KAURI

Oil & Gas (NZ) Ltd

An Alternative (Geological) Climate Model

Summary

August 2020

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- An alternative climate model is proposed, integrating earth science with atmospheric science.
- Carbon dioxide and methane concentrations in the atmosphere have negligible impact on climate.
- Most of the energy in the atmosphere is derived from the earth's crust.
- This energy is stored in water (particularly oceans) and transferred to the atmosphere by evaporation and conductive/convective transfer.
- Emission of CFCs depletes ozone and increases the amount of short-wave radiation reaching earth, increasing evaporation and heat transfer to the atmosphere.
- Decarbonisation is therefore a futile (and expensive) undertaking. The objective should be adherence to the 1987 Montreal Protocol

Context

- The Greenhouse model was developed in the mid to late 1800's to explain how a small amount of solar radiation could generate enough energy to heat (and cool) the earth.

- Since then, science has discovered radiation, isotopes, plate tectonics, the Milankovitch cycles, and thousands of deep wells have been drilled – by both industry and research groups, confirming heat generation in the crust and increasing temperatures with depth in the subsurface.

- The Greenhouse model assumes all energy comes from the sun. An average of 60 W/m2 of incoming shortwave radiation is available to be re-emitted as longwave radiation, yet the earth emits ~396W/m^2 of longwave radiation

- An alternative model (the Rutherford Model) is described here in which most energy is derived from long term crustal heat flow, transferred by evaporation and conductive energy transfer, then released as longwave infrared radiation.

- The incremental 330W/m^2 is measured as both downgoing and upgoing longwave radiation.

Crustal Heat Flow Option

- Crustal heat flow is discounted as a heat source by IPCC because current heat flow through rock is low (average 87 mW/m^2) compared to solar energy (average 330 W/m^2)

- Solar energy is high frequency, high intensity energy and can drive temperature ranges of 40 degrees+ in 24 hours

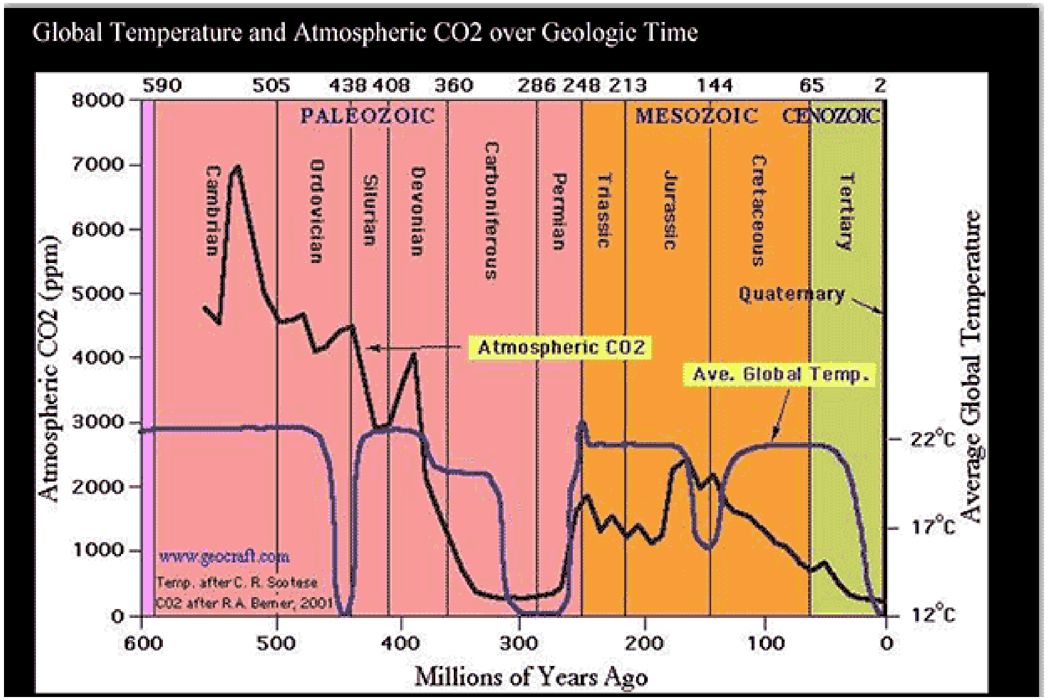
- Crustal heat flow is low frequency, low intensity energy and drives temperature change of 12 degrees over 100,000 years (indicated by ice core data).

- Comparing the two is like comparing the heat from a radiant heater (which is only switched on intermittently) with heat flow in a heated concrete floor (which is on permanently)

CO_2

- Atmospheric CO_2 levels are lower than they have been for most of earth's history – now only present in trace amounts.

- CO_2 concentrations have almost reached the level where plant photosynthesis becomes impossible – which will result in the largest mass extinction in earth's history



(www.geocraft.com)

CO_2 Sources

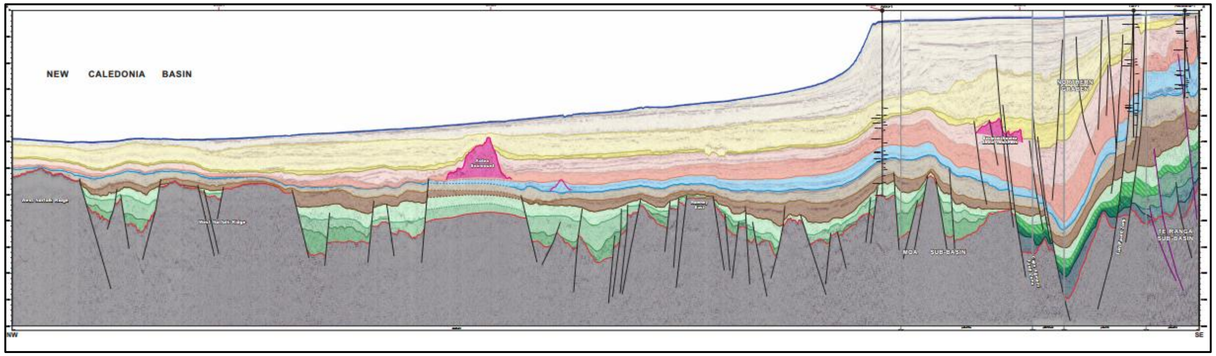
- Carbon dioxide is released by :
  - Burning of vegetation
  - Geothermal complexes
  - Volcanic eruptions
  - Thermal combustion of fossil fuels
  - Thermogenic generation of hydrocarbons
  - Breakdown of methane

- While estimates are made for volumes associated with volcanic events the CO_2 is highly mobile and probably gone within minutes.

- Another major source is the burial and thermal maturation of coals and organic-rich shales in sedimentary basins.

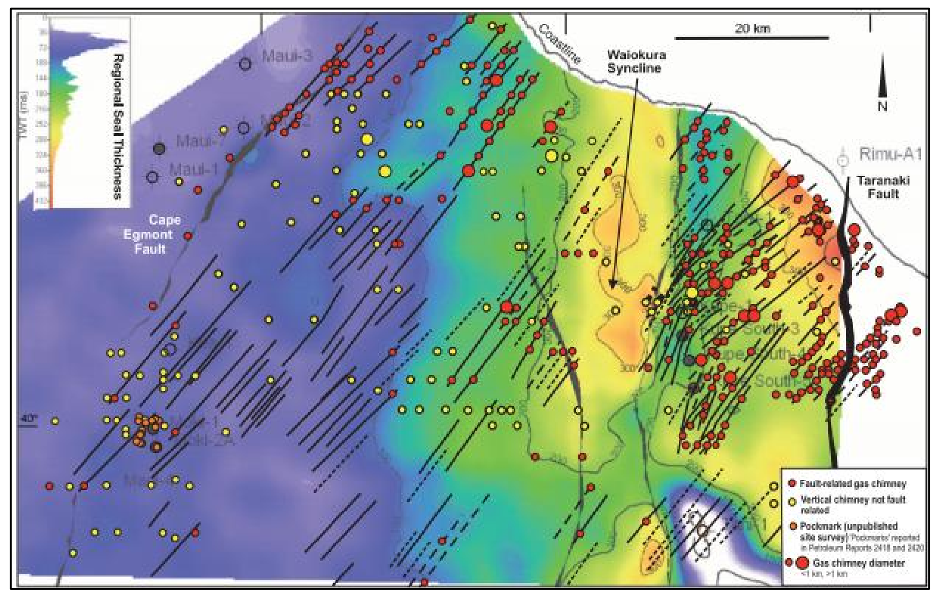
- New Zealand has over one million sq km of sedimentary basins on the continental shelf and minimal data on volumes of carbon dioxide and methane being emitted.

CO_2 Sources



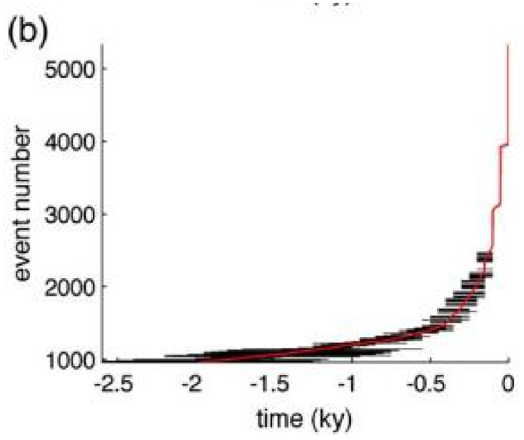
(GNS,2014)

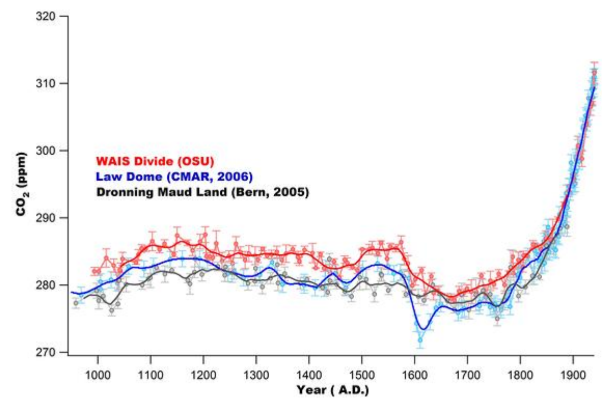
- New Zealand's continental shelf is host to 18 sedimentary basins, covering 1 million sq km.
- The coal sequences (green) are mature and generating CO_2 and methane, which escape via faults & fractures (right)



(Ilg,2009)

Volcanic Carbon Dioxide



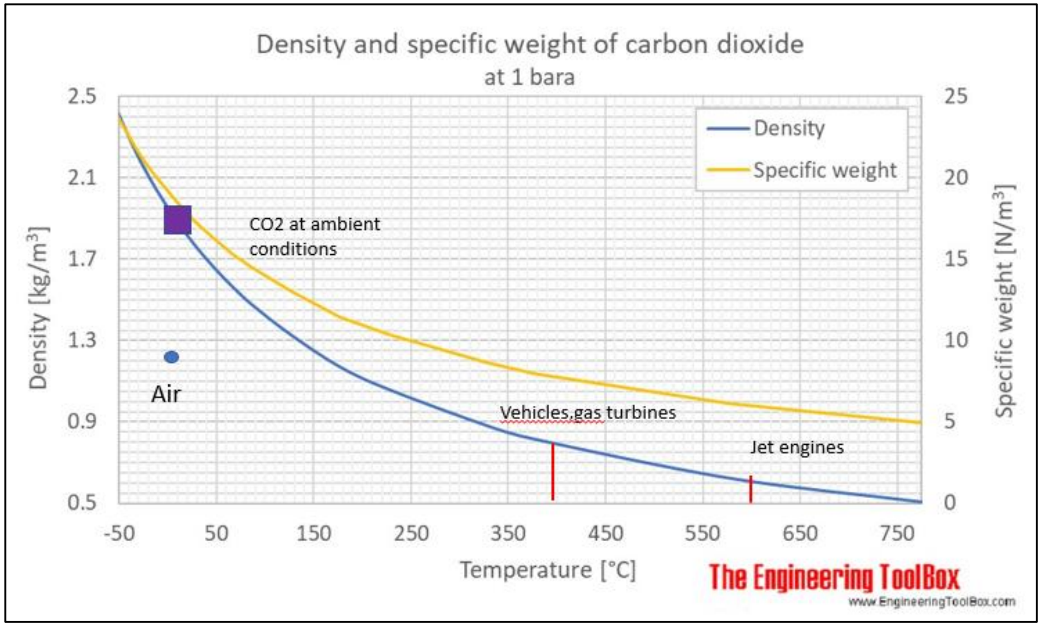


(Huybers, 2009)

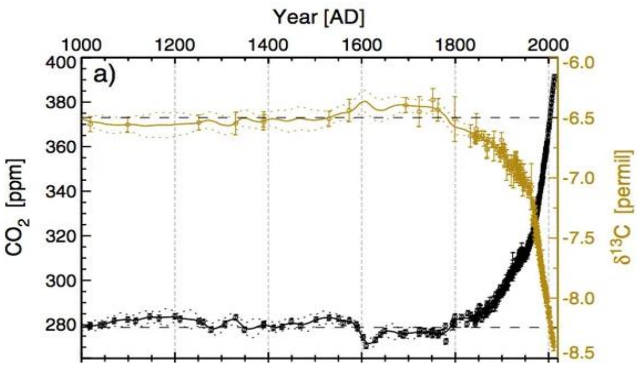
There has been a sharp increase in the number of volcanic eruptions since 1850, mirroring the rise in CO_2 concentrations.

Estimates of the anthropogenic contribution to this increase range from <5% to >50%

CO_2 Properties

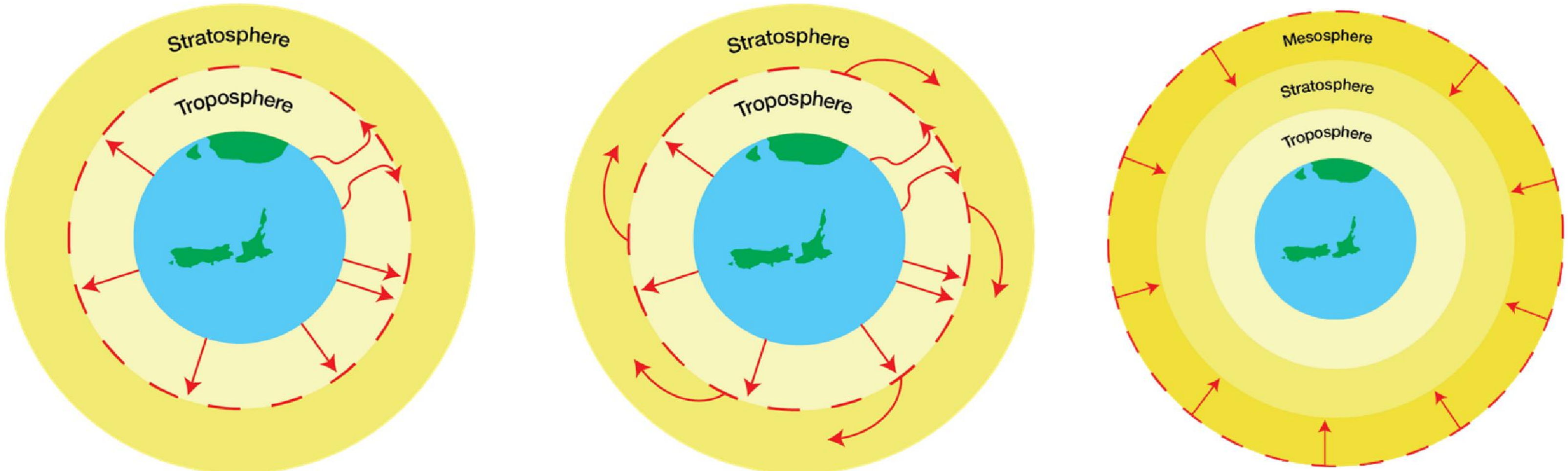


- CO_2 is heavier than air unless it is heated
- Thermal combustion produces hot, light CO_2
- Isotope data confirm pre-industrial CO_2 was from thermal sources (volcanoes and geothermal)



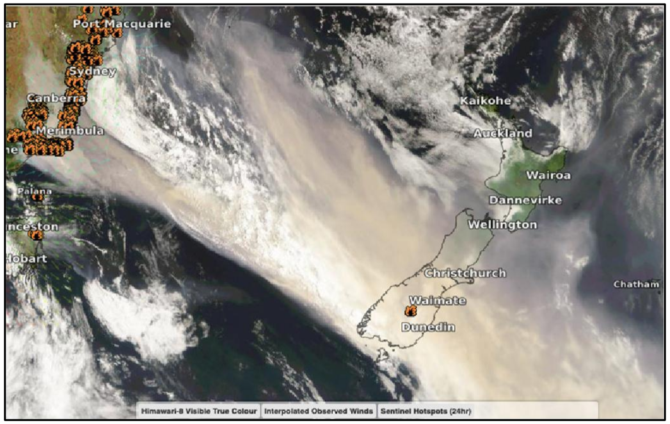
(Rubind et al, 2013)

How CO_2 enters the atmosphere



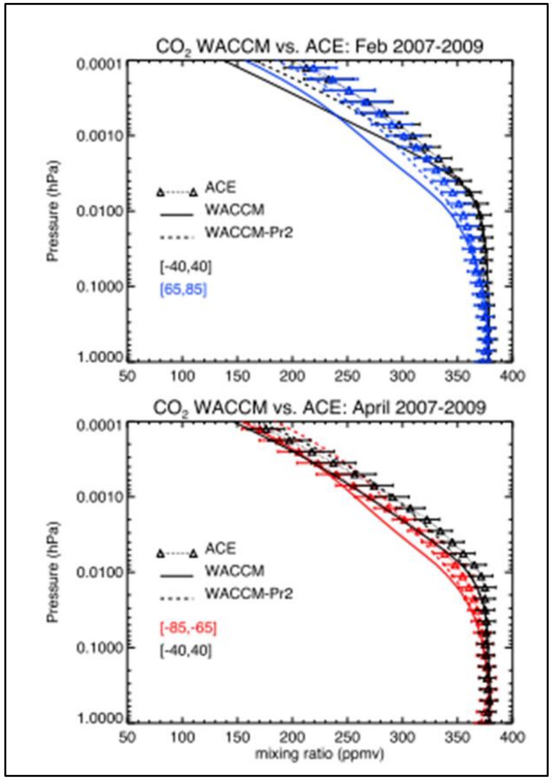
Hot CO_2 is released or blown from thermal sources as plumes. These enter the stratosphere and are flung outward by centrifugal forces. In the mesosphere the CO_2 freezes around nuclei (dust aerosols) before falling to the surface.

This was apparent during the Australian bushfires of 2019/2020 when smoke plumes covered New Zealand but no additional CO_2 was measured.



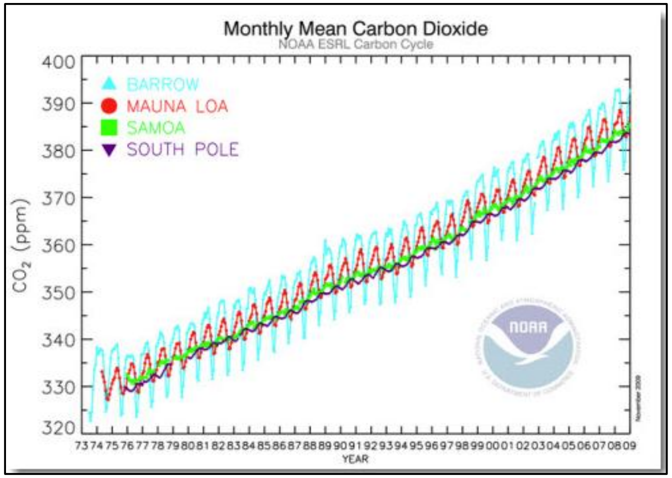
(WeatherWatch.co.nz)

Distribution of CO_2



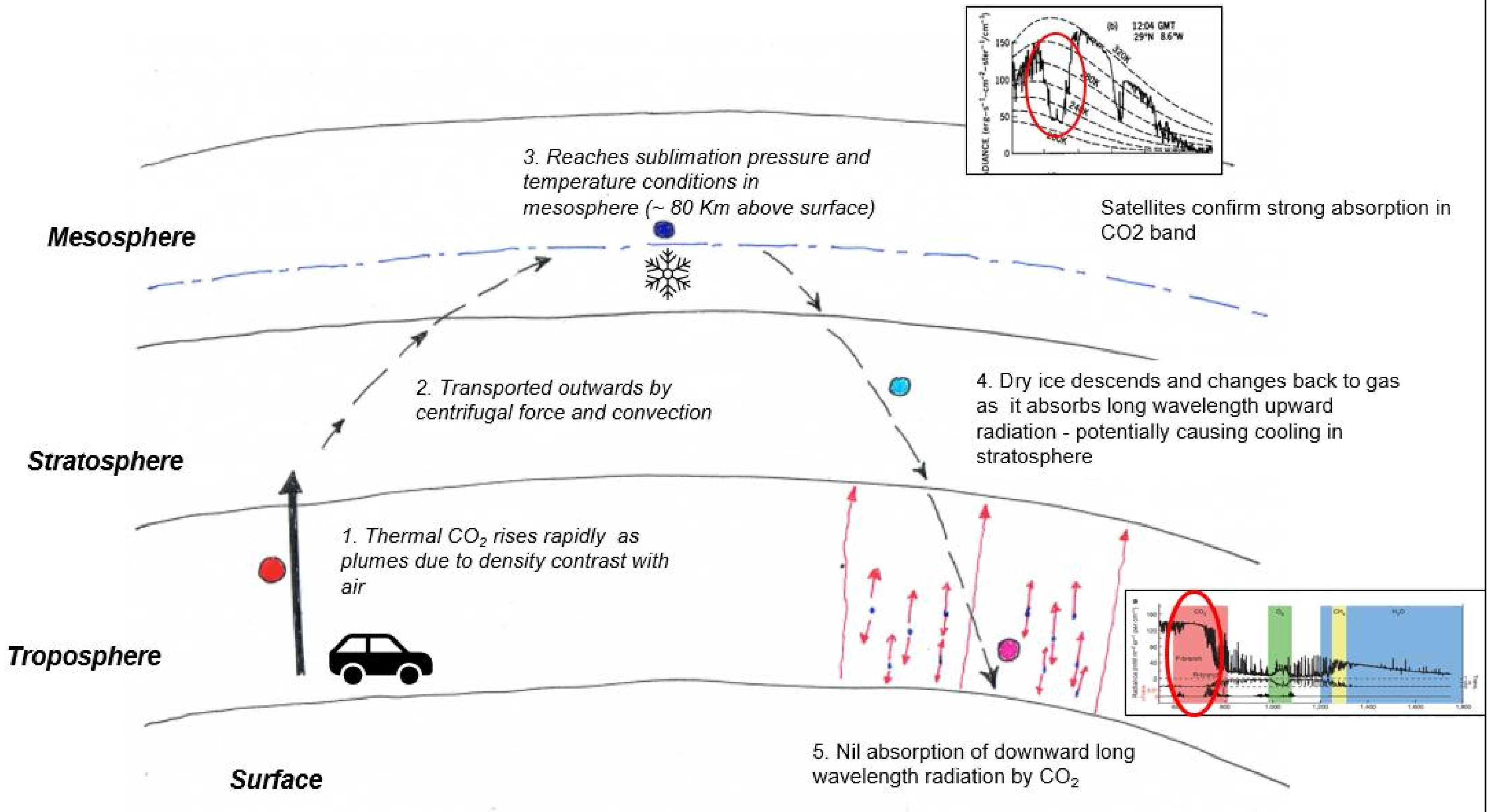
(Diallo et al, 2017)

The concentration of CO_2 is remarkably consistent around the globe, and through the atmosphere up to around 80km elevation, where concentrations drop off.

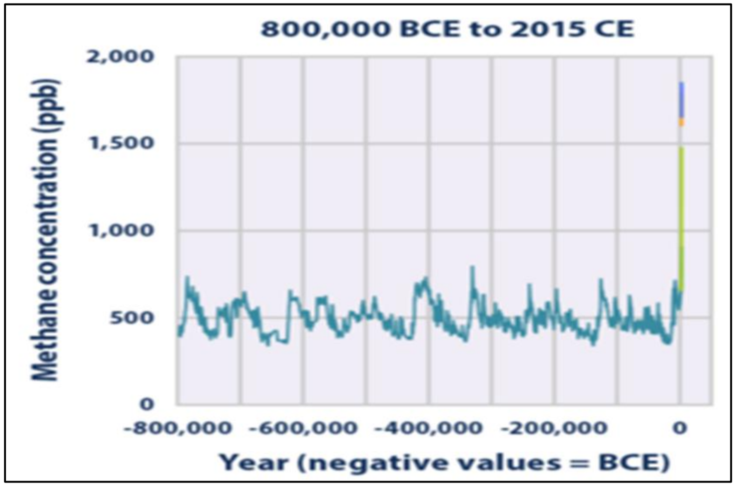


Annual cycles are measured, with minima in July. Climate scientists attribute this to photosynthesis, but it is more likely to reflect annual release of methane and CO_2 associated with ice melt.

Atmospheric Carbon Dioxide Cycle



Methane

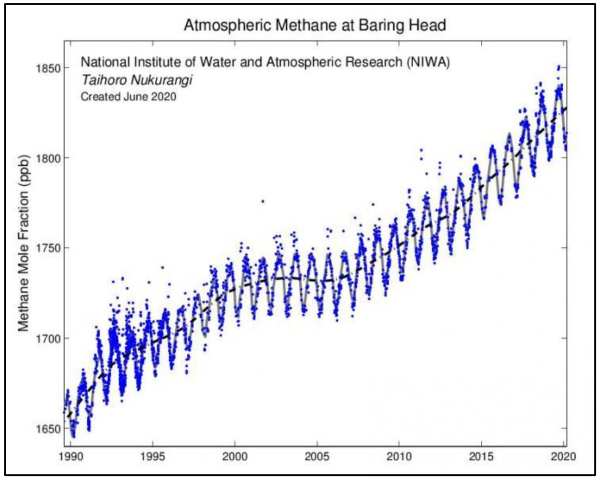


(Wikipedia)

The concentration of methane in the atmosphere has risen dramatically since the late 1800s.

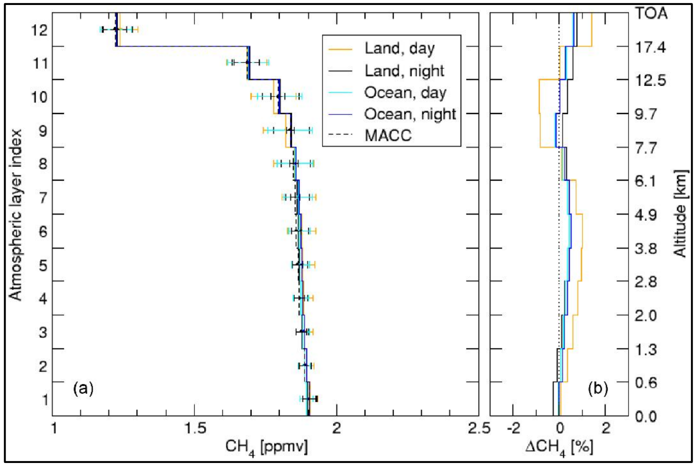
The methane in the atmosphere is a small fraction of the methane produced at surface.

Methane levels started increasing in the late 1800s and continued to rise until 1998. They plateaued until 2008 then started to increase again.



(NIWA)

Methane

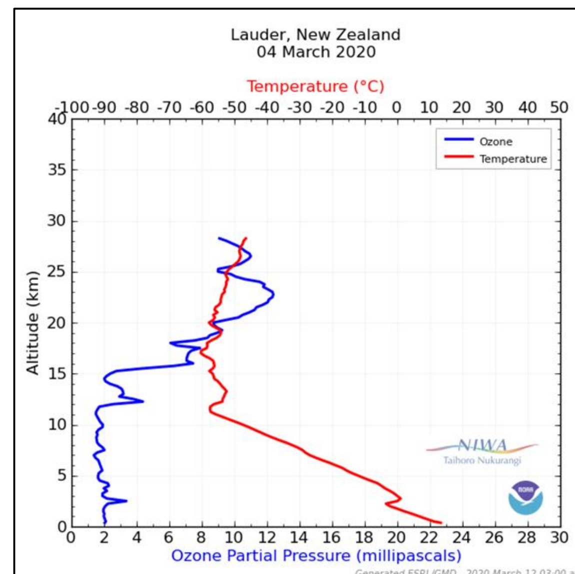


(de Lange & Landgraf, 2018)

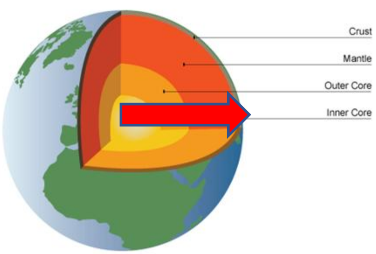
The concentration of CH_4 is variable geographically, but it is well mixed in the troposphere.

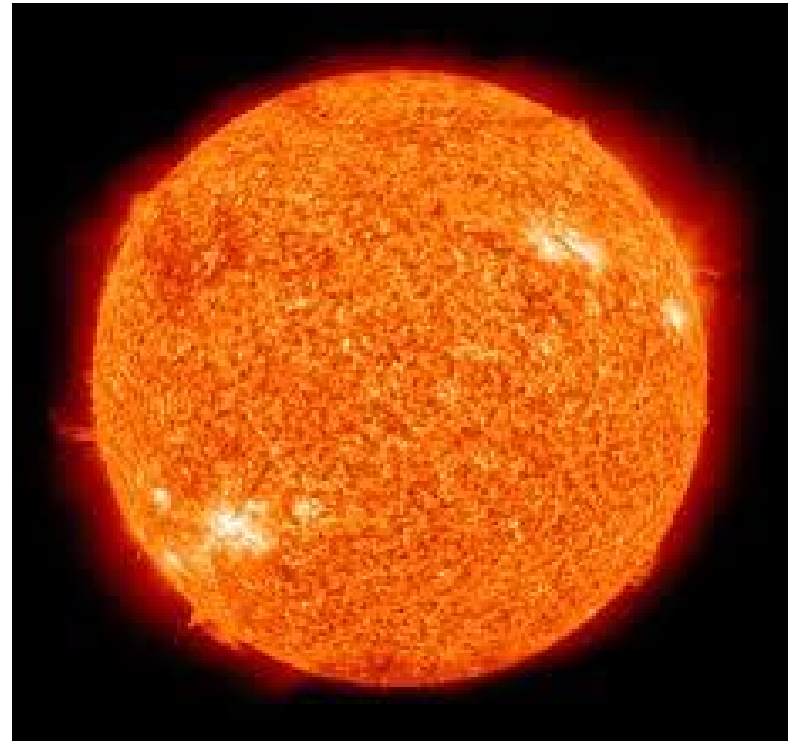
The reduction in methane at top troposphere coincides with increased ozone. It is likely that ozone and methane react to produce CO_2 and water

$CH_4 + O_3 \rightarrow CO_2 + H_2O + H_2$



Heat Sources

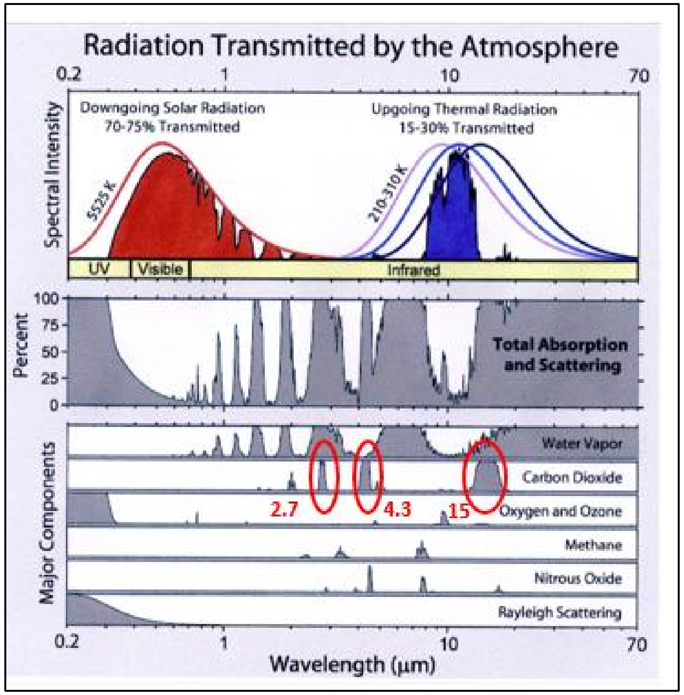


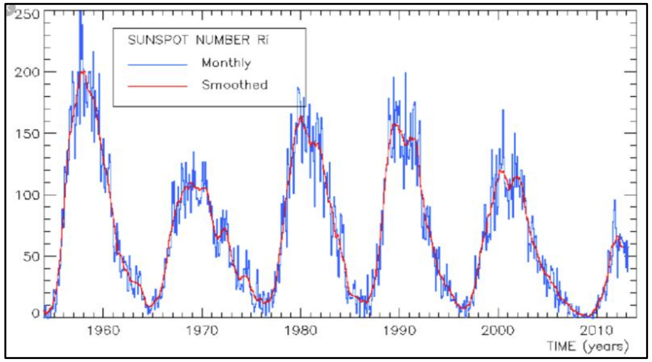


The atmosphere is warmed by two heat sources:

- Short wave radiation from the sun.
- Conductive heat transfer from the earth.

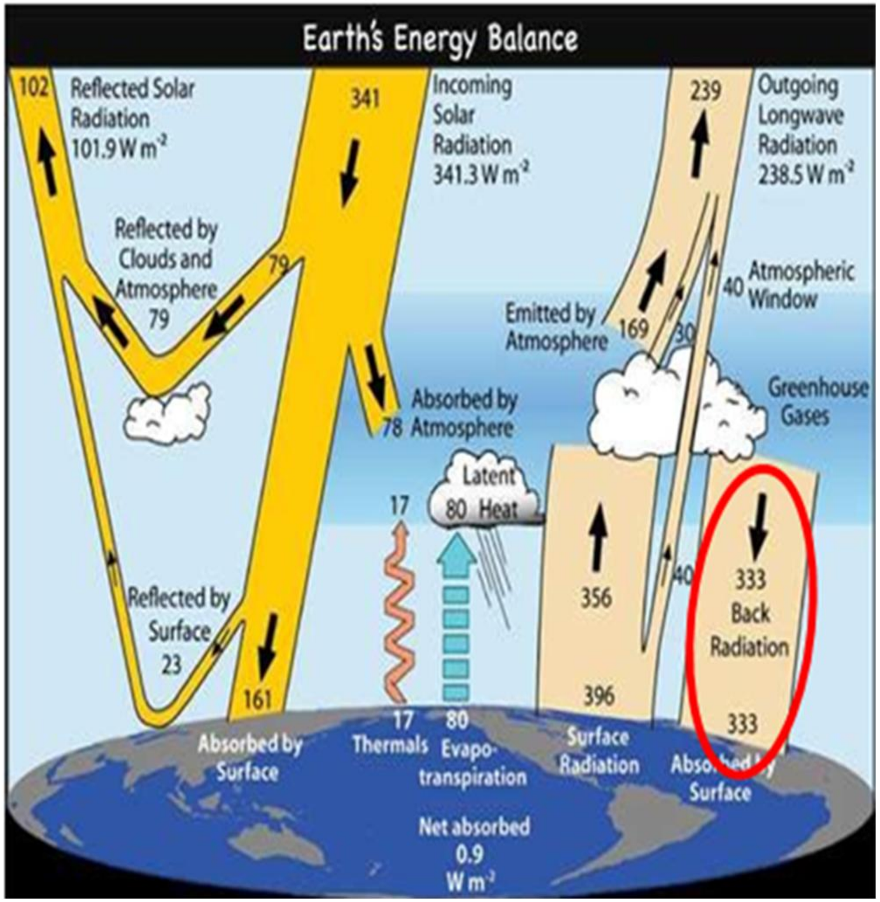
Solar Energy





- Solar radiation enters earth's atmosphere as short wave radiation (red spectrum). Some is absorbed before radiation reaches earth (solid red spectrum)
- The absorption bands for each Greenhouse gas are shown below the spectra.
- The blue spectrum is expected longwave outgoing radiation based on earth temperature
- Total Solar Irradiance (TSI) varies on an 11 year cycle associated with sunspot activity

Energy Budget



Incoming solar energy delivers 161 W/m^2 to the surface. This is only enough to reach an average surface temperature of -18 deg Celsius

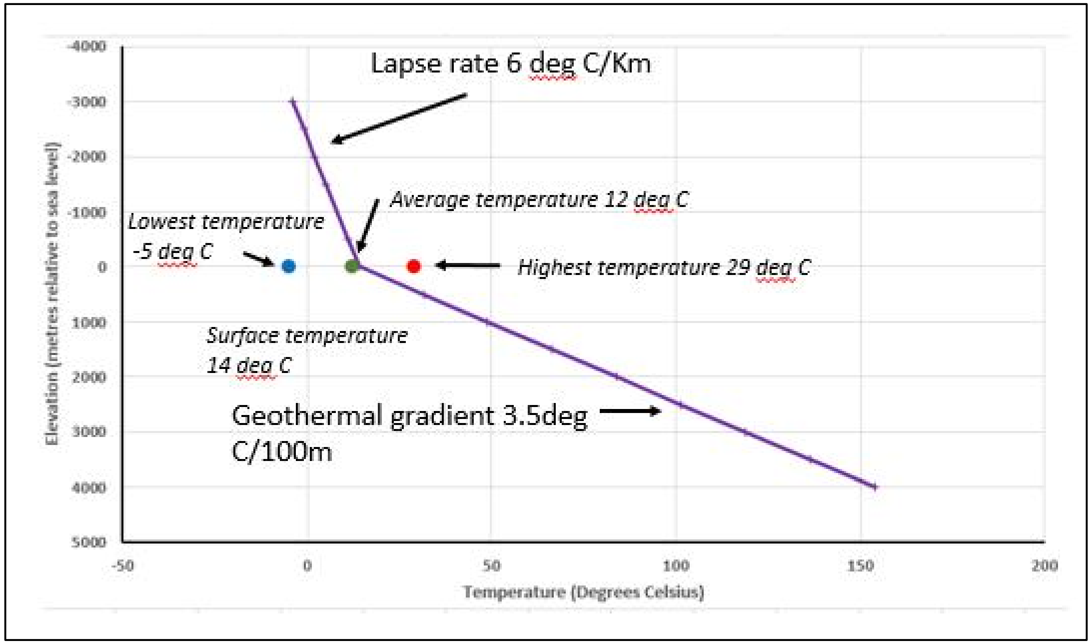
After evaporation and thermals, this leaves a maximum of 60 W.m^2 that could be radiated as long wave infrared radiation.

Yet the earth radiates 396 W.m^2 of longwave infrared radiation.

So around 330 W.m^2 of additional energy is required.

The Greenhouse model claims this energy is stored by Greenhouse Gases and re-emitted

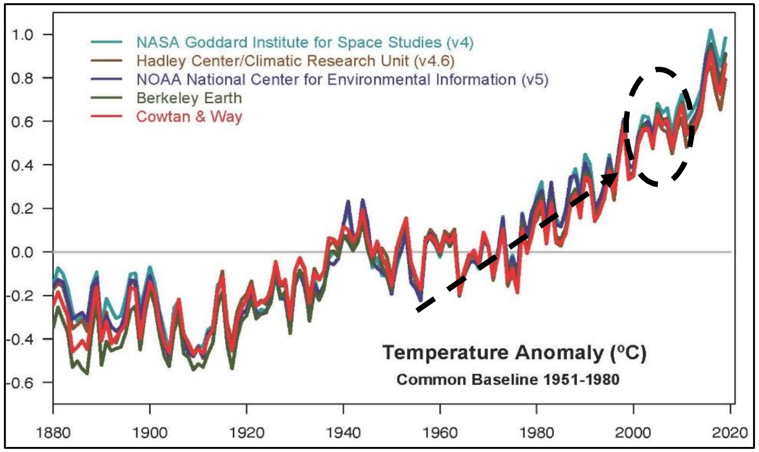
Crustal Heat Flow

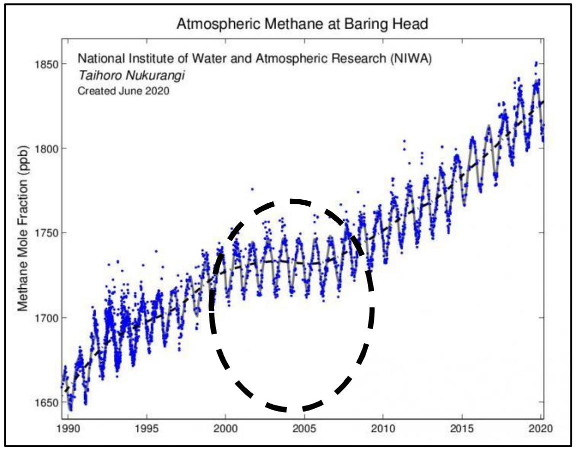


The mean temperature profile in the atmosphere (the lapse rate) is a **continuation** of the geothermal gradient and reflects heat loss from earth.
The different gradients reflect conductive transfer through rock+water (35 deg C/km) vs evaporative/conductive transfer through vapour (6 deg C/km).
The equalisation of temperatures and temperature increasing with depth are compelling reasons to believe atmospheric temperatures are controlled by the earth's heat flow.

Climate Drivers

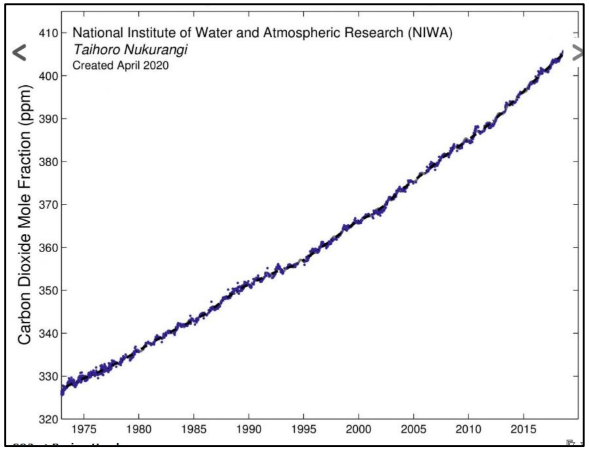
- The rate of temperature increase was less in 1998 – 2012 than in the period prior (1951-1998) and the period after (2012 – 2020) – this is known as the **hiatus.**





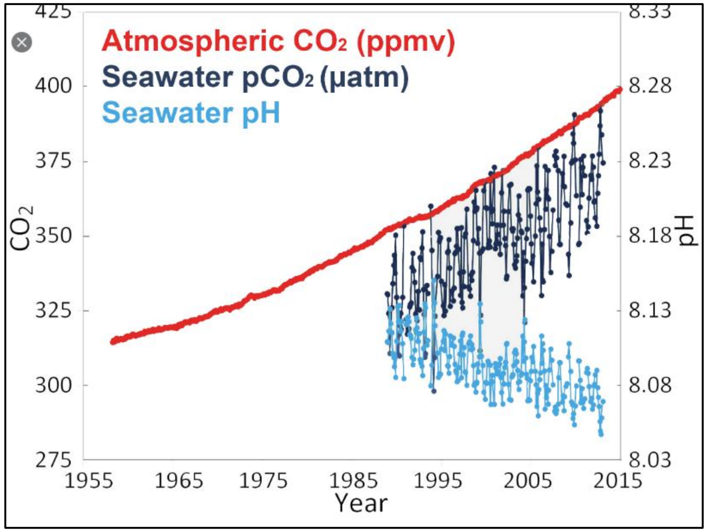
Methane concentrations

CO2 concentrations



- The temperature hiatus is reflected by a plateau in methane concentrations but is not reflected in the CO2 concentrations.

Ocean Acidification



- A reduction in the pH of surface ocean waters (acidification) has also been attributed to increased levels of CO_2 in the atmosphere
- CO_2 reacts with water to form carbonic acid. This is very weak and unstable, however, and breaks down to carbonate, which combines with calcium to form calcium carbonate.

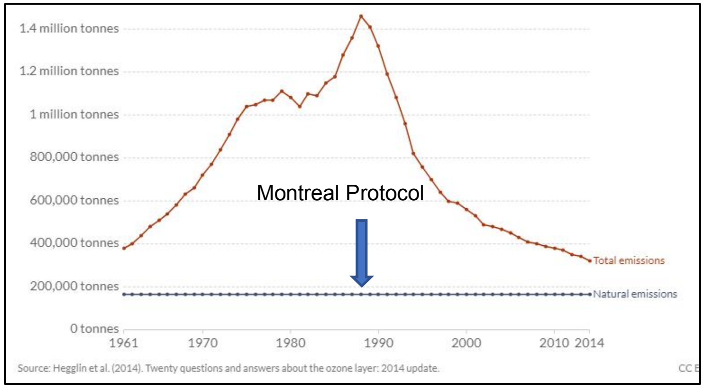
- The change in pH is more likely to be due to Hydrochloric acid, formed in a photoelectric reaction in the presence of Chlorine and UV light.

$$CH_4 + O_3 + Cl \rightarrow CO_2 + H_2O + 2HCl$$

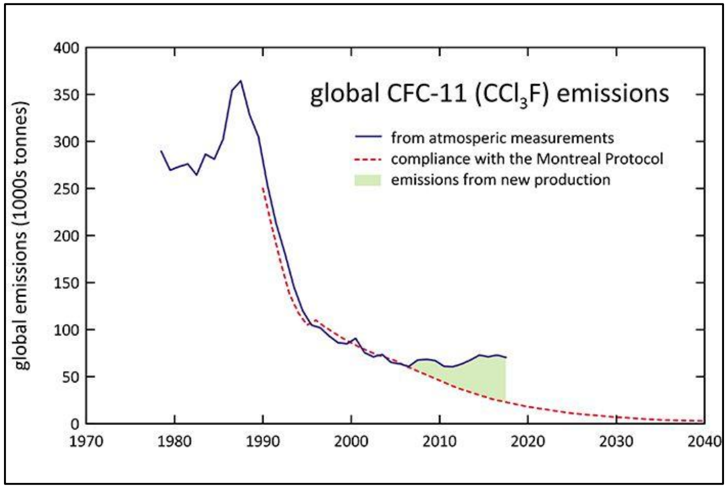
Methane + ozone + chlorine → carbon dioxide + water + Hydrochloric Acid

Key Conclusions

- Following the Montreal Protocol in 1987 a ban on CFCs was introduced
- Ozone depletion slowed and from 1998 – 2012 methane levels stabilised and temperature increase slowed
- From 2012 illegal emissions by China have again increased, with subsequent higher rate of temperature increase.
- CFCs also react in the atmosphere to produce hydrochloric acid



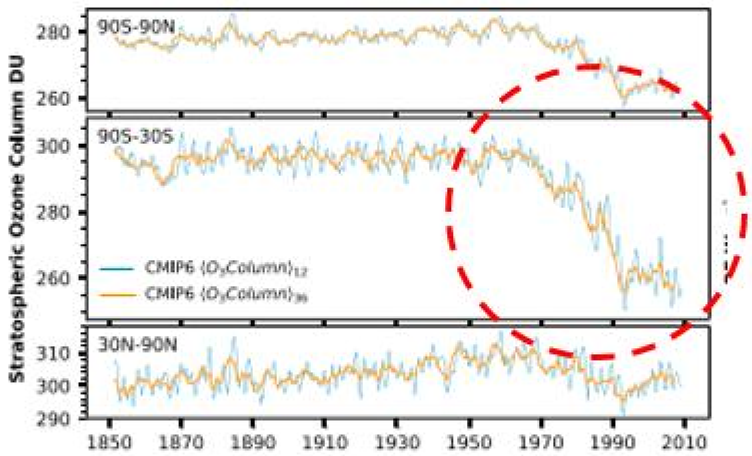
Total reported production of CFCs



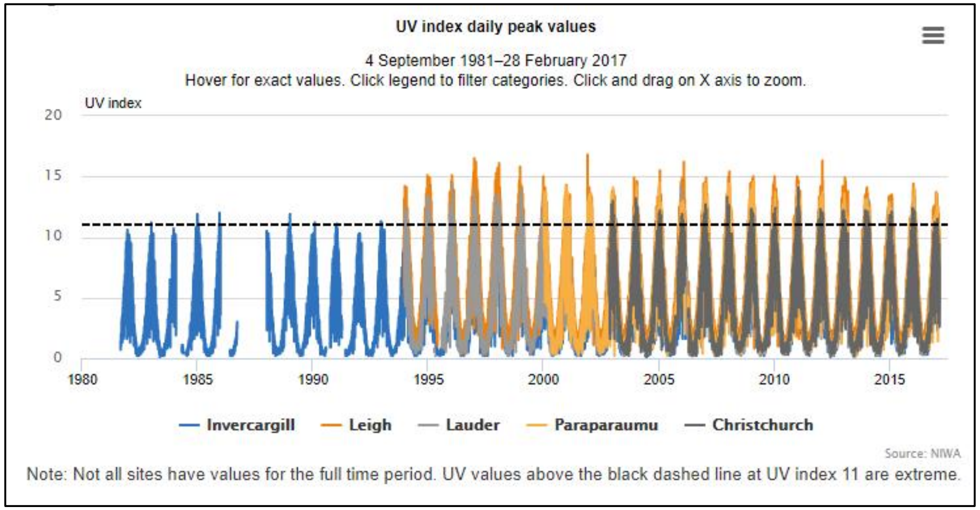
Post Montreal production of CFCs showing inferred illegal production (Smith 360)

Ozone Depletion and UV

- Ozone depletion is marked in the southern hemisphere stratosphere beginning in the late 1950's
- The UV Index for New Zealand has been Extreme since 1994
- There is a lag in both depletion and recovery before temperatures respond.



Ozone column, southern hemisphere stratosphere (Checa-Garcia et al 2018)



UV Index for New Zealand 1980 – 2018 (NIWA)

Key Conclusions

- The increase in atmospheric methane concentrations reflects ozone depletion.
- The decrease in ozone allows more UV radiation to reach earth's surface.
- This in turn increases evaporation. Energy from the earth's crust, stored as heat in water, is transferred to the atmosphere and released via conduction and infra-red radiation.
- The hiatus (1998-2012) in the global temperature rise coincides with the plateau in atmospheric methane increase (1998-2008) and the reduction in production and emission of CFCs.
- The renewal and expansion of CFC production since 2012 is driving the current temperature increase. Removing CO_2 is not the answer; the ban on CFCs is.

Key Conclusions

- Emissions from the CO_2 band of the spectrum have been measured over a 10 year period at two sites. These measurements confirm Greenhouse Gas emissions contribute less than 0.001% of surface temperatures.

- CO_2, rather than increasing temperatures, acts as a heat sink in the atmosphere. The only impact it has reduce warming and increase photosynthesis. Far from being a pollutant, we have inadvertently been helping the planet and all species on it.

- Further ozone depletion can be stopped by ceasing emissions of CFCs; the recovery could be accelerated by generating ozone in the stratosphere.

How can 97% of climate scientists be wrong?

- Because they fail to consider crustal heat flow. This is partly a result of using the same parameter to compare two different processes , and the absence of geologists in IPCC advisory groups which comprise atmospheric and hydrological scientists.

- Because they fail to consider the variability of CO_2 properties with temperature and pressure. The distribution of CO_2 in the atmosphere should be easily modelled.

- Because all work is predicated on the assumption that, because CO_2 emits infrared radiation, increasing CO_2 must increase temperature. However, CO_2 also absorbs infrared radiation when it is colder than the surrounding molecules, as is the case.