Geophysical Research Abstracts
Vol. 14, EGU2012-5955, 2012
EGU General Assembly 2012

Cloud radiative effects on responses of rainfall to large-scale forcing during a landfall of severe tropical storm Bilis (2006)

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The cloud radiative effects on responses of rainfall to the large-scale forcing during a landfall of severe tropical storm Bilis (2006) are investigated by analyzing sensitivity experiments imposed by large-scale forcing from NCEP/GDAS data in a two-dimensional cloud-resolving model. The daily average analysis is conducted on 15 and 16 July 2009, respectively, due to dominant stratiform and convective rainfall associated with different large-scale forcing. When cloud radiative effects are excluded, the increased mean rainfall is associated with the increased mean radiative cooling through the enhanced mean latent heat on 15 July. The reduction in mean rain rate is related to the slowdown in the mean net condensation while the enhanced mean radiative cooling from the removal of cloud radiative effects is balanced by the suppressed heat divergence on 16 July. The increased mean rainfall on 15 July and decreased mean rainfall on 16 July are mainly from raining stratiform regions. The enhanced stratiform rainfall is associated with the weakened local atmospheric moistening and strengthened local hydrometeor loss on 15 July, whereas the reduced stratiform rainfall is related to the weakened water vapor convergence on 16 July. When cloud-radiation interaction is excluded, the decreases in the mean rain rate are associated with the slowdown in the mean hydrometeor loss on 15 July and the suppression in the net condensation on 16 July. The decreased mean rainfall is mainly from convective regions on 15 July and raining stratiform regions on 16 July. The reduced convective rainfall is associated with strengthened transport of hydrometeor concentration from convective regions to raining stratiform regions on 15 July, whereas the decreased stratiform rainfall is related to the weakened water vapor convergence on 16 July.