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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Measurements of spectral irradiance during the solar eclipse of 21 August 2017: reassessment of the effect of solar limb darkening and of changes in total ozone" *by* Germar Bernhard and Boyan Petkov

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TWO KEY POINTS: The authors have made several important revisions to their paper, but they simply must remove their erroneous assertions to the effect that: (1) the signal at 300 nm is noisy, which suggests poor measurements by TOPS (which used 300 nm and 305 nm) and (2) full-sky measurements of the ozone layer are "similar" to the direct sun measurements employed by Dobsons (and TOPS, Microtops, Brewers and Pandoras). These inappropriate claims and their 2-minute measurement time support their general assertions that raises doubts about the papers by me and others.

My recommendations are fully supported by these facts:

1. OPTIMUM WAVELENGTH SELECTION FOR MEASURING TOTAL COLUMN OZONE DURING A SOLAR ECLIPSE:

The authors claim the 300-nm minimum employed by TOPS provides a noisy signal. They erroneously observe that: "Of note, the shortest wavelength of a Dobson is 305.5 nm and if measurements at 300 nm would be of great advantage, these instruments would likely use a shorter wavelength."

The 305.5-nm Dobson minimum wavelength was selected due to the use of the instrument across a wide band of latitudes. However, there is ample signal at 300 nm at my site (29.9 N), as demonstrated by the instrument's detection of an error in NASA's Nimbus-7 TOMS ozone instrument (Mims, Nature, 1993). The 300 nm signal was especially strong at 22 N during the 1991 solar eclipse reported in my paper in GRL. The authors might be right about the 300-nm signal at their northerly location. But they cannot compare what might have been a noisy 300 nm signal at their northerly 44.36 N site to the much higher amplitude 300-nm signal at the 22 N site for the eclipse I measured.

Furthermore, DeLuisi and others have demonstrated that wavelengths below 305 nm provide more accurate ozone measurements than higher wavelengths. (This explains why TOPS found the satellite error.) Of special concern is this from the author's abstract: "The total ozone column (TOC) was derived from measurements of global irradiance at 306 and 340nm." While the 306 nm minimum is appropriate for 44.36 N, the 340 nm upper wavelength is far too high, for it allows for significant aerosol errors. The closely-spaced 300 nm and 305 nm wavelengths of TOPS nearly eliminated the aerosol error, which explains this instrument's excellent accuracy when compared with hundreds of satellite measurements and an EPA Brewer for 60 days at my site. Consider this abstract by Saunders et al in "HighâĂŘprecision atmospheric ozone measurements using wavelengths between 290 and 305 nm" (JGR Atmospheres 1984 https://doi.org/10.1029/JD089iD04p05215) “Abstract “It is shown theoretically that many errors are significantly less when determining atmospheric ozone thicknesses from measurements of solar terrestrial spectral irradiance in the wavelength region between 290 and 305 nm as compared to the 305âĂŘ to 340âĂŘnm region employed by the Dobson spectrophotometer. In order to test this conclusion experimentally, an elaborate set of stateâĂŘofâĂŘtheâĂŘart measurements have been made in the shorter wavelength region in Gainesville, Florida, between June 13 and June 18, 1980. Details of these measurements, including an extensive error analysis, are presented and indicate that such shortâĂŘwavelength measurements, particularly between 295 and 305 nm, can be used to detect longâĂŘterm changes of atmospheric ozone with an uncertainty not exceeding 1%. Observing conditions restricted the Gainesville measurements to zenith angles of less than 35°. Further investigations are required to determine the shortest wavelength that can be used at significantly greater zenith angles.”

2. FULL-SKY VS. DIRECT SUN TOTAL OZONE MEASUREMENTS:

The authors state in their paper: “The method of calculating TOC from measurements of global irradiance (instead of direct irradiance as it is typically done for Dobson, Brewer, TOPS, and Microtops instruments) was first proposed by Stamnes et al. (1991). We found that the accuracy of TOCs derived from global irradiance is similar to that of data from Dobson instruments or satellite (TOMS, OMI) observations if the look-up table takes local conditions into account (ozone profile, albedo, elevation, etc.) (Bernhard et al., 2005b).”

The authors suggest that global irradiance provides TOC data “. . . similar to that of data from Dobson instruments or satellite. . . .” But the authors provide no data or citations to support this assertion, while leaving open the counter suggestion that Dobsons (and TOPS, Brewers and Pandoras) could be replaced by much simpler instruments that measure global irradiance and require no tracking and pointing. Of course, this is not the case. The authors have gone much, much too far in suggesting their global,

full-sky data is “similar” to direct sun measurements made by the recognized standard for nearly a century and all other ozone instruments.

I have always been intrigued by the prospect of accurate ozone retrievals by pairs of global UV measurements at closely-space wavelengths. I urge the authors to prepare a detailed paper about their claim that global TOC measurements are “similar” to those by traditional direct sun instruments. An ideal comparison would be with Brewers, which measure both direct sun and global TOC. Meanwhile, it is inappropriate to make an unsupported claim about “similar” results.

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