



**National Space Science Center
Chinese Academy of Sciences**



Some phenomena Observed by DPS-4D in Hainan

X. Wang, J. K. Shi, G.J. Wang

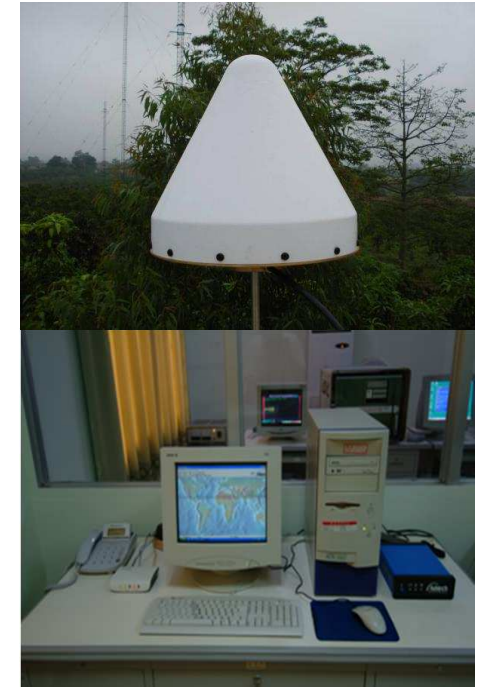
State Key Laboratory of Space Weather, NSSC, CAS, Beijing, China

Outline

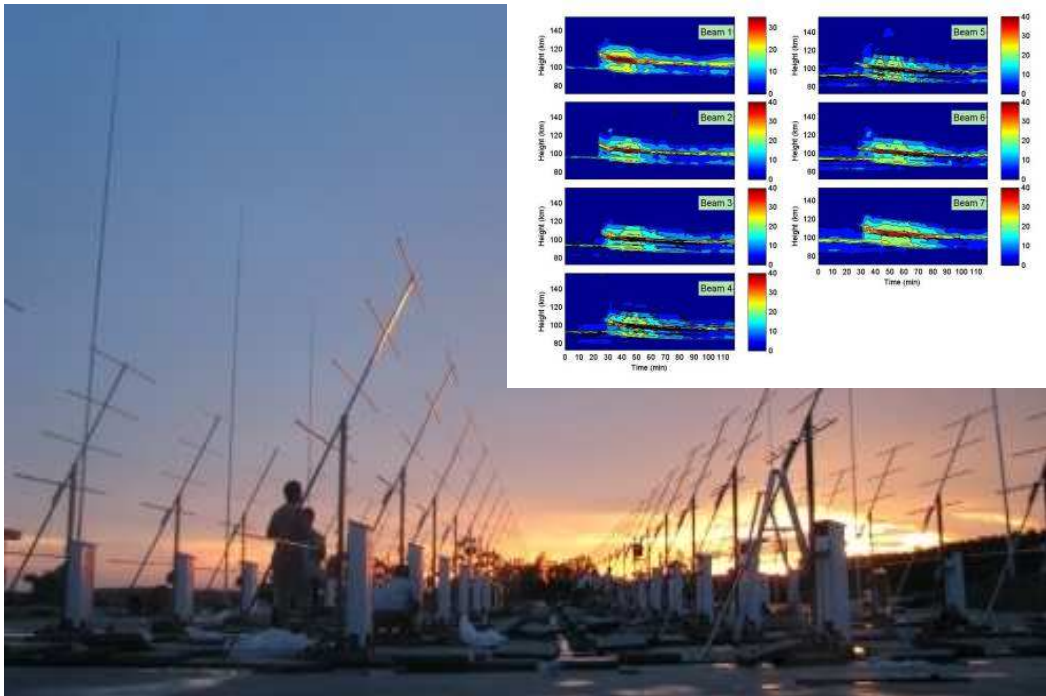
- **Ionospheric observation in Hainan**
- **Some phenomena observed by
DPS-4D in Hainan**
- **Summary**

1. Ionospheric observation in Hainan

- Beginning in Oct 1989, DGS-256 shipped from Beijing to Hainan
- VHF, GPS-TEC and GPS scintillation monitor
- Sounding rocket (300 km)



GPS TEC





History of DPS in Hainan

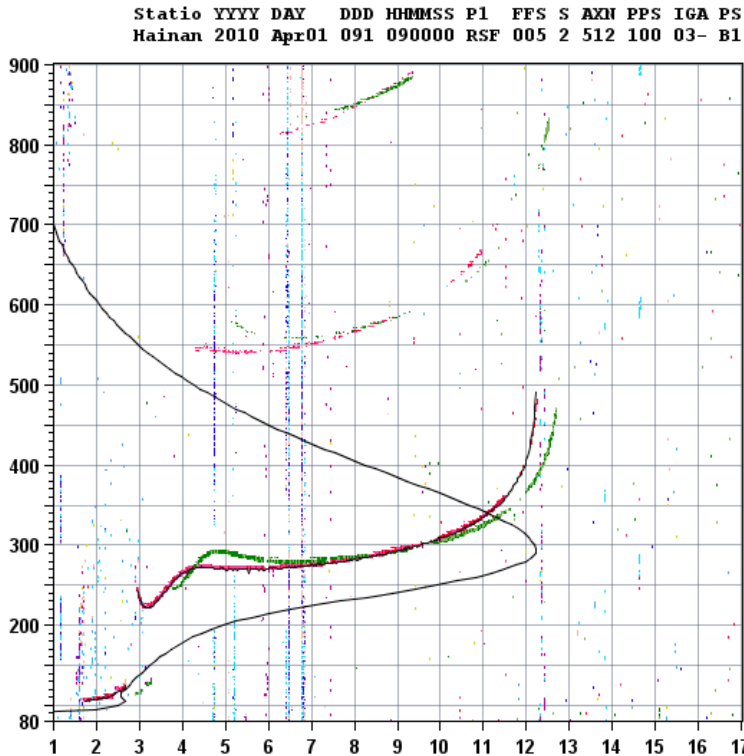
- DPS-4: from Feb 5, 2002 to Nov 21, 2009, about 8 years

| | |
|--------|--------|
| foF2 | 10.825 |
| foF1 | 3.22 |
| foFlp | N/A |
| foE | 2.12 |
| foEp | 1.85 |
| fxI | 11.30 |
| foEs | 2.10 |
| fmin | 1.50 |
| MUF(D) | 34.96 |
| M(D) | 3.24 |
| D | 3000.0 |
| h'F | 220.0 |
| h'F2 | 257.0 |
| h'E | 105.0 |
| h'Es | 105.0 |
| hmF2 | 283.5 |
| hmF1 | 182.7 |
| hmE | 101.8 |
| yF2 | 61.3 |
| yF1 | 33.0 |
| vF | 11.6 |

| | |
|---------|--------|
| foF2 | 12.225 |
| foF1 | N/A |
| foFlp | N/A |
| foE | 2.68 |
| foEp | 2.66 |
| fxI | 12.90 |
| foEs | N/A |
| fmin | 1.73 |
| MUF(D) | 38.05 |
| M(D) | 3.11 |
| D | N/A |
| h'F | 221.5 |
| h'F2 | 221.5 |
| h'E | 104.9 |
| h'Es | N/A |
| hmF2 | 293.3 |
| hmF1 | N/A |
| hmE | 105.3 |
| yF2 | 77.3 |
| yF1 | N/A |
| yE | 15.0 |
| BO | 72.4 |
| B1 | 1.79 |
| C-level | 22 |



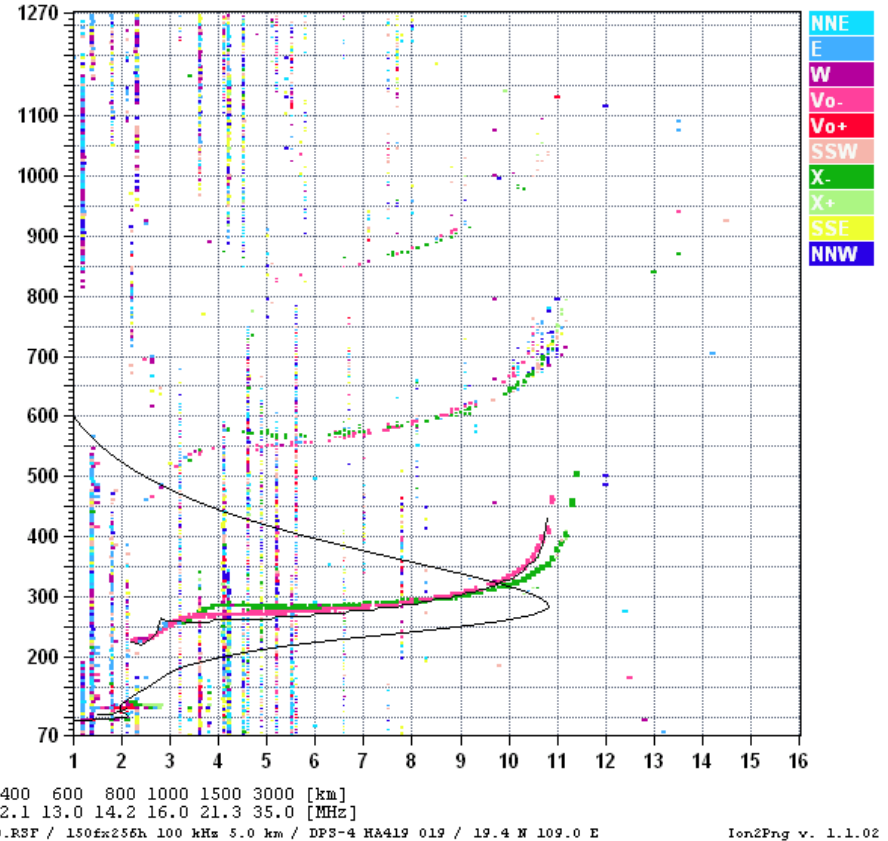
| | |
|---------|--------|
| foF2 | 12.225 |
| foF1 | N/A |
| foFlp | N/A |
| foE | 2.68 |
| foEp | 2.66 |
| fxI | 12.90 |
| foEs | N/A |
| fmin | 1.73 |
| MUF(D) | 38.05 |
| M(D) | 3.11 |
| D | N/A |
| h'F | 221.5 |
| h'F2 | 221.5 |
| h'E | 104.9 |
| h'Es | N/A |
| hmF2 | 293.3 |
| hmF1 | N/A |
| hmE | 105.3 |
| yF2 | 77.3 |
| yF1 | N/A |
| yE | 15.0 |
| BO | 72.4 |
| B1 | 1.79 |
| C-level | 22 |
| Auto: | |
| Artist5 | |
| 500200 | |



D 100 200 400 600 800 1000 1500 3000 [km]
 MUF 12.8 12.9 13.5 14.5 15.8 17.8 23.4 38.0 [MHz]
 HA419_20100910090000.RSF / 640fx512h 25 kHz 2.5 km / DPS-4D HA419 019 / 19.4 N 109.0 E

Ion2Png v. 1.3.11

Statio YYYY DAY DDD HMM P1 FFS S AXN PPS IGA PS
 Hainan 2009 May01 121 1030 RSF 1 715 100 10+ AI



- DPS-4D: from Feb 28, 2010 to now
- ✓ Clear and high-quality ionogram
- ✓ Fast running and high time interval

2. Observation of DPS-4D

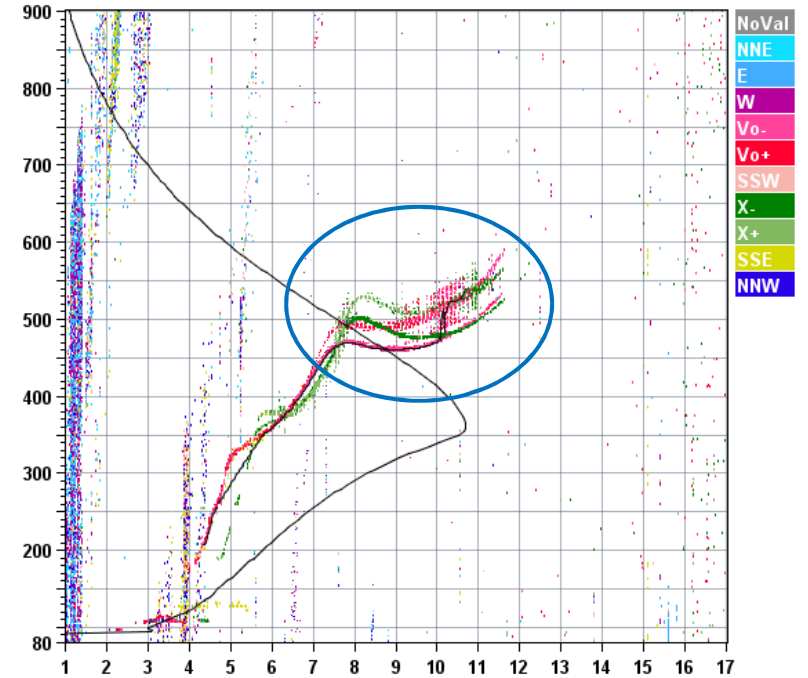
2.1 Multi-trace of F2 layer

- With range Spread-F
- Mostly two traces
- From 1 hour to several hours



| | |
|---------|--------|
| foF2 | 10.688 |
| foF1 | 4.68 |
| foFlp | 4.34 |
| foE | 3.10 |
| foEp | 3.28 |
| fxI | 11.15 |
| foEs | N/A |
| fmin | 3.02 |
| MUF(D) | 28.09 |
| M(D) | 2.63 |
| D | N/A |
| h'F | 206.5 |
| h'F2 | 260.8 |
| h'E | 106.0 |
| h'Es | N/A |
| hmF2 | 357.9 |
| hmF1 | 150.8 |
| hmE | 96.0 |
| yF2 | 84.7 |
| yF1 | 50.8 |
| yE | 5.9 |
| BO | 173.7 |
| BI | 1.00 |
| C-level | 22 |

Statio YYYY DAY DDD HMMSS P1 FFS S AXN PPS IGA PS
Hainan 2011 May09 129 030000 RSF 005 2 512 100 03- B1



Auto:
Artist5
500200

D 100 200 400 600 800 1000 1500 3000 [km]
MUF 11.2 11.3 11.7 12.4 13.3 14.6 18.5 28.1 [MHz]

HA41S_2011129030000.RSF / 640fx512ch 25 kHz 2.5 km / DPS-4D HA41S 01S / 19.4 N 109.0 E

| | |
|---------|-------|
| foEs | 2.95 |
| fmin | 1.63 |
| MUF(D) | 30.11 |
| M(D) | 3.53 |
| D | N/A |
| h'F | 241.0 |
| h'F2 | 241.0 |
| h'E | 108.0 |
| h'Es | 107.5 |
| hmF2 | 255.2 |
| hmF1 | N/A |
| hmE | 98.8 |
| yF2 | 39.7 |
| yF1 | N/A |
| yE | 8.7 |
| BO | 58.1 |
| BI | 1.00 |
| C-level | 22 |

Auto:
Artist5
500200

D 100 200 400 600 800 1000 1500 3000 [km]
MUF 9.1 9.2 9.7 10.5 11.6 13.2 17.9 30.1 [MHz]

HA41S_201411S103000.RSF / 760fx512ch 25 kHz 2.5 km / DPS-4D HA41S 01S / 19.4 N 109.0 E

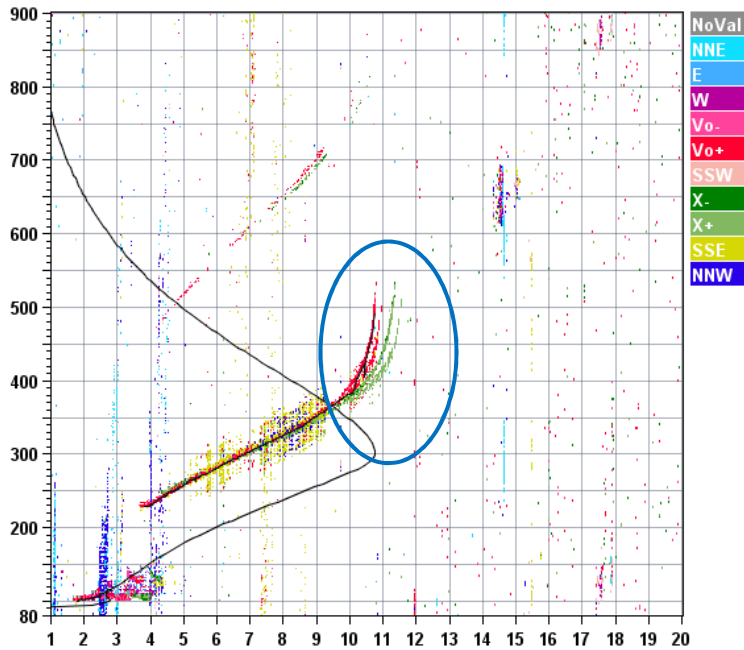
Ion2Png v. 1.3.11



Statio YYYY DAY DDD HMMSS P1 FFS S AXN PPS IGA PS
Hainan 2014 Apr13 103 004500 RSF 005 2 512 100 03- B1

| | |
|---------|--------|
| foF2 | 10.750 |
| foF1 | N/A |
| foFlp | N/A |
| foE | 2.78 |
| foEp | 2.77 |
| fxI | 10.90 |
| foEs | 3.77 |
| fmin | 1.80 |
| MUF(D) | 32.00 |
| M(D) | 2.98 |
| D | N/A |
| h'F | 229.0 |
| h'F2 | 229.0 |
| h'E | 100.1 |
| h'Es | 127.5 |
| hmF2 | 299.8 |
| hmF1 | N/A |
| hmE | 101.9 |
| yF2 | 91.6 |
| yF1 | N/A |
| yE | 11.7 |
| BO | 115.7 |
| BI | 1.29 |
| C-level | 33 |

Auto:
Artist5
500200



D 100 200 400 600 800 1000 1500 3000 [km]
MUF 11.3 11.4 11.9 12.7 13.8 15.4 20.1 32.0 [MHz]

HA41S_2014103004500.RSF / 760fx512ch 25 kHz 2.5 km / DPS-4D HA41S 01S / 19.4 N 109.0 E

Ion2Png v. 1.3.11

Ionograms of recent several years are reviewed and results as following:

- Very few for DPS-4: before 2009
- 2010: none
- 2011 : summer: End of April to August, about 9 o'clock to midnight
- 2012 : from April to Dec, about 9 o'clock to sunrise of next day
- 2013 / 2014: each month, about 9 o'clock to sunrise of next day

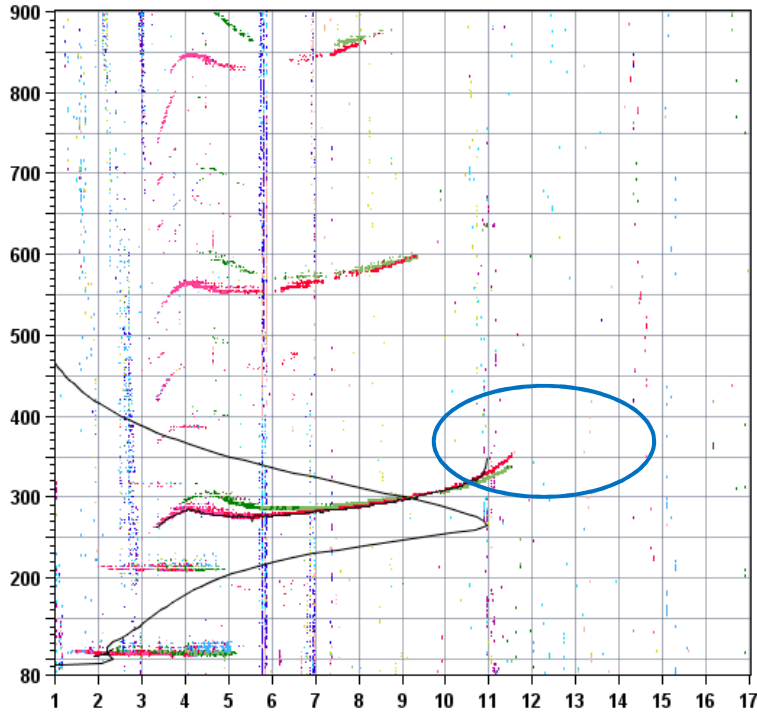
From 2011 to 2014, the occurrence rate: 5% ~ 70% each day

2.2 End Cutting off of F2 layer trace



Statio YYYY DAY DDD HHMMSS P1 FFS S AXN PPS IGA PS
 Hainan 2011 Feb07 038 093000 RSF 005 2 512 100 03- B1

| | |
|---------|--------|
| foF2 | 10.950 |
| foF1 | N/A |
| foF1p | N/A |
| foE | 2.33 |
| foEp | 2.25 |
| fxI | 11.45 |
| foEs | 4.10 |
| fmin | 1.90 |
| <hr/> | |
| MUF(D) | 37.64 |
| M(D) | 3.44 |
| D | N/A |
| <hr/> | |
| h`F | 263.0 |
| h`F2 | 263.0 |
| h`E | 102.5 |
| h`Es | 103.8 |
| <hr/> | |
| hmF2 | 264.6 |
| hmF1 | N/A |
| hmE | 99.0 |
| yF2 | 37.9 |
| yF1 | N/A |
| yE | 8.9 |
| B0 | 59.9 |
| B1 | 1.01 |
| <hr/> | |
| C-level | 22 |
| <hr/> | |
| Auto: | |
| Artist5 | |
| 500200 | |



D 100 200 400 600 800 1000 1500 3000 [km]
 MUF 11.5 11.7 12.3 13.2 14.6 16.6 22.5 37.6 [MHz]
 HA419_20110308093000.RSF / 640fx512h 25 kHz 2.5 km / DPS-4D HA419 019 / 19.4 N 109.0 E Ion2Png v. 1.3.11

It is an older phenomenon but yet resolved.

Data in 2011 are investigated, some results:

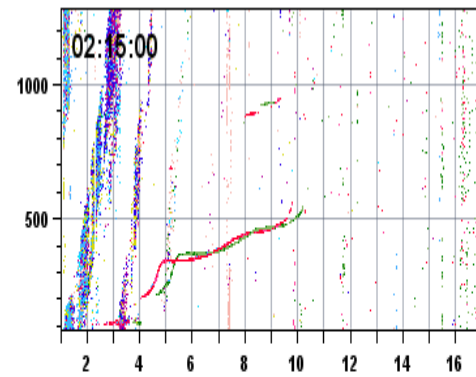
- the frequency of cutting off is: 9.5 ~ 14MHz
- Time: about 1100LT ~2200LT
- Winter and summer: occurrence time is later and short (about 1500~2000)

2.3 F1.5

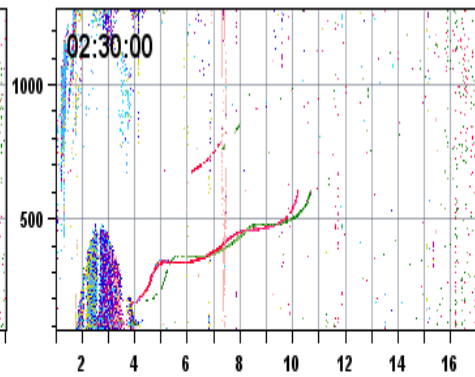
Time: 1000LT
~1500LT
Occurs nearly
everyday

But it can't be
scaled in
SAOExplorer.

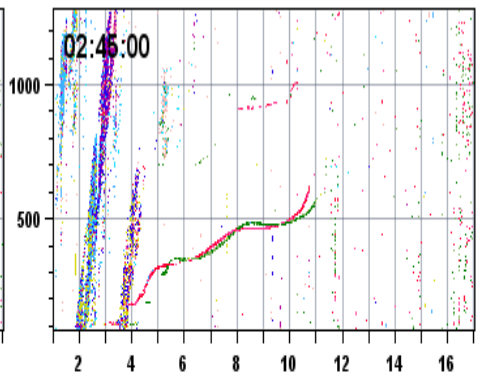
Survey, SAOExplorer, v 3.5.1
HA419 2011.04.18



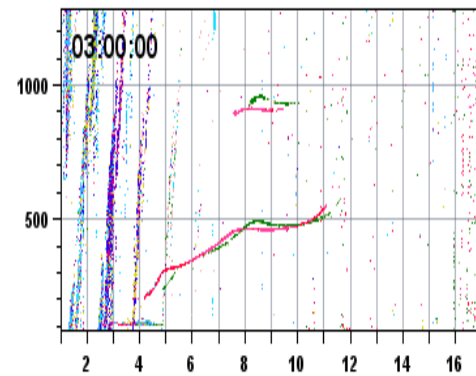
HA419 2011.04.18



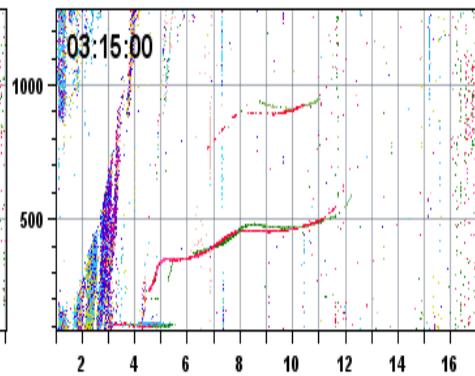
HA419 2011.04.18



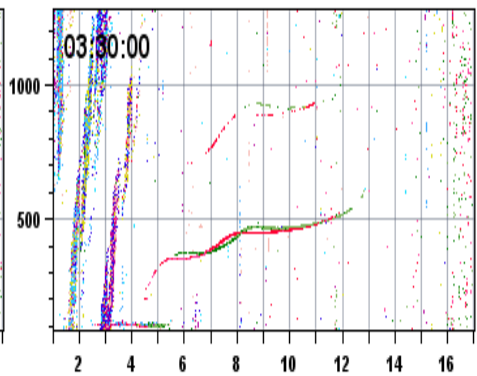
HA419 2011.04.18



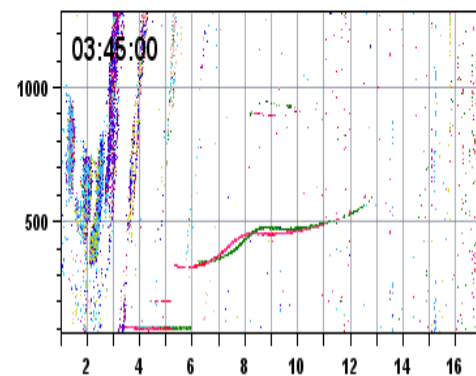
HA419 2011.04.18



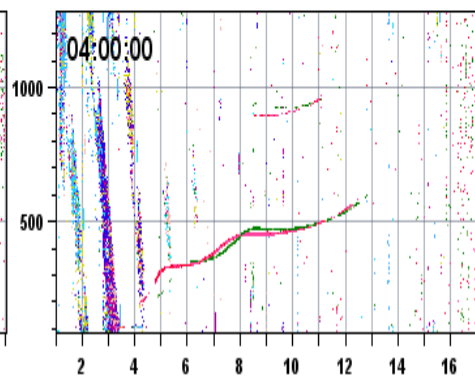
HA419 2011.04.18



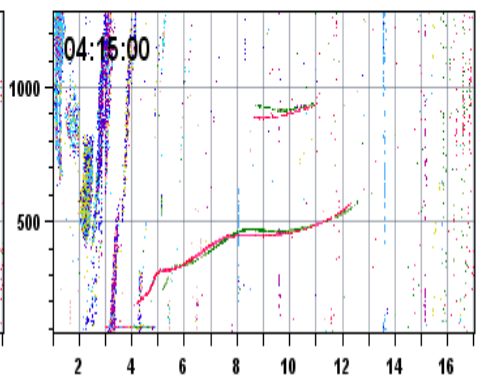
HA419 2011.04.18



HA419 2011.04.18



HA419 2011.04.18



3. Summary

Three kinds of main ionogram phenomena observed in Hainan are shown.

- They are very common and important for the scaling of ionograms, and also for the research of low latitude ionosphere.
- They represent the complex variability of low latitude ionosphere.

DPS-4D's high-quality ionogram will contribute to the observation and research of ionosphere in Hainan.

Suggestion: add one more layer in the SAOExplorer for F1.5 or F3 etc which are common in some stations. It will be convenient for the research of them.

谢谢！

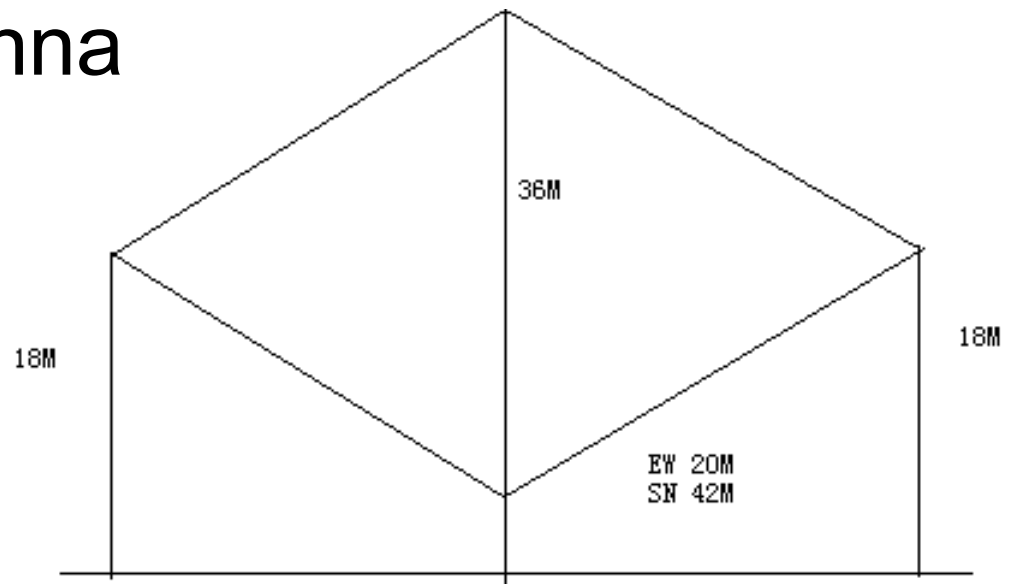
Thanks for your
attentions!

Lastest BIT

Test Case=Dummy Load Tx CaseNumber=4

| Name | Raw | Phys | Units | RedLow | YellowLow | YellowHigh | RedHigh | State |
|-----------|-------|--------|-------|--------|-----------|------------|---------|-------|
| AMP_RF1_V | 299 | 183.19 | V | 175.0 | 200.0 | 375.0 | 400.0 | GO |
| AMP_RF2_V | 263 | 169.32 | V | 175.0 | 200.0 | 375.0 | 400.0 | NOGO |
| TX_OUT1_V | 750 | 4.25 | V | 4.05 | 4.1 | 4.3 | 4.35 | GO |
| TX_OUT2_V | 751 | 4.25 | V | 4.05 | 4.1 | 4.3 | 4.35 | GO |
| RX_MAX1 | 36075 | 36075 | | 0.0 | 1.0 | 30000.0 | 35000.0 | NOGO |
| RX_MAX2 | 36789 | 36789 | | 0.0 | 1.0 | 30000.0 | 35000.0 | NOGO |
| RX_MAX3 | 38505 | 38505 | | 0.0 | 1.0 | 30000.0 | 35000.0 | NOGO |
| RX_MAX4 | 41524 | 41524 | | 0.0 | 1.0 | 30000.0 | 35000.0 | NOGO |

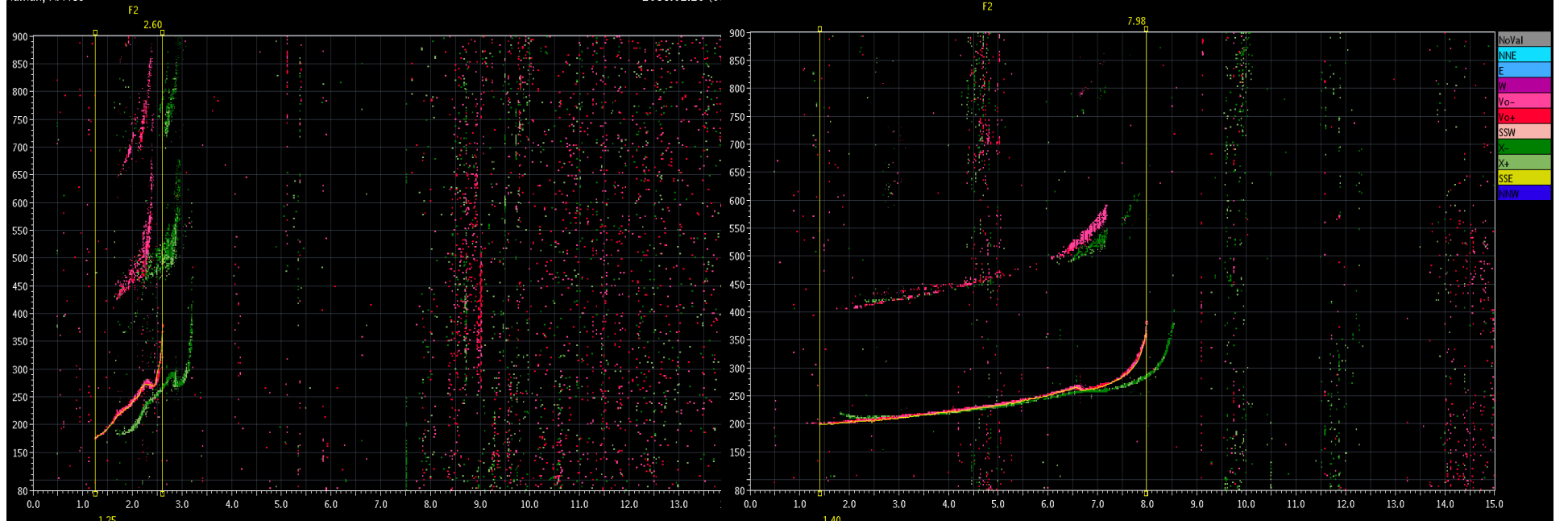
Transmit antenna



Hainan, HA419

2011.02.26 (0) Hainan, HA419

2011.04.01 (091) 18:00:00.00 SL

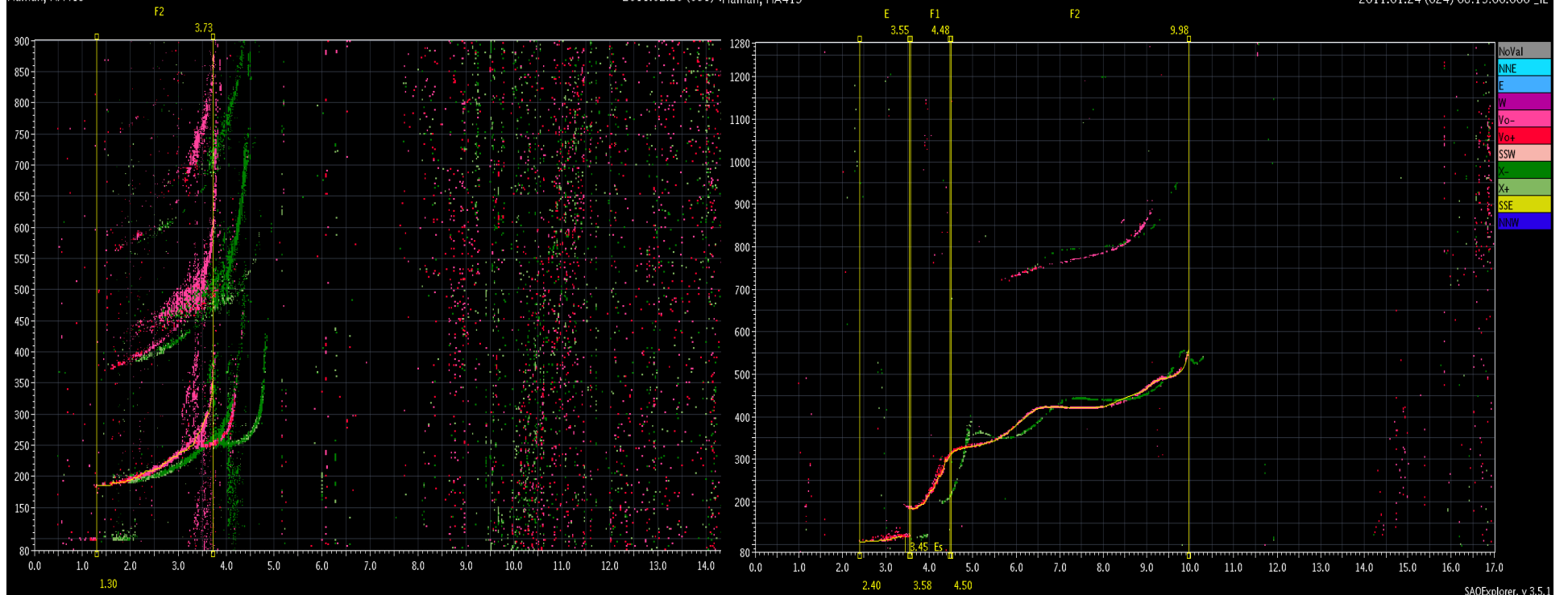


SAOExplorer, v 3.5.1

Hainan, HA419

2011.02.20 (051) Hainan, HA419

2011.01.24 (024) 06:15:00.00 IE



SAOExplorer, v 3.5.1