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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of urban pollution on UV spectral irradiances" *by* R. L. McKenzie et al.

Anonymous Referee #2

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The paper aims at investigating the effect of tropospheric pollution on surface UV irradiance, by comparing measurements at an urban site (Tokyo) with those at a clean site (Lauder). Quantitative results are presented for the summer and winter seasons, and the effects of the various UV influencing factors are discussed in adequate detail. The data to support the findings of the paper are limited to one year only for Tokyo and to one and a half year for Lauder. The limited length of the dataset reduces the robustness of the results quantitatively. The methodology that is followed to analyze the measurements is presented clearly. I think that the paper should be accepted for publication with some revisions.

Specific comments

The paper has many figures. Figure 1 may be omitted since the reader can get only a rough idea of the irradiances measured at the two sites. The comparison between the two sites is illustrated repeatedly in figures 2 and 3and it can be inferred form figures 6, 7 and 13. Figure 4 is very informative for the operators, but may not be necessary for the reader of the paper.

The information contained in tables 2 and 3 may be incorporated in the text.

The retrieval of column amounts of NO2 and SO2 is marginally innovative, in the sense that the DOAS method is not new and there is no way to judge whether the retrieved columns are correct or not. Although the absorption signatures of the two gases are evident in one particular case (Figure 10), it is hard to say that this constitutes a new scientific result. In absolute sense, the retrieved slant columns are not validated and only qualitative statements are made for the levels of the retrieved quantities. Are the authors confident that the absolute levels of Figure 9 are correct? How large can be the uncertainty of these results? On the other hand, some meaningful information is given in Figure 8, which shows the seasonal differences of NO2 in Tokyo, but with respect to Lauder.

1. 7151, 2: The reference to aerosol single scattering albedo here does not fit with the discussion of the paragraph. I suggest rephrasing.

2. 7151, 3: Absorption effects of air pollutants can be enhanced in the presence of aerosols through increasing scattering. I think this should be mentioned here.

3. 7151, 27: Explain why one scan is made at midnight.

4. 7152, 13: Actinic flux and irradiance are influenced differently by aerosols. This makes the direct comparison of the two quantities dependent on the actual conditions. Was this taken into account in the back-correction of the irradiance measurements?

5. 7154, 8: How the transmissions were calculated? Are they normalized to SZA=0?

6. 7154, 11: Was total ozone stable during these days? Would it be possible that the

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asymmetry is caused by changing ozone column?

7. 7155, 5: The irradiance in each 5° bin can change significantly, especially at large SZA.

8. 7155, 11-13: I suggest plotting the absorption cross sections of the three gases on figure 3. This would highlight the discussed absorption features.

9. 7155, 24: What could cause this increase in the ratio? Different cloud patterns of cloud thicknesses? More pollutants?

10. 7156, 27: If the comparison was repeated for other wavelengths, one could estimate better if the effects are from clouds or from aerosols.

11. 7157, 5: Why these calculations (reduction of diffuse irradiance) are not shown in the paper?

12. 7157, 14: How good was the agreement between measurements and model?

13. 7157, 23: The SZA of 68° is not small!

14. 7158, 20-25: Why the average transmission in Lauder is the same in the UV-B and UV-A, whereas this does not happen in Tokyo? In addition, Tokyo has much smaller SZA dependence than Lauder. Could this be attributed to the effect of the aerosols in Tokyo which decreases the contribution of the direct component and redistribute the diffuse radiation? Are similar effects evident in the actinic spectra?

15. 7159, 9: Describe how these ratios are formed. Are these average transmission spectra, or individual measurements? Are the spectra measured at Lauder used as "reference" (free of effects from pollutants) spectra?

16. Mention that T(Tokyo) or T(Lauder) are transmission spectra.

17. 7159, 19: The retrieved tropospheric ozone effect is not discussed. Since it is included in Table 5, a reference to this table should be given here. This discussion is

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partly repeated in section 8.

18. 7160, 21-27: Why Figure 9 was made with data derived from the "standard" DOAS method and not from the alternative method described before in this section?

19. 7160, 10: The lowest transmission is about 0.6 so I suggest changing the absorption of 50% to 40%.

20. 7160, 19-20: This statement is not supported by the discussion and the results presented in sections 6 and 7.

21. 7161, 3: Is it really necessary to have this section 7 separated from section 6?

22. 7162, 23-26: This sentence should be rephrased. (The effect of differences.... on spectral UV where modeled using the DISSORT ....)

23. 7163, 4-7: If the irradiance calculations were made for Tokyo, why ozone columns measured at Lauder were used? I suggest deleting in line 5 the words "for Tokyo".

24. 7163, 7: Mention the wavelength for which the aerosol optical depth is considered.

25. 7163, 9-10: Delete the word "integral" in both occurrences. Figure 12 shows spectra and not integrals.

26. 7163, 18: This reversal is theoretically possible, but it may be also caused by stray light effects or the low signal at these wavelengths.

27. 7164, 2: Mention here for clarity that the measured spectral ratios are averages.

28. 7165, 9-10: I think that the quoted better agreement of the afternoon ratios with the model results in winter is not justified by figure 13. The spectral dependence is still opposite from that of the model. There should be other reasons to explain this spectral effect. One possibility could be effects from clouds and the fact that these ratios are averages of spectra measured over a period of 6 months each acquired under different conditions (ozone, aerosol, clouds, tropospheric absorption, etc). I wonder whether

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this pattern remains the same if instead of 6 months the authors would have used 3 month averages (DJF) for winter.

29. 7166, 11-13: The model was run for 2 different values of the ozone column, while the averaged spectra were measured under different ozone columns. The combined ozone effect on the averaged irradiance cannot be the same with the effect of the averaged ozone on irradiance, especially if one considers also the combined effect of the high aerosol load in Tokyo. This may be one reason for the higher measured ratios in the UVB. One way to investigate more deeply this effect would be to compare individual spectra (measured and modeled) and not averages.

30. 7174, Table 4: The header or at least the caption should mention clearly what quantities are shown in Table.

31. 7178, Figure 2: The upper panel should be labeled in hours instead of decimal day of the year.

Technical comments

7151, 1: Replace "absorptions" with "absorption"

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7149, 2008.