We thank the reviewer for the insightful suggestions to improve the manuscript. We have provided point-wise responses to the reviewer's comments in blue text, followed by our replies in black text.

They mentioned that the new VCSs "largely eliminated the need for bathymetric smoothing" and cited Morey et al. (2020). I read thru that paper and the related papers on VCSs, and actually they all mentioned the challenges they faced in representing the steep bathymetry, and that smoothing was a major error source. So, this reference and sentence should be revised;

The reference is removed and the sentence is revised to read:

"They have also improved preservation of climate-critical water masses and overflows (Legg et al., 2006). "

The baroclinic time step was shown, but how about the external time step (I think MOM6 uses splitting)?

Yes, MOM6 uses split-explicit time stepping mode. The barotropic equations are time stepped on a relatively short timestep compared to the rest of the model. Since the timestep constraints for this are known, the barotropic timestep is computed at runtime.

The albedo shown in Table 1, 0.33 seems too large?

The value, 0.33 corresponds to the fraction of the shortwave radiation that penetrates below the surface rather than being reflected by the surface (albedo). The parameter in Table 1 is corrected to read as,

 "The fraction of the shortwave radiation that penetrates below the surface"

I understand they did not add river flows and evap/precip. Can they comment on the challenges in doing that, specifically, the largest rivers connecting Superior and Lake St Clair? Would the omission be a factor of underestimation of through flow in Strait in MOM6?

Thank you for this comment. We would like to clarify the treatment of surface mass fluxes in our model configuration. The model configuration does include evaporation, precipitation, and the associated surface heat fluxes through atmospheric surface forcing. However, the model employs closed lateral boundaries and does not include lateral freshwater fluxes such as river inflows or outflows. As a result, it is not possible to maintain a stable long-term mean lake level without the lateral fluxes (rivers). To close the mass budget and prevent artificial drift at lake level, the model applies a spatially uniform correction to the surface freshwater flux that offsets the domain-averaged imbalance between evaporation and precipitation. This approach ensures that the total lake volume remains stable over long simulations. A similar approach is used in the LMH-FVCOM simulations with which we compare our results. Importantly, this correction only affects the lake-mean volume and does not influence the spatial patterns of lake surface height, which primarily reflect circulation-driven variability. We have added the lines as indicated below in our revised version to clarify our model configuration,

"For this initial configuration of MOM6-SIS2-LMH, similar to previous model simulations (Cannon et al., 2023), the lake domain is closed at its lateral and bottom boundaries, with no river inflows or groundwater exchange. Evaporation and precipitation are included through the atmospheric surface

forcing; however, because lateral freshwater fluxes are not represented, a spatially uniform correction is applied to the net surface freshwater flux to prevent long-term drift in lake level."

Flow through Mackinac Straits is driven almost entirely by wind and water level seiching between Lakes Michigan and Huron (Saylor and Sloss, 1976). We have added the following text to the revised version, to justify ignoring stream flows in the lakes.

"Currents in the Great Lakes are driven primarily by wind and rotation (e.g. Beletsky et al., 1999), and rivers in Lake Michigan-Huron are only expected to influence dynamics relatively close to the outlet of each stream or connecting channel (e.g. St Mary's River and St Clair River). As such, this assumption is not expected to influence discussions in the current study, which are focused on lake wide flow and stratification patterns."

Table 4, 6 have mis-aligned columns: no MBE for z*, 2 MBEs for FVCOM;

Tables 4 and 6 have been fixed in the revised version.

They compared the dates for summer stratification and fall overturn, but need to clearly show how they calculate those times;

Thank you for the comment. The methods for the dates assessment are described in Anderson et al. (2021) (this reference is indicated in the methods section) and followed in this study. We have added the following lines in Section 2.4, 'Model evaluation' in the revised version to clarify the dates assessment.

"The dates for summer stratification and fall overturn for observations and models were calculated based on the following: Summer stratification onset date – date on which the surface temperature exceeds 4 ° Celsius. Fall overturn date - Date on which bottom temperature spikes from minimum temperature and stays constant. The bottom temperature depths for Southern Lake Michigan and Lake Huron were considered at 110m and 188m, respectively."

Line 357 mentioned "observations exhibit flat-lined behaviour that is indicative of instrument noise floors". Could this be short-period internal waves?

Thanks for the interesting comment, which motivated some additional analysis and literature review. Although high frequency internal waves (HFIW) have been observed in other large, stratified lakes (Lake Kinnert, Lake Constance, Lake Geneva, Lake Biwas), spectral peaks are generally an order of magnitude higher (f: 5 - 36 1/hr, ~1e-2 Hz) than our maximum resolved frequency (fmax: 0.5 1/hr). As far as we can tell, HFIW have not been observed in the Laurentian Great Lakes. While some regions of the lakes seem like they may be prone to HFIW events (Niagara River outlet in Lake Ontario, steep bathymetry in Lake Superior, etc.), the central basin of Lake Michigan, where the data presented in Figure 8 were collected, is not one of them. Bathymetry in Lake Michigan is relatively smooth, and the thermistor deployment site is nearly 40 miles from the closest shoreline. To confirm our noise hypothesis, we computed spectra for the unstratified period, when internal waves cannot form (by definition). We observed identical spectral flattening at frequencies above 0.2 1/hr, providing evidence that power spectra are, in fact, dominated by noise at high frequencies.

Near Line 405: should add reference to Fig. 12. Line 564: '12m' is confusing; change to 12 million.

This is fixed in the revised version.

References

Beletsky, D., Saylor, J. H., and Schwab, D. J.: Mean circulation in the Great Lakes, J. Great Lakes Res., 25, 78–93, 1999.

Saylor, J. H. and Sloss, P. W.: Water Volume Transport and Oscillatory Current Flow through the Straits of Mackinac, J. Phys. Oceanogr., 6, 229–237, https://doi.org/10.1175/1520-0485(1976)006<0229:WVTAOC>2.0.CO;2 1976.