BIOMASS ESTIMATION OF WETLAND VEGETATION IN POYANG LAKE AREA USING ENVISAT ASAR DATA

Jingjuan Liao[1] Lei Dong[2] Guozhuang Shen[1]
[1]Center for Earth Observation and Digital Earth, Chinese Academy of Sciences, Beijing 100080
[2]State Key Laboratory of Remote Sensing, Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing, 100101
Email: jjliao@ceode.ac.cn

Abstract

Wetlands are important components of ecosystems because of their role in the maintenance of environmental quality and biodiversity. As an important part of the wetland ecosystem, the wetland vegetation biomass is a key index to weigh the healthiness of the wetland ecosystem. Therefore, estimation of the wetland vegetation biomass plays the role of understanding dynamic changes of the wetland ecosystem. Poyang Lake is the largest freshwater lake in China with an area of about 3000 km^2. Its wetland ecosystem has a significant impact on China's environment change. It is difficult to estimate wetland biomass in this region using conventional field methods. So remote sensing is an efficient way to estimate biomass. Traditional optical remote sensing using Landsat TM data to estimate biomass in this region has been conducted in the last few years. But the optical remote sensing data are limited by the cloud coverage during the rainy season. The SAR data is a good choice for biomass estimation during rainy and dry seasons in this region. In this paper, The ENVISAT ASAR alternating polarization mode precision image is acquired over the test area during the experimental periods.

Field measures of biophysical parameters of wetland vegetation standing above-water were collected during two field campaigns coincident with the satellite overpasses at sites in April and November. During each collection, ground data including plant water content, above-ground biomass, and plant height were collected in 52 and 57 sampling sites, respectively. The biomass measurements at each sampling site consisted in clipping the total standing biomass within an area of $0.5\times0.5m^2$. The clipped samples were weighted in situ and oven-dried (at 120℃ during 24 hours), then used to obtain estimates of humid and dry total biomass.

In this study, we used the neural network algorithms (NNA) to retrieve wetland vegetation biomass. Firstly, the scattering model was used to generate the training data for the neural network. We used the Michigan Microwave Canopy Scattering (MIMICS) model to generate training data for the neural network,

and to examine the influence of wetland vegetation biophysical parameters on ENVISAT ASAR backscatter measurement. The MIMICS model is a canopy scattering model which has been widely used for the tree canopy comprising a crown layer, a trunk layer and rough-surface ground boundary. For the vegetation in our study area, this model should be modified because there is no trunk layer in the grass-like plants. The model was modified two layers, including the ground surface and vegetation canopy. In the model, we considered backscatters from ground surface, multi-path scattering between the surface and vegetation canopy, and vegetation canopy volume scattering. Since the study area is wetland with high soil moisture, especially in April and July, the ground surface is flooded. In this case, there is no backscattering of energy from the ground surface. We generated a set of 50 training data pairs, and each pair consists of biomass, plant water content, height, and backscattering coefficients of HH and VV polarizations. A topology of the neural network, which is a one-hidden-layer back propagation (BP) neural network with three inputs elements and two outputs, was used in this study. Then the samples collected in April and November was used to validate the inversion accuracy of NNA. The intermediate level of biomass between 400 -800g/km^2 is well simulated, while the high and low biomass estimation results are not satisfactory. The error between ground truth and estimated biomass was analyzed. The overall results of ASAR data inversion into biomass have a root mean square error (RMSE) of 0.3kg/m^2 in April, and 0.4kg/m^2 in November. While the intermediate biomass level estimate has a RMSE of 0.17 kg/m^2 and 0.3 kg/m^2 , this shows good inversion accuracy using NNA combined with MIMICS model. Finally, the trained neural network is used to estimate the overall biomass of Poyang Lake wetland vegetation. The total biomass reaches a level of 1.06×10^9kg, 1.72×10^8kg, 1.0×10^9kg in April, July and November 2007.

Key words: Biomass, Wetland vegetation, Estimation, Multi-polarization SAR data