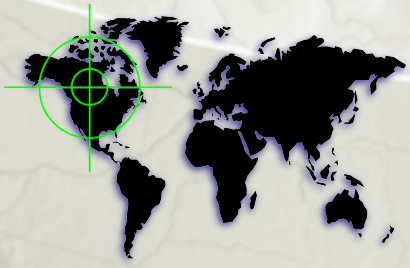
BRITISH GEOLOGICAL SURVEY

Fort McMurray Observatory *Monthly Magnetic Bulletin*

October 2015

15/10/FM



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Fort McMurray OBSERVATORY MAGNETIC DATA

1. Introduction

The British Geological Survey (BGS) now operate or assist in the operation of six overseas geomagnetic observatories. The most recently established of these, Fort McMurray Observatory, is a joint venture between BGS and Sperry Drilling, Halliburton Group Canada in support of directional drilling programmes. The installation was carried out in December 2014 and the earliest data and data products are available from January 2015.

This bulletin is published to provide rapid access to the provisional geomagnetic observatory results. The information is freely available for personal, academic, educational and non-commercial research or use. Magnetic observatory data are presented as a series of plots of one-minute, hourly and daily values, followed by tabulations of monthly values. The operation of the observatory and presentation of data are described in the rest of this section.

Enquiries about the data should be addressed to:

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Internet: www.geomag.bgs.ac.uk

2. Position

Fort McMurray Observatory is situated on Halliburton land, to the south of the town of Fort McMurray in Alberta, Canada. The observatory co-ordinates are:-

Geographic: 56° 35'53"N 248° 41'06" E
Geomagnetic: 63° 31'41"N 309° 32'49" E
Height above mean sea level: 386m

The geographical co-ordinates and altitude were determined by a surveying company using a differential GPS and reference station. Data were provided in GPS co-ordinates to UTM 12 NAD83: Ellipsoid GRS1980, and converted to WGS84 by BGS. The geomagnetic co-ordinates are approximations, calculated using the 12th generation International Geomagnetic Reference Field (IGRF) at epoch 2015.5. On-line access to models (including IGRF), charts and navigational data are available at http://www.geomag.bgs.ac.uk/data_service/models_compass/home

3. The Observatory Operation

3.1 GDAS

The observatory operates under the control of the Geomagnetic Data Acquisition System (GDAS), which was developed by BGS staff, installed and became fully operational from December 2014. The data acquisition software, running on QNX operated computers, controls the data logging and the communications.

There are two sets of sensors used for making magnetic measurements. A tri-axial linear-core fluxgate magnetometer, manufactured by DTU Space at the Technical University of Denmark, is used to measure the variations in the horizontal (*H*) and vertical (*Z*) components of the field. The third sensor is oriented perpendicular to these, and measures variations, which are proportional to the changes in declination (*D*). Measurements are made at a rate of 1 Hz.

In addition to the fluxgate sensors, a GEM Systems GSM-90 Overhauser magnetometer makes measurements of the absolute total field intensity (*F*) every 5 seconds.

The raw unfiltered data are retrieved automatically via Internet connections to the BGS office in Edinburgh in near real-time. The fluxgate data are filtered to produce one-minute values using a 61-point cosine filter and the total field intensity samples are filtered using a 13-point cosine filter.

3.2 Absolute Observations

The GDAS fluxgate magnetometers accurately measure variations in the components of the geomagnetic field, but not the absolute magnitudes. Two sets of absolute measurements of the field are made manually twice per month. A fluxgate sensor mounted on a theodolite is used to determine *D* and inclination (*I*); the GDAS PPM measurements, with a site difference correction applied, are used for *F*. The absolute observations are used in conjunction with the GDAS variometer measurements to produce a continuous record of the absolute values of the geomagnetic field

elements as if they had been measured at the observatory reference pillar.

4. Observatory Results

The data presented in the bulletin are in the form of plots and tabulations described in the following sections.

4.1 Absolute Observations

The absolute observation measurements made during the month are tabulated. Also included are the corresponding baseline values, which are the differences between the absolute measurements and the variometer measurements of *D*, *H* and *Z* (in the sense absolute−variometer). These are also plotted (markers) along with the derived preliminary daily baseline values (line) throughout the year. Daily mean differences between the measured absolute *F* and the *F* computed from the baseline corrected *H* and *Z* values are plotted in the fourth panel (in the sense measured−derived). The bottom panel shows the daily mean temperature in the fluxgate chamber.

4.2 Summary magnetograms

Small-scale magnetograms are plotted which allow the month's data to be viewed at a glance. They are plotted 16 days to a page and show the one-minute variations in *D*, *H* and Z. The scales are shown on the right-hand side of the page. On disturbed days the scales are multiplied by a factor, which is indicated above the panel for that day. The variations are centred on the monthly mean value, shown on the left side of the page.

4.3 Magnetograms

The daily magnetograms are plotted using one-minute values of *D*, *H* and *Z* from the fluxgate sensors. The magnetograms are plotted to a variable scale; scale bars are shown to the right of each plot. The absolute level (the monthly mean value) is indicated on the left side of the plots.

4.4 Hourly Mean Value Plots

Hourly mean values of *D*, *H* and *Z* for the past 12 months are plotted in 27-day segments corresponding to the Bartels solar rotation number. Magnetic disturbances associated with active regions and/or coronal holes on the Sun may recur after 27 days: the same is true for geomagnetically quiet intervals. Plotting the data in this way highlights this recurrence. Diurnal variations are also clear in these plots and the amplitude changes throughout the year highlight the seasonal changes. Longer term secular variation is also illustrated.

4.5 Daily and Monthly Mean Values

Daily mean values of *D*, *H*, *Z* and *F* are plotted throughout the year. In addition, a table of monthly mean values of all the geomagnetic elements is provided. These values depend on accurate specification of the fluxgate sensor baselines. It is anticipated that these provisional values will not be altered by more than a few nT or tenths of arcminutes before being made definitive at the end of the year.

5. Conditions of Use

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Commercial users can contact the geomagnetism team for information on the range of applications and services offered. Full contact details are available at www.geomag.bgs.ac.uk/contactus/staff

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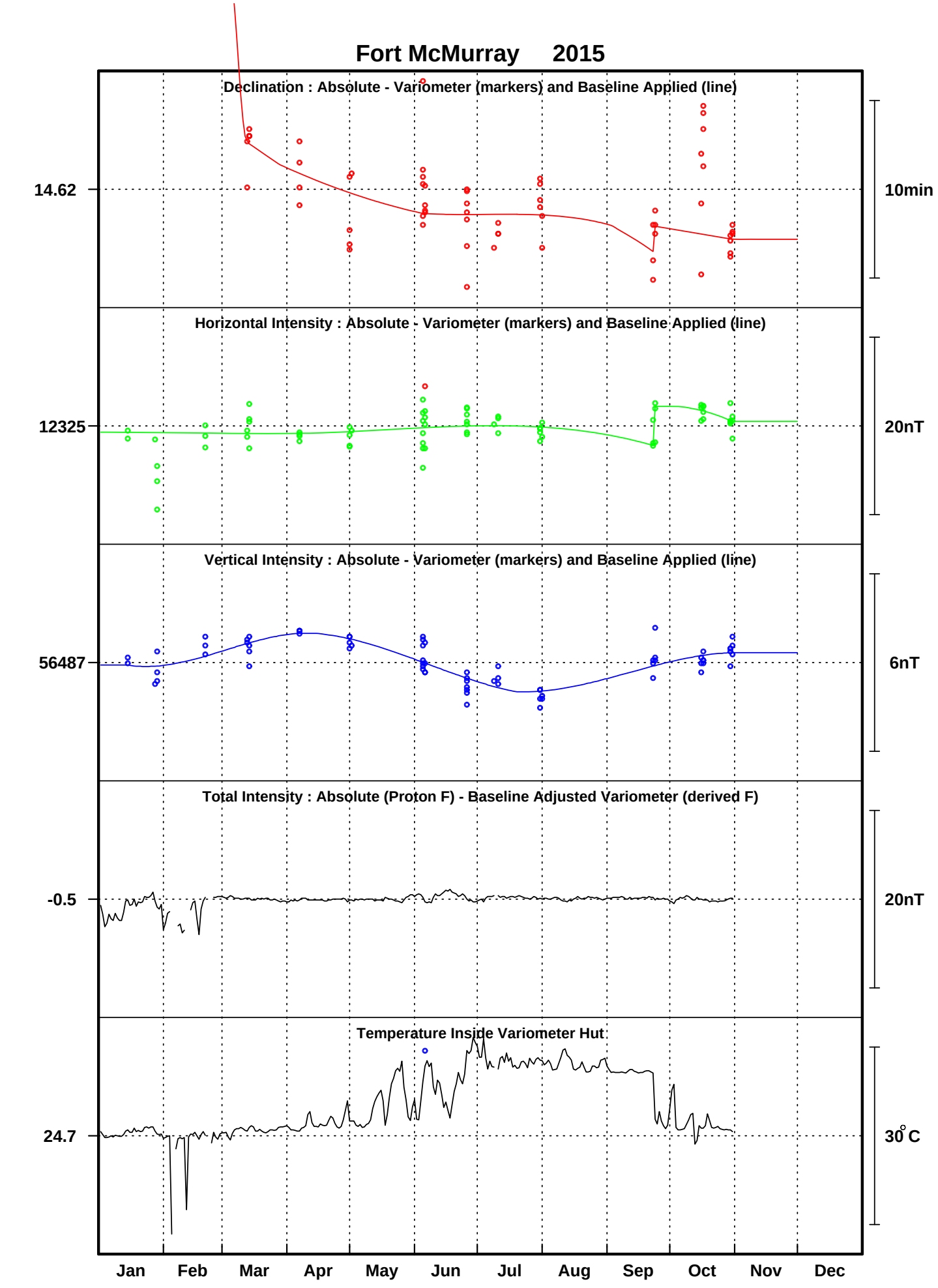
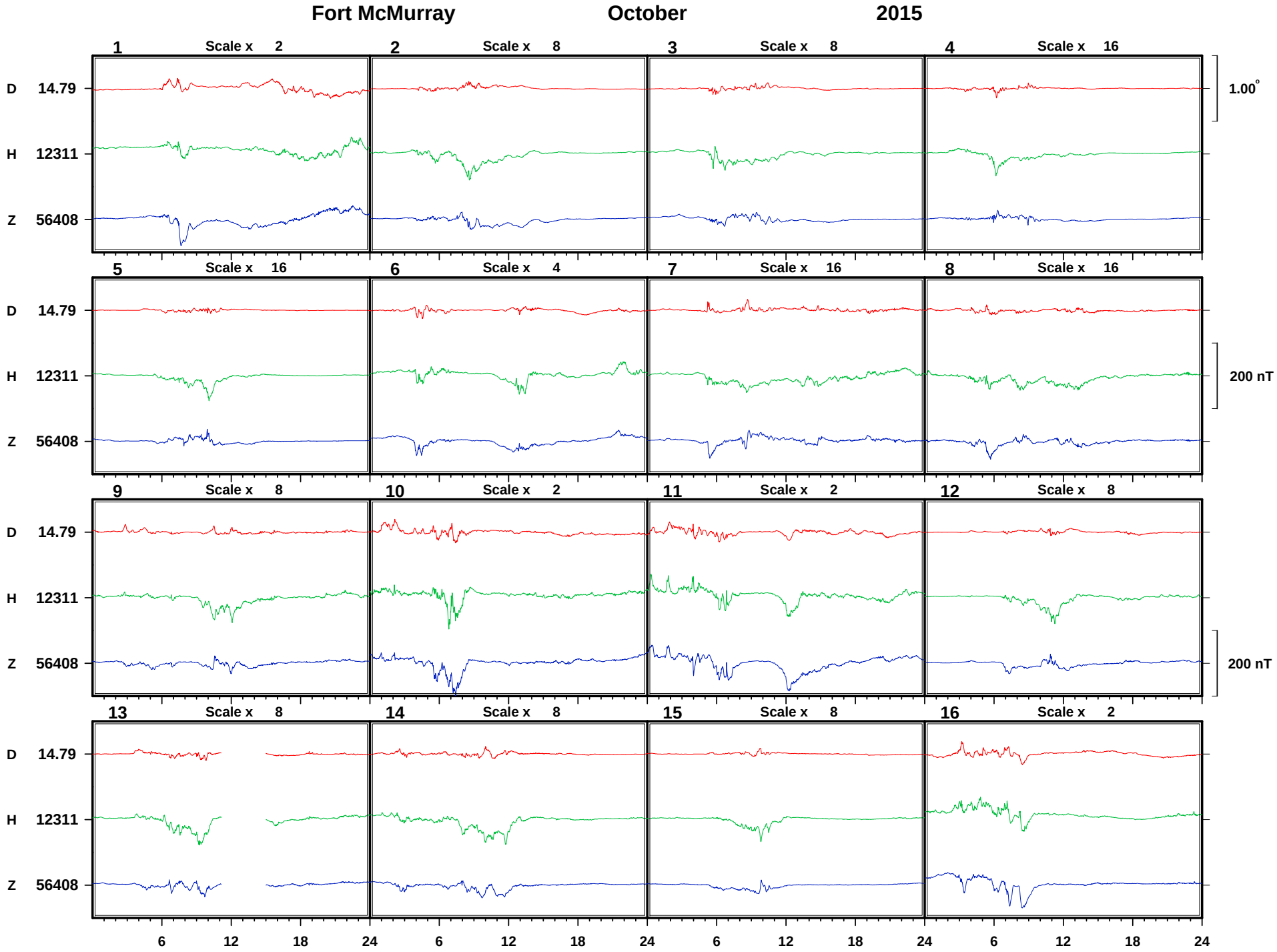
Fort McMurray OBSERVATORY

ABSOLUTE OBSERVATIONS

		Declination			Inclination		Total Field		Horizontal Intensity		Vertical Intensity		
Date	**Day Number**	**Time (UT)**	**Absolute (º)**	**Baseline (º)**	**Time (UT)**	**Absolute (º)**	**Site difference (nT)**	**Absolute corrected (nT)**	**Absolute (nT)**	**Baseline (nT)**	**Absolute (nT)**	**Baseline (nT)**	**Observer**
15-Oct-15	288	21:49	14.6658	14.5367	21:56	77.6538	0.5	57774.9	12353.4	12325.5	56438.7	56487.4	TM
15-Oct-15	288	22:07	14.7297	14.6033	22:15	77.6533	0.5	57777.8	12354.4	12327.3	56441.5	56486.9	SP
15-Oct-15	288	22:25	14.7896	14.6500	22:34	77.6671	0.5	57776.0	12340.5	12327.0	56442.7	56487.2	TM
16-Oct-15	289	16:09	14.9459	14.6383	16:16	77.6769	0.5	57751.1	12325.4	12327.1	56420.5	56487.2	SP
16-Oct-15	289	16:29	14.9692	14.6733	16:39	77.6804	0.5	57748.5	12321.5	12327.2	56418.7	56487.3	TM
16-Oct-15	289	16:48	14.9508	14.6883	16:55	77.6835	0.5	57749.1	12318.6	12326.5	56420.0	56487.3	SP
16-Oct-15	289	17:04	14.9375	14.6950	17:08	77.6838	0.5	57749.9	12318.5	12325.7	56420.8	56487.6	TM
29-Oct-15	302	21:13	14.6783	14.5683	21:36	77.6658	0.5	57739.9	12334.0	12325.2	56407.1	56487.7	IP
29-Oct-15	302	21:56	14.6946	14.5567	22:02	77.6600	0.5	57741.0	12340.0	12327.5	56407.0	56487.1	TM
29-Oct-15	302	22:28	14.6904	14.5533	22:34	77.6546	0.5	57744.8	12346.1	12325.4	56409.5	56487.6	TM
29-Oct-15	302	22:51	14.7176	14.5733	23:08	77.6524	0.5	57745.4	12348.4	12325.5	56409.7	56487.7	IP
30-Oct-15	303	15:17	14.6479	14.5833	15:31	77.6788	0.5	57691.9	12311.0	12323.5	56363.1	56488.1	IP
30-Oct-15	303	15:45	14.7125	14.5767	15:51	77.6771	0.5	57693.7	12313.1	12326.0	56364.5	56487.5	TM
30-Oct-15	303	15:59	14.7816	14.5750	16:06	77.6858	0.5	57699.6	12305.7	12325.5	56372.1	56487.8	TM


Fort McMurray 2015
Declination : Absolute - Variometer (markers) and Baseline Applied (line)
14.62
10min
Horizontal Intensity : Absolute - Variometer (markers) and Baseline Applied (line)
12325
20nT
Vertical Intensity : Absolute - Variometer (markers) and Baseline Applied (line)
56487
6nT
Total Intensity : Absolute (Proton F) - Baseline Adjusted Variometer (derived F)
-0.5
20nT
Temperature Inside Variometer Hut
24.7
30°C
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Fort McMurray
October
2015
1
Scale x 2
2
Scale x 8
3
Scale x 8
4
Scale x 16
D 14.79
H 12311
Z 56408
1.00°
5
Scale x 16
6
Scale x 4
7
Scale x 16
8
Scale x 16
200 nT
9
Scale x 8
10
Scale x 2
11
Scale x 2
12
Scale x 8
200 nT
13
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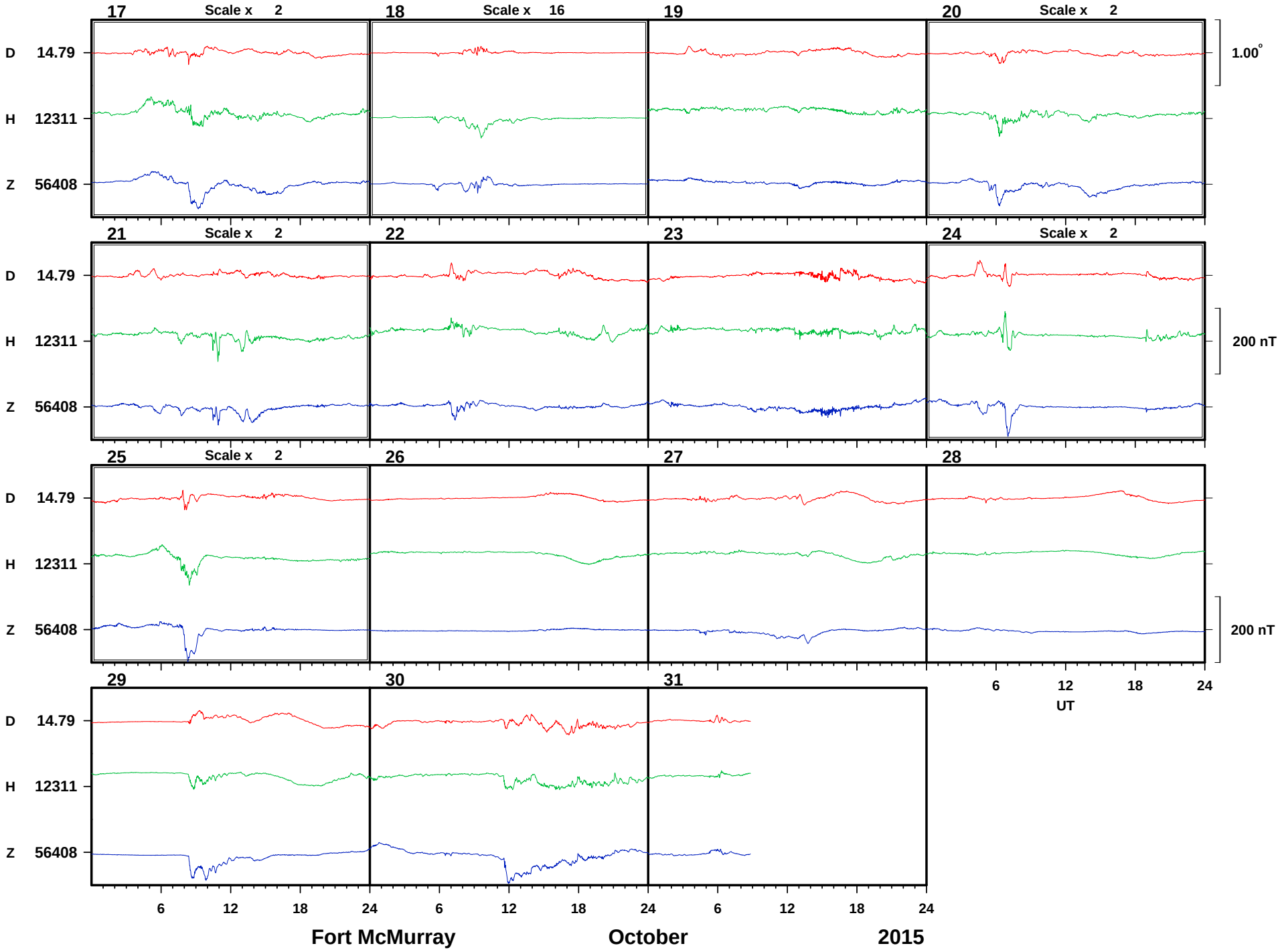
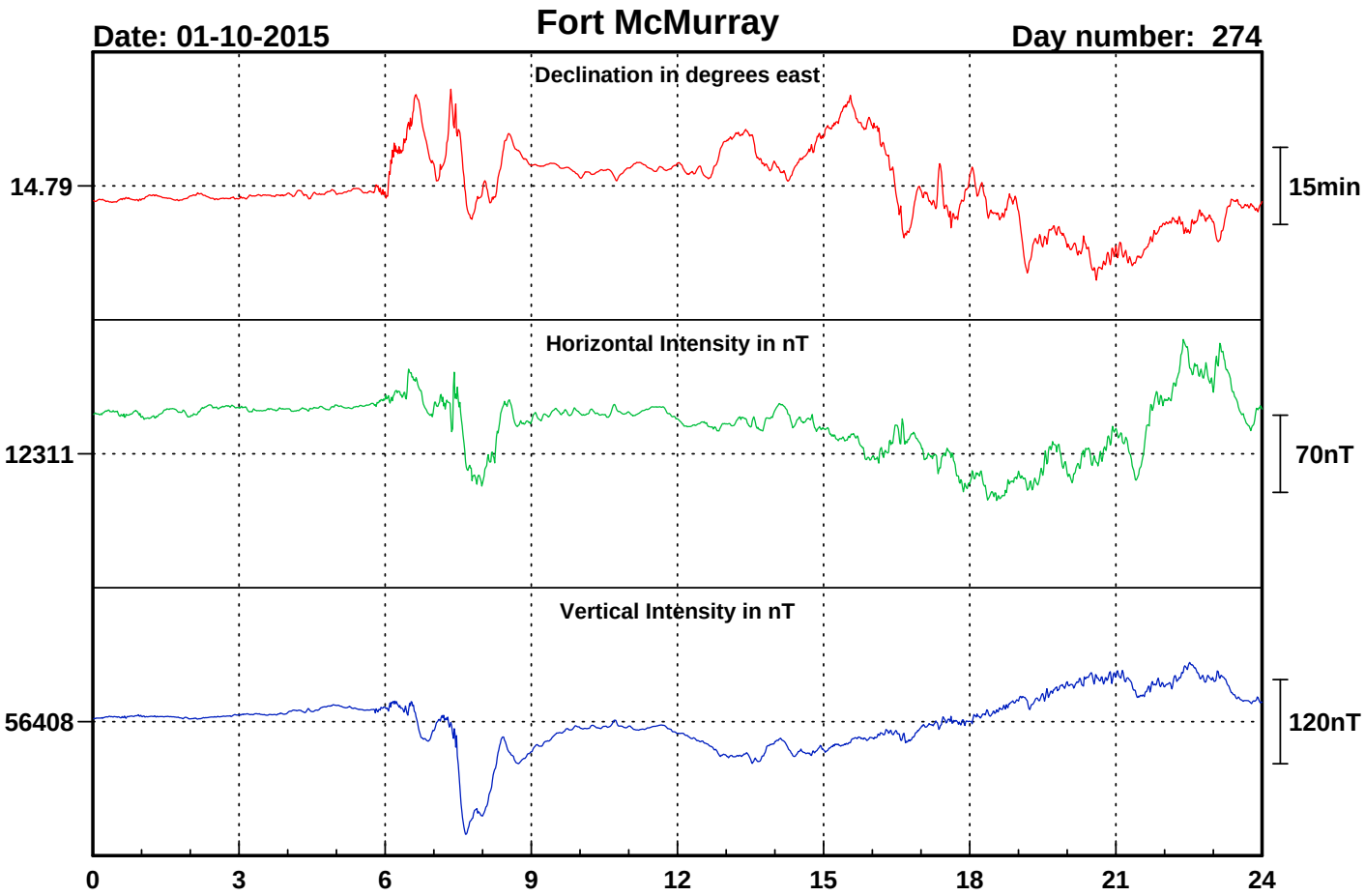
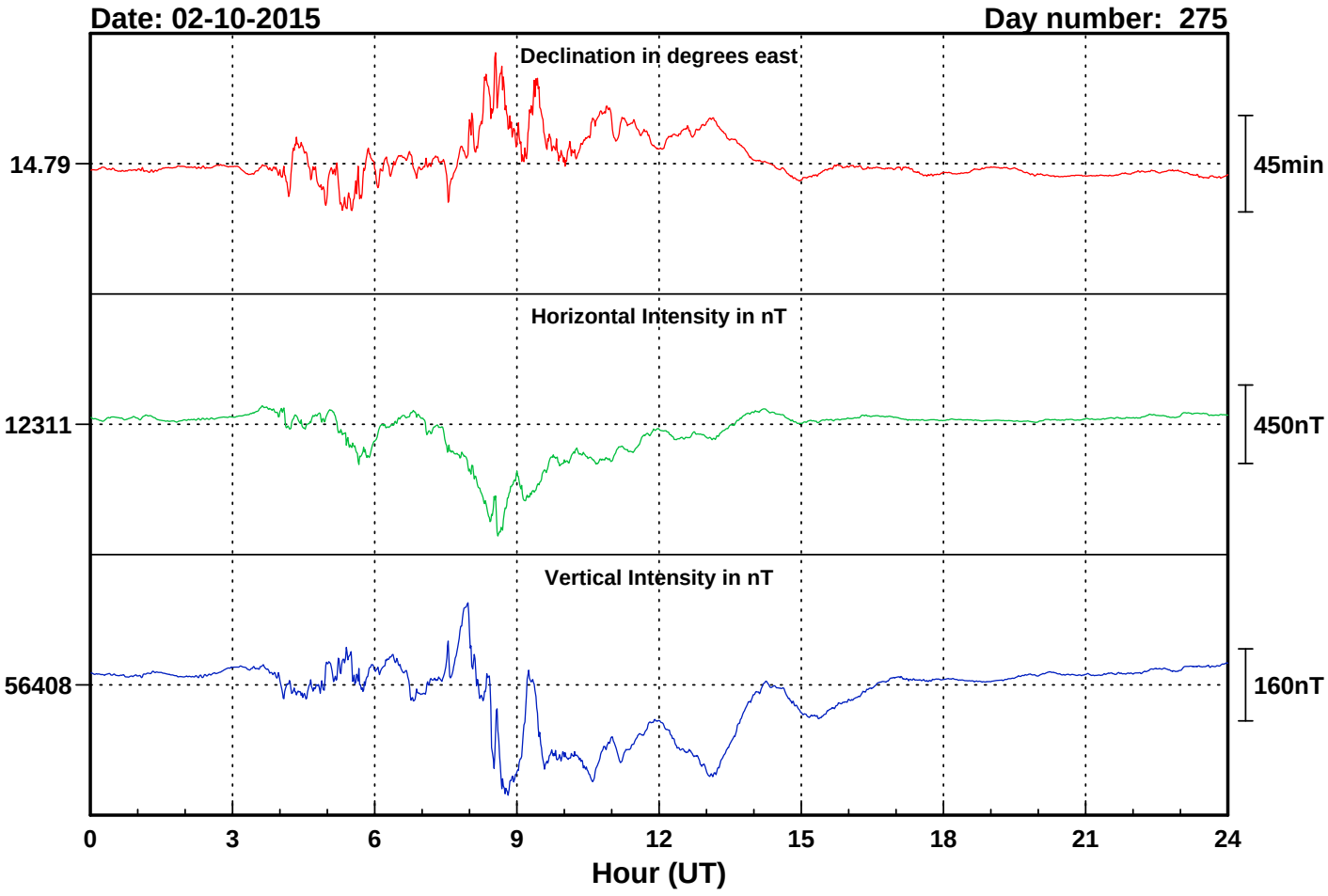
15
Scale x 8
16
Scale x 2
6
12
18
24


17
Scale x 2
18
Scale x 16
19
20
Scale x 2
D 14.79
H 12311
Z 56408
1.00°
21
Scale x 2
22
23
24
Scale x 2
200 nT
25
Scale x 2
26
27
28
29
30
31
6
12
18
24
UT
Fort McMurray
October
2015


Fort McMurray
Date: 01-10-2015
Day number: 274
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
70nT
Vertical Intensity in nT
56408
120nT
0
3
6
9
12
15
18
21
24


Date: 02-10-2015
Day number: 275
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
450nT
Vertical Intensity in nT
56408
160nT
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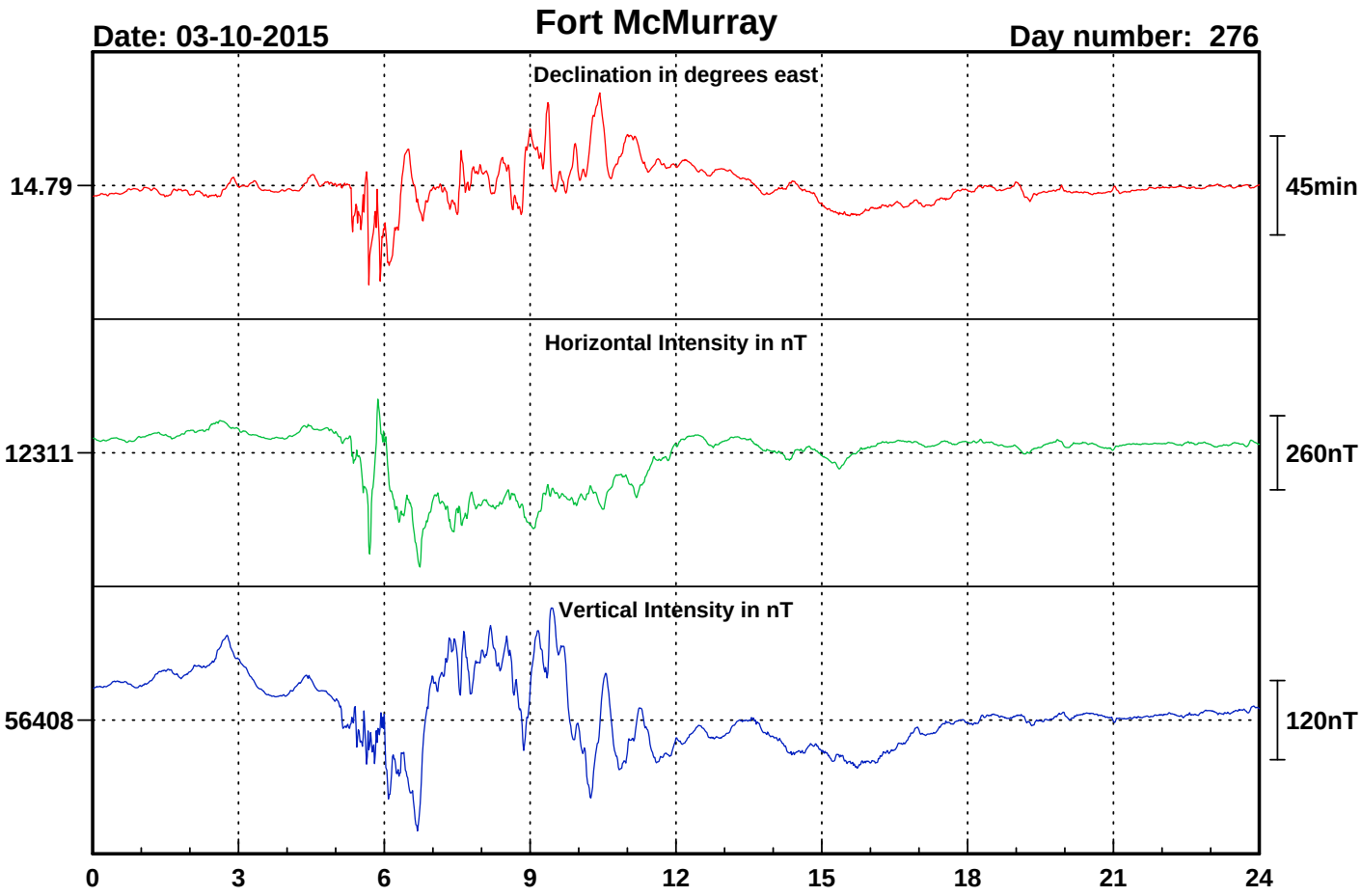
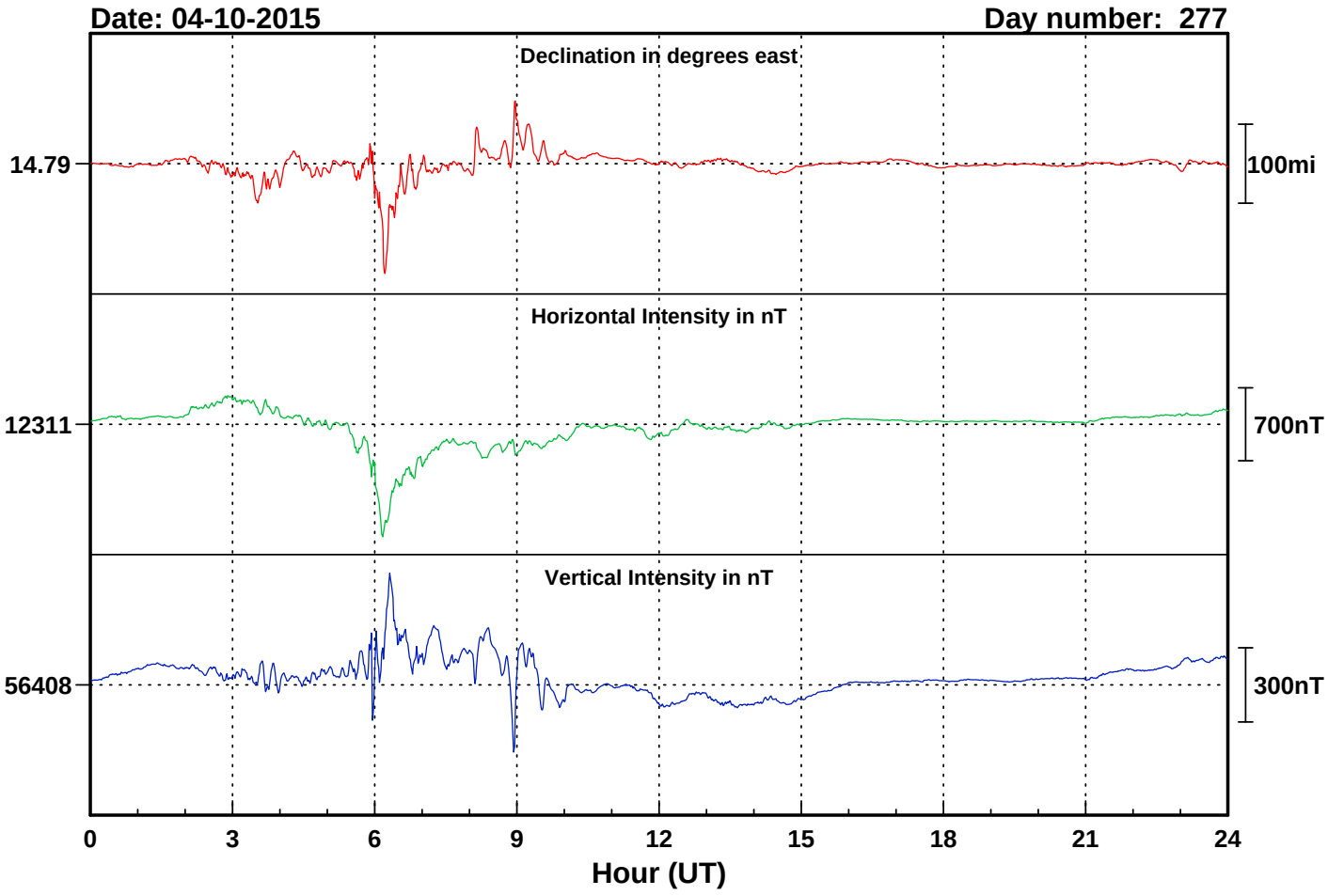
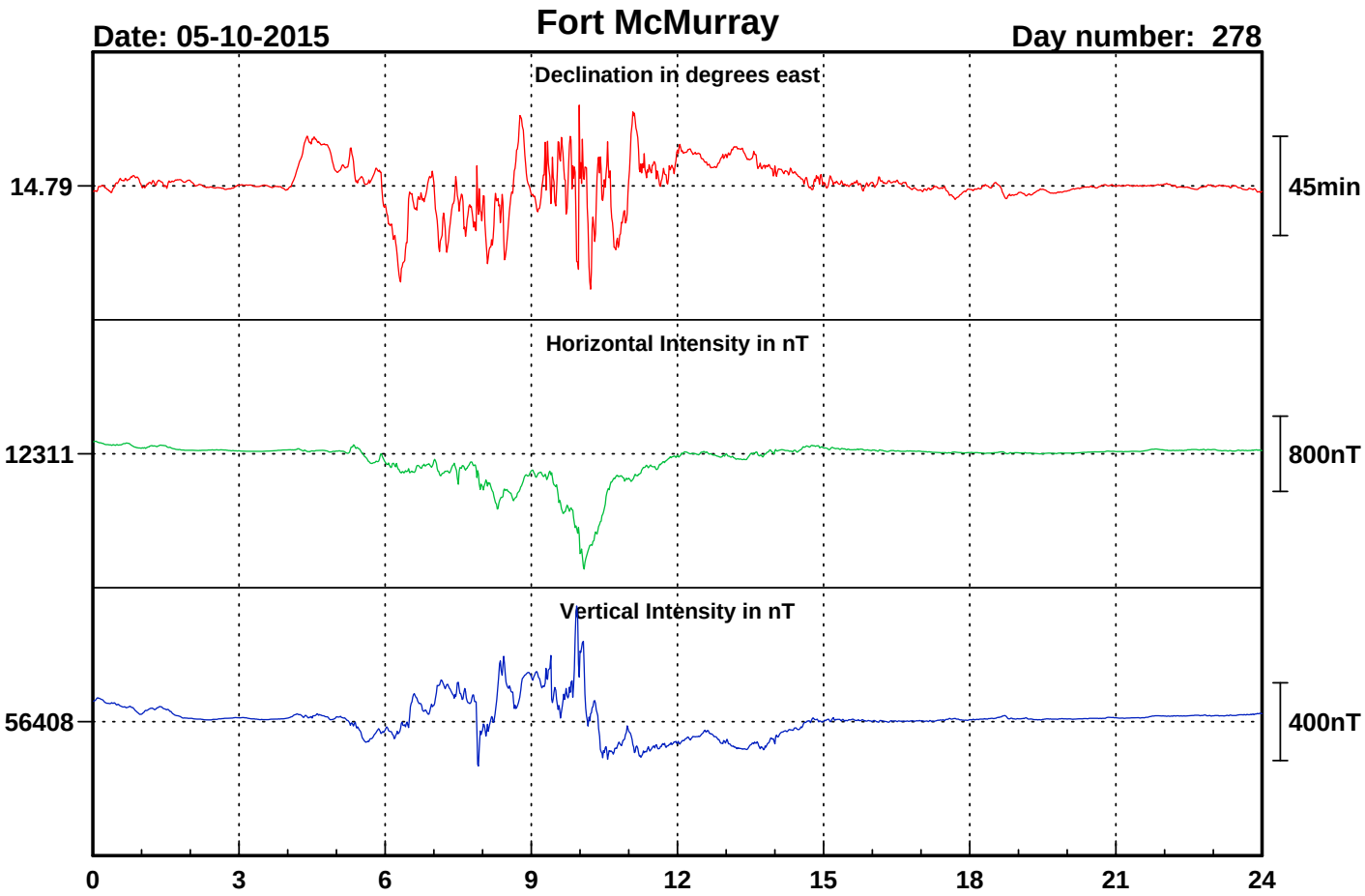
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 03-10-2015
Day number: 276
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
260nT
Vertical Intensity in nT
56408
120nT
0
3
6
9
12
15
18
21
24


Date: 04-10-2015
Day number: 277
Declination in degrees east
14.79
100mi
Horizontal Intensity in nT
12311
700nT
Vertical Intensity in nT
56408
300nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
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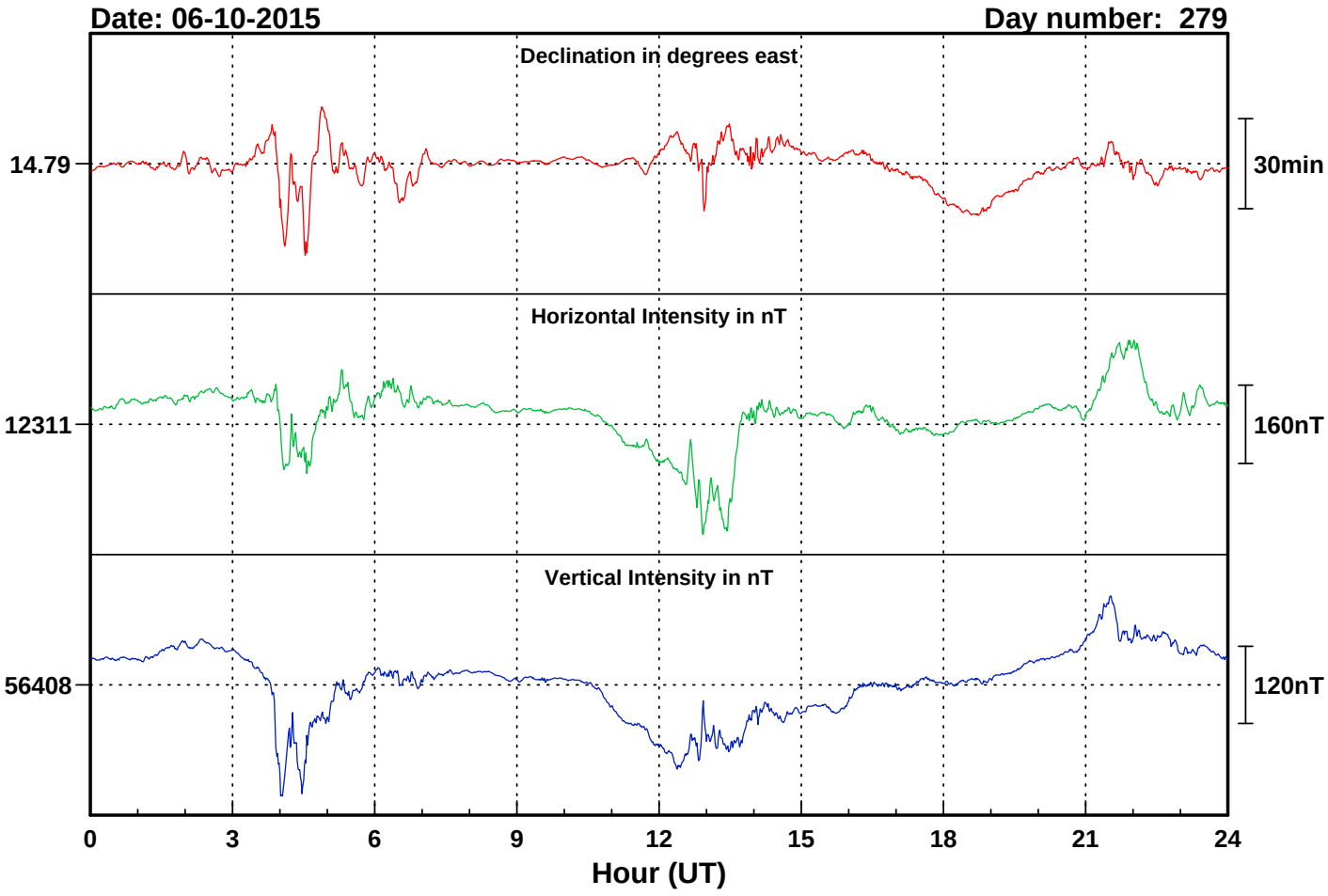
Day number: 278
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
800nT
Vertical Intensity in nT
56408
400nT
0
3
6
9
12
15
18
21
24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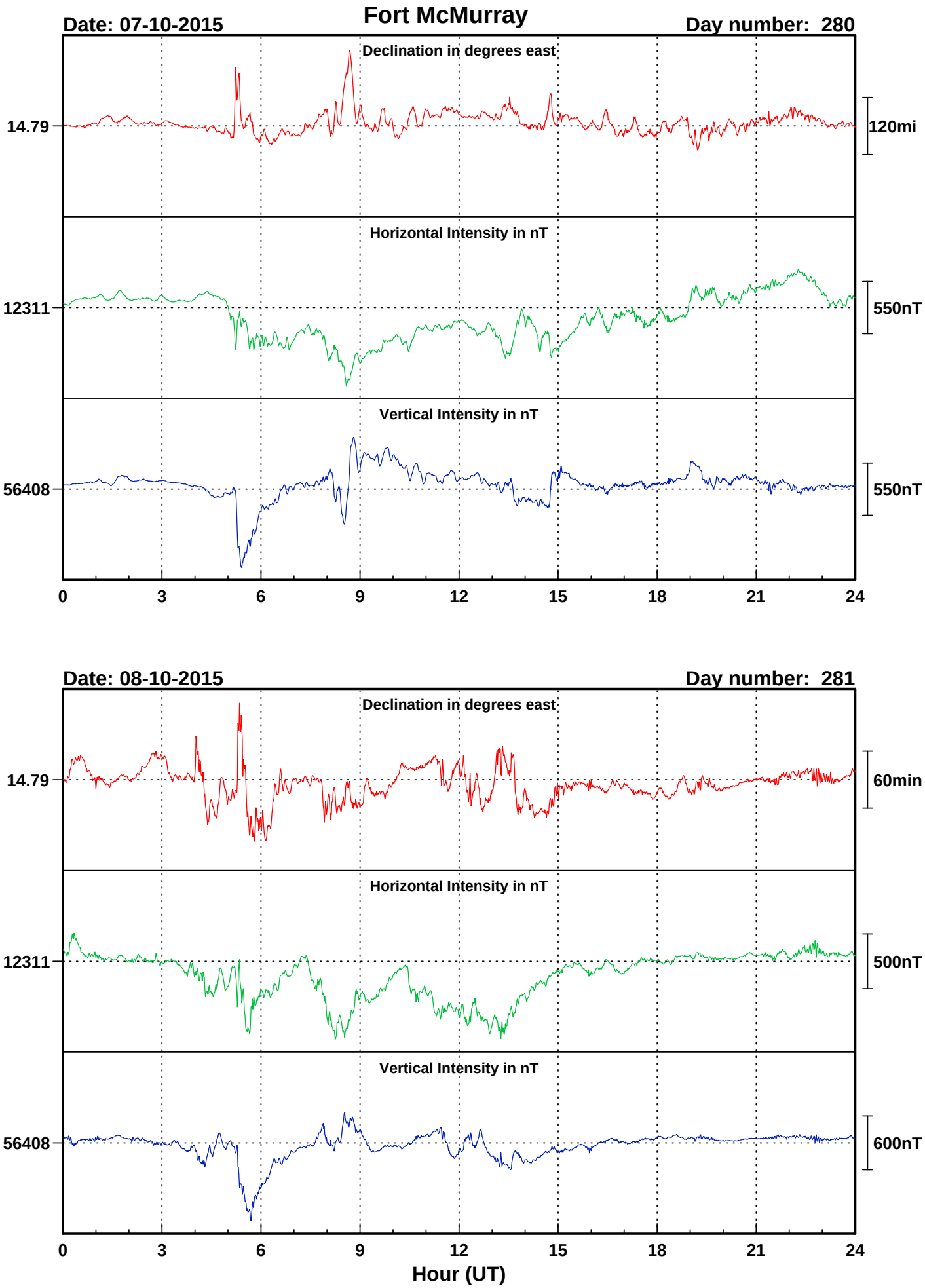
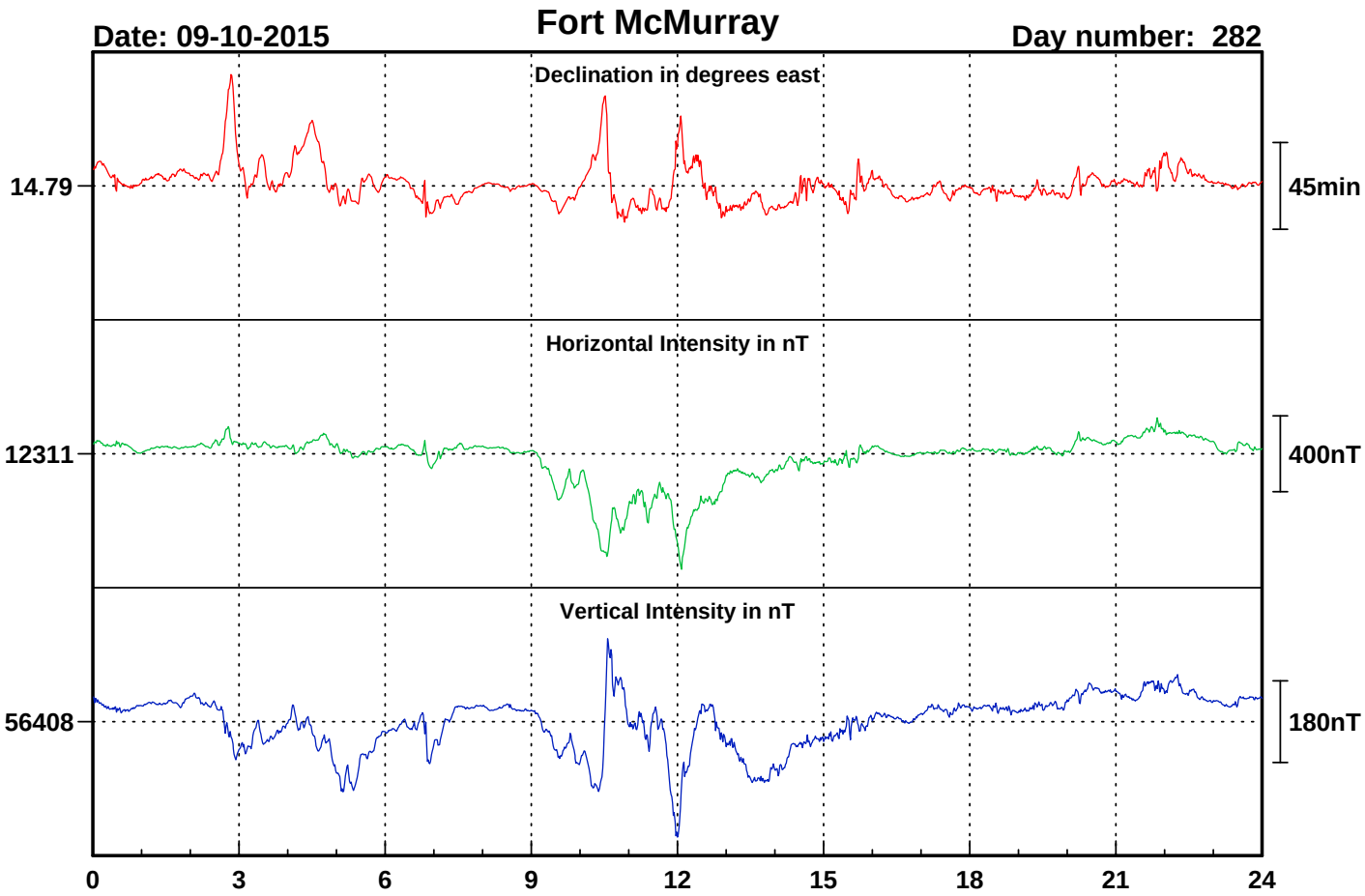
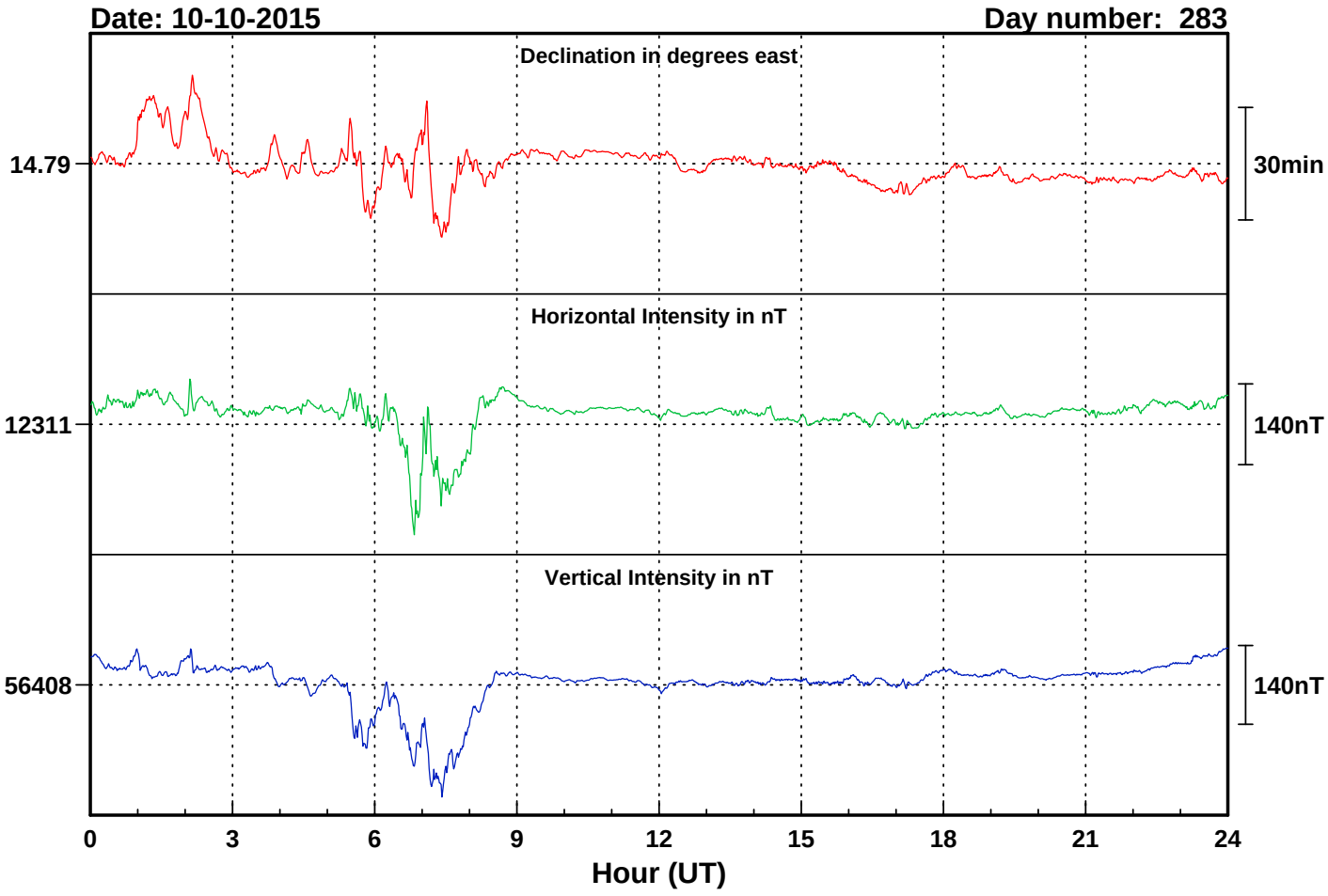
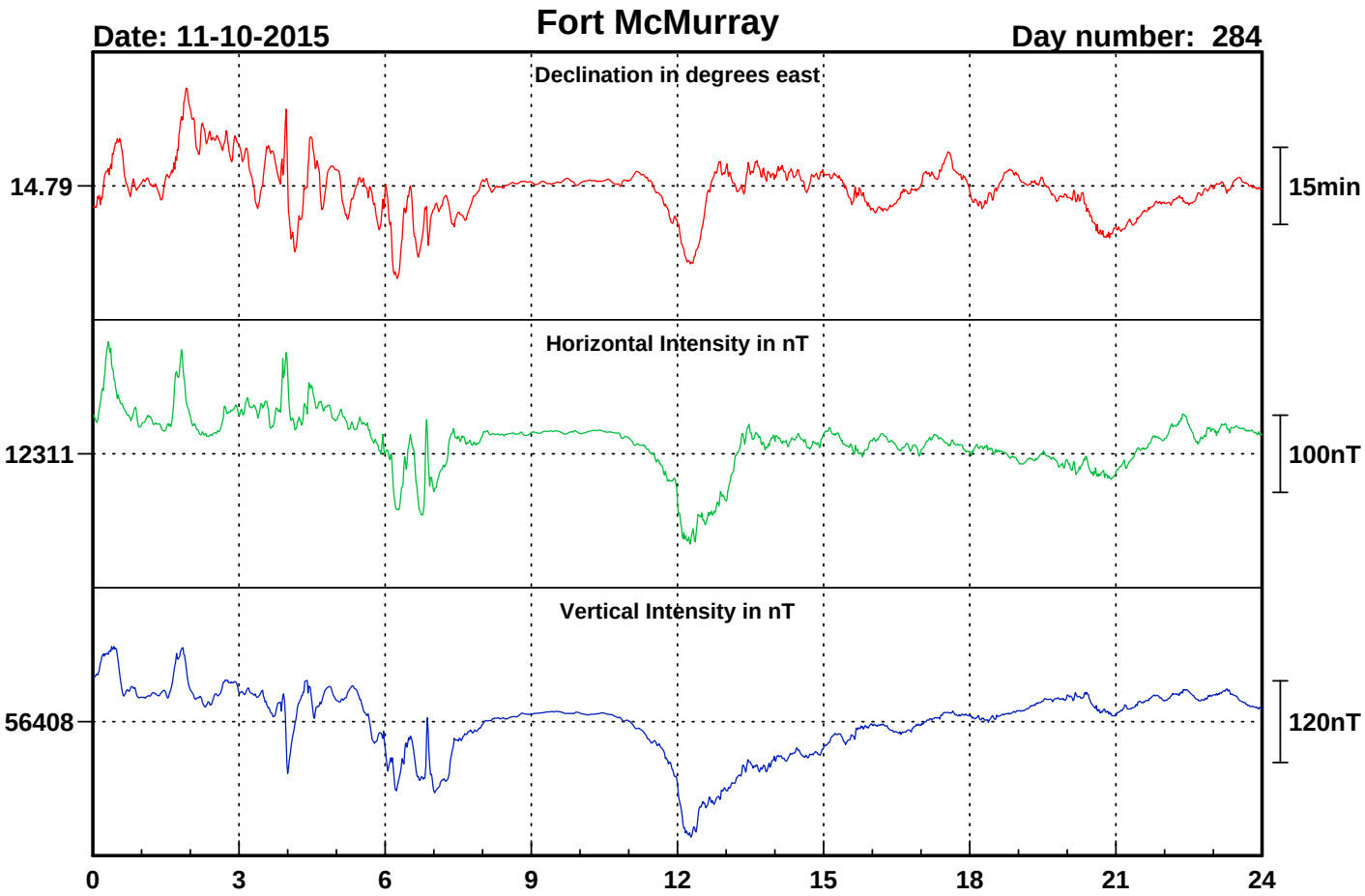
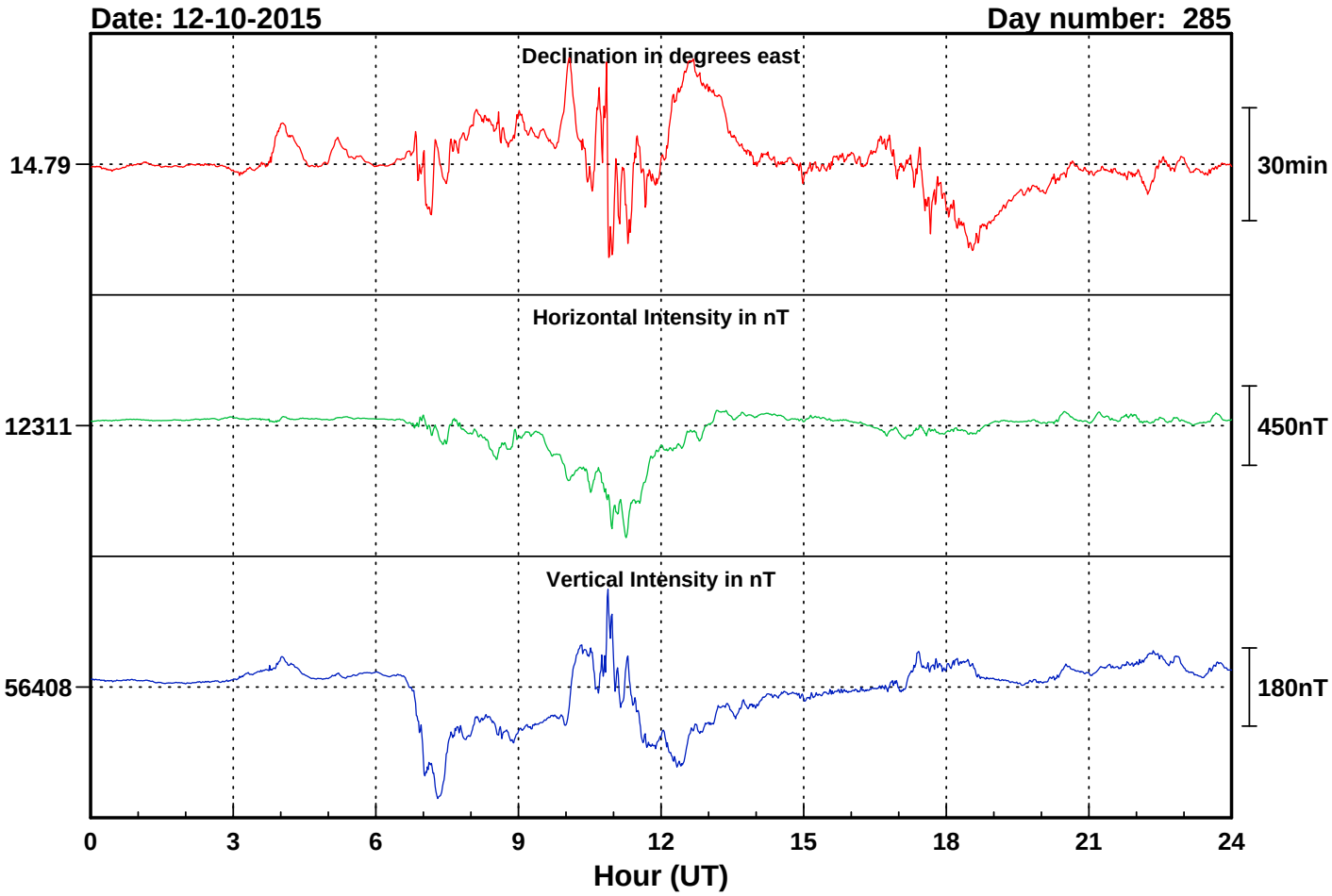
Day number: 279
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
160nT
Vertical Intensity in nT
56408
120nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 07-10-2015
Day number: 280
Declination in degrees east
14.79
120mi
Horizontal Intensity in nT
12311
550nT
Vertical Intensity in nT
56408
550nT
0
3
6
9
12
15
18
21
24
Date: 08-10-2015
Day number: 281
Declination in degrees east
14.79
60min
Horizontal Intensity in nT
12311
500nT
Vertical Intensity in nT
56408
600nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 09-10-2015
Day number: 282
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
400nT
Vertical Intensity in nT
56408
180nT
0
3
6
9
12
15
18
21
24


Date: 10-10-2015
Day number: 283
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
140nT
Vertical Intensity in nT
56408
140nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 11-10-2015
Day number: 284
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
100nT
Vertical Intensity in nT
56408
120nT
0
3
6
9
12
15
18
21
24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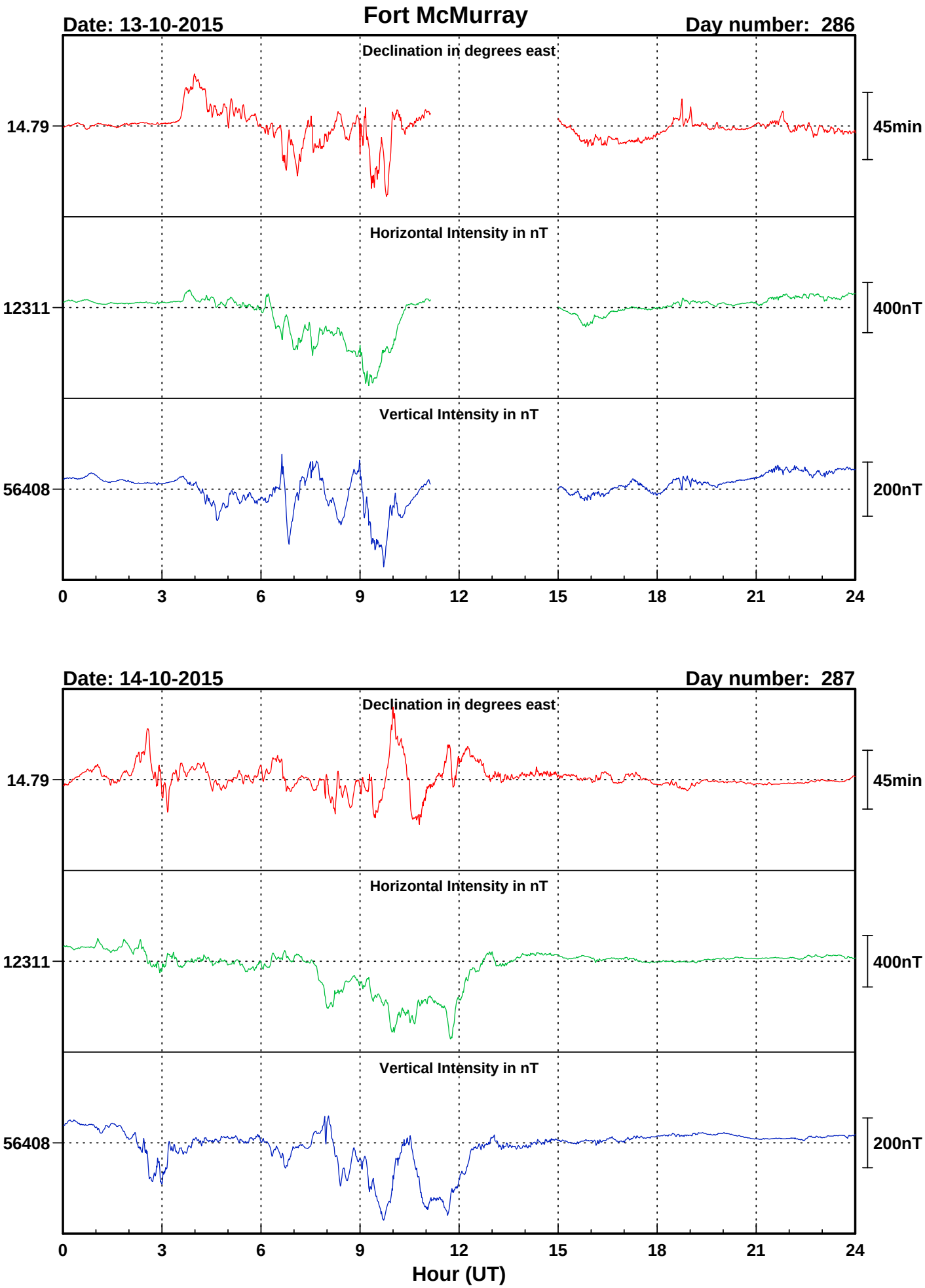
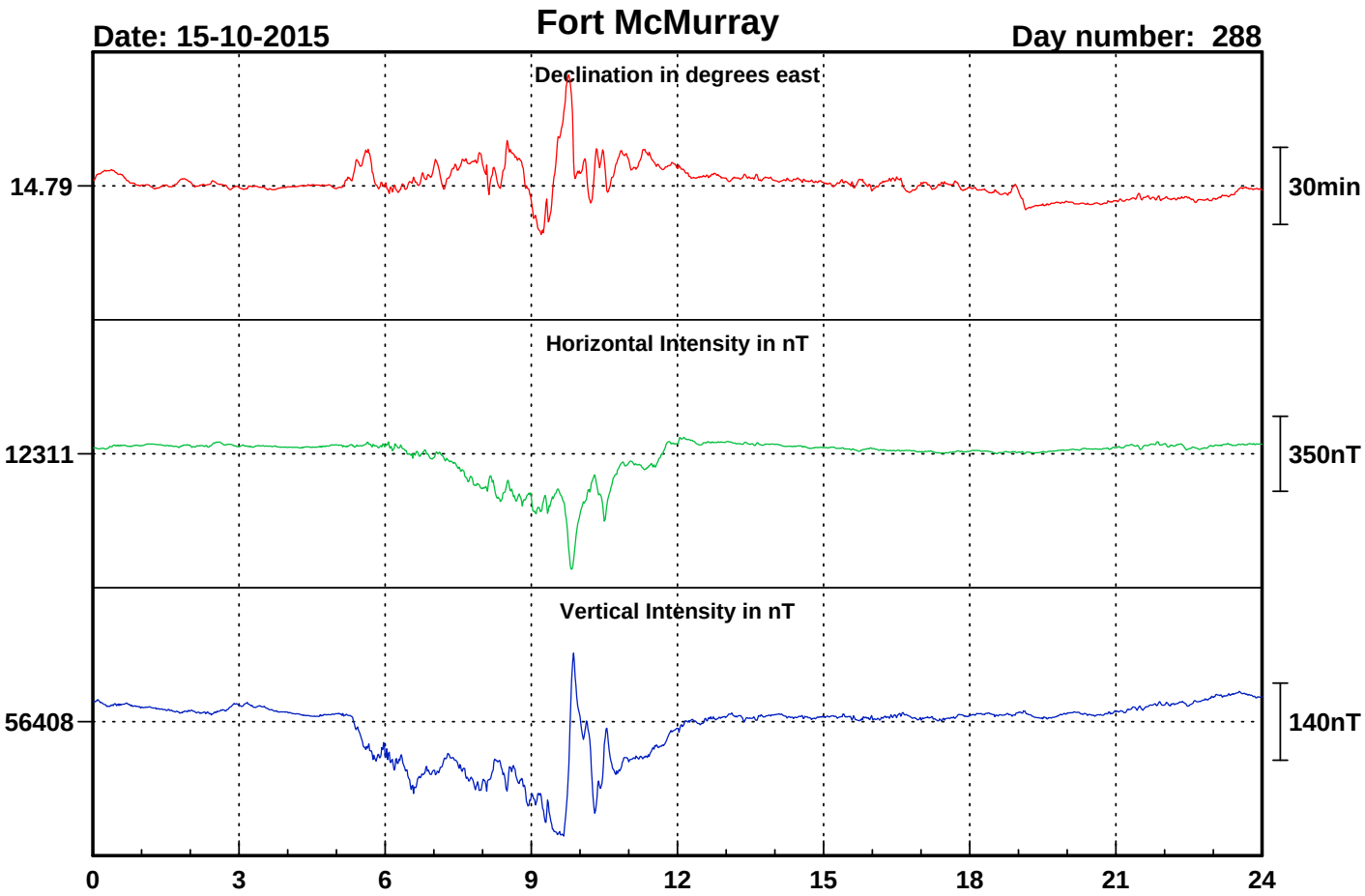
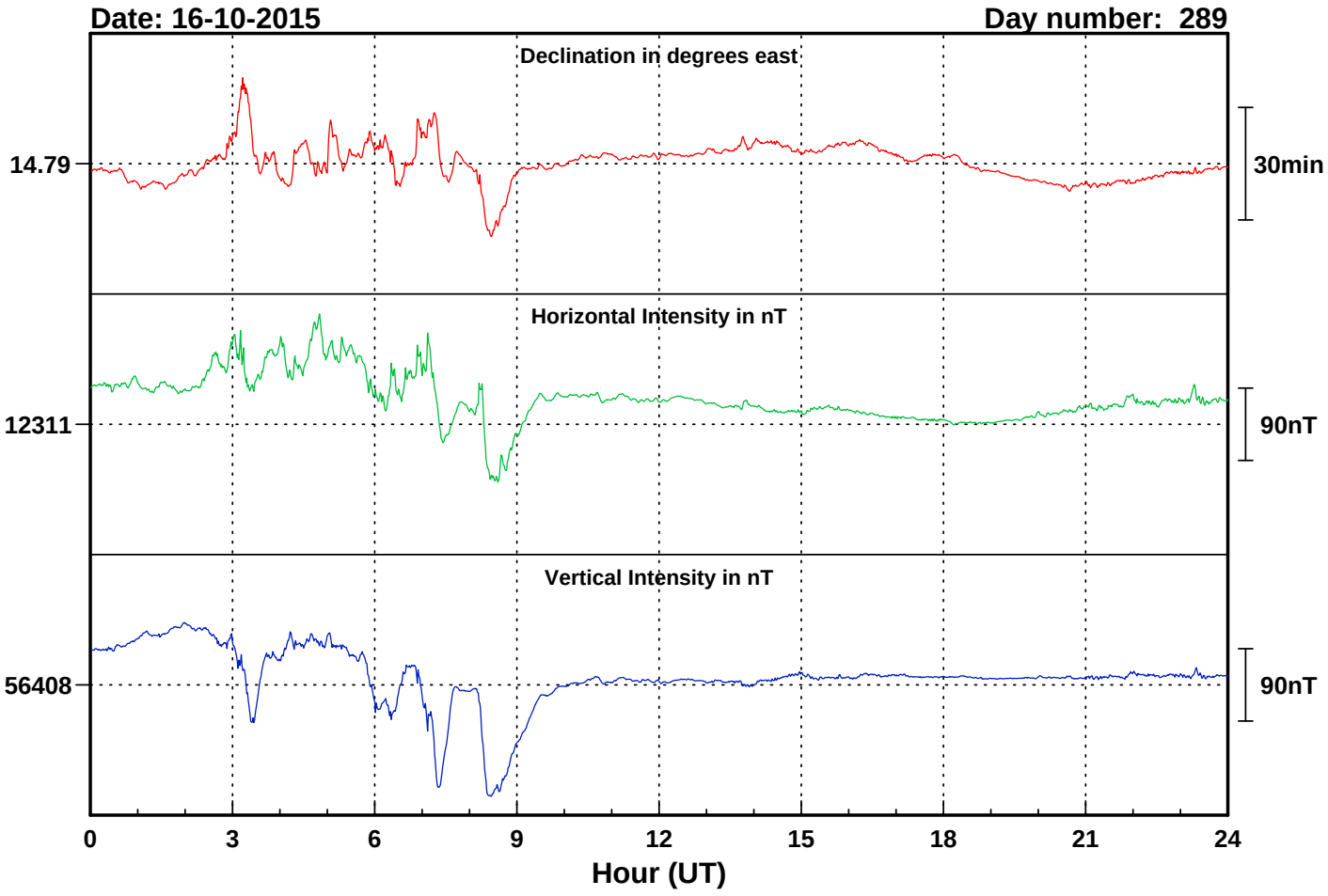
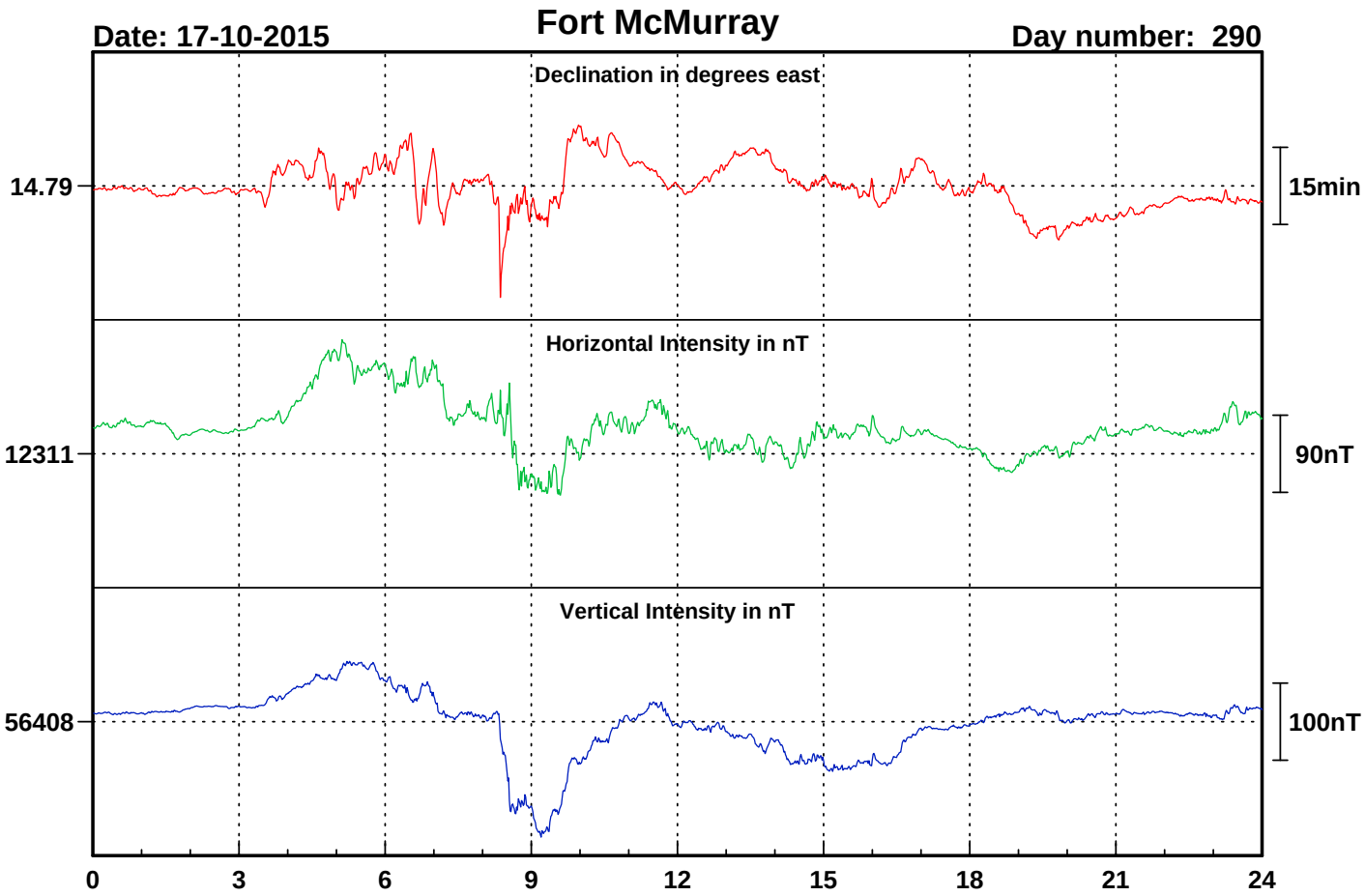
Day number: 285
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
450nT
Vertical Intensity in nT
56408
180nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 13-10-2015
Day number: 286
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
400nT
Vertical Intensity in nT
56408
200nT
0
3
6
9
12
15
18
21
24
Date: 14-10-2015
Day number: 287
Declination in degrees east
14.79
45min
Horizontal Intensity in nT
12311
400nT
Vertical Intensity in nT
56408
200nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 15-10-2015
Day number: 288
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
350nT
Vertical Intensity in nT
56408
140nT
0
3
6
9
12
15
18
21
24


Date: 16-10-2015
Day number: 289
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
90nT
Vertical Intensity in nT
56408
90nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 17-10-2015
Day number: 290
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
90nT
Vertical Intensity in nT
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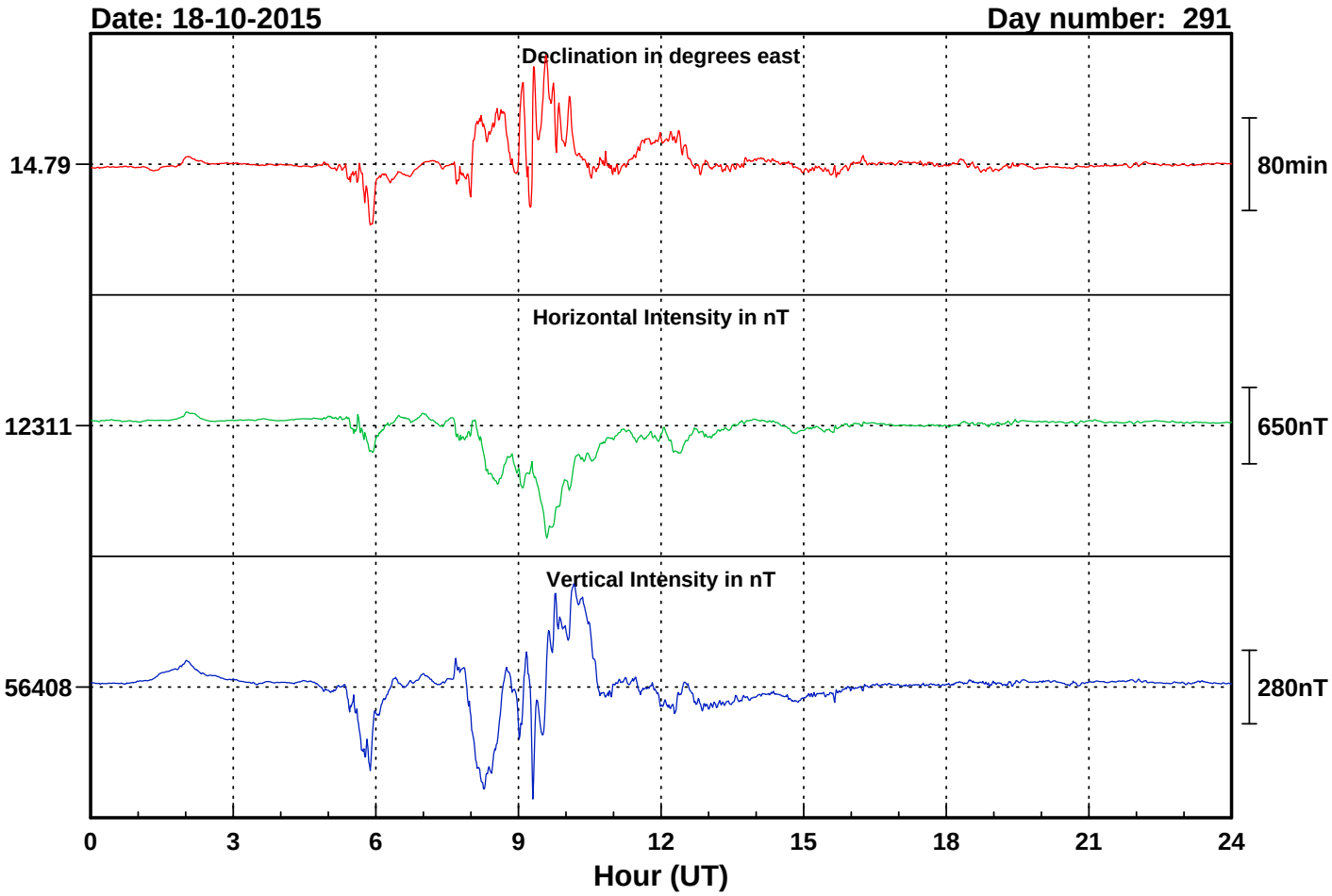
100nT
0
3
6
9
12
15
18
21
24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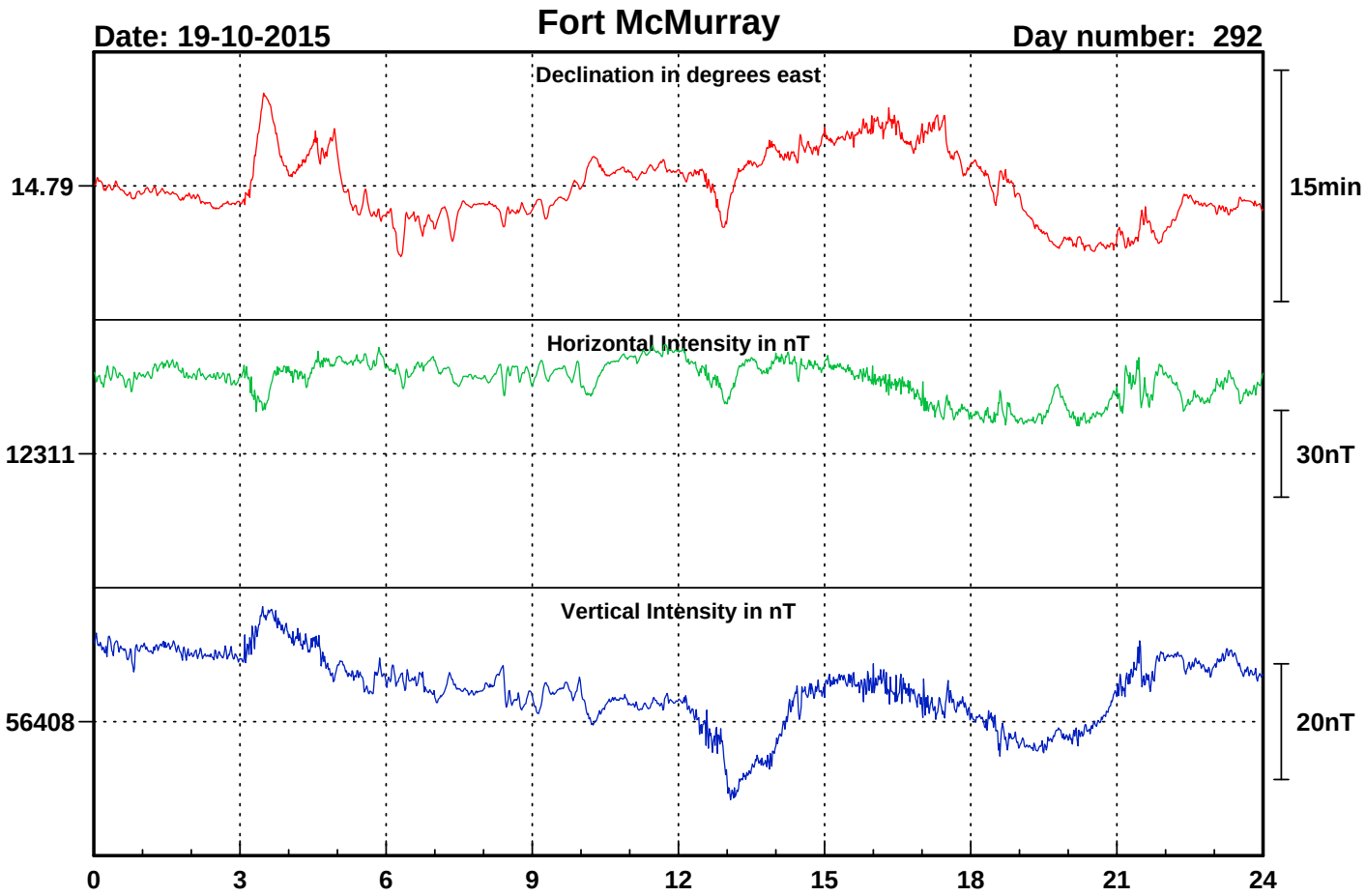
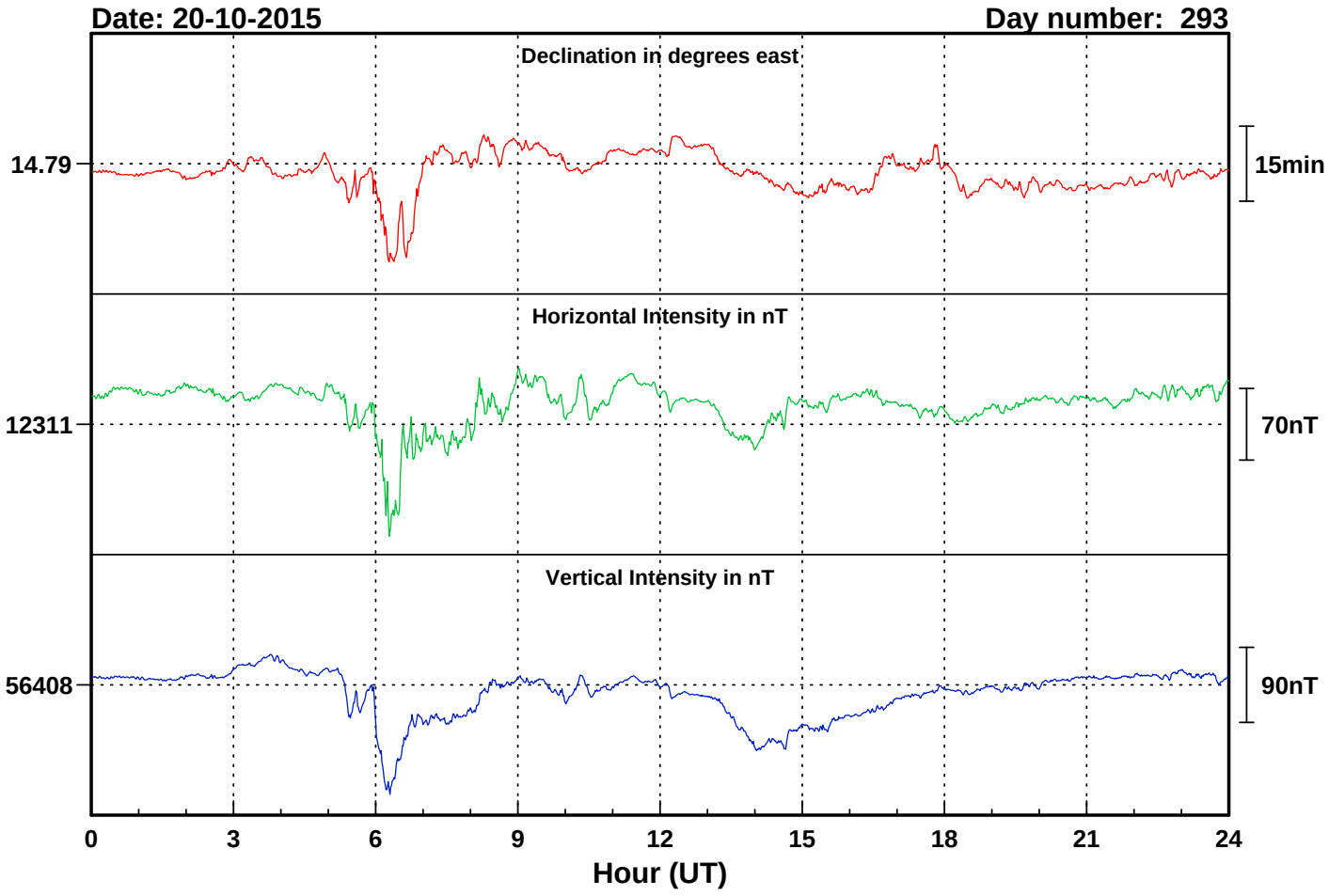
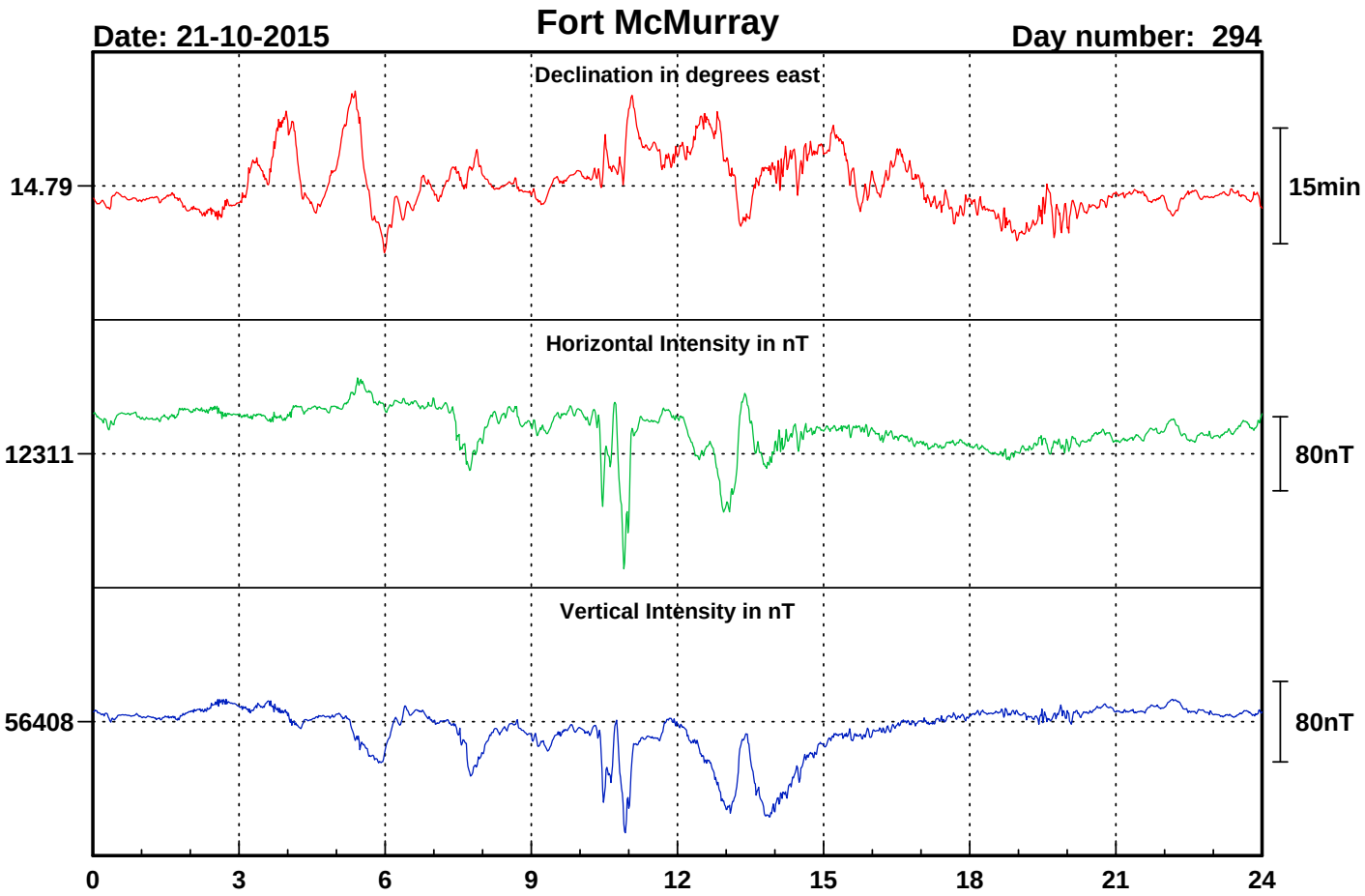
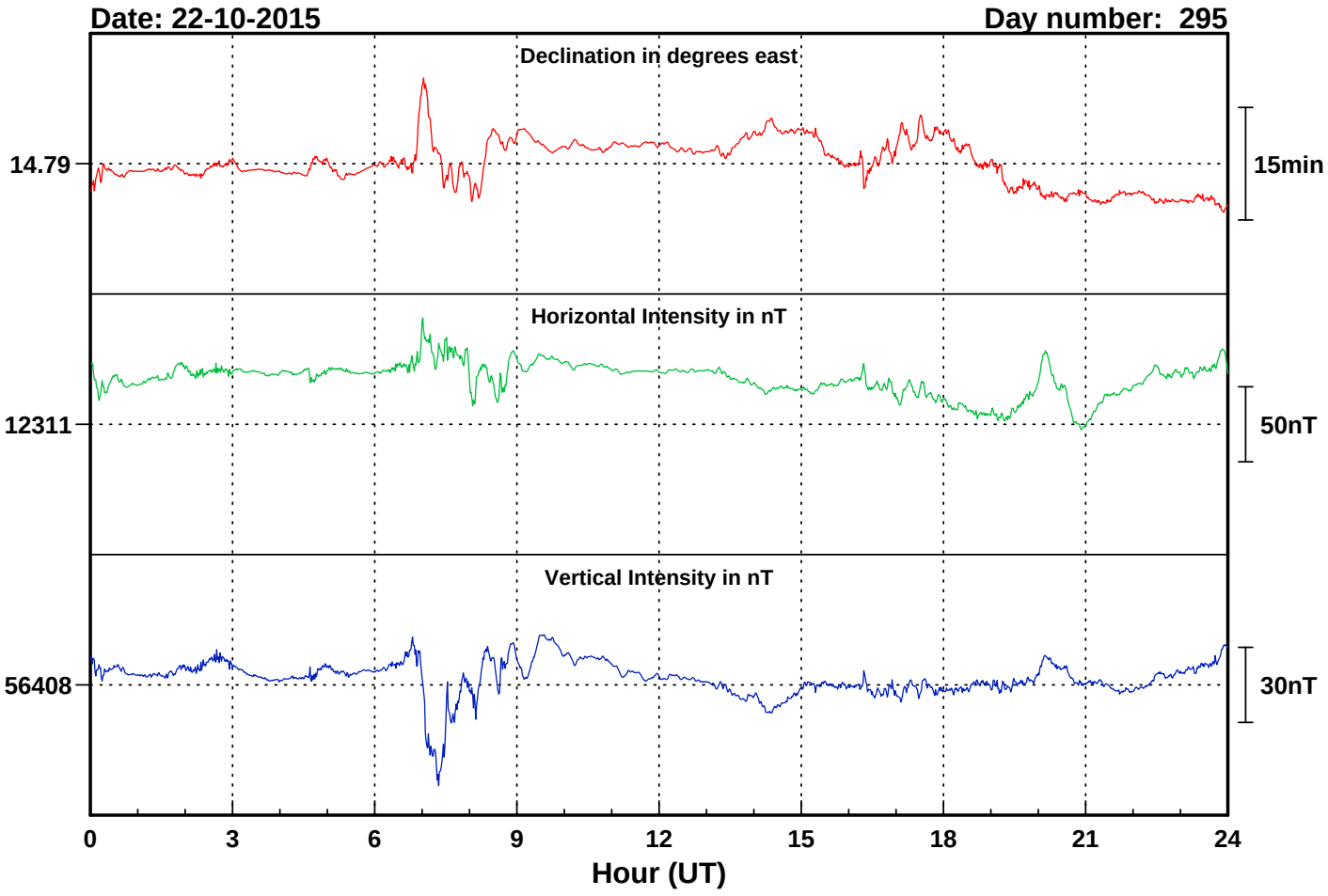
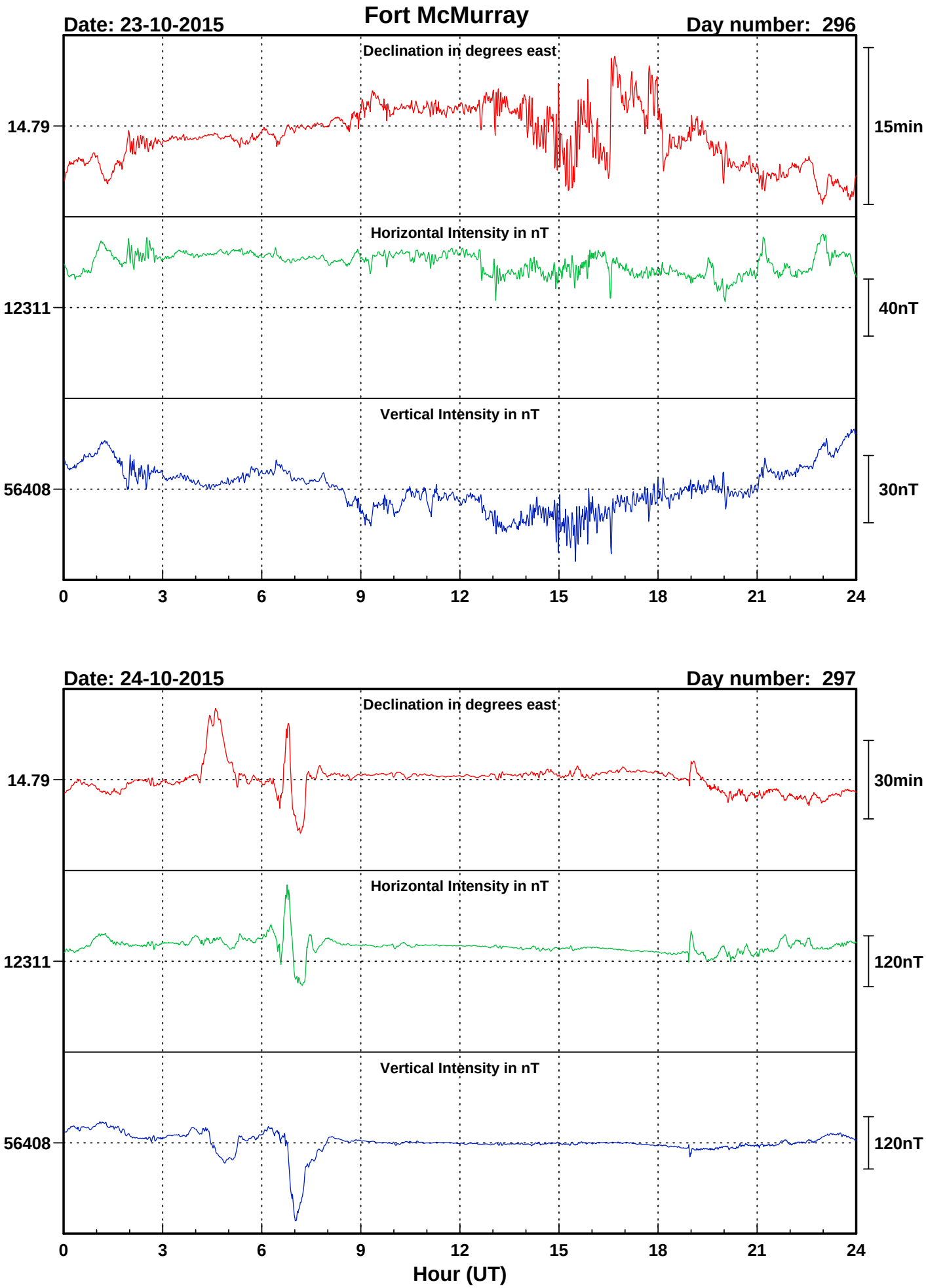
Day number: 291
Declination in degrees east
14.79
80min
Horizontal Intensity in nT
12311
650nT
Vertical Intensity in nT
56408
280nT
0
3
6
9
12
15
18
21
24
Hour (UT)

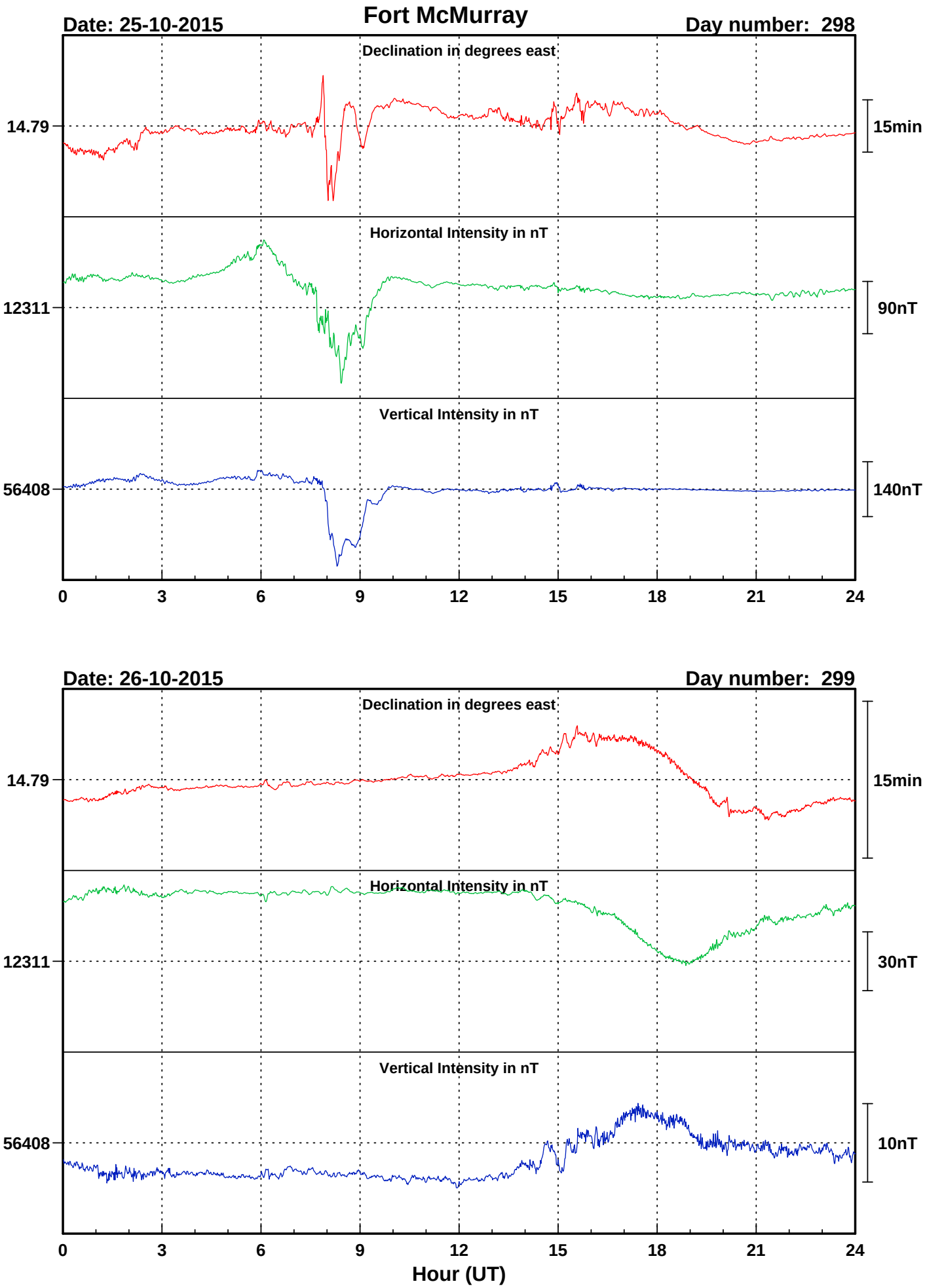

Fort McMurray
Date: 19-10-2015
Day number: 292
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
20nT
0
3
6
9
12
15
18
21
24

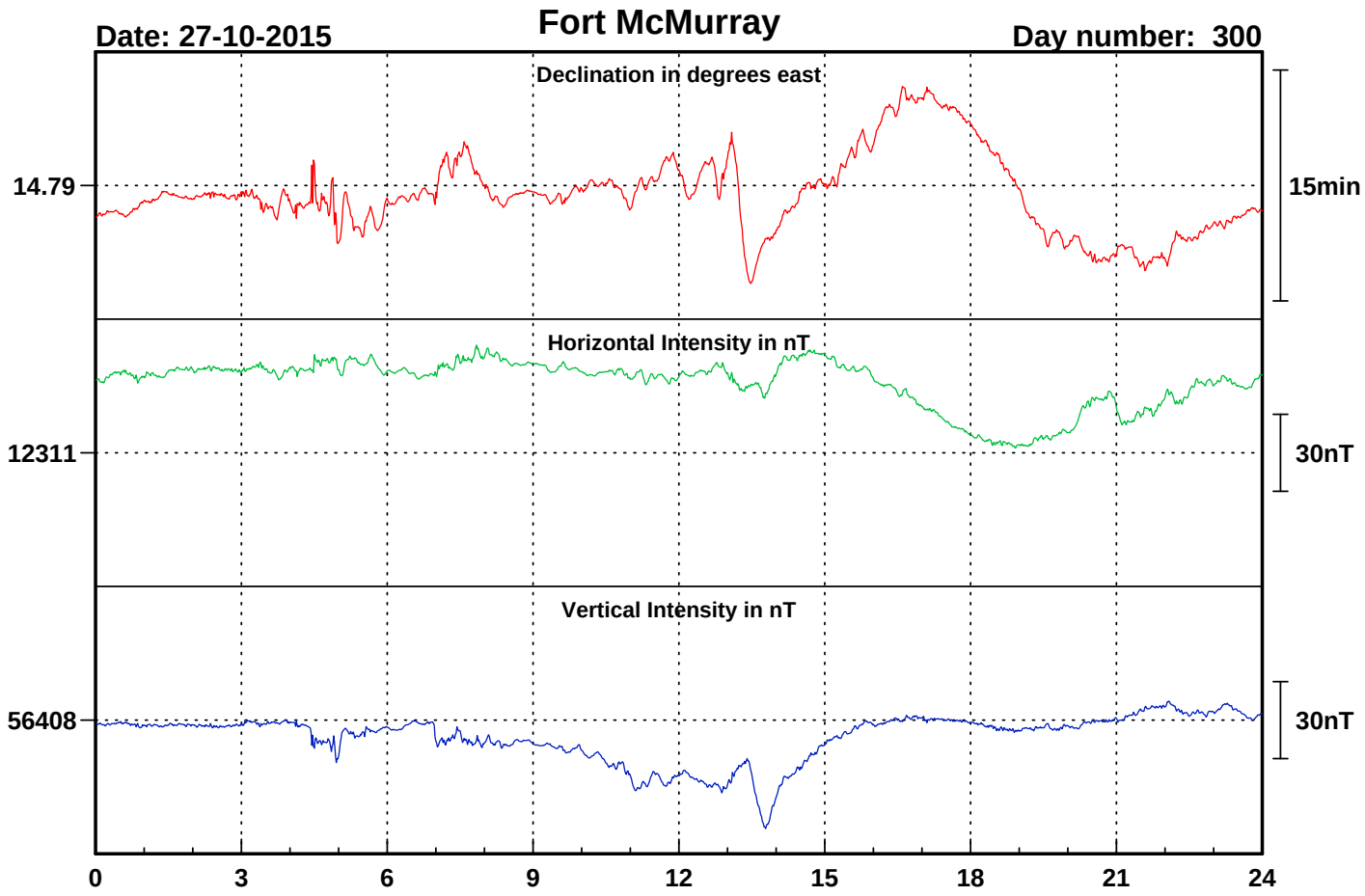

Date: 20-10-2015
Day number: 293
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
70nT
Vertical Intensity in nT
56408
90nT
0
3
6
9
12
15
18
21
24
Hour (UT)

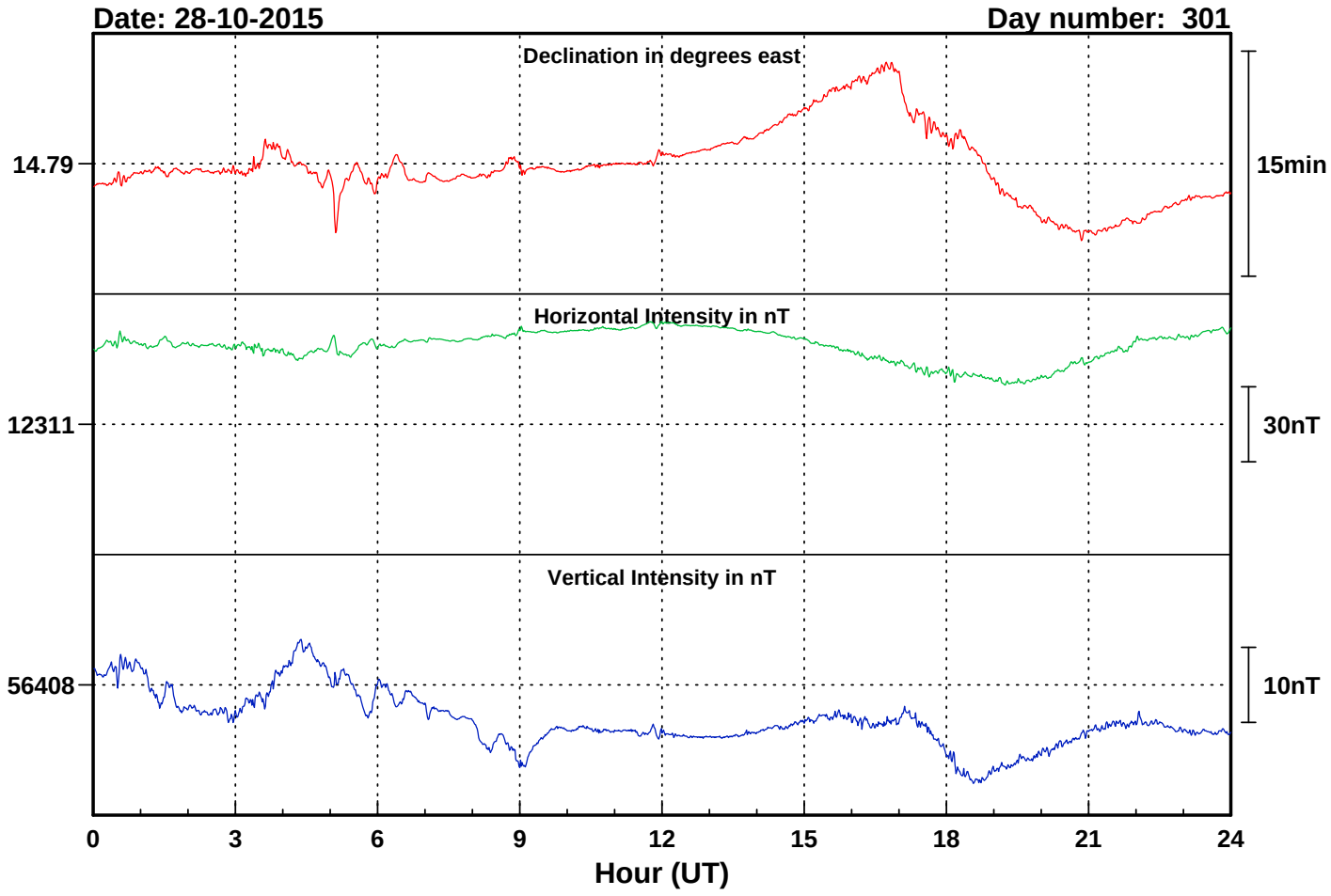

Fort McMurray
Date: 21-10-2015
Day number: 294
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
80nT
Vertical Intensity in nT
56408
80nT
0
3
6
9
12
15
18
21
24

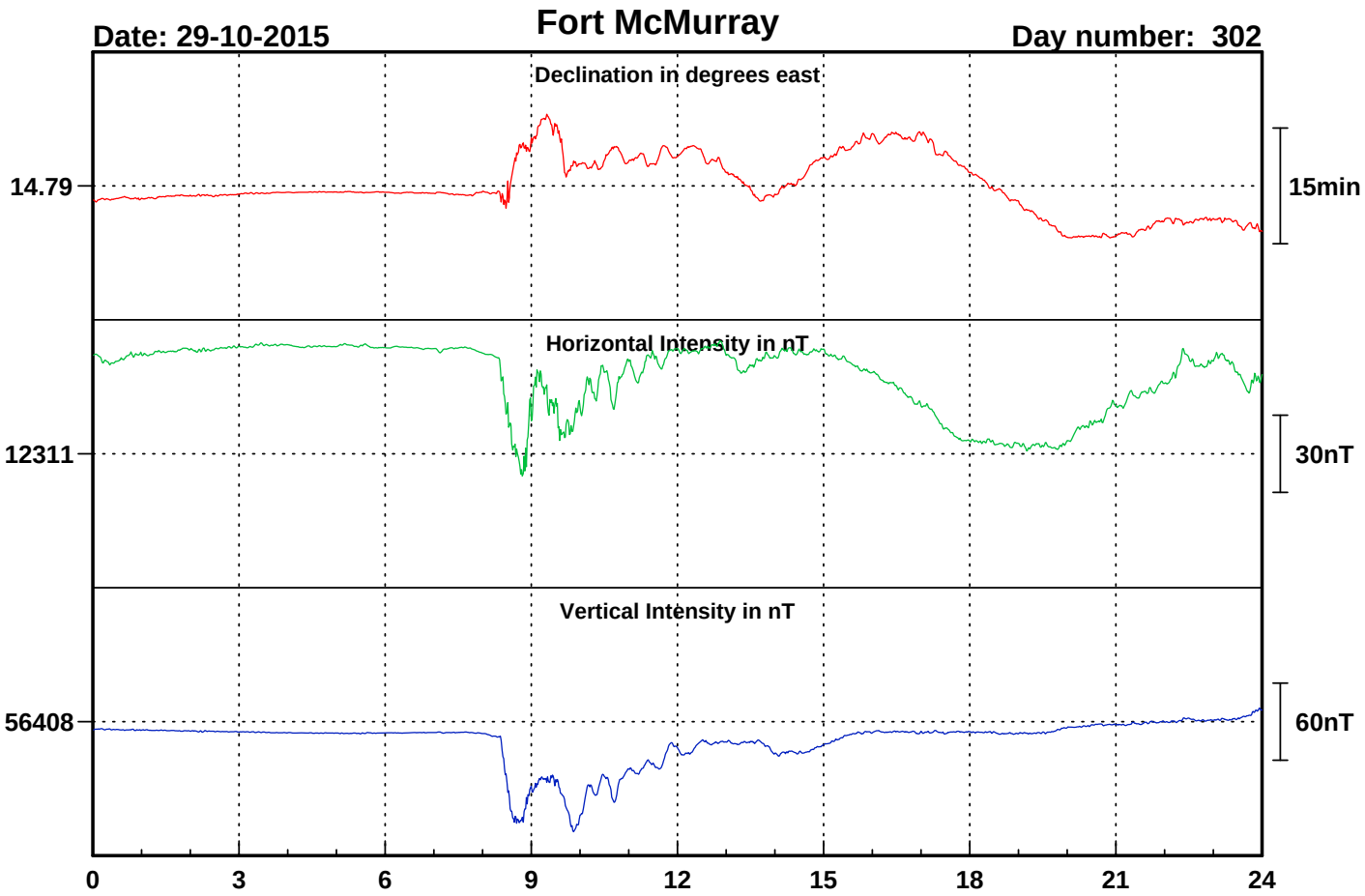

Date: 22-10-2015
Day number: 295
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
50nT
Vertical Intensity in nT
56408
30nT
0
3
6
9
12
15
18
21
24
Hour (UT)

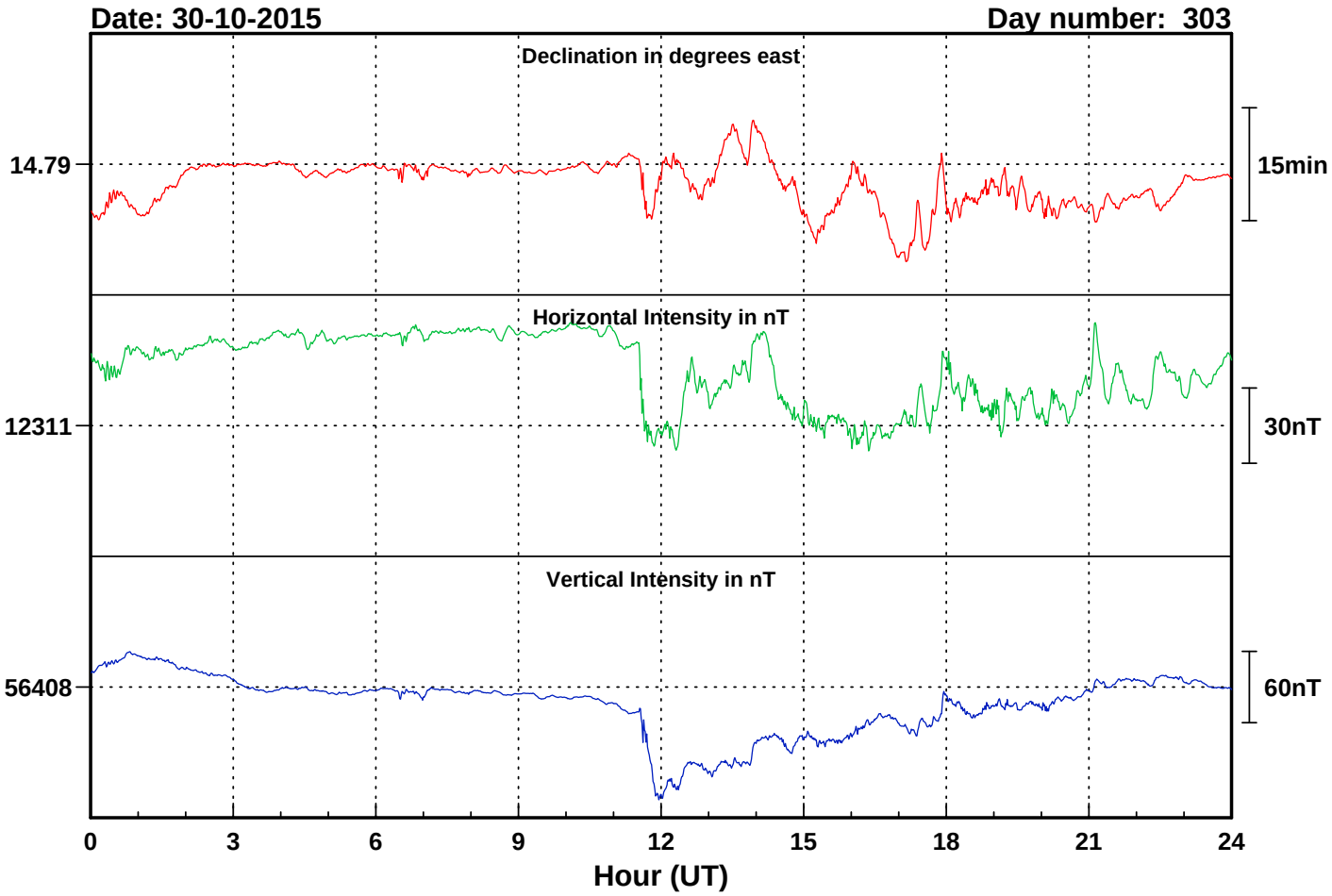

Fort McMurray
Date: 23-10-2015
Day number: 296
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
40nT
Vertical Intensity in nT
56408
30nT
0
3
6
9
12
15
18
21
24
Date: 24-10-2015
Day number: 297
Declination in degrees east
14.79
30min
Horizontal Intensity in nT
12311
120nT
Vertical Intensity in nT
56408
120nT
0
3
6
9
12
15
18
21
24
Hour (UT)

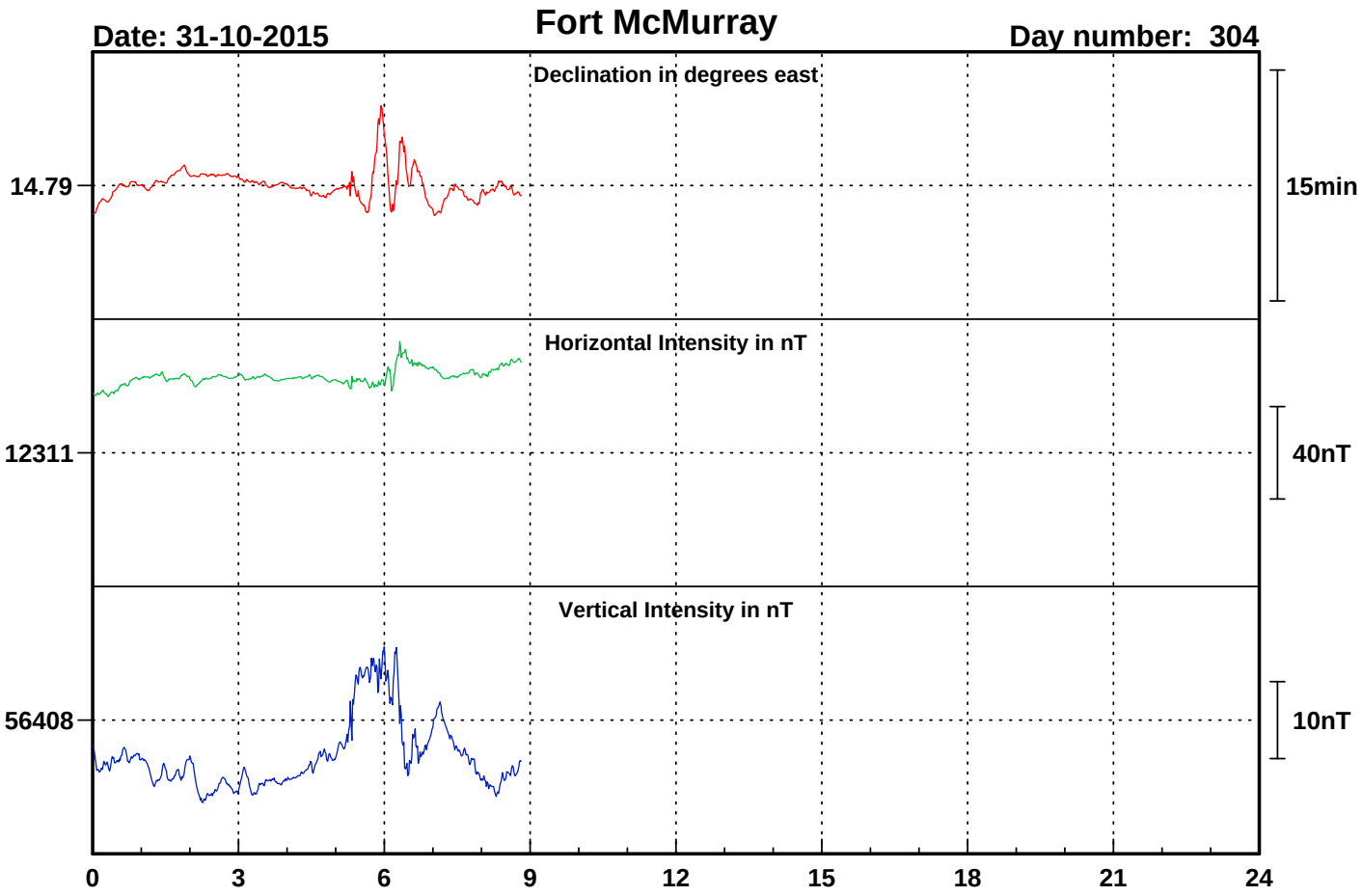

Fort McMurray
Date: 25-10-2015
Day number: 298
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
90nT
Vertical Intensity in nT
56408
140nT
0
3
6
9
12
15
18
21
24
Date: 26-10-2015
Day number: 299
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
10nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 27-10-2015
Day number: 300
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
30nT
0
3
6
9
12
15
18
21
24

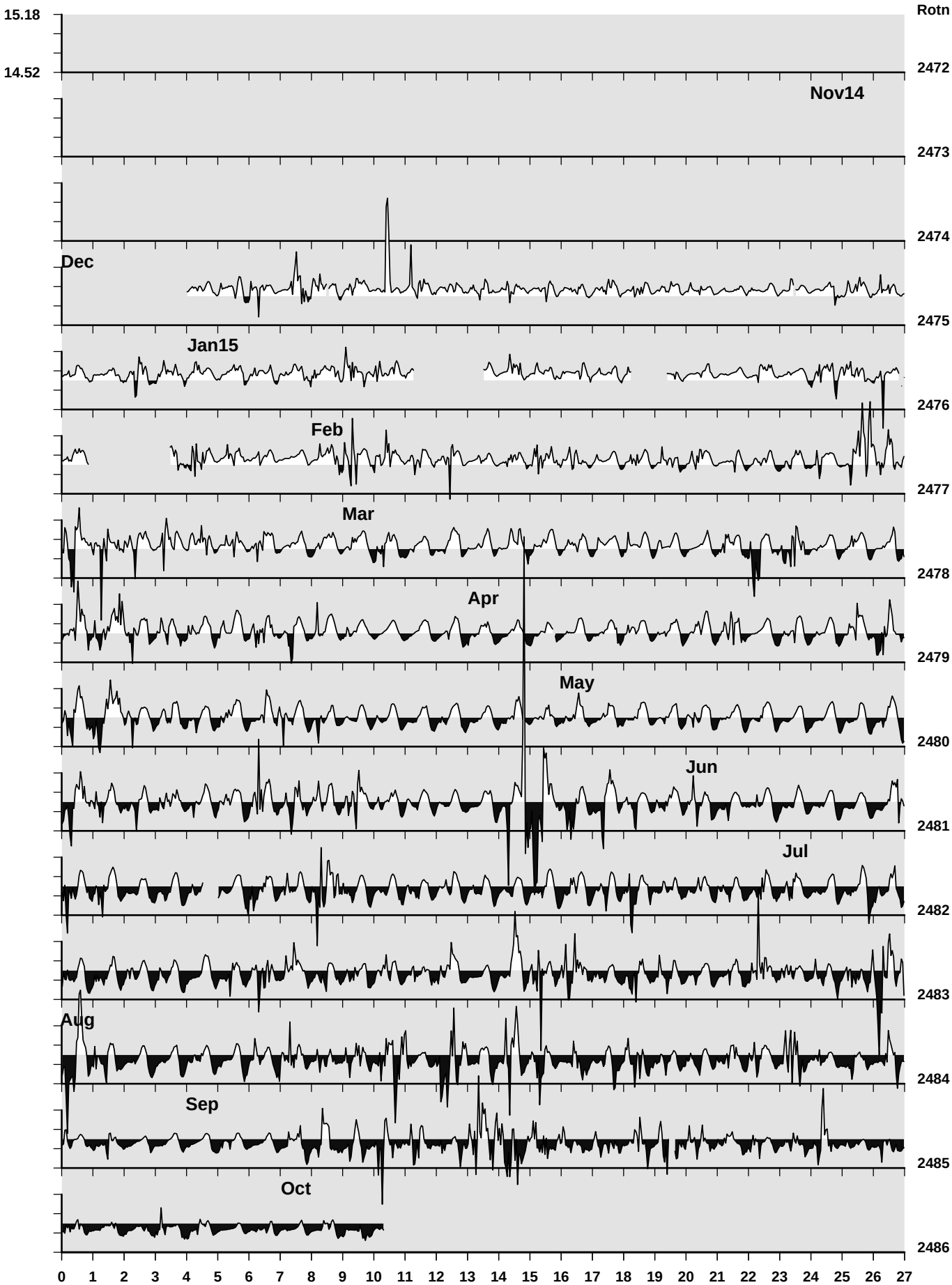

Date: 28-10-2015
Day number: 301
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
10nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 29-10-2015
Day number: 302
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
60nT
0
3
6
9
12
15
18
21
24


Date: 30-10-2015
Day number: 303
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
30nT
Vertical Intensity in nT
56408
60nT
0
3
6
9
12
15
18
21
24
Hour (UT)

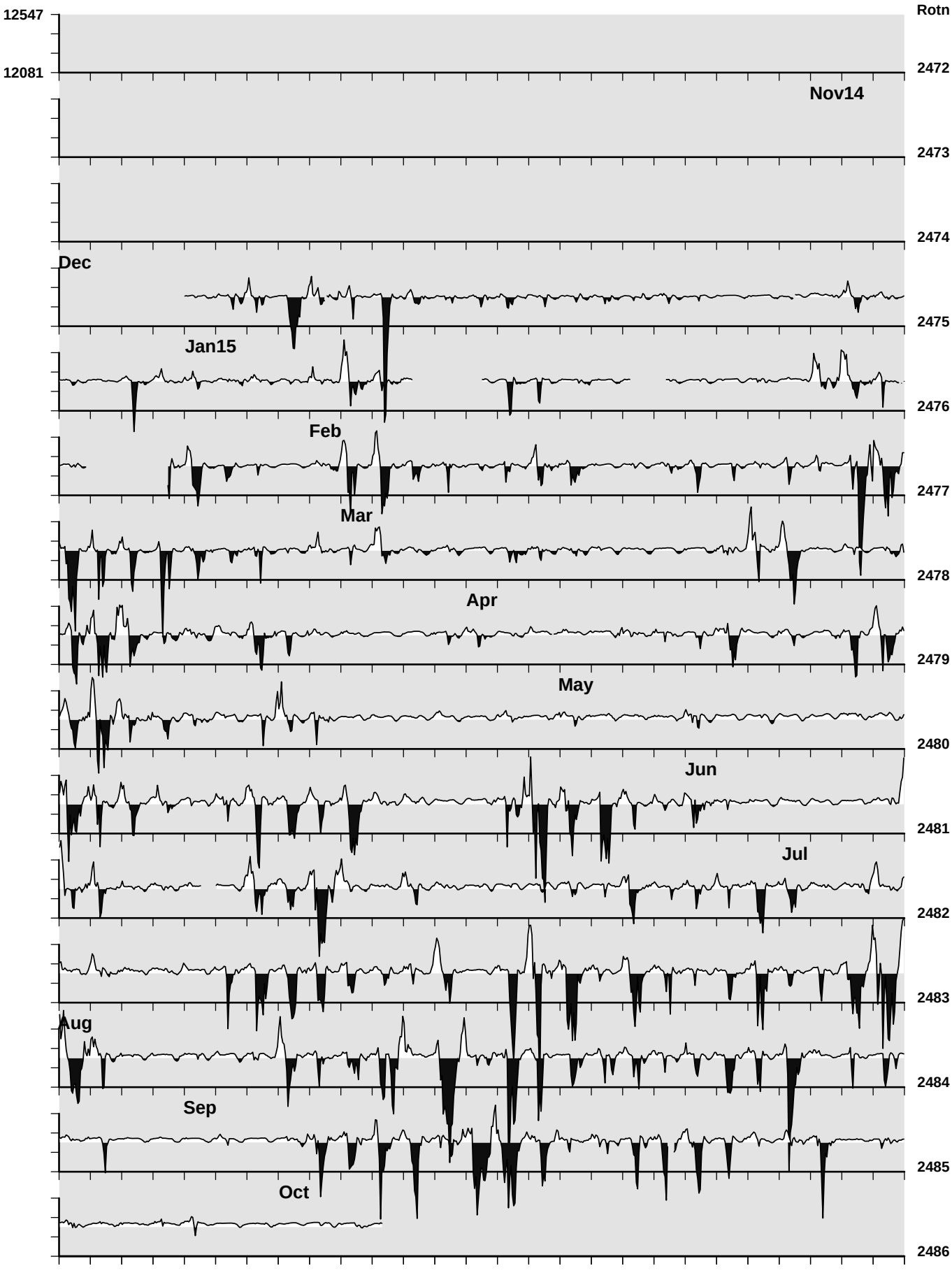

Fort McMurray
Date: 31-10-2015
Day number: 304
Declination in degrees east
14.79
15min
Horizontal Intensity in nT
12311
40nT
Vertical Intensity in nT
56408
10nT
0
3
6
9
12
15
18
21
24

Fort McMurray Observatory: Declination (degrees)



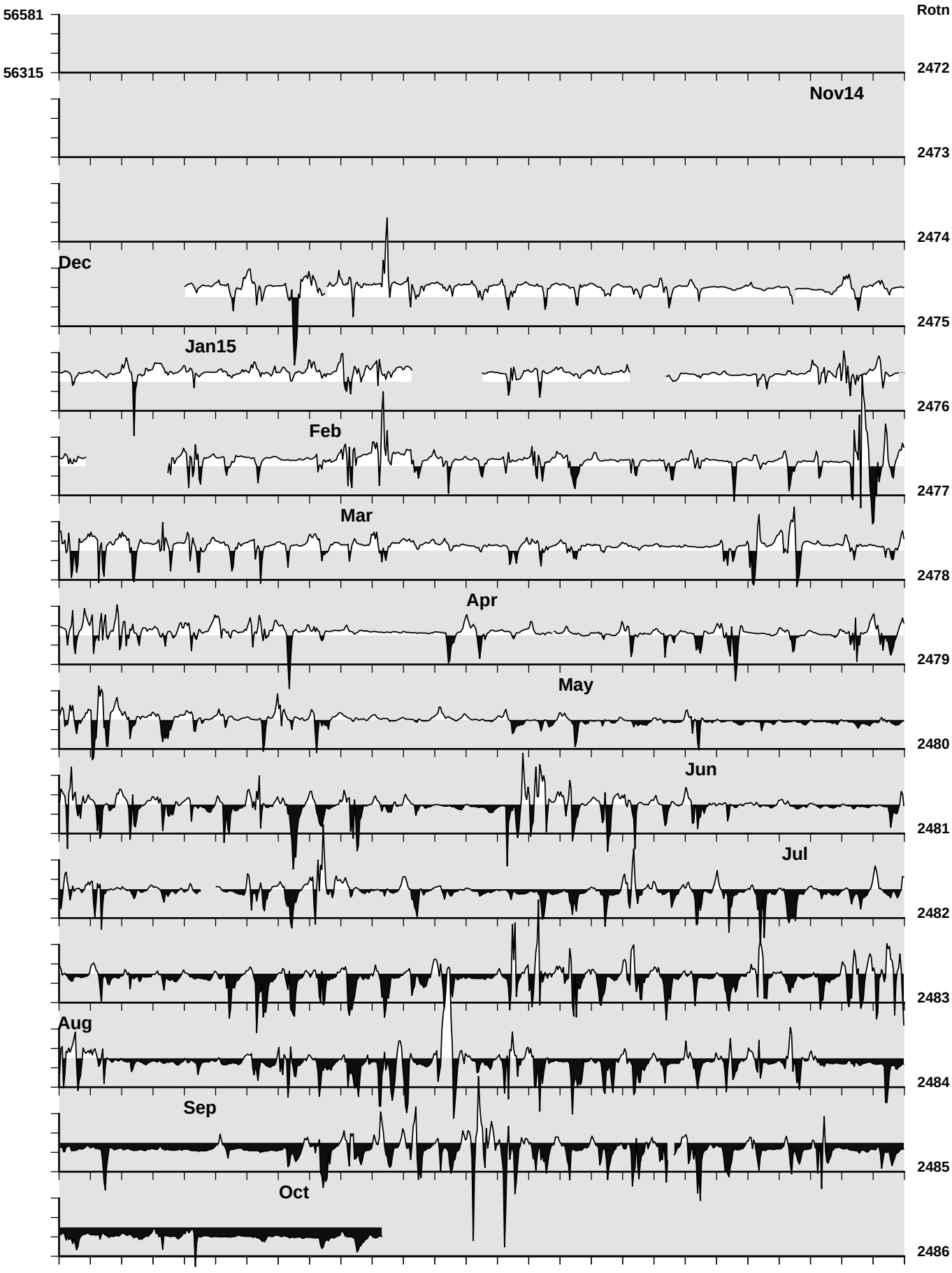
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Horizontal Intensity (nT)



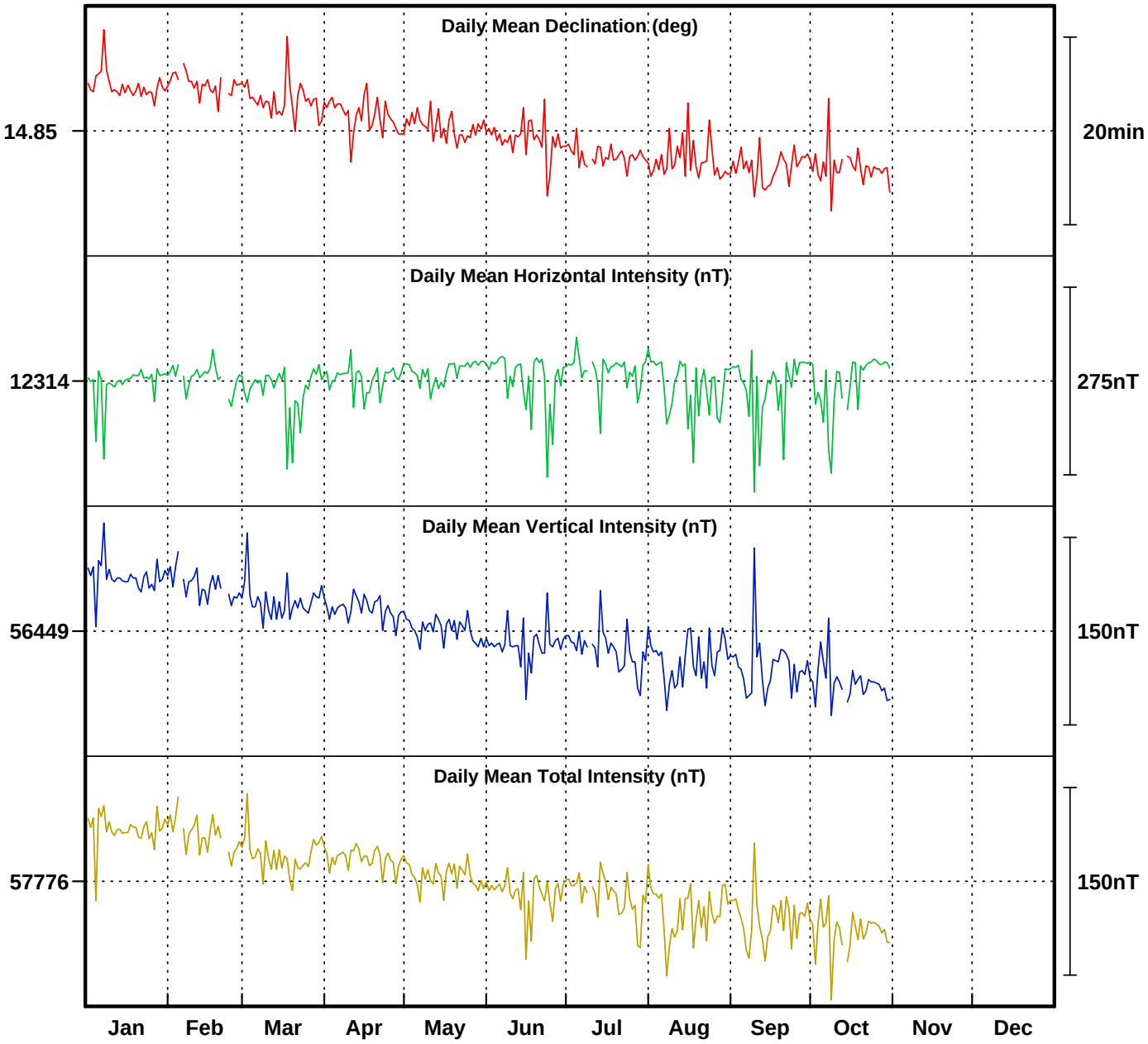
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Vertical Intensity (nT)



Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory 2015



Monthly Mean Values for Fort McMurray Observatory 2015

Month	*D*	*H*	*I*	*X*	*Y*	*Z*	*F*
January	14° 55.8′	12310 nT	77° 42.4′	11895 nT	3172 nT	56492 nT	57818 nT
February	**° ***′	***** nT	**° ***′	***** nT	***** nT	***** nT	***** nT
March	14° 54.3′	12300 nT	77° 42.8′	11886 nT	3164 nT	56473 nT	57796 nT
April	14° 52.6′	12318 nT	77° 41.6′	11905 nT	3162 nT	56466 nT	57794 nT
May	14° 51.4′	12328 nT	77° 40.8′	11916 nT	3161 nT	56449 nT	57780 nT
June	14° 50.1′	12315 nT	77° 41.4′	11905 nT	3153 nT	56438 nT	57766 nT
July	14° 48.3′	12330 nT	77° 40.5′	11920 nT	3151 nT	56434 nT	57765 nT
August	14° 47.9′	12304 nT	77° 41.9′	11896 nT	3143 nT	56425 nT	57751 nT
September	14° 47.2′	12306 nT	77° 41.7′	11898 nT	3141 nT	56419 nT	57746 nT
October	14° 47.1′	12311 nT	77° 41.3′	11903 nT	3142 nT	56408 nT	57736 nT

Note

i. The values shown here are provisional.