WARM RAIN PROCESSES OVER THE TROPICAL OCEANS.AND IMPLICATIONS ON CLIMATE CHANGE : RESULTS FROM TRMM AND GEOS GCM

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In this talk, we will first show results from TRMM data regarding the characteristics of warm rains over the tropical oceans, and the dependence of rate of warm rain production on sea surface temperature. Results lead to the hypothesis that warm rain production efficiency, i.e., autoconversion, may be increased in a warm climate. We use the GEOS-II GCM to test this hypothesis. Our modeling results show that in a climate with increased rate of autoconversion, the total rain amount is increased, with warm rain contributing to a larger portion of the increase. The abundant rainout of warm precipitation causes a reduction of low and middle cloud amount due to rainout, and reduced high clouds due to less water vapor available for ice-phase convection. However, clod radiation feedback caused by the increased rainfall efficiency , leads to differential vertical heating/cooling producing a more unstable atmosphere, allowing, more intense, but isolated penetrative convection, with contracted anvils to develop. Results also show that inceased autoconversion reduces the convective adjustment time scale, resulting in faster recycling of atmospheric water. Most interestingly, the increased low level heating associated with warm rain leads to more energetic Madden and Julian oscillations in the tropics, with well-defined eastward propagation. While reducing the autoconversion leads to an abundant mix of westward and eastward tropical disturbances on daily to weekly time scales. The crucial link of precipitation microphysical processes to climate change including the effects of aerosols will be discussed.