Expansion of polarimetric SAR application by MIMP SAR approach

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Various polarimetric decomposition techniques have been proposed and demonstrated for more than 20 years. However, they still have never been operational applications such as a differential SAR interferometry for a surface deformation because of insufficient validations. The true composition ratio of scattering mechanisms within a radar backscatter has to be known. To achieve this, a novel comprehensive approach to accurately identify the contribution of each scattering mechanism by a multi-incidence angle and multi-polarimetric (MIMP) synthetic aperture radar (SAR) observation combined with a theoretical model simulation is introduced. Rice paddies in Niigata City in Japan having a simple vegetation structure without topography were observed by X-band Polarimetric and Interferometric SAR 2 (Pi-SAR2) by gradually varying the flight path in terms of incidence angle. In addition to the MIMP SAR observation, a dominant scattering mechanism is reliably isolated through the theoretical characterization of the data by a Discrete Scatterer Model (DSM). In the case of the rice paddies at a late vegetative stage, a dominant scattering on HH gradually varies from the double-bounce scattering to the volume scattering of rice grains in terms of incidence angle, whereas a VV is affected by the various volume scatterings of grains, leaves and stems at the small, medium, and large incidence angles, respectively. An HV is simply affected by the volume scattering of grains at the small incidence angle, and then it gradually switches to the volume scattering of the stalks. This brand new approach based on the MIMP SAR observation with the theoretical modeling could expand the use of polarimetric SAR data to various applications.

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