

Interactive comment on “Analysis of local AWS and NCEP/NCAR reanalysis data at Lake El’gygytgyn, and its implications for maintaining multi-year lake-ice covers” by M. Nolan

Anonymous Referee #3

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General comments: This paper seeks to understand the weather and climate regimes necessary to maintain contemporary seasonal ice-cover that occur at Lake E with the goal of better defining conditions necessary to cause perennial ice cover in the past. Another objective is to compare local weather stations observations to modeled reanalysis data, though it is not entirely clear if this is included to facilitate understanding of ice cover regimes only or if this is for additional analysis of decadal-scale climatology as I believe is discussed in companion paper by Nolan et al in this same issue. The need to understand the modern conditions necessary to maintain perennial ice cover is certainly very compelling given the importance of Lake E sediment records as a proxy for long-term Arctic climate and the likely important role ice perennial ice cover would

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have on sediment accumulation and proxy indicators driven by lake circulation, water balance, biological processes, etc. The author is very frank about the assumptions and relative simplicity of the approach used, but ultimately provides some reasonable answers that 1) summer temperature are the key driver of melt timing, yet most recent climate warming has come in the winter, and 2) a reduction of 4 deg C from modern MAAT is what is required to cause a shift to perennial ice cover. This seems like a useful starting point for developing a long-term record of Lake E ice cover regimes and also useful information for lake core interpretation. I also think that a very nice discussion is provided about how ice growth and decay likely works on Lake E and how this might impact sedimentation rates / delivery processes and lake water levels. However, I also think that some of these very useful aspects may never be discovered due to the generally poor organization and quality of writing. Additionally, many basic details about the site characteristic and datasets used are neglect or simply referenced from other work, making this a difficult paper to review without additional research. Specific comments: P1443. Title: suggest not using abbreviations in title and simply saying “Analysis of local weather station and reanalysis data...”. I understand that these are fairly well recognized terms and that NCEP/NCAR is used in citation for this model product, however I think a title should be able to stand alone. Similarly the acronym for NCEP/NCAR is never stated in manuscript, nor is it this model product described at all in methods or elsewhere. It is commonly used, but some description needs to be included. For AWS, aren’t all weather stations AWS now, so just saying weather or meteorological stations seems better. P1446 – This is a well studied system, but still some site description is warranted including a site map and location of the met station and domain of reanalysis grid cell used relative to lake and station. P1445-1451 – For description of the weather station and its operation, I’m not sure this level of detail is necessary, particularly the exact circumstances for early system malfunction. Data from many of the sensors described here weren’t used at all in the analysis (i.e. snow depth, soil temp) and thus don’t seem necessary to include. Though analysis of snow accumulation and melt, even if not representative of the lake, could have been useful

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in ice growth modeling and of general interest to hydroclimatic conditions. Additionally, why not call the “tipping bucket” a rain gain and specify that it operates by a tipping bucket mechanism. Similar point for sonic ranger. P1458-1459 – Discussion here of ice decay process is very intriguing and relevant to paper. What constitutes full ice-out and how does partial ice-decay (development of motes and leads, but with large pans) impact subsequent ice growth and more importantly lake sedimentation rates, mixing, and productivity? This could be expanded upon it seems could be analyzed using remote sensing products (i.e. MODIS, SAR, landsat, etc). This was done in Nolan et al 2003 very nicely and doing such analysis that corresponds to period with local met data would seem very helpful to this story to verify modeled ice-out and ice-formation, but it doesn't appear to be attempted. P1459&1463 – I assume there hasn't been any lake level reconstruction attempted here or it would be cited and discussed. Having a lake bathymetry map would be helpful to facilitate discussion in this section. P1464 L3-6 – It would be nice if provide at least some details here as to synoptic drivers of air temperature, but instead have to look at companion paper. P1466-1467 L28-6 – I'm not sure I follow the logic in how seasonal vs. perennial ice cover would impact sediment transport and deposition. It seems only on years with initial congelation ice formation with snow free period, would lake ice be bare. And if these conditions did occur, they could promote substantial sediment transport across the smooth surface which wouldn't occur with a snowpack and this could be a mechanism for increased sediment deposition into the main body of the lake that is of interest. Table 1 and Figure 4 and Figure 9 – Why so much emphasis placed on comparing rainfall between local weather and reanalysis data? Is this with the goal of understanding lake level variability and sediment delivery? It doesn't seem relevant to lake ice growth or decay. Even if this is and I'm not understanding the objectives of this paper, why are they presented in this order? Figure 3 – Why show daily RH here over 7 year period? Figure 5 – Symbols can't be recognized and difference colors not indicated.

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