

Interactive
Comment

Interactive comment on “The CO₂ tracer clock for the Tropical Tropopause Layer” by S. Park et al.

S. Park et al.

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Reply to review 1

We have made changes to the manuscript to answer the suggestions of the reviewers and clarified a few points raised in review. We respond to the reviewer's comments below and a revised version of the manuscript including most of the changes suggested by the reviewers will be submitted to the editor. We thank the reviewers and the editor for their time and effort and appreciate the recommendation for publication.

Specific Comments

1. The measurements from Darwin, Australia (12°S, 130°E) during TWP-ICE show the CO₂ mixing ratio was 378.6 ppmv at 1 km, and was nearly constant in the range of 379.5 +/- 0.3 ppmv above 4 km. These values are very similar to the monthly average of 379.2 ppmv observed at Ascension Island (7.6°S, 14.3°W) ESRL site, which is located in the same southern hemisphere but in the Atlantic, and quite different than the

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value of 381.6 ppmv at Guam (13.3°N, 144.5°E) in the same eastern Pacific but in the northern hemisphere. We also note the Guam value is not much different from 381.8 ppmv observed at Barbados (13.1°N, 59.2°W) near Costa Rica. Therefore, the observed difference between CR-AVE and TWP-ICE CO₂ data appears to represent the difference between the northern and southern hemispheres. This has been clarified in section 3.2.3 of the revised text.

2. The winter rising branch of the CO₂ seasonal cycle starts in October, providing sufficient time period for the clock to the observations made in Jan-Feb. However, the CO₂ clock of the TTL must have low resolution in the monthly time frame of July or October due to the maximum of the CO₂ index in June and minimum in September, respectively. This comment has been added in section 3.3.2 of the revised text.

3. The stated uncertainty in the slope of the CO₂ index is related with linear fitting, including both uncertainty in SMO and MLO measurements and standard deviation (1-sigma) between SMO and MLO in each given month. The parameters used to infer a mean age are the index slope and the value of deltaCO₂ between 360 and 390K, for which uncertainty was constrained with the standard deviation (1-sigma) of 11-flight observations. All the uncertainties were reflected in the final uncertainties given for the mean age and ascent rate, through error propagation.

4. The mean age analysis using the CO₂ clock requires adequate dataset obtained below the lower boundary of the TTL, which could help define the ceiling for convective input of the boundary layer air and thus the average level where zero-age air occurs. STRAT measurements did not go lower than potential temperature of 363.5 K and the observed CO₂ mixing ratio of 362.5 ppmv at that level could not be determined with this small set of observations as zero mean age air; the CO₂ index of 360.9 ppmv in August, 1996 was notably different than that single datum. It was, however, possible to constrain a mean vertical ascent rate in the TTL of NH summer in comparison with the summer slope of the seasonal cycle and the vertical slope of observed CO₂ against altitude. The interfered ascent rate was 1.6(+/-0.1) mm s⁻¹, compatible with 1.5(+/-0.3)

mm s⁻¹ in NH winter.

Minor Comments

pg 7, l 16-21: The citation has been revised.

Pg 14, l 11-: The discussion has been moved.

Pg 18, line 26-27: We have expanded the discussion about the model in the revised text and added a figure (new figure 10) that illustrates advection and diffusion effect from the model on CO₂ and ozone profiles.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6655, 2007.

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