Geophysical Research Abstracts
Vol. 16, EGU2014-11602, 2014
EGU General Assembly 2014

The impact of oceanic heat transport on the mean meridional circulation

Marc-Andre Knietzsch, Valerio Lucarini, and Frank Lunkeit
Meteorologisches Institut, Universität Hamburg, Germany (marc-andre.knietzsch@zmaw.de)

A general circulation model of intermediate complexity and an idealized earthlike aquaplanet setup are used to study the impact of oceanic heat transport on the mean meridional circulation. Oceanic heat transport is prescribed by a q-flux following Rose et al. (2012) with peak at 27°. Annual means of 30 years of investigation are used.
The mean meridional circulation is studied by means of the zonal mean mass stream function. It shows that the mean circulation weakens with increasing oceanic heat transport especially the Hadley cell. The margin between the Hadley and the Ferrel cell is shifted poleward. Hence the Hadley cell expands with increasing oceanic heat transport. If the maximum magnitude of oceanic heat transport exceeds 3 PW, the whole tropical Hadley circulation shifts poleward and a weak inverse cell develops in the deep tropics.
The diagnostic equation of the zonal mean mass stream function called Kuo-Eliassen equation is used to investigate the forcings of the mean meridional circulation. These are the meridional gradient of diabatic heating, the meridional gradient of eddy heat flux divergence and the vertical gradient of eddy momentum flux convergence. Frictional effects are ignored.
Increasing oceanic heat transport affects the zonal mean diabatic heating distribution leading to a decreasing of its meridional gradient with increasing oceanic heat transport. With increasing oceanic heat transport the region of baroclinic unstable waves shifts poleward and both the eddy fluxes and their gradients decline. This leads to a weakening of the eddy flux driven Ferrel cell. Furthermore the poleward shifting of the eddy influenced region leads to Hadley cell's expansion and Ferrel cell's poleward shifting. The whole Hadley circulation is shifted poleward, if the oceanic heat transport leads to a poleward shifting of the diabatic heating maximum away from the equator.