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利用CloudSat卫星资料分析热带气旋的结构特征

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Analysing the structure characteristics of tropical cyclones based on CloudSat satellite data

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摘要

利用2006—2010年的CloudSat热带气旋过境数据集资料,定量分析了大西洋地区飓风的云、降水和热力结构在不同演变阶段内的分布特征,结果表明:雷达反射率的发生概率以5 km高度为"拐点"呈现不同的分布特点,且成熟阶段的回波强度明显大于发展和消亡阶段.各径向环内深对流云发生概率始终最大,积云和雨层云始终最小.冰水含量的最大值位于内核区且沿径向不断减小,有效粒子半径和分布宽度参数随高度减小而粒子数浓度却增大.温度距平在距离中心200 km以内随飓风演变不断增大,而200 km以外始终较小.各阶段8 km以下存在湿心区,而其上方正好对应暖心区.内核区发展阶段存在近饱和区而成熟和消亡阶段存在向外倾斜的未饱和区.各阶段不同径向环内4 km以上主要为稳定层结而4 km以下的层结特性各异,且假相当位温沿径向逐渐减小.

关键词 CloudSat, 大西洋, 飓风, 云发生概率, 热力结构

Abstract:

Using tropical cyclone crossing dataset of CloudSat from 2006 to 2010, the distribution characteristics of cloud, precipitation and thermal structure of hurricanes at different evolutionary stages in Atlantic are quantitatively analyzed, the results show that occurrence probability of radar reflectivity has different changing characteristics when considering 5 km height as a "turning point", and the echo intensity at mature stage is significantly greater than that at developing or decaying stage. Occurrence probability of deep convective cloud is always largest and those of cumulus and nimbostratus are always smallest in each radial ring. The maximum of ice water content occurs in inner-core area and it decreases along radial direction, and effective radius and distribution width parameter decrease as height increasing while particle number concentration increases. The temperature anomaly increases as development of hurricane within 200 km of center but it's always small outside 200 km. Below 8 km altitude, a wet core area exists at each stage and above it there is a hot core area. In inner-core area, a nearly saturated area appears at developing stage while at mature or decaying stage there is an unsaturated area tilted outwardly. Atmosphere stratification is mainly stable above 4 km altitude in each radial ring at different stages but below that it varies between stages, and pseudo-equivalent potential temperature decreases along radial direction.

Keywords CloudSat, Atlantic, Hurricane, Cloud occurrence probability, Thermal structure

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