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Monitoring of Rice Phenology and Agricultural Practices from Sentinel 2 Images

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Abstract : In the global change context, efficient management of the available resources has become one of the most important topics, particularly for sustainable crop development. Timely assessment with high precision is crucial for water resource and pest management. Rice cultivated in Southern France in the Camargue region must face a challenge, reduction of the soil salinity by flooding and at the same time reduce the number of herbicides impacting negatively the environment. This context has lead farmers to diversify crop rotation and their agricultural practices. The objective of this study was to evaluate this crop diversity both in crop systems and in agricultural practices applied to rice paddy in order to quantify the impact on the environment and on the crop production. The proposed method is based on the combined use of crop models and multispectral data acquired from the recent Sentinel 2 satellite sensors launched by the European Space Agency (ESA) within the homework of the Copernicus program. More than 40 images at fine spatial resolution (10m in the optical range) were processed for 2016 and 2017 (with a revisit time of 5 days) to map crop types using random forest method and to estimate biophysical variables (LAI) retrieved by inversion of the PROSAIL canopy radiative transfer model. Thanks to the high revisit time of Sentinel 2 data, it was possible to monitor the soil labor before flooding and the second sowing made by some farmers to better control weeds. The temporal trajectories of remote sensing data were analyzed for various rice cultivars for defining the main parameters describing the phenological stages useful to calibrate two crop models (STICS and SAFY). Results were compared to surveys conducted with 10 farms. A large variability of LAI has been observed at farm scale (up to 2-3m^2/m^2) which induced a significant variability in the yields simulated (up to 2 ton/ha). Observations on more than 300 fields have also been collected on land use. Various maps were elaborated, land use, LAI, flooding and sowing, and harvest dates. All these maps allow proposing a new typology to classify these paddy crop systems. Key phenological dates can be estimated from inverse procedures and were validated against ground surveys. The proposed approach allowed to compare the years and to detect anomalies. The methods proposed here can be applied at different crops in various contexts and confirm the potential of remote sensing acquired at fine resolution such as the Sentinel2 system for agriculture applications and environment monitoring. This study was supported by the French national center of spatial studies (CNES, funded by the TOSCA).

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