JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 112, D24S08, doi:10.1029/2006JD008229, 2007

Unresolved issues with the assessment of multidecadal global land surface temperature trends

Roger A. Pielke Sr.,[1] Christopher A. Davey,[2] Dev Niyogi,[3,4] Souleymane Fall,[4] Jesse Steinweg-Woods,[3,4] Ken Hubbard,[5] Xiaomao Lin,[5] Ming Cai,[6] Young-Kwon Lim,[7] Hong Li,[8] John Nielsen-Gammon,[9] Kevin Gallo,[10] Robert Hale,[11] Rezaul Mahmood,[12] Stuart Foster,[12] Richard T. McNider,[13] and Peter Blanken[14]

Received 7 November 2006; revised 5 February 2007; accepted 14 May 2007; published 29 December 2007.

[1] This paper documents various unresolved issues in using surface temperature trends as a metric for assessing global and regional climate change. A series of examples ranging from errors caused by temperature measurements at a monitoring station to the undocumented biases in the regionally and globally averaged time series are provided. The issues are poorly understood or documented and relate to micrometeorological impacts due to warm bias in nighttime minimum temperatures, poor siting of the instrumentation, effect of winds as well as surface atmospheric water vapor content on temperature trends, the quantification of uncertainties in the homogenization of surface temperature data, and the influence of land use/land cover (LULC) change on surface temperature trends. Because of the issues presented in this paper related to the analysis of multidecadal surface temperature we recommend that greater, more complete documentation and quantification of these issues be required for all observation stations that are intended to be used in such assessments. This is necessary for confidence in the actual observations of surface temperature variability and long-term trends.

Citation: Pielke, R. A., Sr., et al. (2007), Unresolved issues with the assessment of multidecadal global land surface temperature trends, *J. Geophys. Res.*, *112*, D24S08, doi:10.1029/2006JD008229.

1. Introduction

[2] The global average surface temperature trend is the climate metric that has been most used to assess the human impact on climate change [*IPCC*, 2001]. The data used to assess this trend have been concluded to be robust and able to accurately define this trend in tenths of a degree per decade (Climate Change Science Program (CCSP) report, Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences, U.S. Climate Change Science Program, Washington, D. C., available at http://www.climatescience.gov/Library/sap/sap1-1/public-review-draft/sap1-1prd-all.pdf; hereinafter referred to as CCSP report, 2006). The CCSP report concluded that with respect to global average temperature trends,

> "For observations since the late 1950s, the start of the study period for this report, the most recent versions of all available data sets show that both the surface and troposphere have warmed, while the stratosphere has cooled,"

while for tropical temperatures (20°S to 20°N),

> "Although the majority of observational data sets show more warming at the surface than in the troposphere, some observational data sets show the opposite behavior. Almost all model simulations show more warming in the troposphere than at the surface. This difference between models and observations may arise from errors that are common to all models, from errors in the observational data sets, or from a combination of these factors. The second explanation is favored, but the issue is still open."

[1]University of Colorado, CIRES/ATOC, Boulder, Colorado, USA.
[2]Desert Research Institute, Reno, Nevada, USA.
[3]Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, Indiana, USA.
[4]Department of Agronomy, Purdue University, West Lafayette, Indiana, USA.
[5]School of Natural Resources, University of Nebraska-Lincoln, Lincoln, Nebraska, USA.
[6]Department of Meteorology, Florida State University, Tallahassee, Florida, USA.
[7]Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee, Florida, USA.
[8]Department of Atmospheric and Oceanic Science, University of Maryland, College Park, Maryland, USA.
[9]Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, USA.
[10]Center for Satellite Applications and Research (STAR), National Environmental Satellite, Data, and Information Service (NESDIS), NOAA, Camp Springs, Maryland, USA.
[11]CIRA, Colorado State University, Fort Collins, Colorado, USA.
[12]Department of Geography and Geology, Western Kentucky University, Bowling Green, Kentucky, USA.
[13]Department of Atmospheric Science, University of Alabama in Huntsville, Huntsville, Alabama, USA.
[14]Department of Geography and Environmental Studies, University of Colorado, Boulder, Colorado, USA.

0148-0227/07/2006JD008229$09.00