

Supplementary File

1. The effects of AHR at different stages of urbanization at various periods between 1992-2013.

AHR is an important factor for urban climate. In this study, we consider the effect of AHR due to global energy consumption in Southwest China (SWC). We consider different stages of urbanization at 3 different periods: 1992-1995, 1992-2005, 1992-2013, the results are shown below:

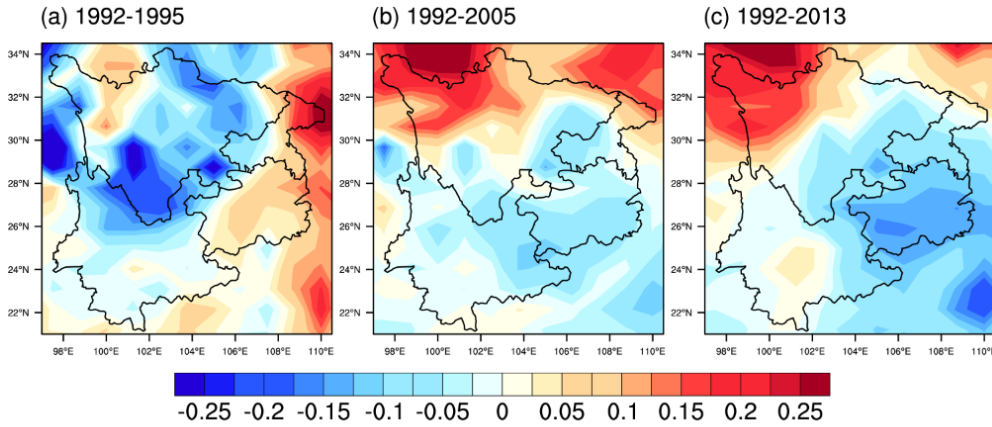


Figure S1 Effect of AHR on 2-m air temperature (T_{2m}) in southwest China: (a) during 1992-1995; (b) 1992-2005; (c) 1992-2013 (Unit: $^{\circ}\text{C}$).

2. The validation results between CRU data and CESM1 control results (CESM1-CTL) from 1992-2013 in Southwest China are listed below:

	CRU	CESM1-CTL	Bias
T_{2m} ($^{\circ}\text{C}$)	19.56	19.97	+0.41 K
T_{\max} ($^{\circ}\text{C}$)	24.07	24.59	+0.52 K
T_{\min} ($^{\circ}\text{C}$)	15.10	15.35	+0.25 K

3. The topography of Southwest China is very complex. This includes the Yunnan-Guizhou plateau, which has a very complex topography with many mountains and high altitudes, with many areas over 3000 meters above sea level. If the altitude of lower layers is used (for example, 850 hPa), it may be lower than the altitude of the local area. So, we choose 500 hPa. The 850 hPa results are shown below:

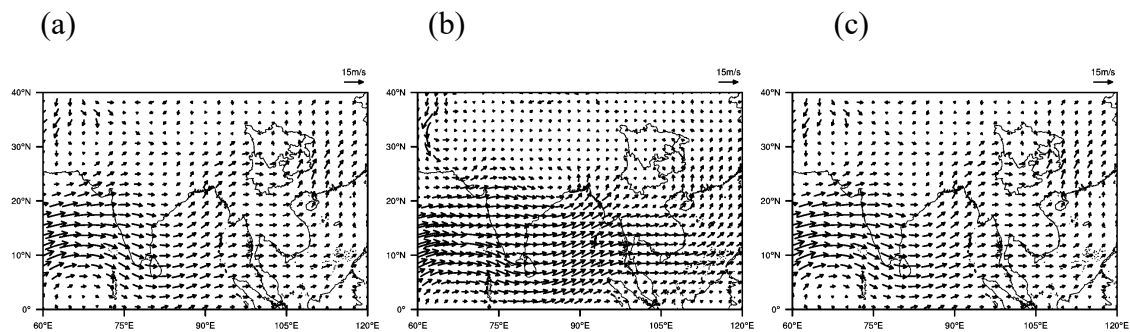


Figure S2 Mean horizontal wind (U, V) at 850 hPa (unit: m s^{-1}) in the domain (0-40°N, 60°E-120°E) from 1992 to 2013 in the boreal summer (JJA): (a) CESM1 control modeling results without AHR; (b) ERA5 data results; (c) CESM1 modeling results with AHR.

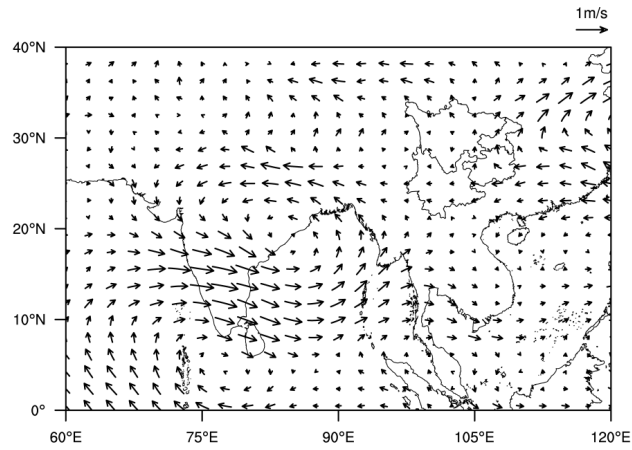


Figure S3 Effects of AHR on the horizontal wind (U, V) at 850 hPa in the boreal summer (JJA) from 1992 to 2013 (unit: m s^{-1}).