New observations and climate model data

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For the first time, new climate observations and computer models provide a consistent picture of recent warming of Earth's tropical atmosphere.

Over the past decade, scientific evidence from a variety of sources has implicated human-caused increases in greenhouse gases as a major driver of recent climate change. A key argument used to rebut such findings relates to satellite records of temperature change in the troposphere – the lowest layer of Earth's atmosphere.

Until recently, climate modelers compared their simulations with temperatures from a single satellite dataset, which showed slight cooling of the tropical troposphere since 1979. This region of the atmosphere is predicted to warm in climate model simulations that include observed increases in greenhouse gases. The discrepancy in tropical temperature trends has been used to cast doubt on the reliability of computer models, and on their usefulness for predicting future climate changes.

Three papers published in today's edition of Science Express shed light on this debate. The first two studies revisit temperature data obtained from satellites and weather balloons, and provide compelling evidence that the tropical troposphere has warmed since 1979. The third study, led by scientists at Lawrence Livermore National Laboratory, finds that these new observational estimates of temperature change are consistent with results from state-of-the-art climate models.

The computer models analyzed in the Livermore study show that in the

deep tropics, temperature changes in the troposphere are larger than at the surface. This “amplification” effect is caused by the release of heat when moist tropical air rises and condenses into clouds. The size of the amplification effect is very similar in nearly 50 simulations performed with 19 different models.

The new satellite and weather balloon data described in the first two Science Express papers have amplification behavior that is in agreement with the model results and with basic physical theory.

“This strongly suggests that there is no longer any fundamental discrepancy between modeled and observed temperature trends in the tropical atmosphere,” said Benjamin Santer, lead author of the Livermore-led Science Express paper and a scientist in LLNL’s Program for Climate Model Diagnosis and Intercomparison. “The new observational data helps to remove a major stumbling block in our understanding of the nature and causes of climate change. Our work illustrates that progress toward an improved understanding of the climate system requires a combination of observations, theory and models.”

Santer led an international team of scientists, including Livermore researchers Stephen Klein, Karl Taylor, Peter Gleckler, Jim Boyle and Charles Doutriaux. Other team members were from the National Center for Atmospheric Research, Remote Sensing Systems of Santa Rosa, Calif., the National Oceanic and Atmospheric Administration’s Air Resource Laboratory, the Hadley Centre for Climate Prediction and Research, Lawrence Berkeley National Laboratory, NOAA’s Geophysical Fluid Dynamics Laboratory, the University of Washington, NASA Goddard Institute for Space Studies and NOAA’s National Climatic Data Center.

Source: Lawrence Livermore National Laboratory