

We deeply thank the reviewer for the careful and constructive assessment of our manuscript. We are also grateful for the rapid review, which enabled us to improve the paper efficiently. Below are our point-by-point responses to the comments and questions. Since this response includes figures, we would appreciate it if you could read the PDF version attached.

> Line 4, 280, 357. The authors should note that the figures in Partamies et al. (2025) do show green emissions below the continuum emissions, for example in their Figure 1a, 11a, and 12c. Their spectrograph data shows evidence of strong 557.7 nm emissions. While the simultaneous presence of the continuum and picket fence does not appear to be Partamies et al.'s focus, this information, which is available within your author team, should be acknowledged, and the claim of “first observation” should be removed.

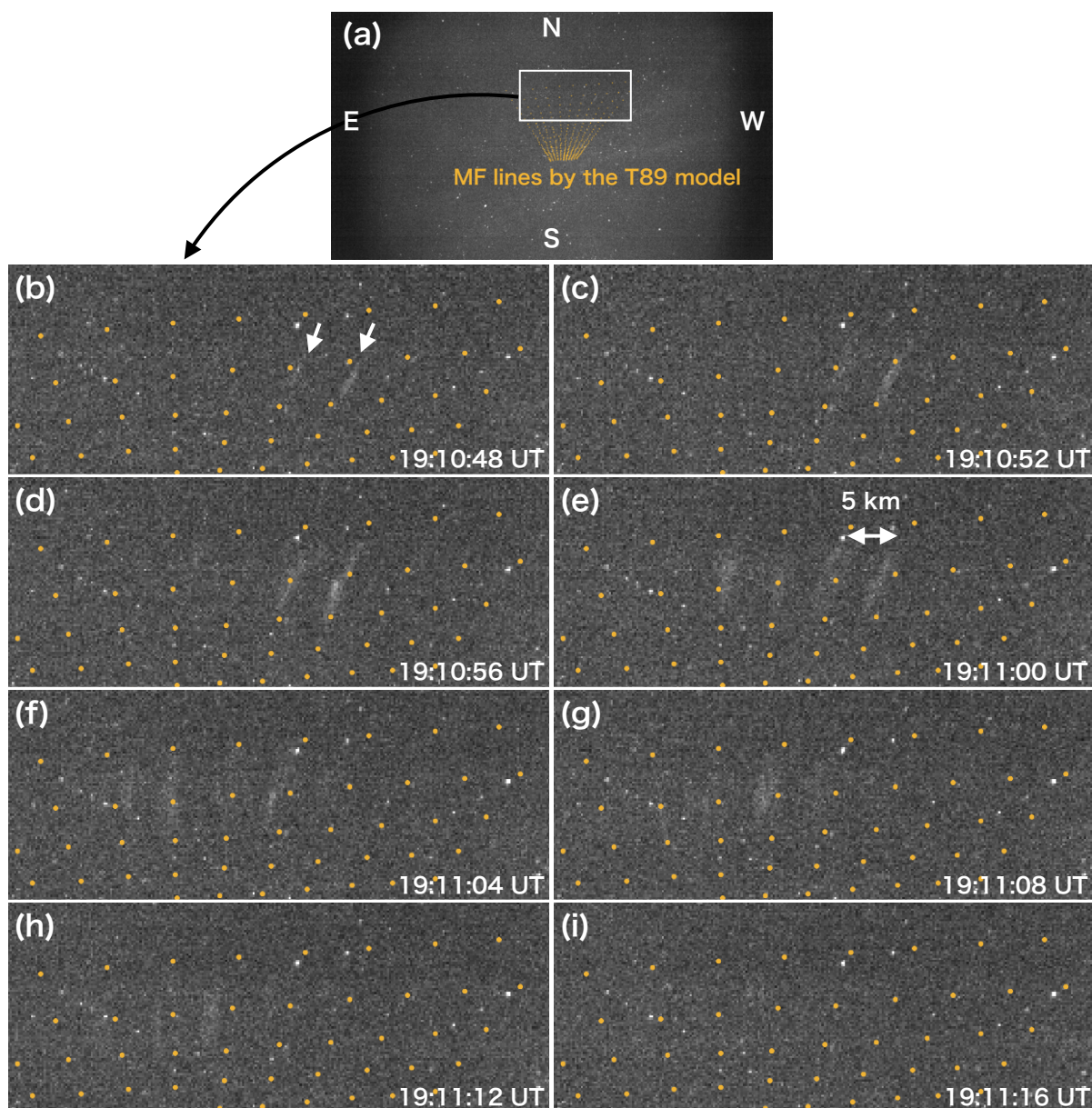
Thank you for pointing out our insufficient explanation. We will explicitly acknowledge that Partamies et al. (2025) reported continuum emissions together with co-located green emissions in the introduction. However, all events discussed by Partamies et al. (2025) are dayside cases observed at Svalbard, whereas our study analyzes nightside events observed in Scandinavia, so the local-time context differs. Because this MLT difference may be useful for future discussion of generation mechanisms, we will make the distinction explicit by adding the term “nightside” throughout the manuscript. In addition, the statement at Line 280 concerns a feature not reported by Partamies et al. (2025)—namely, the simultaneous occurrence of FAEs at multiple longitudinally separated locations in auroral latitudes—and we would like to keep this statement.

> Line 175 The authors claim that the picket fence is field-aligned. It appears to be true for some pickets, but a significant part of the picket fence is not field-aligned. See the figure in the PDF version of the comments. The ones marked in red are tilted away from the magnetic field lines. (a) The authors should mention that a significant part of the picket fence is not field-aligned. (b) The magnetic field lines depend on the assumed emission altitude. Please describe the assumption used to draw the magnetic field lines, and discuss uncertainties of the field-alignment considering uncertainties in the altitude.

Thank you for the helpful comment, and we apologize if our previous figure caused confusion. Our manuscript reports three events (on the same night) separately. For Events 2 and 3, we do not find any field-aligned FAEs. In contrast, for Event 1, we consider that the structures are essentially field-aligned. We did not extract only those FAEs that happened to align within randomly extended structures; rather, the sequence shows orientations parallel to the local field in general.

To clarify this point, we provide a revised Figure 5 below and will state the assumptions to calculate the field lines: the lowest points (footpoints) of the field lines are placed at geographic latitude 69.6°, altitude 110 km, and geographic longitudes 19.0°–21.0° in 0.2° steps. As you noted, some FAEs in individual snapshots do not appear perfectly

parallel to the model field lines. However, when following the sequence, as the FAEs propagate from west to east, their orientation tracks the change in the model field-line inclination across the FoV (features that are oblique on the western side become more nearly vertical where the local field-line direction is more vertical). Such a trend is not consistent with mechanisms that are independent of the magnetic-field direction. While some snapshots indeed show FAEs not perfectly parallel to the model field lines, the systematic alignment supports the view that a field-aligned mechanism essentially contributes to their formation. Accordingly, we wish to avoid the characterization that a ‘significant part’ of the FAEs is non-field-aligned.



Revised Figure 5

> Line 190-202. Several issues exist regarding the results from Swarm. (a) Swarm did not cross FAE, and therefore the FAC, density and temperature from Swarm cannot be used to discuss the generation conditions of FAE. Swarm provides background plasma conditions at best. This limitation should be mentioned explicitly. (b) Downward region 2 FACs on the red aurora is inconsistent with the converging electric field deduced from Figure 3. The converging electric field should be connected to upward FACs, likely where the region 1 is. (c) Looking at Figure 4a, Swarm crossed the latitude of the FAE before 19:10:30 UT. The FAE location in Figure 6 should be corrected. (d) It is difficult to compare Figure 6 and 4a. Add more tick marks along the satellite trajectory of Figure 4a. Then make the location of the red aurora and FAE in Figure 6 consistent with Figure 4a.

Thank you very much for these helpful suggestions. We have revised Figure 4a and Figure 6 and reinterpreted the Swarm data accordingly, as summarized below.

(a) Scope of Swarm measurements for this study.

We agree that FAEs occurred in a very confined region and that Swarm did not cross them directly. We will state explicitly that Swarm's measurements in this case are used only as background conditions, not to infer FAE generation directly.

(b) FAC sense over the red aurora.

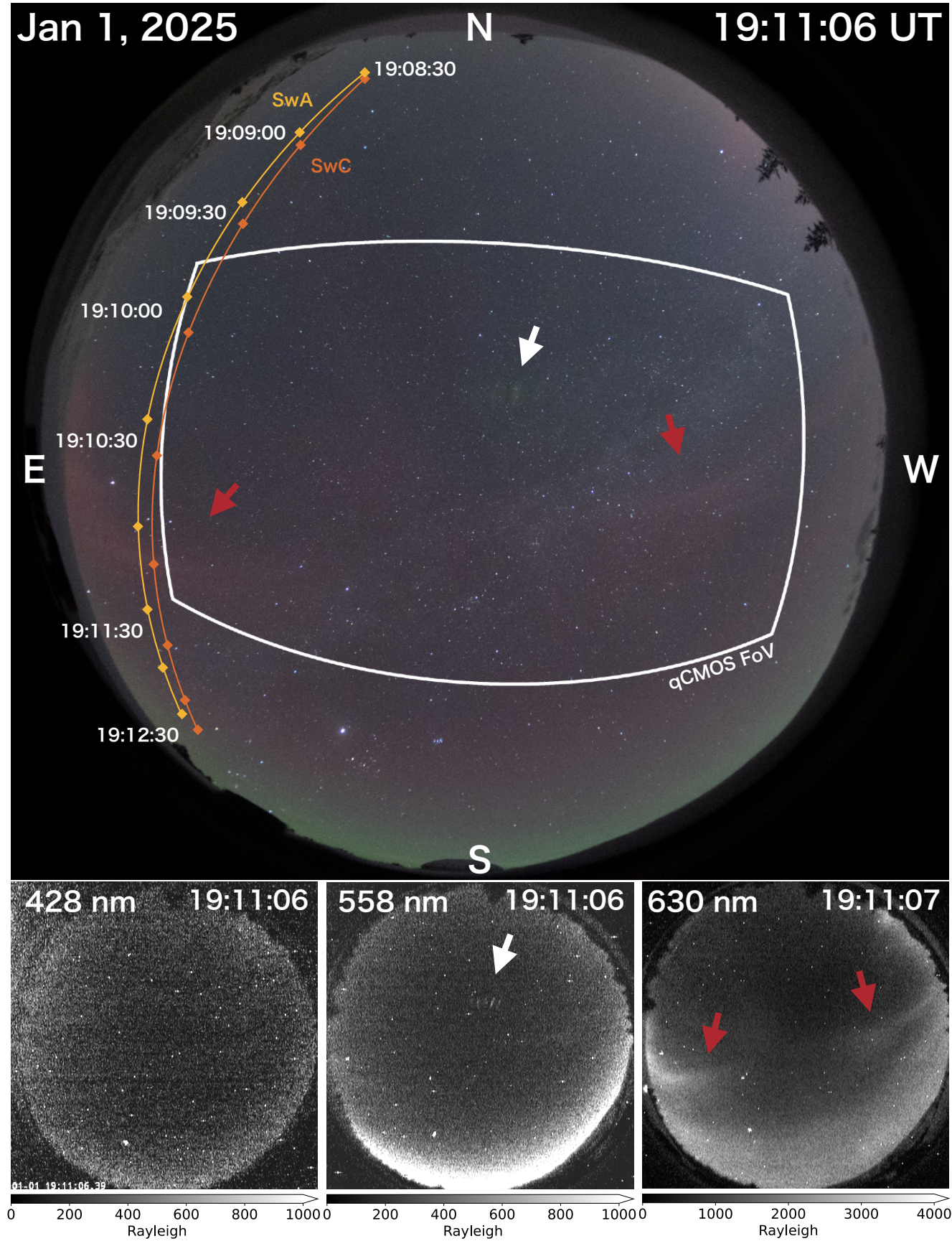
As seen in the revised Figure 4a, the red aurora (marked by red arrows) extends longitudinally and overlaps the Swarm tracks. Swarm A and C appear to cross the red aurora near 19:11:15 UT and 19:11:00 UT, respectively. In the revised Figure 6, this interval would correspond to the electron-density enhancement labeled "Red aurora?". In our first preprint this was labeled "FAEs?", but we now withdraw that labeling and interpret the enhancement as a crossing of the red aurora. This region corresponds to upward Region 1 FACs (see Figure 6b), addressing the inconsistency you noted.

(c) FAE latitude vs. Swarm timing.

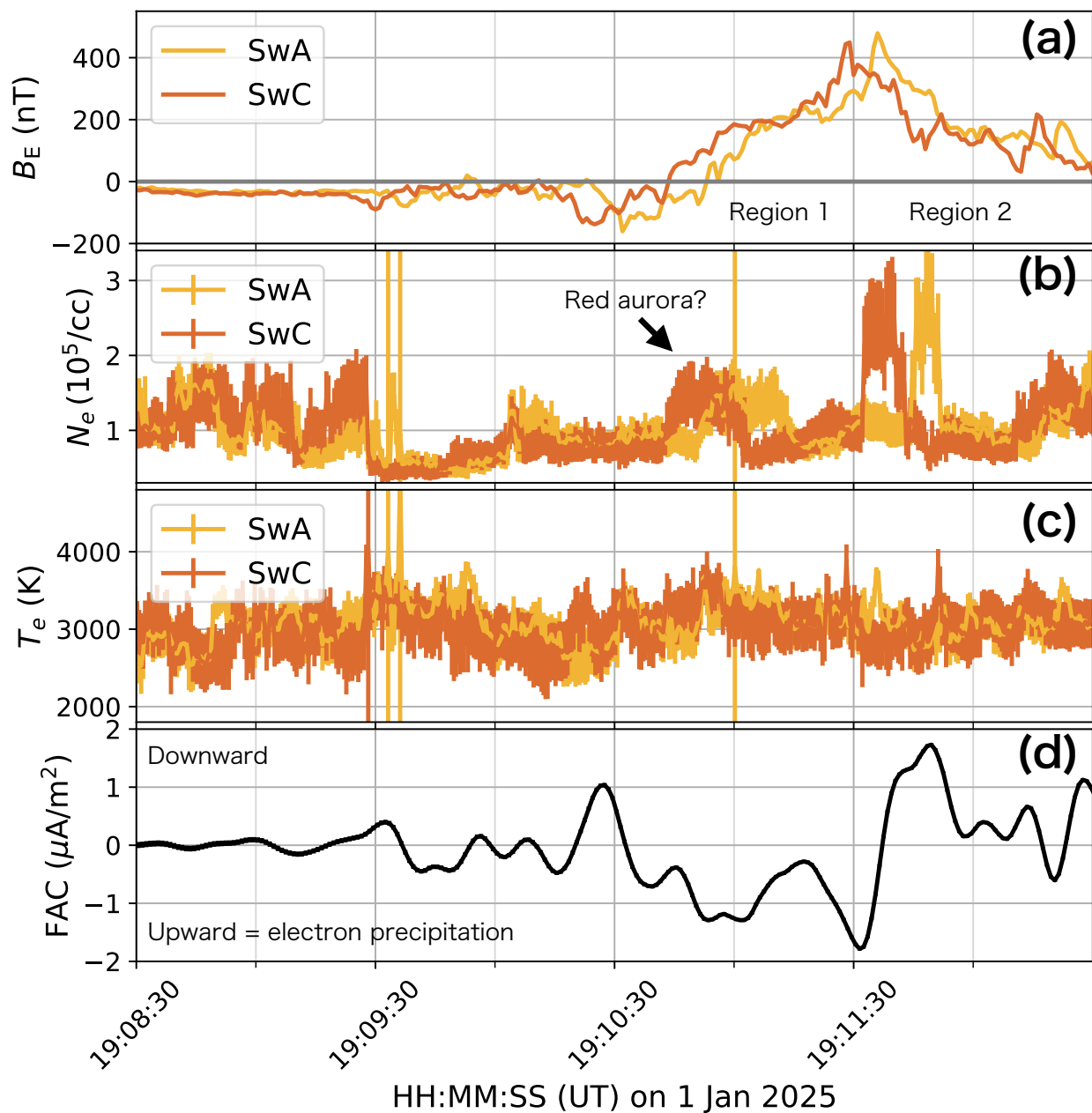
The revised Figure 4a shows that Swarm passed the latitude where FAEs later appeared at about 19:10:30 UT. However, as you correctly point out, the FAEs were spatially offset from the Swarm track. We therefore avoid using Swarm measurements to deduce FAE properties in the formal revision.

(d) Figure labels.

To improve comparability, Figure 4a now includes diamonds every 30 s along the Swarm trajectories, and Figure 6 has matching vertical grid intervals (every 30 s). In addition to the figures, the main text will be revised to ensure consistency with these interpretations. We are grateful for your comments; they helped us correct our interpretation and clarify the manuscript.



Revised Figure 4



Revised Figure 6

Data availability:

The Watec ASIs data used in this study are publicly available at <http://esr.nipr.ac.jp/www/optical/watec/skb/rawdata2/>. The qCMOS camera data are also available at <http://gwave.cei.uec.ac.jp/~hosokawa/public/flagments/>. The ASIS data are available at: <https://asis.aeronomie.be/papers>. The spectral riometer data are currently being processed for public release, and will be made available in the formal revision of the manuscript.

Minor comments:

> Line 4, 278, 357 Line 4 and 357 state that FAEs are in the oval, but line 278 states the FAEs are poleward of the auroral oval. Please be consistent.

We will revise Lines 4, 278, and 357 to consistently describe the FAE region as near the poleward edge of the auroral oval.

> Line 24 Please provide references that show the picket fence is “usually” field-aligned. I’m only aware of the case studies by Semeter et al. If there are no references showing the usual field-aligned occurrence of the picket fence, this sentence should be rewritten to “Semeter et al. suggested that the picket fence is field-aligned.”

We will revise it as suggested.

> Line 38 Nanjo et al. (2024) did not demonstrate that the emission similar to STEVE is aurora. “Aurora” should be removed.

We will revise "auroral emissions" to "emissions" as suggested.

> Section 2 should provide references to each of the instruments, unless this is the first paper that uses the data from the instruments.

Thank you for your suggestion.

Ground-based magnetometer (IMAGE): This is part of the IMAGE magnetometer network. We will add the reference in the formal revision (10.1029/2008JA013682).

ASIS and qCMOS camera: These instruments were not developed exclusively for this study, but they have only recently become operational, and a dedicated instrument paper has not yet been published. We believe the technical specifications currently described are sufficient for interpreting the data used here.

> Line 137 Auroral explosion is not a widely used term in auroral physics. Change this to “poleward expansion.”

We will revise it as suggested.

> Figure 3 and 4. It is unclear why Figure 3 presents many images without FAE. FAE is shown in only one image in Figure 4 with a gap in time from Figure 3. Please show more images between 19:08:33 and 19:11:06 UT, and describe how the red aurora changes during the FAE appearance.

Thank you for the comment. In Figure 3, we show multiple frames to illustrate the motion of the red aurora, as indicated by the white arrows. The frames between 19:08:33 UT and 19:11:06 UT that connect Figure 3 and Figure 4 are already provided

as Video A1 (Supplement). As can be seen there, the red aurora exhibits no pronounced evolution during this interval; therefore, adding more still images would not materially improve clarity. We will add a brief sentence in the text describing this point.

> Line 221 Describe what assumptions were used to determine the latitude.

We did not determine the latitude by assumption. Rather, we chose the latitude slice for which the features captured from Abisko and Skibotn align most closely in projection, minimizing their separation in the longitude–altitude plane. We will explain this in the text.

> Line 278. Change “poleward side of” to “near the poleward edge of.” The poleward side means near but poleward of the auroral oval, but it is not what the authors say in the conclusion.

We will revise it as suggested.