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Intercomparison of long-term ground-based tropospheric ozone measurements

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Ground-based observations are indispensable for the long-term monitoring of atmospheric constituents. In this work, we take advantage of multiple collocated instruments to analyze potential biases and drifts in ground-based ozone observations, within the context of the HEGIFTOM (Harmonization and Evaluation of Ground-based Instruments for Free Tropospheric Ozone Measurements) working group in the Tropospheric Ozone Assessment Report, Phase II (TOAR-II). This work is performed at Lauder (New Zealand), Boulder (Colorado), and Mauna Loa (Hawaii) where comparisons are made between Fourier Transform Infrared (FTIR) spectroscopy, Dobson Umkehr, and ozonesonde observations. The validation is performed with respect to FTIR as arbitrary reference, while considering the differences between the a priori profile information for the techniques that employ these as well as accounting for the different vertical resolution of each measurement technique. Such intercomparison is done for a handful discrete altitude partial columns, defined to have independent pieces of information also in the case of the low vertical resolution techniques (FTIR and Umkehr). This leads to 4 independent vertical layers to be compared, including one in the troposphere where ozone plays an important role as a greenhouse gas and as a risk to human health. In this tropospheric layer we compare the FTIR, Dobson Umkehr and ozonesonde techniques and derive a consistent bias from the FTIR data of about 5%, which we attribute in part to the assumed spectroscopy. Fitting the time series of the relative measurement differences using multiple linear regression, we obtain a linear trend, which quantifies the drift between pairs of techniques. Within the uncertainties, we find no significant drift between FTIR and Umkehr or ozone sonde data in the troposphere.