Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 5, 1655-1663, 2005
www.atmos-chem-phys.net/5/1655/2005/

Fall vortex ozone as a predictor of springtime total ozone at high northern latitudes

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Abstract. Understanding the impact of atmospheric dynamical variability on observed changes in stratospheric O_3 is a key to understanding how O_3 will change with future climate dynamics and trace gas abundances. In this paper we examine the linkage between interannual variability in total column O_3 at northern high latitudes in March and lower-to-mid stratospheric vortex O_3 in the prior November. We find that these two quantities are significantly correlated in the years available from TOMS, SBUV, and POAM data (1978-2004). Additionally, we find that the increase in March O_3 variability from the 1980s to years post-1990 is also seen in the November vortex O_3, i.e., interannual variability in both quantities is much larger in the later years. The cause of this correlation is not clear, however. Interannual variations in March total O_3 are known to correspond closely with variations in winter stratospheric wave driving consistent with the effects of varying residual circulation, temperature, and chemical loss. Variation in November vortex O_3 may also depend on dynamical wave activity, but the dynamics in fall are less variable than in winter and spring. We do not find significant correlations of dynamic indicators for November such as temperature, heat flux, or polar average total O_3 with the November vortex O_3, nor with dynamical indicators later in winter and spring that might lead to a connection to March. We discuss several potential hypotheses for the observed correlation but do not find strong evidence for any considered mechanism. We present the observations as a phenomenon whose understanding may improve our ability to predict the dependence of O_3 on changing dynamics and chemistry.

Final Revised Paper (PDF, 446 KB) Discussion Paper (ACPD)

Citation: Kawa, S. R., Newman, P. A., Stolarski, R. S., and Bevilacqua, R. M.: Fall vortex ozone as a predictor of springtime total ozone at high northern latitudes, Atmos. Chem. Phys., 5, 1655-1663, 2005. Bibtex EndNote Reference Manager