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太阳活动低年电离层磁场VLF波的观测特性研究

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Observational characteristics of ionospheric magnetic VLF wave in the solar minimum year

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摘要 本文利用搭载在DEMETER卫星上的感应式磁力仪(Instrument Magnetometer Search-Coil, IMSC)探测数据分析了磁场甚低频(Very Low Frequency, VLF)波功率谱的空间分布.在排除地磁扰动影响(*Dst*≤-30 nT,*Kp*≥3,*AE*≥200 nT)的前提下,我们给出2007年不同季节,日侧和夜侧,磁场VLF波功率谱的全球分布的背景场探测和对应的统计误差分布.利用太阳活动低年的背景场探测统计分析了磁场VLF波功率谱的频谱特性和季节变化,以及对来自空间的地磁活动的响应特征.太阳同步高度卫星探测的磁场VLF波功率谱也可以观测到源于地球特定区域里的磁场异常所产生的频谱响应.12.5~17.5 kHz频段的磁场VLF波功率谱全球分布清楚地给出了南大西洋磁场异常区的分布轮廓.夜间百慕大地磁异常影响了磁场VLF波功率谱的多个频段,并显示出类似于高纬极区磁场的地磁活动响应的观测特征.卫星磁场VLF波功率谱探测背景研究表明,源于空间的地磁扰动和源于地球的局部地磁异常都会引起电离层磁场VLF波功率谱的变化.特别是在12.5~17.5 kHz频段,我们发现了沿板块边缘分布的电离层磁场VLF波功率谱增强带,这将为我们探寻由板块运动引起的地球突发事件的电离层响应增加探测依据,为定量甄别此类事件的电离层异常信号积累实用的背景参照.

关键词: 磁场VLF波 功率谱密度 电离层地震响应 地磁异常 地磁活动

Abstract: Ionospheric VLF wave recorded by the Instrument Magnetometer Search-Coil (IMSC) onboard the DEMETER spacecraft during 2007, the solar minimum year, were investigated statistically. By excluding the influence of geomagnetic activity with geomagnetic active indexes *Dst* ≤ -30 nT,*Kp*≥3 and *AE*≥200 nT, the quiet global distributions of power intensity spectrum of VLF wave, and the corresponding statistical error, were displayed for different seasons in both the dayside and the nightside. By using the power spectral global distribution background, the spectrum characteristics, seasonal variations and geomagnetic active responses of the VLF wave were analyzed statistically. The magnetic VLF wave observation in the solar synchronous orbit can also be sensitive to the magnetic anomalies produced from the Earth. At the frequency channel of 15 kHz and 17.5 kHz, the south Atlantic magnetic anomaly contour was presented clearly with the power spectral enhancement under the global background. The Bermuda geomagnetic anomalies caused VLF wave power spectral increase in almost all spectral bands at the nighttime, and showed about similar geomagnetic active responses as observed at higher latitude. Especially in the frequency band 12.5~17.5 kHz, we found that the power spectral increase along the edge of geographical plates, which will enhance our search for ionospheric seismo-response caused by the plate motion, and accumulate experiential background references for such anomalous signal identification quantitatively.

Keywords: Magnetic VLF wave Power intensity spectrum Ionospheric seismo-response Geomagnetic anomaly Geomagnetic active

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