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Variability and trends in total and vertically resolved stratospheric ozone based on the CATO ozone data set

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Abstract. Trends in ozone columns and vertical distributions were calculated for the period 1979–2004 based on the ozone data set CATO (Candidoz Assimilated Three-dimensional Ozone) using a multiple linear regression model. CATO has been reconstructed from TOMS, GOME and SBUV total column ozone observations in an equivalent latitude and potential temperature framework and offers a pole to pole coverage of the stratosphere on 15 potential temperature levels. The regression model includes explanatory variables describing the influence of the quasi-biennial oscillation (QBO), volcanic eruptions, the solar cycle, the Brewer-Dobson circulation, Arctic ozone depletion, and the increase in stratospheric chlorine. The effects of displacements of the polar vortex and jet streams due to planetary waves, which may significantly affect trends at a given geographical latitude, are eliminated in the equivalent latitude framework. The QBO shows a strong signal throughout most of the lower stratosphere with peak amplitudes in the tropics of the order of 10–20% (peak to valley). The eruption of Pinatubo led to annual mean ozone reductions of 15–25% between the tropopause and 23 km in northern mid-latitudes and to similar percentage changes in the southern hemisphere but concentrated at altitudes below 17 km. Stratospheric ozone is elevated over a broad latitude range by up to 5% during solar maximum compared to solar minimum, the largest increase being observed around 30 km. This is at a lower altitude than reported previously, and no negative signal is found in the tropical lower stratosphere. The Brewer-Dobson circulation shows a dominant contribution to interannual variability at both high and low latitudes and accounts for some of the ozone increase seen in the northern hemisphere since the mid-1990s. Arctic ozone depletion significantly affects the high northern latitudes between January and March and extends its influence to the mid-latitudes during later months. The vertical distribution of the ozone trend shows distinct negative trends at about 18 km in the lower stratosphere with largest declines over the poles, and above 35 km in the upper stratosphere. A narrow band of large negative trends extends into the tropical lower stratosphere. Assuming that the observed negative trend before 1995 continued to 2004 cannot explain the ozone changes since 1996. A model accounting for recent changes in equivalent effective stratospheric chlorine, aerosols and

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Eliassen-Palm flux, on the other hand, closely tracks ozone changes since 1995.

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