

Thank you for the careful and constructive assessment, and for the quick turnaround. Below are our point-by-point responses to your comments and questions. As this reply includes figures, please refer to the attached PDF for proper viewing.

> My main additional question and concern are about the method used to determine whether the FAEs are field-aligned. The alignment of FAEs in space is three-dimensional, whereas both the camera view and the T89 model mapping are two-dimensional. Even if the field-line mapping appears aligned with the FAEs in a 2D projection, this does not necessarily mean the FAEs are actually parallel to the field lines in 3D space, given the lack of information about the third dimension. This method can demonstrate that the FAEs are not field-aligned in Events 2 and 3, but it seems insufficient to conclude that the FAE structures are field-aligned in Event 1. In this case, it might be premature to draw the conclusion stated in Lines 358–359.

Thank you for this important comment. This issue was partially raised by Referee #1 as well, so some of our response below necessarily overlaps.

We agree with your concern: model magnetic field lines are defined in three dimensions, whereas images by a camera are two-dimensional. Any projection of aurora from one site therefore requires an assumed emission height.

That said, the relevant heights are constrained. The green emissions typically peak near 110 km (e.g., Whiter et al., 2023). Dreyer et al. (2021) also inferred that FAEs occur at altitudes around 110 km. Also in our data, green emissions with morphology similar to Event 1 occur within 110–140 km (see Figure 8). Based on this, we drew model field lines started at altitude 110 km, geographic latitude 69.9°, and longitudes 19.0°–21.0° at 0.2° steps. As shown in the figure below, these field lines converge slightly below the FoV center (the magnetic zenith), and the FAEs in panels (b–i) appear approximately parallel to the modeled local field-lines and would converge toward a similar point. Importantly, when we vary the starting height to 100 km or 140 km, the magnetic-zenith location is essentially unchanged, and the alignment of the FAEs with the local field lines remains the same. In other words, the conclusion that the FAEs tend to follow the local field-line direction holds across a reasonable range of altitudes.

We are not identifying strict 3D distributions of emissions. Our point is that the FAEs are consistent with alignment to the local modeled field lines within a reasonable emission-height range. We will state this limitation in the main text in the formal review.

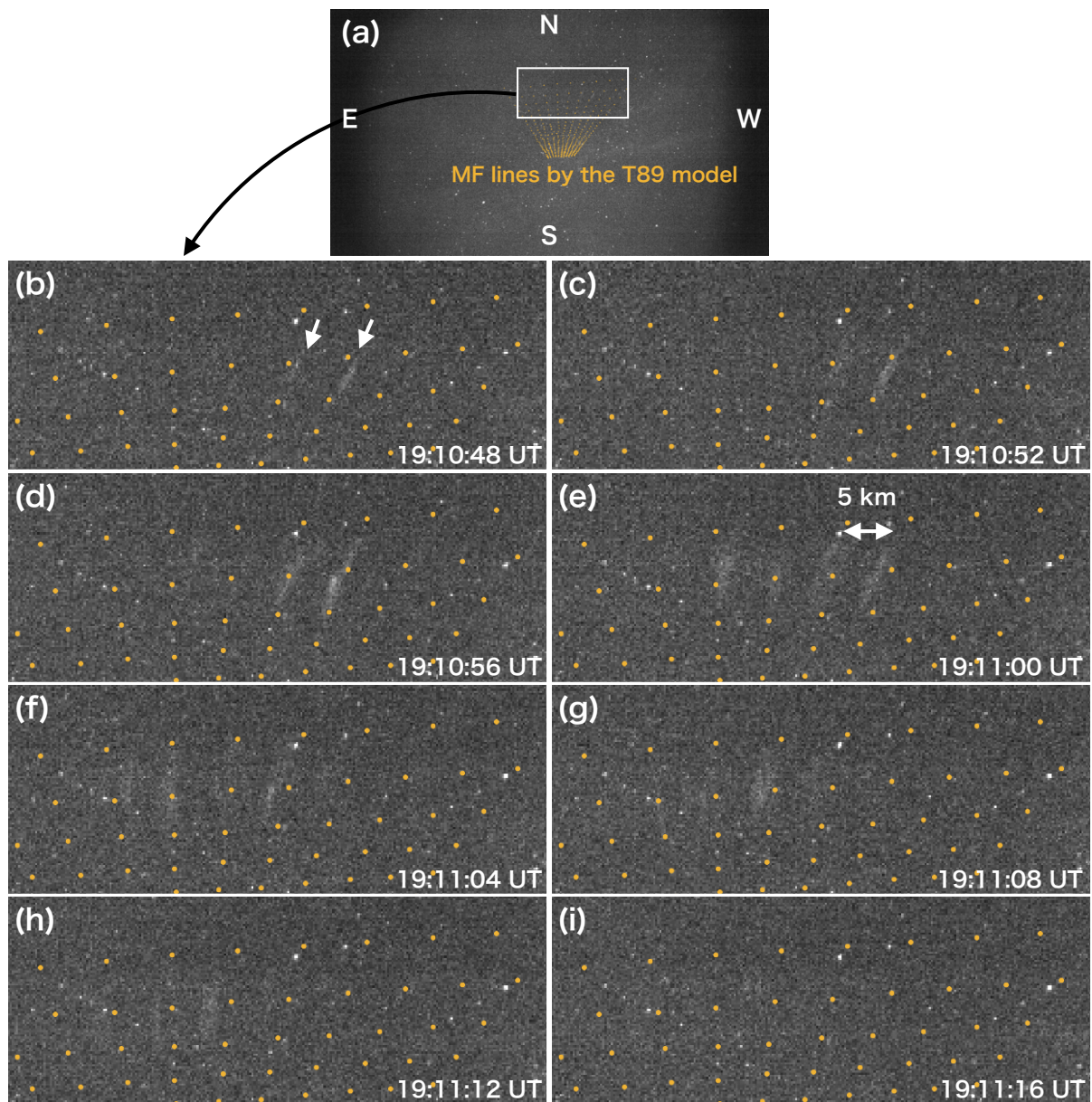
Minor issue:

We will also correct DOI links. Thank you very much for checking.

Reference:

Whiter, D. K. et al.: The altitude of green OI 557.7 nm and blue N₂⁺ 427.8 nm aurora, *Ann. Geophys.*, 41, 1–12, <https://doi.org/10.5194/angeo-41-1-2023>, 2023.

Dreyer, J. et al.: Characteristics of fragmented aurora-like emissions (FAEs) observed on Svalbard, *Ann. Geophys.*, 39, 277–288, <https://doi.org/10.5194/angeo-39-277-2021>, 2021



Revised Figure 5