Response to Reviewer 1 (Dr Chris Boone)

We thank the reviewer for the positive assessment of the TCOM dataset and its usefulness to the community. We have addressed the specific points regarding tropical asymmetry and technical corrections below. Our replies are in *##blue italics.*

General Comments:

1. This article describes a new model dataset for CFC-11 and CFC-12 where TOMCAT model outputs have been empirically nudged to achieve agreement with ACE-FTS measurements for the two molecules, providing global, gap-free information that is consistent with observational data. Most of the observational constraints appear to be compensation for transport effects, such as the descent of air within the winter polar vortex. It looks like a good dataset and should be useful to the community. The dataset is reasonably well described, although there is an unexplained asymmetry in the Tropics for the differences from the TOMCAT model (discussed more later) that would be interesting to explore. It implies an inconsistency between the TOMCAT model and the ACE-FTS observations, but it doesn't necessarily need to be understood to use the data (the whole point of the empirical observational constraint is to correct for differences whether or not the source of the differences are known). I would say an explanation for the asymmetry is not required in the current paper, but it might be something worth understanding in the future.

Tropical Asymmetry (Line 351): We have noted the asymmetry mentioned by the reviewer. While a full physical investigation is beyond the scope of this data description paper, we have added a reference to Schmidt et al. (2024) regarding potential emission/transport driven asymmetries in the Northern Hemisphere.

2. Line 278: Beyond the primary TOMCAT tracer feature, the remaining features show subtle, altitude-dependent differences.

Both molecules show similar altitude dependences on Age of air and measurement date, which seems heartening. Higher altitude (> 20 km) CFC-12 has a strong dependence on tracers (N2O and CFC-113) that isn't reflected in the CFC-11 results. I assume that is a way to track atmospheric descent within the winter polar vortex for CFC-12, but I wondered why something similar wasn't seen for CFC-11. Perhaps the slightly enhanced dependence on PV above 20 km is sufficient to account for atmospheric descent with the CFC-11 data?

We added clarification that the difference in tracer dependence above 20 km is likely due to the longer lifetime and CFC-12 photolysis occurring at higher altitudes, making species like N2O better proxies for its high-altitude variability. Comparing Figures 1 and 2, clearly shows that R^2 drops rather rapidly for CFC-11 (most probably due to much

lower volume mixing ratio) whereas for CFC-12 it remains stable up to 28 km. See Sections 5.1 and 5.1.2 in the revised manuscript.

3. Line 351: At 10 km, a band of sustained positive difference is visible across the tropical and mid-latitude regions (50◦S to 50◦N) throughout the entire 2000–2024 period for both CFCs.

Looking at Figures 7 and 8, the bulk of the difference is not symmetric about the equator; it is larger in the Northern Hemisphere than in the Southern Hemisphere for both molecules. This suggests an asymmetry about the equator in the Tropics in one of the two sets that is not present in the other. It is most easily seen in the 15 km plots. I suspect it is somehow associated with an asymmetry seen in ACE comparisons to results from ground-based measurements of CFCs, HCFCs, and HFCs: Schmidt et al., "Trends in atmospheric composition between 2004-2023 using version 5 ACE-FTS data," JQSRT, 325, 109088 (2024). For these molecules, ACE results generally agreed well with measurements from Southern Hemisphere ground-based stations, but a 2.25-year time lag was required to get good agreement with results from Northern Hemisphere ground-based stations.

So, is the asymmetry in the Tropics that drives the differences for the Northern Hemisphere Tropics found in the model or in the ACE-FTS data? That might provide a clue as to the source of the difference.

We have expanded discussion in the revised manuscript (Section 5.3) explaining these interhemispheric differences as discussed in Schimdt et al. (2024). "An interesting feature at lower altitudes is the inter-hemispheric asymmetry at low-mid latitudes. Persistent positive bands of difference are observed from the tropics to the NH mid-latitudes, particularly between 10 and 15 km (see Figs. 7 and 8). This appears consistent with the results of Schmidt et al. (2024), who analysed ACE-FTS data sets for various long-lived species and identified a distinct hemispheric asymmetry. They found that SH VMRs in the lower stratosphere exhibit a 2.25-year lag compared to those in the NH. They noted similar lags in NOAA surface observations and suggested that these differences may be linked to the concentration of industrial emissions in the NH, the time required for these changes to mix thoroughly into the measured atmospheric regions, or a combination of complex vertical and horizontal transport pathways."

Minor Issues

4. ACE-FTS Start Date:

Line 52: For example, the longest time series (March 2004 to present)

Line 86: The instrument has been operational since April 2004

There are two contradictory indications for the start time of ACE-FTS measurements. The instrument has been operational since late February 2004

We have corrected the start date inconsistencies. The instrument has been operational since late February 2004, and we will standardise this throughout the manuscript (Lines 52, 86).

5. Data Archive Link:

Line 106: the ACE-FTS Data archive: https://uwaterloo.ca/atmospheric-chemistry-experiment

The link provided is for the general website, not the data archive. One could explore the website and figure out where to find the data, or you could provide a more direct link to the archive: https://databace.scisat.ca

We have updated the link to the more direct archive: https://databace.scisat.ca.

***6.* Figure 5 and 6 Visibility and Supplementary Figures:**

Figures 5 and 6: the vertical lines on the TCOM data are somewhat difficult to see.

Figure S2 is supposed to be a plot for CFC-12 but instead appears to be a repeat of the CFC-11 plot in Figure S1 (judging by the titles and the altitude ranges, and the plots also look identical). Similarly, Figure S4 looks identical to Figure S3 (including the title).

We have increased the visibility of the vertical lines on the TCOM data in Figures 5 and 6 (and Supplementary Figures: S13 to S20). We apologies for the errors in the Supplementary Figures; Figures S2 and S4 were indeed incorrect repeats, and these have now been replaced with the correct CFC-12 plots.