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The Cryosphere Discussions

Interactive comment on "Classification of Sea Ice Types in Sentinel-1 SAR images" *by* Jeong-Won Park et al.

Anonymous Referee #3

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General comments The manuscript by Park et al presents Random Forest based classifier (Python Scikit-Learn) for sea ice type classification from dual pol (HH-HV) Sentinel-1 images which were collected during the winter period only. Training dataset were collected from the National Ice Center weekly ice chart and the classification algorithm exploits standard GLCM features along with some additional features. Since the launch of Sentinel-1 SAR sensors (a+b), it continuously monitoring Arctic Sea ice with high spatial and temporal resolution and an automated sea ice type classification product from high resolution SAR is highly desirable and relevant for the sea ice monitoring community. Having said that, there are several limiting factors which are preventing researchers to come up with a robust SAR based sea ice type classification scheme, (1) Backscatter variation due to varying incidence angle, along with sensor

specific noise related issues (2) Backscatter variation due to seasonal changes (winter – melt- early summer - summer) In this manuscript authors performed a denoising technique which was developed by authors previously (Park et al., 2018), and a standard linear incidence angle correction (Section 2.2.3). It is important to note here that different sea ice types have different incidence angle dependency. Moreover, if the incidence angle correction was applied over all classes (i.e. including open water), it will most likely not contribute to the robustness of the classifier. Backscatter variation due to seasonal changes is completely ignored in the presented manuscript. As authors aimed to develop an operational system, in my opinion authors cannot ignore this major issue completely. Specific comments The proposed classification scheme is based on Python Scikit-Learn library and GLCM features, this kind of classification scheme is well known and published several times for different frequency bands. Therefore the current manuscript is very limited in terms of innovation. What I find slightly different is use of weekly ice chart for training data generation. However I am also concerned about the automated training data generation as it is not clear which images were used to generate the ice chart by NIC and there is a high probability that that the ice chart polygons will not match that Sentinel-1 mosaics ice types. Hence there is a high risk that the classifiers were trained with wrong training data. Authors mentioned that 57 images were selected manually where only 'ice egdes' match well with the ice chart. In my opinion, this is also a manual selection of training data which authors criticised in the introduction section. The selection (and definitions) of ice types for SAR based sea ice classification scheme is crucial. The 5 class classifier has some classes which might be very close to each other in terms of backscatter and texture. This might be the main reason for significantly low classification accuracy. I would recommend the authors to restrict the classifier for 4 classes (Open Water, Young Ice, FYI and old ice). A seasonal assessment of the classification scheme is missing. It the most important issue to address and without this assessment it would not be reasonable to claim the scheme to be either operational or innovative. Due to above mentioned major issues I didn't listed any technical corrections, I would kindly invite the authors to address this

issues in future. Due to the lack of innovation and failed to address the basic issues, at current stage I can only recommend the manuscript to be rejected despite it is well within the scope of The Cryosphere.

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