Atmos. Chem. Phys. Discuss., 2, S805–S808, 2002
www.atmos-chem-phys.org/acpd/2/S805/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The H Lyman-$\alpha$ actinic flux in the middle atmosphere" *by* T. Reddmann and R. Uhl

**Anonymous Referee #2**

Received and published: 6 January 2003

The paper addresses the problem of penetration of solar Lyman alpha radiation into the deeper layers of the middle atmosphere and the photodissociation of molecular oxygen caused by this radiation. The authors' intention is to assess the accuracy of currently used parameterisations of EUV photolysis by examining the impact of temperature dependence and the contribution from resonance scattering by atomic hydrogen on the dissociation rate. Because of the general importance of this photo-dissociation this investigation is timely and well motivated. The authors demonstrate that under some cases, specifically in the deeper layers of the atmosphere significant changes are observed when these effects are accounted for. The authors develop a set of improved formulae for computing the Lyman-alpha energy flux and the EUV dissociation rate including the important branching ratio of O1D atoms in the photolysis. The paper is based on Monte Carlo calculations of the radiation transport of the hydrogen line using



Full Screen / Esc
Print Version
Interactive Discussion
Original Paper

a well-documented methodology and up-to-date input data.

1. The authors include in the photon flux the effect of resonance scattering by atmospheric H which becomes important when the direct radiation from the Sun is strongly attenuated, e g at large solar zenith angles. The discussion is limited to zenith angles allowing the plane-parallel atmosphere approximation which, regrettably, exclude twilight situations as observed in high latitudes. This may be the reason why the authors do not even mention the diffuse geocoronal hydrogen radiation which provides a significant contribution to the Lyman-alpha flux. A reference to the geocoronal Lyman-alpha component and a justification to its omission is suggested.

2. A weak point of the paper is that the discussion is strictly concentrated to the Lyman-alpha line and its effect in the deeper layers of the mesosphere. There is no mention of the relative efficiency of the EUV photolysis in comparison to that of radiation at longer wavelengths. In particular, the comparison of EUV production of O1D with that caused by by ozone photolysis is missing. Thus, while the authors' conclusions are in essence correct, the reader is given no chance to judge how important the proposed changes in the parameterisation are.

3. Regarding the language, the text in the paper is concise and clear although in some places it becomes too evident that the authors' mother tongue is not English. This leads to some unusual formulations such as ``UV dominant hydrogen..." in the second sentence of the introduction followed in the next sentence by ``playing a dominating role" which should sound better as "dominant role...". There are also some small repeatedly committed mistakes such as in the first sentence of Paragraph 2.2 ``starts in some altitude..." instead of ``at some altitude". (Unless of course the authors mean "within the layer".

4. Another example of difficult-to-read language appears in the second sentence of paragraph 2.3 (``in the previous direction of the photon.." which clearly refers to the ``direction of the incident photon". The subsequent sentence is also clumsy and the



**ACPD**

2, S805–S808, 2002

Box-Muller method referred to is not explained.

5a. The angular distribution of the resonantly scattered radiation is obtained by means of a scattering matrix derived by Hamilton and reproduced in the authors' reference Chandrasekhar (1960). Hamilton's formula applies to specific angular momentum conditions and the use of this expression needs a sentence of justification.

A remark is in place regarding the expression ``calculate randomly.." appearing in the same paragraph. The referee suggests the word ``pick a random number to calculate.." and for the sake of more easy reading replace ran as a name for a random number by Ran.

5b. Regarding the resonance scattering contribution, how sensitive is the computation to to changes in the H-atom concentration within the height range considered?

6. The beginning of the last paragraph in section 3.1 is rather unclear and the wording must be reformulated, to something like ``This is caused by the scattering of photons to space at high altitudes. Because of the higher temperature there, the spectral range of this loss becomes relatively wide". Also, for better clarity ``high zenith angles" should be replaced by ``large zenith angles". This also applies, to the last paragraph of section 3.1,

7. Finally, the last paragraph of this section ``Finally, the photon may now be considered to start once more, but with .....": suggested ``Having completed one step the computation is repeated with the updated values..."

8. Part 3, beginning, ``equinoctial" and ``solstitial" appear to sound better as ``equinox and solstice conditions"

In the last paragraph of section 3.1, ``High zenith angles" should be replaced by ``large zenith angles".

Apart from these remarks, the paper is worthwile and with some improvements it is recommended for publication in Atmospheric Chemistry and Physics (Discuss).



**ACPD**

2, S805–S808, 2002

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 1635, 2002.