GMD-2021-409 response to Anonymous Reviewer #2 - 21 July 2021

Thanks to Anonymous Reviewer #2 for her/his very helpful comments. Responses are shown below in bold font.

Overall this paper provides and important and interesting contribution to operational coupling of lake temperature and weather models, I enjoyed reading the paper and the structure of the arguments. Fundamentally the science presented here should be published and is appropriate for the journal audience, however the manuscript needs additional work in two significant areas.

Firstly, a more comprehensive methods description is required describing how the assimilation was implemented, and secondly the figures could be significantly improved (there is much repetition and little content on most map based figures). I also found that the early context setting in the introduction assumes a lot of prior knowledge and believe the article could be made more accessible with some relatively minor alterations to this section.

These are excellent suggestions and we agree with them.

My specific comments are below.

Line 71: Could you define SST on first use.

Done.

Line 71-76: I would like a more specific background here on what is done operationally (e.g. which models and data) and how that differs between the great lakes and smaller non-great lakes. I think this makes too many assumptions about how well the reader will know the problem being addressed and there are not even any references in this section which should form a key component of the study rational. I appreciate a more comprehensive review is provided later, but I think this section needs to set out the problem better.

We have revised this paragraph and agree that it needed to be much clearer. Here is our revised paragraph:

In operational US NOAA weather prediction models (global and regional) up to this point, daily sea-surface temperature (SST) analyses have been used to specify the surface water temperatures for even small inland lakes. Inland lake temperatures in North America have been obtained by the interpolation of SST values from the ocean and the Laurentian Great Lakes. An alternative is to incorporate one-dimensional (1-d) lake models within NWP models and use coupled cycling forced by atmospheric conditions updated by new observations

and continuously simulated 1-d lake models   to obtain realistic lake water temperatures (e.g., "cycling"). This cycling to initialize small lakes in NOAA operational regional weather prediction models complements loose coupling with a 3-d hydrodynamical lake model for the Laurentian Great Lakes as described elsewhere in Fujisaki-Manome et al 2020.

Figure 1a/b, It's quite difficult to see the lakes in these figures. Could you provide an insert map to zoom in on an example area so that the reader gets a better impression of the data.

We have merged Figs. 1a and 2 into a single figure now with an insert zoom map for a region near the state of Wisconsin. We also decided to delete Fig. 1b since the emphasis in the paper is for the 3-km HRRR model even though the same lake initialization is still used for the 13-km RAP model.

Could figures 1a and 2 be combined? And perhaps you could label the lakes to link with Table 5? I'm not convinced of the need for Figure 2 and 8, perhaps these become too busy if combined but a more efficient use of plots seems possible.

After merging Figs. 1a and 2 and adding an insert, we felt it would be best to keep Fig. 8 separate. There is still a reduction of 2 graphics (Fig. 2 and Fig. 1b) overall.

Line 317: Is this ocean separation different to the elevation thresholding method described at line 300?

This is also an excellent point and our paper was confusing on this point. Yes, there are 2 factors to identify lagoon areas: <5m ASL and disconnected from ocean points using the 3-km land-water mask. A revised first sentence in section 3.2 now reads*:* *Grid points were assigned as lake points when the fraction of lake coverage in the grid cell (derived from yet finer 15" MODIS data) exceeds 50% and when HRRR gridpoint elevation > 5 m above sea level (ASL, to distinguish from ocean) and is disconnected from ocean areas with the 3-km land-water mask.*

Additional wording was also added later with the discussion of lagoon identification to combine these 2 factors.

Line 329: Global lake products will include significant uncertainties, could you briefly outline what is known about these here?

We added a new sentence here to address this uncertainty: ***K12 identified uncertainties in their own database including estimates of lake depth and errors in coastlines***.

Line 449: I was expecting to see a description of the assimilation method. What is provided here is too brief given the focus of the paper and journal style. If these details really mess up the flow of the article this methodological detail could take the form an appendix.

We agree – the flow of the text promised some discussion on the actual assimilation but there was nothing in the previous version. We now have a new paragraph reading as this: ***The 2-way cycling (Table 4) used now in the HRRR and RAP models benefit via hourly data assimilation using latest hourly observations both for the atmosphere (D22) and land-surface snow conditions (Benjamin et al 2021). In the 3-km HRRR model, the 3-d state of the atmosphere, land surface, and inland lake conditions are advanced on 20-second time steps using the HRRR-specific configuration (described in D22) of the WRF model (Powers et al, 2017; Mallard et al, 2015). As atmospheric conditions change every 20 s (including temperature, moisture, wind, and radiation), the exchange of heat, moisture, and momentum between inland lake points and the atmosphere also vary. Lake temperature is not modified in the hourly data assimilation step, but the ongoing exchange recalculated every 20 s forces an evolution of lake conditions to values consistent with atmospheric conditions.***