Geophysical Research Abstracts, Vol. 8, 03328, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03328

Box model studies of radical levels during the CHABLIS campaign at Halley Base, Antarctica

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The Chemistry of the Antarctic Boundary Layer and the Interface with Snow (CHABLIS) campaign, involving the British Antarctic Survey together with the Universities of Leeds, York, East Anglia, Bristol and Imperial College, took place at Halley Base, Antarctica from January 2004 until February 2005. In addition to the year-round monitoring, the campaign included a summer intensive focussing upon oxidant chemistry, featuring measurements of OH and HO_2 radicals (via LIF / FAGE), total peroxy radicals (PERCA) in addition to the long-term observations of NOx, VOCs, peroxides, HONO, HCHO and halogen species.

Measurements of reactive species, especially HO_x (OH and HO_2) obtained during the summer period (January - February 2005) of the CHABLIS campaign have been analysed using box model simulations. The model, based upon the Master Chemical Mechanism (version 3.1), was constrained to observed meteorological parameters, photolysis rates, and concentrations of long-lived species such as VOCs (up to C_4 species), O_3, CO and NO_x. The basic simulations overestimate the observed OH and HO_2 levels. Comparison with other reactive species ($e.g.$ HONO, total peroxy radicals RO_2) is also discussed.

Simulations in which the model was forced to the observed HO_xlevels yield the local gas-phase chemical contribution to the observed levels of intermediate species such as HCHO and H_2O_2, and hence constrain their net production/loss from the snowpack (and entrainment / loss to the free troposphere). A simplified version of the model based upon CH_4 and CO-only chemistry has been used to investigate the potential

impact of the halogen oxides IO and BrO upon the HO_x levels, which are shown to substantially improve the model-measurement agreement.