POLARIMETRIC ANALYSIS OF THE DEPENDENCY OF BACKSCATTERING FROM OCEAN SURFACE ON WIND DIRECTION

Akitsugu Nadai, Toshihiko Umehara, Takeshi Matsuoka, Seiho Uratsuka, Tatsuharu Kobayashi, Makoto Satake

National Institute of Information and Communications Technology

1. ABSTRACT

The polarimetric feature of the backscattering form the ocean surface is analyzed by the multiple observation of the same ocean surface area with different illumination directions in a short time using an airborne dual-frequency polarimetric synthetic aperture radar (SAR) in the L- and X-bands; Pi-SAR. By using the some cases of observation data, the dependencies of the normalized radar cross section (NRCS) in the parallel polarizations and the polarization ratio (PR) on the relative wind direction under the wide range of the wind speeds are analyzed based on the geophysical model function (GMF).

In the X-band HH polarization, because the asymmetric dependency component of the NRCS is not small to neglect, the NRCSs under the up- and down-wind conditions are different. On the other hand, in the X-band VV polarization, because the asymmetric dependency component is small, the difference of the NRCSs between the up- and down-wind conditions is small. In the L-band, the dependency of the NRCS on the wind direction is almost same between the parallel polarizations, and the dependencies are almost same with the X-band VV polarization. The intensity of the dependency of the NRCS in the X-band on the wind direction is stronger than that in the L-band. These dependencies of the NRCSs on wind direction are almost same in the incidence angle range from 20 to 60 degrees.

The opposite-phase structures of the fluctuations of the asymmetric and symmetric dependency coefficients in the NRCS GMF are common in the parallel polarizations. Moreover, the relations of fluctuations of the dependency coefficients in the X- and L-band are also in-phase. There fluctuations may be caused by the small scale NRCS change due to the ocean surface phenomena. Because of the difference between the observation times and the exact positions of the target, the influence of the ocean surface phenomena are different between each observations. These small scale changes of the NRCS also influence on the independent coefficients of the NRCS.

The PR in the X-band also depends stronger on the wind direction than that in the L-band. In the X-band, because the intensity of the asymmetric dependency component of the PR is larger than that of the symmetric component, the PR under the up-wind condition is smaller than those under the down- and cross-wind conditions. The dependencies of the PR in both radar frequencies are almost same between the incidence angle ranges from 20 to 60 degrees. The fluctuations of the asymmetric and symmetric dependency coefficients in the PR GMF are much smaller than that of the NRCS GMFs. The difference of the fluctuations of the dependency components between the NRCS GMFs and PR GMFs supports that the fluctuations of the dependency coefficients in the NRCS GMF are caused by the NRCS change with small spatial scale due to ocean surface phenomena.

These results suggest that the dependencies of the backscattering from the ocean surface between the X-band parallel polarizations are unique. As a result, the possibility of the measurement of ocean surface winds only using the polarimetric SAR in the X-band is suggested. The wind velocity measurement based only on the SAR data is able to achieve the wind measurement with high-spatial resolution in the coastal ocean area, where the wind field changes with small spatial due to the topography.