Model Descriptions and Experimental Design

Abstract:
In this study two model systems are assessed on how they represent total ozone variability due to the influence of the North Atlantic Oscillation (NAO). The main focus will be on the northern hemisphere winter and especially on January. A brief comparison with TOMS data will also be included.

One model is the chemistry-transport model (CTM) SLIMCAT, which is driven by meteorological observations and therefore includes meteorological trends in the atmospheric circulation. The other is the Unified Model (UM) of the UK Met. Office, which is a comprehensive general circulation model forced by prescribed sea-surface temperatures (SSTs) only. In both models a simplified ozone chemistry (Cariolle and Déqué, 1986) is used with a parameterization of polar ozone loss, but with no allowance for changing chlorine or aerosol levels on the chemistry.

Suitable indices of the NAO will be used in the diagnostic of the two model systems and the correlation between these indices and the total ozone as derived by the models will be compared. Composite ozone maps will be constructed for high and low index phases and will be also compared with TOMS observations.

Unified Model:
- horizontal resolution: 90x71 grid points (3.75° in longitude and 2.5° in latitude)
- vertical resolution: 55 levels (L55), z=1.3 km, model top in 0.1 hPa (65 km)
- timestep: 15 minutes (900 s)
- tracer transport: Roe flux redistribution method with choice of limiters; Superbee or Van Leer (Cullen and Burston, 1997)
- gravity wave drag: based on Palmer et al. 1986
- radiation: 2-stream radiation code; 6 bands SW, 8 bands LW; every 3 hours (Edwards and Shigo, 1996)
- ozone: Cariolle parameterization with an additional “cold tracer” (passive/interactive)
- climatological SSTs (AMIP II, monthly mean data)

SLIMCAT:
- horizontal resolution: T21, 64x32 grid points (5.6° in longitude and 5.6° in latitude)
- vertical resolution: 11 isentropic levels (L11); z=0.5-2.5 km, model top in 1030 K (8 hPa, 32 km), model bottom in 345 K (250 hPa, 10 km)
- timestep: 1 hour (3600 s)
- tracer transport: Second-order moments advection driven by ECMWF analysis (Prather, 1986; Gibson, 1997)
- gravity wave drag: calculation of heating rates for the vertical transport; 2 dummy levels above and below model domain; uses climatological ozone (Shine, 1987; Shine and Rickaby, 1989)
- ozone: Cariolle parameterization with an additional “cold tracer”

Further work: How does the NAO variability affect the trends in total ozone?