

General Comments:

The authors of the paper are utilizing a very commonly used MODIS albedo retrieval and parameterizing this variable into the FLAKE model that is then incorporated into the ORCHIDEE land surface model. The aim of this manuscript is to highlight that by parameterizing the albedo retrievals from MODIS that it better constrains the albedo parameter of the lake ice thickness model, thereby improving the ice-on and ice-off dates, providing a better assessment of ice phenology for lakes of various sizes, from small up to the Laurentian Great Lakes. In my assessment, the authors have done well to incorporate the MODIS data into the FLAKE model used in the ORCHIDEE land surface model, and I do believe that the improvements they are reporting are conceivable.

The presentation and assessment of the outputs of the model, in the Observed/Prior/Post experiment is lacking in detail, glossing over much of the potential detail that could have been provided for both the Great Lakes GLIC dataset, and the GLRP database. There needs to be significant work done to a) show the inter-year distribution of albedo parameter improvement in the Great Lakes dataset, and b) show how the improvement of ice phenology parameters varied across distance and time. The authors do well to describe the spatial distribution of lakes within the study among multiple countries, but do not present a study site figure, or segment the results by administrative or geographical boundaries (which have influences on how and the frequency of phenology reports). Section 3.1. presents a significant improvement to the model since the albedo is being parameterized, but it does not read as an important contribution, mainly because it is only shown through an average of 10 years for each lake. More detail in the inter-year distribution of results needs to be shown.

With improvement to the presentation of the study site, methods, and results section this manuscript would be an important contribution to the body of literature.

Specific Comments:

Page 1 Line 19 – 20: “The role of lakes... demonstrated in various works”

Briefly describe what the role of lakes actually are, not that other people say they're important.

Page 2 Lines 37-38: “In these large-scale models... linked to the varying bathymetry”

Please provide references for this statement.

Page 2 Line 44: “free water and ice show very different characteristics”

In what way? Please be specific

Page 2 Lines 47 – 48: “When the air temperature falls... on its bathymetry and weather conditions”

This is an oversimplification of how freezing occurs – what about general density of water at 4 degrees, and the mixing that happens?

Page 2 Line 60: “daily albedo time series at a few hundred metres”

Be specific- how many metres?

Page 3 Line 89: “Crossing the albedo raster images”

Do you mean “overlaying”?

Page 3 Lines 90 – 91: “To avoid radiance contamination by the lake shore pixels... to mask such mixed pixels”.

This is a surprising way to mask out all non-water pixels. For instance, what about exposed soil/sand? Those pixels would not have vegetation but would have higher albedo than water, so it could still erroneously be included for small and medium lakes.

Page 3 Line 100 – 102: *The GLIC provides a slew of ice concentration data – but how was it derived? It’s important to note that it was derived using a combination of paper charts, SAR, visible/infrared imagery and met data, not just interpolated.*

Page 4 Line 110: “SYKE”

Define.

Page 4 Line 124: “LMDZ”

Define.

Page 7: *There is no workflow diagram shown here – which is necessary to help the reader understand the new implementation and model experiment.*

Page 7 Lines 206 – 207: “the only two lakes we could formally identify in the HydroLAKES database”

This needs a better explanation. Are these the only two lakes with names? How does one identify the lakes?

Page 7 Lines 213 – 214: larger surface roughness observed... and reduce the overall surface reflectance”

Would the surface roughness increases not actually increase reflectance as well? Surface roughness on water could cause white caps?

Page 8 Line 238 – 239: “Here, we present daily values averaged over the 20098-2018 period...”

There are a lot of dates averaged together here, and one year may be very different from another, especially considering the size of the Great Lakes. There is no presentation of the standard deviation of the albedo values, the interquartile range of the deviation of the albedo and no presentation of the spread of observations, prior or post. The results that are presented are a significant wrapping up of the data, presenting 10 years in one line.

Page 8 Line 242: “The results clearly show”

Conjecture, please avoid using the word “clearly”.

Page 9 Lines 244 – 245: “The RMSEs are considerably reduced... Supporting Information)/.

Some of this needs to be included in the manuscript – it’s important for the reader to see.

Page 8 Line 247: “then reducing”

Do you mean “thus reducing”?

Page 8 Line 250: “not shown here)”

When highlighting a particular year to discuss deviation in expectations of results, this needs to be shown.

Page 8 Line 250 – 251: We have seen that for all these lakes, the spatial variability is very large...”

How can this be shown within the manuscript?

Page 9 Line 262: “according to their mean depth”

Reminder the reader what shallow, medium and deep mean here

Page 9 Lines 264 – 269: “Given that deep lakes... fractional ice cover parameterization”

This needs to be included in the methods, not introduced in the results.

Page 9 Line 270: “Figure 2 clearly...”

Conjecture

Page 9 Line 271 – 279: *This description of the data would be well served in a table that is included in the manuscript.*

Page 9 Line 280 – 283: “Besides, the fact that the ice-off... most of the lakes observed”

Is this not more likely because the albedo changes significantly quickly in the spring compared to the Fall, where ice onset may be congelation ice with albedo increasing less quickly?

Figure 2: Are there values for data representing one year? Multiple years? Is there more or less agreement based on the year observed? What about the RMSE of the sim-observed values? There are a lot of potential tests that can be run to showcase how the correction is behaving across space and time. Also, GLRP is worldwide, you could segment the data across administrative or geographic boundaries.

Figure 2 caption, Line 289: “GLIC database”

Is this not the GLRP database?