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罗布泊湖相沉积物极化散射特性及其环境意义

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Polarimetric and scattering properties of subsurface saline lacustrine deposits in Lop Nur Lake Basin, China using Synthetic Aperture Radar data

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摘要

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摘要

通过对罗布泊古湖盆区域("大耳朵")湖相沉积物含水量与含盐量、介电性质、地表微地貌等理化参量的分析,本文提出了罗布泊古湖盆区域的散射过程与次地表散射结构;利用全极化测量技术(PolSAR, Polarimetric Synthetic Aperture Radar),本文对不同纹理区域进行了物理散射机制的定量化剖析,同极化相关分析与极化度推算结果表明整个"大耳朵"区域后向散射强烈,亮条带比暗条带的散射机制更为复杂,地表微地貌状态是造成"大耳朵"特征的表现原因.在此基础上,本文利用极化分解技术进一步分离不同散射机制分量,通过定量比较各部分贡献对于"大耳朵"特征的表征能力,提出次地表介质性质(如含盐量)是"大耳朵"特征的根本性成因,相关性可达0.784,同时分析了次地表高含水含盐湖相沉积物在SAR响应中的重要性及其与地表形态之间的动力学形成机制.最后,本文论证了合成孔径雷达(SAR, Synthetic Aperture Radar)在罗布泊地区的穿透能力,预示着SAR遥感技术在干旱区环境研究中的应用潜力.

关键词 罗布泊, PolSAR, 极化参数, 极化分解, 穿透性, 湖盆演化

Abstract:

Analyses about physical and chemical parameters of lacustrine deposits such as moisture, salinity, dielectric property and surface micro-topography, were carried out to investigate the scattering mechanisms and subsurface scattering structure in Lop Nur Lake Basin (the "Ear" region). Using PolSAR (Polarimetric Synthetic Aperture Radar) technology, physical scattering mechanisms in different texture regions were analyzed quantitatively. The calculated results of the co-polarization correlation and degree of polarization reveal that the whole "Ear" region produced strong backscattering energy, and the scattering mechanism of bright strip is more complicated than that of grey strip. The formation of "Ear" feature is apparently due to the status of surface micro-topography. Then, this paper further extracted the contributions of different scattering mechanisms using polarimetric decomposition algorithm. Based on quantitative comparison among the three parts, subsurface characteristics (e.g.: salinity) are demonstrated to be fundamental cause of "Ear" feature, with R square of 0.784. Meanwhile, the results indicate that subsurface lacustrine sediments with high moisture and salinity are important for SAR response, which are also related with surface pattern. The penetrating capability of SAR is proposed to be effective in Lop Nur Lake Basin, which means its significant potential for arid environment study.

Keywords Lop Nur, PolSAR, Polarimetric parameter, Polarimetric decomposition, Penetration, Lake basin evolution

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