Research Article

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Remote Sensing-Based Extraction and Analysis of Temporal and Spatial Variations of Winter Wheat Planting Areas in the Henan Province of China

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Abstract: The aim of this study is to assess the winter wheat planting (WWP) area in Henan Province and investigate its temporal and spatial variations by using remote sensing (RS) technology. A spectral angle mapper (SAM) was adopted to identify the WWP area of each district divided by the hierarchical grades of land surface drought index during 2001-2015. The results obtained show the expediency of monitoring the WWP areas at the regional scale via drought regionalization, which provides a goodness-of-fit R^2 =0.933, a mean relative error MRE=49,118 ha, and an overall accuracy up to 90.24%. The major WWP areas in Henan Province were located in Zhoukou, Zhumadian, Shangqiu, Nanyang, and Xinxiang prefecture-level cities. Two representative sites are mountainous districts, with rich water resources or high urbanization rate, which have a low probability of WWP. Both sites exhibited a strongly manifested evolution of WWP areas, which could be attributed to extremely cold weather conditions, crop alternation, the popularization of new varieties, and fast expansion of built-up areas. The results of this study are instrumental in the analysis of crop planting variation characteristics, which should be taken into account in the further decision-making process related to the crop planting strategies.

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Keywords: winter wheat planting (WWP) area; spatial and temporal variations; remote sensing monitoring; planting probability

1 Introduction

Henan province of China is a large-scale producer of winter wheat, whose crop yield is closely correlated to the planting area and applied planting strategies. In view of global climate change, especially, the effect of global warming on the safety of agricultural production, real-time accurate monitoring of winter wheat planting (WWP) area data becomes a “must-have” feature of state-of-the-art agricultural management, which stimulates the relevant government departments in China to master the monitoring techniques [1]. In this respect, remote sensing (RS) technology possesses a series of advantages, such as a wide coverage, short data updating cycle, strong objectivity, and low cost, which makes it a lucrative tool for the accurate, rapid, and convenient extraction of the WWP area data [2, 3].

Thus, a comprehensive analysis of phenological (i.e., related to periodic plant life cycle events influenced by seasonal and interannual variations in climate) characteristics can be considerably enhanced by RS-based monitoring.

Since the pioneer application of RS technology to the estimation of wheat area and total yield by the US researchers in 1974 [4], international scholars have reported numerous achievements in this domain and implemented several innovative RS-treatment procedures, which can be briefly outlined as follows:

1) Visual interpretation and automated computerised identification. According to the phenological characteristics of winter wheat growth and development, RS images are appropriately selected, and the multi-dimensional green map is constructed. Then, the winter wheat data are hierarchically and automatically