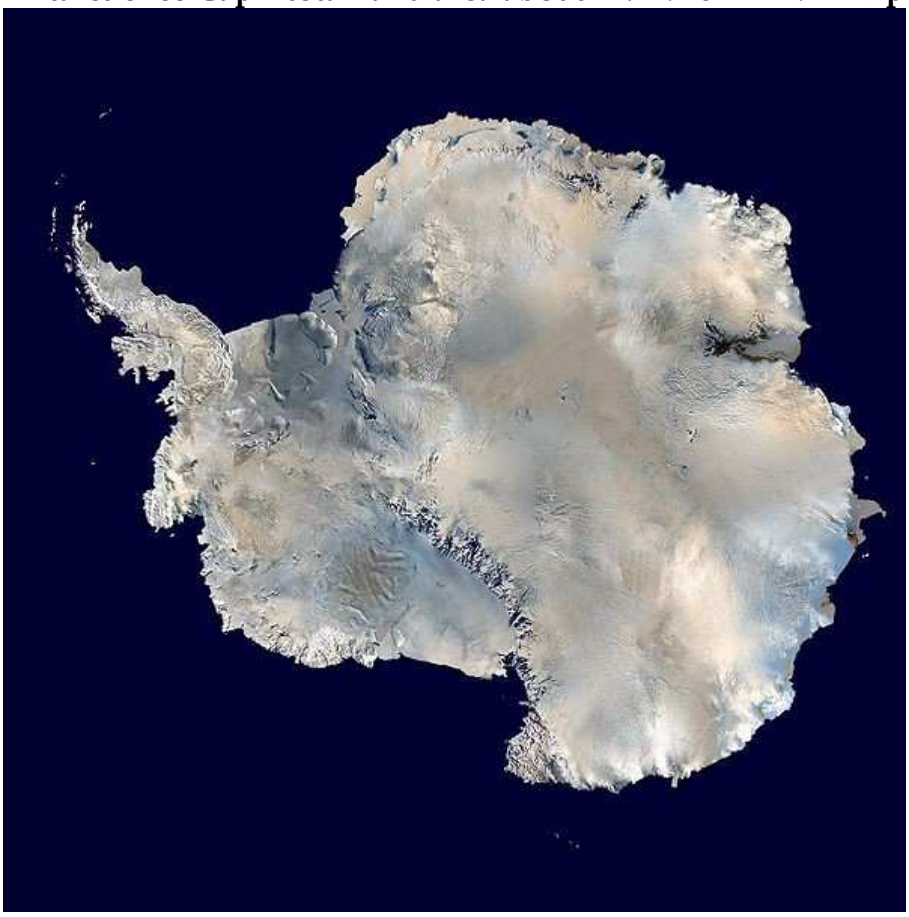
The dominant influence of the Antarctic land ice is apparent. It is also apparent that even if every glacier on earth were to disappear entirely the effect on global sea level would be a rise of less than 0.27 metres and there is no evidence whatsoever of that happening. On the other hand a mere 1% melt of the Antarctic ice would give a global sea level rise of 0.82 metres; a 1% accretion would lower sea level by a similar amount. A -/+ 1% change in Greenland ice volume would give a +/- 0.07 metres change in sea level.

Taking that one stage further; if, over a given (long) period, there is a 10% melt in Greenland ice and a 1% accretion in Antarctic ice then global sea level will fall by 0.12 metres (120 mm). This may perhaps be happening. Temperatures around Greenland cause some land ice to melt (but see NASA photo on page 28). However, the slightly higher global temperatures also cause some more ocean evaporation and thus some more precipitation in the form of snow on the Antarctic land ice. This increases the volume of that land ice field so lowering sea level. It is consistent with the findings on Kiribati and similar islands.

Antarctic temperature – effect of altitude on land ice

The South Pole is cold but the adjacent sea ice does melt every summer and re-freeze every winter on an immense scale. Antarctic land ice is always so cold that it scarcely melts at all. The average altitude of Antarctica of some 2,300 metres means that the average surface temperature is about 23°C lower (the *dry adiabatic lapse rate* applies in the arid air over the South Pole) than the temperature at sea level. This is why the Antarctic ice cap grows very gradually due to annual snowfall with minimal melting. The very high altitude of the Antarctic creates a 'thermal step barrier' which protects the land ice against melting even *if* the sea were to warm substantially.

Antarctic Ice Cap – total land area about 14.2 x 10^6 Km^2. Wikipedia Commons



Antarctica is the **coldest** (-50°C average.), **driest** (precipitation of 50 mm water equivalent/yr) and **highest** (2,300 metres on average) continent on Earth.

It is significant that the coldest continent is also the driest.

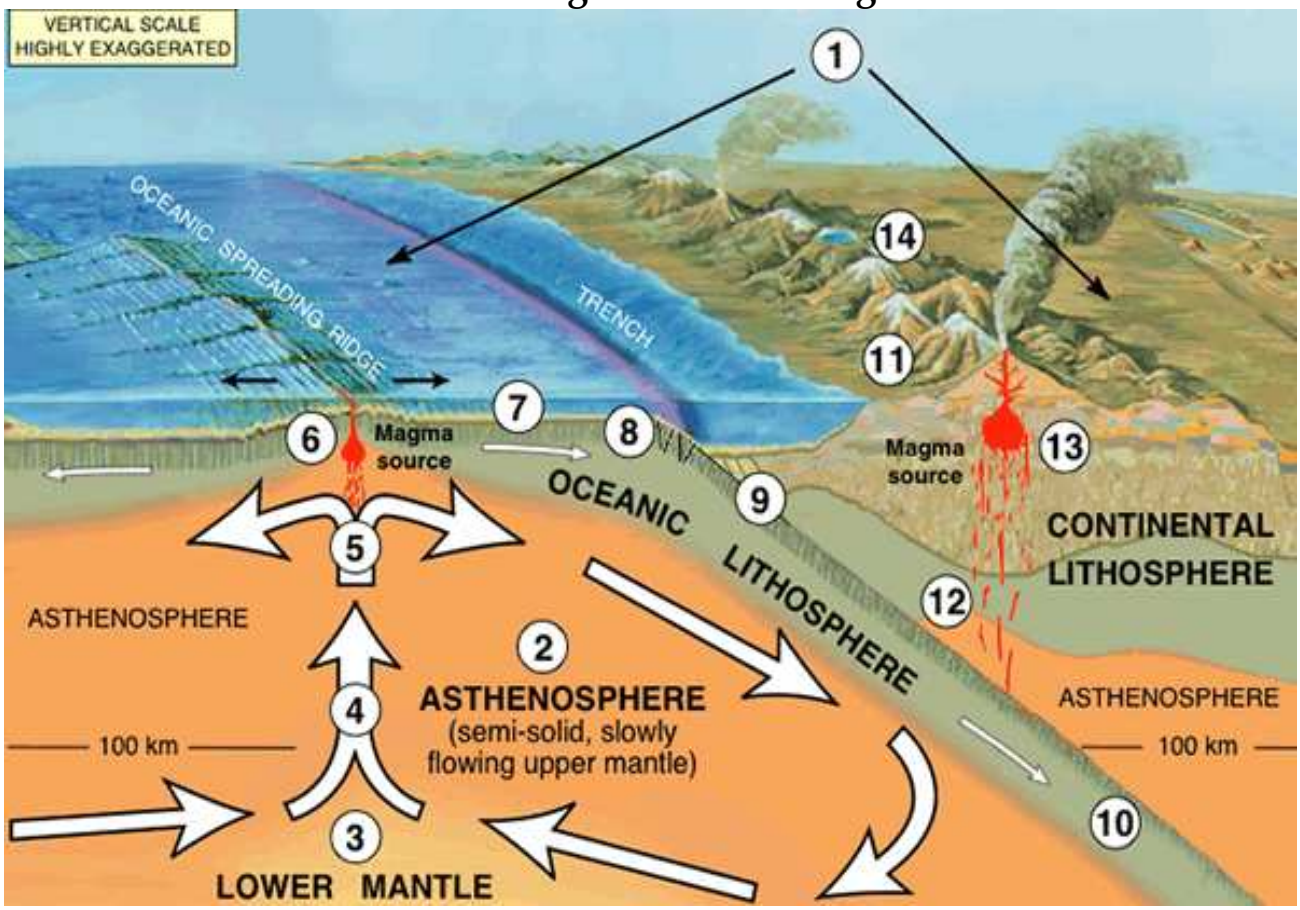
It is about 1.8 times as big as Australia and 1.5 times as big as the USA or China.

Given Antarctica's land area, annual snow fall and slight summer sublimation, some 700 billion tonnes of new ice are created every year. Recent work also shows that considerable additional ice forms at the interface between the ice cap and the land mass.
700 billion tonnes of icebergs would need to 'calve' each year just to match the snowfall and keep the Antarctic land ice from becoming deeper; that is 2 billion tonnes per day. The 'calving' rate is less than that so the Antarctic icecap is getting slowly deeper.

Will ocean warming cause a sea level rise?

It is reasonable to expect that warmer air, albeit only by a degree or so, will, over time, create a warmer sea which will then expand. If water in a mug is warmed and the mug remains cold then the water level will rise measurably due to its expansion. But will the mug stay cold? How will it expand when it warms and what will that do to the water level relative to the mug? A similar, but vastly more complicated, question applies to the earth/ocean interface. The earth's crust cannot be regarded as an inert lump. Its volume and height are temperature driven and warmer air is at least as likely to warm the earth as the sea.

US Geological Service image



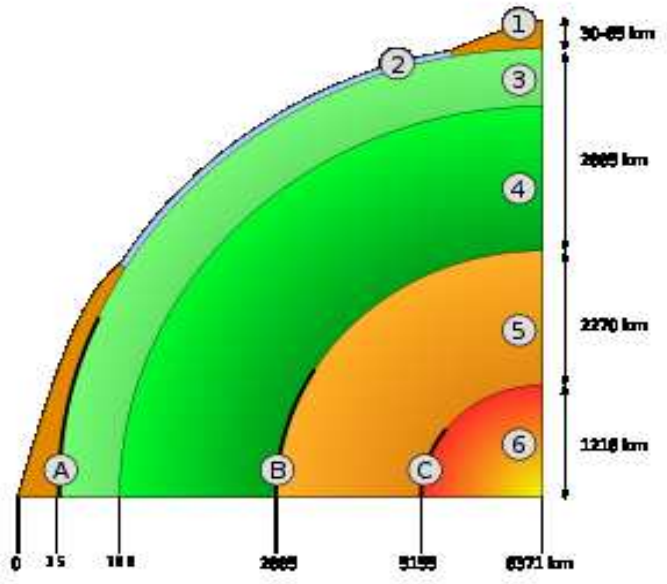


Diagram shows:- 1. continental crust - 2. oceanic crust - 3. upper mantle - 4. lower mantle - 5. outer core - 6. inner core - A: **Mohorovičić discontinuity** - B: **Gutenberg Discontinuity** - C: **Lehmann Discontinuity**

The earth's internal temperature profoundly influences the relationship between sea level and that of places on land. It is naive to the point of absurdity to assume that the oceans can warm without effect upon the earth. As shown above the **continental crust (1)**, on which humans, animals and plants all reside, is between 30 and 65 km thick. If 40 km depth of crust increases in temperature by 1°C it will expand by about 300 mm and rise accordingly. Heat flows constantly from the earth's interior to the surface so earth's internal response to a rise in surface temperature is relatively rapid.

So how can we truly assess the movement of global sea level?

By going back to basics and making measurements on the beaches of the world. The work of CERF (page 22 above) is an exemplar of commonsense and rigor.

Kiribati is a 'canary in the coal mine' in this context. For Kiribati we know the answer; on average, the land is winning decisively and quite rapidly against the sea.

Kiritimati, Kiribati - 322 Km², 5,100 people (both increasing) – NASA photo

More on Sea Level Change - Predictions from the IPCC

The results from the IPCC Third Assessment Report (TAR) sea level chapter (convening authors John A. Church and Jonathan M. Gregory) are given below:

IPCC change factors 1990-2100	**IS92a prediction**
Thermal expansion	110 to 430 mm
Glaciers	10 to 230 mm[32] (or 50 to 110 mm)[33]
Greenland ice	–20 to 90 mm
Antarctic ice	–170 to 20 mm
Terrestrial storage	–83 to 30 mm
Ongoing contributions from ice sheets in response to past climate change	0 to 55 mm
Thawing of permafrost	0 to 5 mm
Deposition of sediment	not specified
Total global-average sea level rise	
(IPCC result, not sum of above)[32]	**110 to 770 mm**
SRES prediction	**90 to 880 mm (central value of 480 mm)**

Figures given for Antarctic and Greenland ice caps are consistent with the suggestion earlier in this note. The mean of the Antarctic figures, -170 mm to 20 mm, i.e. -75 mm average and Greenland average +35 mm, indicate a net sea level fall of 40 mm by 2100 due to the two causes combined. If the 'low' estimates above are added together the result is -153 mm, i.e., a sea level fall by 2100 of 0.15 metres. The 'global-average' given by the IPCC of +110 to +770 mm does not correspond with their own input numbers.

What is happening to the Greenland Ice Cap?

NASA's IceSat saw thickening (pink) in places and thinning (blue) in others between 2003 and 2006. Readers can judge for themselves whether there is more pink or more blue. Is the Greenland ice cap shrinking or growing?

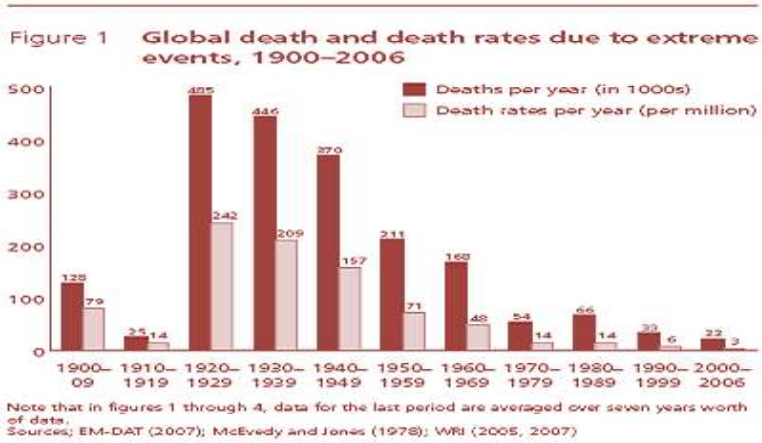
Won't more CO_2 cause widespread species extinction?

No; rather the opposite. More CO_2 will increase food supply for all creatures. The continuing rise in human population and the consequent competition for habitat will adversely affect some species and that *may* cause extinctions; but more carbon dioxide will mitigate, not exacerbate, the problem. The fossil record shows that Earth had its most abundant flora and fauna many millions of years ago when atmospheric CO_2 was well over 1,000 ppmv.

Flora and Fauna in the Jurassic – From Texas Geology

CO_2 was then about 2,000 ppmv (0.2%)

Surely CO_2 is to blame for the Extreme Weather Events we have had recently?



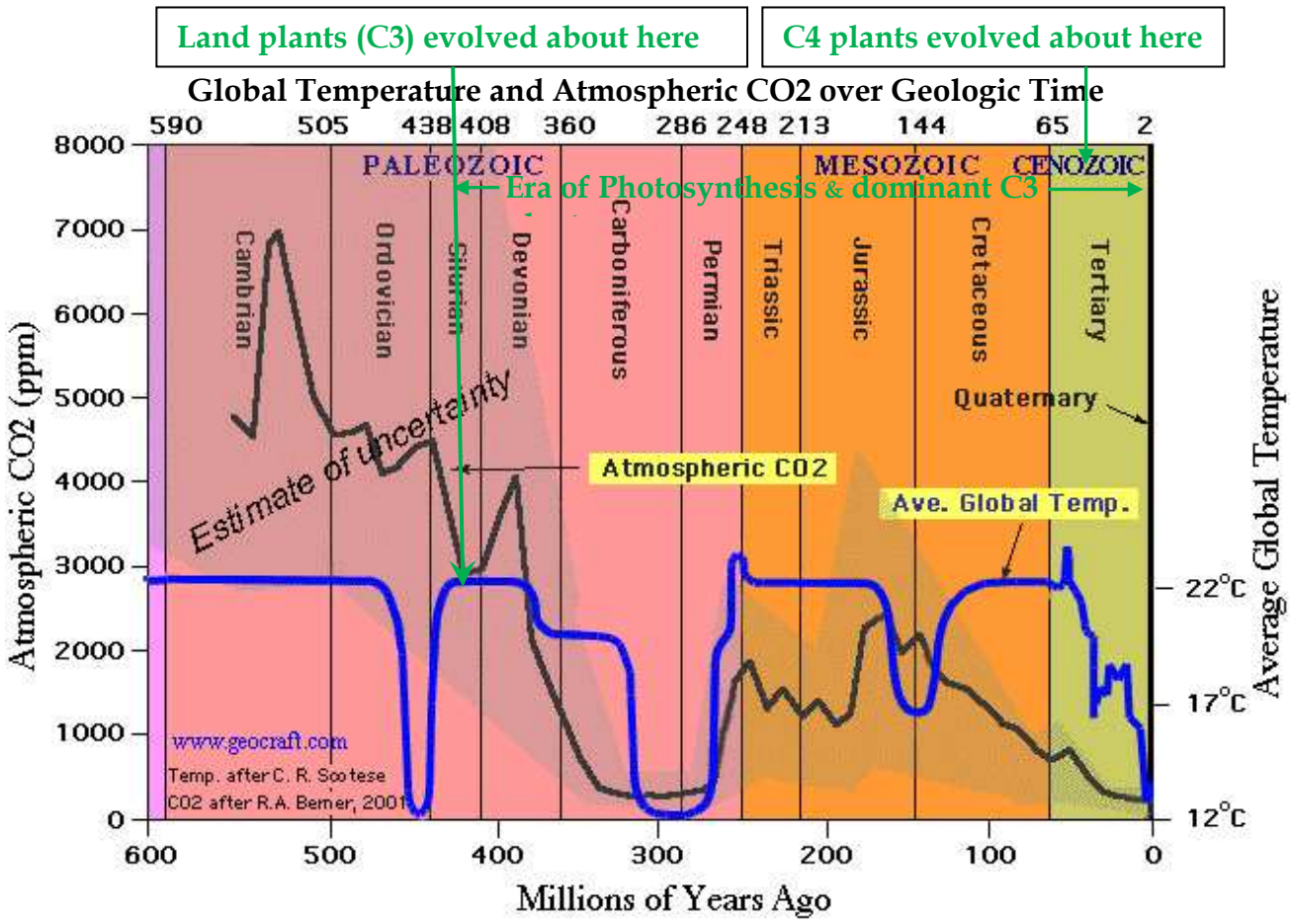
The objective evidence shows that there has not been an increase in extreme weather events by comparison with times past. There are now many more people and far more numerous and costly structures than in earlier years. News of such events which could take ages then, takes only seconds now, to circle the globe. Media hype grossly exaggerates any current happening relative to earlier ones. All this has led to an understandable, but mistaken, impression of more extreme weather events.

False Forecasts; an Example: During the period 2006 to 2009 in Australia the BOM and CSIRO combined to give the Australian Government an alarming prediction of increasingly severe droughts in future. (There was drought at the time). They were supported by a clutch of professors and pundits. In the event, the years 2010 to 2011 brought very severe floods – the exact opposite of the prediction. The forecasters were not in the least abashed; "we told you there would be an extreme event and here it is" said they. Such casuistry is despicable and gives science a bad name.

Flora and Fauna in the Jurassic – from Texas Geology. CO_2 was then about 2,000 ppmv

Is not the historically high level of CO_2 dangerous in itself?
No. Whether the level of CO_2 is now 'high' depends on one's historical time span. Compared to the past few centuries CO_2 is now relatively high – around 390 ppmv versus 280 ppmv earlier. But see below for the full record over a significant geological time.

There is no evidence that the recent modest rise has any adverse consequences. Rather is there pervasive and compelling evidence that it has improved world food supply. If one takes a longer view and looks at the most recent 10% of Earth's history, which also spans the 'Era of Photosynthesis', the picture – see below - is quite different.



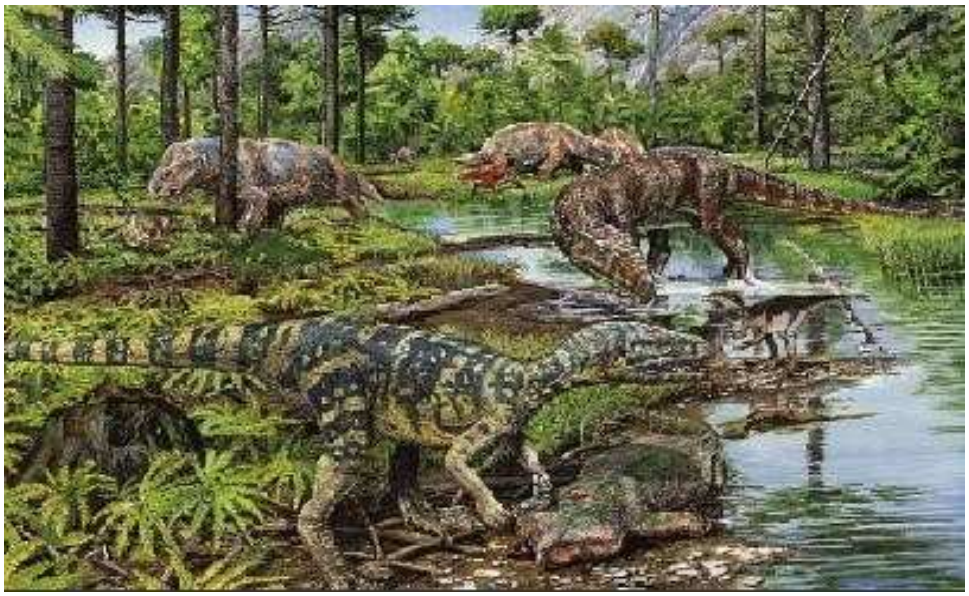
Temperature after C.R. Scotese *http://www.scotese.com/climate.htm*
CO_2 after R.A. Berner, 2001 (GEOCARB III) *Emeritus Professor of Geology and Geophysics at Yale University.*

1,000 ppm is 0.1%. ppm shown above is ppmv.

So what is the real history of atmospheric CO_2?

As shown above the levels of CO_2 and global temperature are presently near the bottom, not the top, of their historical range. During times of mostly 'high' CO_2 – over 1,000 ppmv and up to 2,000 ppmv – there was no runaway warming. We would not be here now if there had been.

We do not need computer simulations to answer this question. Earth has conducted its own 'experiments' over hundreds of millions of years and has demonstrated, time and again, that high CO_2 does not cause 'runaway warming'. Those times of high CO_2 brought bountiful plant growth and a profusion of animal life. Given that carbon dioxide is, by far, the earth's main plant food that is hardly surprising. It was during one such era that the deep beds of plants which eventually formed coal and oil grew and were laid down. They were fed by the CO_2 then in the atmosphere; burning coal today merely recycles a small part of that CO_2 back to where it came from in the first place. Is this '*Gaia*' in action?



Plants and animals in the Triassic – from *National Geographic* magazine. CO_2 was then about 1,500 ppmv (0.15%)

Won't higher temperatures reduce bio-diversity and thus damage the planet?
No; quite the opposite. Again there is good fossil evidence of what really happened in the past with high levels of CO_2 and rapid global warming – both going far beyond anything projected by the IPCC. It is set out in a recent report in the journal *'Science'* shown below:

Science 12 November 2010: Vol. 330. no. 6006, pp. 957 – 961 DOI:10.1126/science.1193833

Effects of Rapid Global Warming at the Paleocene-Eocene Boundary on Neotropical Vegetation. By Carlos Jaramillo and 21 others:

"Temperatures in tropical regions are estimated to have increased by 3° to 5°C, compared with Late Paleocene values, during the Paleocene-Eocene Thermal Maximum (PETM, 56.3 million years ago) event. We investigated the tropical forest response to this rapid warming by evaluating the palynological record of three stratigraphic sections in eastern Colombia and western Venezuela. We observed a rapid and distinct increase in plant diversity and origination rates, with a set of new taxa, mostly angiosperms, added to the existing stock of low-diversity Paleocene flora. There is no evidence for enhanced aridity in the northern Neotropics. The tropical rainforest was able to persist under elevated temperatures and high levels of atmospheric carbon dioxide, in contrast to speculations that tropical ecosystems were severely compromised by heat stress."

Image of vegetation during the PETM - the Eocene was like the 'Garden of Eden'.

High atmospheric CO_2 is making the oceans acid. Won't fish and coral die off?
No and no. The *carbon-antis* often claim that the oceans are becoming acid (pH < 7.0). They are not, they did not become so when CO_2 was above 1,000 ppmv for eons and they will not irrespective of the future level of CO_2 in the atmosphere. Sea water has a strong 'buffering' capacity which keeps it mildly alkaline (pH 8.0 to 8.3).

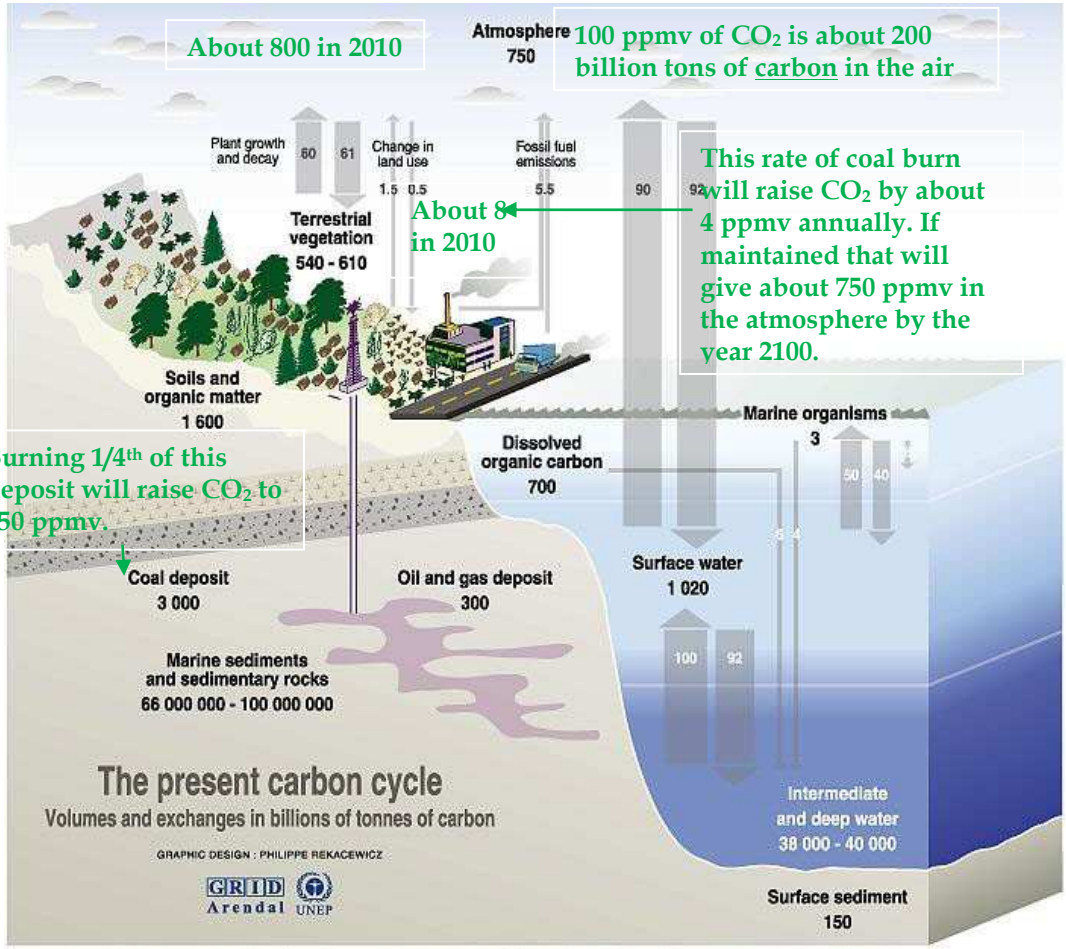
Contrary claims notwithstanding, there is no threat to fish, crustaceans or coral from atmospheric CO_2. In fact they all depend for their existence on CO_2. (Please note the Kiribati experience outlined above and see the diagram of carbon inventory and carbon annual turnover following.)

Coral Reef Photo – NASA Earth Observatory

'Hot and Dry' *or* 'Warm and Wet'?
Arrenhuis' greenhouse equation indicates that a rise in atmospheric CO_2 to around 750 ppmv will, relative to what would happen with a constant CO_2 level, produce a temperature rise of about 1.2°C. Other factors may cause the actual temperature change to be nil, or greater or less, than 1.2°C. Temperature rise is often presented as a move to *hot and dry* conditions with implications of increased drought. The reverse is true; greater global temperatures will, as always in times past, mean a change to relatively ***warm and wet*** conditions. As noted above, on average, this makes droughts less probable and floods more probable.

This can be seen every day on Earth right now. The poles are cold and arid whereas the tropics are generally warm and wet. The one slowly changes to the other as latitude decreases and temperature increases. Biological diversity increases with rising temperature. The temperature range across the Earth today is by far larger than even the most absurd of the IPCC forecasts for temperature rise.

The Global Carbon Inventory in Billion (10^9) Tonnes.
Arrows show Annual Movements of Carbon in Billion Tonnes
Numbers below refer to carbon - not carbon dioxide.



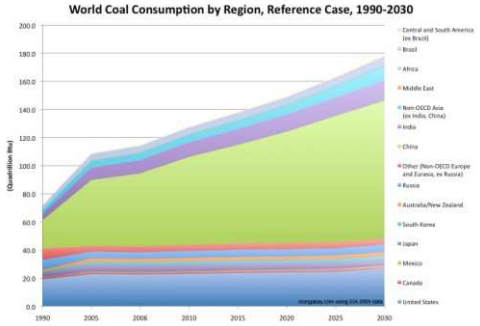
Sources: Center for climatic research, Institute for environmental studies, university of Wisconsin at Madison; Okanagan university college in Canada, Department of geography; World Watch, November-December 1998; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1998.

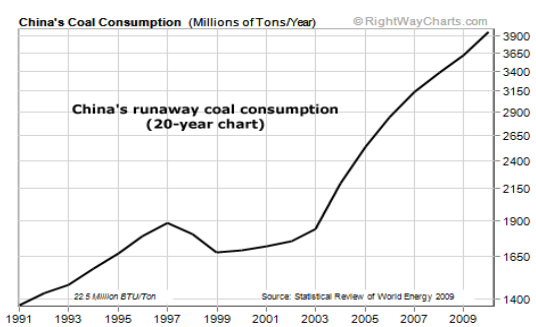
What is happening to coal consumption in the real world?

This image below shows that in the real world coal consumption is growing as never before - despite all the *anti-carbon* rhetoric. How fortunate for all of us that the real world pays the *carbon-antis* no heed!

The rising coal burn increases atmospheric CO_2 and thereby benefits food production everywhere.

In some places power stations and factories have totally inadequate stack gas scrubbing which causes severe local smog and air pollution. This needs urgent correction.





China is by far the world's largest producer and user of coal.
Between 2000 and 2010 China's coal output rose from 1.6 billion tonnes per year to 3.2 billion – a rise of 100%. This is shown in the two graphs above. The left hand chart uses the heat equivalent - quadrillion BTU – and the right hand, millions of tons of coal. China is doing the whole world a service by increasing atmospheric CO_2 and thus plant growth for all of us.

What Does China's Current (12th) 5-year Plan Provide for Carbon?
China's currrent (2011-16) ***5-year plan*** calls for a 17% reduction in CO_2 output per unit of GDP over the 5-year period and also for an average increase of GDP of 7% per annum. That will compound to give a 40% rise in GDP 2016 v. 2011. In turn this means that annual CO_2 output to atmosphere in China is planned to be 16% higher in 2016 v. 2011. This will further benefit plant growth in every country of the world. It is consistent with the rising coal consumption displayed in the graph above.

Will a "4°C average temperature rise destroy world agriculture"?
No! Highly productive agriculture goes on right now in, for example, Manitoba which grows superb wheat at an average annual temperature of 2.5°C. At the other end of the temperature scale excellent rice which feeds hundreds of millions of people is grown in Indonesia (the world's third largest rice producer) at an average annual temperature of 25.5°C.
Large-scale agriculture is successful here and now over a range of at least 23°C. Why ever should a 4°C rise bring disaster? Let alone that a temperature rise of that amount is wildly unlikely. Those who have recently made such alarmist and absurd assertions should know better. Give the facts a go!

A wheat field in Manitoba - Av. 2.5°C

Terraced rice paddies in Indonesia – Av. 25.5°C

Wheat in Western Australia – Av. 19°C

Rice in NSW Australia – Av. 20°C

What is 'climate change' really doing to crop yields?

The abstract report below from the scientific journal *Nature* shows the considered view of Dr Neville Nicholls. Dr, now Professor, Nicholls leads the Climate Group of the Bureau of Meteorology Research Centre in Melbourne, Australia. After careful study he found that at least 30% of the large increase in Australian wheat yield between 1952 and 1997 was due to the beneficial effects of climate change. No downside was detected. This was not a theoretical projection but rather a sober assessment of what had already happened.

Nature **387**, 484 - 485 (29 May 1997); doi:10.1038/387484a0

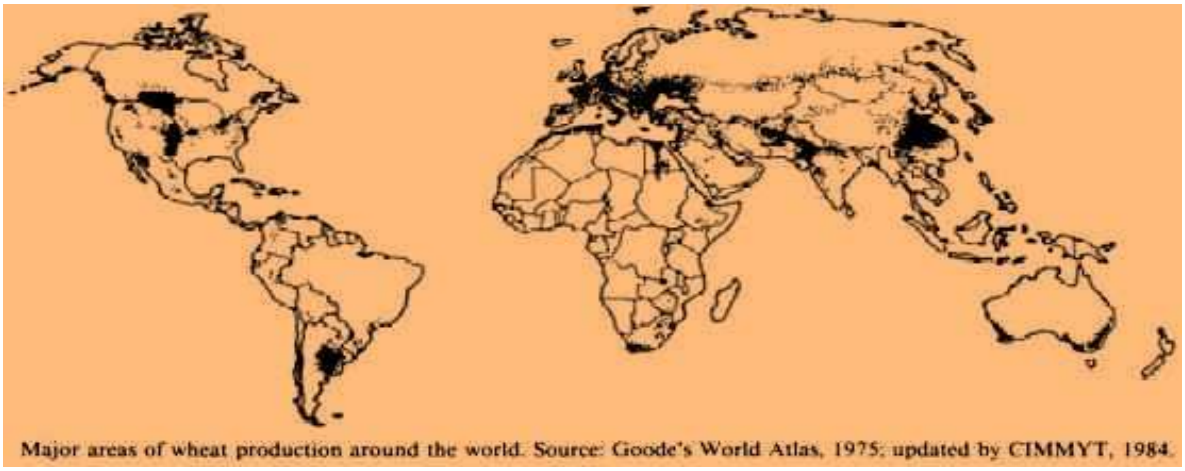
Increased Australian wheat yield due to recent climate trends

NEVILLE NICHOLLS Bureau of Meteorology Research Centre, Melbourne, Victoria 3000, Australia

"The possibility that future climate change may affect agriculture has attracted considerable attention[1,2]. As a step towards evaluating such influences, the effect of climate trends over the past few decades[3] needs to be assessed. Here I estimate the contribution of climate trends in Australia[4,5] to the substantial increase in Australian wheat yields since 1952. Non-climatic influences - such as new cultivars and changes in crop management practices - are removed by de-trending the wheat yield and climate variables and using the residuals to calculate quantitative relationships between variations in climate and yield. Climate trends appear to be responsible for 30–50% of the observed increase in wheat yields, with increases in minimum temperatures being the dominant influence. This approach should be applicable in other regions for which sufficient data exist."

In so far as additional carbon dioxide does increase temperatures, one effect may be that some northern areas, e.g. in Canada and Russia, which are now just beyond the temperature margin of commercial wheat cultivation will come within the band of successful cultivation. This could add further resources to food production. However, what temperature increase, if any, will accompany the rise in CO_2 is speculative so this potential is also speculative.

The food production increase due to additional CO_2 is certain & is quite obvious now.



Major areas of wheat production around the world. Source: Goode's World Atlas, 1975; updated by CIMMYT, 1984.

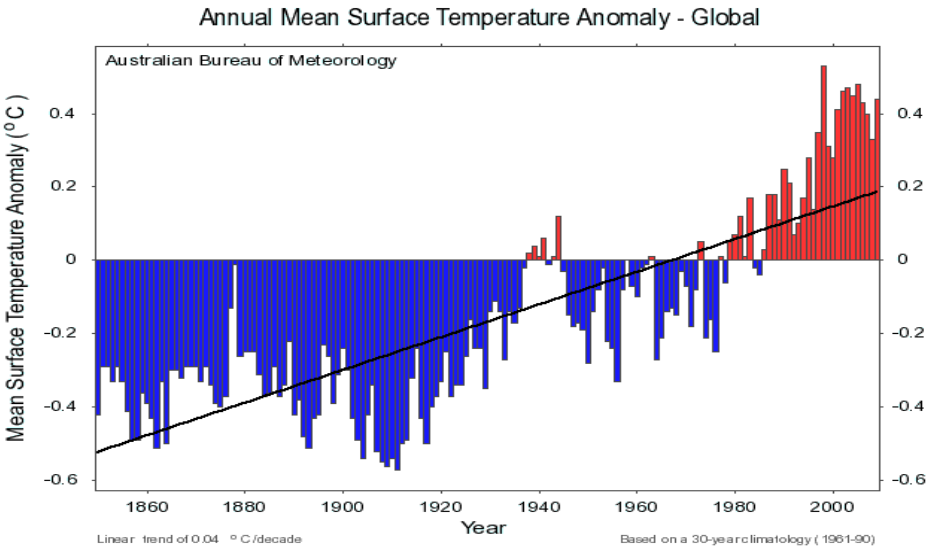
According to the IMF, World GDP in 2009 was about $60,000 billion. The proportion of that comprising food varies from about 10% for urbanised countries through 16% for transforming countries to 29% for agricultural countries. The average for food is about 12%. Thus, in very round terms, the annual value of the world's food is some $7,000,000,000,000. Every $ of that depends crucially on atmospheric CO_2. So does the ethanol which, thanks to *anti-carbon*, uses good farm land to produce vehicle fuel. So do all the forests of the world and all their products such as timber and paper. All of Nature's daily bounty also depends crucially on atmospheric CO_2.

Dodgy data, fudged facts and wrong reports.

In any field of specialist activity it is easy for the practitioners to 'baffle with science'. It should not happen but it does – nowhere more so than in 'climate change'. For example, *anti-carbon* graphs are often presented with false origins to exaggerate or mask a trend. Two graphs below illustrate this.

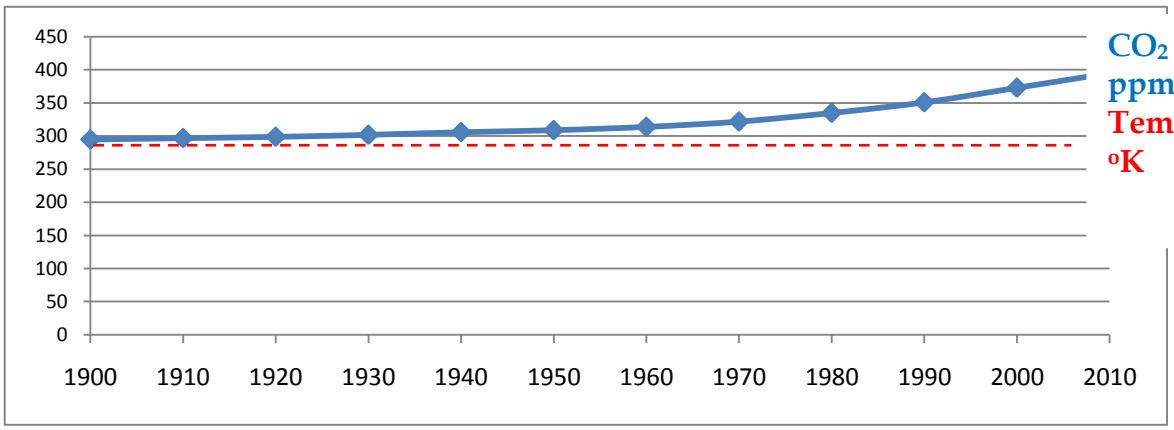
Baseline temperature is 13.97°C i.e. 287.12°K.

Shown as 0 on the graph.

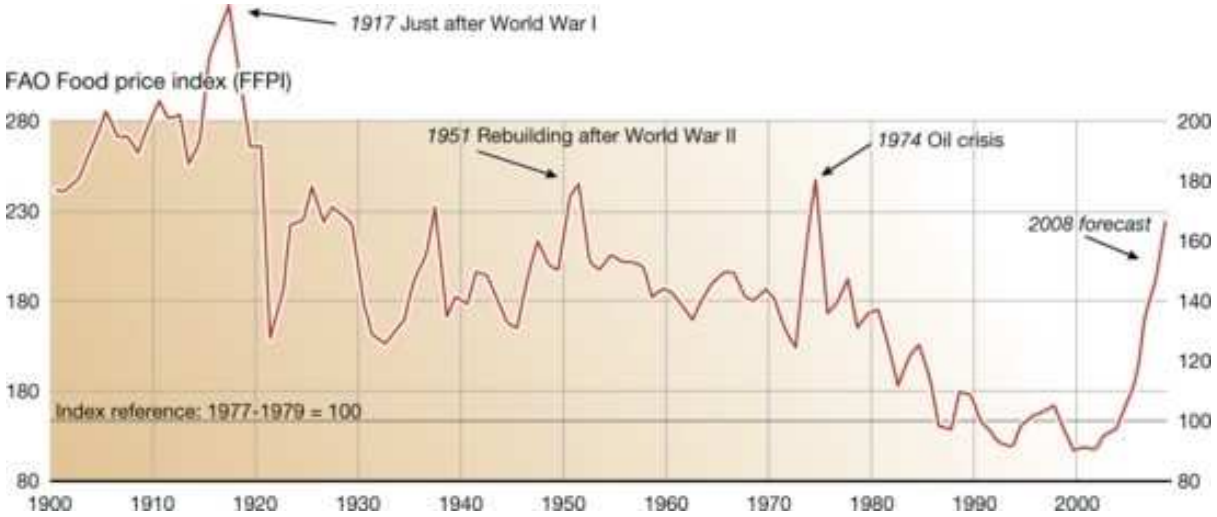


The black trend-line on the above graph from the Australian BOM shows that the average world temperature has risen from 13.65°C to 14.2°C between 1900 and 2010; that is; from 286.80° Kelvin to 287.35° Kelvin. Kelvin measures absolute temperature which is the standard for physics. The increase in absolute temperature is 0.2%. This reflects the log relationship (Arrenhuis' 'greenhouse' equation) with CO_2 content which has risen 30% in absolute terms.

The visual impression above is of large and important changes taking place. Compare this, however, with dotted red line on the graph below which plots the identical data to a true origin. Here the temperature rise appears as it genuinely is 0.2% - modestly advantageous for plants and animals and not in the least threatening. The change in atmospheric CO_2 is also plotted to a true origin and shows a significant rise of about 30%.



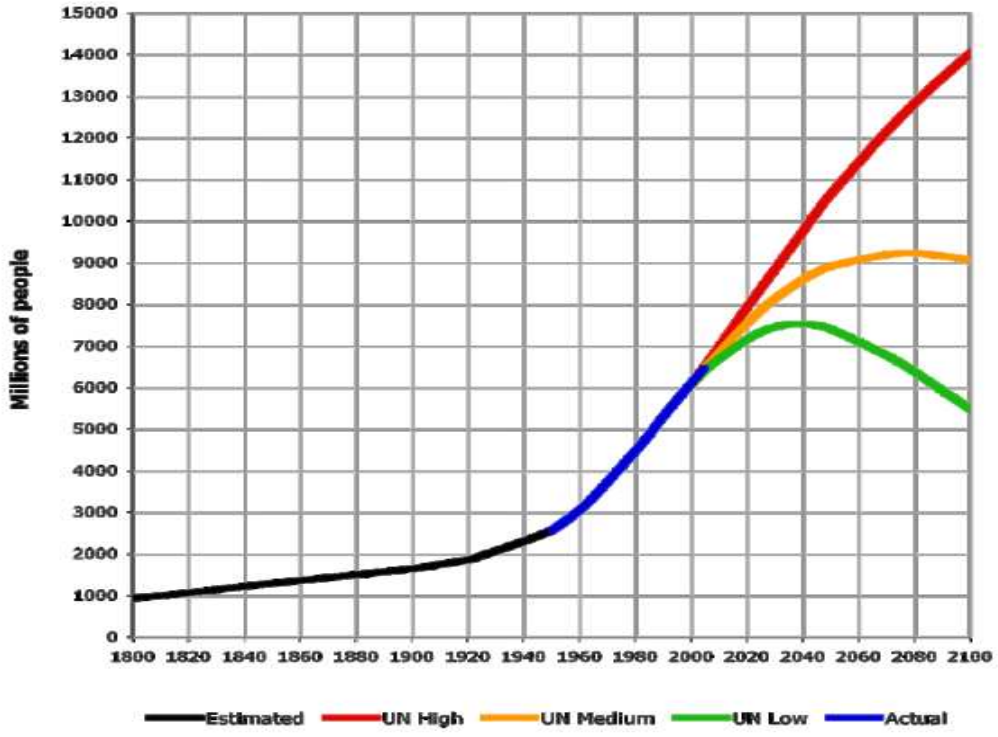
UN FAO Food Price Index Graph 1900 - 2010



The FAO graph above is an excellent idea. As of December 2010 it had been on the FAO website for 18 months. **It shows that over the period 1900-2010 as CO_2 levels have risen and population has quadrupled the world food price has fallen markedly in real terms. This almost incredible fact is a most important part of the CO_2 story.** Every morsel of that food derived from atmospheric CO_2. However, the truth that the graph showed did not fit in with the notions of the UN's IPCC – so it was doctored. This was done by putting different scales on the left and right hand side of the diagram so the number 280 on the left aligns with 200 on the right. Where the changeover on the graph occurs is not stated.

The visual effect is to make it seem that the food price fall is much less than it really is. Not an honest tactic! The slipshod approach is also shown by the error whereby the lower 180 should, in fact, read 130. Similarly the index base of 100 is said to be at 1977/79. A glance at the graph shows that the index in 77/79 is about 170 measured by the left hand scale and about 130 by the right. The year 1917 was at the height of WW1 - with some 2.5 million combatants killed and 5 million wounded – not after it. Over an 18 month period no one in FAO saw fit to correct any of those errors! In December 2010 the author drew FAO's attention (unacknowledged) to the errors so the graph may soon disappear from its website.

Rising CO_2 feeds a fast rising population



Feeding the World's Rising Population

Rising CO_2 has fed a world population increased from 1.6 billion souls to 6.8 billion, >300% increase. If CO_2 is allowed to continue increasing to about **750 ppmv it will feed 50% more people than at present; about 10 billion with no extra land or water. The value of this additional 'free' food will be at least $3,500,000,000,000 per annum.**

The graph shows that population may well level off around the 10 billion mark.

Stern, Garnaut and Other Contemporary Fiction

Many economic reports have been published on 'climate change'. Stern from the UK and Garnaut from Australia are typical. They all assume that increasing CO_2 is very bad and purport to show that 'taking action to curb CO_2 pollution now' rather than later will have large economic benefits. In their cost-benefit analyses no value whatsoever is placed on CO_2. It is assumed to be a bad pollutant. Those reporters seem to know nothing about plant growth and physiology. If they did they would have factored in the massive additional food production to a value of about $700,000,000,000 which the world is now receiving annually from increased CO_2 compared to 1900 which had only 300 ppmv of CO_2.

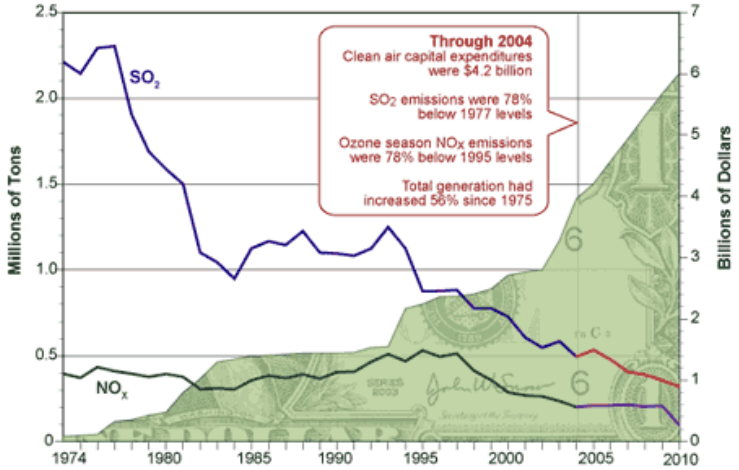
This vast benefit is missing from the reports. Absent also is the huge food production increase worth about $3,500,000,000,000 annually (without extra land or water) to be had if we allow CO_2 to continue rising to around 750 ppmv. Still less is any account taken of the great gains to the world of nature from more CO_2. If the reporters had done their job faithfully they would have found that more CO_2 has been and will be a huge net benefit to the world.

A Carbon Tax, an Emissions Trading Scheme (Cap & Trade) or 'Direct Action'?
All three are predicated on more atmospheric carbon dioxide being very harmful. In reality **CO_2 is highly beneficial** so each of these reductionist propositions is damaging to Earth's best interests. They came about because many economists, politicians and financial manipulators jumped on the anti-carbon bandwagon without first checking the validity or otherwise of the basic premise. Bad mistake!

What are the worst consequences of the anti-CO_2 obsession?
It stands in the way of the huge food bonus the world can get from higher CO_2 *and* it wastes vast physical, financial and intellectual resources on a chimera. We should grasp the opportunity and stop the waste. There are countless real problems at the interface of the environment and the economy which truly need the resources presently being thrown away on anti-carbon.

Air Pollution Reduction – the Clean Air Acts

The second half of the 20th century brought very welcome and much needed clean air to most of the industrialized world. Typically an Act sought reduction to about a tenth of the existing level of pollution by, for example, sulfur dioxide, oxides of nitrogen or particulates such as smoke. Often this was followed by further Acts which mandated still further reductions. These Acts were profoundly beneficial across the world and showed the value of legislation with penalties in securing clean air for the public good.



Tennessee Valley Authority Air Pollution Reduction Report

A real pollutant is bad and the lower its level the better

If those who rail against CO_2 as a 'pollutant' succeeded in reducing it to a third of its present level (let alone the 80% reduction in SO_2 shown above) they would bring CO_2 below the critical 150 ppmv threshold at which plant growth stops. That would starve us all to death; a scary thought – especially given the extremism of *anti-carbon*. It puts terrorism in the shade. A 'pollutant' whose reduction to a third of its current value would kill us all is a very strange 'pollutant' indeed. Almost as strange is a 'pollutant' whose increase works wonders for plant growth in general and for tree growth in particular. Carbon enables and sustains all life on earth and categorizing it as a 'pollutant' is perverse to a pathological point.

What about Pollution by Carbon Monoxide?

Carbon monoxide, CO, is a very different beast from its double oxide relation, CO_2. CO is highly toxic to humans and other animals because it locks onto the hemoglobin in the blood and stops it carrying oxygen around the body. CO is a real pollutant and the ideal amount in the atmosphere is zero.

Air quality standards relate to six criteria air pollutants: carbon monoxide, nitrogen dioxide, photochemical oxidants, sulfur dioxide, lead and particles. ('Criteria air pollutants' is a term used internationally to describe air pollutants that have been regulated and are used as indicators of air quality.)

Needless to say CO_2 is not on the list as it is not harmful.

In Australia the limit prescribed for CO is 9 ppm averaged over an 8 hour period. Similar limits apply in many other countries. A typical level of CO in the open in Australia is 0.2 ppm.

CO was in common use up to half a century ago as a component of coal or town gas. 'Gas' then was very poisonous and killed many people – some of them by suicide. Natural gas, methane CH_4, has replaced the old coal gas so that danger from carbon monoxide is now gone. However, dangerous CO is produced whenever there is incomplete combustion of a carbon fuel. Complete combustion, which is always the aim, produces only beneficial CO_2. Incomplete combustion can happen, for example, when a combustion stove is used in a poorly-ventilated, confined space such as a room in a house. For time to time deaths in the home are caused by this.

Most of the CO produced today comes from the exhausts of internal combustion engines. The exhaust from a petrol (gasoline) car exhaust without a catalytic converter contains around 7,000 ppm of CO. A catcon converts about 90% of the CO to benign CO_2 but the remaining CO is still dangerous until it is diluted by the surrounding air. Even with general use of catcons on vehicles, inner urban streets may have CO levels near or sometimes exceeding the prescribed limits.

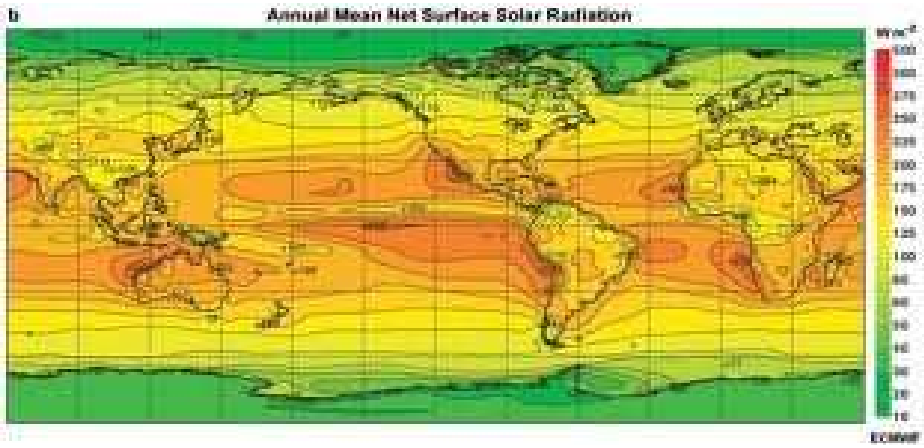
Vehicle exhausts do produce large amounts of CO_2 but that is beneficial and not harmful. It is important not to confuse CO (bad) with CO_2 (good).

CO_2 and Temperature Rise – Use Real World Evidence Not Theory

The quotation in red below is a trenchant criticism of the IPCC's theoretical construct. The key IPCC error is to multiply the temperature rise actually due to CO_2 by a factor of 2.2 to allow for the assumed amplification by the additional water vapor in the atmosphere. Given that one false assumption, all models however complicated they are, however many there may be and however frequently they are run inevitably produce forecasts with an excessive temperature rise relative to the increase in CO_2.

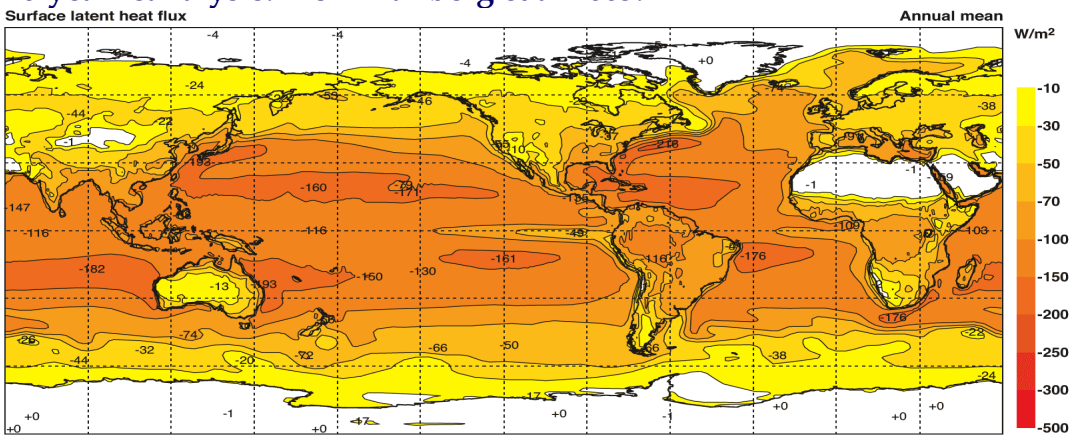
"Now the IPCC errors become very obvious. Using the former forcing of 4.3 W/m² for tropopause level, application of the differential form of the Stefan-Boltzmann Law dT/T=1/4*dS/S, with S=240 W/m² and T=255 K, yielded a temperature increment of dT=1.14 K (which is now reduced to 0.98 K with 3.7 W/m²).
The IPCC assumed that this increment would be transmitted 1:1 down to the ground, based on a constant lapse rate. Because water vapor is a strong greenhouse gas, the IPCC then used a factor of 2.2 as the effect of water vapor feedback – neglecting that on the other hand vapor should also reduce the radiative CO2 forcing – and thus obtained a warming of 2.5 °C for CO2 doubling, the 'best guess' – so called by T. Wigley and S. Raper in a review paper [Nature 357, 293-300 (1992)]). D. Rind titled his article about the feedback approach "Just add Water Vapor" [Science 281, 1152 (21 Aug 1998)]."

The dT/T=1/4*dS/S reflects the Stephan Boltzmann Law which states that the rate of heat loss from a body is proportional to the 4th power of its absolute temperature. For small changes this means that a 1% rise in Kelvin temperature causes a 4% rise in heat loss. Carbon dioxide is a greenhouse gas and when it doubles it does produce some rise in temperature – provided other factors remain constant. Using 4 watts/m² radiative forcing at sea level for a rise in CO_2 from 390 to 750 ppmv gives a forecast temperature rise due to CO_2 of 1.2°K. In the event the rise may be more or less than that due to the numerous factors which affect global temperature - but have nothing to do with carbon dioxide.



However, the purpose of this section is to urge an **appeal to evidence** and not to theory. There is evidence aplenty starting in the (wet) tropics. The air there has far more water vapor than at higher latitudes. However, the temperature is somewhat lower than one would expect given their relatively intense exposure to the Sun's rays. If 'water vapor feedback' temperature rise was real it would be all too obvious in the tropics right now. It is not. The evidence of the tropics is that more water vapor has the effect of much reducing the diurnal temperature range and somewhat reducing the average temperature – not increasing it.

Annual mean latent heat flux (loss) through the sea surface Q_L in W/m² calculated from the ECMWF 40-year reanalysis. From Kallberg et al 2005.



As noted above, given the amount of sunlight the tropics receive they are less warm than one would expect despite having lots of water vapor. Why does the water vapor, a potent greenhouse gas, not make them hotter? There are a great many intricate and complex reasons but two merit mention; more water vapor means more clouds and their brilliant white tops, typically at high altitude, reflect incoming sunlight straight back into space before it reaches Earth's surface *and* more water vapor means more evaporation from the oceans which removes latent heat as shown above.

Going back into geological history as in '**Global Temperature and Atmospheric CO_2 over Geologic Time'** (page 30 above), CO_2 was then about 5 times the present figure. At no stage did 'runaway warming' caused by 'water vapor feedback' (or anything else for that matter) occur. We would not be here now if it had done so.

"Getting the Message Across" – Politics, Economics, PR or Science?

The carbon-antis see that public opinion is turning against their propaganda so they bewail their 'failure to get the message across' and blame political cowardice, adverse economics or poor PR. But the mantra is always; 'this is settled science'. In fact, it is the ***science*** that is at fault. So far from being cowardly many politicians have been foolhardy and reckless in their support of this nonsense. Most of the economists involved, as is their wont, fumble about in a fog of their own making.

As it becoming increasingly evident and as this note has further demonstrated the so-called *climate science* is not 'settled'. Rather is it a tottering house of cards founded on fallacious assumptions and constantly contradicted by practical observation. **If** the science was sound the failings of presentation would be overcome by the weight of the facts. By contrast, the public is increasing seeing the falsity and the absurdity of the '***carbon dioxide is bad***' doctrine. It goes to the heart of the matter – the science itself. There will, relative to what would have happened with constant CO_2, be warming of about 1°C as CO_2 rises to around 750 ppmv but that modest change will come with large benefits - not harm.

Predictions:

Scientific theories stand or fall by making or failing to make correct predictions. This note makes the following predictions:

1. **The level of atmospheric CO_2 will continue to rise throughout this century to a level around 750 ppmv by the year 2100.**
2. **Over that time the total area of land on the globe will remain the same or increase slightly.**
3. **Thanks to the extra CO_2 food plant growth will increase by about 50%, 2100 v. 2010, using no more land or fresh water than were used for food production in 2010.**
4. **Tree growth will increase by at least 100%.**
5. **All plants will become more resistant to drought and other adverse conditions.**
6. **Total rainfall on land will increase, 2100 v. 2010, by about 15%. Floods will increase and droughts will decrease pro rata.**
7. **Every current IPCC prediction of practical importance will prove to be wrong.**

Because the level of atmospheric CO_2 has already risen by some 30% over the past century, predictions **2** to **6** above can now be tested against actuality. In every case real events confirm their correctness along the ascending path forecast above. This has been noted at various points in the text.

Several IPCC predictions have already proved to be wrong. The "Himalayan Glaciers Gone by 2035" is typical. Supposedly peer-reviewed and then publicized to the rooftops by the IPCC, it was and is rubbish. Any Sherpa, although having no scientific training whatsoever, knows it was and is rubbish. This did not prevent the 'intellectual giants' of the IPCC embracing it as revealed truth.

One of the many unhappy by-products of the anti-carbon fiasco is that the formerly prized "peer-reviewed" accolade has, in matters of 'climate change', too often been degraded to a mere certificate of conformity with required opinion; granted or withheld on that basis.

Edmund Halley used Newton's Laws of Motion and Gravity to predict that the great comet seen in 1682 would return in 76 years. He died long before this happened but he was exactly right and remains so to this day. If he had made his prediction in the manner of the IPCC's sea level forecast he might have predicted a return sometime between 110 and 770 years hence; a fatuous forecast incapable of proof or disproof. Of course, Halley did no such thing – but he was a real scientist!

***"Science is the organised scepticism of expert opinion"* – Richard Feynman, 1969**

CO_2 Action Plan

1 Welcome more CO_2 and the extra food that it brings.

2 Aim for about 750 ppmv of CO_2 by 2100 to bring global food supply automatically into balance with a world population of about 10 billion.

3 Wind up *'anti-carbon'* with all deliberate speed.

4 Redeploy the resources released to help solve the most urgent real problems in each country.

5 Continue to build and use coal fired power plants – always with stringent emission controls on noxious gases and smoke.

6 Ensure that the additional food and the drought-proofing generated by the additional atmospheric CO_2 are used to maximum benefit for all.