New Climate Risk Classification Created to Account for Potential "Existential" Threats

Researchers identify a one-in-20 chance of temperature increase causing catastrophic damage or worse by 2050

Sep 14, 2017

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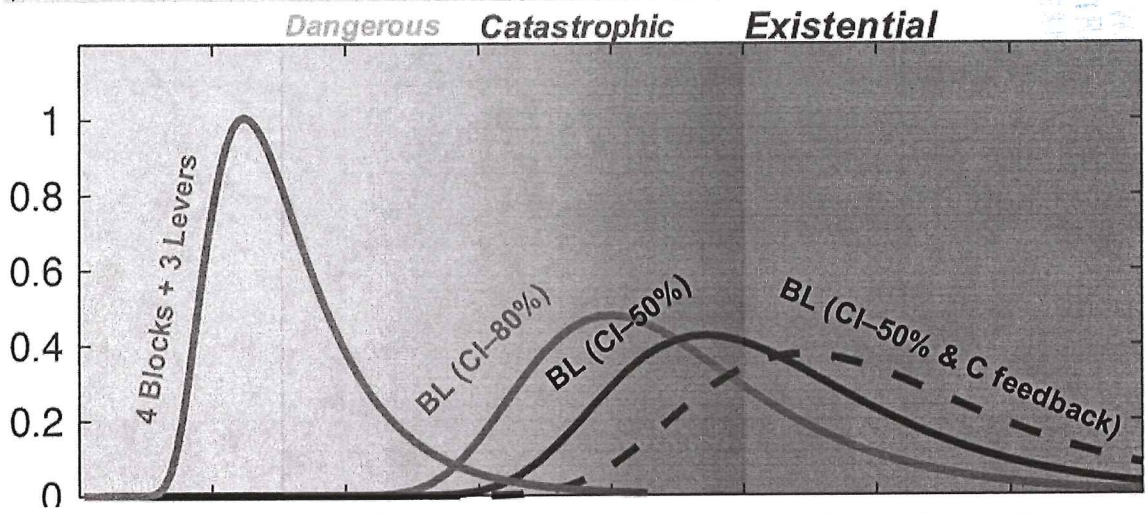


Researchers projected warming scenarios that vary based on what societal actions are taken to reduce emissions

A new study evaluating models of future climate scenarios has led to the creation of the new risk categories "catastrophic" and "unknown" to characterize the range of threats posed by rapid global warming. Researchers propose that unknown risks imply existential threats to the survival of humanity.

These categories describe two low-probability but statistically significant scenarios that could play out by century's end, in a new study by Veerabhadran Ramanathan, a distinguished professor of climate and atmospheric sciences at Scripps Institution of Oceanography at the University of California San Diego, and his former Scripps graduate student Yangyang Xu, now an assistant professor at Texas A&M University.

The risk assessment stems from the objective stated in the 2015 Paris Agreement regarding climate change that society keep average global temperatures "well below" a 2°C (3.6°F) increase from what they were before the Industrial Revolution.

Even if that objective is met, a global temperature increase of 1.5°C (2.7°F) is still categorized as "dangerous," meaning it could create substantial damage to human and natural systems. A temperature increase greater than 3°C (5.4°F) could lead to what the researchers term "catastrophic" effects, and an increase greater than 5°C (9°F) could lead to "unknown" consequences which they describe as beyond catastrophic including potentially existential threats. The specter of existential threats is raised to reflect the grave risks to human health and species extinction from warming beyond 5°C, which has not been experienced for at least the past 20 million years.

The scientists term warming probability of five percent or less as a "low-probability high-impact" scenario and assess such scenarios in the analysis "Well Below 2°C: Mitigation strategies for avoiding dangerous to catastrophic climate changes," which appears today in the journal *Proceedings of the National Academy of Sciences*.

Ramanathan and Xu also describe three strategies for preventing the gravest threats from taking place.

"When we say 5 percent-probability high-impact event, people may dismiss it as small but it is equivalent to a one-in-20 chance the plane you are about to board will crash," said Ramanathan. "We would never get on that plane with a one-in-20 chance of it coming down but we are willing to send our children and grandchildren on that plane."

The researchers defined the risk categories based on guidelines established by the Intergovernmental Panel on Climate Change (IPCC) and previous independent studies. "Dangerous" global warming includes consequences such as increased risk of extreme weather and climate events ranging from more intense heat waves, hurricanes, and floods, to prolonged droughts. Planetary warming between 3°C and 5°C could trigger what scientists term "tipping points" such as the collapse of the West Antarctic Ice Sheet and subsequent global sea-level rise, and the dieback of the Amazon rainforest. In human systems, catastrophic climate change is marked by deadly heat waves becoming commonplace, exposing over 7 billion people to heat related mortalities and famine becoming widespread. Furthermore, the changes will be too rapid for most to adapt to, particularly the less affluent, said Ramanathan.

Risk assessments of global temperature rise greater than 5°C have not been undertaken by the IPCC. Ramanathan and Xu named this category "unknown??" with the question marks acknowledging the "subjective nature of our deduction." The existential threats could include species extinctions and major threats to human water and food supplies in addition to the health risks posed by exposing over 7 billion people worldwide to deadly heat.

With these scenarios in mind, the researchers identified what measures can be taken to slow the rate of global warming to avoid the worst consequences, particularly the low-probability high-impact events. Aggressive measures to curtail the use of fossil fuels and emissions of so-called short-lived climate pollutants such as soot, methane and HFCs would need to be accompanied by active efforts to extract CO2 from the air and sequester it before it can be emitted. It would take all three efforts to meet the Paris Agreement goal to which countries agreed at a landmark United Nations climate conference in Nov 2015.

"This report shines a bright light on the existential threat that climate change presents to all humanity," said Calif. Governor Edmund G. Brown Jr., who has collaborated with Ramanathan on carbon neutrality measures in the state. "Scientists have many ideas about how to reduce emissions, but they all agree on the urgency of strong and decisive action to remove carbon from the economy."

Xu and Ramanathan point out that the goal is attainable. Global CO2 emissions had grown at a rate of 2.9 percent per year between 2000 and 2011, but had slowed to a near-zero growth rate by 2015. They credited drops in CO2 emissions from the United States and China as the primary drivers of the trend. Increases in production of renewable energy, especially wind and solar power, have also bent the curve of emissions trends downward. Other studies have estimated that there was by 2015 enough renewable energy capacity to meet nearly 24 percent of global electricity demand.

Short-lived climate pollutants are so called because even though they warm the planet more efficiently than carbon dioxide, they only remain in the atmosphere for a period of weeks to roughly a decade whereas carbon dioxide molecules remain in the atmosphere for a century or more. The authors also note that most of the technologies needed to drastically curb emissions of short-lived climate pollutants already exist and are in use in much of the developed world. They range from cleaner diesel engines to methane-capture infrastructure.

"While these are encouraging signs, aggressive policies will still be required to achieve carbon neutrality and climate stability," the authors wrote.

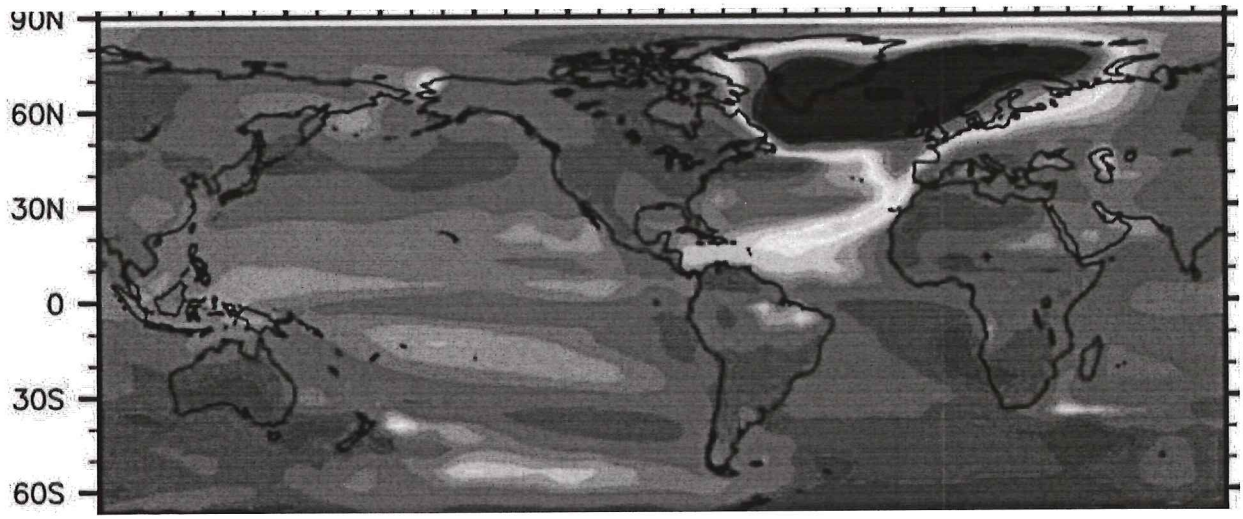
The release of the study coincides with the start of Climate Week NYC in New York, a summit of business and government leaders to highlight global climate action. Ramanathan and colleagues will deliver a complementary report detailing the "three-lever" mitigation strategy of emissions control and carbon sequestration on Sept. 18 at the United Nations. That report was produced by the Committee to Prevent Extreme Climate Change, chaired by Ramanathan, Nobel Prize winner Mario Molina of UC San Diego, and Durwood Zaelke, who leads an advocacy organization, the Institute for Governance and Sustainable Development, with 30 experts from around the world including China and India.

In what seems to be a leaf out of a fiction movie, one that's already been made 12 years ago, climate scientists have issued a warning that could have severe ramifications for the world at large, and the Atlantic rim countries, especially those in Europe, specifically.

While it sounds very similar to the plot of the 2004 disaster film "The Day After Tomorrow," the warning is not a piece of fiction. According to a paper published this week in the journal Science Advances said most climate models wrongly assume the relative stability of the Atlantic Meridional Overturning Circulation (AMOC). This circulation system carries warm surface water toward Greenland, which sinks as it cools and then flows back toward the equator closer to the seafloor.

"Observationally based freshwater budget analyses suggest that the AMOC is in an unstable regime susceptible for large changes in response to perturbations. By correcting the model biases, we show that the AMOC collapses 300 years after the atmospheric CO2 concentration is abruptly doubled from the 1990 level. Compared to an uncorrected model, the AMOC collapse brings about large, markedly different climate responses: a prominent cooling over the northern North Atlantic and neighboring areas, sea ice increases over the Greenland-Iceland-Norwegian seas and to the south of Greenland, and a significant southward rain-belt migration over the tropical Atlantic," the study said.

Effects of the resultant cooling would include the spread of Arctic sea ice, and a drop in surface temperatures — as much as 4.3 degrees Fahrenheit over the North Atlantic Ocean and a far bigger 12.6 degrees Fahrenheit over northwest Europe. Tropical rain belts in the Atlantic would also move farther south.



AMOC

More

North Atlantic Ocean cooling scenario following collapse of Atlantic Meridional Overturning Circulation. Photo: Scripps Institute of Oceanography

Led by Wei Liu of Yale University, researchers from Yale and the Scripps Institute of Oceanography in the University of California, San Diego, removed the stability bias and re-ran climate model simulations to arrive at their conclusions.

"The significance of our study is to point out a systematic bias in current climate models that hinders a correct climate projection. A bias-corrected model puts the AMOC in a realistic stability regime and predicts a future AMOC collapse with prominent cooling over the northern North Atlantic and neighboring areas. Therefore, our study has enormous implications for regional and global climate change," Wei said in a statement.

The study is titled "Overlooked possibility of a collapsed Atlantic Meridional Overturning Circulation in warming climate."