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Implementation of the GFS physical package in the GRAPES regional model: single column experiment

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There is a growing concern about coupling among physical components in NWP models. The Physics package of the NCEP Global Forecast System (GFS) has been considerably turned and connection among various components is well considered. Thus, the full GFS physical package was implemented into the GRAPES-MESO and its single column version as well. Using the data collected at ARM Southern Great Plain site during the summer 1997 Intensive Observing Period, several experiments of single-column model (SCM) were conducted to test performance of a set of original physical processes of GRAPES(CTL experiment) and the GFS physics package implemented(GFS experiment). Temperature, moisture, radiation, surface heat flux, surface air temperature and precipitation are evaluated. It is found that potential temperature and vapor mixing ratio simulated by GFS experiment is more accurate than that of CTL experiment. Errors of surface downward solar and long-wave radiation simulated by GFS experiment are less than that of CTL experiment and upward latent and sensible heat flux are also better agreeing with observation. The maximum and minimum 2-m air temperatures of the GFS experiment are close to observation compared with that of CTL experiment. Analysis of precipitation simulated shows that both sets of physical processes well reproduce heavy rainfall events. Failure and delay of moderate rainfall events and over predictions of drizzle events are commonly found for two sets of experiments. For the case of three rainfall events, the errors of potential temperature and vapor mixing ratio simulated by GFS experiment were smaller than that of CTL experiment. It is shown that the late occurrences of rainfall are resulted from a more stable temperature profile and lower moisture simulated in boundary layer than those from the observation prior to rainfall. When the simulated rainfall occurs, the simulated temperature and moisture become more favorable to the precipitation than observation.