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Convolutional Neural Networks for Sea Ice Concentration Charting for Maritime Navigation in the Arctic

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In recent years the Arctic has seen renewed political and economic interest, increased maritime traffic and desire for improved sea ice navigational tools. Despite a rise in digital technology, maps of sea ice concentration used for Arctic maritime operations are still today created by humans manually interpreting radar images. This process is slow with low map release frequency, uncertainties up to 20 % and discrepancies up to 60 %. Utilizing emerging AI Convolutional Neural Network (CNN) semantic image segmentation techniques to automate this process is drastically changing navigation in the Arctic seas, with better resolution, accuracy, release frequency and coverage. Automatic Arctic sea ice products may contribute to enabling the disruptive Northern Sea Route connecting North East Asia to Europe via the Arctic oceans.

The AI4Arctic/ASIP V2 data set, that combines 466 Sentinel-1 HH and HV SAR images from Greenland, Passive Microwave Radiometry from the AMSR2 instrument, and an equivalent sea ice concentration chart produced by ice analysts at the Danish Meteorological Institute, have been used to train a CNN U-Net Architecture model. The model shows robust capabilities in producing highly detailed sea ice concentration maps with open water, intermediate sea ice concentrations as well as full sea ice cover, which resemble those created by professional sea ice analysts. Often cited obstacles in automatic sea ice concentration models are wind-roughened sea ambiguities resembling sea ice. Final inference scenes show robustness towards such ambiguities.