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地球附近第23太阳活动周磁云和非磁云ICME的对比统计

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Comparative statistical study between MCs and non-cloud-like ICMEs during solar cycle 23 near 1AU

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摘要

行星际日冕物质抛射（ICME），作为影响地球空间天气的重要源头之一，根据其磁场结构特点可分为磁云（MC）和非磁云ICME两个子集.本文对第23周的磁云和非磁云ICME结构及其地磁效应进行对比统计研究.第23周ICME事件总数为317个，其中磁云占ICME比例为33.75%，非磁云ICME占66.25%.统计结果表明，非磁云ICME数与太阳黑子数呈现出非常好的正相关性，而磁云与太阳黑子数的这种相关性并不明显.相反，磁云占ICME的比率与太阳黑子数呈现出一定的反相关性.对磁云与非磁云ICME引起的地磁暴的比较研究表明：磁云及其鞘区引发的地磁暴平均水平要高于非磁云ICME及其鞘区.磁云和非磁云ICME的磁场强度、南向磁场强度和传播速度整体上都随地磁暴水平提升而增加.对磁云与非磁云ICME参数的进一步对比分析表明，磁云及其鞘区的平均磁场强度和南向磁场分量平均值都明显要比非磁云ICME的大；而二者的等离子体温度、密度和速度平均值相差并不明显.

关键词 行星际日冕物质抛射, 磁云, 地磁暴

Abstract:

As the major interplanetary origin of disastrous space weather of Earth, interplanetary coronal mass ejections (ICMEs) can be divided into two parts: magnetic clouds (MCs) and non-cloud-like ICMEs (non-MCs), based on the features of magnetic field. Here, we report some comparative statistical studies between MCs and non-MCs during solar cycle 23. During this period, there were 317 ICMEs, of which 33.75% were MCs and the other 66.25% were non-MCs. We find that the yearly variation of non-MCs is well correlated with the variation of sunspots while this correlated relationship between variations of MCs and sunspots is not fulfilled. On the other hand, the MCs-to-ICMEs ratio shows an approximately anticorrelated relation. The average strength of geomagnetic storms caused by MCs and their sheaths is much larger than that caused by non-MCs and their sheaths. In general, as the geomagnetic storm level enhances, the magnetic field strengths and the southward magnetic field strengths and propagation speeds of both MCs and non-MC ICMEs will increase. The further statistical study of the magnetic field and plasma parameters of MCs and non-MCs shows that the average strength and southward component of magnetic field of MCs are obviously larger than those of non-MCs while their proton densities, proton temperatures and bulk speeds differ insignificantly on average.

Keywords Interplanetary coronal mass ejection, Magnetic cloud, Geomagnetic storm

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