The near-normal 2008 U.S. annual temperature was a departure from the unusual warmth of the previous 10 years (Fig. 7.6). However, the decline relative to 2007 was only about one standard deviation of the historical interannual variability. Two sets of climate models—CMIP model data and atmospheric general circulation models forced with the monthly evolution of observed SSTs (AMIP experiments)—were used to assess the influence of external climate forcings (greenhouse gas concentrations and other forcings) and SSTs on U.S. temperatures.

Figure 7.6 (middle) shows the time series of the CMIP ensemble mean annual U.S. temperatures for 1895–2008 and the 2008 projection of +0.73°C, which is considerably warmer than the observed anomaly. Further, the observed coolness appears to have been a low-probability outcome: only 5% of the model runs (7 of 144) are as cold as observed for 2008, despite the considerable spread among ensemble members.

The 2008 ocean conditions were persistently cool in the tropical Pacific, which was not predicted due to external forcing (CMIP runs). Global SSTs as a whole have cooled in recent years, possibly due to strong natural internal coupled variability. The time series of AMIP ensemble mean annual U.S. temperatures for 1895–2008 is shown in Fig. 7.6 (bottom). The observed anomaly was also colder than the expected SST-forced signal (+0.45°C), though the probability of exceedence of such coolness in the AMIP realizations was 15% (23 of 150), threefold greater than implied by the CMIP runs.

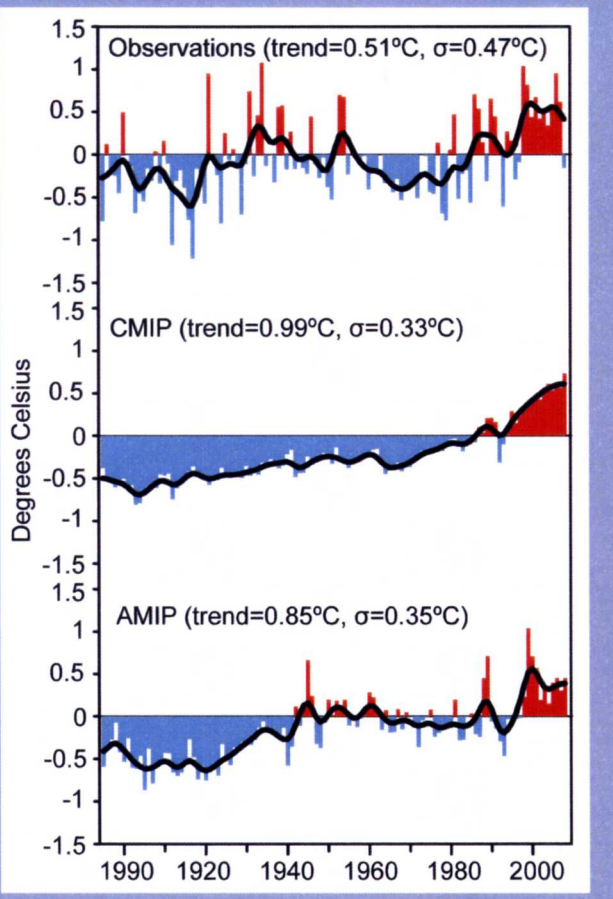

FIG. 7.6. Time series of annual land temperature departures (°C) for the contiguous United States during 1895–2008 based on (top) NCDC climate division observational analyses, (middle) the ensemble of CMIP simulations forced with observed greenhouse gas, aerosol, solar, and volcanic aerosol variability, and (bottom) the ensemble of AMIP simulations forced with observed global sea surface temperature variability. Bars plot the annual departure, computed relative to a 1971–2000 reference period, and the black curve is a 9-point Gaussian filter applied to the annual values.

This preliminary assessment has not taken other potentially important factors into account (e.g., land surface conditions, uncertainties in external climate forcings in the CMIP runs, observed values of solar forcing for 2008). Nonetheless, a key outcome of the model diagnosis is that the average spread among individual simulations for both CMIP and AMIP runs is roughly 0.50°C, a value close to the observed historical interannual variability. As such, the observed coolness over the United States appears consistent with a scenario of moderate-intensity atmospheric internal variability masking the warming influences of boundary forcings. In other words, although the United States was colder than many recent years, temperatures in 2008 were well within the range of variability associated within natural internal climate fluctuations. Indeed, the model simulations suggest that even stronger cooling could have resulted—one AMIP run using observed SSTs for 2008 generated colder U.S. temperatures than any prior observed year since 1895.