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**An Even Warmer Future Ahead**

**A new model finds that the world could be up to 5.5 degrees warmer in 2050 than it was in the 1990's.**

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**THE GIST**

* Many variables go into climate predictions and each variable is rife with uncertainty.
* Twenty-five separate climate models contributed to the IPCC’s most recent set of climate predictions.
* A warming of more than 5°F is possible by 2050.

International Space Station astronaut Ron Garan took this picture of the rising sun as the station flew along a path between Rio de Janeiro, Brazil and Buenos Aires, Argentina in 2011.

By 2050, global average temperatures will probably be between 1.4°C and 3°C (between about 2.5°F to 5.5°F) higher than they were from 1960 to 1990.

A lot is riding on global warming predictions for everyone from biologists to policy-makers to farmers. And while the climate scientists who create the models want to get the numbers right, the new study, which used many thousands of personal computers to both refine and raise previous estimates of future temperatures, points out just how hard it is to predict the future of something as multi-faceted and complex as climate.

“We’ve shown that basically we can find a much larger warming by 2050 than we had previously anticipated,” said Dan Rowlands, a climate scientist at the University of Oxford in the United Kingdom. “This level of warming has not necessarily been seen by a complex climate model before.”

When scientists meet to develop climate predictions for the Intergovernmental Panel on Climate Change, they consider all available data on every conceivable detail that might influence climate, while also making a number of assumptions.

Some of those assumptions have to do with human behavior and our projected levels of greenhouse gas emissions. Others are more technical, as scientists have to factor in how sure they are about the variables involved in processes like cloud formation around ice crystals or temperature mixing in the oceans. Much is still unknown about how all those processes work and how they ultimately contribute to temperature changes.

To create a more refined model that included known levels of uncertainty about all of those details, Rowland and colleagues picked one of 25 climate models used by the IPCC in a climate scenario called A1B, which assumes greenhouse gas emissions will generally continue to increase at their current levels, with some reduction in sulphate aerosols. In a 2007 report, the IPCC predicted that global temperatures would rise by about 1.5 to 2°C (about 2.5 to 3.5 °F) by 2050.

Then, the researchers took on the herculean task of running the model thousands of times with slight perturbations to each climate detail. The job was too much for any one computer to deal with, so the team enlisted the help of tens of thousands of people who allowed computer simulations to run in the background on their personal computers for up to six months.

“These are horrendously complex computer codes,” Rowlands said. They have one, two, three million lines of code. We are indebted to our participants. This shows what citizen science can contribute to top-level scientific research.”

Narrowing the model’s results to scenarios that were realistic based on past trends, the researchers report in the journal Nature Geoscience, that global temperatures could be as much as 3°C (5.4°F) higher in 40 years than they were in the 60’s through the 90’s.

That kind of change could have profound effects on ecosystems, according to the IPCC, with higher rates of coral bleaching, extinctions and melting ice.

The new study represents a major technical advance, said Isaac Held, a climate modeler at NOAA’s Geophysical Fluid Dynamics Laboratory at Princeton University in New Jersey. But, he said, the results should not be taken as the last word on what to expect from global warming.

Instead, the next IPCC report will likely take the new findings into account along with all other available data to come up with ever-more accurate predictions, particularly on a more regional basis.

“We can generate models with quite different climate responses over the next 50 years, and a large subset of those will look reasonable when compared with the last 50 years,” Held said. “This is a work in progress.”