



Kauri Position on Climate Change

As a petroleum geologist, I'm often asked for my views on climate change and the alarming predictions that have become the hallmark of the IPCC. I have documented my understanding here and propose an alternative cause for anthropogenic climate change— I don't claim to be a climate scientist and any errors are mine alone.

Kauri's position on climate change is straightforward. Climate change is real and constant but the proportion of warming caused by increasing atmospheric CO₂ is insignificant in the scale of earth processes. The primary driver of elevated surface temperatures during the last 60 years is an increase in shortwave radiation reaching the earth's surface. This is due to ozone depletion, historically attributed to emissions of chlorofluorocarbons (CFCs). The 2022 Tongan eruption, however, dramatically demonstrated a mechanism to displace large volumes of seawater to the stratosphere where reactions involving constituents chlorides (30,000 ppm) and bromide (65 ppm) can degrade ozone. Within one week of the eruption stratospheric ozone above the southwestern Pacific and Indian Ocean region decreased by 5% (Evan et al 2023). The same process would have been initiated for the 200+ nuclear tests carried out between 1946 and 1996 over and in the Marshall Islands and Mururoa Atoll. The main period of ozone depletion was **1950-1993** and coincides with the nuclear testing programmes in the Pacific. It has always been impractical to attribute depletion to CFCs; they are 5 to 20 times heavier than air, and would have been washed into waterways and eventually the sea. The barely detectable levels of chlorofluorocarbons in the atmosphere (measured in parts per billion or parts per trillion) are likely to also have been transported skyward in vapourised seawater. The premature conclusion that CFCs were responsible for ozone depletion has parallels with the conventional wisdom that CO₂ is responsible for warming. This paper summarises the evidence that led to this conclusion and is intended for a non-technical audience; background details, including references, can be found in the Kauri submission to the Climate Commission on the Kauri website (www.kaurioilandgas.co.nz).

The earth is not a static, stable, benign system but is constantly re-equilibrating in response to both natural and, more recently, human events. The climate is continually changing, driven by large scale processes such as solar cycles and sun spots, lunar cycles, orbital variations, volcanism, plate tectonics, ocean circulation, cloud cover, gravity variations etc. Our understanding of each of these processes individually is still far from complete, and we have a very poor knowledge of the complexities created by the interaction of these processes over different timeframes. The actual climate deniers are those who do not recognise the system is dynamic, and believe the climate should remain static, or that changes can be reversed. While human activity has had an influence in recent history there is no climate crisis, just climate change - all measures of climate are varying within ranges that have been experienced even in the brief period of recorded human history.

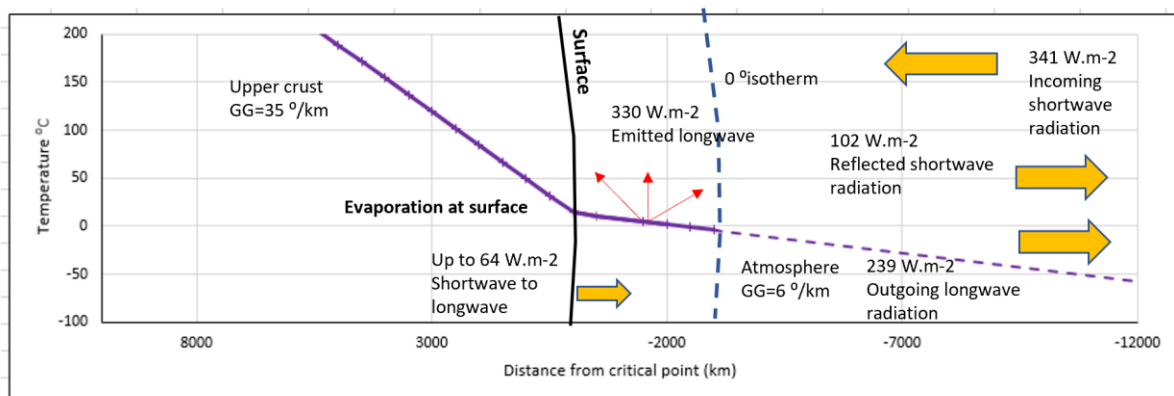
It is becoming increasingly apparent that the effects of nuclear testing were broader and longer-lived than we ever understood. So much so that a new geological epoch, the Anthropocene is being defined. The epoch's base is marked by a plutonium-enriched layer in lacustrine sediments deposited around 1950.

Solar Energy

To start, there are fundamental flaws in the assessments issued by the IPCC:

1. IPCC assume all energy and heat is derived from the sun, ignoring heat flow from the earth. Any imbalance between incoming energy and outgoing energy is therefore attributed to Greenhouse Gas storage or emissions.
2. IPCC assume the Greenhouse Effect is the only active warming mechanism
3. The Greenhouse model violates the First Law of thermodynamics – temperatures decline with altitude so any heat transfer is skyward. Greenhouse gases are effectively **cooling** the planet, not warming it.

The diagram below shows the temperature profile through the upper crust and troposphere. Heat from within the earth is transmitted via conductivity and convection to the surface. The average temperature above and below the surface is very similar around the world and the temperature profile in the lower atmosphere is effectively a continuation of the subsurface geothermal gradient. Heat flow through rocks is very low but water connects the subsurface with the troposphere. The exchange of heat across this boundary is poorly understood, but the temperature gradient in the lower atmosphere is consistent up to an altitude of approximately 12km – this is the point where CO₂ desublimation occurs (from gas to a solid) and the concentration of Greenhouse gases rapidly declines. Shortwave radiation reaching the surface penetrates only 100m or so into the oceans and less on land. Shortwave radiation is converted into kinetic energy which is transmitted via conductivity into the lower, dense atmosphere. The solar and terrestrial systems are in equilibrium around the surface. A useful analogy is that the earth provides baseload power (low intensity, stable) while the sun provides peaking power (intermittent but high intensity).



Conductive energy sets temperature profile through crust and troposphere



Figure 1 : Temperature profile through crust and troposphere

The earth's surface receives on average 494 W.m^{-2} of electromagnetic radiation, 161 as shortwave (solar) radiation and 333 W.m^{-2} as longwave radiation from the atmosphere (Figure 2). CO_2 is a very minor component of the atmosphere, constituting only 0.0004%, and absorbs and emits only longwave (low intensity) radiation.

Carbon Dioxide (CO_2) has been demonised as the control knob for earth's temperature because it can absorb and emit longwave electromagnetic radiation. This was observed in the 1850s, before radioactivity, plate tectonics or the ozone were recognised and before technology had been developed to actually quantify the effect.

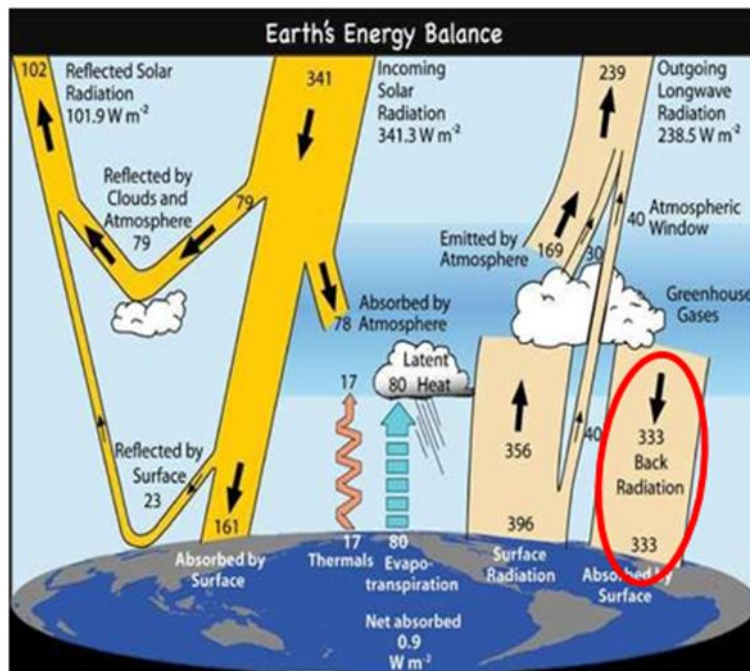


Fig 2 : Earth's energy budget (IPCC, Ar5)

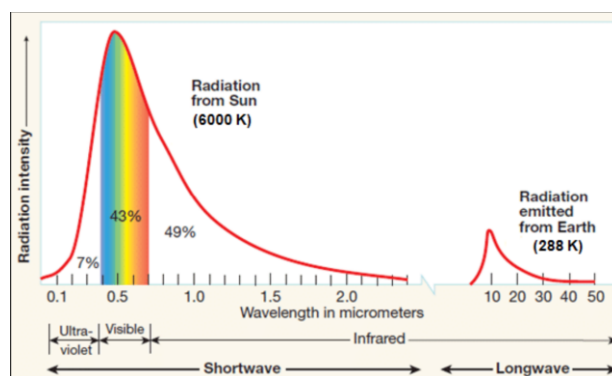


Figure 3 : Comparative intensity of shortwave and longwave radiation (Lutgens et al, 2013)

Radiative forcing is the difference between incoming shortwave (solar) radiation and outgoing longwave radiation and is the measure used by climate scientists to estimate the impact of natural

or anthropogenic factors on temperature – the theory being that if the energy leaving the atmosphere is less than the energy entering the atmosphere, the earth must be warming.

Solar radiation is transformed into kinetic energy upon reaching the surface and heats land and water via conductivity before being discharged as infrared radiation.

Temperature

The change in radiative forcing in the absorption frequencies of CO₂ **has been measured** and results published in two key papers.

Feldman et al (2015) presented data from sensitive Atmospheric Emitted Radiance Interferometers at two surface locations; one on the North Slope of Alaska, and one on Southern Plains of the U.S which showed an increase of 0.2 W.m⁻² over a decade (2000-2010). Atmospheric CO₂ increased by 22ppm over this period.

Rentsch (2020) presented data collected over 17 years (2002-2019) by the Atmospheric Infrared Sounder (AIRS) at top of atmosphere. Radiative forcing in the CO₂ range increased by 0.36 W.m⁻² over 17 years or 0.2 W.m⁻² over 10 years. During this period atmospheric CO₂ increased from 373 to 410 ppm (37ppm, or 22 ppm over 10 years).

The fact that two independent studies, at different times and different places, both recorded the same change in CO₂ radiative forcing in the atmosphere (0.2 W.m⁻² over a ten year period), gives these data credibility. Even if we assume human activity is responsible for all the CO₂ added since the industrial revolution (130 ppm), the net effect has been to add 1.1 W.m⁻² (0.002%) to the total electromagnetic energy budget.

In contrast, shortwave (solar) radiation increased by 2.4 W.m⁻² over a decade during the period 1984-2000. Summer levels in the southern hemisphere increased by 14 W.m⁻². Longwave radiation increased by 1.8 W.m⁻². That is an additional 4.2 W.m⁻² over 10 years (around 10 W.m⁻² over 40 years), or 20 times the energy released by CO₂. This also **has been measured**. The impact of direct solar radiation on temperature is evident every day; in the extreme example the temperature of the space station facing the sun, with no atmospheric interference, is 121° C, while the temperature on the opposite (dark) side is -157° C. Radiative forcing estimates are, however, very small for the increased SWR because the energy is transformed into LWR and the flux is small.

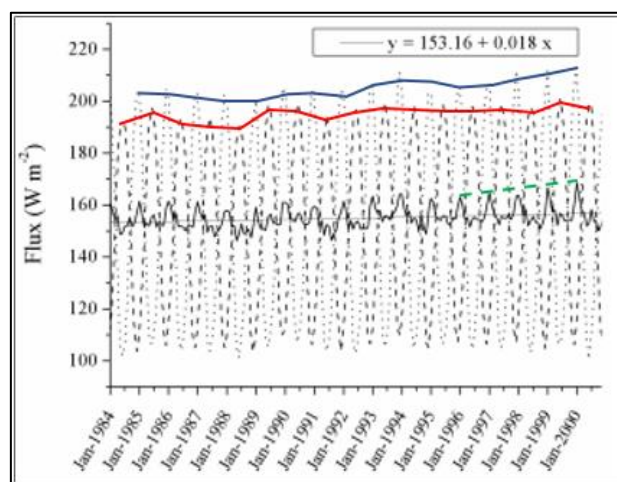


Figure 4 : Time series of monthly average net downwards shortwave radiation at earth's surface 1984-2000. Blue line=southern hemisphere maxima, red = northern hemisphere. Hatzianastassiou et al 2005

Ozone Depletion

The amount of shortwave radiation reaching earth's surface has increased as a result of ozone depletion. Ozone depletion has been happening since measurements were first taken in 1979. Figure 5 combines measured and modelled ozone column height for northern and southern hemispheres through time. The decline in ozone thickness between 1950 and 1993 (left hand plot) is most apparent in the southern hemisphere. This loss is treated as a negative radiative forcing (as shown on right hand plot).

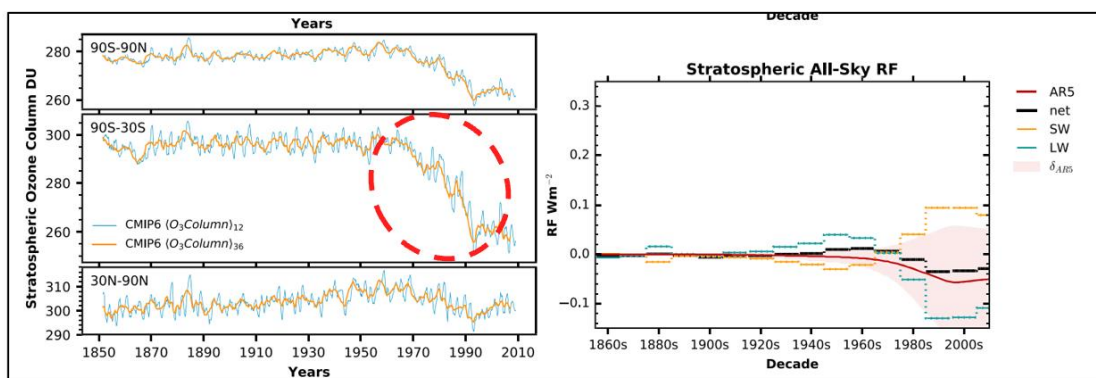


Figure 5 : Ozone column in southern hemisphere (Checa-Garcia et al, 2018). These plots show the modelled and measured stratospheric ozone column. The decrease in ozone column between 1960 and 1993 is reflected in the size of the Ozone hole.

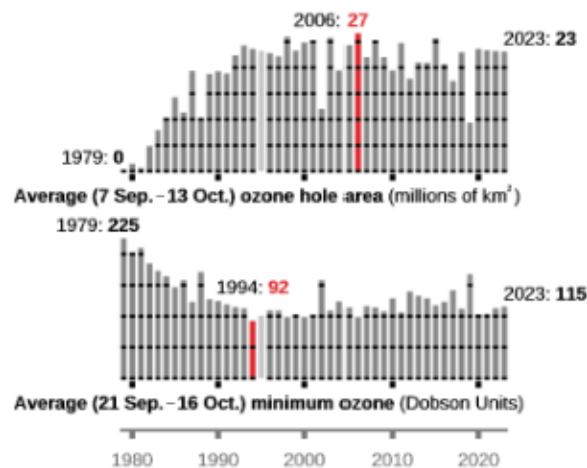


Figure 6 : Ozone hole area and Ozone minimum 1979-2022 (NASA)

Figure 6 shows the change in ozone since 1979 when measurements began. The graphs show a rapid decline in ozone until 1993 and relative stability since. The ozone hole **reached 26 million sq km in both 2022 and 2023** (compared to a maximum of 26.6 million sq km in 2006) It appears that the ozone hole is not diminishing but is re-equilibrating.

The rate of skin melanomas, not surprisingly, correlates strongly with the ozone depletion and can be used as a proxy where data are not available; these data suggest the depletion started during the 1950s (see below).

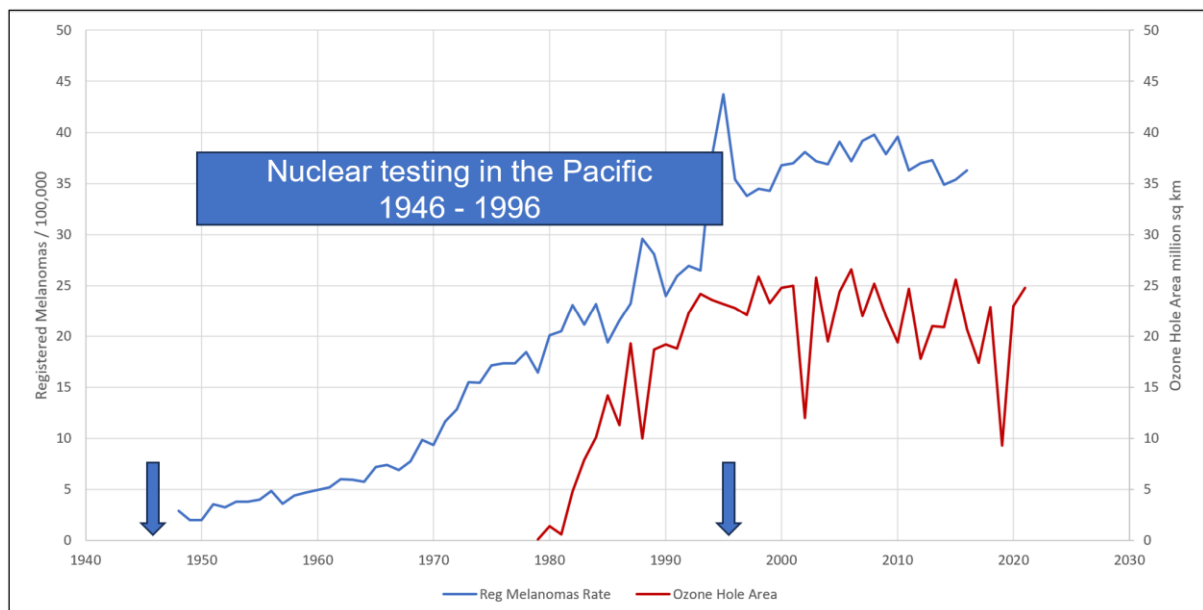


Figure 6 : Plot showing correlation between melanoma rate and ozone hole area. The melanoma data suggest the hole formed in the late 1950s.

Climate scientists claim CFCs were to blame for the ozone depletion and successfully lobbied for a complete ban on production (the Montreal Protocol in 1987). There are several lines of evidence that cast doubt on this conclusion:

1. CFCs are 5 to 20 times heavier than air. While convection may lift some material (as winds can lift a trampoline) it is impossible to transport significant volumes of CFCs from areas of manufacture 25km vertically and thousands of kms laterally to monitoring sites (Figure 7). The concentration is remarkably consistent around the world and no correlation is evident with proximity to manufacturing site. We have extensive data and knowledge of tropospheric circulation systems (from weather balloons etc) and no Chinese or European trampoline has ever been dropped at the South Pole. Climate scientists gloss over this by referring to CFCs and CO₂ as “well-mixed gases”.
2. On **5 October 2022** and **21 September 2023** the ozone hole was 26 million sq km; it has only been larger once in the last 45 years (26.6 million sq km in 2006) and is significantly larger now than it was in the 1980’s when the Montreal Protocol was signed, banning the release of CFCs to the atmosphere. In 2023 the ozone hole developed earlier than usual, thought to be due to the impact of the Tonga-Huanga Haai eruption in 2022.
3. Ozone is broken down by chlorine and bromine. In the same way that CO₂ has been convicted without evidence for warming, CFCs were identified as the source of ozone-damaging chlorine, despite their density being five times heavier than air. The concentration of CFCs in the stratosphere is measured in parts per trillion. Kauri interprets the uniform

distribution and concentration of these gases to reflect raining down from the stratosphere, as is the case for CO₂ (Figure 8).

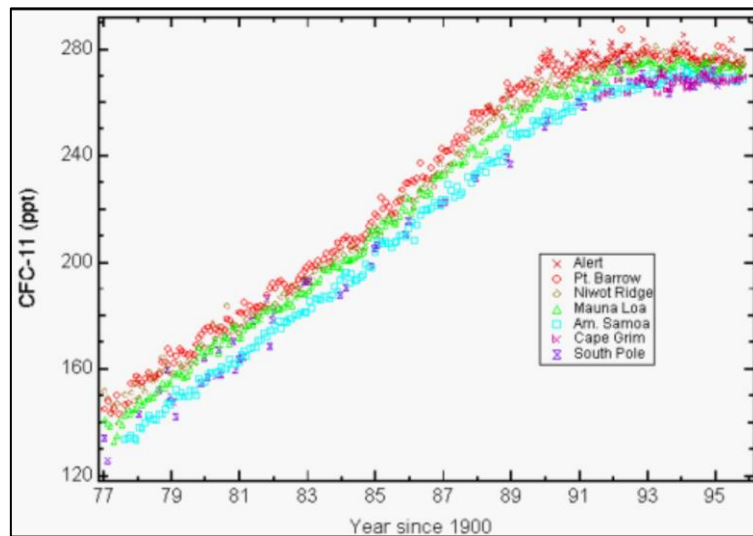


Figure 7 : Atmospheric CFC concentrations (NASA)

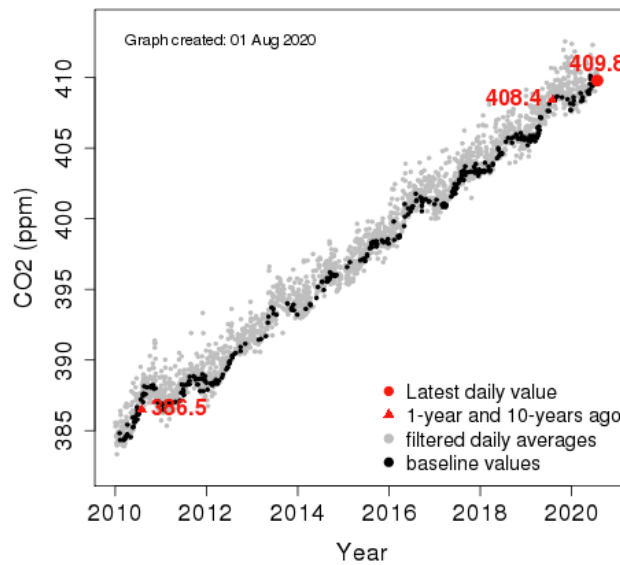


Figure 8: Carbon dioxide readings from Baring Head (NIWA) showing no spikes during Australian bushfires or CoronaVirus lockdown.

In the same way that alarmists have been issuing shrill declarations of imminent disaster for the last 50 years, scientists have been claiming the ozone hole is about to close since the signing of the Montreal Protocol.

The Role of Volcanism

Large explosive volcanic eruptions inject large amounts of material into the atmosphere, including volatile gases (sulphur dioxide, carbon dioxide), halogens (Chloride and bromide) and tephra (Brenna et al,2019)

Eruptions of submarine volcanoes incorporate large volumes of seawater in the plume. When Hunga Tonga-Hunga Haai erupted offshore Tonga in January 2022, satellite measurements indicate over 150 billion litres of seawater (equivalent to >13% of the total water vapour in the atmosphere) was vapourised and carried into the stratosphere (Figure 9). The plume rose to 58km altitude, well above the ozone layer. Seawater contains around 30,000 ppm chloride and 65 ppm bromide. These react in the presence of water and uv light to form chlorine and bromine which then breakdown ozone molecules. After initially being confined to a latitudinal corridor, the gases disperse globally through large-scale meridional circulation. Modelling indicates that subsequent ozone depletion is evident in the ozone hole above Antarctica 3 to 4 years after eruption.

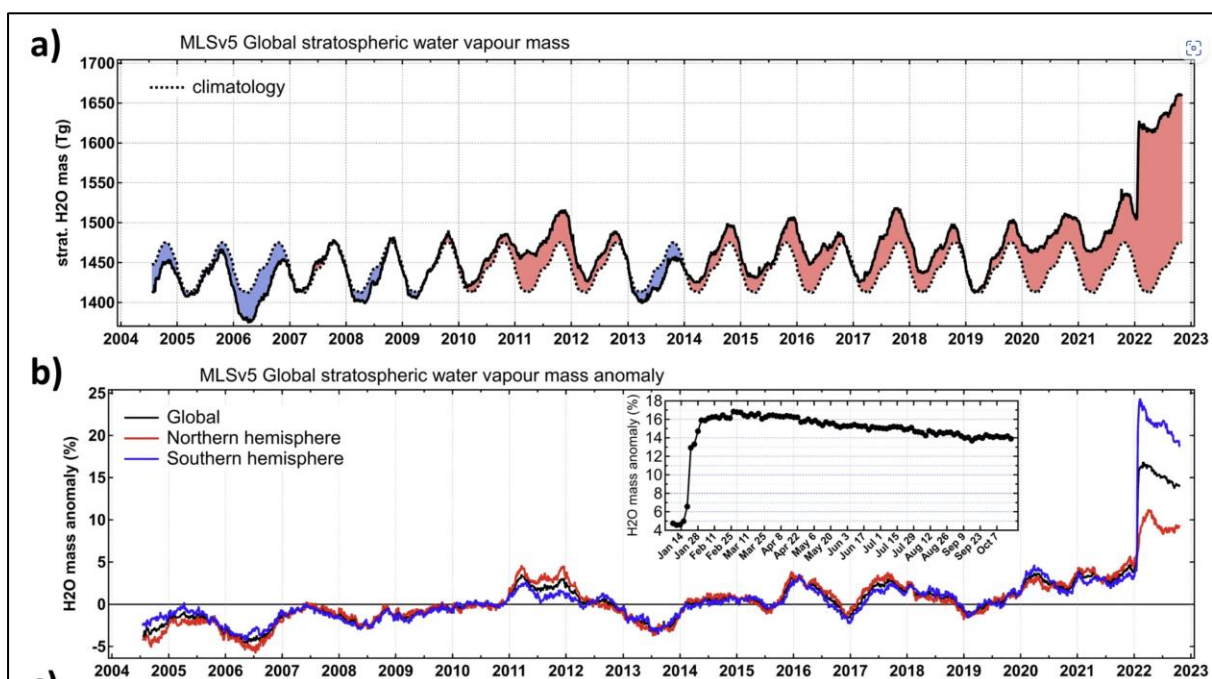


Figure 9: The impact of the 2022 Hunga Tonga-Hunga Haai eruption on stratospheric water vapour mass (Khaykin et.al, 2022)

Alarmists claim it is the rate of CO₂ increase in the atmosphere that is unnatural and the atmosphere cannot re-equilibrate fast enough. During the Tongan eruption the atmosphere absorbed an increase in water vapour of around **250ppm in one day**, compared to CO₂ increasing at around 2.5ppm/year. And yet the world continued to turn.

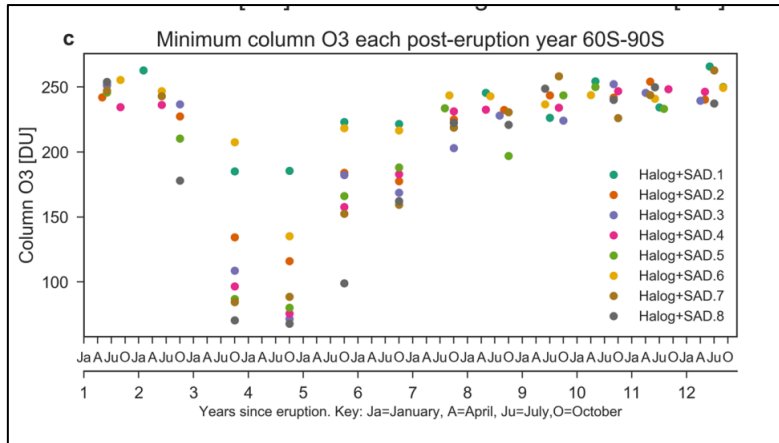


Figure 10: Antarctic ozone response to tropical volcanic eruptions (Brenna et al, 2019)

Anthropogenic Ozone Depletion

Another mechanism for vapourising sea water and injecting it into the stratosphere is nuclear testing. Between 1946 and 1958 America detonated 23 atomic bombs over and in Bikini Atoll and Fangataufa Atoll in the Marshall Islands. Between 1966 and 1996 France detonated 193 bombs over and in Muroroa Atoll in French Polynesia. Even the atmospheric tests were reported to have gouged the seafloor so huge volumes of seawater were vapourised and jetted up to the stratosphere.

Climate scientists have enjoyed 40 years of backslapping self-congratulation, claiming they averted disaster by getting CFCs banned, when in fact it is now apparent the link was never there. Forecasts of the size of the ozone hole, like climate forecasts, have been consistently wrong for 40 years.

These are models, not measurements, and reflect assumptions made by climate scientists.

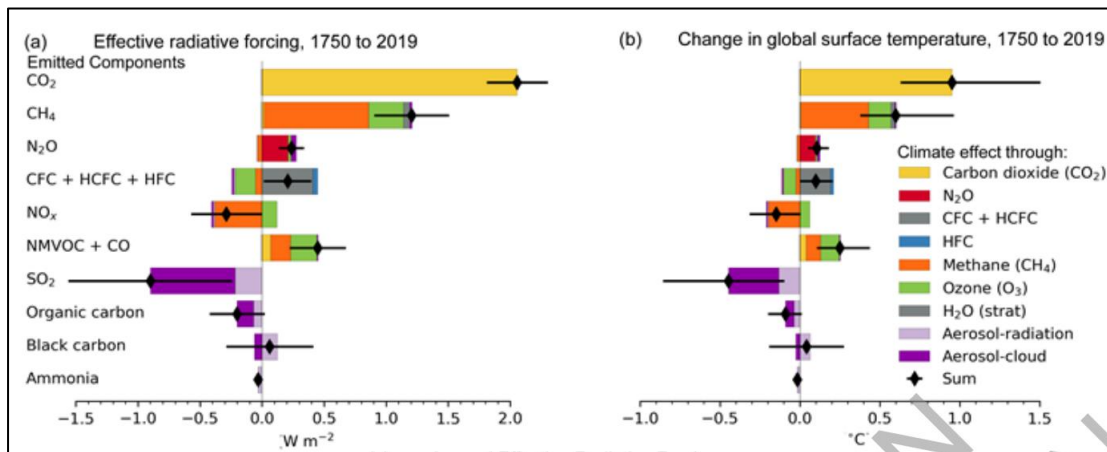


Figure 11 : Radiative forcing factors (IPCC Ar6)

Because climate scientists assume warming is due to radiative forcing (the Greenhouse Effect) their models only attribute warming to radiative forcing. This plot from IPCC ranks the supposed drivers of temperature via radiative forcing. It is a predictable conclusion given the erroneous assumptions on which it is based.

Implications

Society's response to the CO₂ dogma has been to commit some \$130 trillion to decarbonising the atmosphere to try and stop, or reverse, current temperature trends. This is a futile exercise that will

damage western economies and only divert money away from real needs – including climate research by credible scientists.

Until someone explains how 0.2 W.m^{-2} (the change in radiative energy over a decade due to increased atmospheric concentrations of CO_2) is more significant than 4.2 W.m^{-2} (the change in radiative energy over a decade due to ozone depletion), I will disagree with those who attribute climate change to the use of fossil fuels. Whenever I try to discuss this with AGW proponents, they inevitably resort to their last line of defence “but thousands of climate scientists agree”. Thousands more disagree, but their views don’t fit the narrative and so aren’t reported.

Fossil fuels were responsible for lifting a large portion of the world’s population out of poverty. Natural gas, in particular, is concentrated energy, abundant and clean. Eliminating these sources of energy will not only deprive developing nations of accessible energy, it will be economically crippling to trading nations such as New Zealand. Apart from the costs associated with changing our infrastructure – changing the vehicle fleet to EVs and hydrogen vehicles, increasing generation capacity to provide the necessary electricity, the loss of productive land to carbon farming etc, we have committed to emissions targets that cannot be met. The gap between emissions and target reductions is around 20 million tonnes/year and will be offset by purchasing carbon credits overseas. These have quickly become a commodity and are expected to cost $>\$170/\text{tonne}$, costing us around $\$4 \text{ billion/year}$. Add in over $\$4 \text{ billion}$ (or according to more recent estimates $>\$10 \text{ billion}$) for the Lake Onslow project, plus the proposed financial penalties to be imposed on NZ businesses for importing or exporting goods, and the economic and social impact is going to be severe. This is money that could be directed at health, education, housing etc. At the same time, we are slashing our high-value export industries such as oil & gas and agriculture but the opportunities lost are not factored into economic modelling.

New Zealand is fortunate in having a hydrocarbon resource, the scale of which many believe has been grossly underestimated. An LNG (exporting liquified gas by ship) project could earn NZ $\$300 \text{ billion}$ over 30 years, add 30,000 jobs and inject $\$40 \text{ billion}$ into regional economies. Norway’s sovereign fund, accumulated from oil and gas earnings, now exceeds $\$1 \text{ trillion}$. That is why they have a far higher standard of living than NZ and are able to buy EVs for their population. New Zealand is crippling its own economy in a futile bid to remove CO_2 , which will have no effect on global climate.

But, apart from the technical and economic issues, the main reason I persist with this debate is the manipulation of children by alarmists, exploiting their feelings of guilt by delivering an incessant torrent of dramatic and unsubstantiated forecasts of impending doom, which has led to a culture of fear and anxiety. It is unjustified, unwarranted, and cynical. Alarmists love to claim we are destroying our children’s futures by burning fossil fuels. In fact, they are consigning future generations to poverty for no reason other than virtuous posturing. For the first time in history, our society has consciously taken backward steps to lower energy density, higher costs and poorer environmental outcomes.

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Updated November 2023

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