The Cryosphere Discuss., 9, C1422–C1426, 2015
www.the-cryosphere-discuss.net/9/C1422/2015/

The Cryosphere
Discussions
Open Access

Interactive comment on "Utilisation of CryoSat-2 SAR altimeter in operational ice charting" *by* E. Rinne and M. Similä

Anonymous Referee #1

Received and published: 15 August 2015

General comments:

The study investigate the feasibility of classifying sea ice types for ice charting in the Arctic using radar altimeter waveform characteristics when synthetic aperture radar data is not available. The authors have developed an automatic classification that is based on 4 parameters of CryoSat-2 near real-time data, however a training data set based on Russian ice charts is necessary to adapt the classification scheme for the seasonal cycle of the waveform characteristics. The classified sea ice types are open water, thin first year, first year and multi-year sea ice with mixed classification results in the study area. Open water, multi-year and first year ice seem to be reliably classified, though a notable ambiguity between deformed first year and multi-year sea ice remains. The target rate of thin first year ice in spring is rather poor.

The authors have set their primary goal at the application of radar altimeter data for operational services though the classification of sea ice surface types directly from radar waveforms though is also of interest in the field of climate research. It is not discussed if and how the classification scheme can be employed for the entire Arctic. It must be said though that the need of a training set for that region and the not very distinct differences in the waveform characteristics between different ice classes would make this task probably quite difficult. However most of the current CryoSat-2 based ice thickness processors employ a binary (first year or multi-year) classification scheme of ice from an external passive microwave dataset and surface type information of more classes and higher spatial resolution would be helpful. The study would therefore have a much broader impact if the authors would discuss a potential use of waveform-based sea ice type classification beyond ice charting. The choice of a manually classified ice charts as a benchmark for a waveform-based classification is an interesting and novel approach which seems to have more potential than has been exploited here.

Though the manuscript is well-structured, I found it particular difficult to follow the method section containing the automatic classification scheme. Some key elements, such as a basic description of the k-NN classifier or how the distances of the feature vectors are actually used are missing. Some terms as distance metric or ties are just mentioned without further explanation or later reference in the manuscript. This all make it quite unclear what is actually done here. There are more examples in the detailed comments, but the authors should consider rewriting the method section and target an audience that not is not necessarily familiar with automatic classifications.

It is therefore the two points of discussing the impact of their findings for the prospect of sea-ice thickness retrieval and a better method description that need to be addressed before publication. There are a few more detailed comments and suggestions below.

Minor comments / Suggestions:

The authors use lead identification to exclude leads from the classification scheme.

Later they use the term “open water” for the diffuse echoes that originate from areas without ice and a obviously a significant wave height as can be seen by the large leading edge width. Since sometimes “open water” is also used as synonym for lead in ice-covered areas, I would suggest using the term “open ocean” instead of “open water” throughout the manuscript.

It would be helpful to show the parameters for the two test periods in the same plot (with the exception of thick FYI). That could be used as indication how the waveform properties differ between November and March and why each period needs its own training dataset. Just from looking at the two plots I do not see a substantial difference between the histograms.

Specific Comments:

P4121 L9 The (pulse-limited) across track footprint of CryoSat-2 is 1650m (CryoSat footprints, Document: SAR-CRY2-TEN-6331)

P4121 L26 A resolution of 2 km is quite close to the size of the CryoSat-2 footprint (see previous comment), therefore there might be some spillover between adjacent grid cells. Will this influence the k-NN classifier?

P4123 L20 The definition of the pulse peakiness here is based on 128 range bins. The latest version of CryoSat-2 SAR data is oversampled to 256 bins. Is this not the case for the SAR NRT data?

P4124 L12 Same question is previous comment: Do the authors use 128 range bins or the oversampled 256 bins?

P4125 L7ff The authors should add a short description of the basic concept of a k-NN classifier since it is a crucial part of this study

P4126 L1ff The description in this part is difficult to follow.

P4126 L6 What does "Ties are broken at random" mean?

P4126 L13ff What are the actual limits for the scaling (the same as the x-axis in figures 3 & 4)? Why has this choice been made and not the [0,1] interval range? Does proper metric mean that all 4 parameters must /will have an equal weight?

P4126 L14 But how is the distance between feature vectors used in the classification scheme?

P4127 L2 Suggestion: Describe TPP as late tail to peak power and KF1 as early tail to peak power since their definition is essentially the same and only the indices of the tail bins differ

P4127 L23 Move the last sentence to the next paragraph. It reads as if the LEW > 14 is used for the removal of leads

P4128 L12 Is there a reason to smooth the feature space and not the waveforms?

P4128 L20 The authors should add a description how the classification is done

P4129 L11ff If the classifier takes the next 3-5 neighbors of one waveform that these will be almost certainly the neighboring waveform on the same track. So that basically means that 1) even smoothed parameters are to variable to be classified as a the same class and 2) the correlation between waveform parameters breaks down again with a distance of 3 or more waveform to each side? It would be good if the author could relate the k value to the spatial scale on the ground.

P4130 L6ff Also the incidence angles between SAR images (oblige) and CryoSat-2 radar altimetry (nadir) are not compatible

P4131 L6 Add "following" before "five days test set"

P4132 L26ff For the very thin ice it is crucial to define the term open water. Very thin ice close the ice edge might be classified as open water if swell generates surface roughness. Without the surface roughness very thin ice might still be a specular target that might be identified as a lead and thus be removed from the classification process.

Can the authors check whether there are a higher levels of lead detections in the areas which are labeled as thin ice? Also in November the young FYI has a significant misclassification as MYI. Would this be in areas that were ice covered by the end of the melting season?

P4133 L24ff Based on their interaction with the ice service, would the authors think that NRT ice thickness information would be at least helpful for ice charting?

Table 1 & 2 Add a description of the rows and columns (columns: AARI classifications?)

Interactive comment on The Cryosphere Discuss., 9, 4117, 2015.