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Satellite-observed Storm Top Visible and IR Features and Their Physical Interpretation

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Severe storms that produce heavy damages due to the associated high winds, flood and hail have been observed by meteorological satellites to exhibit certain identifiable visible and infrared features on their cloud tops. These features include the enhanced V, the warm-cold couplet, the close-in warm spot, distant warm area, and cold point. It would be desirable to understand the physics behind these features because such knowledge are not only important to storm science but may be used as the basis for designing new technologies for storm nowcasting and forecasting. For two decades these features have been investigated, yet not definite conclusions seem to yet emerge.

This paper uses a 3-D nonhydrostatic cloud model to simulate some severe thunderstorms and utilizing the model results to shed some lights on the physical mechanisms responsible for producing the observed features. We will show the animations of the modeled storm to illustrate the fact that the simulation reproduced the satellite observed visible and IR features, and the correlation analysis to illuminate the relation between the IR brightness temperatures and cloud top physical variables. Finally, a synthesis of the study will be made to explain the physics and dynamics behind the observed features.