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Assessment of biochemical concentrations of vegetation using remote sensing technology

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The main biochemicals (such as lignin, protein, cellulose, sugar, starch, chlorophyll and water) of vegetation are directly or indirectly involved in major ecological processes, such as the functions of terrestrial ecosystems (i.e., nutrient-cycling processes, primary production, and decomposition). Remote sensing techniques provide a very convenient way of data acquisition capable of covering a large area several times during one season, so it can play a unique and essential role provided that we can relate remote sensing measurements to the biochemical characteristics of the Earth surface in a reliable and operational way. The application of remote sensing techniques for the estimation of canopy biochemicals was reviewed. Three methods of estimating biochemical concentrations of vegetation were included in this paper: index, stepwise multiple linear regression, and stepwise multiple linear regression based on a model of the forest crown. In addition, the vitality and potential applying value are stressed.

Assessment of biochemical concentrations of vegetation using remote sensing technology DING Shengyan1, GU Jidong2, QIAN Lexiang1 (1. College of Environment and Planning, Henan University, Kaifeng 475001, China; 2. Department of Ecology & Biodiversity, The University of Hong Kong, Hong Kong, China) Abstract: The main biochemicals (such as lignin, protein, cellulose, sugar, starch, chlorophyll and water) of vegetation are directly or indirectly involved in major ecological processes, such as the functions of terrestrial ecosystems (i.e., nutrient-cycling processes, primary production, and decomposition). Remote sensing techniques provide a very convenient way of data acquisition capable of covering a large area several times during one season, so it can play a unique and essential role provided that we can relate remote sensing measurements to the biochemical characteristics of the Earth surface in a reliable and operational way. The application of remote sensing techniques for the estimation of canopy biochemicals was reviewed. Three methods of estimating biochemical concentrations of vegetation were included in this paper: index, stepwise multiple linear regression, and stepwise multiple linear regression based on a model of the forest crown. In addition, the vitality and potential applying value are stressed. Key words: biochemicals; vegetation; remote sensing techniques CLC number: TP79; Q50 1 Introduction The main biochemicals in plants are lignin, protein, cellulose, hemicellulose, sugar, starch, chlorophyll and water. These materials are directly or indirectly involved in bio-geochemical cycles. The functions of ecosystems, such as nutrient-cycling processes and photosynthesis, are critical in determining the exchange of greenhouse gases between soil, vegetation and atmosphere (Mooney et al., 1987; Steudler et al., 1989; Wofsy et al., 1993). For understanding the functions of terrestrial ecosystems, different data or information must be surveyed at different date and space scales. Remote sensing techniques provide a very convenient way of data acquisition covering a large area several times one season. In this context, remote sensing can play a unique and essential role provided that we can relate remote sensing measurements to the biochemical characteristics of the Earth surface in a reliable and operational way (Demarez et al., 2000). Estimating canopy biochemicals with remote sensing data is a challenge for the years to come. Knowledge of the biochemicals of the vegetation canopy is a key issue when describing, understanding and predicting ecosystem´s functions. For instance, litter degradation is governed by the contents of lignin and nitrogen (Melillo et al., 1982). In the same way, net primary production depends strongly on the availability of nitrogen (Vitousek, 1982). The biochemicals of terrestrial vegetation are among essential parameters that control physiological processes (e.g., nutrient cycles, primary production and litter decomposition). The ability to detect changes in ecosystem processes, such as carbon fixation, nutrient cycling, net primary production and litter decomposit

ion are all important part in defining global biogeochemical cycles and identifying changes in climate. Foliage is th e most important interface of a plant canopy interactive with sun. Accurate remotely sensed estimates of the foliar b iochemical concentrations of vegetation canopies can provide a valuable aid to understand ecosystem function over a w ide range of scales (Dawson et al., 1999; Peterson et al., 1988). Such remotely sensed estimations have also found ap plication to a wide range of ecosystem for estimating vegetation stress (Jago et al., 1999), identifying species (Mar tin et al., 1998), and driving ecosystem simulation models over large areas (Lucas and Curran, 1999). Connecting the optical properties of leaves with their biochemicals is a priority. How to connect the method of statistical analyse s with the data that acquired from the remote sensed image to estimate biochemicals of leaves must be considered. 2 E stimating the biochemical concentration of vegetation by remote sensing techniques 2.1 Index method 2.2 Stepwise mult iple linear regression 2.3 Stepwise multiple linear regression based on the model of forest crown 3 Conclusions (1) V egetation is critical for the functions of terrestrial ecosystems. The composition of vegetation are directly or indi rectly involved in bio-geochemical cycles. For further understanding the functioning of terrestrial ecosystems, diffe rent data or information must be surveyed at different date and space scales. Remote sensing techniques represent a v ery convenient way of data acquisition that is able to cover large areas several times during the season. Remote sens ing can play a unique and essential role provided that we can relate remote sensing measurements to the biochemical c haracteristics of Earth surface in a reliable and operational way. (2) Using remote sensing technique to estimate th e biochemicals of terrestrial vegetation need much more knowledge about mathematics, physics, chemistry and biology. To certain extent, the application of these presenting models was limited, because of its considering a few parameter s. There are many factors which will influence the accuracy of remote sensing of the biochemicals. When the model is developed, more factors must be considered, the stronger of its adapting ability. Along with the development of spac e technique and the improvement of modelling method, these limiting factors will be overcome. (3) For improving the e stimation accuracy of biochemicals of terrestrial vegetation by using remote sensing technique, the empirical measure ment must be connected with the acquired data (i.e., vegetation type and its composition, position in situ, the shap e of crown and its structure, the spectra feature etc.). So the developing direction of this research should be the c onnection of RS, GPS, and GIS. The space analysing function of GIS could provide the comprehensive information about atmosphere and topography etc. These factors will determine directly or indirectly the distribution pattern, dynamic process and development of vegetation. Especially, under the background of further study about global change, it is t he most important to use the integrated method of RS, GPS, and GIS to estimate the biochemicals for studying the func tions and process of regional or global ecosystems. References

关键词： biochemicals; vegetation; remote sensing techniques

