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Accuracy, precision, and temperature dependence of Pandora total ozone measurements estimated from a comparison with the Brewer triad in Toronto

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The Brewer reference triad was established by Environment Canada at Toronto in the 1980s. The triad is used to calibrate Brewer instruments around the world, ensuring high quality total ozone column measurements. To reduce stray light, the double Brewer was introduced in 1992, and a new reference triad of double Brewers is also presently operational at Toronto. Since 2013, Environment Canada has deployed two Pandora spectrometers co-located with the old and new Brewer triads, making it possible to study the performance of these three generations of ozone monitoring instruments. The statistical analysis of column ozone data records from these Brewer and Pandora instruments indicates that the random uncertainty for Brewer instruments is below 0.6 %, while that for Pandora instruments is below 0.4 %, . However, there is a seasonal difference (0.7-1.3%) and 2.7-3.2% constant bias between the Pandora and Brewer instruments that are likely related to the temperature dependence caused by the Pandora's ozone retrieval algorithm. A statistical model was developed to remove these seasonal differences. It was based on the daily temperature profiles from ECMWF Interim data over Toronto and ozone records from the six instruments of the Brewer reference triads. When the statistical model was used to correct Pandora data, the seasonal difference was reduced to ~0.2-0.4%.