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Interannual variations of total ozone at northern midlatitudes correlated with stratospheric EP flux and potential vorticity

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At northern midlatitudes over the 1979 - 2002 time period, column ozone trends are observed to have maximum negative amplitudes in February and March. Here, the portion of the observed ozone interannual variability and trends during these months that can be attributed to two specific dynamical transport processes is estimated using correlative and regression methods. In approximate agreement with a recent independent study, 18 to 25\% of the observed maximum negative trend is estimated to be due to long-term changes in the diabatic (Brewer-Dobson) circulation driven by global-scale changes in planetary wave (EP flux) forcing. In addition, 27 to 31\% of the observed maximum midlatitude trend during these months is estimated to be due to long-term changes in local non-linear synoptic wave forcing as deduced from correlated interannual variations of zonal mean ozone and Ertel's potential vorticity. Like long-term decreases in the Brewer-Dobson circulation, this trend component reflects an overall net increase in the polar vortex strength, which is associated with increased numbers of anticyclonic, poleward breaking Rossby waves at northern midlatitudes. Together, these components can explain approximately 50\% of the observed maximum column ozone trend and interannual variance at northern midlatitudes in February and March. The combined empirical model also approximately simulates a leveling off or slight increase in column ozone anomalies that has been observed for some months and latitudes since the mid-1990's.