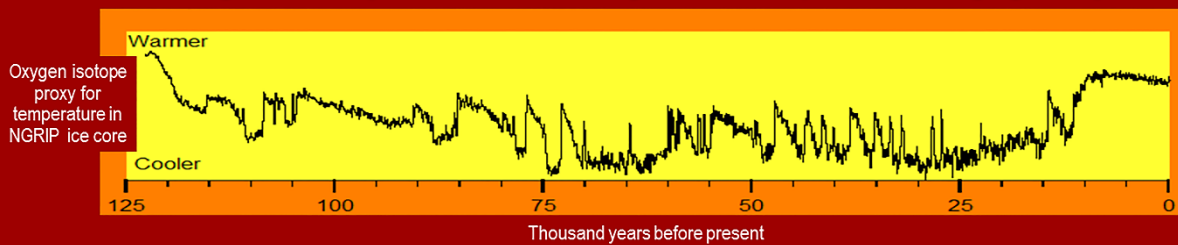


The Footprints of Climate Change

Sudden warming followed by much slower cooling in erratic sequences averaging 5000 years



The footprints of climate change throughout geologic history show clearly that major global warming occurs suddenly, often within years, while major global cooling occurs incrementally over centuries to millennia. Global warming is initiated very erratically, not cyclically.

1. Global cooling of approximately 0.5°C has been observed throughout written history to follow most large explosive volcanic eruptions. These eruptions eject water vapor and sulfur dioxide into the lower stratosphere forming sulfuric acid aerosols that spread worldwide within months, that persist for a few years, and whose droplets grow large enough to reflect and scatter sunlight, causing net global cooling. This cooling of the whole ocean surface for a few years is shown by computer modeling to decrease ocean temperatures at depths of 2000 feet for as long as a century. Sequences of many such large explosive eruptions per century are observed, over tens of thousands of years, to cool the ocean and the world incrementally into ice-age conditions.
2. Sudden global warming, on the other hand, occurs during and immediately following major effusive volcanic eruptions that extrude basaltic lava over large areas without forming significant stratospheric aerosols. Four dozen of these Large Igneous Provinces, each with basalts covering areas greater than 155,000 square miles, have occurred sporadically throughout Earth history, typically causing sudden warming of climate and sudden changes in sedimentation and life forms that mark the end of major divisions within the Geologic Time Scale. They can last tens of thousands to hundreds of thousands of years causing sudden major global warming, sudden major ocean acidification, and the highest known rates of mass extinction. Smaller basaltic eruptions occur much more frequently.
3. The largest effusive, basaltic eruption since 1783, covering an area of 33 square miles, occurred in central Iceland at the volcano Bárðarbunga from August 2014 to February 2015, causing very rapid warming—making 2016 the hottest year on record since thermometers were invented.

4. In 1783, Laki, in southern Iceland, extruded basalts covering an area of more than 200 square miles, providing some warming during the Little Ice Age. In 935 AD, Eldgjá extruded basalts over an area of more than 300 square miles leading to the Medieval Warm Period.
5. The balance between the numbers and volumes of explosive eruptions versus effusive basaltic eruptions is determined by the configuration of tectonic plates forming Earth's surface. Explosive eruptions form primarily along convergent plate margins where ocean plates are subducted under continental plates, such as along the circum-Pacific "Ring of Fire." Effusive basaltic eruptions are most voluminous in rifts where plates are being pulled apart, such as in Iceland and Ethiopia.
6. The greatest depletion of stratospheric ozone observed since records began in 1927 was in 1992 and 1993 following the 1991 eruption of Mt. Pinatubo in the Philippines, the largest volcanic eruption since 1912. When the ozone layer is depleted, less ultraviolet-B radiation is absorbed in the ozone layer causing it to cool and more ultraviolet-B radiation reaches Earth, causing it to warm. Temperatures from December 1991 to February 1992, months when ozone is typically depleted, rose as much as 3.5°C in northern continents, but the aerosols ultimately caused net global cooling.
7. Chlorine and bromine emitted by explosive volcanic eruptions and in much greater volumes by effusive, basaltic eruptions, appear to reach the lower stratosphere where, especially in the presence of volcanic aerosols or polar stratospheric clouds, they deplete ozone. It takes only one atom of chlorine to destroy 100,000 molecules of ozone.
8. Humans caused major ozone depletion and resulting global warming from 1970 to 1998 by manufacturing chlorofluorocarbon gases (CFCs) used as refrigerants, spray-can propellants, and solvents. Scientists discovered in 1974 that these chemically inert CFCs, when lofted high in the stratosphere, are broken down by ultraviolet-C sunlight to ultimately release atoms of chlorine. When the Antarctic ozone hole was discovered in 1985, scientists and political leaders worked rapidly together to pass the UN Montreal Protocol limiting CFC production beginning in 1989. By 1993, increases in CFC production stopped. By 1995, increases in ozone depletion stopped. By 1998, increases in temperature stopped. Humans appear to have caused global warming by manufacturing CFCs and stopped global warming from continuing to increase by stopping manufacture of CFCs.
9. Atmospheric concentrations of greenhouse gases are primarily a function of ocean temperature based on well-known solubility curves. A colder ocean absorbs more carbon dioxide. A warming ocean loses carbon dioxide to the atmosphere much

like a warming glass of beer. Observed changes in greenhouse-gas concentrations can be explained by observed changes in ocean temperatures. It does not appear possible for greenhouse gases, on the other hand, to cause observed changes in ocean or global temperatures.

10. It has never been shown experimentally that increasing concentrations of greenhouse gases actually cause air to warm substantially. Such warming does not appear to be physically possible. I am offering \$10,000 to the first scientist who can demonstrate such warming experimentally.

WhyClimateChanges.com/challenge/

11. Climate models based on greenhouse-warming theory have not predicted global temperatures correctly since 1998 and, therefore, are highly unlikely to be predicting temperatures accurately in future decades.

12. Climate models do not calculate heat correctly. They conclude there is more heat in the infrared absorbed by carbon dioxide than in ultraviolet radiation reaching Earth when ozone is depleted. Yet everyone knows that you get much hotter standing in solar ultraviolet radiation than standing outside at night with infrared radiation welling up from Earth. Ultraviolet-B radiation reaching Earth when ozone is depleted is hot enough to burn your skin and damage DNA. It is 48 times more energetic, 48 times “hotter” than infrared radiation absorbed most strongly by carbon dioxide.

13. Each molecule of carbon dioxide absorbs along narrow spectral lines less than 10% of terrestrial infrared radiation. Furthermore, carbon dioxide molecules make up only 0.04% of the molecules in air. Carbon dioxide simply does not absorb enough heat to have a major effect on global temperatures.

14. Climate models are based on a fundamental assumption about radiation made in the 1860s that does not turn out to be correct. Correcting this assumption not only shows that greenhouse-warming theory is mistaken, but it provides new insight into quantum physics.

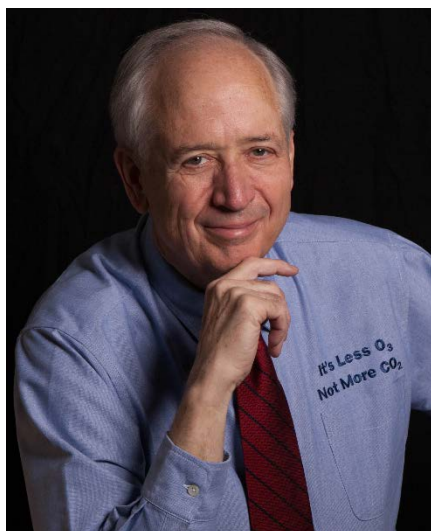
15. Humans can continue to burn fossil fuel without overheating Earth, but they must minimize pollution that is currently killing millions of people each year in Asia.

Peter Langdon Ward, BA Dartmouth College, PhD Columbia University, worked 27 years with the United States Geological Survey studying volcanoes, earthquakes, regional geology, and plate tectonics. As a public educator, he taught people how to live more safely with potential natural hazards, such as volcanic eruptions and earthquakes, winning two national awards. Ward helped develop and led the National Earthquake Hazard Reduction Program and chaired a White House committee on effective disaster warning.

Since 2006, while retired and after he discovered that something did not make sense about climate change theory, Ward has worked full time trying to understand how volcanoes could both cool and warm climate, what radiation and radiant energy are, and how solar radiation is absorbed, which determines the structure of Earth's atmosphere. He carefully reexamined each of the key assumptions made in developing greenhouse warming theory.

The details of his research are explained in his new well-illustrated book: **What Really Causes Global Warming? Greenhouse gases or ozone depletion?**

His major website **WhyClimateChanges.com** provides extensive detail including his scientific papers, scientific talks, TEDx talk, and much more detailed information about his background.



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