Ionospheric observations in Japan and Southeast Asia (June 2014 - March 2015)

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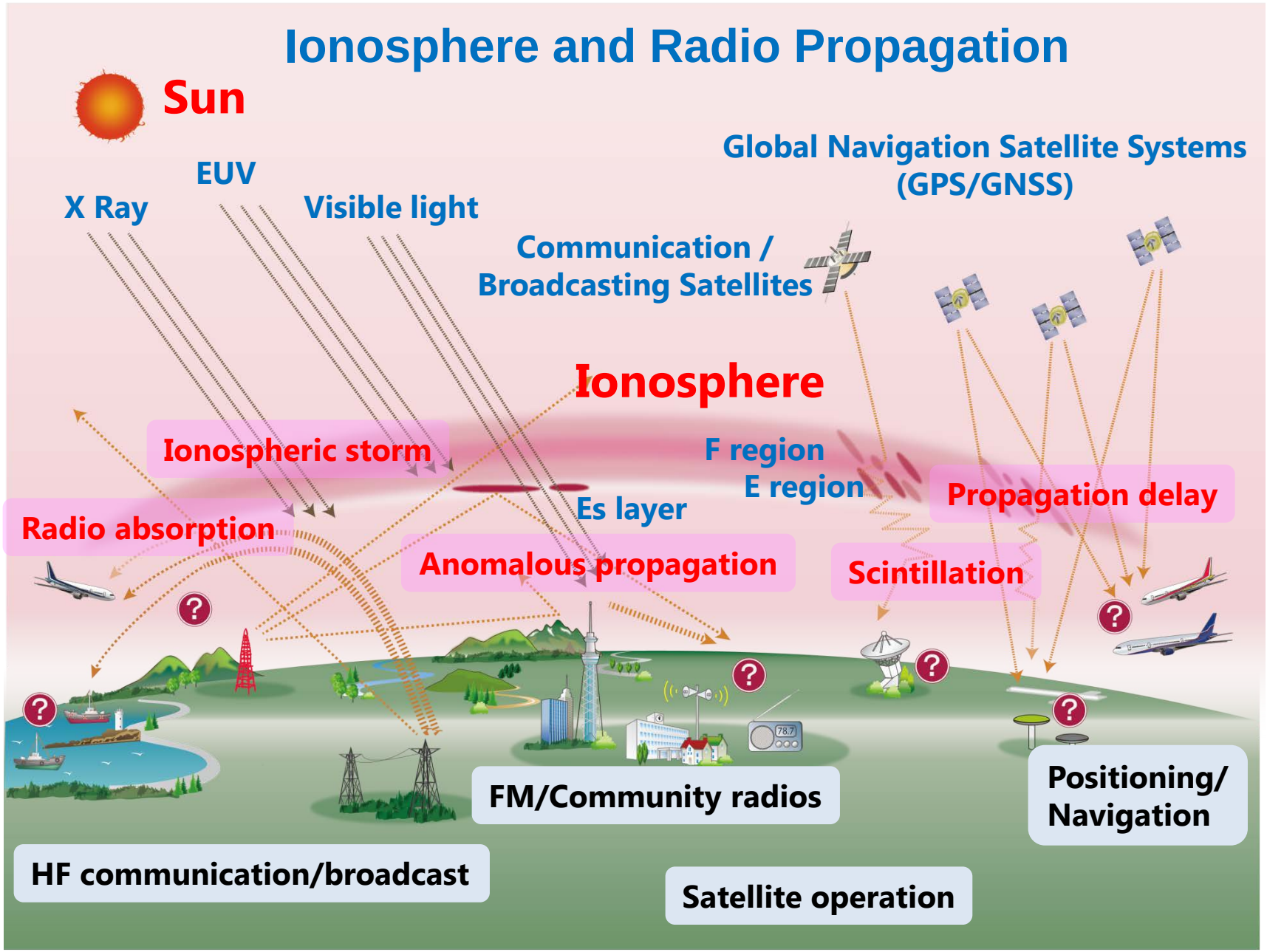
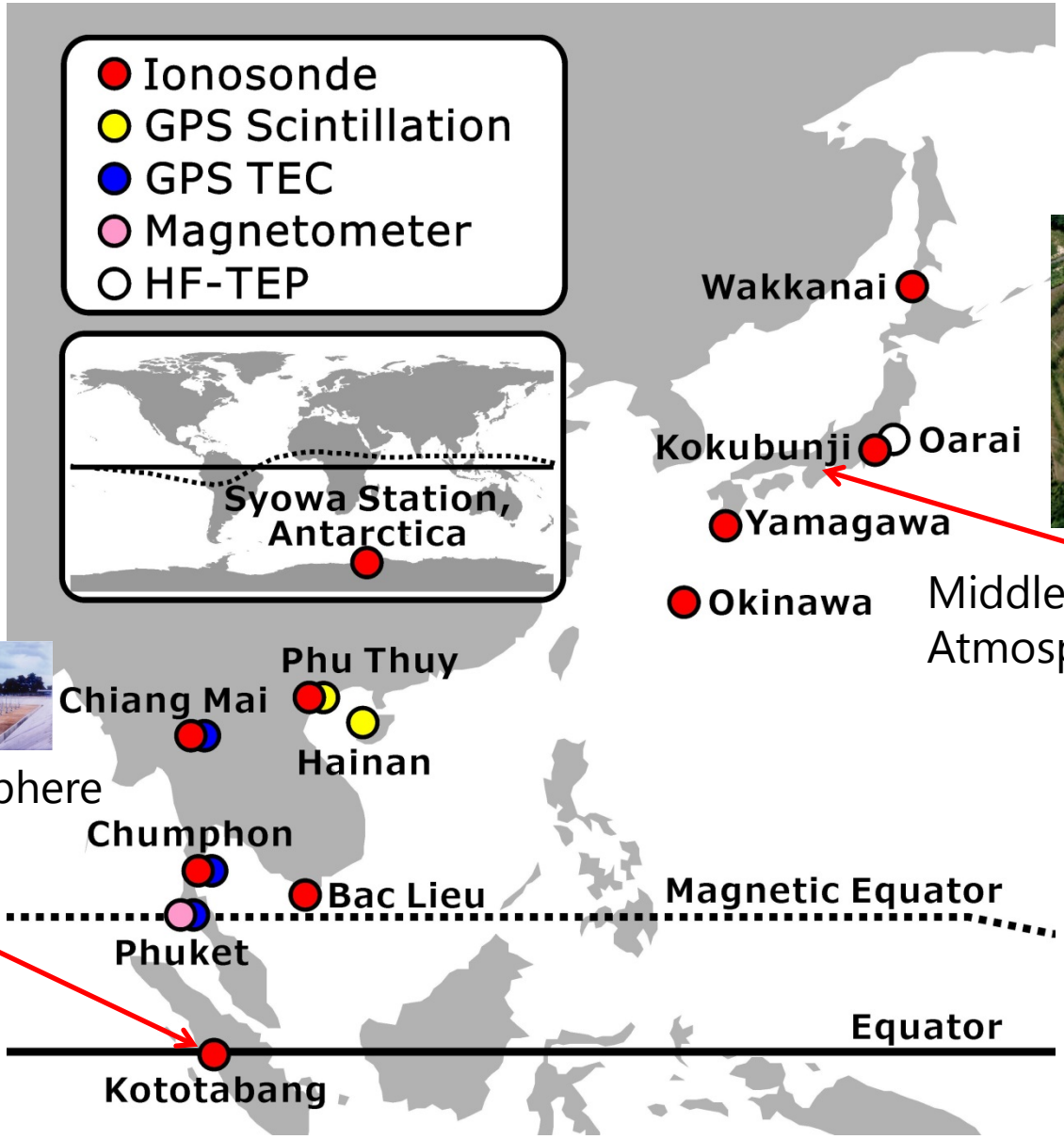

Ionosphere and Radio Propagation
Sun
EUV
X Ray
Visible light
Global Navigation Satellite Systems
(GPS/GNSS)
Communication /
Broadcasting Satellites
Ionosphere
Ionospheric storm
F region
E region
Es layer
Radio absorption
Anomalous propagation
Propagation delay
Scintillation
FM/Community radios
Positioning/
Navigation
HF communication/broadcast
Satellite operation

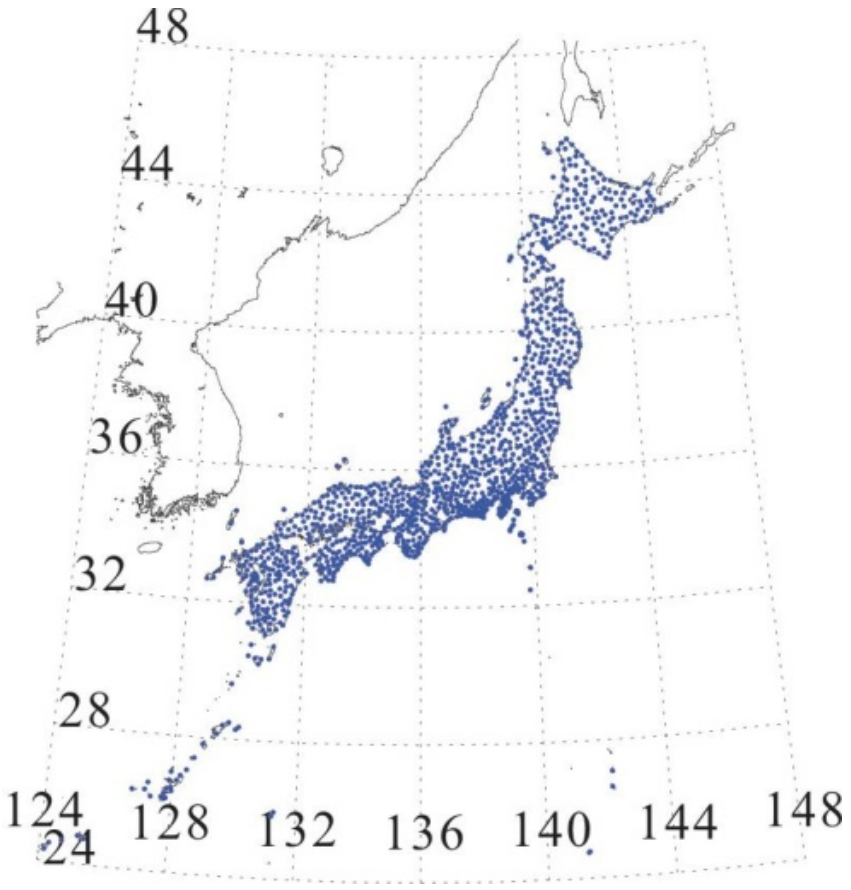
Ionospheric Observatories in Japan and Southeast Asia

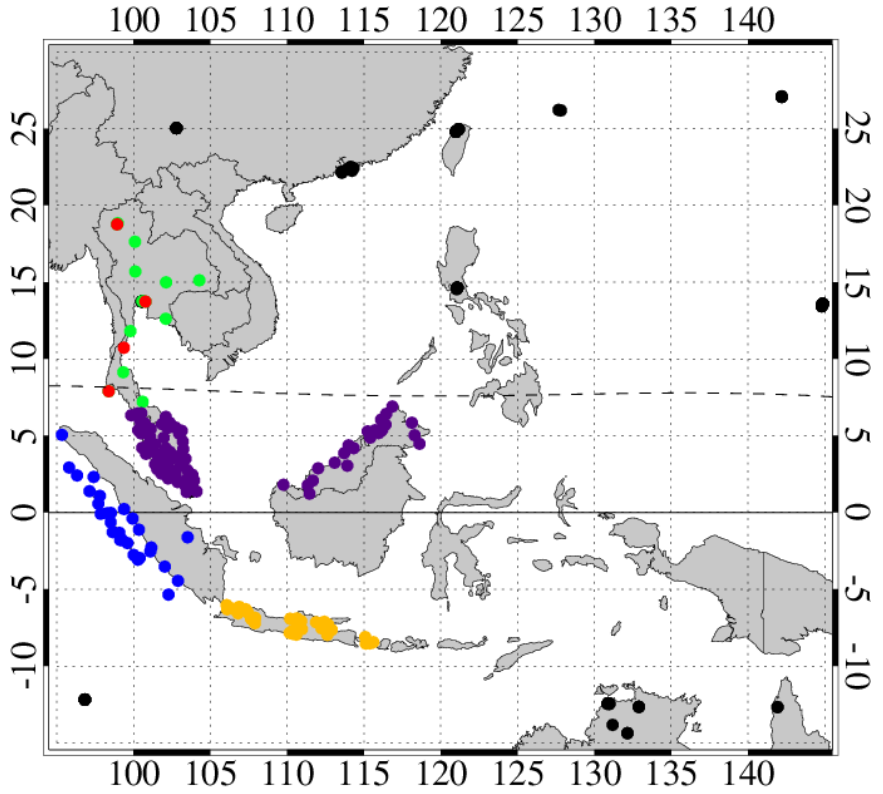


Middle and Upper Atmosphere (MU) Radar

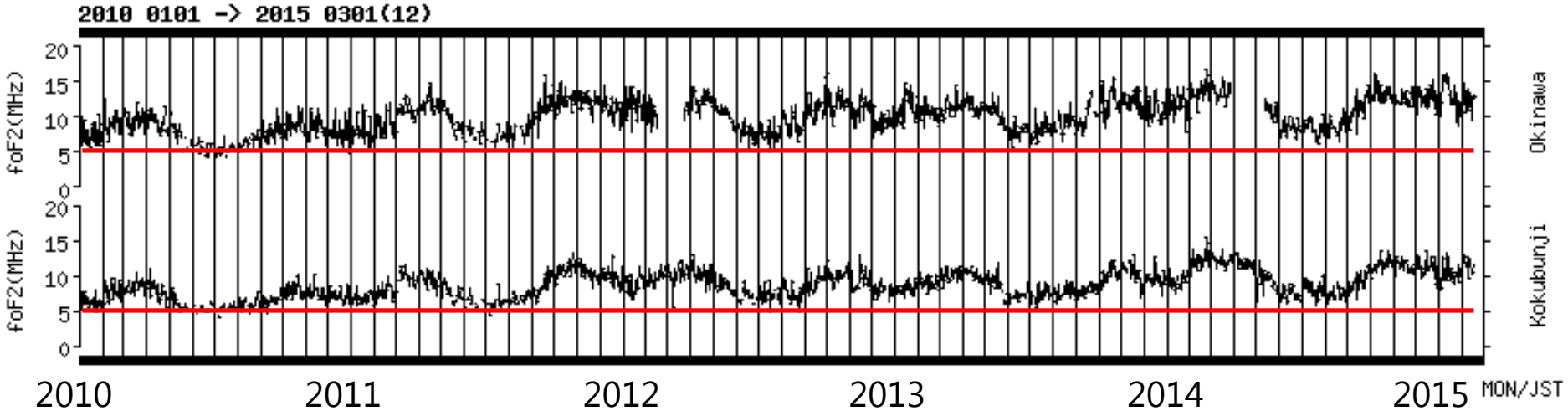
Equatorial Atmosphere Radar (EAR)

Currently available GPS receivers for the measurement of total electron content (TEC)



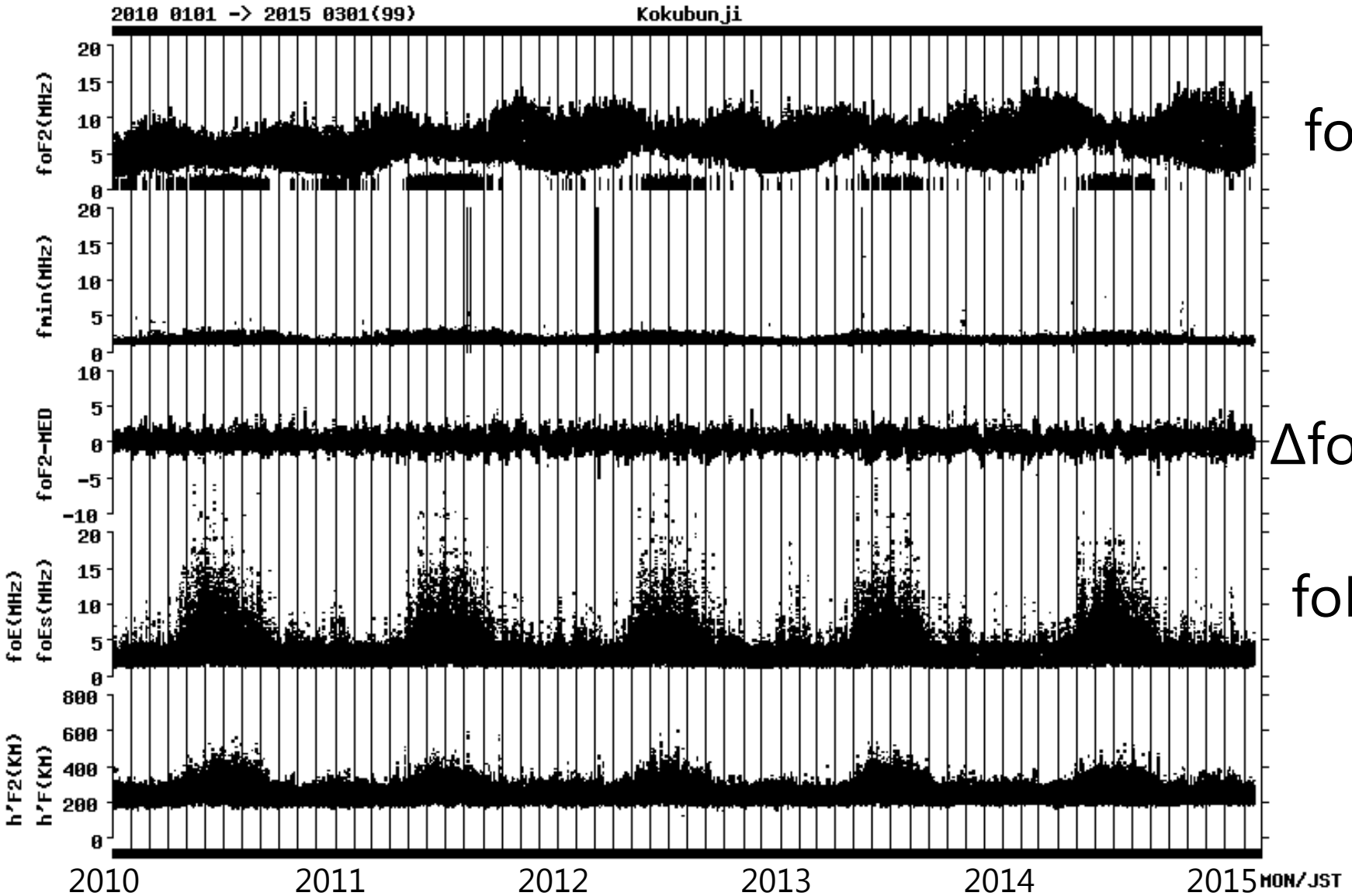


Long-term variation of foF2 over Okinawa and Kokubunji at 12LT



http://wdc.nict.go.jp/IONO/index_E.html

Long-term variation over Kokubunji at all local time

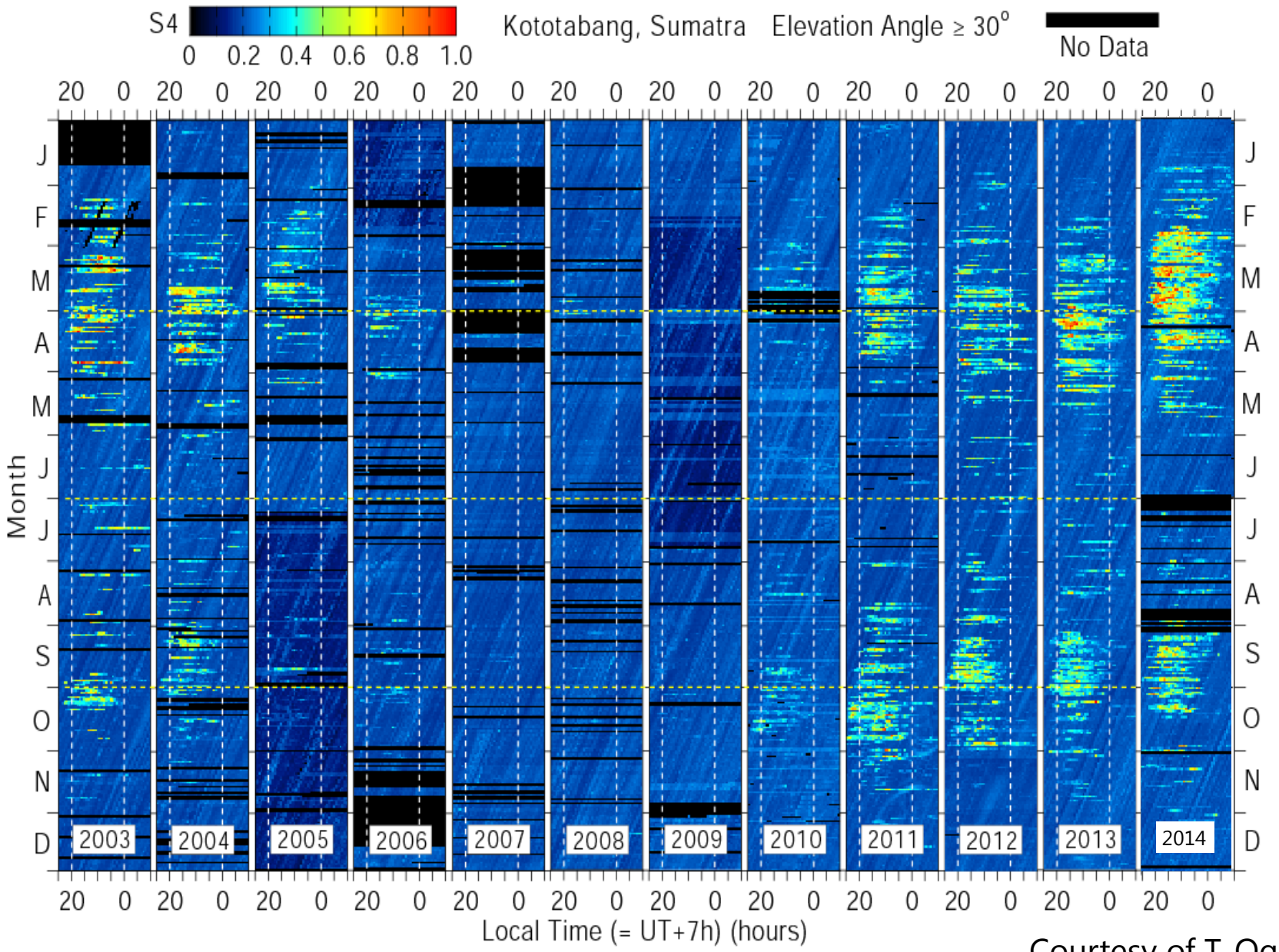


foF2

ΔfoF2

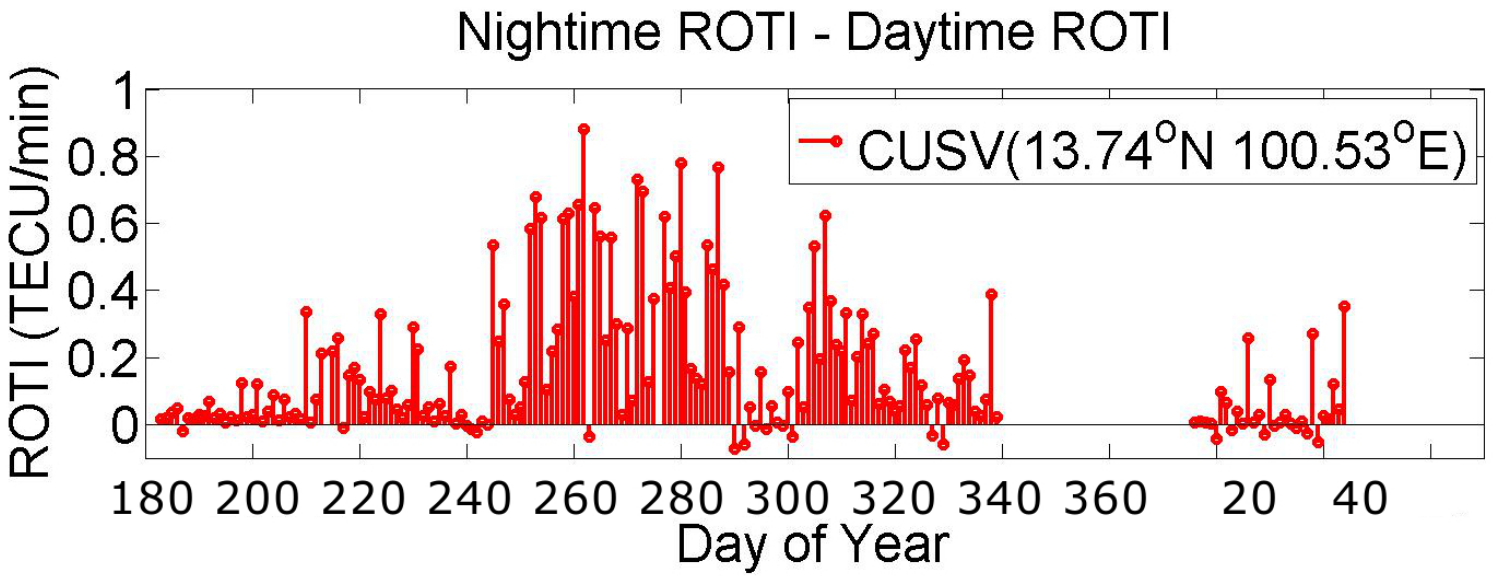
foEs

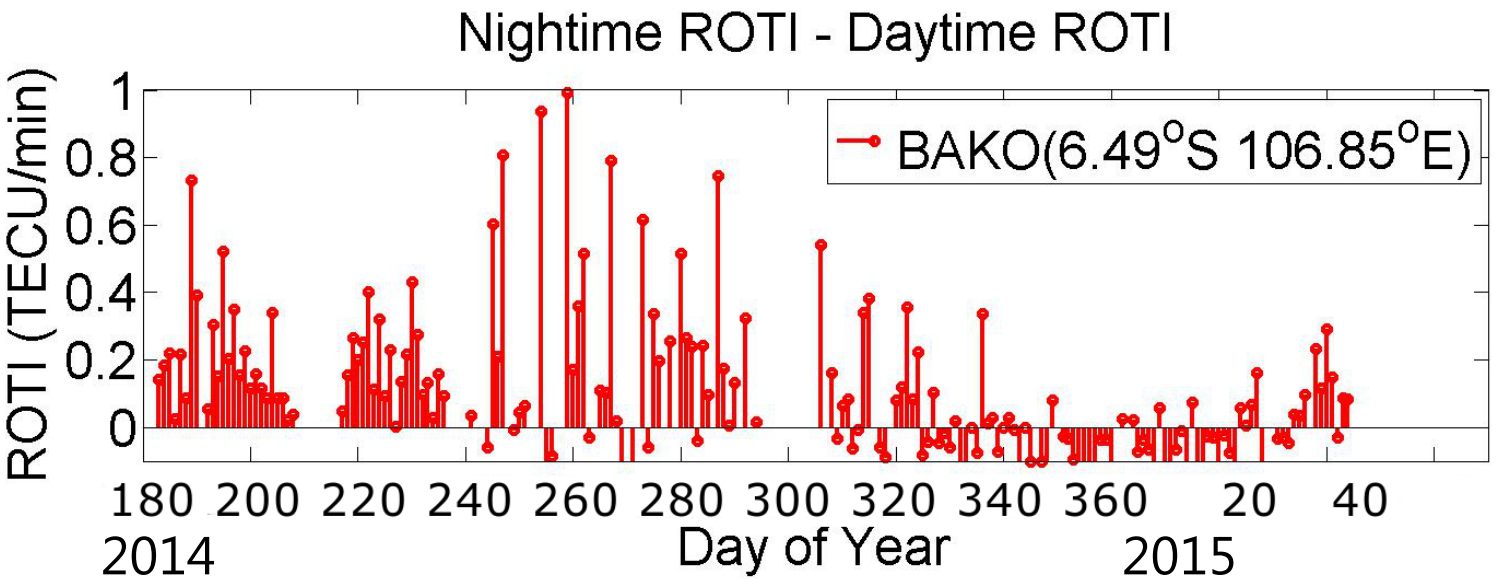
Long-term variation of GPS scintillation at Indonesia



Courtesy of T. Ogawa

Recent activity of GPS ROTI in Southeast Asia





Courtesy of S. M Buhari; G2-5 on Friday session

Ionospheric Storm

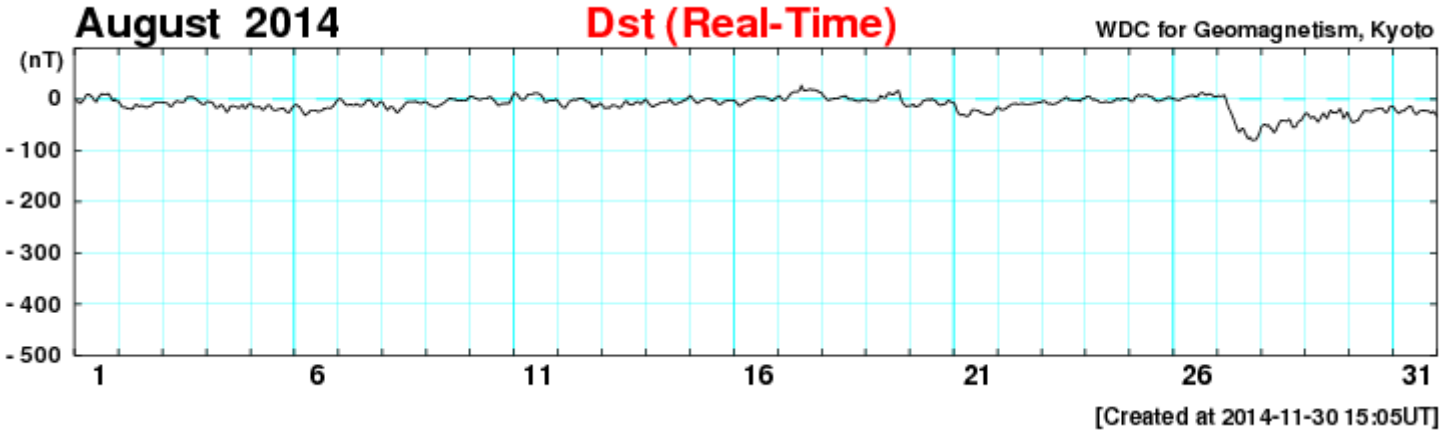
Positive Storm

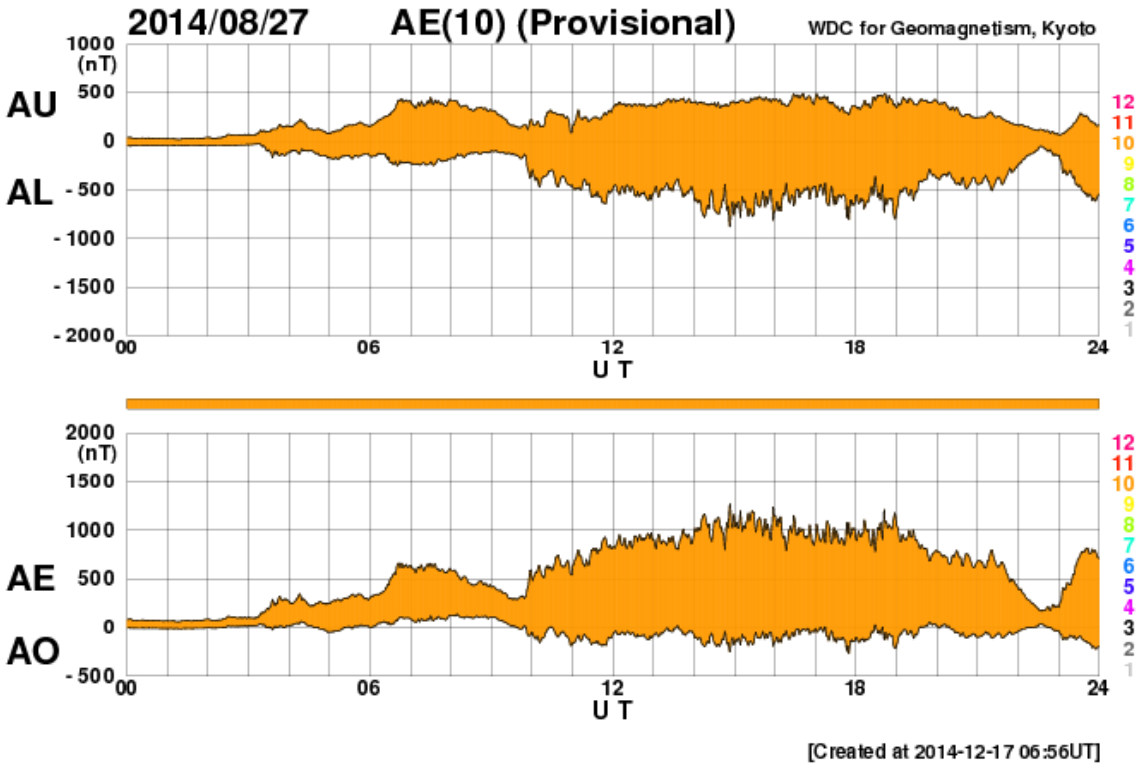
- F2-region plasma density enhancement
- Caused by disturbed electromagnetic force/ thermospheric wind
- Frequently occurs at the initial phase of magnetospheric storms
- Positioning/navigation error

Negative Storm

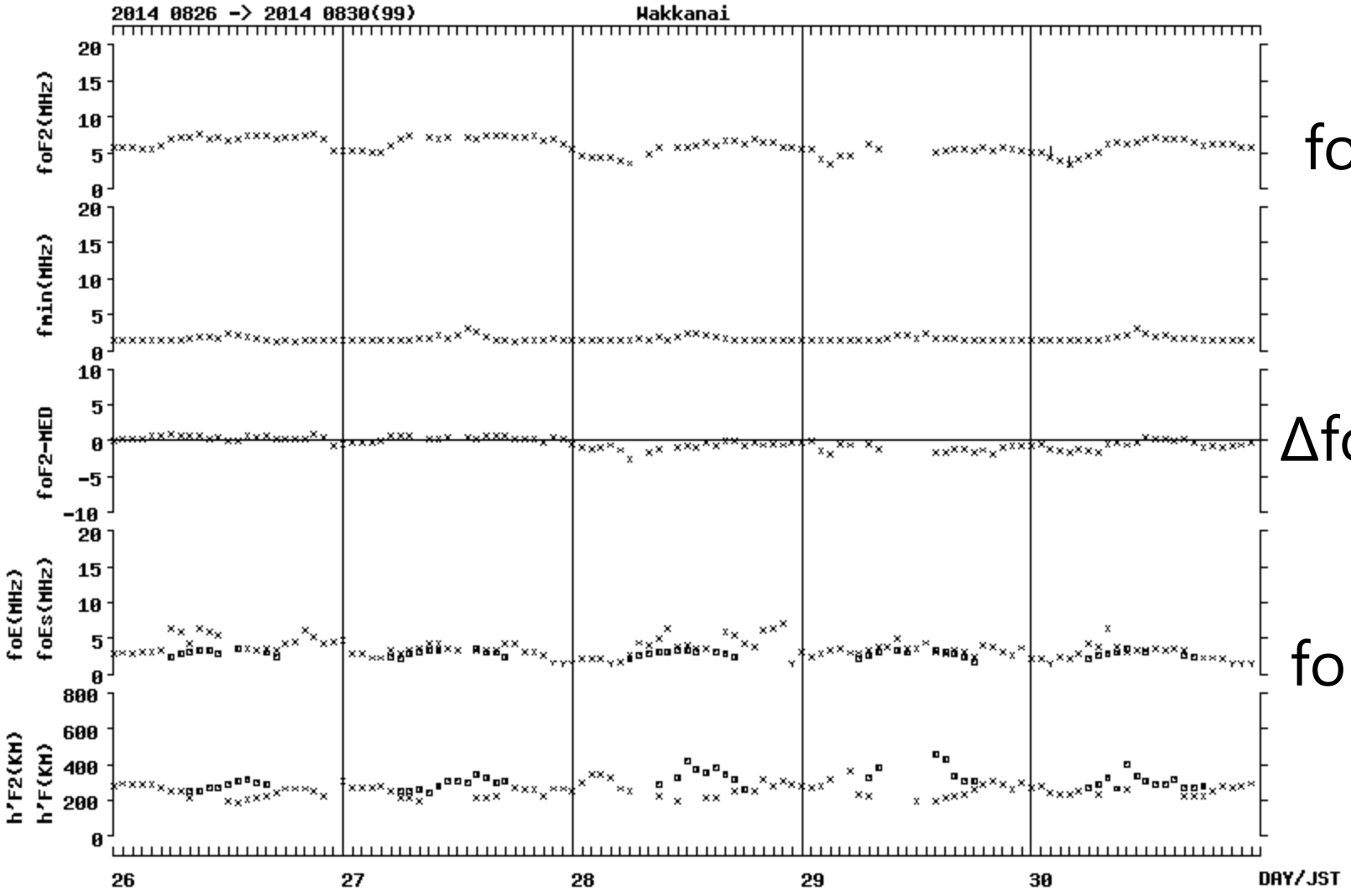
- F2-region plasma density decrease
- Mainly caused by composition change in the thermosphere ([O]/[N2])
- Often continues for one to several days after positive storm
- HF communication outage

26-30 August 2014





Wakkanai (45.16°N, 141.75°E)

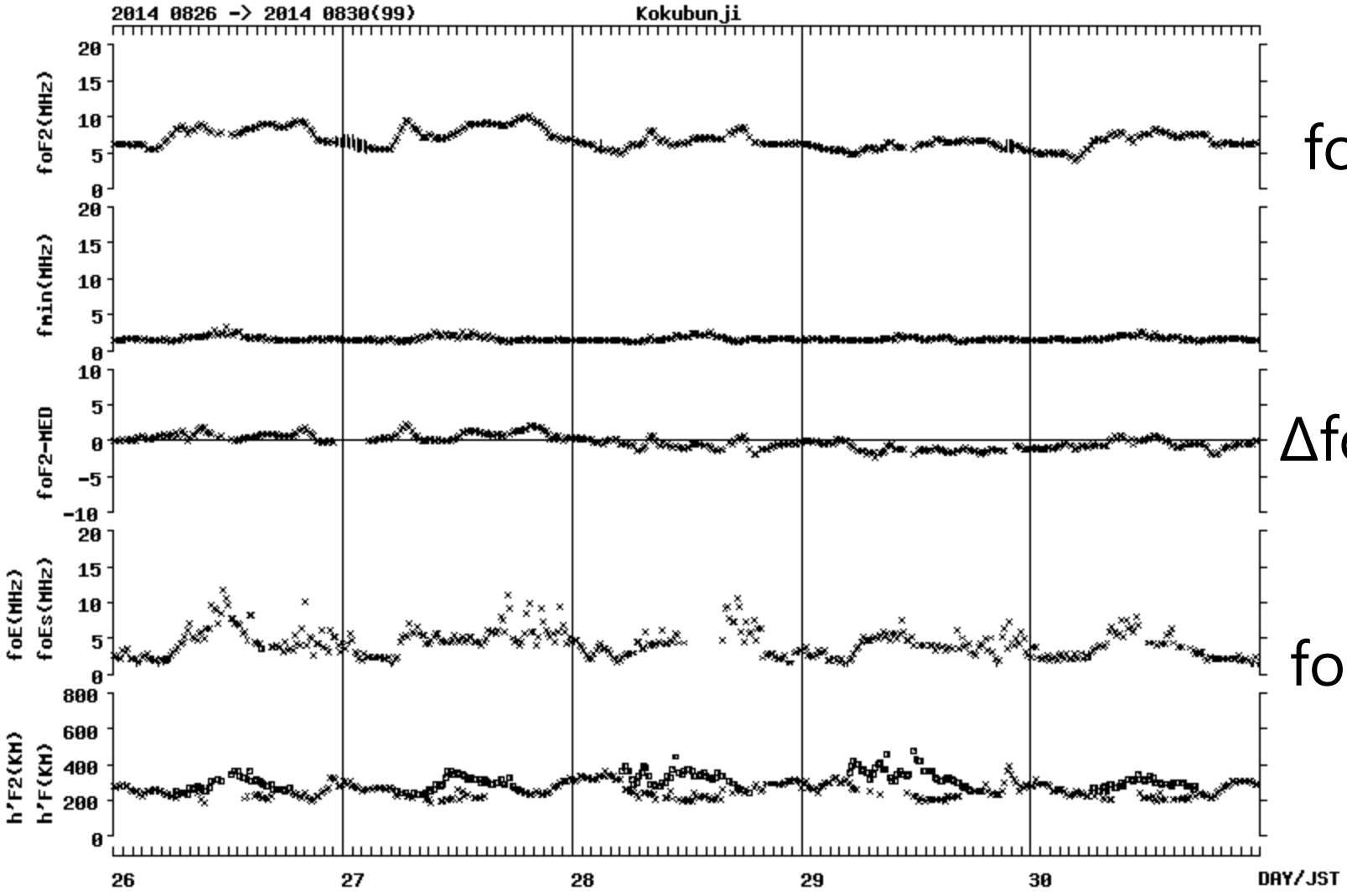


foF2

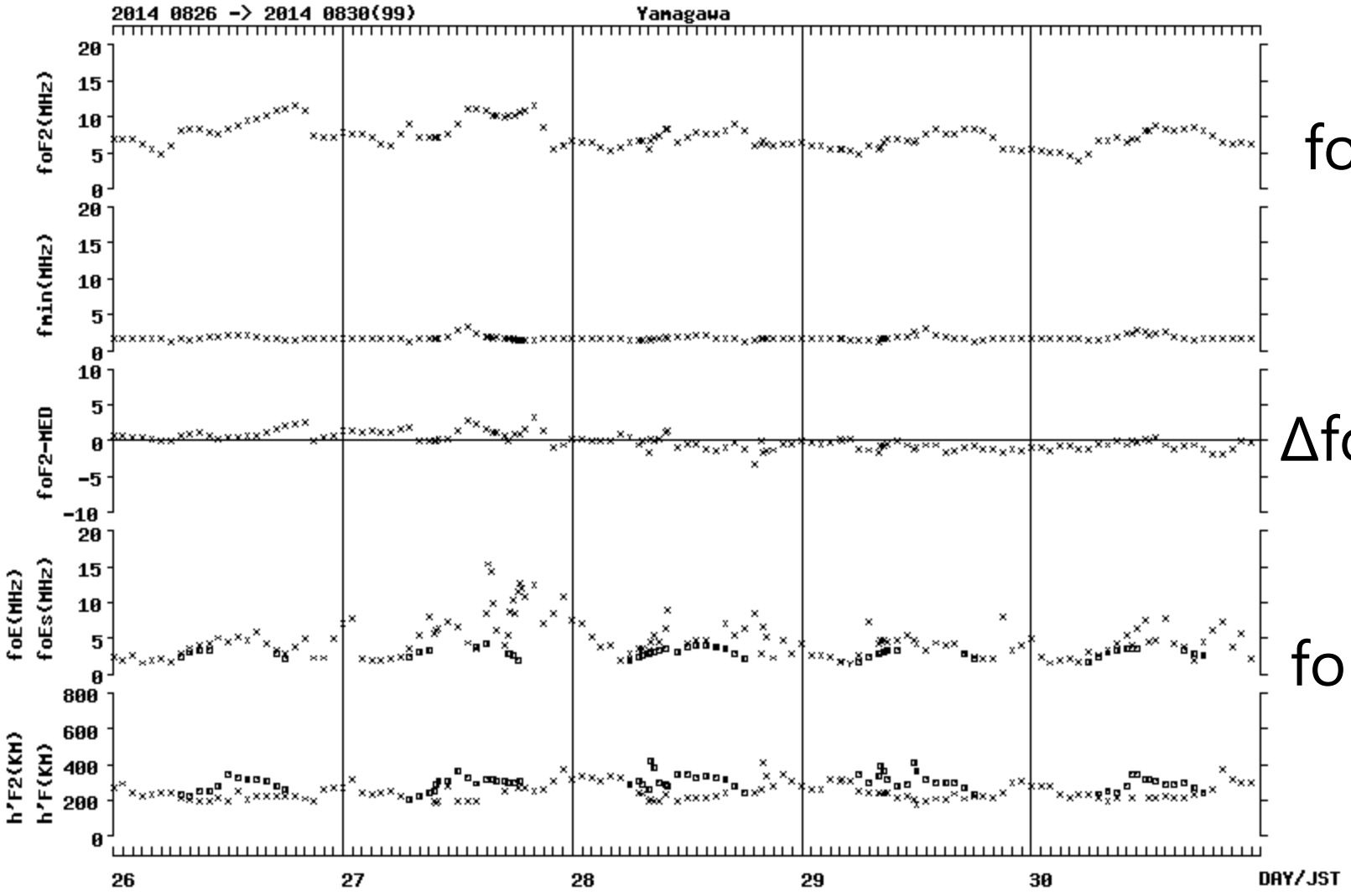
ΔfoF2

foEs

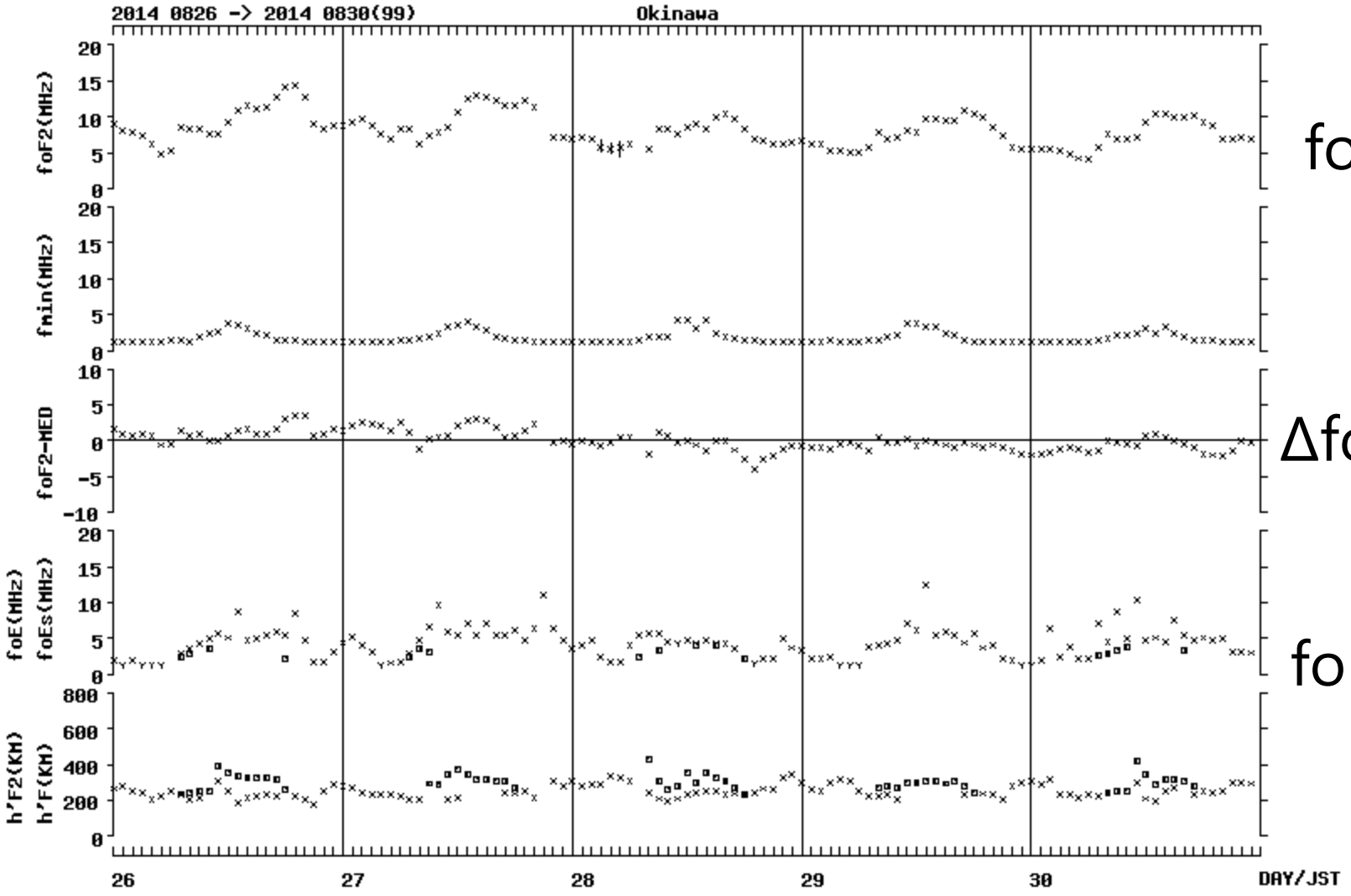
Kokubunji (35.71°N, 139.49°E)



Yamagawa (31.20°N, 130.62°E)



Okinawa (26.68°N, 128.15°E)



foF2

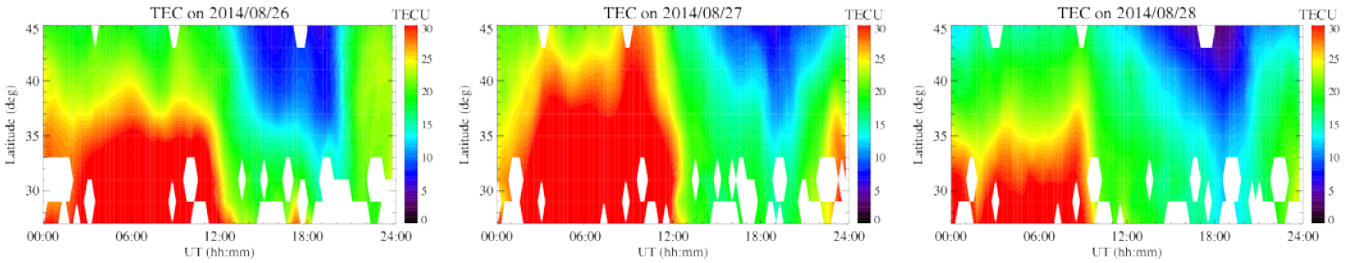
ΔfoF2

foEs

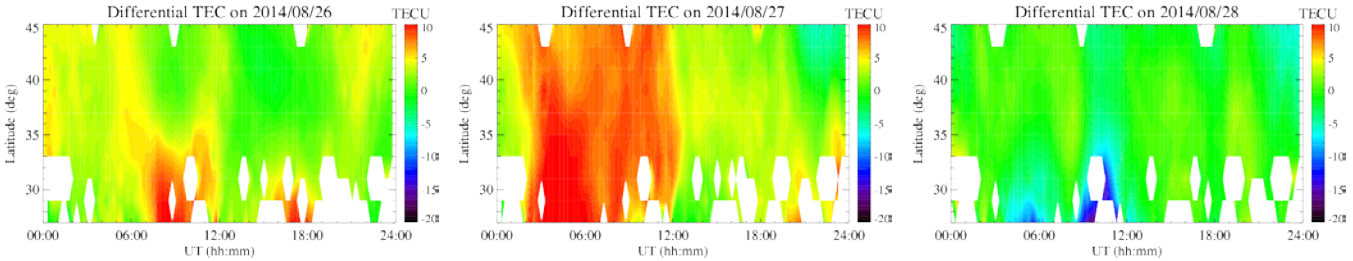
TEC over Japan

8/26 8/27 8/28

Absolute TEC



Differential TEC
(5-day quiet period)



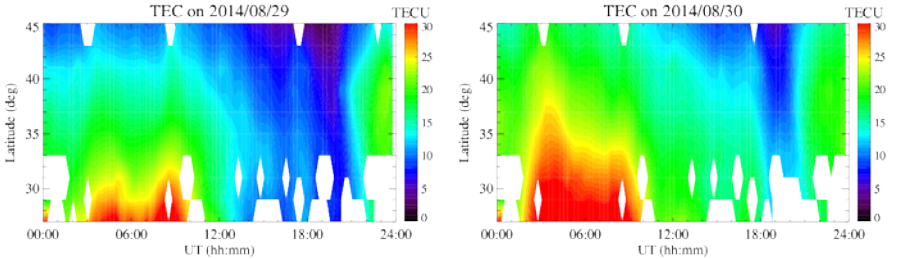
Latitude

Positive storm

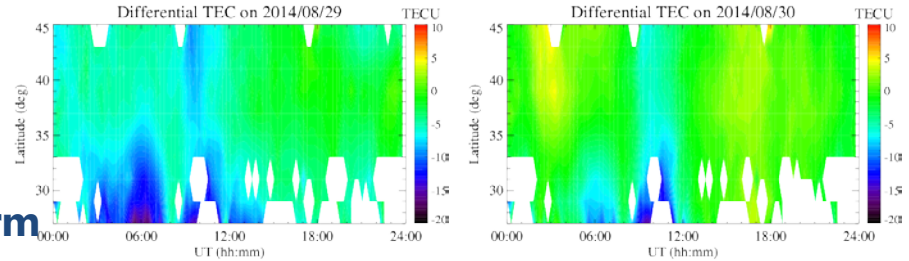
Time (UT)

8/29 8/30

Absolute TEC

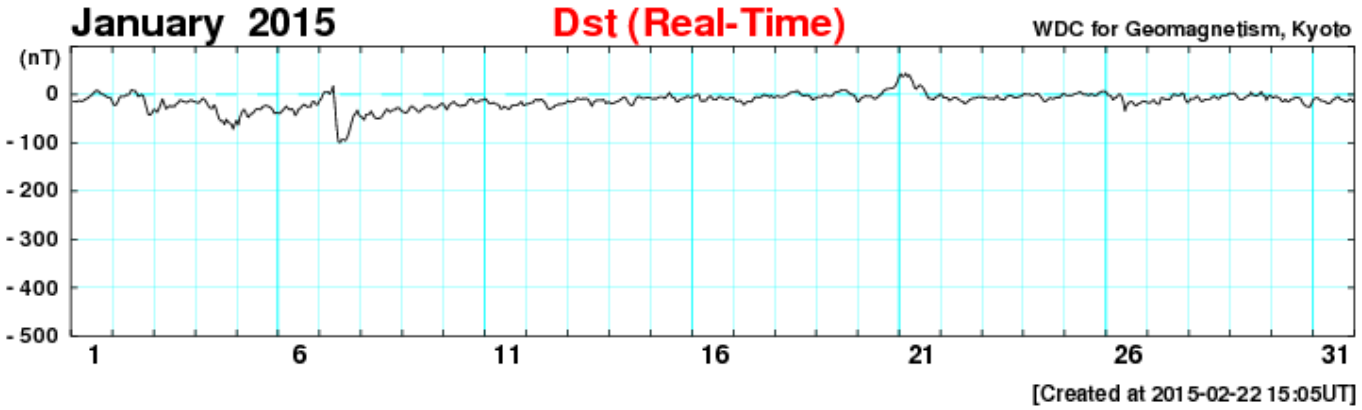


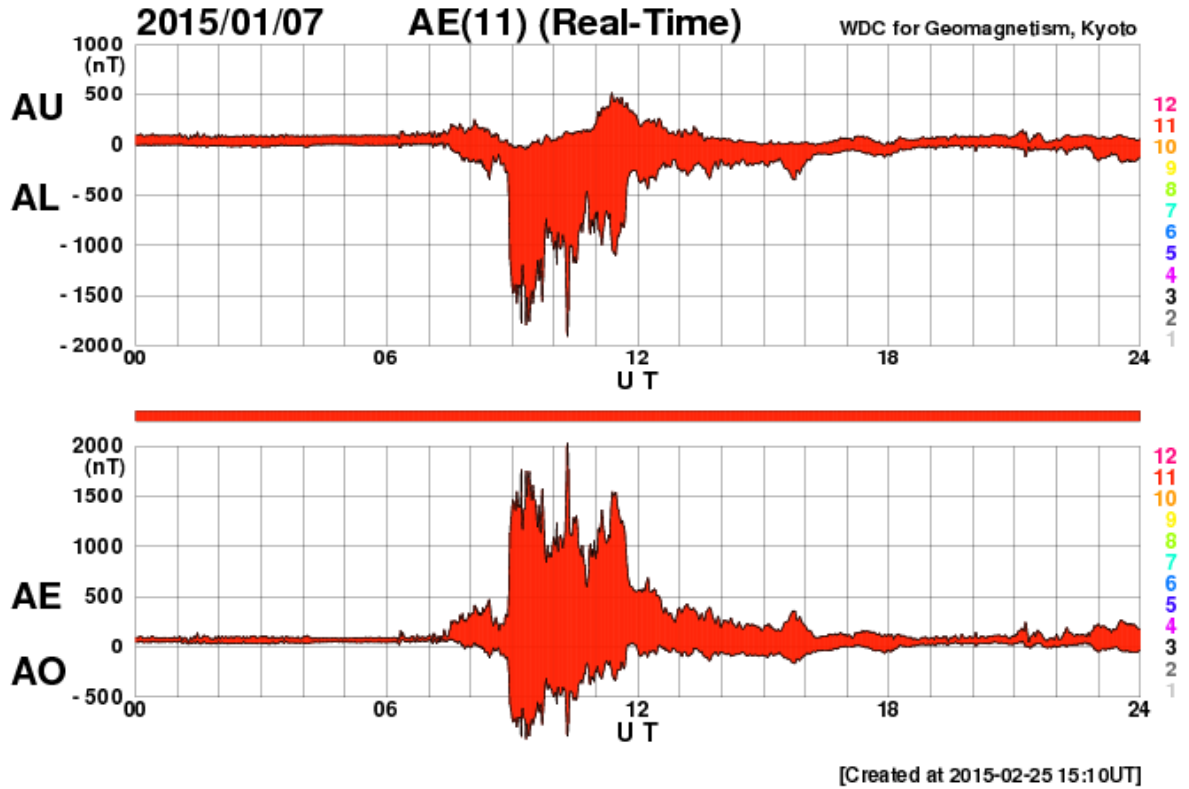
Differential TEC



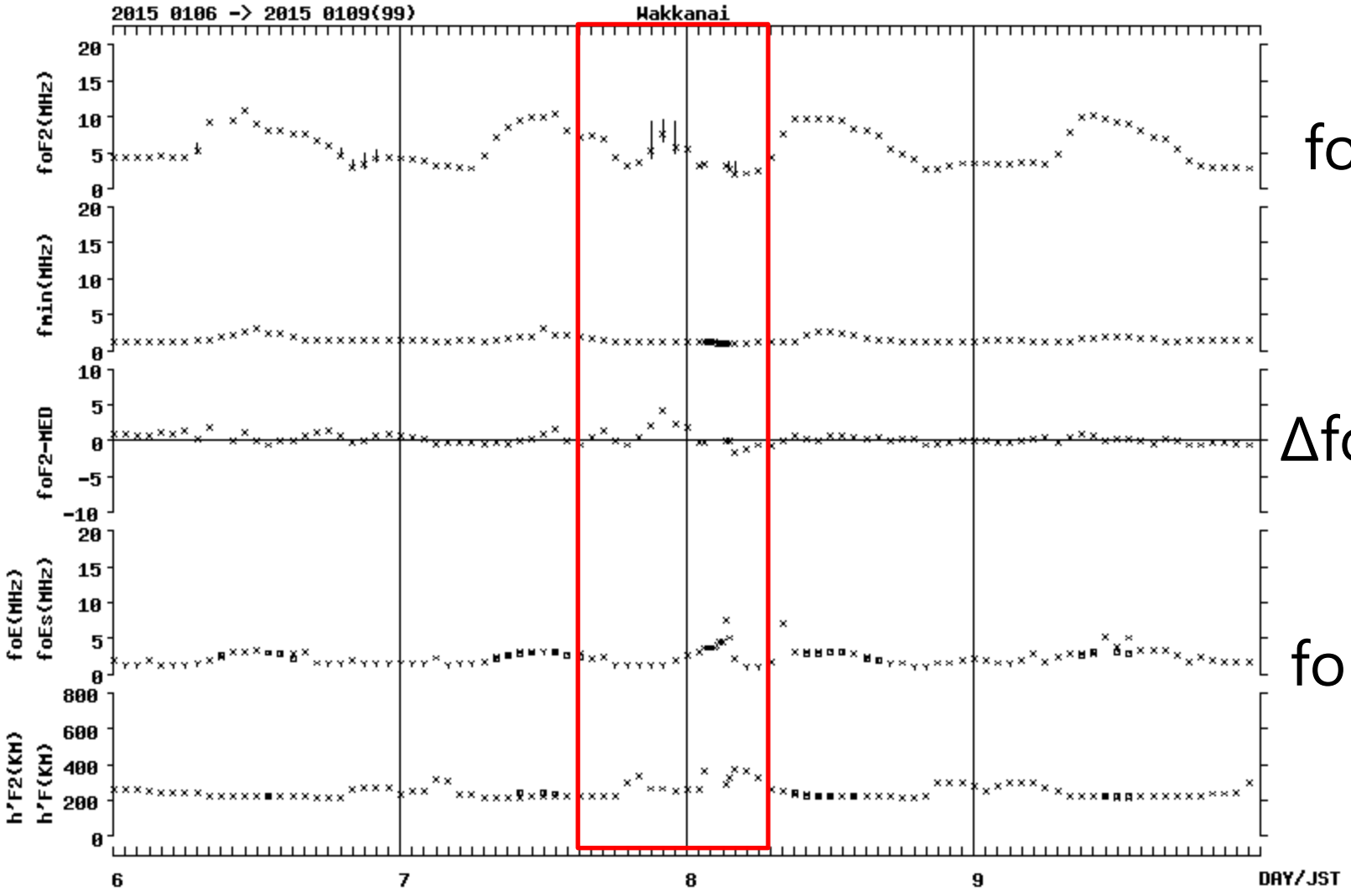
Negative storm

6-9 January 2015

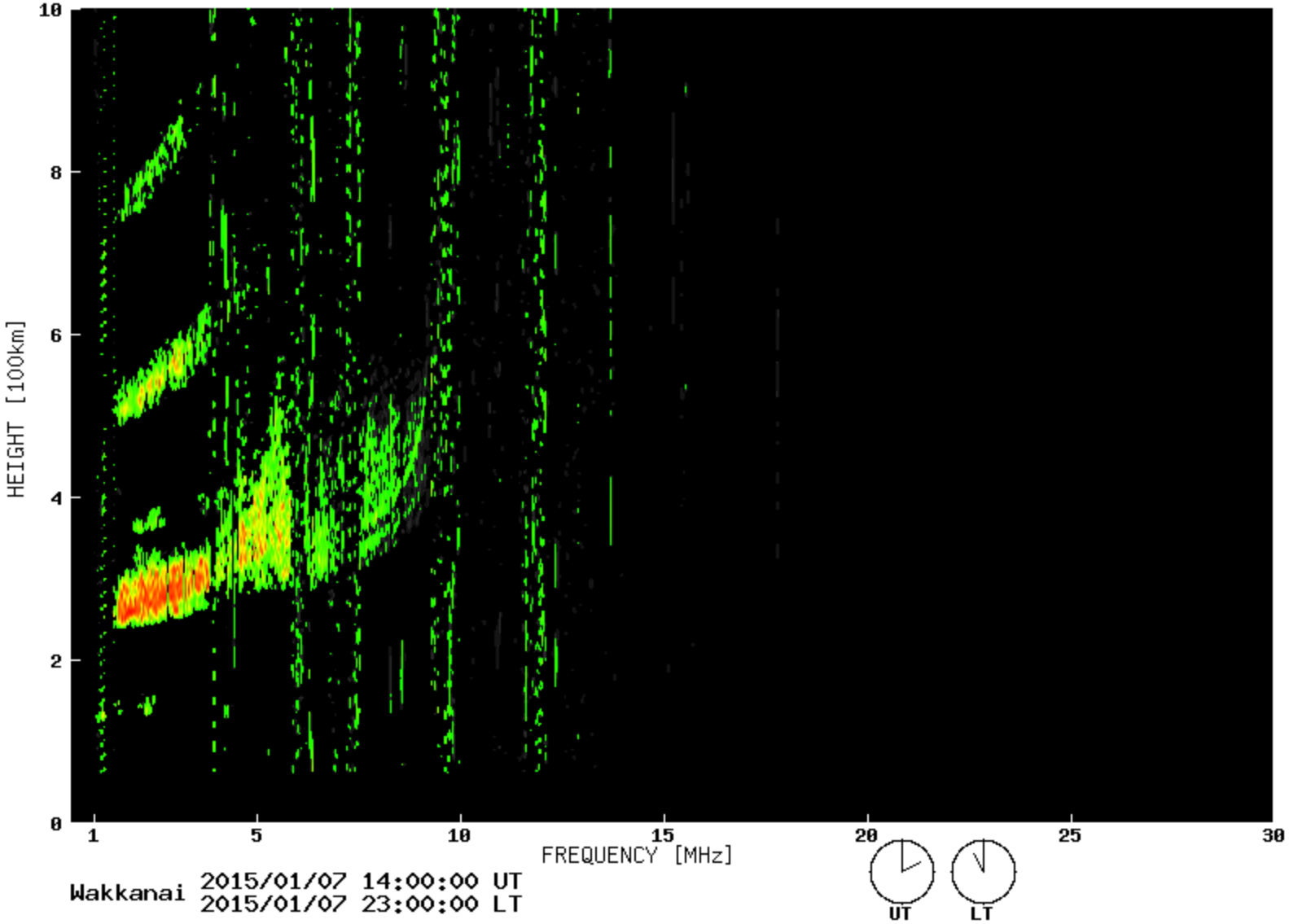




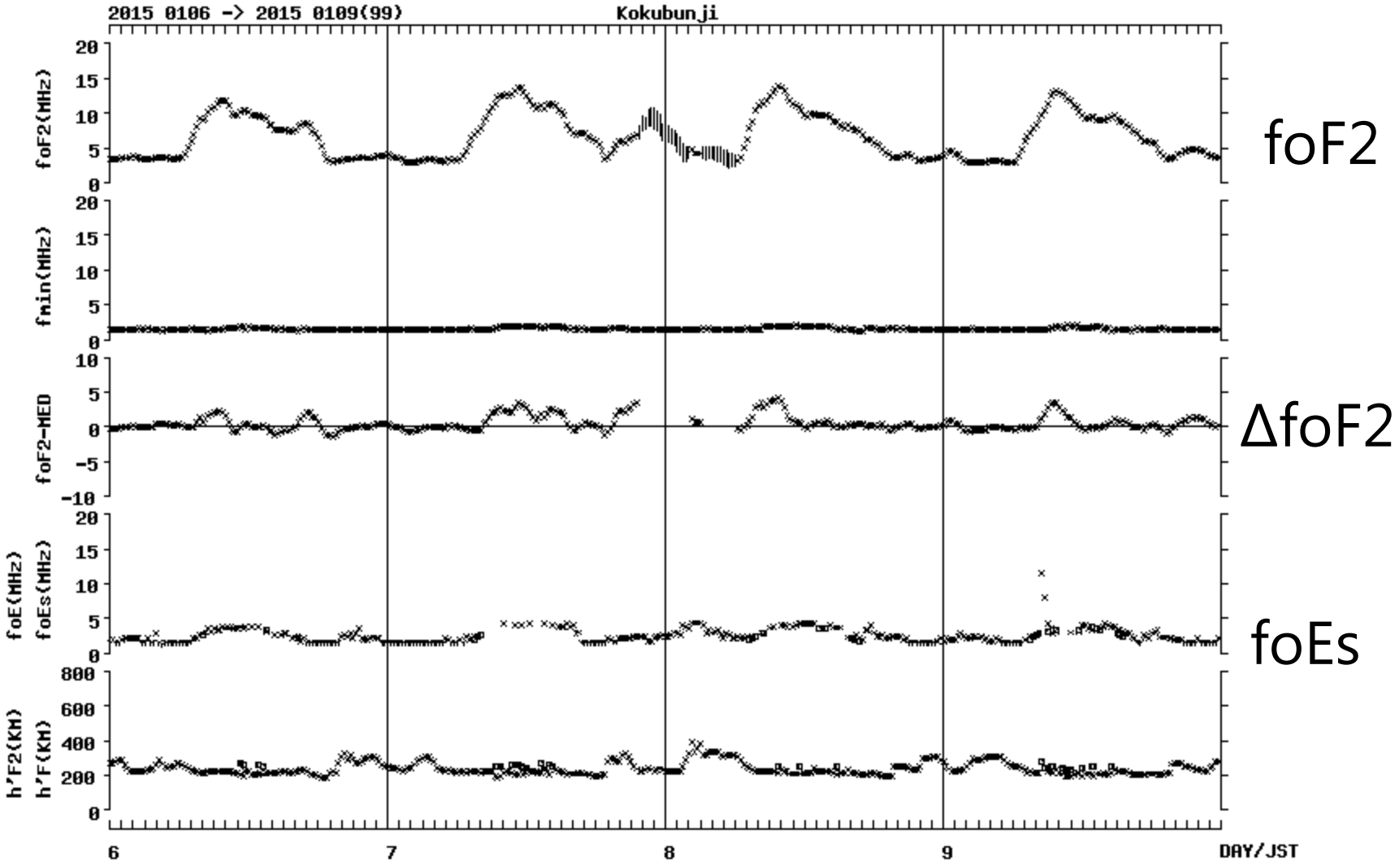
Wakkanai (45.16°N, 141.75°E)



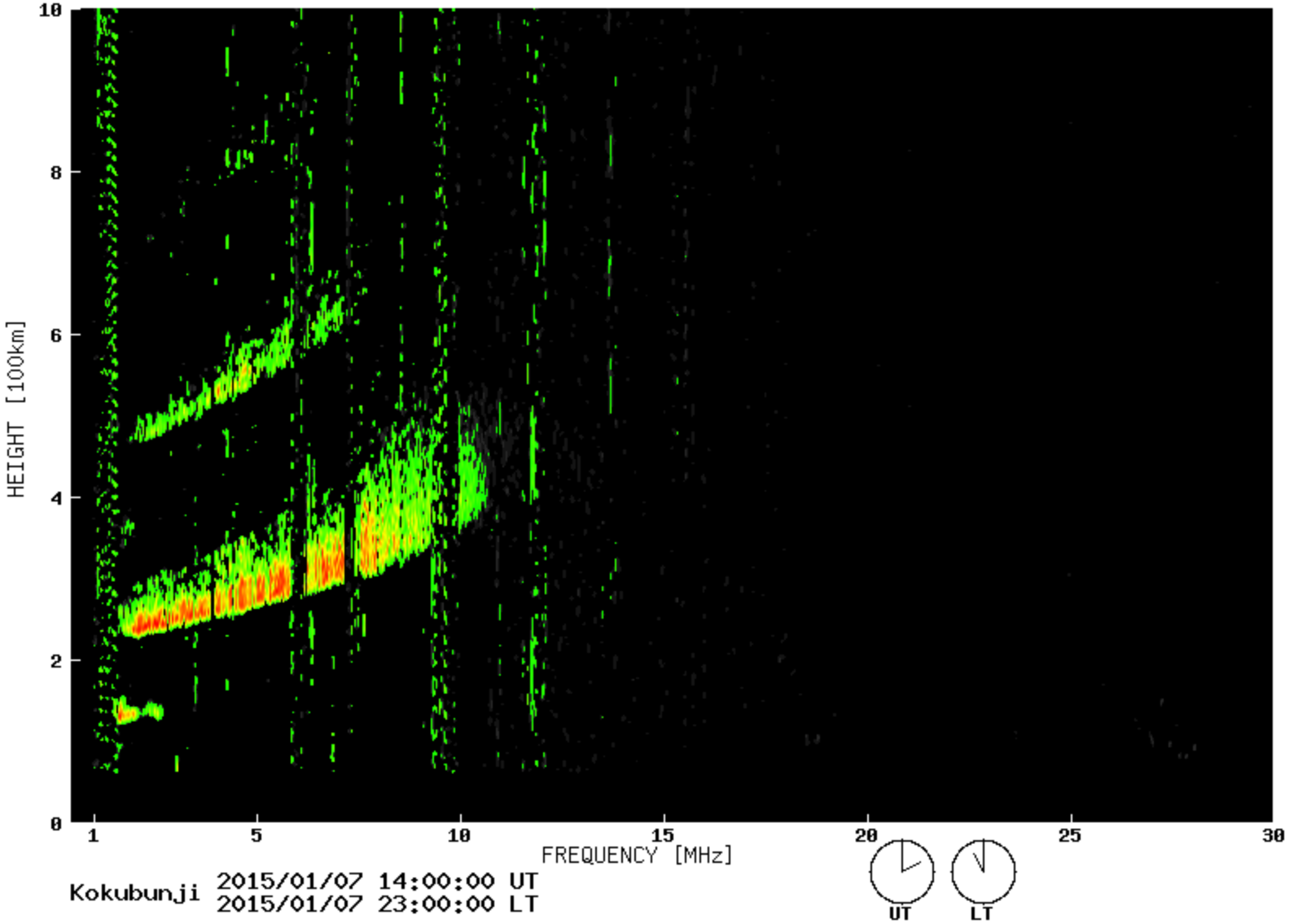
Wakkanai (45.16°N, 141.75°E)



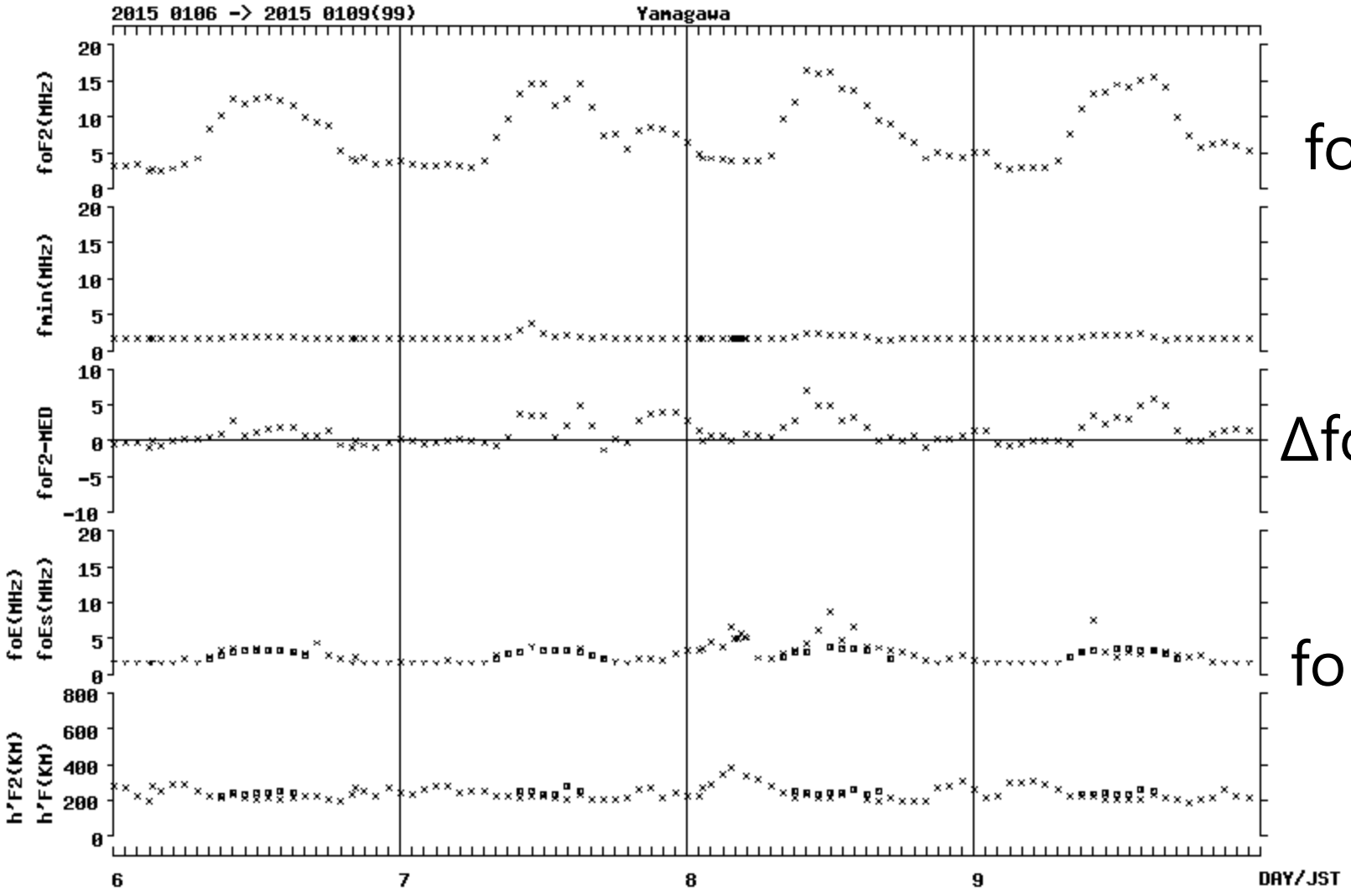
Kokubunji (35.71°N, 139.49°E)



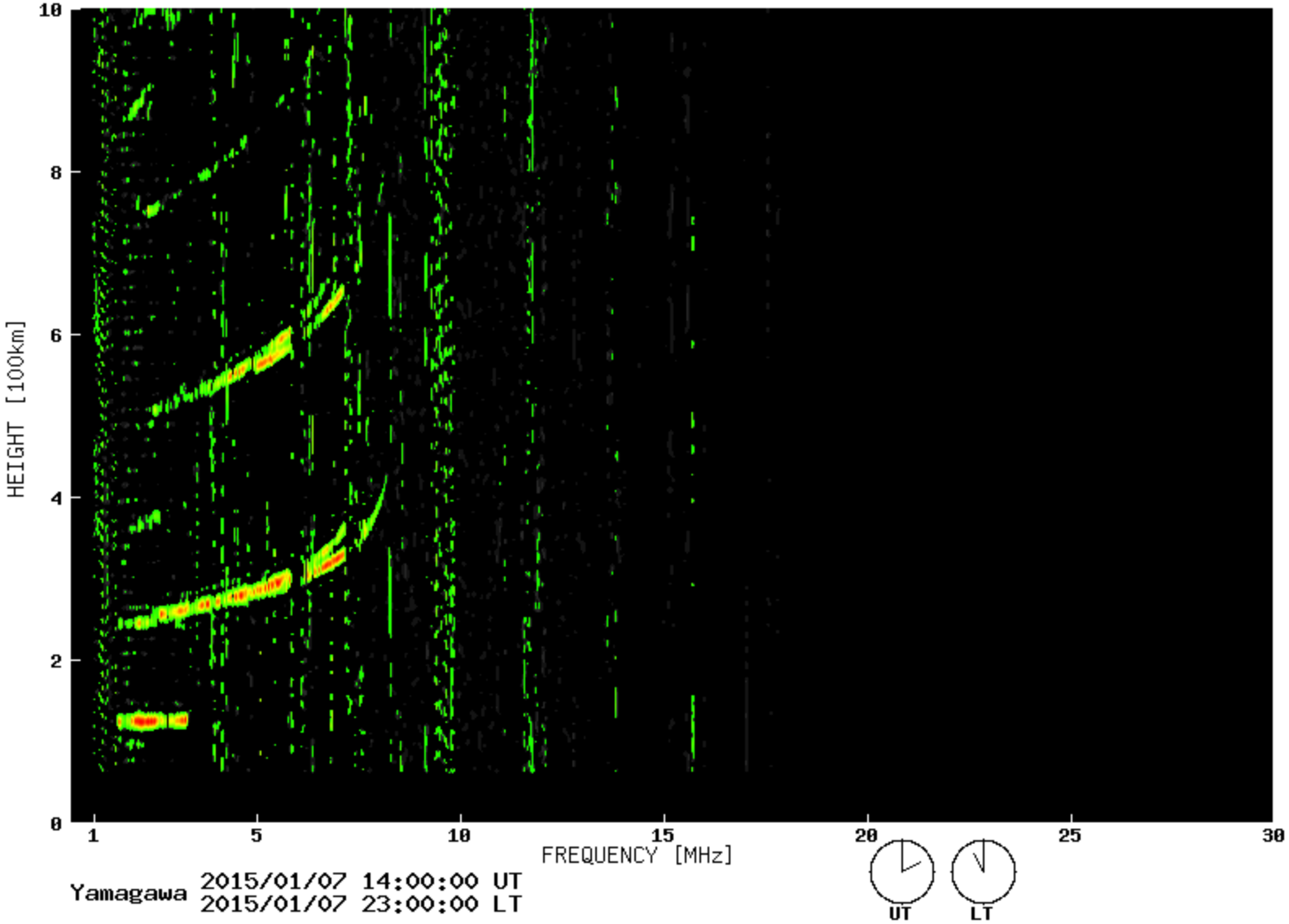
Kokubunji (35.71°N, 139.49°E)



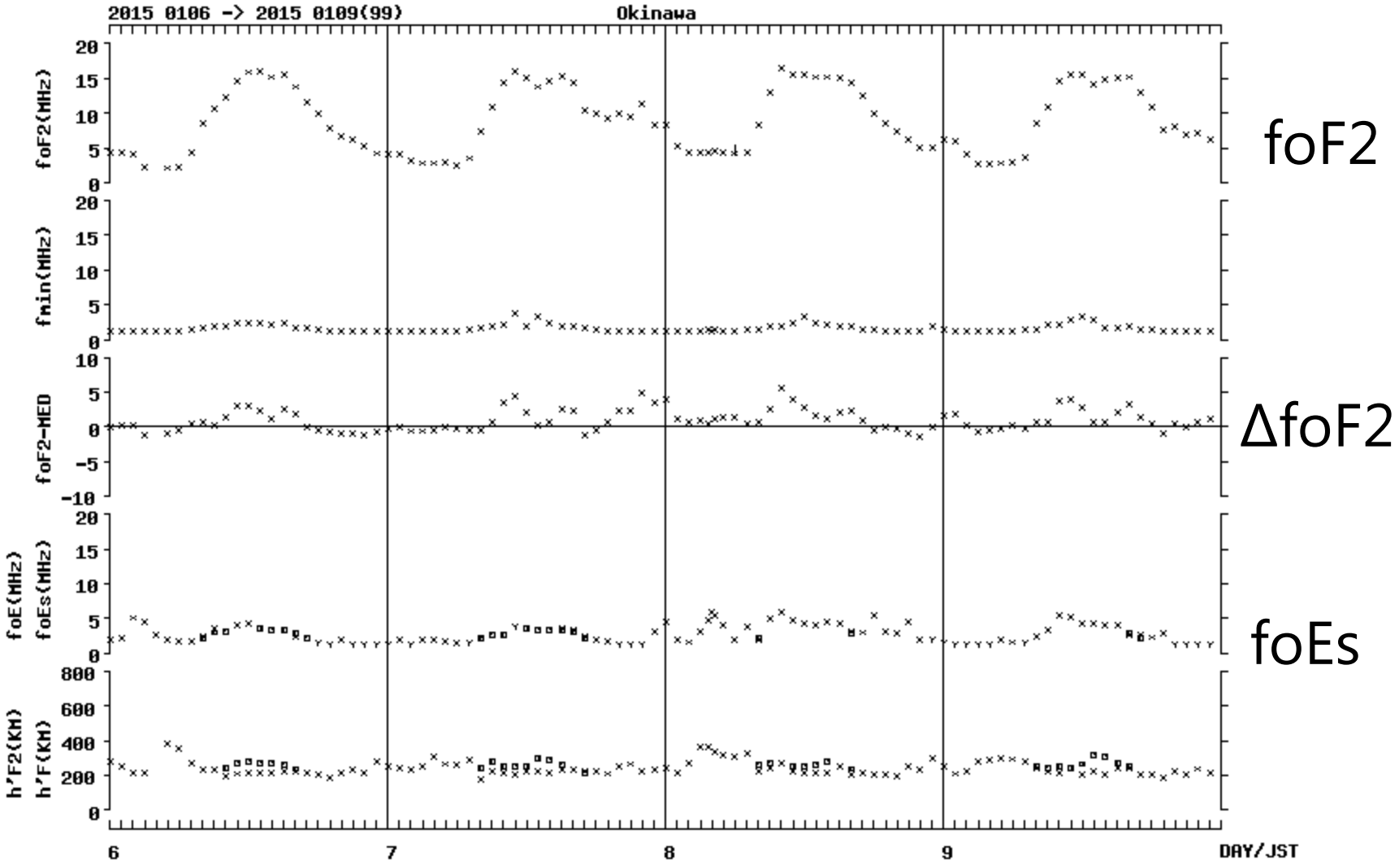
Yamagawa (31.20°N, 130.62°E)



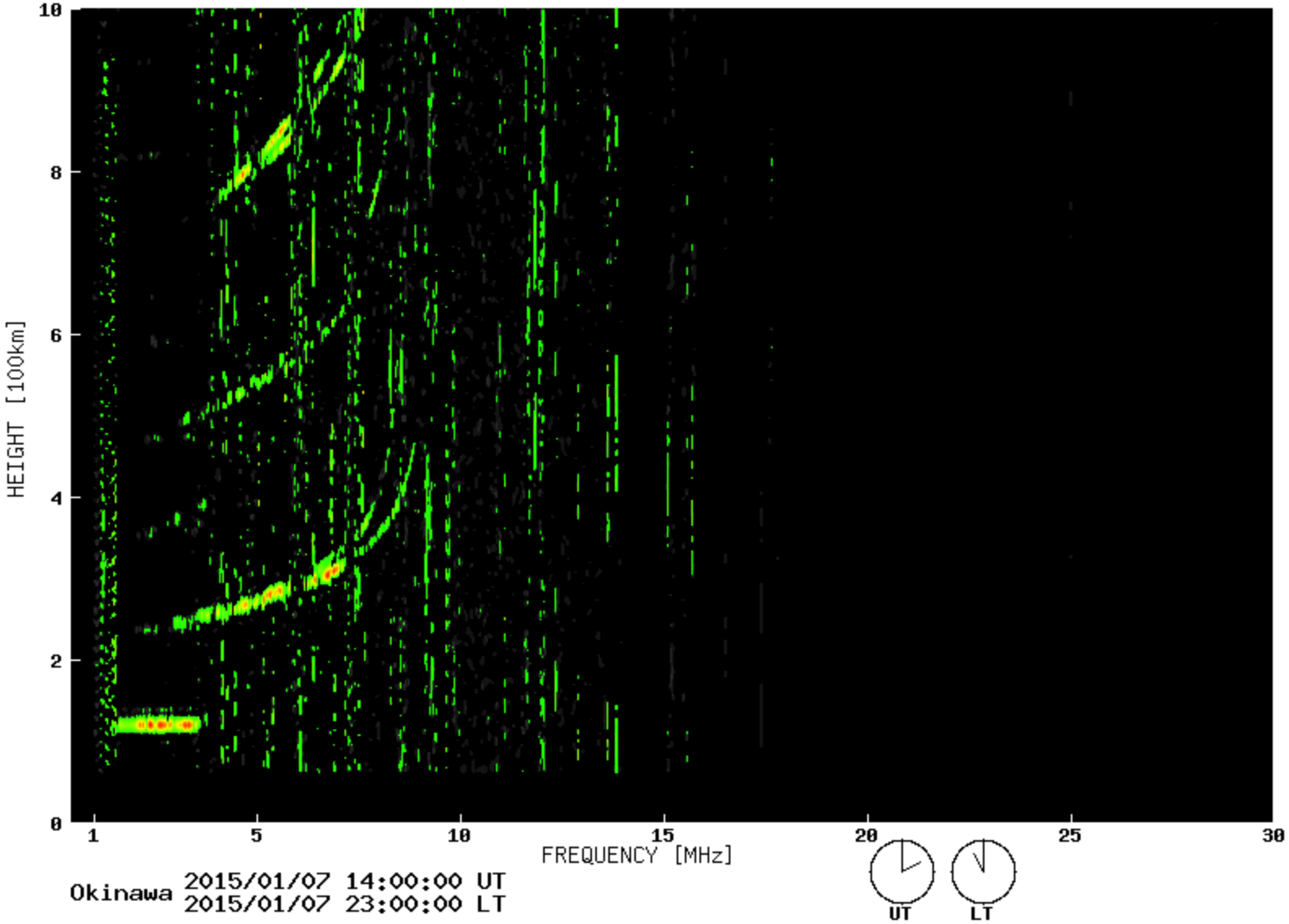
Yamagawa (31.20°N, 130.62°E)



Okinawa (26.68°N, 128.15°E)



Okinawa (26.68°N, 128.15°E)

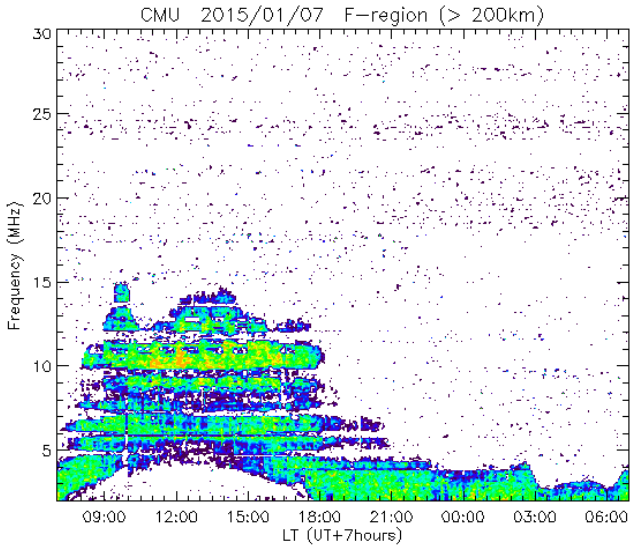


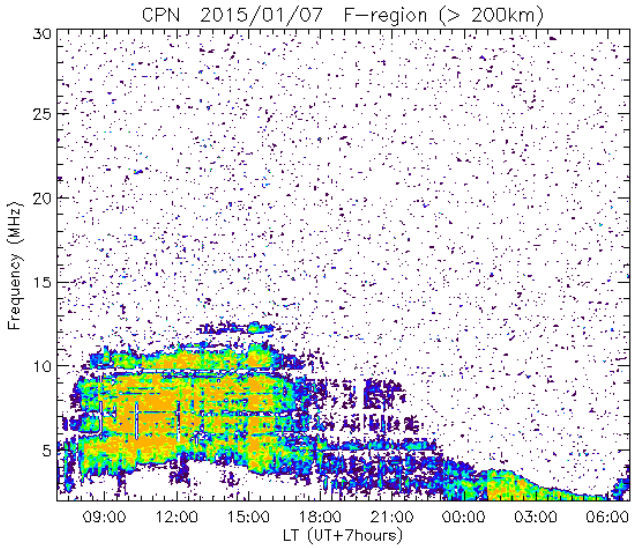
Ionosphere over Thailand on 7 January 2015

Chiang Mai (18.76°N, 98.93°E)

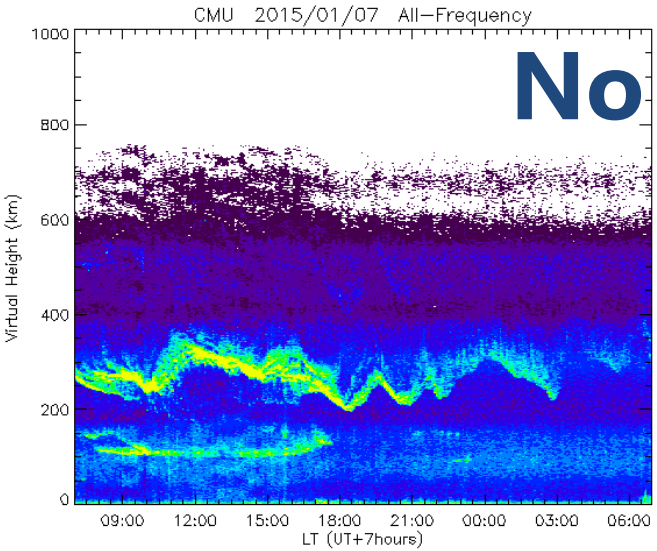
Chumphon (10.72°N, 99.37°E)

Frequency

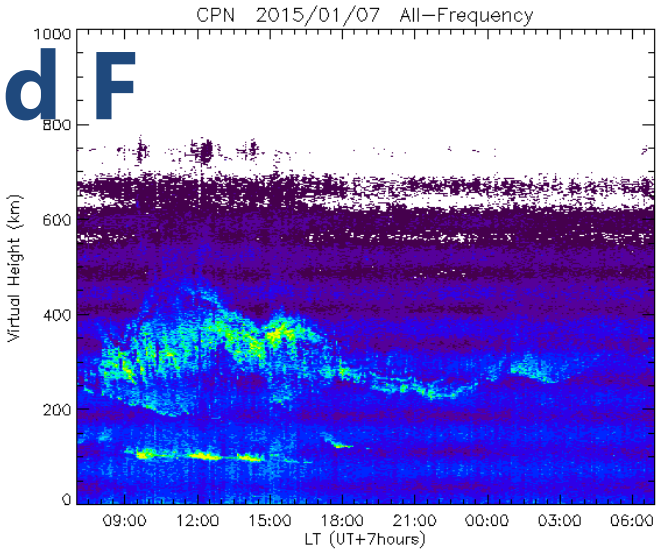




Virtual Height



No Spread F



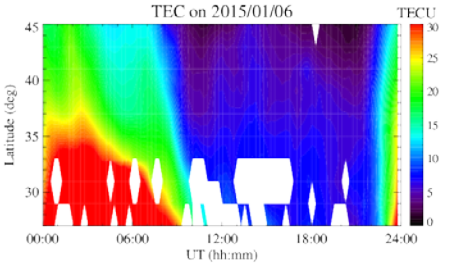
Time (LT)

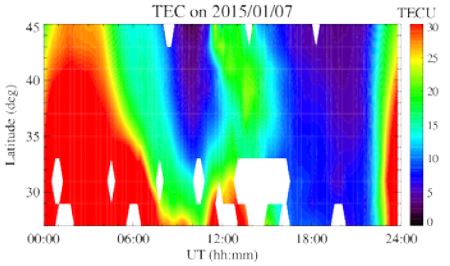
TEC over Japan

1/6

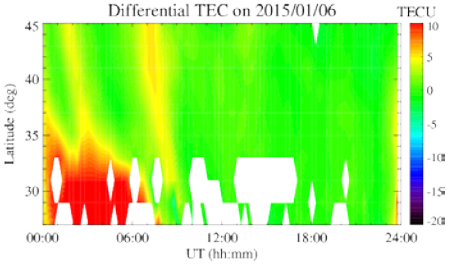
1/7

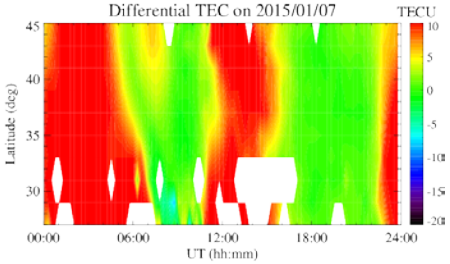
Absolute TEC





Differential TEC
(5-day quiet period)





Latitude

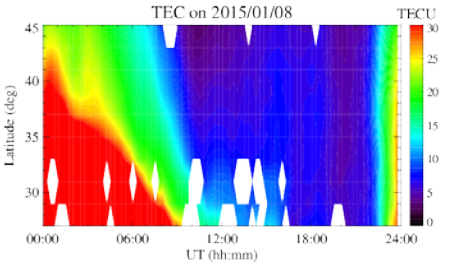
Time (UT)

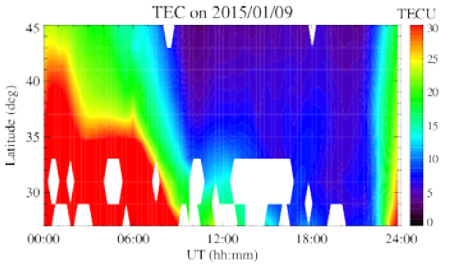
Positive storm at day and night

1/8

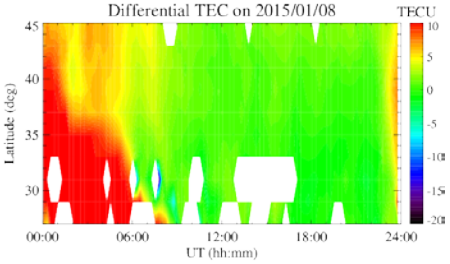
1/9

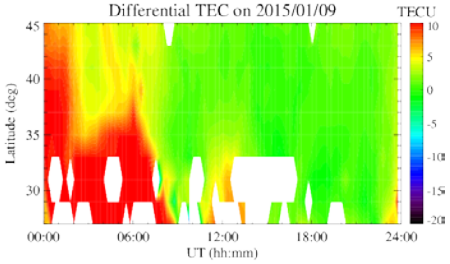
Absolute TEC



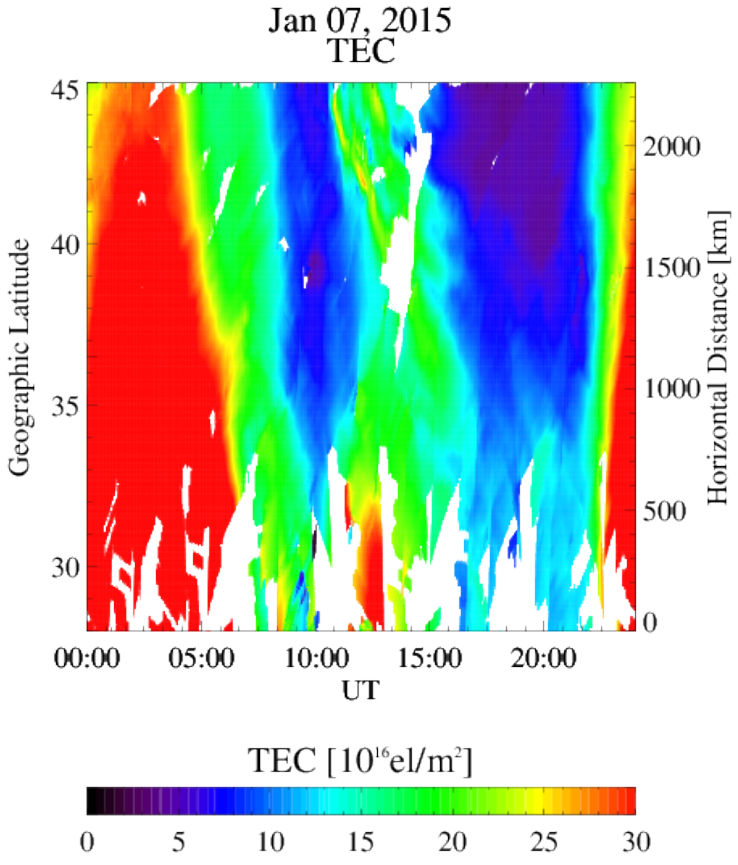


Differential TEC

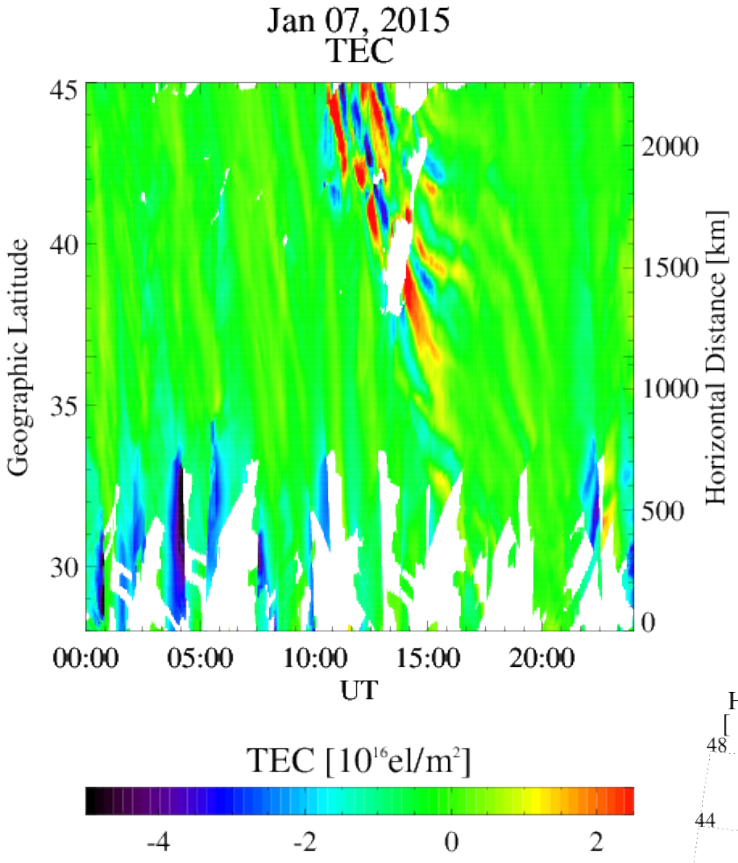




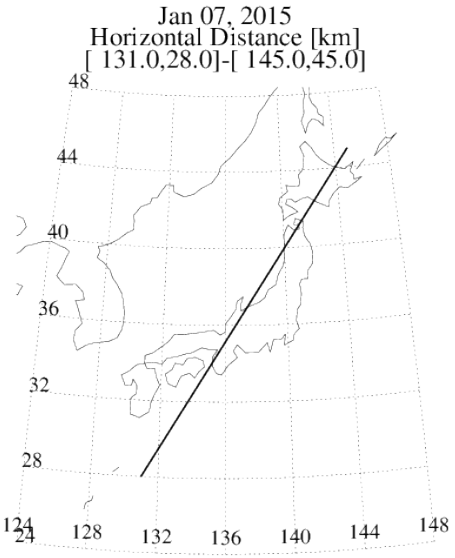
High-resolution TEC on 7 January 2015



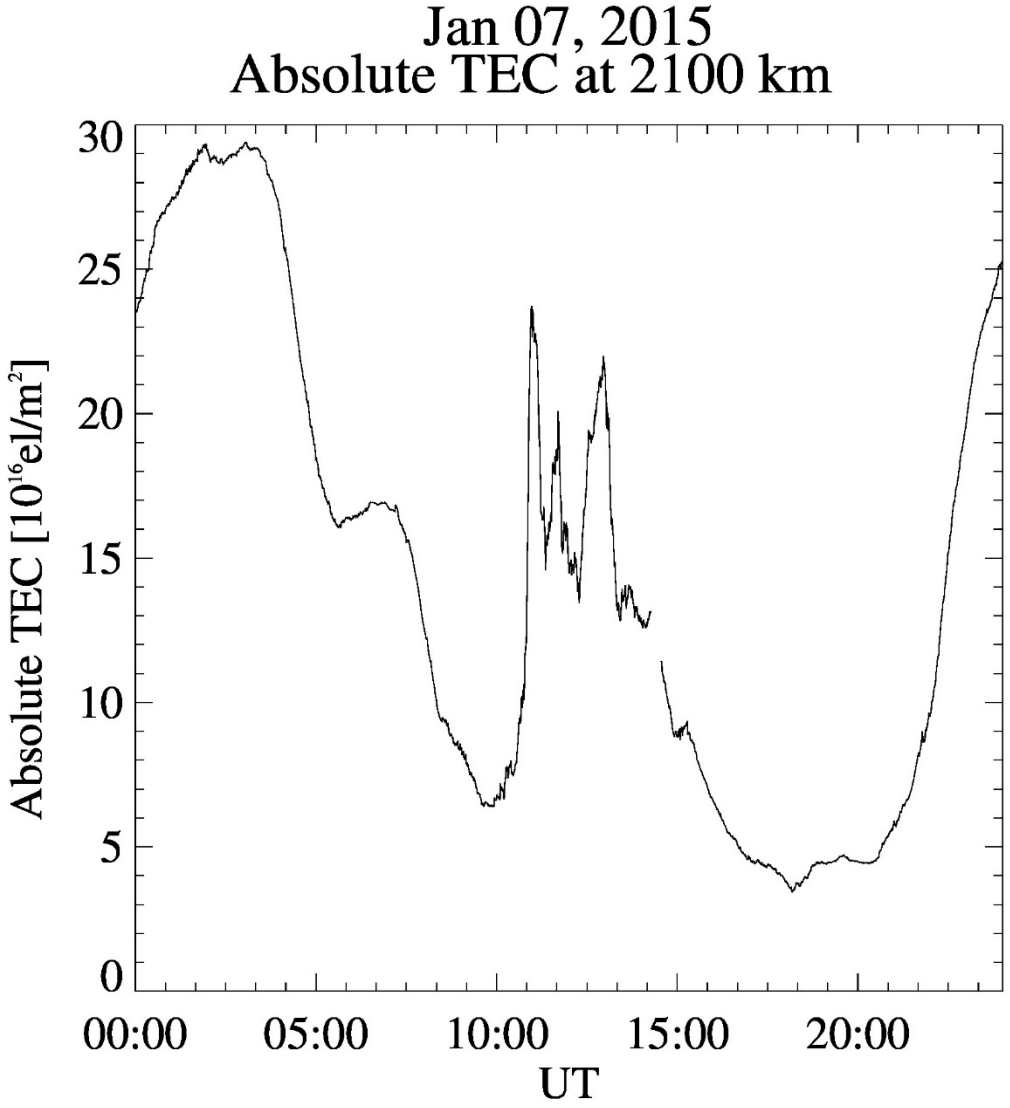
Absolute TEC

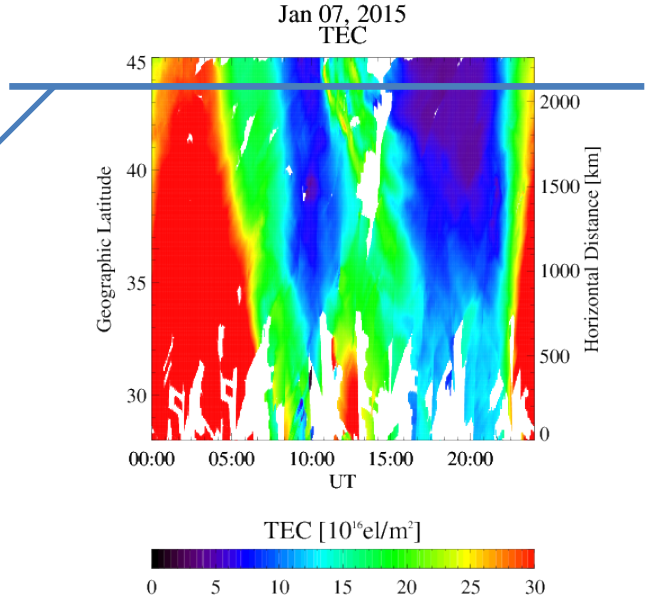


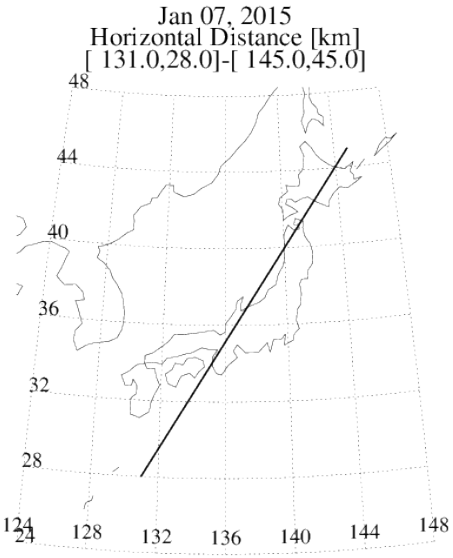
60-min detrended TEC



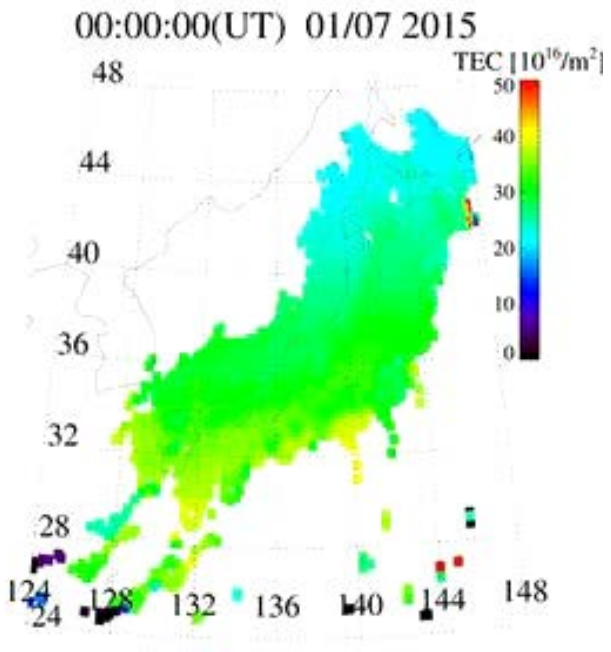
High-resolution TEC on 7 January 2015



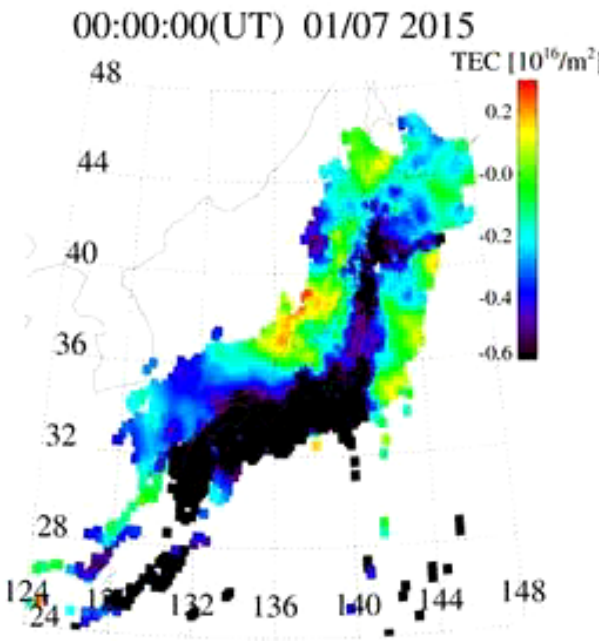




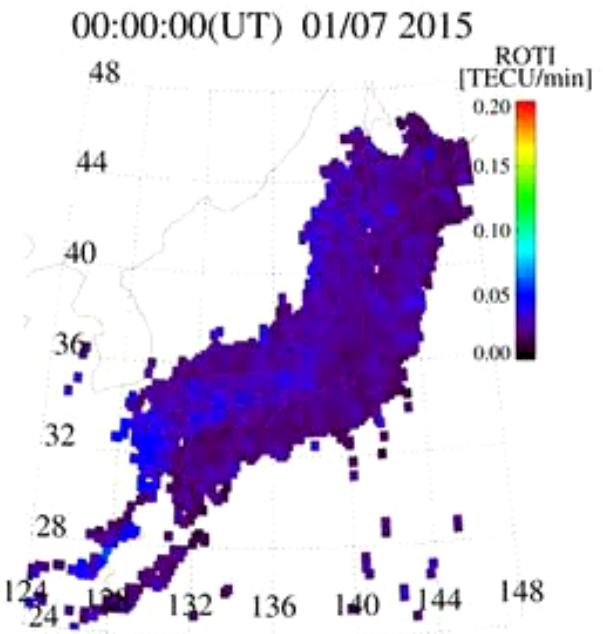
TEC over Japan on 7 January 2015



Absolute TEC

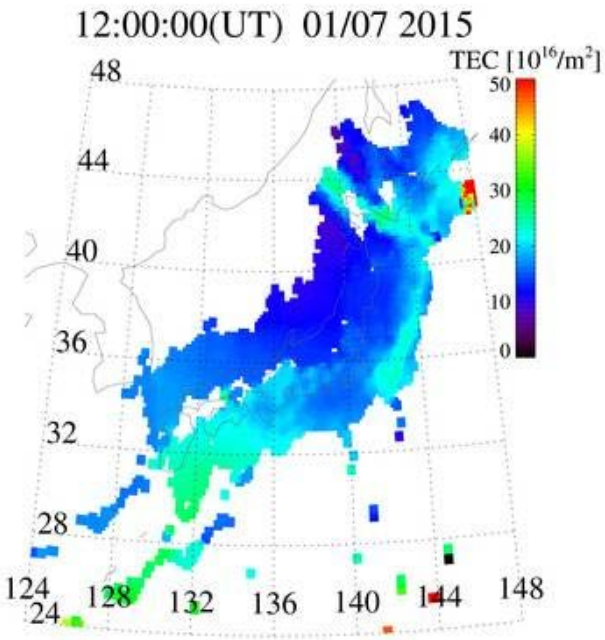


60-min detrended

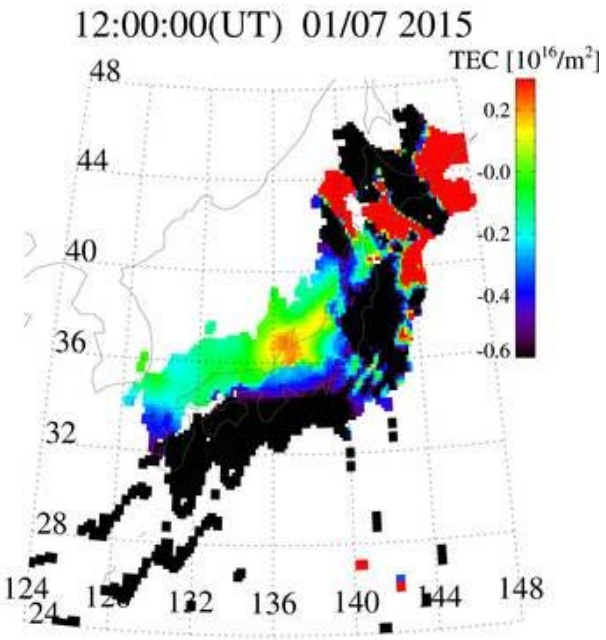


5-min ROTI

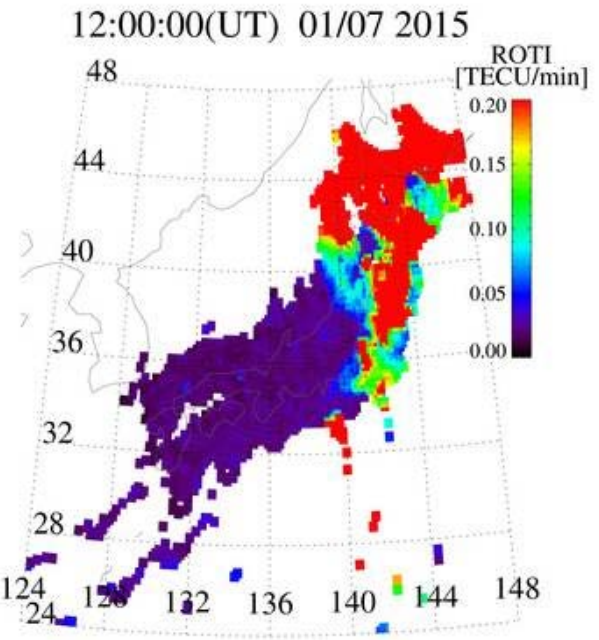
TEC over Japan on 7 January 2015



Absolute TEC

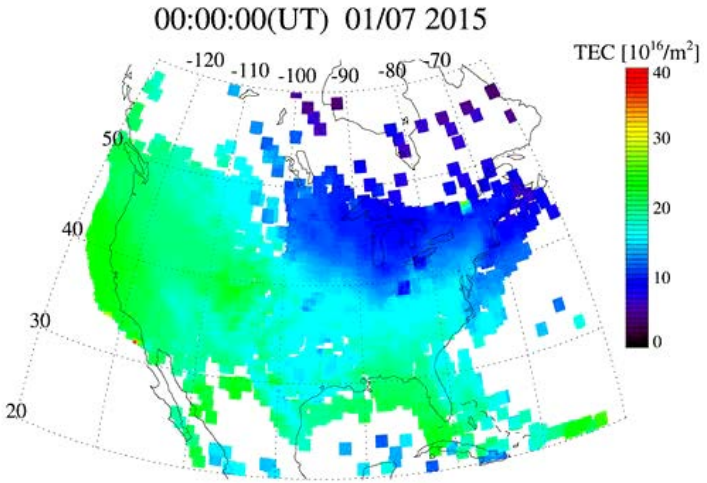


60-min detrended

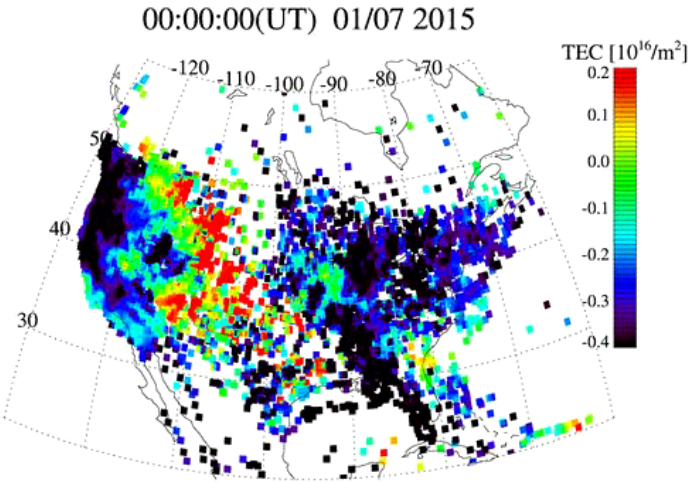


5-min ROTI

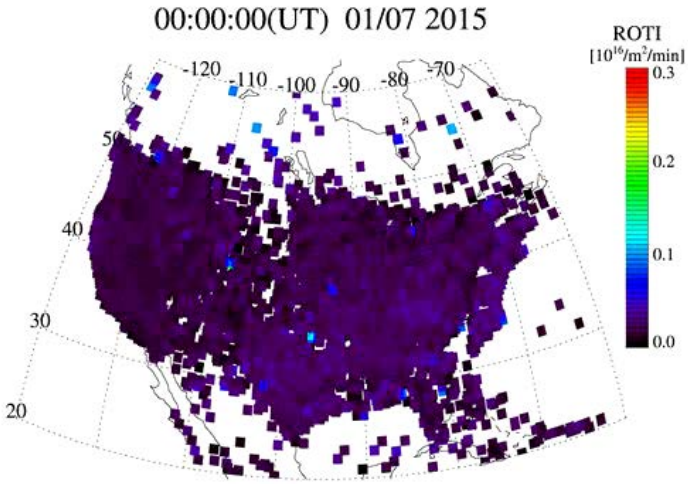
TEC over North America on 7 January 2015



Absolute TEC

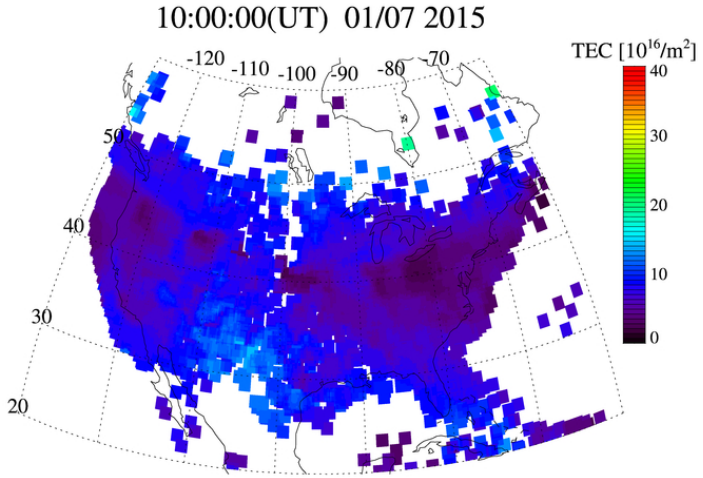


60-min detrended

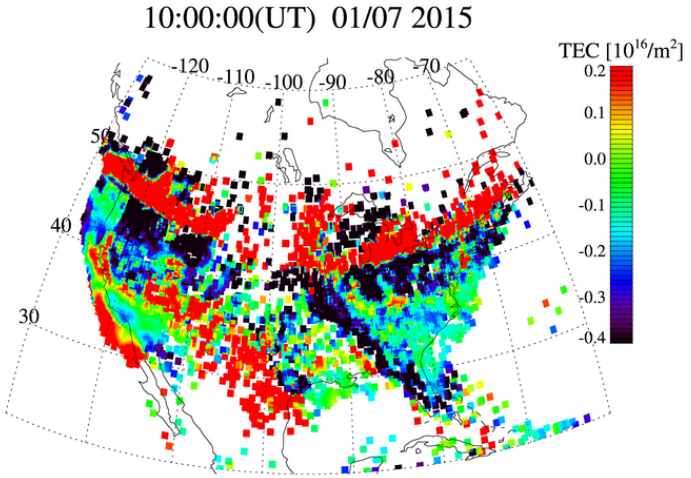


5-min ROTI

TEC over North America on 7 January 2015



Absolute TEC



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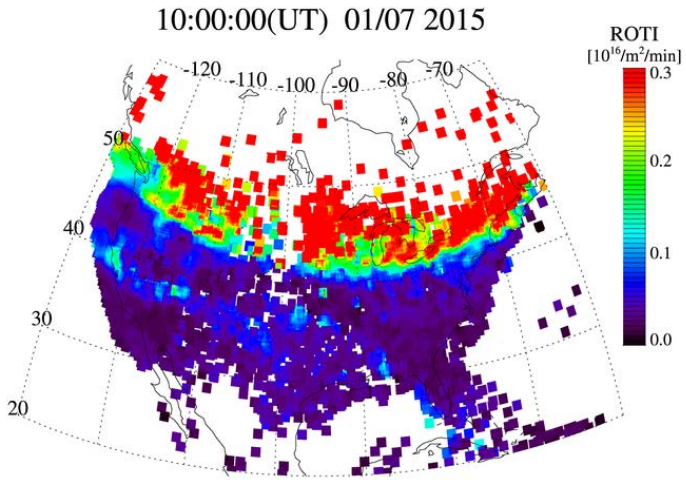
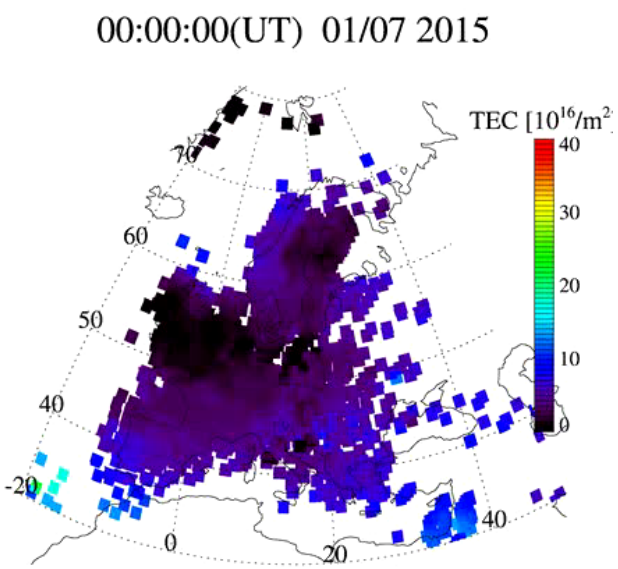
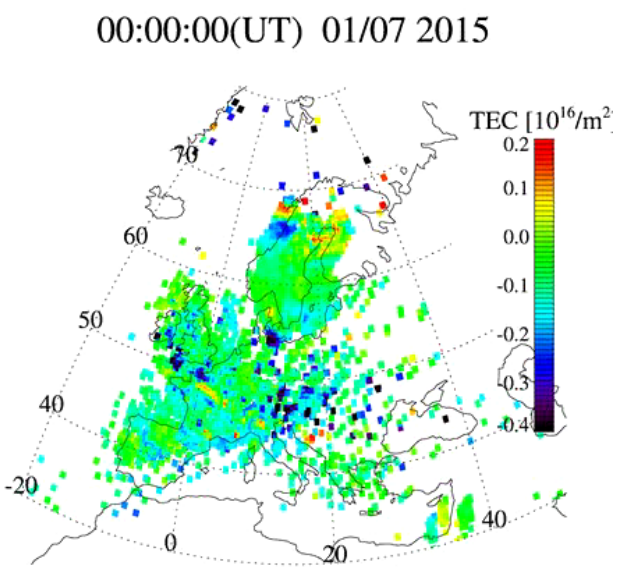


5-min ROTI

TEC over Europe on 7 January 2015



Absolute TEC



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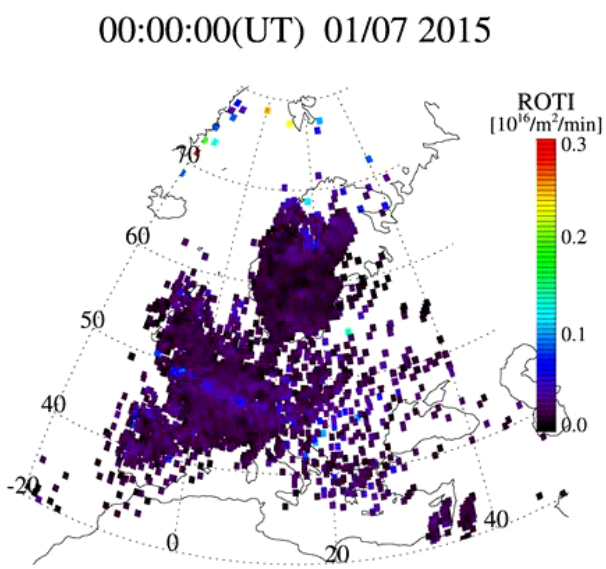
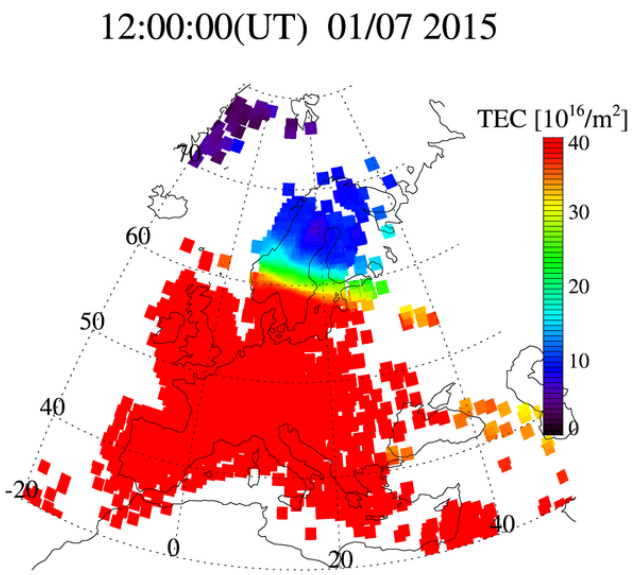
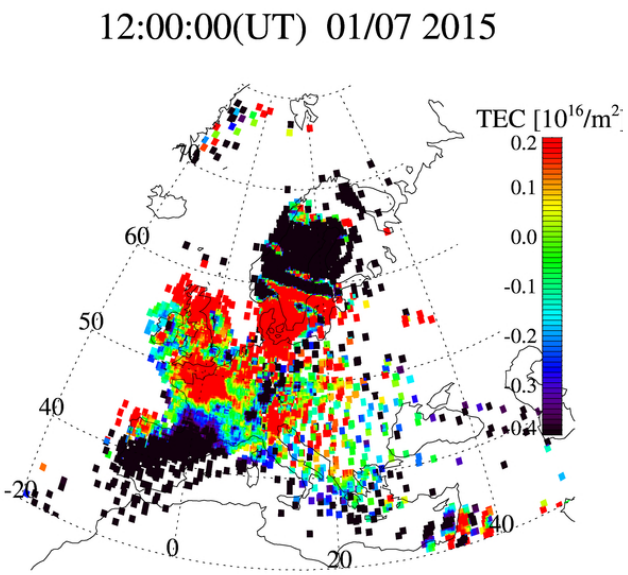


5-min ROTI

TEC over Europe on 7 January 2015



Absolute TEC



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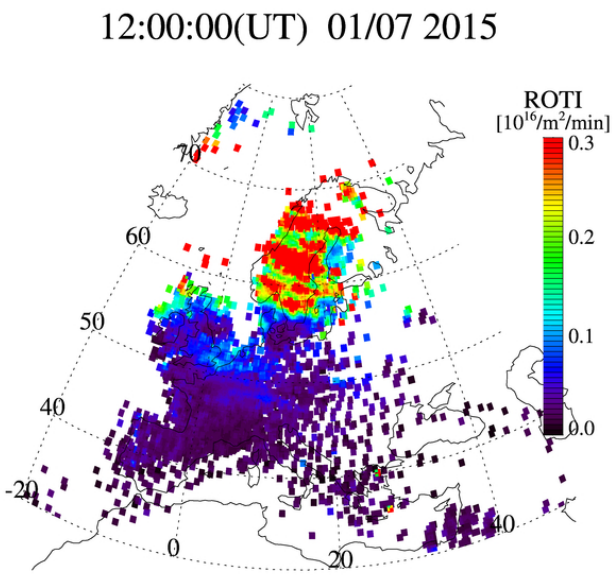
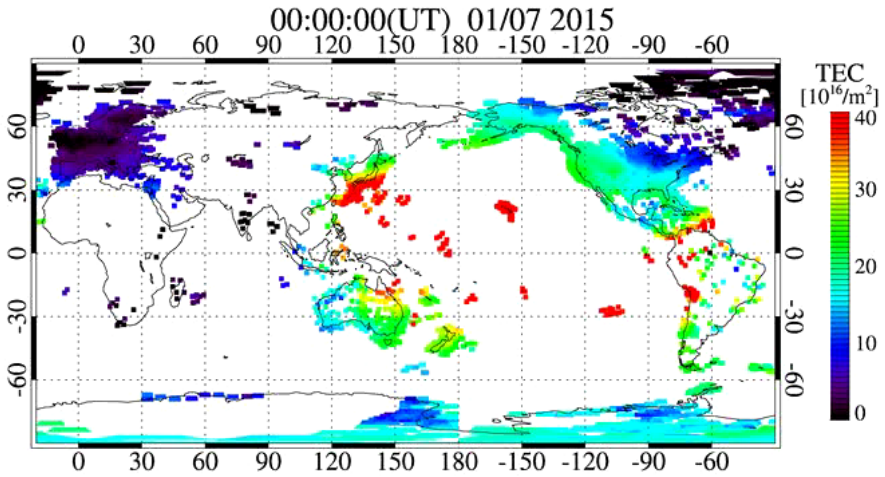
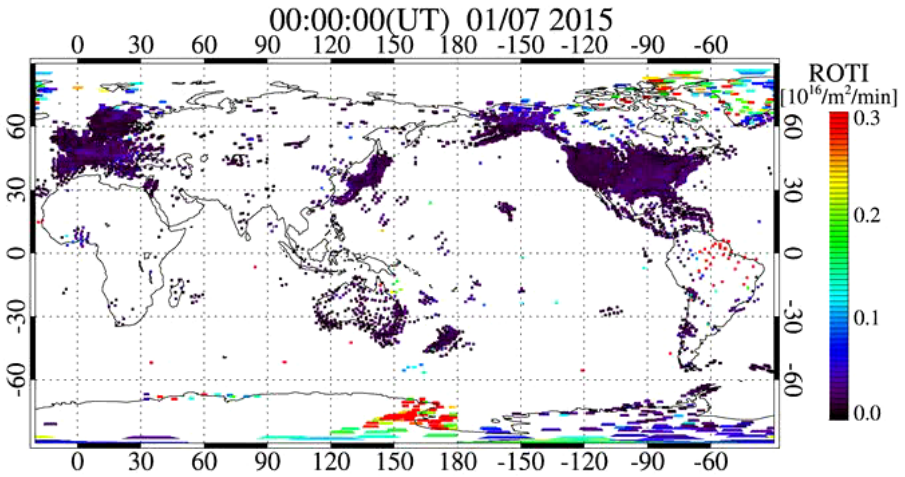


5-min ROTI

Global TEC on 7 January 2015



Absolute TEC



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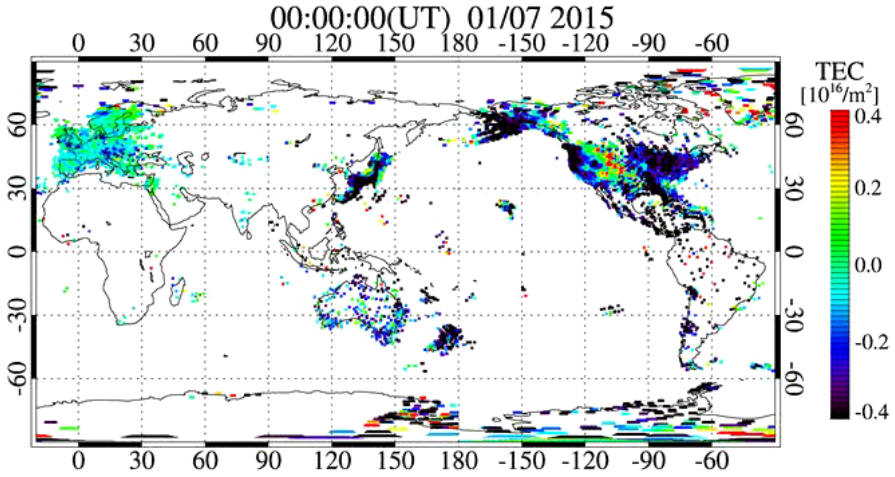


5-min ROTI

DRAWING-TEC

seg-web.nict.go.jp/GPS/DRAWING-TEC/

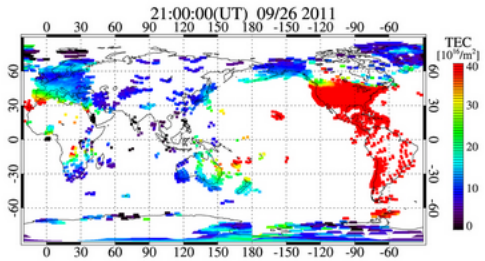
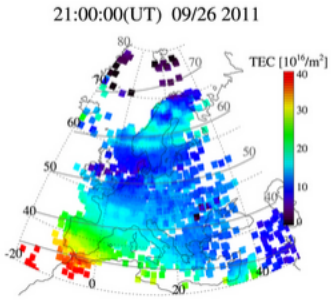
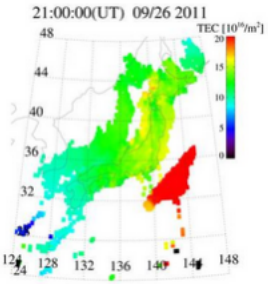
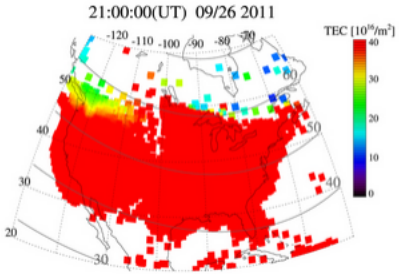
DRAWING-TEC

DRAWING-TEC

(Dense Regional And Worldwide INternational GNSS-TEC observation)

The purpose of Dense Regional And Worldwide INternational GNSS-TEC observation (DRAWING-TEC) project is to promote studies of ionospheric variations and their effect on GNSS among ionospheric researchers and GNSS researchers in the world. This project consists of (1) standardizing GNSS-TEC data, (2) developing dense TEC mapping technique, and (3) sharing the standardized TEC or GNSS data. If you have any questions or comments, please e-mail to iono@ml.nict.go.jp .

Quicklook

	Global	Europe	Japan	N. America
Absolute TEC				

Summary

- Peculiar ionospheric storm was observed on 7 January 2015.
  - ✓ Strong spread F over northern Japan
  - ✓ Unusually strong ROTI enhancement (like equatorial plasma bubbles)
  - ✓ Did not reach lower and equatorial latitudes
  - ✓ TEC enhancement in the nightside (Japan and US), and TEC decrease in the dayside (Europe) simultaneously (around the same UT)

→→→ Any suggestions for this event??

IONOGRAM
http://wdc.nict.go.jp/IONO/index_E.html
GPS-TEC
http://seg-web.nict.go.jp/GPS/DRAWING-TEC/