TEMPERATURE TRENDS IN THE LOWER ATMOSPHERE

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SUMMARY

A new publication by NOAA (US National Oceanic and Atmospheric Administration) claims to have removed the previously evident discrepancies between mean global temperature anomalies measured on the surface and those measured in the lower troposphere. It claims that a combination of attention to inaccuracies and the use of linear regression equations on selected climate sequences have removed these discrepancies.

This paper shows that these claims are untrue. The apparent agreement of the two sets of records for the chosen sequences is dependent on the enhanced influence of volcanoes and El Niño events in the lower troposphere, compared with an additional warming factor on the surface. If a temperature sequence comparatively free from these influences, (1979 -1997) is chosen, there is no detectable warming in the lower atmosphere for six of the seven records, and for the seventh, no warming between 1988 and 1997, whereas warming still prevails on the surface over these periods. The supposed enhanced greenhouse effect is thus currently undetectable in the lower atmosphere, where it is supposed to be most prominent, so the warming on the surface must have some other cause.

TEMPERATURE TRENDS IN THE LOWER ATMOSPHERE

A new publication on this subject by the NOAA (US National Oceanic and Atmospheric Administration), is now available in full (9.2MB) or in part, from

http://www.climatescience.gov/Library/sap/sap1-1/finalreport/default.htm

The full title is "Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences"

Its authors include T.R.Karl, T.M.Wigley, J.R.Christy, T.C. Peterson, F.J.Wentz, K.Y.Vinnikov, .R.W.Spencer, R.S.Vose, R.W. Reynolds, B.D.Santer, P.W. Thorne, C.K. Folland and D. Parker. This includes most of the people working on temperature records, with the notable exceptions of P.D. Jones and J.E.Hansen

Part of the Abstract is as follows "Specifically, (i.e. previously) surface data showed substantial global average warming while early versions of satellite and radiosonde data showed little or no warming above the surface. This significant discrepancy no longer exists because errors in the satellite and radiosonde data have been identified and corrected. New data have also been developed that do not show such discrepancies"

In order to check on the validity of the discrepancies which previously existed between the surface and the lower troposphere, exhaustive efforts have been made to correct errors; but only in the lower troposphere records. They state "Errors in observed temperature trend differences between the surface and the troposphere are more likely to come from errors in tropospheric data than from errors in surface data". Yet no effort has been made to check the errors and discrepancies which undoubtedly exist in the surface data, and have been documented by, among others, Gray (2001) and McKitrick and Michaels (2004)

After this one-sided correction the report compares seven surface temperature anomaly records to with seven lower troposphere temperature anomaly records.

The seven surface records are

Weather Stations /Sea Surface

NOAA From weather stations , plus ocean measurements from satellites and models.
NASA Goddard Institute of Space Studies. A similar compilation
HadCRUT2v The Hadley Centre; Climate Research Unit, University of East Anglia. A compilation of weather station and sea surface measurements

Radiosondes

RATPAC Radiosonde Atmospheric Temperature Products for Assessing Climate
HadAT2 Hadley Centre, Radiosonde Temperatures

Reanalyses

NCEP50 National Center for Environmental Prediction
ERA40 European Centre for Medium-range weather forecasts

For those unfamiliar with reanalysis, it is an extension of weather forecasting, using models. It is defined as "A mathematically blended record that incorporates a variety of observational data sets (with adjustments) in an assimilation model". Further information may be found from Kalnay et al (1996)

The seven lower troposphere records are

Radiosondes
RATPC and HadAT2

Satellites

UAH. University of Alabama at Huntsville. This is the NASA station that has been responsible for the satellite measurements from the beginning in 1979
RSS Remote Sensing Systems
UMd University of Maryland.

Reanalyses

NCEP50
ERA40

Two sets of comparisons are made, based on the sequences of the temperature records of the radiosondes (1958 to 2004), and the satellites (1979 to 2004).

Figure 1 is the bottom half of Figure 1 of the "Executive Summary". The top graph plots on top of one another, four of the seven lower troposphere records, two from radiosondes (HadA2 and RATPC) and two satellites (UAH and RSS).

The lower graph plots on top of one another, three of the seven surface records; two of the surface, (NOAA and NASA/GISS), and one of the radiosonde records (HadAT2)..

At first sight the two records appear almost identical, but the differences are fairly obvious on closer inspection.

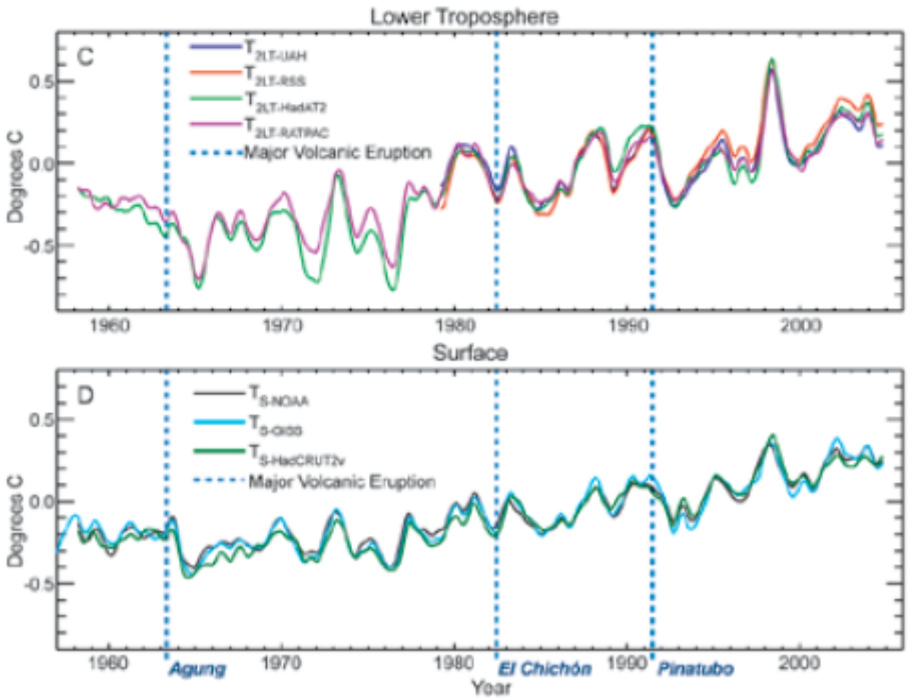

Figure 1 Comparison between global temperature anomalies in the lower troposphere with those the surface. From 1958 to 2004 there are two (radiosondes) in the lower troposphere compared with three on the surface. From 1979 to 2004 there are four in the lower troposphere (radiosonde and satellite) compared with three on the surface. From Figure 1 of the "Executive Summary"

The major volcanic eruptions of Agung,(1963}, El Chichon (1982) and Pinatubo (1992) are indicated. It is obvious that they have a greater influence on temperature in the lower troposphere than they do on the surface.. They would therefore provide a a greater contribution to a linear upward trend in the lower troposphere than on the surface for both a 1958 to 2004 sequence and a 1979 to 2004 sequence.

The influence of El Niño events is even greater. These events are not shown on this particular graph, although the text of the Executive Summary does draw attention to the very large El Niño event in 1998. The major El Niños are portrayed in two graphs of appendix A, and it is useful to quote one of them here, to compare with Figure 1

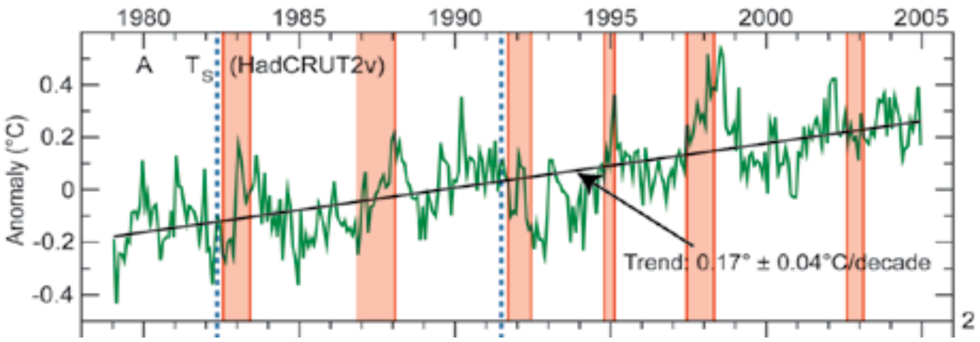

Figure 2 Surface Temperature Record (HadCRUT2v) showing El Niño events (shaded pink). From Figure 1 of Appendix A.

It will be seen that the warming effects of the 1983 El Niño would have pertly cancelled the cooling from Mt Agung, and the 1993 El Niño would have partly cancelled the cooling effects of El Chichon. However, the El Niño events of 1998, and to a lesser extent, 2003, which appear right at the end of both the 1958-2004 and 1079-2004 sequences, have caused an upwards effect on linear trends for both sets of records, but are much greater for the lower troposphere.

It is evident at once from Figure 1 that between 1979 and 1997 there was no warming in the lower troposphere, whereas there was significant warming on the surface/ This means that the influence of greenhouse gas forcing is undetectable where it should be most prominent, and that the residual warming on the surface is from some other cause.

This conclusion can be checked more thoroughly by considering all the records, rather than the sample shown in Figure 1.

1979 to 2004 Comparisons

There were seven records for each of the surface and the lower troposphere. for the sequence 1979 to 2004.

The surface records gave the following linear trends for this sequence (from Table 3.3 Chapter 3) with approximate 95% confidence intervals

NOAA (weather stations/ ocean) 0.16±0.04ºC per decade
NASA (weather stations/ocean) 0.16±0.04ºC per decade
HadCRUT2v 9weather stations/ships) 0.17±0.04ºC per decade
RATPAC (radiosonde) 0.17±0.05ºC per decade
HadA2 (radiosonde) 0.18±0.05ºC per decade
NCEP50 (reanalysis) 0.12±0.07ºC per decade
ERA40 (reanalysis) 0.11±0.06ºC per decade.

It will be seen that there is close agreement between the three weather station/sea surface records and the two radiosonde records for the surface. The two reanalysis results give a smaller trend which is barely within the "approximate" 95% confidence limits and is therefore probably significantly different., We do not have a graph of these two records, so it is difficult to know whether there is an obvious reason for this difference.

It should be noted from Figure 1, and more accurately from Figure 2, that the choice of the sequence from 1979 to 1997 for the weather-station--based surface records has only a slight effect on the linear trend of the record.. I estimate the change on Figure 2 to be from 0.17 to 0.14ºC per decade.

The lower troposphere linear trends between 1978 and 2004 are

RATPAC (radiosonde) 0.02±0.07ºC per decade
HadAT2 (radiosonde) 0.03±0.08ºC per decade
UAH (satellite) 0.04±0.08ºC per decade
RSS (satellite) 0.13±0.08ºC per decade
UMd (satellite) 0.20±0.07ºC per decade
NCEP50 (reanalysis) -0.04±0.10ºC per decade
ERA40 (reanalysis) 0.07±0.10ºC per decade.

It is difficult to claim that these results are compatible with the surface records, or with each other, without examination of the individual records.

Four of them, two radiosondes, one satellite and one reanalysis have very low values, despite the obvious influence of the high El Niño peak in 1998 and the lesser one in 2003. The NCEP50 Reanalysis is even negative.

It is difficult to assess the importance of the El Niño events on the reanalysis records without the full data, which are not available. However, the Appendix A to the report does provide the three satellite records, shown in Figure 3

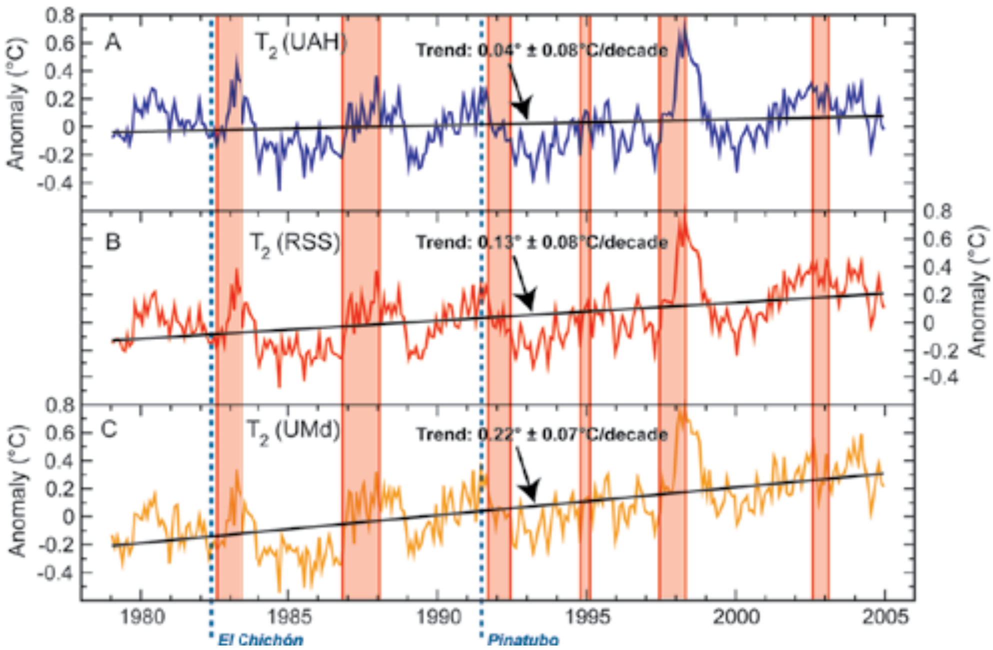

Figure 3. The three satellite temperature records compared. UAH (University of Alabama, Huntsville), RSS (Remote Sensing Service) and UMd (University of Maryland)

These graphs show the marked effects of the El Chichon volcano of 1982 and the partial reduction of its downward influence by the El Niño of that year, the El Niño of 1987, the

Pinatubo volcano of 1992, its cooling partially obscured by the El Niño of that year, the very large El Niño of 1998, and the smaller one of 2003. Comparison with Figure 2 shows that all of these effects are less prominent on the surface record.

They also show that if the sequence from 1978 to 1997, relatively less affected by the 1998 El Niño is chosen, that two of the records, UAH and RSS show no evident warming. They therefore do not display evidence of an influence of greenhouse forcing for this period

This leaves us with the bottom record from the University of Maryland. Not only does it give the largest trend of any of the records, but the actual value seems to be a matter of opinion. Here it is said to be 0.22±0.07ºC per decade. Table 3.3 of Chapter 3 says it is 0.20±0.07ºC per decade.

It has been left out from the records plotted together in Figure 1. If it were done it would disrupt the claimed agreement between them, and perhaps draw attention to the fact that the surface record also shows a positive trend over the period 1979 to 2004 for which all the others show no trend.

If the 1998 and 2003 El Niños are ignored by choosing 1979 to 1997 to derive a trend, it is the only lower troposphere record showing a trend different from zero. I estimate it at 0.10ºC per decade, significantly less than the 0.14ºC I estimate for the surface, whatever the reduction in confidence interval.

If a shorter sequence is chosen, 1988 to 1997, this record also shows no warming. It is only ten years compared with nineteen years for the other records,, but there was still no evident effect of greenhouse forcing for this period

1958 to 2004 comparison

There were seven surface records and four lower troposphere records for this comparison.

The results of linear regression gave the following trends

Surface

NOAA (weather stations/ocean) 0.11±0.02ºC per decade
NASA (similar) 0.11±0.02ºC per decade
HadCRU2v (weather stations/ sea surface) 0.13±0.02ºC per decade
RATPAC (radiosonde) 0.11±0.02ºC per decade
HadAT2 (radiosonde) 0.11±0.03ºC per decade
NCEOP50 (reanalysis) 0.12±0.03ºC per decade
ERA40 (reanalysis) 0.11± 0.03ºC per decade

Lower Troposphere

RATPAC 0.07±0.03ºC per decade
HadAT2 0.08±0.04ºC per decade
NCEP50 0.13±0.06ºC per decade
ERA40 0.10±0.04ºC per decade (1958 to 2001 only)

These results illustrate the danger of using linear regression as a guide to trends of irregular climate data. The linear trend will change, depending on the choice of sequence, so none of the "trends" can be regarded as reliable guides, either to the past or to the future.

The surface results show good agreement, and the improved accuracy reflects the lesser influence of the 1998 El Niño. which is a more important outlier for the 1979 to 2004 sequence than for the 1958 to 2004 sequence Removal of this outlier from both trends would give even better accuracy .to both

Comparisons with the lower troposphere records from 1958 to 2004 are difficult as we do not have the individual records. Three of the four are less than the surface despite the extra influence of the 1998 El Niño and the cooling effect of the Mt Agung volcano, which is much greater in the lower troposphere. These results tend to confirm the belief that there is no significant extra warming influence, such as greenhouse forcing in the lower troposphere beyond these natural events..

1979 to 1997 and 1988 to 1997 sequences.

The choice of these sequences suffers from the same danger as any other arbitrary choice of sequence .in that they cannot necessarily be regarded as guides to future trends. However, since they have been chosen to minimise the influence of natural temperature influences, which are more prominent in the lower troposphere, these sequences should give a better guide as to the possible influence of greenhouse forcing in the region where it is supposed to be prominent.. As has been shown above, these sequences shows no evidence of temperature change for all of them except for the one record out of seven, which shows an absence of temperature change only for the lesser sequence of 1988 to 1997. The actual linear trends for these sequences have been estimated here as close to zero for the lower troposphere, and as 0.14ºC per decade for the surface. The confidence limits of these estimates will be much lower than those found when the 1998 El Niño was present, so the differences between the surface and the lower troposphere are highly significant.

The evidence that greenhouse forcing cannot be detected in the lower troposphere for long periods shows that the warming which is evident in surface measurements cannot be caused by greenhouse forcing.

CONCLUSION

This study does not remove discrepancies between surface and lower troposphere temperature records, but, instead, confirms them. It shows that for temperature sequences comparatively free from the interference of natural influences there is no detectable warming in the lower troposphere, the place where the enhanced greenhouse effect is claimed to be evident. For six out of the seven the lower troposphere temperature records there is no influence of greenhouse forcing for a period of nineteen years, and even the seventh one shows no warming for ten of those years.. The warming evident on the surface for these periods cannot be due to greenhouse forcing, but must therefore have a different cause. Evidence that surface records are biased from urban influences, as shown by Gray (2001) and by McKitrick and Michaels seems the most likely explanation.

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