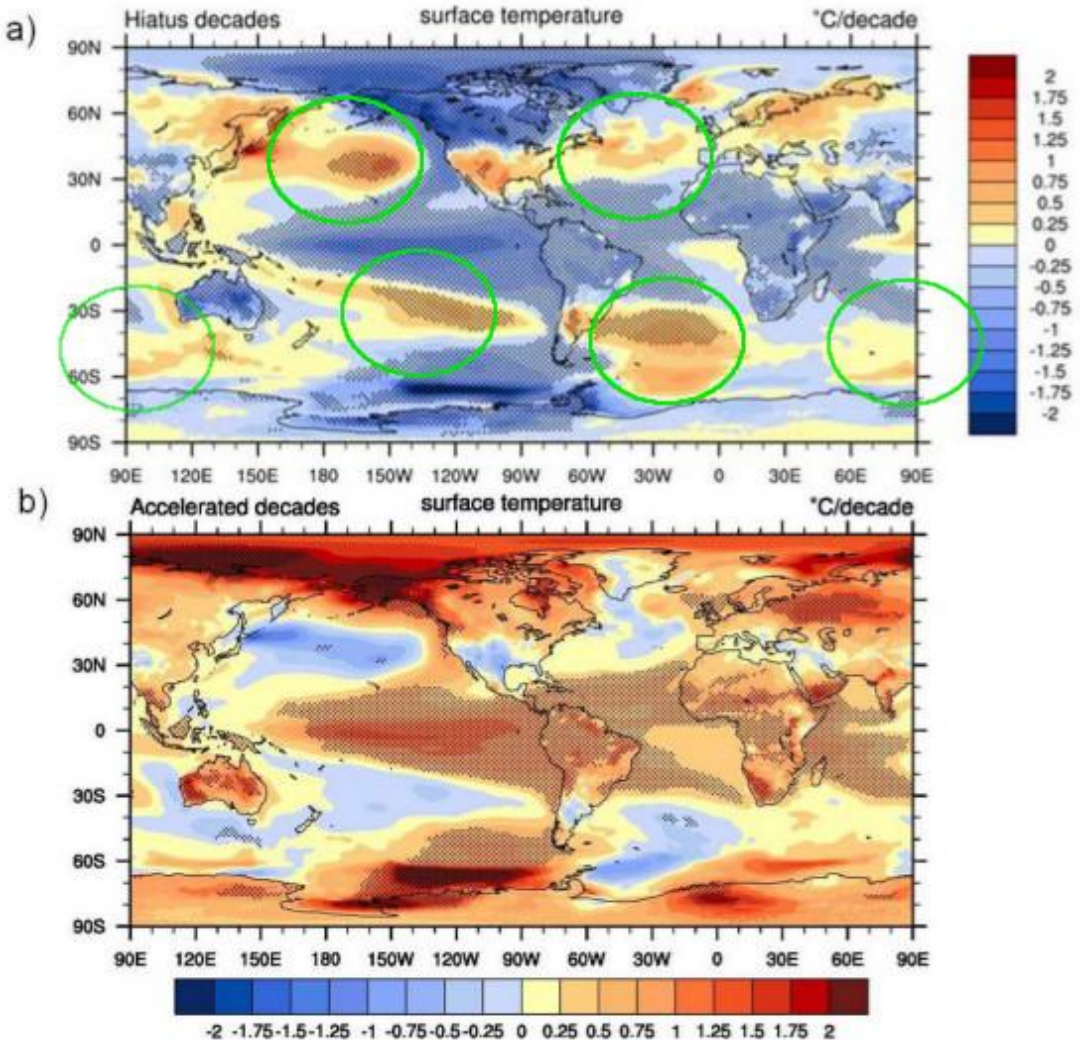
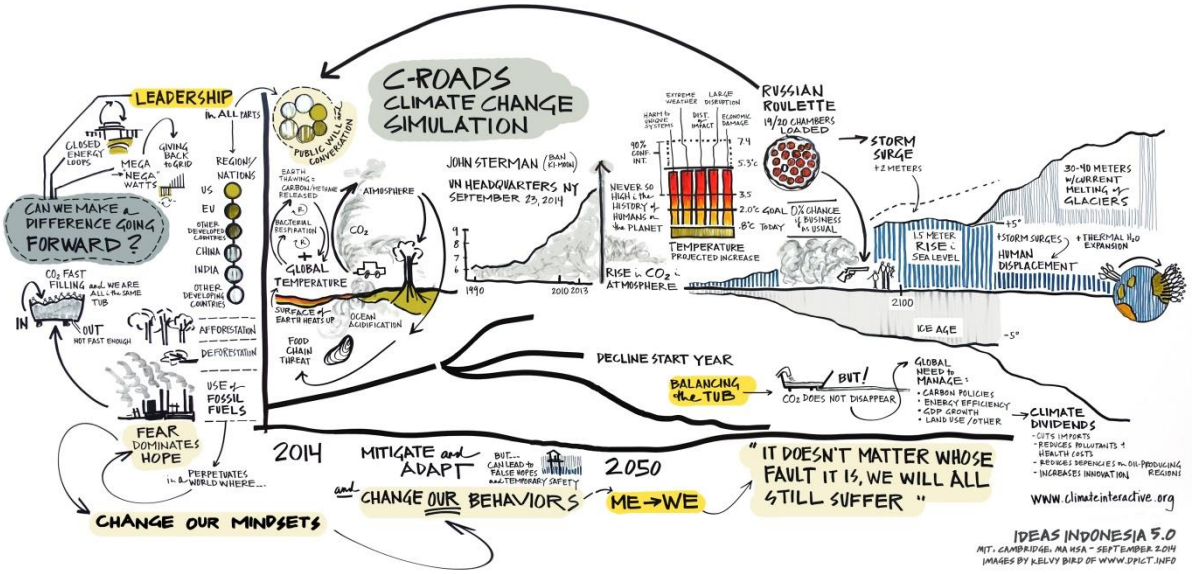
The climate change simulations predict DIRE CONSEQUENCES



The climate change simulations that best capture current planetary conditions are also the ones that predict the most dire levels of human-driven warming, according to a statistical study released in the journal Nature Wednesday.

The study, by Patrick Brown and Ken Caldeira of the Carnegie Institution for Science in Stanford, Calif., examined the high-powered climate change simulations, or “models,” that researchers use to project the future of the planet based on the physical equations that govern the behavior of the atmosphere and oceans.

The researchers then looked at what the models that best captured current conditions high in the atmosphere predicted was coming. Those models generally predicted a higher level of warming than models that did not capture these conditions as well.



The science and policy of environmental issues.

The study adds to a growing body of bad news about how human activity is changing the planet's climate and how dire those changes will be. But according to several outside scientists consulted by The Washington Post, while the research is well-executed and intriguing, it's also not yet definitive.

The government's National Climate Assessment cited human influence as the "dominant cause of the observed warming since the mid-20th century." (Patrick Martin/The Washington Post)

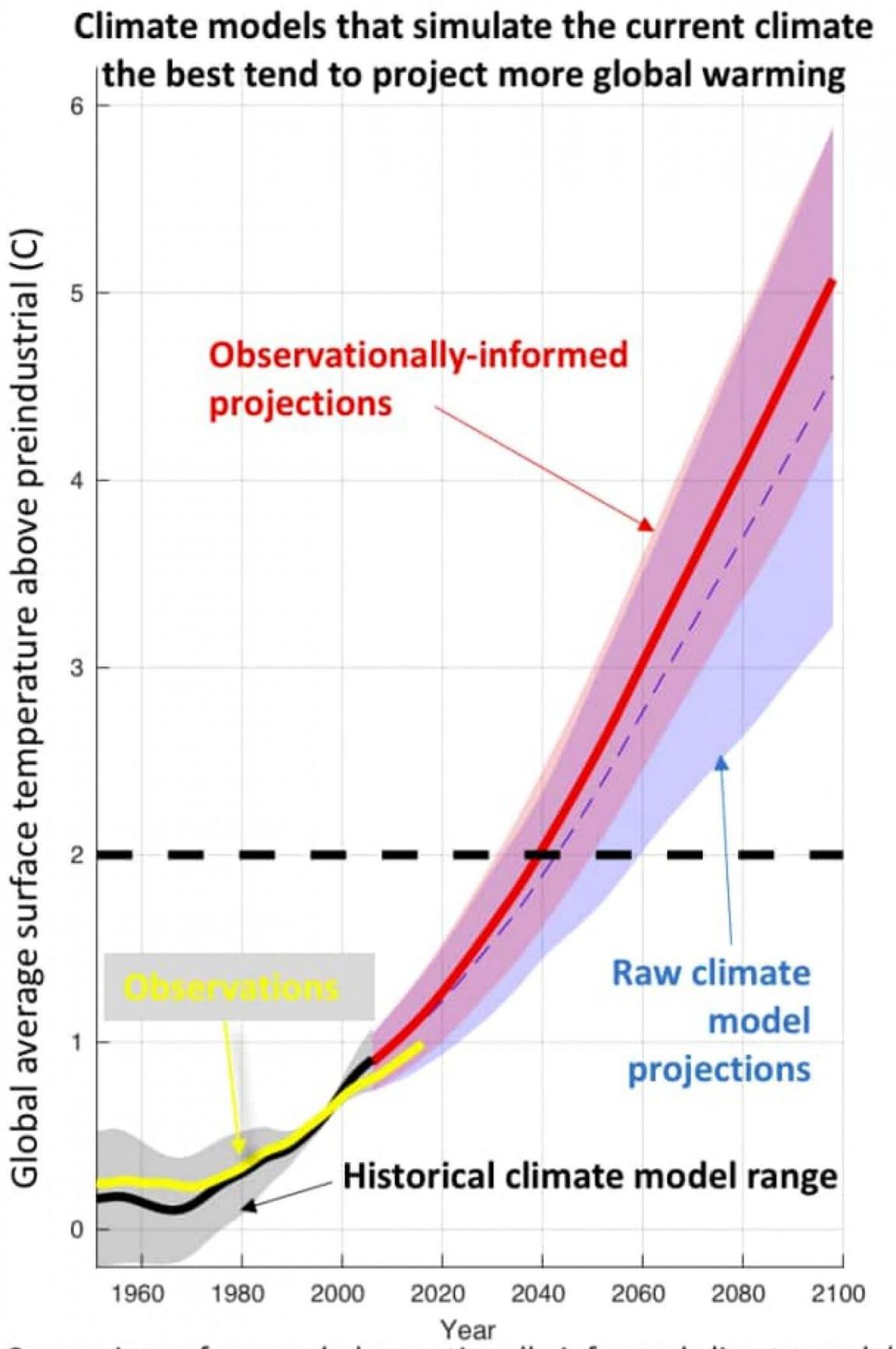
"The study is interesting and concerning, but the details need more investigation," said Ben Sanderson, a climate expert at the National Center for Atmospheric Research in Boulder, Colo.

Brown and Caldeira are far from the first to study such models in a large group, but they did so with a twist.

In the past, it has been common to combine together the results of dozens of these models, and so give a range for how much the planet might warm for a given level of carbon dioxide emitted into the atmosphere. That's the practice of the leading international climate science body, the United Nations' Intergovernmental Panel on Climate Change.

Instead, Brown and Caldeira compared these models' performance with recent satellite observations of the actual atmosphere and, in particular, of the balance of incoming and outgoing radiation that ultimately determines the Earth's temperature. Then, they tried to determine which models performed better.

"We know enough about the climate system that it doesn't necessarily make sense to throw all the models in a pool and say, we're blind to which models might be good and which might be bad," said Brown, a postdoc at the Carnegie Institution.



Comparison of raw and observationally-informed climate model projections from Brown and Caldeira (2017, *Nature*)

The research found the models that do the best job capturing the Earth's actual "energy imbalance," as the authors put it, are also the ones that simulate more warming in the planet's future.

Under a high warming scenario in which large emissions continue throughout the century, the models as a whole give a mean warming of 4.3 degrees Celsius (or 7.74 degrees Fahrenheit), plus or minus 0.7 degrees Celsius, for the period between 2081 and 2100, the study noted. But the best models, according to this test, gave an answer of 4.8 degrees Celsius (8.64 degrees Fahrenheit), plus or minus 0.4 degrees Celsius.

Overall, the change amounted to bumping up the projected warming by about 15 percent. The researchers presented this figure to capture the findings:

When it comes down to the question of why the finding emerged, it appears that much of the result had to do with the way different models handled one of the biggest uncertainties in how the planet will respond to climate change.

"This is really about the clouds," said Michael Winton, a leader in the climate model development team at the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration, who discussed the study with The Post but was not involved in the research.

Clouds play a crucial role in the climate because among other roles, their light surfaces reflect incoming solar radiation back out to space. So if clouds change under global warming, that will in turn change the overall climate response.

How clouds might change is quite complex, however, and as the models are unable to fully capture this behavior due to the small scale on which it occurs, the programs instead tend to include statistically based assumptions about the behavior of clouds. This is called "parameterization."

But researchers aren't very confident that the parameterizations are right. "So what you're looking at is, the behavior of what I would say is the weak link in the model," Winton said.

This is where the Brown and Caldeira study comes in, basically identifying models that, by virtue of this programming or other factors, seem to do a better job of representing the current behavior of clouds. However, Winton and two other scientists consulted by The Post all said that they respected the study's attempt, but weren't fully convinced.

Sanderson of the National Center for Atmospheric Research, was concerned that the current study might find an effect that wasn't actually there, in part because models are not fully independent of one another — they tend to overlap in many areas.

"This approach is designed to find relationships between future temperatures and things we can observe today," he said. "The problem is we don't have enough models to be confident that the relationships are robust. The fact that models from different institutions share components makes this problem worse, and the authors haven't really addressed this fully."

“It’s great that people are doing this well and we should continue to do this kind of work — it’s an important complement to assessments of sensitivity from other methods,” added Gavin Schmidt, who heads NASA’s Goddard Institute for Space Studies. “But we should always remember that it’s the consilience of evidence in such a complex area that usually gives you robust predictions.”

Schmidt noted future models might make this current finding disappear — and also noted the increase in warming in the better models found in the study was relatively small.

Lead study author Brown argued, though, that the results have a major real world implication: They could mean the world can emit even less carbon dioxide than we thought if it wants to hold warming below the widely accepted target of 2 degrees Celsius (3.6 degrees Fahrenheit). This would mean shrinking the “carbon budget.”

The study “would imply that to stabilize temperature at 2 degrees Celsius, you’d have to have 15 percent less cumulative CO2 emissions,” he said.

The world can ill afford that — as it is, it is very hard to see how even the current carbon budget can be met. The world is generally regarded as being off track when it comes to cutting its emissions, and with continuing economic growth, the challenge is enormous.

In this sense, that the new research will have to win acceptance may be at least a temporary reprieve for policymakers, who would be in a tough position indeed if it were shown to be definitively right.

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