

Interactive comment on “Diurnal variation of stratospheric HOCl, ClO and HO₂ at the equator: comparison of 1-D model calculations with measurements of satellite instruments” by M. Khosravi et al.

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In support of a decision on the manuscript, an additional referee was called for the revised paper. Below his review is enclosed:

Review of the revised version of ACP paper entitled

Diurnal variation of stratospheric and mesospheric HOCl, ClO and HO₂ at the equator: comparison of 1-D model calculations with measurements of satellite

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instruments

by M. Khosravi et al.

General comments:

This is a generally well written study on observed and modeled diurnal variations of stratospheric and lower mesospheric Cl and HO_x compounds. The material presented is interesting, comprehensive and novel in several ways. I don't agree with the main criticism of the 2 reviewer's of the last version of the paper, i.e. that the manuscript presents little new results. The diurnal cycles of HOCl, ClO and HO₂ may have been investigated in a few earlier studies, but the number of studies is very limited. With SMILES a comprehensive new data set has become available that covers the entire diurnal cycle without gaps. In my opinion this alone provides justification to publish a study dealing with the diurnal cycle in difference Cl and HO_x species. I do partly agree with the comments by the 2 reviewers of the initially submitted version that a large part of the paper is a descriptive summary of what is shown in the Figures, and that it may be shortened.

Overall, this manuscript should eventually be accepted for publication, in my opinion, but I ask the authors to consider the following comments and suggestions:

Specific comments:

Page 6, line 6: 'of two faster' -> of two higher'

Page 8, line 3 bottom-up: 'The intercomparison of sun-synchronous .. and solar occultation satellite measurements ..' sun-synchronous and occultation measurements do not mutually exclude each other. SCIAMACHY performed occultation measurements from a sun-synchronous orbit.

Page 12, line 6 bottom-up: 'the geopotential altitudes measured by MLS' Does MLS really 'measure' geopotential altitude?

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Page 15, line 8: 'ENVISAT crossed the equator with the ascending node at 10:00 LT (local time) and the descending node at 22:00 LT.' I think it's the other way around: descending/ascending node at 10:00 LT/22:00 LT

Caption Fig. 3: 'The standard error of the mean are' -> 'The standard errorS of the mean are' or better 'The standard error of the mean IS'

Fig. 5: Please add MIPAS (cyan) and MLS (blue) to the legend in the top left panel of Fig. 5.

Page 24, line 6 bottom-up: 'to the solar maximum activity in 2003/2004' I suggest rephrasing this part of the sentence, because 2003/2004 was well after the last solar maximum. Solar proxies (MgII index or F10.7 flux) almost reached the 2004 values in 2010 again. I agree, however, that the average 'solar activity' was somewhat larger in 2003/2004 compared to 2009/2010, so your argument may still be valid.

Page 27, line 6: 'Due to the sun's MAXIMUM activity, when SMR data were collected (year 2003/2004)' See last comment

Page 27, line 10: 'The source of the HOx family, in fact, ARE the photo-dissociation reactions of water vapour' -> 'The source of the HOx family, in fact, IS the photo-dissociation of water vapour'

Page 27, line 4 bottom-up: 'the mean of differences are' -> 'the mean of differences is'
Same sentence: remove extra space before period

Page 30, line 7: 'common span' It's not entirely clear to me what 'span' exactly refers to here. Do you mean the FWHM of the Gaussian?

Page 35, bottom line: 'source of HO2 formation' This is somewhat tautological. Suggest replacing by 'source of HO2.'

Page 38, line 6: 'Similarly, Jones et al. (2011a) analysis' -> 'Similarly, the analysis by Jones et al. (2011a)'

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Page 39, line 1: 'amplitudes .. is' -> 'amplitude .. is'

Page 39, last paragraph before section 4.3: another exception to the generally good agreement between model simulations and observations is certainly the difference in absolute HCl amounts at all altitudes (Fig. 4). Please mention this here as well.

Fig. 7: Please also add a legend for the different rate constants to Fig. 7. If Figs. 7 and 8 appear on different pages of the final paper, Fig. 7 will be difficult to interpret. I also suggest increasing the size of the panels (perhaps by arranging them vertically), otherwise the lines are very difficult to distinguish.

Fig. 7: There appear to be two lines with the same colour and same pattern (dash-dot) in all panels of Fig. 7. Looking at the legend in Fig. 8, these probably correspond to: Stimple and JPL2011-low Err. Please change line styles such that each line can be clearly identified.

Page 40, line 9: '55km' -> '55 km'

Page 41, line 10: 'negligible small impact' -> 'negligibly small impact'?

Page 42, line 8: 'angel' -> 'angle'

Page 42, bottom paragraph: 'The result for HOCl at 55 km, presented in the right plot in the top row of Fig. 8, shows that all observations fall in the range of the JPL 2011 errors for k1.' This is true for the daytime values and for SMILES observations, but not at night. Also, the MIPAS daytime values are outside the JPL-err range.

Page 43, line 11: 'However, at this altitude the amplitude of the night-time variation of ClO (the difference of ClO between sunset and the reference period corresponding to the MLS night-time observations, i.e. 1.30 am) is consistent with the model result obtained with k1 within the range of the upper limit of the JPL 2011 (Sander et al., 2011) uncertainty range and the JPL2006 recommendation (Sander et al., 2006).' This may be true, but looking at the overall diurnal variation of ClO at 55 km in the bottom right panel of Fig. 8, it seems like none of the k1 values reproduces the measured

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values well. Nikolaisen and Stimpfle lead to good agreement during the day, but a high bias at night. JPL 2006 and 2011 lead to a low bias at daytime, but better agreement during the night. I think it should be mentioned that the results presented do not clearly indicate which reaction rate leads to the best agreement between the model and the observations.

Page 46, line 6: 'during the maximum of the solar cycle' See related comments on the solar maximum above.

Page 47, last sentence: 'The best agreement between the model and observations is achieved when the reaction rate coefficient of the HOCl formation reaction (k_1) is calculated using the LOWER ..' 'lower' should be 'upper', right ?

General comment on references: some of the journal titles are abbreviated, some are not. Please consistently use abbreviated journal titles.

Another general comment on reference list: I didn't read every single line of the reference list, but there seems to be a significant number of typos etc. Please go through the list carefully and correct the errors.

von Clarmann 2011 and 2012: the latter reference appears to be the accepted ACP version of the 2011 paper. Is it really necessary to cite both?

Kasai 2012 reference: 'SMILE' -> 'SMILES'

Meier 1982 reference: something wrong with author names

Sander 2006 reference: 'Barker, J. R., , Golden, D. M.,'

Sander 2009 reference: 'Barker, J. R., , Golden, D. M.,'

Wrotny 2010: 'Nedoluha1'

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 21065, 2012.

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