1) General Comments

The manuscript "*Analyses of different propagation models for the estimation of the topside ionosphere and plasmasphere with an Ensemble Kalman Filter*" by Tatjana Gerzen et al. subjects the topic to propagate the state vector in an Ensemble Kalman Filtering (EnKF) process from one analysis step to the next, here applied to the assimilation of slant Total Electron Content (sTEC) observation data into 3D electron density grids of the topside ionosphere & plasmasphere. – Thereby investigations are focussed on statistics-based approaches, as potential alternative to more computer-intense physics-based methods to propagate the ionosphere's & plasmasphere's state from one update epoch to the next, in order to establish a new background for the next epoch's new state vector computation.

The work presented in the manuscript is set well into context with other activities concerning 3D ionospheric data assimilation techniques and modelling, that have been/are conducted in the past, more recently and actually. The presentation of algorithms and testing scheme & results appears in principle concise and clear (see also Point 2) – specific Comments). The manuscript length is adequate.

2) Specific Comments

Concerning the approaches to propagate the state vector by "Rotation", by "Exponential decay", or by a combination of both, it is not really clear to me, in which reference system the assimilation is conducted. – If being conducted in an earth-fixed frame, e.g. geographic, "Rotation (+ Exponential decay)" would make sense to propagate the state vector from one epoch to the next. If being conducted in a reference system being fixed w.r.t. the Sun, e.g. what the authors denote as "magnetic coordinates" (I suppose what's meant here is the Solar-Magnetic (SM) system (https://arxiv.org/ftp/arxiv/papers/1611/1611.10321.pdf, therein Section 3.5, or something similar) then "Exponential decay" would make sense. Might this be the reason why "The method Rotation delivers much higher values than NeQuick" (manuscript lines 237 – 238). – I am personally would implement a system in which the assimilation grid is maintained in SM coordinates, i.e. being fixed w.r.t. the Sun and no rotation, only exponential decay. Then, at each assimilation epoch, the observation data would for its assimilation be transformed from earth-fixed into SM, i.e. by converting the positions at which the observables were taken (in case of sTEC, position of slant range start and end point) from earth-fixed into SM. And for products generation, e.g. of TEC/Ne maps, out of this 3D SM assimilation grid, I would for requested epochs transform earth-fixed grid points, e.g. of an IONEX grid, into SM, then interpolate Ne-values/vertically integrate TEC values in the SM grid, and finally assign them to their earth-fixed positions. – So the reference frame used for the assimilation process should be clearly specified in the manuscript.

As far as I understand, the computations are done with 100 ensembles. This appears at least quite disk space-intensive to me (but probably also w.r.t. computational effort). – So it might be helpful, in this regard, to specify a bit more the computational benefits of the statistics-based approach, presented in the manuscript, over physics-based methods to propagate the state vector.

Perhaps it should be explained how the formula for *ratio*, Eq. (6), has been derived and under which criteria, e.g. the Factor 3 in its denominator.

Lines 268 – 269: STD and RMS are also higher during the quiet period, numbers listed in Fig. 4. – Do you perhaps mean "significantly higher" in relation to median, i.e. in terms of the ratios (RMS/median) and (STD/median)?

Lines 289 – 291: Where do these big sTEC differences between Swarm A (105 and 170 TECu) and GRACE (282 and 264 TECu) come from? Do you have an explanation for this?

Lines 318 – 319: I think this is not always so. Please specify more detailed.

Lines 353 – 358: See my comments above.

3) Technical Corrections

Line 36: "insight" should be replaced by "inside".

Line 51: The reference "Zeilhofer et al., 2010" is obviously given in the reference list as "Zeilhofer et. al., 2009" (Lines 493 – 494) – so 2010 or 2009?

Lines 56 – 57 and 69: Some braces are missing when citing references "(cf. …)" instead of "cf. …".

Eq. (8): I suppose the denominator of 20 in the square root term stands for the update rate of 20 minutes?

Eq. (9): Where does the factor 8/10 come from (which is by the way 4/5)?

Line 154: Replace "bevor" by "before".

Line 157: Instead of 0.5/100, I would write 1/200, to be more illustrative (and eventually 2/200 instead of 1/100). How are the 0.5/100 and 1/100 derived from *ratio*, i.e. from Eq. (6)?

Line 159: "… as follows: For …", i.e. capital "F".

Line 161: "… In detail …" not "… In details".

Line 162: "… = 100 x 1 and calculate to calculate …". Remove "and calculate" from this phrase.

Line 164: "… In detail …" not "… In details".

Line 209: "… Both data providers supply …", i.e. plural of "provider".

Lines 213 – 214: "… Further, information on the pre-processing of the LP data is made available." – By whom, where and when? – Probably you mean "In addition, further information on the pre-processing of the LP data is made available on this website".

Line 238: "… values seem to be …", not "seems".

Line 284: "… It is to mention here that in 2015 …", i.e. include "in".

Line 287: "For each of the tree LEOs …". "tree" should be replaced by "two" (Swarm A and GRACE) (instead of "tree" you probably meant "three").

Line 306: "~7" TECu. I think this should be rather "~8" TECu (7.96 TECu in the plot).

Line 378: "… therefore …", i.e. with an "e" at the end.

Line 506: "Figure 3: Subfigures top: …". "top" can be removed here, since Fig. 3 has no bottom row.

Plots: NeQuick is displayed in pink, SMART+ in red. These rather similar colours make it sometimes difficult to distinguish both curves. So NeQuick might be displayed in a more different colour, e.g. yellow.

*** I couldn't check all numbers (Median / RMS / STD) in the plots and their percental ratios in the text, but selected and proved only a few of them randomly.

4) Rate:

All in all, I would consider the scientific contribution of the manuscript as "**fairly important**".