Technical Comment on: 'Anthropogenic Influence on the Auto Correlation Structure of Hemispheric-Mean Temperatures' by Wigley, Smith, and Santer

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Wigley et al. (1) find significant evidence for a climate forcing which cannot be attributed solely to solar variability or the internal variability of the climate system. They conclude that the prime candidate for external forcing is the radiative forcing due to build-up of atmospheric greenhouse gases combined with aerosols. We suggest that there are other anthropogenic factors that may also contribute to observed changes in climate. One of these is the effect of landcover change arising from human activity. This forcing may be of similar importance to that of increased greenhouse gases. (2,3)

The influence of idealized, and usually quite large, landcover changes on near-surface atmospheric temperatures has been demonstrated in a wide variety of modeling studies (e.g., 4 and references within, 5,6). Other simulation studies using more realistic changes in landcover also indicate significant near-surface temperature effects (e.g., 2,7,8,9). In support of these modeling results, regional observational studies have also identified the influence of landcover change on temperature (10,11). While strong and significant regional trends have been found in recent global observational studies (12,13), a clear, systematic globally-averaged temperature signal attributable to landcover change has yet to emerge.

Figure 1 compares recent trends in observed near-surface (1000-850 mb layer-averaged) temperature (Fig. 1a) with general circulation model (GCM) simulated effects due to the estimated sum-total of historical landcover change (Fig. 1b; experiment described fully in 3) and those generated by present levels of CO_2 forcing (Fig. 1c; approximately 75ppm above pre-industrial levels) in a transient greenhouse model experiment with the National Center for Atmospheric Research Climate System Model (NCAR CSM; 14). Observed trends in the past two decades (Fig. 1a) are based on the National Center for Environmental Prediction (NCEP) reanalysis

(15) and must be interpreted with caution because of inhomogeneities in the data (16). The transient CO_2 experiment is described and archived on the NCAR CSM homepage as experiment b006 (http://www.cgd.ucar.edu/csm/index.html). Though performed with the same atmospheric and land-surface model (NCAR CCM3/LSM) we note that the simulations are not identical. The transient CO_2 experiment included dynamic ocean and sea-ice model components which were not present in the vegetation change experiment. Nonetheless, comparison of these results permits an initial assessment of the relative magnitude of the effects due to historical increases in CO_2 and those due to historical landcover change.

From Fig. 1, we conclude that simulated temperature anomalies due to CO_2 increases at the level observed today and simulated temperature anomalies due to the direct and remote effects of anthropogenic landcover change as currently observed are of similar amplitude and occur in the same regions of the globe. Both are comparable to observed trends in the past two decades.

The role of increased atmospheric greenhouse gases and aerosols has dominated the discussion of climate change. Based upon recent literature and illustrated by the example presented, it is becoming more plausible that landcover changes may be an important component of recent climate trends. A comprehensive effort toward quantifying the regional and teleconnected effects of landcover change on the climate system is needed to adequately attribute trends in the observational record.

1 References

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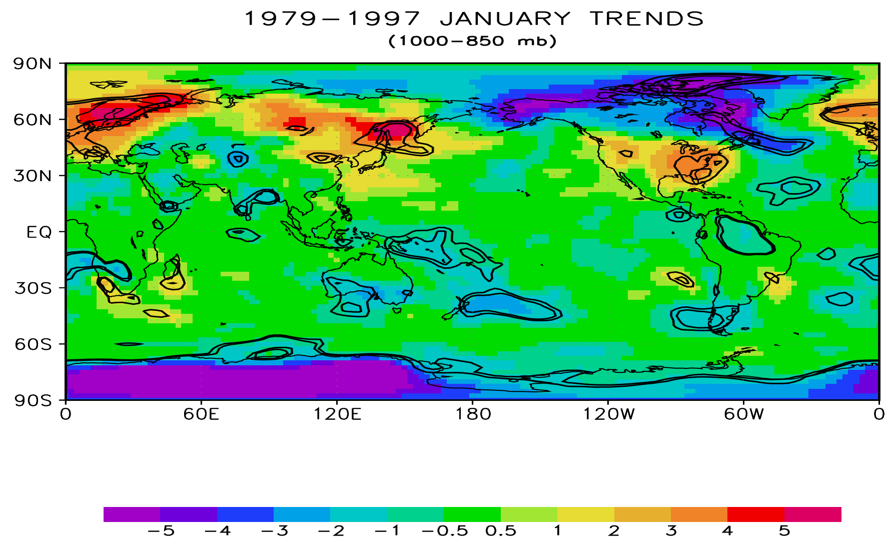
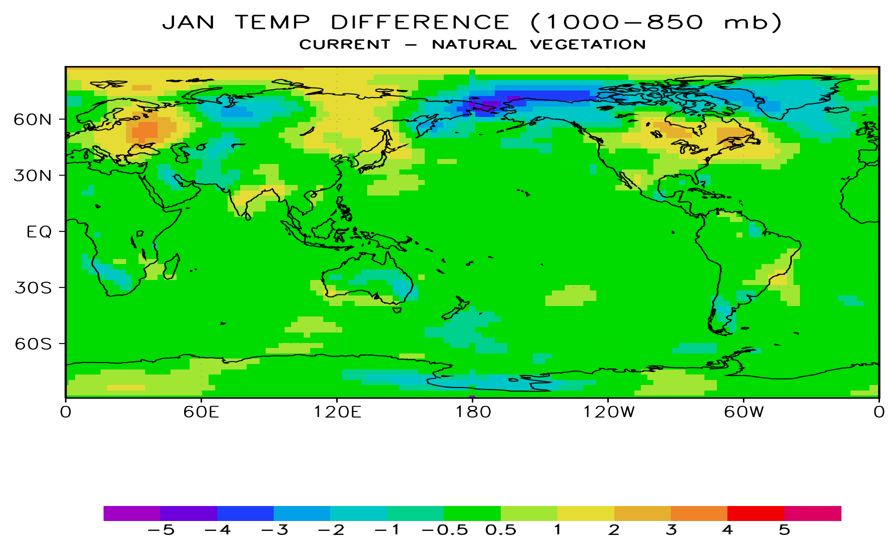
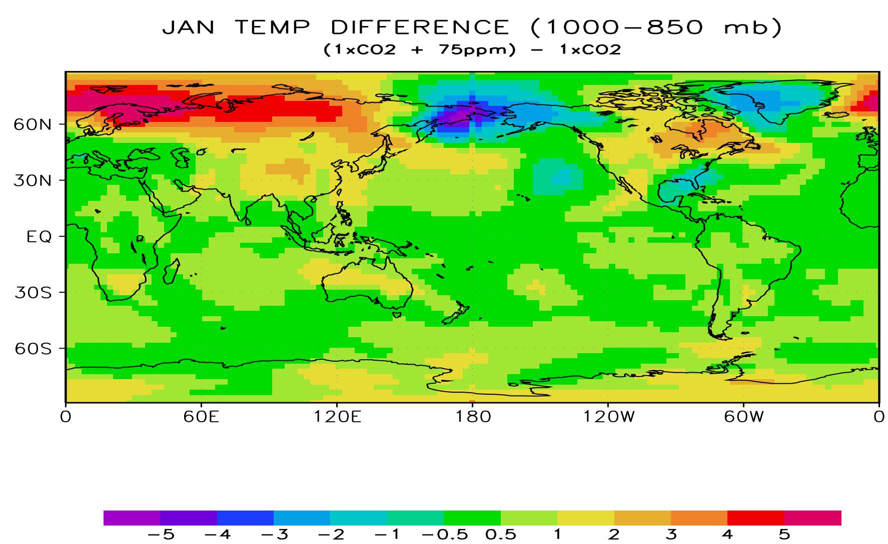
2 List of Figures


1979–1997 JANUARY TRENDS
(1000–850 mb)
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
0
–5 –4 –3 –2 –1 –0.5 0.5 1 2 3 4 5


JAN TEMP DIFFERENCE (1000–850 mb)
CURRENT – NATURAL VEGETATION
60N
30N
EQ
30S
60S
0
60E
120E
180
120W
60W
0
–5 –4 –3 –2 –1 –0.5 0.5 1 2 3 4 5


JAN TEMP DIFFERENCE (1000–850 mb)
(1xCO2 + 75ppm) – 1xCO2
60N
30N
EQ
30S
60S
0
60E
120E
180
120W
60W
0
–5 –4 –3 –2 –1 –0.5 0.5 1 2 3 4 5