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GLACIER SURFACE MONITORING BY MAXIMIZING MUTUAL INFORMATION

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**Abstract.** The contribution of Polarimetric Synthetic Aperture Radar (PolSAR) images compared with the single-channel SAR in terms of temporal scene characterization has been found and described to add valuable information in the literature. However, despite a number of recent studies focusing on single polarized glacier monitoring, the potential of polarimetry to estimate the surface velocity of glaciers has not been explored due to the complex mechanism of polarization through glacier/snow. In this paper, a new approach to the problem of monitoring glacier surface velocity is proposed by means of temporal PolSAR images, using a basic concept from information theory: *Mutual Information* (MI). The proposed polarimetric tracking method applies the MI to measure the statistical dependence between temporal polarimetric images, which is assumed to be maximal if the images are geometrically aligned. Since the proposed polarimetric tracking method is very powerful and general, it can be implemented into any kind of multivariate remote sensing data such as multi-spectral optical and single-channel SAR images.

The proposed polarimetric tracking is then used to retrieve surface velocity of Aletsch glacier located in Switzerland and of Inyltshik glacier in Kyrgyzstan with two different SAR sensors; Envisat C-band (single polarized) and DLR airborne C-band (fully polarimetric) systems, respectively. The effect of number of channel (polarimetry) on tracking investigation demonstrated that the presence of snow, as expected, affects the location of the phase center in different polarizations such as glacier tracking with temporal HH compared to temporal VV channels. Shortly, a change in polarimetric signature of the scatterer can change the phase center, causing a question of how much of what I am observing is motion then penetration. In this paper, it is shown that considering the multi-channel SAR statistics, it is possible to optimize them to separate these contributions.

