Atmos. Chem. Phys. Discuss., 12, C606–C609, 2012
www.atmos-chem-phys-discuss.net/12/C606/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the dependence of the OH* Meinel emission altitude on vibrational level: SCIAMACHY observations and model simulations" *by* C. von Savigny et al.

Anonymous Referee #1

Received and published: 15 March 2012

Review of "On the dependence of the OH* Meinel emission altitude on vibrational level: SCIAMACHY observations and model simulations" by C. von Savigny, I. C. McDade, K.-U. Eichmann, and J. P. Burrows [MS No.: acp-2012-42].

In this manuscript, the authors use Envisat/SCIAMACHY observations of the vertical volume emission rate profiles of the OH(3-1), OH(6-2) and OH(8-3) Meinel bands to study the differences in emission peak altitudes between the different OH Meinel bands. This work gives observational evidence that the higher vibrational levels have higher emission peak altitudes, and gives some quantitative information of the peak altitude for different vibrational bands. There is some useful information here, even

though some of the insights presented here are already known. In all, the results shown in this paper will be interesting to the middle and upper atmospheric science community. The paper is overall well written and easy to follow. I believe this paper can be published on ACP eventually.

However, I think that some work should be done to improve the paper before it is published on ACP. I hence recommend that this paper be accepted for publication on ACP after some revisions are made.

Major comments:

A brief introduction of the satellite should be given. For instance, what is the satellite's orbit. Is it Sun-synchronous polar orbit? What is the height of the satellite orbit. If it is sun-synchronous, what is the local time of the observation of the night glow? This information is important because airglow is strongly modulated by tides [e.g., Ward, GRL, 1999; Marsh et al., JGR, 2006; Xu et al., GRL, 2010]. The peak height of the airglow emission varies with time because of the modulation by tides.

The introduction section should be extended to include a comprehensive review of previous research. For the differences of the peak altitudes OH airglow emission rates for different vibrational levels, Makhlouf [JGR, 1995, Figure 4] and the TIMED/SABER observation and theoretical model [Xu et al., JGR, 2012, Figure 1, 2] indicated that v=9 peak at slightly higher altitude than v=1 peak. And Makhlouf [JGR, 1995] pointed out that [OH(v)] peak altitude moves down slightly as the quenching is increased.

It is better that the comparison between the TIMED/SABER observation and the Envisat/SCIAMACHY observations of the OH airglow is added if possible, because the observation periods of the two satellite observations overlap. There are two channels of the SABER's OH airglow observations, one is 2.0um band (OH(9-7)+OH(8-6)), another is 1.6um (OH(5-3)+OH(4-2)). There are obvious differences between the peak altitudes of the two channels airglow observation of the SABER's observation (Figure 1, 2 in Xu et al., 2012).

For the model simulation, some sensitivity tests have been made. However, this reviewer thinks they are not enough. Some additional tests should be added in order to address the aim of this work, which is to give quantitative information of the peak altitudes for different vibrational bands. The following tests may be needed:

(1) The assumption of Eq (5): This paper assumed that the initially produced OH follows a Gaussian altitude profile with a peak height of z0=87 km, and a FWHM of 8 km. In reality, this profile is mainly controlled by O3(z)+H(z). Therefore, sometimes, it is not a Gaussian function, or at least not a symmetrical Gaussian function. The peak altitude changes with latitude and seasons, and also local time induced by tides. Do these changes vary the conclusion? Simple tests, such as changing the peak altitude or FWHM of Gaussian function should be made.

(2) Vertical concentration profiles of O, O2 and N2 are taken from the MSIS-E90 climatology in this paper. Dose the profile of O influence the results? A simple test should be done.

(3) Some tests of important photochemical reaction parameters, such as, the quenching rate of O2, the O-quenching rate, and A(9), should be done using the new parameters given in recent papers [Smith et al., JGR, 2010; Xu et al., JGR, 2012].

(4) The measurements are used to establish a relationship between the emitting vibrational level and the altitude of the peak emission. However, they only show one transition per vibrational level. For example, Figures 2-4 show (8-3) but not (8-7), (8-6), etc. Are the peak altitudes all the same? This appears to be assumed in the model (Figure 6, right panel), since all the emissions from a given vibrational level are combined.

Minor comments:

Line 8-10 in page 5822: "The retrieval is based on the assumption that the atmosphere can be approximated by a set of 10 homogeneously emitting layers of 3.3 km thickness

ranging from about 73 km up to 103 km." should be "……70 km up to 103 km" or "……73 km up to 106 km".

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 5817, 2012.