# Mapping Paddy Rice Planting Areas on the Cloud: Is Spatio-Temporal Fusion Helpful or Not

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Mapping paddy rice planting area has great significance for calculating the paddy rice planting area, monitoring rice yield, monitoring global freshwater usage and monitoring methane emissions. If remote sensing satellite images can be used instead of manual visits to map paddy rice planting areas, it will greatly reduce the money and time. The basic principle of using remote sensing images to map paddy rice is to capture the characteristics of rice, that is, they are all transplanted in water. Different vegetation indices calculated from remote sensing images respond differently to water, so this characteristic of paddy rice can be used to distinguish it from other surface types. However, because Japan’ s farming modes mostly are family farming, the area of a single paddy field is small, and due to the existence of fallow or crop rotation, there are often multiple uses of land in a piece of farmland. Coarse spatial resolution remote sensing satellite images will not achieve good results. At the same time, due to the influence of climate and other factors, the transplantation period of rice generally occurs in the rainy season in Japan. Images with low temporal resolution will be affected by clouds and rain, and it is difficult for them to provide effective data. Unfortunately, due to technical limitations, no sensor can obtain images with high temporal resolution and high spatial resolution at the same time. One processing method is to use a fusion algorithm to fuse images with high temporal resolution and low spatial resolution (e.g. MODIS, MERIS) and images with high spatial resolution and low temporal resolution (e.g. Sentinel, Landsat) to obtain images have both high temporal resolution and high spatial resolution. However, the existing Spatio-temporal fusion algorithm does not have high accuracy for heterogeneous areas or areas where the type of landcover will change in one year (e.g. agricultural land). Therefore, this study will use Spatio-temporal fusion algorithm based on similar pixels (e.g. ESTARFM) and filtering based fusion algorithm (e.g. GF-SG) to fuse MODIS, Landsat and Sentinel images in different latitudes and regions. The vegetation index time series obtained after the fusion is used for searching for the flooding signal that can represent the rice transplantation period (that is, the time when the vegetation index LSWI is less than the NDVI before the start of the green up stage of paddy rice), and compare it with the real data published by the Ministry of Agriculture, Forestry and Fisheries. It is found that the fusion algorithm based on similar pixels retains the details of the time series better than the filtering-based fusion algorithm, and the time series fused by the filtering-based algorithm cannot reflect the mutation of LSWI or NDVI. But fusion algorithms based on similar pixels are more susceptible to cloud influence.

Keywords: mapping paddy rice, family farming, flooding signal, Spatio-temporal fusion