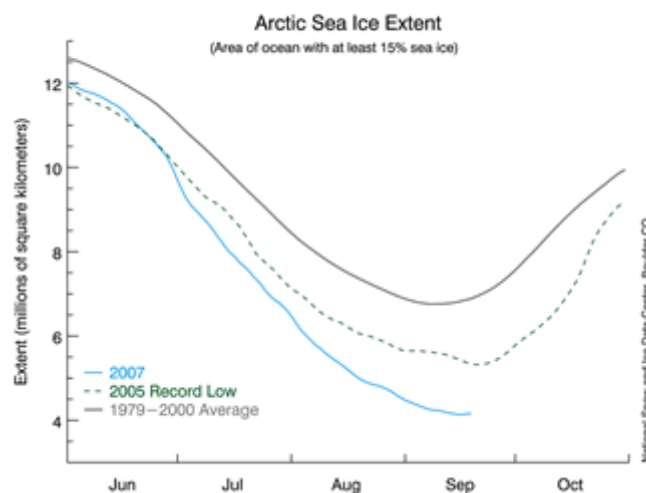


Section 1. Introduction: Abrupt climate change and the search for solutions

In 1992, governments worldwide agreed the UN Framework Convention on Climate Change, which obliges all states to work towards stabilising greenhouse gas concentrations “at a level that would prevent dangerous anthropogenic interference with the climate system”, allowing ecosystems to adapt and protecting food production from climate change. It is increasingly clear that the Climate Convention and the Kyoto Protocol have failed: All the signs are that dangerous climate change is a reality now, not a threat for the distant future, and that current greenhouse gas levels in the atmosphere are anything but safe.

The dramatic loss of Arctic sea ice in 2007 and 2008 confirmed those fears:



National Snow and Ice Data Center, http://nsidc.org/news/press/2007_seaiceminimum/20070810_index.html

Just as the Intergovernmental Panel on Climate Change published its latest report warning that Arctic summer sea ice could almost disappear in the second half of the century,⁴ satellite reports revealed a far more rapid meltdown: By September 2007, the sea ice extent had dropped to half the extent it had during the 1950s and 60s, 30 years ahead of what climate models had predicted. Since 2005, half of the thicker perennial sea ice cover has melted.⁵ The 2008 summer melting season came close to, but did not reach the 2007 minimum sea ice extent, following a relatively cold Arctic winter and a cooler summer than the previous year. However, it is likely to have seen the lowest ever volume of sea ice, given the continued thinning of the ice that remains and August 2008 saw the fastest rate of Arctic sea ice melting ever recorded as well as the disintegration of Canadian ice shelves believed to have had survived since the last ice age.⁶

As the Arctic warms, methane hydrates released from melting permafrost and released from biomass decomposition in shallow waters is causing global methane levels to rise again.⁷ This could well accelerate dramatically as the sea ice disappears: According to a new study by the National Centre for Atmospheric Research in the US, the rate of warming over northern Alaska, Canada and Russia could more than triple during periods of rapid sea ice loss.⁸ Global methane levels have begun to rise again, having been stable for around eight years.⁹

Altogether, up to 400 or even 450 billion tonnes of methane or carbon dioxide could eventually be released from melting permafrost. The thawing of the Arctic sea floor could release all or part of a further 540 billion tonnes of methane stored in submarine hydrates and far greater amounts are stored in deep marine clathrates (methane ice), stored in or close to the continental shelves across much of the world's oceans. Any major methane releases from the Arctic would threaten the future of all life.



Melting Siberian permafrost is releasing large amounts of greenhouse gases.¹⁰

Not surprisingly, leading climate scientists, such as James Hansen, now warn that not only do we need to cut greenhouse gas emissions more dramatically than previously thought, but that our future also depends upon taking carbon dioxide out of the atmosphere. Without the removal of excess atmospheric CO₂ other climate tipping points will be crossed, the impacts of which will be catastrophic and irreversible. Catastrophic impacts could include sea level rises at the rate of one metre every twenty years, as happened at the end of the last ice age along with ecosystem breakdown and mass extinction of species, (see Section 5).

Some NGO climate campaigners are beginning to look seriously at those proposals – for example the report 'Climate Code Red',¹¹ calls for zero carbon emissions and a massive effort to take carbon dioxide out of the air. Just like James Hansen, the authors of 'Climate Code Red' regard bioenergy with carbon sequestration as essential for reducing carbon dioxide to safe levels. Other groups advocating these proposals are the Norwegian Bellona Foundation and the Australian NGO, Beyond Zero Carbon. 350.org, a new organisation founded in the US, with growing international support, promotes James Hansen's paper as the basis for climate action, without officially referring to the proposals for planetary engineering contained in the paper.

The US Administration has long been interested in exploring ways of countering global warming by dimming the planet or increasing the earth's albedo (reflectivity), in the hope that geo-engineering can allow 'business as usual' to continue. Calls by James Hansen and others for reducing atmospheric CO₂ levels are different: They support drastic measures to move away from fossil fuel burning, but also believe that equally drastic measures are required to sequester carbon in soils, forestry and underground. While James Hansen and others support 'carbon negative' bioenergy for climate change mitigation only in conjunction with steep cuts in fossil fuel emissions, some of the language used by other supporters of this concept suggests that it could be seen as an alternative to reducing fossil fuel burning. For example, when Johannes Lehmann states that carbon sequestration from biochar could in future exceed the current annual fossil fuel emissions, this could be interpreted as making fossil fuel reductions less urgent, even if this may not be Dr Lehmann's intention. And Peter Read of the International Biochar Initiative, has stated, "We need to replace the emissions reductions paradigm with the concept of 'Biosphere Carbon Stock Management', thus directly promoting biochar as an alternative to reducing carbon emissions."¹²

The case for 'drastic action', which goes beyond ending fossil fuel use, is strong since runaway global warming in the worst possible scenario threatens the survival of all life on earth. The Intergovernmental Panel on Climate Change (IPCC) predicts that the planet could this century warm by up to 6.3°C, even without taking account of major feedbacks, such as methane releases from melting permafrost and ocean clathrates. There is strong evidence that 6°C warming, almost certainly over a much longer time-scale, (probably triggered by carbon dioxide releases from super-volcanoes), caused the planet's biggest mass extinction event ever, 251 million years ago. At that time, 96% of marine species and 70% of terrestrial vertebrate species, as well as most insects became extinct. Large parts of the planet became lifeless and it took 30 million years for life to recover and for biodiversity reaching similar levels as before the extinction event.

The question is: Can the proposed actions for withdrawing carbon dioxide from the atmosphere prevent catastrophic climate change and a mass extinction event, or will they, instead, trigger an even faster and more severe ecological and climate collapse

For the purpose of this report, we will use the term 'catastrophic climate change' in the same way as the term 'dangerous climate change' is generally used by the UNFCCC and by climate scientists, though there is no universally accepted definition. The term is generally used in a very restrictive way, to describe climate change which triggers major and potentially rapid sea-level rises, which threatens global food security and which causes a mass extinction. It is also widely used to mean abrupt and self-reinforcing climate change, where feedback mechanisms ensure that the planet will continue to warm even in the absence of any further anthropogenic GHG emissions. We recognise that such a definition is very questionable, given that even today's level of climate change causes impacts which are not just dangerous but catastrophic for hundreds of millions of people.

⁴ IPCC Fourth Assessment Report, 2007, www.ipcc.ch/ipccreports/ar4-syr.htm

⁵ <http://www.reuters.com/article/environmentNews/idUST22148420080512>

⁶ www.sciencedaily.com/releases/2008/09/080922195943.htm

⁷ www.spiegel.de/international/world/0,1518,547976,00.html and
<http://news.bbc.co.uk/1/hi/sci/tech/7364679.stm>

⁸ <http://www.ucar.edu/news/releases/2008/permafrost.jsp>

⁹ www.spiegel.de/international/world/0,1518,547976,00.html and
<http://news.bbc.co.uk/1/hi/sci/tech/7364679.stm>

¹⁰ <http://www.celsias.com/blog/images/permafrost.jpg>

¹¹ "Climate Code Red", David Spratt and Philip Sutton, Scribe Publications, 2008

¹² Biochar Commercialisation, IBI Workshop facilitated by Peter Read, http://www.biochar-international.org/images/Peter_Read_presentation.pdf