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A Synergy Cropland of China by Fusing Multiple Existing Maps and Statistics

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Abstract: Accurate information on cropland extent is critical for scientific research and resource management. Several cropland products from remotely sensed datasets are available. Nevertheless, significant inconsistency exists among these products and the cropland areas estimated from these products differ considerably from statistics. In this study, we propose a hierarchical optimization synergy approach (HOSA) to develop a hybrid cropland map of China, circa 2010, by fusing five existing cropland products, i.e., GlobeLand30, Climate Change Initiative Land Cover (CCI-LC), GlobCover 2009, MODIS Collection 5 (MODIS C5), and MODIS Cropland, and sub-national statistics of cropland area. HOSA simplifies the widely used method of score assignment into two steps, including determination of optimal agreement level and identification of the best product combination. The accuracy assessment indicates that the synergy map has higher accuracy of spatial locations and better consistency with statistics than the five existing datasets individually. This suggests that the synergy approach can improve the accuracy of cropland mapping and enhance consistency with statistics.

Keywords: synergy map; cropland mapping; data fusion; statistics; agreement

1. Introduction

Knowledge of the extent and dynamics of cropland is important for food security and environmental sustainability. Estimates of the global population in 2050 exceed 9 billion, with the resulting growing demand for food [1,2]. Changes in dietary patterns with rising income will increase demands for animal protein, vegetable oils, fruits, and vegetables, which implies that the cropland needed to support average human diets will increase [3]. These changes will undoubtedly put greater pressure on already overstretched cropland. Moreover, farming activities have enormous environmental consequences because they alter a large proportion of structure and function of ecosystems, which influences the ecosystem interaction with the surrounding atmosphere, aquatic systems and soils [4,5]. Thus, one of the greatest human challenges is to ensure that agricultural land systems can supply our society with sufficient, safe, and nutritious foods while reducing their negative impacts on the environment. Meeting these goals requires accurate information on cropland distribution and its spatiotemporal changes to support agricultural monitoring, food production estimation, food security assessment, and geophysical models [6,7].

Satellite images provide an efficient data source from which to derive cropland extent over large areas. In recent decades, several global and continental cropland datasets have been derived from remotely sensed data and made freely available to the public. Early cropland products