

General Comments

- 1) This paper describes global observations of the Mg and Mg ion from the SCIAMACHY satellite instrument. The observations are discussed in terms of previous measurements and concluded to be in generally good agreement. The SCIAMACHY measurements are compared to 3D model results of the Mg and Mg ion number density. These comparisons indicate better agreement for Mg ions than for Mg, although differences exist. In particular the model indicate a seasonal cycle in Mg that is not present in the observations, and the model does not indicate latitudinal dependence in the Mg ion peak height which the observations show.
- 2) The results of this paper are relevant to a variety of areas including studies of meteor influx and deposition of meteoric material in the atmosphere, and studies of aerosols and chemistry where interaction with meteoric remnants (smoke) is relevant.
- 3) The paper is, however, somewhat lacking in scientific interpretation but rather reads as a recitation of results. For example, the discrepancies between model and observation concerning the seasonality in Mg could be discussed in terms of the potential measurement and model shortcomings, ultimately leading to suggestions for future work.

We would like to thank the reviewer for his insights.

To meet the general criticism we have improved the manuscript.

We initially described the data. Our focus was to show the Mg and Mg+ measurements, make comparisons with model results and discuss similarities and differences.

In the discussion we point where the model and measurements agree and where not.

For the point where the agreement is well, the assumptions put into the model appear to be correct.

We have addressed this issue (see also the answers to others referees comments pointing harsher at the same point) by adding discussion for the possible reasons for differences between the measurements focusing on the most likely explanations.

Specific Comments

- 1) Many of the Mg+ observations are presented separately for retrievals using two different wavelengths. The results are different, however, there is no discussion of why they vary for the two wavelengths, or if the authors suspect that one wavelength gives a better result. This may be discussed elsewhere, but the present study should give a synopsis of any issues. It would be preferable to show only results from the most reliable of the two wavelengths, and then state that the other wavelength indicates similar variability in time and space yet with some bias.

- Agreed, removed figures for the 279.6 nm line. The initial intention was to show that the densities retrieved from both lines show very similar results and to make it directly visible to the reader where the small differences are and to judge which features appear to be significant and which not. The 279,6 nm has the better signal to noise ratio, but also has the stronger self-absorption effect, which is however very small for Mg+. However, the 280.4 nm line is independent of any polarization related issues, as it depolarizes the light and a wrong polarization correction leads to systematic biases. However, with the latest corrections results from both lines are in better agreement.

- 2) pg. 1980, second paragraph: The discussion of electron distributions comes with no motivation. Please begin with a sentence or two discussing why this is relevant to the study.

- An introductory sentence has been added and the discussion of the transport processes in electromagnetic fields has been moved to the section, where the differences between model and measurements are tried to be reasoned.

- 3) Section 5: The comparison of SCIAMACHY to previous observations is useful and appreciated. It would be instructive, however, to convey these results in the form of a

figure or table if possible.

- It is of course more instructive to show figures for comparison. I added these figures to the manuscript with the recommendation of using the original figures as a reference. I hope this is sufficient.

4) Section 6, Figures 16: It would be useful to add panels that show the VCD vs. time for both model and observation on the same plot, for selected two latitudes. This is suggested because the model - observation comparisons are a major part of the work, and could benefit from some additional illustration.

- Added as part in point 3)

5) Section 6, Figures 17 & 18: The comparisons of SCIAMACHY and WACCM are instructive as shown, but it might be more illuminating with an additional panel that shows VCD vs. latitude for both model and observation as lines on the same plot.

- I understand that showing a 2D(x-y-plot) slice of the presented data might be easier to read, than the 3D(x-y-color-plot). However, it has also been criticized by the other referee, that there are already too many figures in the manuscript, and I think its better to keep the VCD vs. lat. vs. time plot, as much it contains much more information than a slice of it.

Technical Corrections

pg. 1974, line 26: "125 km." remove period

- done

pg. 1975, line 2: "density" should be "number density"

- done

pg. 1975, line 14: "can act" should be stated "are thought to act as"

- done

pg. 1976, line 2: "wavelengths" should be "wavelength"

- done

pg. 1977, lines 19-20: please clarify this sentence.

- tried to clarify the sentence

To correctly explain, what is meant here, several sentences are needed. And this would need to much space compared to the weighting of the statement made.

To find the reference orbit from, e.g. the 15 daily orbits it is not just sufficient to take of this orbits. For technical reasons it should be the orbit with the most measurements, to avoid unnecessary gaps in latitudinal coverage. Furthermore every 2nd orbit has a slightly shifted scanning pattern, alternating the role of limb and nadir measurements to cover all latitudes with both measurement modes. Therefore, the reference orbit is build from the 2 orbits with the most number of measurements, one for the odd orbit numbers and one for the even orbit numbers and the geolocations of this 2 reference orbits are merged, to form the final reference orbit.

The point here is, that not just the spectra are averaged, but there must be also information provided on the geolocation, which are used.

pg. 1978, line 5: try this "These features are not dependent on the orbit phase, but. . ."

- done

pg. 1980, line 24: you introduce undefined nomenclature, "E x B-Drift", please define these terms.

- The ExB is shortly introduced now.

pg. 1980, line 27: within 3 deg. latitude of what?

- of Mg⁺, done

All figures with latitude as the abscissa: The left and right abscissa labels are "-60" and "60", respectively. These should be "-90" and "90"

- This was not well enough explained. Figure 1 shows the latitudinal and local time coverage during an Orbit of SCIAMACHY. The highest latitude is 82°. High latitudes are passed twice, e.g. 70°N is passed at 11 and 21 hours, which are very different local times. To separate this, additional latitude bins are used for the ascending node (when the satellite moves northwards).

- As the first measurements of the sunlit part of the orbit are cut off, beside for Fig 9 (in the ACPD

version), it appears to be reasonable to use 82° as the highest latitude, to avoid confusions and just to add a sentence to Fig 9 hinting to Fig 1 and the explanation of the latitude grid choice

- Figures 2, 3, 5, 6, 8, 11, 12, 17 and 18 have been changed

pg. 1983, line23: " $(\pm 200\text{m})$ " should be " $\pm 200\text{m}$ "

- done

General: You could introduce the terms Southern Hemisphere (SH) and Northern Hemisphere (NH) early in the paper as they are used extensively.

- done

pg. 1985, line 18: You should briefly define the "Ring effect".

- done

pg. 1988, line 8: by "3.3 km step size" I believe you mean 3.3 km vertical resolution. Please clarify.

- done

-Averaging Kernels for the 1D and linear version of the retrieval algorithm have been calculated, showing nearly diagonal entries for dx/dx_{true} . Comparisons with the full 2D and non linear algorithm indicate, that there have not been significant changes in the resolution. And the folding of the model results with the resolution function (approximately a triangle with a base width of 4 km), does not show significant changes in to the unfolded model results, as the metal layer width is wide enough to make this effect negligible, which is also shown in Fig 19 and 20.

Fig 19 actually does not show the global, but equatorial profile. This has been corrected in the text. In figure 17 larger differences in the Mg altitude can be found in the high latitudes region and the corresponding paragraph is changed.