Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2019-93-AC1, 2019

Annales Geophysicae Discussions

Interactive comment on "Density correction of NRLMSISE-00 in the middle atmosphere (20–100 km) based on TIMED/SABER density data" *by* Xuan Cheng et al.

Xuan Cheng et al.

chengxuan_nssc@126.com

Received and published: 19 October 2019

I indeed appreciate the reviewer for very useful and constructive comments and suggestions. We have studied comments carefully and have made correction which we hope meet with approval. Revised portions are marked in blue in the paper and detailed information of changes in the supplement. The main corrections in the paper and the responds to the reviewer's comments are as flowing:

Comment 1: Line 87: earth -> Earth;

Reply 1: In line 87, the statement of "earth" was corrected as "Earth".

Comment 2: Line 175: Below âĹij45 km -> Below about 45 km;

Reply 2: In line 179, the statement of "Below âĹij45 km" was corrected as "Below about 45 km". In line 71∼72, the statements of "the orbital height of GRACE is ∼ 500 km, and that of CHAMP is ∼ 454 km" were corrected as "the orbital height of GRACE is about 500 km, and that of CHAMP is about 454 km".

Comment 3: Line 213âĹij214: This decreases to an average relative error of 1.44% and standard deviation of 4.29% after correction, an absolute correction of 1.59%. -> These decrease to an average relative error of 1.44% and standard deviation of 4.29% after correction, with an absolute correction of 1.59%. The same mistake appears in line 231. Besides, there are also some other grammar mistakes which will not be listed here, please correct them in the manuscript.

Reply 3: In line 253∼254 and line 270∼271, these grammer mistakes have been corrected.

Comment 4: The value "68%" in line 169 are not consistent with "60%" in line 184, please check it. The same for "15%" in line 183 and "19%" in line 184.

Reply 4: The value "68%" in line 164 and line 195 were checked and revised consistently. The value "19%" in line 193 and line 195 were checked and revised.

Comment 5: Why the deviations are so large at 72 km given by NRLMSISE-00 in Fig. 3b and Fig. 4b? An explanation is suggested in the manuscript.

Reply 5: As Reviewer suggested that an explanation was added in line 180∼187 as "Atmospheric planetary waves, atmospheric tidal waves and atmospheric gravity waves are important sources of atmospheric disturbances above 70 km (Pancheva and Mukhtarov, 2011, Xiao, et al., 2016, Zhang, et al., 2006). The atmospheric density of the NRLMSISE-00 model is calculated from the atmospheric temperature. In the UMLT region, there is a large error between the model temperature and the TIMED/SABER observation (Xuan, et al., 2018). The contribution of traveling planetary waves to at-

mospheric disturbances and the inaccurate estimation of atmospheric tides are the possible reasons for the large error of atmospheric temperature in the UMLT region. The atmospheric model transmits the error caused by the inaccurate representation of the atmospheric temperature disturbance to the atmospheric density, which makes the atmospheric density have larger errors in the UMLT region."

Comment 6: It is found that the average relative error decreases a lot while the refinement of standard deviation is not so clear, how to explain it? Especially the case of 32 km in Table 1 and Table 2.

Reply 6: Because the relative error of NRLMSISE-00 density increases with height, the relative error is smaller at lower heights (the correction factor is close to 1). The correction effect of the spatiotemporal correction function on the model is not significant at lower heights, so the change of the standard deviation is not clear at 32 km.

Comment 7: The average deviation becomes very small while the standard deviation decreases slightly, how to explain it?

Reply 7: The statistical results of the relative error of the model before and after correction given in Tables 1 and 2 include the correction results of different latitude and longitude under the satellite orbits. From figure 1-4, the relative error of the model is different with the distribution of latitude and longitude before or after correction. The statistical results of the average relative error before and after correction directly reflect the overall correction effect of the model at the observation points under different latitude and longitude. The standard deviation reflects the dispersion of the relative error at different latitude and longitude, indicating the difference of correction effect under different latitude and longitude. The standard deviation decreases slightly may be related to the modeling method of this paper and the property of the satellite data used. Since the coverage of the TIMED/SABER satellite alternates every 60 days, the observation capability is limited at high latitudes above $\pm 52^{\circ}$, resulting in limited to data volume. Taking this factor into consideration, this paper uses a 120-day window to

mesh the correction factor R so that the satellite data can cover both the high and the latitudes of the northern and southern hemispheres in the process of establishing the spatiotemporal correction function. These may be the reasons for the limited correction capability of the space-time correction function in high latitudes, and the standard deviation decreases slightly.

Comment 8: Throughout the paper, the quantitative results after corrections are insufficient. In order to make a comprehensive assessment, more quantitative results under different conditions (latitude, month, altitude, local time) should be provided.

Reply 8: More quantitative results were provided in section 3.1 In order to make a comprehensive assessment, the corresponding changes in the manuscript are as follows: (1) Latitude–month cross-section of relative error (figure 3) and latitude-height cross-section of relative error (figure 4) were added in section 3.2. The latitude–month cross-section of relative error after correction at 90 km, 60 km and 30 km were added in figure 3. The latitude-height cross-section of relative error after correction in January, April, and October were added in figure 4. And some detailed analysis of the correction effect was added in the manuscript. (2) In order to make it more intuitive to compare with the corrected results in (1), the density of observations and model output at 90 km in figure 1 were delete in section 3.1 and the latitude–month cross-section of relative error before correction at 60 km and 30 km were added in figure 1. Besides, the latitude-height cross-section of relative error before correction in January, April, July, and October were added in figure 2. And some detailed analysis was added in the manuscript. (3) The relative error of the model varies with local time before and after correction was added in section 3.3. (4) Adjust the original section 3.3 to section 3.4. (5) In line 239, "(both node heights and non-node heights were contained)" was added.

Comment 9: In line 111, it is mentioned that "Cubic spline interpolation is used to calculate the correction factor at other heights". However, there is no correction result at other heights. This is very important for the assessment of the correction method. Hence some correction results at non-node heights are suggested to be presented in

the paper.

Reply 9: The statistical correction results given in Section 3.2 include the results of non-node heights. For example, the latitude–month cross-section of relative error after correction at 30 km and 60 km shown in figure 3 are the corrected results for the non-height nodes, and the latitude–month cross-section of relative error at 90 km is the correction result for the height nodes. The data used in Figure 4 have a height resolution of 1 km and contain correction results for 7 node heights and 74 non-node heights. In Section 3.4, the result of 72 km in Figures 6 and 7 were replaced with that of 70 km in order to include a non-node height in the correction results under different geomagnetic activity conditions.

Please also note the supplement to this comment:
https://www.ann-geophys-discuss.net/angeo-2019-93/angeo-2019-93-AC1-supplement.pdf

---

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2019-93, 2019.