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Cloud-precipitation processes associated with a severe tropical storm: A numerical study

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Cloud-precipitation processes associated with a landfall of Severe tropical storm Bilis (2006) are investigated using a cloud-resolving simulation. The model is integrated for 6 days with imposed zonally-uniform vertical velocity, zonal wind, horizontal temperature and vapor advection from NCEP/GDAS data. The simulation is validated with observations in terms of surface rain rate, satellite and radar reflectivity observations. The simulated stratiform clouds cover 89 % of the simulation domain that leads to dominant stratiform rainfall on 15 July 2006. The convective clouds develop to cover 29 % of the simulation domain that yields dominant convective rainfall whereas the stratiform clouds shrink to 46 % on 16 July 2006. The domain-mean simulation shows that the increase of domain-mean surface rain rate from 15 to 16 July 2006 mainly results from local vapor gain on 15 July and local vapor loss on 16 July although vapor convergence rates in the two days are similar. The rainfall distribution shows that stratiform rainfall covers most of the simulation domain on 15 July 2006 whereas convective rainfall is significantly seen on 16 July 2006. Thus, the cloud properties and rainfall processes in the two days are analyzed and compared. The similarities in cloud and rainfall processes between the two days include the following: (1) vapor convergence mainly accounts for surface rainfall in domain-mean and convective rainfall budgets; (2) domain-mean ice water path is smaller than domain-mean liquid water path. The differences include the following: (1) the change of local vapor from the gain on 15 July to the loss on 16 July accounts for the increase of domain-mean surface rain rate from 15 to 16 July 2006; (2) raining stratiform rainfall covers 88.8

% of simulation domain on 15 July 2006 whereas it only covers 46.0 % on 16 July; (3) fractional convective and non-raining stratiform coverage and clear-sky coverage significantly increases on 16 July; (4) domain-mean surface rainfall and cloud hydrometeors come from stratiform regions on 15 July and by convective regions in 16 July; (5) vapor convergence is a major stratiform rain source on 15 July whereas about half of stratiform rainfall comes from local vapor loss and another half is from local hydrometeor loss/hydrometeor convergence and vapor convergence on 16 July; (6) in non-raining stratiform regions, the vapor convergence yields atmospheric moistening on 15 July whereas the vapor divergence causes atmospheric drying on 16 July.