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Weakening Trend in the Atmospheric Heat Source over the Tibetan Plateau during Recent Decades

Anmin Duan and Guoxiong Wu

Institute of Atmospheric Physics, State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Beijing, China (amduan@lasg.iap.ac.cn)

The trend in the atmospheric heat source over the Tibetan Plateau (TP) during the last four decades is evaluated using historical observations at 74 meteorological stations in the period of 1961–2003 and satellite radiation data from 1983 to 2004. It is shown that in contrast to the strong surface and troposphere warming, the sensible heat (SH) flux over the TP exhibits a significant decreasing trend since the mid-1980s. The largest trend occurs in spring, a season of the highest SH over the TP. The subdued surface wind speed contributes most to the decreasing trend. At the same time, the radiative cooling effect in the air column enhances persistently. Despite the fact that the in situ latent heating presents a weak increasing trend, the springtime atmospheric heat source over the TP loses its strength during two recent decades. By analyzing historical observations and the NCEP/DOE Reanalysis. The steady declining trend in the surface wind speed over the TP after the 1970s arises mainly from the zonal component. Since the mean altitude of the TP is about 600 hPa and the surface flow is controlled by the East Asian Subtropical Westerly Jet (EASWJ) for most parts of the year, the substantial tropospheric warming in the mid- and high-latitudes to the north of the plateau results in a decrease of the meridional pressure gradient in the subtropics. As a result, the EASWJ and the surface winds over the TP are decelerated. Moreover, changes of the general circulation in the twentieth century simulated by 16 coupled climate models driven by natural and anthropogenic forcings are examined. Intercomparison results suggest that sulfate aerosol indirect effects and ozone may be important in reproducing the weakening trend in EASWJ. Although nearly half of the models can successfully reproduce the observed trends in the EASWJ during the last two decades, there is an obvious spread in simulation of the spatial patterns of twentieth-century tropospheric temperatures, suggesting significant room still exist for improvement of the current state-of-the-art coupled climate models.