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In-Season Crop Mapping with GF-1/WFV Data by Combining Object-Based Image Analysis and Random Forest

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Received: 17 October 2017; Accepted: 16 November 2017; Published: 17 November 2017

Abstract: Producing accurate crop maps during the current growing season is essential for effective agricultural monitoring. Substantial efforts have been made to study regional crop distribution from year to year, but less attention is paid to the dynamics of composition and spatial extent of crops within a season. Understanding how crops are distributed at the early developing stages allows for the timely adjustment of crop planting structure as well as agricultural decision making and management. To address this knowledge gap, this study presents an approach integrating object-based image analysis with random forest (RF) for mapping in-season crop types based on multi-temporal GaoFen satellite data with a spatial resolution of 16 meters. A multiresolution local variance strategy was used to create crop objects, and then object-based spectral/textural features and vegetation indices were extracted from those objects. The RF classifier was employed to identify different crop types at four crop growth seasons by integrating available features. The crop classification performance of different seasons was assessed by calculating F-score values. Results show that crop maps derived using seasonal features achieved an overall accuracy of more than 87%. Compared to the use of spectral features, a feature combination of in-season textures and multi-temporal spectral and vegetation indices performs best when classifying crop types. Spectral and temporal information is more important than texture features for crop mapping. However, texture can be essential information when there is insufficient spectral and temporal information (e.g., crop identification in the early spring). These results indicate that an object-based image analysis combined with random forest has considerable potential for in-season crop mapping using high spatial resolution imagery.

Keywords: crop mapping; in-season; object-based classification; Random Forest

1. Introduction

The timely availability of the spatial distribution of crop types is required for statistical and economic purposes as well as agrarian policy actions related to subsidy payments or implementation of agro-environmental measurements [1,2]. Understanding the dynamic progress of the composition and spatial structure of mosaicking crops is critical for a diversity of agricultural monitoring activities (e.g., crop acreage estimation, yield modeling, harvest operations schedules and greenhouse gas mitigation) [3–5]. Recently, there has been an increasing demand for delivering information on the spatial distribution and dynamics of different crop types as early as possible, as in-season the crop