

On the Variation of Energy Inputs to the Nightside Auroral Oval with Substorm Phase

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Motivation

- Discrete (inverted-V) aurora is caused by precipitating electrons which are nearly monoenergetic, as if the electrons fall through a quasi-static potential drop, and cover all pitch angles outside the loss cone
 - Near the poleward boundary, electrons are field-aligned and bidirectional, consistent with acceleration in an Alfvén wave (Alfvénic aurora)
 - Case studies (Mende et al., 2003; Lessard et al., 2006) have reported that nightside aurora following substorm onset appears more Alfvénic than inverted-V
- Question: **to what extent does the nightside aurora become more Alfvénic after substorm onset**, i.e., are the reported case studies typical?

Data Set

- Using data from FAST (launched 1996, 350x4200 km orbit, 83° inclination)
- Electron precipitation data from EESA, divided into soft (< 1 keV) and energetic (> 1 keV) portions
- DC and Alfvénic Poynting flux computed from spin-plane E and axial B data
- Substorm onset list from Wilson et al. (2004): 120 usable events (full nightside passes with both electron and fields data)

Example Passes

- Figure 1** shows the energy inputs from Orbit 1690. The nearest substorm onset was at 16:42 UT.
- Figure 2** shows the energy inputs from Orbit 1556. The nearest substorm onset was at 07:24 UT. All energy inputs are higher in the orbit 1556 pass—as much as two orders of magnitude in the Poynting fluxes.

Methodology

- Superposed epoch analysis with substorm onset time as zero epoch
- Data binned as follows:
 - 15 minutes in time
 - MLT divided into pre- and post-midnight
 - Auroral oval divided in five parts based on visual inspection of auroral boundaries



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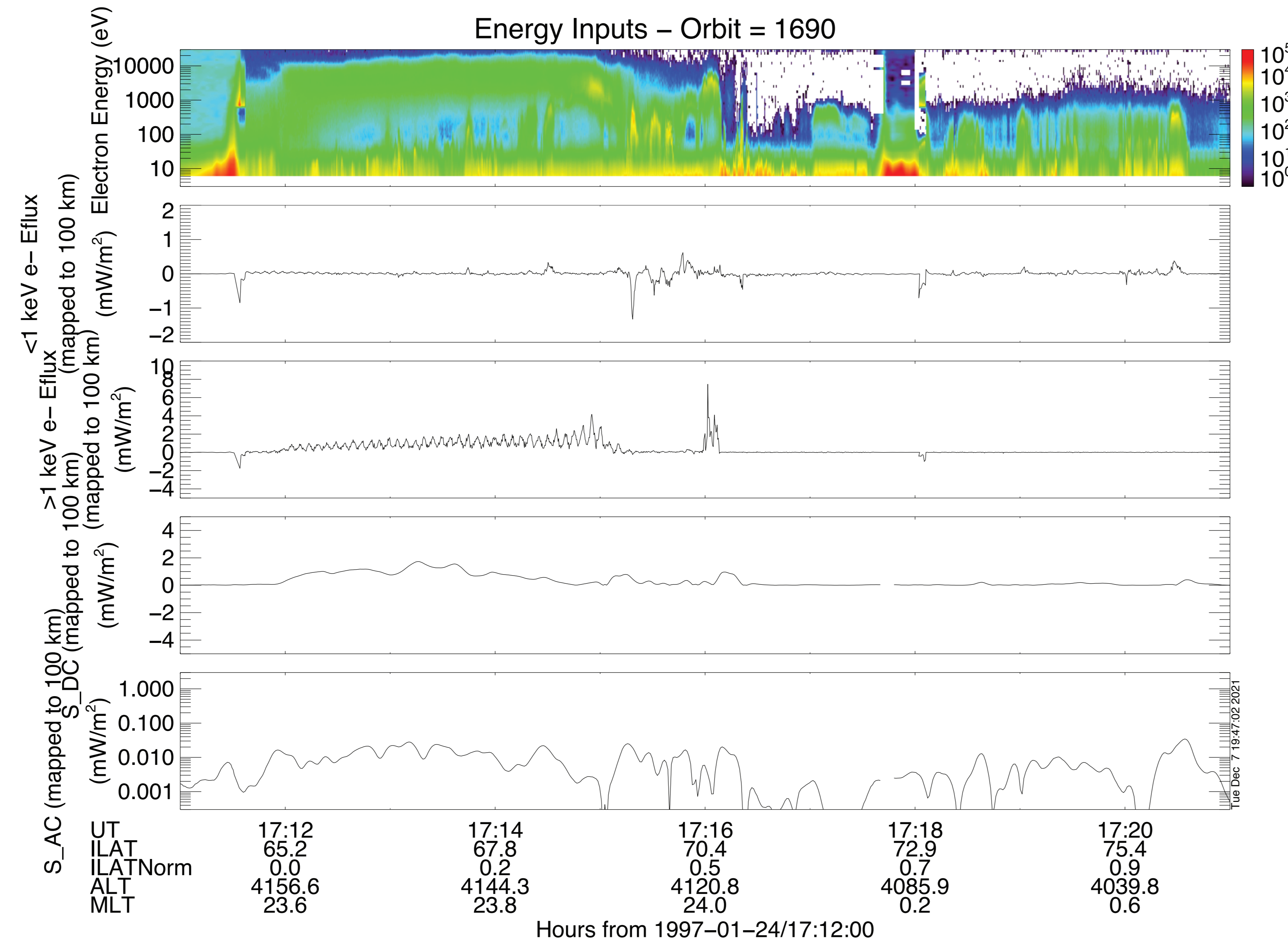


Figure 1

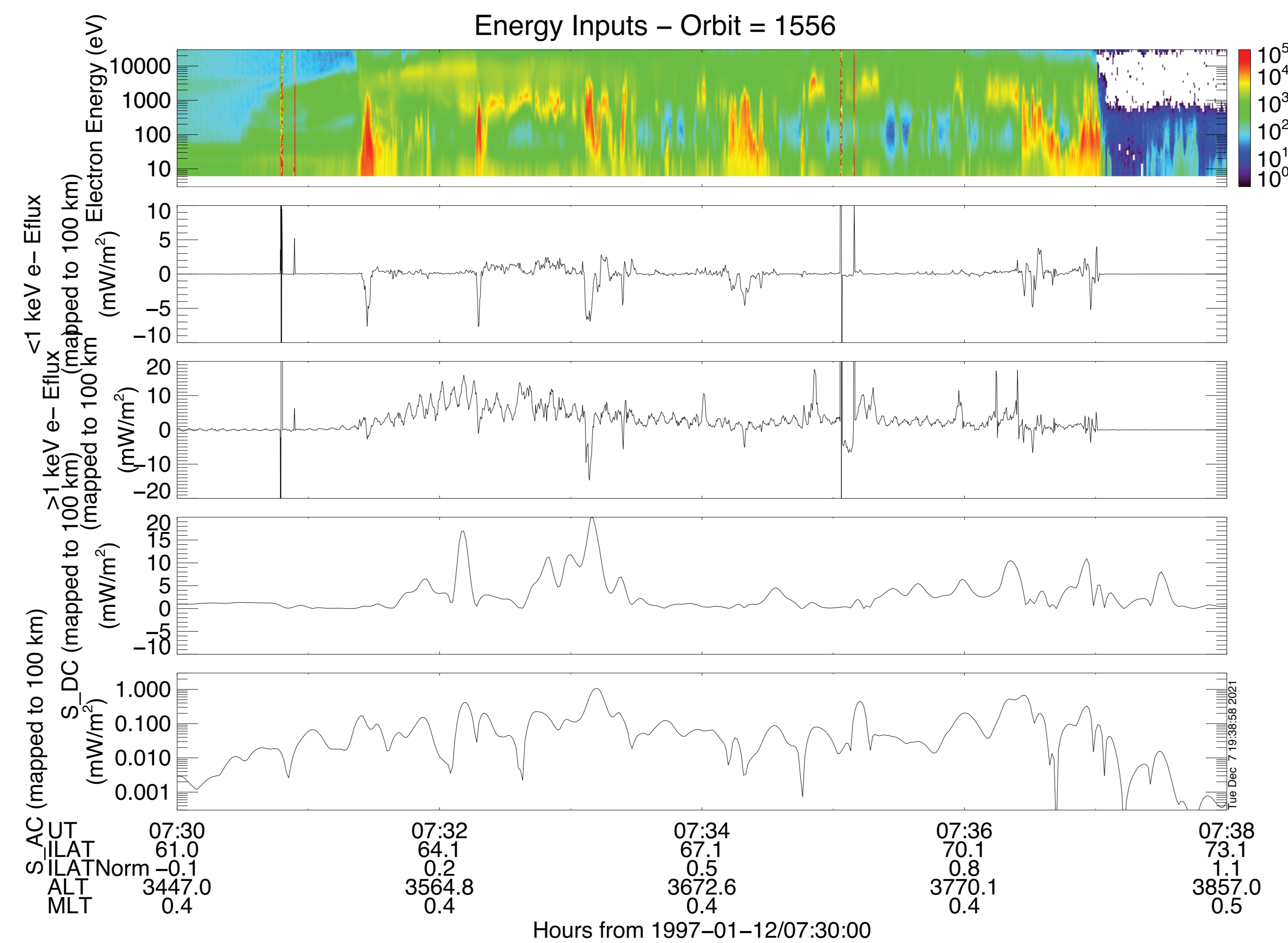


Figure 2

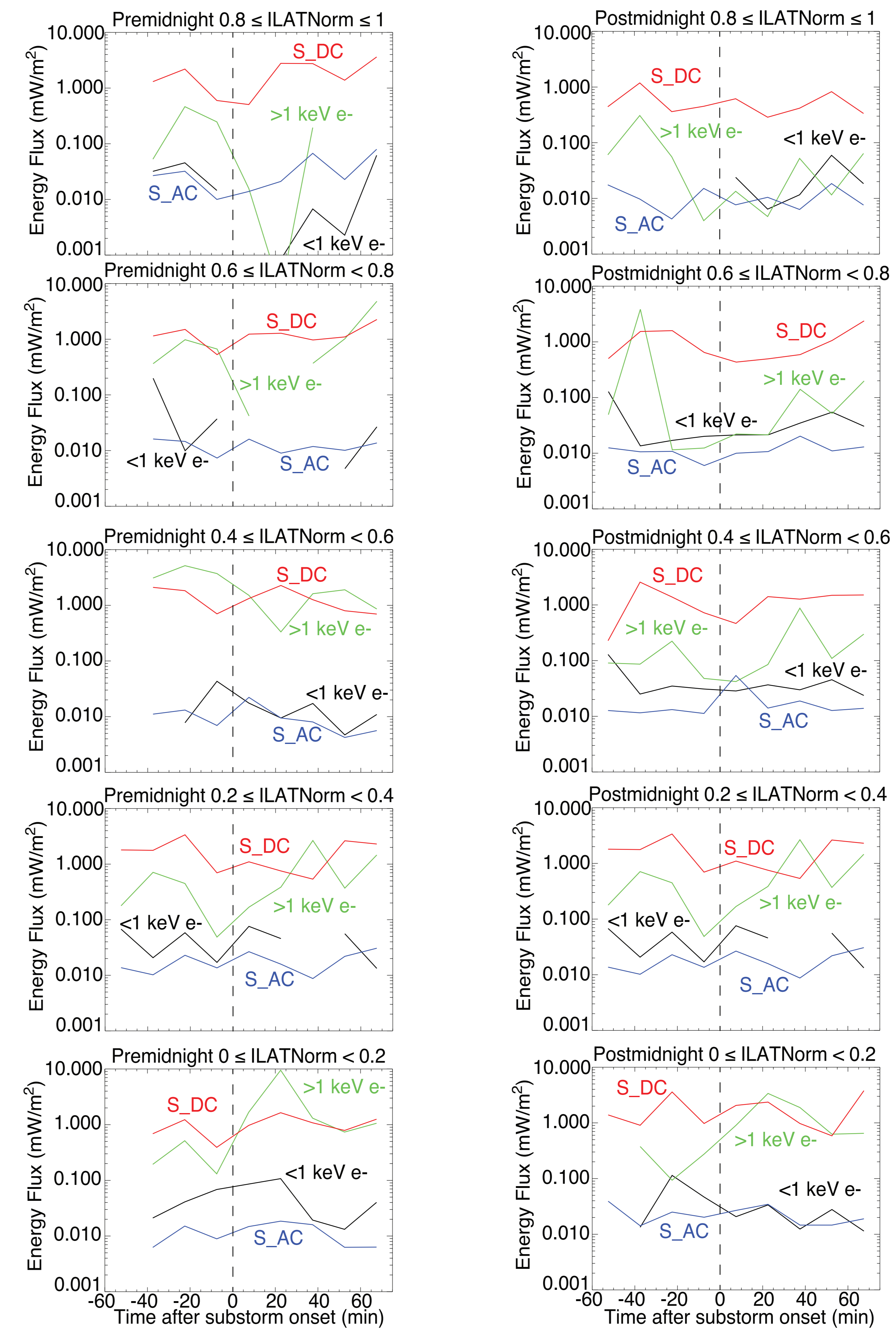


Figure 3

Results

- Figure 3** shows the results broken into pre- and post-midnight, and location within the oval (0 = equatorward edge, 1 = poleward edge)
- Premidnight: Energetic electron fluxes decrease after onset except near equatorward edge, recover after ~30 min
- Premidnight: DC Poynting flux minimum near substorm onset, increasing for ~30 min thereafter
- Postmidnight: Energetic electron fluxes peak ~30 min after onset
- Postmidnight: No significant trend in Poynting fluxes after onset
- Soft electrons and AC Poynting flux are minor contributors to energy budget but are expected to impact ion outflow in other ways

Acknowledgements

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References

- Lessard, M R, et al. (2006), GRL 33, L14108, doi:10.1029/2006GL026411
 Mende, S B, et al. (2003), JGR 108, 1344, doi:10.1029/2002JA009787
 Wilson, G R, et al. (2004), JGR 109, A02206, doi:10.1029/2003JA009835

Summary

- Evidence that DC Poynting flux increases in importance relative to energetic electrons following substorm onset in the premidnight aurora
- DC Poynting flux is the dominant energy source at all times near the poleward boundary
- However, the postmidnight aurora does not appear to be significantly more Alfvénic after substorm onset than before