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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Accurate satellite-derived estimates of the tropospheric ozone impact on the global radiation budget" *by* J. Joiner et al.

J. Joiner et al.

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Response to Reviewer 1

The authors thank the reviewer for the careful review and for providing constructive comments on the paper. We have revised the paper accordingly as stated below.

1 General comments

1. Regarding the need to mention and discuss the effect of the unadjusted calculations on the radiative effect compared to other studies, we have now highlighted this several more times in sections 4 and 5. We note that all table entries, ex-

cept the IPCC mean, are actually unadjusted (instantaneous) values as are our calculations.

2. Regarding the sensitivity of the ozone radiative effect to the ozone profile, the reviewer has pointed out that we had not investigated the sensitivity of the ozone radiative effect to the assumed profile shape. The short-wave RE is significant only when the reflecting surface is bright such as over clouds or desert. In these cases, the SW RE does not depend significantly on the vertical profile of ozone. The LW calculation, however, is significantly dependent upon the ozone vertical profile. To address this point we have recomputed the radiative effect using a model profile scaled to give the measured column. The difference is significant ($\sim$30% globally averaged). We now use the model profile shape for all LW calculations. We compare this with the radiative effect previously computed with a uniform profile (in a new appendix subsection).

3. Regarding the tropopause effect discussion: We have now included global maps of the LW and SW difference in RE produced by the two definitions in the appendix as suggested. We chose the lapse rate definition because it is the more commonly used definition, although the dynamical definition is perhaps the more relevant one for this application. The reason for our selection is now mentioned in the text.

4. Regarding the sensitivity to a priori meteorological parameters: Discussion is now provided on this point. The largest sensitivity of the RE is with respect to surface skin temperature errors. We computed the day-night difference in the RE. The expected errors in skin temperature are expected to be much smaller than the day-night difference. Therefore, the day-night difference can be considered as an upper bound on the error. Note that because some of our error estimates are rather crude upper limits, we have chosen not to summarize these in a table or to compute cumulative uncertainties.

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2 Specific comments

1. P 5507 lines 4-7: We removed text referring to anthropogenically-produced ozone to clarify. Thank you.

2. P 5508 lines 3-5: We removed the text referring to stratophere-troposphere exchange to clarify.

3. P 5512 lines 14-22: We agree that this is a specific (and important) result of this study and have added a figure and expanded the text on this point as suggested.

4. P 5513 lines 10-19: We believe that the ozone maxima over the Arctic and Antarctic regions that the reviewer refers to are due primarily to stratospheric ozone that is brought down into the troposphere during fold events. We have discarded some of these areas as indicated in the text mainly to limit extrapolation of MLS data. We also eliminated regions where the tropopause is ill-defined leading to unrealistically large values of the tropospheric column. However, some areas of large column-mean mixing ratios still appear in the daily and monthly fields. We prefer to leave these in our data set. When comparing with present day model runs, we must also check to see whether models reproduce such features. When performing a quantitative comparison between the present-day model-computed ozone radiative effect and that from the satellite data (beyond the scope of this paper) one should similarly filter out model data where the tropopause pressure is greater than 320 hPa or the tropospheric column is greater than 120 DU. The text has been expanded to address this point.

5. P 5519 lines 20-23: We have high confidence in the measured ozone columns over snow and ice. The bright surface provides excellent sensitivity down to the surface except at very high solar zenith angles ($\sim$80 degrees) where Rayleigh scattering begins to limit the lower tropospheric sensitivity and causes a profile

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shape dependence. The derived column-mean mixing ratios may be underestimated in the presence of optically thick cloud because P_{eff} is overestimated. Therefore, the radiative effect can be underestimated, though only for high cloud optical thicknesses when over the brightest surfaces (Greenland and Antarctica). We have now added some discussion of this in both in the results section and in the section describing the derivation of the column mean mixing ratio.

6. P 5519 lines 24-26: The authors agree that it has not been demonstrated that biomass burning is producing the tropospheric ozone over those regions. We have removed the text pertaining to that statement and other similar statements.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5505, 2009.