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Warm cloud microphysics and its interaction with aerosols: cloud-resolving modeling and satellite observation

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Warm cloud microphysics is an important process that determines how the liquid water falls from the atmosphere and controls optical properties of liquid clouds that are of particular importance in the Earth's radiation budget. The warm cloud microphysics also provides a pathway through which aerosols influence the clouds, precipitation and climate. The aerosol effect on clouds is recognized as one of the most uncertain factors in understanding and predicting the climate change with current global climate models that are based on much coarser grid resolution than is typical of individual clouds.

Under these circumstances, recent emergences of a global cloud-resolving model and the CloudSat/A-Train satellites have started to provide new capabilities of studying the cloud microphysics and its interaction with aerosols. The global cloud-resolving model has recently been implemented with aerosol transport module and has started to simulate the aerosol effects on clouds and precipitation in more detail than has been possible with traditional climate models. In this talk, some of the simulation results will be highlighted in comparison with observational statistics obtained from combined analysis of CloudSat and A-Train multi-sensor satellite measurements that offer new insights into the warm cloud microphysical processes. Through these comparisons, we would like to discuss how to use the multi-sensor satellite observations to evaluate the cloud microphysics parameterizations in models for aerosol-cloud interaction studies and then to point to a possible area of model improvement for more realistic representation of warm rain formation processes.