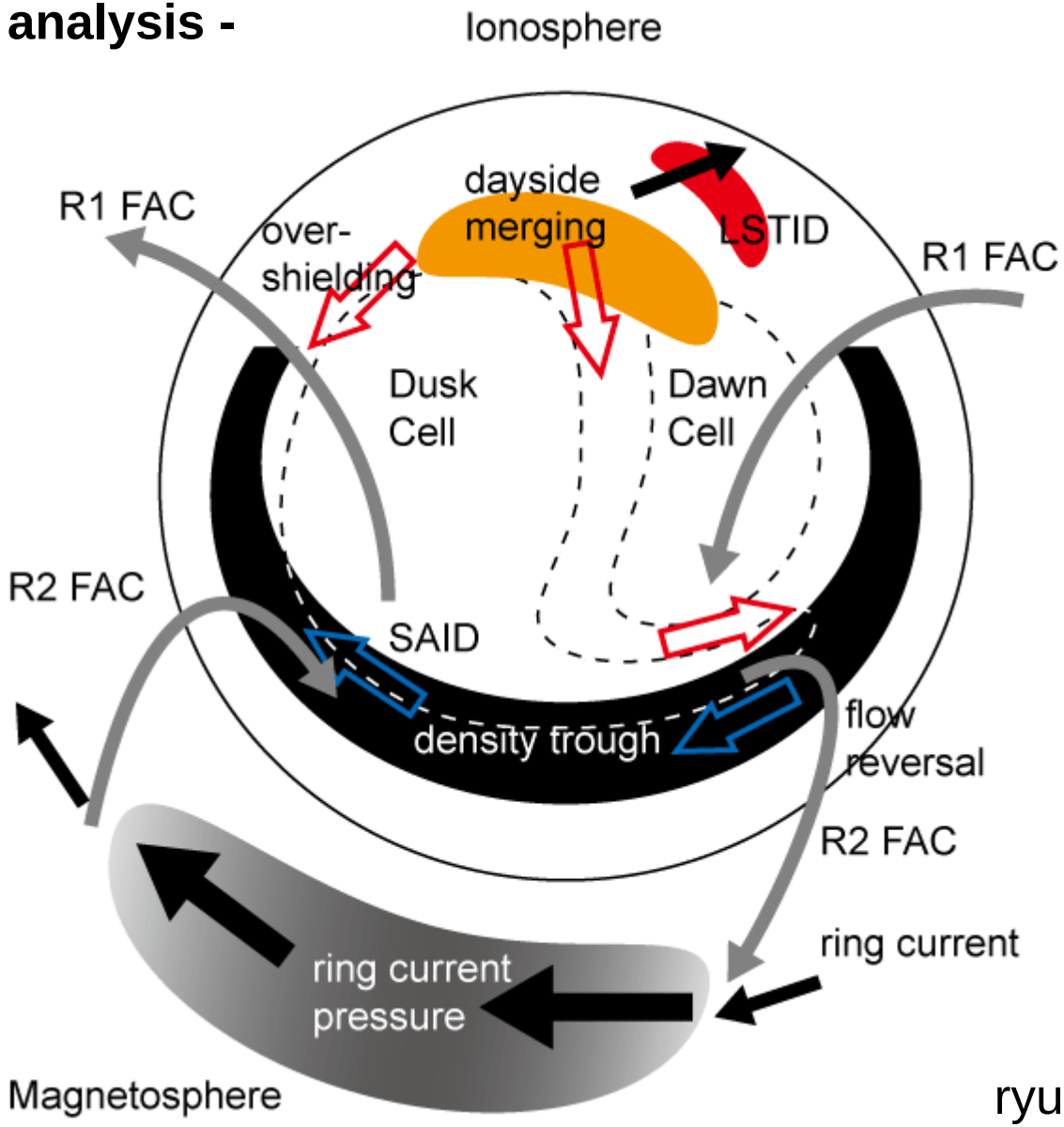
Subauroral convection during storms

- KEOGRAM analysis -

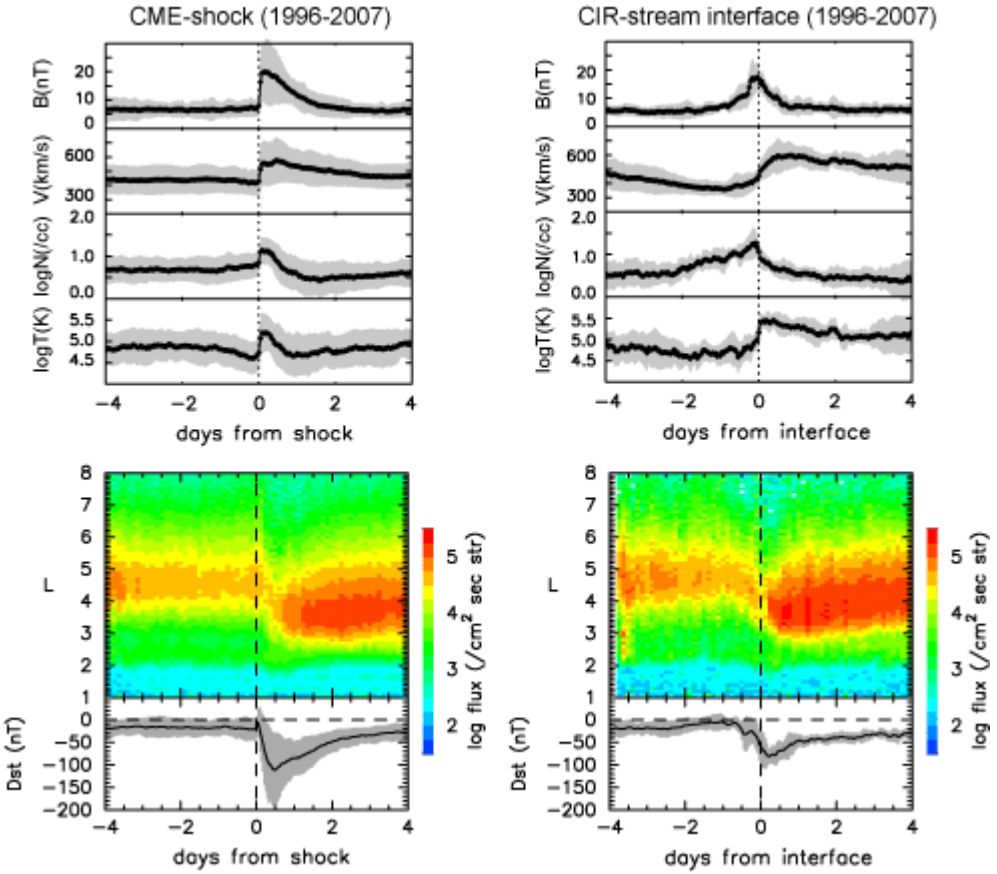


2008.1.28

ryuho@riken.jp

CME/CIR storms (solar cycle 23)

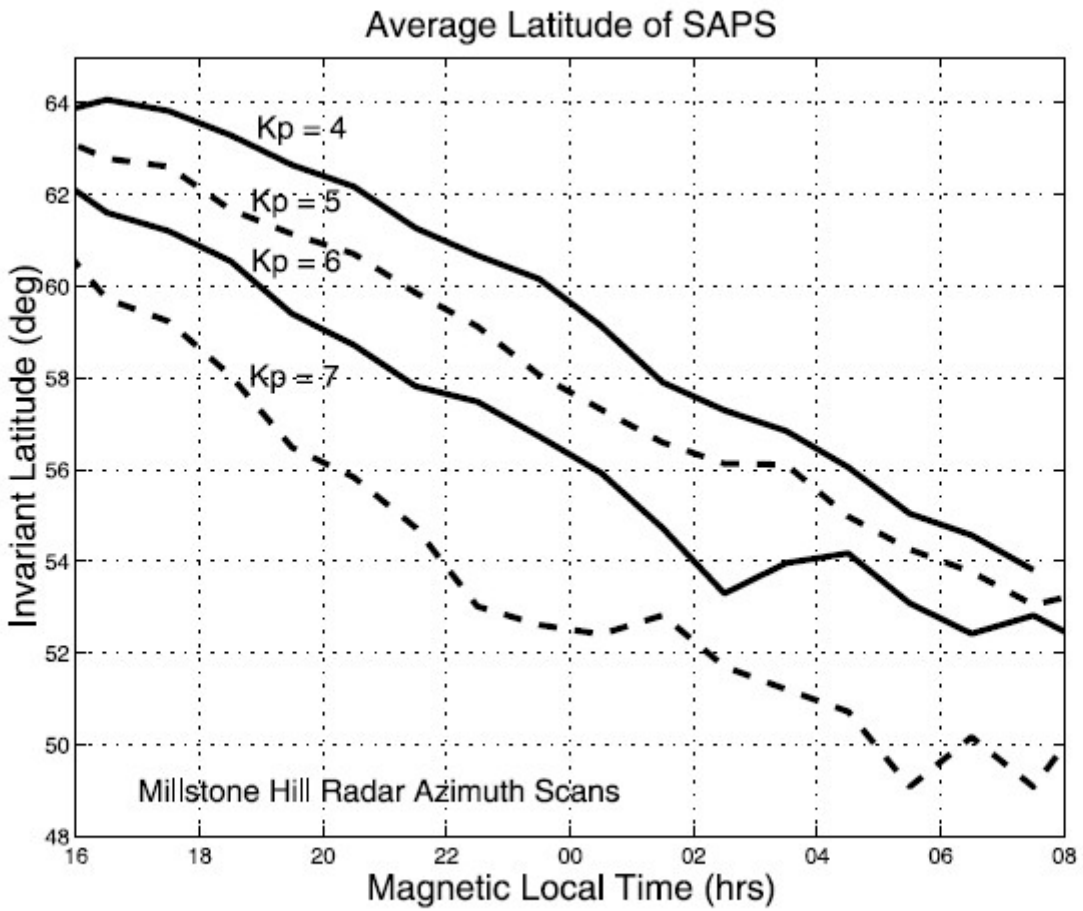
Year	CME	CIR
1996	0	1
1997	4	0
1998	7	1
1999	5	0
2000	10	0
2001	11	0
2002	5	2
2003	4	1
2004	3	1
2005	5	2
2006	1	1
2007	0	0



No 100 nT storms in 2007…

(Kataoka and Miyoshi, 2006, updated)

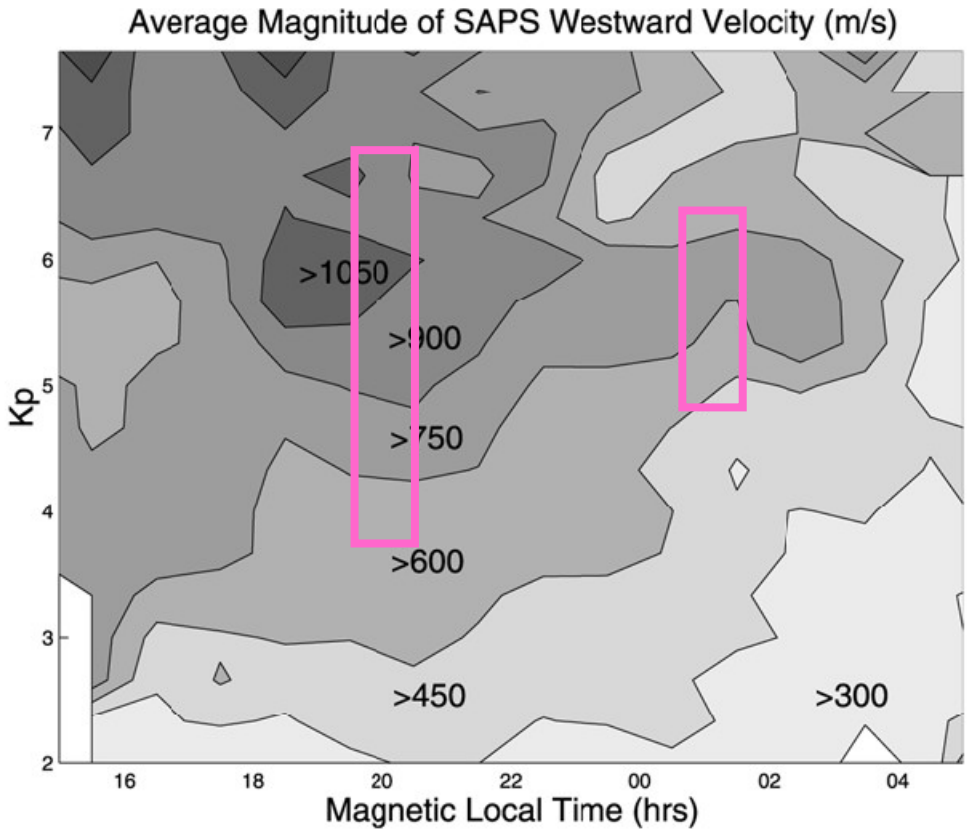
Average SAPS position



Kp>4

Figure 3. The average latitude of the peak of the polarization stream decreases uniformly as a function of both MLT and increasing *Kp* index.

Average SAPS speed

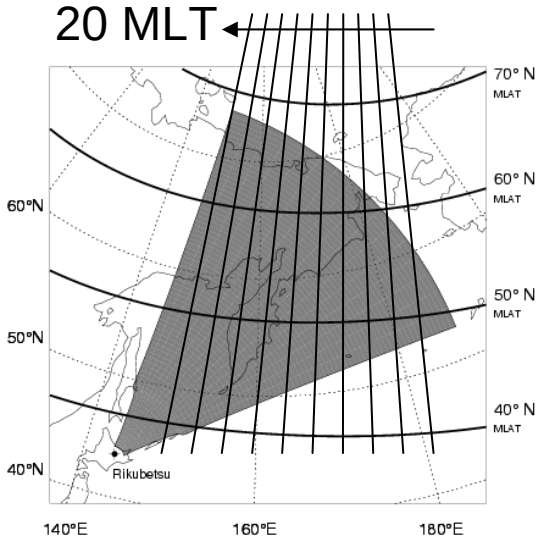


V>600m/s

Figure 5. The average magnitude of the peak SAPS westward velocity observed from Millstone Hill has been determined as a function of *Kp* and MLT. The average SAPS peak velocity exceeds 1000 m/s near 2000 MLT for $Kp \sim 6$ conditions.

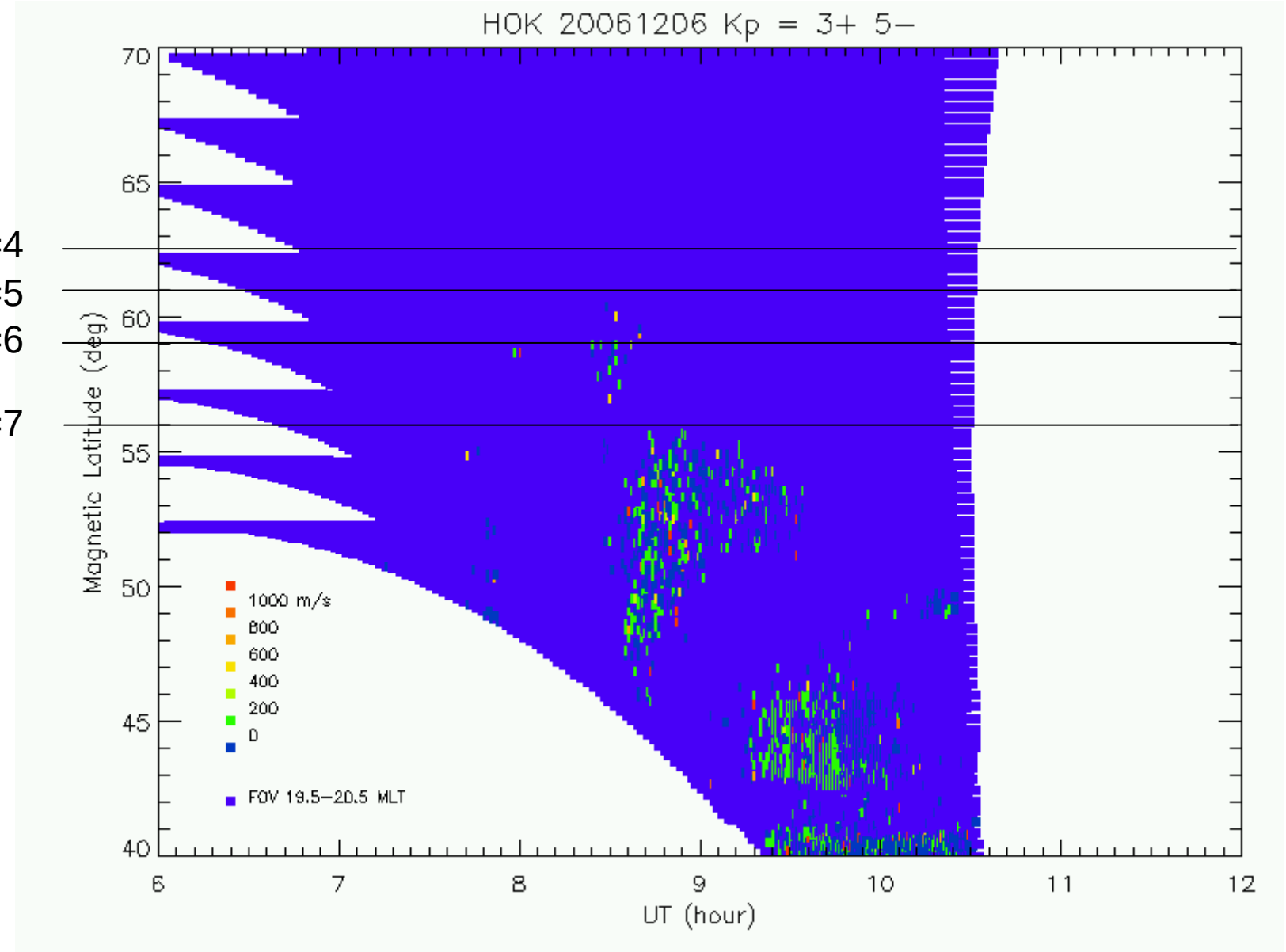
Purpose of this study

- Create the SAPS list (2006/12-2008/1)
  - 20 MLT “KEOGRAM” of westward drift
  - A total of 48 events of Kp > 3+
    - 30: No SAPS Kp = 3.66±0.80
    - 11: SAPS Kp = 3.77±1.14
    - 07: no data Kp = 3.46±0.72

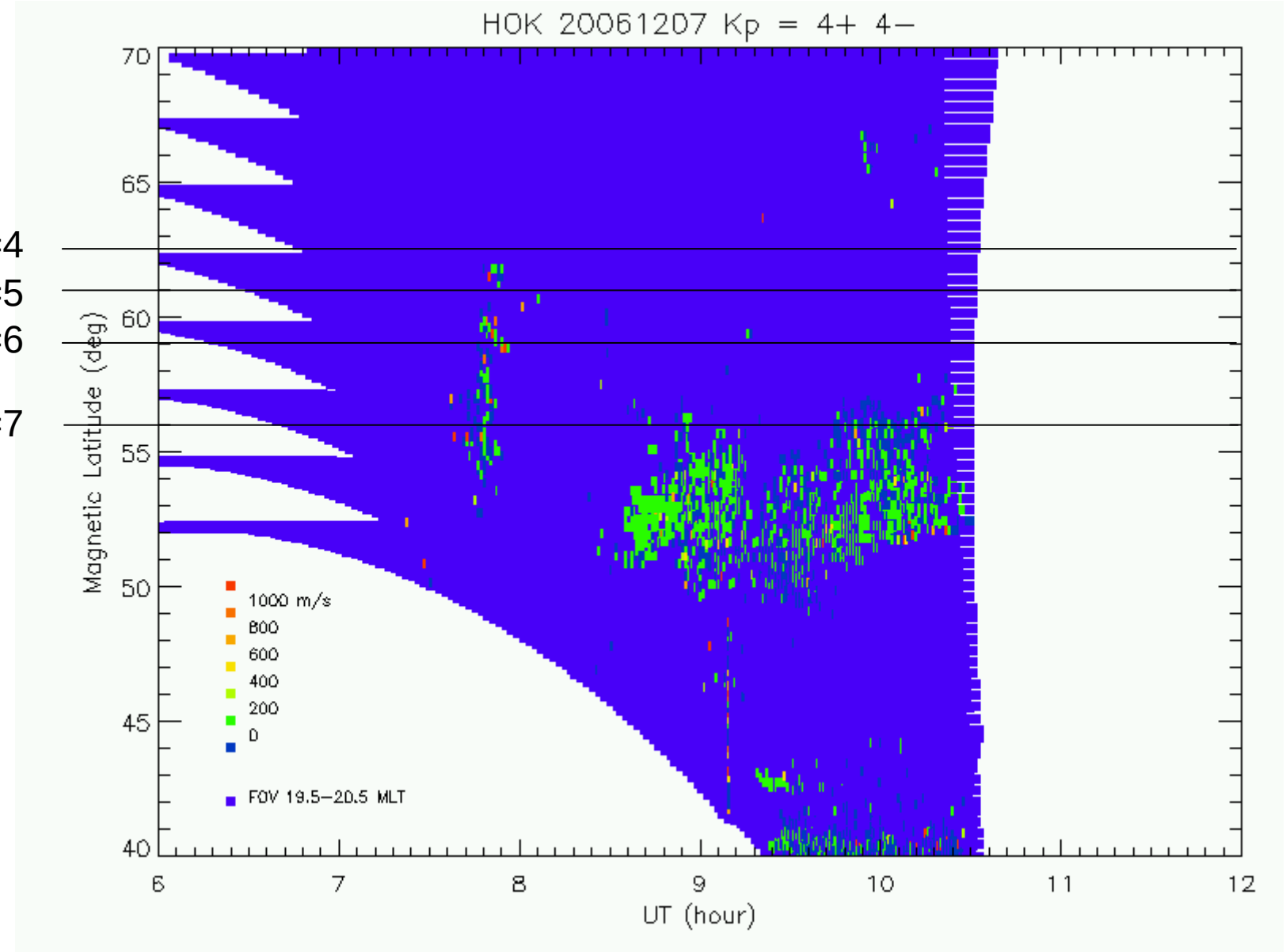


- To answer some fundamental questions
  - Is storm condition necessary for SAPS?
    - YES, it is. Not sufficient though.
  - How the rapid latitudinal motion of SAPS looks like?
    - Satellite observation never knows the rapid motion.
    - Rapid motion is identified during early main phase. (20July07)

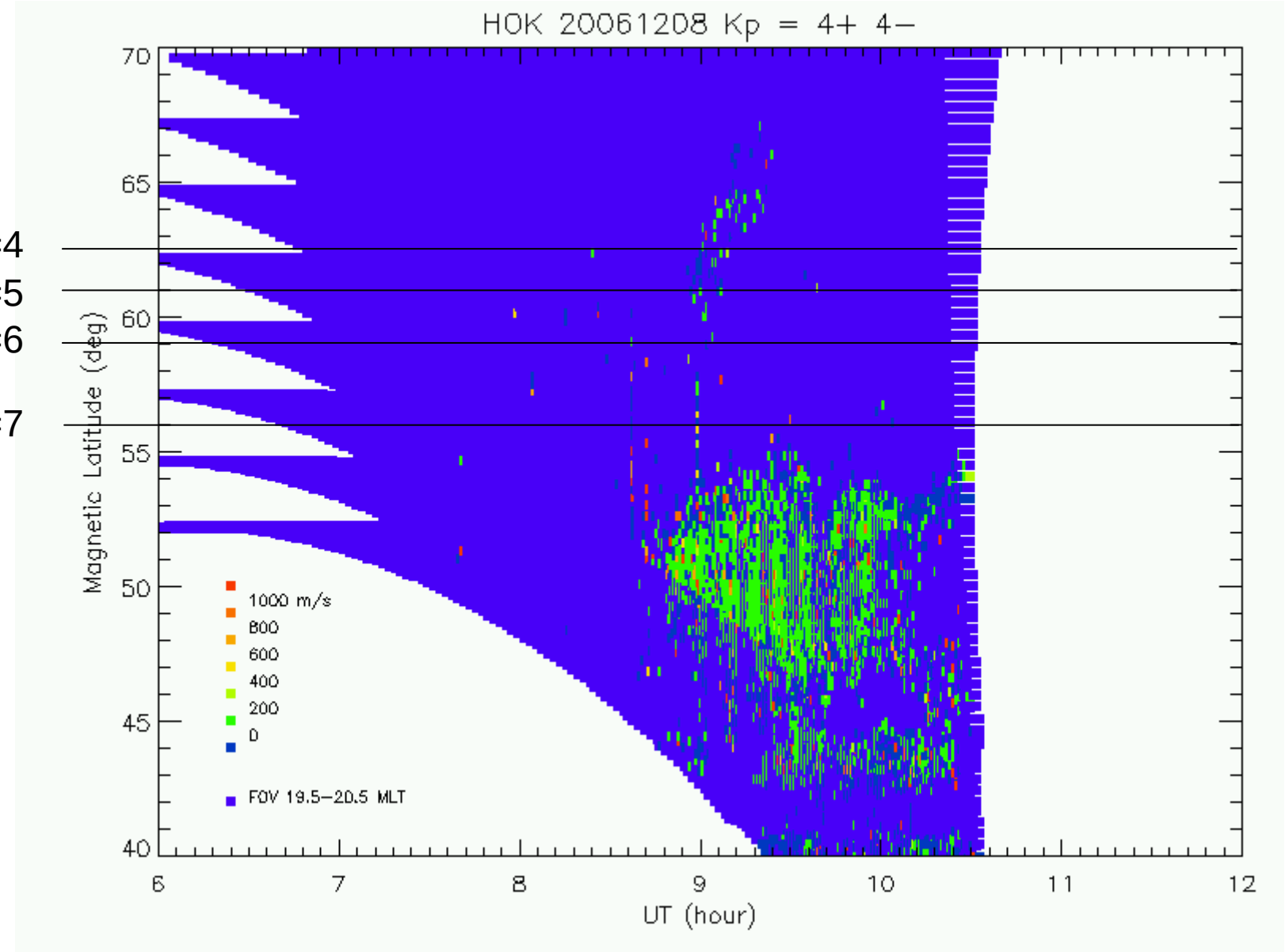
No SAPS 1


HOK 20061206 Kp = 3+ 5−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 2


HOK 20061207 Kp = 4+ 4−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 3


HOK 20061208 Kp = 4+ 4−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
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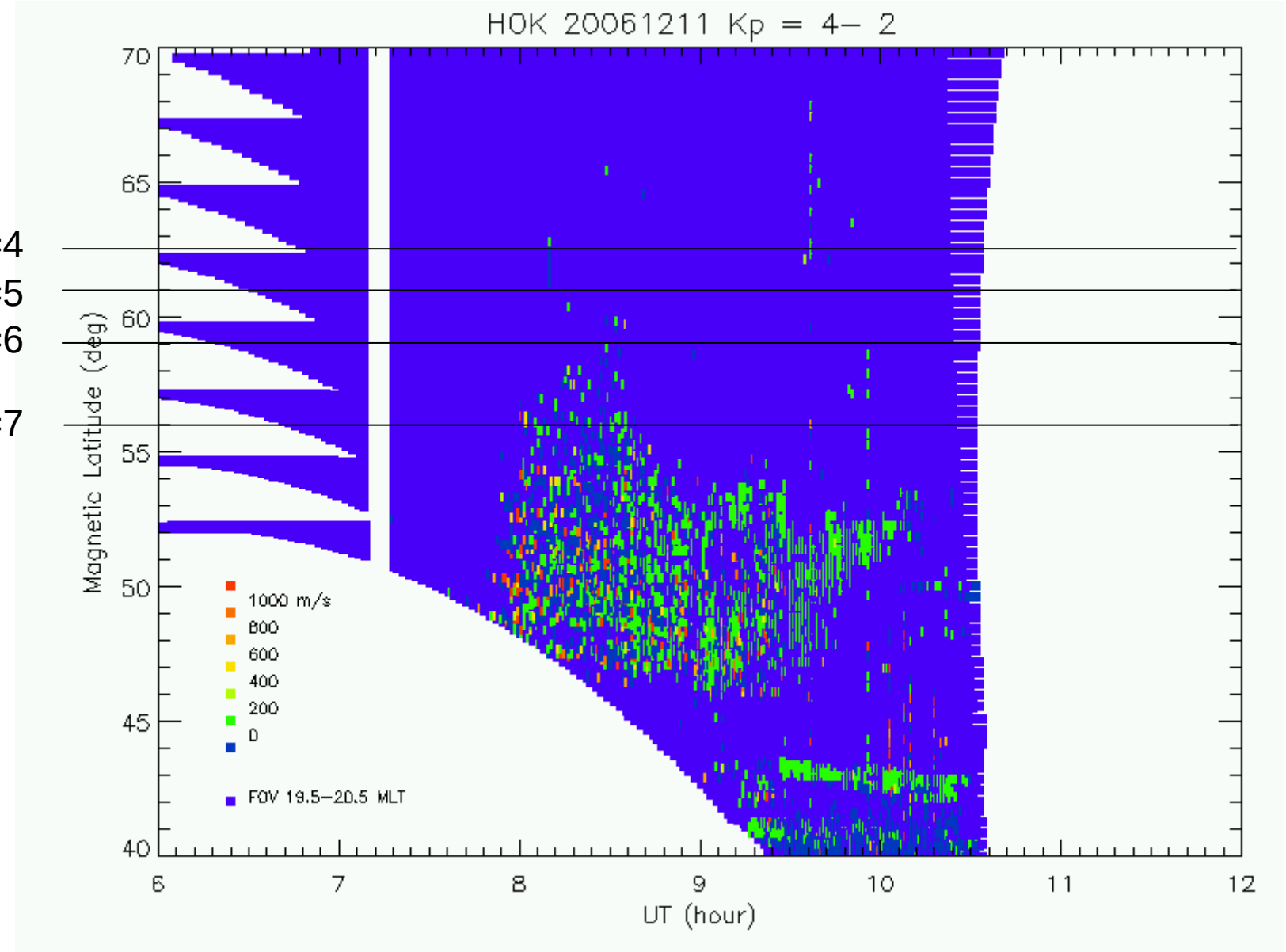
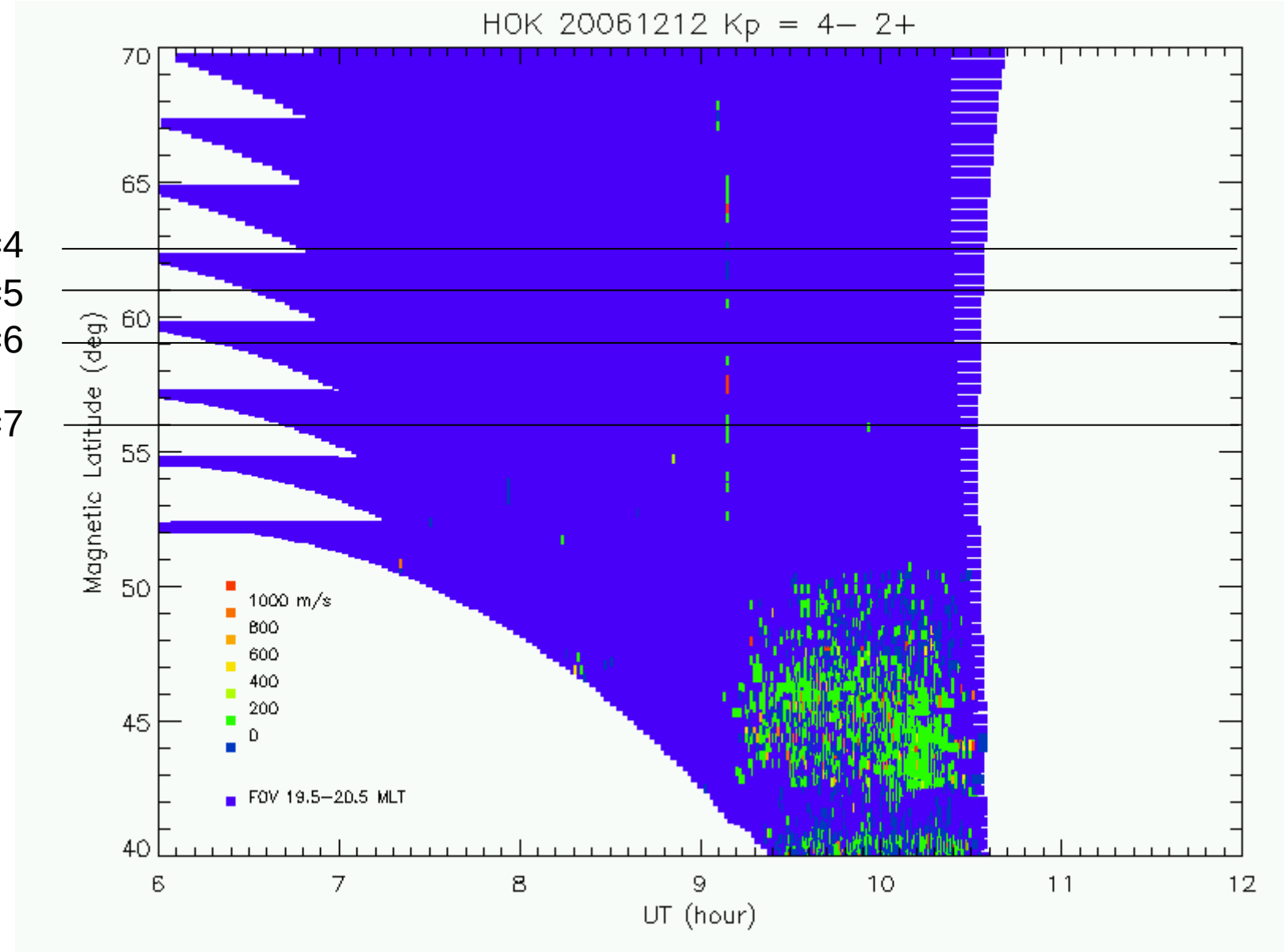
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 4

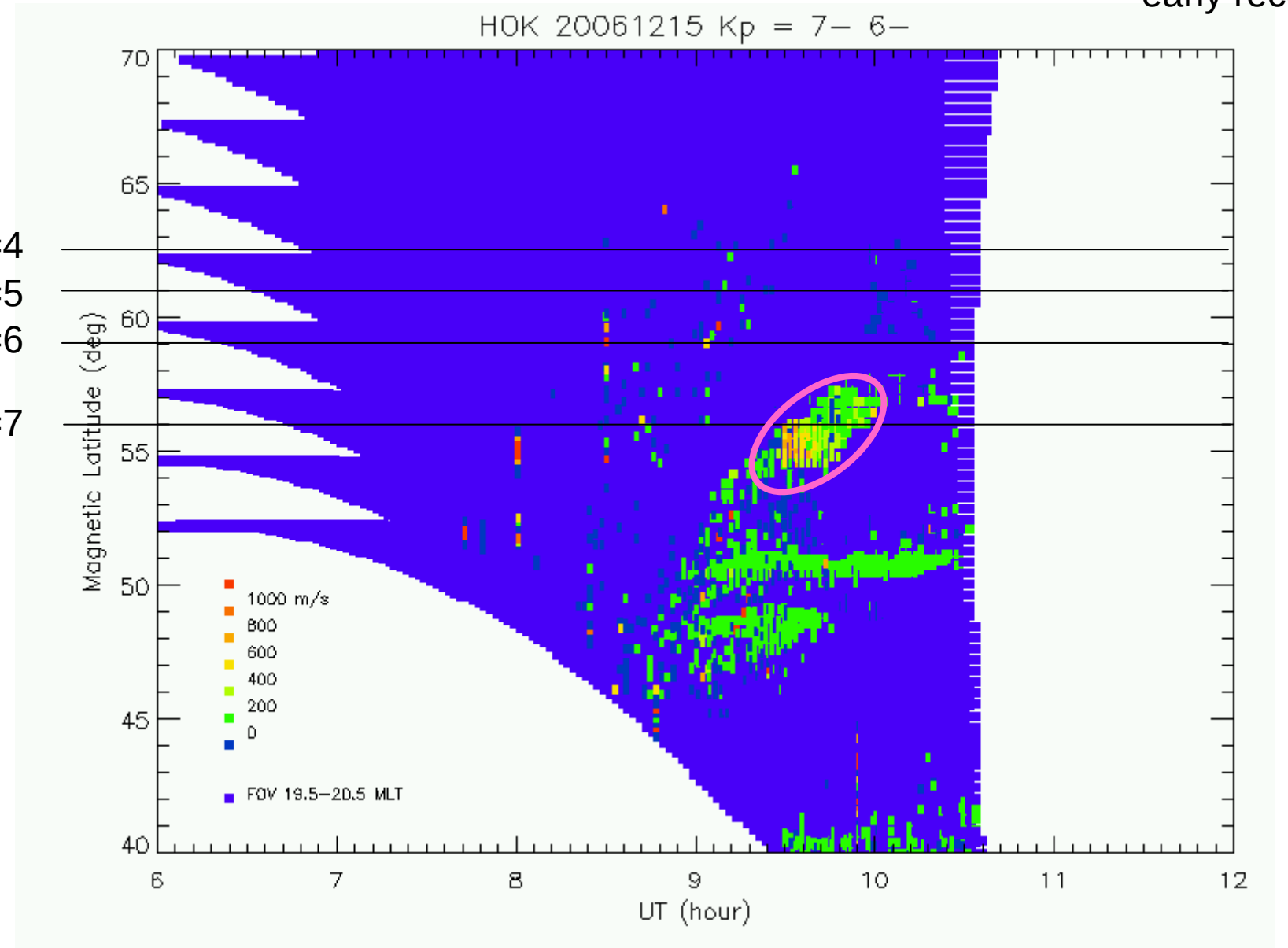

HOK 20061211 Kp = 4− 2
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 5

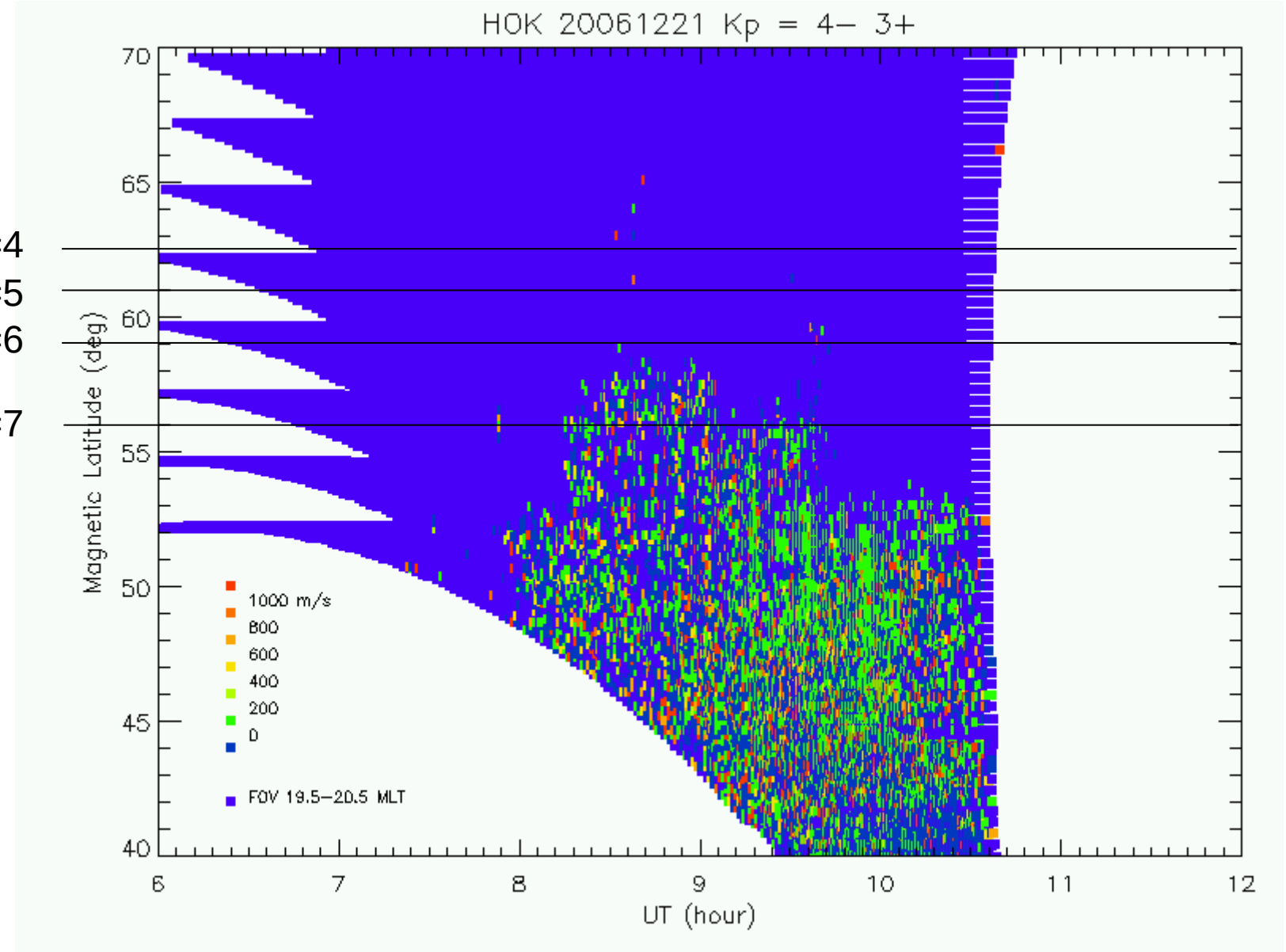

HOK 20061212 Kp = 4− 2+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

SAPS 1

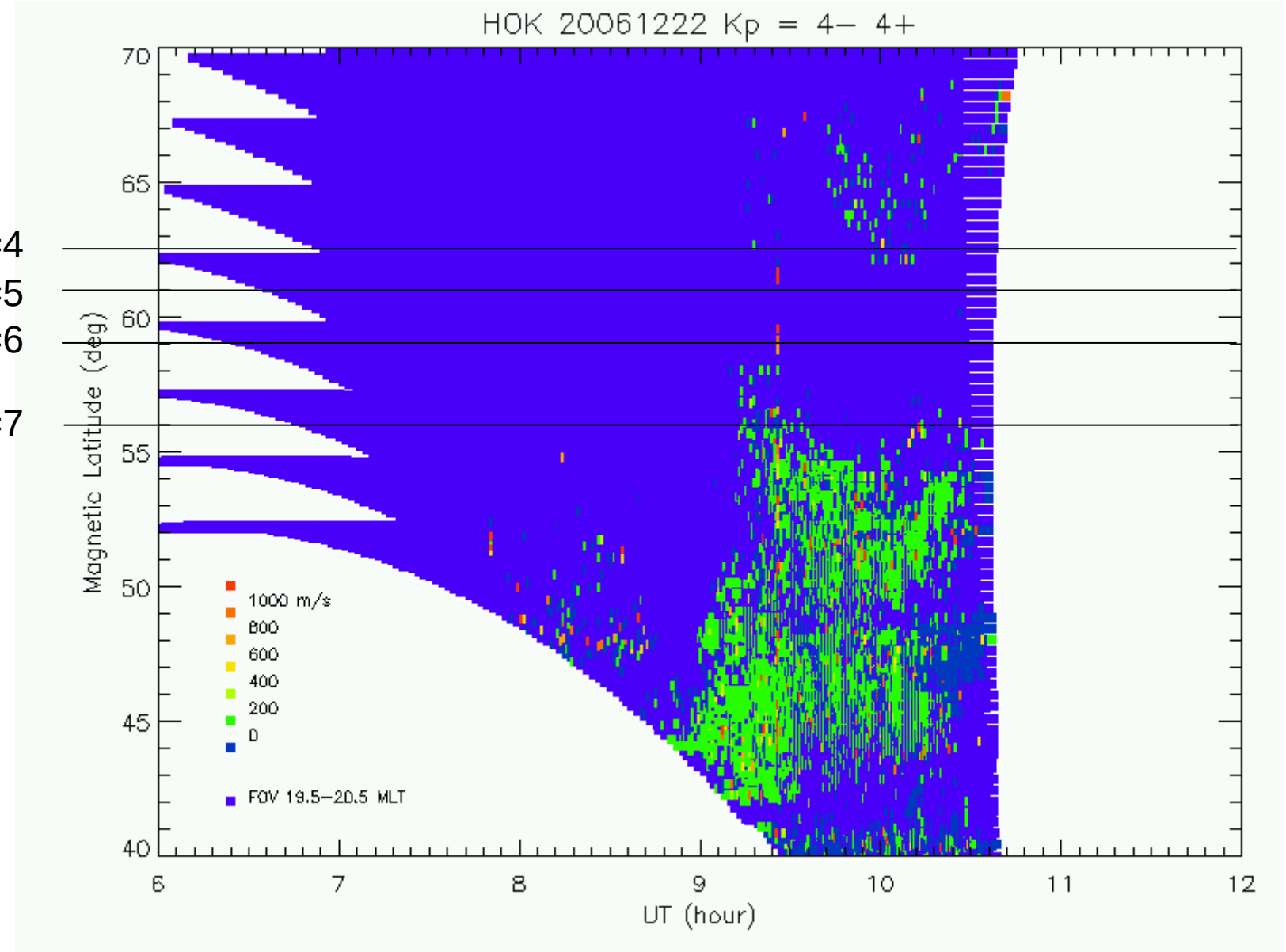
Dst = -138-146-138 -116-106-100
early recovery



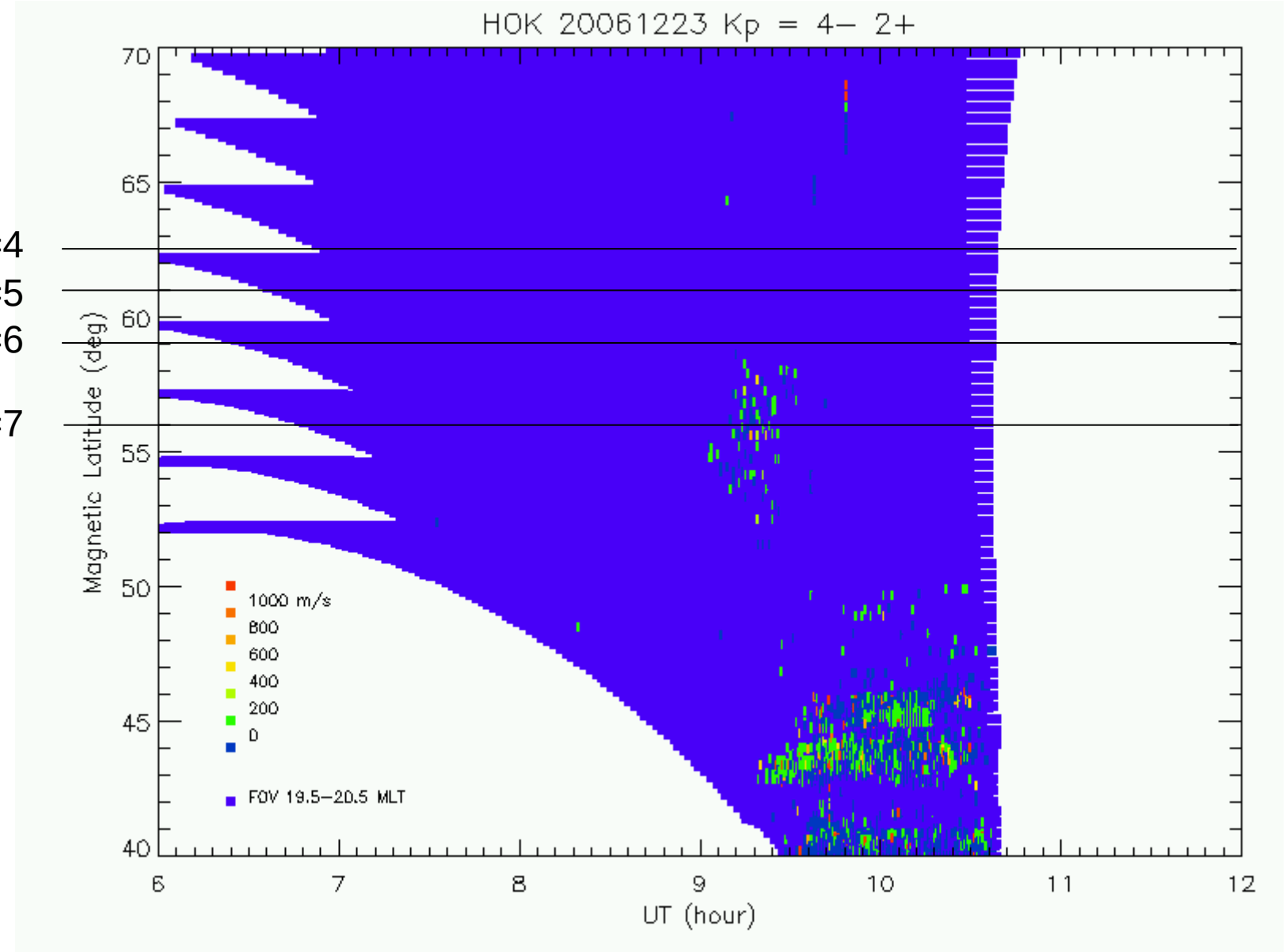
No SAPS 6


HOK 20061221 Kp = 4− 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

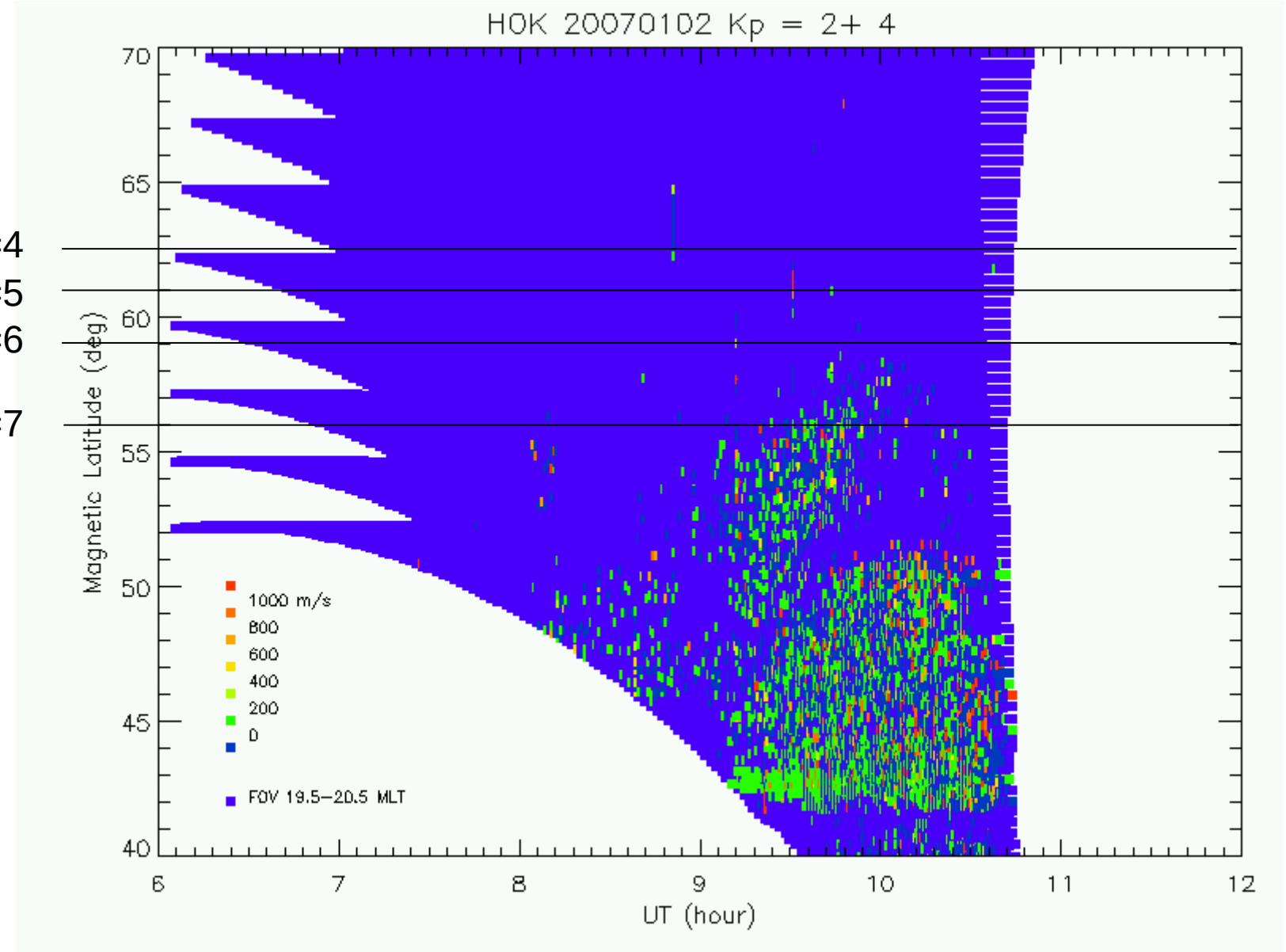
No SAPS 7


HOK 20061222 Kp = 4− 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

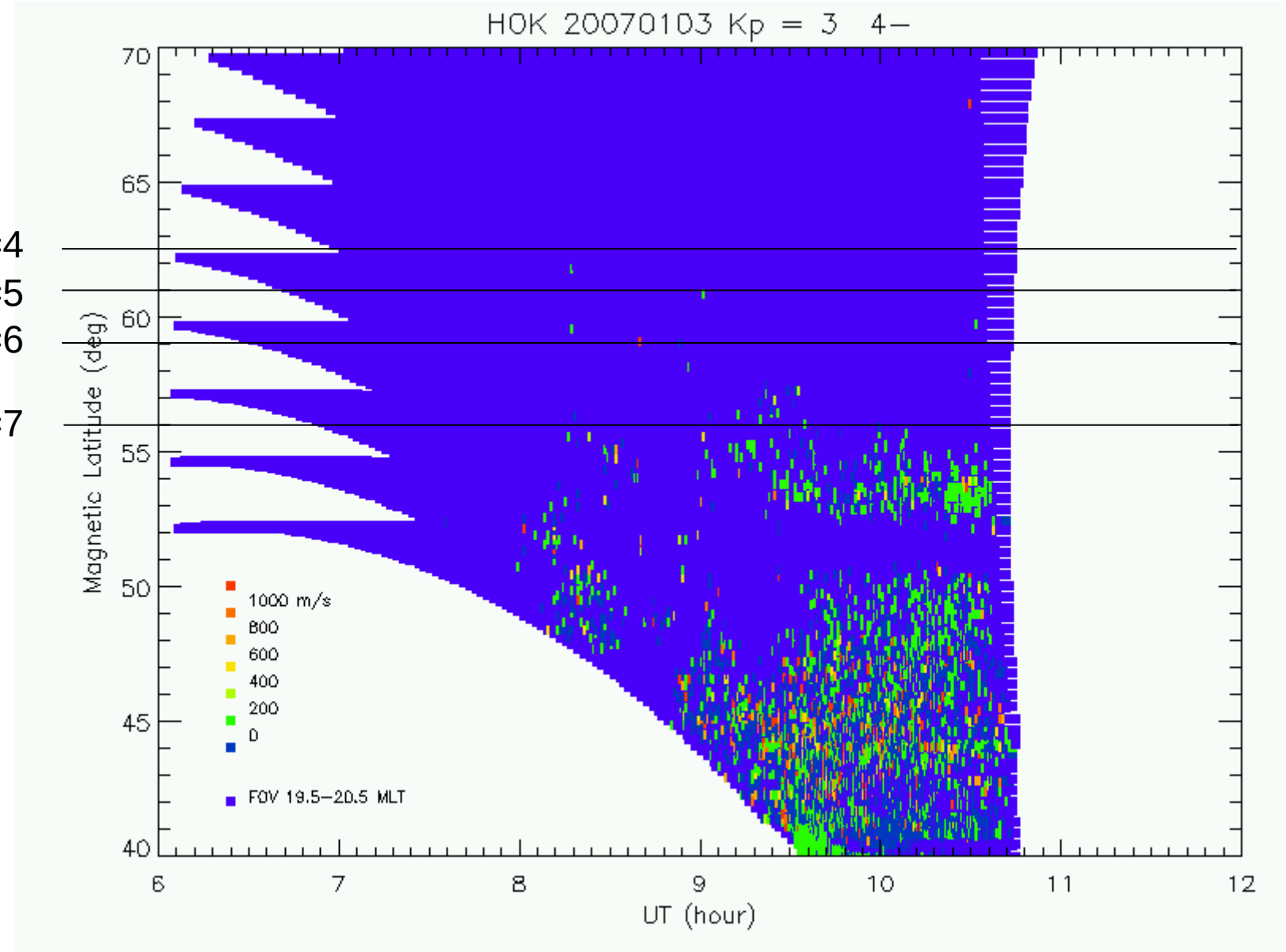
No SAPS 8


HOK 20061223 Kp = 4− 2+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

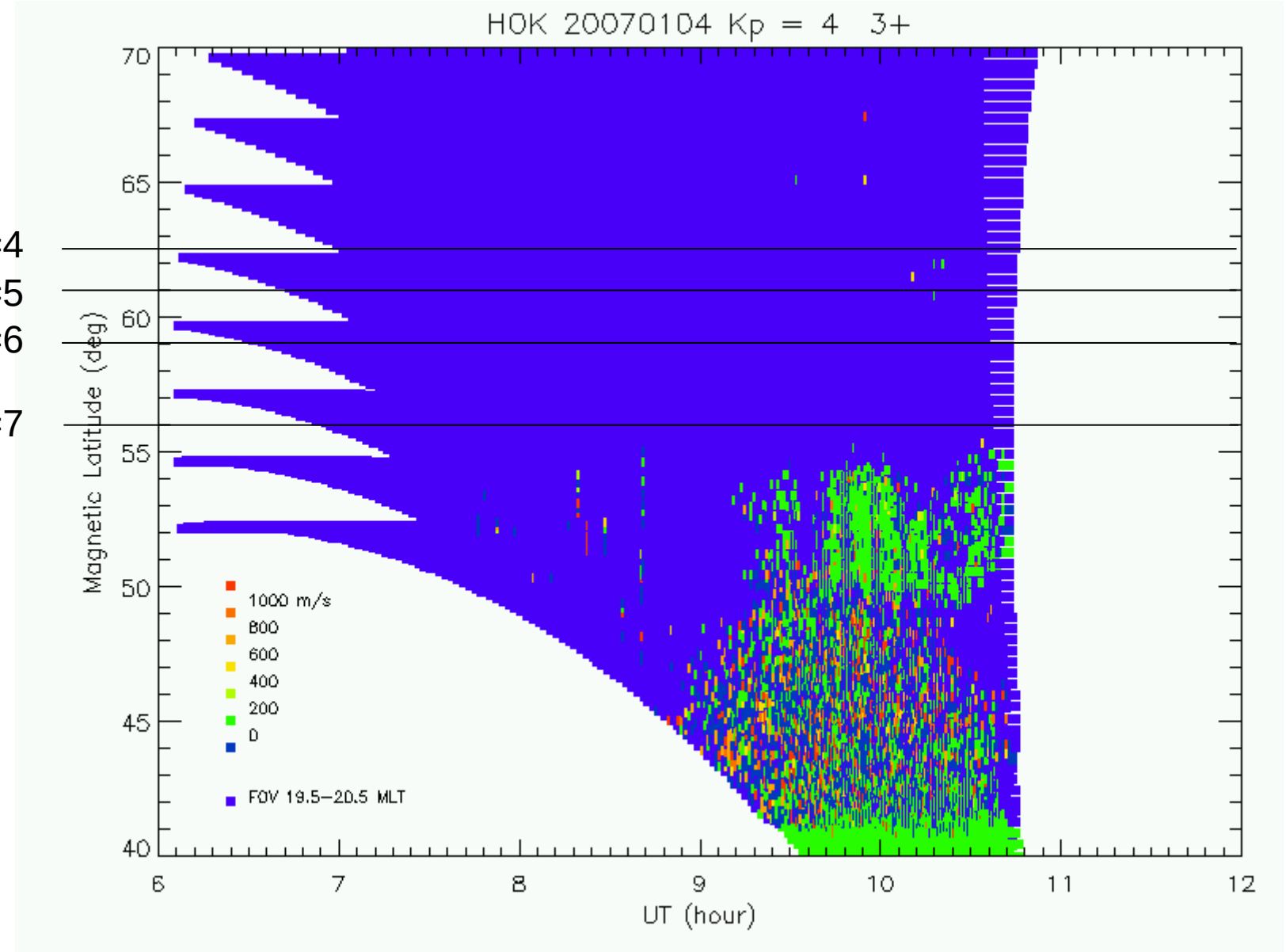
No SAPS 9


HOK 20070102 Kp = 2+ 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

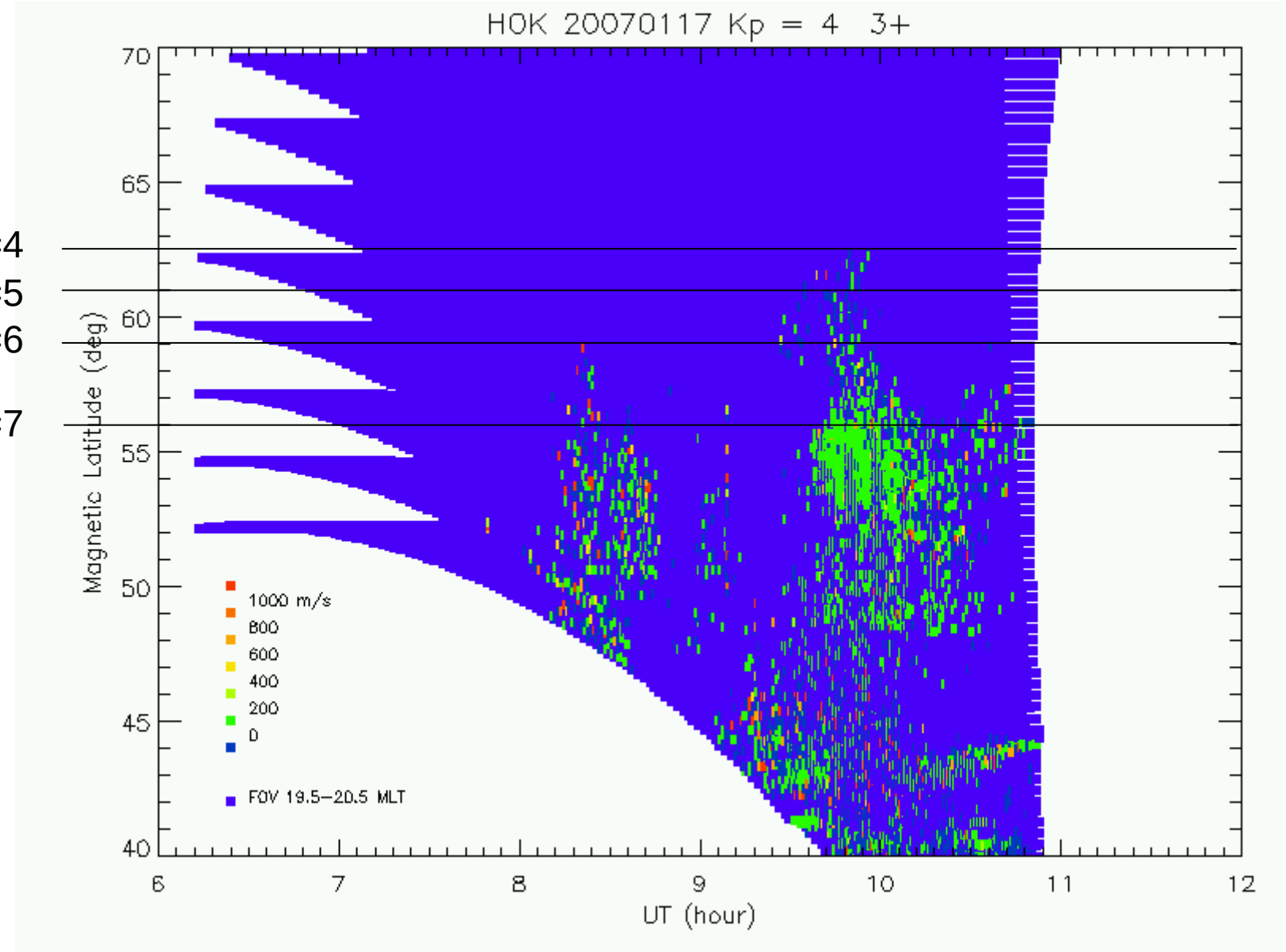
No SAPS 10


HOK 20070103 Kp = 3 4−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

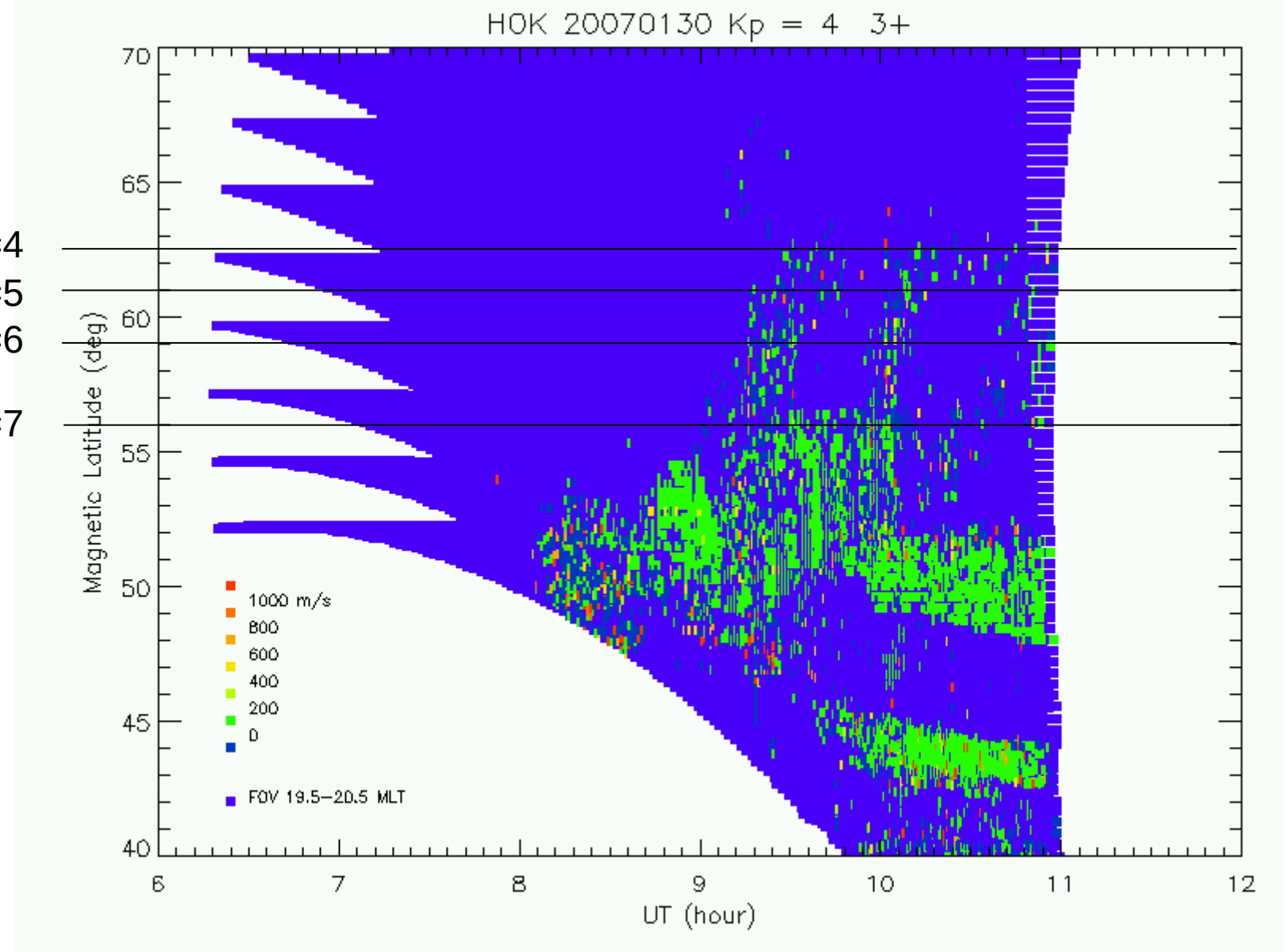
No SAPS 11


HOK 20070104 Kp = 4 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

No SAPS 12

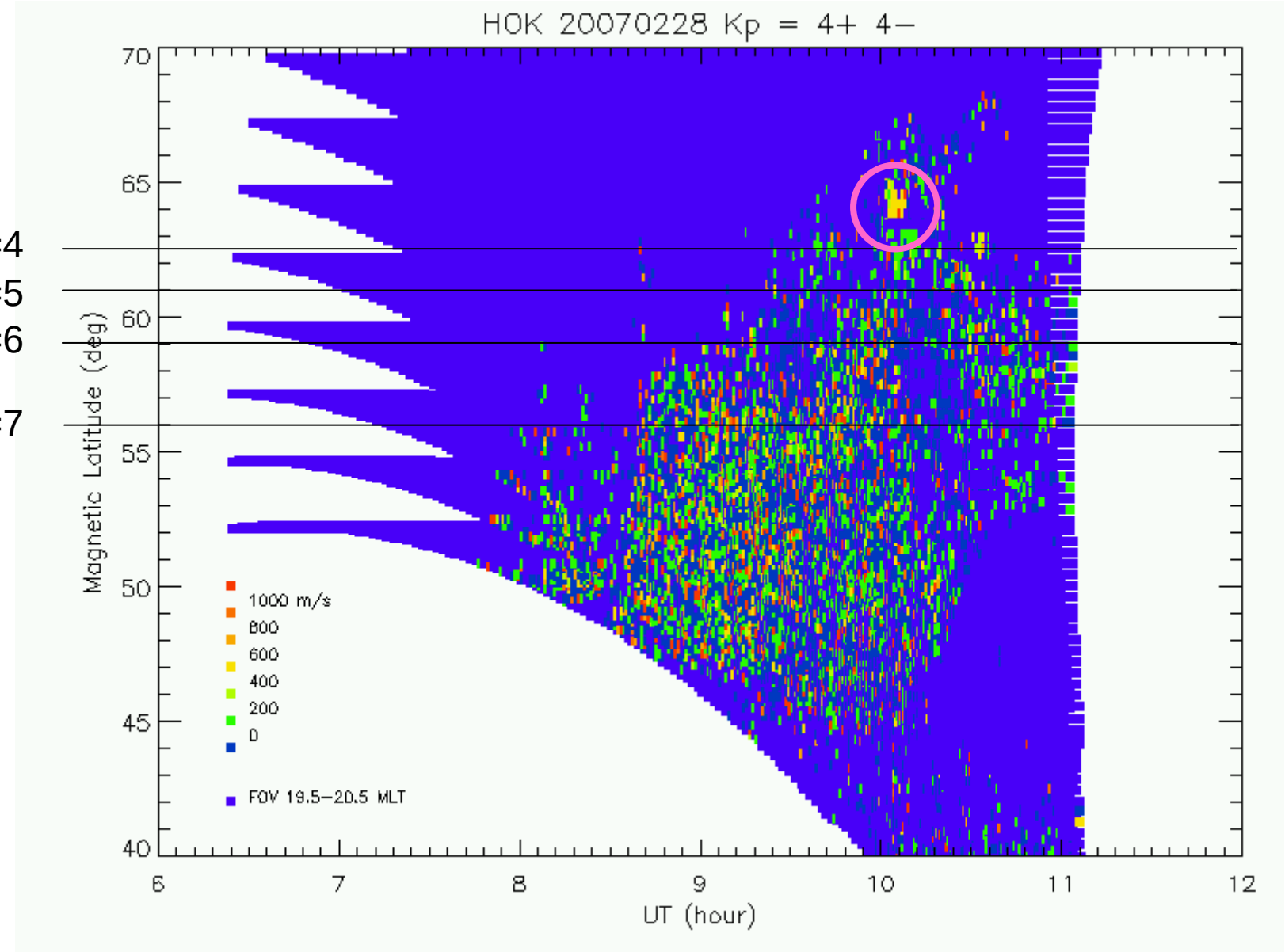

HOK 20070117 Kp = 4 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

No SAPS 13

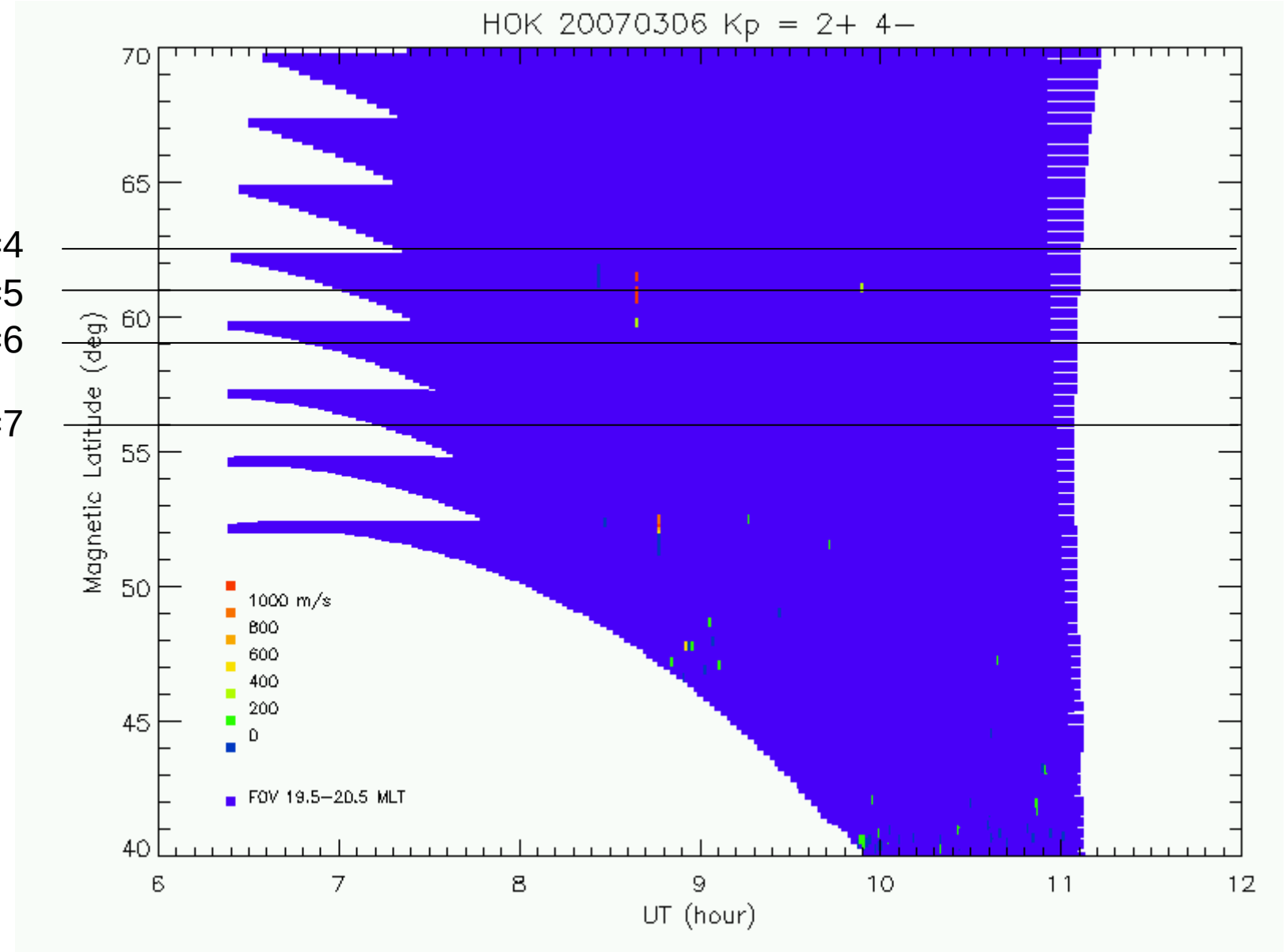

HOK 20070130 Kp = 4 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

SAPS 2, possible

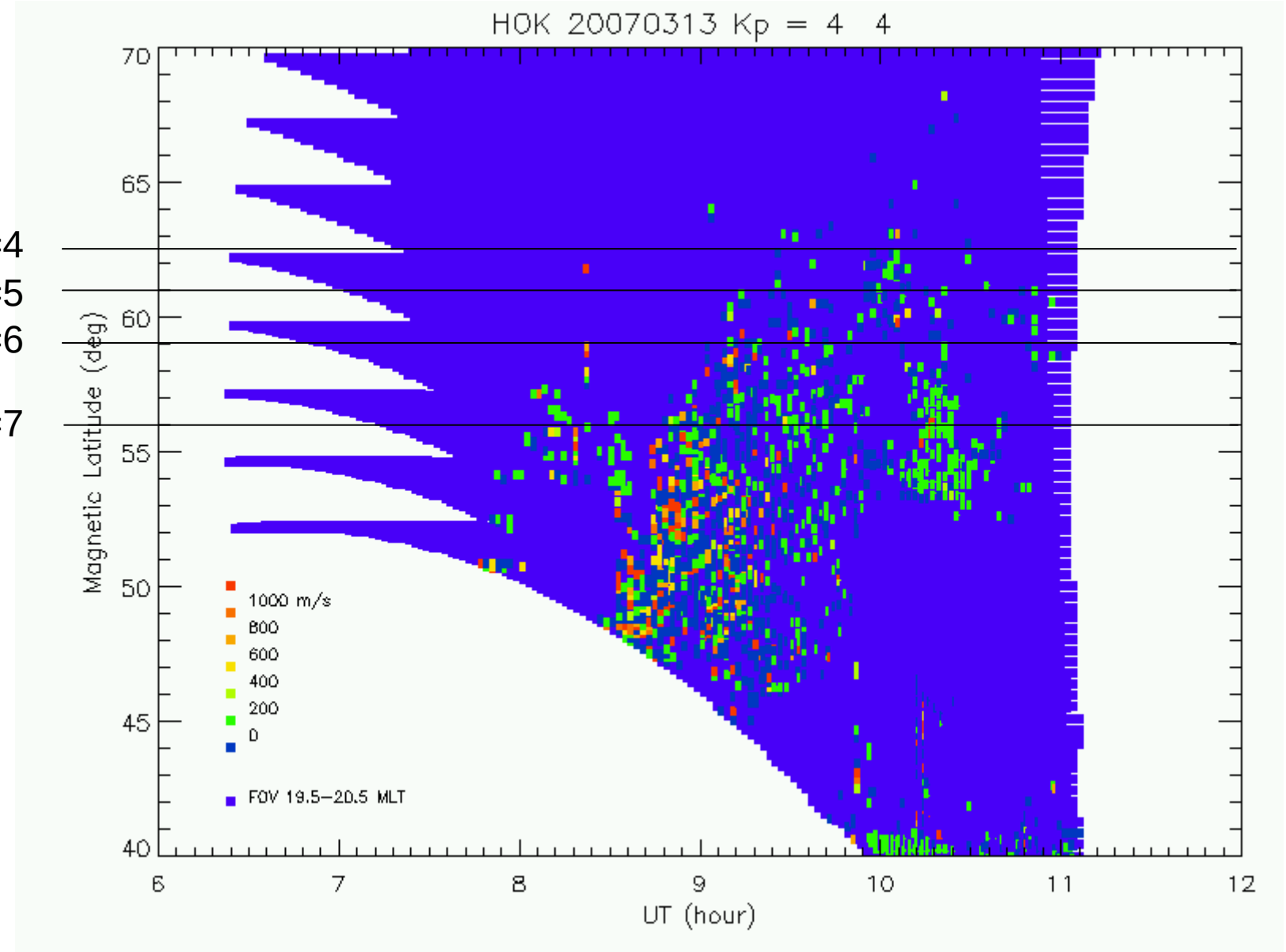
Dst = -32 -29 -22 -17 -31 -39
main



No SAPS 14

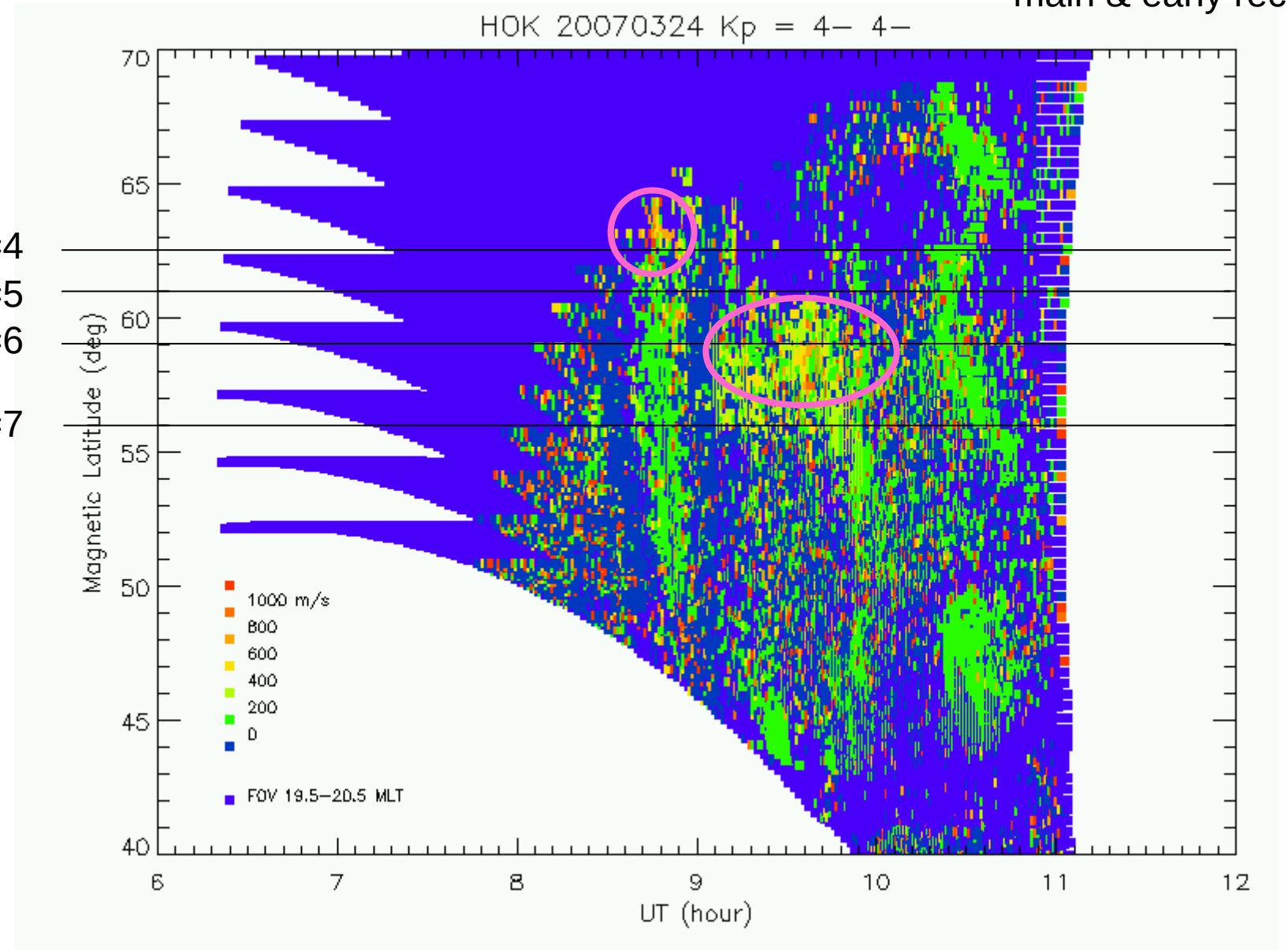

HOK 20070306 Kp = 2+ 4−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
UT (hour)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 15


HOK 20070313 Kp = 4 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

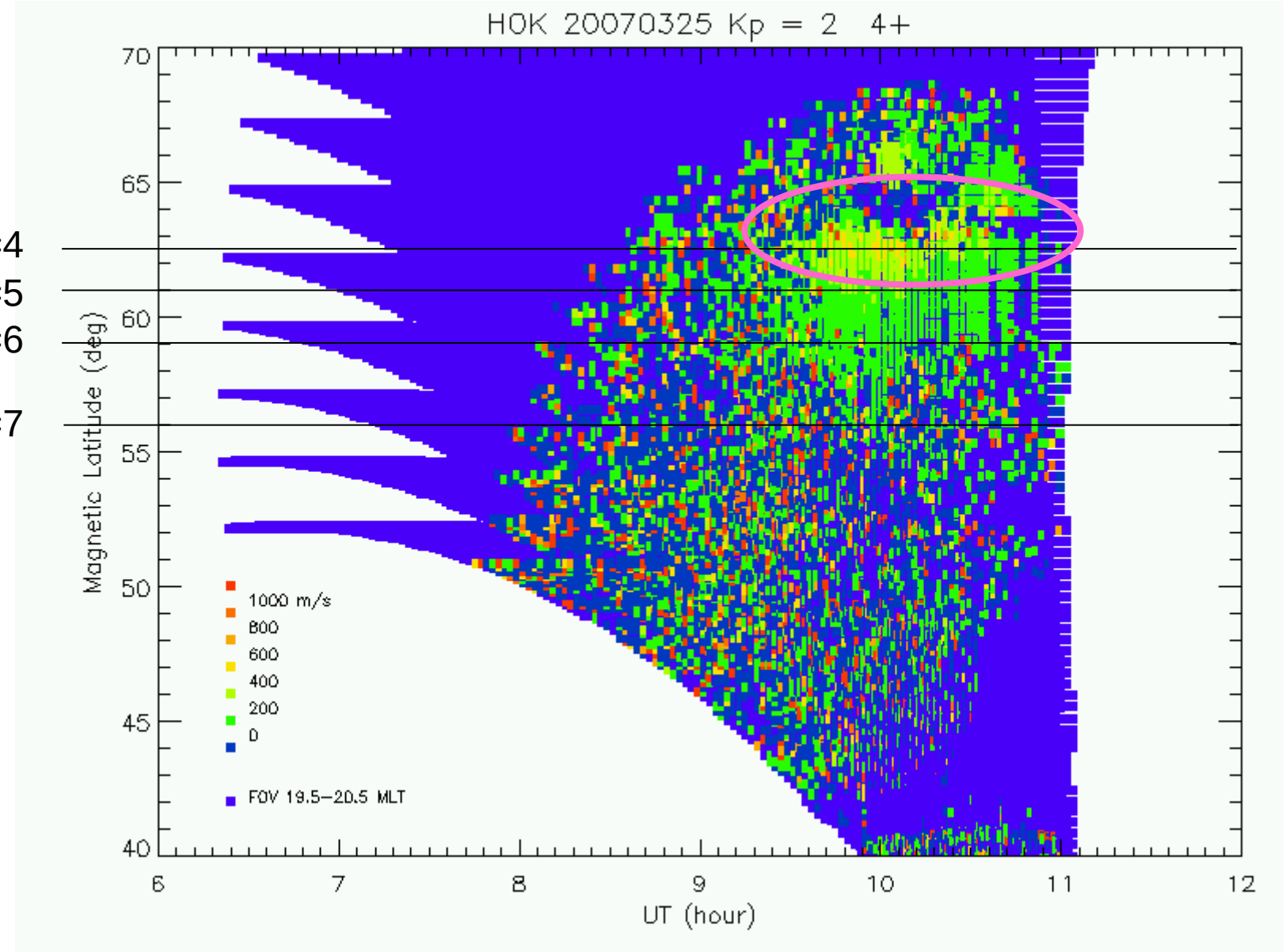
SAPS 3

Dst = -54 -63 -71 -69 -63 -60
main & early recovery



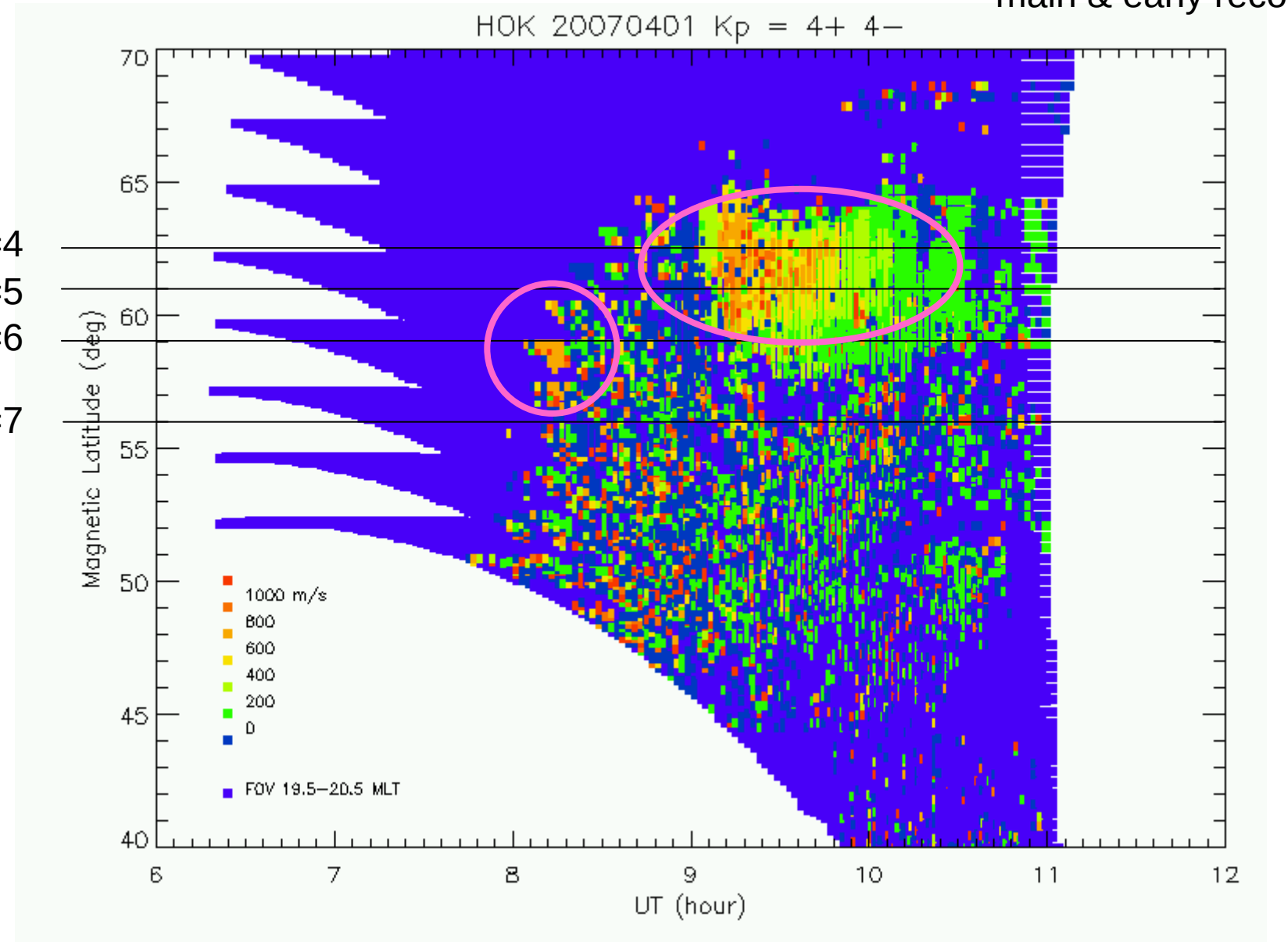
SAPS 4

Dst = -11 -9 -10 -21 -32 -27
main

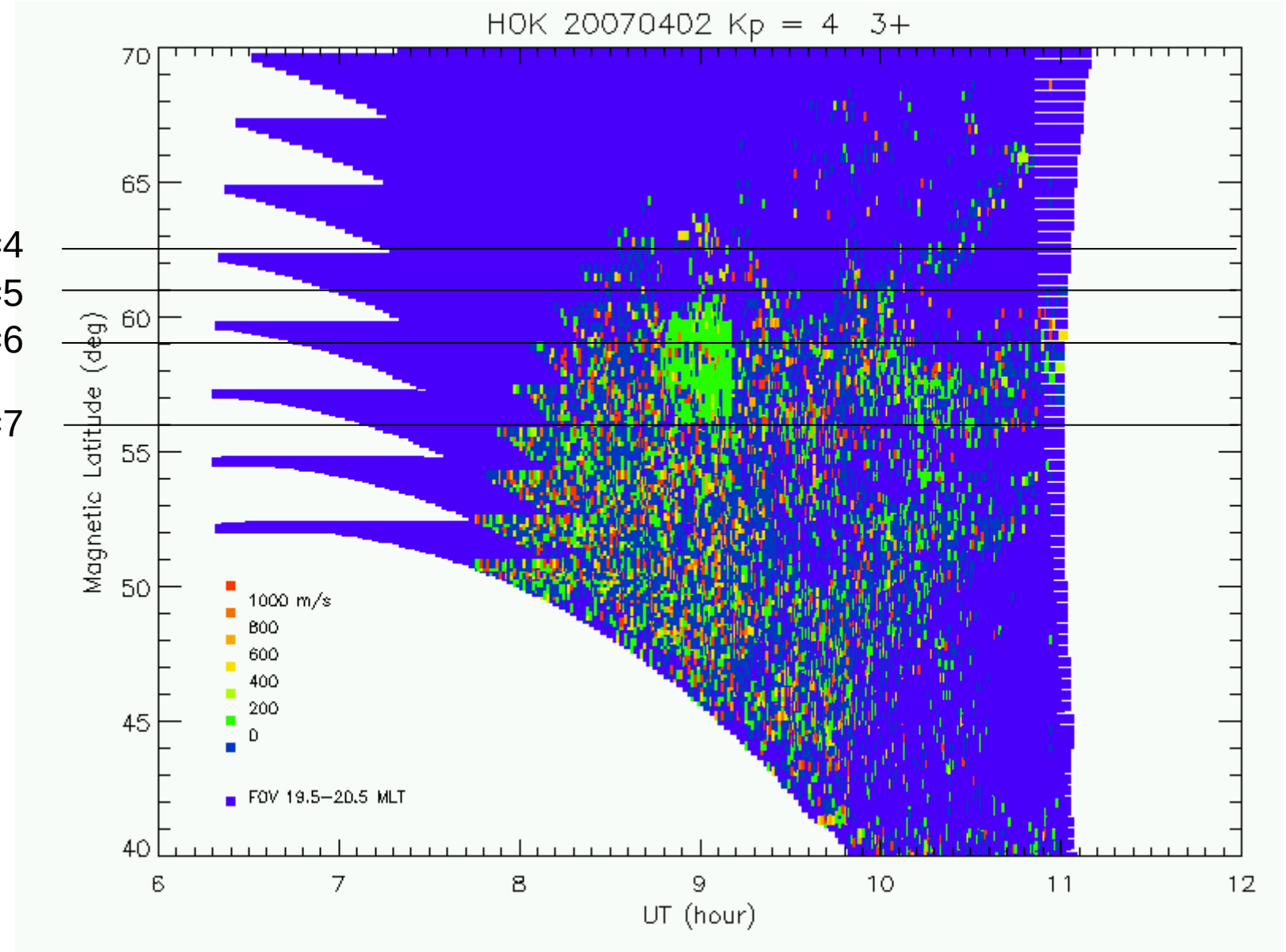


SAPS 5

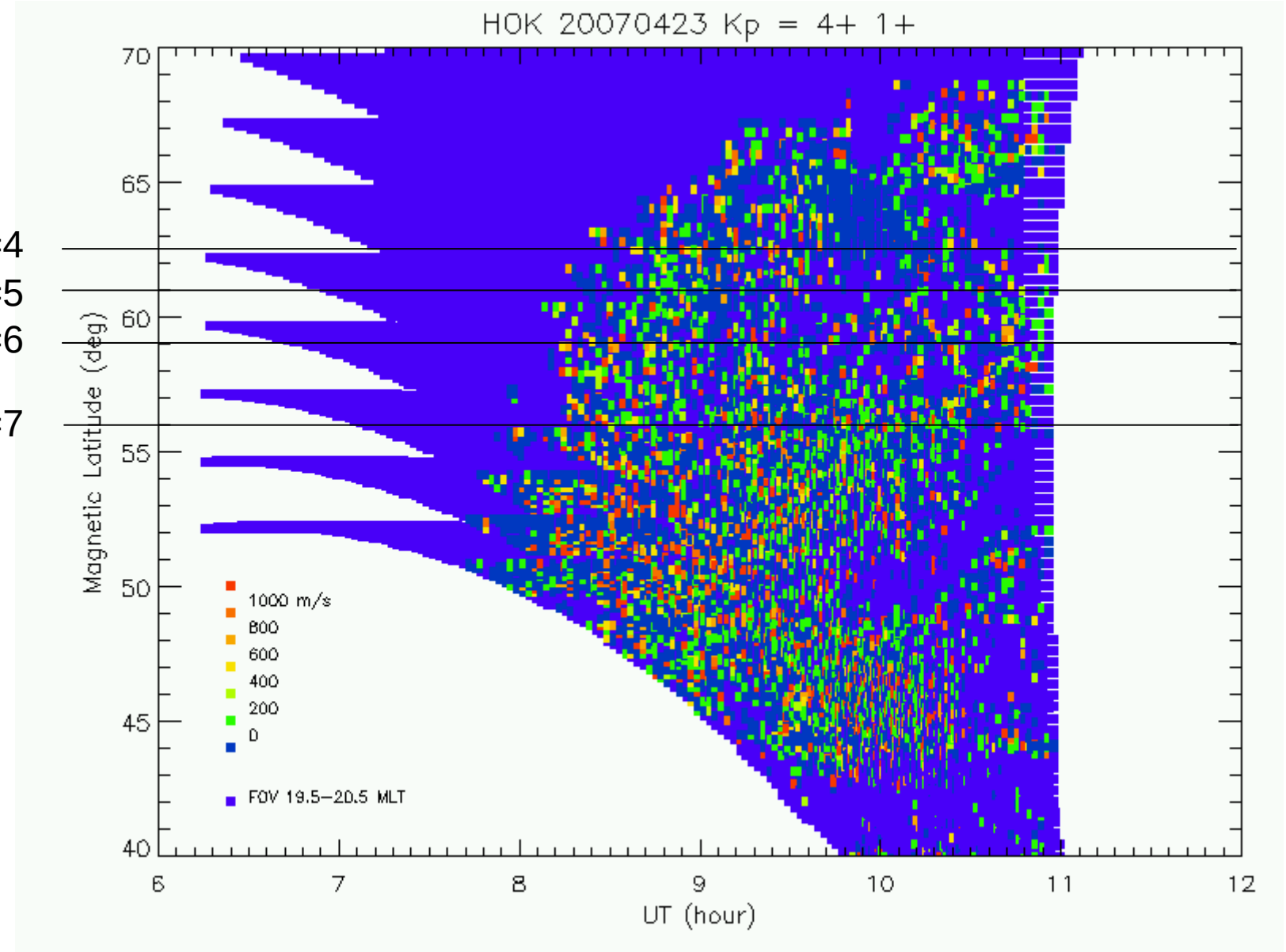
Dst = -40 -61 -63 -42 -28 -25
main & early recovery



No SAPS 16

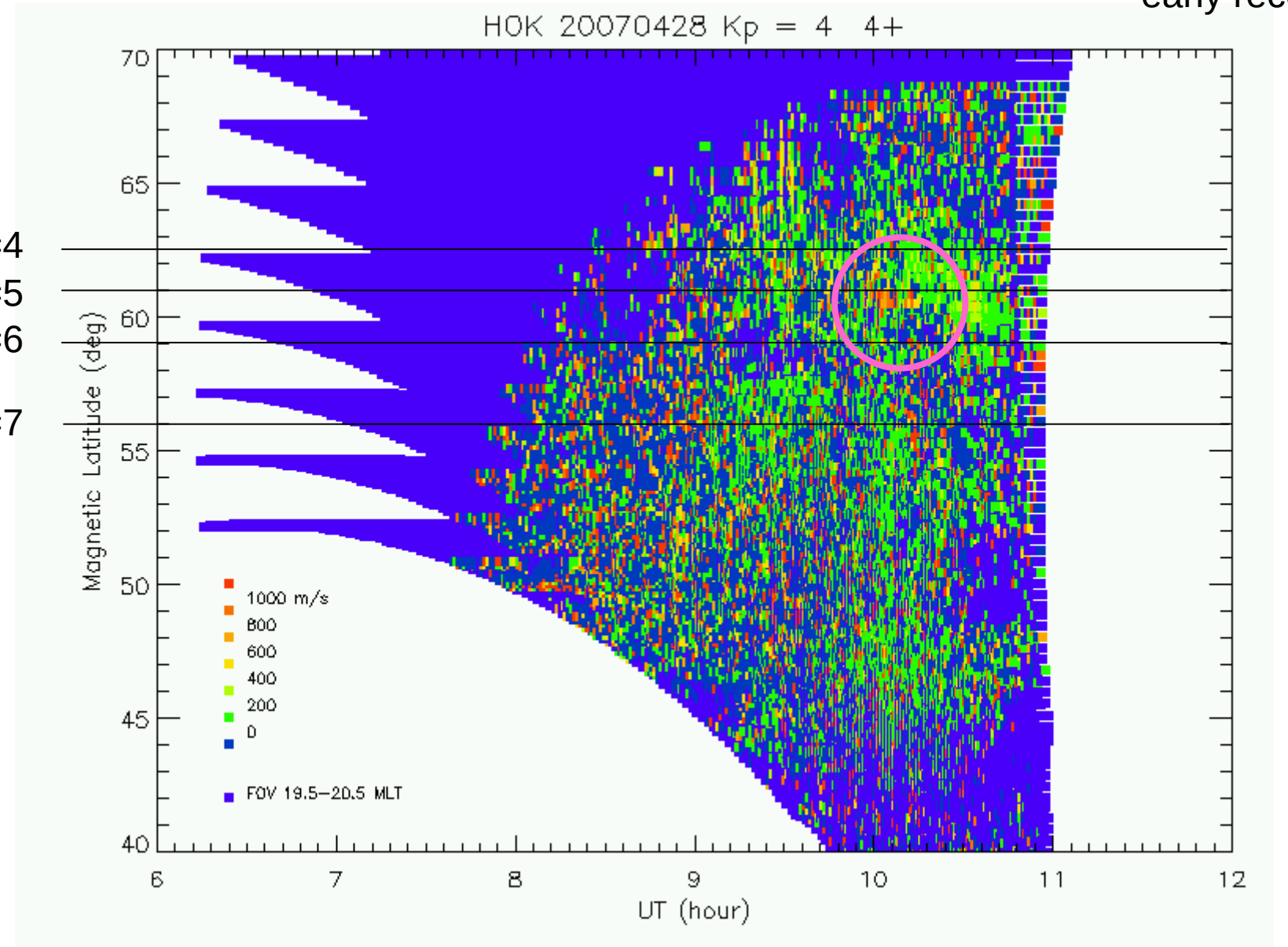

HOK 20070402 Kp = 4 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

No SAPS 17, E-flow?

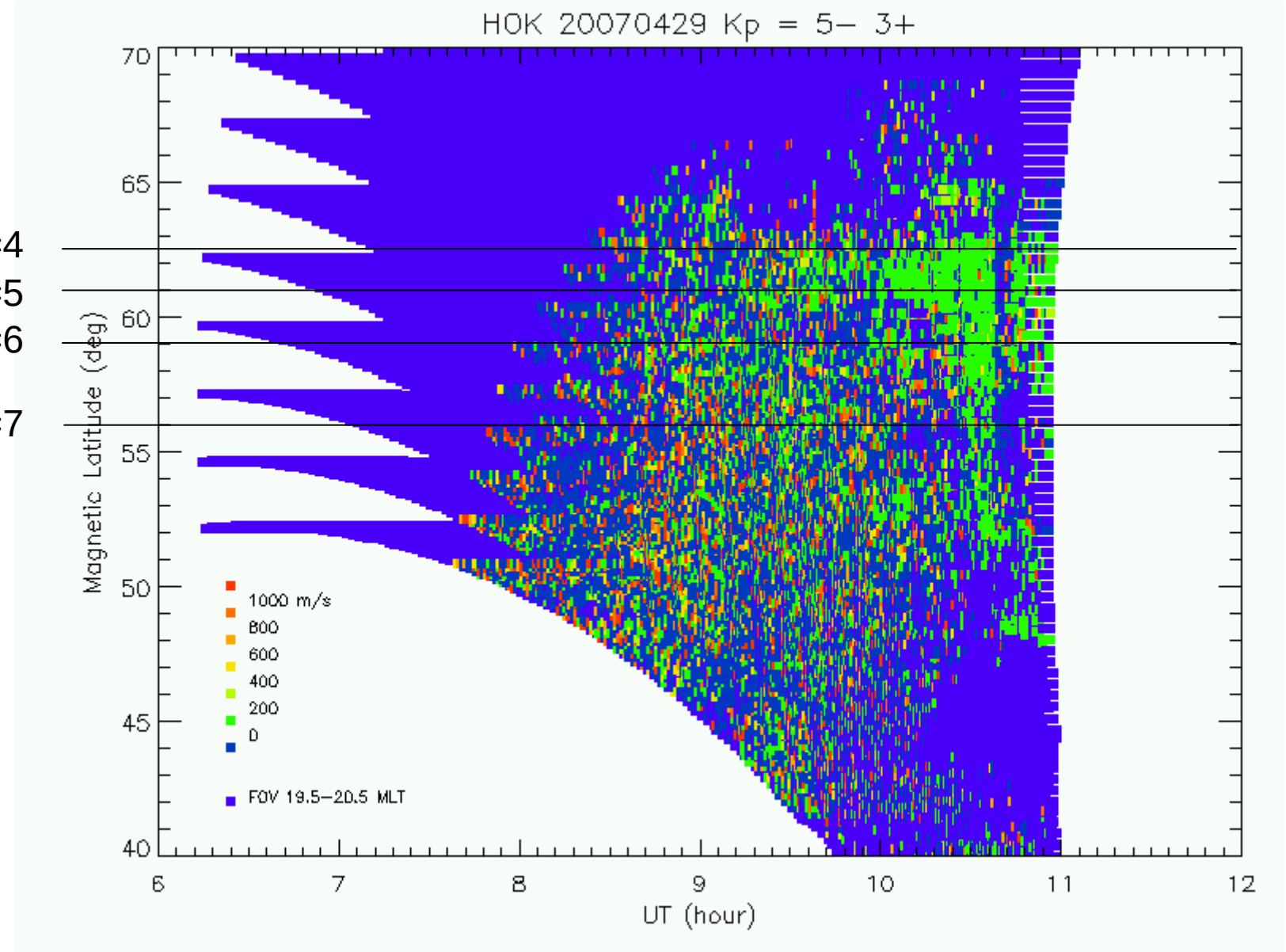


SAPS 6, possible

Dst = -48 -56 -31 -32 -27 -20
early recovery

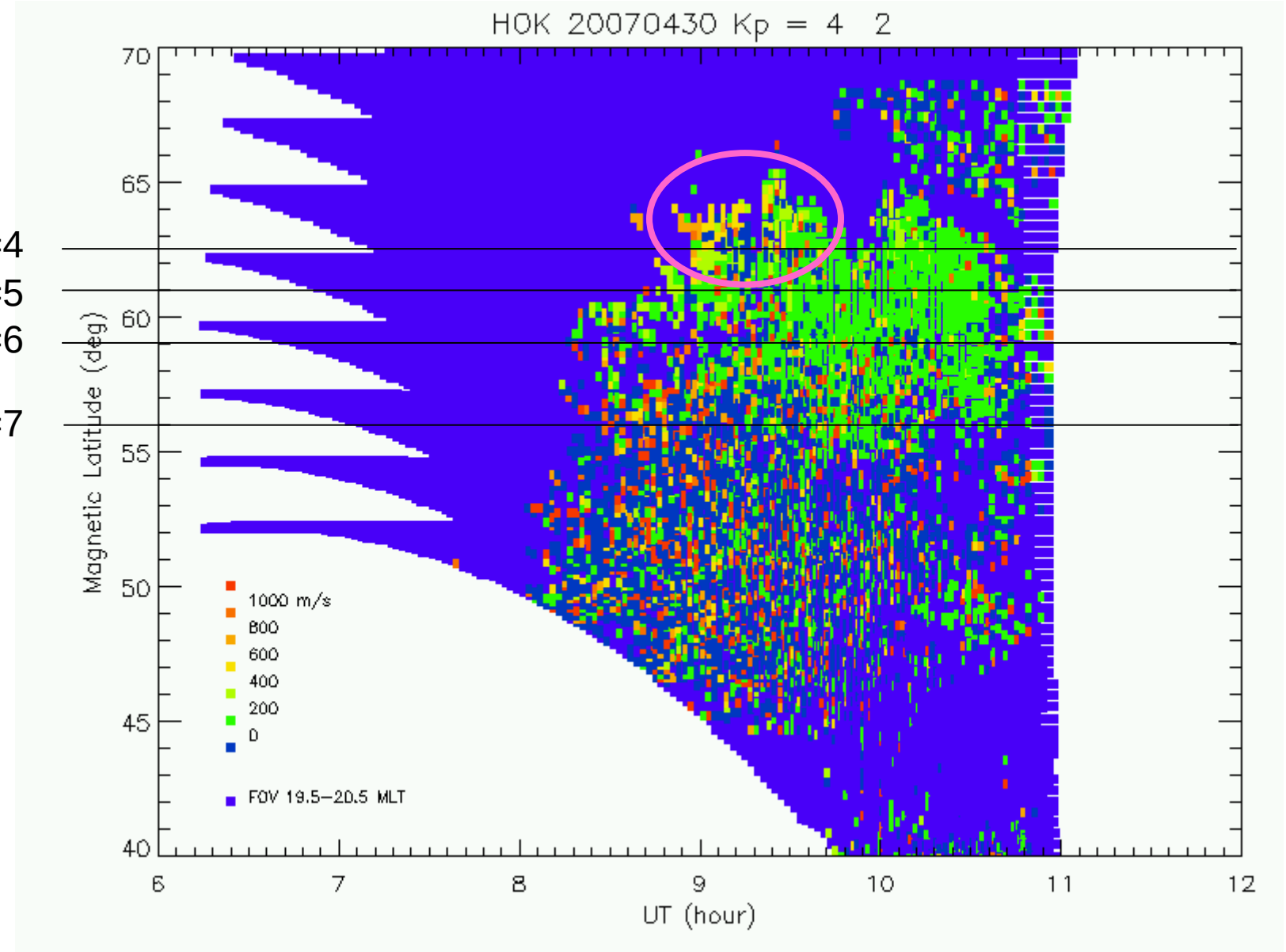


No SAPS 18

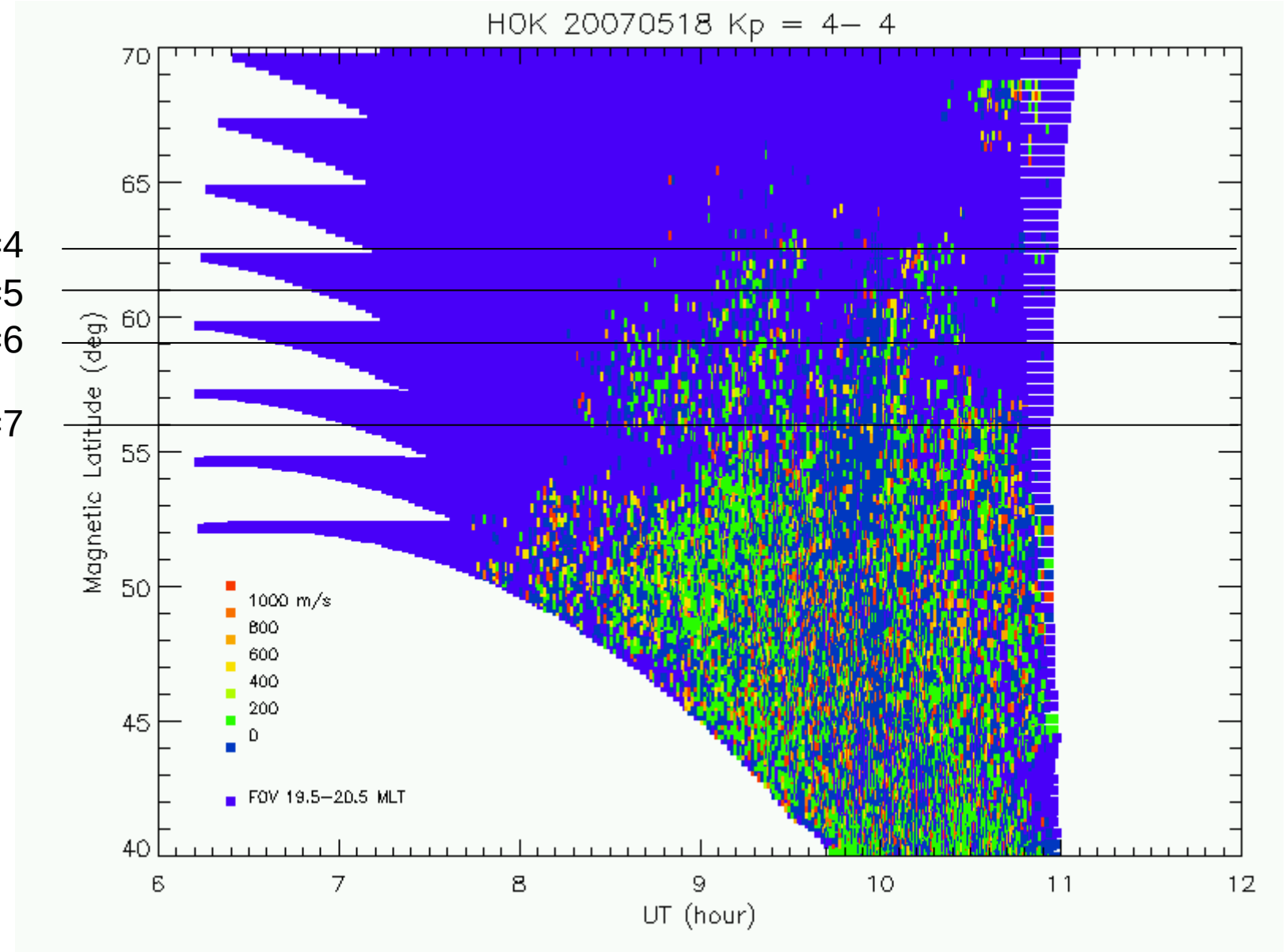

HOK 20070429 Kp = 5− 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

SAPS 7, possible

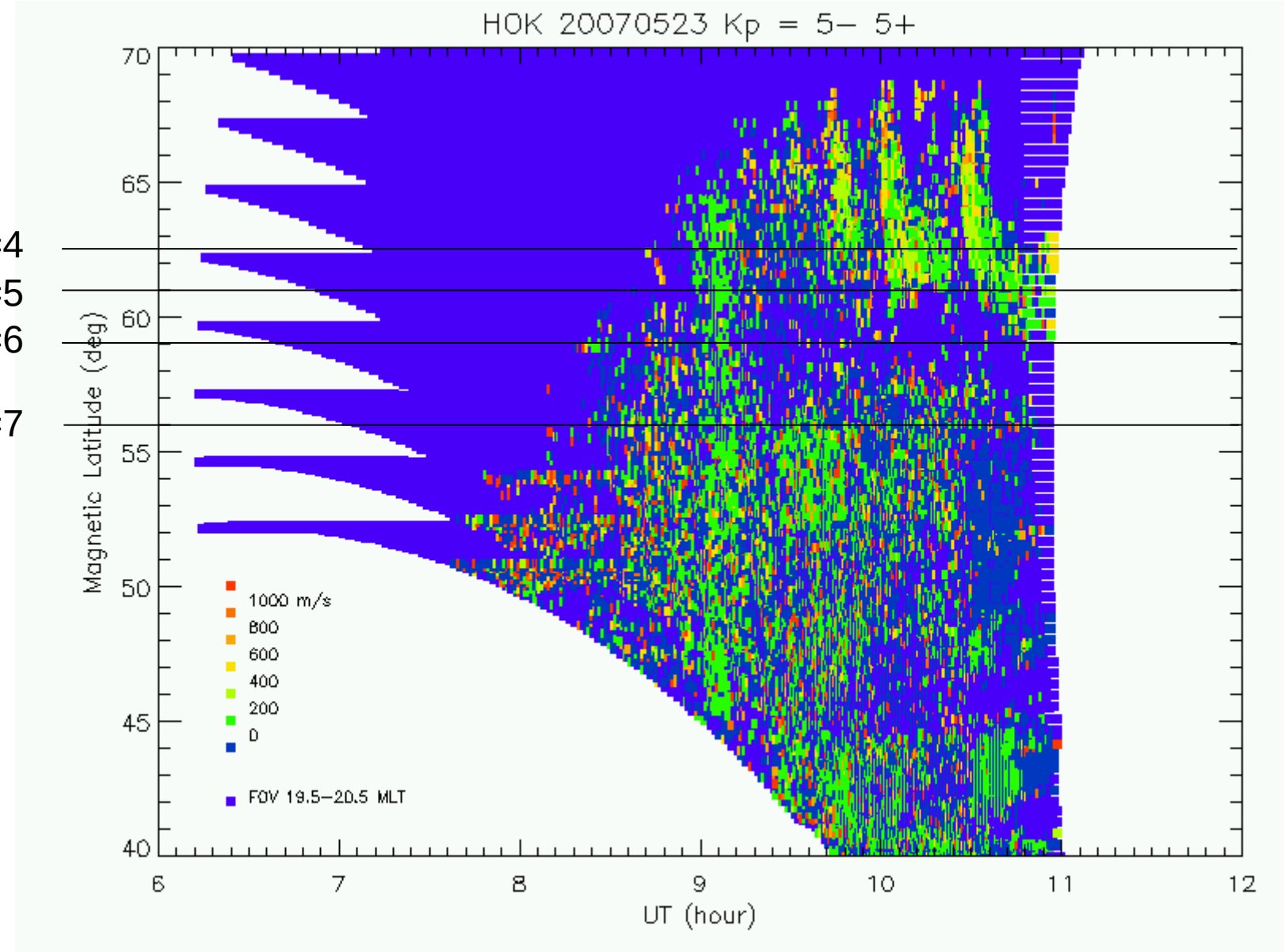
Dst = -33 -36 -43 -43 -33 -25
main



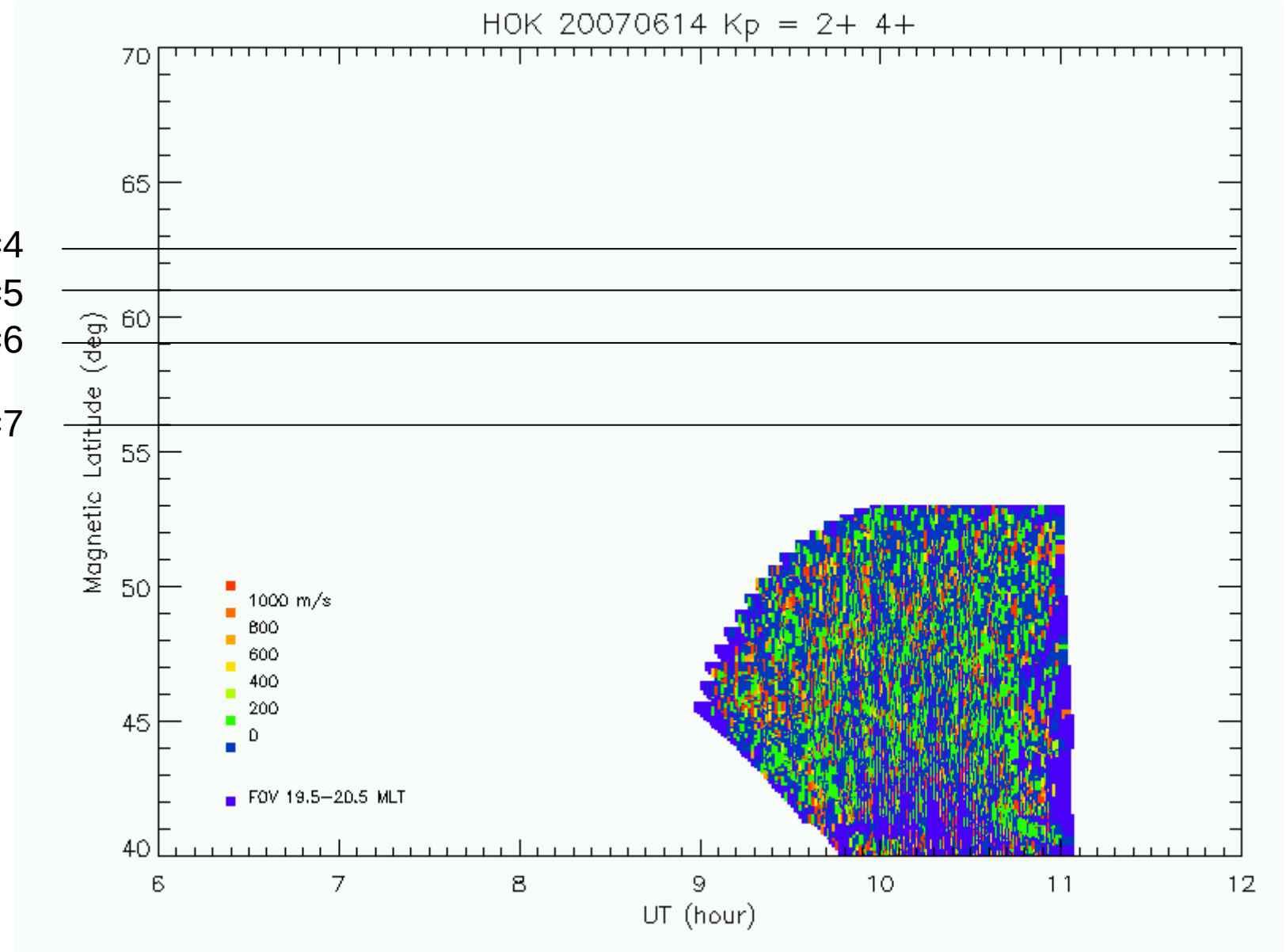
No SAPS 19


HOK 20070518 Kp = 4− 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

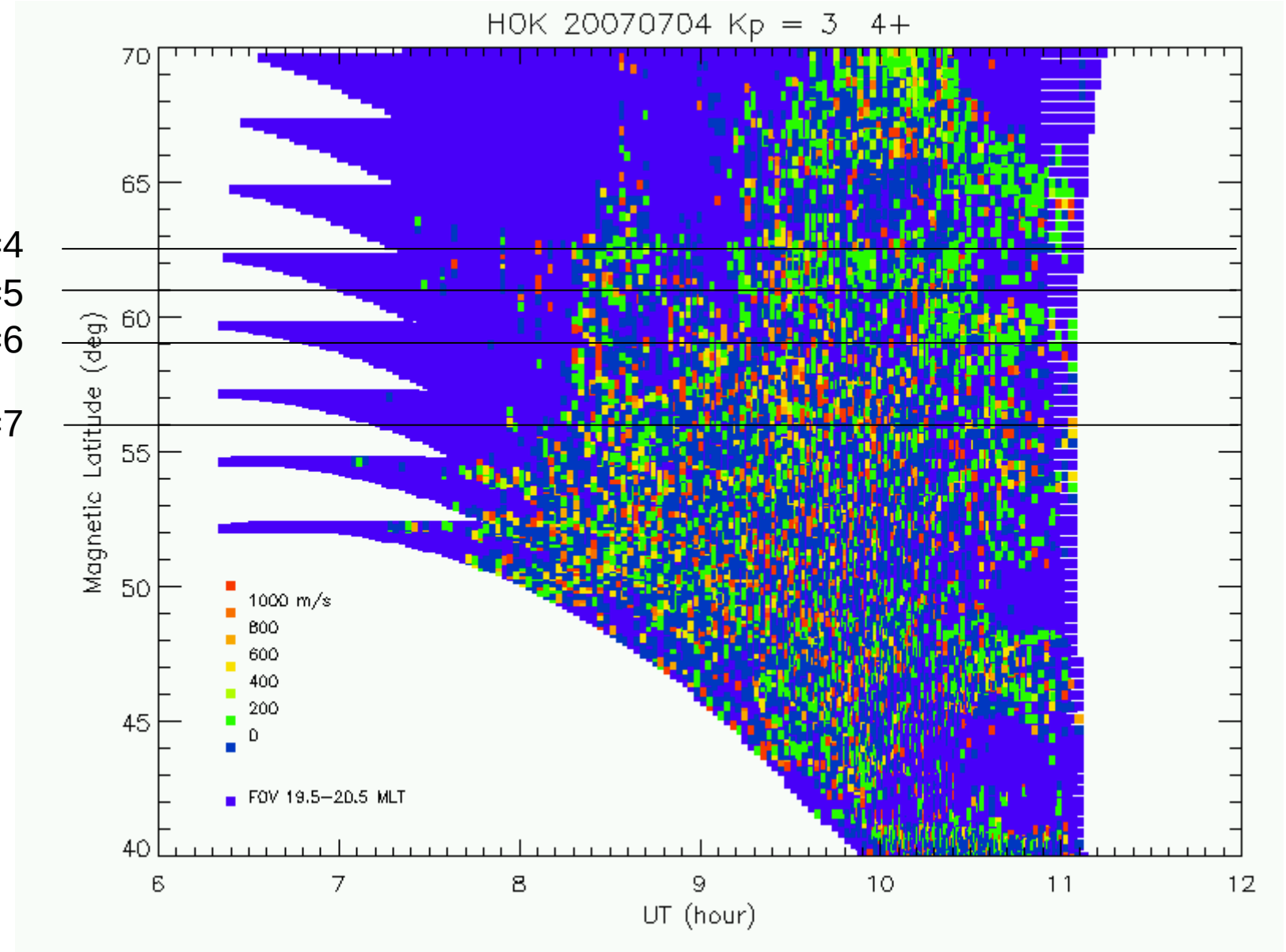
No SAPS 20, ???


HOK 20070523 Kp = 5− 5+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

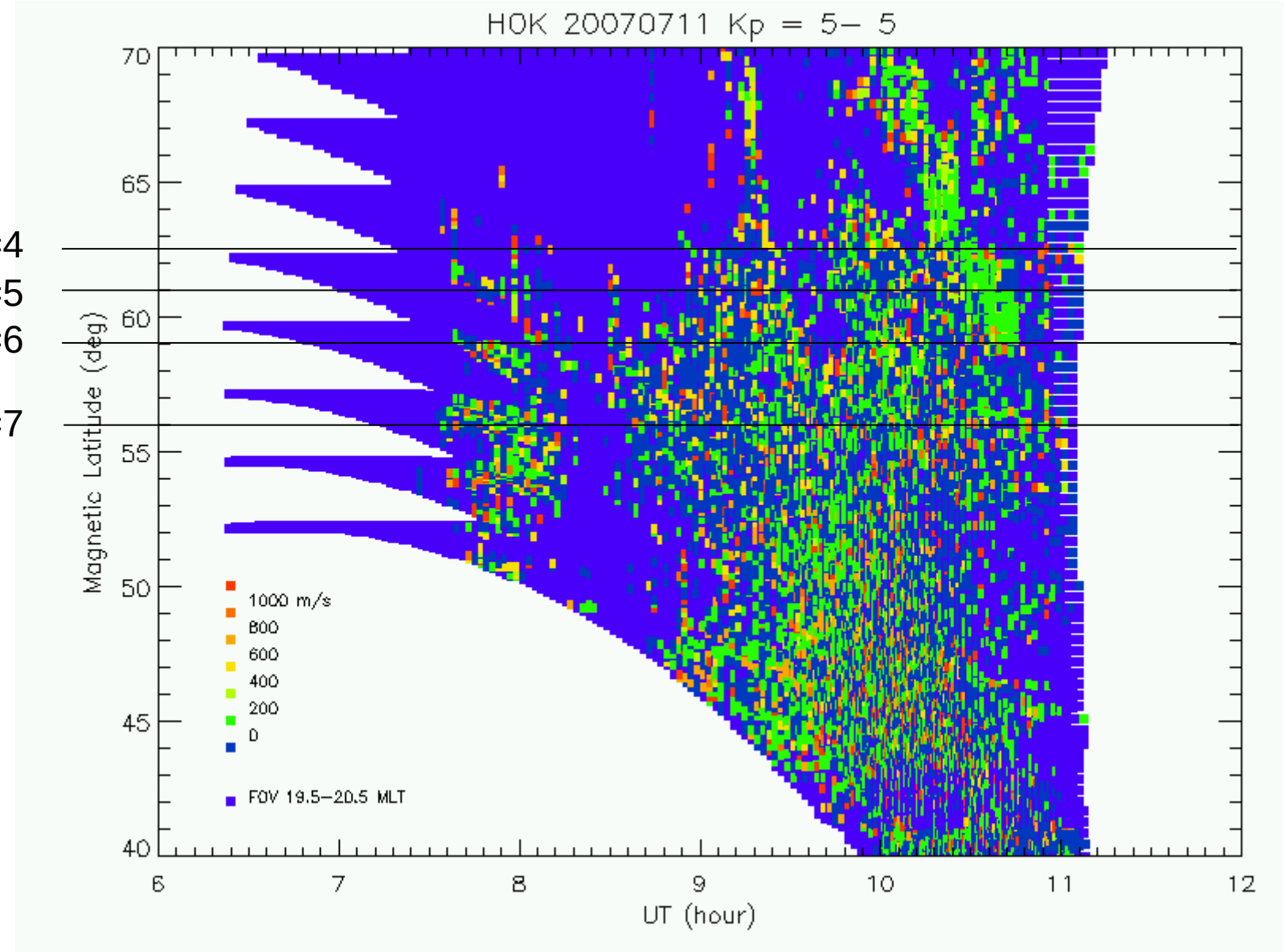
Near range 1


HOK 20070614 Kp = 2+ 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5-20.5 MLT

No SAPS 21

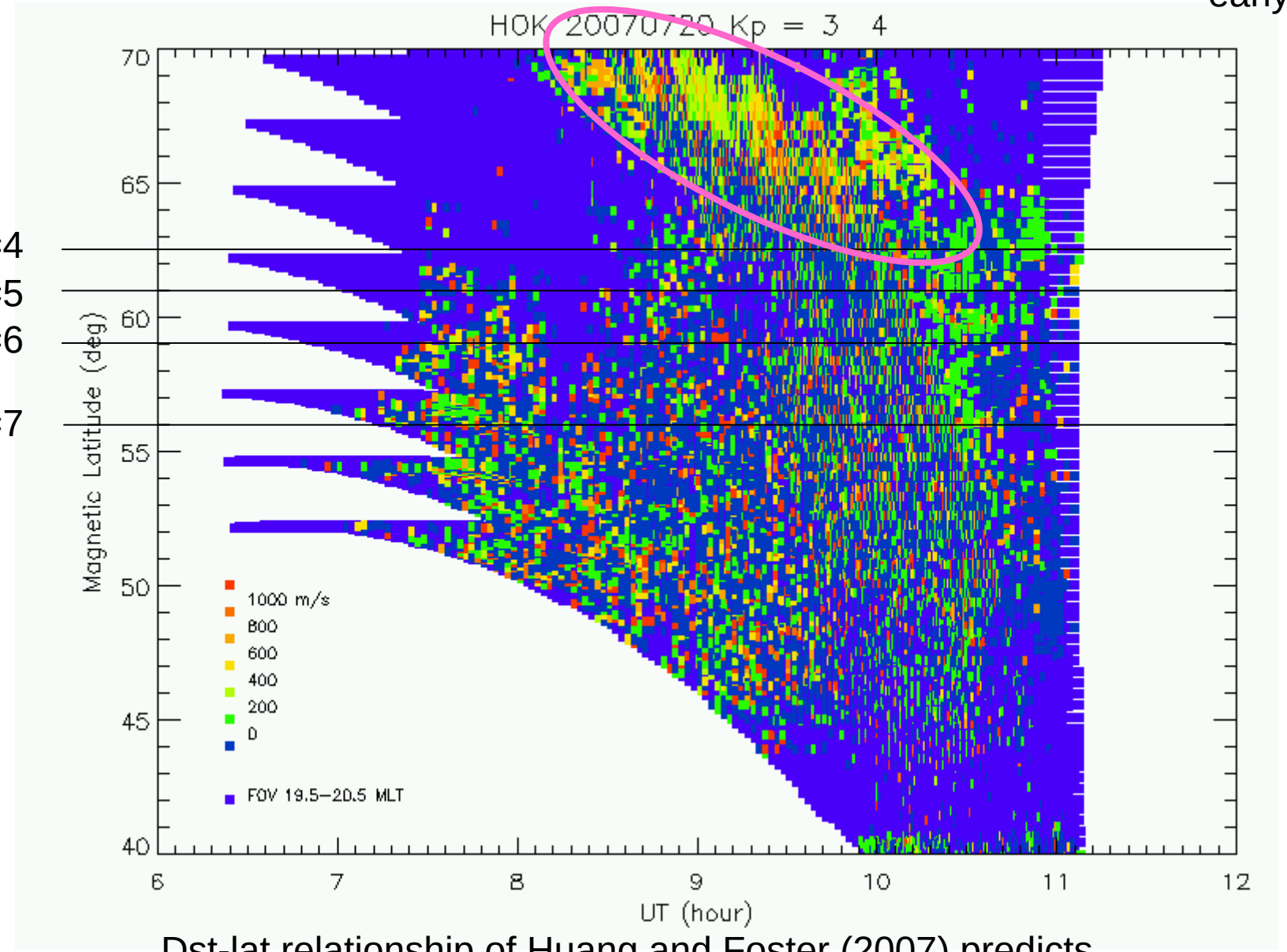

HOK 20070704 Kp = 3 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

No SAPS 22


HOK 20070711 Kp = 5− 5
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

SAPS 8

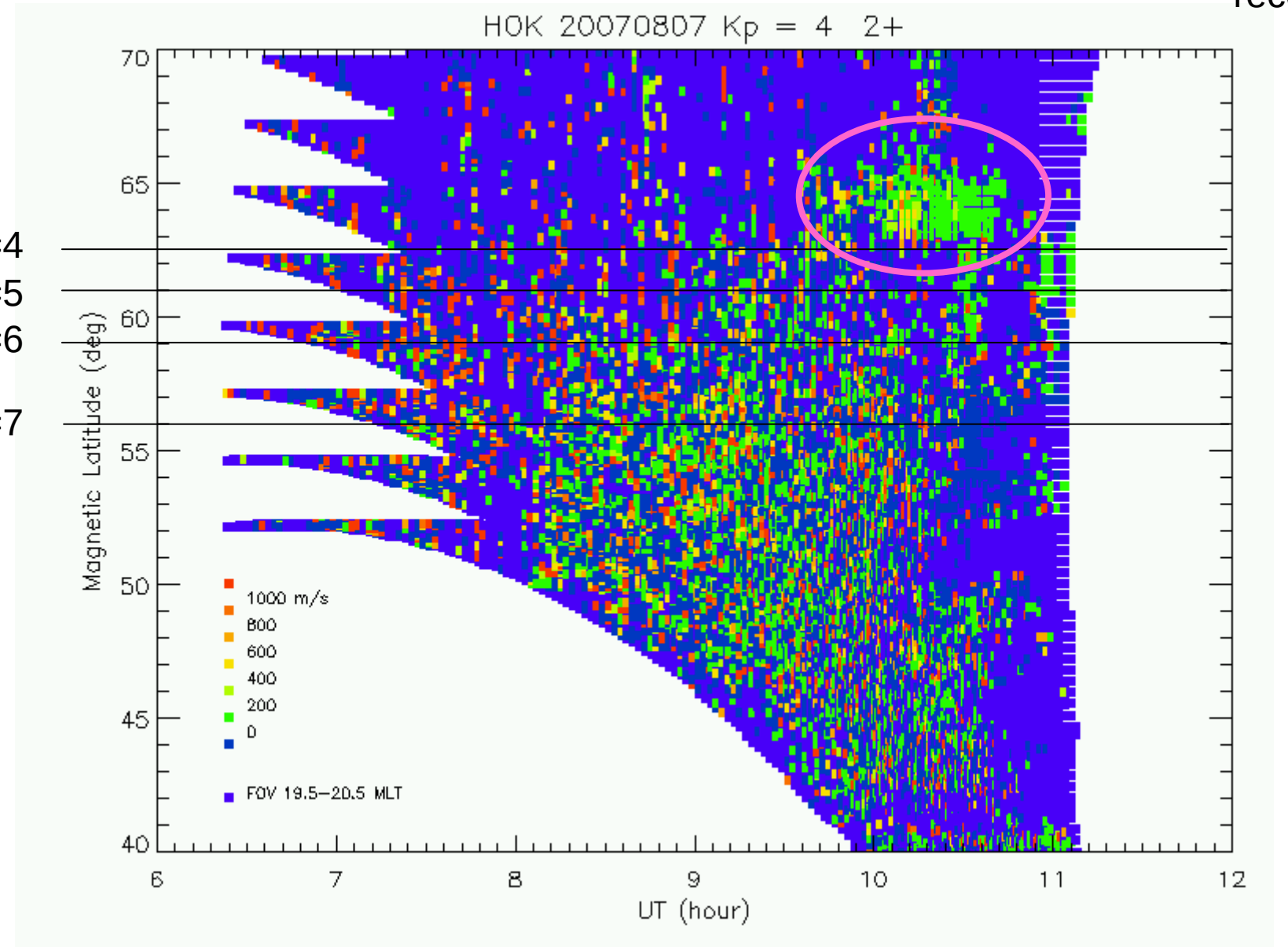
Dst = 13 15 5 -13 -23 -21
early main



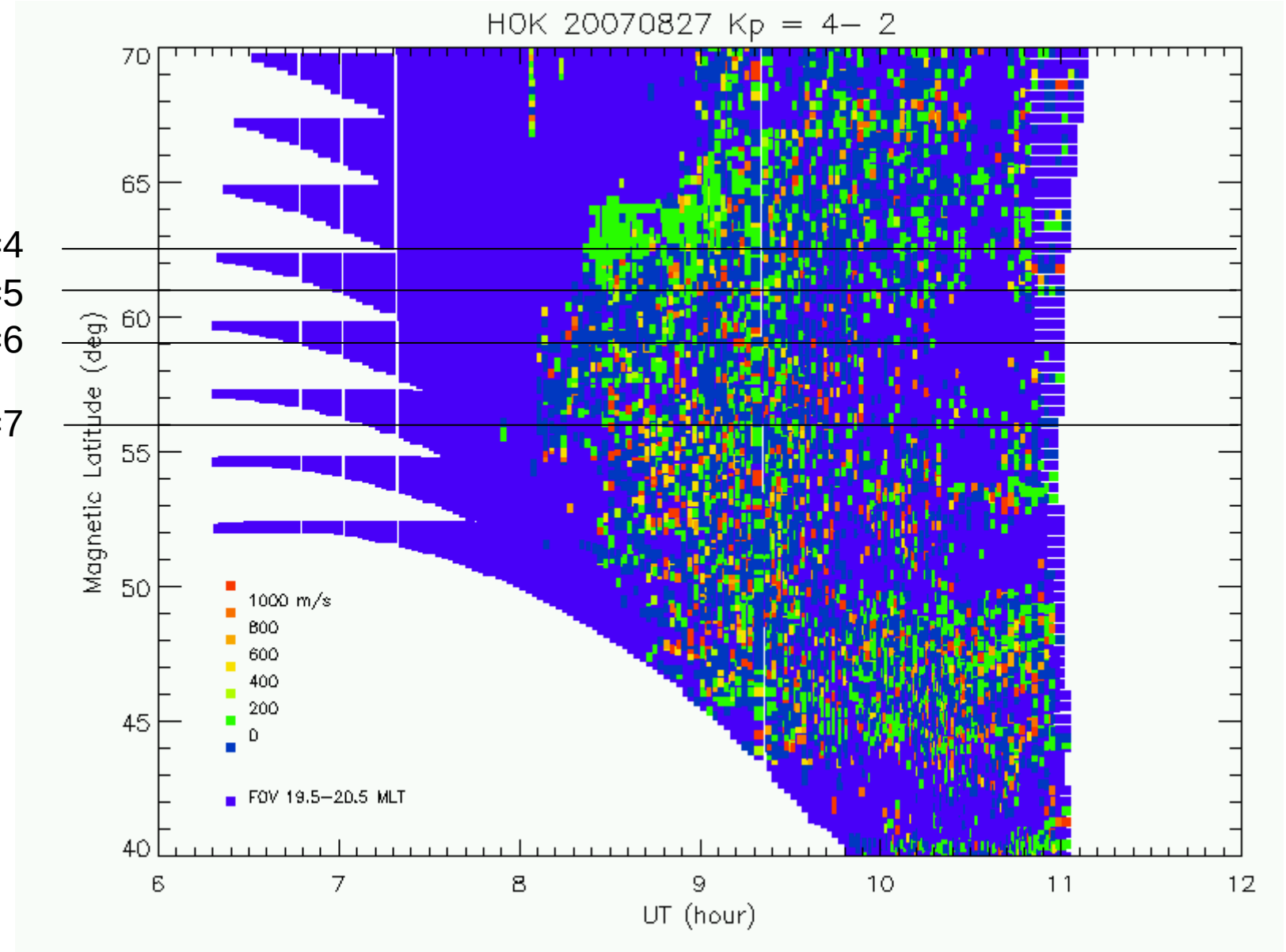
Dst-lat relationship of Huang and Foster (2007) predicts only a few deg motion of SAPS by 40 nT Dst change.

SAPS 9, possible

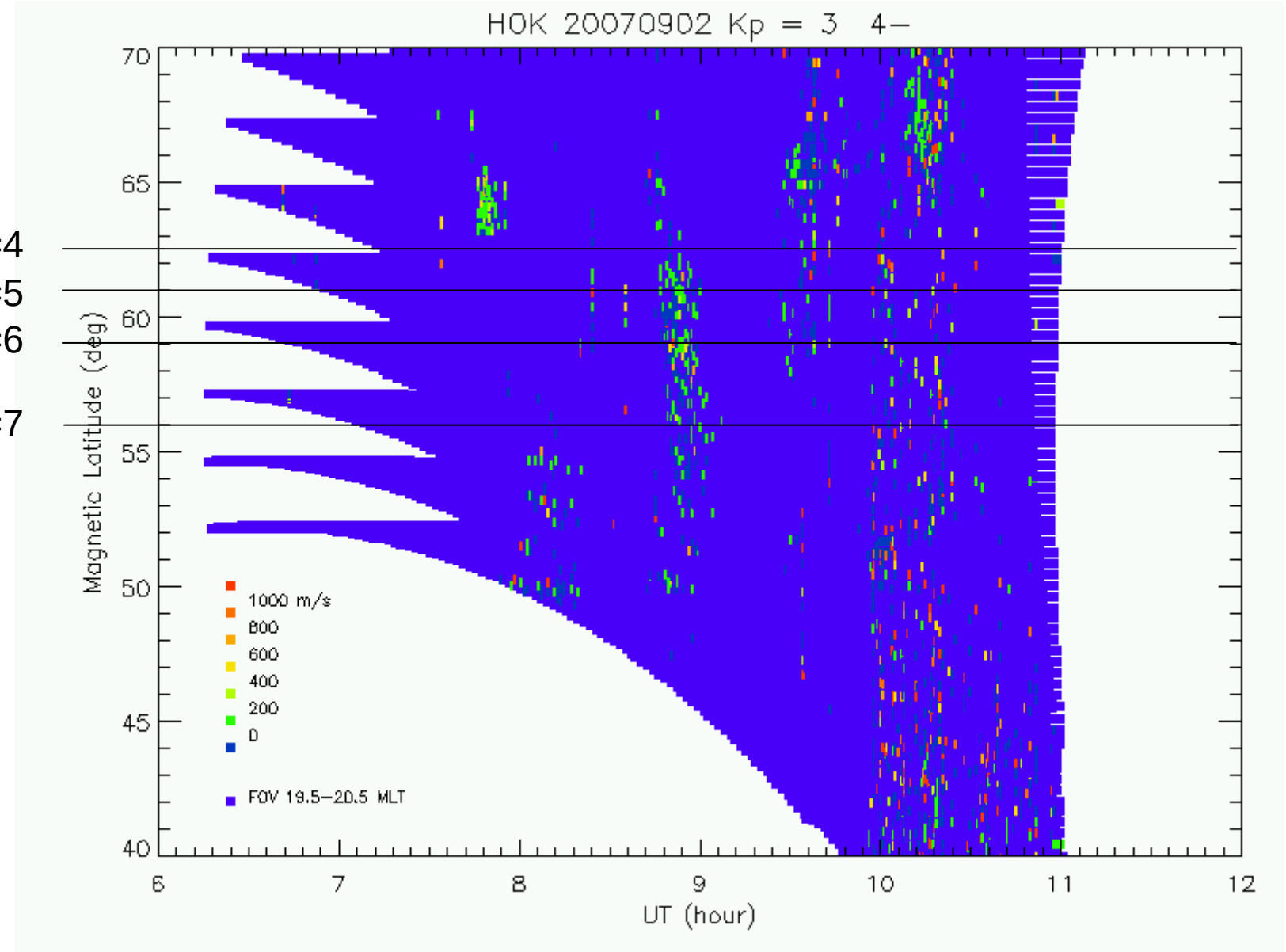
Dst = -23 -25 -30 -25 -21 -18
recovery



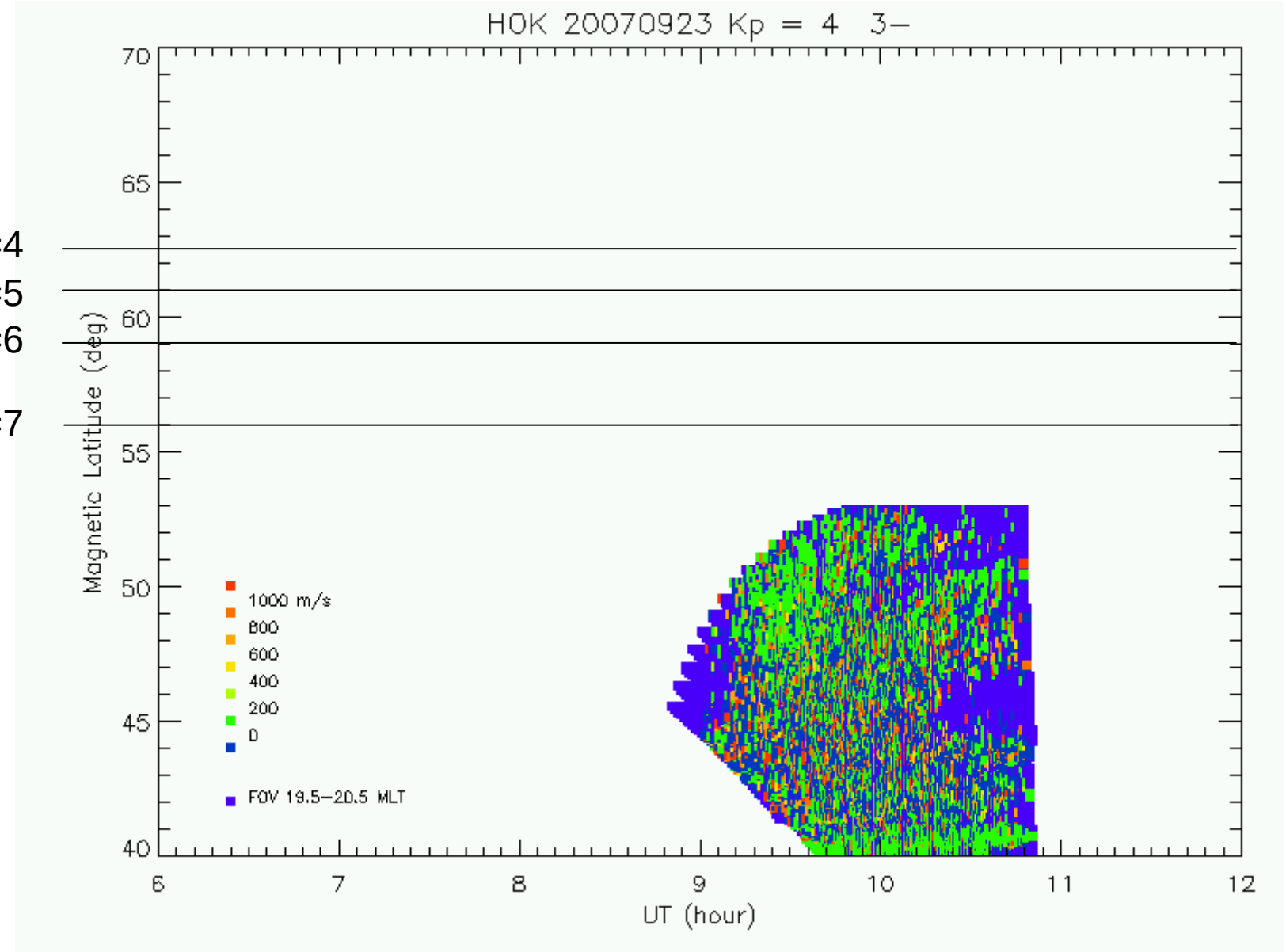
No SAPS 23


HOK 20070827 Kp = 4− 2
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

No SAPS 24

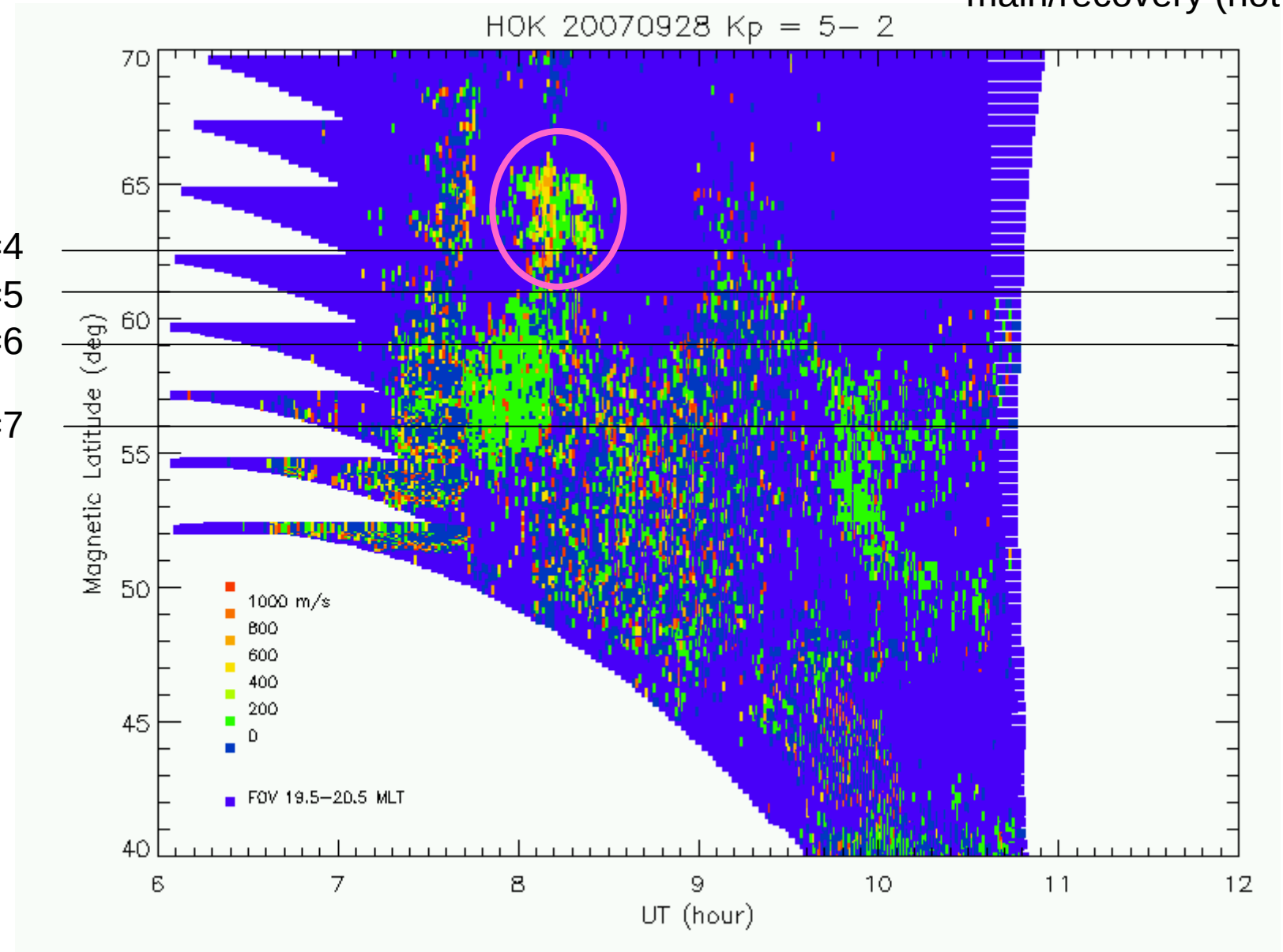

HOK 20070902 Kp = 3 4−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

Near range 2

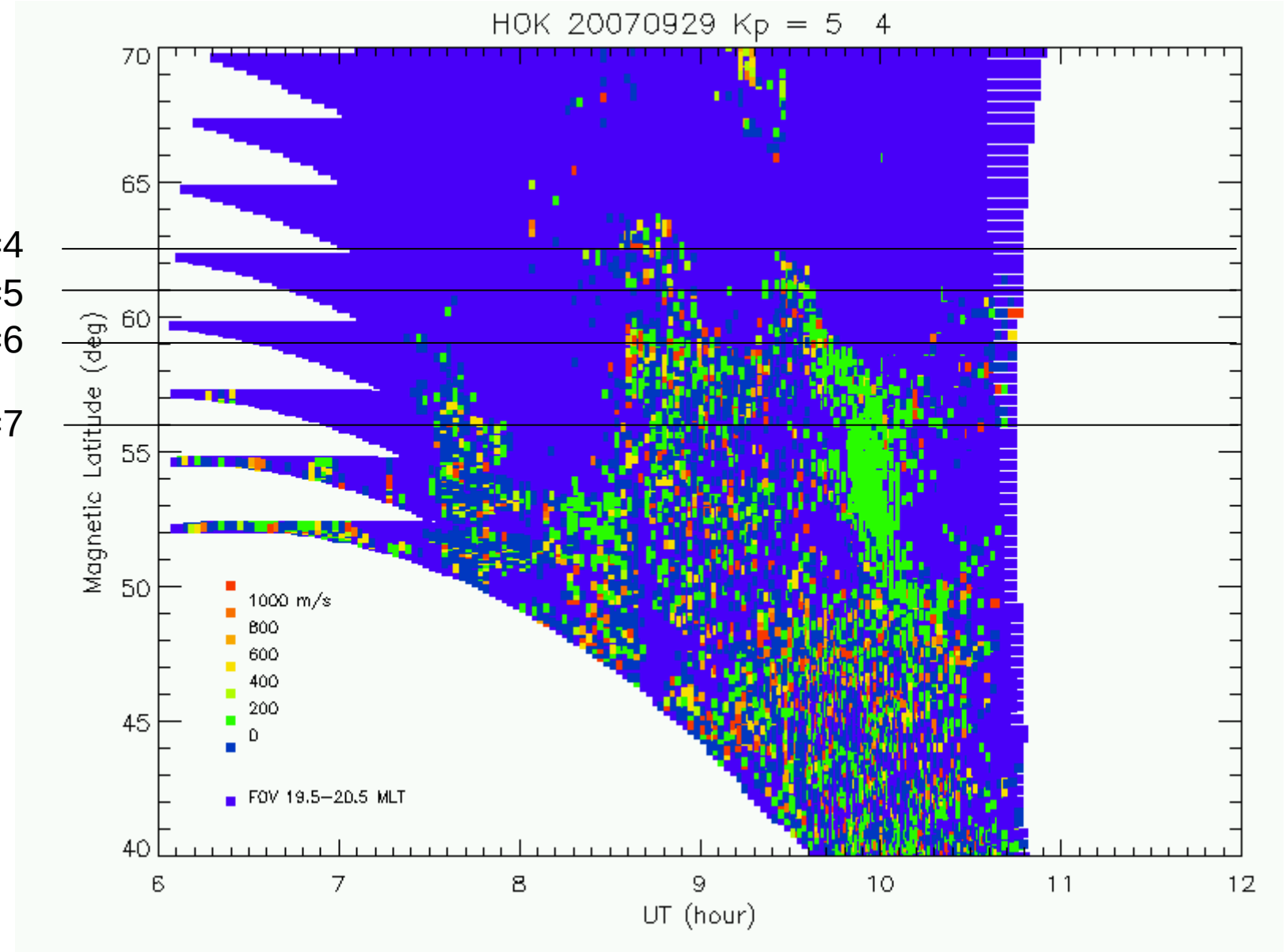

HOK 20070923 Kp = 4 3−
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

SAPS 10, possible

Dst = -12 -20 -21 -24 -21 -15
main/recovery (not clear)



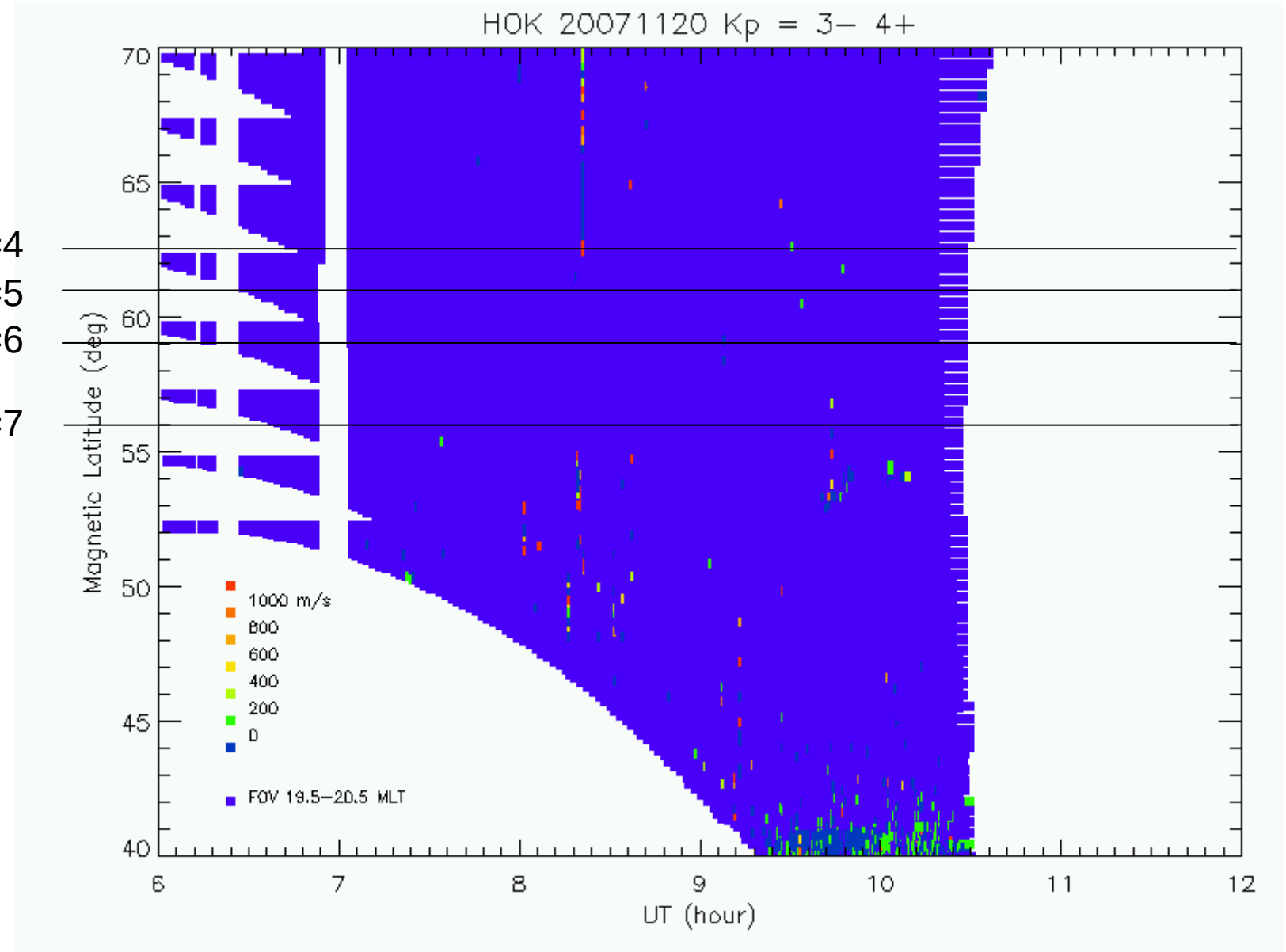
No SAPS 25


HOK 20070929 Kp = 5 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

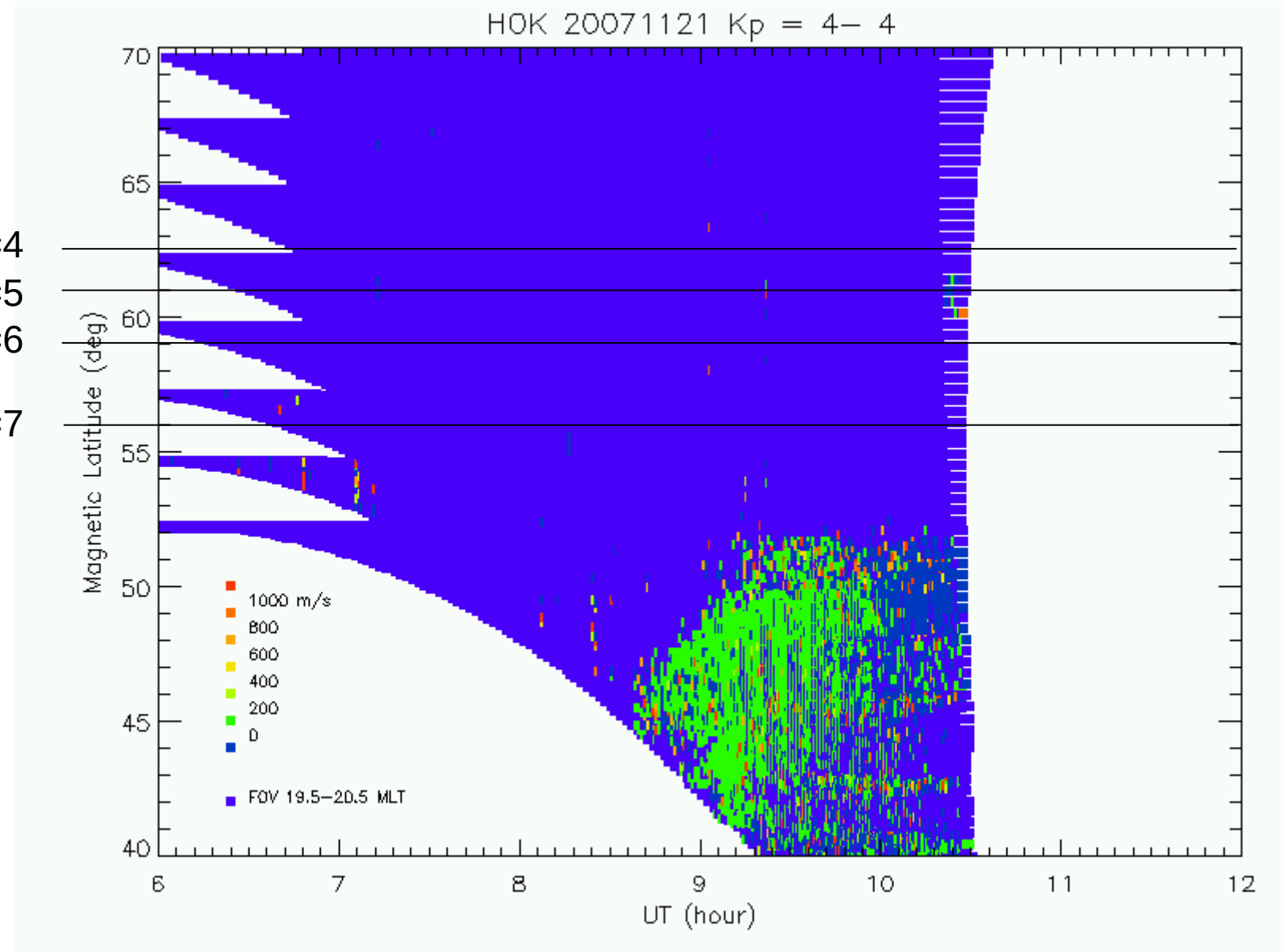
Data gap

- 1: 2007/10/18 Kp = 3- 4-
- 2: 2007/10/27 Kp = 2 4-

No SAPS 26


HOK 20071120 Kp = 3− 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

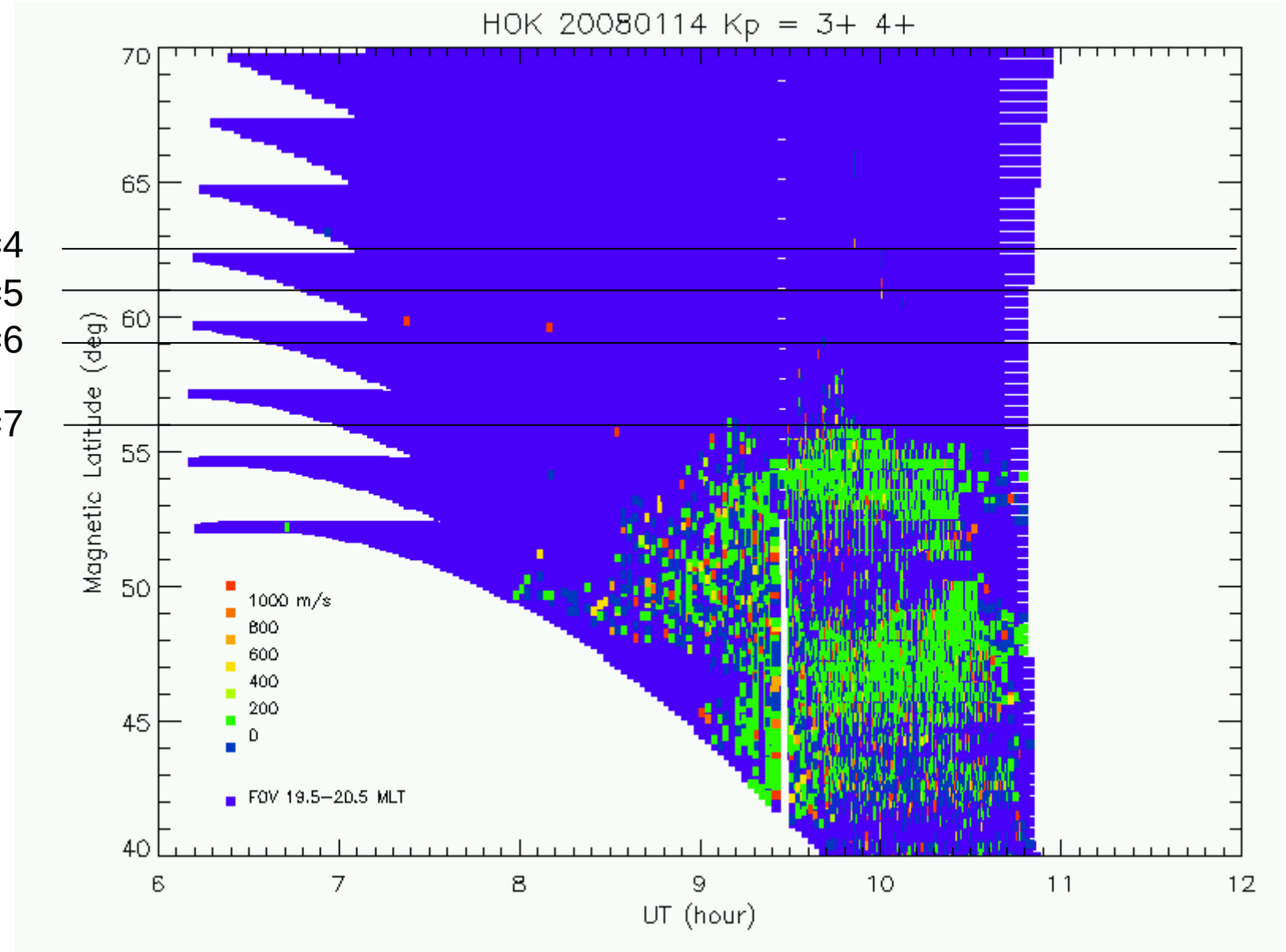
No SAPS 27


HOK 20071121 Kp = 4− 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

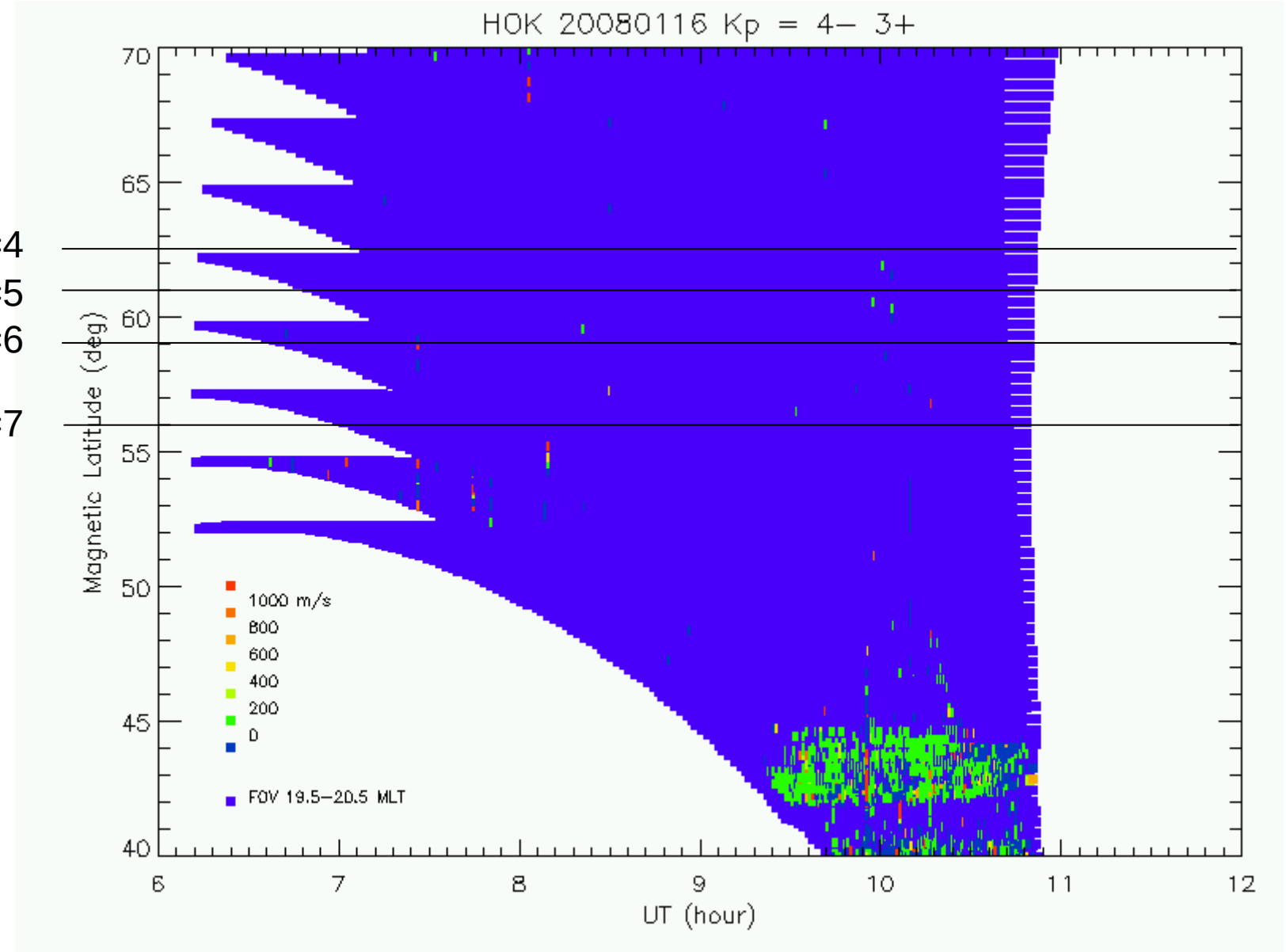
Data gap

- 3: 2008/12/17 Kp = 4- 4
- 4: 2008/12/18 Kp = 4- 4-
- 5: 2008/01/05 Kp = 4 4 (QL)

No SAPS 28

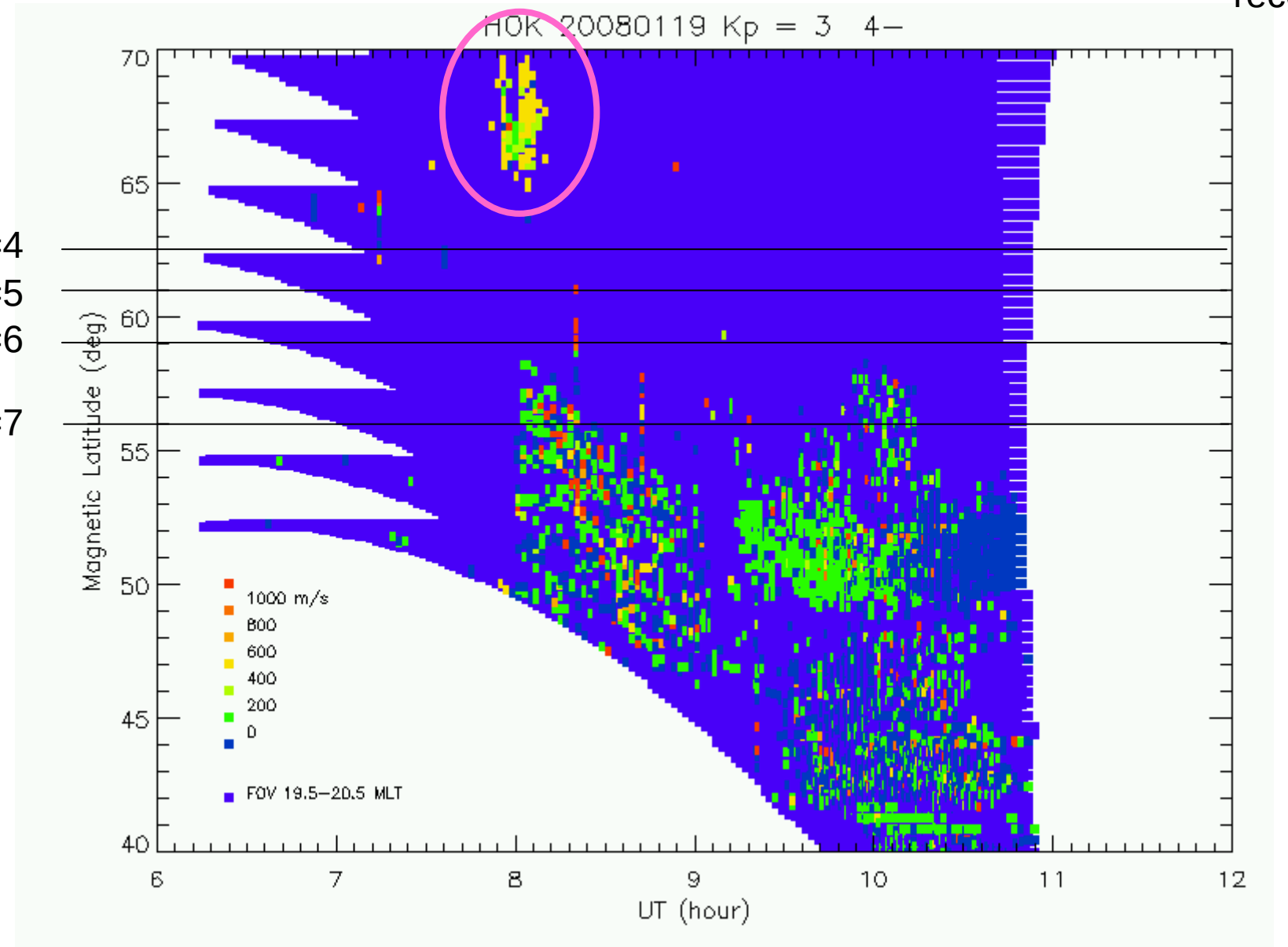

HOK 20080114 Kp = 3+ 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5–20.5 MLT

No SAPS 29


HOK 20080116 Kp = 4− 3+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

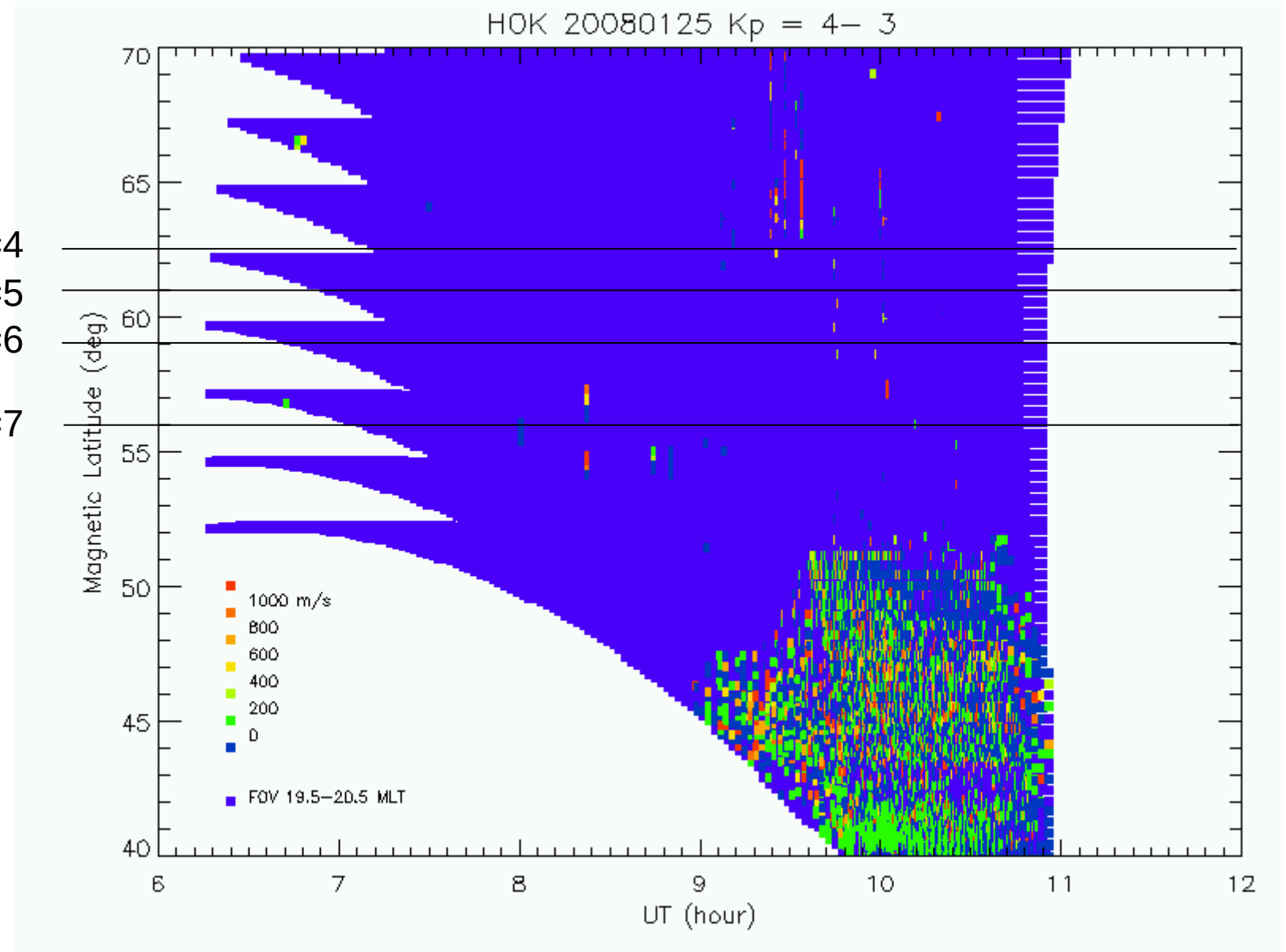
SAPS 11, possible

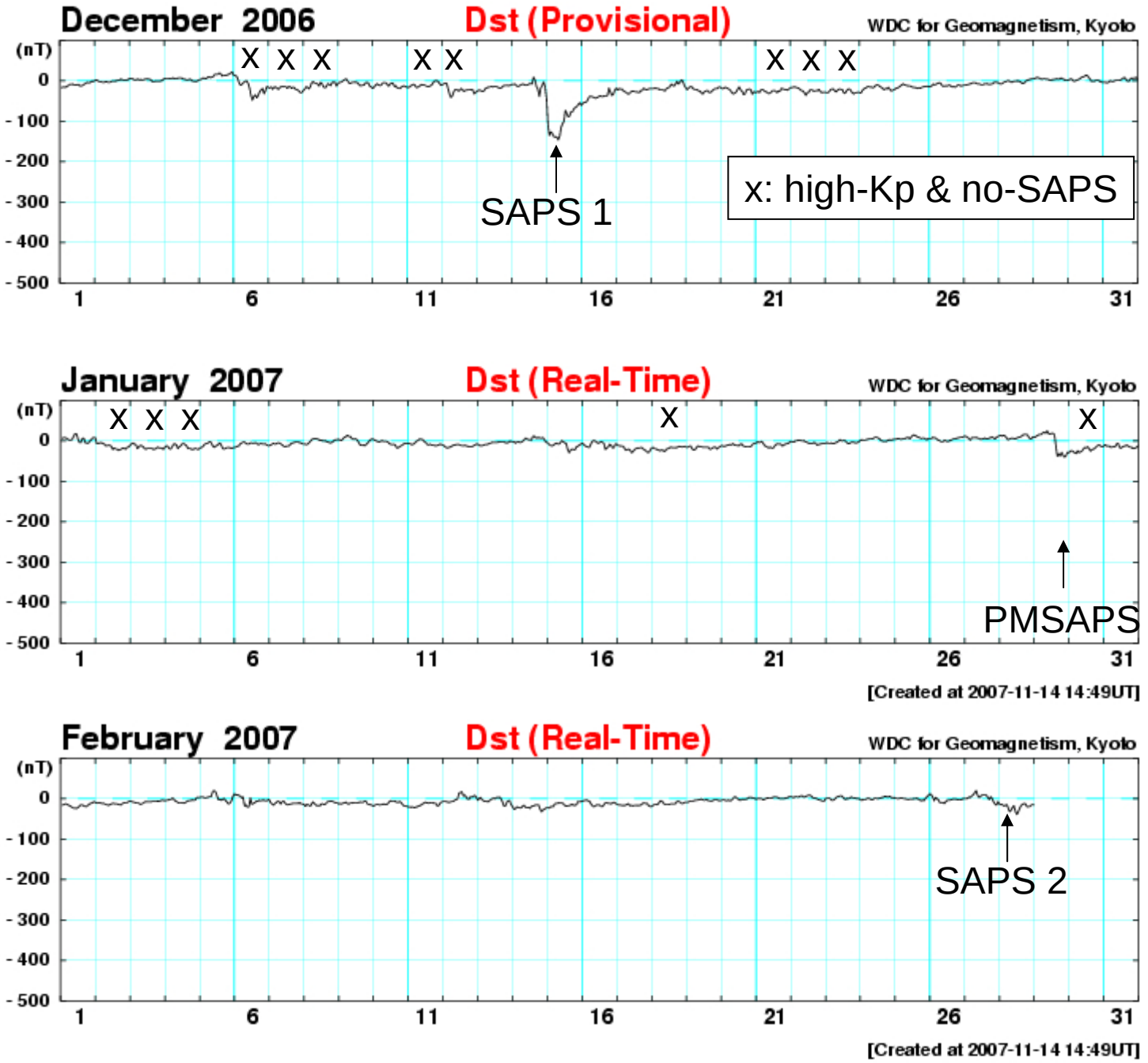
Dst = -54 -52 -50 -46 -45 -49
recovery

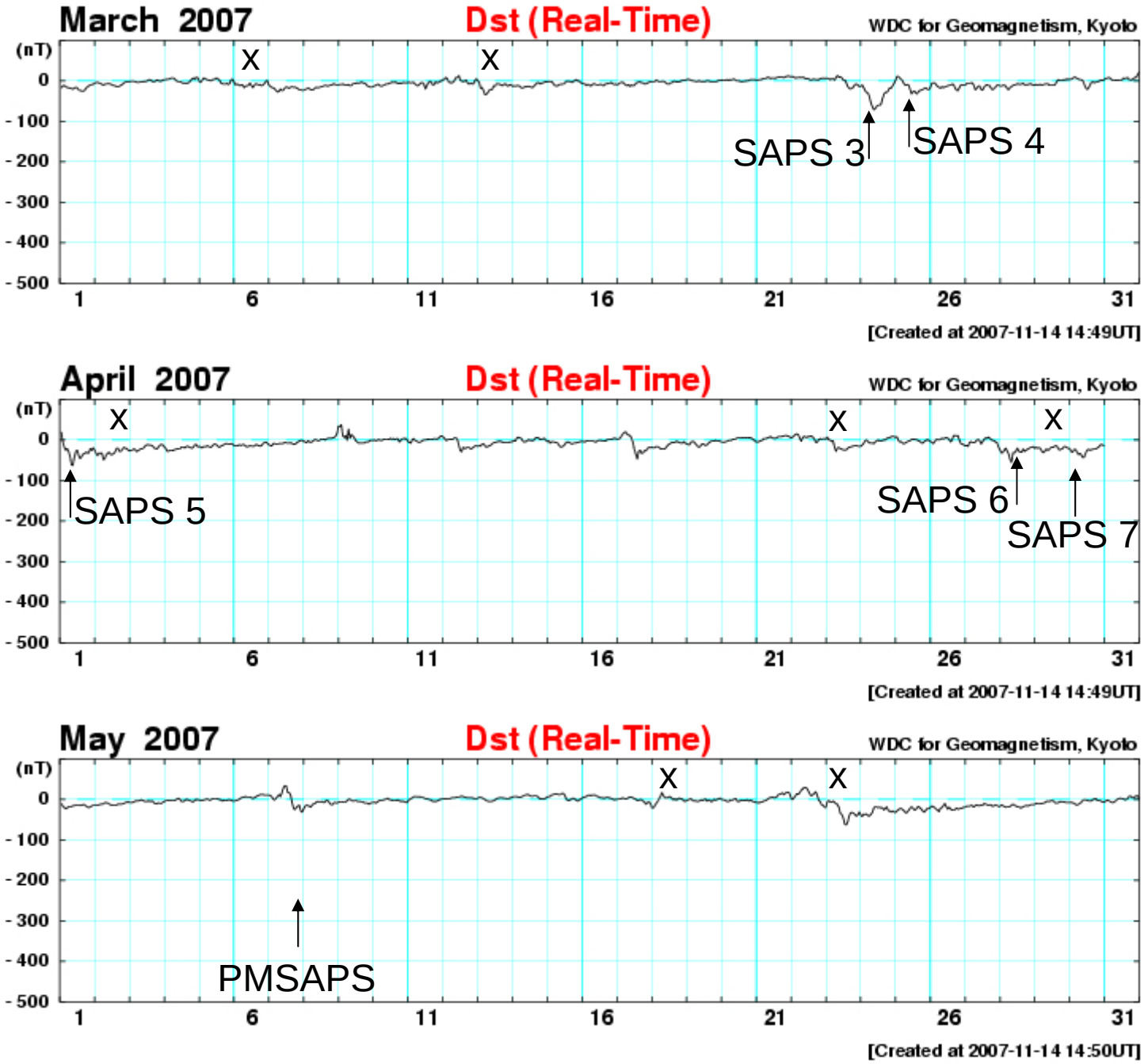


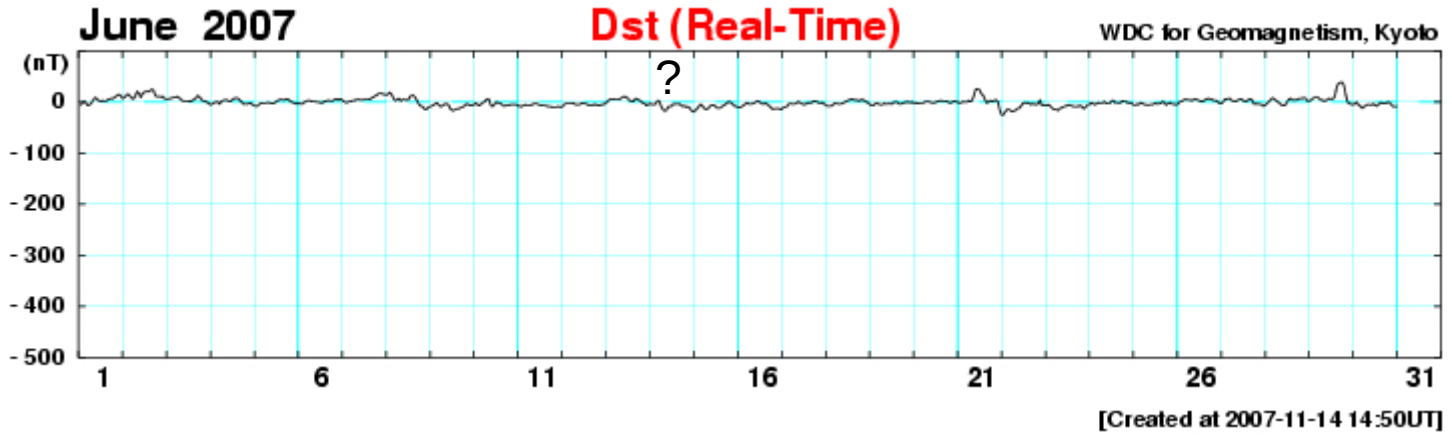
Kp=4
Kp=5
Kp=6
Kp=7

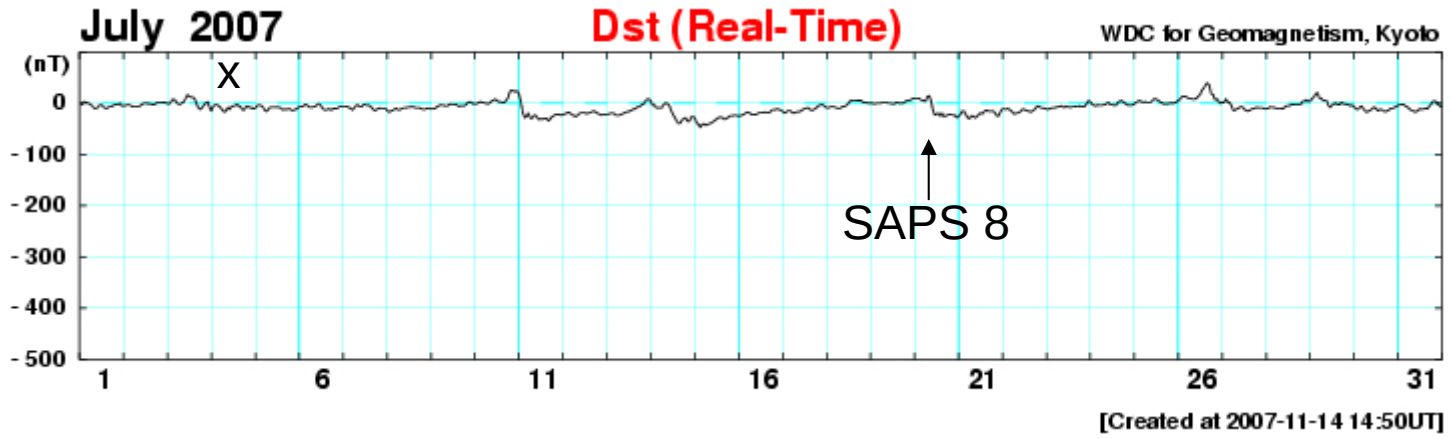
No SAPS 30

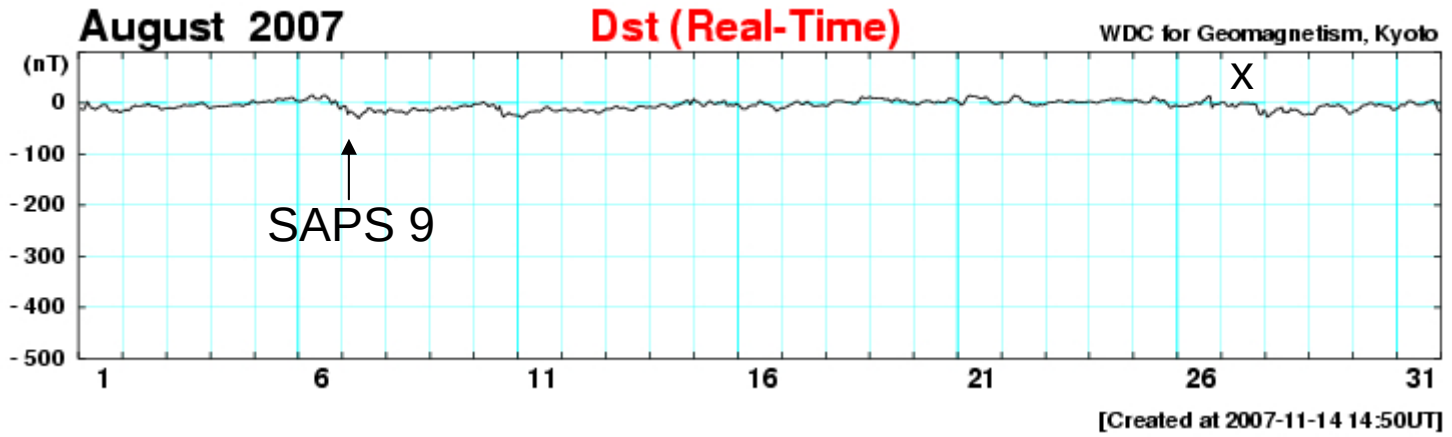

HOK 20080125 Kp = 4− 3
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
6
7
8
9
10
11
12
UT (hour)
1000 m/s
800
600
400
200
0
FOV 19.5−20.5 MLT

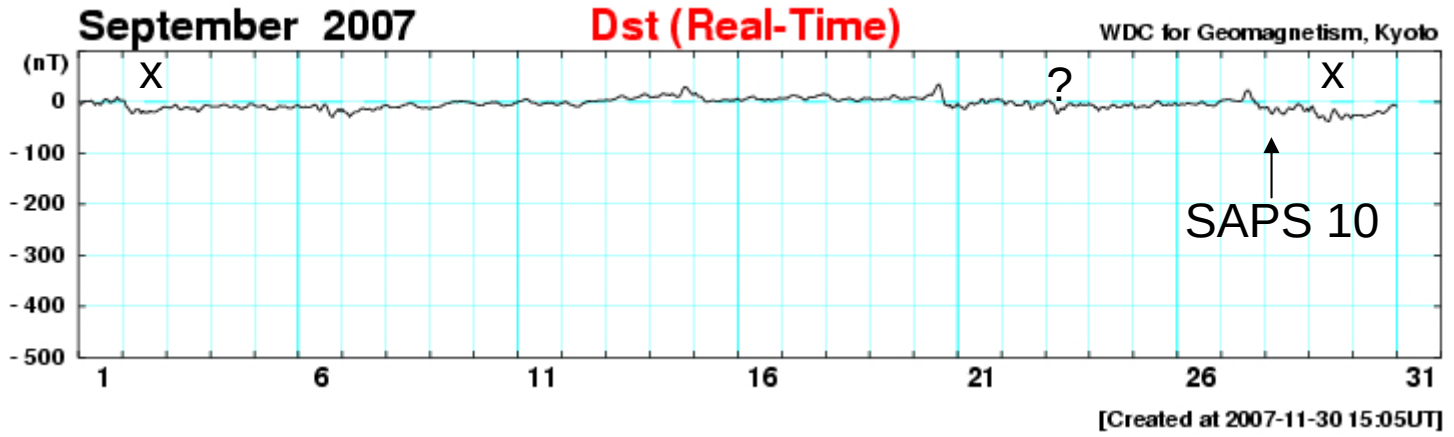

December 2006
Dst (Provisional)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
SAPS 1
x: high-Kp & no-SAPS
January 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
PMSAPS
[Created at 2007-11-14 14:49UT]
February 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
SAPS 2
[Created at 2007-11-14 14:49UT]

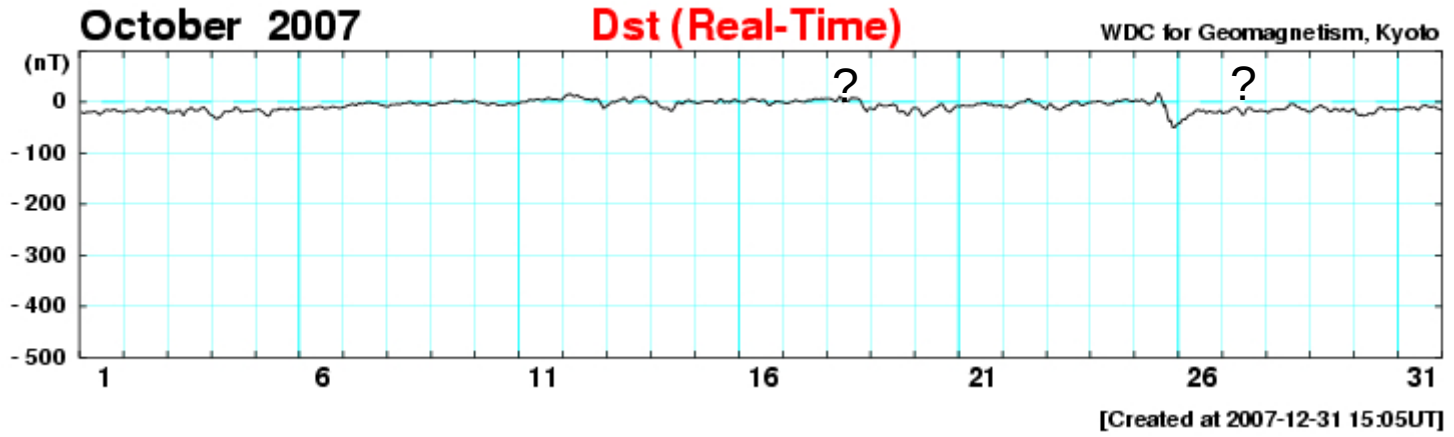

March 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
X
X
SAPS 3
SAPS 4
[Created at 2007-11-14 14:49UT]
April 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
X
X
X
SAPS 5
SAPS 6
SAPS 7
[Created at 2007-11-14 14:49UT]
May 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
X
X
PMSAPS
[Created at 2007-11-14 14:50UT]

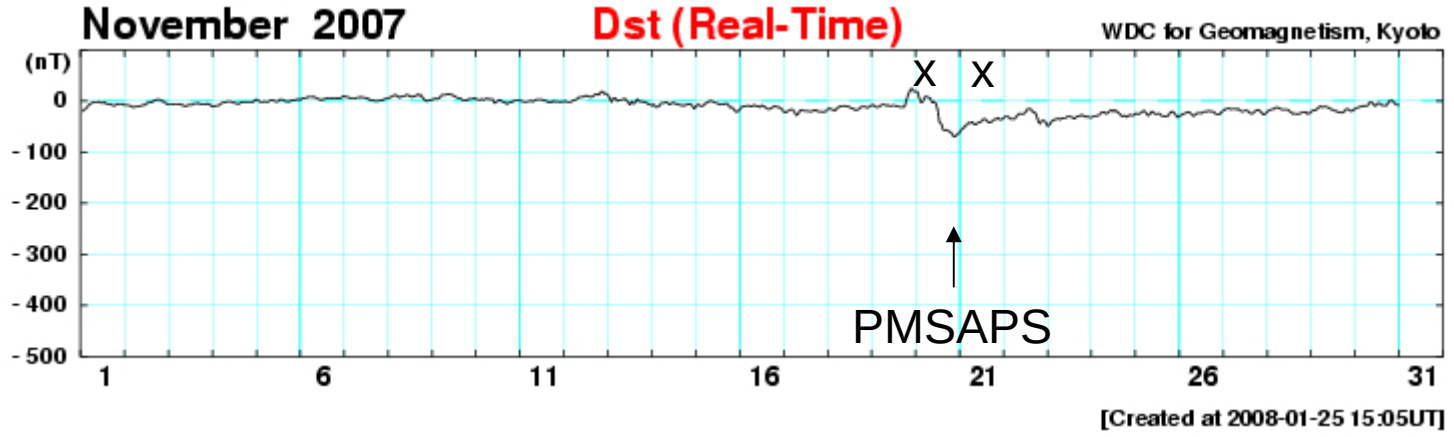

June 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
?
[Created at 2007-11-14 14:50UT]

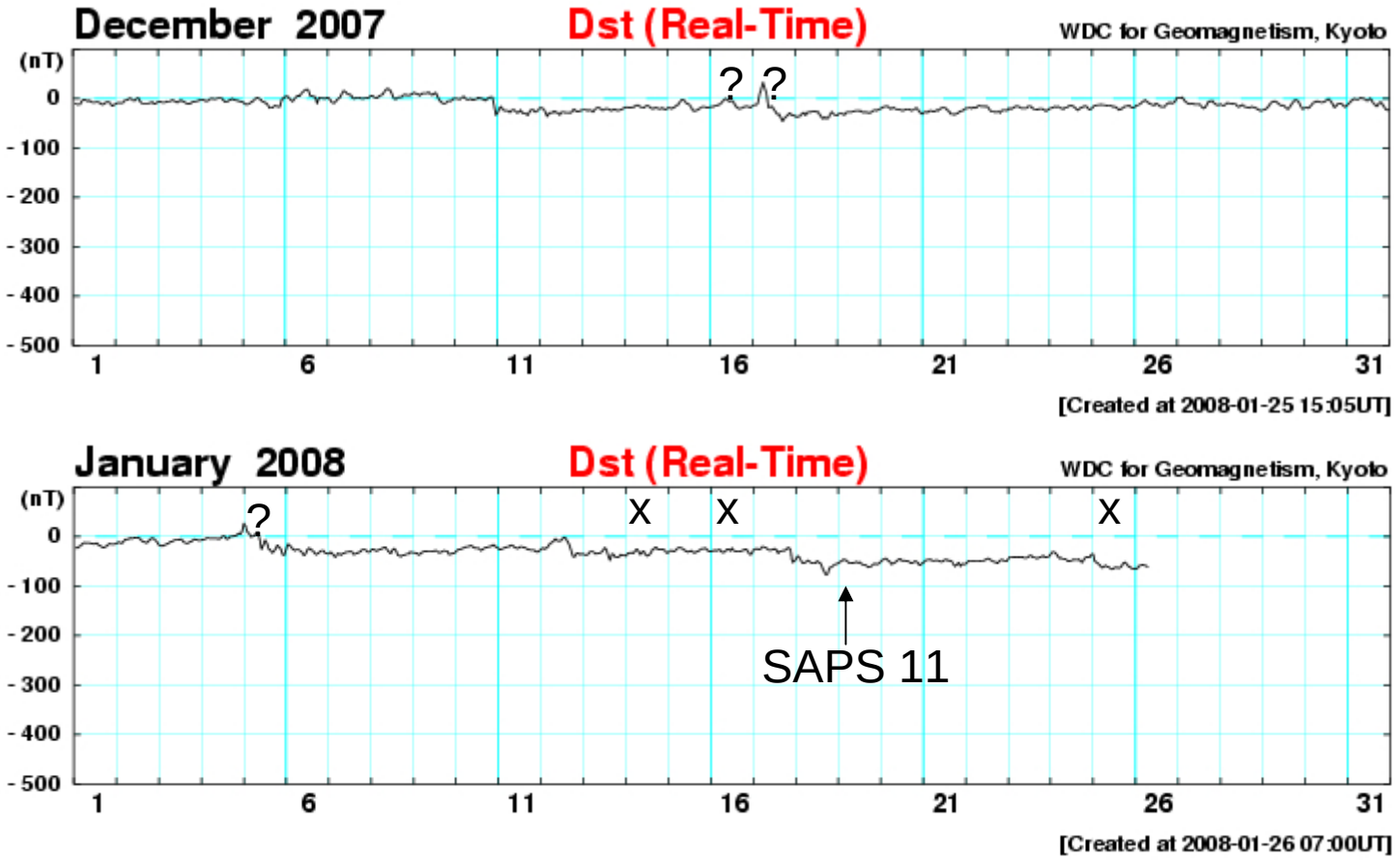

July 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
X
SAPS 8
[Created at 2007-11-14 14:50UT]


August 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
X
SAPS 9
[Created at 2007-11-14 14:50UT]

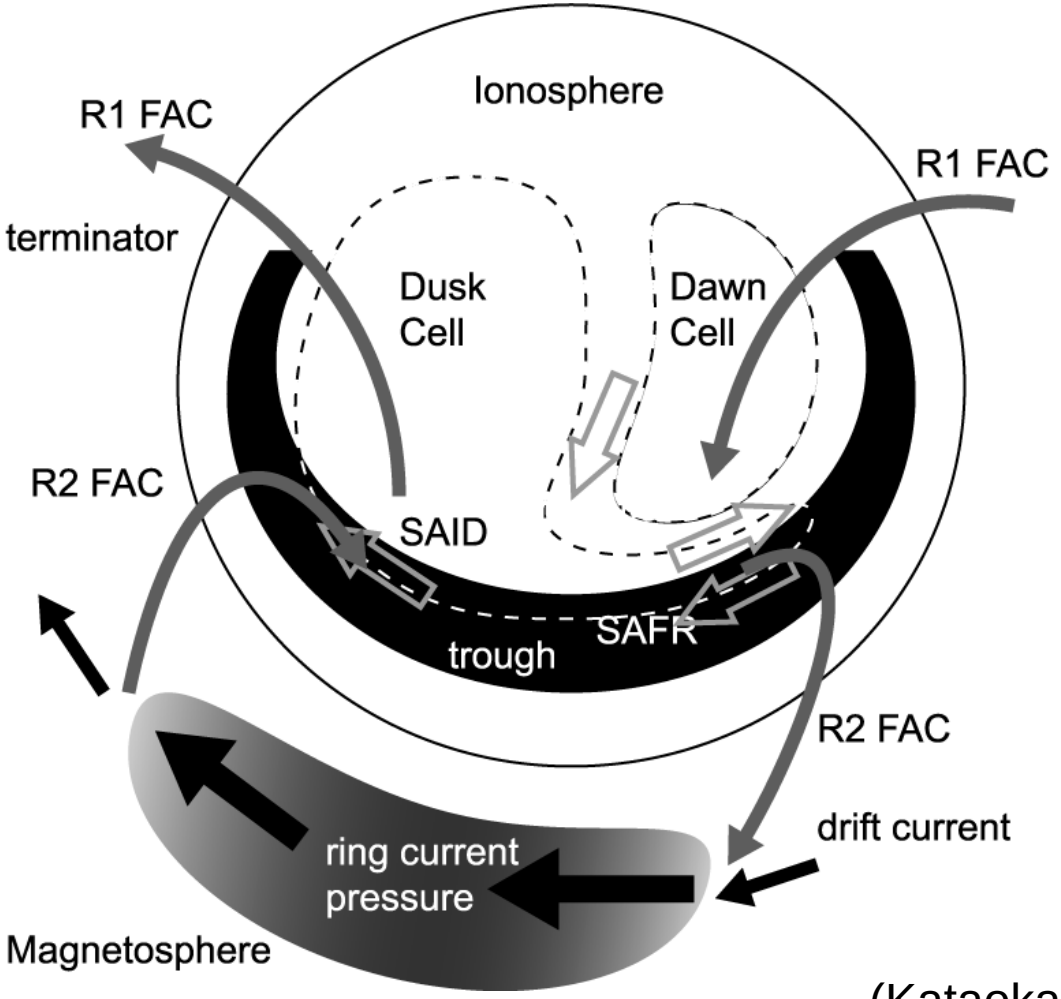

September 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
X
?
X
SAPS 10
[Created at 2007-11-30 15:05UT]


October 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
?
?
[Created at 2007-12-31 15:05UT]


November 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
X
X
PMSAPS
[Created at 2008-01-25 15:05UT]


December 2007
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
? ?
[Created at 2008-01-25 15:05UT]
January 2008
Dst (Real-Time)
WDC for Geomagnetism, Kyoto
(nT)
0
- 100
- 200
- 300
- 400
- 500
1
6
11
16
21
26
31
?
X
X
X
SAPS 11
[Created at 2008-01-26 07:00UT]

SBZ storm-time convection



(Kataoka et al., GRL, 2008)

Summary of KEOGRAM analysis

- List of 20-MLT SAPS (2006/12-2008/1)
  - No significant Kp difference between No-SAPS and SAPS
    - 30 No-SAPS events Kp = 3.66±0.80
    - 11 SAPS events Kp = 3.77±1.14
  - KEOGRAM analysis is useful, but West Radar is needed to double the effective FOV for hours of lat. motion tracking.

- Storm is a necessary condition for SAPS.
  - Ring current particles should play an essential role, consistent with the idea of Ebihara et al. (2008) and Kataoka et al. (2008).

- Rapid motion is identified during early main phase.
  - Very interesting event. Need further analysis of 2007/1/29 and 2007/7/20 storm using many other ground-satellite data set.

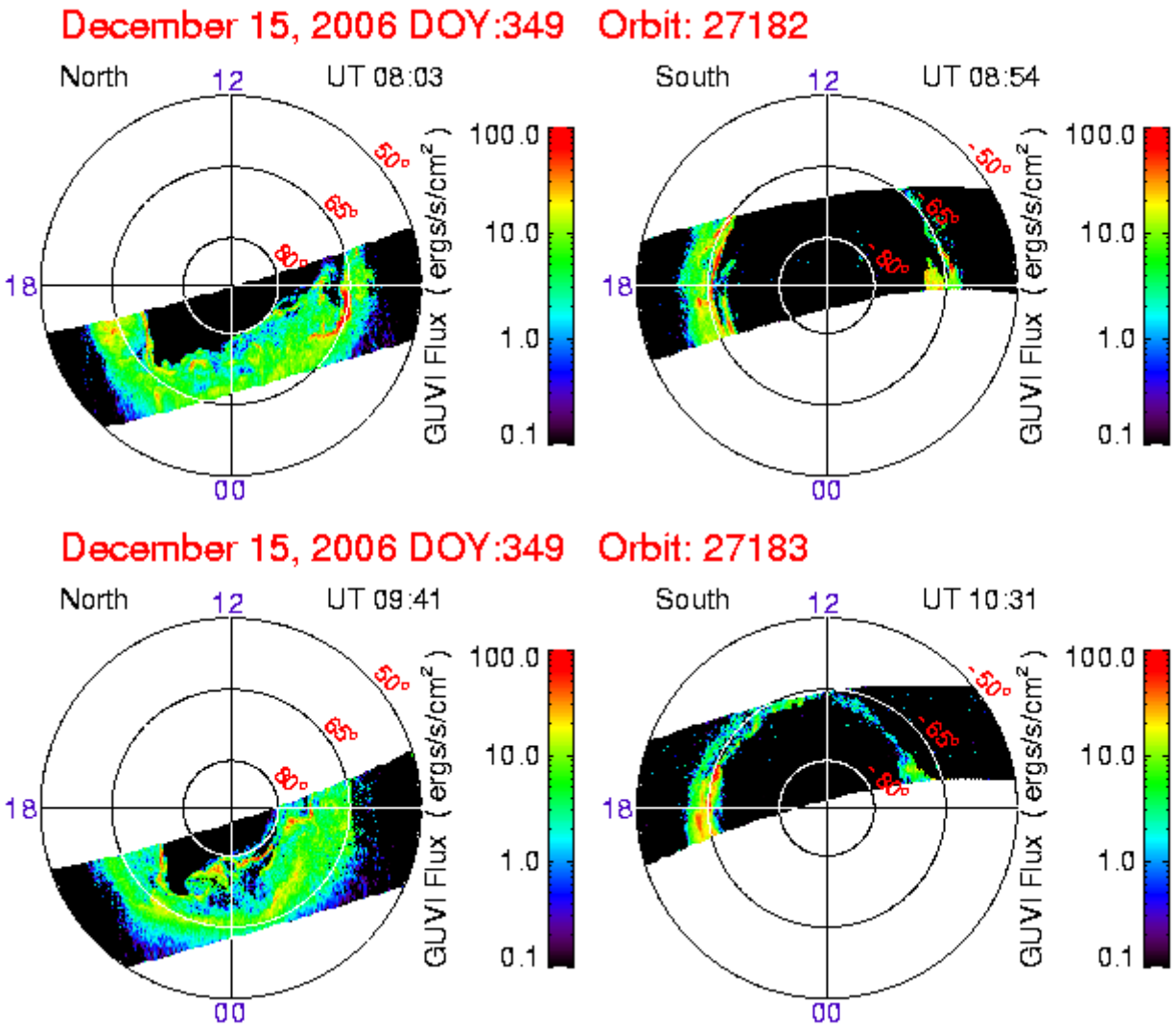
ryuho@riken.jp

Appendix 1

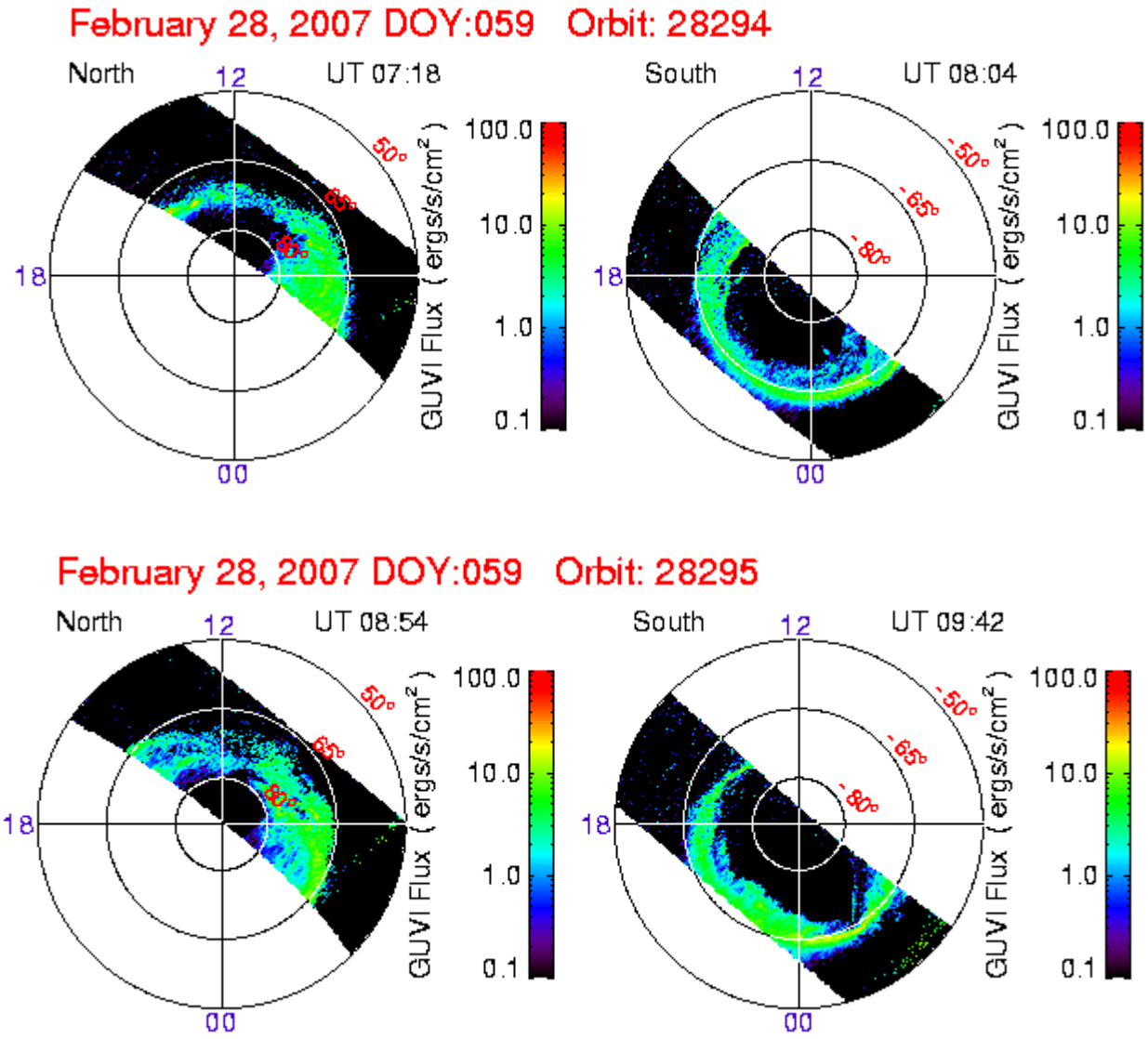
TIMED/GUVI

Aurora oval location check

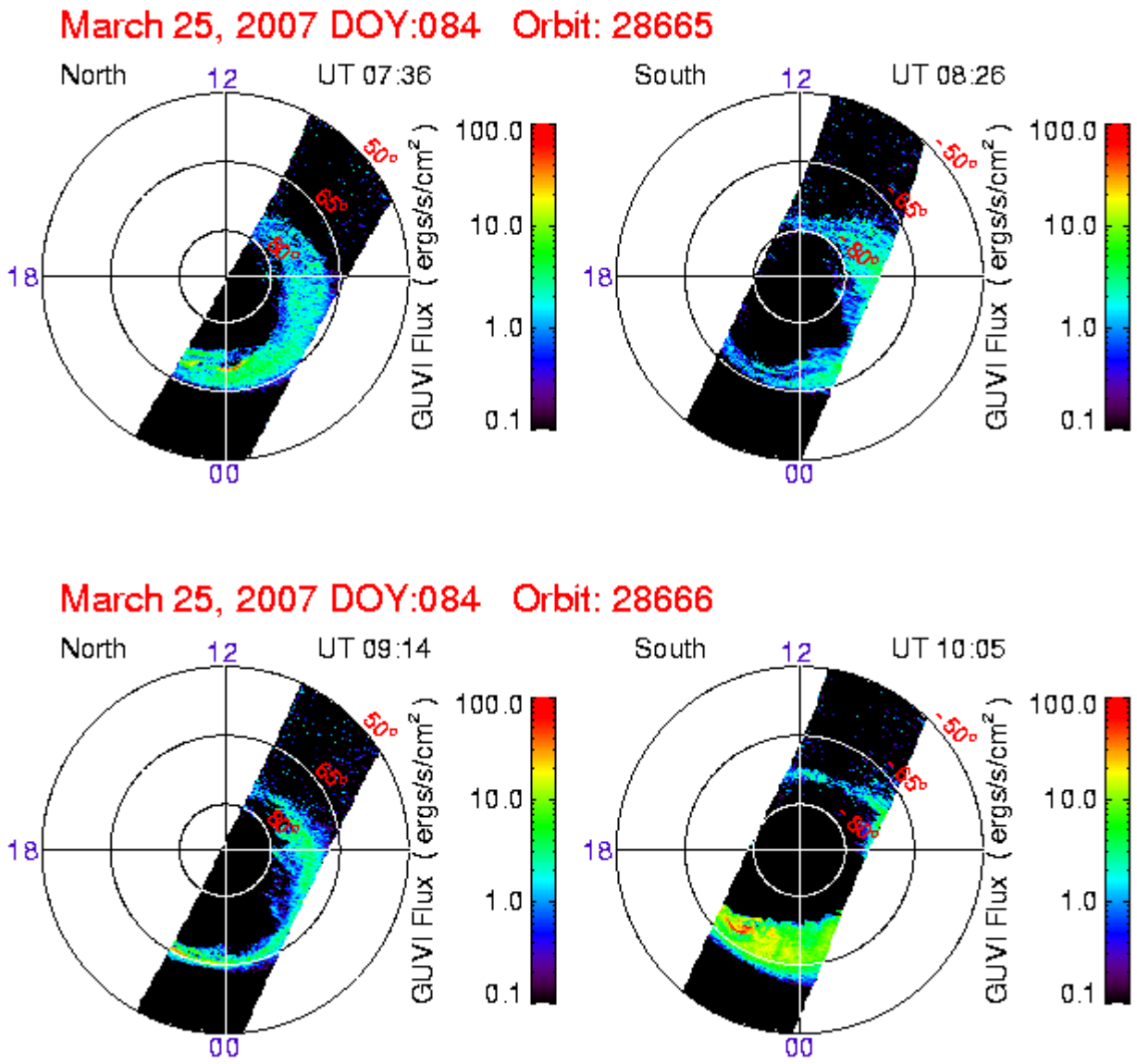
SAPS 1 = 55-56


December 15, 2006 DOY:349 Orbit: 27182
North
UT 08:03
South
UT 08:54
December 15, 2006 DOY:349 Orbit: 27183
North
UT 09:41
South
UT 10:31
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1

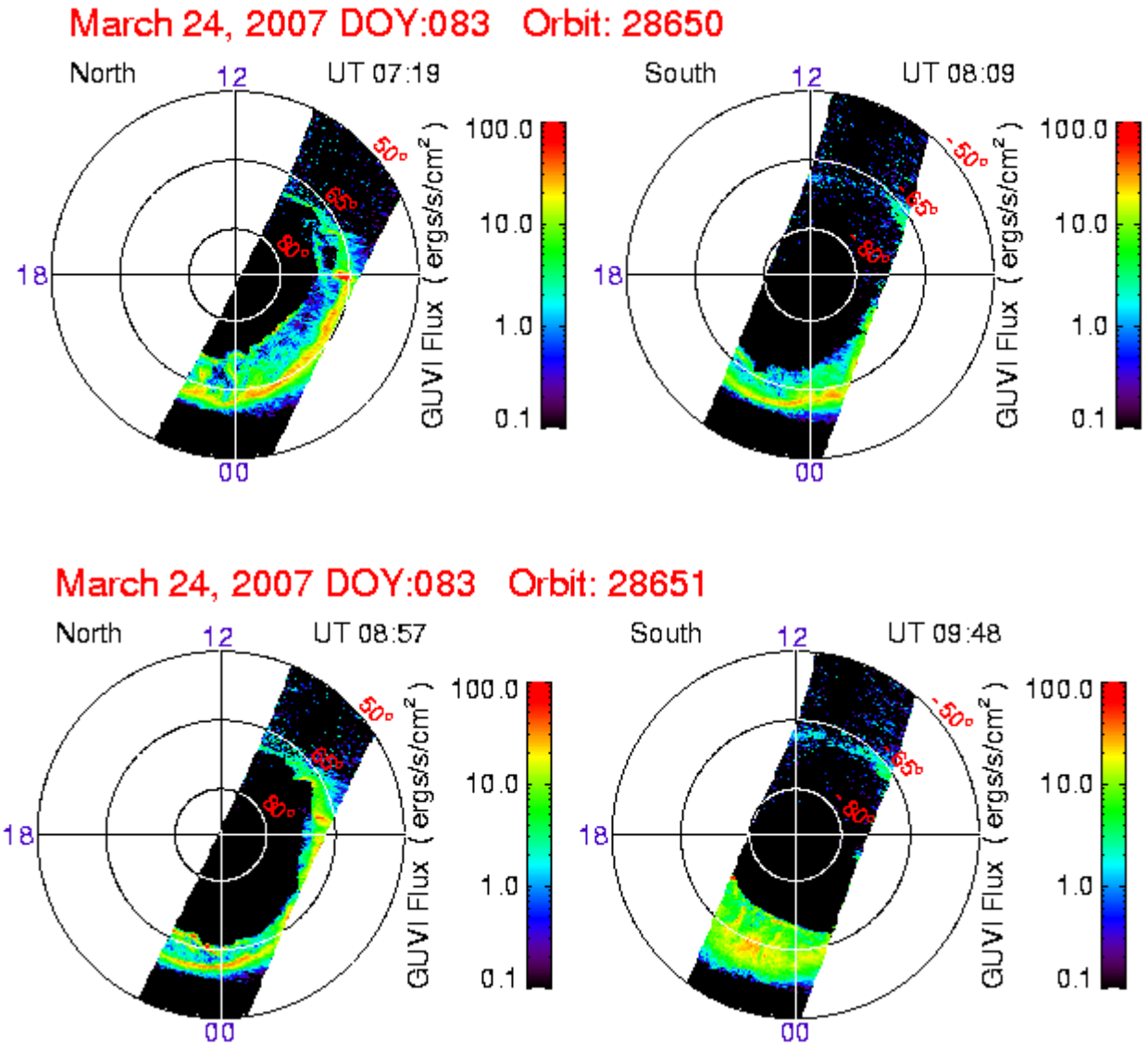
SAPS 2 = 64-65


February 28, 2007 DOY:059 Orbit: 28294
North
UT 07:18
South
UT 08:04
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1
February 28, 2007 DOY:059 Orbit: 28295
North
UT 08:54
South
UT 09:42

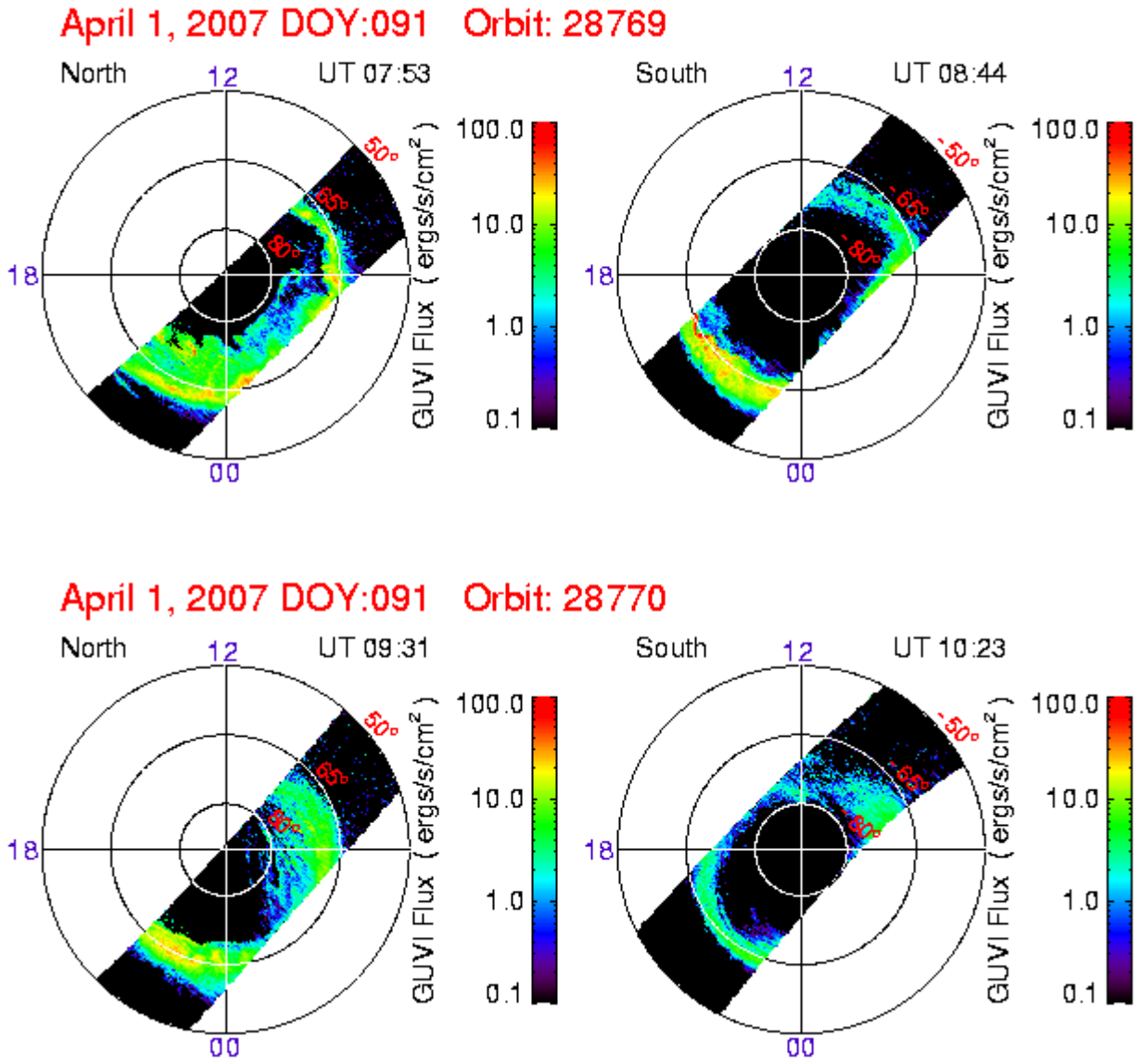
SAPS 3 = 63


March 25, 2007 DOY:084 Orbit: 28665
North
UT 07:36
South
UT 08:26
March 25, 2007 DOY:084 Orbit: 28666
North
UT 09:14
South
UT 10:05
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm^2)
100.0
10.0
1.0
0.1

SAPS 4 = 63 >> 59

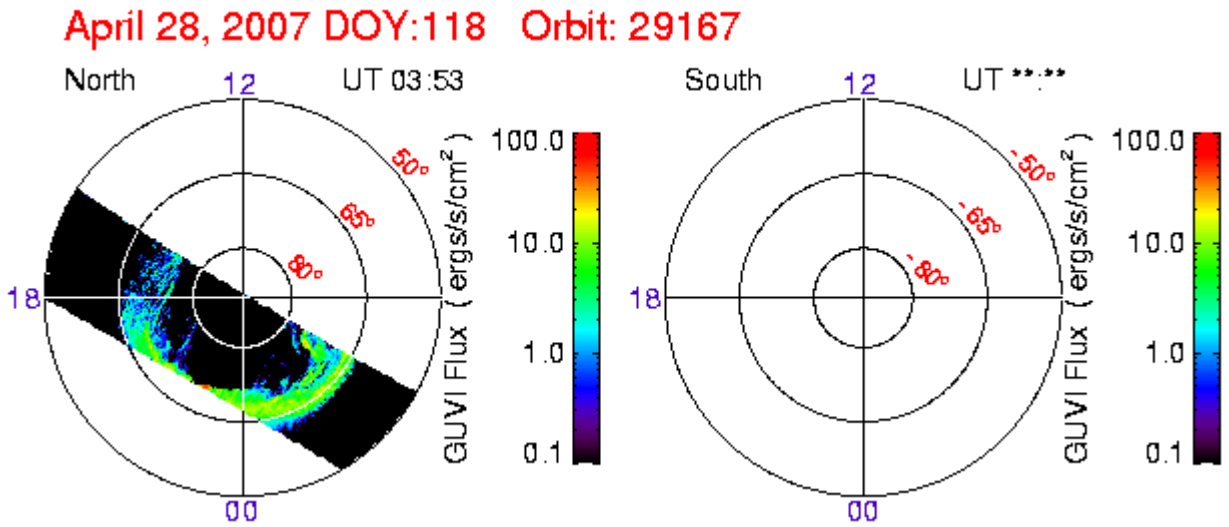

March 24, 2007 DOY:083 Orbit: 28650
North
UT 07:19
South
UT 08:09
March 24, 2007 DOY:083 Orbit: 28651
North
UT 08:57
South
UT 09:48
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1

SAPS 5 = 59 >> 64


April 1, 2007 DOY:091 Orbit: 28769
North
UT 07:53
South
UT 08:44
April 1, 2007 DOY:091 Orbit: 28770
North
UT 09:31
South
UT 10:23
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1

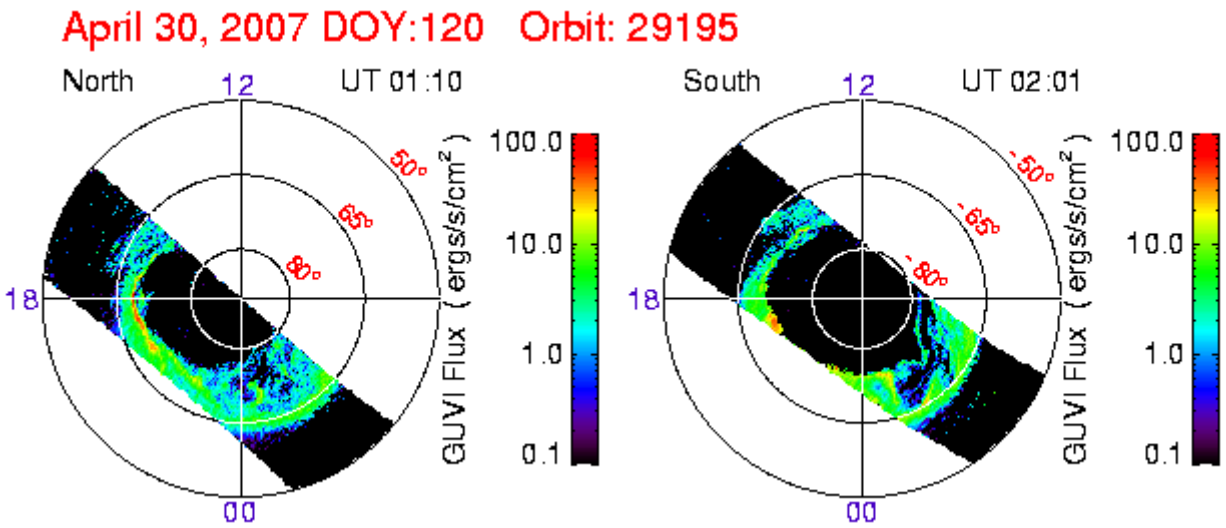
SAPS 6 =

No data

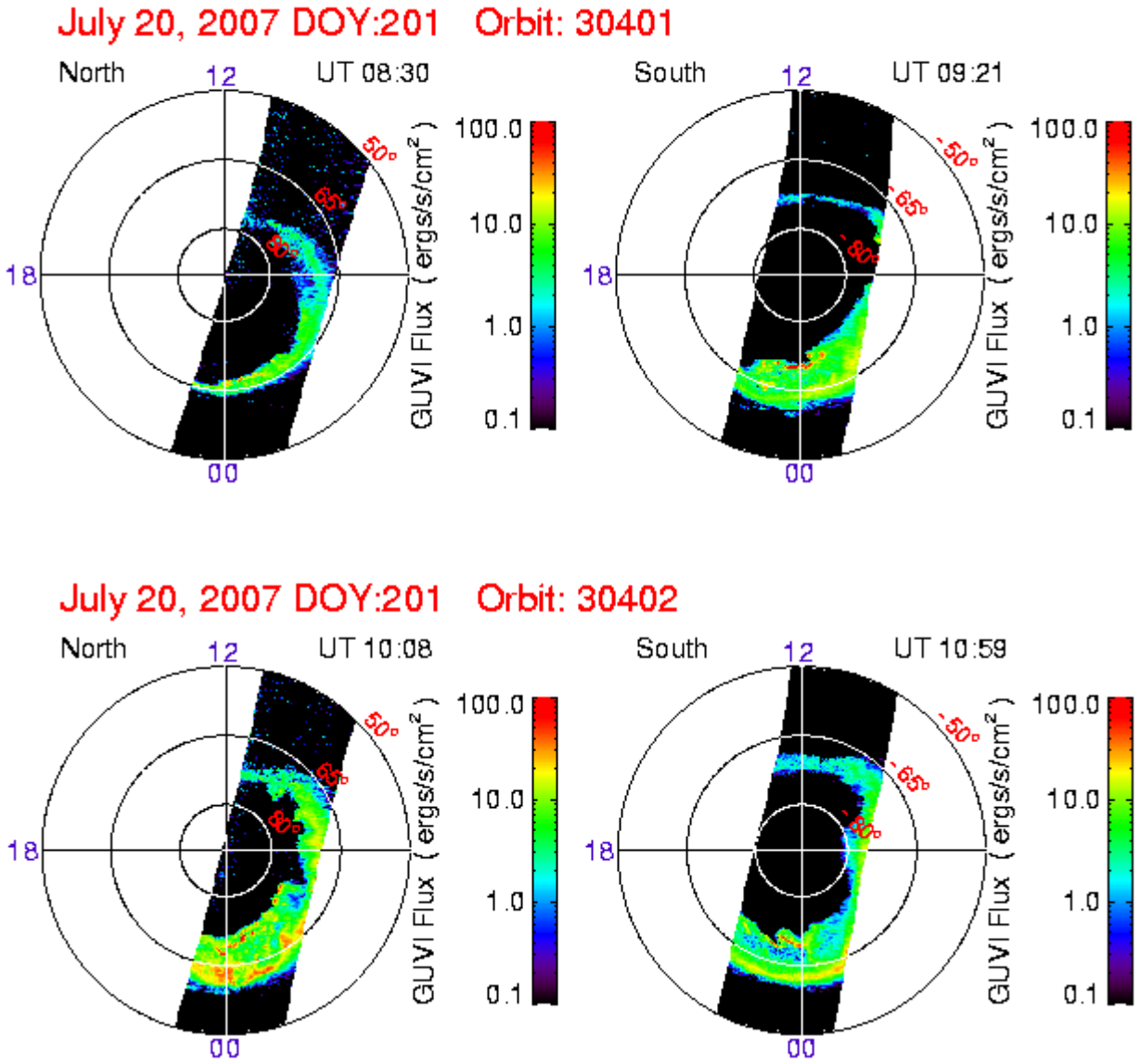


SAPS 7 =

No data

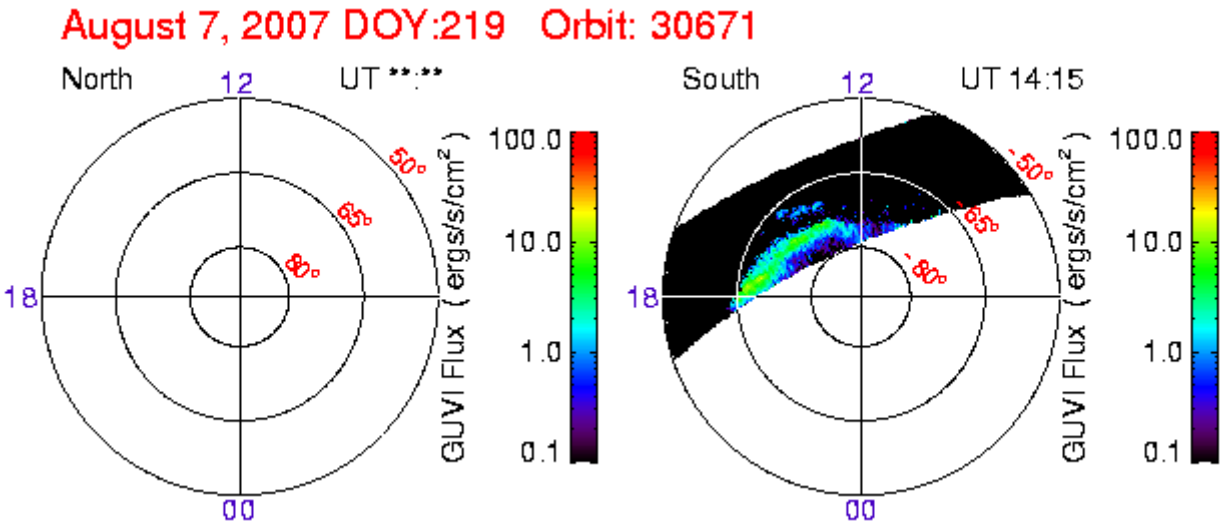


SAPS 8 = 70 >> 64

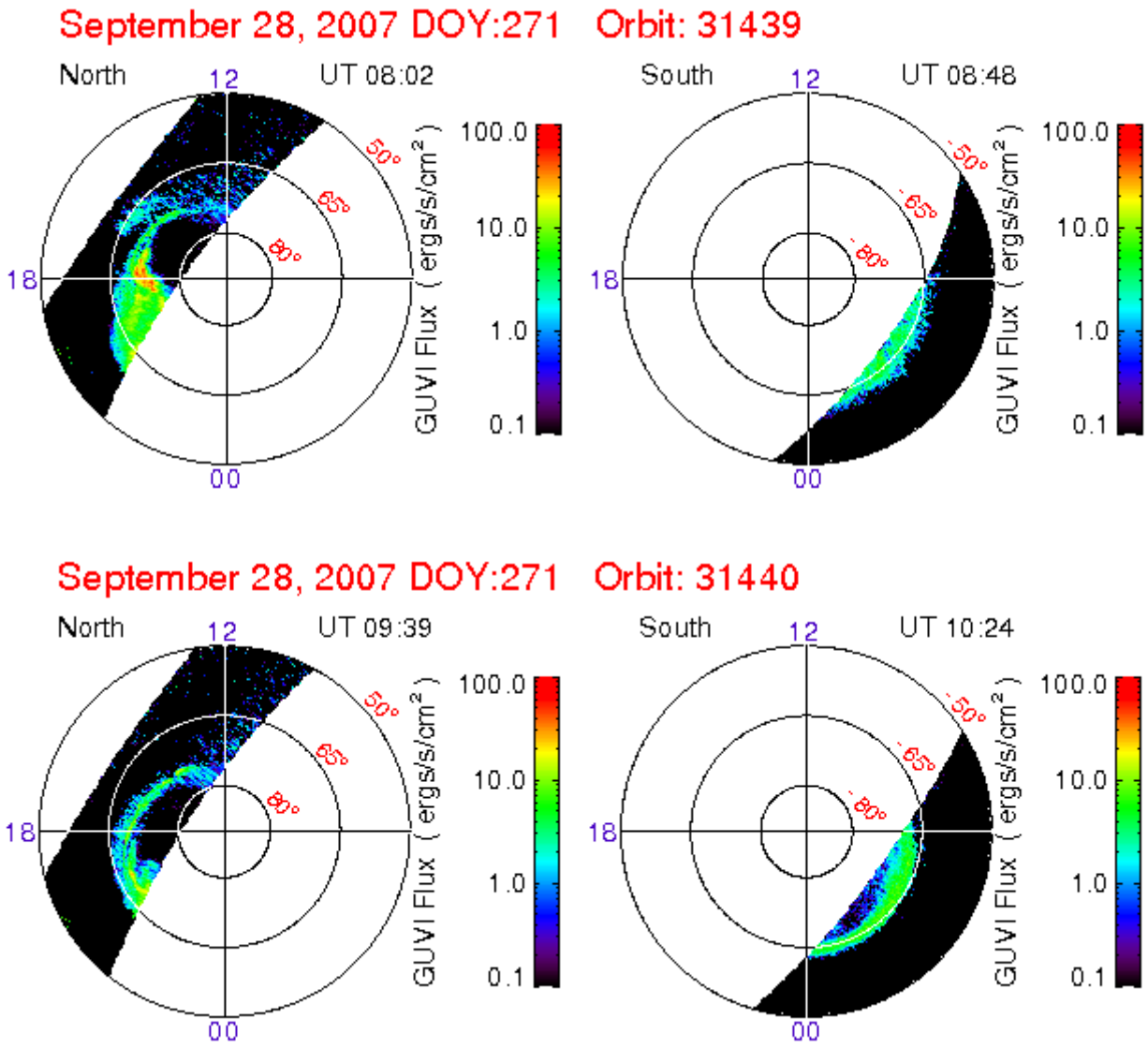

July 20, 2007 DOY:201 Orbit: 30401
North
UT 08:30
South
UT 09:21
July 20, 2007 DOY:201 Orbit: 30402
North
UT 10:08
South
UT 10:59
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1

SAPS 9 =

No data



SAPS 10 = 63-65

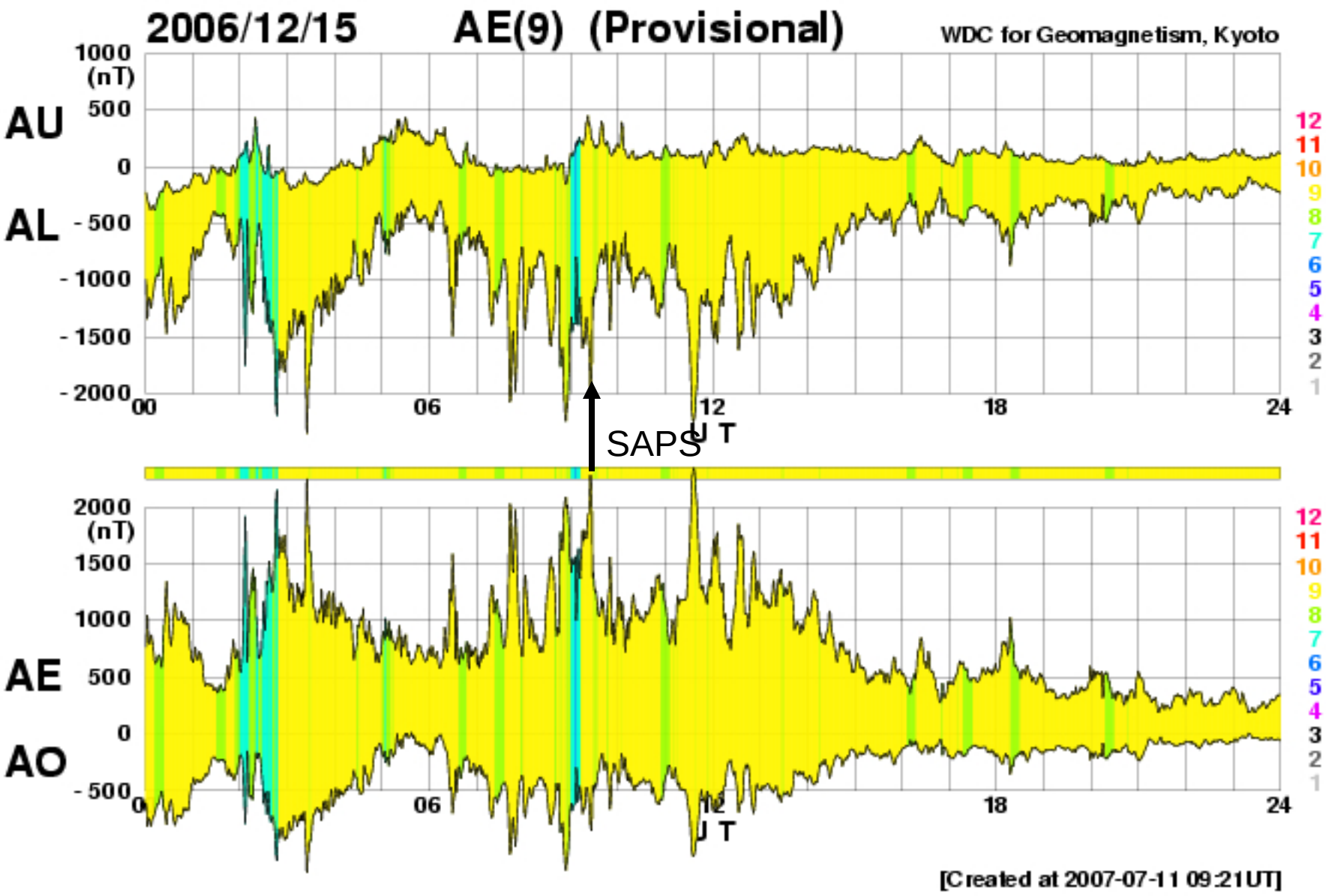

September 28, 2007 DOY:271 Orbit: 31439
North
UT 08:02
South
UT 08:48
September 28, 2007 DOY:271 Orbit: 31440
North
UT 09:39
South
UT 10:24
12
18
00
50°
65°
80°
-50°
-65°
-80°
GUVI Flux (ergs/s/cm²)
100.0
10.0
1.0
0.1

SAPS 11 = 65-70

No data

Appendix 2

Substorm recovery check


2006/12/15
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
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18
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U T
SAPS
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4
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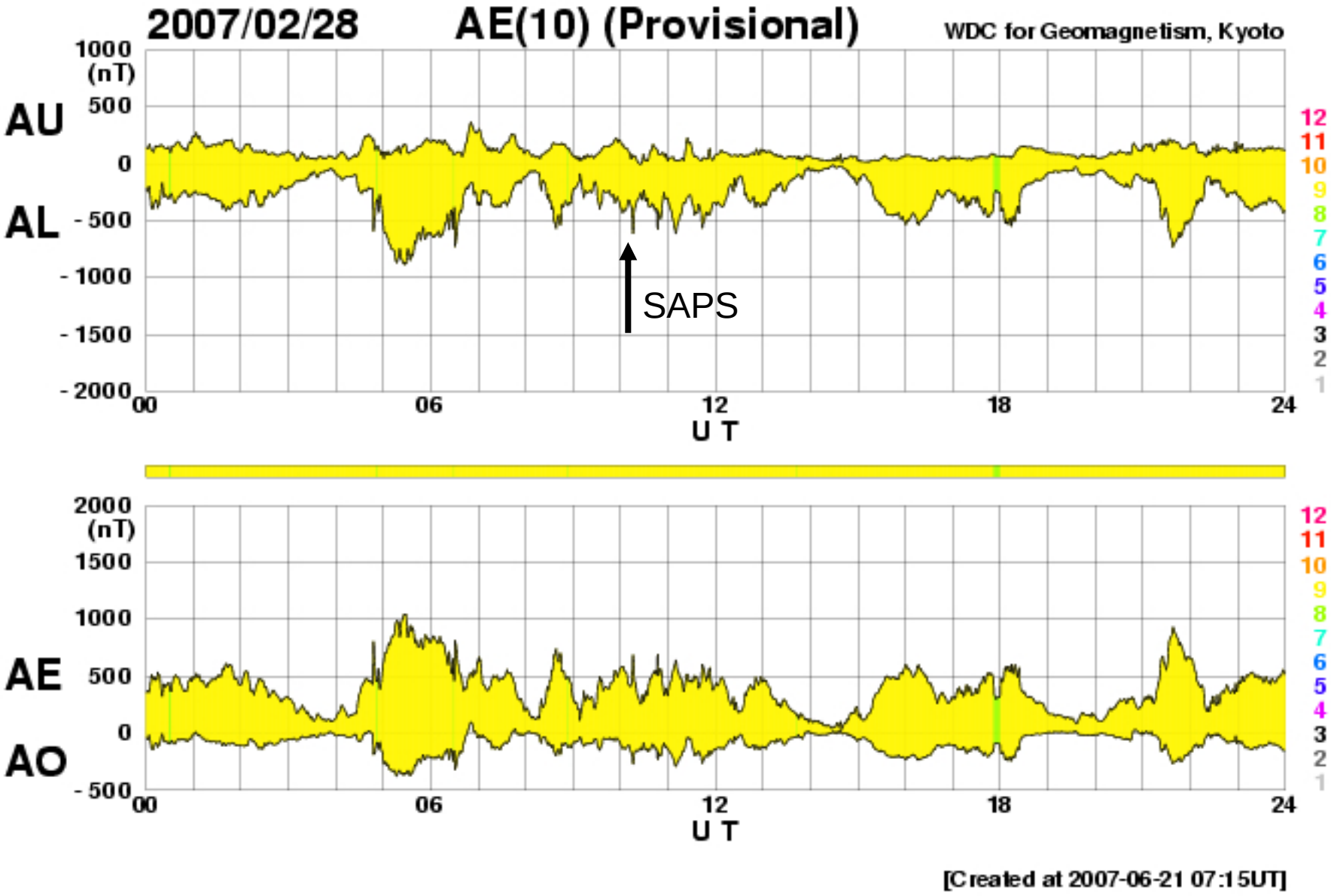
2
1
AE
AO
2000
(nT)
1500
1000
500
0
- 500
[Created at 2007-07-11 09:21UT]


2007/02/28
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
SAPS
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AE
AO
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(nT)
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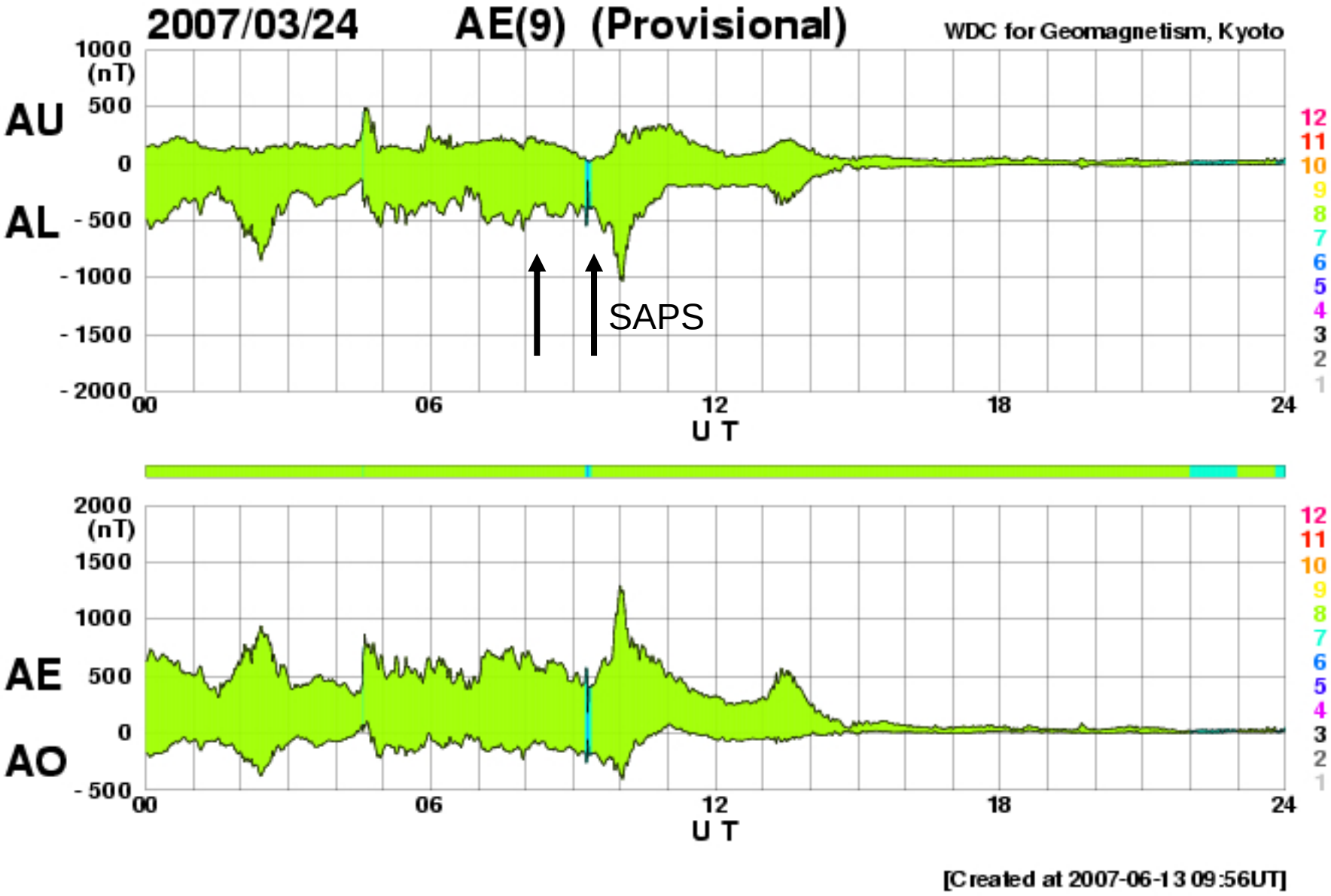
1
[Created at 2007-06-21 07:15UT]


2007/03/24
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
SAPS
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U T
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(nT)
1500
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- 500
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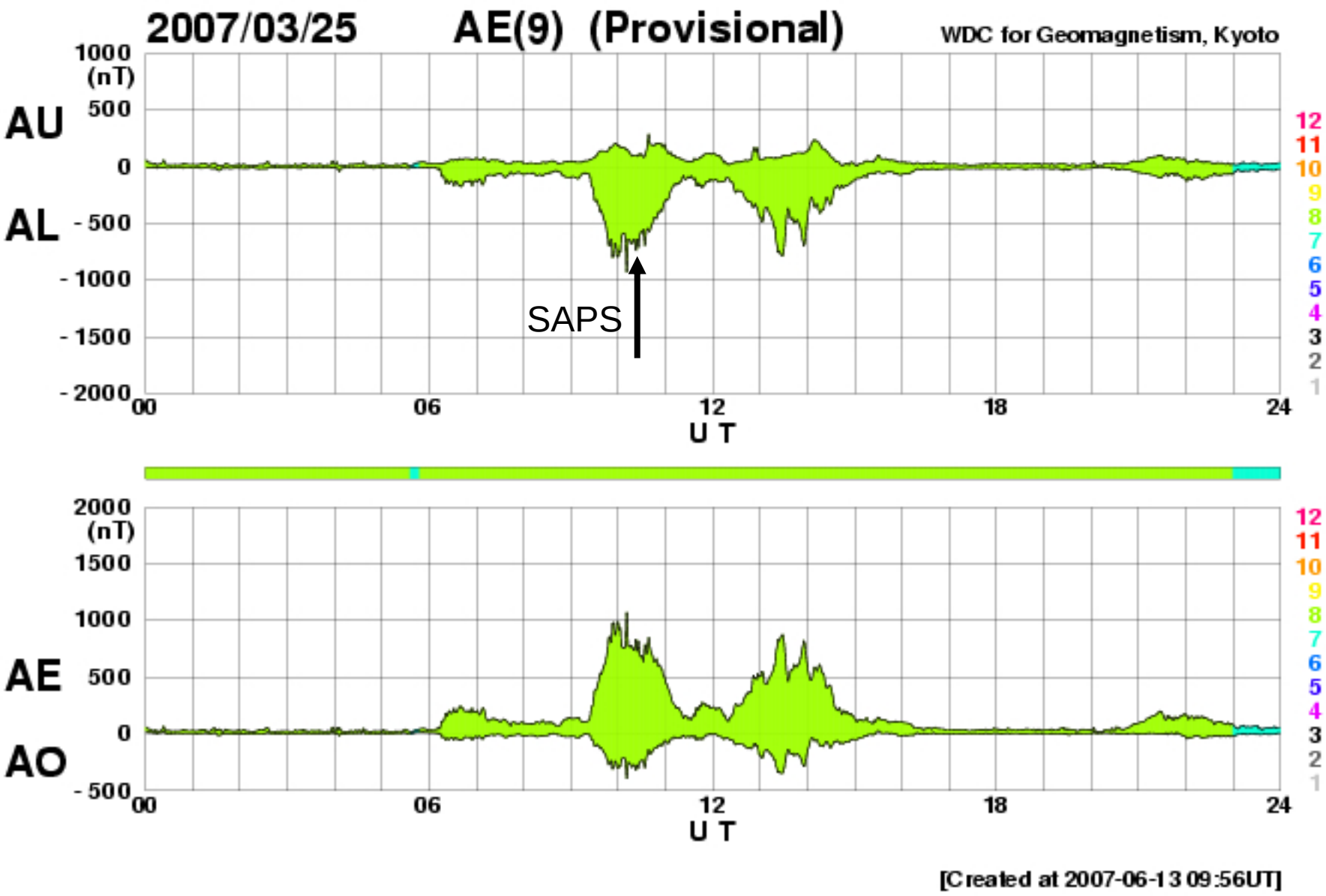
[Created at 2007-06-13 09:56UT]


2007/03/25
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
SAPS
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06
12
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24
U T
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AE
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2000
(nT)
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- 500
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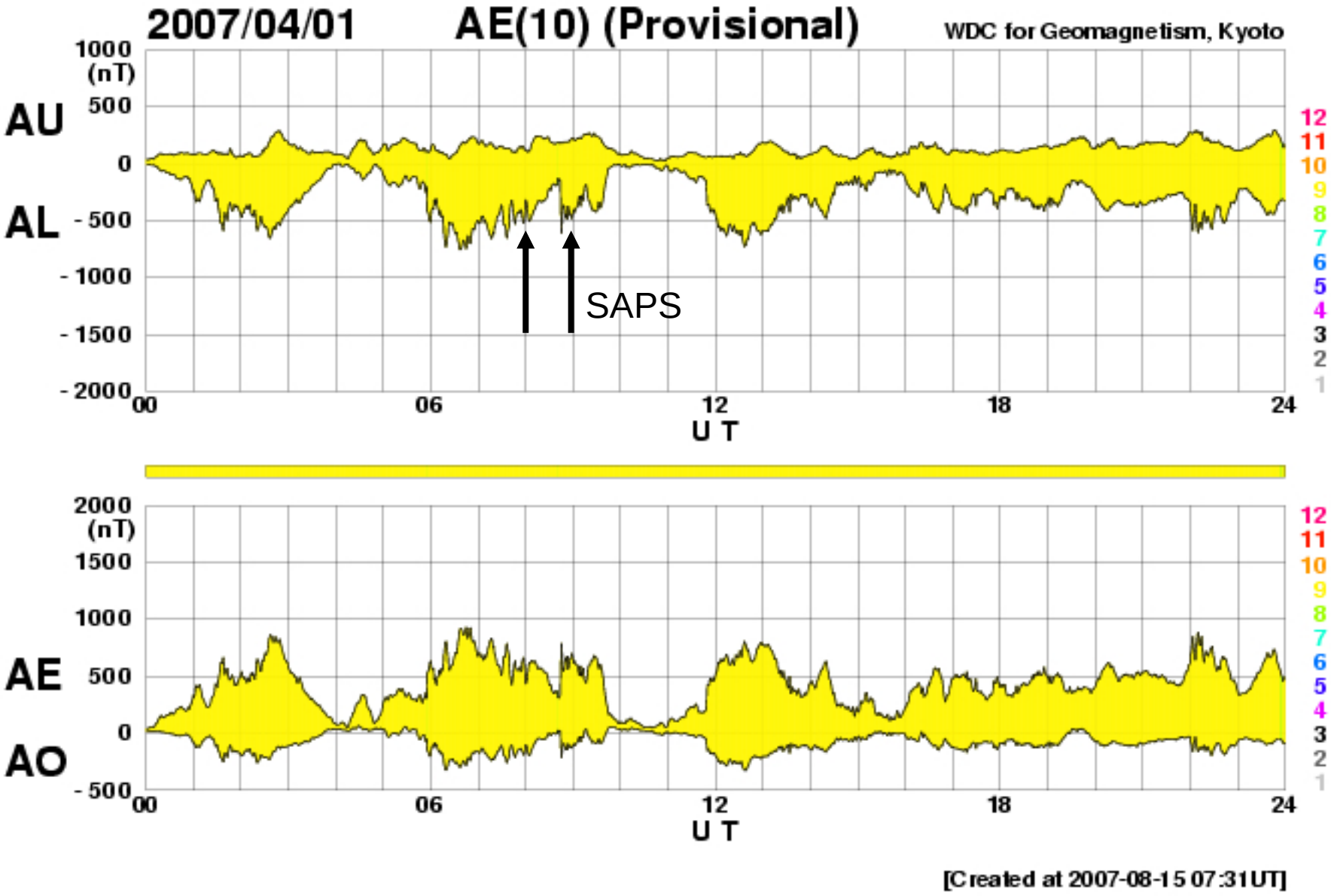
7
6
5
4
3
2
1
[Created at 2007-06-13 09:56UT]


2007/04/01
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
SAPS
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12
18
24
U T
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(nT)
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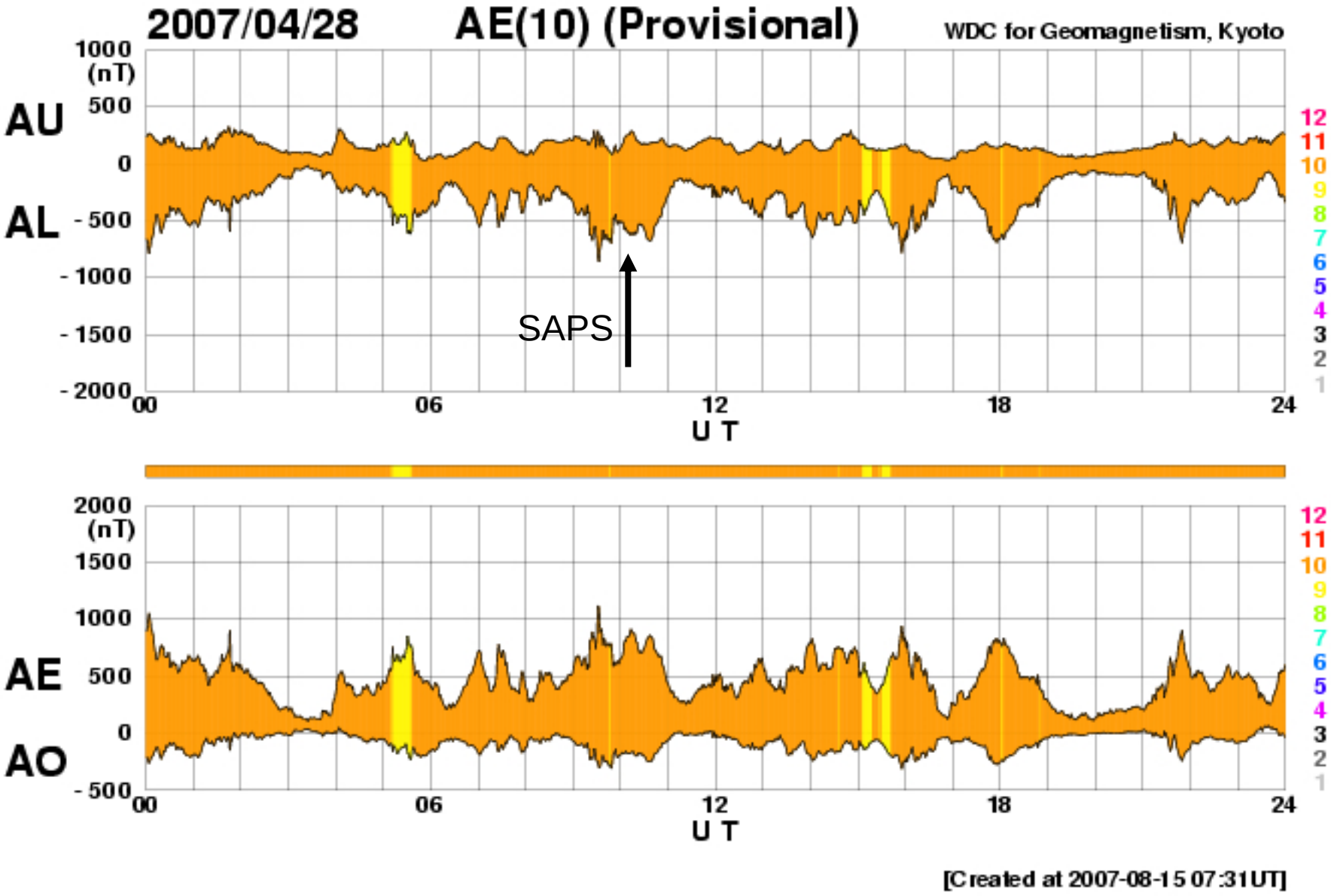
[Created at 2007-08-15 07:31UT]


2007/04/28
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
SAPS
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(nT)
1500
1000
500
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- 500
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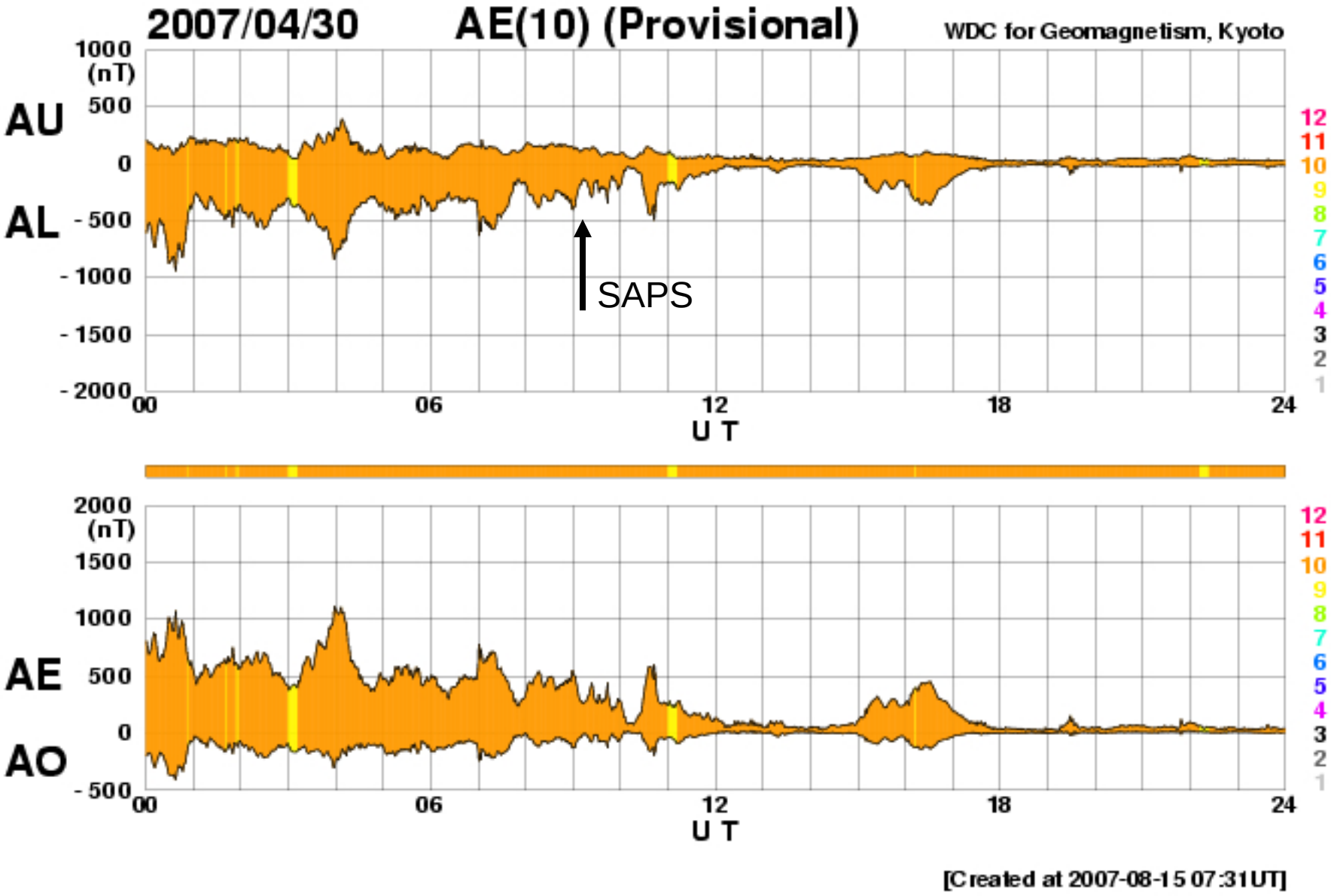
2
1
[Created at 2007-08-15 07:31UT]


2007/04/30
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
SAPS
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AE
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(nT)
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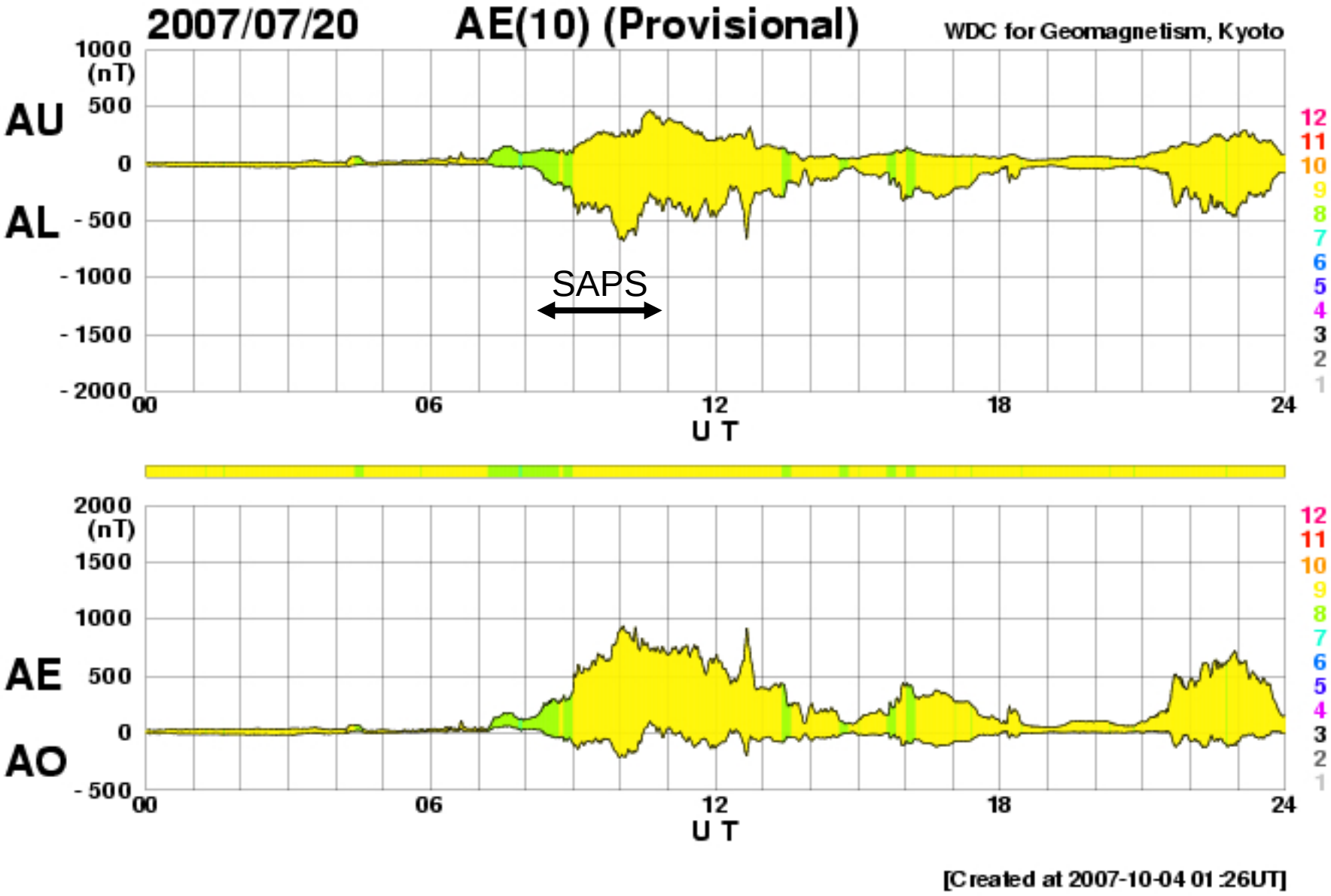
2
1
[Created at 2007-08-15 07:31UT]


2007/07/20
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
SAPS
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(nT)
1500
1000
500
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- 500
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AO
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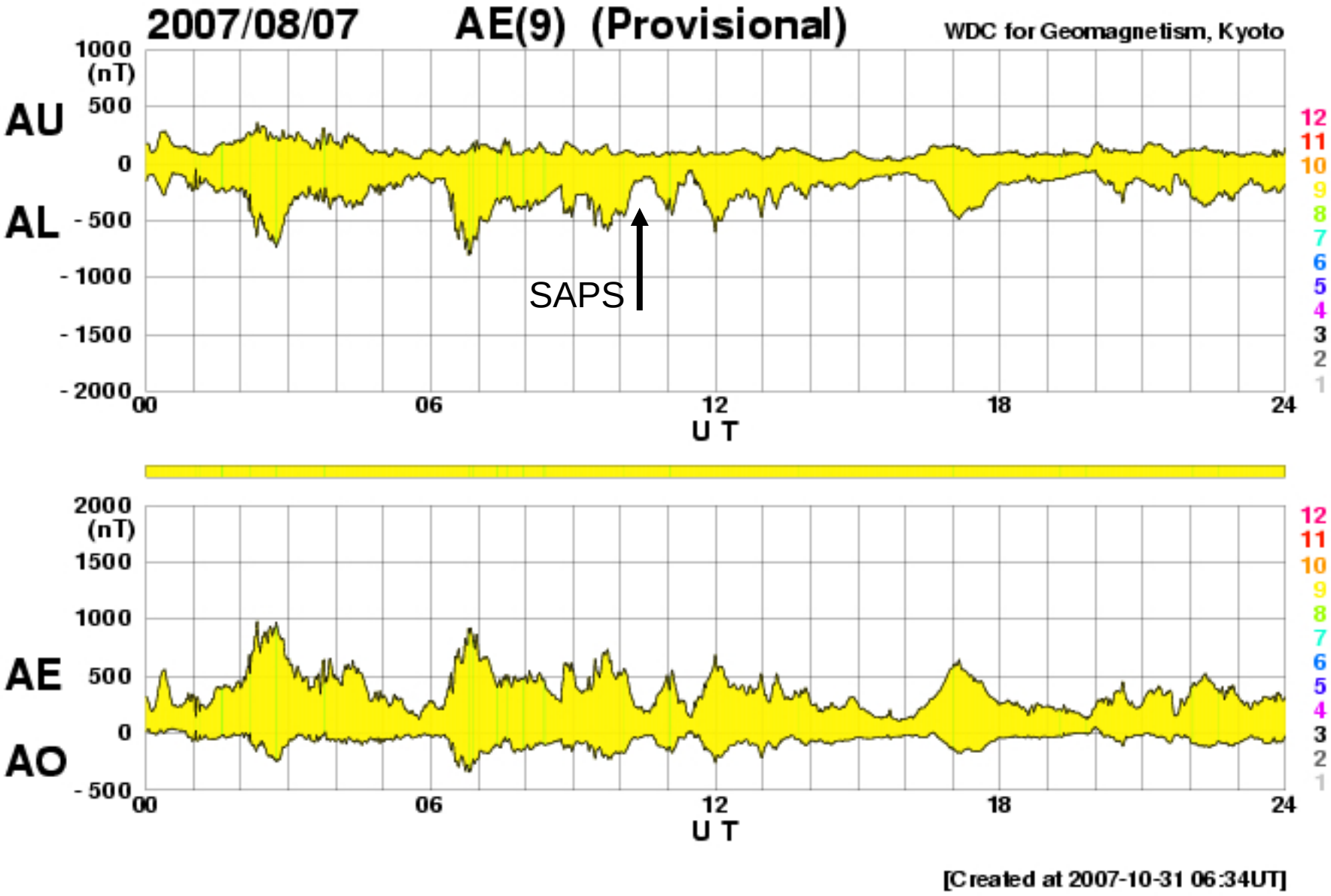
1
[Created at 2007-10-04 01:26UT]


2007/08/07
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
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- 500
- 1000
- 1500
- 2000
SAPS
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(nT)
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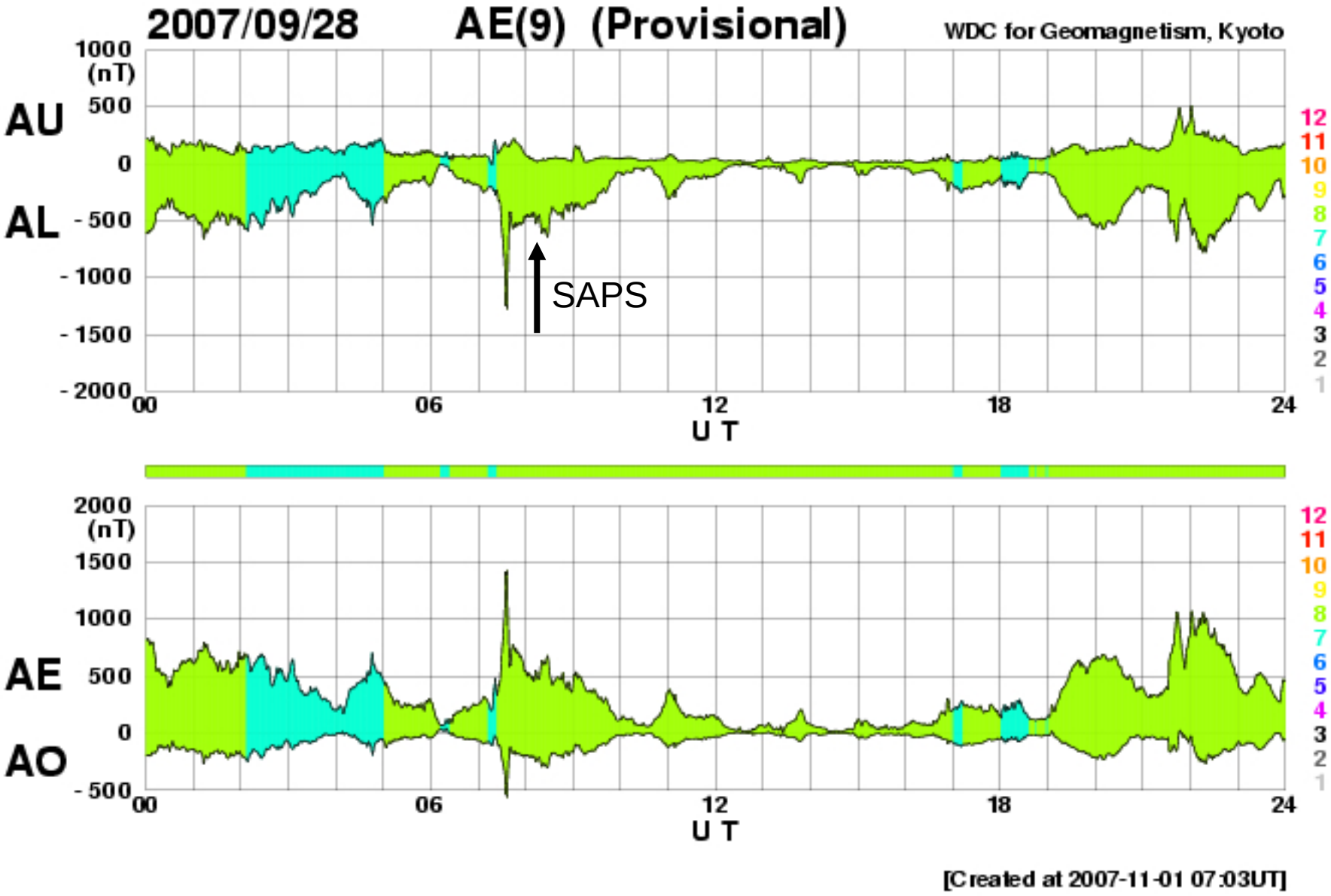
1
[Created at 2007-10-31 06:34UT]


2007/09/28
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
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- 500
- 1000
- 1500
- 2000
SAPS
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(nT)
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1000
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- 500
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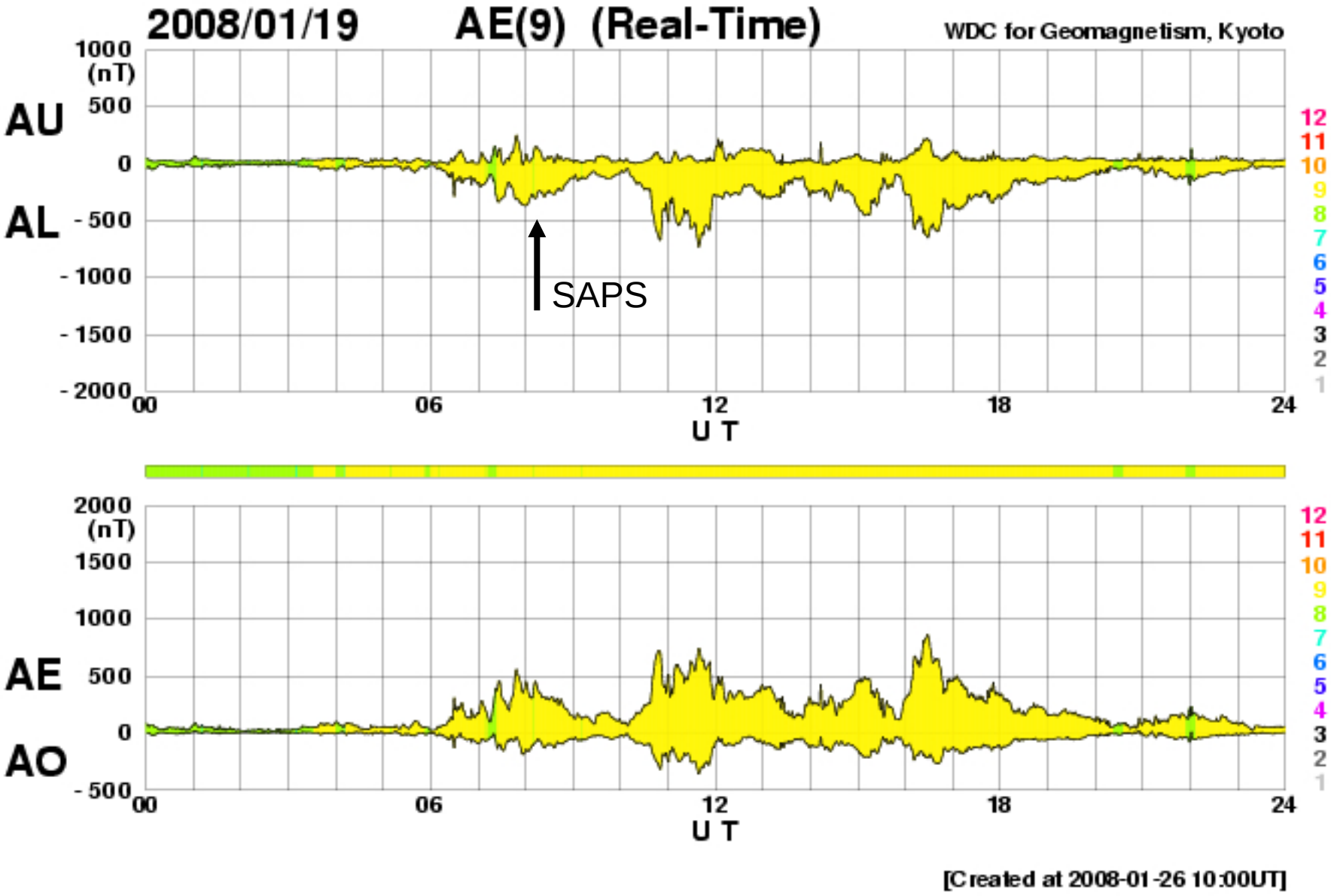
1
[Created at 2007-11-01 07:03UT]


2008/01/19
AE(9) (Real-Time)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
SAPS
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AE
AO
2000
(nT)
1500
1000
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6
5
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3
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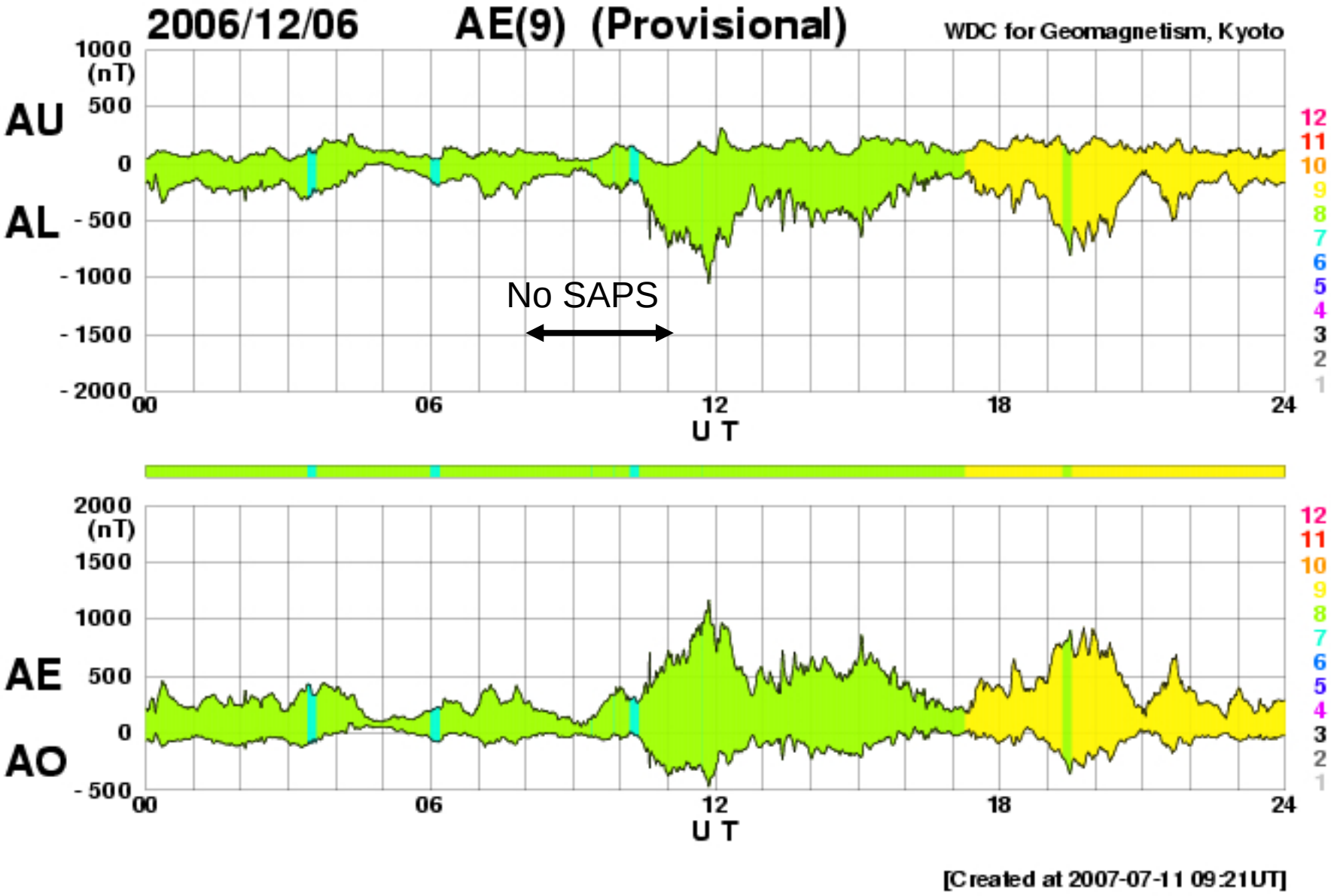
1
[Created at 2008-01-26 10:00UT]

Appendix 3

Why no SAPS?


2006/12/06
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
No SAPS
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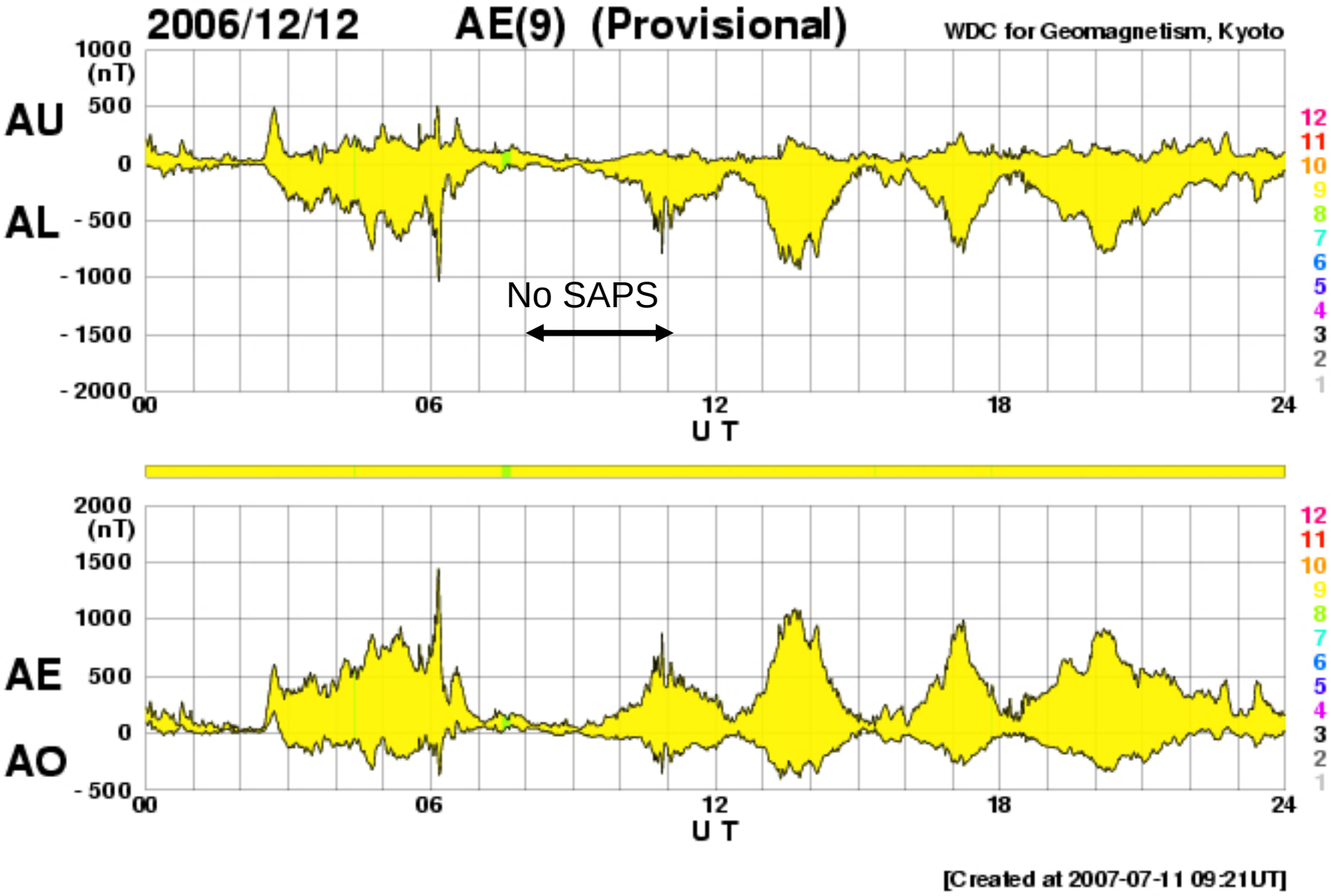
[Created at 2007-07-11 09:21UT]


2006/12/12
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
No SAPS
00
06
12
18
24
U T
AE
AO
2000
(nT)
1500
1000
500
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- 500
12
11
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8
7
6
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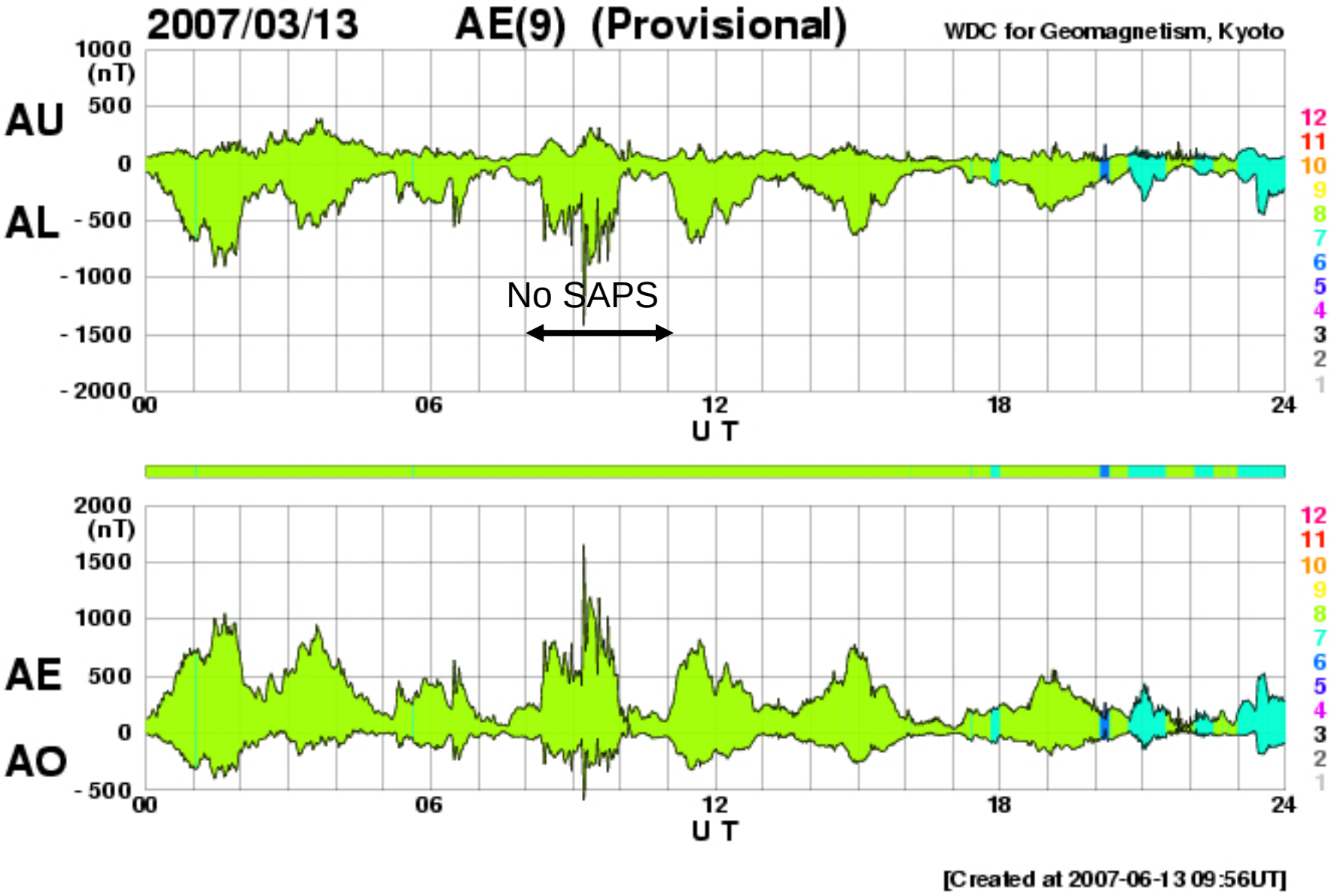
4
3
2
1
[Created at 2007-07-11 09:21UT]


2007/03/13
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
No SAPS
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6
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4
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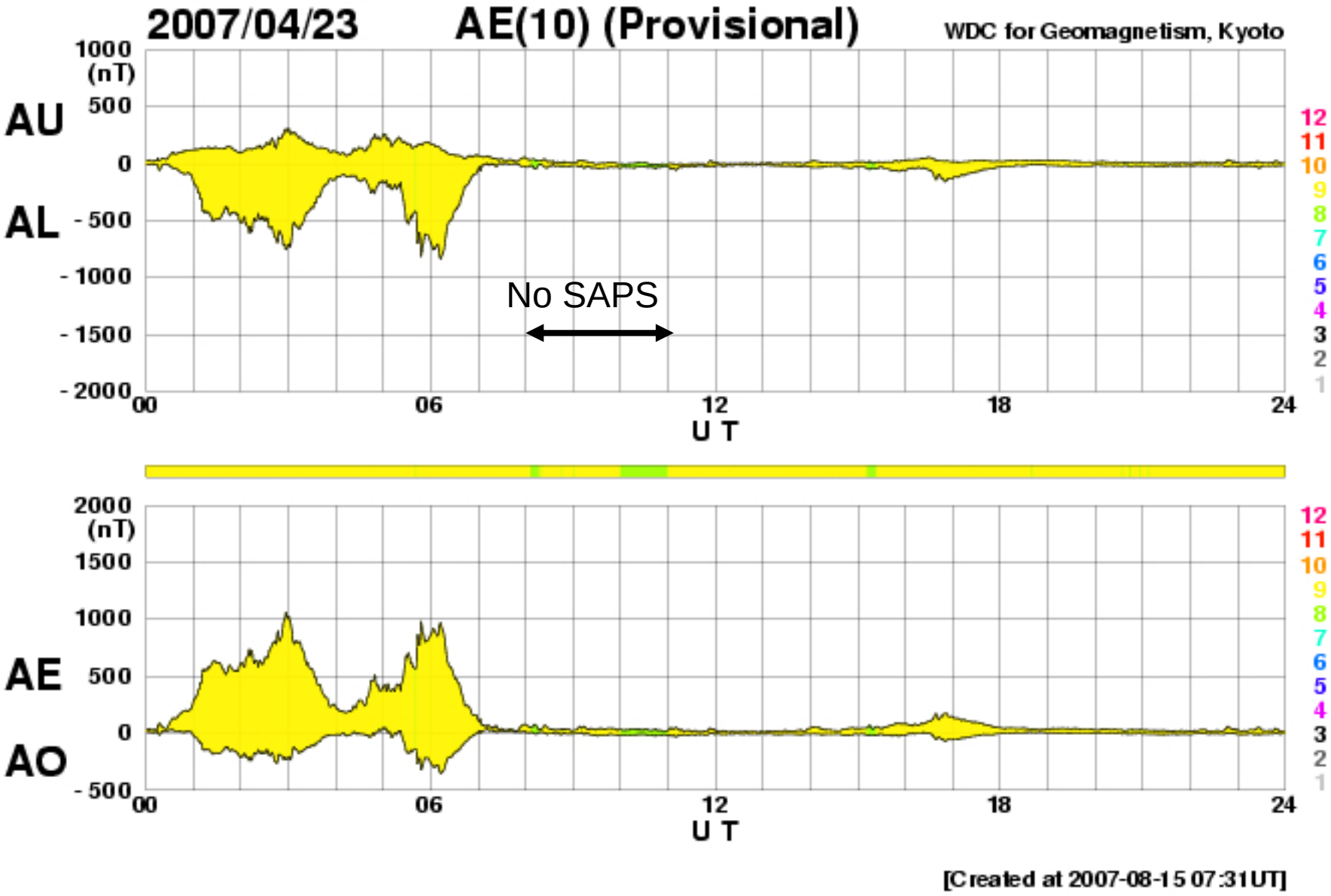
2
1
[Created at 2007-06-13 09:56UT]


2007/04/23
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
No SAPS
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24
U T
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(nT)
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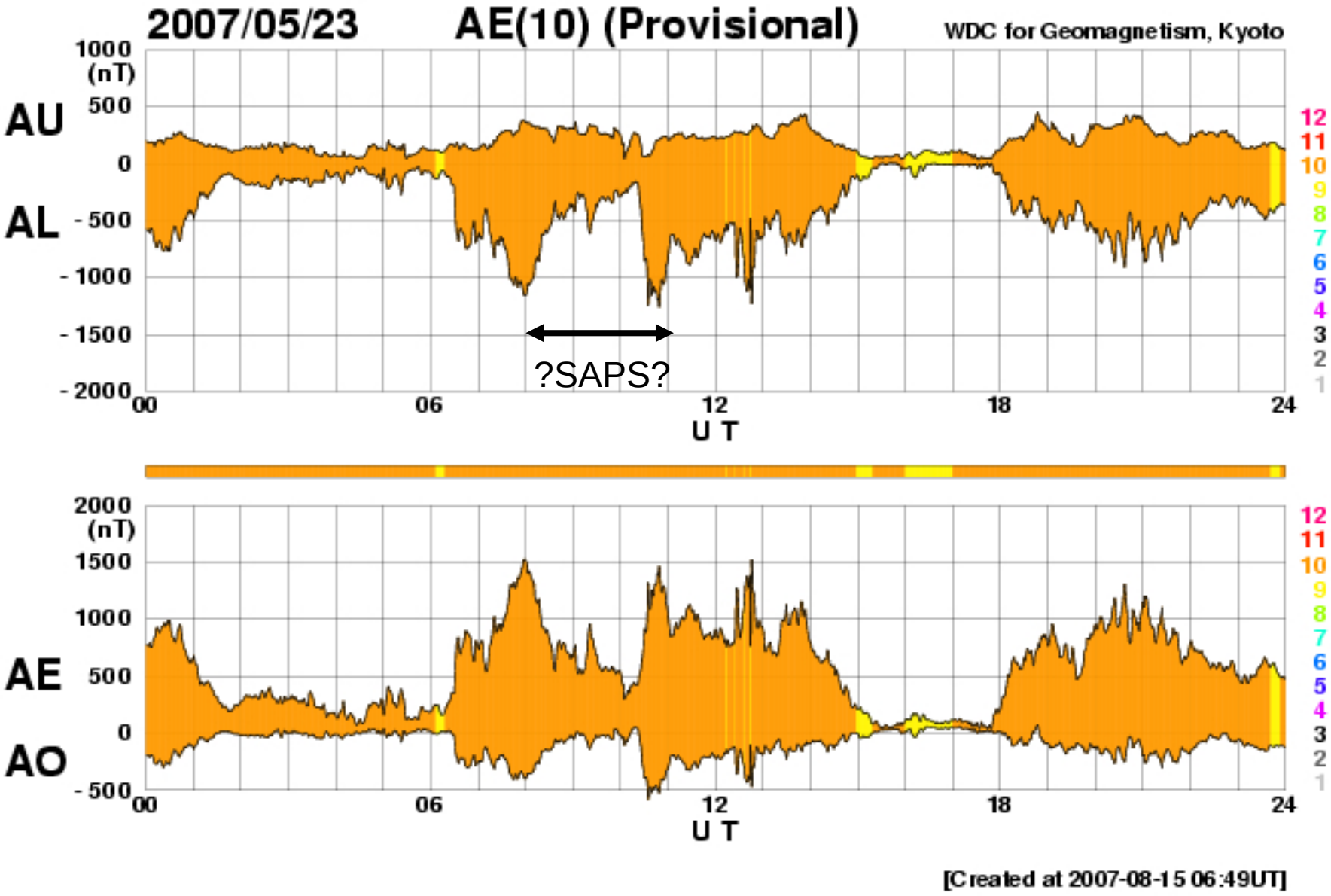
[Created at 2007-08-15 07:31UT]


2007/05/23
AE(10) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
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- 500
- 1000
- 1500
- 2000
AU
AL
?SAPS?
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24
U T
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(nT)
1500
1000
500
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- 500
AE
AO
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U T
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6
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2
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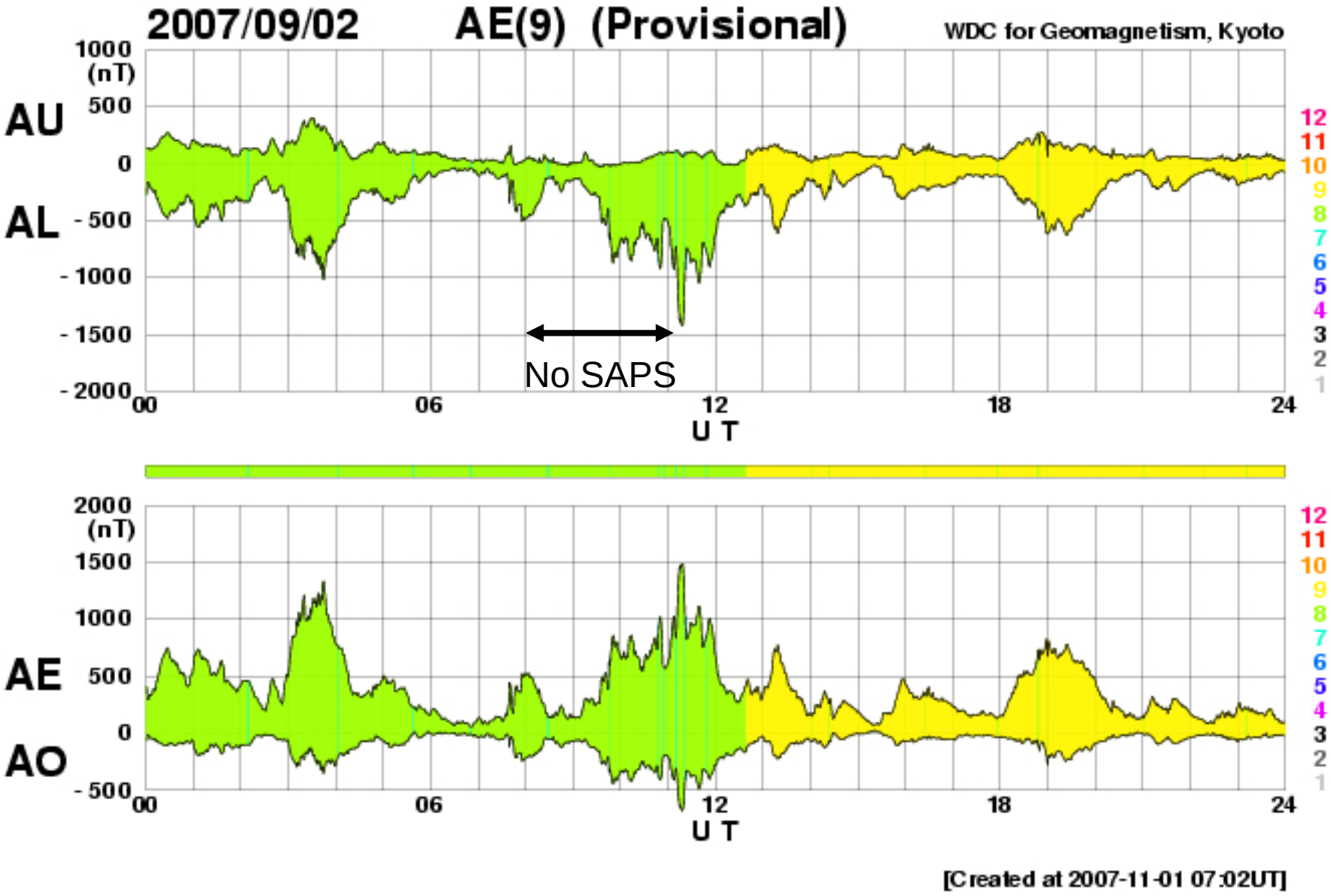
[Created at 2007-08-15 06:49UT]


2007/09/02
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
No SAPS
00
06
12
18
24
U T
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(nT)
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1000
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AE
AO
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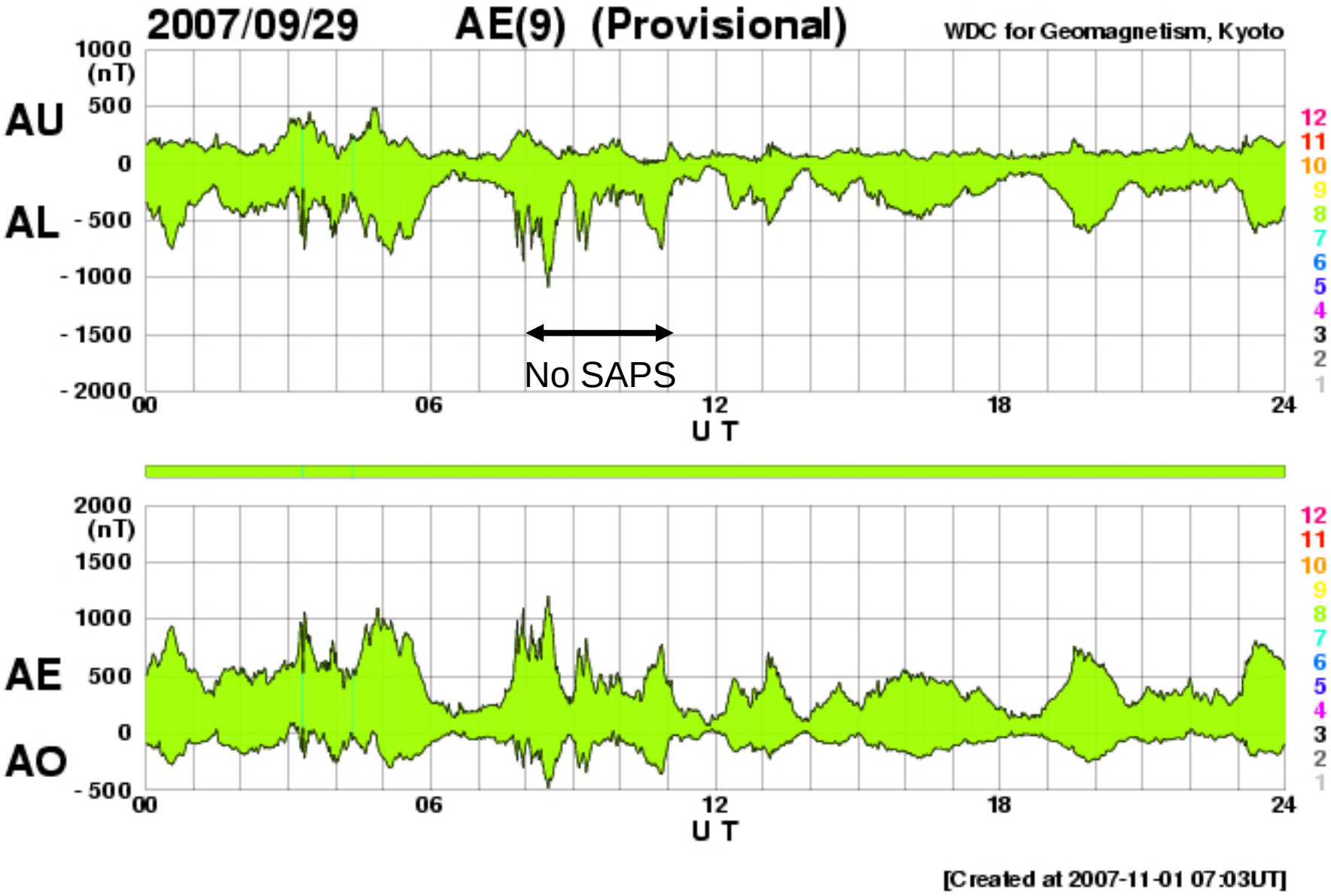
2
1
[Created at 2007-11-01 07:02UT]


2007/09/29
AE(9) (Provisional)
WDC for Geomagnetism, Kyoto
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
AU
AL
No SAPS
00
06
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18
24
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(nT)
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1000
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AE
AO
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24
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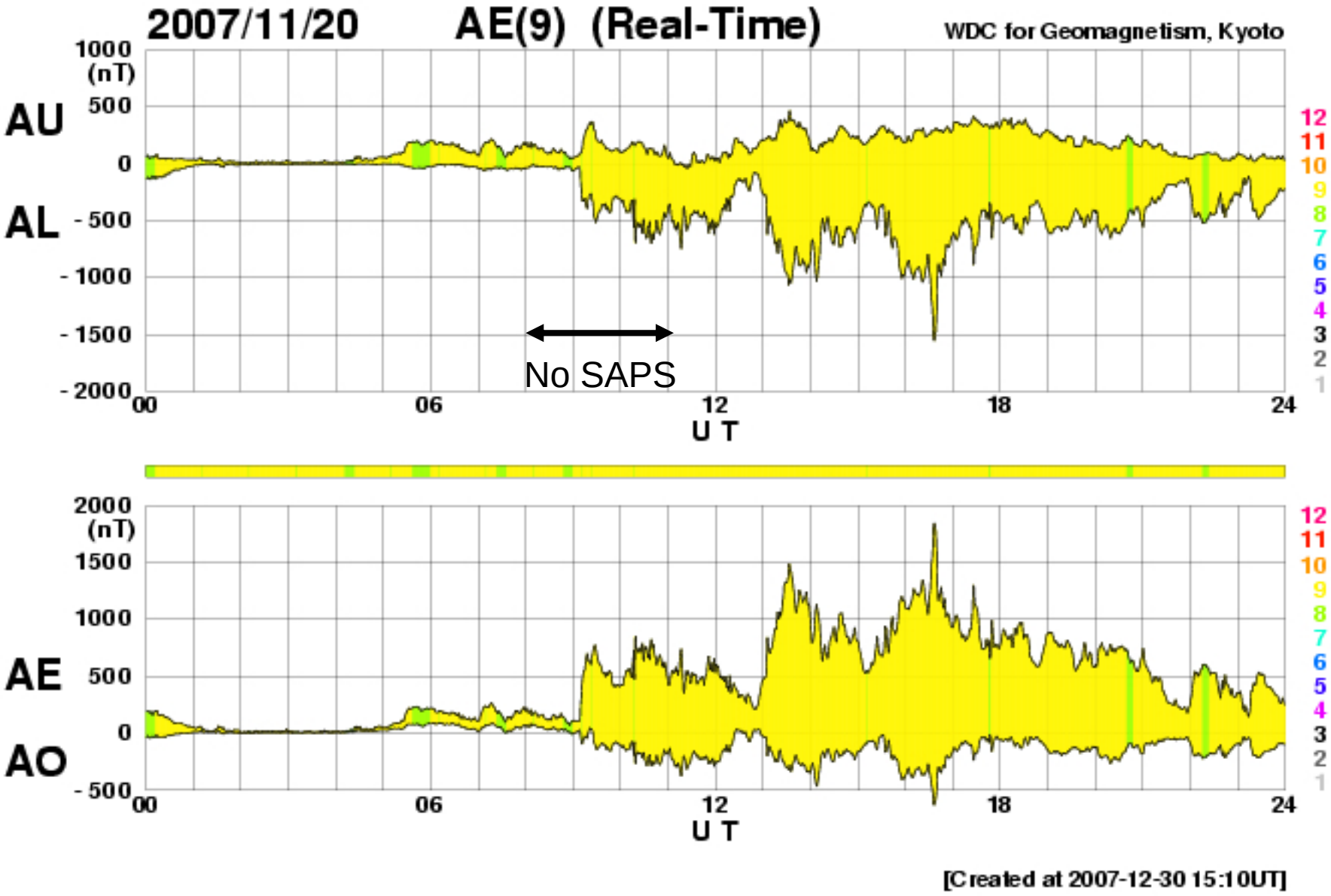
8
7
6
5
4
3
2
1
[Created at 2007-11-01 07:03UT]


2007/11/20
AE(9) (Real-Time)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
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- 500
- 1000
- 1500
- 2000
No SAPS
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AO
2000
(nT)
1500
1000
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- 500
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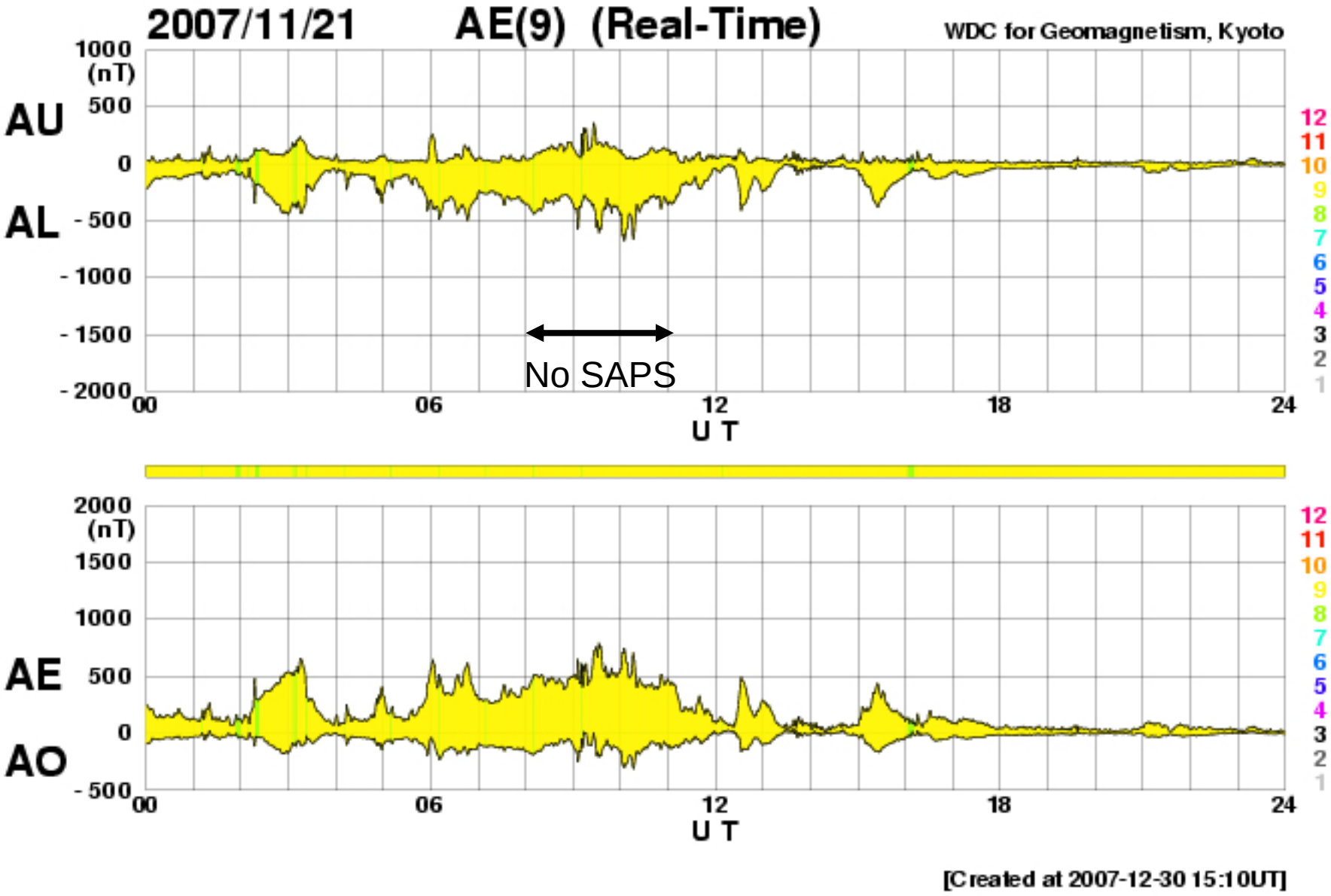
[Created at 2007-12-30 15:10UT]


2007/11/21
AE(9) (Real-Time)
WDC for Geomagnetism, Kyoto
AU
AL
1000
(nT)
500
0
- 500
- 1000
- 1500
- 2000
No SAPS
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18
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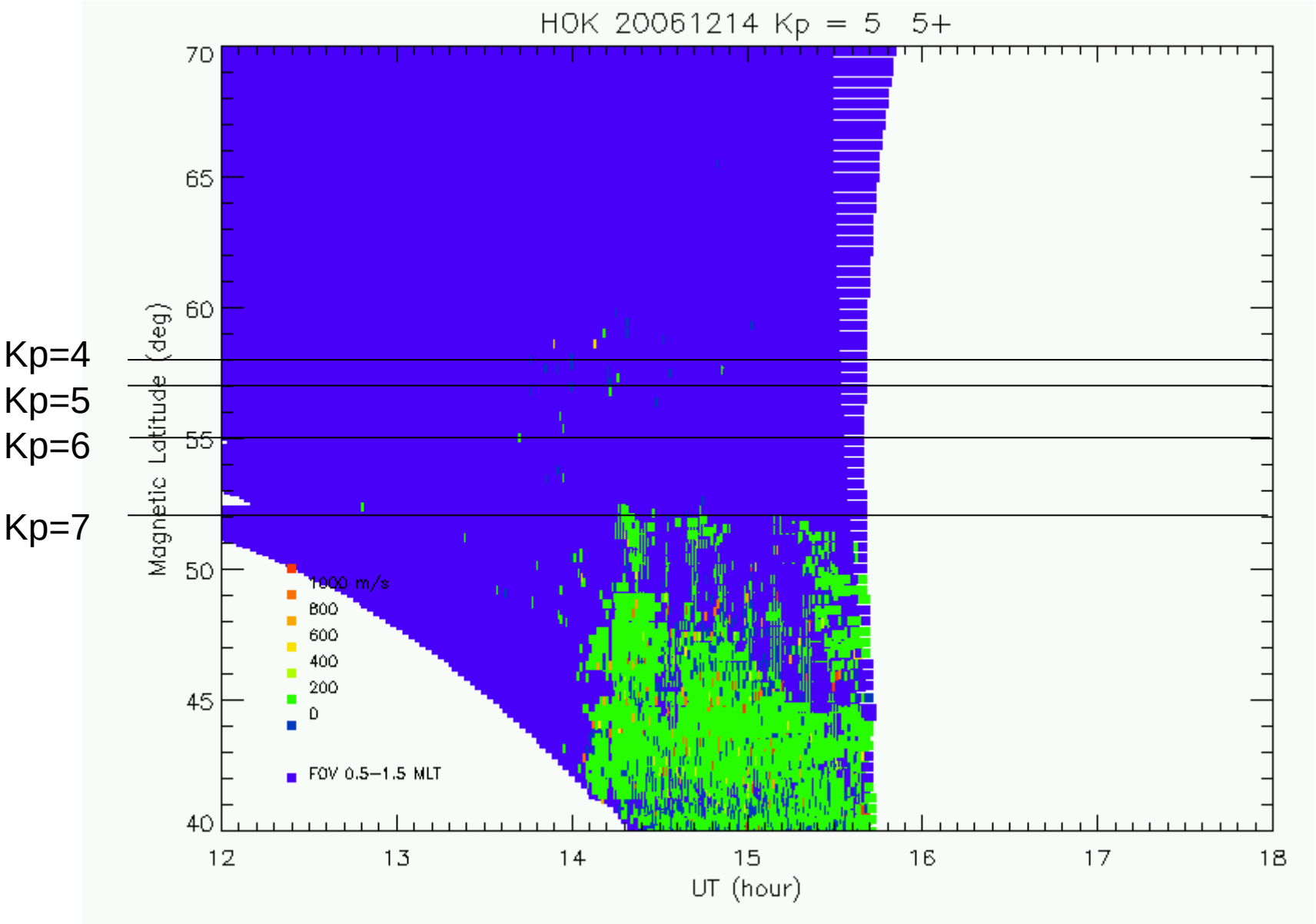
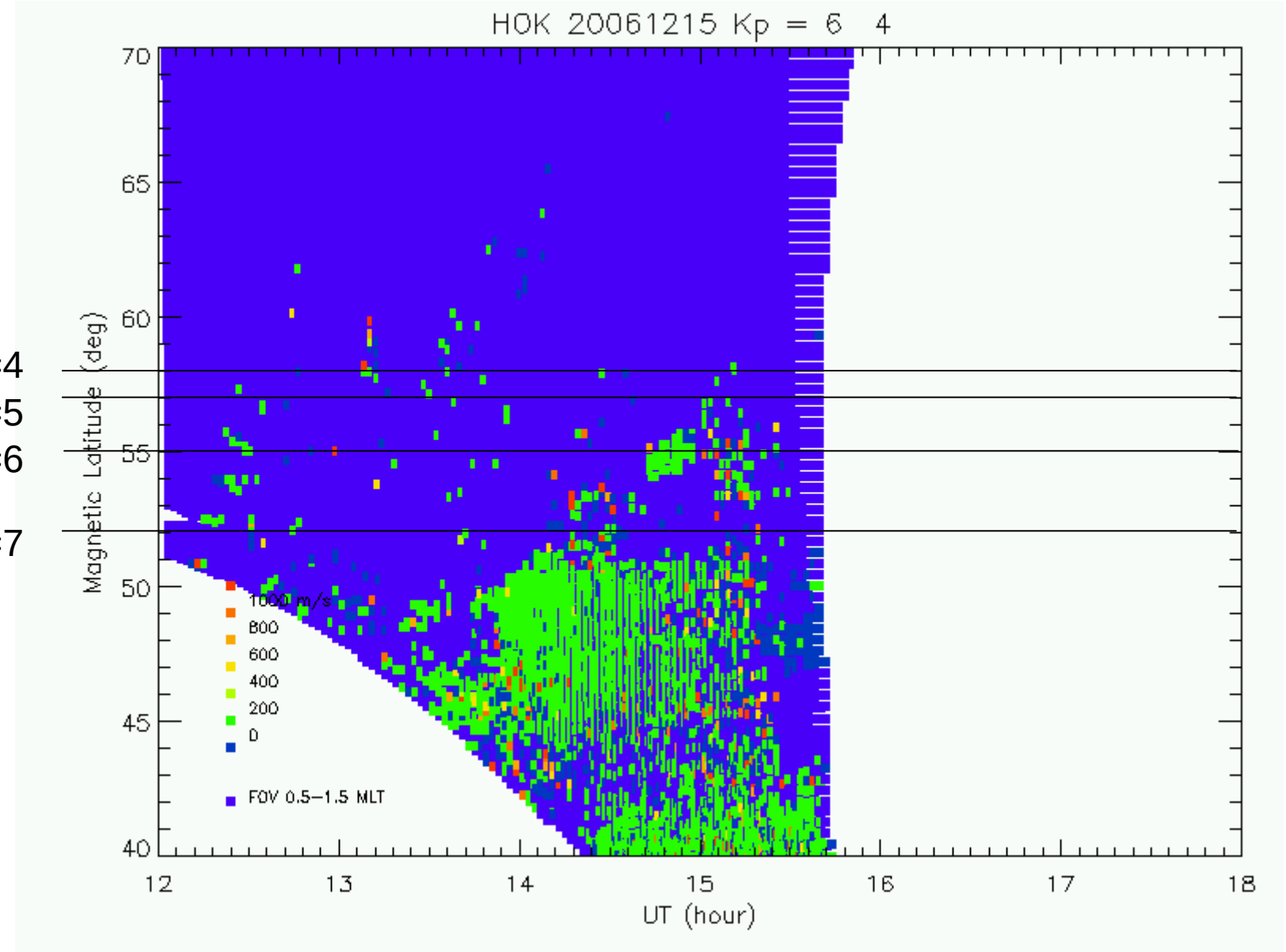
U T
AE
AO
2000
(nT)
1500
1000
500
0
- 500
[Created at 2007-12-30 15:10UT]

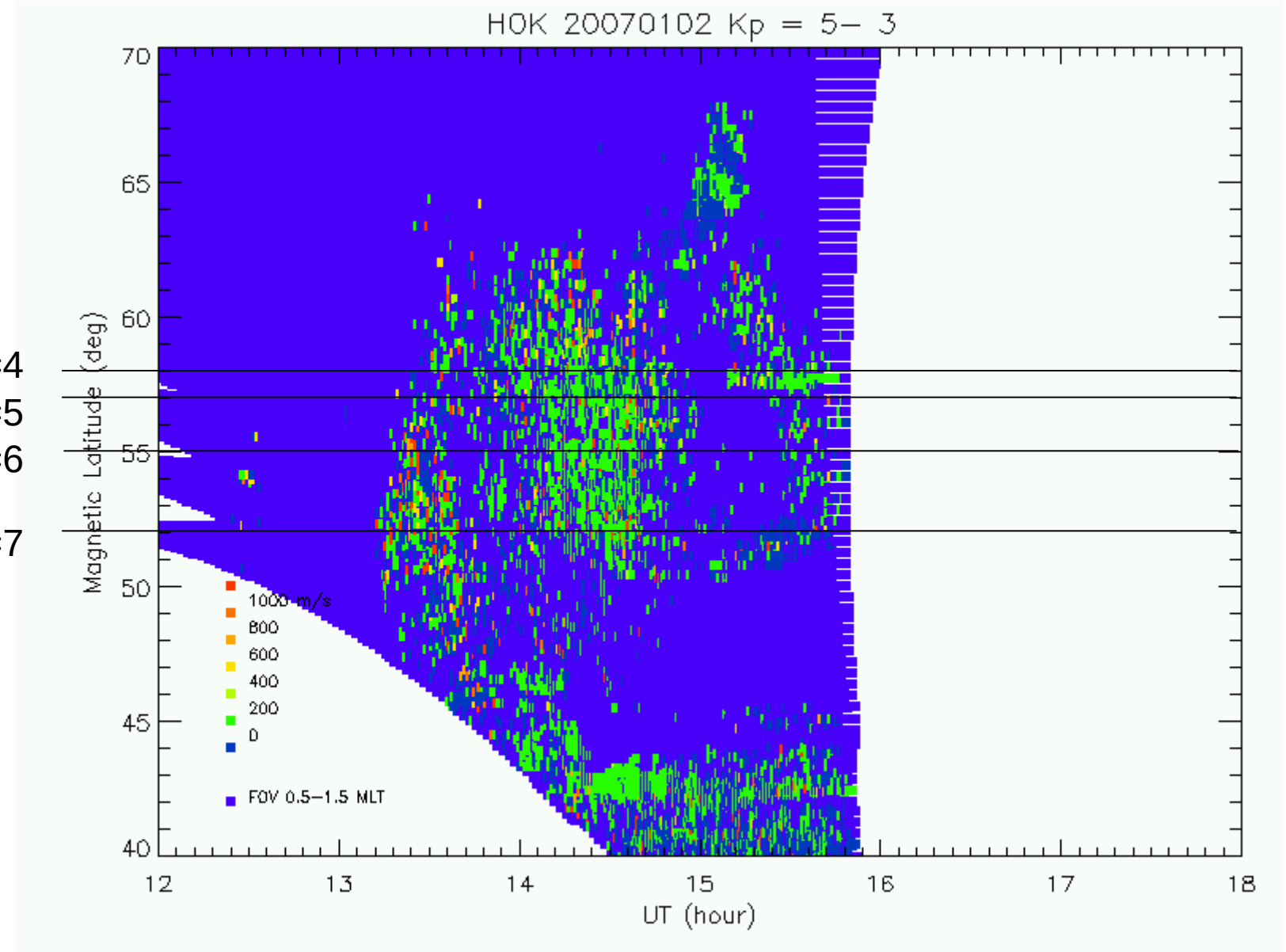
Appendix 4

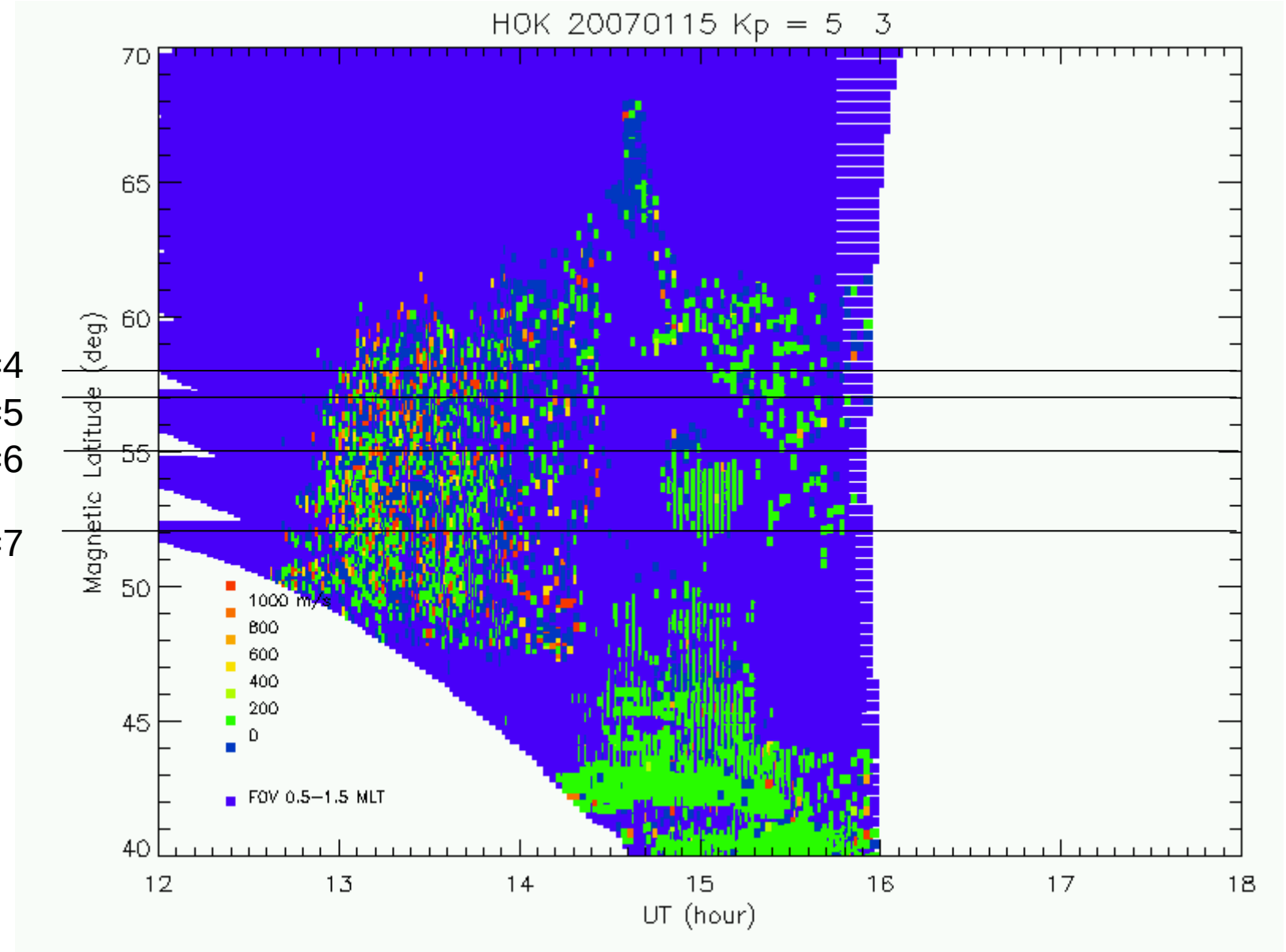
How about different local time?

Kp>4+, 0.5-1.5 MLT


HOK 20061214 Kp = 5 5+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
UT (hour)
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT

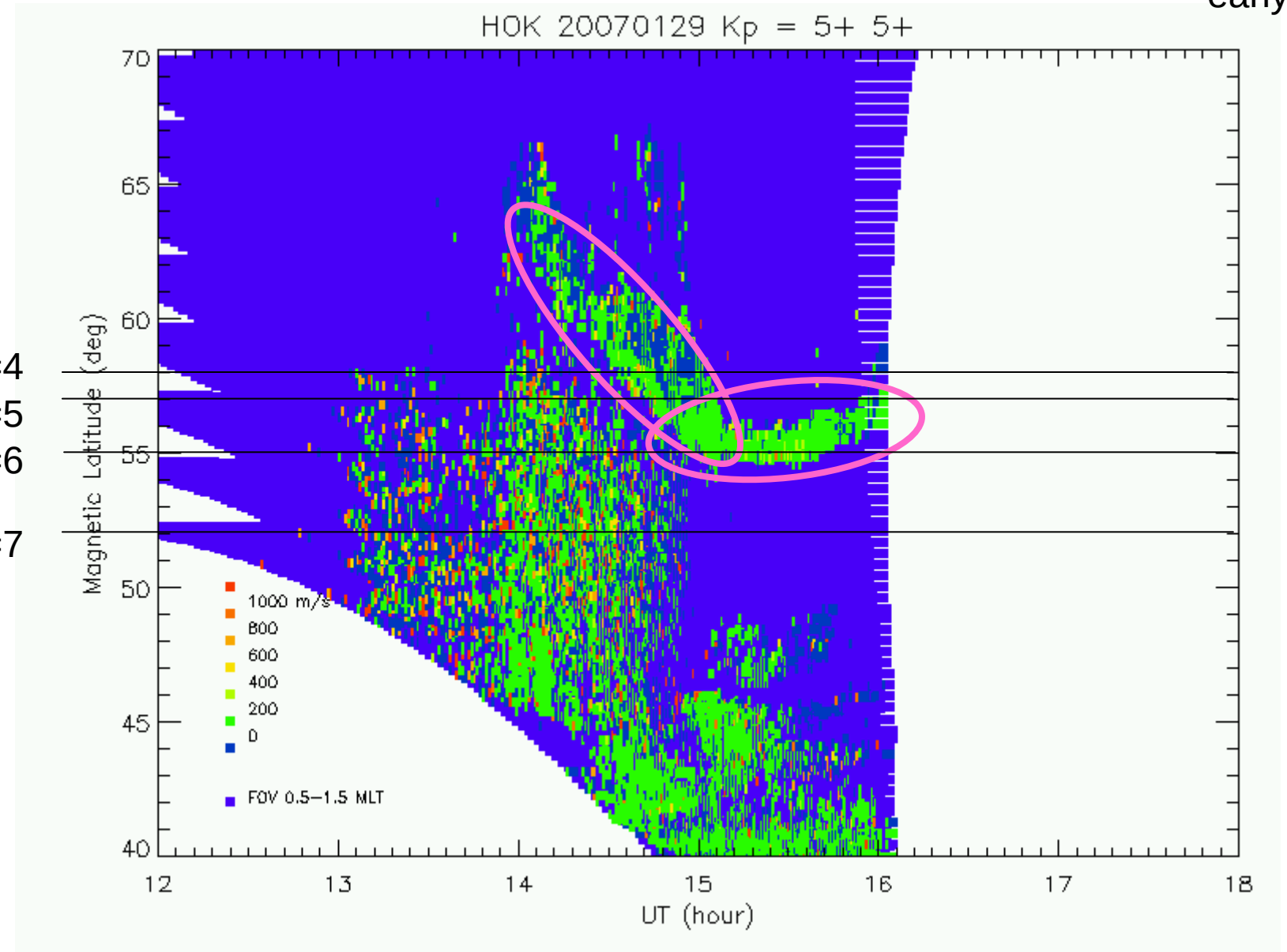

HOK 20061215 Kp = 6 4
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
UT (hour)
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT


HOK 20070102 Kp = 5− 3
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
UT (hour)
1000 m/s
800
600
400
200
0
FOV 0.5−1.5 MLT


HOK 20070115 Kp = 5 3
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
UT (hour)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT

Dst = 19 16 -13 -38 -32 -37

early main

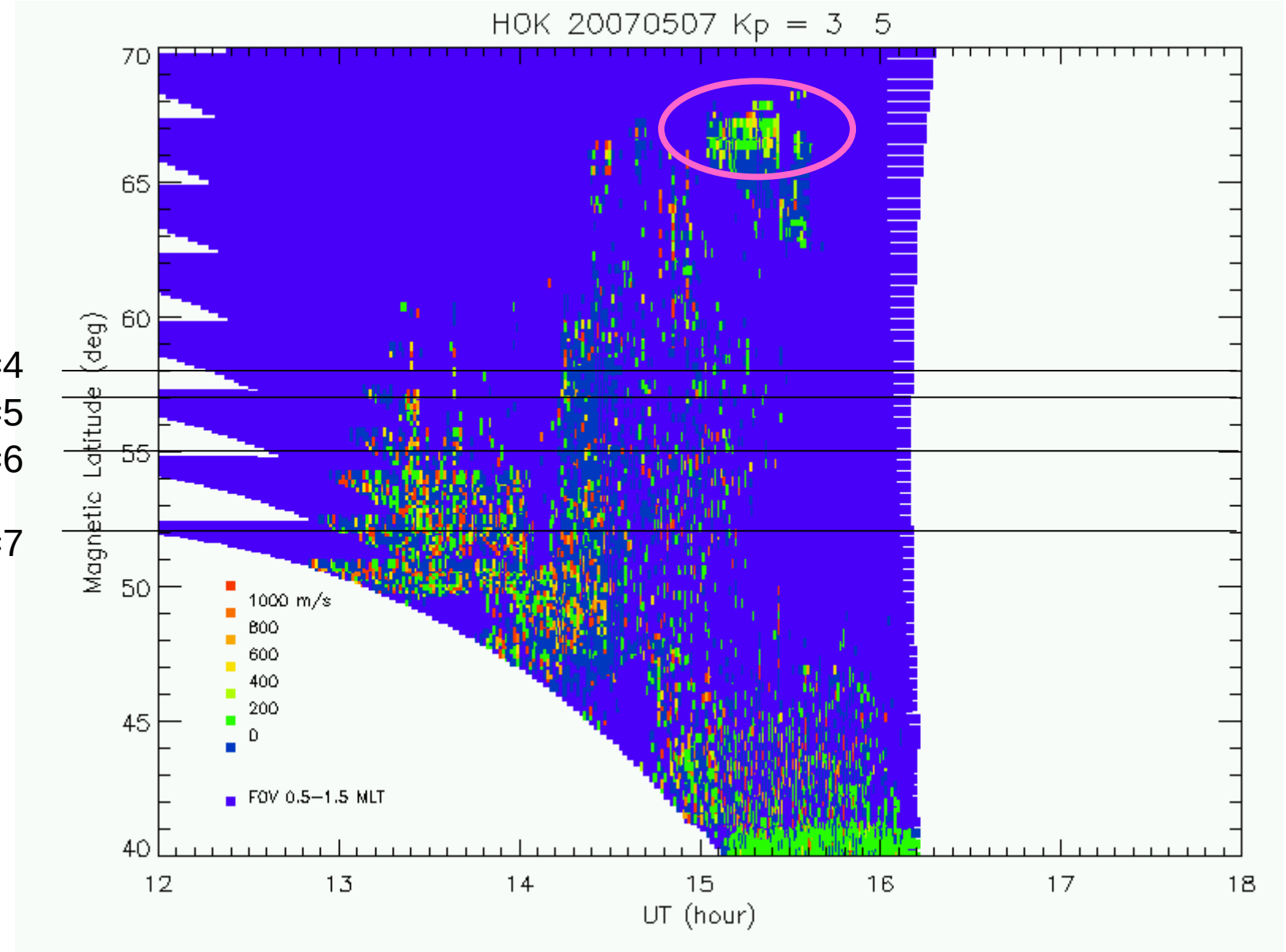


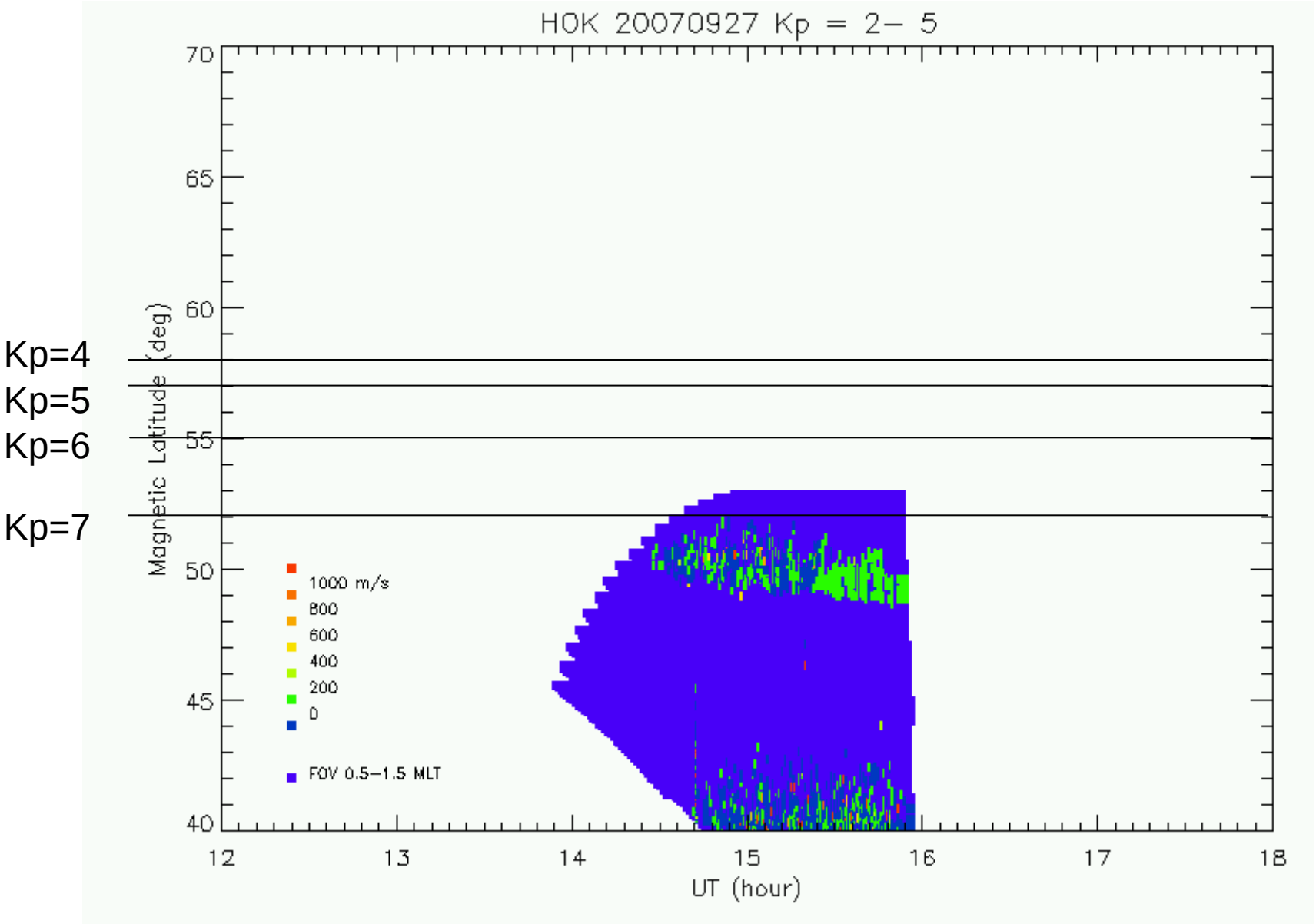
Kp=4

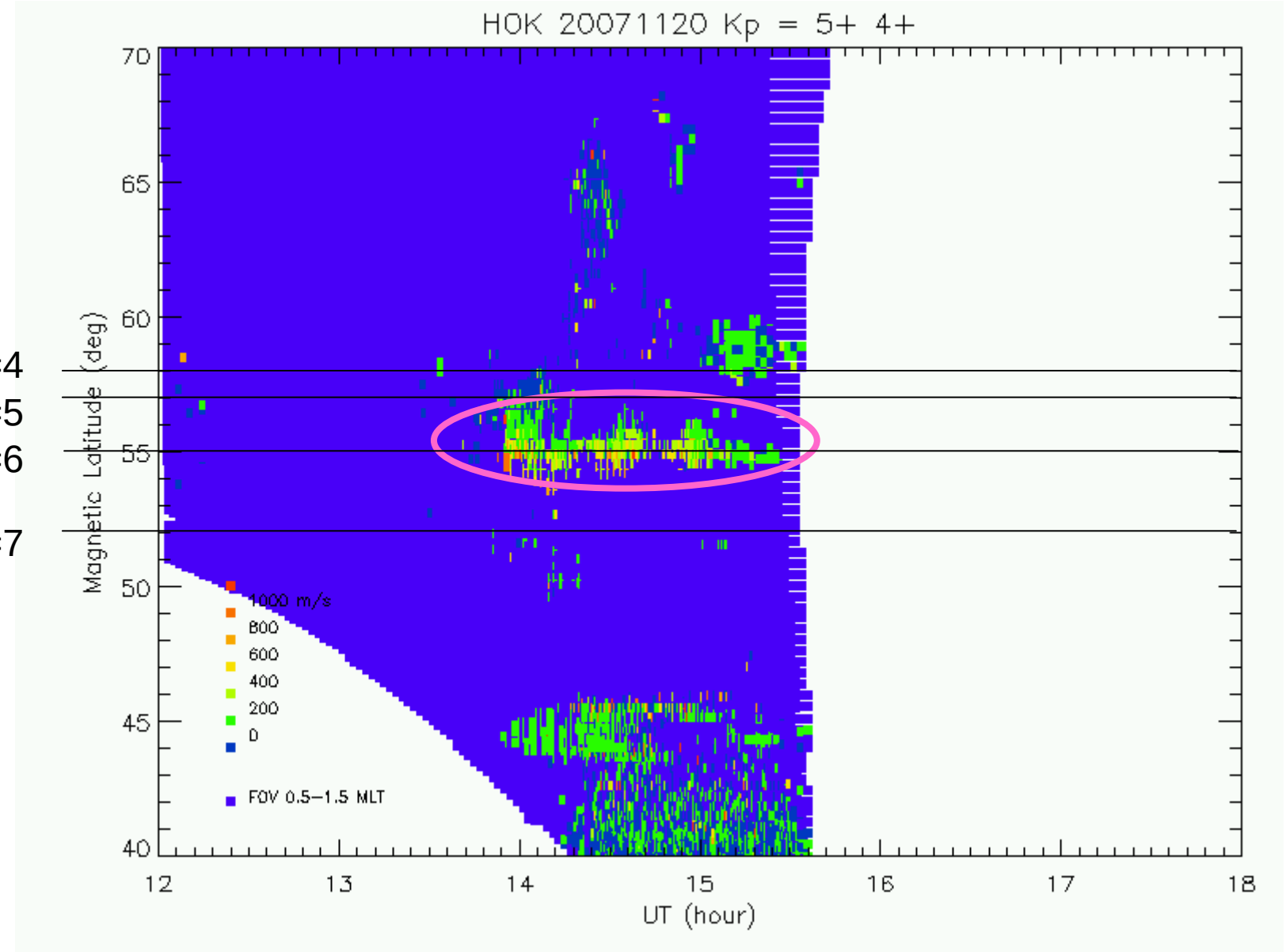
Kp=5

Kp=6

Kp=7


HOK 20070507 Kp = 3 5
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
UT (hour)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT


HOK 20070927 Kp = 2– 5
Magnetic Latitude (deg)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
UT (hour)
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT
Kp=4
Kp=5
Kp=6
Kp=7


HOK 20071120 Kp = 5+ 4+
Kp=4
Kp=5
Kp=6
Kp=7
Magnetic Latitude (deg)
70
65
60
55
50
45
40
12
13
14
15
16
17
18
UT (hour)
1000 m/s
800
600
400
200
0
FOV 0.5–1.5 MLT