

# ***Interactive comment on “Mapping potential signs of gas emissions in ice of lake Neyto, Yamal, Russia using synthetic aperture radar and multispectral remote sensing data” by Georg Pointner et al.***

## **Anonymous Referee #1**

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### General Comments

The article ‘Mapping potential signs of gas emissions in ice of lake Neyto, Yamal, Russia using synthetic aperture radar and multispectral remote sensing data’ provides an extensive analysis of backscatter anomalies linked to possible gas emissions for Lake Neyto, Yamal, Russia. Multiple image products and processing techniques were used to support the authors’ hypothesis and the results are supported by the existing literature. The study is particularly interesting due to its connection to gas emission from the warming Arctic and the multiple recent publications addressing similar elements from

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Alaska and northern Canada.

The literature review provided in the article is well constructed and provides a good background. Furthermore, the discussion is well organized and outlines how the results in this study reflect and differ from similar work. The methods section requires the most revision in the current manuscript. There must be further documentation of the Sentinel-1 catalog used (dates, number of images, and gaps between images). There are small concerns about the Sentinel-1 image processing done regarding how noise in the images was addressed. While many image processing techniques are used, the description given is not adequate. These techniques should be better described to ensure that the method can be replicated in future studies. Specific comments are provided regarding these issues, in addition to short comments about figures and sentence structure.

### Specific Comments

Line 11: Include the actual percentage of holes mapped in the VHR data that relate to the SAR anomalies.

Lines 100-118: These lines are more suited for a study site section, an additional section could be added before 'Data' or as a subheading of the same section to present the information. Some additional information about lake Neyto would also strengthen the description of the study site (temperature, precipitation, lake properties, distance to major settlements/coordinates). This could also be addressed in Figure 1 by adding a fourth frame that provides a geographic context.

Lines 119-128: This is a crucial reason for why the research needs to be conducted, however, it feels out of place at the end of the introduction. A better location could be a t or around line 95 before the introduction of the objectives. This would also serve as valuable information as to why one of the primary objectives is to map these anomalies.

Section 2.1: Further discussion on the Sentinel-1 images used is needed. While the

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other imagery sources use one or a handful of images, Sentinel-1 appears to be the focus of this study. Therefore, a table listing the years of data, the number of images, and the average temporal gap between imagery would be good to include. Alternatively, a calendar plot showing the dates of the study period with associated acquisitions (Sentinel-1, Worldview, PALSAR, Sentinel-2, and Landsat-8) would be a good way to convey the amount/temporal resolution of the imagery used to the reader.

Line 192-193: No mention of speckle filtering or multi-looking is made. Was this not done? How do the authors address the issue of noise within the SAR images? The process was done for the PALSAR-2 images as stated on line 208.

Line 194: Further explanation of the incidence angle normalization process is needed. According to Pointer et al., 2019, backscatter was normalized to  $30^\circ$ , was the same value used here? The normalization process requires further attention so that it is clear to the reader.

Line 200: Line 201 states that the Sentinel-2 images were atmospherically corrected, were the Worldview-2 images also corrected?

Line 229: A short description of the Otsu thresholding method should be included. Were backscatter values used for thresholding or were images converted to greyscale?

Line 236: How were images rescaled? Was this done using a min-max normalization?

Line 272: Similar to above, more information should be provided about the watershed segmentation. Additional settings used for the process and the software packages used to perform both blob detection and segmentation should be included.

Figure 4: The boxplots for 2017-05-22 and 2019-05-24 are initially confusing when you look at the plot. Could the y-axis labels be dropped on the middle frames and 2019-05-24 frame so that there is only one shared axis? Additionally, a better demonstration that the outside frames are part of the dataset shown in the middle frame would help improve the figure.

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Figure 5: It would be better to show the same image/area for both a) and b) – that way the reader could see how the watershed was used to best identify the holes in the ice.

Figure 9: The intersection fraction is confusing, the explanation needs to be changed so that the metric is clear to readers. The repeated mention of 'positive class' makes the explanation wordy, possibly it could be changed to anomaly regions.

#### Minor Typography

Line 4: 'so far' can be removed to improve conciseness, and it should be changed to 'due to a lack of...'

Line 22: 'remain' should be changed to are.

Line 28: 'distinguish' should be changed to 'distinguished'

Line 122: 'threads' should be threats?

Line 361-362: "temperature is often approaching or slightly exceeding" should be changed to "often approaches or slightly exceeds".

Line 375: "is by approximately", the 'by' can be removed.

Line 404: A citation is needed for the causes of holes on Lake Baikal.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-226>, 2020.

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