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An efficient and accurate method for obtaining regional scale rice growth conditions based on WOFOST model and satellite images

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It is very important to obtain regional crop growth conditions efficiently and accurately in the agricultural field. The data assimilation between crop growth model and remote sensing data is a widely used method for obtaining vegetation growth information. This study aims to present a parallel method based on graphic processing unit (GPU) to improve the efficiency of the assimilation between RS data and crop growth model to estimate rice growth parameters. Remote sensing data, Landsat and HJ-1 images were collected and the World Food Studies (WOFOST) crop growth model which has a strong flexibility was employed. To acquire continuous regional crop parameters in temporal-spatial scale, particle swarm optimization (PSO) data assimilation method was used to combine remote sensing images and WOFOST and this process is accompanied by a parallel method based on the Compute Unified Device Architecture (CUDA) platform of NVIDIA GPU. With these methods, we obtained daily rice growth parameters of Zhuzhou City, Hunan, China and compared the efficiency and precision of parallel method and non-parallel method. Results showed that the parallel program has a remarkable speedup (reaching 240 times) compared with the non-parallel program with a similar accuracy. This study indicated that the parallel implementation based on GPU was successful in improving the efficiency of the assimilation between RS data and the WOFOST model and was conducive to obtaining regional crop growth conditions efficiently and accurately.