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Analysis and assessment of Shortwave Angle and Slope Index for monitoring rice phenology and hydroperiod.

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According to the United Nations, more than 50 percent of the world population depends on rice for about 80 percent of its food requirements. Besides, rice fields are important aquatic ecosystems, hosting a great variety of aquatic species. However, environmental issues such as water consumption and the emission of greenhouse gases, as well as the effects of climate change in crops, may endanger their sustainability. In this context, the determination of rice hydroperiod and phenology is necessary for rice monitoring and impact management, and is expected to become more relevant in the near future. The present study has explored the potential of Shortwave Angle Slope Index (SASI), based on the spectral data contained in Moderate Resolution Imaging Spectroradiometer, to monitoring rice paddy fields under different water management practices.

SASI is a spectral shape index (SSI), based on the angle formed in SWIR1 vertex with NIR and SWIR2 in the spectrum, and the slope of the line linking NIR and SWIR2 vertices. This index was developed to distinguish between dry soil, wet soil, dry vegetation and green vegetation. It takes large, positive values for dry soil and large, negative values for green vegetation. Two case studies in Spain, the Ebro Delta and Orellana are presented. The behaviour of the index in each zone for the period 2001-2012 has been evaluated to characterize the response of SASI index to phenological and flooding events in rice. The average values and standard deviation of the index for the period 2001-2012 were calculated to identify the significant points of SASI in coincidence with phenological and flooding field data. An algorithm for the detection of significant points was also applied to determine phenological metrics, based on the information obtained.

SASI presented similar values for both zones during the rice growing period. Differences arose during the non-growing period when the Delta was flooded for environmental reasons (i.e. environmental flooding). An absolute minimum was in coincidence with heading dates, and two relative maxima were found previous to flooding events and indicating the end of harvesting. Although this index clearly detected the drainage of flooded soils, it was difficult to find a relevant point to identify the end of the flooding of the fields. The determination of phenological metrics based on the points detected showed better results in the Ebro Delta than in Orellana, probably due to the existence of mixed pixels. The best detection capacity was shown with heading date, by identifying 93,6% pixels in the Ebro Delta, although satisfactory results were also obtained in detecting harvesting, with a 90,3% of successful detections, and at the end of the environmental flooding, achieving 73%.

This approach has showed the possibility of determining main phenological and flooding events in rice with SASI. The potential of this index for detecting changes in soil water content, especially the drainage of flooded soils was confirmed, and the results obtained may encourage its use in other studies, such as wetland monitoring.