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A vertically resolved, global, gap-free ozone database for assessing or constraining global climate model simulations

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High vertical resolution ozone measurements from eight different satellite-based instruments have been merged with data from the global ozonesonde network to calculate monthly mean ozone values in 5 degree latitude zones. These 'Tier 0' data are provided on 70 altitude levels (1 to 70 km) and on 70 pressure levels spaced approximately 1 km apart (878.4 hPa to 0.046 hPa). A least squares regression model, which expands the fit coefficients in Legendre polynomials to account for latitudinal structure and in Fourier series to account for seasonality, is fitted to the Tier 0 ozone number densities and ozone mixing ratios at each level. Regression model fit coefficient patterns (latitude/season fields) from the Nth level serve as an initial guess for the fit at the N 1th level. The initial guess field for the first fit level (20 km/58.2 hPa) was derived by applying the regression model to total column ozone fields. Perturbations away from the initial guess are captured through the Legendre and Fourier expansions. By applying a single fit at each level, and using the approach of allowing the regression fits to change only slightly from one level to the next, the regression is less sensitive to measurement anomalies at individual stations or from individual satellite-based instruments. Particular attention is paid to ensuring that the low ozone abundances in the polar regions are captured. By summing different combinations of contributions of different regression model basis functions, four different `Tier 1' databases (denoted Tier 1.1 to 1.4) have been compiled for different intended uses. These databases, extending from 1978 to 2006 and spanning the ozone field from the surface to 70 km with no missing data, are suitable for assessing ozone fields from chemistry-climate model simulations or for providing the ozone boundary conditions for global climate model simulations that do not treat stratospheric chemistry interactively.