Review of Gerke et al.'s "The changing composition of the Gulf of St. Lawrence inflow waters observed from transient tracer measurements" (manuscript #: egusphere-2025-3999)

General comments:

The authors of this manuscript assess the mean ages of the waters in the Gulf of St Lawrence and suggest that there has been a gradual increase in the proportion of North Atlantic Central Waters from inshore areas to the entrance of the Gulf of St Lawrence is evidence of a shift towards deep waters dominated by North Atlantic Central Waters since 2022. They use transit-time distributions to derive the mean ages and then integrate them into a water mass analysis to analyze the water mass composition of the region. The authors use transient tracer measurements collected and described in Stevens et al. (2024) and use the same density surface to represent the core of the deep water inflow. CFC-12 has seen its maximum concentrations in the atmosphere, but SF6 continues to increase; CFC-12 is useful for water masses between 23-85 years in mean age whereas SF6 is useful for younger water masses and in helping to resolve the ambiguity in mean age estimates using the Inverse Gaussian transit-time distribution approach (e.g., Guo et al., 2025). Although, it seems like the authors here just relying on SF6 according to their Appendix B and back-calculate CFC-12, which makes me wonder what information the authors are getting from CFC-12. There may be data issues with regions lacking SF6 and in the regions where waters approach the time scale of CFC-12 beginning to be emitted, there are signal issues. I appreciate the trend analysis and other detailed efforts that went into this manuscript, especially to the end that the relative proportion of waters is changing, but the authors need to perform some additional analyses to convince me of their interpretation of the data beyond that. I suggest minor revisions. Specific comments are listed below:

Specific comments:

Line 36: You should add "abiotic" in front of "transient tracer concentrations" here; you could say "passive" but that would exclude radioactive transient tracers

Line 151: I'm not sure why a Delta/Gamma ratio of 1.2 was chosen; Ebser et al. (2018), which a co-author on your study was also a co-author on, found different ratios for different water masses (e.g., 0.5-0.6 where Labrador Sea Water dominates and 0.9 where North Atlantic Deep Water dominates). Please say more about Figure B1, which seems to be where 1.2 came from. Please also explain why you don't consider using a different ratio of mean age to half-width for North Atlantic Central Waters as opposed to Labrador Current Waters.

Lines 167-168: According to Guo et al. (2025), your estimates of the mean age are likely biases wherever you only use CFC-12 and no SF6 so did you see any spatial discontinuities or other signs that your estimates were different where you have SF6 vs where you do not? You can evaluate the bias you would have in regions where you have SF6 measurements by doing the mean age estimation with both CFC-12 and SF6

and again with only CFC-12 to assess the bias. Analysis was done to corroborate the CFC-12 measurements with the back-calculated CFC-12 concentrations in Appendix B where there are SF6 data but it's unclear to me what information CFC-12 is then providing.

Lines 174-177/Equations 1-4: Is the water in the Gulf of St Lawrence exclusively composed of LCW and NACW? There's also the cold intermediate layer and surface/warm slope water, I thought. Also, while the mean ages of two IG TTD for LCW and NACW would linearly sum to a new mean age, the resulting TTD will not be IG. So are you assuming that the TTDs for LCW and NACW are not IG but their sum is IG (in which case the TTDs for LCW and NACW will still need to have their means linearly combine)? Or are you going to use a sum of two IGs as your TTD?

Lines 246-247: Is the sudden discontinuity in temperature and salinity at the eastern tip of Anticosti Island physical or actually due to the availability of SF6 on one side and lack of SF6 measurements on the other?

Figures 4-5: When I see waters with mean ages of 60+ years using the tracer-based constraints you have, there becomes a signal detection issue because of the very low concentrations of CFC-12 in its first couple of decades of being emitted and the fact that you used a backwards calculation to infer the CFC-12 concentrations from the mean ages that you got from SF6 measurements (lines 450-452). Your Figure 4d makes it look like this generally is reflected in your uncertainties, but your Figure 4b has mean ages of up to 100 years, which shouldn't be detectable using CFC-12 and/or SF6. Also, your Figures 4a-b makes it look like waters are being ventilated after mixing with waters coming from the St Lawrence River in the western part of the Gulf of St Lawrence and there is a barrier for younger waters southeast of the Gulf of St Lawrence to get into the Gulf there through the Laurentian Channel, which leads to an increase in age as the waters reside for longer within the southeastern portion of the Gulf. Your interpretation is that the younger waters in the western portion of the Gulf are due to a higher portion of LCW mixing with the other waters there but is the mix of high and intermediate proportions of LCW shown in Figure 5 in the western portion of the Gulf with large variability over a small spatial distance due to potential data issues such as the ones I've pointed out in this comment and others? For example, you tend to have higher proportions of LCW where you don't look like you have SF6 measurements in the western part of the Gulf.

Figure 6: I'm not sure what the purpose of showing the relative stability of the oxygen concentrations is here because oxygen concentrations can change due to respiration changes, which isn't part of your analysis here. If you use your TTDs to calculate the preformed oxygen, on the other hand, then that may be worth showing. This figure, on the other hand, does show a trend in the variables that support your interpretation of the relative proportion of NACW vs LCW changing.

Lines 327-330: Where was this shift previously reported to be occurring, specifically?