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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Attenuation of global ultraviolet and visible irradiance over Greece during the total solar eclipse of 29 March 2006" *by* A. Kazantzidis et al.

Anonymous Referee #2

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General comments

The paper by Kazantzidis et al. describes measurements of eight multichannel radiometers during a solar eclipse in Greece. Measurements were evaluated for the change in spectral irradiance at several wavelength in the UV during the progression of the eclipse. These measurements were further compared with results of 1-D and 3-D radiative transfer models. Data gathered during a solar eclipse are naturally sparse and the UV measurements by the authors are a welcome addition. Compared to earlier work, the availability of several instruments in close proximity of the umbral shadow is a novelty. I also believe that multichannel radiometers have never been used before

for studying an eclipse.

My main criticism of the paper is that it lacks a Discussion Section where the authors interpret their results and compare them with similar observations that have already been published. For example, why is UV radiation decreasing more rapidly than the visible fraction of the Sun (Page 13483, Line 14)? In addition, reasons explaining the pattern of the irradiance ratios of Figures 4-5 should be provided. The following explanation for the spectral effect comes to my mind:

During totality, diffuse radiation originates from photons that have entered the top of the atmosphere far away from the measurement site. Since photons at shorter wavelengths are more effectively scattered than photons at longer wavelengths, they have a smaller chance of reaching the instrument. Hence, the ratio 340/380 decreases as the eclipse progresses. Based on the literature cited in the paper, the authors should determine whether this explanation is correct and either include it in the paper or give a more appropriate interpretation of the effect.

It would be nice if the reason of the inflection of the 305/380 ratio (Figure 5 top) could also be explained, although I understand that an explanation may not be possible at this time. It is puzzling that the 3-D model fails to reproduce the effect (Page 13487, Line 3) . It may be pointed out in the conclusions that the interpretation of this observation remains a challenge for future research.

The topic of the paper is appropriate for ACP, the analyses are scientifically sound and the presentation is by and large well structured and clear. I recommend publication of the manuscript by ACP, provided that the authors appropriately address the issues raised in my review.

Specific comments

Page (P) and line (L) numbers refer to version "http://www.atmos-chem-phys-discuss.net/7/13475/2007/acpd-7-13475-2007.pdf"

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1- Some important results are missing in the abstract. For example, I suggest to include: "UV irradiance decreased more rapidly than irradiance in the visible at all sites."

2- P13476, L10: "The spectral ratios between wavelengths was generally reproduced by the 1-D model" I disagree with this statement. Figures 4 and 5 demonstrate that the ability of the 1-D model to reproduce the measured ratio quantitatively is poor. The work "generally" could be replaced with "qualitatively," although I would prefer seeing a more quantitative statement in the abstract.

3- P13479, L8: "a powerful 10000 W xenon lamp" -> "a 1000 W xenon lamp" (or was the characterization really done with a 10,000 Watt lamp?)

4- P13480, L1: "considered negligible" Please quantify!

5- P13481, L3: "very small" Please quantify! This can easily be done with model calculations. For example, the SZA and irradiance at the channel's wavelengths can be calculated for the day and time of the eclipse, and the closest clear sky day, and compared.

6- P13482, L4: "they are realistic also for the sites where no aerosol measurements were available." Can this statement be supported for sites other than Kastelorizo? Is there a Reference?

7- P13484, L9: "The differences are smaller than 10% for sun coverage of up to 40%, increasing by up to 30% for larger sun coverage." This statement should be improved. Model and measurement agree at small and large coverage, but not in between. The largest difference between measurement and model is at about 70% coverage (30% of Sun visible), but the model agrees almost ideally with the measurement for 90-95% coverage.

8- P13484, L22ff: "The modeled rapid decrease of solar irradiance and the use of one-minute averaged measurements lead to the reveal of significant and probably artificial differences between modeled and measured values." If that were the case, shouldn't

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the difference between measurement and model reverse sign at the time of totality? Figures 2 and 3 show that measurements tend to be smaller than the model. If the bias is caused by the averaging, I would expect a different pattern before and after totality. Since 1-second measurements are available for Kastelorizo, the effect of averaging could be easily checked.

9- P13485, L9ff: "The results discussed ..." I am not sure what this statement is referring to. The paper at hand deals with global irradiance, Kazadzis et al. 2007 apparently with direct irradiance. Do the authors want to say that the relative differences between measurement and model are similar for global and direct irradiance?

10- P13486, L6: "The model generally underestimates the spectral effect, up to 10% close to the totality." This statement is a bit misleading. The measured ratio 340/380 decreases from 1 to about 0.9 as Sun's visibility changes from 100% to 10%. The model ratio only decreases from 1 to 0.95. So it can be argued that the model is off by 100% in relative terms. The same is true for the ratio PAR/380.

11- P13486, L23: "It is not clear yet whether this behavior is caused by changes in total ozone ..." I think this possibility is unlikely. Total ozone at Kastelorizo and Nicosia changes in opposite directions but the inflection of the ratio goes in the same direction at all sites.

12- P13487, Section 6: The calculation of total ozone should be better explained. Was total ozone calculated with a look-up table that relates the SZA angle and the ratio of 305/320 to total ozone? I assume that the look-up table was not altered during the time of the eclipse, but the measured ratio 305/320 was corrected for the limb-darkening effect. I further assume that this correction takes into account that the limb-darkening is wavelength-dependent. Please include this description in the paper, or adjust my interpretation if the actual procedure was different.

13- P13487, L21: "...which is likely an artifact of the irradiance measurements (e.g. Zerefos et al., 2001; Kazadzis et al., 2007)." I don't understand this. Is there are

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systematic error in the irradiance measurements at low radiation levels that is different for the 305 and 320 nm channel? Can the contents of Zerefos et al., 2001 and Kazadzis et al., 2007 be summarized in one or two sentences to explain the artifact without having to read these papers?

Technical corrections

1- P13476, L4: actinometers -> radiometers (Although the term "actinometer" is technically correct for any instrument measuring radiation, it has recently mainly been used for photochemical systems measuring radiation)

2- P13476, L14: "Comparison results with 3-D model calculations approaching and during totality revealed an agreement with measurements in the UV-A region." -> "Results of 3-D model calculations for times shortly before, during, and shortly after totality agreed with measurements in the UV-A region to within x%. (Please provided value for "x"!)

3- P13479, L18: "Kastelorizo, Kazadzis et al. (2007)" -> "Kastelorizo (Kazadzis et al., 2007)"

4- P13486, L6: "for the largest during the eclipse solar zenith angle (44°)" -> "for the largest SZA during the eclipse (44°)"

5- P13482, L17: Provide reference for the SUSIM ATLAS 3 spectrum (e.g. M. E. van Hoosier, Solar ultraviolet spectral irradiance data with increased wavelength and irradiance accuracy, SPIE proceedings, Vol 2831, 57-64, 1996.)

6- P13482, L24: "was estimated to less than 1%." -> "was estimated to be less than 1%."

7- P13484, L23: "... measurements lead to the reveal of significant and probably artificial differences between modeled and measured values." -> "... measurements is probably responsible for some of the bias between modeled and measured values."

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8- P13485, L6: "are smaller, compared to the UV-B" -> "are somewhat smaller compared to the UV-B" (I think the difference is rather minuscule, in particular between start and totality.)

9- P13489, L2: "due to the impact the ozone profile." -> "due to the impact of the ozone profile."

10- P13490, L29: "forradiative" -> "for radiative"

11- Figures 2-6: It is a bit confusing that the abscissa of the figures is "percentage of visible part of Sun" while the text generally discusses "sun coverage", which is "100% - (visible part)". Can figures and text be reconciled?

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 13475, 2007.