Determination of Dobson Spectral Characteristics, A New Method

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The Dobson instrument has been used for the determination of Total Ozone Column (TOC) since the mid-1920s. A complete description of the instrument operation, principles of measurement, and use is available elsewhere; briefly, the instrument measures the difference between the intensity of selected wavelength pairs in the 300-340 nm spectral range. ESRL GMD operates 16 of these instruments throughout the world, and serves as the Central Calibration Laboratory for the measurements with this instrument. The record of TOC starts in the early part of the 1900s, and the part of the record prior to 1979 is almost exclusively from measurements with the Dobson instrument. As the requirements for accuracy increase, a better understanding of the instrument characteristics is needed. In the past, only one Dobson instrument (D083, the World Primary Standard held at ESRL GMD) has had the slit functions measured, as this is a time-consuming process that required the instrument be taken to a special facility specializing in this characterization. The data processing algorithms were developed based on the characteristics of the reference instrument, and consistently applied to the world network. There are still differences in the TOC results of the individual Dobson instruments and stations, especially when compared to other measurement systems, ground-based and satellite-borne. The results of measurements using the possible combinations of wavelengths are also inconsistent. To understand these differences, a method is being developed for quick characterization of the individual Dobson instruments while at the instrument's normal operational site. NASA provided several Avantes AvaSpec-2048x14 Fiber Optic Spectrometers (specifications are compatible with the Dobson instrument spectral characteristics) to ESRL for investigation. We present the results of measurements inside the photomultiplier box of ten Dobson instruments, and a method for determining the slit functions. We show that the results of the new method predict the "real-world" response of one instrument, and produce a more consistent result with the wavelength combinations.

Info	Apair	Cpair	Dpair	AD	CD	Difference based on AD from official	Difference based on CD from official
Official	1.806	0.833	0.374	1.432	0.459		
D102	1.803	0.825	0.373	1.430	0.452	0.1%	1.5%
D080	1.796	0.832	0.381	1.415	0.451	1.2%	1.8%
D040	**1.802**	**0.824**	**0.379**	**1.424**	**0.445**	**0.6%**	**3.0%**
D102	1.804	0.826	0.374	1.430	0.453	0.2%	1.4%
D070	1.799	0.823	0.371	1.427	0.452	0.3%	1.5%
D065	1.805	0.831	0.376	1.429	0.455	0.2%	0.8%
D131	1.796	0.826	0.374	1.422	0.452	0.7%	1.5%
D067	1.806	0.828	0.375	1.431	0.453	0.1%	1.4%
D093	1.804	0.827	0.375	1.429	0.452	0.2%	1.5%
D087	1.802	0.825	0.374	1.428	0.451	0.3%	1.8%
Average	**1.802**	**0.827**	**0.375**	**1.426**	**0.452**	**0.4%**	**1.6%**

Figure 1. Absorption Coefficients for various test instruments determined by use of the Avaspec-2048x14.