Geophysical Research Abstracts
Vol. 14, EGU2012-4297, 2012
EGU General Assembly 2012

Could changes in the extratropical ocean circulation modify the mean tropical climate and ITCZ?

N.S. Fuckar (1), R. Farneti (2), S.P. Xie (3), E. Maroon (4), and D.M.W. Frierson (4)

(1) International Pacific Research Center, University of Hawaii, Honolulu, USA, (2) Earth System Physics Section, ICTP, Trieste, Italy, (3) International Pacific Reserach Center and Department of Meteorology, University of Hawaii, Honolulu, USA, (4) Department of Atmospheric Sciences, University of Washington, Seattle, USA

This study explores how interhemispheric asymmetry in the ocean meridional overturning circulation (MOC) leads to asymmetry in extratropical surface heat fluxes that can exert control over elements of the tropical circulation and the position of intertropical convergence zone (ITCZ). The primary goal is to further the understanding of crucial processes and teleconnection pathways, therefore we use an intermediate complexity coupled climate model derived from GFDL CM2.0 through a set of modular simplifications in physical parameterizations implemented in a sector geometry. A symmetric configuration with closed rectangular ocean randomly places the source of deep-water production and key heat release in one hemisphere (MOC dominant). Advective feedback in the extratropical ocean, with emphasis on surface salinity advection, causes this unforced hemispheric symmetry breaking. This leads to the development of anomalous Hadley circulation with surface branch towards and positioning of the ITCZ in the MOC dominant hemisphere. The opening of a circumpolar channel in subpolar region reduces there the upper ocean meridional salinity and heat flux that suppresses deep-water production and induces expansion of sea ice. Such tectonically forced hemispheric symmetry breaking moves the dominant region of deep-water production and extratropical ocean heat release to the opposite hemisphere from the circumpolar current, and again shifts the ITCZ across the equator into the MOC dominant hemisphere. Overall, in this simplified coupled general circulation system, the ITCZ is always downstream of the cross-equatorial ocean heat transport, i.e. in the MOC dominant hemisphere, controlled by the extratropical circulation asymmetry on multidecadal and centennial timescales.