Global climate models do not easily downscale for regional predictions

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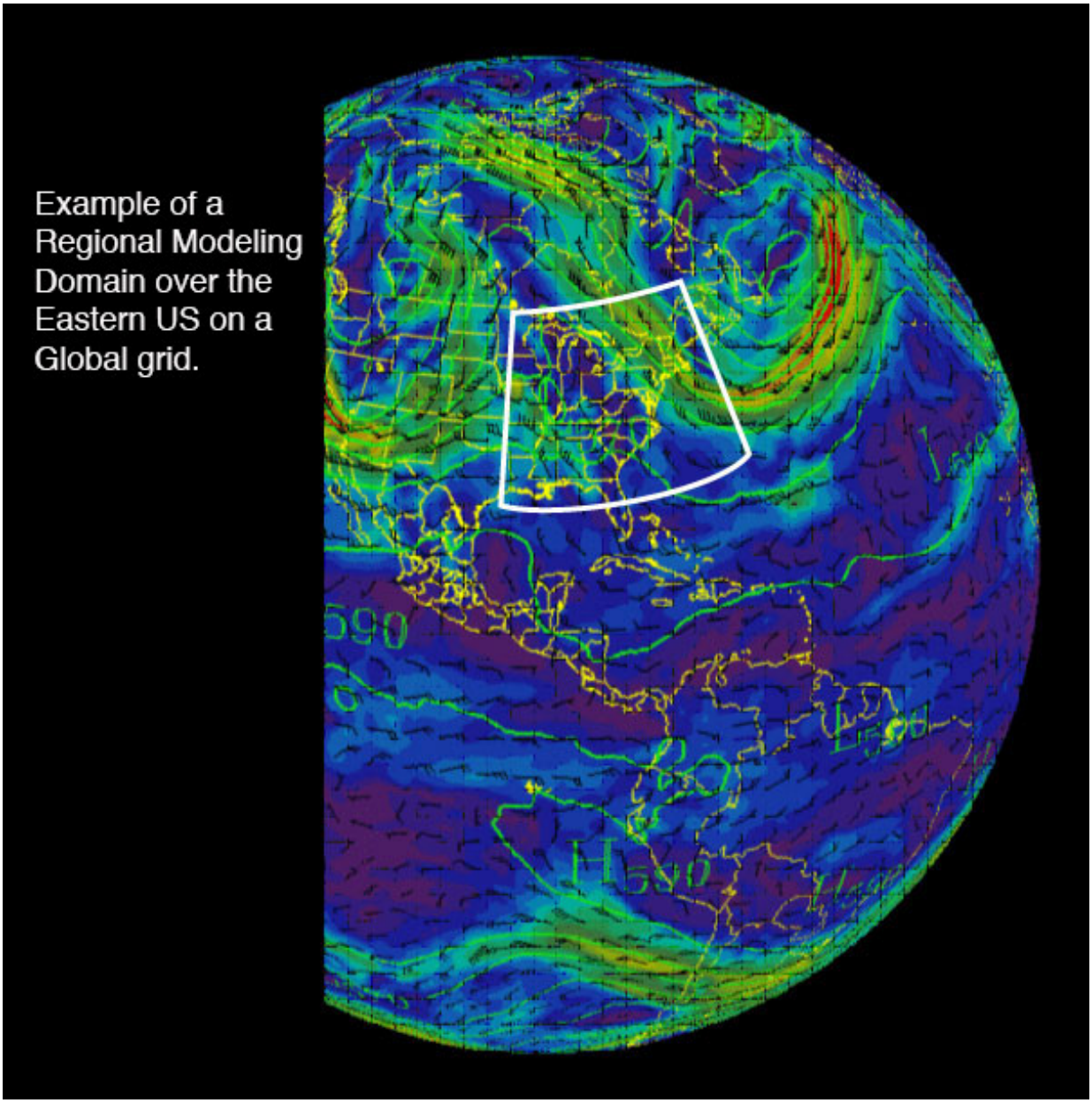

Credit: NOAA

One size does not always fit all, especially when it comes to global climate models, according to Penn State climate researchers.

"The impacts of climate change rightfully concern policy makers and stakeholders who need to make decisions about how to cope with a changing climate," said Fuqing Zhang, professor of meteorology and director, Center for Advanced Data Assimilation and Predictability Techniques, Penn State. "They often rely upon climate model projections at regional and local scales in their decision making."

Zhang and Michael Mann, Distinguished professor of atmospheric science and director, Earth System Science Center, were concerned that the direct use of climate model output at local or even regional scales could produce inaccurate information. They focused on two key climate variables, temperature and precipitation.

They found that projections of temperature changes with global climate models became increasingly uncertain at scales below roughly 600 horizontal miles, a distance equivalent to the combined widths of Pennsylvania, Ohio and Indiana. While climate models might provide useful information about the overall warming expected for, say, the Midwest, predicting the difference between the warming of Indianapolis and Pittsburgh might prove futile.

Regional changes in precipitation were even more challenging to predict, with estimates becoming highly uncertain at scales below roughly 1200 miles, equivalent to the combined width of all the states from the Atlantic Ocean through New Jersey across Nebraska. The difference

between changing rainfall totals in Philadelphia and Omaha due to global warming, for example, would be difficult to assess. The researchers report the results of their study in the August issue of Advances in Atmospheric Sciences.

"Policy makers and stakeholders use information from these models to inform their decisions," said Mann. "It is crucial they understand the limitation in the information the model projections can provide at local scales."

Climate models provide useful predictions of the overall warming of the globe and the largest-scale shifts in patterns of rainfall and drought, but are considerably more hard pressed to predict, for example, whether New York City will become wetter or drier, or to deal with the effects of mountain ranges like the Rocky Mountains on regional weather patterns.

"Climate models can meaningfully project the overall global increase in warmth, rises in sea level and very large-scale changes in rainfall patterns," said Zhang. "But they are uncertain about the potential significant ramifications on society in any specific location."

The researchers believe that further research may lead to a reduction in the uncertainties. They caution users of climate model projections to take into account the increased uncertainties in assessing local climate scenarios.

"Uncertainty is hardly a reason for inaction," said Mann. "Moreover, uncertainty can cut both ways, and we must be cognizant of the possibility that impacts in many regions could be considerably greater and more costly than climate model projections suggest."

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