Geophysical Research Abstracts
Vol. 15, EGU2013-3689, 2013
EGU General Assembly 2013

Effects of sea surface temperature, cloud radiation and microphysical processes, and diurnal variations on rainfall in equilibrium cloud-resolving model simulations

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The effects of sea surface temperature (SST), cloud radiation and microphysical processes, and diurnal variations on rainfall statistics are documented with grid data from the two-dimensional equilibrium cloud-resolving model simulations. For rain rate of higher than 3 mm h-1, water vapor convergence prevails. The rainfall amount decreases with the decrease of SST from 29oC to 27oC, the inclusion of diurnal variation of SST, or the exclusion of microphysical effects of ice clouds and radiative effects of water clouds, which are primarily associated with the decreases in water vapor convergence. However, the rainfall amount increases with the increase of SST from 29oC to 31oC, the exclusion of diurnal variation of solar zenith angle, and the exclusion of radiative effects of ice clouds, which are primarily related to the increases in water vapor convergence. For rain rate of less than 3 mm h-1, water vapor divergence prevails. Unlike rainfall statistics for rain rate of higher than 3 mm h-1, the decrease of SST from 29oC to 27oC and the exclusion of radiative effects of water clouds in the presence of radiative effects of ice clouds increase the rainfall amount, which corresponds to the suppression in water vapor divergence. The exclusion of microphysical effects of ice clouds decreases the rainfall amount, which corresponds to the enhancement in water vapor divergence. The rainfall amount is less sensitive to the increase of SST from 29oC to 31oC and to the radiative effects of water clouds in the absence of radiative effects of ice clouds.