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Comparison of Two Synergy Approaches for Hybrid Cropland Mapping

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Abstract: Cropland maps at regional or global scales typically have large uncertainty and are also inconsistent with each other. The substantial uncertainty in these cropland maps limits their use in research and management efforts. Many synergy approaches have been developed to generate hybrid cropland maps with higher accuracy from existing cropland maps. However, few studies have compared the advantages, disadvantages, and regional suitability of these approaches. To close this knowledge gap, this study aims to compare two representative synergy methods of cropland mapping: Geographically weighted regression (GWR) and modified fuzzy agreement scoring (MFAS). We assessed how the sample size, quality of input satellite-based maps, and various landscapes influence the accuracy of the synergy maps based on these two methods. The GWR model is a regression analysis predominantly dependent on the cropland percentage of the training samples, while the MFAS method is largely influenced by the consistency of input datasets, and the training samples only play an auxiliary role. Therefore, the GWR method was relatively more sensitive to the number of training samples than the MFAS method. The quality of input maps had a significant impact on both methods, particularly on MFAS. In regions with heterogeneous landscapes and high elevations, the croplands are generally more fragmented, and the consistency of the input satellite-based maps was lower; the application of cropland percentage samples could compensate for the low dataset consistency. Therefore, GWR is more suitable for regions with heterogeneous landscapes, while MFAS is more appropriate for regions with homogeneous landscapes. The MFAS method uses cropland area from the agricultural statistics to calibrate the initial synergy maps, while the GWR model only considers the spatial distribution of cropland and does not make use of the distribution information of cropland area. The MFAS method showed a higher correlation with the statistical data, while GWR model exhibited a stronger relationship with cropland percentage. Our study reveals the advantages, disadvantages, and regional suitability of the two main types of synergy methods (regression analysis methods and data consistency scoring methods) and can inform future synergy cropland mapping efforts.

Keywords: data fusion; cropland mapping; synergy map; geographically weighted regression; modified fuzzy agreement scoring

1. Introduction

Cropland is a fundamental resource for human existence and societal development [1,2], as it provides most of the products (e.g., food commodities, feed, fiber, and biofuels) that humans rely on