

#Referee 2

The work of C. Xiong et al. shows a thermospheric empirical model based on the accelerometer measurements of the CHAMP satellite. The analysis looks simple and straightforward. However, in my opinion, a more in-depth reasoning needs to be made because some conditions imposed to the model, might have led to inaccuracy in the presented results.

My main comment is on the evaluation of the height scale factor. Although the altitude of CHAMP shows a strong variability, the authors decided to divide the overall mission in only two periods of 5 year each, one for high and one for low solar activity. Furthermore, the approximation of constant scale height can strongly affect the results, in particular the dependency on the temperature. In my opinion, this part of the methodology should be fully revised.

The work of Liu et al. (2013), cited many times in the paper, shows a more in-depth analysis of the same problem and even better results. As an example, Fig. 6 of Xiong et al. shows a correlation of the CHAMP model wrt to the observations of at most 0.89 in the high solar activity phase, whereas Fig. 1 of the paper of Liu et al., shows a correlation coefficient of 0.96. The choice of a simpler model used in the revised paper is not always understandable.

Thanks to your valuable comments on our manuscript angeo-2018-25, that will definitely help to improve our results.

We indeed used for our analysis a constant scale height in this study as defined in Equation (4), and we agree that the actual scale height depends on many parameters, e.g., altitude, solar activity, latitude, etc. Therefore, we have selected six key parameters (defined in Equations 5-10) for describing the variations of neutral density at the reference altitude, 310 km. By using the multivariable least-square fitting method, the variation of scale height depending on different parameters is absorbed by the coefficients in Equations 5-10. As a consequence the coefficient, H_d , as defined in Equation (4) can be considered as a mathematical expression for an isothermal atmosphere, but does not reflect the actual scale height. In the revised manuscript we will make these circumstances clearer and discuss the implications.

The reason why we divided the dataset into two periods is that the CHAMP observations are too sparse when considering all the thermospheric variations with altitude, solar activity, season, etc. Our parameterization is not capable of tracing the full range of variability over the CHAMP mission. For that reason we decided to divide the dataset into two periods. The most important parameters (altitude and solar activity) vary simultaneously in the CHAMP observations and are therefore challenging to separate. Satisfying agreement with observations is achieved when dividing the data into two periods.

In this way we can check the variability of the mass density with respect to certain parameters for both high and low solar activity periods (see Figs 3 and 4).

As for the better performance of the model from Liu et al. (2013), one possible reason is that , they used for Figure 1 only observations from magnetically quiet ($ap < 32$) times at low and middle latitudes ($-60^\circ < \text{latitude} < 60^\circ$). But we have considered all the observations at all latitude and get quite good correlation coefficients, 0.89 and 0.86, in our Figure 6. For us the determination of the dependences on magnetic activity is an important aspect. This will be made clearer in the manuscript.