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Interactive comment on “Electron density profiles probed by radio occultation of FORMOSAT-7/COSMIC-2 at 520 and 800 km altitude” by J. Y. Liu et al.

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Dear Editor and Referee,

We would like to thank you for your helpful comments on the manuscript entitled “Electron Density Profiles Probed by Radio Occultation of FORMOSAT-7/COSMIC-2 at 520 km and 800 km Altitude”. Our responses to your comments are as follows:

REFeree RESPONSE:

“The present paper discusses the differences in GPS RO electron density profiles

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based on satellite altitudes of 500 and 800 km altitudes. The results are potentially relevant for combining GPS RO electron density profiles from missions at different altitudes. Overall the results are interesting, and I believe that it is suitable for publication. There are, however, several aspects of the paper that could be improved. Specifically there are several areas where the paper would benefit from additional depth. Detailed comments are provided below.”

Major Comments:

1 – “In the abstract the authors state “The electron density derived from 500 and 800 km satellite altitude of the F3/C observation and the OSSSE confirm that the standard Abel inversion can correctly derive the electron density profile”. Given the known error of the Abel inversion due to the assumption of spherical symmetry, the authors should revise this statement. To say that the Abel inversion can “correctly” derive the electron density profile is misleading given the known errors.”

Response: Sorry for the misleading statement. The authors have replaced the statement by the main result of this study.

2 – “I believe that the paper does not provide sufficient background information for the reader to fully understand the purpose of this study. For example, why would the results be expected to be different when derived from satellite altitudes of 500 km vs. 800 km? Given that other RO missions profiled the ionosphere from lower altitudes, one would assume that there is not a large difference in the electron density based on the satellite altitude. Additional background information as to why this study is necessary would be beneficial.”

Response: Since the sounding geometries of satellites at 500 and 800 km altitudes are different, the electron density profiles derived from these two altitudes are expected to be different. To see whether there is not a large difference in the electron density

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based on the satellite altitude or not, we conduct an OSSE by comparing the electron density profiles retrieved from satellites at 800 km altitude and those from satellites with identical sounding geometries but at 500 km altitude. Nevertheless, the authors have been added more background information about this study in Introduction of the revised manuscript.

3 – “In March and April 2007, one satellite (LEO 4) is in between 500 and 800 km. The authors should clarify whether this satellite is assigned to the 500 or 800 km group.”

Response: Sorry for the unclear. LEO4 was transferred from 500 to 800 km altitude during the study period. In this study, electron density profiles retrieved by LEO4 below and above 600 km altitude are classified into 500 and 800 km altitude, respectively.

4 – “In the final paragraph of section 3, the error between the Abel OSSE and IRI truth is discussed. Many previous studies have examined the error in the Abel inversion. The authors should place their results in the context of these prior studies.”

Response: The error between the Abel OSSE and IRI truth computed in this study is to find whether there is any common systematic error in the electron density profiles retrieved from 500 and 800 km altitude (Figs. 5a and 5b in manuscript). Therefore, the Abel OSSEs at 500 and 800 km altitude are further investigated (Fig. 5c in manuscript). The systematic errors shown in Figs. 5a and 5b (in manuscript) agree with those of Liu et al. (2010a). Moreover, the study goal of this paper is to find the sounding geometry effect, which is the given by Figs. 4c and 5c (in manuscript).

5 – “The authors only present the differences between the electron density profiles based on satellite altitudes of 500 and 800 km. There is no explanation as to why these differences appear. An additional discussion of the source of the differences would be beneficial.”

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Response: The authors conduct an OSSE by comparing the electron density profiles retrieved from satellites at 800 km altitude and those from satellites with identical sounding geometries but at 500 km altitude. Figure 1 shows that the electron density profiles retrieved by the satellite at 500 km tend to be smaller than these at 800 km altitude in the EIA region but are greater than these in the magnetic equator and/or poleward sides of the EIA crests. These discrepancies result from the spherical symmetry assumption of Abel inversion in the EIA region (Liu et al., 2010a). Nevertheless, the discrepancies are relatively small. By contrast, the real sounding geometries result in the electron density profiles retrieved by the satellite at 500 and 800 km altitude being significant different (Fig. 4 in manuscript). A comparison between Figs. 4c (in manuscript) and Fig. 1c confirms that the sounding geometries are the source of the differences. The source of the electron density structure differences between 500 and 800 km orbiting altitude satellites is discussed in revised manuscript.

6 – “The present results are for near solar minimum conditions. Do the results hold true for solar maximum when 500 km is much closer to the F-region peak altitude? Discussion of any potential impact of the solar cycle variability on the results would be a useful addition to the paper.”

Response: In the revision, the authors have already contrasted OSSEs in the solar maximum situation of 2002. Figure 2 (similar to Fig. 4 in manuscript) displays the OSSEs results for 500 and 800 km satellites, and their difference. Figure 3 (similar to Fig. 5 in manuscript) displays the difference between OSSEs results and simulation truth for 500 and 800 km satellites, and their difference. It can be seen that patterns in Fig. 2 and Fig. 3 are similar those in Fig. 4 and 5 (in manuscript), respectively, expect the electron density values being much greater in the solar maximum. Table. 1 shows that the standard deviation in the solar maximum is similar to the corresponding one in the solar minimum, which confirms the results hold true even for the solar maximum.

Minor Comments:

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1 – Page 1616 line 13 - GPS should be defined.

Response: Thanks for the suggestion. It has been done as suggested accordingly.

2 – Page 1618, line 8 - “difficult to identical” should be “difficult to identify”

Response: Thanks for the suggestion. It has been done as suggested accordingly.

3 - Page 1618, line 20 - “can be fund in” should be “can be found in”

Response: Thanks for the suggestion. It has been done as suggested accordingly.

4 - Figure 1 caption - “from launched to middle” should be “from launch to middle”

Response: Thanks for the suggestion. It has been done as suggested accordingly.

5 - Figure 3 caption - “showed” should be “shown”

Response: Thanks for the suggestion. It has been done as suggested accordingly.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 1615, 2015.

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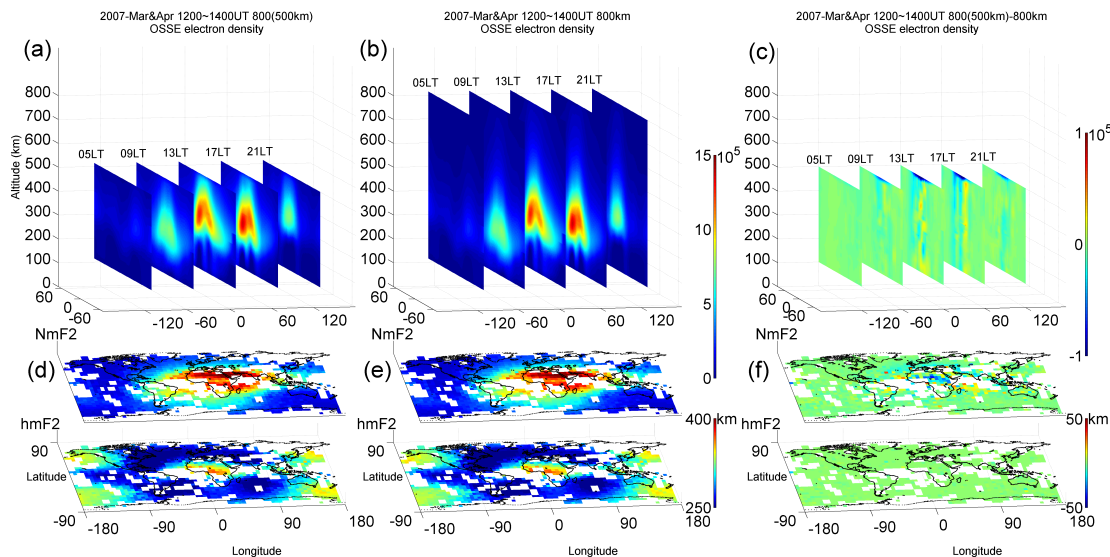
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Fig. 1. The Abel inversion OSSE electron density, NmF2, and hmF2 observed from 500 km and 800 km altitude satellites, which their sounding geometries are identical, and their difference.

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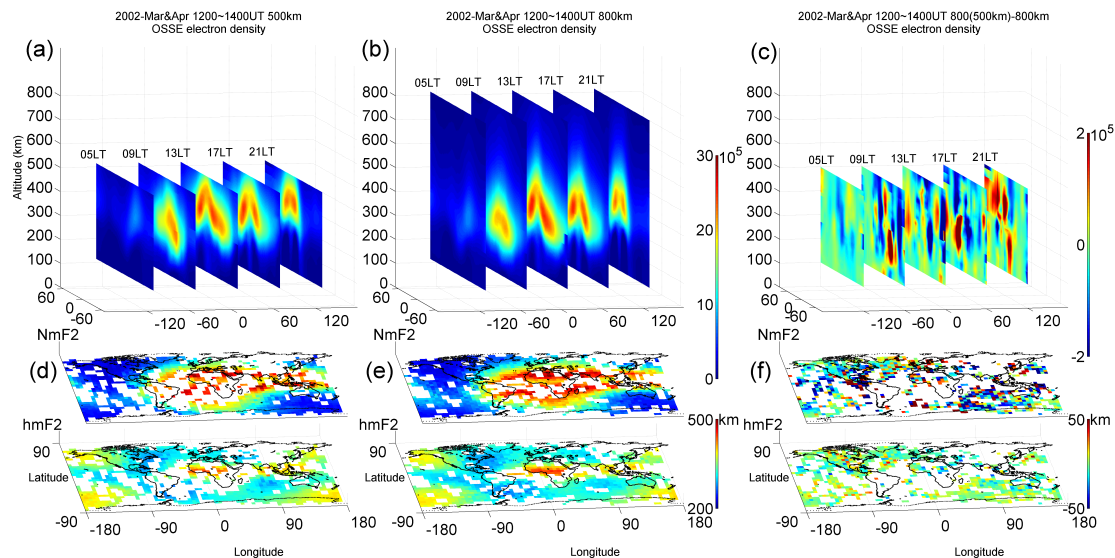
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Fig. 2. The Abel inversion OSSE electron density, NmF2, and hmF2 observed from 500 and 800 km altitude satellites, and their difference during 1200-1400 UT in March and April of 2002 (solar maximum).

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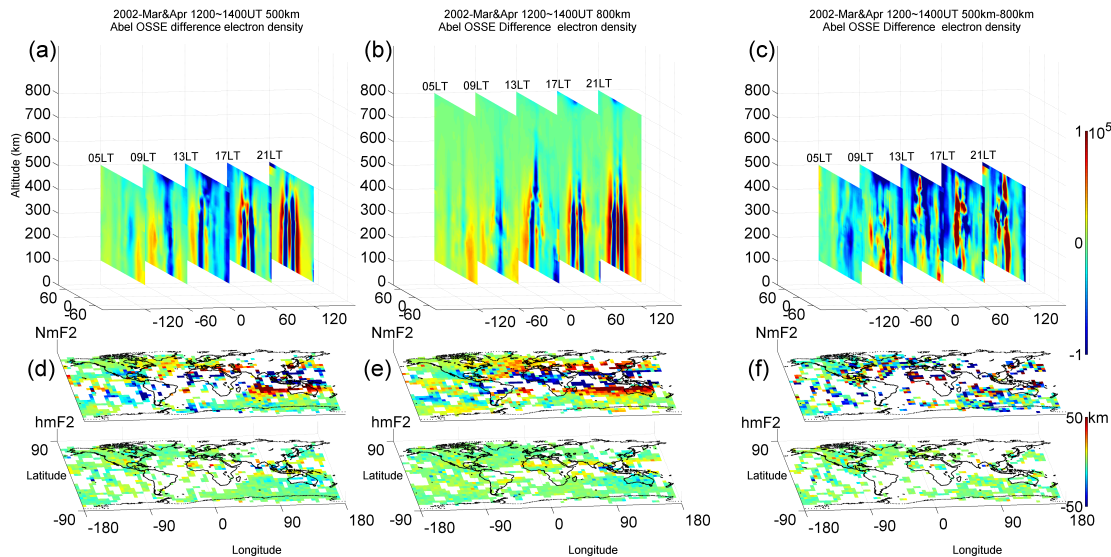
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Fig. 3. The Abel inversion OSSE error electron density, NmF2, and hmF2 observed from 500 and 800 km altitude satellites, and their difference during 1200-1400 UT in March and April of 2002 (solar maximum).

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