Geophysical Research Abstracts
Vol. 19, EGU2017-5881, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

The impact of oceanic heat transport on the atmospheric circulation

Valerio Lucarini (1,2) and Frank Lunkeit (2)

(1) Department of Mathematics and Statistics, University of Reading, Reading, UK (v.lucarini@reading.ac.uk), (2) CEN, University of Hamburg, Hamburg, Germany

A general circulation model of intermediate complexity with an idealized Earth-like aquaplanet setup is used to study the impact of changes in the oceanic heat transport on the global atmospheric circulation. Focus is on the atmospheric mean meridional circulation and global thermodynamic properties. The atmosphere counterbalances to a large extent the imposed changes in the oceanic heat transport, but, nonetheless, significant modifications to the atmospheric general circulation are found. Increasing the strength of the oceanic heat transport up to 2.5 PW leads to an increase in the global mean near-surface temperature and to a decrease in its equator-to-pole gradient. For stronger transports, the gradient is reduced further, but the global mean remains approximately constant. This is linked to a cooling and a reversal of the temperature gradient in the tropics. Additionally, a stronger oceanic heat transport leads to a decline in the intensity and a poleward shift of the maxima of both the Hadley and Ferrel cells. Changes in zonal mean diabatic heating and friction impact the properties of the Hadley cell, while the behavior of the Ferrel cell is mostly controlled by friction. The efficiency of the climate machine, the intensity of the Lorenz energy cycle and the material entropy production of the system decline with increased oceanic heat transport. This suggests that the climate system becomes less efficient and turns into a state of reduced entropy production as the enhanced oceanic transport performs a stronger large-scale mixing between geophysical fluids with different temperatures, thus reducing the available energy in the climate system and bringing it closer to a state of thermal equilibrium.