



Workshop on Space Weather  
“Science and Data Products from ISWI Instruments”

*Title:*

**SOME VARIATIONS OF THE IONOSPHERIC  
SCINTILLATION IN VIETNAM AND THE  
OCCURRENCE OF EQUATORIAL SPREAD-F OVER  
PHUTHUY OBSERVATORY**

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- **Part I: Some variations of the ionospheric scintillation in Vietnam from the continuous GPS data**
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- **Conclusions**

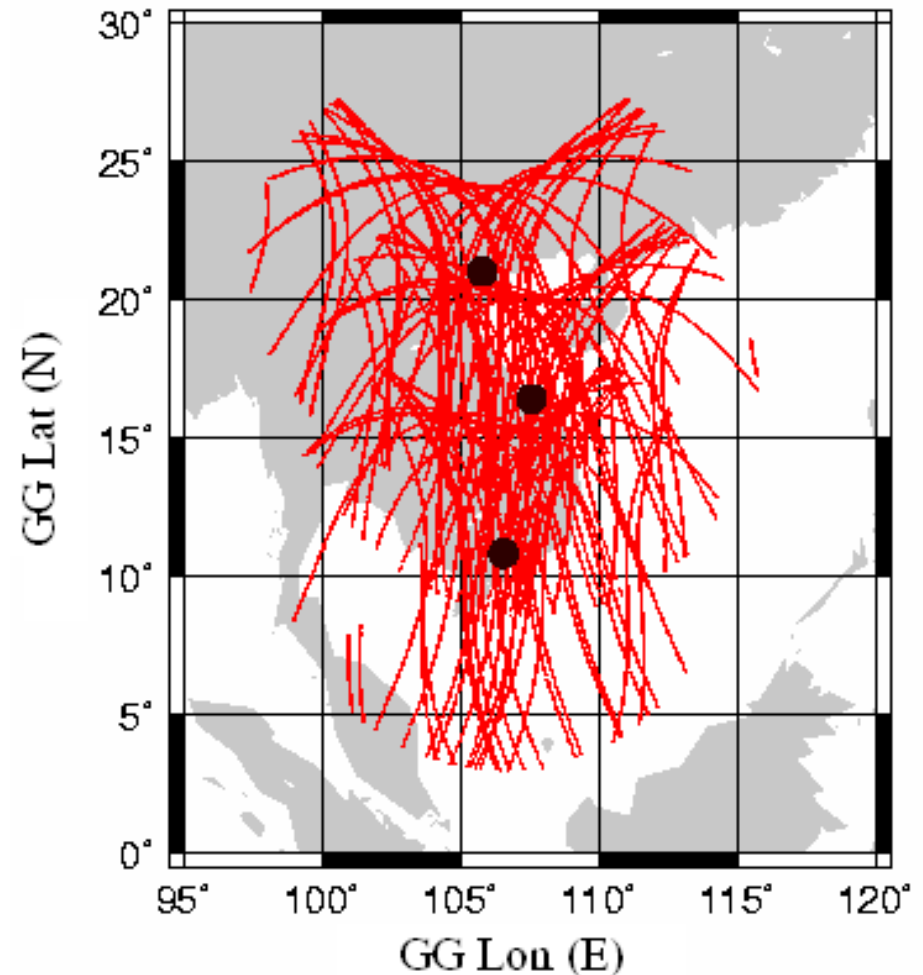
# Data and method of analysis

Three GSV4004 receivers installed since 2005:

+ at Hanoi ( $21.02^{\circ}\text{N}$ ,  $105.47^{\circ}\text{E}$ )

+ at Hue ( $16.27^{\circ}\text{N}$ ,  $107.35^{\circ}\text{E}$ )

+ at Ho Chi Minh city (Hocmon station) ( $10.5^{\circ}\text{N}$ ,  $106.33^{\circ}\text{E}$ )



The location of the GPS receivers in Vietnam and the traces of satellite at the Ionospheric pierce point

# Data and method of analysis (cont...)



GPS Receiver in Hanoi, Hue and HOCM: GSV4004 model

# Ionospheric scintillation

$$S_4 = \sqrt{\frac{\langle SI^2 \rangle - \langle SI \rangle^2}{\langle SI \rangle^2} - \frac{100}{C/N_o} \left[ 1 - \frac{500}{19C/N_o} \right]} \quad (1)$$

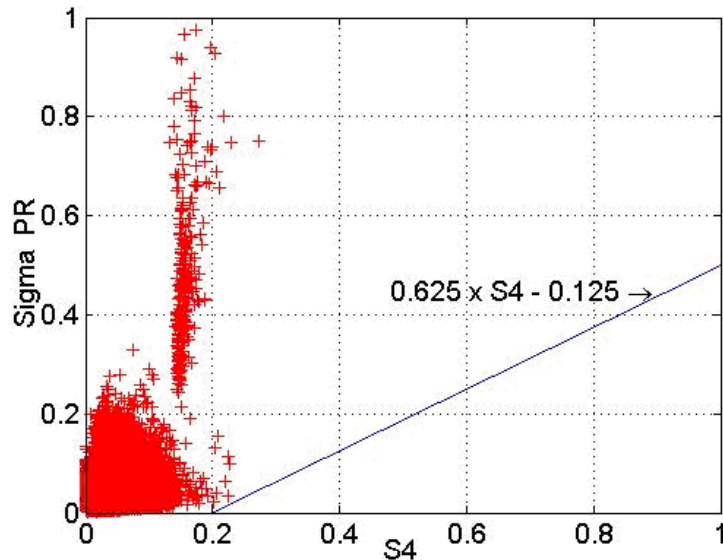
SI : signal intensity,  $\langle SI \rangle$  : Signal intensity averaged in 60 sec.

C/No: signal and noise ratio

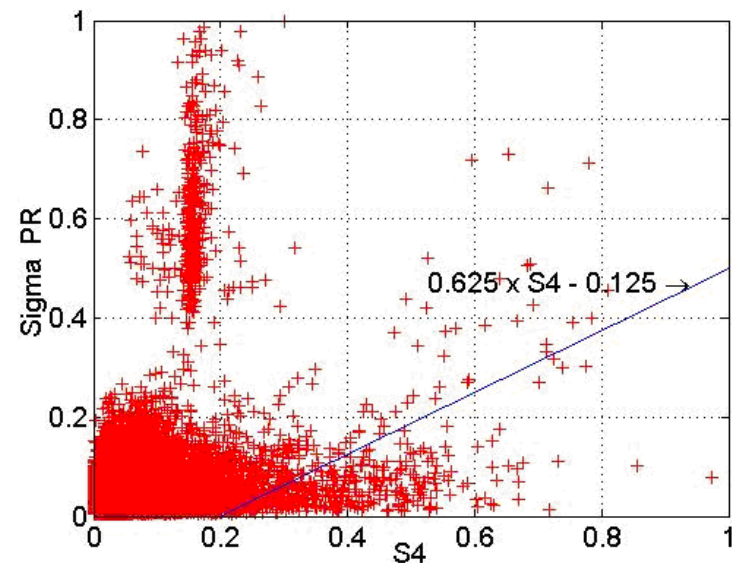
**Correction for the multipaths:**

*(GSV4004 User's Manual, 2005)*

$$Sigma\_PR = 0,652 * S_4 - 0,125 \quad (2)$$

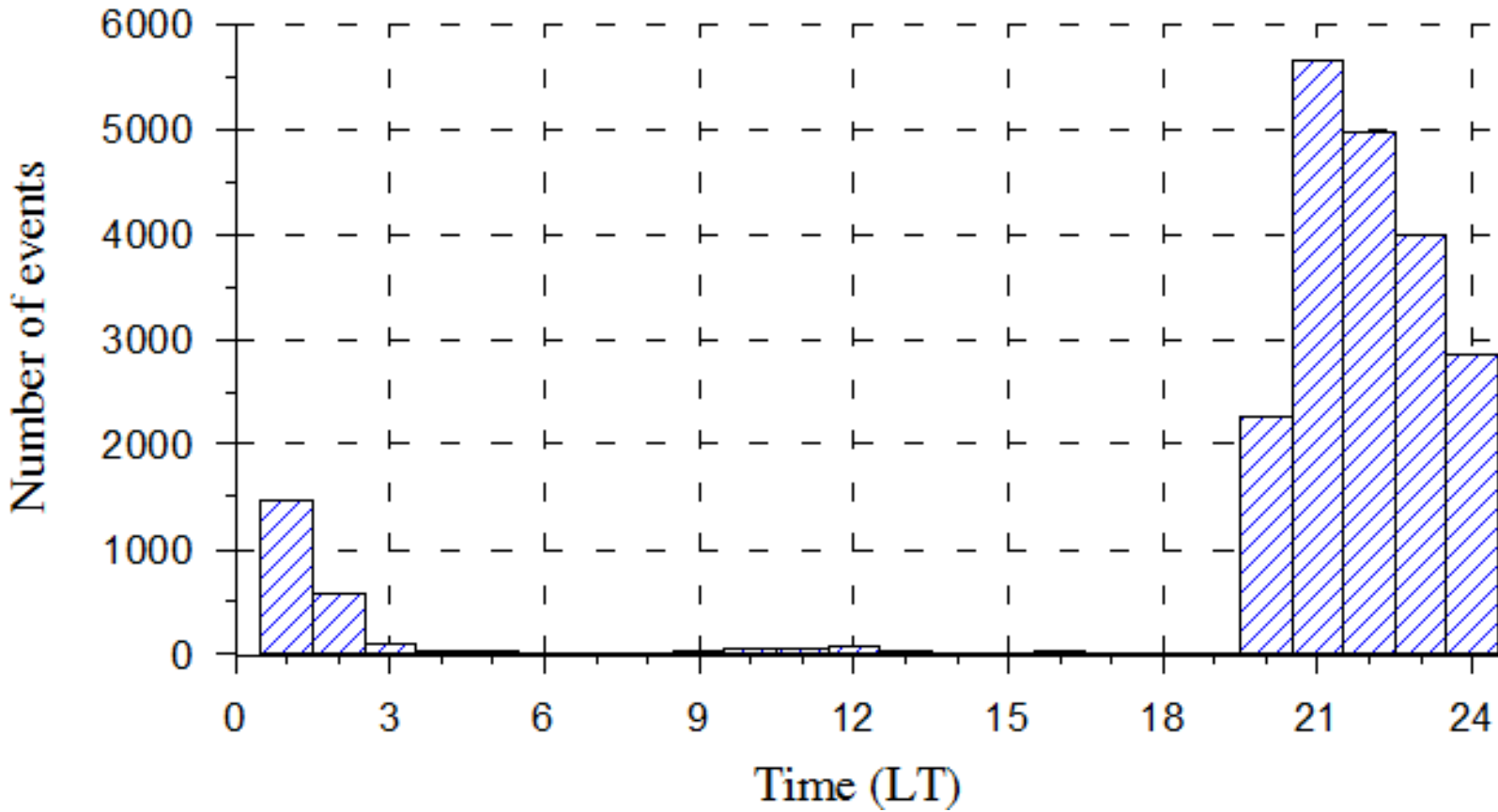


a) Non-scintillation environment,



b) Scintillation environment

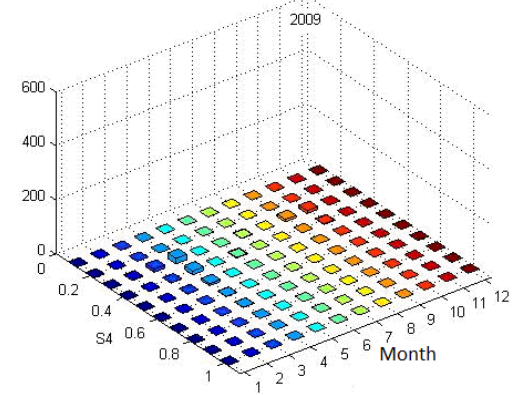
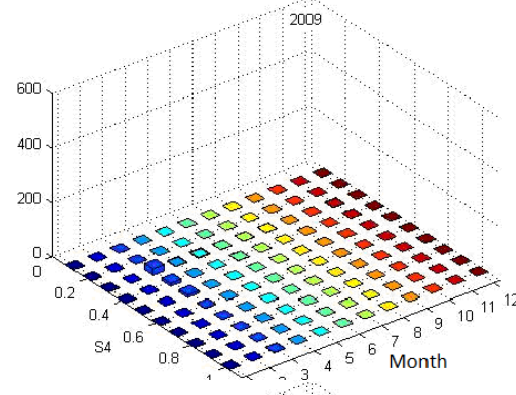
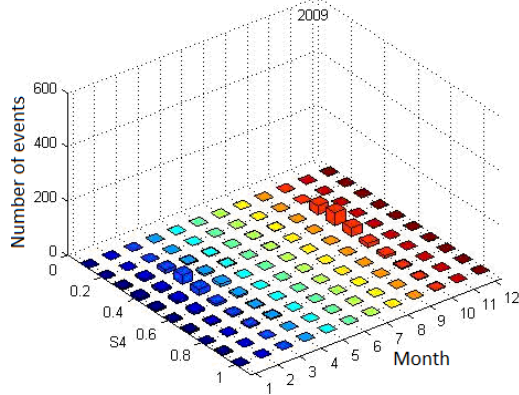
# Occurrence of the ionospheric scintillation depending on local time



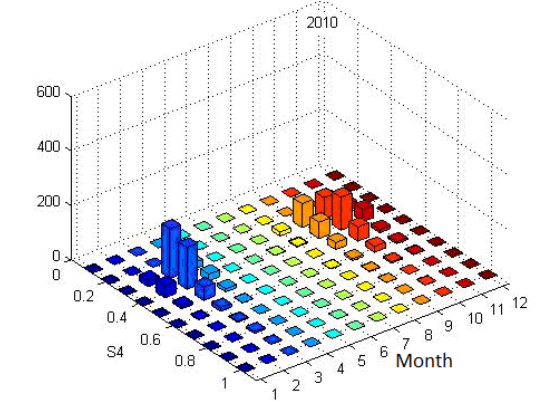
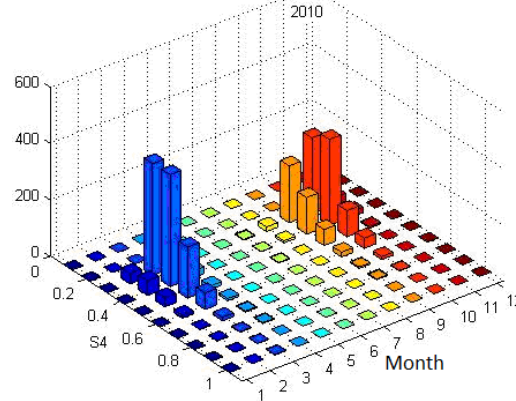
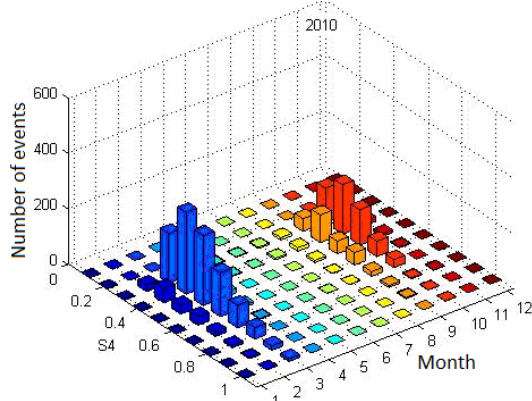
Occurrence statistics of the ionospheric scintillation for the period 2009-2011 in Vietnam region

# Occurrence statistics of the ionospheric scintillation depending on season and Solar activity

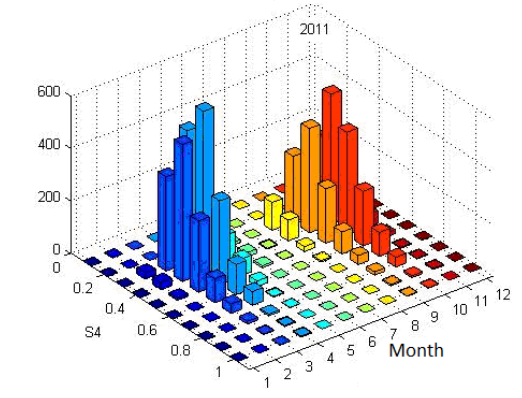
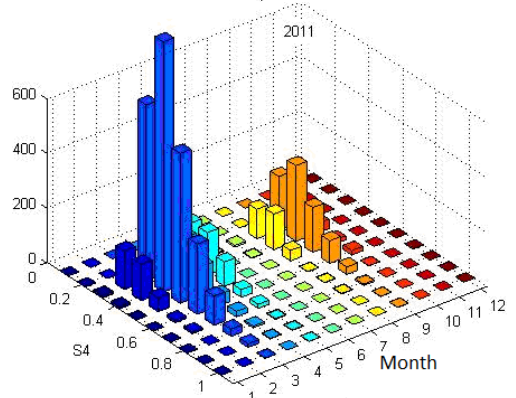
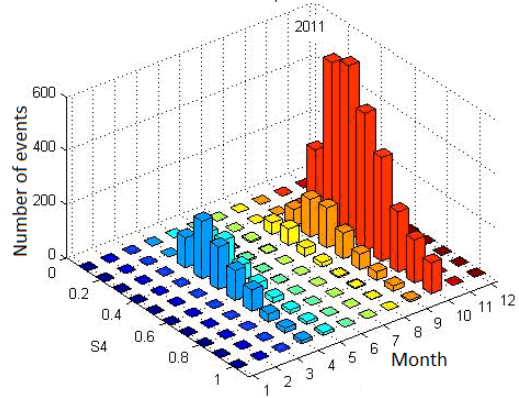
2009



2010



2011

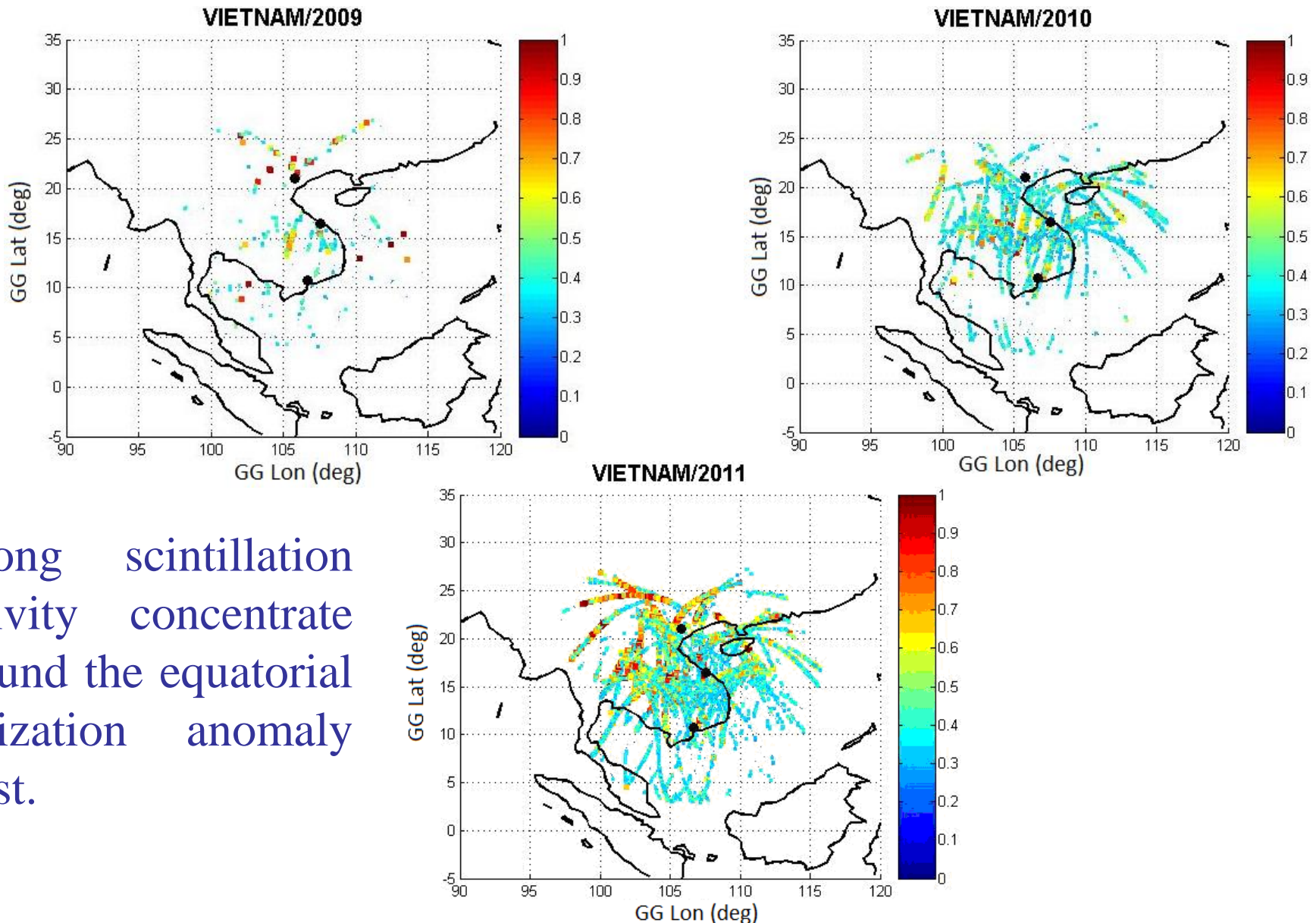


Hanoi

Hue

Ho Chi Minh City

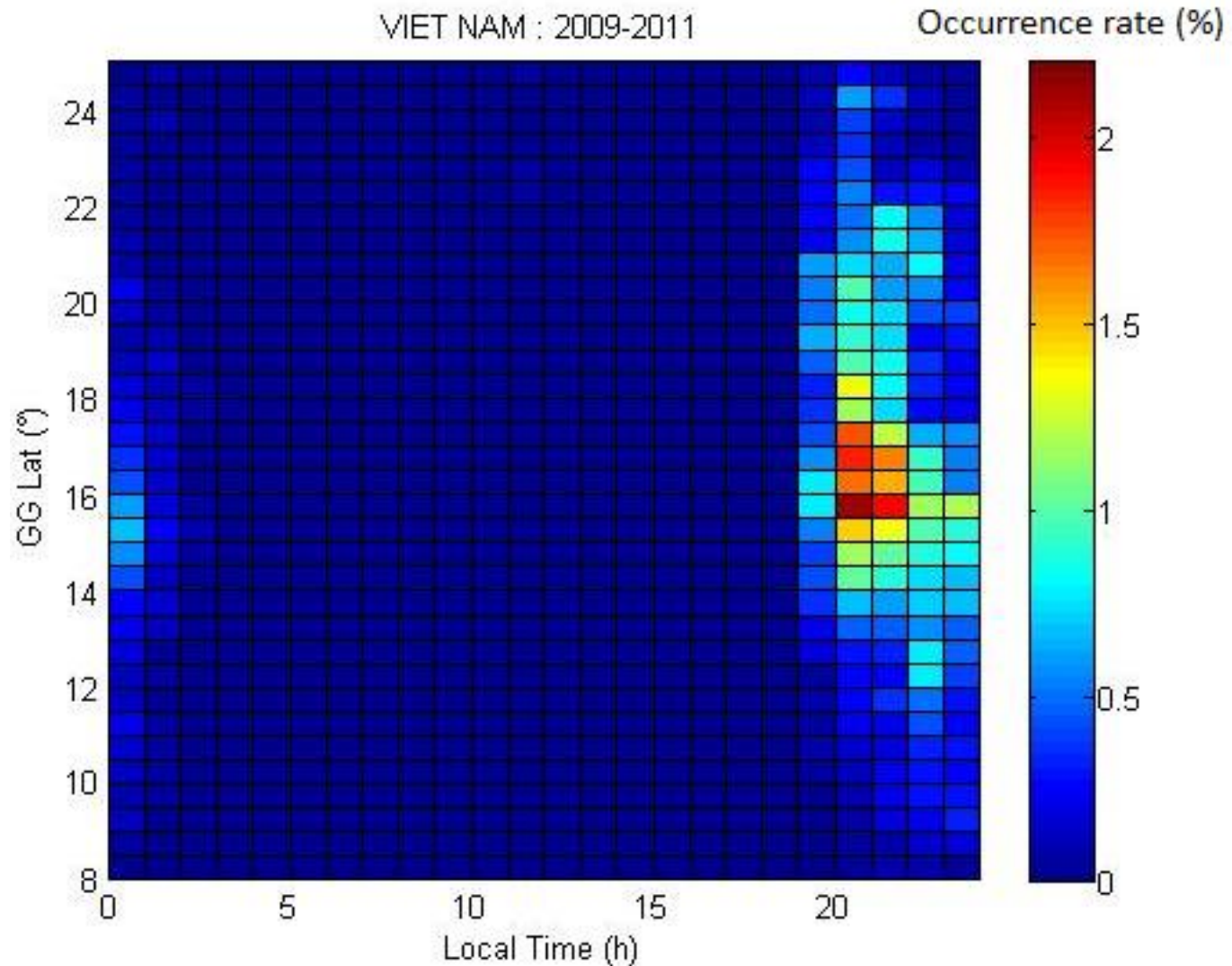
# Geographical distribution of the ionospheric scintillation



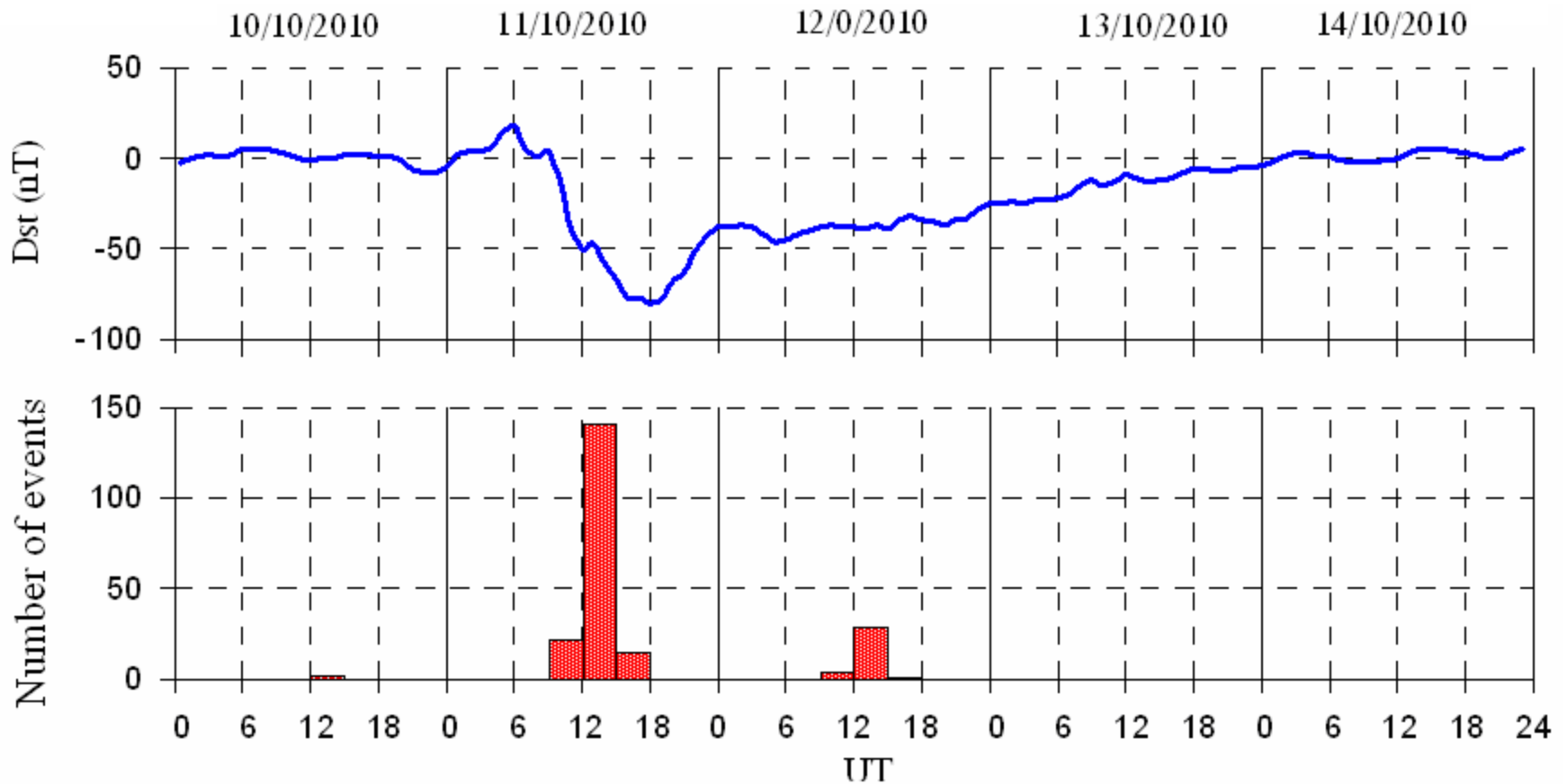
Strong scintillation activity concentrate around the equatorial ionization anomaly crest.



# Latitudinal distribution of the ionospheric scintillation

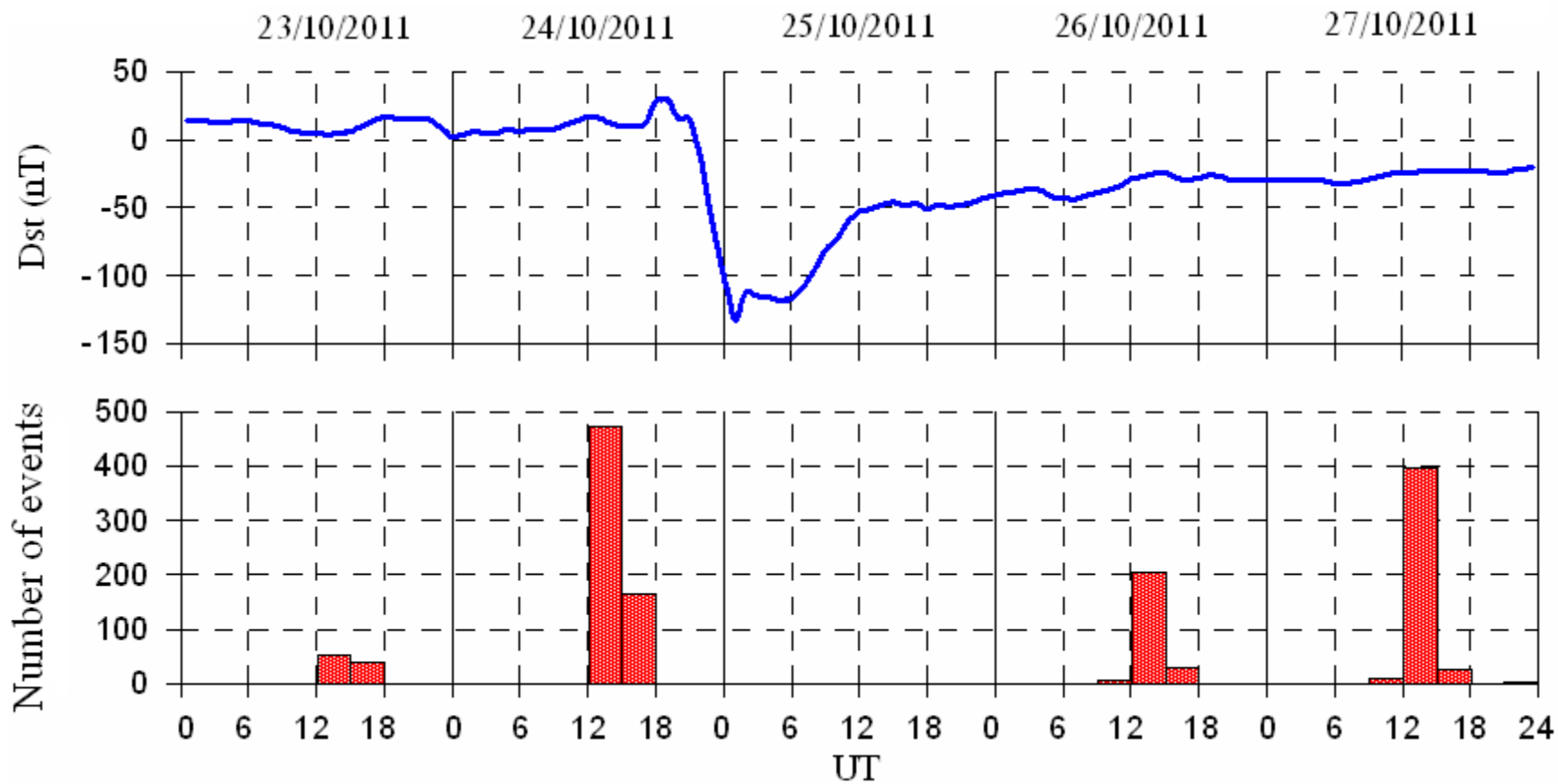


# Effect of magnetic activity on scintillation occurrence in Vietnam



**Magnetic storm 11/10/2010**

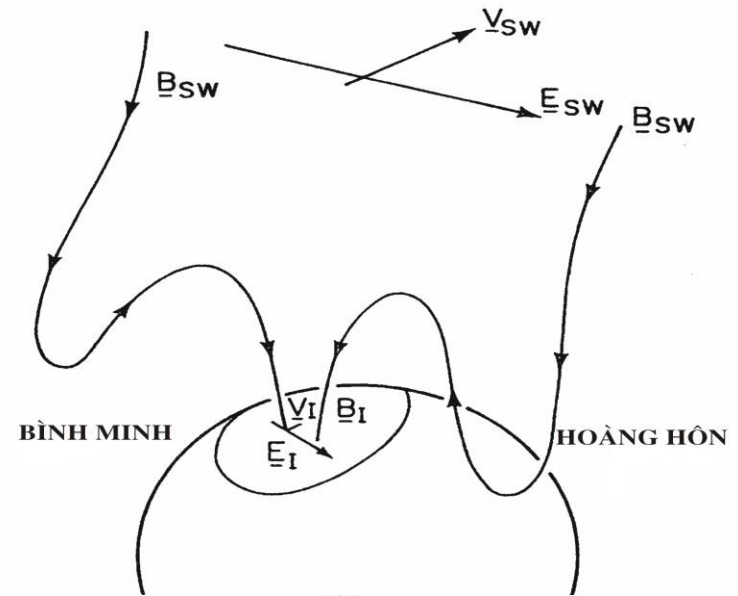
# Effect of magnetic activity on scintillation occurrence in Vietnam



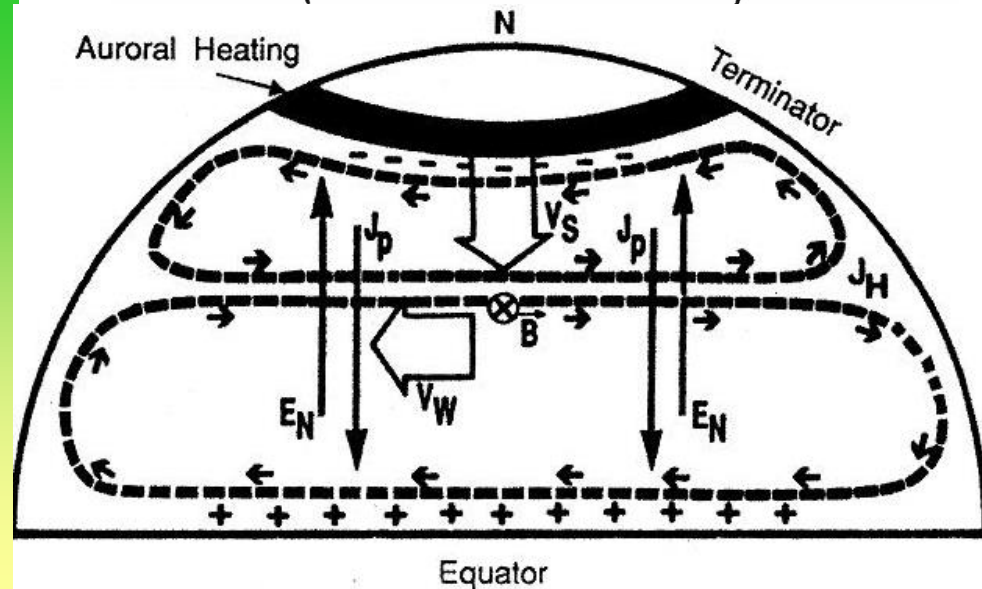
**Magnetic storm 24, 25/10/2011**

## Two main electric field sources can influence on the equatorial plasma fountain effect

1) The prompt penetration of the electric fields from high latitudes to low latitudes  $\rightarrow$  increases the eastward electric field  $\rightarrow$  increases the equatorial plasma fountain in day time .

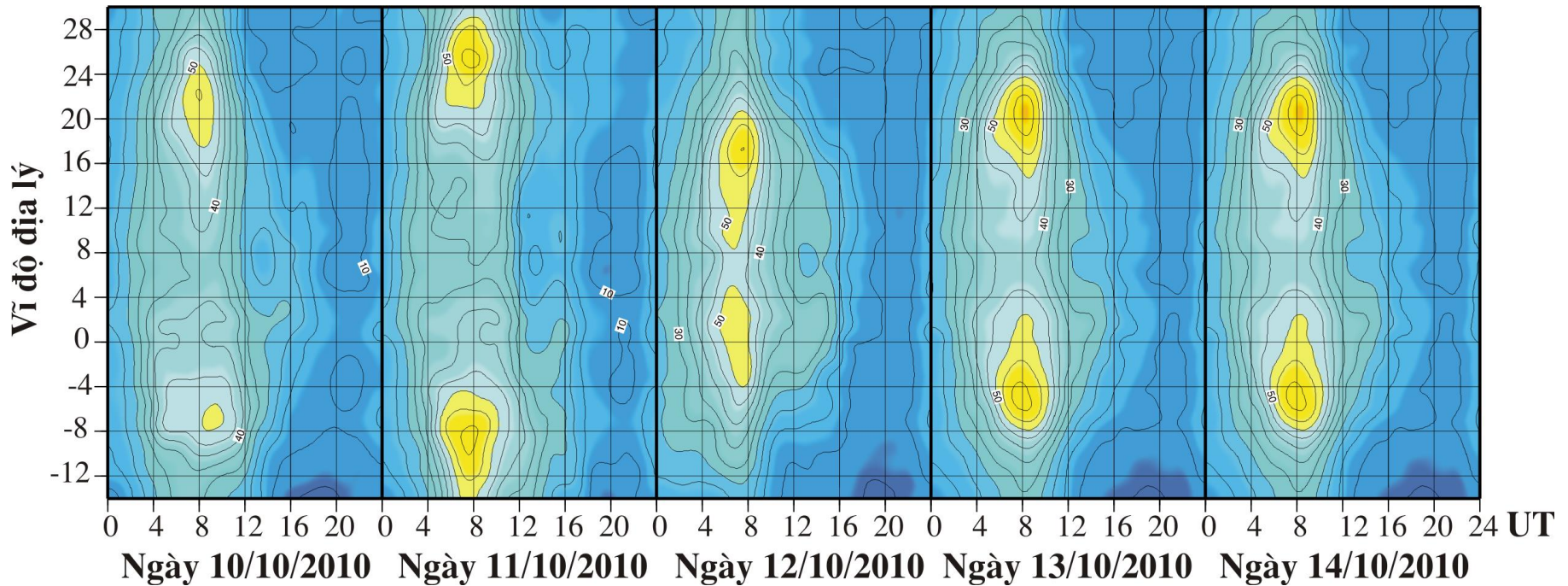


2) **Ionospheric disturbance dynamo:** Both the electric fields and currents at low latitudes vary in opposition to their normal behavior  $\rightarrow$  decreases the eastward electric field  $\rightarrow$  the equatorial plasma fountain decreases.



# Effect of magnetic activity on scintillation occurrence in Vietnam

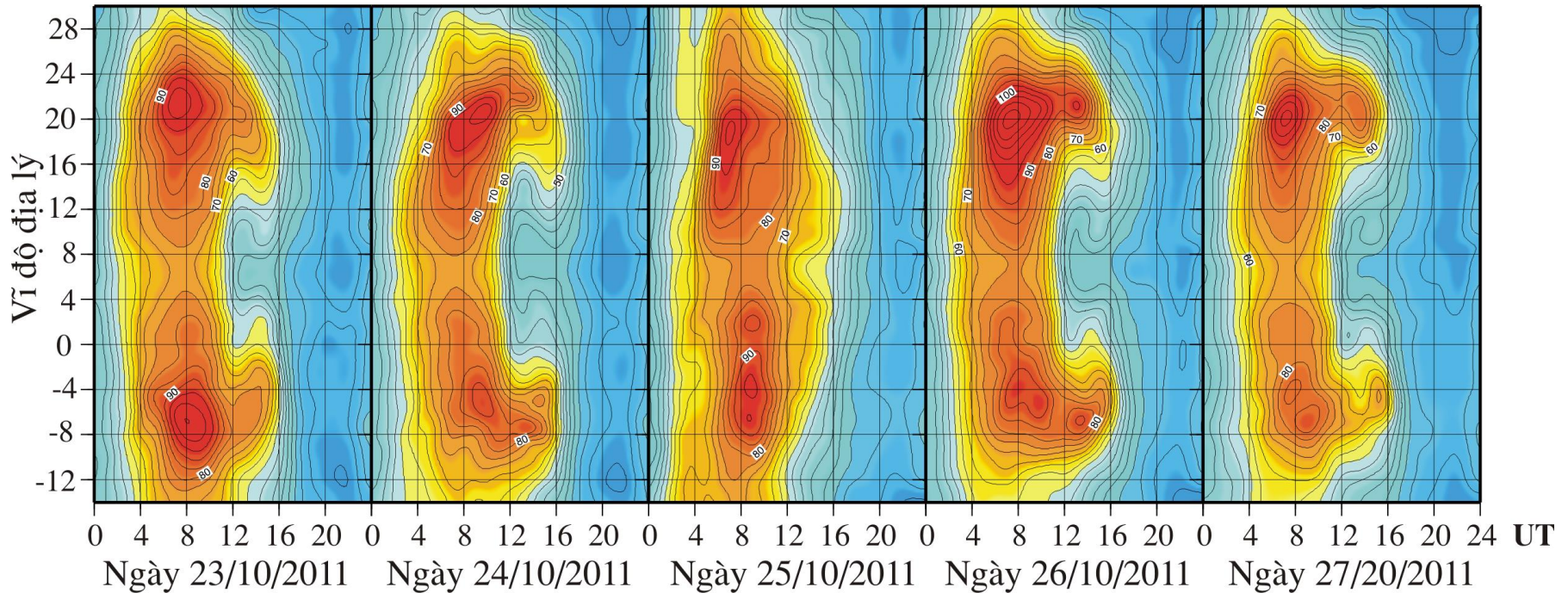
## Magnetic storm 11/10/2010



The prompt penetration of the electric fields from high latitudes to low latitudes → increases the eastward electric field → increases the equatorial plasma fountain in day time → enhancement of the irregularities → enhancement of scintillation

# Effect of magnetic activity on scintillation occurrence in Vietnam

## Magnetic storm 24, 25/10/2011

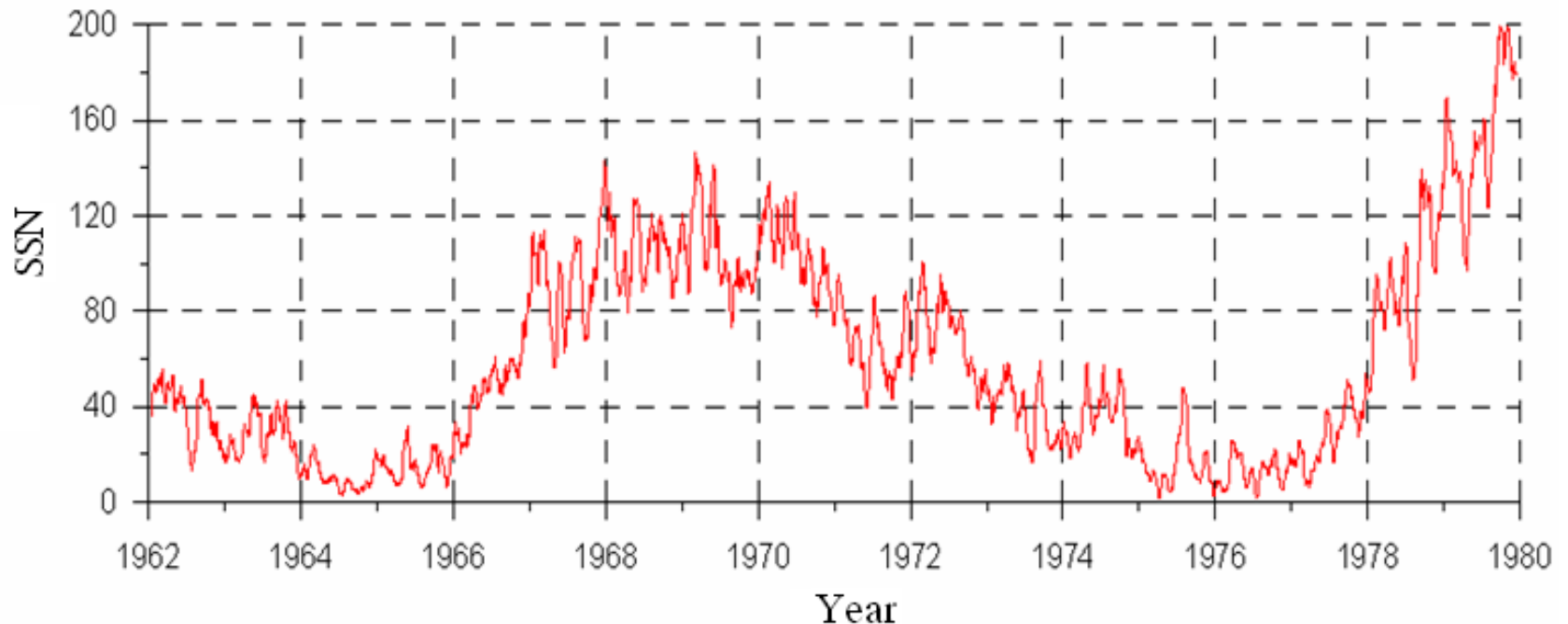


**Ionospheric disturbance dynamo develops:** → decreases the eastward electric field → the equatorial plasma fountain decreases → suppression of the irregularities → suppression of scintillation

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- Conclusions

# Data of analysis



The period 1962-1979, divided into 3 levels of solar activity :

1 - Strong: 1967, 1968, 1969, 1970, 1978 and 1979

2 - Moderate: 1962, 1963, 1966, 1971, 1972, 1973 and 1974

3 - Weak: 1964, 1965, 1975, 1976 and 1977

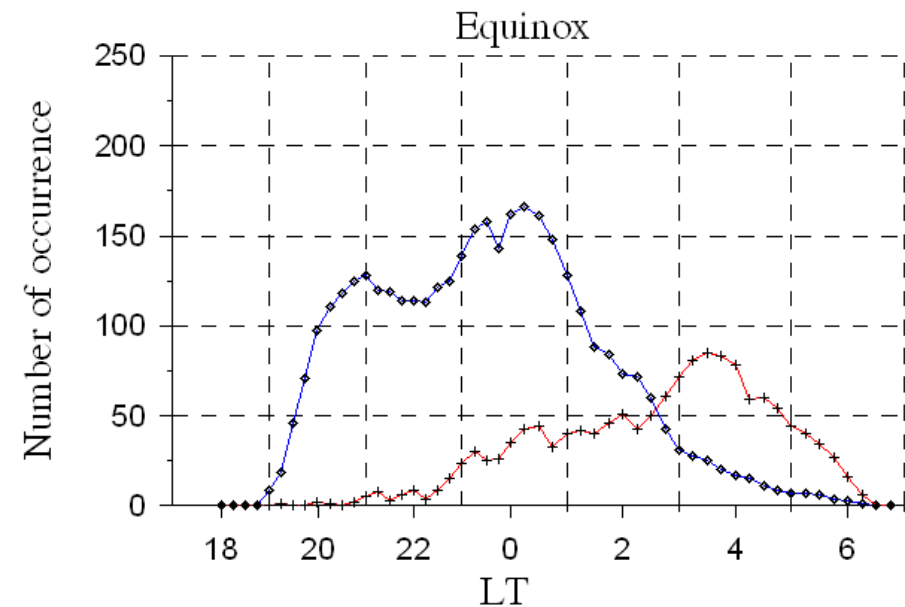
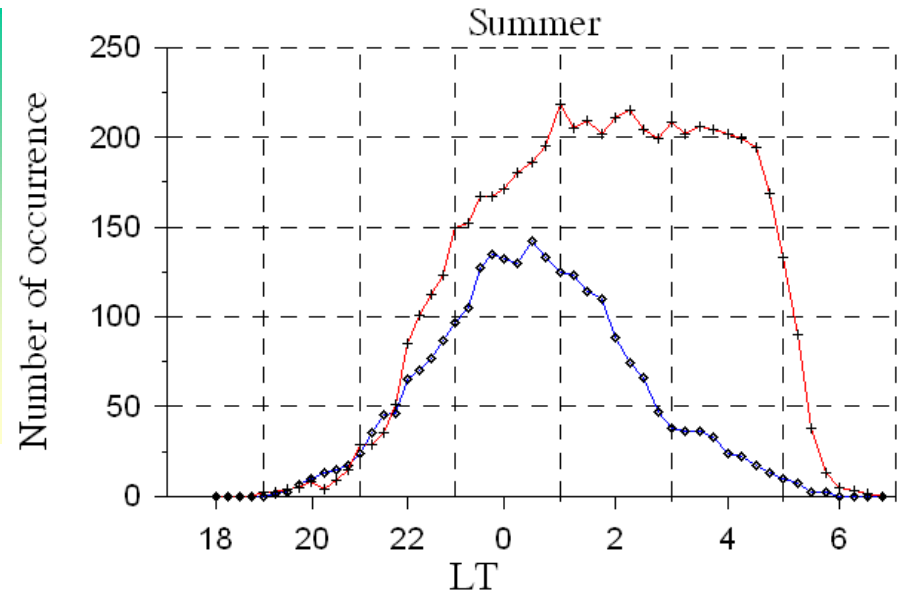
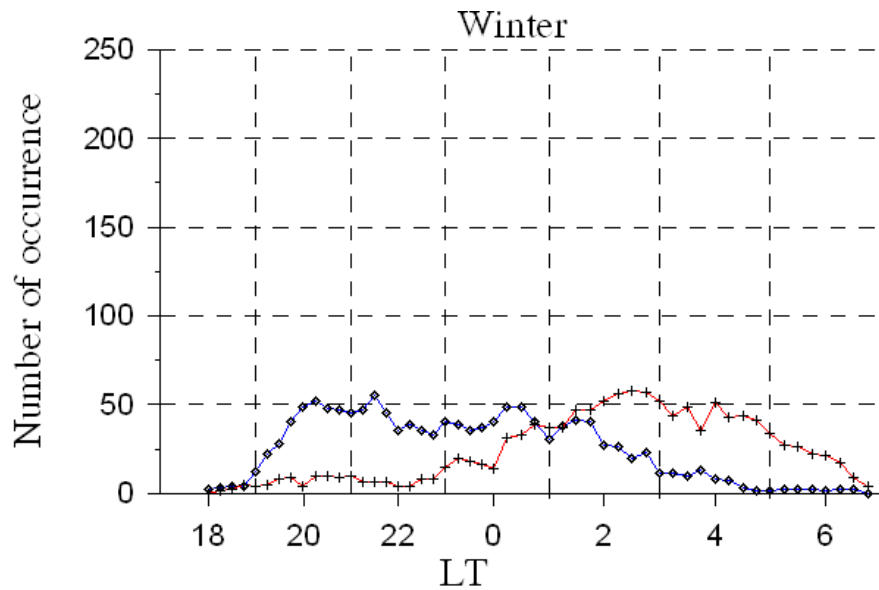


# Results and discussion

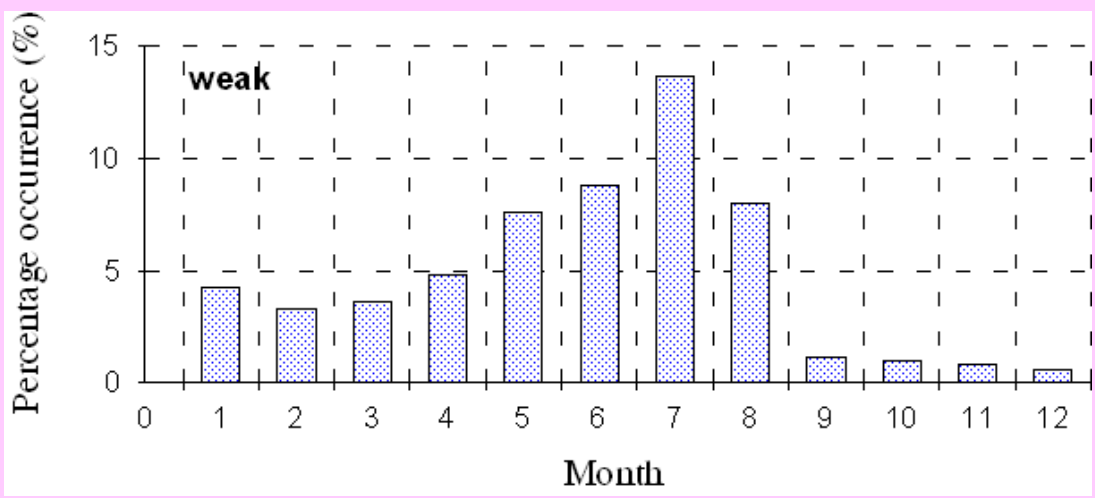
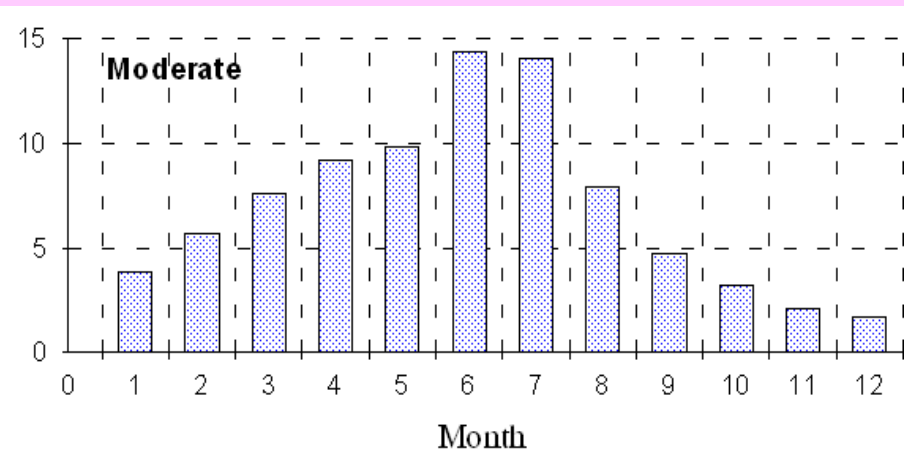
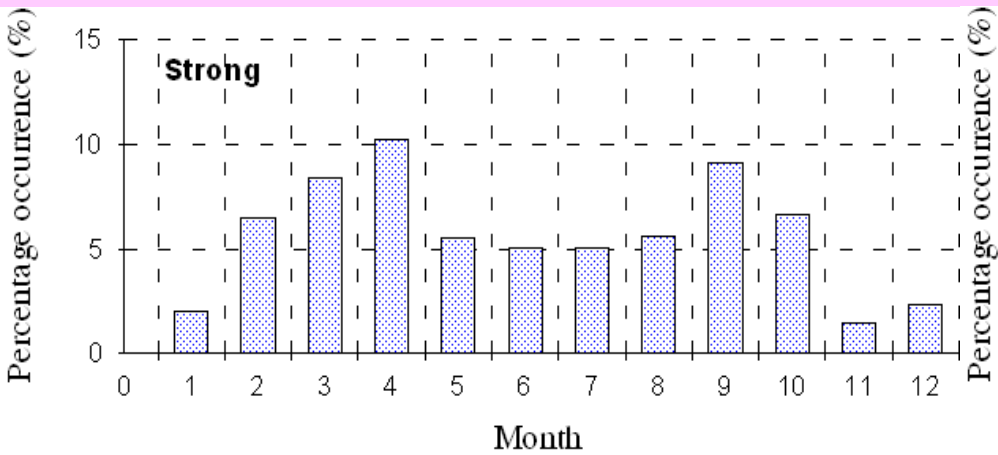
## Diurnal and seasonal variation of $F_s$ at Phuthuy

Two basic Spread type:

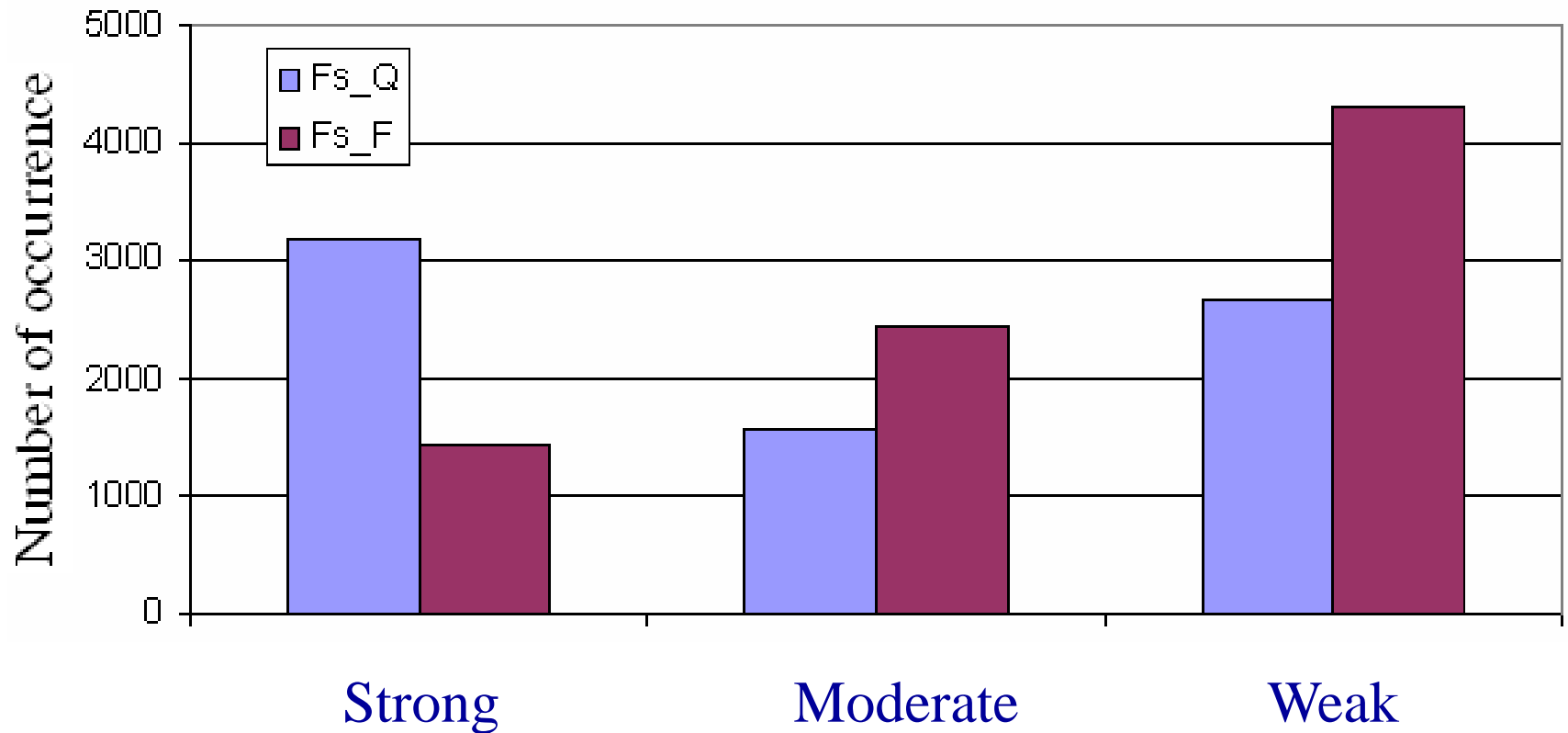
- Range spread type:  $F_s$ -Q - blue
- Frequency spread type:  $F_s$ -F- red



- Seasonal variation of Fs during different epoch of solar activity



- Variation of Fs occurrence with solar activity



# Conclusions

- The occurrence of the ionospheric scintillation as a function of time in the day, almost occurs at night time in this region, maximizes in equinox months and depends clearly on the solar activity.
- Strong scintillation activity concentrate around the equatorial ionization anomaly (EIA) crest in the geographic latitude range of  $15^{\circ}$  to  $25^{\circ}$ N in the Vietnam region.
- Magnetic storm could produce an enhancement or inhibition scintillation activity depending upon local time and phase of magnetic storm.

# Conclusions

- Some characteristic of Spread F at Phuthuy over a solar cycle:
  - Range spread type: occurs concentrately on the period before midnight, on the equinox month and on the maximum sunspot years.
  - Frequency spread type: occurs concentrately on the period after midnight, on the summer and on the period of moderate and weak solar activity.

The characteristic features and the variations of Spread F occurrence at Phuthuy are similar from those at Ahmedabad, Indian.

Thank you for your attentions !