Local Time and Longitudinal Dependence of Equatorial Electrojet Calculated from Ground-based Magnetometer

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1. INTRODUCTION

Global part of Sq current system and Equatorial electrojet, EEJ at dip equator

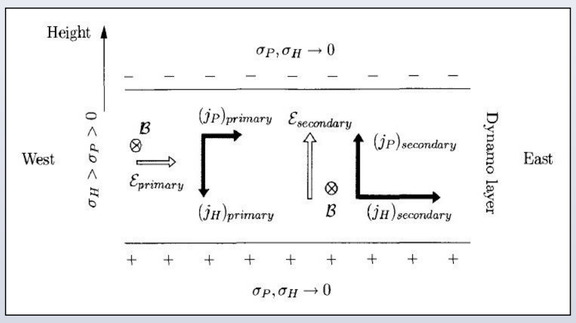

Fig. 1 Dynamo region at EEJ band (Prolss, 2004)

- **Sq** at equator is corresponds to j_P while **EEJ** corresponds to j_H (Onwumechili, 1992).
- Both currents overlap at the magnetic equator to give total current, j_T
- The ground magnetometer observations at the equator is directly influenced by j_T

$$j_T = j_{H\,(secondary)} + j_{P(primary)} = \sigma_2 \underline{\boldsymbol{B}} \times \underline{\boldsymbol{E}}_{\boldsymbol{H}}/B + \sigma_1 = \left(\frac{\sigma_2^2}{\sigma_1} + \sigma_1\right)\underline{\boldsymbol{E}}_{\boldsymbol{y}} = \sigma_3 \underline{\boldsymbol{E}}_{\boldsymbol{y}} \quad \text{where } \underline{\boldsymbol{E}}_{\boldsymbol{H}} = \sigma_2 \underline{\boldsymbol{E}}_{\boldsymbol{y}} \times \underline{\boldsymbol{B}}/\sigma_1 B$$

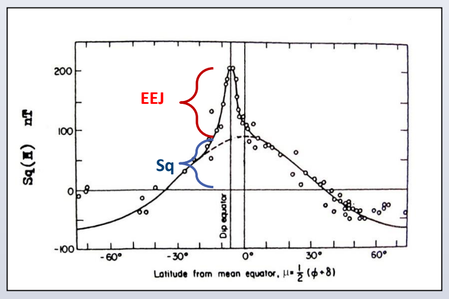

Fig. 2 Latitudinal profile of the quiet daily variation of the horizontal geomagnetic component (Onwumechili, 1967)

- **N**ormalized *EUEL* at dip equator is given by:

$$EUEL(0^\circ) = \frac{\mathrm{CM}_4(0^\circ)}{\mathrm{CM}_4(\theta^\circ)} EUEL(\theta^\circ)$$

- Normalized $EUEL_{\text{dip equator}}$ = Normalized total current
- Normalized $EUEL_{\text{off-dip equator}}$ = Normalized Sq
- EEJ = Normalized total current – Normalized Sq

Normalization of observation data based on CM4 model (Sabaka et al., 2004)

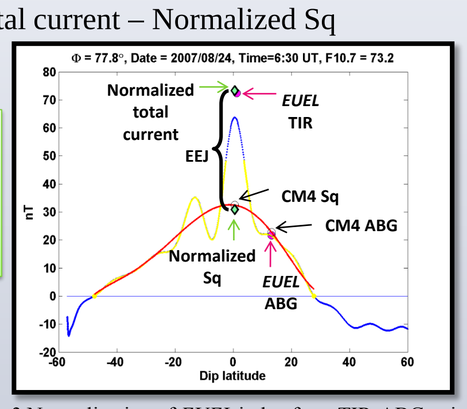

Fig. 3 Normalization of *EUEL* index from TIR-ABG pair

2. DATA AND ANALYSIS

- This study used simultaneous data of *EUEL* index (Uozumi et al., 2008) calculated from northward geomagnetic component from September 16 to 30, 2009 (Kp ≤ 3).

Table 1 Geographic and geomagnetic coordinates of the stations used

Region	Station		Geomagnetic	
	Name	*Code*	*Lat. (°)*	*Lon. (°)*
South America	Ancon	ANC	0.77	354.33
	Fuquene	FUQ	15.72	357.99
African	Ilorin	ILR	-1.82	76.80
	Tamanrasset	TAM	25.4	80.6
	Adis Ababa	AAB	0.18	110.47
	Nairobi	NAB	-10.65	108.18
India	Tirunelveli	TIR	0.21	149.30
	Alibag	ABG	10.36	146.54
Southeast Asia	Langkawi	LKW	-2.32	171.29
	Kototabang	KTB	-10.63	171.93
	Davao	DAV	-1.02	196.54
	Muntinlupa	MUT	6.79	192.25

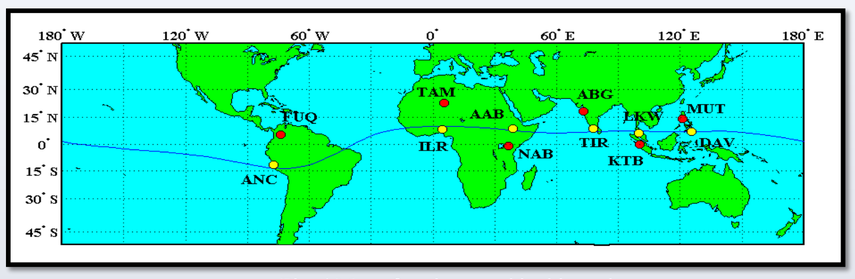

Fig. 4 Map of stations used in this study

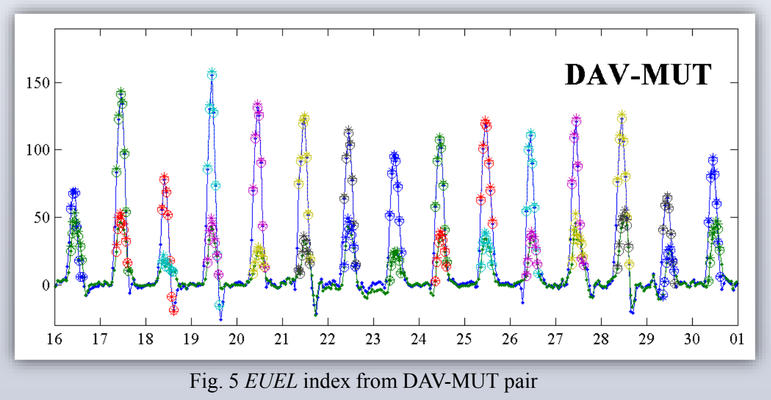

Fig. 5 *EUEL* index from DAV-MUT pair

Calculation of EEJ from normalized *EUEL* from DAV-MUT pair

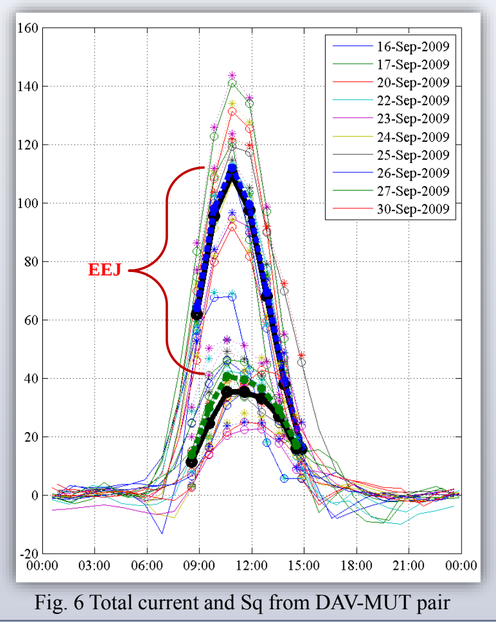

Fig. 6 Total current and Sq from DAV-MUT pair

3. RESULT AND DISCUSSION

Local time dependence

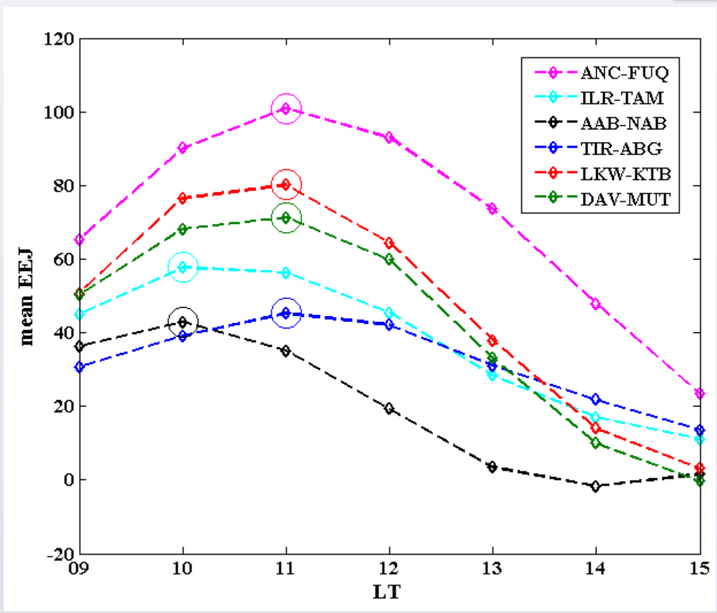

Fig. 7 Mean EEJ from 09 LT to 15 LT calculated from all station pairs. Circle symbols indicate the maximum mean EEJ of each pair

Table 2 Maximum local time (LT) where mean EEJ amplitude is the highest (see Fig. 7)

Pair (region)	Local time
ANC-FUQ (South America)	11
ILR-TAM (west African)	10
AAB-NAB (east African)	10
TIR-ABG (India)	11
LKW-KTB (west Southeast Asia)	11
DAV-MUT (east Southeast Asia)	11

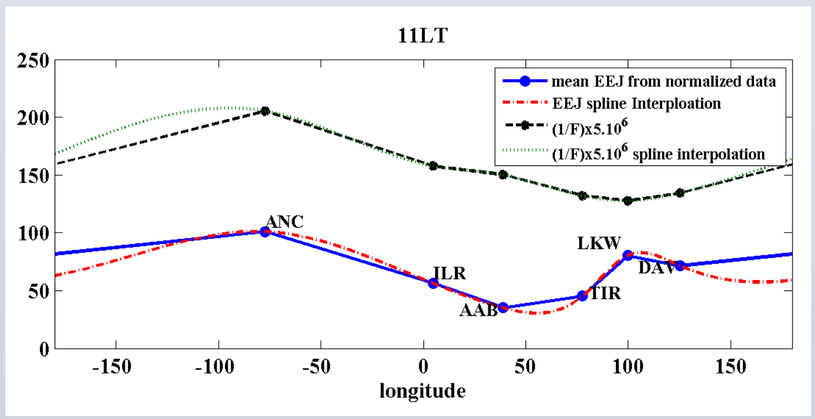

Fig. 9 Longitude variation of of EEJ at 11 LT and the inverse of the main field

Longitudinal dependence

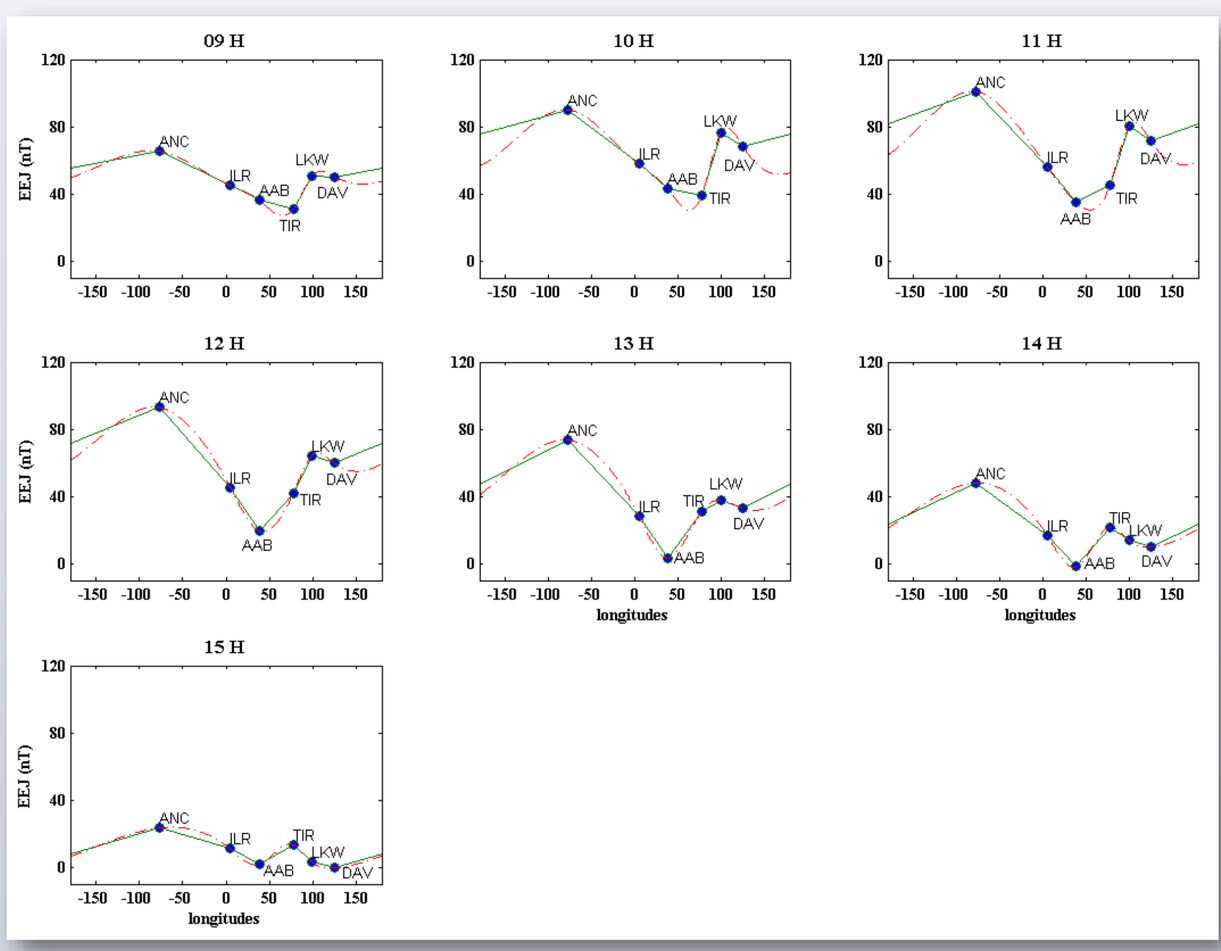

Fig. 8 Longitudinal dependence of the magnetic effects of EEJ from 09 LT to 15 LT. Dot symbols represent mean EEJ calculated from normalized observation data. Solid and dash lines represent linear and spline interpolations respectively.

- The longitude variation of EEJ during 11 LT roughly follow variations of the inversed main field strength along the dip equator except for in Indian and Southeast Asian sectors.

4. CONCLUSION

- EEJ is strongest during 10~11 LT.
- EEJ is found to be always strongest in South America regardless of local time.
- EEJ is weakest in Indian sector during 09 and 10 LT but shifted to African sector during 11 LT.

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