



A Simple Model Study of Bjercknes Compensation in Meridional Heat Transports under Global Warming

Qianzi Yang, Yingying Zhao, and Haijun Yang

Department of Atmospheric and Oceanic Science, School of Physics, Pecking University, Beijing China

The Bjercknes Compensation (BJC) under global warming is studied in a coupled box model. This study suggests that BJC could be valid during the transient period of climate change in response to global warming. The theoretical BJC is derived. The OHT change can be decomposed into two components, one is related to the vertical stratification and the other is related to the strength of meridional overturning (MOC) circulation. The AHT change depends on meridional temperature gradient. Therefore, whether the BJC would happen depends largely on the relative magnitudes between vertical and meridional temperature gradients. During the transient period of global warming, the ocean vertical temperature gradient is enhanced while the AMOC strength does not change too much. The OHT is thus enhanced. At the same time, the surface poleward temperature gradient is weakened due to the polar amplification, so the AHT is reduced, compensating the enhanced OHT. The BJC is valid even the global energy is not conserved during the transient stage. In the equilibrium stage of global warming, the OHT is weakened because both the vertical stratification and the MOC are weakened. The AHT change is in-phase with the OHT change, so the BJC fails.