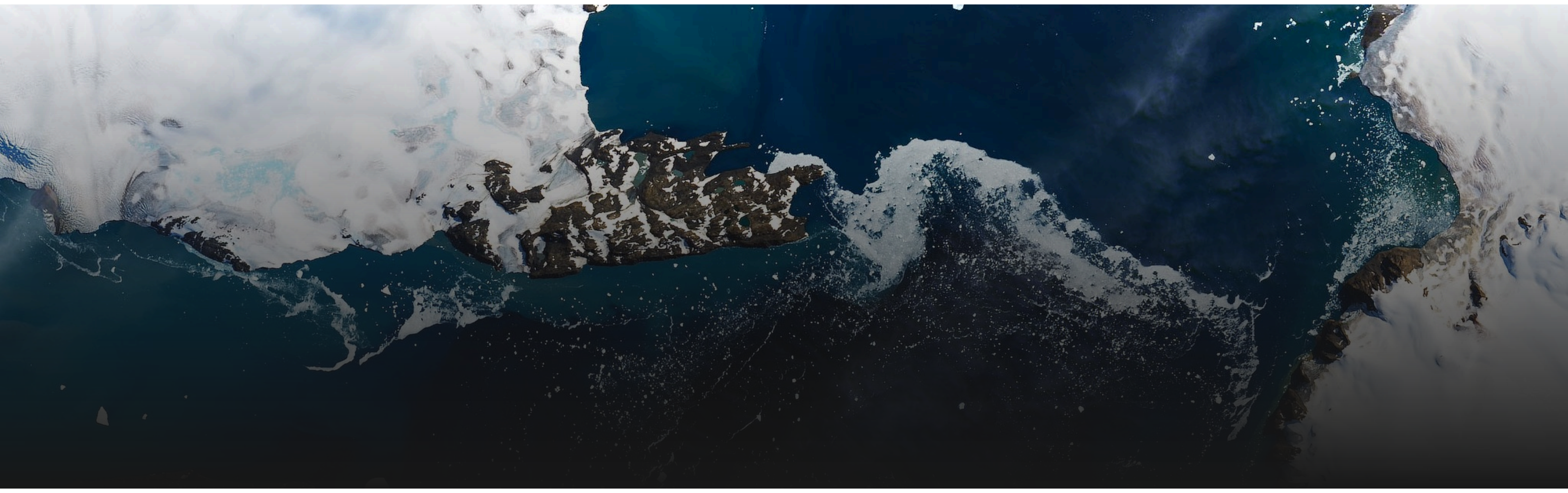

Robert H. Wade David Seckler November 14th, 2024

Prospects for containing global warming, based on a short account of the Earth's climate mechanisms

Professor Robert Wade and Professor David Seckler offer a glimmer of hope that Antarctica's melting glaciers and shrinking sea ice could be tempered in the future by Earth's natural cooling mechanisms and advances in renewable energy.

A revised version of this article can be read here.

In the past few years, Antarctica has moved to the centre of the debate about the future of climate change and our biophysical system, due to (1) collapse of glaciers into the sea and (2) dramatic shrinkage in sea ice. These events have raised the scientifically-based alarm level about future climate and weather prospects.

What follows is a simplified account of the basic mechanisms that drive Earth's climate, including the alarming trends in Antarctica, followed by a brief assessment of prospects for slowing climate change.

We begin with the trend of global average temperature from 1850. The period from 1850 to 1900 is commonly called "the pre-industrial period" in the climate community, and its average temperature is taken as the baseline for measuring increases in temperature since then. This is misleading, because 1850-1900 is in the Little Ice Age, when temperatures were abnormally low. Taking this period as the baseline has the effect of exaggerating the "abnormality" of current high temperatures.

Global temperature increased slowly from 1900 to 1980 and after 1980 increased fairly fast. Each decade since the 1980s has been the hottest on record. But the short-term trend flattened between 2013 and 2022. Most climate scientists describe this as merely a "pause" or "hiatus", and are confident that the longer-term upward trend is resuming.

The determinants of climate

The Earth's climate system is controlled by two basic mechanisms. The first mechanism is the several Milankovitch (M) cycles, which refer to the solar system of the Earth as it rotates and wobbles and tilts around the Sun, changing the amount of radiation hitting Earth and its regions.

The second mechanism is the thermostatic behavior of climate: when it gets too hot, climate cools, and vice versa. The history of temperature over the past million years shows a remarkably robust thermostatic pattern, that when temperature reaches around 1C above the present average, global cooling sets in, and when it reaches around 4C below the present average, global warming sets in. The mechanism works through the influence of temperature on Earth's two turbulent fluids, air and water.

In short, temperature is affected both by the external M cycles and by the Earth's internal thermostatic climate system.

The simple explanation for increasing global temperature since 1980 is that it is due to human activities that excessively raise the stock of greenhouse gases (GHG) in the atmosphere. This is correct as far as it goes, but too simple. It predicts that global temperature will continue to rise into the unlimited future until the stock of GHG falls. But the theory ignores the complicated thermostatic mechanism of the climate system that reacts to the higher temperature and could cause temperature to fall sometime in the future. The thermostatic effect will interact with the M cycles, which are in a mildly cooling phase at present, acting to reinforce the thermostatic effect battling against the GHG warming effect.

To understand the thermostatic mechanism and how it could lead to lower temperatures, we have to start with the image of Earth's climate system made up of two turbulent fluids interacting with each other: water and air, which are differentially heated and cooled by the Sun.

Water

Water comes in three phases: liquid, solid and vapour.

One of the most important water currents is the Great Conveyor Belt (GCB). It flows in irregular circles around all the oceans; in the Atlantic Ocean nearly from one pole to the other and between North America and Europe in the northern portions. The current speeds up and slows down over centuries. On average it takes about a thousand years for a water molecule to travel around the whole circuit.

The oceans have absorbed over 90 percent of the excess heat produced by human activity over the past 50 years (Antarctic and Southern Ocean Coalition, n.d.) In its Gulf Stream and North Atlantic portions the GCB transports a vast amount of heat, equivalent to one million nuclear reactors, to northern Europe. Increasing temperature in polar regions might release a massive flood of fresh water from increased rain and melting glaciers to cause the GCB to slow and cool, causing the higher latitudes north and south to cool substantially.

Ice

Partly because warm flows to cool, not the reverse, the polar regions are warming faster than any other large region on the globe. Antarctic sea ice has decreased 40% over the past few years. This creates loss of regional albedo or whiteness: the loss of reflection of radiation back into space, which increases warming . Glacier melting is accelerating in both polar regions, including giant glaciers in East Antarctica previously thought to be stable. This could cause dramatic sea level rise by tens of meters. This mechanism then feeds into the possible slowing and cooling of the GCB, just discussed.

Water vapour and rain

As global temperature rises the oceans evaporate more water vapour into the atmosphere, where it acts as the single most powerful greenhouse gas. Most of the tropics have already reached the saturation point of water vapour, intensifying rain and flooding. The water vapour spreads into cooler temperature regions, raising temperature, rain, flooding and snow.

Future

If the history of climate cycles over the past million years is a guide, global temperature will continue to increase as long as the stock of GHG in the atmosphere keeps increasing, up to the point where the combination of thermostatic mechanisms and M cycles acts in force to slow down the rise and sends it into reverse. This may well happen when the temperature is only one or two degrees centigrade above the present level. The transition will be accompanied by more violent weather, rapidly rising oceans, large changes in regional climates.

We think that the current dramatic improvements in the *human system* for slowing climate change — renewable energy technologies combined with policies for spreading them — will soon accelerate the rate of fall in GHG emissions. The induced effect of slowing temperature rise will be helped by the *natural system* of thermostatic climate control coupled with the present cooling phase of the M cycles. The combination could substantially slow global warming – and ease a violent transition to global cooling.

References

- Antarctic and Southern Ocean Coalition, n.d., "Heating oceans", Heating Oceans – Antarctic and Southern Ocean Coalition
- Seckler, David, 2024, "Preface to the second edition", *An Essay on Global Warming and Cooling: Second Edition.* (Forthcoming)

- Wade, Robert, 2021, "What is the harm in forecasting catastrophe from man-made global warming?" *Global Policy*, July 22 2024

The views expressed in this post are those of the author and in no way reflect those of the International Development LSE blog or the London School of Economics and Political Science.

About the author

Robert H. Wade

New Zealander, educated Washington DC, New Zealand, Sussex University. Worked at Institute of Development Studies, Sussex, 1972-95, World Bank, 1984-88, Princeton Woodrow Wilson School 1989/90, MIT Sloan School 1992, Brown University 1996-2000.

David Seckler

David Seckler has a PhD in Economics from the London School of Economics (1959) and is Professor Emeritus of Agriculture and Resource Economics at Colorado State University. He has also worked for USAID and the Ford Foundation, and served as Director General of the International Water Management Institute.

Posted In: Climate and Environment | Climate Emergency