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Interactive comment on "Variability of TEC and improvement of performance of the IRI model over Ethiopia during the high solar activity phase" *by* Yekoye Asmare Tariku

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Response to reviewers' comments and suggestions The author is very pleased and thankful for editor's and referees' constructive comments and suggestions as I have got the comments, questions, and suggestions helpful in improving my work. Hence, I have presented the replies in the following manner. Even though the author has a large GNSS data from 2013-2016 over Ethiopia to calculate TEC to compare with many versions of IRI models, the paper should not be accepted since no new contribution, and no substantiated physical explanations are provided.

Response: In connection with model validation over low and equatorial regions, of

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course, a lot of researches have been conducted using the old versions, including IRI 2012 version. However, latest findings that can show the improvement of the model performance from the relatively old to new versions for long lasting period are lacking though the model has been steadily improved and arrived at IRI-2016, which incorporates some new input parameters that did not exist in the previous versions. In addition, only few researches have been conducted to validate the IRI 2016 version of the model over the low and equatorial regions So, to give answer for the question "what is new in the latest versions (especially IRI 2016) of the model in relation to TEC estimation over the region while observing the improvement of the model in general?" this study plays a great role. In short, the study enables to show the improvement of the model from the old to the new version in TEC estimation; and the performance of the most recent version (IRI 2016) in estimating TEC over the region. This is because; validating the new versions of the model enables the model developer to further improve the model. Indeed, here the main purpose is to see the improvement of the IRI model in the estimation of TEC employing IRI 2007, IRI 2012 and IRI 2016 in the same plane using large data for a better accuracy of the results obtained. The past studies might have tested the performance of the model using a single version, either IRI 2007 or IRI 2012. But, few researches have been conducted using IRI 2016. Moreover, as the past studies noted, there are common results obtained in relation to model validation in different version of the model. This shows that the model performance has not been significantly improved. This is one of the basic findings of this study entitled"Assessment of the variability of TEC and improvement of the IRI model. . .". Because the main aim of the study is to show whether the model performance is improved or not. Hence, to further encourage the model developers so that they can significantly improve the model, this study is supposed to give a clear understanding about the improvement of the model performance from the past to the present, especially during the solar maximum phase.

Of course, some modifications have been made (see the revised manuscript to see some new findings that were not discussed in the old manuscript)

.Also the author didn0t provide information about how the satellite and receiver biases were determined to calculate the absolute. He only mentioned the Ciraolo et al. (2007) methodology.

Response: It is given in subsection 2.1 (see lines 131-138). The cited reference, Ciraolo et al. (2007 is not necessary.

The tittle induces us to expect an improvement of the IRI model over Ethiopia, what is not provided. The results description from lines 266 to 281 is very repetive and a table should had be used instead. The paper information that TEC is minimum during 03-06 LT and maximum during 12-16 LT is well known.

Response: improvements have been made based on the given suggestions and comments (see the abstract, result and discussion and conclusion sections).

About the storm study it is not expected to get good IRI responses since this model works with averages and it is very difficult to reproduce storm time behavior. The paper contribution is that there is an overestimation of the modeled VTEC.

Response: Here, the main point is to see the performance of the IRI model in estimating TEC variation using three versions (IRI 2007, IRI 2012 and IRI 2016) in storm time condition. Because in all versions of the IRI model there is storm time option embedded in the model. So, the storm option has to be tested whether it fails to capture the VTEC or not, because the objective is to validate the performance of the model during storm time.

Small corrections and suggestions are: Line Comments/suggestions/questions 103-105 Correct the phrase Response: corrected (see lines 114-116)

107 Klobuchar et al., 1996 Response: corrected (see line 118)

120-124 Improve Response: corrected (see lines 131-138)

150 Is modeling hmf2 referring to using from measurements? Response: yes Two new

model options for the F2 peak height hmF2, one based on digisonde and one based on radio occultation data. Most significantly, these new options are now modelling hmf2 directly and no longer through its relationship to the propagation factor M(3000)F2.

165 sites shown... Response: corrected (see line 177)

177 F10.7 cm solar flux Response: corrected (see line 190)

217 Provide reference Response: corrected (see lines 238-239)

240 Photoionization Response: corrected (see line 260) 242 eastward Response: corrected (see line 261) 244 subsolar Response: corrected (see line 264) 289 Dst index maximum incursion of about... Response: corrected (see line 309) 290 considered (see Figure 12) Response: corrected (see line 310)

291 (16/03/2015), main phase (17/03/2015), Response: corrected (see line 312)

301-304 Which particles and from where? How come penetrated electric field increase TEC? Response: when we say particles, it means plasma (ions and electrons). The particles are transported from the equator towards high altitudes forming a fountain effect. i.e If the electric field penetrates into the dayside equatorial ionosphere, the plasma is convected toward higher altitudes. At these higher altitudes, the recombination rates are considerably longer (hours) than for lower altitudes. Solar photoionization at lower altitudes continues to occur and will replace the uplifted ionosphere/plasma resulting in an overall TEC increase Moreover, additional clarifications are added (see lines 327-334)

405-406 Is the reference complete? Response: corrected (see lines 444-445)

Figure 1 Ambo and Nazret are overlapped Response: corrected (see Figure 1, line 489)

Table 1 Is advisable to inform dip lat instead of geomagnetic coordinates. Response: corrected (see table 1, line 535)

Please also note the supplement to this comment:
https://www.ann-geophys-discuss.net/angeo-2018-48/angeo-2018-48-AC2-supplement.pdf

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