

The cold facts about global warming

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For 80% of time, Earth has been a warm wet greenhouse planet. Polar ice caps are rare. Global atmospheric CO₂ and CH₄ have been variable and decreasing over time whereas O₂ has been in the atmosphere for only 50% of time. There have been scores of major and minor mass extinctions in the history of Earth. Sea levels have risen and fallen thousands of times by up to 400m, land levels constantly rise and fall and massive rapid climate changes derived from supernovae, solar flaring, sunspots, meteorites, comets, uplift of mountain ranges, pulling apart of oceans, stitching together of land masses, drifting continents, orbital changes, volcanoes, changes in the shape of Earth, ice armadas, changes in ocean currents and volcanoes.

The main gases emitted from volcanoes were and still are the greenhouse gases H₂O, CO₂ and CH₄ mixed with minor other gases. The main greenhouse gas on Earth is H₂O. These volcanic gases accumulated to form a primitive O₂-deficient greenhouse gas atmosphere. Planet Earth condensed 4550 million years ago (Ma) from recycled stardust. Since that time, the continents have been enlarging, Earth materials have been constantly recycled and the Earth's systems have been dynamically evolving. The Earth has not stopped being an evolving dynamic system just because humans now live on the continents.

As soon as there was liquid water on Earth, there was life. This early bacterial life thrived, the O₂-deficient atmosphere was hot and CO₂- and CH₄-rich. Rain was extremely acid. Early Earth was very warm and wet however there is some evidence to suggest that there were minor periods of local glaciation. The origin of these climate variations is unknown. Bacteria slowly diversified and, by the time the Earth was middle aged, one group of bacteria had emitted such large quantities of O₂, that the atmosphere contained minor O₂. Some of this excess O₂ was trapped in rocks by weathering, most dissolved in the oceans resulting in the precipitation of iron oxides at 2400Ma.

For at least the last 2500Ma, the continents have been pulled apart and stitched back together. Every time the continents are pulled apart, huge quantities of volcanic H₂O, CO₂ and CH₄ are released into the atmosphere and greenhouse conditions prevail. When continents stitch together, mountain ranges form. Mountains are stripped of soils, new soils form and remove CO₂ from the atmosphere, these soils are stripped from the land and the CO₂ becomes locked in ocean floor sediments. When atmospheric CO₂ is low, glaciation occurs.

The origin of the greatest climate change on Earth is unknown. Between 800 and 600Ma, there were two major glacial events. Sea level changed by up to 400m and interglacial sea temperatures were +40°C. Glaciation was at the sea level and equatorial. After glaciation, the atmosphere had some 20% CO₂ and bacteria thrived in the warm oceans. Multicellular life appeared, diversified and used the CO₂ to make shells and skeletons. This explosion of life from 580 to 520Ma produced all the major life forms currently present on Earth.

Plants appeared at 470Ma and there was a major mass extinction of multicellular life at 430Ma. The origin of this mass extinction is not known. There was another major mass extinction at 368Ma resulting from the extraterrestrial impacting of Sweden. Between 368 and 251Ma, massive coal deposits formed, there was a major 50 million year period of glaciation and the atmosphere had a very high CO₂ and O₂ content. Life continued to diversify. At 251Ma, the biggest major mass extinction on Earth took place. Some 96% of species became extinct and the smoking gun is short-lived volcanicity in Siberia. Huge volumes of CO₂ were released into the atmosphere. This induced a greenhouse that was counterbalanced by the release of sulphur compounds that reflected heat and light. The resultant acid rain destroyed vegetation and created acid oceans.

Another major mass extinction took place at 214Ma. A swarm of asteroids hit the Northern Hemisphere, a continental mass was fragmented, large volumes of lava and CO₂ were released and the Atlantic Ocean formed.

At 120Ma, Australia was at the South Pole enjoying a temperate climate. There were minor glaciers in the highlands. Global sea level was more than 100m higher than at present, the sea surface temperature was 10-15°C higher than now and many continents were covered by shallow tropical seas.

From 250 to 120Ma, the global CO₂ content varied greatly and increased to a peak 6% CO₂ at 120Ma. This derived from intense volcanic activity associated with continental fragmentation. Thick vegetation covered the land masses. The atmospheric oxygen content greatly increased to 35% at 300Ma, decreased and then increased to 27% at 150Ma. It is currently 21%. During times of high atmospheric O₂ content, there was spontaneous combustion of the atmosphere, global bushfires and increased erosion. Australia started to pull away from Antarctica at about 100Ma, India pulled away from Australia and New Zealand moved eastwards with the associated addition of large volumes of H₂O, CO₂ and CH₄ into the atmosphere.

A minor mass extinction of life at 90Ma was the result of volcanoes in the Indian and Pacific Oceans belching out CO₂ and other gases into the oceans and atmosphere. The oceans became acidic and there was a runaway greenhouse until volcanism waned. Volcanic CO₂ is still leaking into the atmosphere. In 1984 and 1986, burps of CO₂ the volcanic crater lakes of Monoun and Nyos (Cameroon) killed thousands and added CO₂ to the atmosphere. Near Mt Gambier, volcanic CO₂ is commercially extracted from rocks, one small hot spring on Milos contributes to 1% of the planet's volcanic CO₂ and huge quantities CO₂, the planet's second most common volcanic gas, constantly leak from unseen submarine volcanoes. The rate of leaking volcanic CO₂ is not constant.

An extraterrestrial visitor at 65Ma was followed by volcanism in India that released CO₂, CH₄ and sulphur gases into the atmosphere to create a mass extinction.

Another minor mass extinction at 55Ma was caused by a Caribbean volcano. This led to the rise of mammals and new terrestrial vegetation. There was a rise in sea temperatures by up to 8°C for 100,000 years, atmospheric CO₂ was 10 times that of today, the oceans

became acid, the oceans lost dissolved O₂ and the ocean floors released CH₄ into the atmosphere. During the greenhouse, plankton sucked up the atmospheric CO₂, mammals thrived and life filled the vacated ecologies. Atmospheric CO₂ decreased from 3500 to 700ppmv within a million years, stayed low until 47Ma and went up and down to about the present level (365ppmv) at 40Ma.

India collided with Asia at 50Ma. Uplift produced the Tibetan Plateau which started to scrub CO₂ out of the atmosphere. The Tibetan plateau is still rising and CO₂ is still being scrubbed out of the atmosphere. The Drake Passage opened as South America drifted from Antarctica, a circum-polar current developed and Antarctica refrigerated. Changes in submarine topography along the Tasman Rise, the closing of the Mediterranean Sea, the onset of polar glaciation and the flow of polar bottom waters formed climate zones, a feature that had not previously existed during the previous long periods of warm wet tropical climates.

Warm currents in the Indian Ocean were deflected and drifted through the Great Australian Bight and up the Pacific coast of Australia. Southern Australia from 17 to 14.5Ma was again tropical with mid-latitude temperatures 6°C warmer than today. Atmospheric CO₂ was 180-290ppmv. This greenhouse occurred when atmospheric CO₂ was 30-50% lower than today. Land changes closed the Straights of Gibraltar at 7Ma, the Mediterranean Sea again dried and because there was less salt in the oceans, parts of the oceans froze. Both the ice and salt reflected sunlight and the planet cooled further. By 5Ma, Earth was so cool that very slight orbital wobbles now had a bearing on climate and every 100,000 years was characterized by 90,000 years of glaciation and 10,000 years of interglacial. We are currently in one of those interglacial periods. Cooling changed forests to grasslands and primate extinction and diversification to upright bipeds took place. By 2.67Ma, central American volcanoes had closed the seaway between the Pacific and Atlantic Oceans, explosive volcanoes in Kamchatka had added dust to the atmosphere, dust reflected sunlight and the planet cooled further. The Northern Hemisphere polar ice cap formed.

The penultimate interglacial was 120,000 years ago. Sea level was 6m higher than at present and the planet was far warmer and wetter than now. During this greenhouse, there was more vegetation than today and atmospheric CO₂ was 78% of that today. Ice core data shows that after warming, the atmospheric CO₂ and CH₄ content increased suggesting that atmospheric temperature rise drives an increase in atmospheric carbon dioxide and methane contents some 800 years later. Orbital-driven cooling commenced, the eruption of Toba (Indonesia) produced dust that reflected sunlight, sea level dropped and glaciation accelerated. During the history of the latest glaciation, armadas of ice were released into the sea every 7,000 years resulting from the physical failure of thick ice sheets. These had a profound effect on climate. Small cool periods occurred every 1,100 to 1,300 years.

The zenith of the last glaciation was 18,000 years ago. Sea level was 130m lower than today, temperature was 10-15°C lower than today and there were very strong cold winds. The northern hemisphere was covered by ice to 38 °N with more northern areas such as

Scandinavia was covered by 3km of ice. Ice caps changed the shape of the planet, rotation changed and as a result ocean currents distributing heat across the Earth were changed. Australia was scoured by anti-cyclonic winds that deposited sand dunes and carried sea salt spray to be trapped in the inland basins. Rainforest disappeared and the Amazon Basin consisted of grasslands with copses of trees.

The northern polar ice sheet started to melt 14,700 years ago. Major global climate changes were not synchronous, some changes occurred in the Northern Hemisphere before the Southern Hemisphere and some changes to the Northern Hemisphere were not recorded in the Southern Hemisphere. There were very rapid and major temperature fluctuations, sea level rose and fell and the total sea level rise over the last 14,700 years has been at least 130m. Landmasses previously covered with ice started to rise. For example, Scandinavia is still rising and has risen 340m over the last 14,700 years. The Netherlands, southeastern England, Schleswig-Holstein and Denmark are sinking. Hence relative sea level changes can be local such as the compaction of coralline sand and the sinking of submarine volcanoes beneath atolls. The breaching of dams of melt waters filled the oceans with cold surface waters 12,000-11,000 and 8,500-8,000 years ago resulted in very cold conditions, an increase in sea level and changes to ocean currents. After these cold periods, temperatures rose by 5-10°C in the space of a few decades. Sea level rise resulted in the breaching of the Mediterranean into the Black Sea Basin some 7,600 years ago and is probably the origin of the Sumerian, Babylonian and biblical stories of a great flood.

One of the consequences of a massive sea level rise over the last 14,700 years was that the West Antarctic Ice Sheet was no longer unpinned by the land. Two thirds of the West Antarctic Ice Sheet collapsed into the oceans and sea level rose 12m. The final third of the West Antarctic Ice Sheet has yet to collapse to produce a 6m sea level rise as part of the dynamic post-glacial climate on Earth. Climate changes induced by changes in ocean currents cooled North Africa, grasslands changed to a desert, humans migrated and the great Mesopotamian cities were established.

Sea levels were 1-3m higher in a greenhouse 6,000 years ago. There was 20% more rainfall. Cold dry periods, glacier expansion and crop failures between 5,800 and 4,900 years ago resulted in deforestation, flooding, silting of irrigation channels, salinisation and the collapse of the Sumerian city states. Long periods of El Nino-induced drought resulted in the abandonment of Middle Eastern, Indian and North American towns.

Global cooling from 1,300-500BC gave rise to the advance of glaciers, migration, invasion and famine. Global warming commenced again at 500BC, there was an excess of food and great empires grew, such as the Ashoka, Ch'hin and the Roman. Contemporary records and Roman clothing shows that conditions were some 5°C warmer than today.

In 535AD Krakatoa exploded, as did Rabaul in 536AD. The Earth passed through cometary dust in 536AD. The dusty atmosphere reflected heat and darkness prevailed and, as a result, the climate cooled and there was famine, disease and warfare. Changes in

ocean currents resulted in the Medieval Warm Period from 900- 1300AD. The first to feel the change were the Vikings who were able to navigate the northern waters, colonized Newfoundland, colonized Greenland and established extensive trade routes as far south as the modern Gulf States. On Greenland, crops were grown and there were cattle. This would not be possible today. The warmer wetter climate of Europe produced excess crops and wealth which resulted in the building of castles, cathedrals and monasteries. As with previous greenhouse events, there was great prosperity.

In 1280AD, volcanic eruptions on Iceland and a change in ocean currents started the Little Ice Age which finished in 1920. The Gulf of Bothnia froze in 1303 and 1306-1307, there was massive famine in 1315 and the plague pandemic attacked the weakened population in 1347-1349. There was massive depopulation and it took Europe 250 years to reach the population of 1280. During the Little Ice Age, there were warmer periods associated with sunspot activity. During minimum sunspot activity (1440-1460, 1687-1703 and 1808-1821), the intensely cold conditions were recorded by the Dutch masters and King Henry VIII was able to roast oxen on the frozen Thames. There were food shortages. Short cold periods occurred after the eruptions of Tambora (1815) and Krakatoa (1883) respectively. Andean glaciers show 4 periods of advance and retreat related to changes in solar activity. The East Antarctic and Greenland Ice Sheets are increasing in volume whereas the West Antarctic Ice Sheet is decreasing. The Medieval Warm Period and Little Ice Age do not register on the 'hockey stick' scenarios of climate for the last 1000 years which are used to predict future climate by the IPCC. Scenarios are not predictions.

The 20th Century and early 21st Century are during natural post-glacial rebound. Ice sheets, a rare phenomenon in the history of time, still exist. Sea level is relatively low, as are global temperatures and atmospheric CO₂. Between 1920 and 1945, there was a period of warming (0.37°C) followed by a period of cooling and another warming that commenced in 1976 (0.32°C). In 1976-1977, global temperatures in the lower atmosphere jumped 0.3°C, sea surface temperature in the equatorial Pacific jumped 0.6°C, sea surface temperature during upwelling increased 1.5 to 3°C but there was reduced upwelling, the heat content of the upper 300 metres of the world's oceans increased, there was increased wave activity in the North Sea and the length of the day changed. The stepwise increase in temperature in 1976-1977 shows that there was a major re-ordering of the ocean heat transport coinciding with an orbital change expressed as a change in the length of the day. Maybe global warming of the 20th Century is just a measure of the variability on a dynamic evolving planet?

To put such measurements into perspective over the history of time, changes in atmospheric temperature in the 20th Century can only be considered small and slow. A three-decade global coverage of satellite atmosphere temperatures shows only modest warming in the Northern Hemisphere, a slight cooling in the Southern Hemisphere and an increase in solar radiation. Solar measurements can account for 0.47°C of the projected 0.61°C 20th Century atmospheric temperature rise. Temperature measurements from balloons agree with the satellite measurements for the period of overlap. Because

greenhouse warming is a phenomenon of the atmosphere, significant changes should have been recorded.

Science is married to evidence and bathes in modest uncertainty at the boundary of what we know and what we don't know. The nature of science is skepticism and science encourages argument and dissent. A dogmatic view on climate change can only damage science, the only methodology we have for solving environmental problems. Scientific evidence is derived from reproducible and validated observation, measurement, experiment and calculation. Scientists engage in healthy argument about the veracity of evidence. On the basis of evidence, an explanation called a scientific theory is constructed. A scientific theory is the best available explanation of evidence, it may change with new evidence and it must be coherent with the existing body of knowledge. Evidence in geology is interdisciplinary, terrestrial and extra-terrestrial and shows the complex and fascinating intertwining of evolving natural processes on a dynamic planet and a concept of human-induced global warming is not in accord with a wholistic view of Earth using geology, astronomy, archaeology and history. By failing the coherence test, the idea of human-induced global warming cannot be scientific but may serve other purposes. To argue that human additions of CO₂ to the atmosphere in a dynamic evolving multicomponent system is ascientific.

Scientists also argue about scientific theory. Scientific theories are testable and once the scientific theory has been tested over time, it becomes accepted into the body of knowledge. The word belief is not used in science because belief is untestable and consensus is the language of politics and religion, not science. This process has not taken place with the construction of what is popularly called the greenhouse effect. Science is unable to make judgments about what is good or bad and the intertwining of alleged human-induced global warming with ethics is disingenuous. These judgments vary with time and are based on contemporary politics, religion, aesthetics and culture.

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