

## Characteristics between the equatorial electrojet and neutral wind

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## Characteristics between the equatorial electrojet and neutral wind

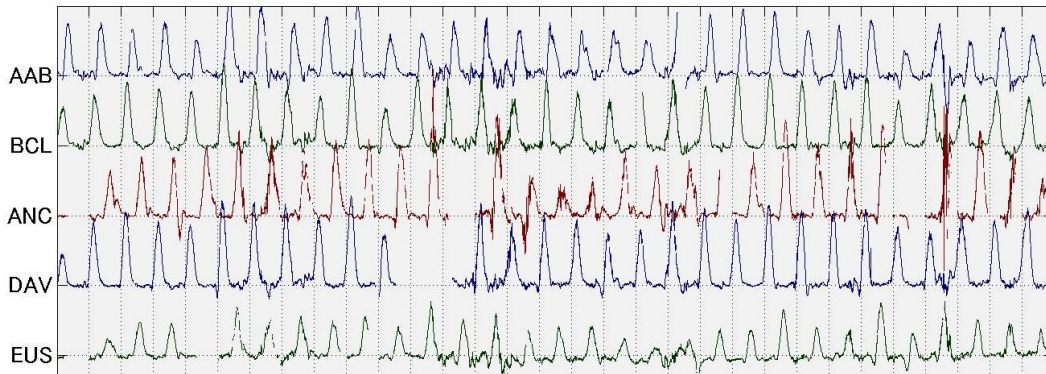
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Kiyohumi Yumoto<sup>1</sup>, Toshitaka Tsuda<sup>2</sup>, and IUGONET Project

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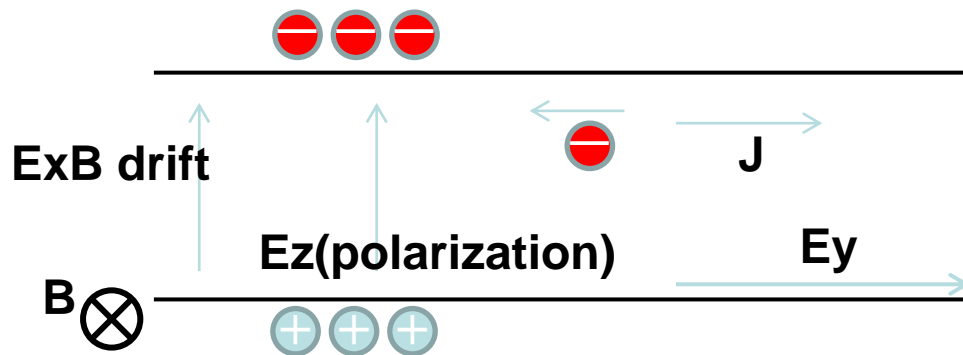
Acknowledgment: The data used in this study have been partly supported by the IUGONET (Inter-university Upper atmosphere Global Observation NETWORK) project (<http://www.iugonet.org/>) funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

# 1. Introduction

## ◆ What is equatorial electrojet?



MAGDAS Equatorial Region H component monthly plot (2010 December)

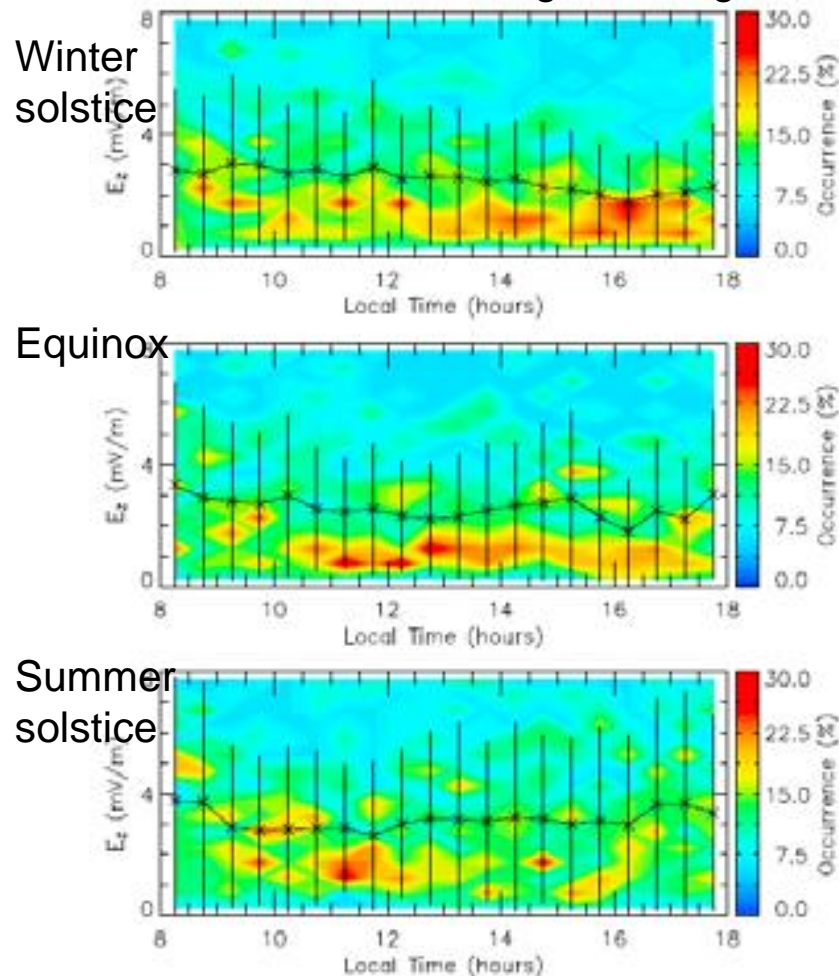


- Strong eastward current flow in the day time equatorial region of the Earth's ionosphere.
- It has very narrow band ( $\pm 3 \sim 5$  degree)
- The amplitude of the daily variation of the geomagnetic H-component measured at near the dip-equator is higher than the variation of data from other regions.

# 1. Introduction

## ◆ Recent radar study at equatorial region

Distribution of vertical component electric field and averaged strength



- From the recent radar study at equatorial region, it is becoming clearer that the existence of neutral wind at ionosphere E-layer and the vertical polarization electric field caused by gravity wave at lower atmosphere. [Aveiro et al., 2009]
- However, the relationship between EEJ strength and neutral wind is not clear because of the lack of long term observation and collaboration study.

# 1. Introduction

## ◆ Motivation of this study

- One of the purpose of IUGONET is to clarify the mechanisms of the long-term variations in the upper atmosphere.
- IUGONET institutes have long term geomagnetic and atmospheric data at equatorial region. We can use easily these data via metadata DB and analysis software released by IUGONET.
- Clarify the relationship between the variation of EEJ and neutral wind variation at mesosphere and low thermosphere.

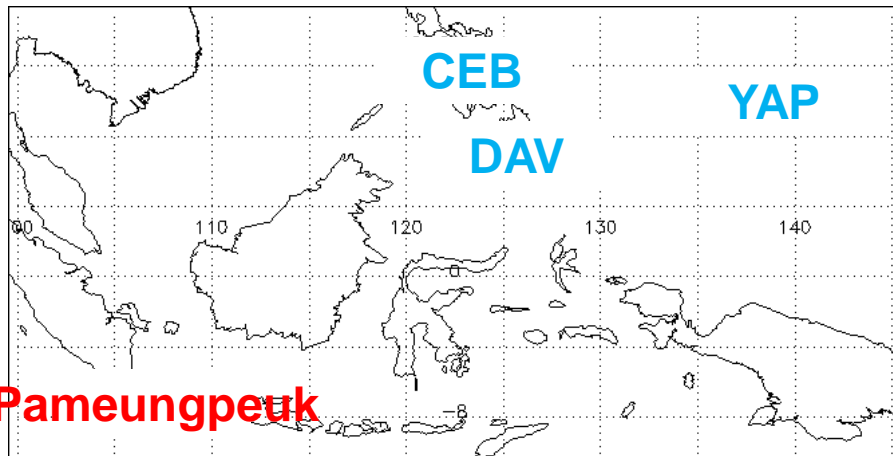
## 2. Data and Method

### ◆ Location map, Instruments

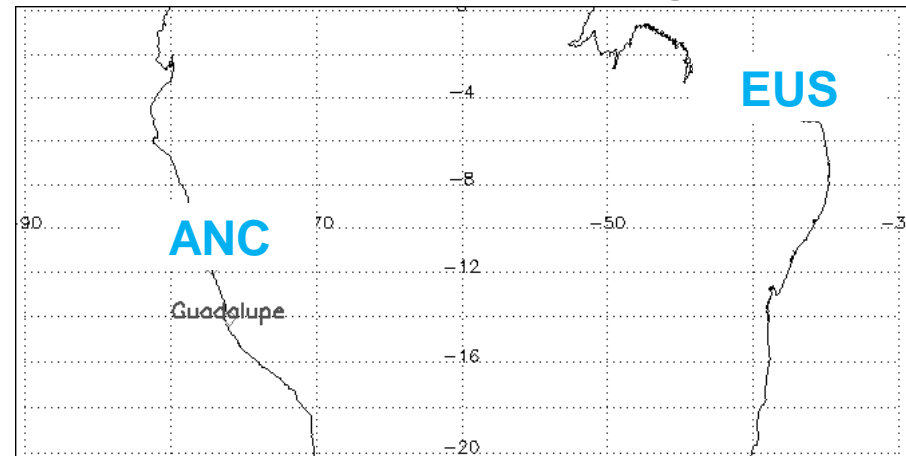


Magnetometer

### Asian Region



### South America Region



	GGLat	GGLon	GMLat	GMLon
Cebu	10.36	123.91	2.53	195.54
Davao	7.00	125.40	-1.02	196.54
Ancon	-11.77	-77.15	0.77	354.33
Eusebio	-3.88	-38.43	-3.64	34.21
Yap	9.50	138.08	1.49	209.06
Pameungpeuk	-7.65	107.69	-17.85	179.47

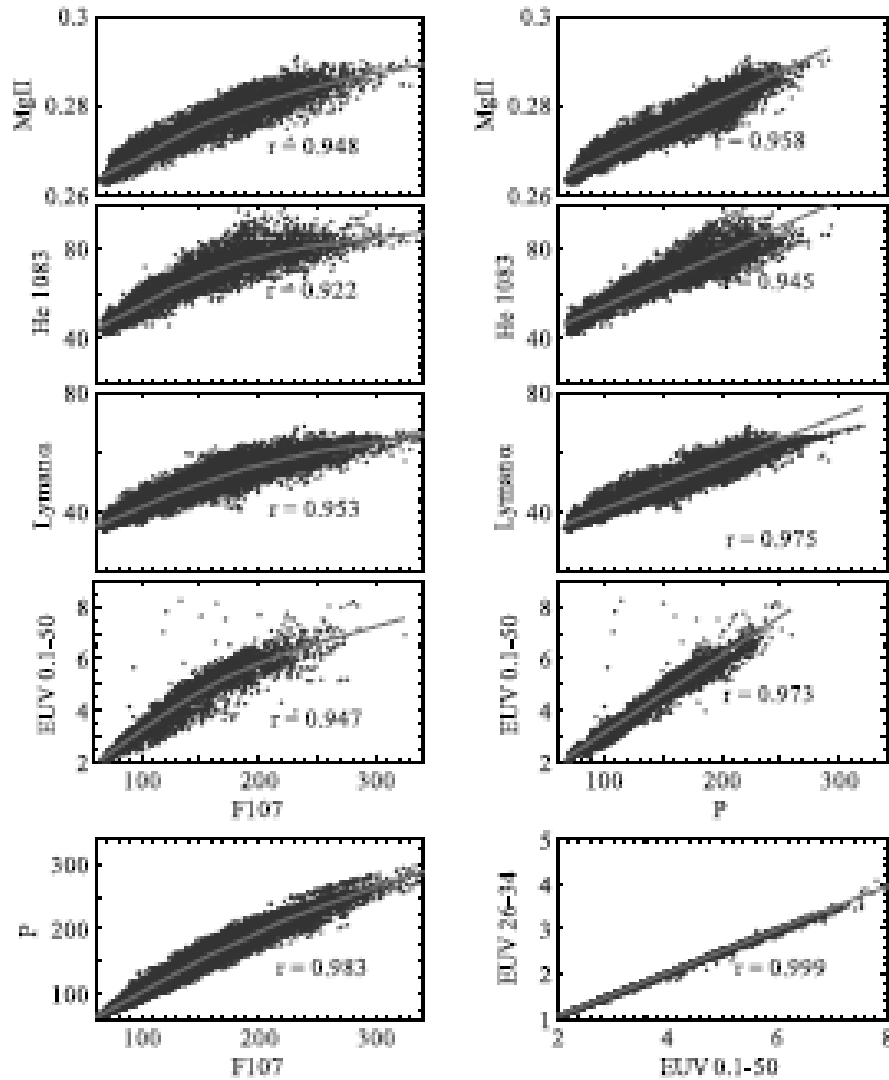


MF Radar

## 2. Data and Method

- ◆ Comparison between magnetometer and radar data
- Magnetometer and radar data analysis
  - Baseline: the median of 30 days(first and last 15days)
  - Delete magnetic disturbance: subtract SYM-H index from the above magnetometer data
  - Calculate maximum and minimum values of EEJ, and the amplitude(max-min) at each day.
  - Delete solar activity: subtract EUV(26-32nm) observed at SOHO SEM from EEJ amplitude.
  - Compare the above Residual-EEJ amplitude variation with neutral wind variation observed at MF radar

## 2. Data and Method

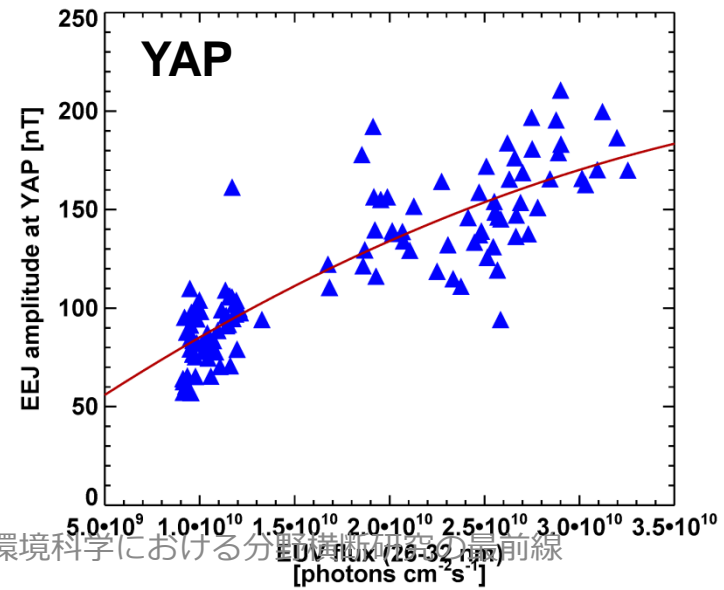
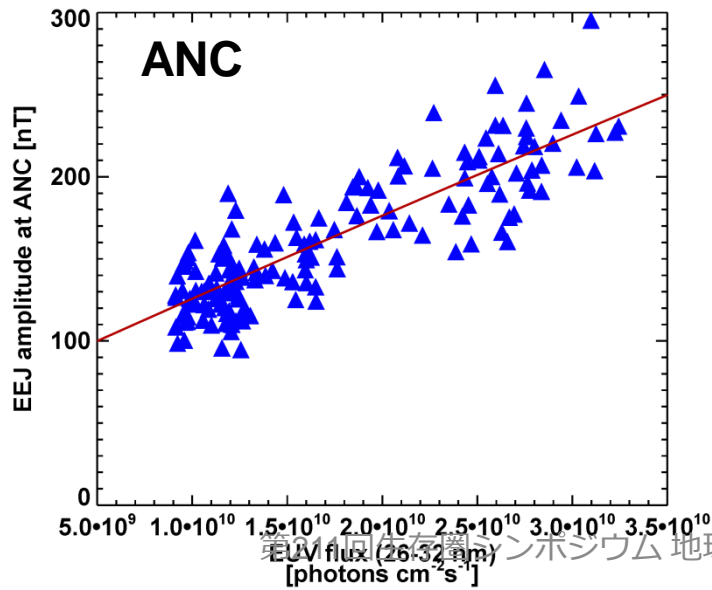
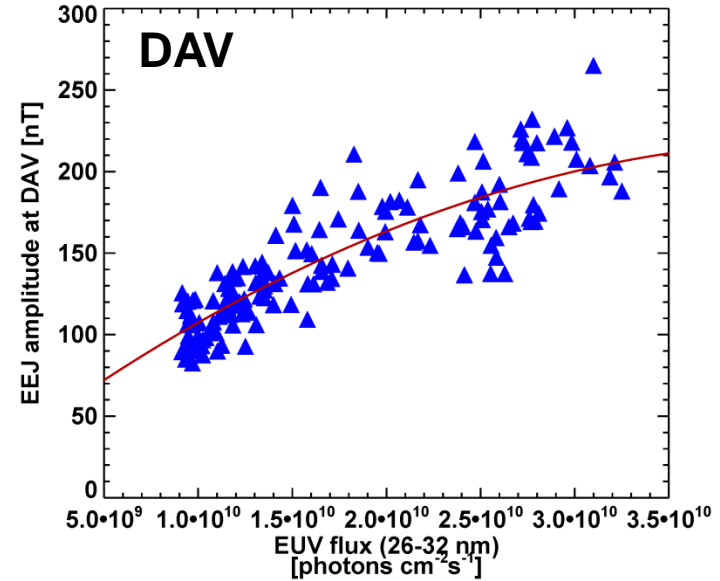
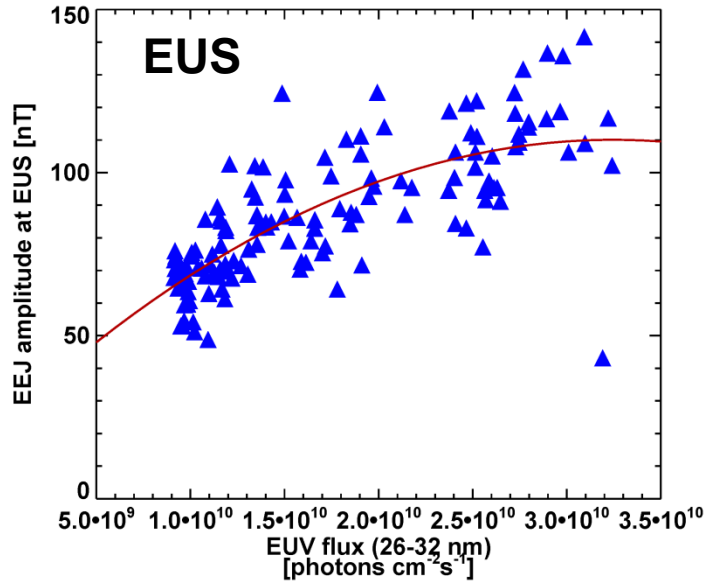


Liu et al., 2006

- F10.7 flux, a major parameter of solar activity index, behavior is different from other solar activity parameters (e.g., Liu et al, 2006)
- In this study, we use SOHO SEM (Solar EUV Monitor) as solar activity index.

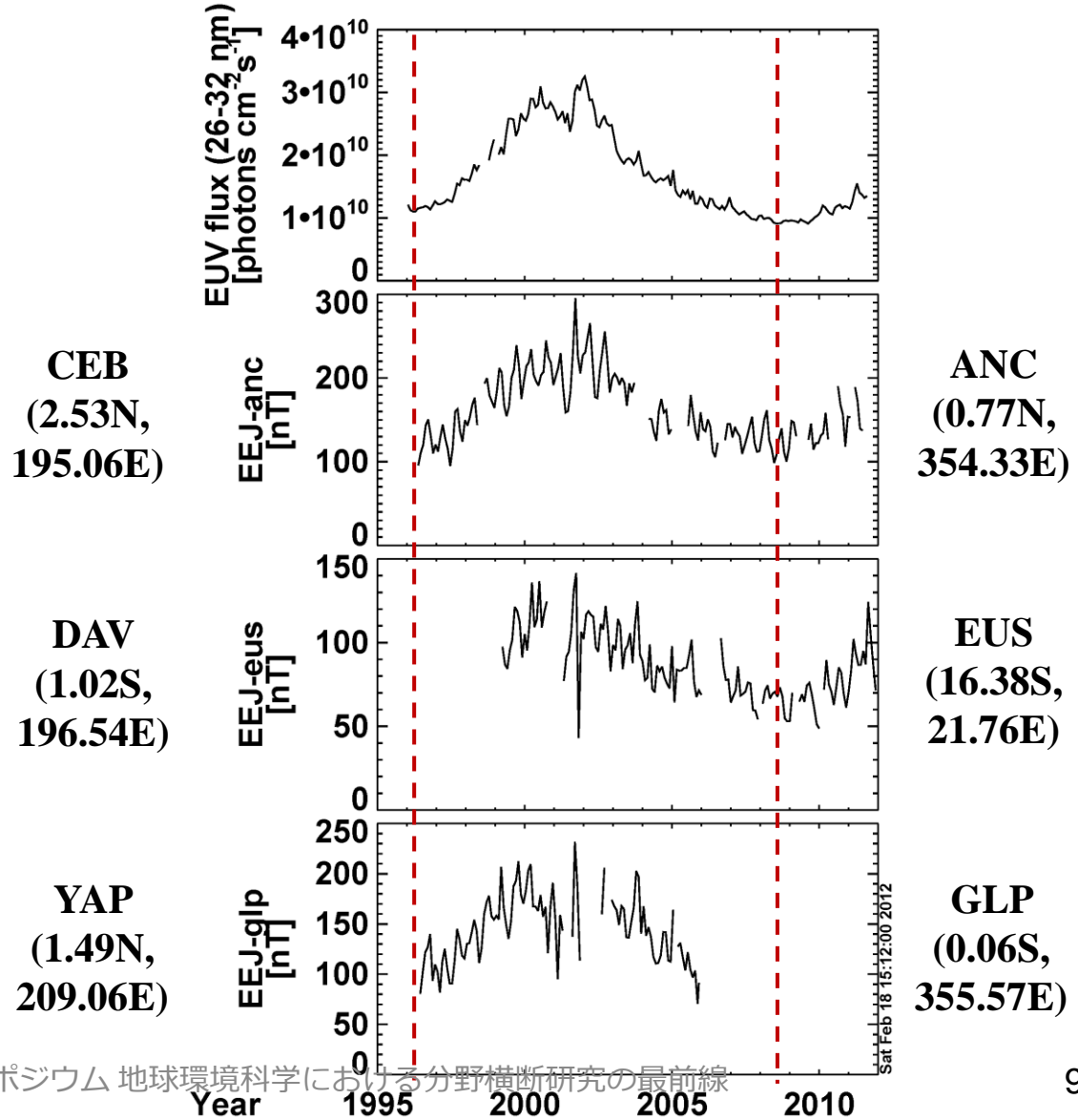
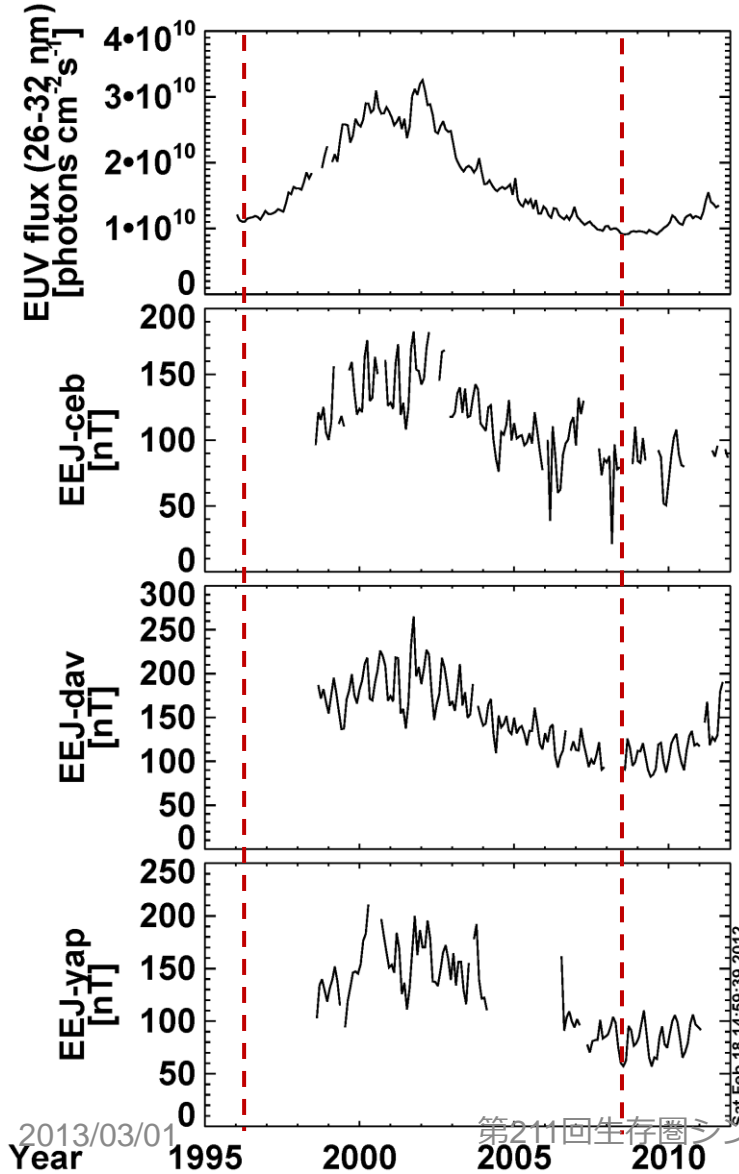
# 3. Analysis and Discussion

## ◆ Relationship between EEJ amplitude and EUV flux(monthly average)



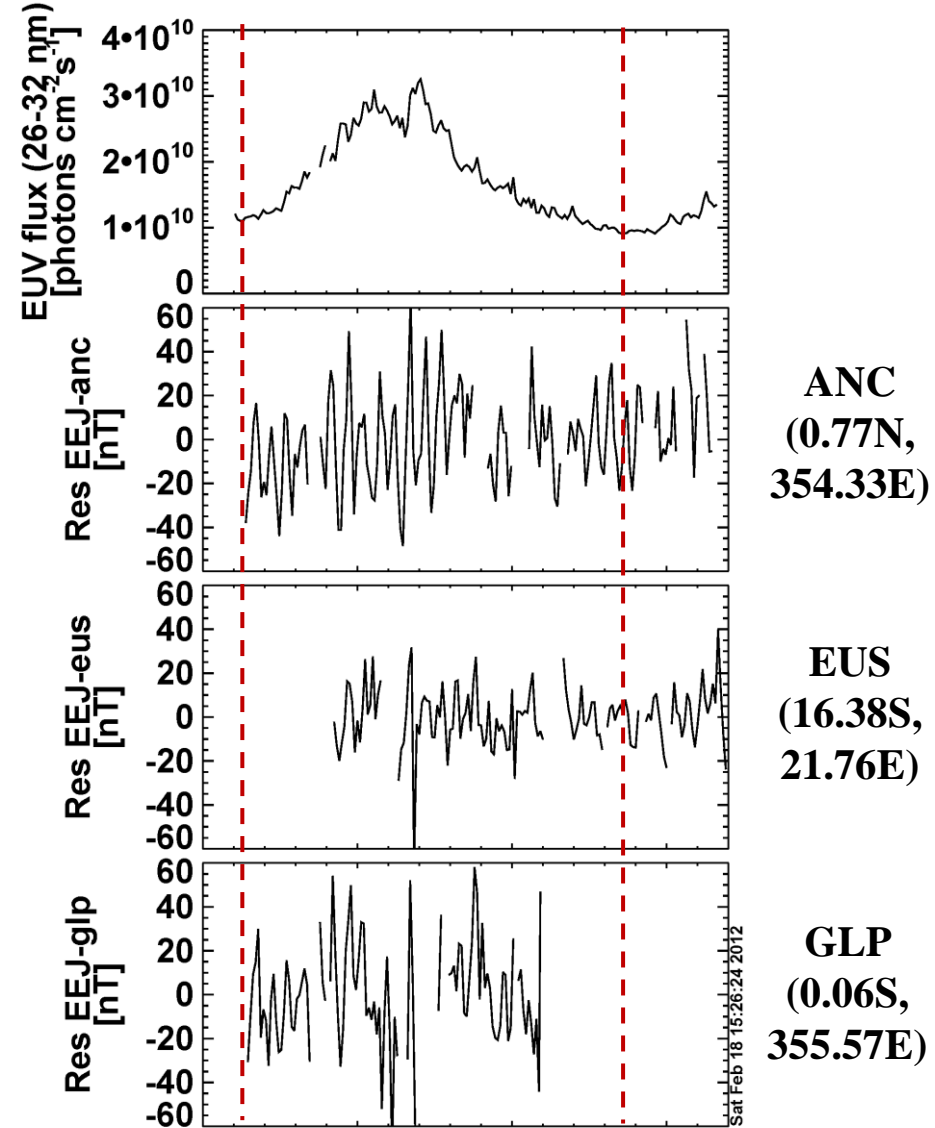
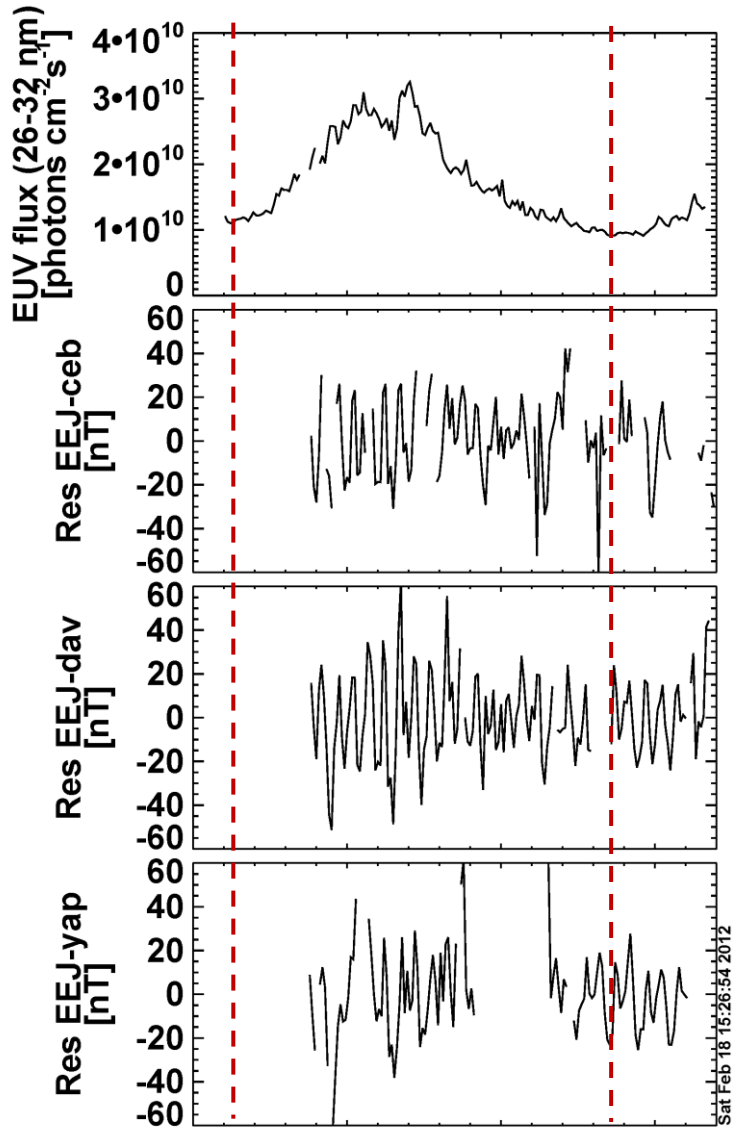
# 3. Analysis and Discussion

## ◆ Long term variation of EEJ amplitude



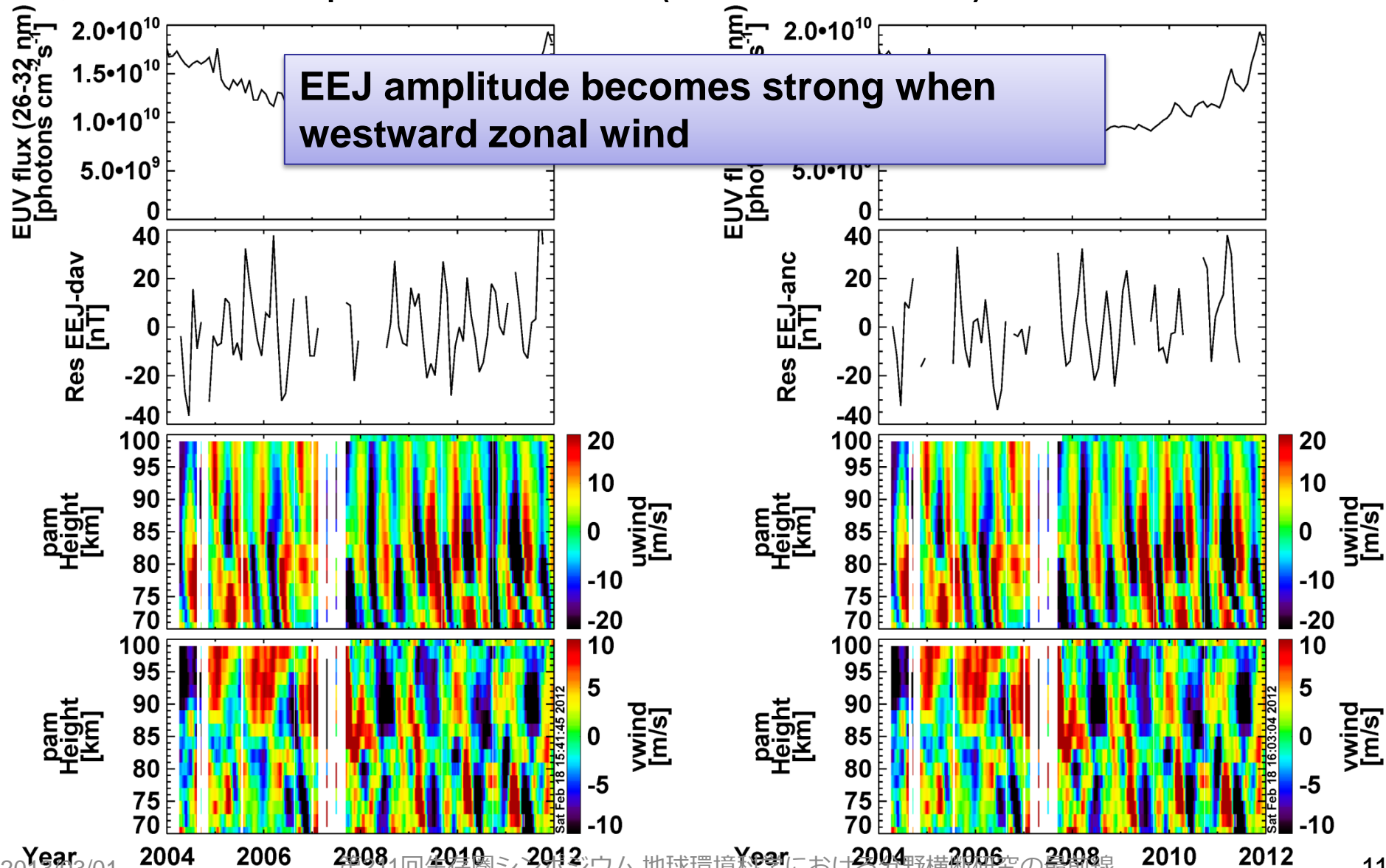
# 3. Analysis and Discussion

## ◆ Long term variation of Residual-EEJ amplitude



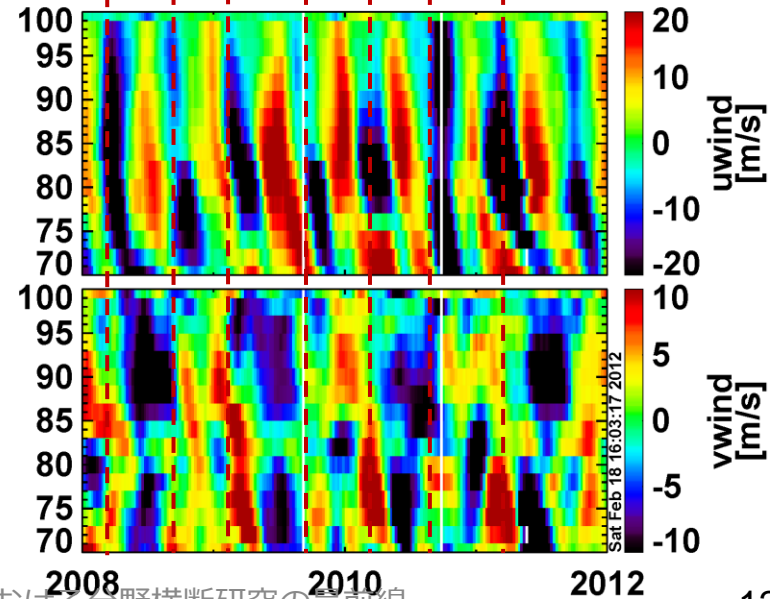
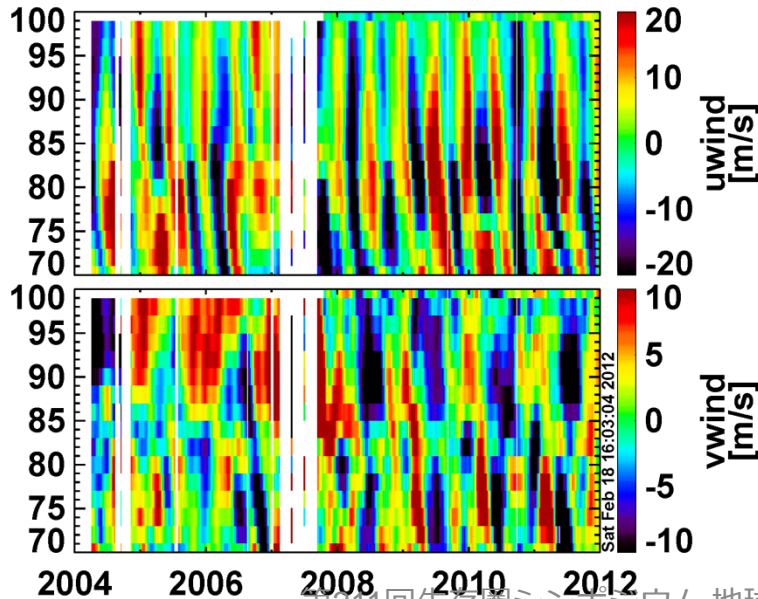
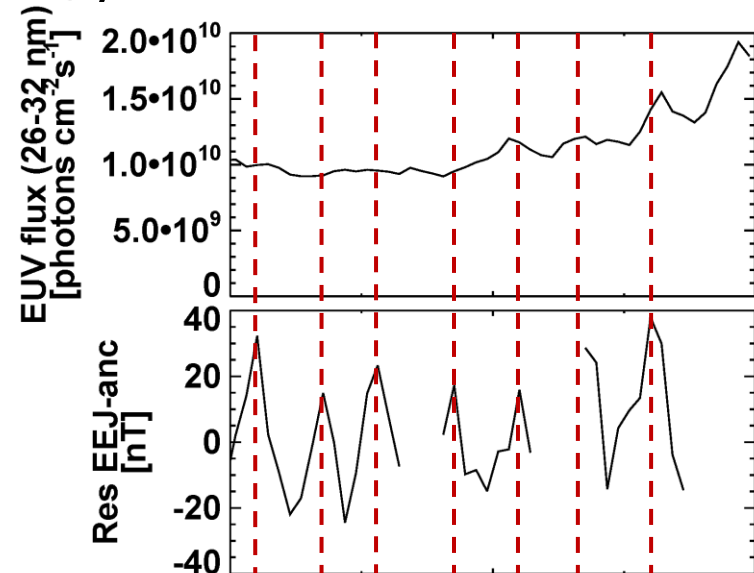
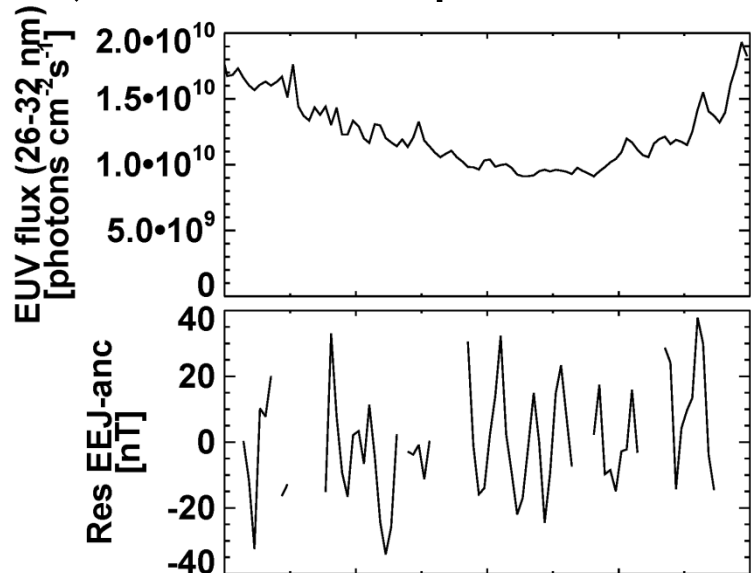
# 3. Analysis and Discussion

## ◆ Relationship between EEJ (DAV and ANC) and zonal wind



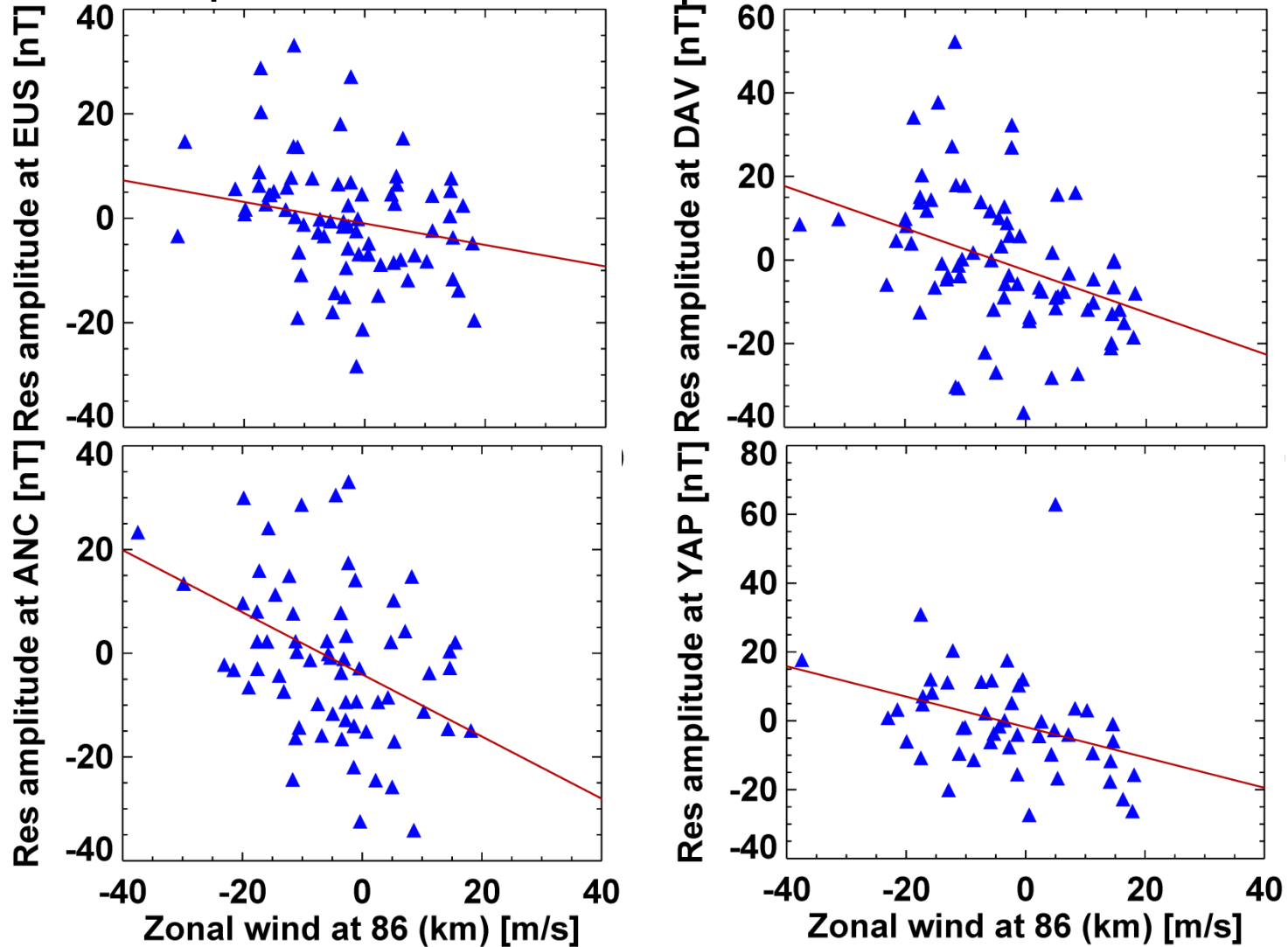
# 3. Analysis and Discussion

## ◆ Relationship between EEJ (ANC) and neutral wind



# 3. Analysis and Discussion

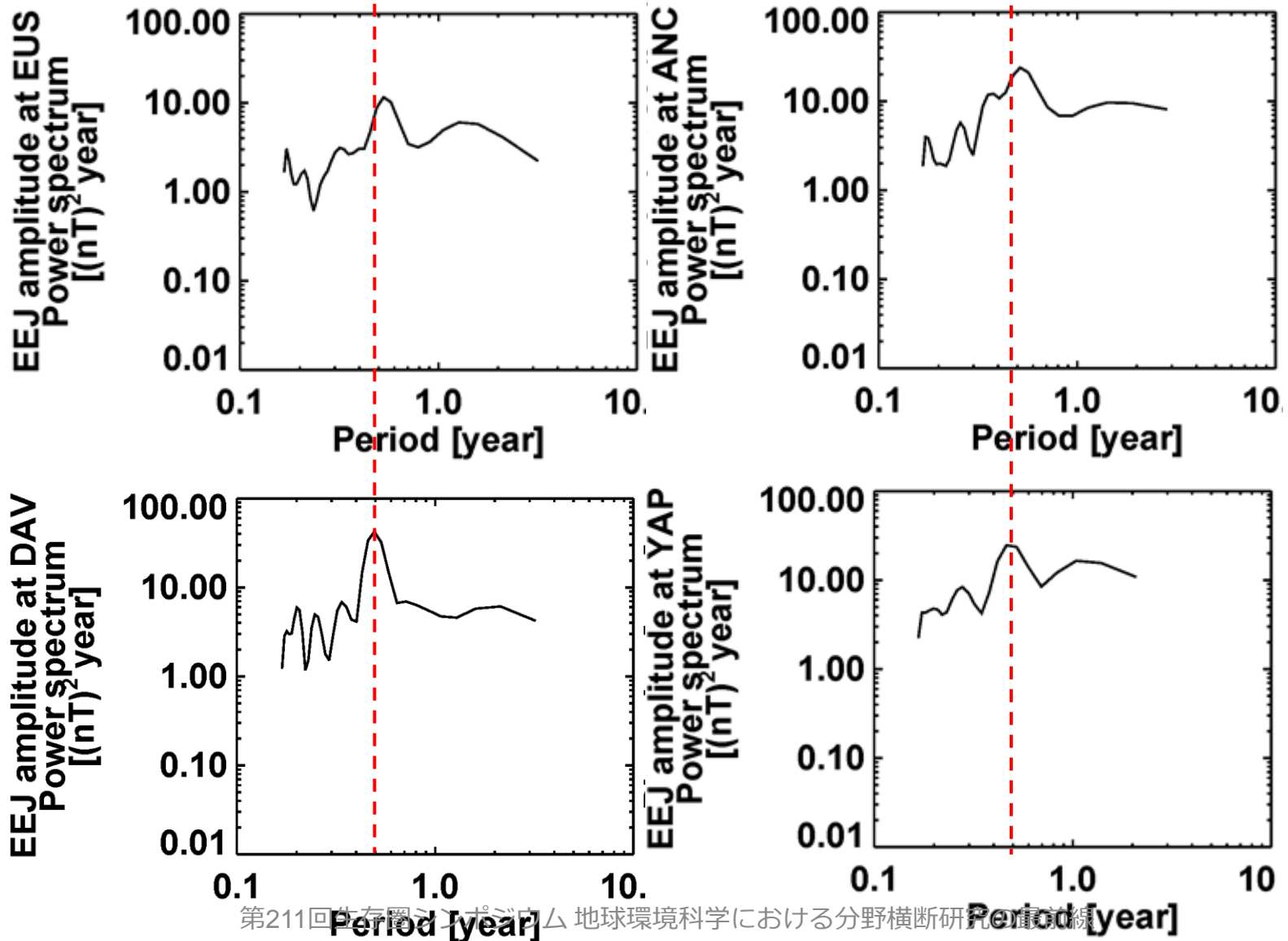
## ◆ Relationship between EEJ amplitude and 86 km zonal wind



EEJ amplitudes become strong at westward zonal wind in all station

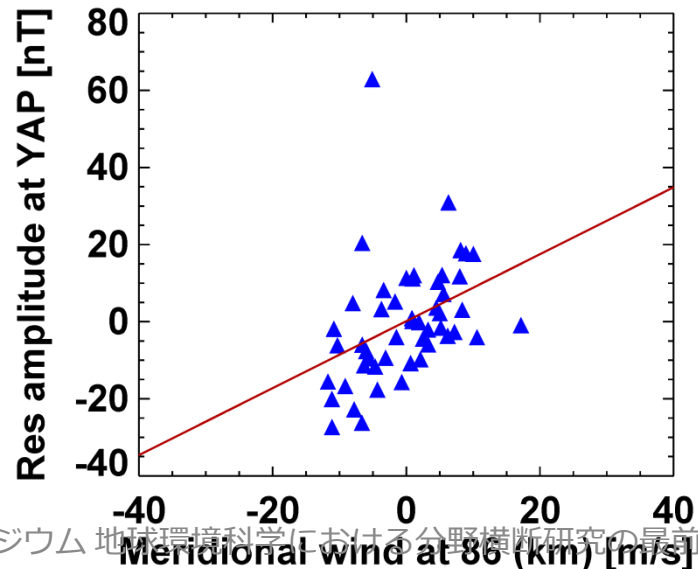
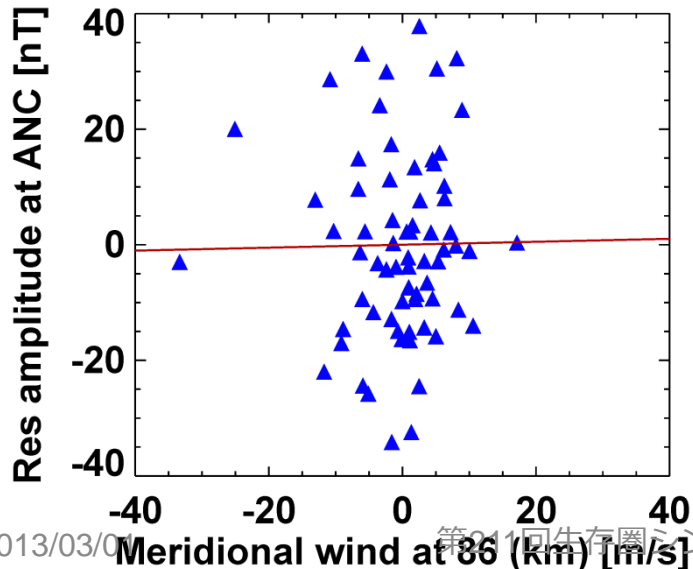
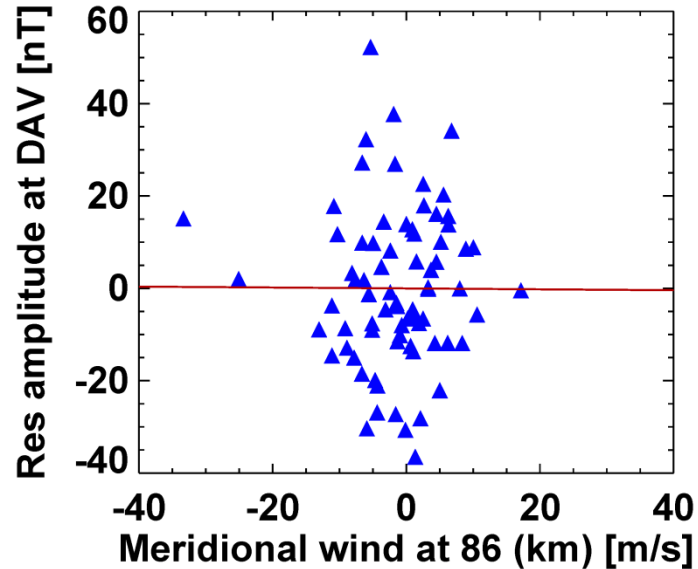
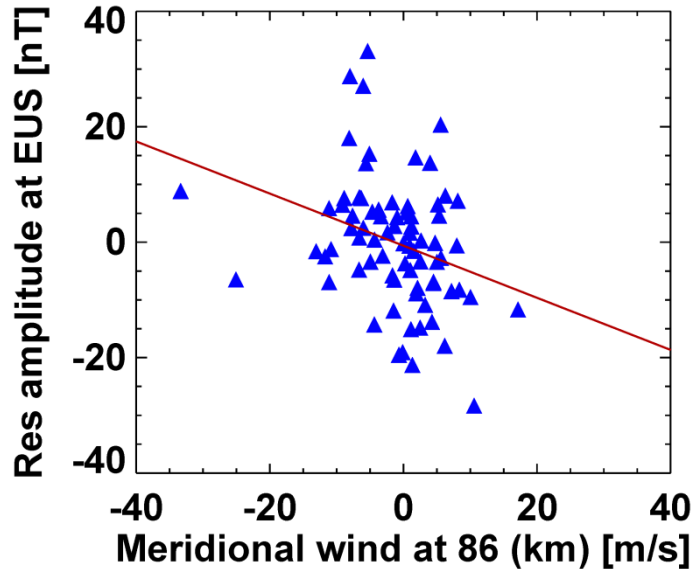
# 3. Analysis and Discussion (Spectrum)

◆ Frequency relationship between all geomag stations



# 3. Analysis and Discussion

## ◆ Relationship between EEJ amplitude and 86 km meridional wind



Looks no relationship between Res-EEJ and meridional wind

# 4. Discussion

## ◆ Location map, Instruments

### TIMED Satellite TIDI

(TIMED Doppler Interferometer)

Launch: 2001/July/01

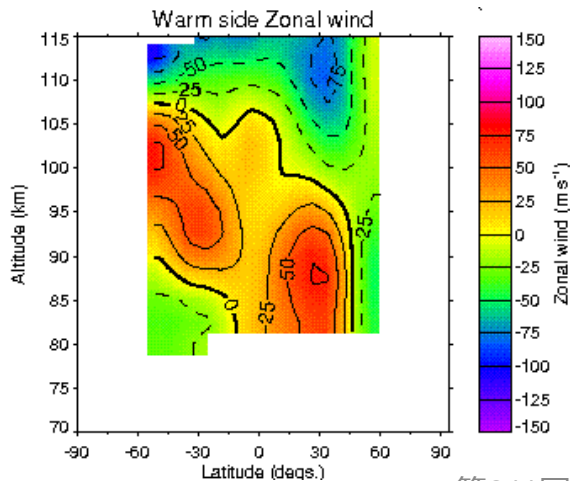
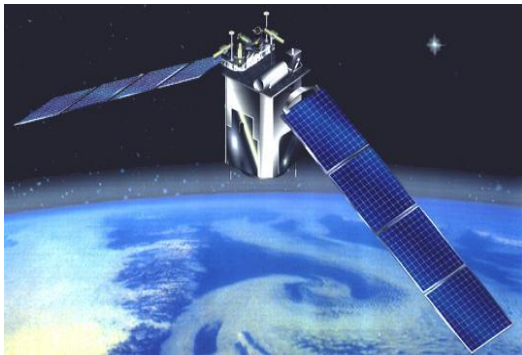
Satellite Orbit: 625 km, inclination: 74.0745 degree

Mean Motion: 14.837 Revs/day

TIDI Observations: winds, temperatures, and density

TIDI Wind accuracy: 3 m/s (line of sight)

TIDI Altitude Resolution: 2.5 km

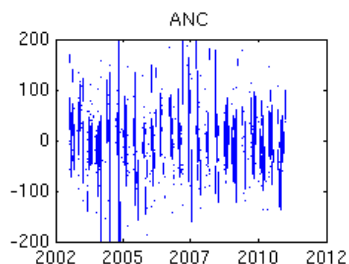
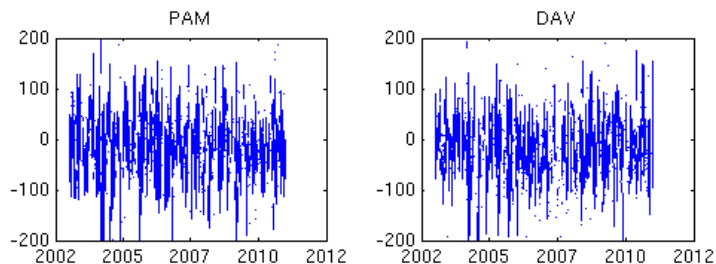


Dayside Measurement	Feature	Altitude Range
Vector Wind	O <sub>2</sub> Atmosphere (0-0) P15	60 - 100 km
	O <sub>2</sub> Atmosphere (0-0) P9	70 - 115 km
	OI (557.7 nm)	100 - 180 km
Nightside Measurement	Feature	Altitude Range
Vector Wind	O <sub>2</sub> Atmosphere (0-0) P9	80 - 105 km
	OI (557.7 nm)	90 - 110 km

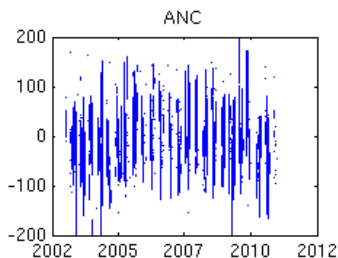
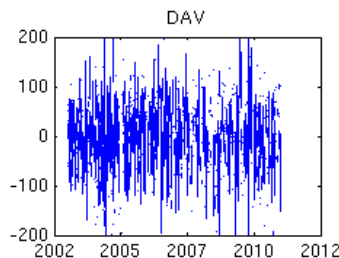
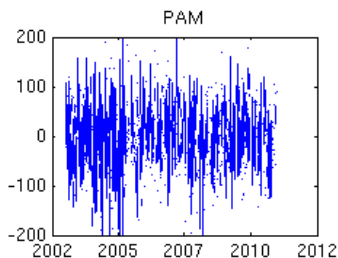
# 4. Discussion

## ◆ ZonalWind at 85 km observed by TIDI

地理緯度経度±5度で各観測点上の風情報を抜粋



**Ascend**



**Descend**

昼夜と軌道方向により4つのデータ種別

Warm\_ascend

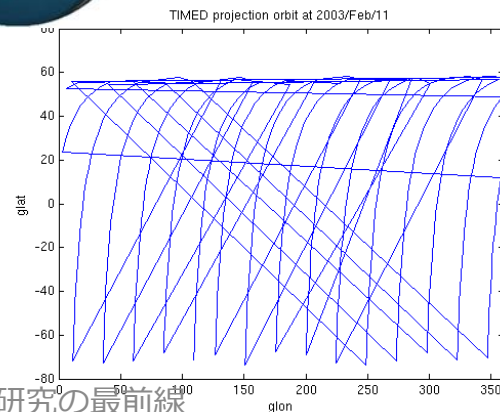
Cold\_ascend

Warm\_descend

Cold\_descend

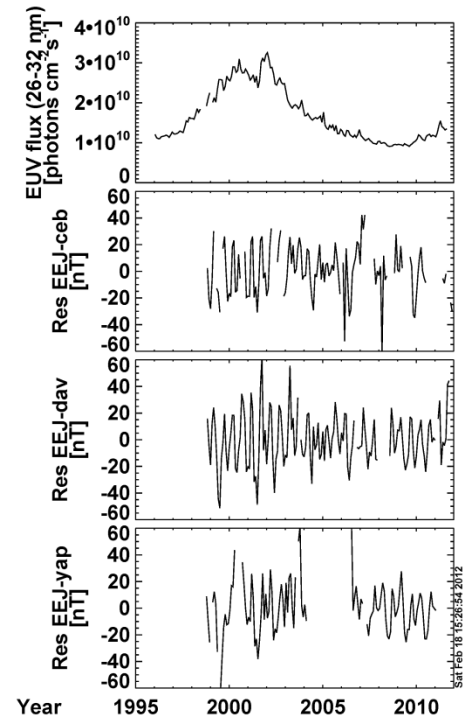
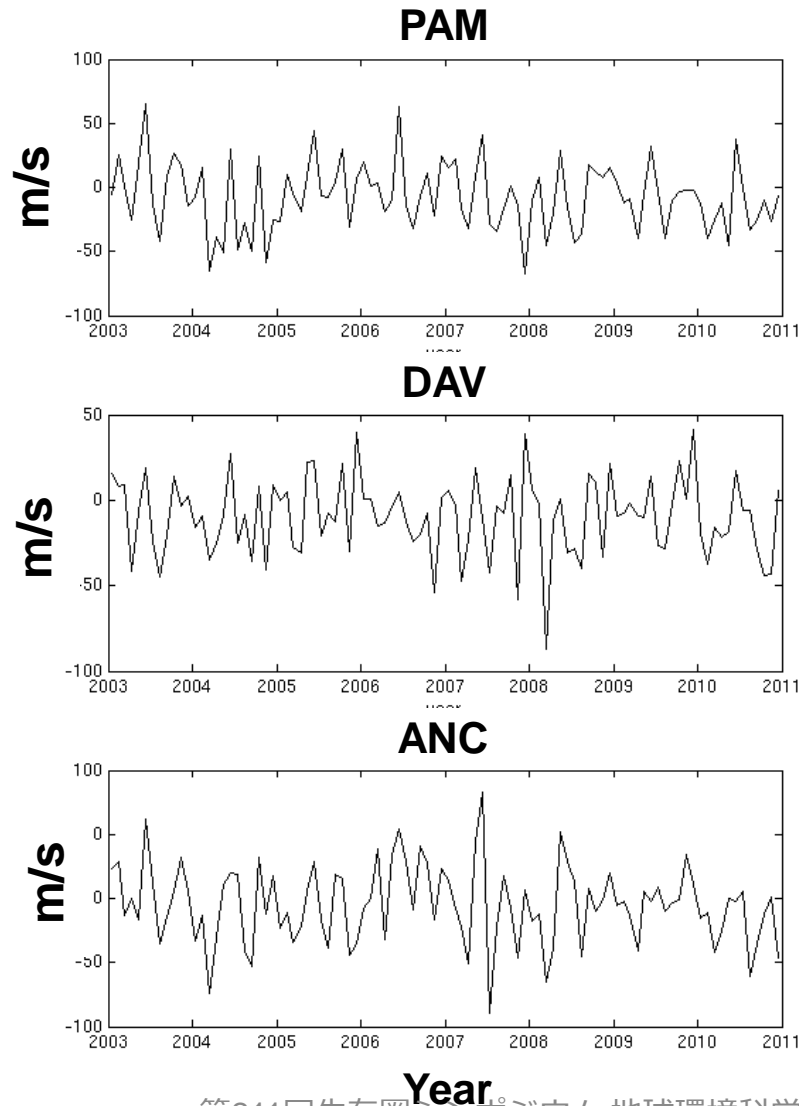
今回は赤道ジェット電流との比較研究

から発展しているので、Warmのみ使用



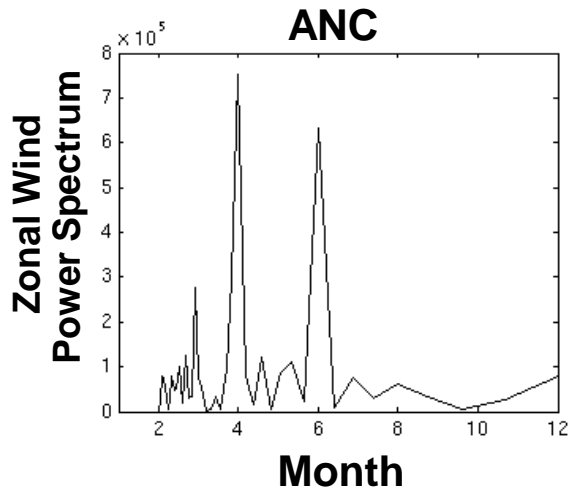
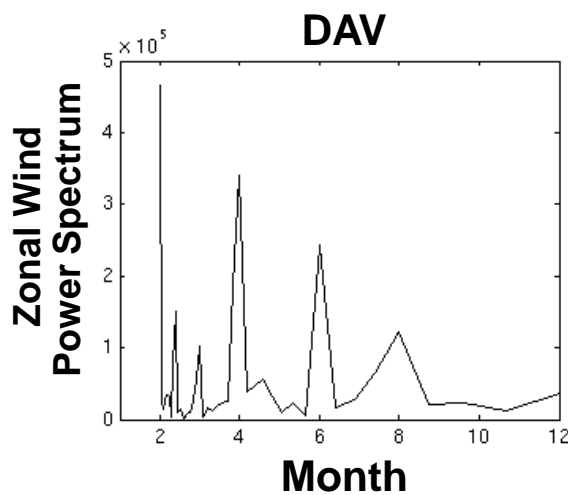
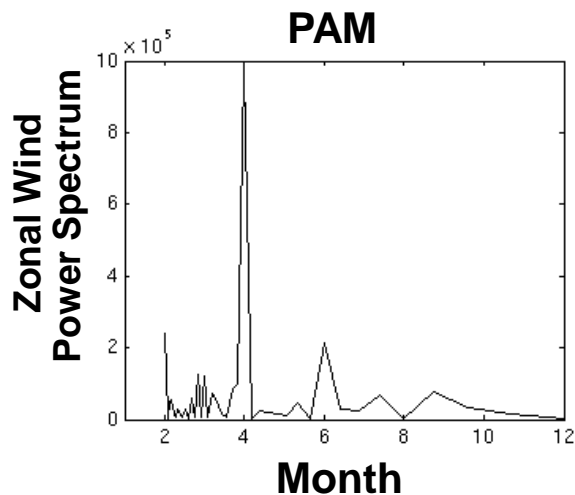
# 4. Discussion

- ◆ Monthly averaged wind velocity at 85 km above each observatory



# 4. Discussion

## ◆ Frequency Analysis



周波数解析の結果、全観測点上で同周期（6か月）の風が観測された

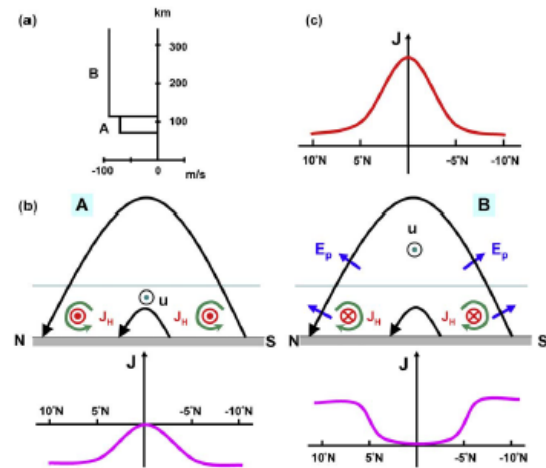
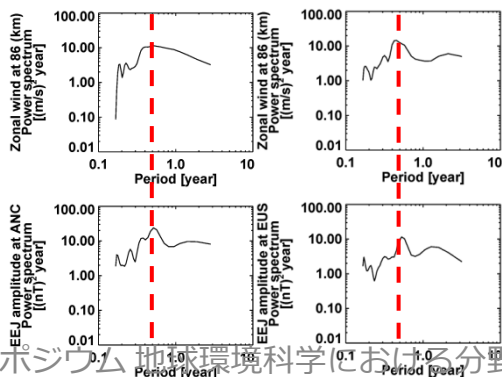
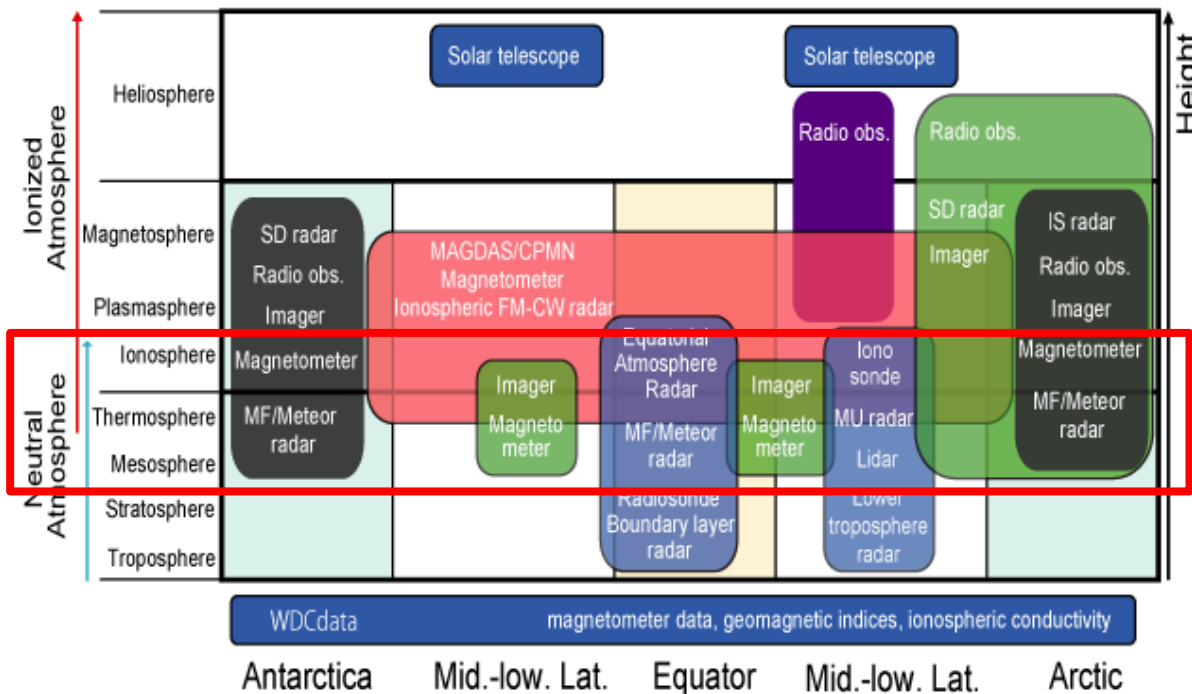


Figure 4. (a and b) Schematic figures of currents driven by different height profiles of westward zonal winds. The gray shaded stripe represents the lower boundary of the ionosphere. Current is positive eastward. See text for further details. (c) Latitudinal distribution of the EEJ driven by an eastward electric field, without low-latitude zonal winds.

Fang et al., 2008

Fang et al.: 高高度の風と低高度の風がEEJに逆センスの影響を与えるシミュレーション

# ex. IUGONET機関所有データの観測領域



## SpatialCoverage

### CoordinateSystem

**CoordinateRepresentation**  
Spherical

**CoordinateSystemName**  
GEO

**NorthernmostLatitude**  
-0.204

**SouthernmostLatitude**  
-0.204

**EasternmostLongitude**  
100.320

**WesternmostLongitude**  
100.320

**Unit**  
degree

**MinimumAltitude**  
80

**MaximumAltitude**  
670

A part of metadata (FAI)

## 5. Summary

- We compared the EEJ with neutral wind variation at mesosphere and low thermosphere
- We found that the relationship between the variations of zonal wind and the residual-EEJ showed a clear inverse correlation.
- We performed the frequency analysis to quantitatively define the relationship of zonal wind and residual-EEJ and found a good correlation.
- We compared the above results with data observed at TIMED satellite, and the result indicates that other possibility for res-EEJ frequency at South American region.
- We will perform additional data analysis and some simulations to get better understanding.