

Abrupt Planetary Catastrophic Global Warming

It's happened before. We have the planet headed that way again.

A statement by the Geological Society
of London

November 2010



The
Geological
Society

http://www.geolsoc.org.uk/gsl/views/policy_statements/climatechange

Conclusion

What does the geological record tell us about the potential effect of continued emissions of CO₂?

Over at least the last 200 million years the fossil and sedimentary record shows that the Earth has undergone many fluctuations in climate, from warmer than the present climate to much colder, on many different timescales.

Several warming events can be associated with increases in the 'greenhouse gas' CO₂. There is evidence for sudden major injections of carbon to the atmosphere occurring at 55, 120 and 183 million years ago, perhaps from the sudden breakdown of methane hydrates beneath the seabed.

At those times the associated warming would have increased the evaporation of water vapour from the ocean, making CO₂ the trigger rather than the sole agent for change.

During the Ice Age of the past two and a half million years or so, periodic warming of the Earth through changes in its position in relation to the sun also heated the oceans, releasing both CO₂ and water vapour, which amplified the ongoing warming into warm interglacial periods.

That process was magnified by the melting of sea ice and land ice, darkening the Earth's surface and reducing the reflection of the Sun's energy back into space.

While these past climatic changes can be related to geological events, it is not possible to relate the Earth's warming since 1970 to anything recognisable as having a geological cause (such as volcanic activity, continental displacement, or changes in the energy received from the sun).

This recent warming is accompanied by an increase in CO₂ and a decrease in Arctic sea ice, both of which – based on physical theory and geological analogues - would be expected to warm the climate.

Various lines of evidence, reviewed by the Intergovernmental Panel on Climate Change clearly show that a large part of the modern increase in CO₂ is the result of burning fossil fuels, with some contribution from cement manufacture and some from deforestation. In total, human activities have emitted over 500 billion tonnes of carbon (hence over 1850 billion tons of CO₂) to the atmosphere since around 1750, some 65% of that being from the burning of fossil fuels. Some of the carbon input to the atmosphere comes from volcanoes, but carbon from that source is equivalent to only about 1% of what human activities add annually and is not contributing to a net increase.

In the coming centuries, continued emissions of carbon from burning oil, gas and coal at close to or higher than today's levels, and from related human activities, could increase the total to close to the amounts added during the 55 million year warming event – some 1500 to 2000 billion tonnes.

Further contributions from 'natural' sources (wetlands, tundra, methane hydrates, etc.) may come as the Earth warms. The geological evidence from the 55 million year event and from earlier warming episodes suggests that such an addition is likely to raise average global temperatures by at least 5-6°C, and possibly more, and that recovery of the Earth's climate in the absence of any mitigation measures could take 100,000 years or more.

Numerical models of the climate system support such an interpretation.

Detail

Has sudden climate change occurred before?

Yes. About 55 million years ago, at the end of the Paleocene, there was a sudden warming event in which temperatures rose by about 6°C globally and by 10-20°C at the poles²². Carbon isotopic data show that this warming event (called by some the Paleocene-Eocene Thermal Maximum, or PETM) was accompanied by a major release of 1500-2000 billion tonnes or more of carbon into the ocean and atmosphere.

This injection of carbon may have come mainly from the breakdown of methane hydrates beneath the deep sea floor, perhaps triggered by volcanic activity superimposed on an underlying gradual global warming trend that peaked some 50 million years ago in the early Eocene.

CO₂ levels were already high at the time, but the additional CO₂ injected into the atmosphere and ocean made the ocean even warmer, less well oxygenated and more acidic, and was accompanied by the extinction of many species on the deep sea floor.

Similar sudden warming events are known from the more distant past, for example at around 120 and 183 million years ago.

In all of these events it took the Earth's climate around 100,000 years or more to recover, showing that a CO₂ release of such magnitude may affect the Earth's climate for that length of time.

Are there more recent examples of rapid climate change?

Abrupt shifts in climate can occur over much shorter timescales. Greenland ice cores record that during the last glacial stage (100,000 – 11,500 years ago) the temperature there alternately warmed and cooled several times by more than 10°C.

This was accompanied by major climate change around the northern hemisphere, felt particularly strongly in the North Atlantic region. Each warm and cold episode took just a few decades to develop and lasted for a few hundred years. The climate system in those glacial times was clearly unstable and liable to switch rapidly with little warning between two contrasting states. These changes were almost certainly caused by changes in the way the oceans transported heat between the hemispheres.