House Committee on Government Reform

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Chairman Davis, Ranking Member Waxman and committee members, I am John Christy, professor of Atmospheric Science and Director of the Earth System Science Center at the University of Alabama in Huntsville. I am also Alabama's State Climatologist. In addition I recently served as a convening Lead Author of the first Climate Change Science Program's (CCSP) report on temperature trends and was a Panelist on the National Academy of Science's report on temperature reconstructions for the past 2,000 years.

Summary

I will be reporting today on research that has just appeared or that will be published shortly. Many of the statements below will be framed in terminology of "consistent with" rather than "proof of". This is the way science works in the field of climate because we basically cannot give a 'final answer" which will stand the test of all time. Science evolves as new information is discovered, and that is particularly true for climate science.

In the following I will first describe how a carefully reconstructed time series of temperatures in the Central Valley of California indicate that changes since 1910 are more consistent with the impacts of land-use changes than the effects now expected from the enhanced greenhouse theory. Secondly, I will present results from two papers which examine our knowledge of atmospheric temperatures as they relate to the surface. The results point to a more modest atmospheric warming than anticipated from our current understanding of the enhanced greenhouse theory.

The meaning for policy makers is two-fold. First, it is apparent that we have little skill at reproducing and predicting changes on regional scales such the U.S. Secondly, it is therefore far more difficult to predict the effect of a particular policy aimed at altering current emissions of greenhouse gases by a tiny amount. In other words, we are unable with any confidence to predict climate outcomes from policy options, especially where our citizens live.

Central California Temperatures

Earlier this year I and 3 coauthors published a paper on temperature trends in Central California since 1910 (Christy et al. 2006a). This was actually a follow-on of work I did as a teenager growing up in the San Joaquin Valley some 40 years ago when all I had was a pencil, graph paper, a slide rule and a fascination with climate. In this new work, sponsored by the National Science Foundation, we set out to collect all available information on surface temperatures in the Valley and nearby Sierra Nevada mountains and then develop a means to generate temperature trends with high levels of confidence.

What drew my attention to this problem was the apparent rapid rise in nighttime temperatures in the Valley, temperatures that appeared to be much above those I remember recording as a teenager. We produced a dataset with many observations never before utilized since we performed the manual digitization of those records. In addition, we examined all of the ancillary information to determine when stations experienced changes that could affect the overall trends. This involved reading and digitizing over 1600 pages of information about the stations and instruments. This has not been done before in California.

We then developed a method which takes into account the various events that affected each station, i.e. a move, a change of instruments, a change in procedure, etc. We discovered that on average, a station experienced about 6 events that could produce a change in the surface temperature. We combined the stations in the Valley to see what went on the last 100 years and did the same for the Sierras as a control experiment. Our work uses literally 10 times the amount of data of previous attempts at creating such temperature records.

We discovered that indeed the nighttime temperatures in the 18 Valley stations were warming rapidly, about 6°F in summer and fall, while the same daytime temperatures fell about 3°F. This is consistent with the effects of urbanization and the massive growth in irrigation around these thermometers.

The real surprise was the temperature record of the 23 stations in the Sierra foothills and mountains. Here, there was no change in temperature. Of course irrigation and urbanization have not affected the foothills and mountains to any large extent. Evidently, nothing else had influenced the temperatures either.

These results did not match the results given by models specifically downscaled for California where the Sierra's are shown to have warmed to a greater degree than the Valley (e.g. Snyder et al. 2002).

These results are provocative, but we performed four different means of determining the error characteristics of these trends and determined that the result that nighttime warming in the Valley was significant but that changes in the Sierras, either day or night, were not. Models suggest that the Sierra's are the place where clear impacts of greenhouse warming should be found, but the records we produced did not agree with that hypothesis. The bottom line here is that models can have serious shortcomings when reproducing the type of regional changes that apparently have occurred. This also implies that they would be ineffective at projecting future changes with confidence, especially as a test of the effectiveness for specific policies. In other words it will be almost impossible to say that a specific policy will have a predictable or measurable impact on climate.

[Note: as a follow-up to Christy (2002) on Alabama temperature trends, we examined the output from 10 climate models. All showed a warming trend for 1900 to 2000. The observations revealed a cooling trend (common throughout the SE U.S. Again, evidence that model reconstructions of the past encounter great difficulty in being correct, and thus future projections should have low confidence attached to them.]

Atmospheric Temperature Trends

There was considerable media attention given to the CCSP report about temperature trends in the atmosphere, about 0 – 35,000 ft, versus those of the surface for period since 1979. The basic task of the CCSP was to look at the various datasets of atmospheric and surface temperature and draw conclusions about their relative trends. Several atmospheric datasets revealed trends less than or the same as the surface, which is at odds with greenhouse theory as projected in present-day climate models.

The key statement regarding GLOBAL trends in the report claimed, “This significant discrepancy no longer exists.” It would have been more accurate in my view to have said, “The magnitude of these global discrepancies is not significant.” This is a subtle but important difference because it acknowledges that discrepancies still exist but that the differences between the global surface and atmospheric trends are within the uncertainty bounds of our various measurements. In other words, rather than being a statement acknowledging the certainty of the measurements and models it should have been a statement claiming the uncertainty of our knowledge. I had proposed the second rendition, but was unsuccessful in seeing it implemented.

Be that as if may, the more interesting issue is found in the tropical region. Here we have significant discrepancies between surface and atmospheric trends for most datasets. The tropical region is not trivial, constituting 1/3 of the global area.

The report acknowledged this curiosity as an “open question” but came to a consensus statement that the reason for the discrepancy was (a) errors common to models (b) errors in most observational datasets or (c) a combination of the two. The report says that the authors “favored” the second reason, i.e. observational error. The word “favor” was used to allow a sense of a majority view, since I did not agree with that assessment. I preferred the third option, that models and observations have roughly the same amount of error.

I was fairly happy with choosing option c because I knew of the two papers that were going to appear this year based on research sponsored by the Dept. of Energy, the Dept. of Transportation and the National Oceanic and Atmospheric Administration (Christy and Norris 2006, Christy et al. 2006b). In these papers I dealt specifically with atmospheric trends and the information we have to assess errors and uncertainties. In both papers we show that atmospheric trends from our UAH datasets are most consistent with independent measurements than is the one dataset that showed enough atmospheric warming to allow the CCSP to make its statement about possible observational error.

In one paper, we examined eight upper air datasets in the tropics. All but one revealed much less cooling aloft than at the surface. And, in all cases, these seven differed from the one warming dataset in the same way, something that would be highly improbably by chance. This suggested that the one satellite dataset showing warming was likely affected by spurious jumps near the middle of the 1979-2004 period. The conclusion of the paper was that there is likely a significant difference between the surface and atmospheric trends, with the atmosphere being cooler. This is significant because all model simulations indicate the atmosphere should be warming faster than the surface if greenhouse influences are correctly included in climate models.

Science evolves. The information we create today may be superceded tomorrow, which always means we should be cautious of the certainty we often ascribe to our results. I wish I could report to you the preliminary results of our temperature work in East Africa that should be published next year, but we must still do all of the details that will enhance the confidence in those results.

What does this mean?

That greenhouse gases are increasing in concentration is clearly true and therefore they will have an impact on the radiation budget of the atmosphere. In our observational work we have not been able to show support for the way this effect is being depicted by the present set of climate models.

For policy makers my point is the following. We cannot reliably project the trajectory of the climate for large regions within the U.S. for example. It would be a far more difficult task to reliably predict the effects of a policy that altered a tiny amount the emissions which act to enhance the greenhouse effect. The evidence I've spoken here is consistent with that view. However, other reasons such as energy security may drive this issue to a different mix of energy sources.

I feel I have some expertise not common to the average scientist that I believe is important in this whole discussion of climate change which may be due to humans. In the 1970's I taught science and math in Kenya as a missionary teacher. I observed the energy system there. The energy source was the wood chopped from the forest. The energy transmission system was the backs of women and girls. The energy use system was burning the wood in an open fire indoors for heat and light. The unintended consequences of that system were poor respiratory and eye health, and a degraded tropical habitat. The U.N. estimates 1.6 million women and children die each year from the effects of this indoor smoke.

Energy demand will grow, as it should, to allow these people to experience the advances in health and prosperity that we in the U.S. have. They are far more vulnerable to the impacts of poverty and political strife than climate changes. I simply close with a plea, please remember the needs and aspirations of the poorest among us when energy policy is made.

Thank you.

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