Physikalisch-Meteorologisches Observatorium Davos
World Radiation Center

T3.2: Report on the comparison of Total Column ozone measurements between pandora #120 and brewer #163

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Introduction

TCO from Brewer #163

Measurements of total column ozone are obtained from spectral direct sun irradiance measurements. The total ozone contained in the atmospheric column above the measurement site is then retrieved by applying the beer-lambert law of direct extinction. The reference instruments for total column ozone are Brewer and Dobson spectrophotometers, operated in strictly defined modes of operation. Their calibration and maintenance procedures are homogenised across the whole global network. Their calibration is ultimately traceable to reference instruments. In the case of the Brewer network, the reference is operated and maintained by the Regional Brewer calibration center at Izana, Tenerife (RBCC-E). Brewer #163 is a double monochromator spectroradiometer, operated continuously at PMOD/WRC. It is calibrated annually by a direct comparison with one of the reference Brewers of the RBCC-E Triad. This calibration is performed every second year at PMOD/WRC, and in the alternate year at the INTA site in El Arenosillo. The measurements are quality controlled and submitted to the EUBREWNET database.

The estimated uncertainty of TCO from Brewer measurements was determined in the EMRP ATMOZ project (http://projects.pmodwrc.ch/atmoz/) and is of the order of 1.5% (e.g. the uncertainty of a TCO measurement of 300 DU, is 4.5 DU).

TCO from Pandora #120

The Total column ozone from Pandora #120 is retrieved from the official Pandonia web-site at http://data.pandonia.net/PMOD/Pandora120/L3b/. The TCO is calculated using the operational Pandonia software and is used as is.

Ozone sondes

The ozone profiles are obtained from ozone sondes launched at Payerne, Switzerland, distant by approximately 300 km from Davos. The ozone sondes are launched 2-3 times per week and are used to retrieve the ozone vertical profile and the ozone effective temperature. Since most of the ozone resides in the stratosphere above about 18 km and responds to large-scale transport processes, it is assumed that the ozone profile obtained above Payerne and the TCO measurement at PMOD/WRC, Davos are strongly correlated. Nevertheless, possible discrepancies might occur in specific conditions with strong stratospheric winds. However it is assumed that such events are averaged out over a long time scale as is analysed here.

Comparison of TCO between P#120 and Br#163

Measurements of TCO are obtained several times per day for each instrument. The most reliable TCO retrievals require clear sky conditions so that the Beer-lambert law can be used to retrieve the atmospheric extinction from direct solar irradiance measurements. This effectively limits the TCO retrievals to the periods when clear sky conditions are available at Davos. As an example, TCO measurements for 19 February 2017 are shown in Figure 1.

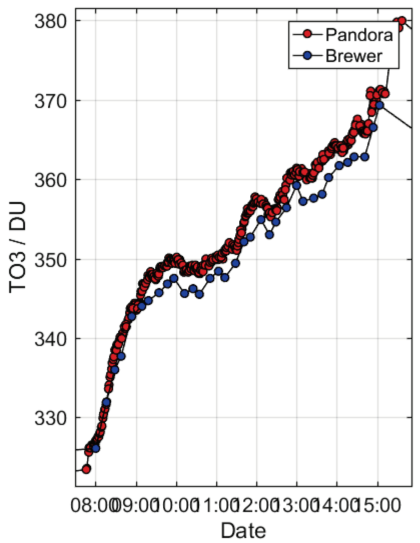

Figure 1 TCO measurements on 19 February 2017 at PMOD/WRC, Davos between Br#163 (blue), and P#120 (red).

As can be seen in the Figure, the TCO varied by nearly 40 DU during this day, gradually increasing from 330 DU to 370 DU. Both instruments track the TCO variability very well, with only slight differences between the instruments which are within the combined uncertainties of Br#163 and P#120.

The whole dataset of P#120 and Br#163 is shown in Figure 2.

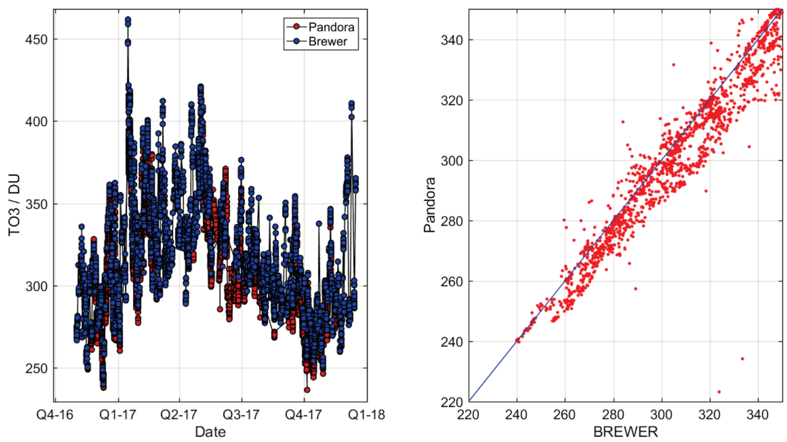

Figure 2 Left figure: TCO from Br#163 and P#120. Right figure: Scatter plot of TCO measurements between Br#163 (x-axis) and P#120 (y-axis).

As can be seen in the right figure TCO measurements scatter between both instruments. The largest differences are of the order of 20 DU. These differences were analysed with respect to the ozone slant column (TCO*airmass) and shown in Figure 3 below:

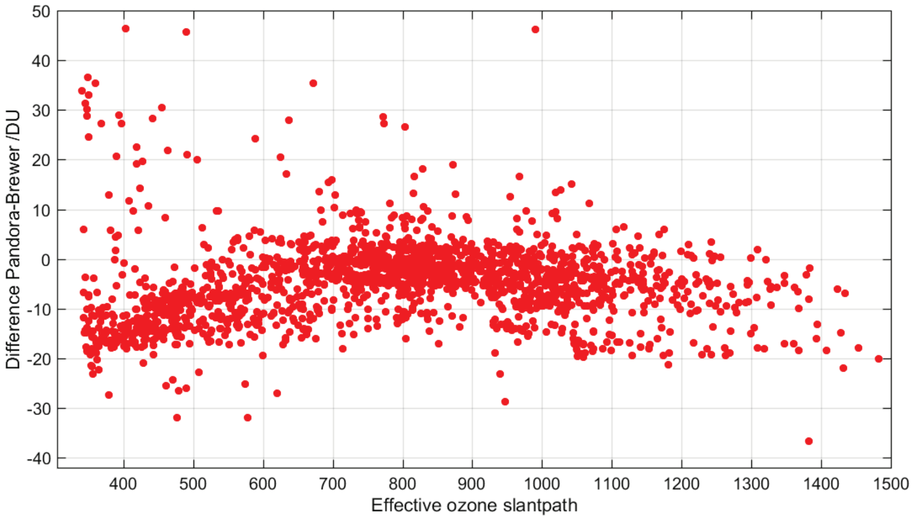

Figure 3 TCO differences between P#120 and Br#163 with respect to ozone slant column (OSC).

As can be seen in the figure, there is a slight dependence, with differences of -10 to -20 DU at small OSC, and larger scatter at large OSC, but without a clear dependence, especially at high OSC.

When the data is analysed with respect to ozone effective temperature, obtained from the ozone sonde measurements, a clear dependence is observed, as shown in Figure 4.

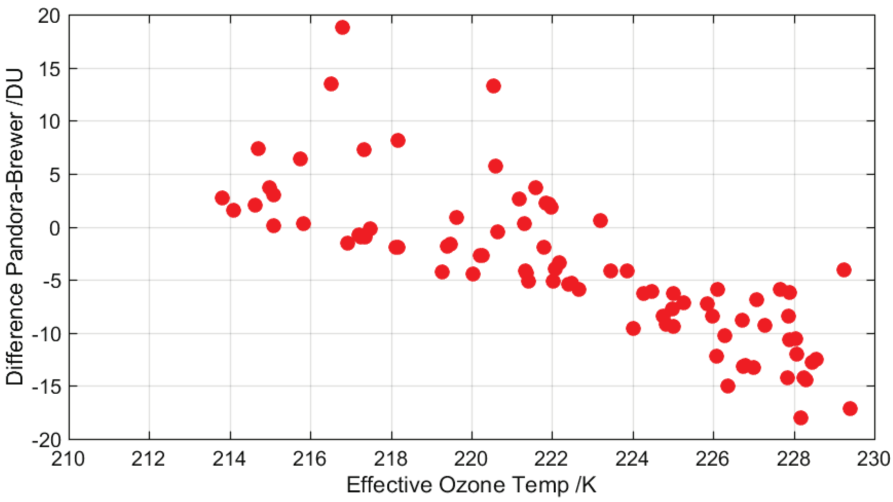

Figure 4 TCO difference between P#120 and Br#163 with respect to effective ozone temperature.

As seen in Figure 4, there is a clear dependence with the effective ozone temperature obtained from the ozone sonde data. At low temperatures, both instruments agree, while at warmer temperatures around 230 K, differences of up to 20 DU are seen, with P#120 measuring lower than Br#163.

Conclusion and outlook

The measurements of P#120 and Br#163 will be continued in phase 3 of ATLAS. The discrepancies in TCO observed between both instruments have been discussed with Pandonia and a new algorithm is in development. Once this algorithm is available, the whole dataset will be re-calculated and analysed with respect to the measurements of Br#163.

Acknowledgments

The support by Pandonia personnel for the smooth operation of P#120 was extremely helpful. The ozone sonde information was obtained from Meteoswiss.