MODIS-NDVI-BASED FAST EXTRACTION OF MULTI-CROP PLANTING AREAS IN CHINA AGRICULTURE REMOTE SENSING MONITORING SYSTEM

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1. ABSTRACT

China is a large agricultural country. The planting structure of crops is very complicated because of climate, terrain and of the small-scale production and decentralized management of peasant households and so on. One of the major problems in China Agriculture Remote Sensing Monitoring System (CHARMS), which is established in 2001, is to extract crop planting areas and to get their spatial distribution rapidly, accurately and automatically. Aiming at the demands of large-scale crop growth monitoring/yield estimation of Remote Sensing Applications Center of Ministry of Agriculture of China, Large-scale crop planting areas automatic identification methods are presented in this paper based on MODIS NDVI (Moderate Resolution Imaging Spectroradiometer, Normalized Difference Vegetation Index) Data.

The extracting principles, methods and models of main crops planting areas, including spring wheat, winter wheat, spring maize, summer maize, cotton, soybean and paddy are introduced in detail in the paper. Accuracy assessments of extracting models as well as the application of extracting results in CHARMS are also analyzed in this paper. As we all know that, vegetation index is an important parameter which carries abundant information of earth surface vegetation properties. We know the NDVI values are different in different crops growth stages and in different region. NDVI

values increase with the growth of the crops, and gradually decrease after reaching the maximum at a certain growth stage of the crops. Because different crops have different growth stages, the NDVI peak values and their occurrences can be different. In order to extract a certain crop planting areas, each day MODIS data were received and processed, and the max NDVI values of every ten days were generated. And then we analyzed the planting structure of the main crops and the characteristics of NDVI time series of different crops in different growth stages, corporation with 1：1000,000 scale land use data, we had built more than 50 models to extract different crop planting areas in different region rapidly and automatically.

For example, we use NDVIxy to present different NDVI values of different time (where x ranges from 1-12, presenting the month, y ranges from 1-3, presenting the first ten days, the middle ten days and the last ten days of each month respectively). The extract model of winter wheat in North China is then as below: if the pixel value can meet the conditions simultaneously: $NDVI_{121}>T_{x1}$, $NDVI_{51}>T_{x2}$, $NDVI_{51}>NDVI_{43}$, $NDVI_{51}>NDVI_{52}$ (where T_{x1} and T_{x2} are different in different growth stages and different region, here, in North China region, T_{x1} and T_{x2} can be given 0.2 and 0.6 respectively), then this pixel can be interpreted as winter wheat. Another example is for summer maize in North China region: if the pixel value can meet the conditions simultaneously: $NDVI_{63}<0.2$, $NDVI_{82}>0.7$, $NDVI_{82}>NDVI_{81}$, $NDVI_{82}>NDVI_{83}$, then this pixel can be interpreted as summer maize. In this way, based on MODIS NDVI data, after analyzing phenological calendars of different crops and the corresponding relationship between the phenology and vegetation index, we built more than 50 models to extract different crop planting areas in different regions. Field sampling investigation, high space resolution remote sensing images and statistical data are all used to assess our accuracy, and the total accuracy is over 80%.

The extracting models and research results have already been used in CHARMS, and have improved the prediction accuracy of crop growth monitoring/yield estimation. The research results have important practical significance for further improving agricultural remote sensing monitoring system of Ministry of Agriculture of China.
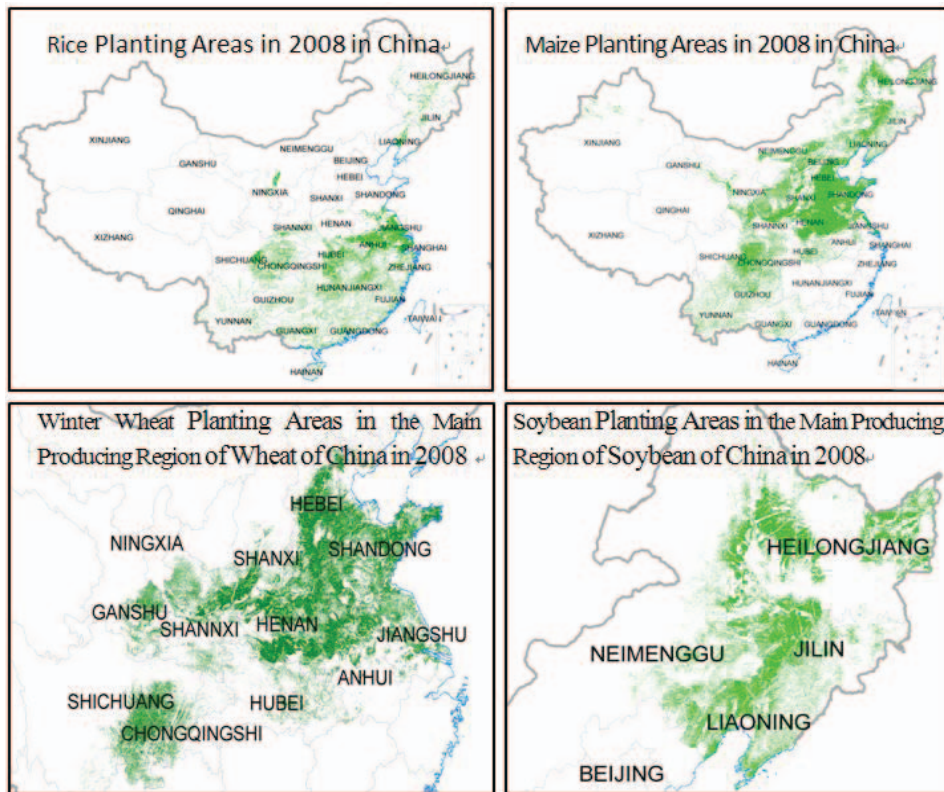
Fig.1 MODOS NDVI-Based some examples of extracting results of crops planting areas

Keywords: MODIS, NDVI, Planting area, China Agriculture Remote Sensing Monitoring System (CHARMS), Multi-Crop, Spatial distribution, phenology, Agriculture, China

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