DO GLOBAL TEMPERATURE TRENDS OVER THE LAST DECADE FALSIFY CLIMATE PREDICTIONS?—J. KNIGHT, J. J. KENNEDY, C. FOLLAND, G. HARRIS, G. S. JONES, M. PALMER, D. PARKER, A. SCAIFE, AND P. STOTT

Observations indicate that global temperature rise has slowed in the last decade (Fig. 2.8a). The least squares trend for January 1999 to December 2008 calculated from the HadCRUT3 dataset (Brohan et al. 2006) is +0.07±0.07°C decade^{-1}—much less than the 0.18°C decade^{-1} recorded between 1979 and

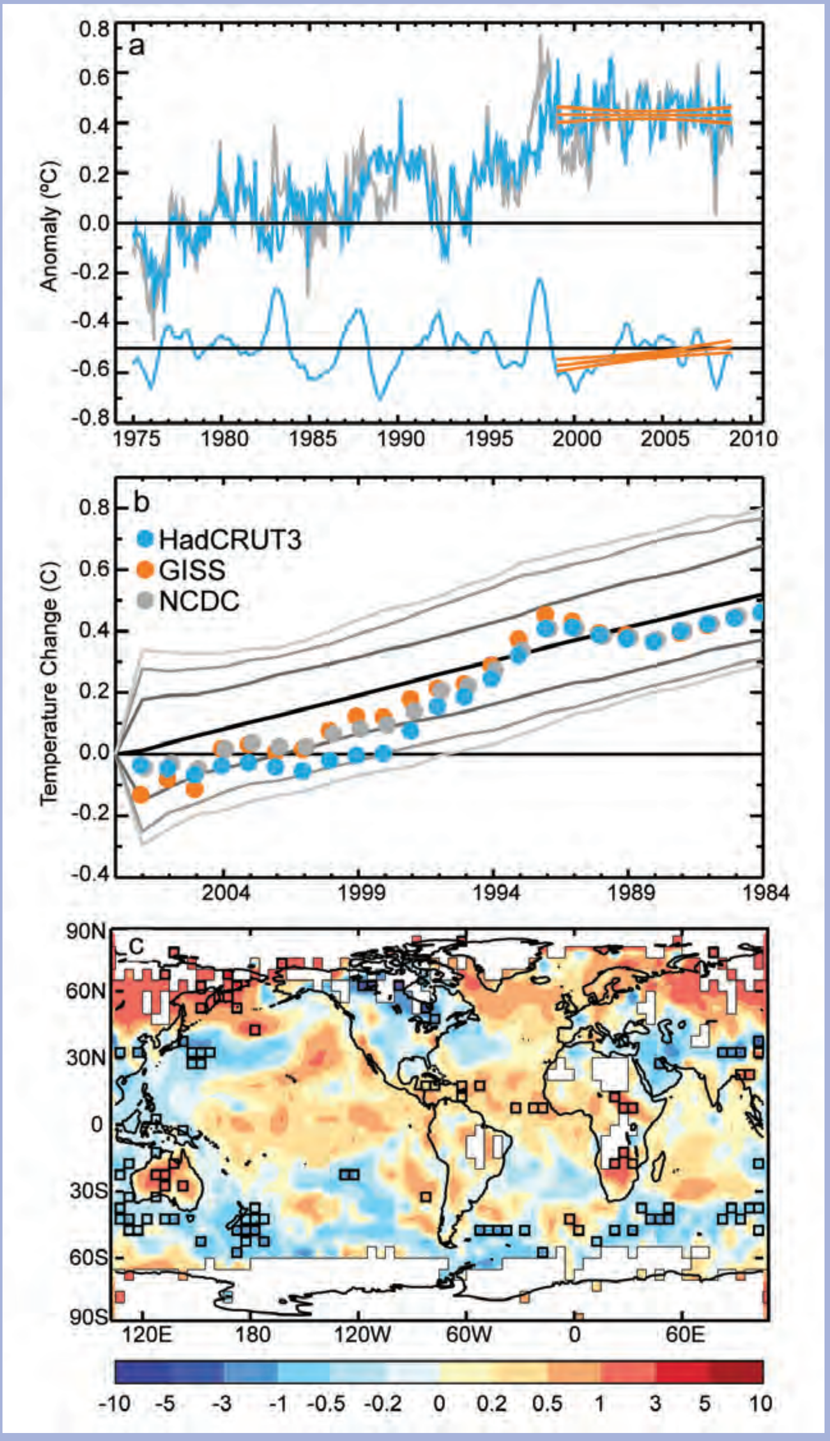

Fig. 2.8. Global mean temperature changes over the last decade in context. (a) Monthly global mean temperature anomalies (with respect to 1961–90 climatology) since 1975, derived from the combined land and ocean temperature dataset HadCRUT3 (gray curve). (top blue curve) The global mean after the effect of ENSO that has been subtracted is also shown, along with (bottom blue curve, offset by 0.5°C) the ENSO contribution itself. Least squares linear trends in the ENSO and ENSO-removed components for 1999–2008 and their two std dev uncertainties are shown in orange. (b) ENSO-adjusted global mean temperature changes to 2008 as a function of starting year for HadCRUT3, GISS dataset (Hansen et al. 2001) and the NCDC dataset (Smith et al. 2008) (dots). Mean changes over all similar-length periods in the twenty-first century climate model simulations are shown in black, bracketed by the 70%, 90%, and 95% intervals of the range of trends (gray curves). (c) Distribution of 1999–2008 trends in HadCRUT3 (°C decade^{-1}). Black squares indicate where the trends are inconsistent at the two std dev level with trends in 17 simulated decades (see text).

2005 and the 0.2°C $decade^{-1}$ expected in the next decade (IPCC; Solomon et al. 2007). This is despite a steady increase in radiative forcing as a result of human activities and has led some to question climate predictions of substantial twenty-first century warming (Lawson 2008; Carter 2008).

El Niño–Southern Oscillation is a strong driver of interannual global mean temperature variations. ENSO and non-ENSO contributions can be separated by the method of Thompson et al. (2008) (Fig. 2.8a). The trend in the ENSO-related component for 1999–2008 is +0.08±0.07°C $decade^{-1}$, fully accounting for the overall observed trend. The trend after removing ENSO (the "ENSO-adjusted" trend) is 0.00°±0.05°C $decade^{-1}$, implying much greater disagreement with anticipated global temperature rise.

We can place this apparent lack of warming in the context of natural climate fluctuations other than ENSO using twenty-first century simulations with the HadCM3 climate model (Gordon et al. 2000), which is typical of those used in the recent IPCC report (AR4; Solomon et al. 2007). Ensembles with different modifications to the physical parameters of the model (within known uncertainties) (Collins et al. 2006) are performed for several of the IPCC SRES emissions scenarios (Solomon et al. 2007). Ten of these simulations have a steady long-term rate of warming between 0.15° and 0.25°C $decade^{-1}$, close to the expected rate of 0.2°C $decade^{-1}$. ENSO-adjusted warming in the three surface temperature datasets over the last 2–25 yr continually lies within the 90% range of all similar-length ENSO-adjusted temperature changes in these simulations (Fig. 2.8b). Near-zero and even negative trends are common for intervals of a decade or less in the simulations, due to the model's internal climate variability. The simulations rule out (at the 95% level) zero trends for intervals of 15 yr or more, suggesting that an observed absence of warming of this duration is needed to create a discrepancy with the expected present-day warming rate.

The 10 model simulations (a total of 700 years of simulation) possess 17 nonoverlapping decades with trends in ENSO-adjusted global mean temperature within the uncertainty range of the observed 1999–2008 trend (−0.05° to 0.05°C $decade^{-1}$). Over most of the globe, local surface temperature trends for 1999–2008 are statistically consistent with those in the 17 simulated decades (Fig. 2.8c). Field significance (Livezey and Chen 1983) is assessed by comparing the total area of inconsistent grid boxes with the range of similar area values derived by testing the consistency of trends in each simulated decade with those in the remaining simulated decades. The 5.5% of the data area that is inconsistent in the observed case is close to the median of this range of area values, indicating the differences are not field significant. Inconsistent trends in the midlatitude Southern Hemisphere strongly resemble the surface temperature pattern of the negative phase of the SAM (Ciasto and Thompson 2008), which did indeed show a negative trend in the last decade.

These results show that climate models possess internal mechanisms of variability capable of reproducing the current slowdown in global temperature rise. Other factors, such as data biases and the effect of the solar cycle (Haigh 2003), may also have contributed, although these results show that it is not essential to invoke these explanations. The simulations also produce an average increase of 2.0°C in twenty-first century global temperature, demonstrating that recent observational trends are not sufficient to discount predictions of substantial climate change and its significant and widespread impacts. Given the likelihood that internal variability contributed to the slowing of global temperature rise in the last decade, we expect that warming will resume in the next few years, consistent with predictions from near-term climate forecasts (Smith et al. 2007; Haines et al. 2009). Improvements in such forecasts will give greater forewarning of future instances of temporary slowing and acceleration of global temperature rise, as predicted to occur in IPCC AR4 projections (Easterling and Wehner 2009).