Characteristics of equatorial Pc 5 during electron flux enhancement

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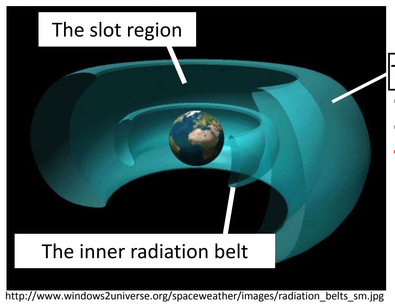
1 : Introduction

<The radiation belt>

In the radiation belt, energetic particles are trapped by the earth's magnetic field.



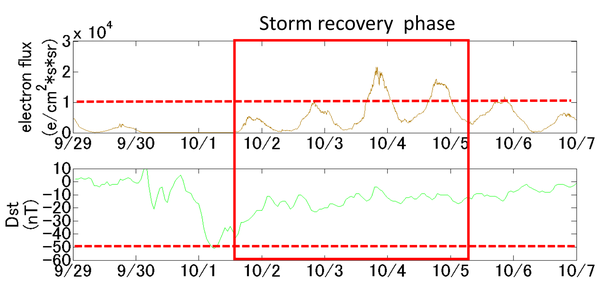
http://www.windows2universe.org/spaceweather/images/radiation_belts_sm.jpg

- Altitude : 20000km
- particle : electron(>1MeV)
- affect geosynchronous orbits

When the electron flux enhance in the outer radiation belt, some troubles can be occurred (ex. Satellites can be damaged)

Important Subject for Space Weather Study!

<Electron flux enhance event>



Electron flux (≥2MeV)≥ 10000[e/cm^2*s*sr]

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We pick up the event as electron flux enhance event

<The magnetic pulsation >

The earth's magnetic field fluctuates periodically …

type	period [s]	frequency [mHz]
Pi 1	1~40	25~1000
Pi 2	40~150	6.67~25
Pi 3	150<	<6.67
Pc 1	0.2~5.0	200~5000
Pc 2	5.0~10	100~200
Pc 3	10~45	22.2~100
Pc 4	45~150	6.67~22.2
Pc 5	150~600	1.67~6.67
Pc 6	600<	<1.67

Pc : pulsation continuous Pi : pulsation irregular

Pc 5 pulsation can interact with electrons

<The Purpose of this study >

By analysis of solar wind parameters data and geomagnetic data

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To clarify the characteristics of Pc 5 during electron flux enhance events

2 : Data set

<Satellite observation>

[The GOES satellite]

http://www.nasa.gov/mission_pages/goes-n/media/goes-east.html

[The ACE satellite]

http://www.nasa.gov/mission_pages/sunearth/news/ace-15th.html

<PC index (Polar cap index)>

$$E_M = Vsw * B_T * sin^2\frac{\theta}{2}$$

$$\Delta F = E_M * \alpha + \beta$$

$$\text{PC index} = \frac{\Delta F - \beta}{\alpha} \approx E_M$$

PC index

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How E_M penetrates into the earth's magnetosphere

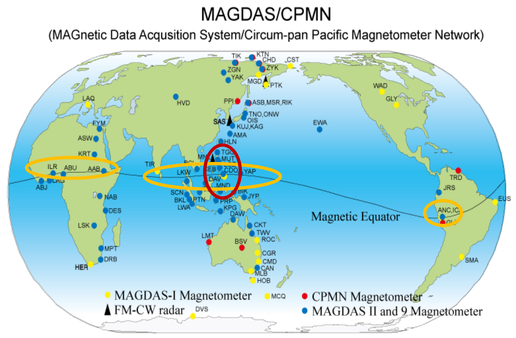
E_M:merging electric field B_T:IMF transverse component

Vsw: solar wind velocity θ:IMF polar angle from GSM Z-axis

ΔF: magnetic variation observed near pole stations

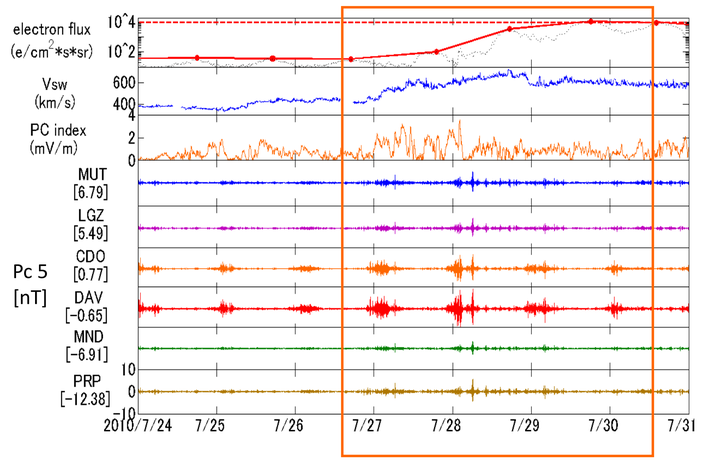
α&β : function of local time and month

<Ground magnetic observation>



3 : Result

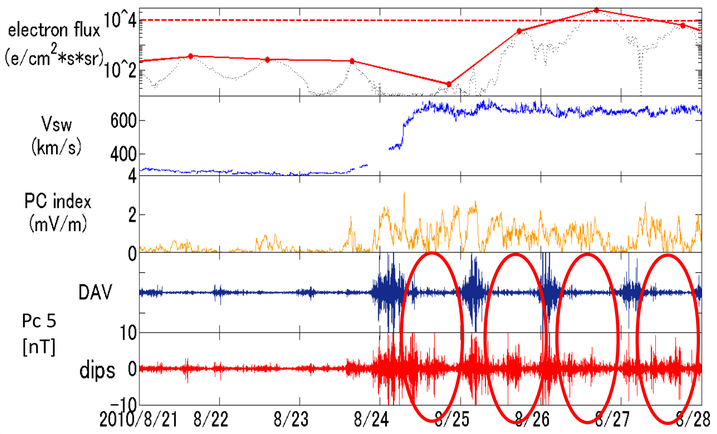
<Latitudinal characteristics>



When the electron flux enhance

- Solar wind velocity increases
- Pc 5 pulsation becomes active (especially, in the magnetic equator station, CDO DAV Pc 5 pulsation is more active than the other stations)

<Longitudinal characteristics>



※In 'dips' plot, we plotted all usable equatorial stations data.

When the electron flux enhance

- Pc 5 pulsation become active (especially, when the stations are in day side, Pc5 activity becomes more active.) During electron flux enhance, Pc5 is continuously active.

4 : Summary

- We can see large increase of solar wind velocity before electron flux enhancement.
- We can also see characteristic variation of Pc 5 pulsation during electron flux enhancement.

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1 : In the magnetic equator station, Pc 5 becomes more active than other stations.

2 : Pc 5 becomes continuously active during electron flux enhancement.

5 : Future works

① In this study, we can see only two events.

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We will check more electron flux enhance events. (During 2005/01/01~2013/12/31, there are 114 electron flux increase events.)

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After checking these events, we will do statistical analysis about the relationship between electron flux variation and Pc 5 pulsation.

② Reeves et al. (2003) shows that different types of electron flux variation are observed. (i.e. not only increase but also decrease and no-change)

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We will investigate the characteristics of equatorial Pc 5 during such electron flux variations.

acknowledgment

The data which I used for this study is provided by below organizations.

The GOES electron flux : NOAA SEC

The ACE solar wind velocity : SWRI

Pc index : Russian Arctic and Antarctic Research Institute

Dst index : Kyoto University WDC for Geomagnetism

Geomagnetic data for Pc 5 pulsation : International Center for Space Weather Science and Education (ICSWSE) Kyushu university

I also appreciate my teachers, senior researchers and colleagues for giving some advice about my study.