Atmos. Chem. Phys. Discuss., 11, C5236–C5238, 2011
www.atmos-chem-phys-discuss.net/11/C5236/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of hydroxyl and peroxy radicals and the impact of BrO at Summit, Greenland in 2007 and 2008" *by* J. Liao et al.

Anonymous Referee #2

Received and published: 21 June 2011

This paper presents measurements of OH and HO_2 + RO_2 at Summit, Greenland during Spring 2007 and Summer 2008. The observations are compared to a simple 0-D model in order to evaluate the impact of halogen chemistry on the modeled radical concentrations. The authors find that the base model reasonably reproduces the observed concentrations of HO_2 + RO_2, but tends to underpredict the observed OH concentrations, especially during 2008. Including bromine chemistry in their model does tend to improve the modeled OH concentrations, suggesting that halogen chemistry impacted the radical chemistry at this site. The paper is suitable for publication in ACP after the authors have considered the following comments in their revised manuscript.

1) Figure 5 shows the model-measurement correlations for the base model constrained by the observed concentrations of HONO. Comparing this Figure to the model-measurement correlations for the base model (Figure 4), it appears that constraining the model to the observed HONO concentrations improves the model measurement agreement for OH for both 2007 and 2008 (Base model slopes for OH of 0.72 and 0.54 for 2007 and 2008, respectively, compared to slopes of 0.92 and 0.72 for the HONO constrained model). However, the discussion in section 4.1.2 states that "constraining HONO in the model does not improve the correlation between predictions and observations significantly. . ." It appears that one basis for this conclusion is the fact that constraining the model to the HONO observations “did not improve the ratio of OH to HO_2 + RO_2 relative to the observations.” This is not clear from the information presented. This issue should be clarified and addressed in more detail in the revised manuscript, including a presentation of the measured and modeled HO_2 + RO_2:OH ratios.

2) Similarly, it is not clear from Figure 6 that inclusion of bromine chemistry significantly improves the model measurement agreement, as the correlation slopes for OH for the base model with CIMS BrO are only slightly better than the base model alone (0.78 and 0.56 versus 0.72 and 0.54 for 2007 and 2008 respectively), while the base model with LPDOAS BrO show slightly worse slopes for OH (0.72 and 0.50). The discussion in section 4.1.3 states that the modeled OH increased 10-12% when including CIMS BrO. Again, the apparent discrepancy between the data shown in the Figure and the discussion needs to be clarified.

3) One of the main conclusions in the paper is that the reasonable agreement between the measurement and model confirms our understanding of the dominant HOx sources and sinks, even though the base model appears to significantly underestimate the measured concentrations of OH based on the slopes in Figure 4. The basis for this conclusion is not clear. In section 4.1.1, the authors state that the agreement between the measured and modeled HO_2 + RO_2:OH ratio "indicates that the BM model captures the dominant sources and sinks of HOx. . ." I would argue that this agreement suggests

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that the model captures the propagation of radicals rather than the major sources and sinks. The conclusion about the ability of the model to capture the dominant sources and sinks of HOx may be based on the agreement between the modeled and measured average values shown in Figure 7 (which do agree to within the error of the measurement and the uncertainty in the model), and perhaps more importantly the significant improvement in the model-measurement agreement when the high RGM periods are excluded (Figure 8). The basis for this conclusion should be clarified in the revised manuscript. The manuscript would also benefit from a brief discussion of the radical budget for the base model, including the rates of radical production and propagation.

4) Minor point – the authors should take care to define the acronyms at the beginning of the manuscript, such as ODE (Ozone Depletion Episode I assume), GEM, RGM, etc.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 12725, 2011.