Auroral energy flow budget as a function of altitude: How does energy arrive from the magnetosphere?

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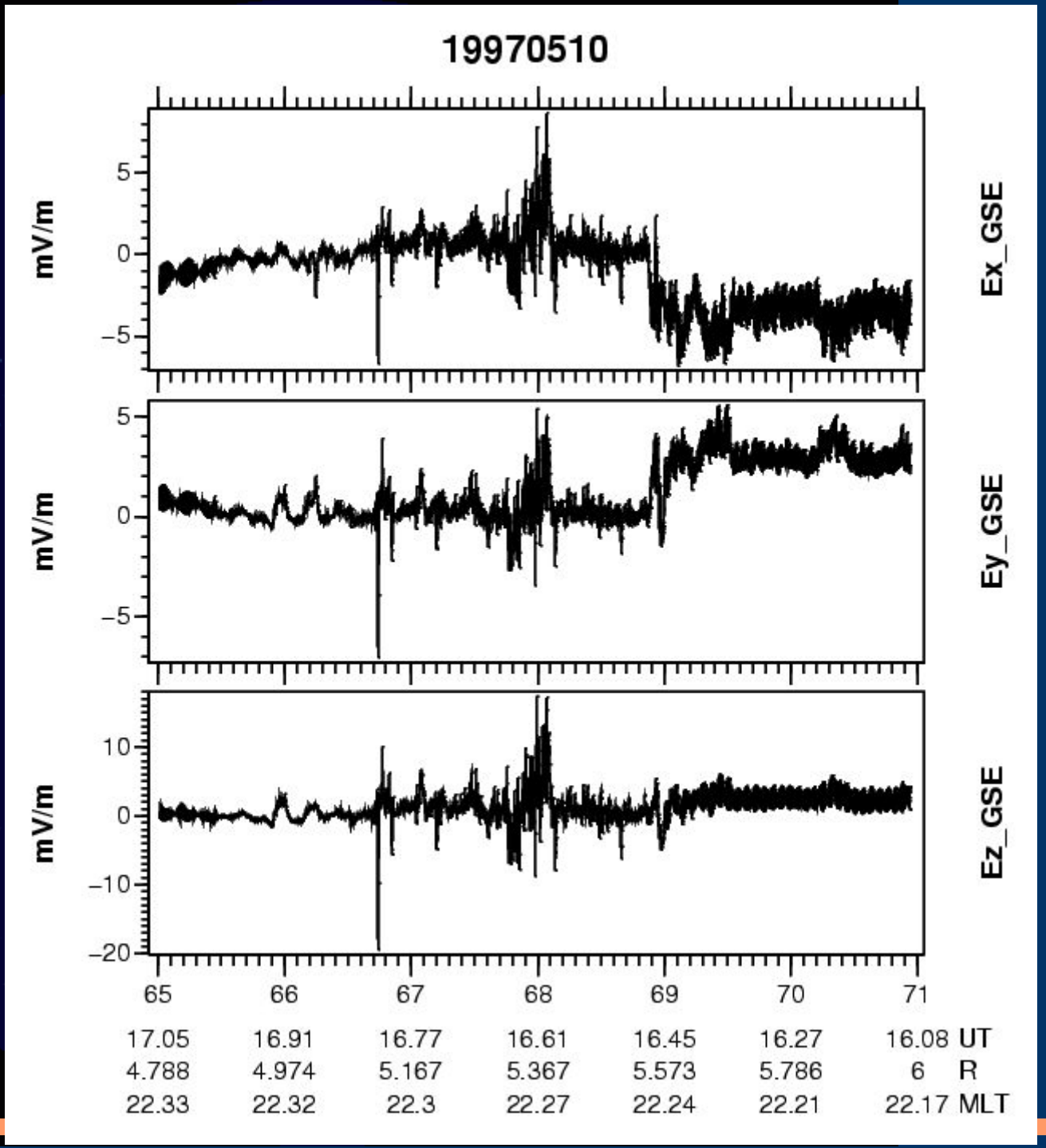
Plan of presentation

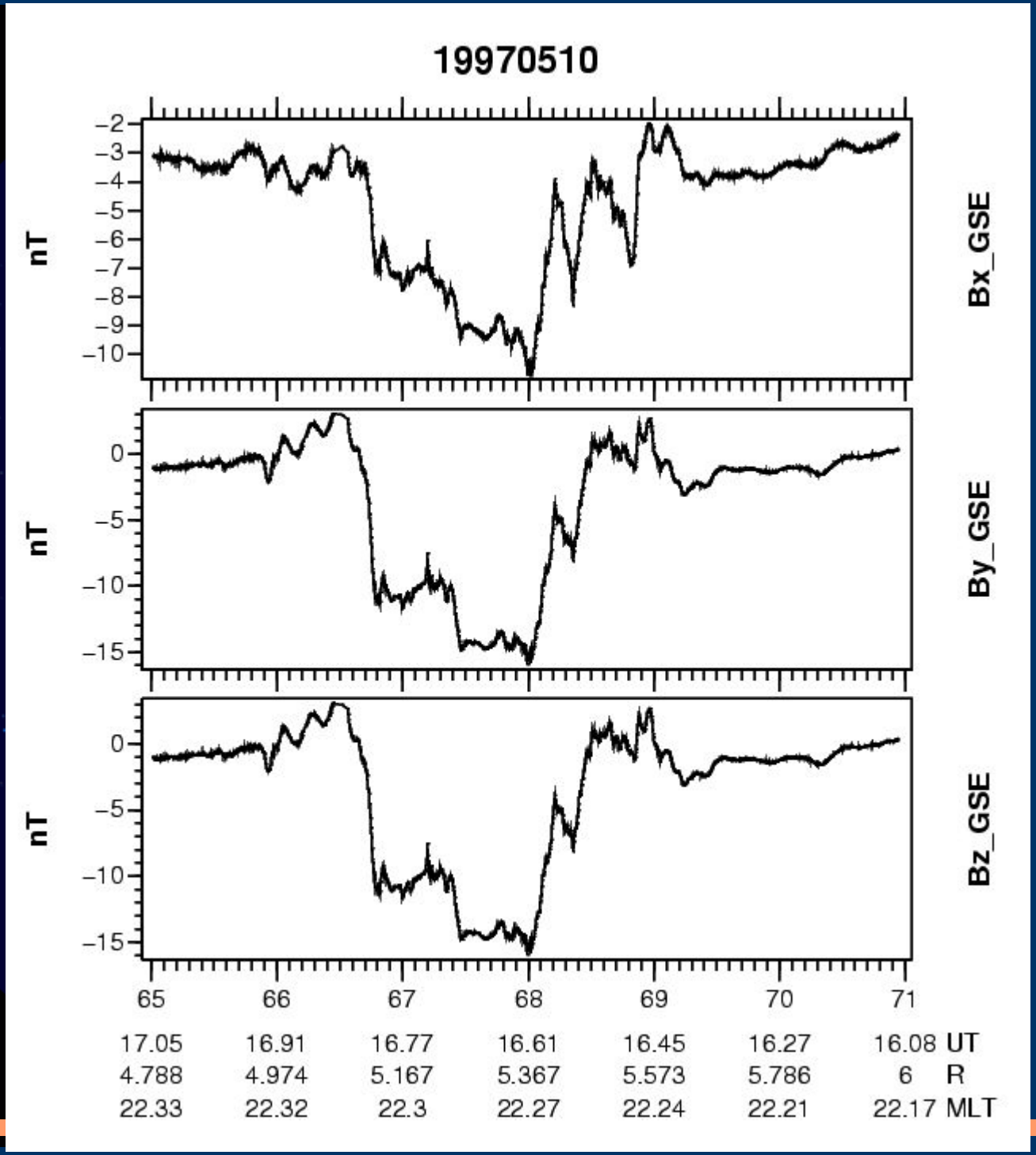
- Poynting flux as function of altitude
- Comprehensive statistical study using 5 years of Polar data (EFI + MFE)
- Locus of Alfvenic electron acceleration ("Alfven Resonosphere")
- Fraction of electron precipitation powered by Alfvenic acceleration

Example Polar EFI and MFE data:

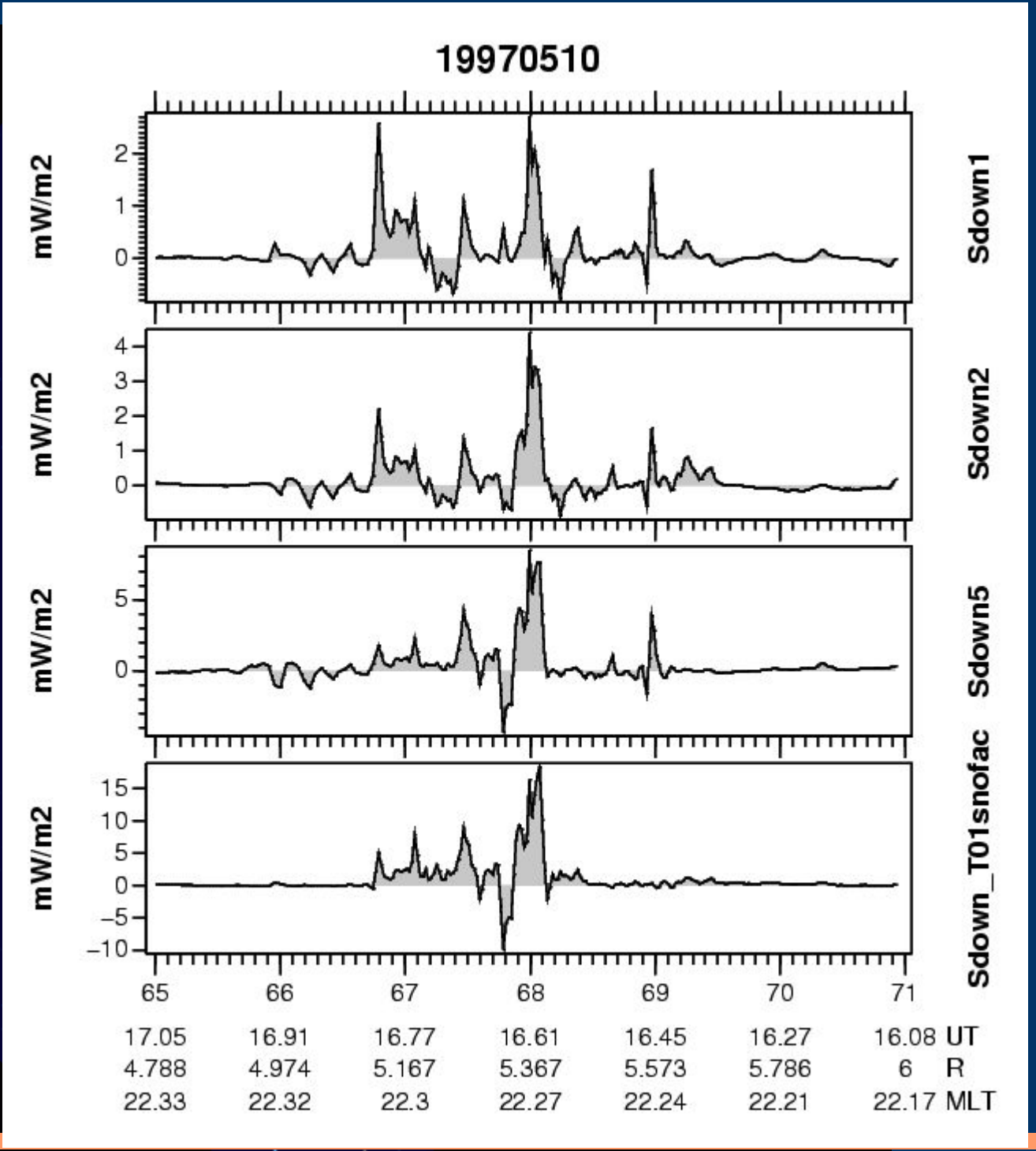
E-field



Polar B-field



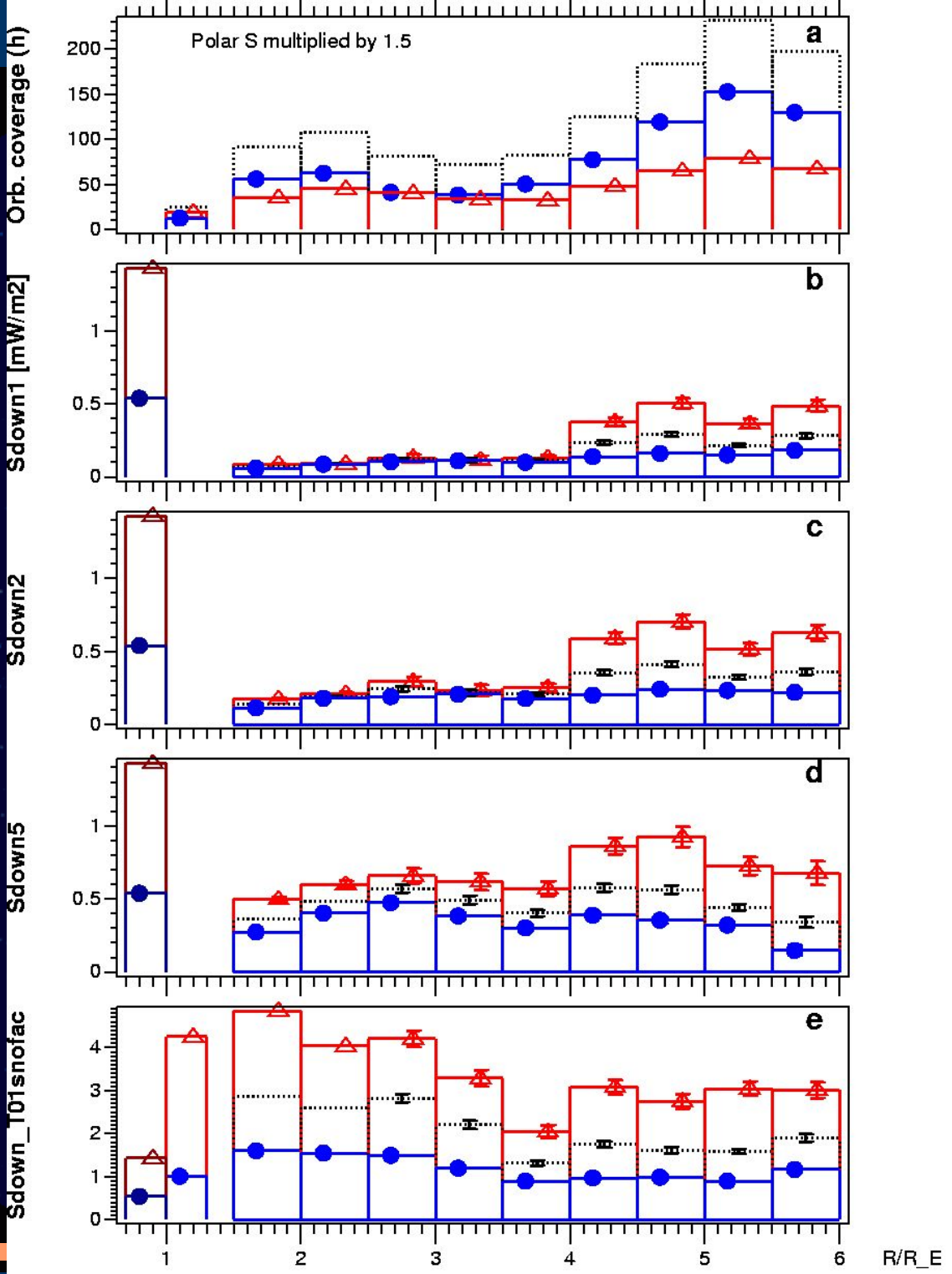
Poynting flux from Polar E-field and B-field



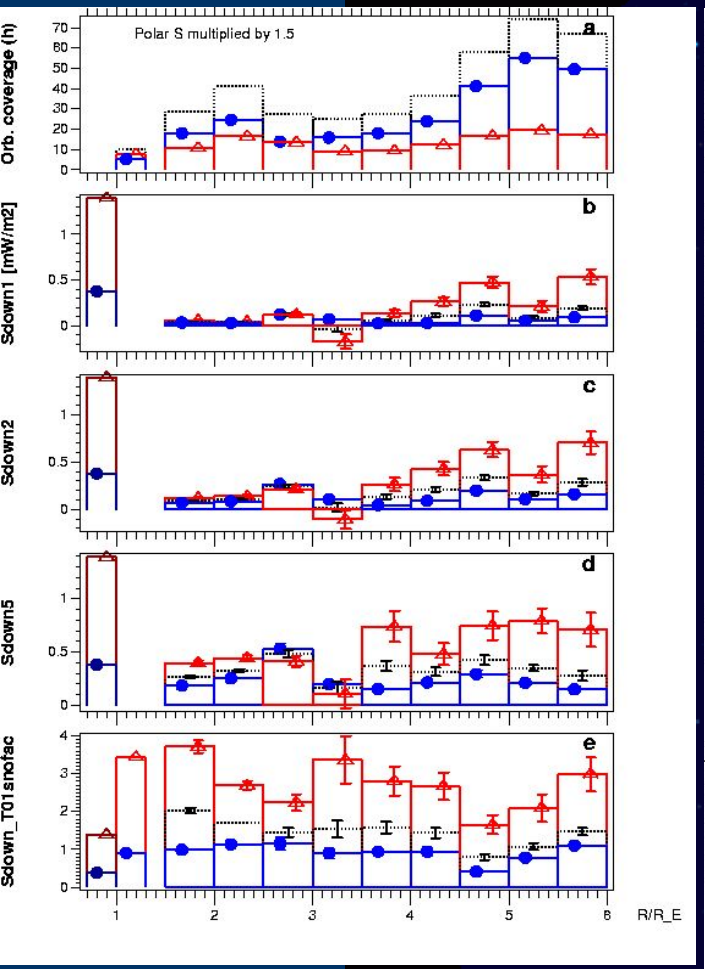
Basic statistical plot from Polar data

MLT 18-06, ILAT 65-74

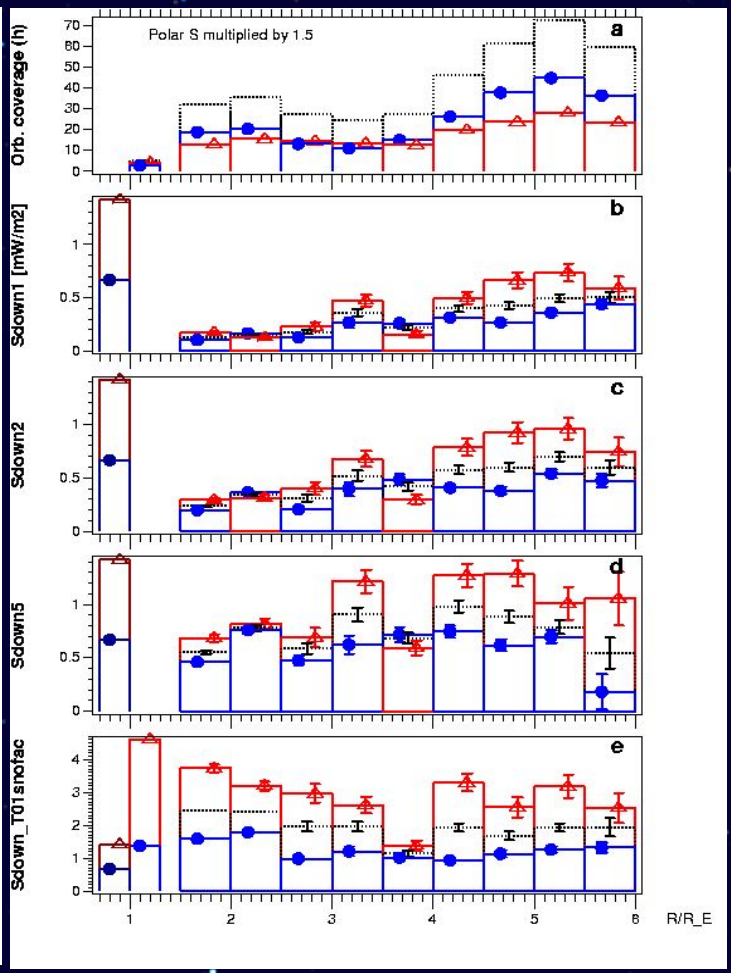
Kp>2 red, Kp 0-2 blue



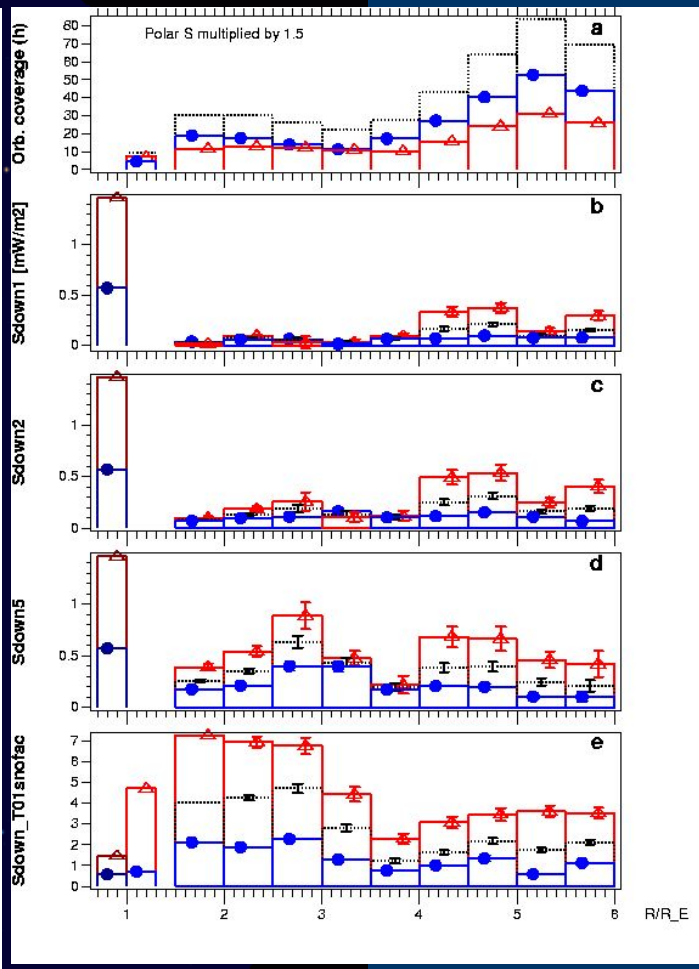
MLT-decomposed Polar statistics



MLT 18-22

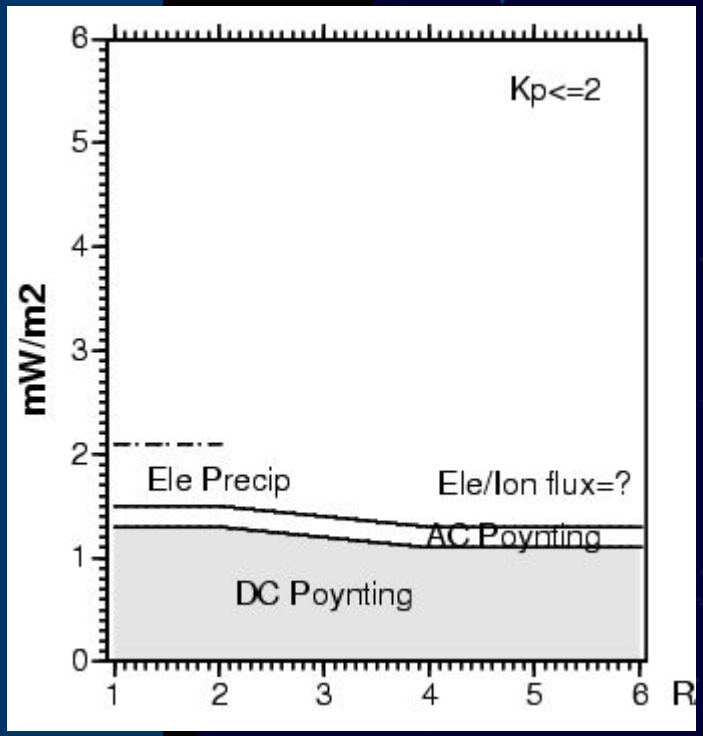


MLT 22-02

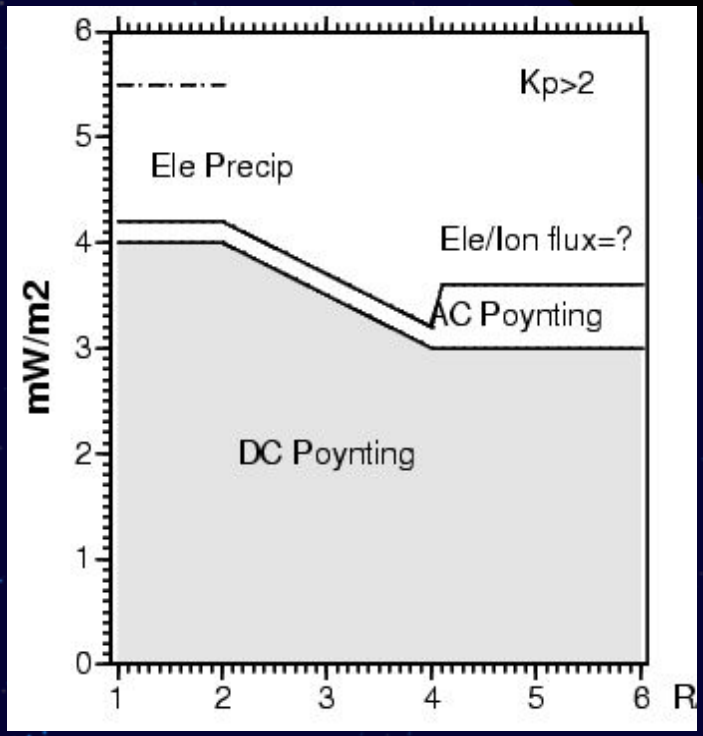


MLT 02-06

Auroral energy budget



Low Kp



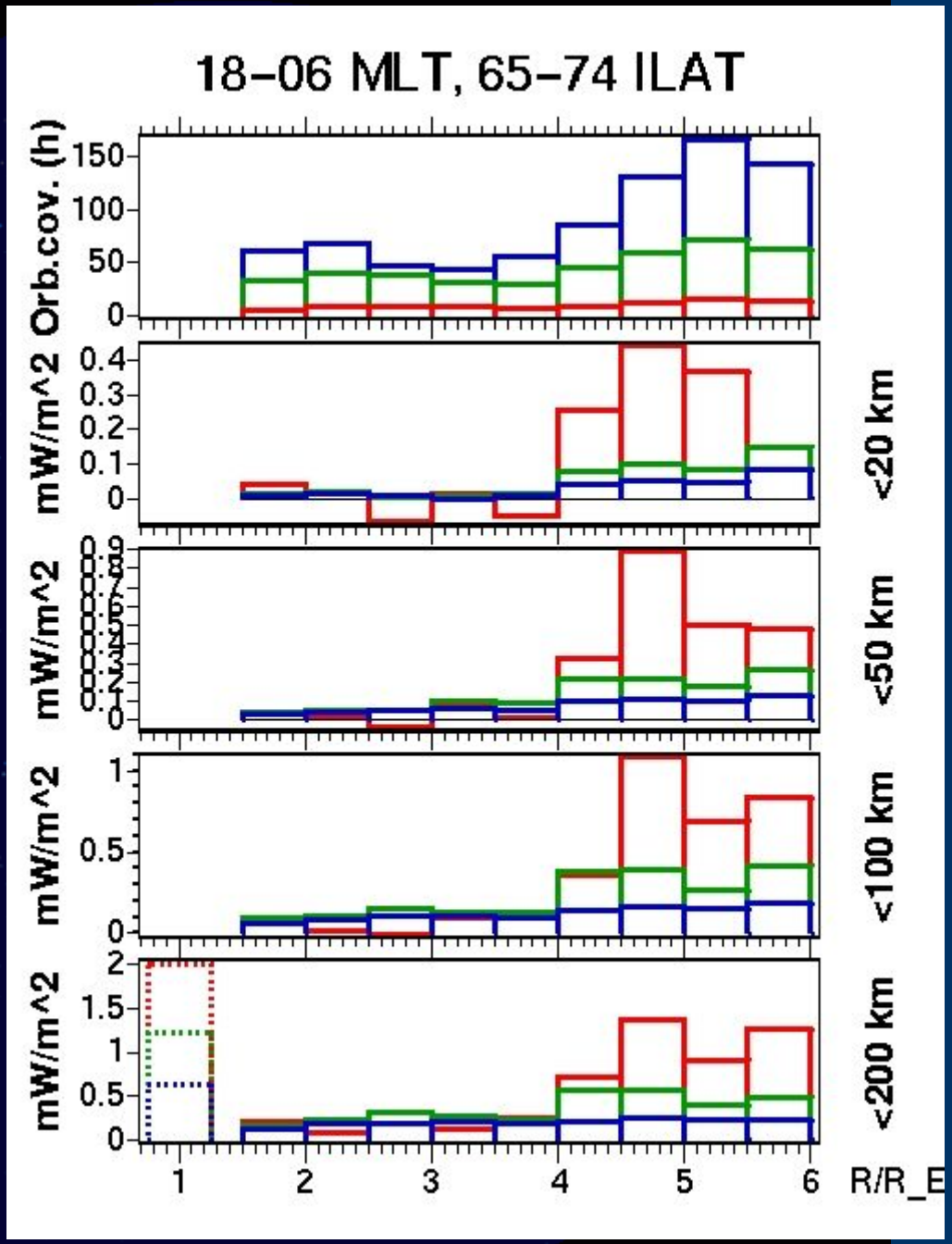
High Kp

- DC Poynting dominates
- AC small, but stepwise transition for Kp>2

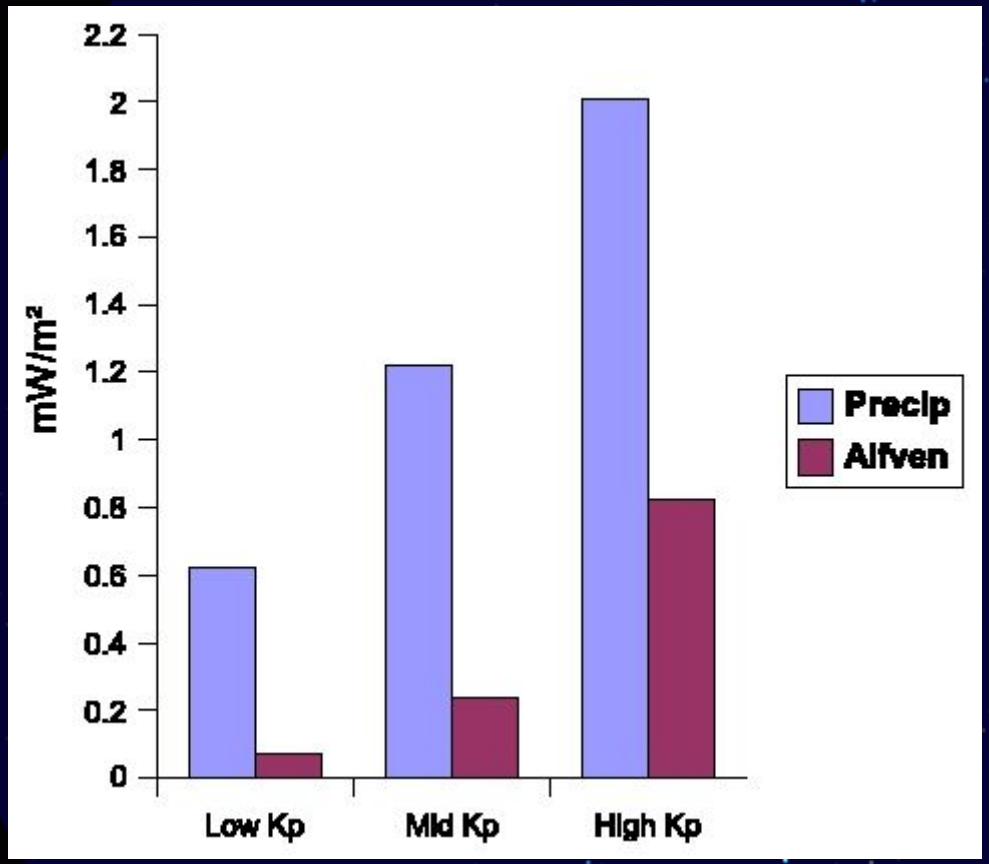
Same data;

only AC;

3 Kp ranges (blue: 0-2, green: 2-4, red: >4)

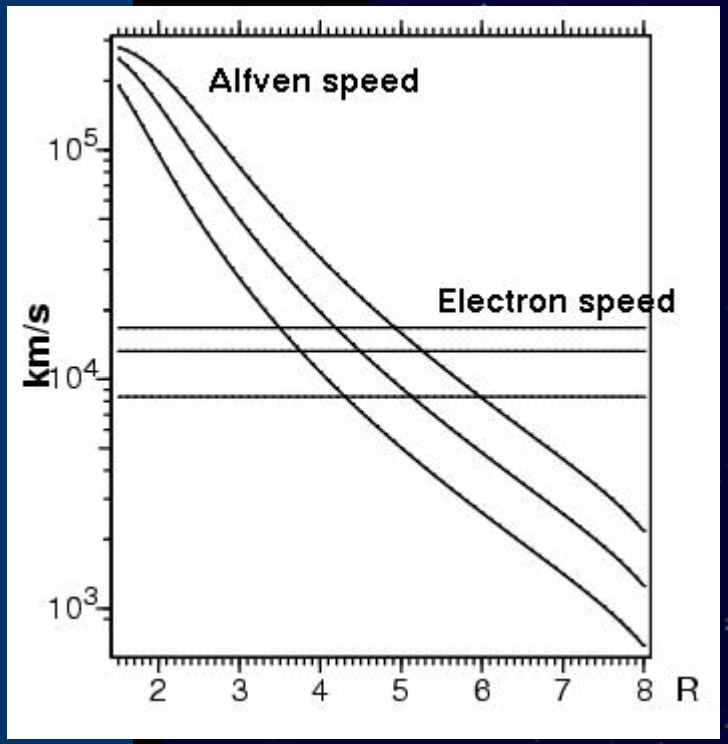


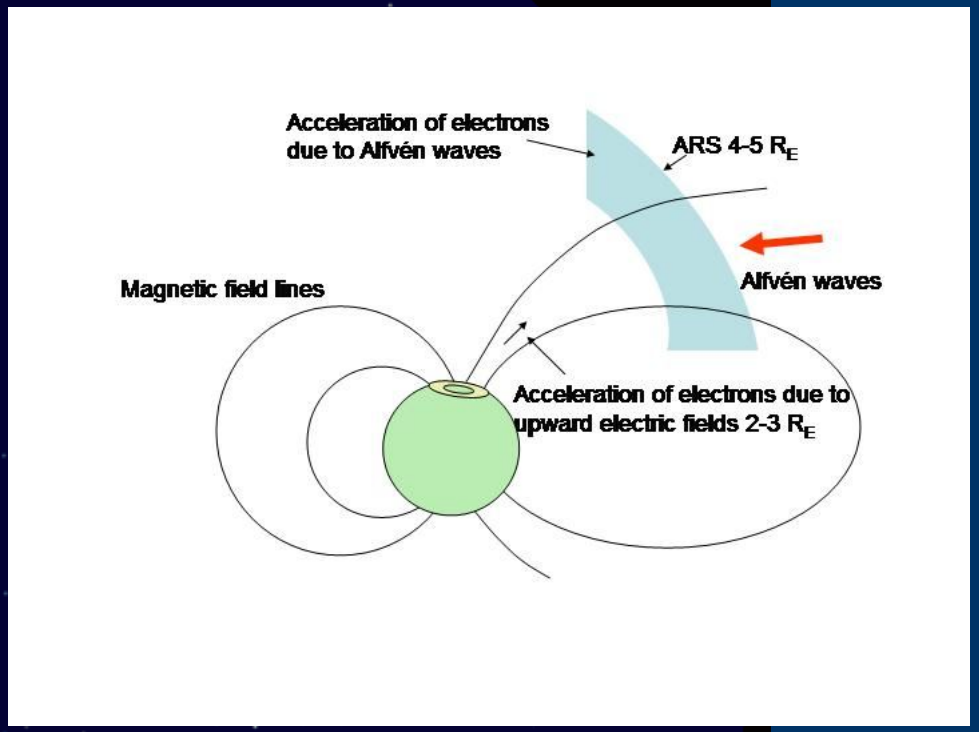
Electron precipitation energy budget



- AC Poynting sink at 4-5 R_E
- Compared to electron precipitation (Hardy)

The "Alfven Resonosphere"





- Alfven speed and electron thermal speed in **Landau resonance** at 4-5 R_E
- Natural explanation for "Alfven Resonosphere" and Poynting sink
- Independent support from dens. & E-field statistics

Conclusions

- 30% particle precipitation (mainly electron), 70% Joule heating
- Alfven waves (~100 km scale) responsible for 10-20-40% of electron precipitation for low-mid-high Kp, respectively
- Alfvenic electron acceleration occurs in the "Alfven Resonosphere" at 4-5 R_E (***not*** in the normal acceleration region)
- ARS explanation: Landau resonance

References

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