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Ozone correlation lengths and measurement uncertainties from analysis of historical ozonesonde data in North America and Europe

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A spatial and temporal correlation analysis is performed on the WOUDC (World Ozone Data Centre) ozonesonde data for 13 mid-latitude stations in North America and Europe. The historical data with as much as 40 years of records since the 1960s are available for some stations. After removal of periodic variations, the data of ozone partial pressures at each altitude from 0 to 35 km are utilized to calculate the spatial correlation coefficients between each pair of stations and the temporal auto-correlation coefficients of each individual station. The spatial correlation coefficient decreases with increasing station distance, and the temporal auto-correlation drops rapidly with time lag; both coefficients can be fitted to an exponential correlation function. The horizontal distance for the correlation coefficient to decrease by 1/e is 1000-2000 km in the stratosphere with a peak at around 22 km altitude, and is 500-1000 km in the troposphere. The time scale of the auto-correlation is 2-4 days in the troposphere, but longer in the stratosphere at 3-6 days. The extrapolation of the correlation function to zero distance or zero time lag gives an estimate of the inherent uncertainty of the ozonesonde measurements. The uncertainty is found to be less than 7% for 20-30 km altitude in the stratosphere, about 15% in the troposphere, and to have a larger value near the tropopause and at the surface. These results are broadly consistent with those from the recent JOSIE and BESOS field experiments. The uncertainty decreases by few percent for altitudes higher than 20 km if the ozonesonde profiles are normalized with respect to ground-based total ozone measurements. A similar correlation analysis on radiosonde temperature data gives an uncertainty of 2 K, which is comparable to

other estimates of the radiosonde standard error.