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Mapping Intertidal Changes Using Polarimetry and Interferometry Techniques

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Abstract : Northern Canadian coasts have vulnerable and very dynamic intertidal zones with very high tides occurring in several areas. The impact of climate change presents challenges not only for maintaining this biodiversity but also for navigation safety adaptation due to the high sediment mobility in these coastal areas. Thus, frequent mapping of shorelines and intertidal changes is of high importance. To help in quantifying the changes in these fragile ecosystems, remote sensing provides practical monitoring tools at local and regional scales. Traditional methods based on high-resolution optical sensors are often used to map intertidal areas by benefiting of the spectral response contrast of intertidal classes in visible, near and mid-infrared bands. Tidal areas are highly reflective in visible bands mainly because of the presence of fine sand deposits. However, getting a cloud-free optical data that coincide with low tides in intertidal zones in northern regions is very difficult. Alternatively, the all-weather capability and daylight-independence of the microwave remote sensing using synthetic aperture radar (SAR) can offer valuable geophysical parameters with a high frequency revisit over intertidal zones. Multi-polarization SAR parameters have been used successfully in mapping intertidal zones using incoherence target decomposition. Moreover, the crustal displacements caused by ocean tide loading may reach several centimeters that can be detected and quantified across differential interferometric synthetic aperture radar (DInSAR). Soil moisture change has a significant impact on both the coherence and the backscatter. For instance, increases in the backscatter intensity associated with low coherence is an indicator for abrupt surface changes. In this research, we present primary results obtained following our investigation of the potential of the fully polarimetric Radarsat-2 data for mapping an inter-tidal zone located on Tasiujaq on the south-west shore of Ungava Bay, Quebec. Using the repeat pass cycle of Radarsat-2, multiple seasonal fine quad (FQ14W) images are acquired over the site between 2016 and 2018. Only 8 images corresponding to low tide conditions are selected and used to build an interferometric stack of data. The observed displacements along the line of sight generated using HH and VV polarization are compared with the changes noticed using the Freeman Durden polarimetric decomposition and Touzi degree of polarization extrema. Results show the consistency of both approaches in their ability to monitor the changes in intertidal zones.

Keywords : SAR, degree of polarization, DInSAR, Freeman-Durden, polarimetry, Radarsat-2
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