Scientists explain why climate models can't reproduce the early-2000s global warming slowdown

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A new study led by Dr. Wei and Dr. Qiao from the First Institute of Oceanography, Ministry of Natural Resources provides an evaluation of the performance of the newly released CMIP6 models in simulating the global warming slowdown observed in the early 2000s. This study reveals that the key in simulating and predicting near-term temperate

change is to correctly separate and simulate the two distinct signals, i.e., the human-induced long-term warming trend and natural variabilities, especially those at interannual, interdecadal and multidecadal scales. This work was published in *SCIENCE CHINA Earth Sciences* on April 15th, 2021.

After the unprecedented warming over the last quarter of the 20th century, global surface temperature growth slowed unexpectedly during 1998-2013 despite the sharp increase in greenhouse gas emissions; this phenomenon is termed the global warming hiatus, or slowdown, to be more precise. The global warming slowdown challenges the existing scientific understanding of global temperature change mechanisms, and thus has been one of the most concerning issues in recent climate research and public debate.

However, the sophisticated and advanced climate models in CMIP5 could not simulate this warming slowdown. During 1998-2013, the models mostly present a rapidly warming surge which greatly deviates from the observed flat temperature time series. The models considerably overestimate the observed warming rate of the recent period. IPCC AR5 stated: "Almost all CMIP5 historical simulations do not reproduce the observed recent warming hiatus." Therefore, the simulation and prediction ability of sophisticated climate models have been questioned.

Now the CMIP6 model data are gradually released since 2020. The newly developed models include better understanding of the global temperature change mechanisms, especially more reasonable physical processes of natural variabilities. Successful simulations of the global warming slowdown are expected in the new-generation models. As the data of 28 new models become available, it is necessary to examine the ability of the CMIP6 models in addressing the recent warming slowdown.

By comparing six widely used global surface temperature datasets, a research team from First Institute of Oceanography, Ministry of Natural Resources evaluated the performance of the 28 newly released CMIP6 models in simulating the recent warming slowdown, and finds that most CMIP6 models still fail to reproduce the warming slowdown, although they present some encouraging improvements when compared with CMIP5 models.

Further, they explored the possible reasons for the difficulty of CMIP6 models in simulating the recent warming slowdown. They reveal that it is associated with the models' deficiencies in simulating the distinct temperature change signals from the human-induced long-term warming trend and/or the three crucial natural variabilities at interannual, interdecadal, and multidecadal scales.

This study reveals that the key in simulating and predicting near-term temperate change is to correctly separate and simulate the two distinct signals, i.e., the human-induced long-term warming trend and natural variabilities, especially those at interannual, interdecadal and multidecadal scales. This suggests that the key-scale variabilities require more attention in the models, considering their vital roles in modulating the warming rate change at decadal to multidecadal scales. This result can provide important insight for the simulation and prediction of near-term climate changes.

More information: Meng Wei et al, Could CMIP6 climate models reproduce the early-2000s global warming slowdown?, *Science China Earth Sciences* (2021). DOI: 10.1007/s11430-020-9740-3

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