A Study of Ionospheric ULF Plasma Oscillation Observed by the Hokkaido HF Radar and its Comparison with Geomagnetic Pulsation on the Ground

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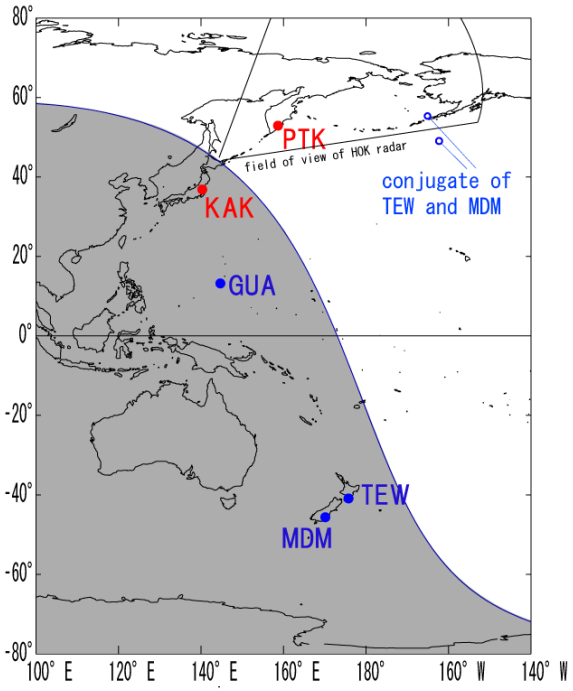
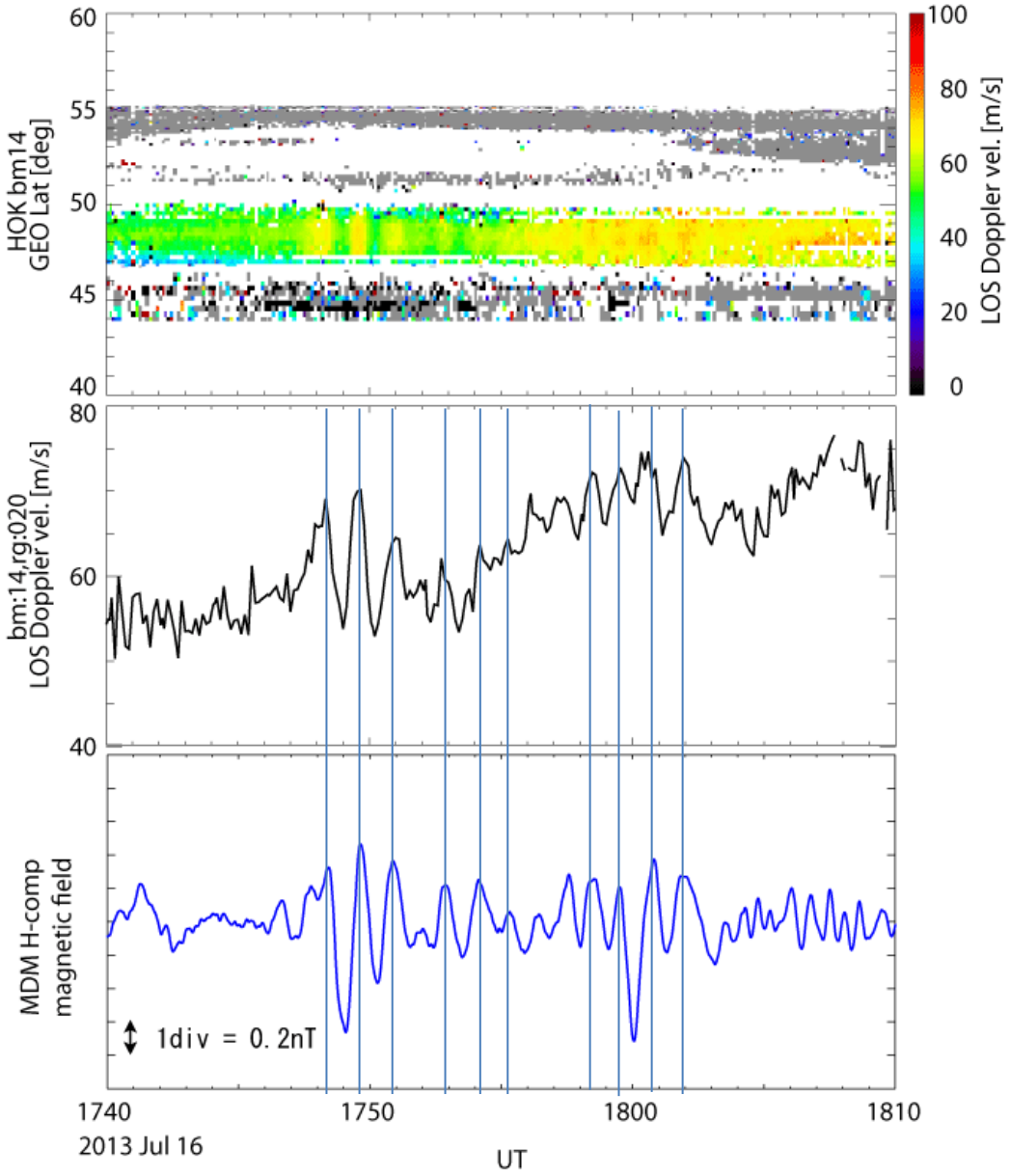
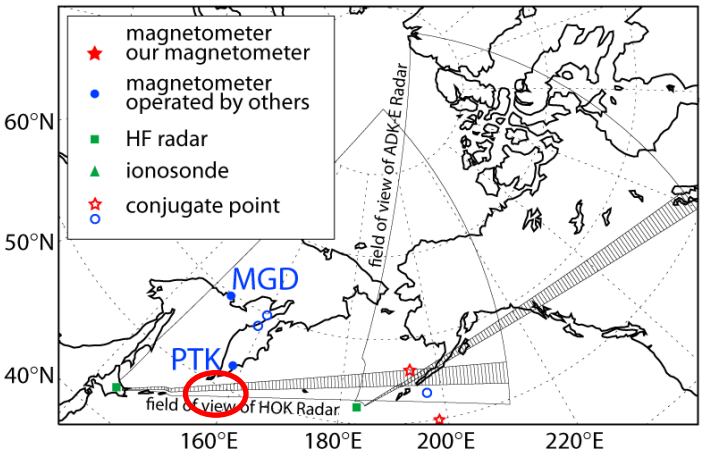
Station List

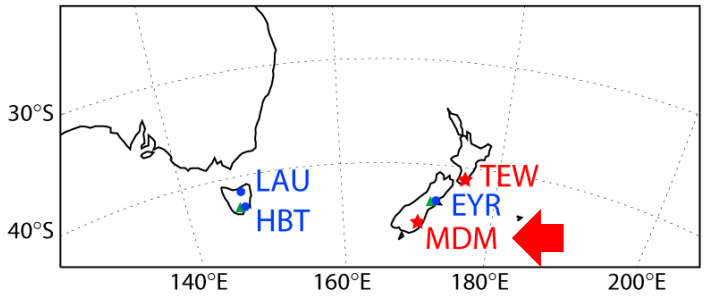
- PTK St.Paratunka RUS 52.94 158.25 L=2.10
- KAK Kakioka JPN 36.23 140.18 L=1.34
- GUA Guam USA 13.59 144.87 L=1.01
- TEW Te Wharau NZ -41.18 175.83 L=2.19
- MDM Middlemarch NZ -45.60 170.09 L=2.78
- FRD Fredericksburg USA 38.20 282.63 L=2.30 …American Meridian
- AMS Amsterdam isl. FRA -37.80 77.57 L=2.28 …Indian Meridian

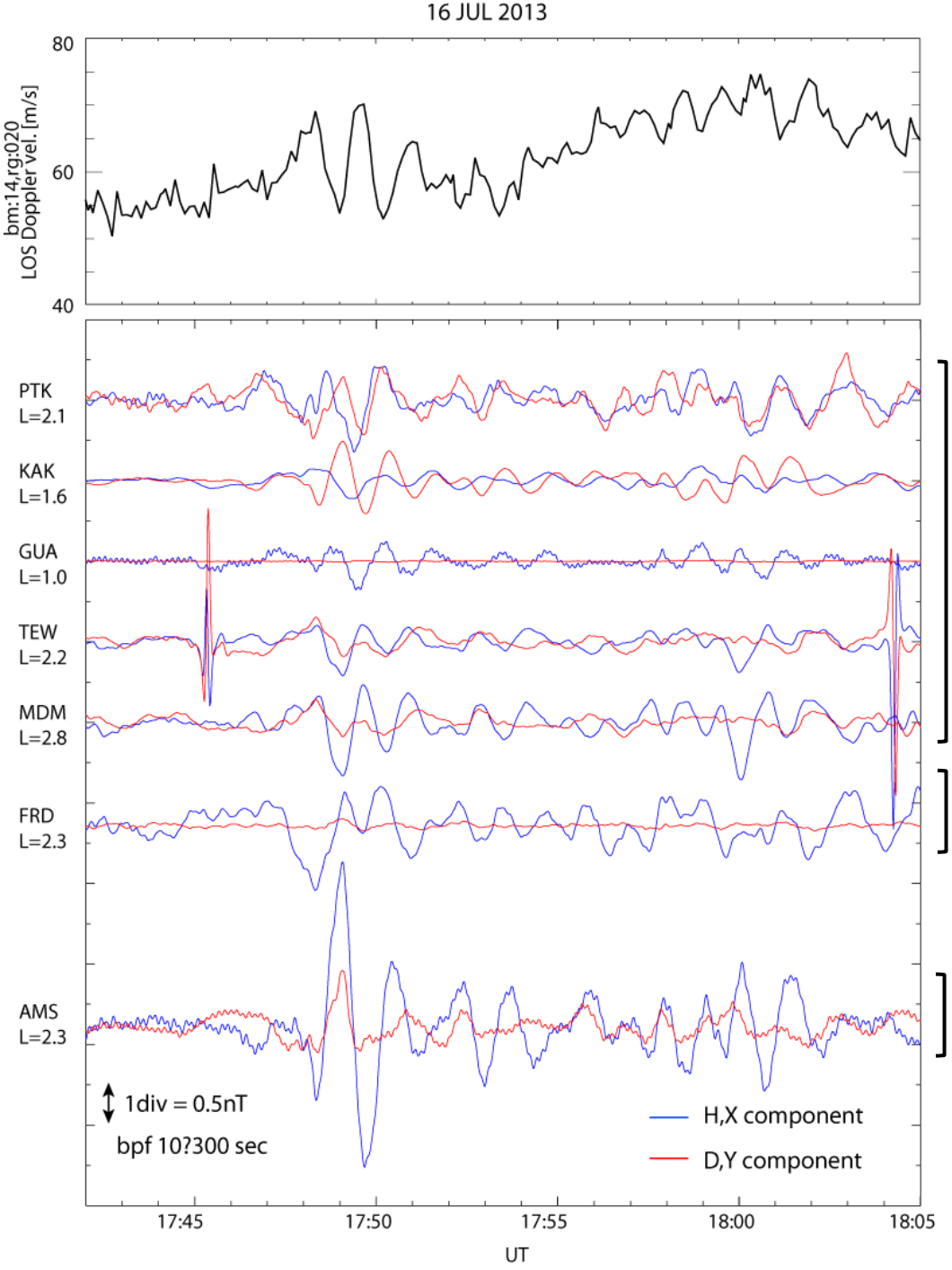


2013 JUL 16 HOK beam14









Where is the source of this pulsation?

210-260° MM

18:00UT=
5:40LT

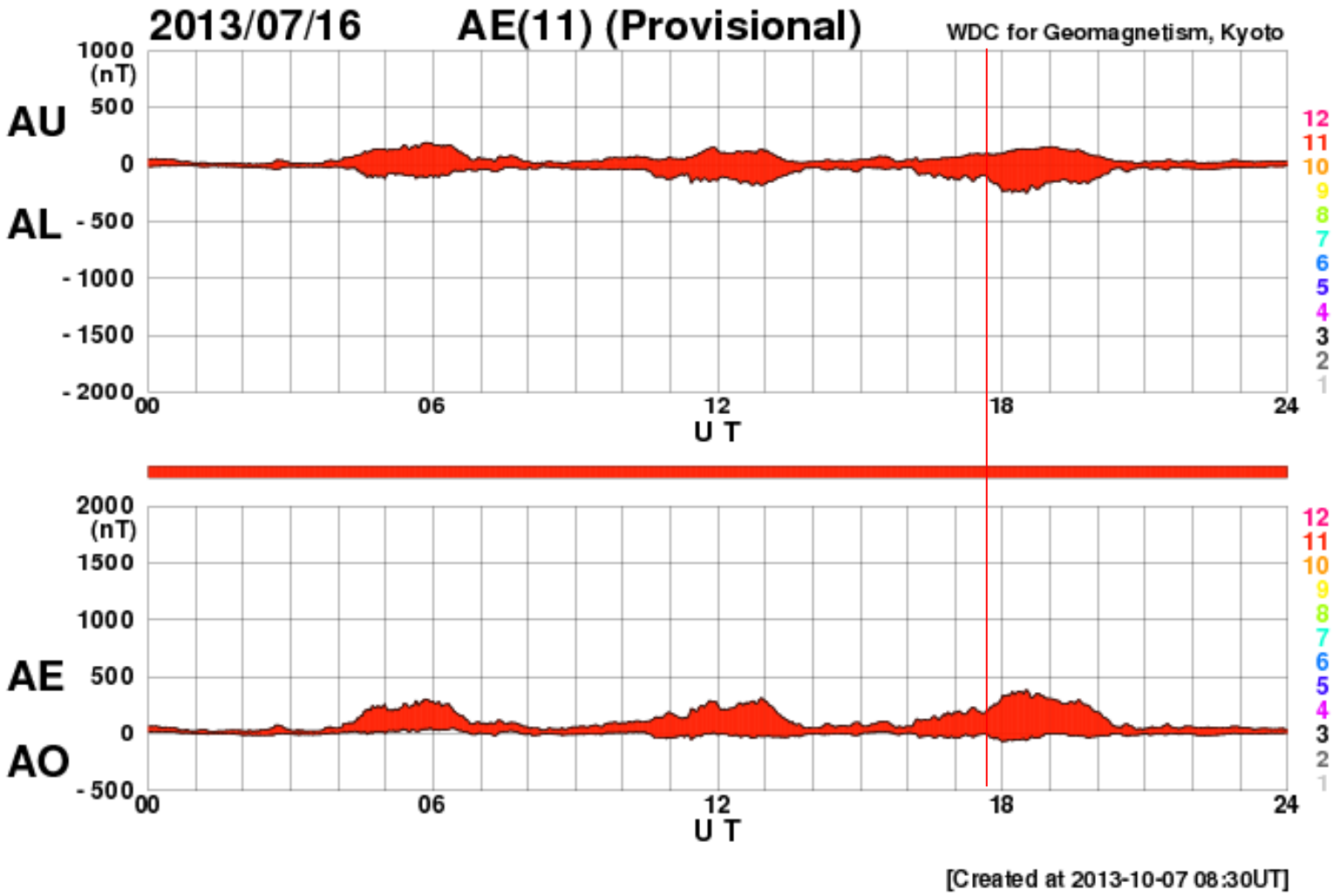
North America
12:50LT

Indian Ocean
23:10LT

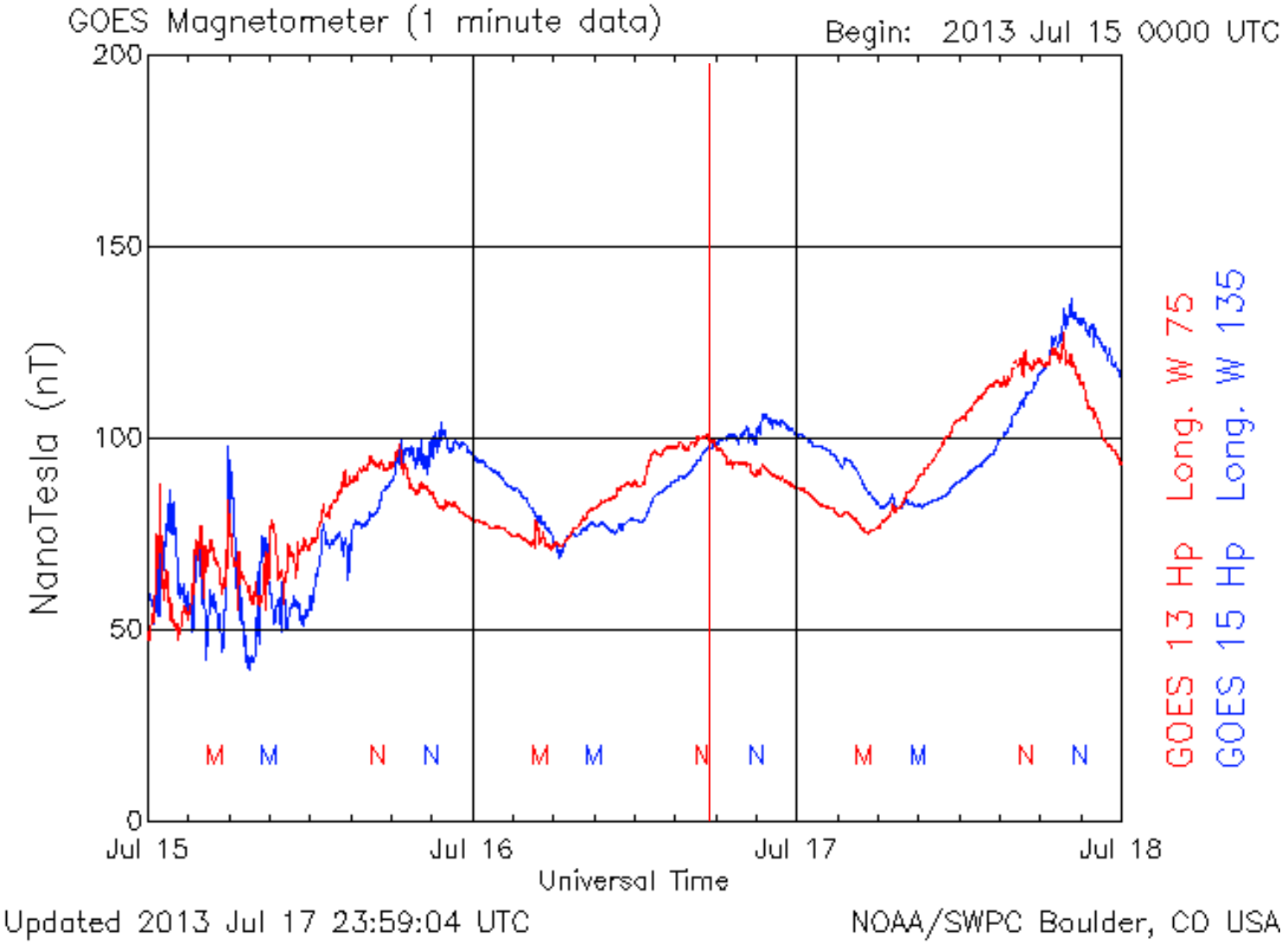
Large Amplitude in night side

Night side origin
Pi 2 ?

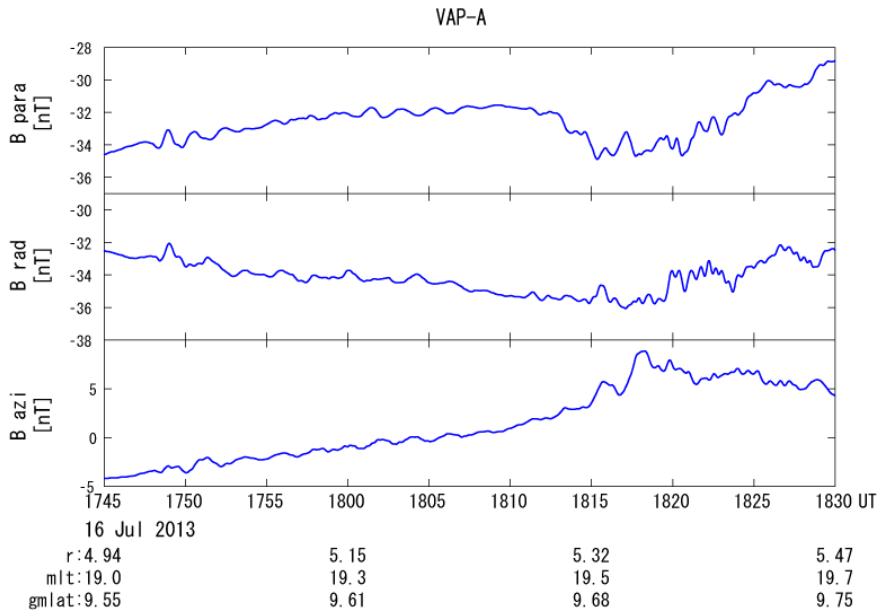
Substorm Onset



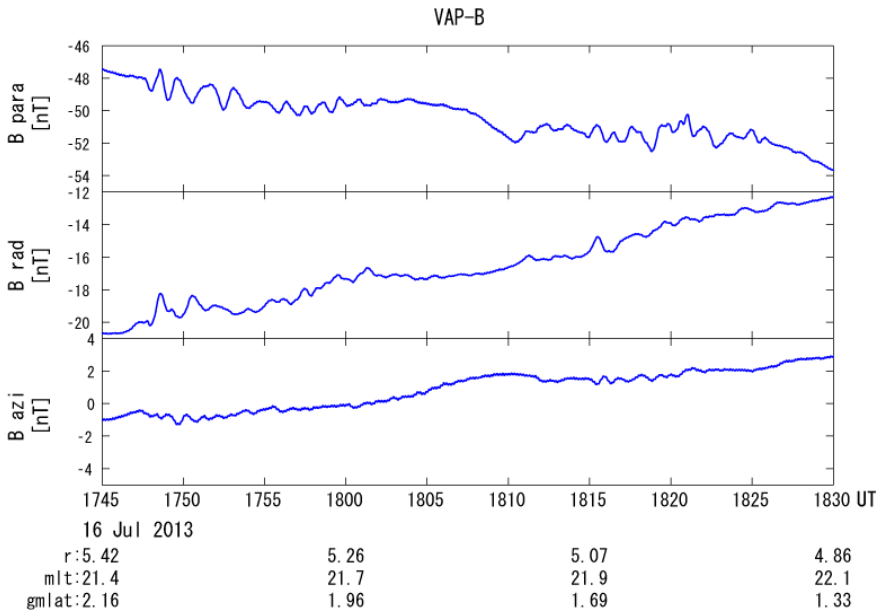
Substorm Onset



Van Allen Probes

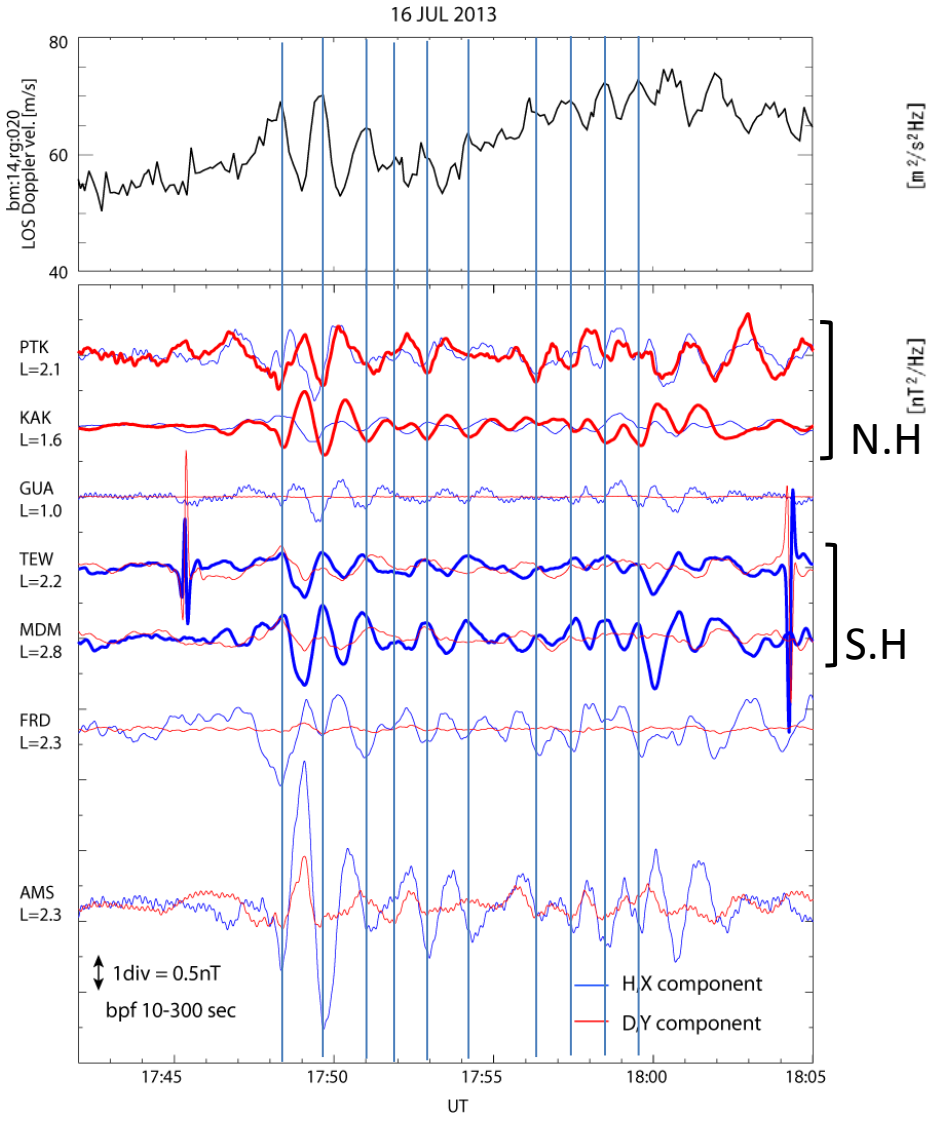


19MLT



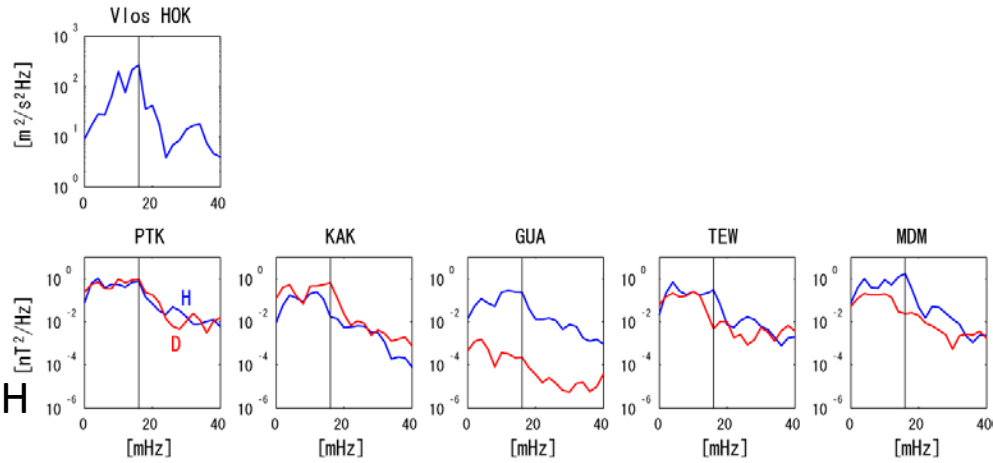
22MLT

Comparison between northern and southern hemispheres

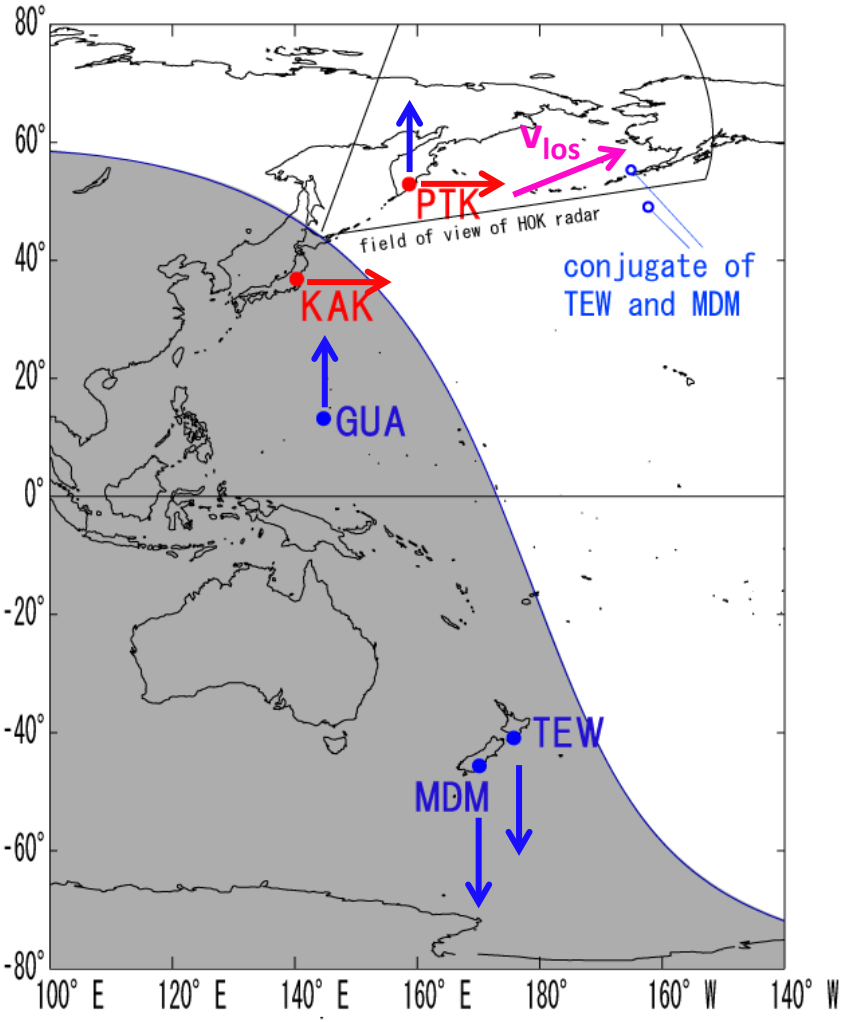


N.H

S.H



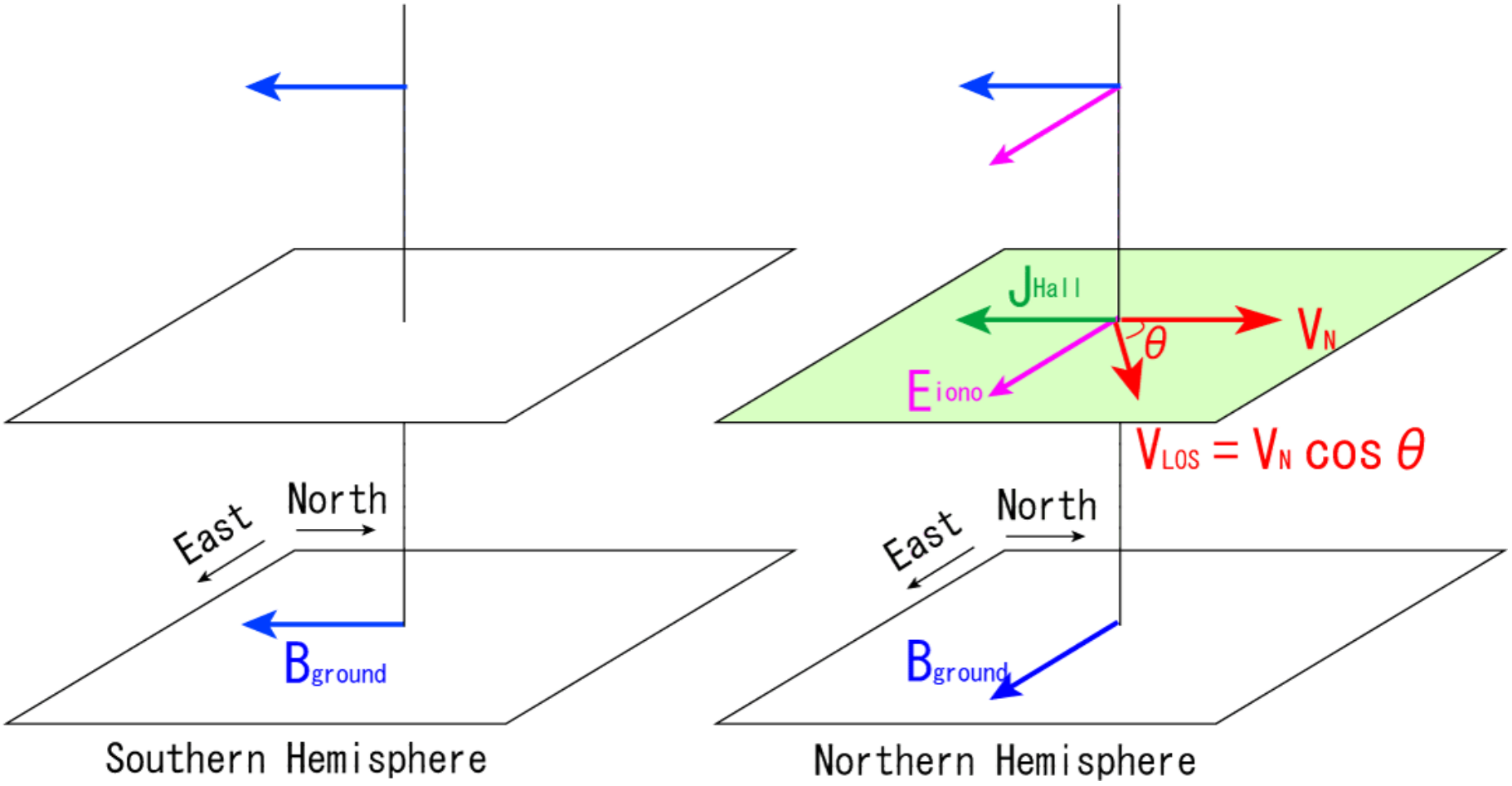
Summary



AMS

FRD

Schematic Picture of the Model



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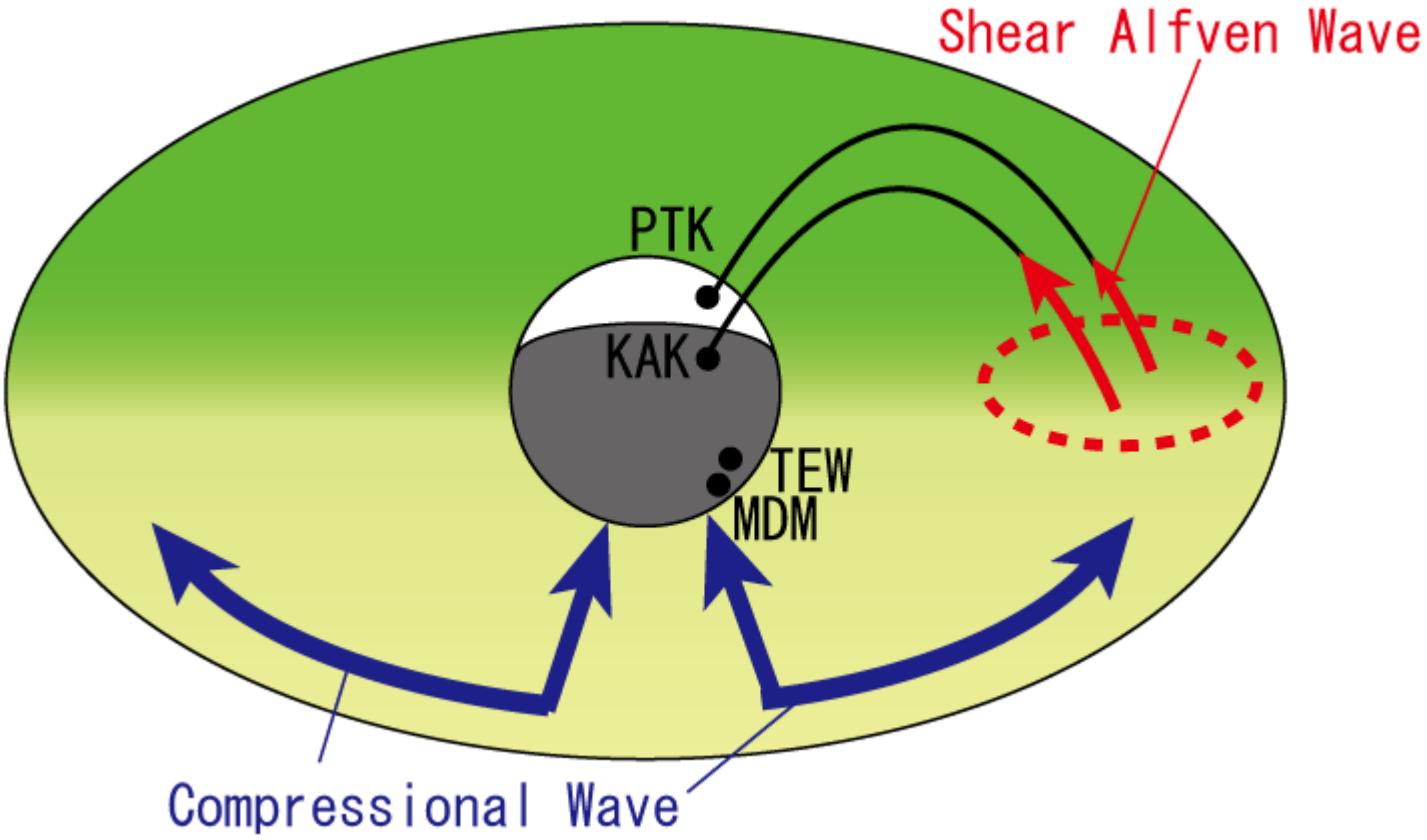
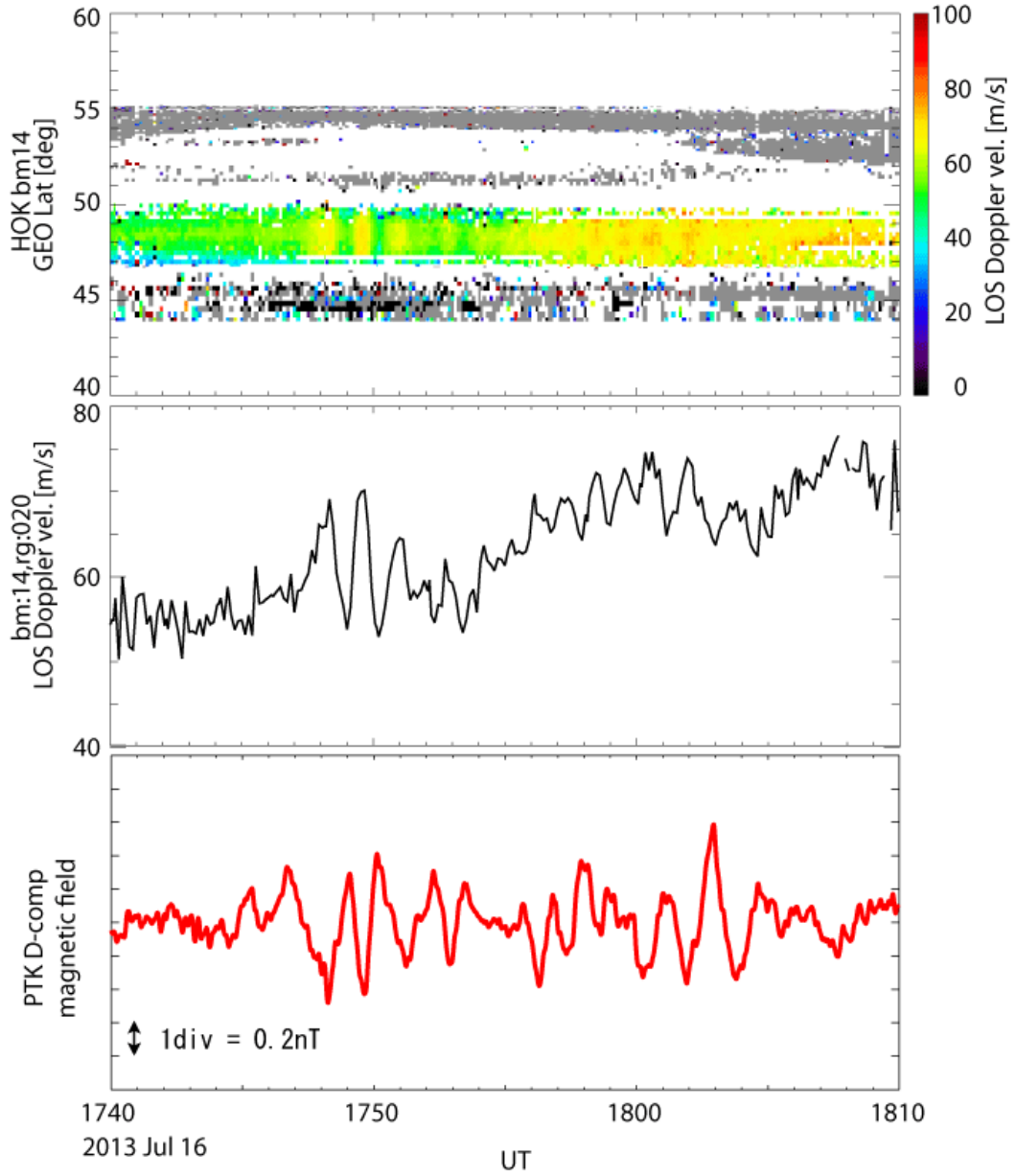


R-T diagram shows　No propagating structure

⇒　assuming a horizontal current sheet, We estimated amplitude of magnetic field variation



$$E_{iono} = -\frac{v_{LOS}}{\cos\theta} B$$

$$J_{Hall} = \Sigma_H E_{iono}$$

$$B_G = \frac{\mu_0 J_{Hall}}{2}$$

$\cos\theta \sim 0.5$

$B = 42800nT$　)

Σ_H=1.7S　)

For　$v_{LOS} = 16\ m/s$

$B_{G,\mathrm{HF}} = 1.5nT$

Observed amplitude of Pi 2 at PTK

$B_{G,obs} \sim 0.98nT$　（67%）

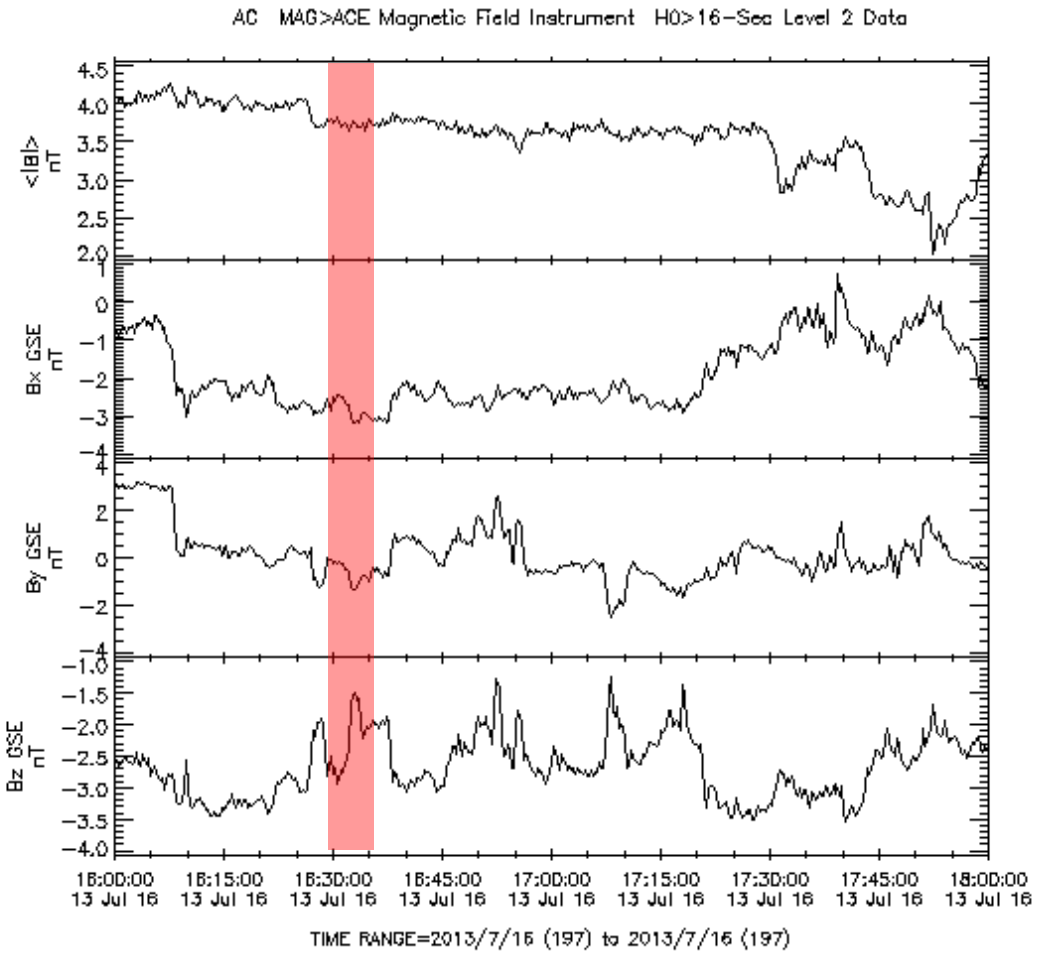
Summary

- We studied a Pi 2 oscillation of ionospheric Doppler plasma velocity observed around the dawn terminator on 16 Jul 2013 on an east-northeast pointing beam 14 of SuperDARN Hokkaido HF radar in Japan.
- We compared this ionospheric Pi 2 oscillation with ground-based magnetic field variations. The waveforms showed high similarity.
- The peak-to-peak amplitude of the HF Doppler velocity was 16 m/s. We estimated amplitude of magnetic field variation based on Doppler velocity oscillation with assuming a horizontal current sheet infinitely extended in the ionosphere. The observed amplitude was 67 % of the estimated amplitude.

Acknowledgement

- The results presented in this paper rely on the data collected at KAK, GUA, AMS, and FRD. We thank JMA, USGS, and EOST for supporting its operation and INTERMAGNET for promoting high standards of magnetic observatory practice (www.intermagnet.org).

Solarwind



Please acknowledge data provider, N. Ness at Bartol Research Institute and CDAWeb when using these data.
Key Parameter and Survey data (labels K0,K1,K2) are preliminary browse data.
Generated by CDAWeb on Wed Apr 23 03:27:31 2014

These results can be interpreted as …

- The Doppler velocity oscillation was caused by an oscillating electric field in the east-west direction.
- In the northern hemisphere, the ionosphere above the observatory was sunlit, thus the ionospheric Hall current induced by the electric field makes D component of magnetic filed oscillation on the ground.
- On the other hand, in the southern hemisphere, the ionosphere above New Zealand was still in the darkness, thus ionospheric current could not be induced due to low conductivity.
- The H component of magnetic field oscillation may reflect direct incidence of magnetic field oscillation from the magnetosphere to the ground.

Station List