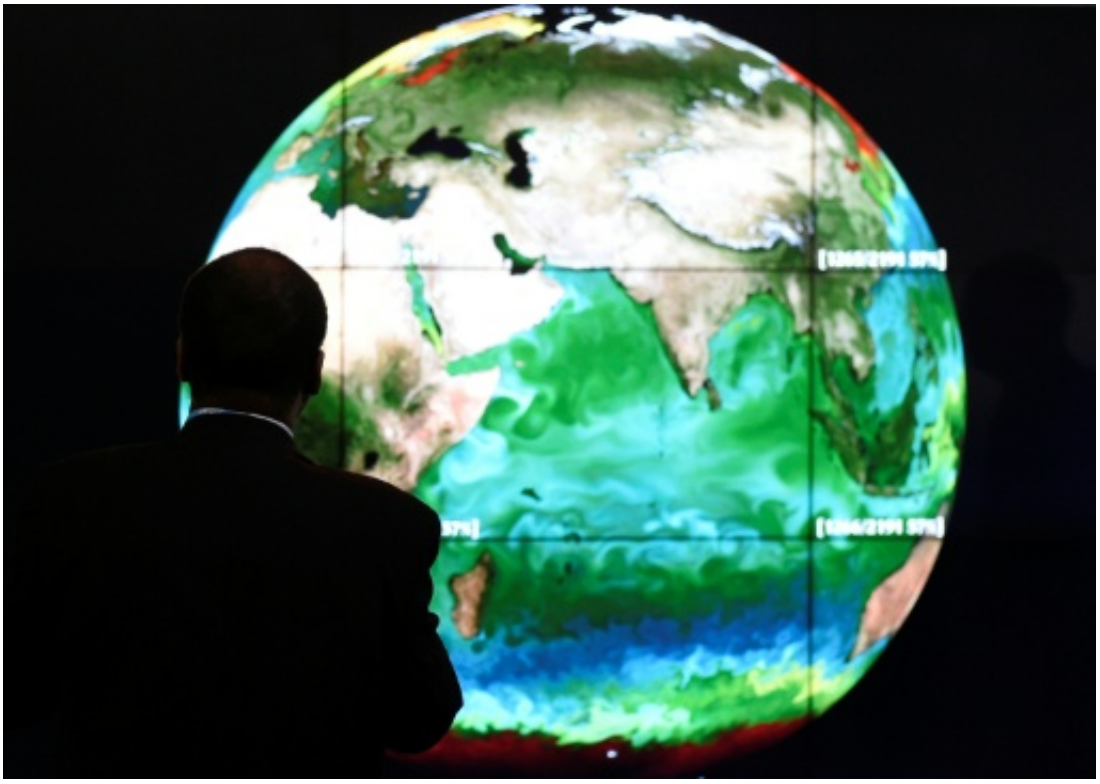
Climate science bedeviled by 'tipping points'

January 19 2017, by Marlowe Hood



Concentrations of CO2 in the atmosphere today are higher than any time in the last three million years, and are increasing more rapidly than at any point in the last 66 million years

Of the many things that keep climate scientists awake at night, tipping points may be the scariest.

To start with, these thresholds for deep, sometimes catastrophic change in the complex web of Earth's natural forces, caused by man-made

global warming, are largely invisible.

You can't see them on the horizon, and could easily cross one without noticing.

Also, there is no turning back—at least not on a human timescale.

Ice sheets with enough frozen water to lift sea levels more than a dozen metres; powerful ocean currents that keep bone-chilling winters at bay on both sides of the Atlantic; monsoon rains upon which hundreds of millions in Asia depend for food—all are at risk of irretrievable disruption.

"There are points-of-no-return where, for example, a certain amount of warming triggers unstoppable collapse of glaciers off of Antarctica, even if the planet cools again," explained Ben Strauss, vice president of the US research group Climate Central.

Think of someone leaning back on two legs of a chair, suggests Sybren Drijfhout, a professor at the University of Southampton.

"The tipping point is when you're exactly in between two states," he said. "A tiny perturbation"—a gentle shove—"will make the system tip over."

In the case of ice sheets, how this might happen is well understood.

Thick ice shelves astride land and sea in Greenland and Antarctica act as giant bulkheads, preventing even larger inland ice masses from sliding into the ocean.

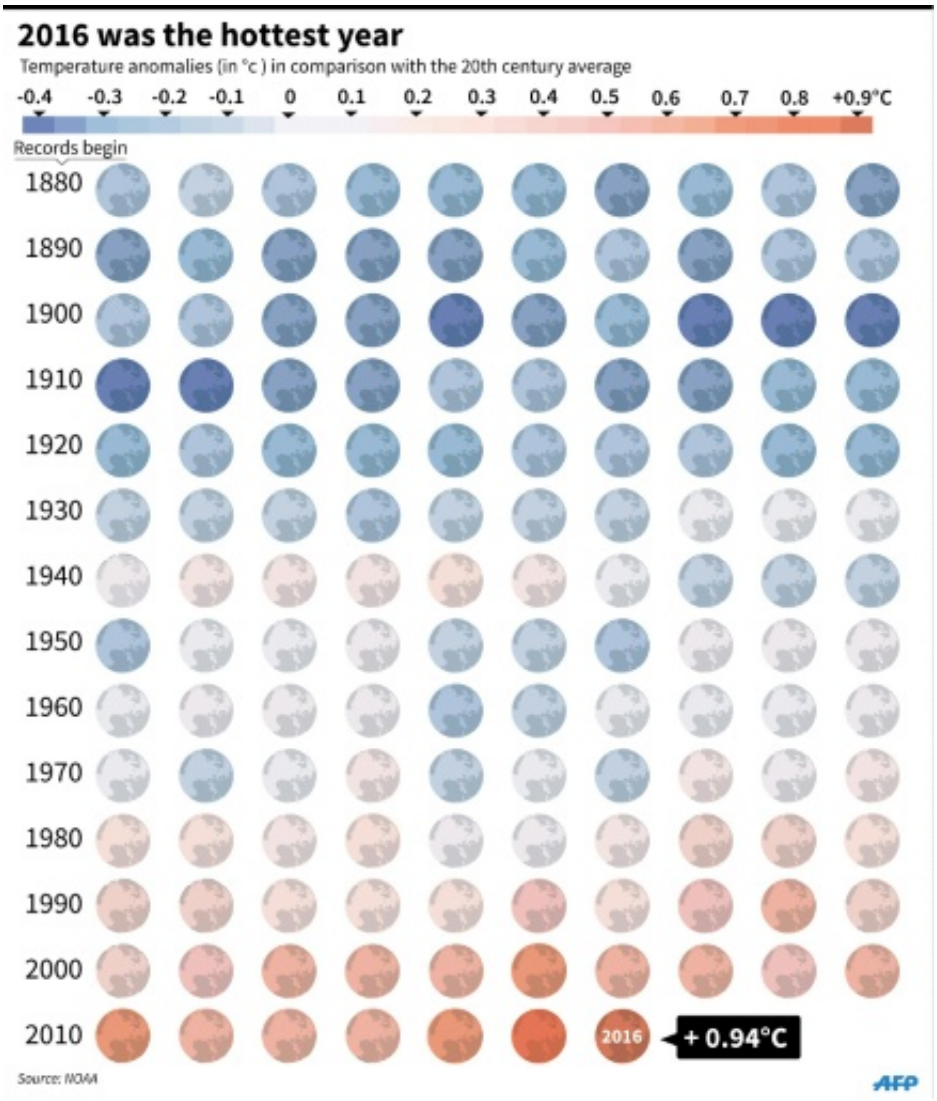
West Antarctica's would lift the global watermark by at least six metres.

Permafrost (not)

Were these ice dams—eroded by warming water (below) and air (above)—to fall away, "the blocking features may not be able to re-form even after hundreds of years of cooling," Strauss told AFP.

As if by way of illustration, an ice block nearly 100 times the size of Manhattan is poised to break off West Antarctica's Larsen C ice shelf within months, scientists said earlier this year.

But if experts agree on the mechanics, they sharply disagree on how much a region would need to warm up to trigger collapse, or how long it would take.



2016 the hottest year

"We don't know exactly when we might pass these points—or whether we already have crossed some of them," Strauss added.

James Hansen, former head of NASA's Goddard Institute for Space Studies, has argued that West Antarctica could disintegrate rapidly, adding up to a couple of metres to ocean levels this century.

But most experts say humanity is still within a "safe operating space" for the ice sheets, even if the margin for error has become uncomfortably thin.

Other tipping points could trigger the natural release, on a massive scale, of the same greenhouse gases that humans have spewed into the atmosphere, further destabilising the delicate balance that has made our planet so liveable over the last 11,000 years.

Methane and CO2 locked in the increasingly misnamed permafrost of Russia, Canada and northern Europe is equivalent to roughly 15 years worth of global emissions from fossil fuels at today's levels.

The release of these gases—negligible so far—would, in turn, aggravate the problem in a vicious circle of warming, what scientists call a positive feedback loop.

Likewise, rock-like formations in shallow ocean waters called methane hydrates, prime suspects for episodes of rapid global warming millions of years ago. Little is known about what it would take to trigger their disintegration today.

No perfect analogue

"Even if global warming is limited to below two degrees Celsius (3.6 degrees Fahrenheit)"—the red line drawn in the 196-nation Paris climate pact—"some important tipping elements may already be harmed or transformed," Hans Joachim Schellnhuber, director of the Potsdam Institute for Climate Impact Research in Germany, commented recently in the journal *Nature Climate Change*.

Even so, the promise of holding global warming "well below 2 C" is a reasonable guarantee that such scenarios can be avoided, he said.

But scientists also admit their tools are better at measuring steady, linear progressions than sudden shifts.

"In general, climate models are too stable," said Drijfhout. "They are calibrated to the present climate, have difficulty simulating the abrupt changes we have witnessed in the geological past."

Looking for lessons from the past also has limits, notes Didier Swingedouw of the University of Bordeaux.

"The problem is that there is no perfect analogue to what we will experience in the near future."

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