3D CTM Study of Polar Ozone Loss During 1999-2003

Wuhu Feng and Martyn Chipperfield
School of the Environment, University of Leeds, Leeds, LS2 9JT, U.K
Howard Roscoe
British Antarctic Survey, Madingley Road, Cambridge, CB3 0ET, U.K.
fengwh@env.leeds.ac.uk; martyn@env.leeds.ac.uk; HKRO@bas.ac.uk

1. Introduction

It is an important issue to quantify and understand the evaluation of the polar ozone loss to study the Antarctic ozone hole and climate change. Here we show how well SLIMCAT does in a successful simulation of special events, such as Antarctic split ozone hole of 2002 and Arctic ozone minihole in 2002/03. Modelled ozone loss rate and its catalytic cycle reactions responsible for ozone loss are also presented.

2. SLIMCAT 3D-CTM

• 3D offline chemical transport model (Chipperfield, 1999).
web: http://www.env.leeds.ac.uk/slimcat

3. Comparison with Observations

3.1 Comparison with TOMS data during SSW and spilt of ozone hole of 2002

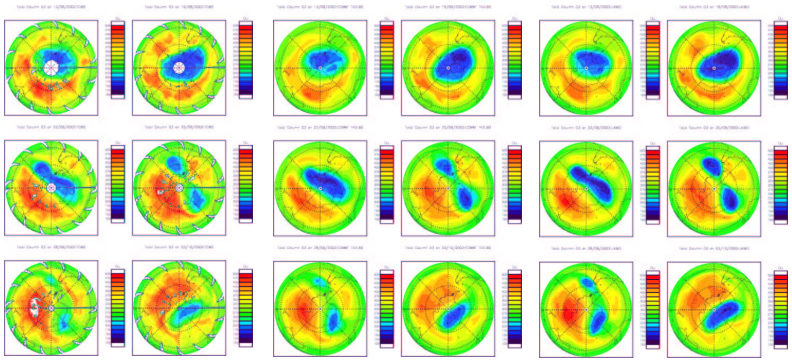

Fig 1 Total column Ozone (DU) for Sep.13, 19, 22, 25 and Oct.3, 2002 observed by TOMS.

Fig 2. As Fig 1. But for SLIMCAT forced by ECMWF analyses.

Fig 3. As Fig.2, But for SLIMCAT forced by UKMO analyses

3.2 Comparison with GOME data during 2002/03 Arctic winter minihole event

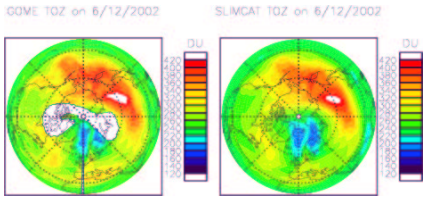

Fig 4. Comparison of SLIMCAT modelled total column ozone on Dec. 6, 2002 with GOME data

4. Modelled O_3 loss rate

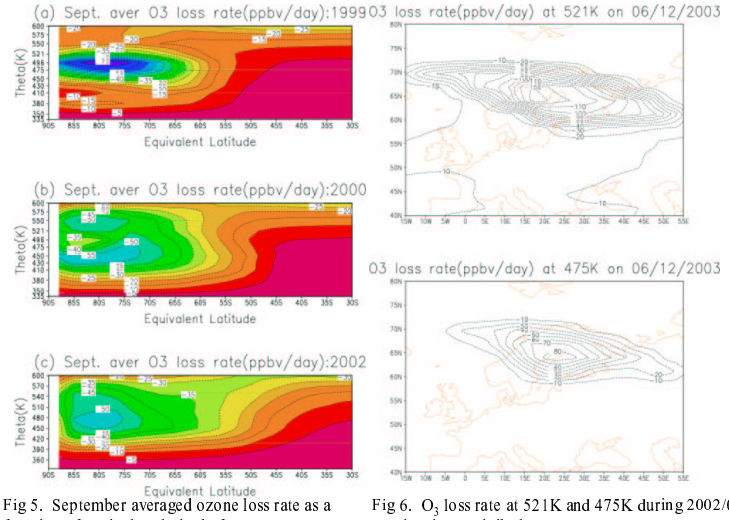

Fig 5. September averaged ozone loss rate as a function of equivalent latitude for 1999, 2000, 2002

Fig 6. O_3 loss rate at 521K and 475K during 2002/03 Arctic winter minihole event on December 6, 2002

5. Different Polar ozone loss

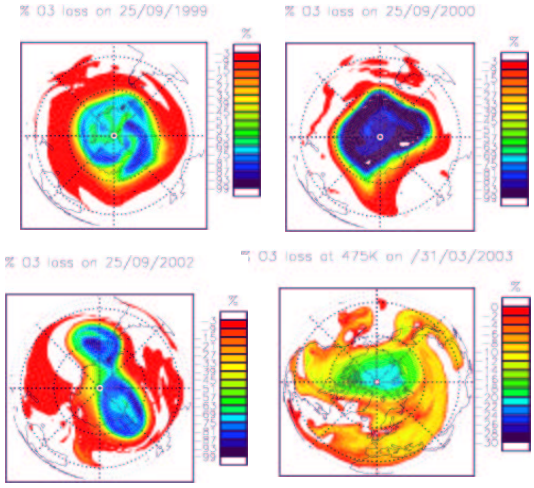

Fig 7. Chemical O_3 loss for the SH under different years and for the NH a) 1999; b) 2000; c) 2002, d) 2002/03 Arctic winter

6. Contribution of catalytic cycle to O_3 loss

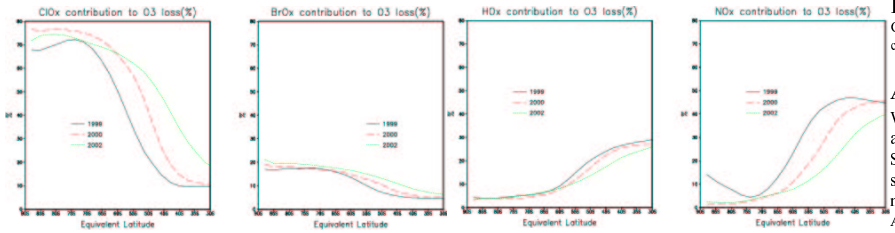

Fig 8. Calculated ozone destruction (%) caused by four catalytic cycles(ClO_x, BrO_x, HO_x and NO_x) in September in the lower stratosphere (335K-600K)

7. Conclusion

- SLIMCAT successfully produce a good simulation of the evolution of the 2002 vortex and its break up based on ozone comparisons with TOMS column data.
- SLIMCAT forced by ECMWF successfully reproduce the 2002/03 Arctic winter O_3 minihole.
- The modelled chemical ozone loss show:

a) Largest ozone depletion occurs in the lower stratosphere
b) Modelled September averaged ozone loss rate as a function of equivalent latitude is about 50-75ppbv/day in the Antarctic winter plays an important role in the polar region
c) Chemical ozone loss rate is smaller than 'normal winter' during the stratospheric sudden warming in 2002
d) Fast chemical ozone loss occurs around polar vortex during 2002/03 Arctic winter deep minihole event
e) Polar ozone loss in the Southern Hemisphere is different to that in the Northern Hemisphere.

References

Chipperfield, M. P. Multiannual Simulations with a three-dimensional chemical transport model, J. Geophys. Res., **104**, 1781-1805, 1999.

Acknowledgments.

We are very grateful to NASA for the use of the TOMS data and to KNMI for the use of GOME data. We thank David Stewart and Jeff Evans for useful discussion. This work was supported by the U.K. NERC UTLS OZONE Programme. The meteorological analyses were obtained via the British Atmospheric Data Centre.