

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

D.K. Swanson (Referee)

david_k_swanson@nps.gov

Received and published: 18 June 2020

This is an excellent paper. It makes a significant contribution to our understanding of this alarming new phenomenon of thermokarst lake drainage. I was particularly interested to see the detailed analysis of the seasonal timing of the drainage events and the implications for the processes involved. Below are some minor comments, identified by line number in the version "tc-2020-106-manuscript-version2.pdf"

I 99-101. Be sure to specify that these are "mean annual ground temperatures". Part of the study area is covered by models of Panda et al 2016. Panda, Santosh K., Sergei S. Marchenko, and Vladimir E. Romanovsky. 2016. "High-Resolution Permafrost Mod-

C1

eling in the Arctic Network of National Parks, Preserves and Monuments." Natural Resource Report NPS/ARC/NRR-2016/1366. Fort Collins, Colorado: National Park Service. <https://irma.nps.gov/DataStore/Reference/Profile/2237720>.

They show a little colder temperatures, for 2000-2009 anyway. You should mention what the time interval is for the Obu temperatures, since temperatures are changing so fast.

I 106, 110. Not sure of the meaning of "strongly degraded" and "highly degraded" here. There are many "healthy" low-center ice-wedge polygons here, and drained lake basins of many different ages, suggesting an ongoing process. There certainly is a lot of thermokarst, but until recently the area had continuous permafrost that was not degrading. Former yedoma in this area presumably degraded in many places, is that what you mean? This probably happened long ago, perhaps in the early Holocene for the most part. I consider this area to be a typical thaw-lake plain, with healthy permafrost until recently.

I 158. So some lakes probably drained between your 2014 and 2017 data sets. It looks like you didn't try to quantify what went on 2014-2017, is this because you were concerned about the differences in water recognition between Landsat (1999-2014) and SAR (2017-2018)? A critical reader might ask for evidence that there wasn't a big drainage year during this interval too. To answer this possible objection you could do an approximate count/area of lakes that drained 2014-2017, based on your data. I'm pretty sure it will show that not many lakes drained then, which is all you really need to say.

I 212. I understand from talking to co-workers that the authors are already aware of the erroneously high temperature values that were posted for Kotzebue in 2019, and that may have found their way into these summaries.

I 258-259. As topographic lows I would expect small lakes, and shores of large lakes, to have drifts with substantially more than the weather station measured snow depth.

C2

I 284-285. Its not clear if there were 9 pre-July drainage events and 1 July, or 8 pre-July drainages and 1 July.

I 309. These are estuaries with salt marshes that are periodically flooded. Presumably you excluded other lagoons and estuaries from the study area, you could exclude this one. The processes controlling flooding/drainage here are different from the thermokarst lakes. Marine sand deposition blocks the mouth of the estuary. Flooding could be caused by this blockage of river runoff, or by storm tides. It looks like there is also thermokarst on the upstream end of the estuary, where they isn't as much marine influence. But in any case it isn't a permafrost-thaw process that causes the water level here to go up and down.

I 348. I understand that the June 2019 temperatures at Kotzebue were erroneously high, so this mean annual average of 0.12 deg C might be exaggerated slightly. But the overall story of temperatures rising to near freezing should not be affected.

I 350-351. Its not clear which year these numbers refer to.

I 352. Table 4 not 5.

I 362-363. The use of "increase to" and "increase of" is grammatically correct but a little confusing here. Also, the increase of 3.7 to 6.6 C is relative to some older average, you should say what the older time period was.

I 403. Another reference to degraded surface morphology. Does this mean pervasive thermokarst?

I 421-422. There's no evidence of beavers in the Espenberg region that I know of. I don't think they had any role in any of the big northern Seward Peninsula lake drainages that you describe. In the Kobuk valley I've seen where they dam up the outlet of a drained lake, allowing it to refill.

I 431. "drainage, in addition to the weather-induced driver."

C3

I 464. "so-far"

I 475-477. I expect that the North Slope will see a similar outbreak of lake drainages when its temperatures hit 0 C also. Do you have any predictions about if and when that will occur?

I 483-484. "This in combination with excess surface water likely caused the rapid drainage ...". This sentence is also a bit long/run-on.

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

C4