

Evaluation of interferometric coherence over snow/ice-covered areas with space-based quadruple polarimetric X-band synthetic aperture radar

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Coherent space-based InSAR observations over snow/ice-covered areas have been very useful resources for detecting glacier movements [1-3]. Coherence is considered a critical parameter for evaluating the quality of an InSAR observation. This study evaluates interferometric coherence using quadruple polarimetric TerraSAR-X (TSX) X-band observations, which were acquired during Dual Receive Antenna campaign period in 2010. We used a total of 57 TSX quad polarization images acquired at latitude higher than 60 degrees north. The coherence analysis of the entire study areas yield high coherence levels in all polarization modes from 0.38 to 0.57, with highest values in VV, then HH, and lowest in HV. It is very surprising that the short wavelength X-band SAR observations can maintain such a high coherence level over snow/ice-covered surfaces. Because it was assumed that the shorter X-band wavelength radar signal can be significantly decorrelated by quickly changing surfaces like snow/ice-covered or vegetated regions. It is interesting that the highest coherence value was found in the VV-pol, because in most scattering environments, HH-pol coherence is the highest [4, 5]. We conducted a comparative coherence analysis by analyzing additional 25 TSX images acquired over six different scattering environments (classes) and compared their coherence characteristics. The scattering six classes are: forest, agriculture, wetland, sea-ice, snow/ice, and urban area. Our results show highest VV-pol coherence in snow/ice, sea-ice, and some agriculture and forest environments, whereas highest HH-pol coherence values are found in urban, wetland and some agriculture and forest environments. In forest and agricultural environments, both HH-pol and VV-pol show similar degree of coherence. In summary, our results indicate that VV-pol is preferable for X-band InSAR applications over the snow/ice-covered areas.

Index Terms – Interferometry, Coherence, Polarimetry, TerraSAR-X, X-band, Snow/ice-covered region, Polar regions

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