Geophysical Research Abstracts,
Vol. 11, EGU2009-9672, 2009
EGU General Assembly 2009

Numerical simulation of ozone loss in the Antarctic winters 2005-2008: Comparison with MLS measurements

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The ozone loss in the recent Antarctic winters were high enough to pause a lag in the recovery phase of stratospheric ozone above this continent. We quantitatively examine the extent of ozone loss variability during 2005-2008 with simulations from a high resolution chemical transport model, MIMOSA-CHIM. The simulated results are cross-checked with the observed loss from Microwave Limb Sounder (MLS) satellite sensor data. This study uses the vortex averaged data at the potential temperature level 475 K from both MIMOSA and MLS to estimate the ozone loss by transport method. Minimum temperatures calculated from ECMWF analyzes over 50-90°S at 475 K are coldest in 2008 during June-July and in 2006 during September-November. In general, Antarctic winters experience NAT temperatures from mid-May to mid-October and ICE temperatures from June to September. Due to the saturation of chemical ozone loss, the year-to-year difference in temperatures do not have a large effect. The estimated cumulative ozone loss from MIMOSA-CHIM at 475 K is 3.2 in 2005, 2.9 in 2006, 2.8 in 2007 and 2.0 ppm in 2008. The measured cumulative loss in the respective years also show similar values: respectively 3.3, 3.2, 2.8 and 2.2 ppm in 2005, 2006, 2007 and 2008. Both data sets show the same loss trend, as the cumulative loss is highest in 2005 followed by 2006 and the lowest in 2008, and are in accord with the chlorine activation and denitrification found in the respective winters. The simulations in 2008 lack adequate diabatic descent as assessed from tracer simulations in comparison with measurements. This eventually produced relatively lower values for ozone loss in 2008 in both data sets even though the observed chlorine activation was found to be similar to previous winters.