Responses to RC2:

Overall review

The authors have used an automated method to extract ice phenology data from passive microwave data. The data set presented here and explained in the article is generally very interesting and will be useful for research community. The data set is likely the longest and most comprehensive ice phenology data set from satellite-based observations for that large number of lakes. This data covers multiple climatological areas and lake sizes and is therefore well worth publication. Data set is usable in the present format.

Response: We thank you for your positive comments and constructive suggestions. We think all the comments can be addressed in the revised manuscript. Our responses to each comment are presented as follows.

Comments:

I would like to present 2 recommendations to improve the usability of the data and the manuscript.

Data set does not include any sort of error estimates for dates, duration, or maximum ice cover area. In the manuscript is long discussion on the errors and their possible sources, but these should be quantified in the data, or at least in the manuscript. It is very difficult to compare this data set to other similar data sets without this information. In the manuscript one major target for this data is climate research, it is difficult to draw conclusion if error marginals are unknown. To use this data to complement data gaps of in situ archives of ice phenology, more precise definition of the errors and their sources compared to the GRLIPD and GLERL ice cover data sets should be included.

Response: Thank you for the comments. Since Reviewer 1 also mentioned the necessity of quantitative uncertainty analysis, we collected the uncertainty caused by missing data for lake ice phenology dates and calculated the representativeness of passive microwave pixels relative to lake area. The average uncertainty of all the records in the dataset were ~1 day, of which 61.70% of the records were not affected by missing data. Overall, the uncertainty of results after 1992 was much smaller than before, and the uncertainty for lakes located at a latitude below 40°N was relatively larger. The representativeness of the pixels ranged from 0.4% (La

Grande 3 Reservoir) to 88.5% (Caspian Sea) depending on the lake area and shore complexity, and the possible existence of islands on the lake. We will add the quantitative analysis in the revised manuscript, the uncertainties caused by missing data will be added to the dataset and the uncertainty caused by the representativeness of passive microwave pixels which was related to the lake size and shape will be added in the revised manuscript as a table.

Using 37 GHz H-polarized data has some limitations in distinguishing ice and open water. Signal can be strongly affected by open water surface roughness from wind (for example, K.-K. Kang et al.: Estimating ice phenology on large northern lakes from AMSR-E; doi:10.5194/tc-6-235-2012). This problem and its implications to the data is not discussed in the manuscript at all, and it is not covered in any of the references provided. By discussing this matter or providing references that discuss this, will make this data much more reliable and usable.

Response: We agree with that 37 GHz H-polarized is sensitive to wind-induced surface roughness during the open water period. Du et al. (2017) mentioned that although microwave emissions from a lake are determined by many factors including the surface roughness, sharp changes in TB observations at multiple frequencies are evident during the transitions between lake freeze-up and breakup periods. Moreover, the effect of wind-induced surface roughness can be attenuated by the smoothing approaches in MTT algorithm. But it may still lead to errors in lake ice phenology results. While the study of Du et al. (2017) clearly demonstrated the strength of the MTT approach applied to 37 GHz data, we will still add this to the discussion in the revised manuscript.

I also have some minor comments to consider:

on line 176: “When the lake is water covered, the TB for land-contaminated pixels will be higher than that of a pure pixel, while when the lake is ice covered, the TB will be lower than that of pure pixel.” Last 2 words: Is it pure pixel of ice/water/land?

Response: When the lake is water covered, the TB for land-contaminated pixels will be higher than that of a pure water pixel, while when the lake is ice covered, the TB will be lower than that of a pure ice pixel. We will modify it in the revised manuscript.

on line 271: “When the lake area was large enough, the gradual freeze-up or break-up within

the pixel can be ignored, but for small lakes, it may lead to certain deviations in the lake ice phenology results." What are the certain deviations?

Response: Before the TB exceeds (/falls below) the threshold, the lake surface within the pixel may have already started to freeze-up (/break-up), and this process may not end even after we detect the ice covered (/water covered) signal. As a result, the beginning signals of freeze-up and break-up extracted from retained pixels may be later compared with the actual ice conditions, while the ending signals may be earlier. We will add the explanation in the revised manuscript.

on line 312: "Overall, if the overlapping time between the two dataset was longer, the lake ice dates could show a higher consistency." How or Why that could be the case?

Response: We will delete the statement in the revised manuscript. The difference between lake ice dates from in-situ observations and passive microwave is tentatively attributed to their different observation ranges, but a follow-up investigation is still needed to quantify and explain the differences between in-situ observations with satellite-derived time series.

on line 353:" This is because a buffer of 6.25 km was used to exclude pixels near the lake shore, which happens to be the place where lake ice forms first." If this is the only explanation in the difference between GLERL data and this data set, one would expect the difference to gradually wannish as one nears 100% ice coverage. This is not the case in all the lakes in all the years. Why is that?

Response: The limitation of MTT algorithm's insensitivity to short-term ice cover would also lead to difference between GLERL data and the ice cover extracted from SMMR, SSM/I & SSMIS data. And this is also why sometimes the lake has been 100% ice covered but only partial coverage was detected by SMMR, SSM/I & SSMIS data. We will modify the explanation in the revised manuscript.