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Rice crop mapping using time-series Sentinel-2 data

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Rice is Taiwan's principal food and most valuable crop, occupying approximately 22.8% of the total agricultural land. Rice cropping practices are officially monitored yearly because government officials need such information to form timely plans to ensure national food security and economic development. It is, however, a real challenge because the rice fields are generally small and fragmental, yet crop mapping requires information of crop phenology regarding the spatiotemporal resolution of satellite data. Traditional rice monitoring has been carried out through visual and costly interpretation of high-resolution aerial photos. Previous efforts using high-resolution satellite data (e.g., FORMOSAT-2 and SPOT data) have demonstrated the effectiveness as promising alternatives to aerial photos for collectively mapping small patches of rice fields. However, several disadvantages complicate the collective delineation of small patches of rice fields, including high cost of data acquisition over a limited range of coverage, limited spectral and temporal resolution, and cloud cover. With the recent launch of Sentinel-2A and 2B satellites, it allows us to delineate rice-growing areas at the field level due to high spatial, temporal, and spectral resolutions of the satellite data. The objective of this study was to investigate the feasibility of time-series Sentinel-2 data for rice crop classification using crop phenological metrics in Taiwan. The mapping methodology used in this study comprise four main steps: (1) construct the time-series Sentinel-2 NDVI data, (2) noise filtering of the time-series data using wavelet transform, (3) rice crop classification using information of rice crop phenology, and (4) accuracy assessment. The mapping results performed for the 2018 first crop by comparing with the ground reference data and government statistics indicated satisfactory results, with the overall accuracy and Kappa coefficient higher than 85% and 0.72, respectively. These findings were reaffirmed by a strong correlation between the rice growing areas estimated from the Sentinel-2 data and the government's rice area statistics, with the values of correlation coefficient of determination (R2) higher than 0.92. The results achieved from such mapping methods in this study could provide agronomic planners with seasonal updated information of rice growing areas at field level in Taiwan. The methods are thus proposed for rice crop monitoring in other regions with similar land-use/cover characteristics.