Electrojet estimates from mesospheric magnetic field measurements

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Key Points:

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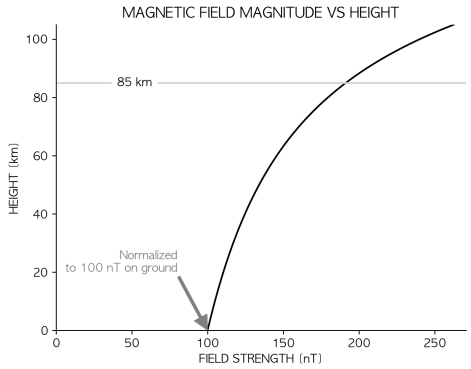

Figure 1. Altitude variation of ΔB, assuming spatial structure of electrojet is similar to field-aligned currents. Normalized to 100 nT on ground.

Abstract

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Plain Language Summary

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1 Introduction

Electrojet traditionally measured from ground + later satellites. Drawback: Distance > 100 km, which removes fine scale structures. ⇒ electrojet spatial structure is not known

New techniques available (EZIE (Yee et al., 2020)+ maybe sodium laser measurements (Kane et al., 2018))

1.1 Prediction of mesospheric magnetic field disturbance magnitudes

Use (Gjerloev et al., 2011) FAC-based spectrum to make synthetic equivalent current that has the same magnetic power spectrum. Use standard radial dependence to calculate structure and magnitude of magnetic field below ionosphere. The point is to quantify the added benefit of measuring at 85 km compared to ground.

2 Resolving electrojet using mesospheric magnetic field measurements

Point: Demonstrate / quantify increased capability in determining electrojet structure with meospheric measurements compared to ground

2.1 EZIE mission concept

Description of mission: Grid, time resolution, precision (basically going from spectrum to B + error)

Limitations of look direction

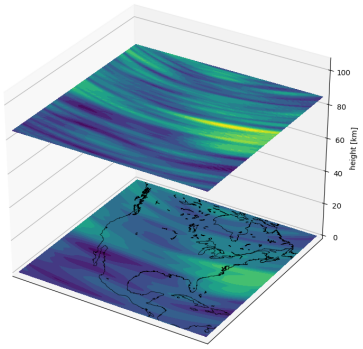

Figure 2. Contour plots of magnetic field of a random electrojet with similar spatial structure (spatial power spectrum) as FACs, shown at 85 km and on ground.

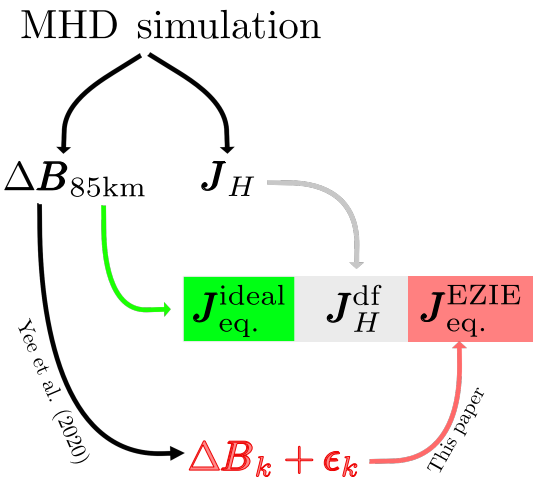

Figure 3. PRELIMINARY FIGURE: Schematic to illustrate what is done in this paper: Calculate equivalent current based on realistic measurements from EZIE, and compare the result to 1) equivalent current calculated from an ideal distribution of perfect measurements of $\Delta \boldsymbol{B}$ at 85 km, and 2) the divergence-free part of the horizontal ionospheric currents.

2.2 Test simulation

Description and plots of MHD simultaion case

Discussion about divergence-free current - what would we get with PERFECT data immediately under current layer?

2.3 Electrojet inversion

Description of algorithm

Presentation of results - in comparison to results

3 Discussion

3.1 Effect of weighted volume emission

Acknowledgments
Enter acknowledgments, including your data availability statement, here.

References

Gjerloev, J. W., Ohtani, S., Iijima, T., Anderson, B., Slavin, J., & Le, G. (2011). Characteristics of the terrestrial field-aligned current system. *Annales Geophysicae*, *29*(10), 1713–1729. doi: 10.5194/angeo-29-1713-2011

Kane, T. J., Hillman, P. D., Denman, C. A., Hart, M., Phillip Scott, R., Purucker, M. E., & Potashnik, S. J. (2018). Laser remote magnetometry using mesospheric sodium. *Journal of Geophysical Research: Space Physics*, *123*(8), 6171-6188. doi: 10.1029/2018JA025178

Yee, J. H., Gjerloev, J. W., & Wu, D. L. (2020). Remote Sensing of Magnetic Fields Induced by Electrojets From Space: Measurement Techniques and Sensor Design. *jgr?*.