

## ***Interactive comment on “The catastrophic thermokarst lake drainage events of 2018 in northwestern Alaska: Fast-forward into the future” by Ingmar Nitze et al.***

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This paper presents interesting and novel research on how quickly lake drainage can happen over a substantial area when extreme weather events occurs. The paper is overall good and easy to follow but there are a few comments that I would suggest that the authors consider before publication.

Major comments: - Why did you choose to do the comparison between 1999-2014 and 2017-2018 and leave out 2015 and 2016? Would be good if you could motivate this as I assume it has a scientific reason.

C1

The two comparison periods are based on data availability. The Planet data has only been available in high temporal resolution for our study region since 2017/2018. As a base for comparison, the 1999-2014 lake extent layer originally produced by Nitze et al 2018a and 2018b was readily available for our analysis. We added a sentence in 3.1.1 to clarify that the 1999-2014 dataset is readily available. We furthermore added a sentence in 3.1.2 why we focused on the change from 2017 to 2018 in the SAR data analysis.

In the aim it is stated that this study should investigate weather and climate data as well as modelled lake ice conditions as potential drivers of the widespread lake drainage. The results from the modelled part are not well covered in the discussion. At present, section 4.2.2. and 4.3 can be deleted or the results should be better incorporated in the discussions

We expanded the discussion with a more thorough analysis and discussion of the lake ice model results.

Why did you choose to work on lakes larger than 1 ha? I assume you could have included smaller lakes as well with the resolution of your data set and given the possible importance of the smaller lakes for GHG emissions (See e.g. Kuhn et al., 2018. Emissions from thaw ponds largely offset the carbon sink of northern permafrost wetlands. Scientific reports), it would be great if you could please add a sentence about why you chose to only work on lakes with this size. –

The data analysis from Nitze et al., 2018a (Dataset: Nitze et al, 2018b) was based on Landsat data with 30m spatial resolution. The minimum mapping unit was set to 1 ha to avoid excessive uncertainties. Therefore, by using this dataset we use the same minimum mapping unit. We added the Sentence “Water bodies smaller than 1 ha were excluded from the original analysis due to Landsat’s spatial resolution of 30m.” to clarify that we use the minimum mapping unit of the original dataset.

In the discussion the influencing factors are discussed, many sentences states that it is

C2

likely.... Would it not be possible to make a multiple regression with the climate parameters (that have already been analysed) to see if you have any statistically significant connections?

We carried out a multivariate RandomForest (Breiman, 2001) regression with annual weather attributes as input features and drained lake area per year (1999-2014, 2018) as the target variable. We used the Random Forest internal Feature Importance metric, which is widely used to quantify an input variable's importance. We furthermore evaluated the model performance during training and independent validation using  $r^2$ . We added a new subsection to the methods (3.5), and results (4.5) sections. We expanded the discussion with the results.

Minor comments:

Line 34 – Brown et al., 1997 is missing from the ref list

The reference has been added.

Line 39 – Nitze et al., 2018 should it be a or b?

We changed the reference to Nitze et al., 2018a

Line 40 – Pastick et al., 2015 is missing from theref list

The reference has been added.

Line 41 – Liljedahl et al., 2015 is missing from the ref list

The reference has been added and changed to Liljedahl et al., 2016.

Line 53 – Jones and Arp, 2015 is missing from the ref list

The reference has been added.

Line 65 – Lawrence and Slater, 2005 is missing from the ref list

The reference has been added.

C3

Line 70 – Nitze et al.. 2018 should it be a or b?

We changed the reference to Nitze et al., 2018a

Line 71 – Nitze et al..2018 should it be a or b?

We changed the reference to Nitze et al., 2018a

Line 109 – Hopkins et al., 1955 should be Hopkins, 1955?

We changes the reference to Hopkins, 1955.

Line 188 – Nitze et al., 2018 should it be a or b?

We changed the reference to Nitze et al., 2018b

Line 204-205 – Lakes where the timing could not be detected manually, e.g. in case of very subtle drainage, were assigned no drainage year (25 of 270); what does the numbers in the parentheses mean?

This part now reads “(25 of 270 lakes)” to clarify that 25 of 270 lakes do not have a drainage year.

Line 212 – Perhaps a good idea to refer to Figure 1a after Kotzebue?

We added “(see Figure 1a)”

Line 281 – I suggest to remove the heading 4.1.2 as then you will have the same style for both 2017-2018 comparison and the past comparison.

We adapted the numbering of sections 3 (Methods) and 4 (Results) that subsection numbering matches

Line 352 – refers to Table 5 which I could not find in the manuscript

Changed to “Table 4”

Line 435 - Walter Anthony et al., 2014 is not in the reference list

C4

The reference has been added.

Line 442 – Smith et al., 2003 is not in the reference list

We changed the reference to Smith et al., 2005

Line 443 – remove too in the beginning of this line

“too” is now removed

Line 642 - Nitze and Grosse, 2016, is this reference referred to in the running text?

The reference is now removed

Line 660 – Pastick et al., 2019, is this reference referred to in the running text?

The reference is now removed

Line 713 – Figure 1. This figure is fairly “empty”. Consider to include the lakes from table 2 in the map. Maybe also include Nome that you mention in the text from section 4.2.1?

We would like to keep the “empty” design as the map already contains several information layers (land/water, elevation, large lakes, place names) in our opinion as this map is targeted to provide a general overview of the region. Results (including large lake drainage events) are shown in Figure 3, which focusses on the results (with fewer information layers). We have added a reference to Nome on the bottom of the map.

Line 727 – Figure 3. What does hillshade stand for? I cannot detect it in the figure

The hillshade is a shaded relief map, based on a digital elevation model, which we used here as a visual background of the land area. We changed the wording of the caption accordingly.

Line 732 – Figure 4 – Suggest to move “remaining pools” to figure d where it is mentioned.

C5

We moved the annotations “remaining pools” to Figure 4d. Furthermore we improved the color scaling for better contrast between different landscape features.

Line 739 – Figure 5 – I think it is quite confusing with the greyscale on the dots, maybe you can have one colour per decade or something (with a legend outside of the box).

We changed the color coding to decadal steps for better visual separation. A legend is attached.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-106>, 2020.

C6