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GNSS-R测量地表土壤湿度的地基实验

严颂华[1,2], 龚健雅[2], 张训械[3], 李冻秀[1]*

1. 武汉大学电子信息学院, 武汉 430079;
2. 武汉大学测绘遥感信息工程国家重点实验室,武汉 430079;
3. 中国科学院武汉物理与数学研究所,武汉 400071

Ground based GNSS-R observations for soil moisture

YAN Song-Hua[1,2], GONG Jian-Ya[2], ZHANG Xun-Xie[3], LI Dong-Xiu[1]*

1. School of Electronic Information, Wuhan University, Wuhan 430079,China;
2. State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan 430079,China;
3. Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan 430071, China

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摘要 应用地基GNSS-R测量土壤湿度,相比空基而言,反射信号接收天线安装位置低,反射区面积小,反射区域内土壤构成成分一致,可以克服空基实验带来的反射区面积大、反射区内土壤地貌复杂的因素,有利于提高反演的精度.本文介绍了地基GNSS-R反演土壤湿度的原理和方法.首先通过归一化处理消除电离层和中性大气对信号强度的影响,然后利用光滑地表散射模型和土壤介电常数模型反演土壤湿度.为验证GNSS-R反演结果的精度, 利用配置右旋天线和左旋天线的GNSS-R接收机在武汉华中农业大学试验田开展地基GNSS-R测量土壤湿度实验,用土壤湿度计(TDR)与GNSS-R一起进行了联合观测, 对实测数据进行分析和统计,在低洼区和平整区观测的对比结果表明,利用多颗高仰角卫星进行联合反演,减小了单颗星反演的误差.实验证明地基实验对于GNSS-R土壤湿度的定量反演研究具有重要作用,其也为利用GNSS-R技术构建大范围的土壤湿度监测网提供了可能性.

关键词: GNSS-R 土壤湿度 地基实验 土壤介电常数

Abstract: The ground-based GNSS-R experiments are more favorable than the airborne experiments for research. Since the antennas are set low in ground-based experiments, the reflecting areas are much smaller than that in airborne experiments, so in these small areas the soil has nearly the same soil structure including soil texture, soil moisture and soil surface roughness,then the precision of the GNSS-R inversion can be improved. In this paper, the principle of soil moisture measuring by GNSS-R is described. First the influence on reflected signal power by ionosphere and neutrosphere is eliminated by normalized processing, then the soil moisture is calculated based on geometric optics approximation and dielectric models for the soil. In order to prove the accuracy of GNSS-R observation a field experiment was completed in Wuhan, in which a soil moisture tester (Time Delay Reflectometry-TDR) was used to observe together with the GNSS-R receiver. Comparison between TDR and GNSS-R observations at different sites and times shows that the average error is small. Therefore the ground based experiment is important for quantitative retrieval of soil moisture, and it also can provide good initial conditions for widespread soil moisture monitoring if using GNSS-R receiver network.

Keywords: GNSS-R Soil moisture Ground based experiment Soil dielectric constant

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About author: 严颂华,男,1971年生,2006年博士毕业于武汉大学无线电物理专业,测绘遥感信息工程国家重点实验室博士后,主要从事雷达应用于海洋与气象遥测遥感.E-mail:ysh567@sohu.com

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