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Supplement of

Development of a next-generation general ocean circulation model for the Great Lakes

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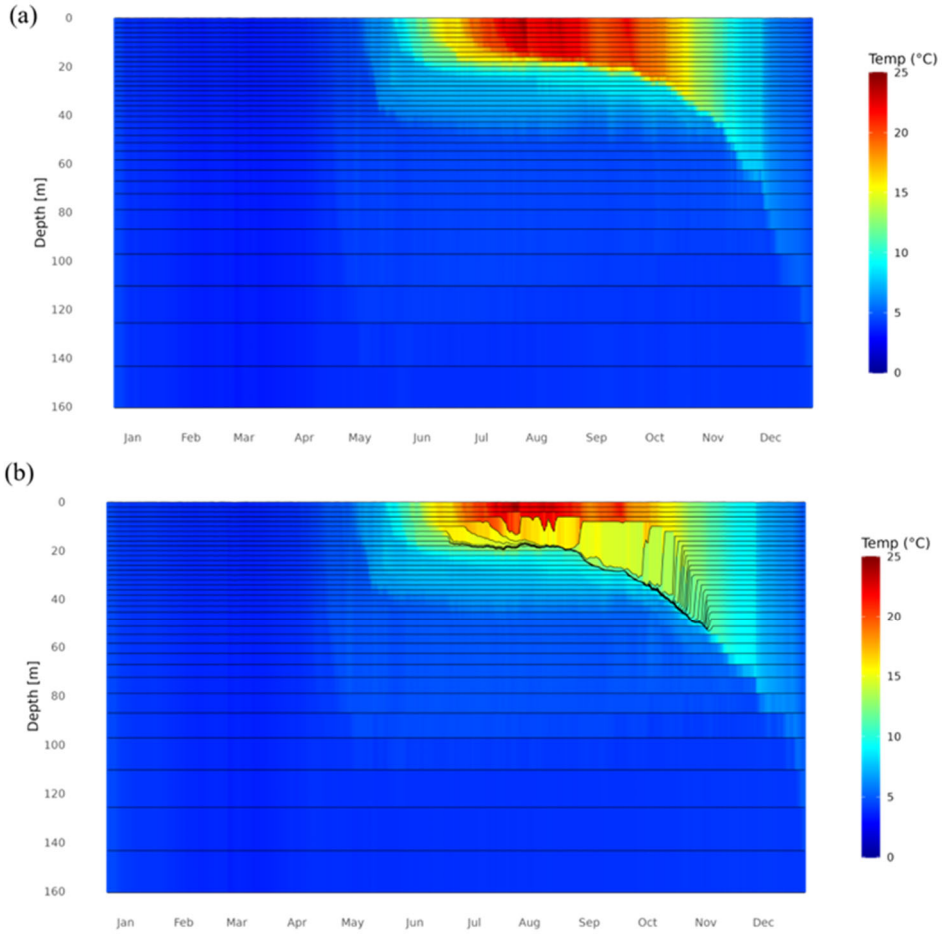
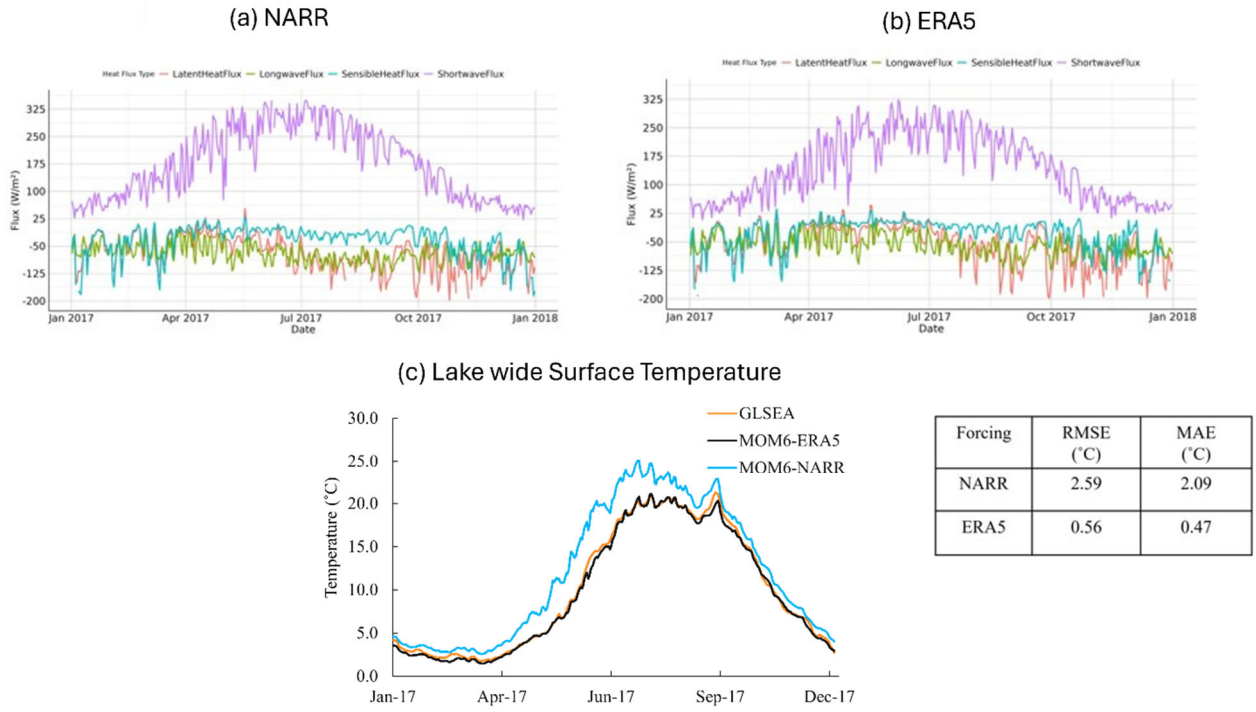


Figure S1: Simulated temperature profiles by MOM6-SIS2-LMH and model interfaces at a thermistor string station in southern Lake Michigan for 2017 (a) z* and (b) hybrid vertical coordinate systems (VCSs). Color shading indicates temperature (°C) over time and depth, while black lines show the positions of model interfaces.



Forcing	RMSE (°C)	MAE (°C)
NARR	2.59	2.09
ERA5	0.56	0.47

Figure S2: (a) Heat budget of MOM6-SIS2-LMH forced with North American Regional Reanalysis (NARR) forcing. (b) Heat budget of MOM6-SIS2-LMH forced with European Center for Medium-range Weather Forecasts reanalysis 5th generation (ERA5). (c) Time series (2017) of simulated daily average lake surface temperature (LST; °C) by MOM6-SIS2-LMH hybrid vertical coordinate system (VCS) forced with NARR, ERA5 forcings, and satellite estimates (Great Lakes Surface Environmental Analysis; GLSEA). Model error metrics are shown in the table. Model results for MOM6-NARR, MOM6-ERA5, and GLSEA are shown in blue, black, and orange, respectively.

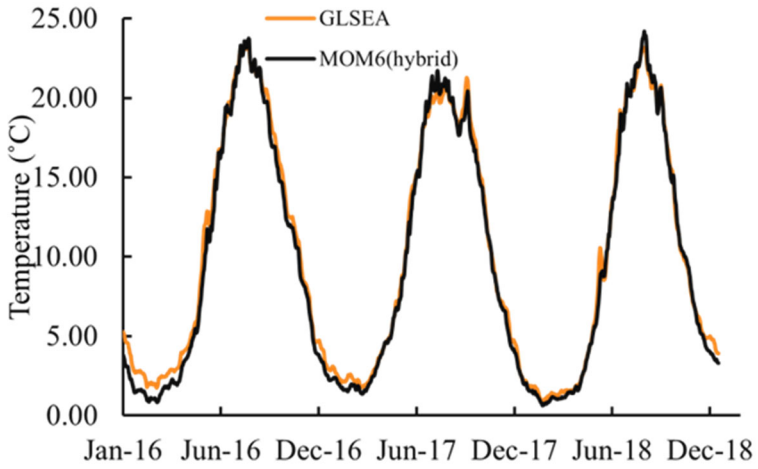


Figure S3: Time series (2016-2018) of simulated daily average lake surface temperature (LST; °C) by MOM6-SIS2-LMH hybrid vertical coordinate system (VCS) and satellite estimates (Great Lakes Surface Environmental Analysis; GLSEA).

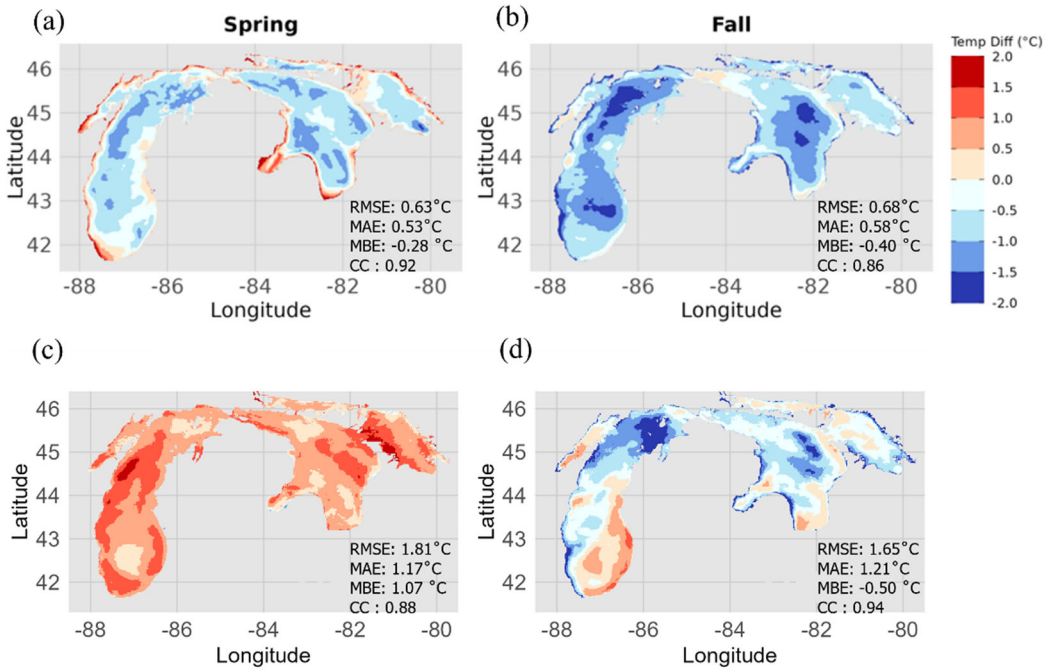


Figure S4: Difference between MOM6-SIS2-LMH's (hybrid VCS) seasonally averaged lake surface temperatures and satellite estimates from the Great Lakes Surface Environmental Analysis (GLSEA) for (a) spring and (b) fall in 2017. Difference between LMH-FVCOM's seasonally averaged lake surface temperatures and satellite estimates from the GLSEA for (c) spring and (d) fall in 2017. The error metrics, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Bias Error (MBE), and Pearson Correlation Coefficient (CC) between simulations and observations are shown in the bottom right corner of the plots.

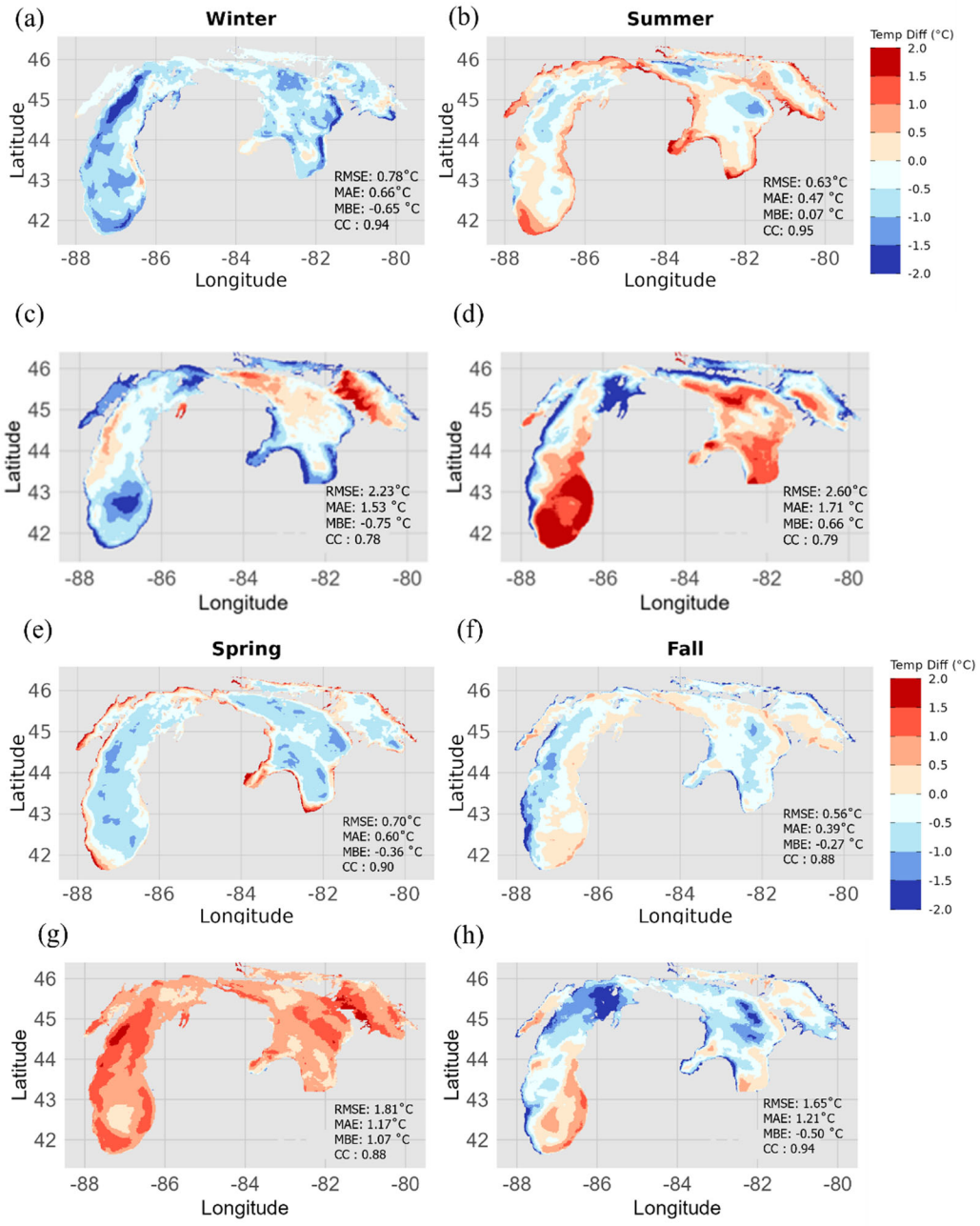


Figure S5: Difference between MOM6-SIS2-LMH's (z*VCS) seasonally averaged lake surface temperatures and satellite estimates from the Great Lakes Surface Environmental Analysis (GLSEA) for (a) winter, (b) summer, (e) spring and (f) fall in 2017. Difference between LMH-FVCOM's seasonally averaged lake surface temperatures and satellite estimates from the GLSEA for (c) winter (d) summer, (g) spring and (h) fall in 2017. The error metrics, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Bias Error (MBE), and Pearson Correlation Coefficient (CC) between simulations and observations are shown in the bottom right corner of the plots.

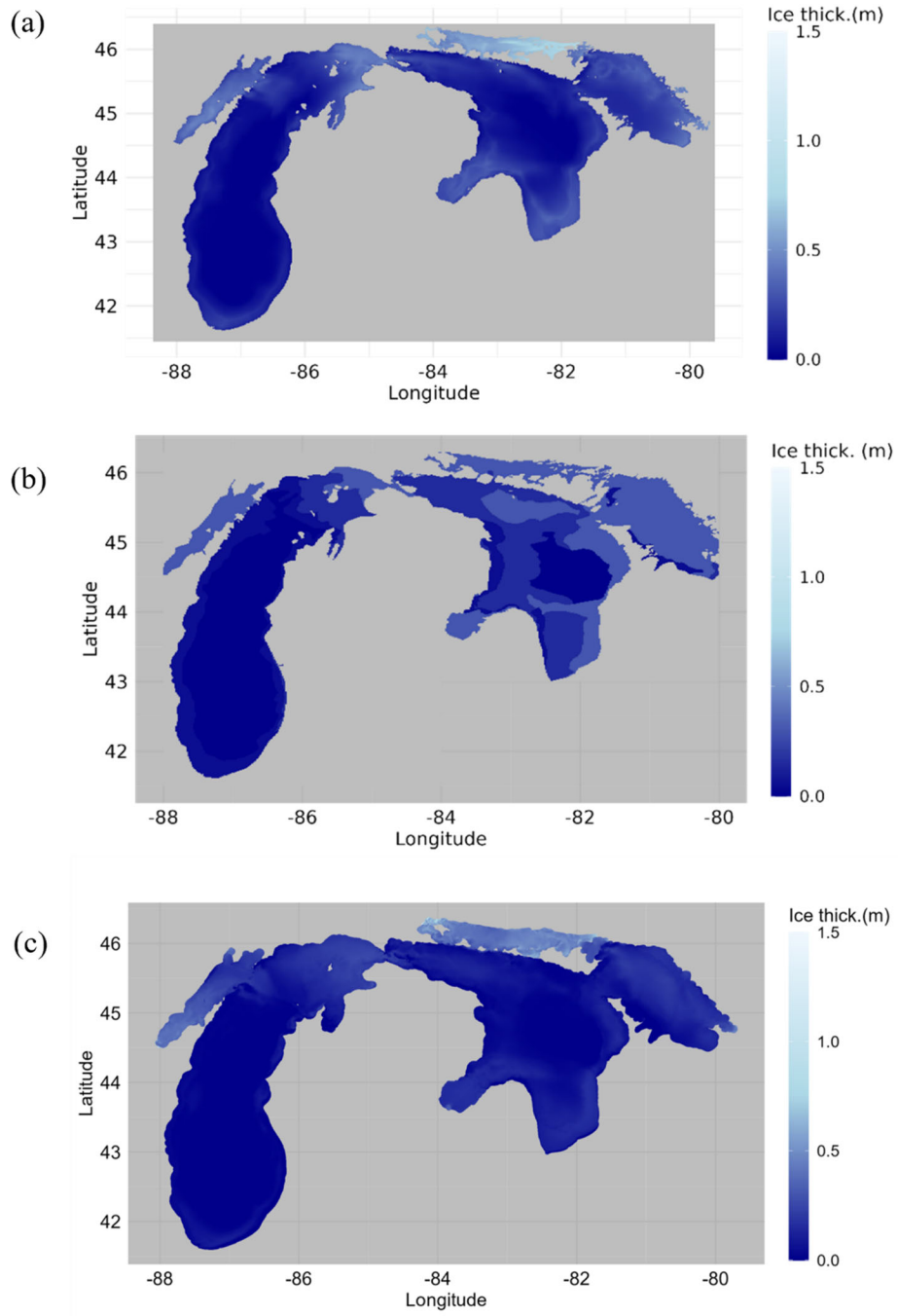


Figure S6: Comparison of ice thickness (m) as simulated by (a) MOM6-SIS2-LMH (hybrid vertical coordinate system, VCS)), estimated by (b) observations (i.e. United States National Ice Center, USNIC), and simulated by (c) LMH-FVCOM, on the day of observed maximum ice concentration, February 13th, 2018, during the simulation period.