Thank you for your comprehensive response to reviewers' comments. Due to the extensive nature of their comments, the reviewers will be given an opportunity to provide feedback on the proposed revisions. Please note that inclusion of additional references, suggested by the reviewers, is entirely at your own discretion. In addition to the comments provided by the reviewers, I have two small observations:

R1C1 In the Introduction, would it be possible to include a brief introduction to Bayesian state-space models and their application in freshwater ecology/ water quality modelling to set this work into a wider context for a less familiar reader, with a few key references?

We agree and propose adding text to Section 1.

> Bayesian frameworks can quantify uncertainty in the effect of nutrient load on nutrient distribution within a dynamic system such as Lake Erie. State-space models have been used in ecology to incorporate temporal and spatial autocorrelation and quantify observation error separate from the error attributable to the modelled ecological process (Auger-Méthé, 2021). State-space models are widely used in ecology to model animal populations (Buckland, 2004), movement (Royer, 2005), and fisheries stocks (Meyer and Russell, 1999). Non-stationary time-series models have been used in the Great Lakes to model water levels (Sellinger, C.E., 2008; Lamon and Stow, 2010) and to predict polychlorinated biphenyls concentration in trout (Stow, 2004). The goal of this study was to use a spatially dependent time-series state-space model approach to define concentrations at unobserved locations and quantify the impact of river nutrient delivery across western Lake Erie.

Auger-Méthé, Marie, et al. "A guide to state–space modeling of ecological time series." *Ecological Monographs* (2021).

Buckland, S. T., et al. "State-space models for the dynamics of wild animal populations." *Ecological modelling* 171.1-2 (2004): 157-175.

Royer, Francois, J-M. Fromentin, and P. Gaspar. "A state–space model to derive bluefin tuna movement and habitat from archival tags." *Oikos* 109.3 (2005): 473-484.

Lamon, E. C., and C. A. Stow. "Lake Superior water level fluctuation and climatic factors: A dynamic linear model analysis." *Journal of Great Lakes Research* 36.1 (2010): 172-178.

Meyer, Renate, and Russell B. Millar. "Bayesian stock assessment using a state–space implementation of the delay difference model." *Canadian Journal of Fisheries and Aquatic Sciences* 56.1 (1999): 37-52.

Sellinger, C.E., C.A. Stow, E C. Lamon, and S.S. Qian. 2008. Recent water level declines in the Lake Michigan-Huron system. *Environmental Science & Technology*, 42: 367-373.

Stow, C. A., E. C. Lamon, S. S. Qian, and C. A. Schrank. 2004. Will Lake Michigan lake trout meet the Great Lakes Strategy 2002 PCB reduction goal? *Environmental Science & Technology*, 38: 359-363.

R2C17 I believe that this clarification may also be useful for inclusion in the actual manuscript.

We agree and propose the following new text for **Section 2.2.2**.

> "The cross-validation via leave one-node-out was used to evaluate model predictions where observations are not available. This estimate of model performance is needed as our dataset has far fewer observations than the product of nodes and timepoints. Estimates of R^2 report how well the model does while given all the available data. Additionally, the cross-validation estimates aggregated by unobserved node (space) or by year (time), defines how well the model estimates TP values irrespective of the node's proximity to the TP river sources or the number and location of annual in-lake observations."