

The Ultimate Stakes: Climate Change and the Fate of Civilization

Viewpoints on Sustainability from Second Nature



By Dianne Dumanoski

Even for scientists, the challenge of global warming can be mind-boggling and complex, but the bottom line is both simple and clear. The change is already under way and hitting harder and faster than expected.¹ And what is ultimately at stake is the human way of life we call civilization.

Despite two decades of research and debate, the notion persists that climate disruption is primarily an *environmental* hazard — a dangerous misconception that continues to be widely perpetuated by those who urge action on climate change to “save the planet.” This plea, repeated even by Nobel laureates and editorial writers in the *New York Times*, belies the true nature of the danger. Based on what scientists now know about our planet’s eventful history, it is a safe bet that Earth itself will survive fossil fuels and industrial civilization just as it has endured previous calamities — asteroid hits, a catastrophic oxygen pollution crisis, and even the deep freeze of “snowball Earth”.

The urgent question, therefore, is not whether the Earth can survive a different climate, but rather what the changes ahead may mean to human societies. Media coverage of global warming and Al Gore’s film *An Inconvenient Truth* have highlighted the physical hazards of extreme weather, melting ice sheets, rising seas, and the eventual loss of low-lying areas and coastal cities. But climate disruption poses other grave hazards as well, which may send our societies and the global economy reeling into chaos long before our coastal cities are lost to rising seas. Whatever else is in jeopardy, this is first and foremost a crisis for humans and our current civilization.

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She is the co-author of *Our Stolen Future*, a seminal work on the health effects of synthetic chemicals that act as endocrine disruptors. Her latest book, *The End of the Long Summer*, explores what revolutionary changes in climate may mean for the kind of complex civilization humans have developed over the past 6,000 years.

- 1  Stefan Rahmstorf, et. al., “Recent Climate Observations Compared to Projections,” *Science* 316, page 709 (2007)
- 2  Alexander T.J. Lennon et. al. “The Age of Consequences. The Foreign Policy and National Security Implications of Global Climate Change.” Center for Strategic & International Studies (2007)
- 3  Mark New, et. al. “Four Degrees and Beyond: The Potential for a Global Temperature Increase of Four Degrees and Its Implications,” *Philosophical Transactions of the Royal Society A* (2011)

If the world’s economy continues on its current trajectory of exponential growth driven by fossil fuels, today’s college students will live in a perilous time that one study on climate change and national security described as *The Age of Consequences*.² They will almost certainly

“Although the consequences of global climate change may seem the stuff of Hollywood — some imagined, dystopian future — the melting ice of the Arctic, the spreading deserts of Africa, and the swamping of low lying lands are all too real. We already live in an “age of consequences,” one that will increasingly be defined by the intersection of climate change and the security of nations.”²

witness a dramatic and dangerous jump in global temperatures in their lifetime; see the demise of coral reefs and other marine life as excess carbon dioxide makes the world’s oceans increasingly acidic; endure severe climate disruption; and possibly even confront outright catastrophe from abrupt shifts in the Earth’s climate system.³ The litany of looming threats includes the end of agriculture in some regions because of permanent drought,



the lead supporting organization of the



What is the difference between weather and climate?

It's a sweltering midsummer day. "It must be global warming," mutters someone. But is it the Earth's changing climate that has made the day so warm? Or, is it just the weather that is so unbearable?

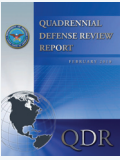
Weather is the mix of events that happen each day in our atmosphere including temperature, rainfall and humidity. Weather is not the same everywhere. Perhaps it is hot, dry and sunny today where you live, but in other parts of the world it is cloudy, raining or even snowing. Everyday, weather events are recorded and predicted by meteorologists worldwide.


Climate is the average weather pattern in a place over many years. So, the average weather of Antarctica is quite different than the average of a tropical island. Hot summer days are quite typical of climates in many regions of the world, even without the effects of global warming.


Climates are changing because our Earth is warming, according to the research of scientists. Does this contribute to a warm summer day? It may, however global climate change is actually much more complicated than that because a change in the temperature can cause changes in other weather elements such as clouds or precipitation.

— University Corporation for Atmospheric Research

4  Kevin Anderson and Alice Bows, "Beyond 'Dangerous' Climate Change: Emission Scenarios for a New World," *Philosophical Transactions of the Royal Society A*, pages 20-44 (2011)

5  "Quadrennial Defense Review Report," United States Department of Defense, pages 84-88 (2010)

6  Owen Kellie-Smith and Peter M. Cox, "Emergent Dynamics of the Climate-Economy System in the Anthropocene," *Philosophical Transactions of the Royal Society A*, pages 868-886 (2011)

7  Mark Stafford Smith, et. al. "Rethinking Adaptation for a 4° C World," *Philosophical Transactions of the Royal Society A*, pages 196-216 (2011)

shrinking food supplies and famine, waves of environmental refugees, and on the heels of these woes — political instability and failed states. In the decades ahead, climate change will threaten the peace and stability of the planet and rank at the top of the list of national security concerns.⁵

It will also increasingly dominate the public health agenda as higher temperatures and climate extremes increase the burden of infectious diseases and globalization increases the likelihood of pandemic. Moreover, at a time when societies will have to channel a significant part of their wealth toward substantial and continuous adaptation, climate instability may foster volatility in the economic system and destabilizing boom and bust cycles.^{6,7} As the former World Bank chief economist Sir Nicholas Stern warned in his widely read report "The Economics of Climate Change," the cost of inaction will be higher in the long run than the cost of phasing out fossil fuels.⁸


The current scientific understanding of climate change is extremely confident in some respects and at the same time deeply uncertain in others. There is overwhelming agreement among most climate scientists that greenhouse gases released by human activity have caused "most" of the 'unequivocal' warming of the Earth's average global temperature over the second half of the 20th century" and that temperatures will continue to rise as excess greenhouse gases accumulate in the atmosphere.⁹ The claim by conservative skeptics that the fundamental *science* of global warming is "uncertain" has no basis.^{10, 11}

Since the start of the Industrial Revolution, the global average temperature of the Earth has risen about .8 degrees Celsius (1.4 degrees Fahrenheit). In climate talks, the international community's stated aim is to hold the total increase in global temperature below 2 degrees to avoid "dangerous" climate change.

The uncertainty lies rather in our ability to forecast the consequences of the change already underway. Scientists cannot predict exactly how climate systems will behave if carbon dioxide levels climb to three or four times what they were at the start of the Industrial Revolution. If the human enterprise continues on the current trajectory, this will easily happen by the end of the century.

"The characterization of 2°C as the appropriate threshold between acceptable and 'dangerous' climate change is premised on an earlier assessment of the scope and scale of the impacts....[The latest assessment], however, suggests a significant increase in the severity of some impacts.... so that 2°C now represents a threshold between dangerous and 'extremely dangerous' climate change. Despite high level statements to the contrary, there is little or no chance of maintaining a temperature increase at or below 2°C." ⁴

8  Nicholas Stern, "The Economics of Climate Change," Cambridge University Press (2007)

9  William R. L. Anderegg, et. al., "Expert Credibility in Climate Change," *Proceedings of the National Academy of Sciences* (2010)

Science and Policy

Science is a process, not a set of facts that are settled once and for all. There are fundamental physical facts about the world, such as gravity, and the fact that the planets rotate around the sun that are regarded as “settled”. But, the leading edge of science is an evolving understanding of the world that changes as new questions spur new research and investigation. In a world as complex and non-linear as ours, we will never have complete knowledge that can “settle” every question once and for all. There will always be phenomena that don’t neatly fit the prevailing theory. In some instances, a skeptical scientist may pursue an anomaly and make a discovery that fundamentally alters the dominant understanding. Some skeptics have raised valid points about some aspects of climate science (though many keep revisiting long disproved claims for apparently ideological reasons). But these various debates (which are normal in science) have not altered the big picture: the evidence that the climate is getting hotter and more unstable, and that human activity is responsible for a good part of this.

When we use science to guide our decisions, whether it’s about medical care or climate change, we’re always acting on our best current understanding.

Since 1988, there has been an active, ongoing effort to track the best current understanding of the threat posed by climate change through an international scientific body called The Intergovernmental Panel on Climate Change [IPCC]. The aim of this United Nations-sponsored process is to provide the world and its leaders with a clear view of what scientists now understand about climate change and about its likely impacts on natural systems, the world economy, and human societies. The IPCC does not itself undertake climate studies or monitoring, but

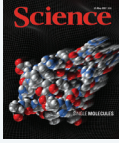

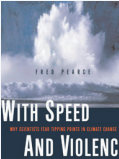
rather reviews and evaluates the most recent studies and data. Thousands of scientists from all over the world have worked as unpaid volunteers in this vast effort to assess the rapidly growing body of information.

Over the past two decades, the IPCC has synthesized its findings about what is known and with what level of scientific confidence in four Assessment Reports, which are unquestionably the most comprehensive reports on the current state of knowledge available. Reports by other national scientific bodies, such as the National Academy of Sciences, the Royal Society in the UK, Australia’s Climate Commission, and others have independently supported the IPCC’s conclusions about the climate threat. The US Department of Defense also recognizes the threats posed by climate change, as outlined in their 2010 Quadrennial Defense Review Report.⁴

The most recent Fourth Assessment Report, published in 2007, spans three volumes, each roughly 1,000 pages long. The writing by its 450 lead authors and 800 contributing authors took three years to complete. The three stage-review of the draft involved 2,500 expert reviewers and a total of 90,000 comments. The authors then responded formally to reviewers’ comments, an exchange one can view in the IPCC’s public record.

Despite the recent controversy following the release of hacked emails recording private exchanges between leading climate scientists, the IPCC reports are anything but alarmist. Most of the dramatic new evidence on retreat of the world’s ice sheets did not appear in the 2007 IPCC report, because its conservative review process excludes the controversial, the not fully quantified, and

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- 10  Naomi Oreskes, “Beyond the Ivory Tower. The Scientific Consensus on Climate Change,” *Science* 306, page 1,686 (2004)
- 11  Peter J. Jacques, et. al., “The Organisation of Denial: Conservative Think Tanks and Environmental Skepticism,” *Environmental Politics* pages 3,349-3,385 (2008)
- 12  Fred Pearce, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change*, Boston: Beacon Press (2007)

The consequences will hinge in large part on *climate sensitivity*, on how the Earth responds as human activity pushes the balance of gases in its atmosphere way beyond the normal range. While climate skeptics accuse those urging action to combat global warming of being “climate alarmists”, there is abundant evidence that we are not as alarmed as we should be. Again and again, scientific studies have documented that real-world change has been happening far faster than the model-based forecasts.¹² This is an unsettling prospect, indeed. Given the range of uncertainty and the speed of change to date, the future could be anything from seriously disrupted to utterly catastrophic.

It may sound melodramatic to say that the fate of civilization hangs in the balance. But this is, in fact, a sober, inescapable conclusion when one examines the nature of the relatively recent social development we call “civi-

“Since 1990 the observed sea level has been rising faster than the rise projected by the models...Overall, these observational data underscore concerns about global climate change. Previous projections, as summarized by the IPCC, have not exaggerated but may in some respects even have underestimated the change, in particular for sea level.”¹

zation” and the long view of the Earth’s climate history recorded in the ice cores scientists have been retrieving from the ice sheets on Greenland and Antarctica. The civilized way of life, which started taking hold some 6,000 years ago, is a specific kind of human culture — one based on the domestication of plants and animals and on permanent human settlements. And despite the dramatic technological development since then, the whole flashy, high tech human enterprise of

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any research not yet incorporated into the climate models. So the worst case scenario in the IPCC's summary for policy makers is a 2-foot rise in sea levels in the coming century. Those who have been watching the astonishing changes on the ice sheets think the coming century may see at least 6 feet of sea-level rise and possibly much more.

In 2007, the Intergovernmental Panel on Climate Change and Al Gore Jr. were awarded the Nobel Peace Prize "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change."

Online Resources

- "America's Climate Choices" National Academies of Science (2011)
- "Climate Change: a summary of the science" The Royal Society (2010)
- "The Critical Decade" The Climate Commission (2011)
- "IPCC Fourth Assessment Report: Climate Change 2007" Intergovernmental Panel on Climate Change (2007)

the 21st century still rests on this ancient foundation, the food technology developed in the late Stone Age during farming revolutions in several parts of the world. This "new" way of obtaining food has allowed large complex societies to develop — societies with cities, governments, armies, social classes, and a variety of specialized professions — doctors, priests, goldsmiths, potters, musicians, and writers. And eventually a global society with astonishing technology and the internet. Civilization may experience a post-industrial era, but it will never have a "post-agricultural" phase.

Our civilized way of life, which is impossible without agriculture, *depends* on a stable climate.

Modern humans emerged some 200,000 years ago and through most of our species' existence we lived as nomadic hunters and gatherers following where the shifting food supply led us. Farming and civilization came very late in our career.

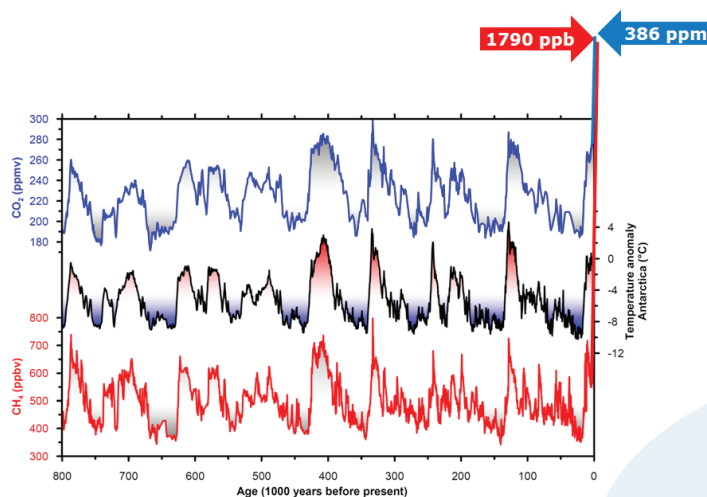
The deep ice, which records the long history of conditions on Earth over the past 800,000 years, tells us many things, but three facts about our situation stand out.

The first is this: the exceptional overall stability of the climate over the past 12,000 years made settled life and farming possible for the first time in the history of our species. For the past million years, the Earth has swung between ice ages and warmer interglacials, but moments on Earth with a climate as warm and benign as ours today have been few, fleeting, and very far between.

Through most of the human past, our ancestors had to cope with a chaotic climate marked by extreme variability, a climate that could not support agriculture. The world as we know it — with agriculture, civilization, and dense human numbers — has only been possible because of a rare interlude of climatic grace. A long summer. This is because the Earth's orbit changes shape over time and plays a role in climate cycles. We live at a truly extraordinary time in the Earth's volatile history.

Second, the ice record shows that current human activity is pushing the Earth system, which sustains life as we know it, way beyond the normal range recorded in the ice cores and doing so at an alarming speed. Without interference, this long summer might have lasted another 10,000 to 20,000 years — given the Earth's current orbit. Now, however, this exceptional moment on Earth is drawing to a close. We know from the ice core record that carbon dioxide levels today are *far higher* than any time in the past 800,000 years.¹³ What lies ahead is radical uncertainty.

- 13  Laurent Augustin, et. al. "Eight glacial cycles from an Antarctic ice core," *Nature* 429, pages 623-628 (2004)
- 14  Jørgen Peder Steffensen, et al., "High-Resolution Greenland Ice Core Data Show Abrupt Climate Change Happens in a Few Years," *Science* 321, pages 680-683 (2008)



Results from the Antarctic EPICA Dome C ice core showing the development of temperature in Antarctica and the concentrations of the atmospheric greenhouse gases carbon dioxide (CO₂, in blue) and methane (CH₄, in red) over the past 800,000 years. Arrows indicate current levels.

Source: Niels Bohr Institute, University of Copenhagen

"Several major catastrophes in 2010 resulted in substantial losses and an exceptionally high number of fatalities. The overall picture last year was dominated by an accumulation of severe earthquakes to an extent seldom experienced in recent decades. The high number of weather-related natural catastrophes and record temperatures both globally and in different regions of the world provide further indications of advancing climate change.

A single weather event is not proof of climate change but the sum total of events constitutes a clear chain of evidence that is backed up by additional meteorological readings. March, April, May and June 2010 were the warmest ever recorded globally, and July looks set to follow suit. Another sign of global warming is that the area covered by sea ice in the Arctic Ocean shrank to record lows in June and July, and is expected to reach a new absolute minimum in September.

This is happening even against the background of minimum solar activity during the first six months of 2010 and indicates that solar radiation can be excluded as a causal factor for the extreme weather events.

These facts show that global warming is playing a significant role in the rising number of extreme events. Analyses performed by Munich Re's natural catastrophe database, the most comprehensive in the world, substantiate this increase: the number of extreme weather events like wind-storm and floods has tripled since 1980, and the trend is expected to persist."

— *Press Release, January 3, 2011, Munich Re (Global Reinsurance Company)*

Third, the notion that global warming is going to proceed like a smooth escalator, carrying northern climes into an era of balmy winters, is common and persistent, but counting on an escalator-like change in climate is sheer folly and may put us in even greater danger. On the contrary, the Earth's climate history writ in the ice cores contains evidence of swift, intense, revolutionary change in less than a century or even within a single decade.¹⁴

One such leap occurred 14,700 years ago, when the Ice Age ended within a remarkable three years. The state-of-the-art climate models do not capture the magnitude nor the abruptness of these climate leaps.

"Climate change cannot be identified from individual events but our figures, backed by verifiable changes in meteorological data, indicate a trend towards an increase in extreme weather events that can only be fully explained by climate change."

- Professor Peter Höppe, Head of Munich Re's GeoRisk Research

The most mind-boggling insight from the ice cores is that rapid climate change is *normal*; it is not a freak event or an exception, it is the rule. When the Earth system changes, this is how it behaves. The faster the warming and the higher temperatures rise, the greater the chance that change will arrive in abrupt shifts and surprises — shocks that could lead to the collapse of social and economic systems.

For most of the human past, the climatic conditions our ancestors encountered often varied more *from decade to decade* than they have during the past twelve thousand years. A return to past patterns of extreme variability would be devastating to agriculture and make farming impossible. And if farming becomes impossible, it will mean the end of the settled, civilized way of life we've enjoyed during the long summer.

The question is no longer will we save the Earth, but rather will we act to preserve conditions necessary for civilization as we know it.



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