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Local time variations of auroral electrojet during storm time: DMSP and CHAMP coordinated observations

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1. Motivation

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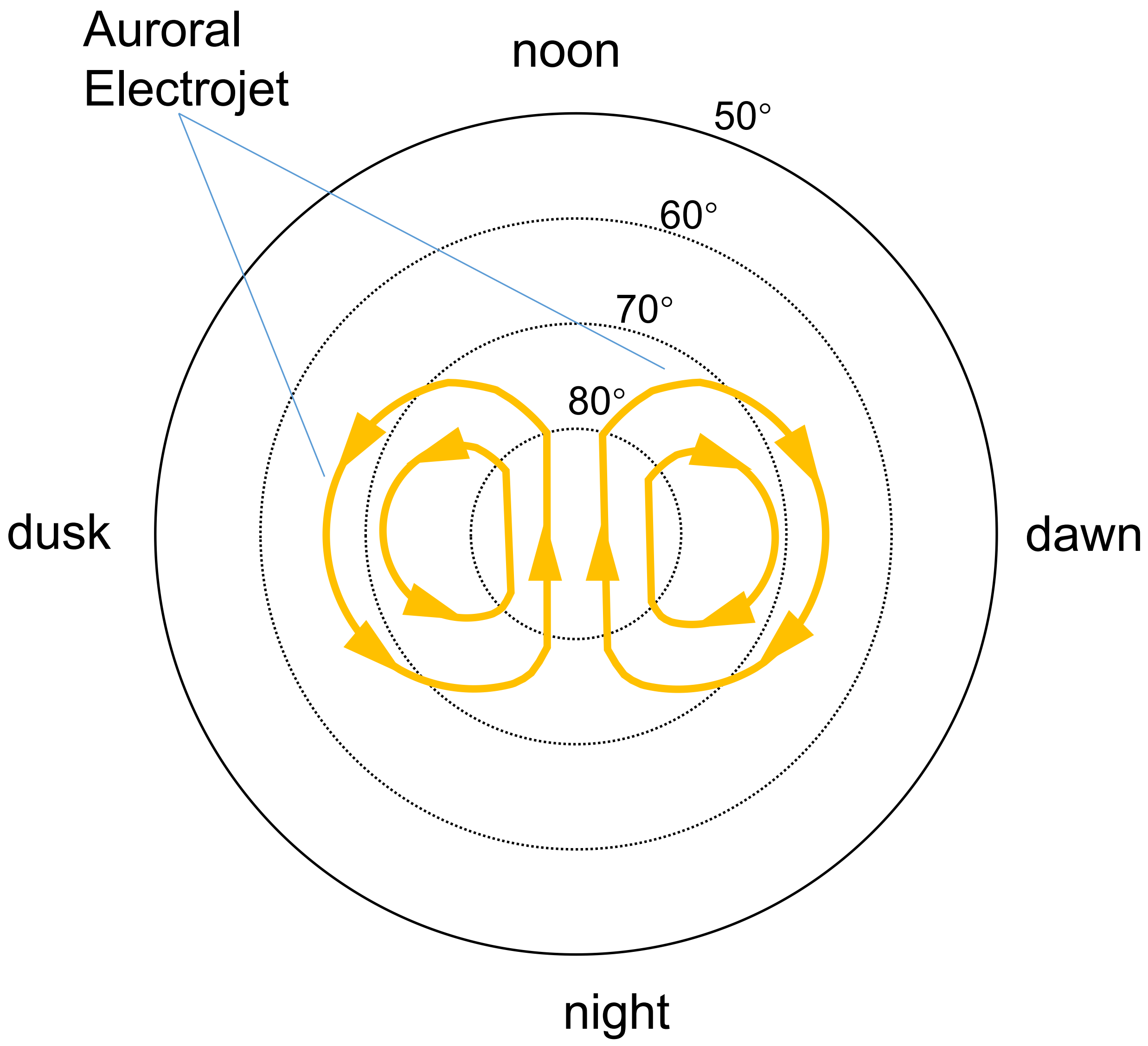

Figure 1. Auroral electrojet diagram

The **auroral electrojet (AEJ)** is ionospheric current in the auroral oval, flowing eastward in the dusk sector and westward in the dawn and midnight sectors.

There is still no comprehensive understanding of the response to the sudden change in solar wind inputs at different local times.

2. Data and Methods

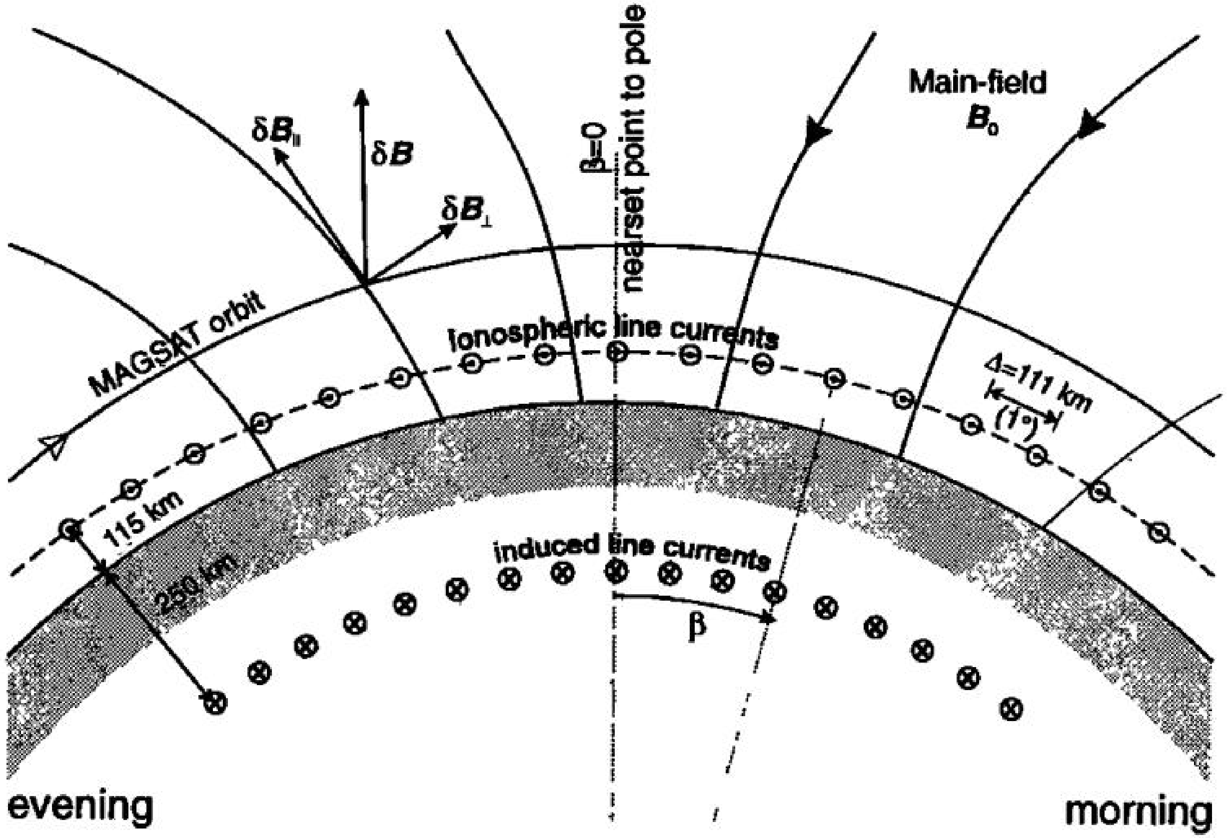

Figure 2. AEJ Model (Olsen, 1996)

We used 10 years of scalar magnetic field data from Challenging Minisatellite Payload (CHAMP) to retrieve the AEJ.

Inversion method:

AEJ → infinite line currents

3. Results 3.1 Solar wind input condition

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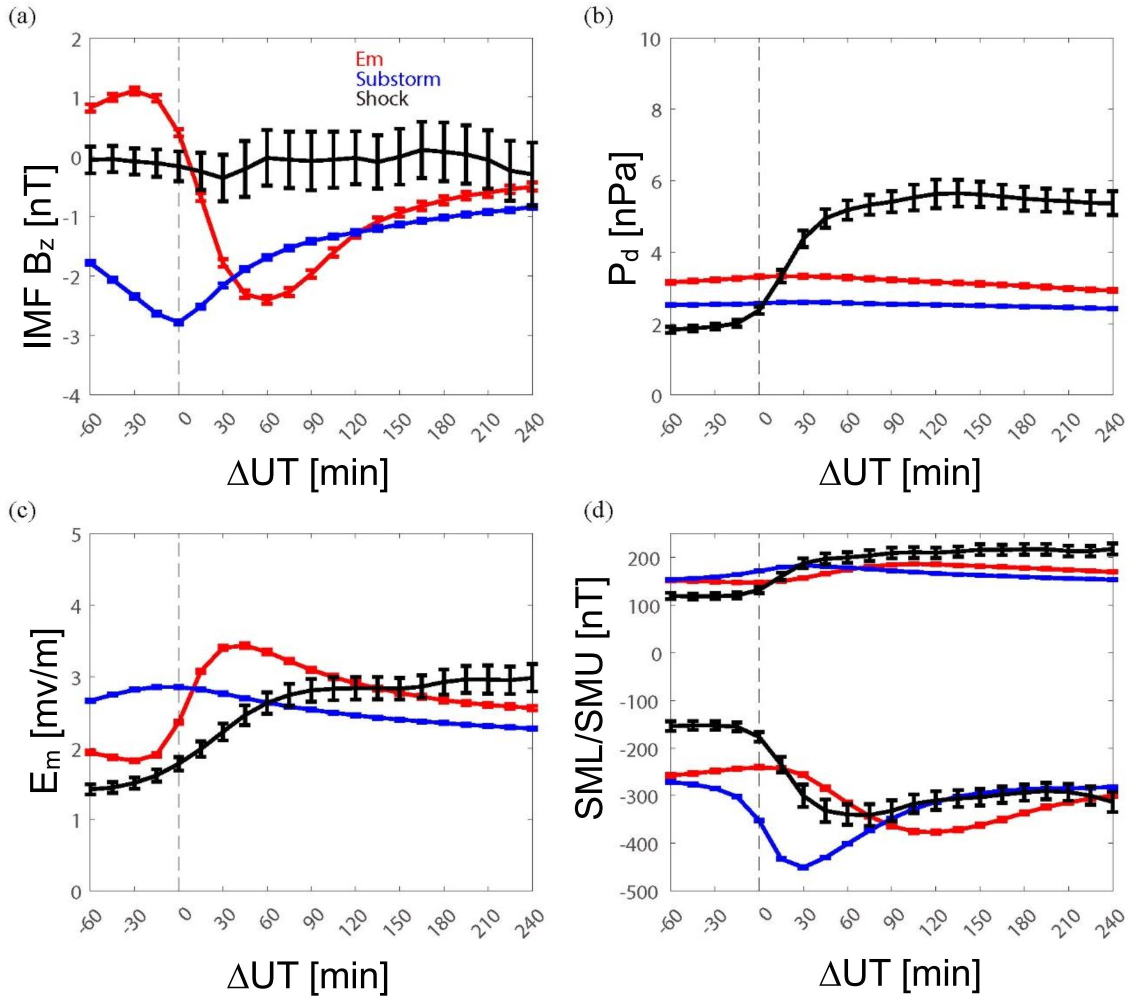

Figure 3. Superposed epoch analysis of the mean variation in interplanetary magnetic field (IMF) B_z (**a**), solar wind dynamic pressure (P_d) (**b**), E_m (**c**), and *SML*/*SMU* (**d**) around the onset time.

Merging electric field (E_m) enhancement:

IMF southward turning

Substorm:

IMF northward turning

Interplanetary (IP) shock:

P_d increase

3. Results 3.2 Local time response of AEJ

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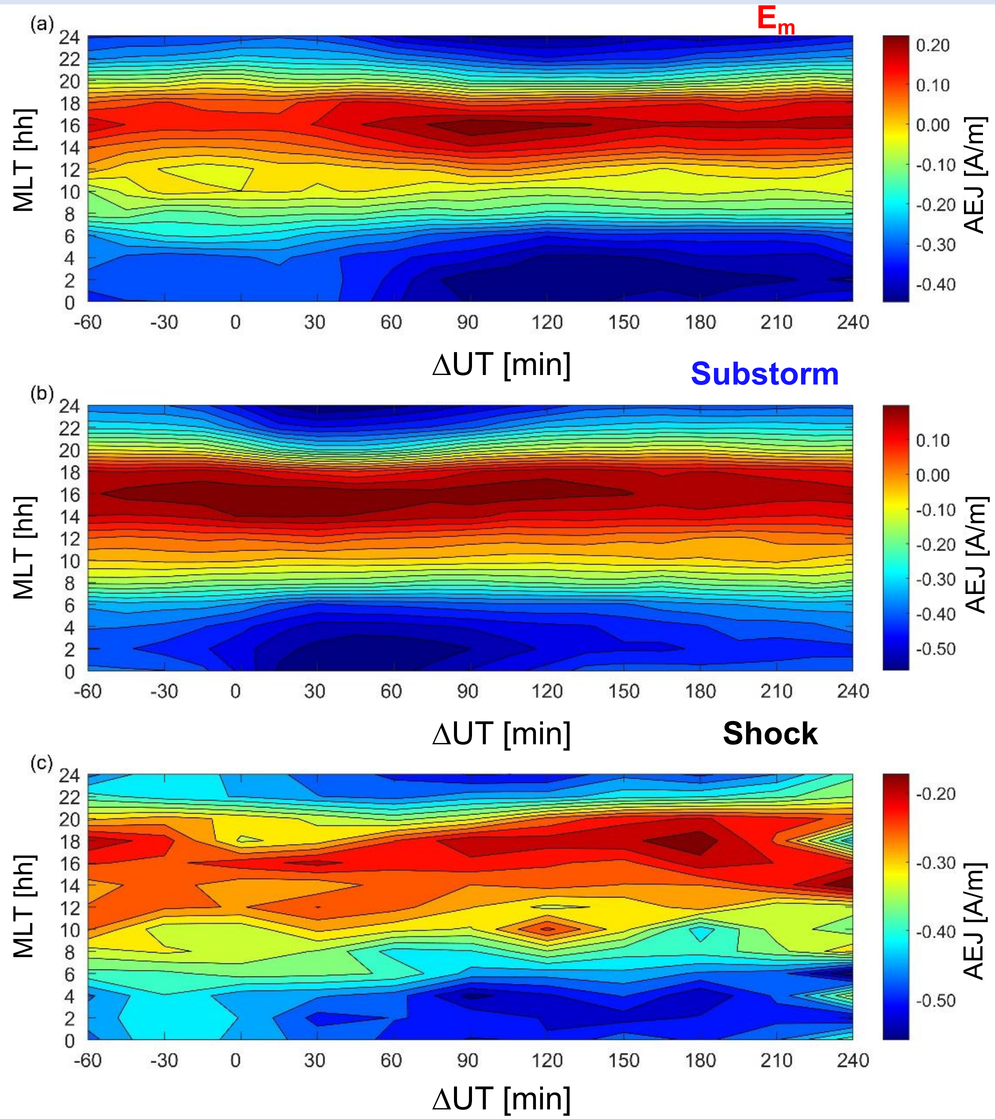

Figure 4. MLT and ΔUT variations in the AEJ during the period of E_m enhancement (**a**), substorm (**b**), and IP shock (**c**) in the Northern Hemisphere.

AEJ is eastward in the dusk sector and westward in the morning and midnight sectors.

Westward currents are much more intense than eastward currents.

3. Results 3.2 Local time response of ΔAEJ

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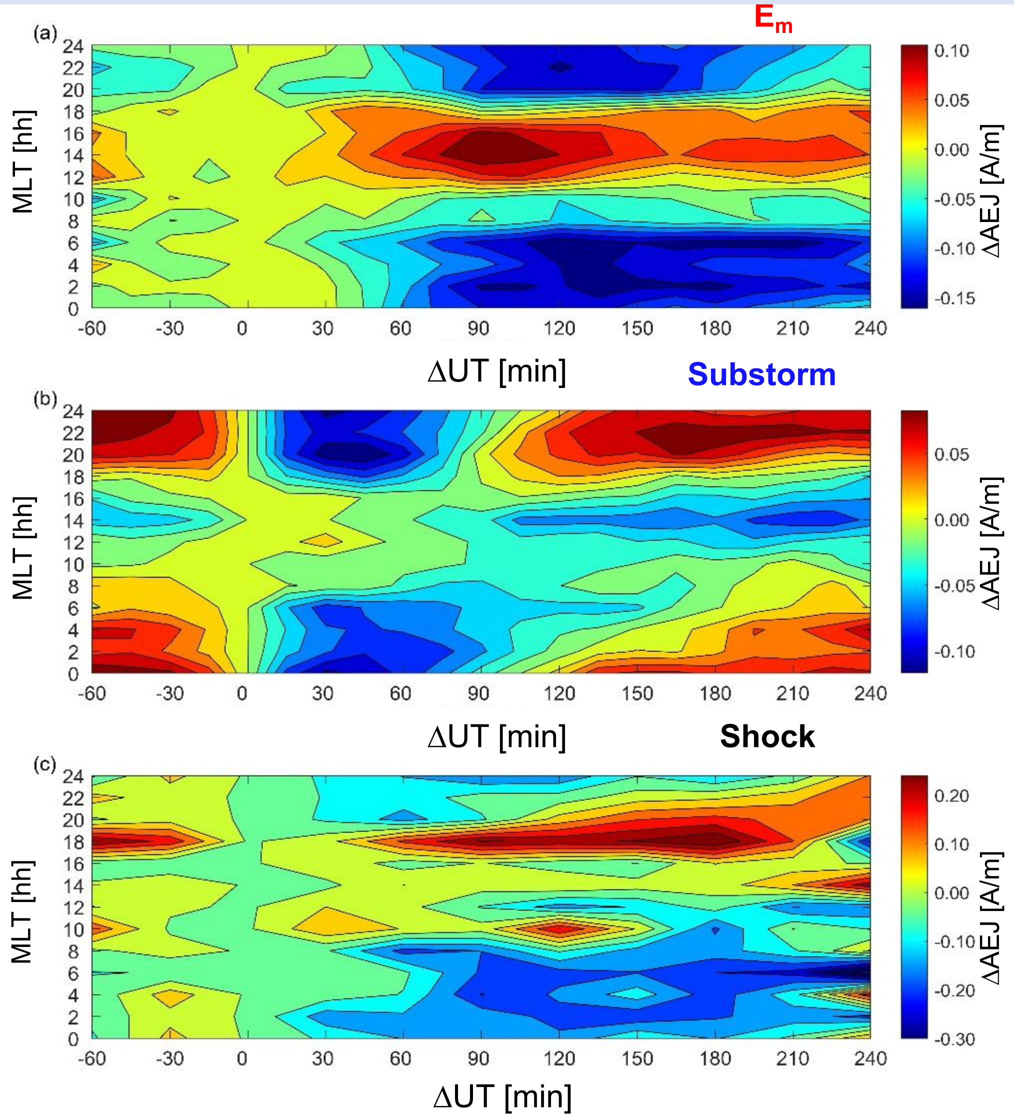

Figure 5. MLT and ΔUT variations in the ΔAEJ during the period of E_m enhancement (**a**), substorm (**b**), and IP shock (**c**) in the Northern Hemisphere.

The initial response time of the AEJ to E_m enhancement in the daytime (nighttime) is within several minutes (more than 30 min). For substorms and IP shocks, the AEJ at all local times shows an instantaneous response.

Auroral electrojet at dusk attains a peak faster than that at dawn.

3. Results 3.3 Hall conductance and convective electric field

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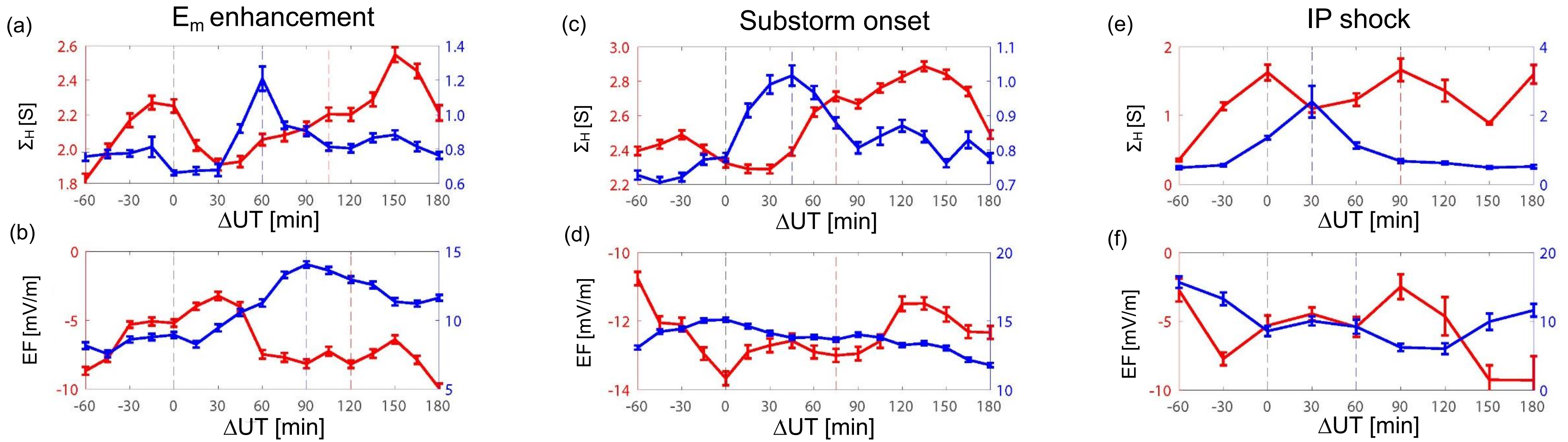

Figure 6. Response of the Hall conductance (Σ_H) and electric field (EF) to E_m enhancement (**a**, **b**), substorm onset (**c**, **d**), and IP shock (**e**, **f**) at 0400–1000 MLT and 1500–2200 MLT.

Hall conductance at dusk attains a peak faster than that at dawn, resulting in faster enhancement of AEJ at dusk.

4. Conclusion

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- Westward electrojets are much more intense than eastward electrojets.

- The daytime (nighttime) AEJ responds several minutes (> 30 min) after the key time of E_m enhancement. For substorms and IP shocks, the AEJ at all local times shows an instantaneous response.

- Auroral electrojet at dusk attains a peak faster than that at dawn, due to the faster enhancement of Hall conductance.