

## ***Interactive comment on “The role of snow and ice thickness on river ice process in Songhua River basin, Northeast China” by Qian Yang et al.***

**Qian Yang et al.**

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Received and published: 7 March 2020

Thanks for those valuable and helpful comments. We have carefully revised the manuscript according to the reviewers' comments.

As general comment the paper present many data, but their discussion is not exhaustive and critical. The introduction is not too effective in presenting the study and its rationale. I therefore suggest to significantly improve Sec 1 and Sec 4.

Reply to comment: We have significantly improved Sec1 and Sec 4 as you suggested. Further, we did additional literature reviews, and provided the knowledge gap, and rationale for conducting the research.

Sec 2.2: In situ data analyzed are not fully described. Their temporal resolution is 5

C1

days, but what about the spatial one?

Reply to comment: We introduced the station numbers. Besides, we added a new citation for the data source as follows, which similar to meteorological station, only represented several hundreds square kilometers.

Reference: Hydrographic Bureau of Ministry of Water Resources of the People's Republic of China, 2010-2015. Annual hydrological report: hydrological data of Heilongjiang River Basin. (in Chinese)

Line 109-11: FUE and BUE have a standard definition? In this case reference is missing, otherwise justify the 20%.

Reply to comment: A new citation on annual hierological report has been inserted, and explain the data source more clearly. The definitions of ice phenology refer to specification for observation of ice regime in rivers (2015) and are further defined in details: freeze-up start (FUS) is considered as the first day when floating ice can be observed with temperature below 0 °C; freeze-up end (FUE) is considered as the day when steady ice cover across the river called ice carapace can be observed, and the area of ice cover is more than 80% of view range; break-up start (BUS) is considered as the first day when ice melting could be observed with surface ponding; break-up end (BUE) is considered as the day when the surface is mainly covered by open water and the area of open water exceed 20%; complete frozen duration (CFD) is the ice cover duration when the lake is completely frozen during the winter, starting from FUE to BUS.

Reference: Cai, Y., Ke, C.Q., Yao, G., and Shen, X.: MODIS-observed variations of lake ice phenology in Xinjiang, China, Climatic Change, 10.1007/s10584-019-02623-2, 2019.

Specification for observation of ice regime in rivers (SL59-2015), Ministry of Water Resources of the People's Republic of China, pp.52, 2015. (in Chinese)

C2

Yang, Q., Song, K., Wen, Z., Hao, X., and Fang, C.: Recent trends of ice phenology for eight large lakes using MODIS products in Northeast China, *International Journal of Remote Sensing*, 40, 5388-5410, 10.1080/01431161.2019.1579939, 2019.

Sec 2.3: Some comment about the two methodologies adopted are needed, i.e. applicability limits, reliability of results, pros, cons...

Reply: The authors really appreciated the comments. We added some comments on the two methodologies, and also explained their application limits, reliability, and pros, and cons as well. Please check the revised manuscript later on will be uploaded when we further did the data analysis, presented the results and discussed these new results.

Figures and caption are generally not consistent. As an example, figure 2 and 3 use both notation DOY and dates, and the label (a) and (b) are never cited in caption.

Reply to comment: The labels (a) and (b) has been cited in the caption of figure 2 and 3.

line 179: PC not yet defined

Reply to comment: The definition has been inserted into the revised manuscript.

Lines 197-200: Figure 5 does not show DOY

Reply to comment: DOY was changed to a specific date, and the caption of figure 5 has been updated, with labels (a) and (b).

Some English revision is needed in the manuscript, for example lines 23-25, 40-43, 215, 299...

Reply to comment: We really appreciate your suggestion. We have carefully revised the manuscript according to the reviewers' comments, and used an English-language editing service Editsprings, to polish our wording.

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Interactive comment on *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-242>, 2019.