Response to Reviewer 1

R1-C1

Regarding the lower calculated concentrations in river, the authors have indicated that river discharge may be higher than observed and veterinary and industrial are not considered. I agree on this point. But on the other hand, it should be mentioned that there are factors that further decrease the river concentration. Within this paper, there is no mention of load reduction before entering the wastewater treatment plant. If the direct discharge coefficient is considered as the inflow from the conduit to the river in urban untreated area, I believe that something similar may be happen in the sewer pipes. Taking this into account will lead to a decrease of river concentration. In addition to this, advanced wastewater treatment plants could lead to further load reductions. It would be desirable to mention these points in the discussion or as future research topics.

A: We agree with the reviewer that sewer leakage, environmental decay and other losses before the contaminant load enters wastewater treatment plants could substantially reduce the river concentration. I.e., if we added these processes to our model, our simulations would lead to even lower calculated concentrations, hence our bias would be further amplified. That said, we added a new paragraph after line 596 to discuss these additional uncertainties:

"The efficiency of a WWTP to remove a specific contaminant is also a complex process that depends on characteristics of the individual facilities and local conditions that are not represented in the global HydroWASTE database. Furthermore, processes not simulated by HydroFATE may have an impact on contaminant loads entering surface waters. For example, depending on how far a household is located from the facility, decay processes in sewers can act on the load on its way to the WWTP. In addition, sewer lines that are poorly maintained may result in wastewater leakages into the ground, further reducing the load of contaminant before it reaches the WWTP."

Also, we changed the statement at line 649:

"As it is not possible to isolate the contribution from domestic sources in the MECs, this uncertainty in both PECs and MECs could explain a portion of the high negative bias found in the evaluation."

We also agree that WWTPs with an advanced level of treatment would typically lead to higher load reductions, thus HydroFATE has the capability to differentiate efficiencies from different levels of treatment. Our decision to use the same efficiency for all treatment levels in our test case study was due to the lack of data on this parameter for the chosen substance sulfamethoxazole. This uncertainty is discussed in lines 635-640, but we added a new statement at line 640:

"This could lead to reduced river concentrations, since secondary and advanced treatment processes are expected to result in higher removal efficiencies."

Minor comments:

R1-C2

It would be good to indicate the 10 km on line 147, if there is any reasoning behind it.

A: According to the methodology used to estimate the outfall location of the wastewater discharge location in the global WWTP database HydroWASTE, 10 km is the maximum distance between the actual facility and the outfall location and it is a described uncertainty in HydroWASTE. The distance was selected based on a statistical determination process using a subset of WWTPs and remote sensing imagery for manual verification (see Ehalt Macedo et al., 2022). To clarify this in the manuscript we added in line 148:

"…, given the locational uncertainties in HydroWASTE of up to 10 km (Ehalt Macedo et al., 2022),…"

R1-C3

Isn't ds,r in line 321 a mistake for dl,r?

A: We thank the reviewer for spotting this typo, though the error is actually in line 322 rather than in the equation. We corrected line 322 to "…$d_{l,r}$ (dimensionless) is the lake decay factor …".

R1-C4

Check line 332 for a reference error.

A: The reference error in line 332 has been reviewed and corrected.

R1-C5

There is a spelling error (individual) in 533 in Fig. 5.

A: The spelling error "individual" in the caption of Figure 5 (line 533) has been fixed.

References

Ehalt Macedo, H., Lehner, B., Nicell, J., Grill, G., Li, J., Limtong, A., and Shakya, R.: Distribution and characteristics of wastewater treatment plants within the global river network, Earth Syst. Sci. Data, 14, 559-577, doi: 10.5194/essd-14-559-2022, 2022.