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PULLING BACK FROM THE BRINK

Relevant for: Environment & Disaster Management | Topic: Environmental Conservation, Sustainable Development & EIA

Just when we thought the news on climate change could not get worse, a group of scientists have published a paper in the *Proceedings of the National Academy of Sciences* deliberating on how the planet might move into a high temperature “hothouse earth” pathway from where there would be no return.

Earth’s equilibrium

We are living in a precariously equilibrated earth where the temperature is just right for ecosystems to flourish. The Holocene, which began about 12,000 years ago, is the stable epoch during which *Homo sapiens* settled and developed agriculture and other technological innovations. These led to social and economic transformations, which have brought the world to this juncture. Human activity, supported by the burning of fossil fuels and deforestation, led to an increase in greenhouse gas (GHG) emissions that are now causing global warming. This time period, the epoch when humans play a dominant role in shaping the earth systems, is being referred to as the Anthropocene.

The delicate equilibrium of the biosphere/earth system has to do with processes that amplify or dampen warming. For instance, melting of Greenland ice increases open waters that absorb more sunlight and then increase warming and cause further melting. This is a positive feedback. With the increase in carbon dioxide (CO2), chemical-weathering increases and removes CO2 from the atmosphere over geological time — an example of a negative feedback. When positive feedbacks become stronger than the negative ones, the system may change abruptly and get pushed out of equilibrium. The earth and its systems have shifted between alternative states through long-term processes over its geological history. Now, it appears we are approaching some critical thresholds.

Tipping point

The paper identifies a threshold beyond which the earth’s systems are no longer able to stabilise at intermediate rises in temperature. The authors point out that technology trends and decisions taken in the next decade or two will determine the path of the earth system over the next hundreds of thousands of years.

Many feedbacks respond either continuously or show abrupt change. A geophysical tipping point is a threshold beyond which a system moves from one stable state to another. This study indicates that crossing a threshold (roughly determined to be about 2º Celsius warmer than pre-industrial times) would lead to the tumbling of a series of tipping points, like a set of dominoes. The destruction of the Amazon forest due to wildfires, the loss of permafrost with warming, the weakening of CO2 absorption by the oceans or the melting of polar ice caps, among many other slow-moving catastrophes, are examples. The authors provide over a dozen examples of regional climate tipping points. If many tipping points tumble beyond 2ºC (as suggested by the scientists), it would irrevocably disrupt ecosystems and societies and there would be runaway climate change, taking us to a hothouse earth.

The authors identify three clusters of tipping-linked cascades, out of human control, that could happen over time with rising temperatures.

Atmospheric concentrations of CO_2 (now over 400 ppm) are responsible for global average temperatures that are about a degree Celsius higher than at pre-industrial times. To find another time on earth with these levels, we need to go back some 3-4 million years to the mid-Pliocene, when sea levels were 10-22 m higher. The authors consider this stage to remain accessible only if there is a great deal of concerted effort in a remarkably short period.

In the mid-Miocene (about 15-17 million years ago), CO_2 concentrations were 300-500 ppm and sea levels were 10-60 m higher than today. This is where the earth is possibly headed with continuing GHG emissions. Even if the Paris Agreement of 2015 is implemented and we managed to keep warming below 2º C or even 1.5º C, the risk of a cascade of feedbacks that pushes the earth into the hothouse path may be unavoidable. In order to stabilise the earth, we would have to recognise and then carry out deliberate, sustained action to secure earth systems and also adapt to a warmer world. Some of these feedback effects, such as loss of Arctic ice, could be reversed over a few hundred years, but others such as Antarctic ice would take much longer.

Global emissions have not plateaued, reportedly having risen by 1.4% last year. According to the authors, deep cuts in GHG emissions, increasing carbon sinks, finding ways to remove CO_2 and perhaps even deflecting solar radiation to modify the energy balance would all be needed along with adapting to living in a warmer world.

Case for change

Technological solutions alone are insufficient. Fundamental shifts in social values and economic mores are essential. The changes required and ways to make them in an ethical manner are still being debated, with a lot of uncertainty on whether these can be accomplished.

Given history and the state of the biosphere, some scientists are not hopeful about avoiding the hothouse path. Others like James Hansen believe that it could still be avoided and the earth could stabilise at a rise below 2º C through infrastructural, societal and institutional transformations. Incremental changes along with increasing contributions from renewables and improvements in energy efficiencies would not be sufficient. There should instead be major changes in technological innovation, behaviour, values and governance. This is an unprecedented challenge for humanity.

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