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A method to distinguish the hail and rainstorm cloud using Microwave Sounder data

Xiang Fang and Xin Wang

CMA/NSMC

Hail and rainstorm are two kinds of important disasters caused by severe convective storms, and the effective monitoring and warning of them is the key point to weather forecasting. There are many differences between them, including weather generating conditions and the microphysical parameters. So it is important to study the relationship and to reveal the generation and development of these mesoscale storms for improving the diagnosis and forecasting.

Due to the similar feature of the convection cloud could cause by hail or rainstorm, the typical observation using visible and infrared channels is difficult to distinguish them. The microwave sounders carried by NOAA and FY-3 can penetrate high level cloud and get the convection internal characteristics. The AMSU-B (NOAA) and MWHS (FY-3) with 5 channels and a frequency range between 89 and 183GHz are usually used to retrieval humidity profile. The observation results of these channels have high sensitivity with ice water concentration and altitude variation, so it is suitable and beneficial using these data to detect differences in the hail and rainstorm.

This study integrates the microwave satellites data to discuss the different features between the hail and rainstorm, basing on the understanding the channels response for the ice and water. With the simulation results of the radiation transmission model, each channel brightness temperature response with hail and rainstorm are separately identified, this is the main basis for the method to distinguish the hail and rainstorm cloud. The main conclusions are as follows.

1) Hail and rainstorm clouds have great differences in characteristics of environmental field. Contrasting with rainstorm cloud, hail cloud has the larger rising velocity and vertical wind shear, lower 0°C level, higher lifting condensation level, thinner warm cloud level, less low level water vapor convergence, and high convective instability.

2) Compared with rainstorm, there is less liquid water in hail, and ice particles concentrate on the top of 8km. Besides, the higher brightness temperature reduce rate in the water vapor channel than in window channel shows in hail system.

3) This method is developed with markedly brightness temperature difference between the 183.3±3GHz and 150GHz. In the convective region, hail cloud can be judged when the two channels brightness temperature difference is less than zero, while the area more than 70%. On the contrary, the cloud is considered rainstorm.