OBSERVATIONS OF EQUATORIAL IONIZATION ANOMALY OVER AFRICA DURING A YEAR OF DEEP MINIMUM

[1]**O.S. Bolaji,** [2,3]A.B. Rabiu, [1]E.O. Oyeyemi, [4]Y. Yamazaki, [5]E. Yizengaw, [7]J.O. Adeniyi, [5]P. Doherty, [6]Radicella, S.M., [8]A. Yoshikawa

United Nations / Japan Workshop on Space Weather "Science and Data Products from ISWI Instruments"

2-6 March, 2015

Overview

- Introduction

  -Equatorial Ionization Anomaly (EIA)

- Solar-quiet (Sq) Current System Features

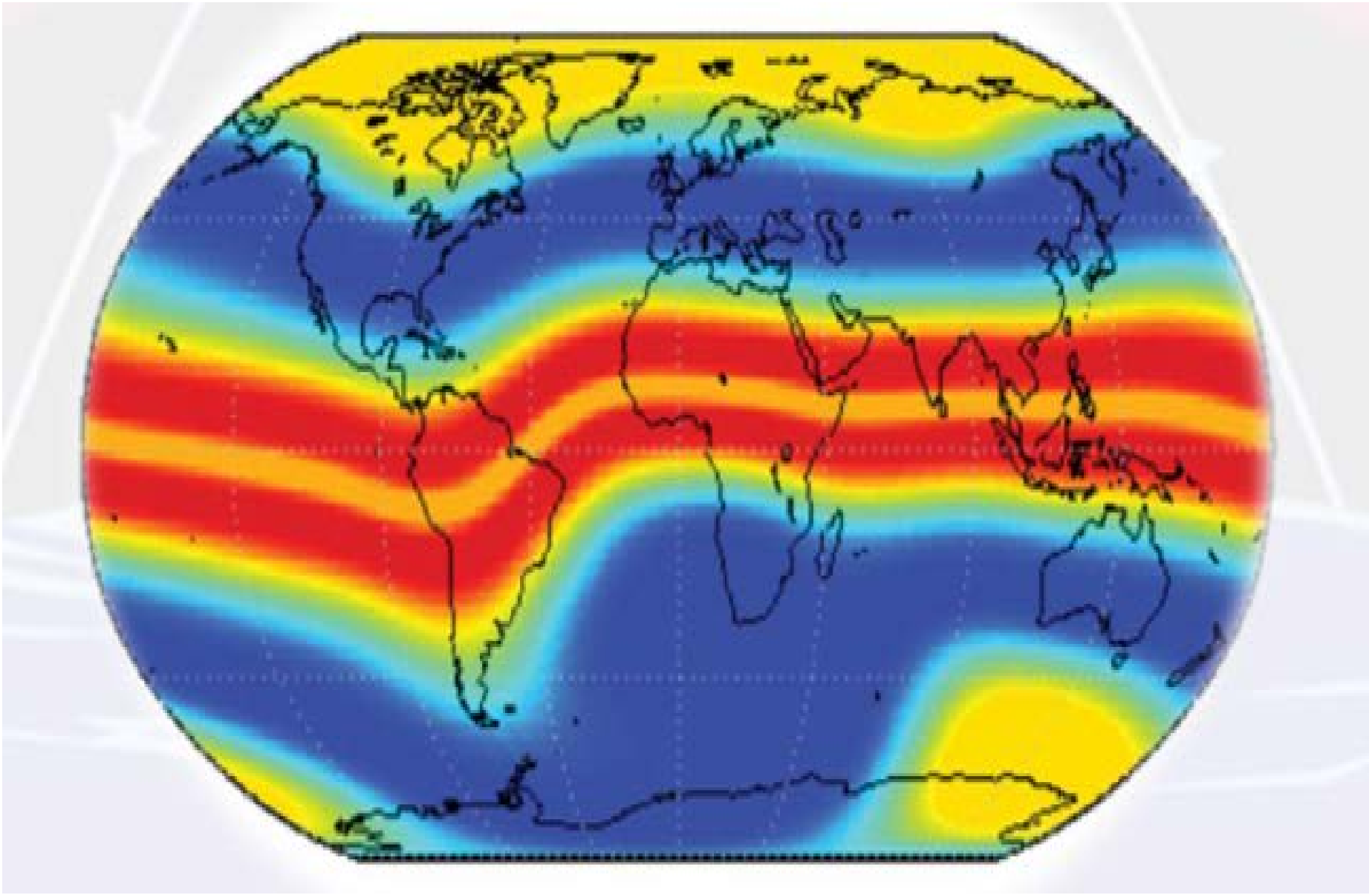
- Typical Equatorial Electrojet (EEJ) and Integrated EEJ Estimates

- Transportation: EEJ, Electric Field and Total Electron Content (TEC)

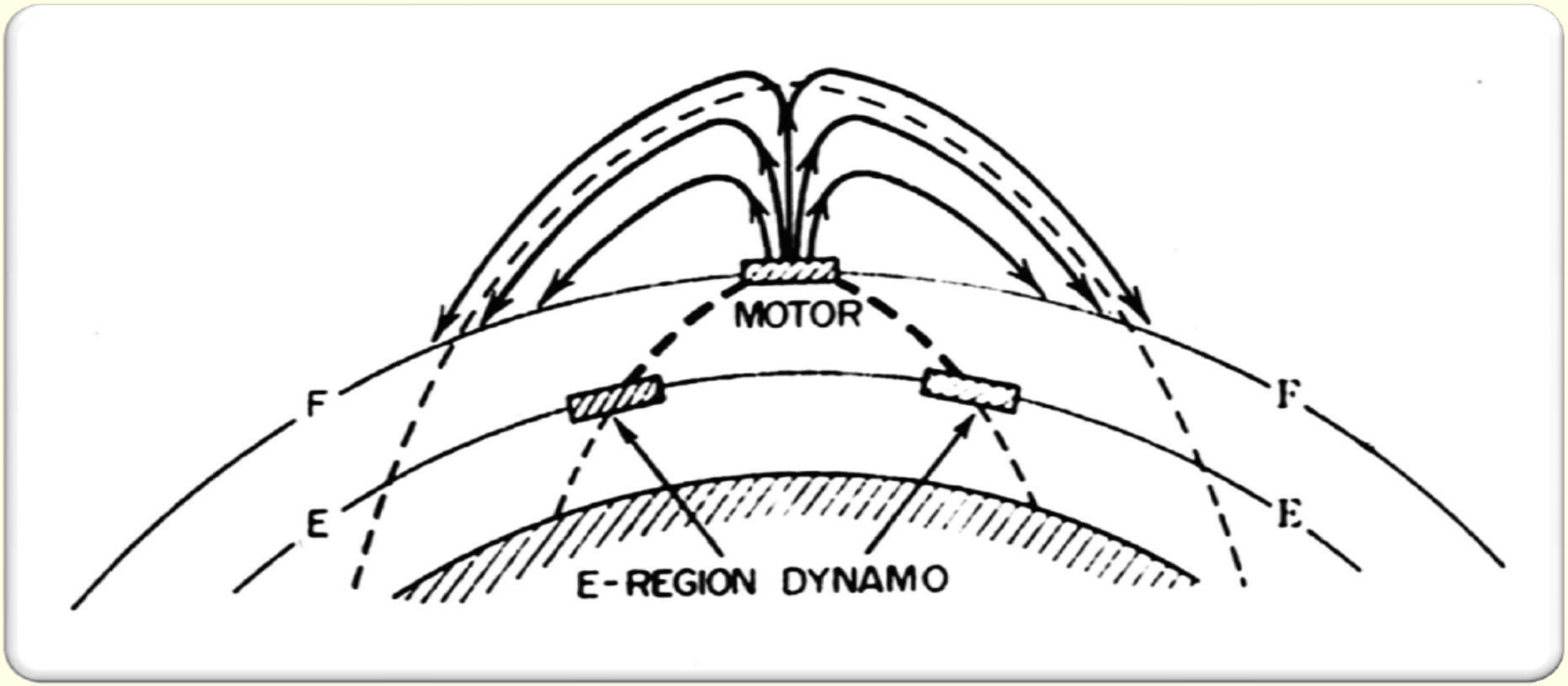
- Experimental Investigation

- Results and Conclusions

Introduction: Equatorial Ionization Anomaly (EIA)



Introduction: EIA contd.



- The F-region geomagnetic anomaly. Near the equator the electric fields of the atmospheric dynamo in the E layer are conveyed upwards along geomagnetic lines of force to the motor in the F layer where they produce an upwards movement of the plasma during the day. The raised plasma then diffuses down lines of force to produce enhanced concentration at places on each side of the equator and decreased concentration at the equator itself. [Ratcliffe. 1972].

Introduction: EIA contd.

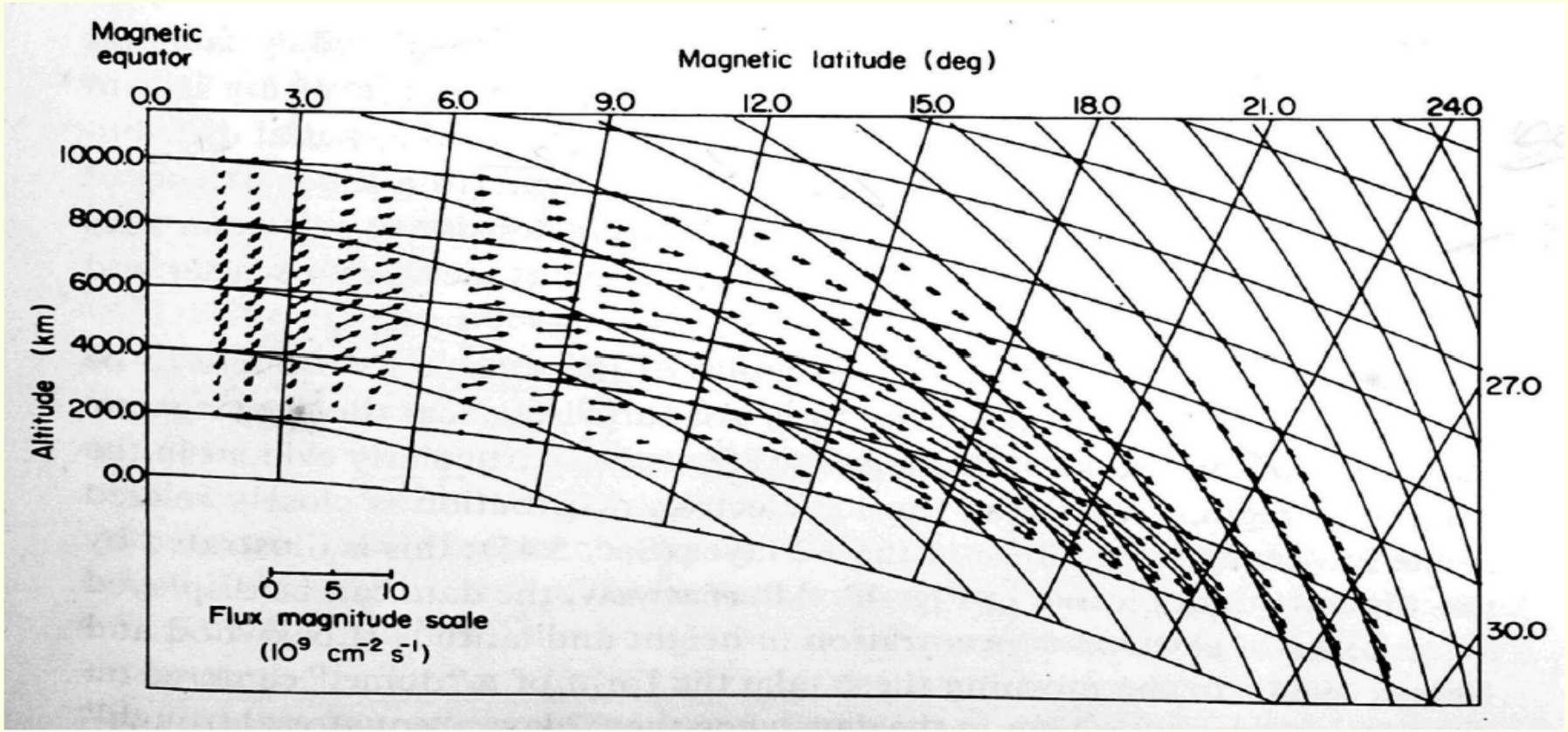
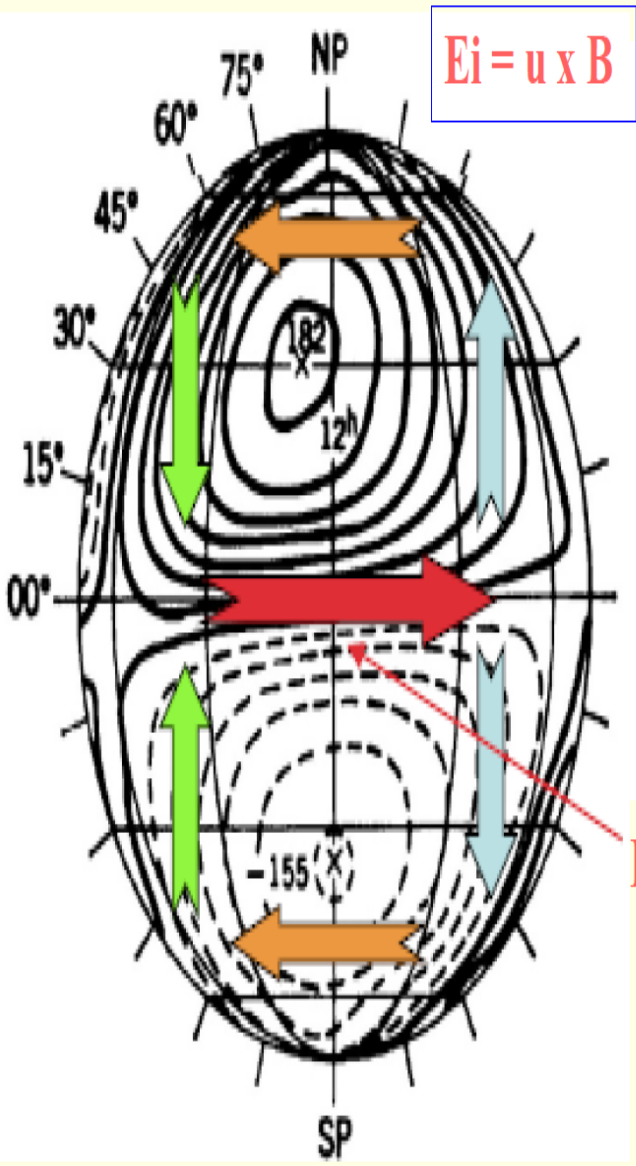


Fig. The "equatorial fountain." Vector plot of electron flux in the meridian plane, in a theoretical steady-state model of the equatorial F region. The motions are due to the combined action of plasma diffusion along magnetic field lines and electromagnetic drift across field lines, produced by an assumed distribution of eastward electric field. The magnetic field lines are shown every 200 km above the equator [Hanson and Moffett (1966)].

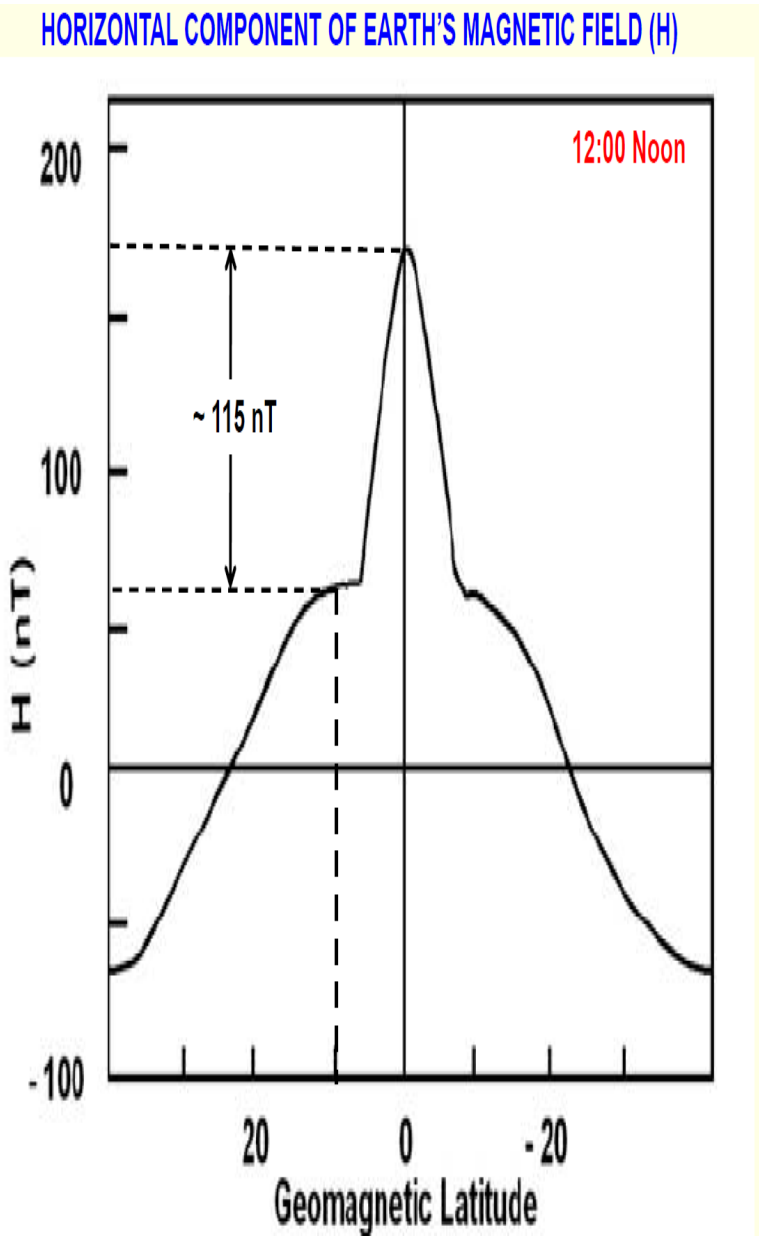
Solar-quiet (Sq) Currents System Features



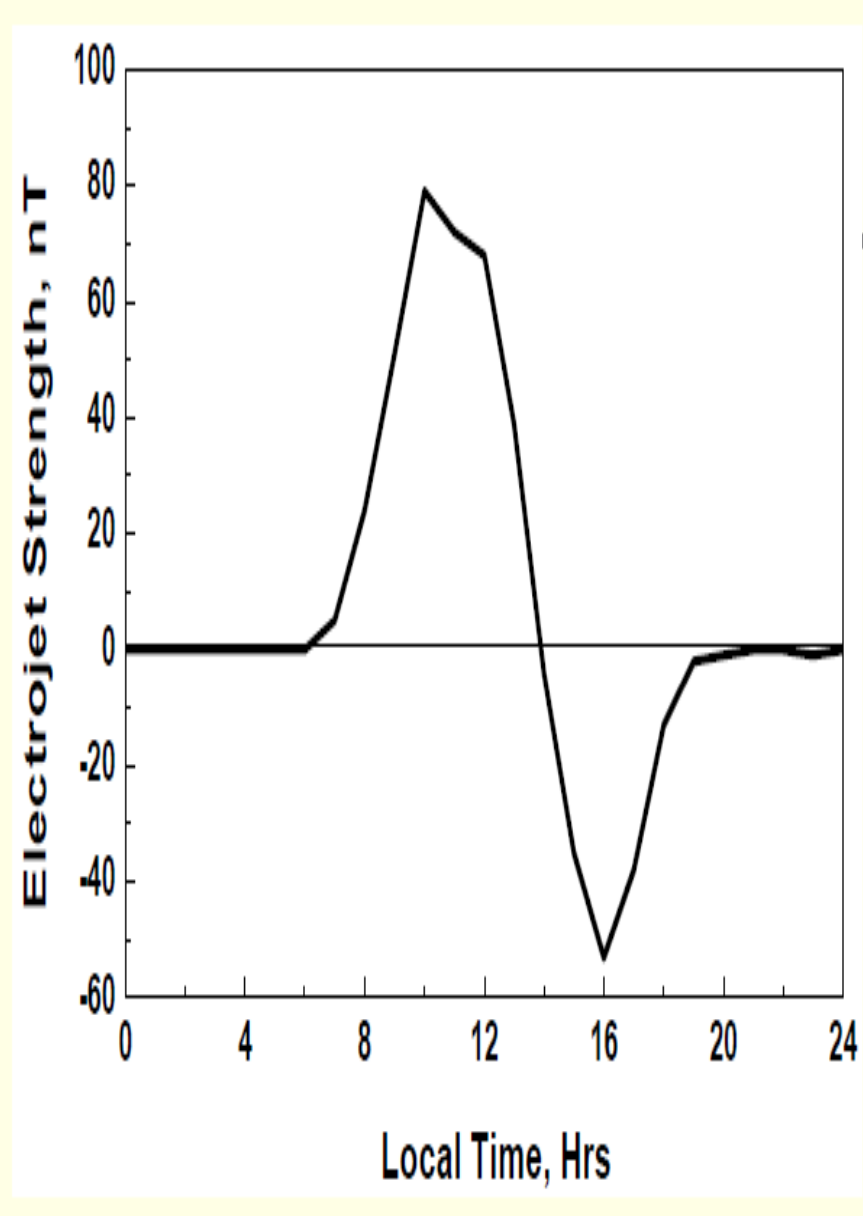
$Ei = u \times B$

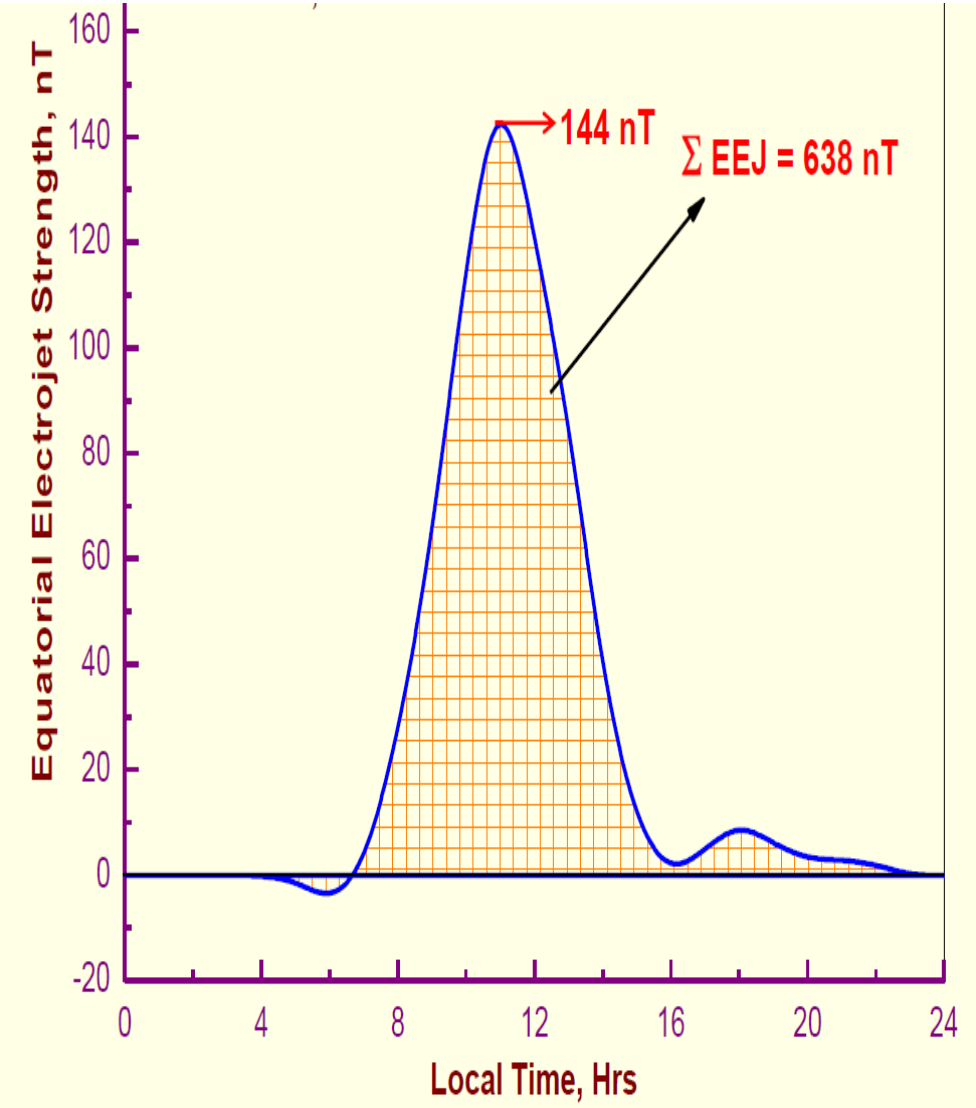
Sq is mainly caused by dynamo action in the ionosphere. EEJ appears on the magnetic equator in the global geomagnetic Sq field.

EEJ (Equatorial Electrojet)

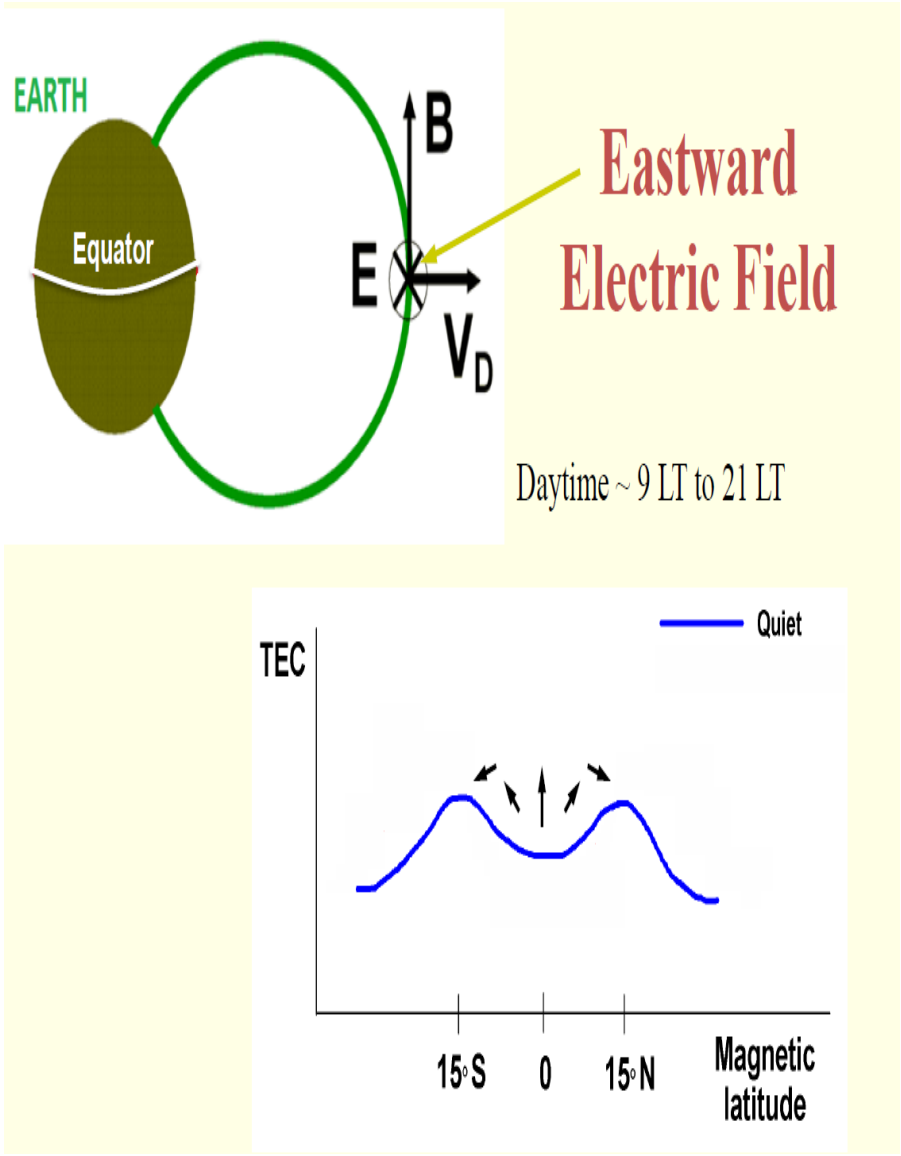


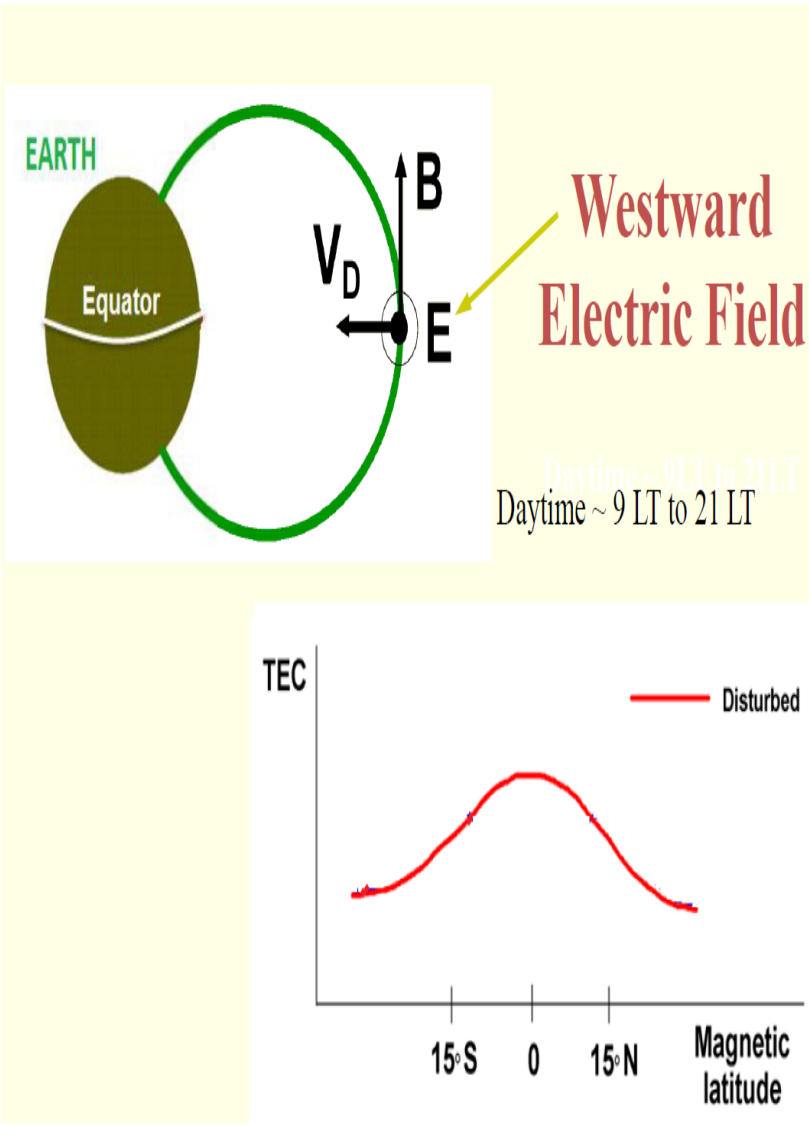
Typical EEJ and IEEJ Estimates



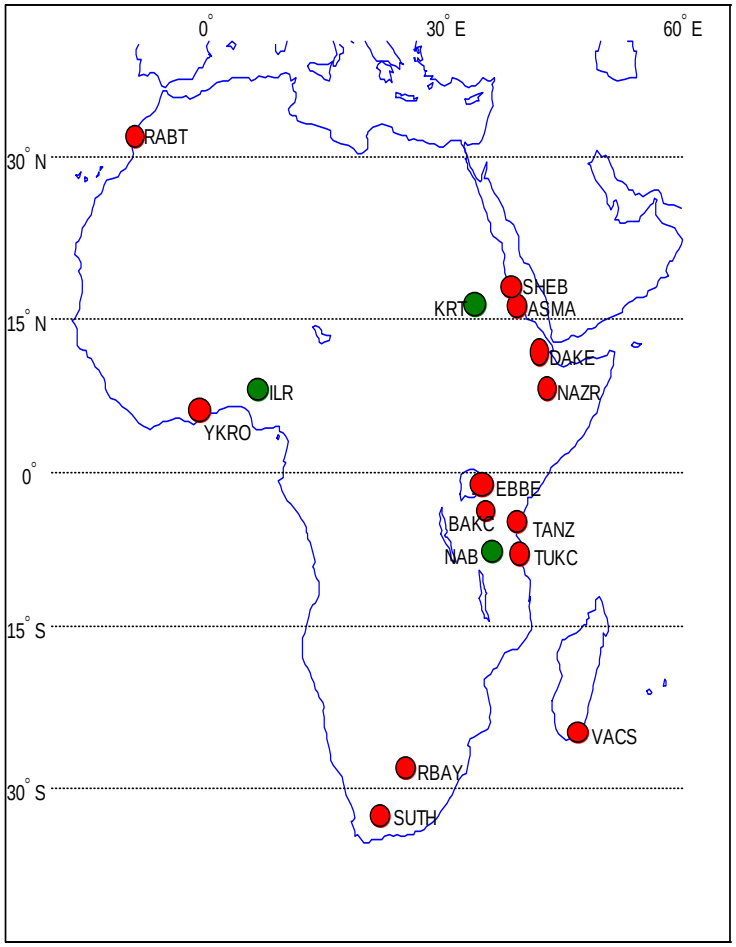


Plasma Transportation: EEJ, Electric Field and TEC



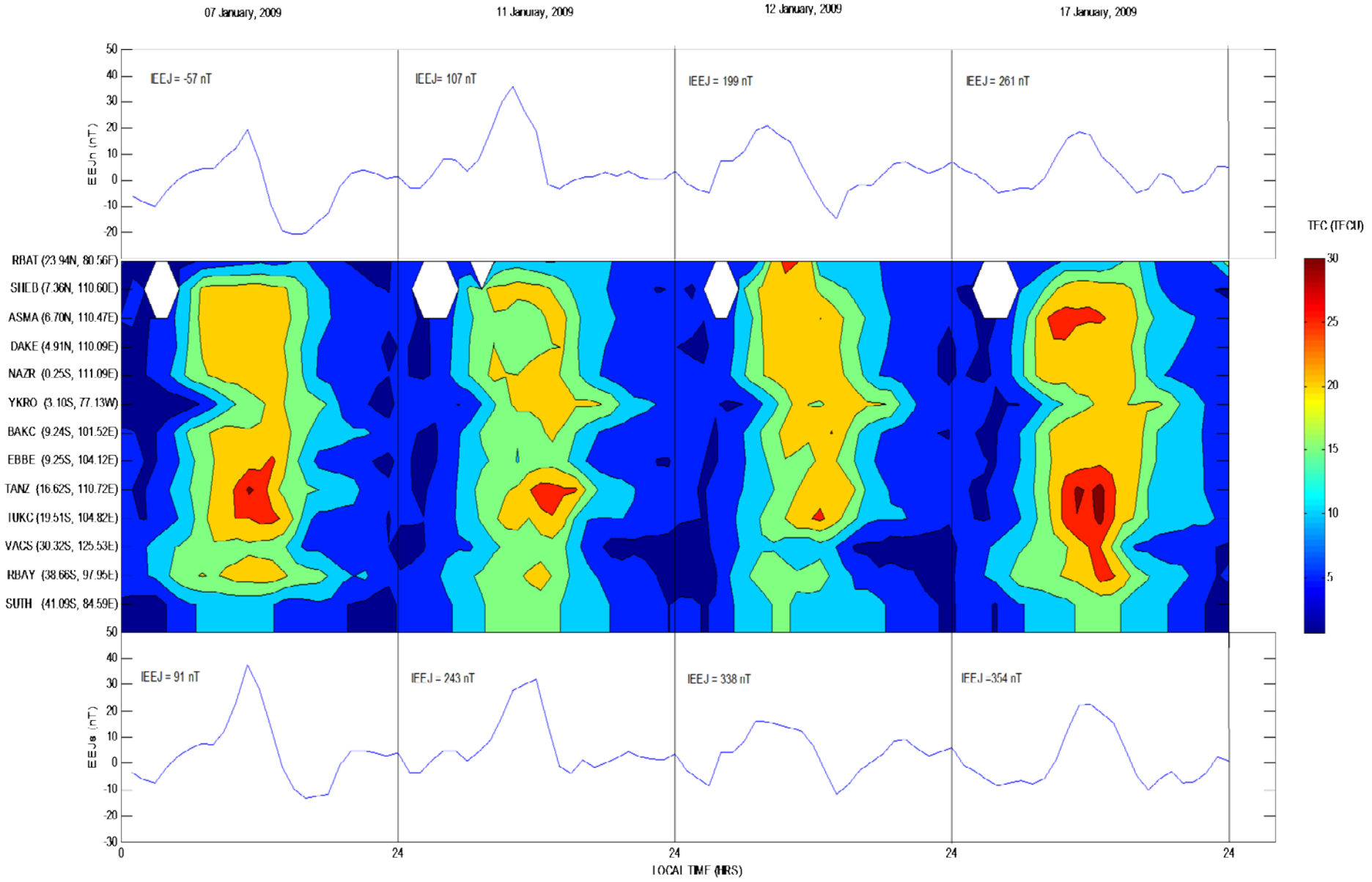


Map and Coordinates of Location Investigated

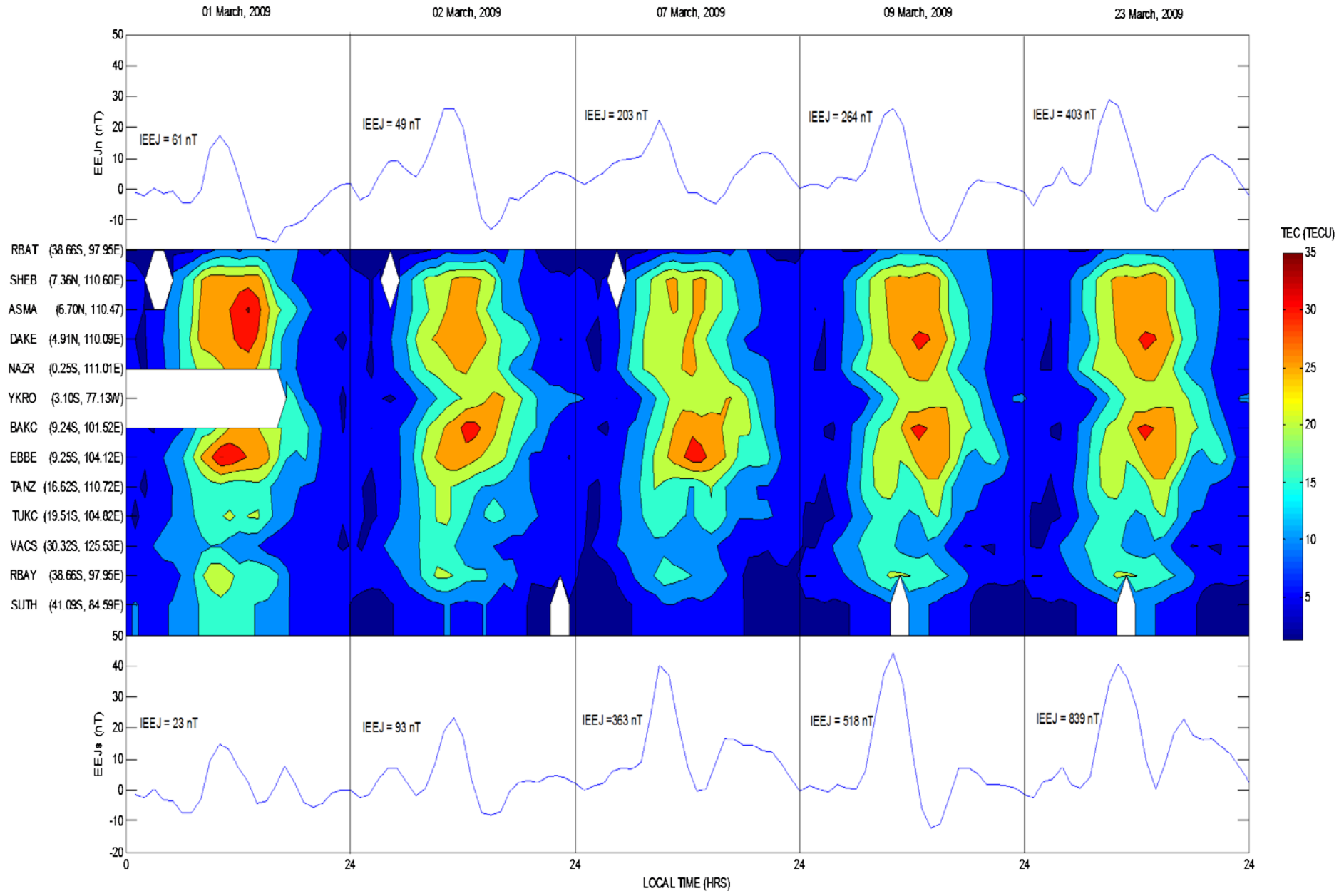


1. DAKE: 4.91N, 110.09E (Ethiopia)
2. ASMA: 6.70N, 110.47E (Eritrea)
3. SHEB: 7.36N, 110.60E (Eritrea)
4. RBAT: 23.94N, 80.56E (Morocco)
5. NAZR: 0.25S, 111.01E (Ethiopia)
6. YKRO: 3.10S, 77.13E (Ivory Coast)
7. BACK: 9.24S, 101.52E (Uganda)
8. EBBE: 9.52S, 104.12E (Uganda)
9. TANZ: 16.62S, 110.72E (Tanzania)
10. TUCK: 19.51S, 104.82E (Tanzania)
11. VACS: 30.32S, 125.53E (Mauritius)
12. RBAY: 38.66S, 97.95E (South Africa)
13. SUTH: 41.09S, 84.59E (South Africa)
14. ILR: 1.82S, 76.68E
15. NAB: 10.76S, 108.51E
16. KRT: 6.03S, 104E

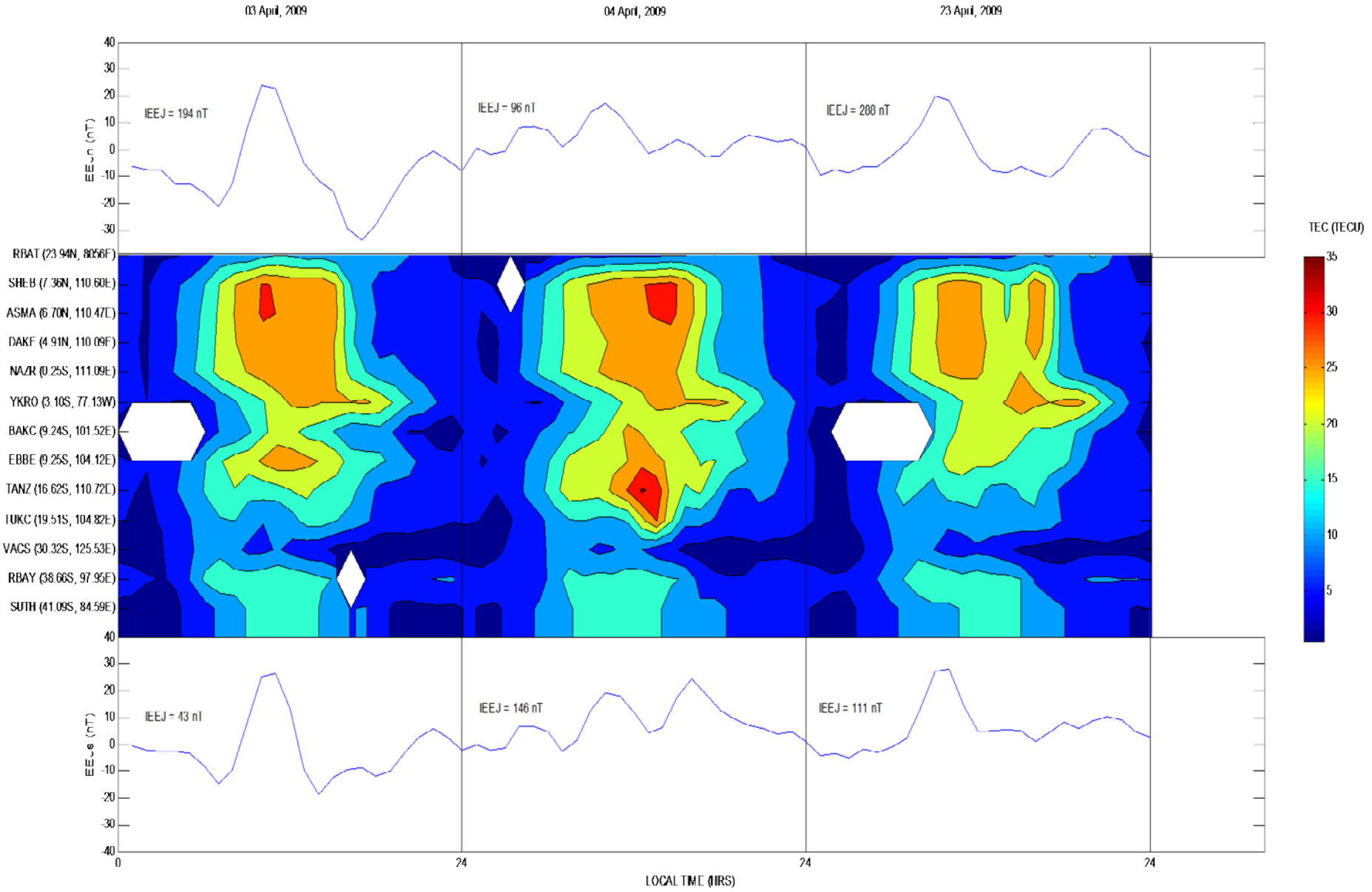
Results


07 January, 2009
11 January, 2009
12 January, 2009
17 January, 2009
IEEJ = -57 nT
IEEJ= 107 nT
IEEJ = 199 nT
IEEJ = 261 nT
EEJn (nT)
RBAT (23.94N, 80.56E)
SHED (7.36N, 110.60E)
ASMA (6.70N, 110.47E)
DAKE (4.91N, 110.09E)
NAZR (0.25S, 111.09E)
YKRO (3.10S, 77.13W)
BAKC (9.24S, 101.52E)
EBBE (9.25S, 104.12E)
TANZ (16.62S, 110.72E)
IUKC (19.51S, 104.82E)
VACS (30.32S, 125.53E)
RBAY (38.66S, 97.95E)
SUTH (41.09S, 84.59E)
TEC (TECU)
IEEJ = 91 nT
IEEJ = 243 nT
IEEJ = 338 nT
IEEJ =354 nT
EEJs (nT)
LOCAL TIME (HRS)

Results contd.



Results contd.



Conclusions

Characterized EIA over Africa

Systematic flow of the plasma transportation; trough and crest

Hemispheric asymmetry; more TEC in the south than north in January

Evidences of day-to-day distribution due to EEJ strength influences on plasma distribution

Acknowledgements

THANK YOU

UNAVCO
IGS
BOSTON COLLEGE
NARSDA