Sensitivity of Simulated Stratus Clouds over Eastern China to Horizontal Resolutions and Dynamical Cores in a General Circulation Model

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Abstract: This study presents an investigation on the systematic errors associated with stratus clouds over Eastern China in the Community Atmosphere Model, version 5 (CAM5), with emphases on the impacts of the model's dynamical components on the cloud simulation. As the horizontal resolution increases, CAM5 produces increased stratus cloud amounts and enhanced shortwave cloud radiative forcing (SWCF) over most areas of Eastern China. This is contributed by more favorable large-scale dynamical conditions in the high-resolution model (e.g., uprising motions). However, over the Sichuan basin, where is on the lee side of the eastern steep slope of the Tibetan Plateau, high-resolution models show decreased stratus amounts and weakened SWCF, exhibiting larger biases against the observations. This problem is only found in the high-resolution configuration, and is caused by the model generated unfavorable dynamical environment over this region. We found this specific problem is sensitive to the choice of the model's dynamical core. Only the default grid-point core has this problem, while an alternative spectral transform core largely alleviates this bias. The difference lies in that the grid-point core generates too strong subsiding motions near the steep topography, unfavorable to the accumulation of stratus clouds. While the spectral core is free from this dynamical problem.

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