Exploring the possible effect of Anthropogenic Heat Release due to energy consumption on global climate

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Part I: Background

- Anthropogenic Heat Release (AHR): all the energy resource consumed in the process of human society and life, will turn into heat released into Earth-atmosphere system, which is called “AHR”.
Global Distribution of AHR(0.1°×0.1° : in 1992, in 2000 and 2009 ) by Chen et al., 2014
Part II: Model and Experiment Design

- Climate Model: CAM 5.1
- Run-Time: From 1992 to 2013, time step: 30 min
- Resolution: $1.9^\circ \times 2.5^\circ$ with 30 vertical levels
- Component sets: AMIP, prescribed SST and sea ice cover
- Control simulation: without AHR (standard CAM5.1)
- Perturbation simulations: AHR added as surface longwave radiation, five ensemble with perturbed initial atmospheric conditions

Total: $5 \times 22$ year simulation with AHR
Part III: Modeling Results

(a) In Spring
\[ \delta T_{\text{land}} = 0.10 \text{ K} \]

(b) In Summer
\[ \delta T_{\text{land}} = 0.06 \text{ K} \]
(c) In Autumn
$$\delta T_{\text{land}}=0.02K$$

(d) In Winter
$$\delta T_{\text{land}}=0.07K$$
Zonal T by AHR from 1992 to 2013

(a) In boreal summer (JJA)

(b) In boreal winter (DJF)
Zonal OMEGA by AHR from 1992 to 2013

(a) In boreal summer (JJA)

(b) In boreal winter (DJF)
(a) In boreal summer JJA, unit: m/s

(b) In boreal winter DJF, unit: m/s
(a) In boreal summer JJA, unit: m/s

(b) In boreal winter DJF, unit: m/s
(a) In boreal summer JJA, unit: m/s

(b) In boreal winter DJF, unit: m/s
(a) In boreal summer JJA

(b) In boreal winter DJF
1. Global climate model results indicate that AHR may disrupt the normal atmospheric circulation and could have an obvious effect on the surface temperature at middle and high latitudes in the Northern Hemisphere.

2. The modeling results suggest that AHR could influence regional atmospheric movement, even global atmospheric circulation.

3. With the continued development of the global economy and urbanization, the climatic effect of AHR will become increasingly pronounced. The climatic effect of AHR should not be merely confined to the regional climate; AHR is a tiny but essential factor in global climate and long-term climate change that should not be ignored.
Thank you!