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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tropospheric ozone sources and wave activity over Mexico City and Houston duringMILAGRO/Intercontinental Transport Experiment (INTEX-B) Ozonesonde Network Study, 2006 (IONS-06)" *by* et al.

et al.

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Responses to Referee Comments

Referee #1

1. A chemical ozonopause is used for the tropopause definition in all calculations, though the white line in Figure 1 refers to a thermal tropopause. In Thompson et al. [2007a] it was shown that ozone budgets and free tropospheric ozone column amounts do not change significantly, depending on whether an ozone *or* thermal tropopause is employed. An extreme example was illustrated in that study, but that happens in

$<$ 10% of the IONS soundings, so that the impact on 20-40 soundings at a given campaign site is fairly small. The tropospheric ozone column amounts and budgets reported here are statistically robust. Recently, a systematic comparison of ozonopause criteria [Dougherty, MS Thesis, Penn State, May 2008] demonstrated how small differences are among five accepted methods, including the one used in the present paper. Dougherty=s study was based on four summers and one spring=s soundings over Houston, as well as other IONS-06 sites across North America. ST, RCL and AD budgets differed $<$ 5% absolute. Note, that if one were to carry out a similar exercise with a thermally defined tropopause – the IONS data show tropopause ambiguity in most T soundings (see response 5 below) – similar results would be expected.

2. A revised manuscript with both Parrington et al and Hudman et al references has been prepared.

3. Good question. Free tropospheric ozone (5-11 km) over Houston in March was ˜10 ppbv higher on average than over the MCB. Yes, the trajectories at these levels over MCB are consistently from tropical marine areas, but often over Houston, back trajectories passed over the Texas coast and SW Texas and northern Mexico.

4. Revised paper modifies this discussion, as suggested. Thank you.

5. Both ozone and temperature profiles show a double tropopause in roughly half the Spring Houston and Mexico City soundings. The remainder have complex ozone and temperature profiles in the tropopause region and one can argue (original wording) that a double tropopause is always present. The double ozonopauses are manifest in Figures 2c, d where MCB and Houston show suggestions of an ozone maximum layer and a double inflection in the temp profile, at 14-15 km (MCB) and 12.5-14 km (Houston). A relevant reference on double t=pause climatology in the sub-tropics is J. Geophys. Res., 112, D07309, doi:10.1029/2006JD007904, 2007, by W. J. Randel, D. J. Seidel, L. L. Pan, which we added to the reference list in a revised manuscript.

Referee #2:

ACPD

8, S3344–S3347, 2008

Overall Comments:

1. Questions about uncertainties in budgets. In Thompson et al. [2007a], uncertainties in the ST assignment were presented, depending on different criteria for RW labeling in the LID method. A conservative estimate is +/- 30% of the fractional amount. Thus, day-to-day differences in Fig 6 for this term are statistically significant in most cases. For RCL, the concern is underestimating recent convection and lightning because the laminar method cannot be applied to soundings in which layers indicate active convection [Thompson et al., 2007b]. This problem affected some of the IONS-04 data (up to 25% of the samples as some locations) but did not compromise the soundings for MCB and Houston examined here. Points about uncertainties are added to the Figure 6 caption. Is a 1 DU increase significant, as the Referee asks? Probably not.

2. The Referee comments that our exploration of a Alinkage@ hypothesis between Houston and the MCB is implicit but not clearly stated nor followed through. Note that line 3 page 5987 is quite explicit in stating the hypothesis. The point is that we reviewed all the trajectories, including days that appeared at first glance to have a connection, but rarely were links clearly established. It seemed important to describe briefly how the connections did not hold up under closer inspection in the March section of the paper. That is all we tried to do.

Lesser Comments:

3. Morning and nighttime launches were not included in the calculations in order that day-to-day comparisons, as in Figure 6, remain valid.

4. Tropopause in caption fixed as suggested. Thank you. See Referee 1 – response to Comment #1 for remainder of response.

5. Good point made about moist layers in mid-upper troposphere.

6. See Response #5 to Referee #1. Comment on double tropopause added to revised Figure 2 caption.

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8, S3344–S3347, 2008

7. More context is given for Figure 3, as requested.

8. Referee describes a “single broad” maximum between 3 and 5 km in Fig 2c. There is structure, with a local ‘peak’ at 3.5 km. The mean lies between 60 and 65 ppbv. At 5 km a localized peak is at 55-60 ppbv.

Technical Corrections:

Title changed in revised paper, as requested.

Fig 5d caption corrected. Yes, only ozone and RH are plotted. Thank you for noticing.

Figure 6 – Revised Figure adopts the shorter abbreviations, as suggested. Thank you.

Referee #3

Double ozonopause comment (as Ref #1, point 5). This material will be introduced into a revised text inasmuch as all three reviewers remarked on it.

Corrected the remarks so as not to imply RH is also distinct before and after 25 August.

Influence of 7 March high ST. See Response above about uncertainties of assignments.

Technical Corrections: Number of North American sites. The total IONS-06 sites numbered 23 but in March, during the “Milagro/INTEX-B” phase, there were 15 stations launching. The Abstract stands. Thank you for asking.

Figure 4 – Ordinate legend has been corrected.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 5979, 2008.