A New Data Product for the NOAA Environmental UV-ozone Brewer Network (NEUBrew) Aerosol Optical Depth in the UV Spectral Region

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The Brewer Mark IV spectrophotometer was designed to passively measure the total column ozone using an algorithm specific to its optical geometry. The Brewer makes near-simultaneous measurements of UV irradiance at five separate wavelengths. It performs these measurements through a sun-pointing prism that provides an approximate 2.3 degree field of view. The chosen wavelengths also provide for the retrieval of total column SO2. The Brewer is normally operated in an automated schedule that makes these direct-sun measurements throughout the day, thereby providing narrow field of view irradiance measurements at five UV wavelengths through different slant paths through the atmosphere. These are the exact type of measurements necessary for an aerosol optical thickness or if enough information is available an aerosol optical depth retrieval for one species. In our case, the objective is to retrieve the aerosol optical depth at the five Brewer ozone operational wavelengths, 306.3, 310.1, 313.5, 316.8, and 320.1 nm.

Due to the fact that the Brewer was designed to operate unattended, the data in the direct-sun output files are not raw. They have been corrected for dark count, dead-time, the natural log of the raw signal is taken, the temperature effects on the various neutral density filters, and Rayleigh scattering has been removed. Additionally, the Brewer makes the direct-sun irradiance measurements through a slanted quartz window, which imparts a degree of polarization to the input beam. The magnitude of the S and P polarization is a function of the incident angle to the quartz window, which is dependent on the solar zenith angle. The polarization is not dealt with in ozone retrievals since it is performed using the near simultaneous five irradiance measurements in a relative manner. This works for the ozone retrieval, but does not work for the aerosol optical depth retrievals, because the measurements are made at an individual wavelength over many hours. The time factor changes the incident angle to the quartz window, which in turn changes the throughput, due to polarization effects to the detection electronics.

To achieve the aerosol optical depth retrieval it is first necessary to back out some of the modifications that the Brewer main program applies to the raw data. The Rayleigh effects must first be removed, followed by the temperature corrections. The data are then plotted, the natural log of the adjusted data to the air mass. Perform a linear regression on these data points and extrapolating to zero air mass yields the signal that the Brewer would theoretically measure at the top of the atmosphere. This gives us our calibration factor which is used in the aerosol optical depth retrievals.

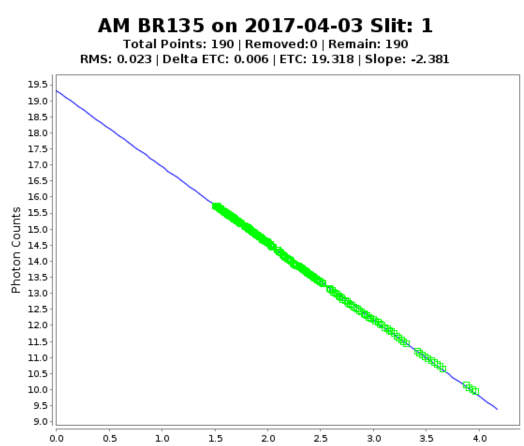

Figure 1. Langley Regression Example