The manuscript is well written and covers an important topic for incoherent scatter radar (ISR) spectra fitting to obtain plasma parameters, specifically the ion composition estimate used when performing the spectra fits. By using a model run from WACCM-X the authors are able to improve the plasma parameter fits from the Guisdap software package during the May 2024 Superstorm using the EISCAT Svalbard 42m radar. There are 2 runs of the WACCM-X model, one driven by 'Heelis' which is effectively driven by the Kp-Index, and one driven by 'AMIE' which is data driven from an extensive set of different ionospheric and geomagnetic measurements. The authors only use the AMIE driven model when presenting the results.

The authors make suggestions to use the re-analysis technique on the larger EISCAT dataset. This is currently not reinforced by their analysis, though it could be with further analysis and information. The following further analysis is suggested:

G*eneral response by the authors:*

We thank the reviewer for their helpful comments and suggestions. We especially appreciate the very sensible suggestion to either extend the analysis or adapt the conclusions of this study.

We would like to emphasize that we do not suggest using Equation 2 as a correction model and never intended this study to provide a statistically valid debiasing. This study explores ISR analysis techniques on a highly important space weather event and provides a proof of concept for the suggested method of debiasing EISCAT measurements using physics-based O+ ratios. At the moment, this proof is limited to storm conditions. A statistical investigation of Heelis-driven O+ ratios will be conducted separately, and if possible, include the derivation of a debiasing model. We have adapted the conclusions of the study to reflect this.

1) Using WACCM-X with Heelis to obtain the plasma parameter fits and comparing the results with the WACCM-X AMIE driven model derived fits.

Authors:

Figure 2b shows the Heelis-driven WACCM-X O+ ratios in comparison to AMIE-driven results in Figure 2c. As the relation of O+ ratio to parameter changes is mostly linear, we deemed it unnecessary to show the results for both geomagnetic driving approaches in this initial test. A future study will show fits using Heelis-driven O+ ratios on a wider range of geomagnetic conditions.

2) Using the full profile incoherent scatter fit provided in, e.g., Virtanen et al. 2021, and comparing with the results here. The study presented here is a perfect opportunity to compare the full profile fits to the model driven fits. This would be appreciated by the greater community, with hopefully good agreement between the methods. Virtanen et al., 2021, provides functions that should be usable in the Guisdap software, and it should not be an insurmountable amount of work to re-process this period of data with that software.

Virtanen, I. I., Tesfaw, H. W., Roininen, L., Lasanen, S., & Aikio, A. (2021). Bayesian filtering in incoherent scatter plasma parameter fits. Journal of Geophysical Research: Space Physics, 126, e2020JA028700. https://doi.org/10.1029/2020JA028700

Authors:

This analysis has been conducted by:

Cai, L., Aikio, A., Geethakumari, G. P., Vanhamäki, H., Virtanen, I. I., Oyama, S.-i., et al. (2026). Ionosphere-thermosphere coupling in the Northern polar region during the May 2024 geomagnetic superstorm. Journal of Geophysical Research: Space Physics, 131, e2025JA034495. https://doi.org/10.1029/2025JA034495

Unfortunately, the above-mentioned article was published very shortly before the original submission of our manuscript, which is why it was not discussed in the original version. We added an extensive discussion of their results and a comparison to our method/results (see also answer to reviewer 1).

3) Including a few days with different geomagnetic conditions to determine how the WACCM-X model driven ISR spectra fit results compare with the IRI model spectra fits during less geomagnetically active days.

Authors:

AMIE inputs are manually generated, commonly only for specific space weather events, which usually involve a certain level of geomagnetic activity. A larger database of EISCAT database, including diversified geomagnetic conditions, will be required for developing the actual debiasing model based on Heelis-driven WACCM-X long-runs (e.g., https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2025JA034630).

It should be stated, that even without this additional analysis the manuscript still has merit. It is only that there is the potential for a much improved study that can be used as a basis for what techniques to use when determining ionospheric parameters from the incoherent scatter spectra when the ion composition is unknown.

Therefore, it is suggested that the authors either present the manuscript as is, and remove some of the suggestions without the proper validation of the statements, or provide an impactful study with some additional figures and comparisons that will be greatly appreciated by the community. It is for this reason that 'Major Revisions' has been suggested.

Please find comments corresponding to the specific lines below.

Lines 91-92: This manuscript is highlighting the re-analysis technique for ISR spectra fitting using the WACCM-X model, and in lines 91-92 it is even mentioned that the Heelis-driven model is more applicable to the re-analysis of the EISCAT measurements in general. The manuscript does not show any results from using the Heelis-driven WACCM-X model though, even though the authors have the data available. It is difficult to determine if the claims of using WACCM-X with Heelis-driving is suitable. Please include the results from Heelis-driven WACCM-X Guisdap spectra fitting and compare with the AMIE-driven WACCM-X Guisdap results.

Authors:

As mentioned above, we are focusing on the presentation of the technique for a single storm case here. For a statistical debiasing model, Heelis-driven O+ ratios as shown in Figure 2b will have to be applied. Heelis-driven O+ ratios show less variability (as expected) but a similar general trend as AMIE-driven O+ ratios. Due to the mostly linear correlation of parameter changes and O+ ratio difference to IRI, conducting the analysis for both Heelis and AMIE would result in similar outcomes, reflecting the differences of Figures 2b and c.

Lines 114-115: The scope of the paper is the May 2024 superstorm, but the manuscript argues for the technique to be applied to the general dataset. More days with different geomagnetic conditions should be investigated before making this claim.

Authors:

We removed this claim and will conduct a statistical study, including quiet time conditions, at a later stage.

Lines 168-169: It is claimed that a validation of BAFIM is difficult, but the data presented here is a great opportunity to compare the techniques and potentially validate both. BAFIM was developed for Guisdap and therefore should be able to be used in the ISR spectra fitting analysis without too much difficulty.

Authors:

An extensive comparison to Cai et al., 2026, who use the BAFIM technique on this campaign, is included in the revised manuscript.

Lines 172-173: The correction function presented has not been sufficiently analysed for different geomagnetic conditions to know if it is suitable. And even then, it potentially only 'corrects' one parameter, T_e. The other parameters do not show such a linear response. Ideally, EISCAT would generate the different incoherent scatter spectra fits with well defined and documented input conditions and make those results available to the users.

Authors:

We agree that an actual correction model requires a thorough statistical analysis. Equation 2 is provided as an example of what a correction function could look like. We have clarified this.

Lines 188-189: It is stated that the Heelis-driven WACCM-X would have to be used for EISCAT ISR spectra corrections but there are no results presented from this, even though the authors have the data available. Further, there is a claim that the correction model would be applicable to all researchers but there are no results showing that such a correction model is viable for different geomagnetic conditions. Please expand the analysis to address these statements.

Authors:

As mentioned above, we present the Heelis-driven O+ ratio in Figure 2b and limit the later results to the AMIE-driven run due to the linear correlation of O+ ratio difference and parameter change.