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Equatorward wind driven significant upwelling of Ca+ layer over middle latitude during the November 2023 strong geomagnetic storm

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Abstract Metallic ions deposited in the Earth's atmosphere by meteoric ablation primarily occur below 120 km altitude, and sometimes could ascend to the F region altitude ~200 km under geomagnetic quiet conditions. With the Mohe (122.3°E, 53.5°N, magnetic latitude 54.8°) lidar, we present the first observation of Ca+ layer upwelling from E to F region up to ~350 km altitude over high middle latitude during the strong magnetic storm on 5 November 2023. The Ca+ layer upwelling process was observed associated with strong equatorward neutral wind. The variations of auroral electrojet index, equatorward neutral wind and Ca+ density profile exhibited close correlations, indicating possible driving source from the polar regions. It is suggested that the equatorward neutral wind enhanced by storm-time auroral energy input could transport the Ca+ upward along the tilted magnetic field lines to F region altitudes over middle latitudes.

References

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Figure 1

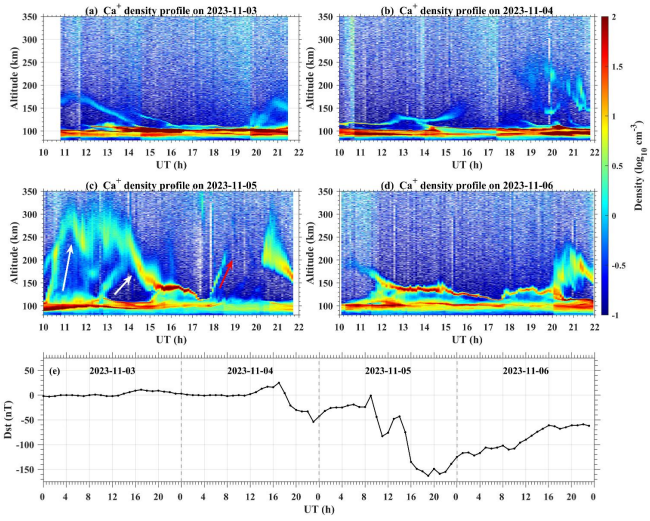

Figure 1. (a-d) The Ca+ density profiles on 4 consecutive nights from 3 to 6 November, 2023. (e) The Dst index during 3-6 November 2023. The white and red arrows indicate the Ca+ upwelling.