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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Retrieval of ionospheric profiles from the Mars Express MARSIS experiment data and comparison with radio-occultation data" *by* B. Sánchez-Cano et al.

Anonymous Referee #2

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The paper "Retrieval of ionospheric profiles from the Mars Express MARSIS experiment data and comparison with radio-occultation data" by Sánchez - Cano et al. describes the technique used to study the ionosphere of Mars with MARSIS. It describes the adapted data available from the MARSIS experiment, and how to process them. Then it compares the results with another experiment (limb-based) MaRS to check the results.

The paper accomplishes the goals of explaining the data and how to process them, and therefore is suitable for a future publication. Several points needs to be revised: 1) the English needs some improvements (see comments below; even if I am not the

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most qualified reviewer for that task).

2) A few references about the thermosphere and the ionosphere of Mars are missing in the discussion part: the understanding of the processed data is better when important processes are known, such as:

- the variation of the density of the upper atmosphere of Mars (e.g. Forget et al. 2009, Bougher et al., 2001; Withers et al., 2003 Simon et al., 2009, Zou et al. 2011 etc.). Which is the main parameter for the altitude of the ionosphere peak. (It is not the Mars-Sun distance, see the discussion in Zou et al. 2011).

- the variation of the ionosphere peak height is loosely related to the F107 parameter (it is dependent only through the variation of the neutral density), because the main models based on that parameters (e.g. EUVAC), have a small spectral dependence on it. But, the actual variations of the solar flux spectra can have impact on that altitude (e.g. http://www.agu.org/journals/gl/gl0915/2009GL039454/)

- The theory of the ionosphere layers (e.g. Fox 2009). Concerning that point, page 98 line 25: you cannot say that ions can be loss by radiation and dissociation processes. You have recombination processes leading to the emission of radiation, or to the dissociation of the former molecular ion, but those are recombination processes. There is basically two way to 'loss' an ion: by recombination (chemical reactions) or by diffusion (also called transport) (the charge exchange just modify the parent atom or molecule of the ion, and therefore I do not consider it as a loss here). The fact that we have a Chapman layer means that the diffusion is negligible. We call that case a photochemical equilibrium. In Fox 2009, it is explained that this equilibrium is a good approximation when solar zenith angles are not too large.

3) The authors discusses the possible errors in the procedure by comparing with the Marsis data. However, it would be interesting to have a discussion (and maybe an estimation) about the errors in the retrieval (including the data noise...).

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Other comments:

p 89 l 20: the sentence should be cut for a better understanding. p 90 l 8:"In both cases ..." should be replaced by something like 'In both cases, the ionosphere is mainly composed of O2+." p 94 l 22 : "To begin the inversion" also, for this paragraph, it may be interesting to explain in details (and/or to give a reference) how the local plasma density is computed from the harmonics. p 95: chap 3: I think it would be interesting to explain that MaRS is doing limb observations, which have also their drawbacks in term of averaging long path inside the ionosphere (especially in high-SZA situation). Moreover, in limb sounding techniques, the data below the peak always have high uncertainties.

====== Biblio

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