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Interactive comment on "Observation-derived ice growth curves show patterns and trends in maximum ice thickness and safe travel duration of Alaskan lakes and rivers" *by* Christopher D. Arp et al.

Anonymous Referee #1

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This MS presents an analysis of ice thickness data from several Alaskan lakes and rivers. The data set is wide for this topic, and the data control has been well performed. The chosen quantities to deal - max annual ice thickness (MIT) and safe travel duration (STD) - are very good to describe the role of ice thickness. The data analysis is, however, quite simple and limited, and much more information could be extracted. The MS ca The dependence of ice thickness on climate is in the first order based on air temperature and snow accumulation in lakes, in rivers also the river flow characteristics play a role. Working with freezing-degree-days (FDD) for ice growth and positive degree-days

(PDD) for ice melting is a traditional approach, but it is good to look more closely to the obtained relationships for interpretation of the role of other factors in addition to the air temperature. Here are a few comments for consideration: (1) Consider the physical interpretation of the FFD and PPD coefficients for ice phenology and thickness, See, e.g., the recent paper by Karetnikov et al. in Journal of Great Lakes Research 43(6). (2) The Stefan's formula is a good estimator of MIT although known to be biased up. The theoretical value of the coefficient a is about 3.5. If empirical fit is more, it is a very specific case. Discuss why? If the empirical fit is less, it can be explained by the snow effect but if the fit is less than 0.5*3.5 that is also a very specific case. Since you seem to have snow data, you can plot a vs. a suitable snow index to examine the role of snow. (3) Discuss ice types. How much is known about snow-ice and frail ice in your sites? Their growth does not follow Stefan formula. (4) Considering STD, Stefan formula is known to be very crude for thin as it does not limit ice-air heat fluxes. Discuss this point but using 'Stefan 30 cm' as an index for STD needs a warning. The end of STD at the time of MIT is OK but conservative. Normally lake ice is safe as long as there is snow on top since the sunlight does not deteriorate ice through snow. (5) The formula a'*PDD for ice melting is incomplete since solar radiation plays a role independently, E.g., in some Antarctic lakes ice melts with PDD almost zero. An optional formula could be e.g. melting = a''*PDD + b*(t-t0). Would this work in your sites? (6) For ice melting, the snow cover is important because snow needs to be melted first. Can you plot a' vs. snow at the time of MIT for further interpretation? (7) Considering the climate trends, the results for MIT and STD are good but it would be interesting to look into the trend of FDD for comparison and understanding where the MIT and STD trends could result.

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