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Waveform retracking based on a Convolutional Neural Network applied to Cryosat-2 altimeter data

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The Antarctic Ice Sheet is an important indicator of climate change and a major contributor to sea level rise. Hence, precise, long-term observations of surface elevation change are required to assess changes and their contribution to sea level rise. Satellite altimetry has been used by various missions to measure surface elevation change since 1992. It has been shown that, next to the surface slope and complex topography, one of the most challenging issues is the spatial and temporal variability of radar pulse penetration into the snowpack, especially over the vast East Antarctic plateau. This results in an inaccurate measurement of the true surface elevation and consequently affects surface elevation change (SEC) estimates.

To increase the accuracy and correct the SEC, we developed a deep convolutional neural network (CNN) architecture. The CNN was trained by a simulated waveform data set containing more than 3.6 million waveforms, considering different surface slopes, topography, and attenuation. The CNN follows standard architectural design choices. The successfully trained network is finally applied as a CNN-retracker to the full time series of CryoSat-2 low resolution mode (LRM) waveforms over the Antarctic ice sheet. We will show the CNN retrieved SEC and compare it to estimates of conventional retrackers like OCOG or ICE2. Our preliminary results show reduced uncertainty and a strongly reduced time variable radar penetration, making backscatter or leading edge corrections typically applied in SEC processing obsolete. This technique provides new opportunities to utilize convolutional neural networks in altimetry, waveform retracking, and processing altimetry data, which can be applied to historical, recent, and future altimetry missions.