

## Temporal variation of simulated rice backscattering of S-band HJ-1 SAR

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### **Abstract:**

Rice is a major food supply in the southeast of China, which is very important for this region's rapid and sustainable development. Optical remote sensing data has been widely used in crop monitoring, while it is often difficult to acquire optical remote sensing data during rice growing seasons in cloudy and rainy areas. Synthetic Aperture Radar (SAR) provides a powerful tool for rice monitoring in these regions because of its all-weather, day-and-night imaging and canopy penetration capabilities. HJ-1 small satellite constellation of China has been designed for environment and disaster monitoring, and HJ-1-C satellite has a SAR system working in S-band with incidence varying from 31° to 40°, VV polarization. It is anticipated to be effectively used in rice monitoring because the S-band microwave can penetrate rice canopies and thus provide more structural information. Backscattering simulation using model is helpful for SAR image understanding before the launch of HJ-1 SAR. In this paper rice backscattering and seasonal variation in S-band and VV polarization have been simulated and analyzed based on radiative transfer model and ground measurements.

Zhaoqing test site in Guangdong province was been selected as test site, and 9-temporal field measurements were acquired during the rice growing period in 1997. Measurements were taken for 20 rice samples within a sample plot about 100m×100m. Parameter acquired in field included date, sample code, row spacing, the number of rice seedlings per cluster, height and width of the rice stem, water content of each rice cluster, and the number of leaves of a single rice plant. The leaves were numbered from bottom to top as leaves 1, 2, 3, 4 and 5 with the length, width, and the inclination angle of each leaf to the rice stem measured. Besides, meteorological data such as temperature, air pressure, relative humidity, wind speed and direction etc. were also collected.

In this study, a 1st-order radiative transfer model developed from a forest canopy

scattering model was employed to simulate S-band scattering characteristics of paddy rice. Rice backscattering was simulated using this model to analyze scattering contributions individually from rice stems, leaves and ears, and then rice scattering mechanisms in S-band was determined. Then temporal variations of rice bio-physical parameters such as rice height, stem diameter, leaf length, leaf width, rice density, leaf density, water content etc. and simulated S-band backscattering calculated using parameters acquired in field were analyzed. Relationships between bio-physical parameters and rice backscattering were computed and structural parameters contributing most to rice backscattering in S-band were determined. Results presented in this paper demonstrate that HJ-1 SAR will be very helpful for rice monitoring.

*Key words* – Rice, Synthetic aperture radar; Radiative transfer model, HJ-1 SAR;