

Zonal asymmetry of tropical precipitation in ECHAM5/MPI OM during El Nino and under global warming

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Abstract

Similarities and differences between El Nino and global warming are examined in hemispherical and zonal tropical precipitation changes of the ECHAM5/MIP MO simulations. Similarities include zonal asymmetry of tropical precipitation changes. This precipitation asymmetry varies with season. In the boreal summer and fall (winter and spring), positive precipitation anomalies are found over the northern (southern) hemisphere and negative precipitation anomalies are found over the southern (northern) hemisphere. This precipitation asymmetry in both the El Nino and global warming cases is associated with the seasonal migration of the Hadley circulation. However, their causes are different. In El Nino, a meridional moisture gradient between convective and subsidence regions is the fundamental basis for inducing the asymmetry. Over the ascending branch of the Hadley circulation, convection is enhanced by less effective static stability. Over margins of the ascending branch, convection is suppressed by the import of dry air from the descending branch. In global warming, low-level moisture is enhanced significantly due to warmer tropospheric temperature. This enhances vertical moisture transport over the ascending branch of the Hadley circulation, so convection is strengthened. Over the descending branch, the mean Hadley circulation tends to transport relatively drier air downward, so convection is reduced.