Investigation of multiple frequency polarimetric SAR signal backscattering from tidal flats

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Tidal flats form a unique ecosystem, providing the habitat for various species of fauna and flora which play an important role in the water purification and marine products industries. However, monitoring and mapping of tidal flats from in situ measurements are severely troublesome work, resulting in vary limited number of observation points. Remote sensing can provide large spatial coverage and non-intrusive measurements over the Earth's surface. Thus it is suited for monitoring and mapping surface characteristics of tidal flats. In particular, microwave remote sensing using airborne and space-borne synthetic aperture radar (SAR) system has great potential for quantitative monitoring and mapping of tidal flats, due to its ability to penetrate cloud cover and the capability of high resolution imaging. Recently, polarimetric SAR measurements have come into the spotlight in the research field of microwave remote sensing. Numerous studies using polarimetric SAR measurements have been conducted to extract information on the surface characteristics. However, most studies have focused on bare soil or vegetation areas on land. In bare soil areas, polarimetric measurements have been used for estimation of surface roughness and soil moisture content. Tidal flats would also be considered as bare soil, but they are completely different from the typical bare soil from an electromagnetic scattering point of view because of the saturation of soil moisture and the high salinity. Although tidal flats form a unique environment and play an important role in ecosystem, very few studies have been carried out in such areas.

The tidal flat of the Korean peninsula are well known for their large tidal range (up to 9m) and extensive area. They cover an area of approximately 2900 km^2, which corresponds to 3% of the entire land area of South Korea. In this study, polarimetric SAR measurements are used to investigate the radar polarimetric characteristics for the tidal flat area. TerraSAR-X (X-band), RADARSAT-2 (C-band), and ALOS PALSAR (L-band) data were acquired over the two study sites near Jebu Island and Sunchon Bay, Korea. All SAR data used in this study were acquired in dual-polarization or full-polarization (HH, HV, VH, VV) mode. We have also conducted field measurements to obtain the surface roughness parameters, soil moisture content, and salinity in the tidal flats. Several theoretical models were used and compared to

describe the radar backscattering characteristics for the tidal flats. Even though the Integral Equation Model (IEM) is valid for a wider range of surface conditions, the simulation results for the tidal flats could not be fully assessed by using the surface roughness (RMS height and correlation length) and soil moisture only. The tidal flats are usually saturated with sea water and covered with water films. There is also remnant water collected in many depressions that are smaller than a resolution cell in the tidal flats. These effects may cause lower backscatters in SAR images due to the partial specular reflection. Such characteristics were usually observed in mud flat area. We tried to develop a new electromagnetic scattering model for the tidal flats of Korea. This model is based on the IEM model but modified for the percentage of the remnant water coverage in a resolution cell.