王新云,郭艺歌,何杰.基于多源遥感数据的草地生物量估算方法[J].农业工程学报,2014,30(11):159-166

基于多源遥感数据的草地生物量估算方法

Estimation of above-ground biomass of grassland based on multi-source remote sensing data

投稿时间： 2013-12-03 最后修改时间： 2014-04-03

中文关键词: 遥感 生态系统 雷达 遥感估算 荒漠草原 地上生物量 RADARSAT-2 HJ1B

英文关键词:remote sensing ecosystems radar remote sensing estimation desert steppe above-ground biomass (AGB) RADARSAT-2 HJ1B

基金项目:国家重点基础研究发展计划（2012CB723206）；国家支撑计划（2011BAC07B03）；国家自然基金（41261089）

作者	单位
王新云	1. 宁夏大学西北退化生态系统恢复与重建教育部重点实验室，银川 750021
郭艺歌	1. 宁夏大学西北退化生态系统恢复与重建教育部重点实验室，银川 750021
何杰	2. 宁夏大学资源与环境学院，银川 750021

中文摘要:

为了寻求有效的草地生物量估算方法和精确估计荒漠草原草地生物量及其变化规律，该文探讨了利用全极化RADARSAT-2 C波段雷达数据和HJ1B图像及野外调查获得的样方生物量数据，估算荒漠草原人工柠条灌木林地上生物量的方法。在对柠条灌木林地上生物量和雷达后向散射系数及HJ1B图像归一化植被指数（normalized difference vegetation index，NDVI）进行相关分析的基础上，采用多元逐步回归分析从RADARSAT-2数据及HJ1B植被指数NDVI建立了人工柠条林生物量模型，用实测草地生物量值对模型进行验证，同时将光学和雷达图像进行融合和分类处理，在此基础上对草地生物量进行分布制图，并将其结果与HJ1B的NDVI模型生物量估算结果进行对比。结果表明：柠条林地上生物量与RADARSAT-2雷达后向散射系数之间存在较好的定量关系（决定系数R2=0.71，均方根误差（root mean square error，RMSE）=14.2 kg/hm2，P＜0.001），其估算生物量与实测生物量一致性较好，估算生物量精度优于HJ1B的NDVI指数估算结果（R2=0.27，RMSE=20.58 kg/hm2）。由此可见，利用光学图像HJ1B和雷达数据RADARSAT-2融合分类能进行地物有效识别，雷达遥感数据可以用于草地结构参数的定量研究。利用光学和微波协同遥感进行草地生态系统监测研究具有一定的应用潜力。

英文摘要:

Abstract: Grassland is one of the most widely distributed terrestrial ecosystems on Earth. It is critical to accurately estimate grassland biomass of the desert steppe, and to understand its dynamics changes in order to study the regional carbon cycle and the sustainable use of grassland resource. The integration of multisensory data provides the opportunity to explore the benefits of grassland biomass effective estimation via multiple data sources. Based on the field survey data, quadrature-polarization (qual-pol) RADARSAT-2 Synthetic Aperture Radar (SAR) C-band data was utilized to develop a biomass regression model and estimate the aboveground biomass (AGB) of the Caragana microphylla shrubbery in the desert steppe region in the northwest of China. The research area was located at Yangzhaizi Village in Ningxia Autonomous region. Grassland inventory was carried out in 45 randomly distributed plots (30 m × 30 m), and the data was used for either model development or validation. An allometric regression model was established to estimate its biomass for every Caragana microphylla shrub with CH (crown width multiple plant height) variable. The local allometric regression equation was applied to calculate AGB per plot. Furthermore, the correlation between the aboveground biomass of Caragana microphylla shrubbery and the radar backscatter coefficient was analyzed. The AGB regression model was developed by integrating field measurements of 25 sample plots with RADARSAT-2 backscatter remotely sensed data. The multiple stepwise regressions algorithm was applied to develop the AGB model and estimate the grassland above-ground biomass from RADARSAT-2 backscatter data. The developed model was validated by using 20 independent sample plots. Simultaneously, RADARSAT-2 images were fused with the optical HJ1B data by using a discrete wavelet transform for the land cover classification. The image classification based on the objects was performed by using the empirical-statistical machine learning techniques, such as a classification and regression trees (CART) algorithm. The overall accuracy and Kappa value of the proposed method was 90.2% and 0.88, respectively. It indicated that the proposed method performed well for the land use and land cover (LULC) classification. An AGB biomass distribution map was produced by RADARSAT-2 backscatter data in combination with the land cover classification image and AGB regression model. As a comparison, the AGB from RADARSAT-2 estimates were compared with the results from the HJ1B normalized difference vegetation index (NDVI) model. The result showed that there was a good quantitative relationship between the AGB from the microphylla shrubbery and the RADARSAT-2 radar backscatter coefficient. A good fit was found between AGB estimated by RADARSAT-2 and ground-measured biomass with a R2 (coefficient of determination) and Root Mean-Square Error (RMSE) of 0.71 and 14.2 kg/hm2 respectively. Its estimated accuracy was higher than that of the HJ1B NDVI model (R2=0.27, RMSE=20.58 kg/hm2). Consequently, the fusion of optical and radar data for the land cover classification could effectively improve the accuracy of the object recognition for the land cover classification and the estimation accuracy of AGB estimation. Radar remote sensing data could be used for quantitative studies on grassland structural parameters. Moreover, it demonstrated a high potential for monitoring indicators of grassland ecosystem by combining the optical with polarimetric SAR remote sensing imanges.

查看全文 下载PDF阅读器

关闭

主办单位：中国农业工程学会 单位地址：北京朝阳区麦子店街41号

服务热线：010－65929451 传真：010－65929451 邮编：100125 Email：tcsae@tcsae.org