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Applicability of logistic model and integrated satellite data for rice crop phenology detection

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Changes in climate condition through global warming locally altered climatic and hydrological conditions and likely trigger the increase of insect populations and diseases, causing the potential loss of rice yields. Because the rice fields damaged by diseases or insects may affect neighbouring fields, monitoring the cropping progress was important to provide agronomic planners with valuable information that could be used to timely devise strategies to mitigate possible impacts on the potential yield. This study aimed to develop an approach to monitor rice sowing and harvesting progress from the integrated Moderate Resolution Imaging Spectroradiometer (MODIS)–Landsat satellite data. We processed for the 2007 winter–spring and summer–autumn cropping seasons in 2007, following four main steps: (1) constructing a set of MODIS-Landsat fusion data using the spatiotemporal adaptive reflectance fusion model (STARFM), (2) creating smooth time-series enhanced vegetation 2 (EVI2) data using the commonly-used empirical mode decomposition (EMD), (3) detecting key phenological stages of rice crops the double logistic algorithm, and (4) error verification of the detected sowing and harvesting dates using field data. The comparison results between the EVI2 data derived from the fusion data and that from the Landsat yielded close agreement between these two datasets ($R2 > 0.9$). The double logistic algorithm applied to the filtered time-series EVI2 data to estimate phenological events of rice crops indicated the validity of our approach for monitoring the progress of sowing and harvesting activities in the region. The results obtained by comparisons between the estimated sowing/harvesting dates and the field survey data indicated that the root mean squared error (RMSE) values archived for the winter–spring crop were respectively 8.4 and 5.5 days, while those for the summer–autumn crop were 9.4 and 12.8 days, respectively. The results obtained from this study could provide decision makers with quantitative information of rice sowing and harvesting activities, which is vitally important for crop management. The methods are thus suggested for rice crop monitoring in the study region and could be transferable to other regions.