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A three-dimensional model study of long-term mid-high latitude lower stratosphere ozone changes

M. P. Chipperfield
School of the Environment, University of Leeds, Leeds, UK

Abstract. We have used a 3D off-line chemical transport model (CTM) to study the causes of the observed changes in ozone in the mid-high latitude lower stratosphere from 1979-1998. The model was forced by European Centre for Medium Range Weather Forecasts (ECMWF) analyses and contains a detailed chemistry scheme. A series of model runs were performed at a horizontal resolution of 7.5°x7.5° and covered the domain from about 12 km to 30 km. The basic model performs well in reproducing the decadal evolution of the springtime depletion of ozone in the northern hemisphere (NH) and southern hemisphere (SH) high latitudes in the 1980s and early 1990s. After about 1994 the modelled interannual variability does not match the observations as well, which is probably due in part to changes in the operational ECMWF analyses - which places limits on using this dataset to diagnose dynamical trends. For mid-latitudes (35°-60°) the basic model reproduces the observed column ozone decreases from 1980 until the early 1990s. Model experiments show that the halogen trends appear to dominate this modelled decrease and of this around 30-50% is due to high-latitude processing on polar stratospheric clouds (PSCs). Dynamically induced ozone variations in the model correlate with observations over the timescale of a few years. Large discrepancies between the modelled and observed variations in the mid 1980s and mid 1990s can be largely resolved by assuming that the 11-year solar cycle (not explicitly included in the 3D model) causes a 2% (min-max) change in mid-latitude column ozone.

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