ATMOSPHERIC TEMPERATURE CHANGE: RECENT ADVANCES AND OPEN ISSUES

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This lecture provides an overview of recent progress in improving scientific understanding of the size, rate, and causes of atmospheric temperature changes. It focuses on three areas. The first area is a brief summary of relevant findings from recent assessment reports and synthesis publications. The second area explores the use of covariance relationships – such as relationships between changes in tropical temperature and water vapor, or between changes in temperatures at different atmospheric layers – to evaluate the physical consistency of independently monitored aspects of observed climate change. These tropical covariance relationships are tightly constrained in CMIP5 and CMIP6 simulations, despite large model differences in climate sensitivity, historical external forcings, and the amplitude of natural internal variability. The same tropical covariance relationships diverge markedly in available observational data sets. If model results and physically based expectations are credible, there is potential for using such well-understood covariance properties to reduce observational uncertainties in tropical temperature and moisture trends.

The third and final area of my talk covers the intersection between climate change detection and attribution research and model representation of key modes of natural internal variability. Concerns have been expressed about the possibility that multidecadal internal variability could significantly hamper the identification of human influence on the annual cycle of tropospheric temperature. Using results from large initial condition ensembles, it is shown that the identification of a human fingerprint on the annual cycle is robust to model differences in the amplitude and phasing of major modes of multidecadal internal variability. This robustness arises because internal variability patterns are distinctly different from the patterns of response to anthropogenic forcing.