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基于三亚VHF雷达的场向不规则体观测研究: 2. 东亚低纬电离层E区准周期回波

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Observations on the field-aligned irregularities using Sanya VHF radar: 2. Low latitude Ionospheric E-region quasi-periodic echoes in the East Asian sector

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摘要

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摘要

中低纬电离层E区不规则体准周期雷达回波现象,在地球不同经度区被观测到并开展了有关研究.本文利用三亚(109.6° E,18.4° N) VHF相干散射雷达2011年2月6日的观测,第一次给出了中国低纬电离层E区准周期回波的发生和变化特征.观测结果表明:准周期回波发生在地方时夜间2100—2200 LT的110 km高度上,与连续性回波可同时发生;准周期回波斜纹在雷达探测的高度-时间-强度(HTI)图上可延伸5~20 km,持续时间为5~15 min,回波斜纹高度随时间以20~30 m/s下降,斜纹在HTI图上彼此间隔10 km和10 min左右.此外,雷达回波多普勒谱和雷达干涉分析显示不同高度准周期回波的多普勒速度随高度-时间表现出不同的变化趋势,与回波条纹斜率无明显联系,不同高度准周期回波对应的不规则体在东西方向也表现出截然不同的运动特征.分析结果表明,三亚电离层E区准周期回波的发生可能并不是由散块Es随着中性风周期性的经过雷达探测区域所致,而可能和Es中的扰动结构相关.

关键词 低纬电离层E区, 准周期回波, 场向不规则体, VHF相干雷达

Abstract:

The quasi-periodic (QP) radar echoes have been widely observed at middle latitudes. Analyzing the field-aligned coherent radar echoes observed on 6 February 2011 over Sanya (109.6° E, 18.4° N), we present first results of quasi-periodic echoes in the Chinese low latitude region. The observational results show that QP echoes occurred above 110 km around 2100—2200 LT, and coexisted with continuous radar echo layers. The altitude extent of the QP striations is in a range of about 5~20 km and the duration is about 5~15 minutes. The QP echoes first appeared at higher altitude and then descended to the height close to the continuous echoing region, with a descent rate of 20~30 m/s and a period of about 8 minutes. Further, the Doppler velocities of QP echoes change in time and range and are not related to the striation slope. The zonal drift velocities derived from radar interferometric analysis of QP echoes show apparent variations with altitude. On the basis of earlier theories and simulations related to QP echoes, we suggest that the generation of QP echoes over Sanya may not be induced by the isolated Es patches which periodically move in the radar-viewing region, but could be associated with the disturbed structures generated within Es layer.

Keywords Low-latitude ionospheric E region, Quasi-periodic echoes, Field-aligned irregularity, VHF coherent radar

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