Atmos. Chem. Phys. Discuss., 3, S1189–S1192, 2003
www.atmos-chem-phys.org/acpd/3/S1189/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity studies of the recent new data on O(^{1}D) quantum yields in O_3 Hartley band photolysis in the stratosphere" *by* N. Taniguchi et al.

N. Taniguchi et al.

Received and published: 7 August 2003

Reply on the comments of referee #1

On General Comments:

It is likely to concentrate our discussion in this study on the stratospheric chemistry since our results have an impact mostly on the chemistry in the upper stratosphere. We have described the ozone deficit problem in the introduction of our revised manuscript and removed the discussions about tropospheric chemistry from our original manuscript, as pointed out by the referee comments. In addition, we have included more detail information about the model and the conditions for the calculations in the revised paper.

On Specific Comments:

In our original manuscript, we studied the impact of the "new experimental data" of O(^1D) quantum yield on stratospheric chemistry through a comparison of the atmospheric model calculations on the bases of the "new experimental data" and JPL-2000 recommendations. As noticed by a reviewer, a new edition of NASA/JPL-2003 evaluations, which includes revision of O(^1D) quantum yield values from O_3 photolysis, has been released after submitting our original paper. The O(^1D) quantum yields from O_3 photolysis for $\lambda < 306$ nm are recommended to be 0.95 in JPL-2000 but to be 0.90 in the latest JPL-2003. We calculated the change of the O_3 concentrations between the model runs with the JPL-2003 and the JPL-2000 recommendations. The result shows little difference (< 0.14%) from the original calculations based on the "new experimental data" and JPL-2000 values, because the latest JPL-2003 recommendations are in good agreement with the experimental results of Taniguchi et al.(2000) and Takahashi et al.(2002) which were presented as "new experimental data" in the original manuscript. Thus we need essentially no substantial change in the discussion about our model results in the original manuscript. We added a comment on this in the revised manuscript (page 8).

The 1-D model employed in this study are originally prepared by Dr. Susan Solomon (NOAA Aeronomy Lab.) and most part of schemes in the model are the same as those of the Garcia and Solomon (G-S) 2-D model: This 1-D model calculated diurnal averaged values of photolysis rates and therefore diurnal averaged mixing ratios of chemical species (by using the family method) for a specific altitude and season in mid-latitude in the northern hemisphere, by using the same formulations as those of G-S model. However, there is large difference in parameterizations of the effect of dynamics between the 1-D model which includes the effect of vertical diffusion and the G-S 2-D model which considers the effect of meridional transport. For the vertical eddy diffusion coefficient in the 1-D model, reference is included in the revised text. The incident solar actinic fluxes specified at the top of atmosphere are taken from World

ACPD

3, S1189–S1192, 2003

Meteorological Organization workshop report (1985) and their atmospheric attenuation is calculated in the model. Kinetic data of rate constants and absorption cross sections are taken from NASA/JPL-2000 recommendations (Sander et al., 2000). Initial values of chemical species are taken from reference values in March at 30° N from Brasseur et al. (1999). The model results of vertical distributions of the chemical species and photolysis rates calculated in the 1-D model used in our study are approximately in good agreement with model results of vertical distributions presented in JPL-1997 and Brasseur et al. (1999) in the same conditions of latitude, altitude, and season in the northern hemisphere. This means that all the chemical reactions related to ozone chemistry are reasonably represented in our 1-D model and thus the model is suitable for assessing the impact of new O(^1D) quantum yield data on stratospheric chemistry.

In regard to the referee comments about initial values used in the model, the mixing ratios of chemical species are initialized by using reference values reported by Brasseur et al. (1999) as the typical values for 30° N in March, in which mixing ratios of Cl_y are corresponded to be 0.7, 2.5, 3.2, and 3.3 ppb at 20, 30, 40, and 50 km respectively, and are in good agreement with WMO (1999) report. Moreover, we performed sensitivity study to evaluate the impact of initial mixing ratio of Cl_y on our model results. In original manuscript, we showed the relative changes in the chemical concentrations alculated on the bases of the "new experimental data" and the JPL-2000 recommendations of O(^1D) quantum yields by using Cl_y initial mixing ratios from Brasseur et al. (1999). In a similar method, we calculated the relative changes in the chemical concentrations calculated on the bases of the "new experimental data" and the JPL-2000 recommendations by using the initial mixing ratios ten times as large as those of Brasseur et al. (1999). We found that there is no serious difference $(\pm 0.1\%)$ between the relative changes calculated with Cl_y initial mixing ratios of Brasseur et al. (1999) and the relative changes with the initial mixing ratios ten times larger than Brasseur et al. (1999). These relative changes in the chemical concentrations of all 40 species included in our model (Table 1) are respectively calculated on the bases of the "new experimental data" and the JPL-2000 recommendations. In this way, we also found

ACPD

3, S1189–S1192, 2003

that such changes in the initial mixing ratios of Cl_y as demonstrated in this sensitivity study are not likely to affect substantial influence on the evaluations of relative changes in chemical concentrations of O_3, NO_x, HO_x, and ClO_x as shown in Figure 6.

On Some Further Detailed comments:

All technical corrections recommended by the reviewer are now included into the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2331, 2003.