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Multisource fusion for high-accuracy land cover mapping: A 10m resolution strategy in China's hill and gully regions

Le Chen
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, State Key Laboratory of Urban and Regional Ecology, China (1113819261@qq.com)

Highly accurate land cover (LC) information with fine spatial resolution serves as the cornerstone for reliable environmental insights, strategic land management, and ecological conservation. Yet, existing public LC products with 1-30m resolution exhibit considerable inconsistencies, particularly within complex terrains and fragmented habitats such as hill and gully regions, leading to uncertainties in various applications. In this context, our study innovatively targeted China's hilly and gully regions to develop an enhanced 10m resolution LC map for 2020, termed CLC-HG. The methodological advancement lied in fusing multiple LC products through accuracy evaluation, spatial consistency verification, object-oriented classification, and random forest classification. The research involved: (1) Strategic zoning of hilly and gully regions into five areas, selecting one or two representative validation regions within each; (2) Leveraging high-resolution imagery and 20000 field verification points to derive a 1m resolution land use dataset for validation regions, named GFLUCC, with 1m resolution and 95% accuracy; (3) Comprehensive validation of seven land use products spatial consistency and accuracy based on GFLUCC; (4) Filtering of layers based on spatial consistency, retaining regions with high and medium consistency; (5) Utilizing object-oriented classification and random forest classification, a higher-accuracy LC dataset was generated to replace the layers that were removed in the spatial consistency process; (6) Successful creation of CLC-HG, mirroring the accurate land use patterns of 2020. Our findings elucidated: (i) The superiority of WorldCover 10m in LC classification, contrasting with other products' regional inaccuracies; (ii) The influences of terrain complexity and human activity on accuracy, highlighting the precision in uniform areas versus the inaccuracy in complex regions; (iii) Substantial variations in spatial consistency across different terrains, with LP showing the weakest consistency; (iv) CLC-HG's remarkable performanced in identifying diverse LC types, boasting 85% overall accuracy; (v) Notable progress in classification accuracy with CLC-HG, uncovering the nuanced influences of land category complexity on consistency and human interventions on accuracy. This study breaks new ground by integrating multidimensional data and methodologies, contributing valuable insights for classification enhancements and more adept land resource management. The pioneering CLC-HGproduct holds significant potential to reduce uncertainties in global environmental change studies, ecosystem evaluations, and hazard assessments, marking an important step forward in remote sensing applications.