Public justification (visible to the public if the article is accepted and published):

Dear authors,

Thank you for addressing the reviewer comments. There are some minor comments pending before the manuscript can be accepted for publication, see below.

Thank you for reviewing our revised manuscript. We have revised the manuscript accordingly.

L54 … with near global coverage on seasonal timescales or …with near global coverage every 3 months

L54: We revised the sentence to "with near global coverage every three months".

L60 please add Waters et al 2006 10.1109/TGRS.2006.873771 after MLS

L60: We added the reference Waters et al 2006 after MLS.

L100 what is the precision and accuracy for Methane

L100 could you just say 660 ppt?

L100: We revised the text as follows: "The precision and accuracy are 660 ppt and less than 2% for CO, and 1200 ppt and 5-20% for $CH_4$, respectively (Schmidt et al., 2024)."

L127 even though you explained how the tropopause was calculated in the response to reviewers; it needs to be reflected here.

L127: we revised the text as follows: "Here, we focus on eight $CH_4$ and CO profiles to compare with ACE-FTS measurements and to highlight their contrasting structures near the tropopause, identified from collocated temperature profiles using the WMO definition (Fig. 1)."

L214: Please add the tropopause line to figure 3. The one shown Fig 2 for air core. And one derived for ACCLIP (note that the AIRCORE and ACCLIP related tropopauses seem to be at different heights).

We have added the tropopause for both AirCore and ACCLIP to Figure 3. The difference in tropopause height reflects the different geographic regions sampled: the AirCore campaign took place over the Tibetan Plateau, whereas ACCLIP sampled the western Pacific.

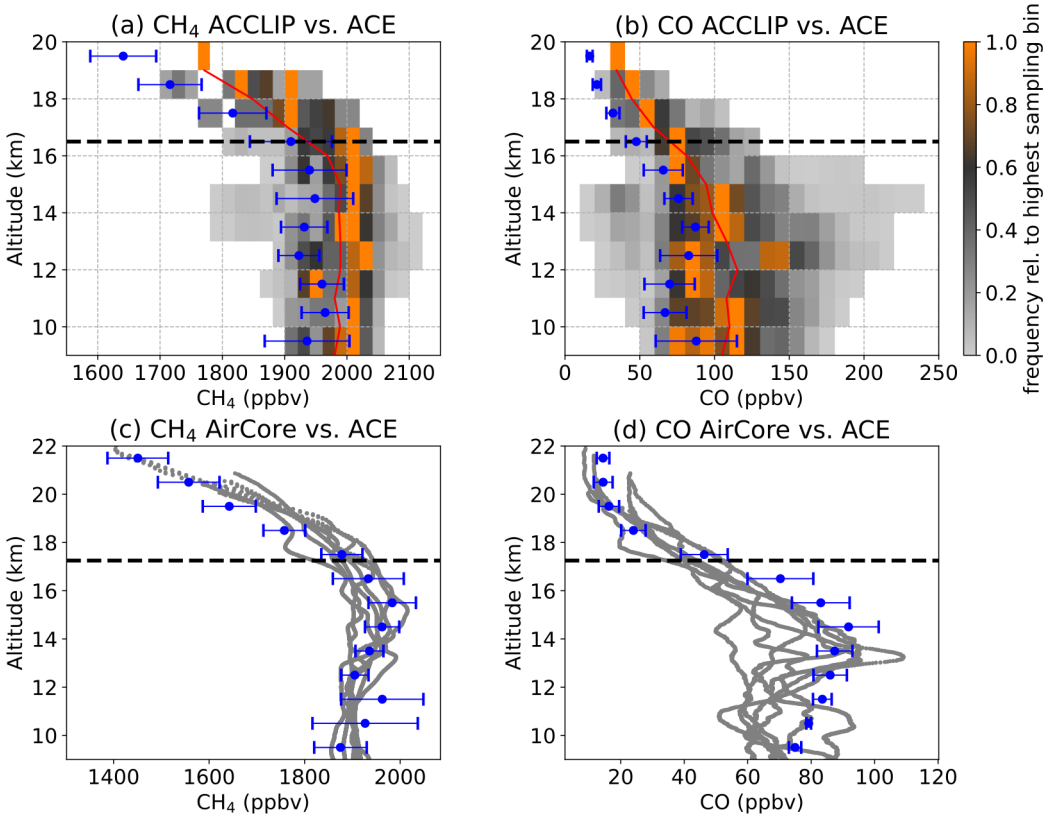



**Figure 3: Comparison of ACE-FTS measurements with in-situ observations in the ASM region. (a) Layer-normalized relative frequency distributions of $CH_4$ measured during the ACCLIP campaign, with horizontal and vertical bin sizes of 20 ppbv and 0.5 km, respectively. The red line shows the mean $CH_4$ mixing ratio for each vertical bin level. The blue dots represent the mean vertical $CH_4$ profile measured by ACE-FTS, and the blue error bars indicate one sigma standard deviation at each level. The black dashed line indicates the mean tropopause determined from the collocated temperature profiles using the WMO definition; (b) Same as (a), but for CO. (c) Comparison between the AirCore $CH_4$ profiles (gray lines) and the mean ACE-FTS profile (blue dots and error bars, as in panel a). (d) Same as (c), but for CO.**

L230. The stream function doesn't seem to be capturing the ASM anticyclone, or at least the enhancements on CO. I think the levels perhaps need to be fine-tuned per height (Pan et al use 4 and 25 at 150hPA). Please confirm that you are using the correct levels.

Figure 4: In the original Figure 4b, the stream function contours shown at 100 hPa, as in Figure 4a. We have revised Figure 4b to show the contours at 150 hPa, using levels of 4, 14 and 25 following Pan et al. The revised contours better delineate the ASM anticyclone and its spatial correspondence with the CO enhancement.

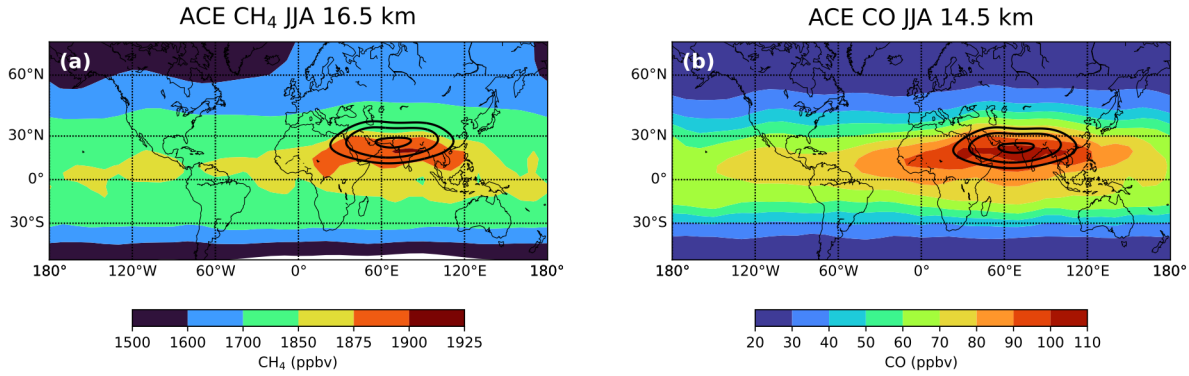



**Figure 4: Horizontal distributions of JJA climatological mixing ratios from ACE-FTS measurements during 2005-2023. (a) $CH_4$ at 16.5 km and (b) CO at 14.5 km. The black solid contours show selected stream function levels ($[4, 14, 25] \times 10^6\ m^2\ s^{-1}$; based on the ERA5 data) at the corresponding altitudes, averaged over JJA during 2005-2023, to indicate the climatological location and horizontal extent of the ASM anticyclone. Note that the JJA map predominantly represents measurements over the midlatitudes in June, the northern subpolar region in July, and the tropics in August (see Fig. 1), rather than spatially uniform sampling throughout JJA.**

Figure 6. Please use a regular scaling for the colorbars (i.e., every 10 for panel a, and every 4 for panel b, for example). In panel a, the jumps between colors are not even linear. In panel b, the white region encompasses a really broad region. It seems that you are cherry picking your results.

We have revised Figure 6 to use uniformly spaced contour levels, with intervals of 10 ppbv in panel (a) and 4 ppbv in panel (b). This removes the broad white region, providing a more consistent representation of the data.

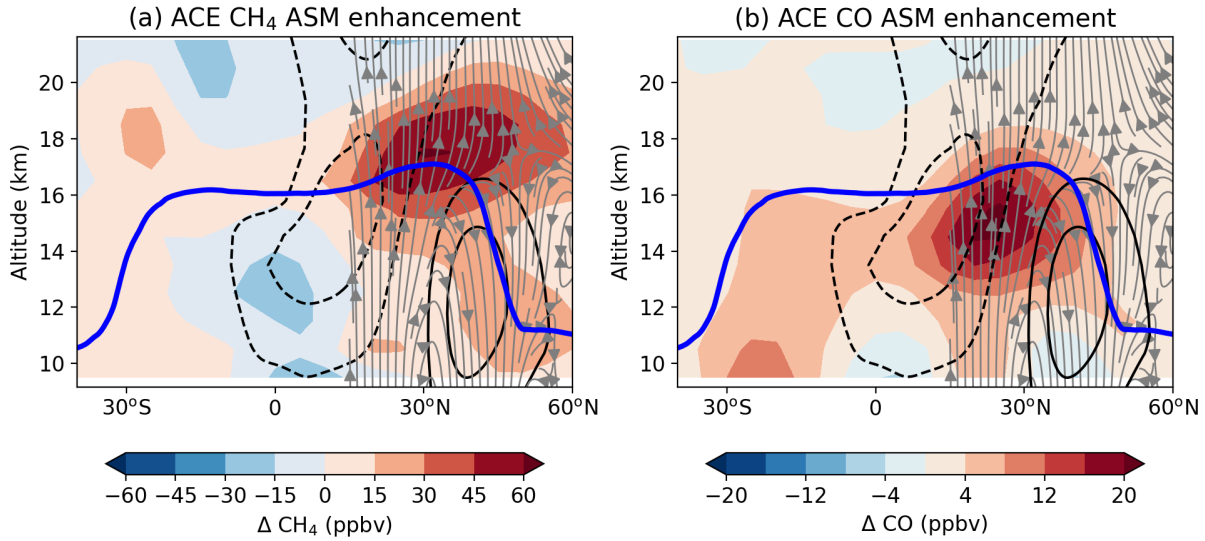


**Figure 6: Meridional cross sections of the ASM enhancement in (a) $CH_4$ and (b) CO derived from ACE-FTS observations for JJA during 2005-2023, defined as the mean mixing ratio over 20°-120°E minus the background mean over all remaining longitudes. Blue lines indicate the lapse-rate tropopause provided by Hoffmann et al., 2022. Solid and dashed black contours represent westerly (10 and 20 m/s) and easterly winds (-10 and -20 m/s), respectively. Gray streamlines, shown only between 15-60°N to cover the ASM region and higher latitude potentially influenced by ASM transport, depict the circulation in the latitude-altitude plane and are constructed from the meridional wind (m/s) and vertical velocity (mm/s). All meteorological fields are averaged over 20-120°E during JJA 2005-2023 based on ERA5 reanalysis. Note that the vertical velocity is converted from pressure-coordinate vertical velocity using the hydrostatic relation.**