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## 基于毫米波雷达、无线电掩星和探空仪资料的云边界高度对比研究

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Comparative research of cloud boundary heights based on millimeter-wave radar, radio occultation and radiosonde data

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摘要

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摘要 为准确评估基于相对湿度廓线法反演云边界高度的有效性,以CloudSat和CALIPSO联合探测结果为基准,对2008年1月至2009年1月COSMIC无线电掩星和探空仪的云底高与云顶高反演结果进行定量对比验证,结果表明:CloudSat、掩星和探空仪检测到高云的比例差异较大,掩星和探空仪云检测效率相近,但云检测质量掩星优于探空仪,云层沿高度的发生概率同样掩星与CloudSat具有更好的一致性;陆地与海洋地区掩星和探空仪云底高反演精度大于云顶高,且反演精度与云层高度有关,二者对不同类型云的边界高度具有不同的反演优势,云底高发生概率掩星和探空仪与CloudSat都有很好的一致性,但云顶高概率掩星与CloudSat的吻合程度更好;CloudSat云边界高度随纬度升高而减小,其与掩星和探空仪的反演偏差同样是低纬大于中高纬,且具有不同的季节分布特点.此外,三者检测的底层云中低云所占比例从冬季到夏季逐渐减小,顶层云中云顶高于10 km的比例从冬季到夏季却逐渐增加.

关键词 CloudSat, COSMIC, 探空仪, 云底高, 云顶高, 相对湿度

Abstract: In order to accurately evaluate the validity of cloud boundary heights retrieved from relative humidity profiles, this paper quantitatively compares the retrievals of cloud-base and cloud-top heights based on COSMIC and radiosonde data from January 2008 to January 2009 with those from both CloudSat and CALIPSO, and refers the collaborative sounding results from CloudSat and CALIPSO as a benchmark. The results show that CloudSat, COSMIC and radiosonde have quite different detection results for high-level clouds. COSMIC and radiosonde have comparatively close cloud detection efficiency but COSMIC has better detection quality than radiosonde. Similarly, COSMIC has better consistency with CloudSat than radiosonde for occurrence frequency of different clouds along the height direction. The retrieval accuracy of cloud-base heights over land and ocean is larger than that of cloud-top heights for both COSMIC and radiosonde and it is related to cloud-layer heights. COSMIC and radiosonde have different retrieval advantages for cloud boundary heights of different types of clouds, and the occurrence frequency of cloud-base heights from CloudSat agrees well with that from both COSMIC and radiosonde but COSMIC has better consistency with CloudSat for cloud-top heights than radiosonde. Cloud boundary heights from CloudSat decrease with increasing latitudes and retrieval biases with COSMIC and radiosonde are larger at low latitudes and smaller at middle and high latitudes, and the retrieval biases have different seasonal variation regularities. In addition, the proportions of low-level clouds among the lowest layer clouds become smaller from winter to summer while the proportions of clouds whose cloud-top heights are larger than 10 km among the highest layer clouds increase gradually from winter to summer.

Keywords CloudSat, COSMIC, Radiosonde, Cloud-base heights, Cloud-top heights, Relative humidity

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