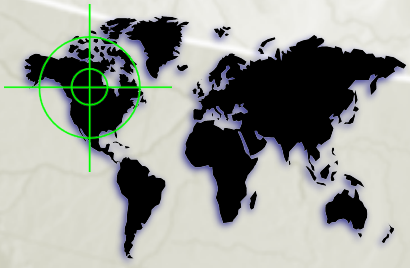
BRITISH GEOLOGICAL SURVEY

Fort McMurray Observatory *Monthly Magnetic Bulletin*

July 2017

17/07/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° 35'52.8"N 248° 41'06.0" E
Geomagnetic: 63° 28'12"N 310° 04'12" 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 2017.5. 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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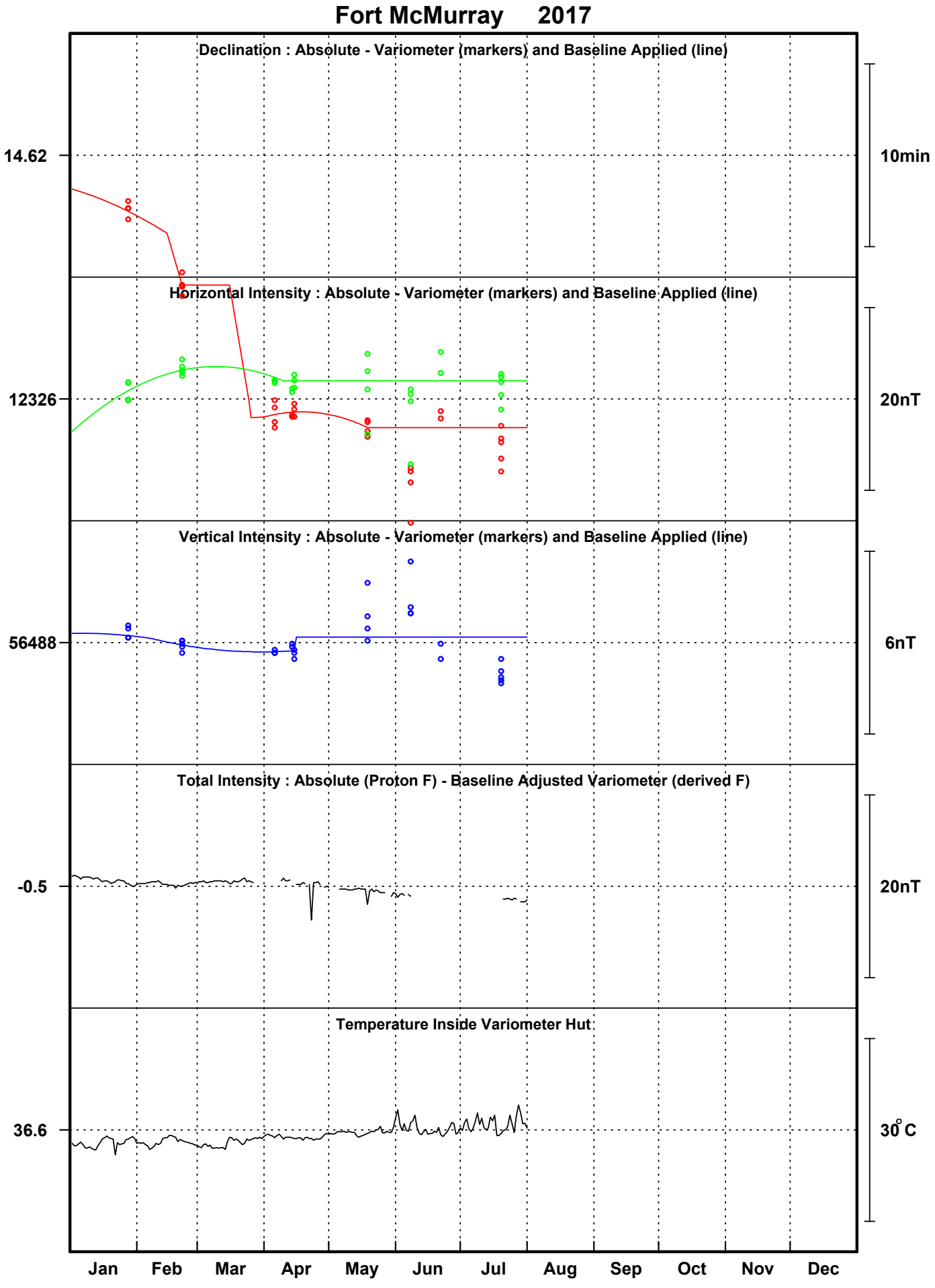
Reproduction of any part of this bulletin should be accompanied by the statement: 'Reproduced with the permission of the British Geological Survey ©NERC. All rights Reserved'. Publications making use of the data should include an acknowledgment statement of the form: ‘The results presented in this paper rely on the data collected at Fort McMurray observatory, operated by Sperry Drilling, Halliburton Group Canada and the British Geological Survey.’

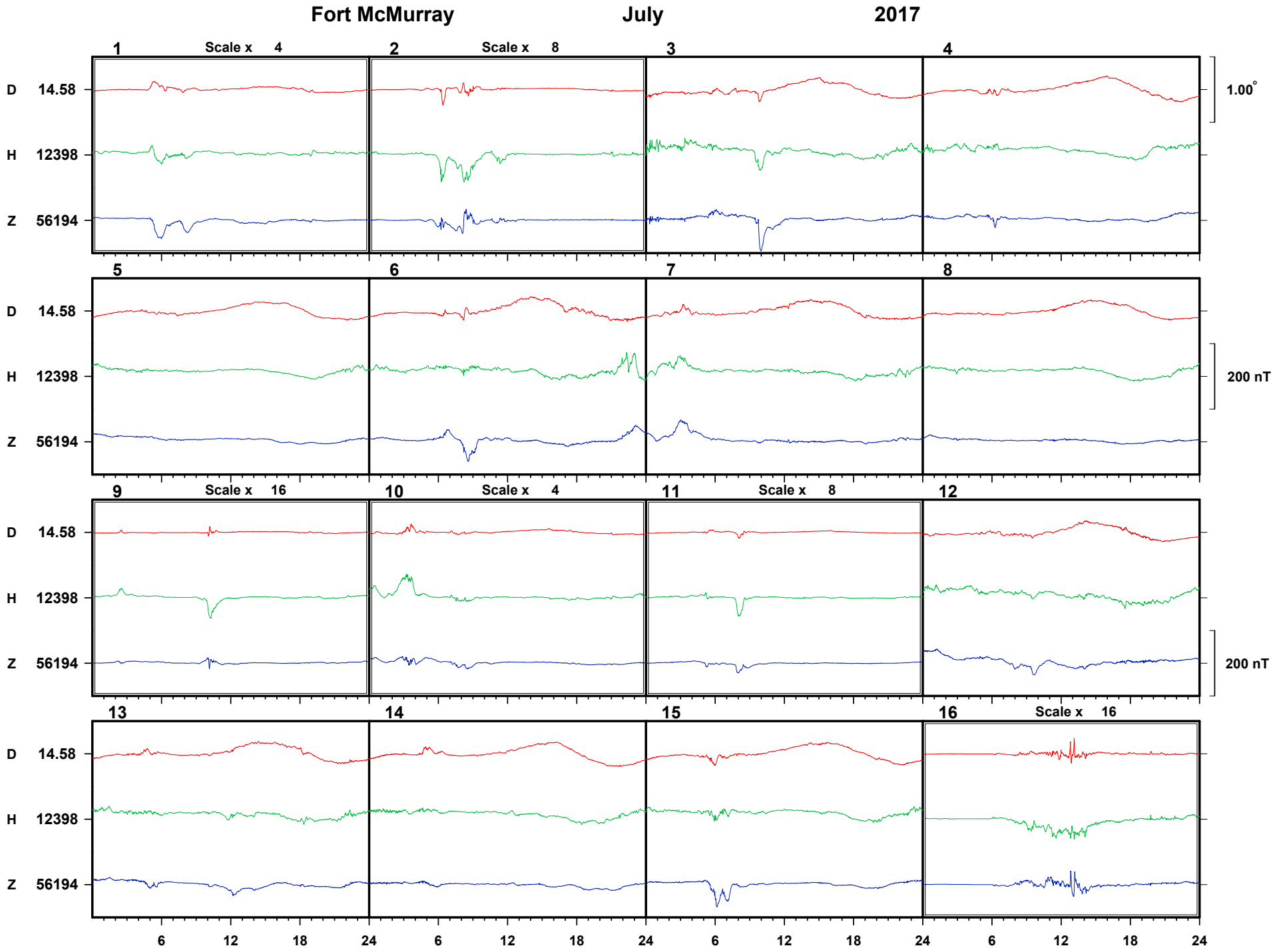
Commercial users can contact the geomagnetism team for information on the range of applications and services offered. Full contact details are available at www.geomag.bgs.ac.uk/contactus/staff

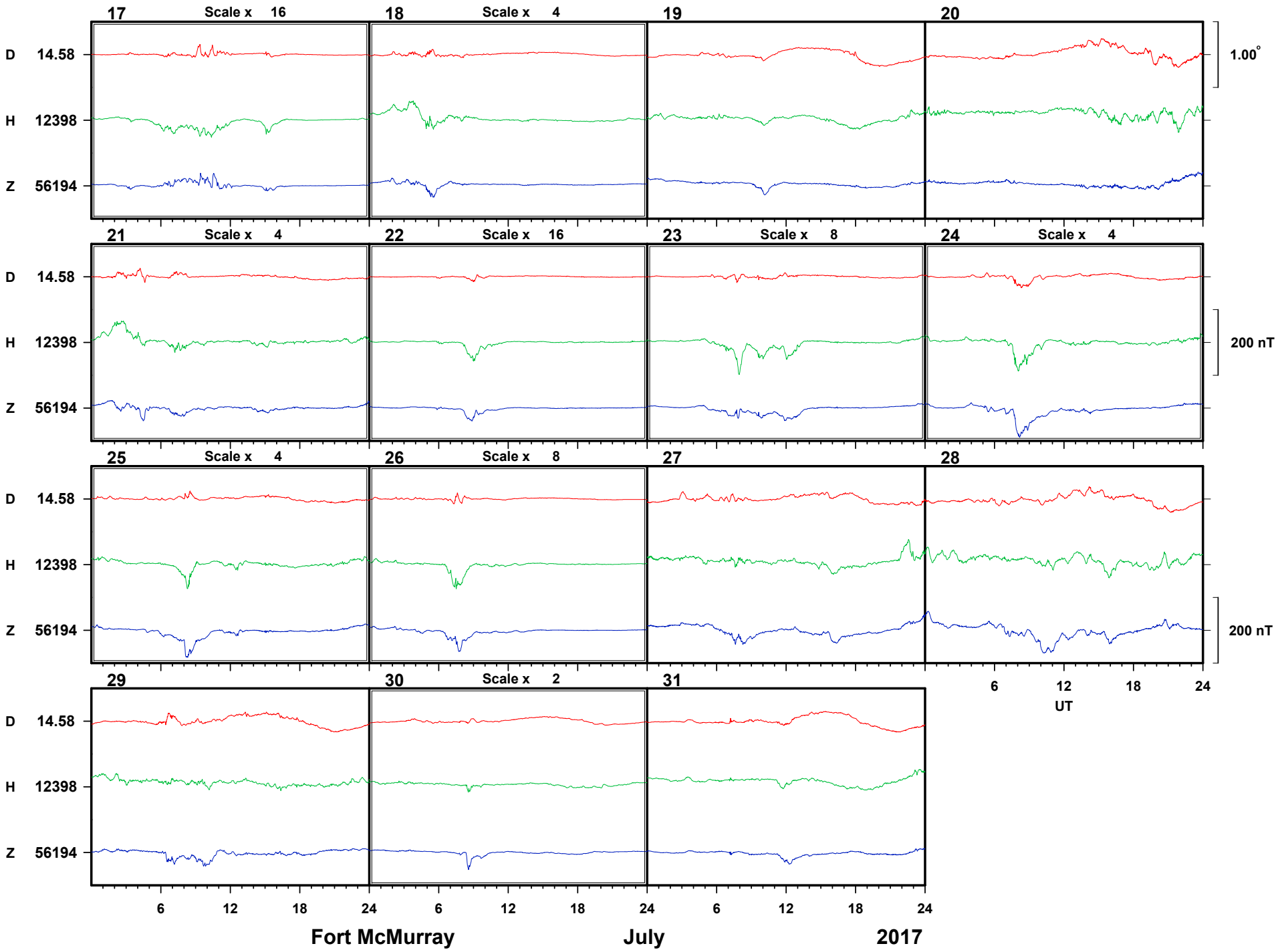
FORT McMURRAY OBSERVATORY

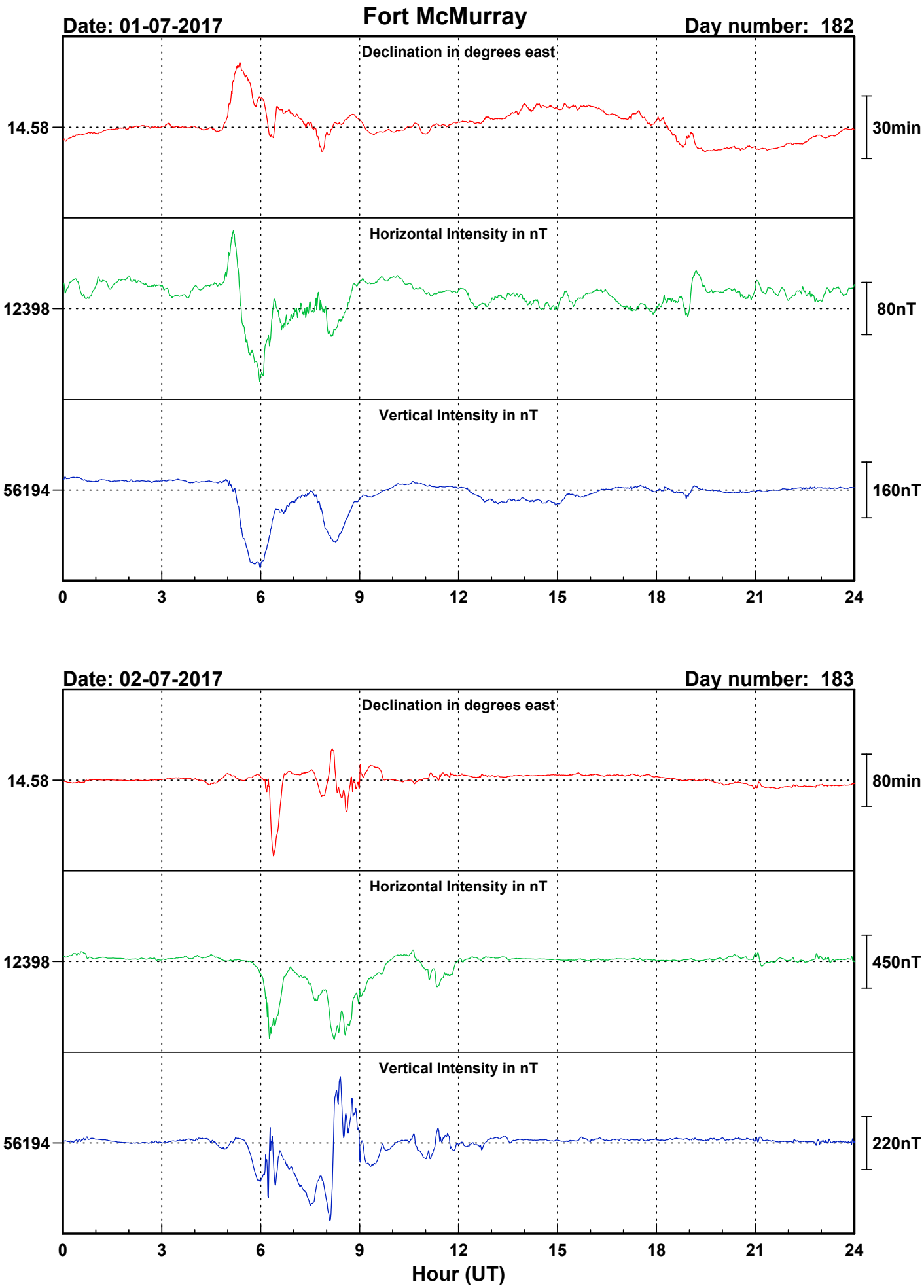
ABSOLUTE OBSERVATIONS

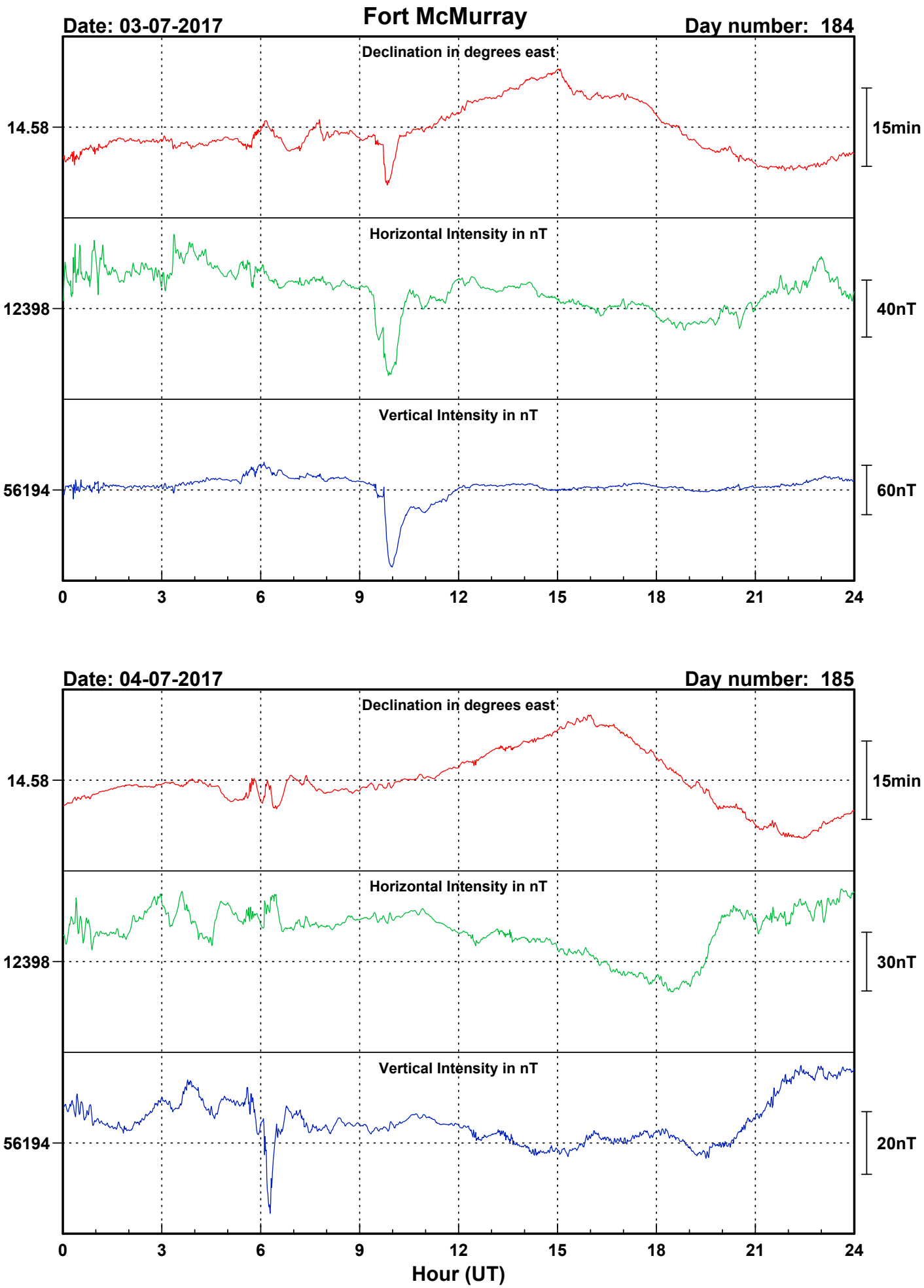
		Declination			Inclination		Total Field		Horizontal Intensity		Vertical Intensity		
Date	**Day Number**	**Time (UT)**	**Absolute (º)**	**Baseline (º)**	**Time (UT)**	**Absolute (º)**	**Site difference (nT)**	**Absolute corrected (nT)**	**Absolute (nT)**	**Baseline (nT)**	**Absolute (nT)**	**Baseline (nT)**	**Observer**
19-Jul-17	200	19:20	14.4018	14.3400	19:28	77.5654	0.5	57537.8	12389.3	12328.7	56188.1	56487.1	TM
19-Jul-17	200	19:38	14.3992	14.3550	19:44	77.5629	0.5	57539.2	12392.1	12328.1	56188.9	56487.2	TM
19-Jul-17	200	19:53	14.4029	14.3583	19:59	77.5592	0.5	57539.8	12395.9	12329.0	56188.7	56487.0	TM
19-Jul-17	200	20:09	14.3692	14.3283	20:16	77.5608	0.5	57539.4	12394.2	12326.7	56188.7	56487.4	TM
19-Jul-17	200	20:48	14.4179	14.3700	20:58	77.5617	0.5	57541.0	12393.7	12325.1	56190.5	56487.8	TM

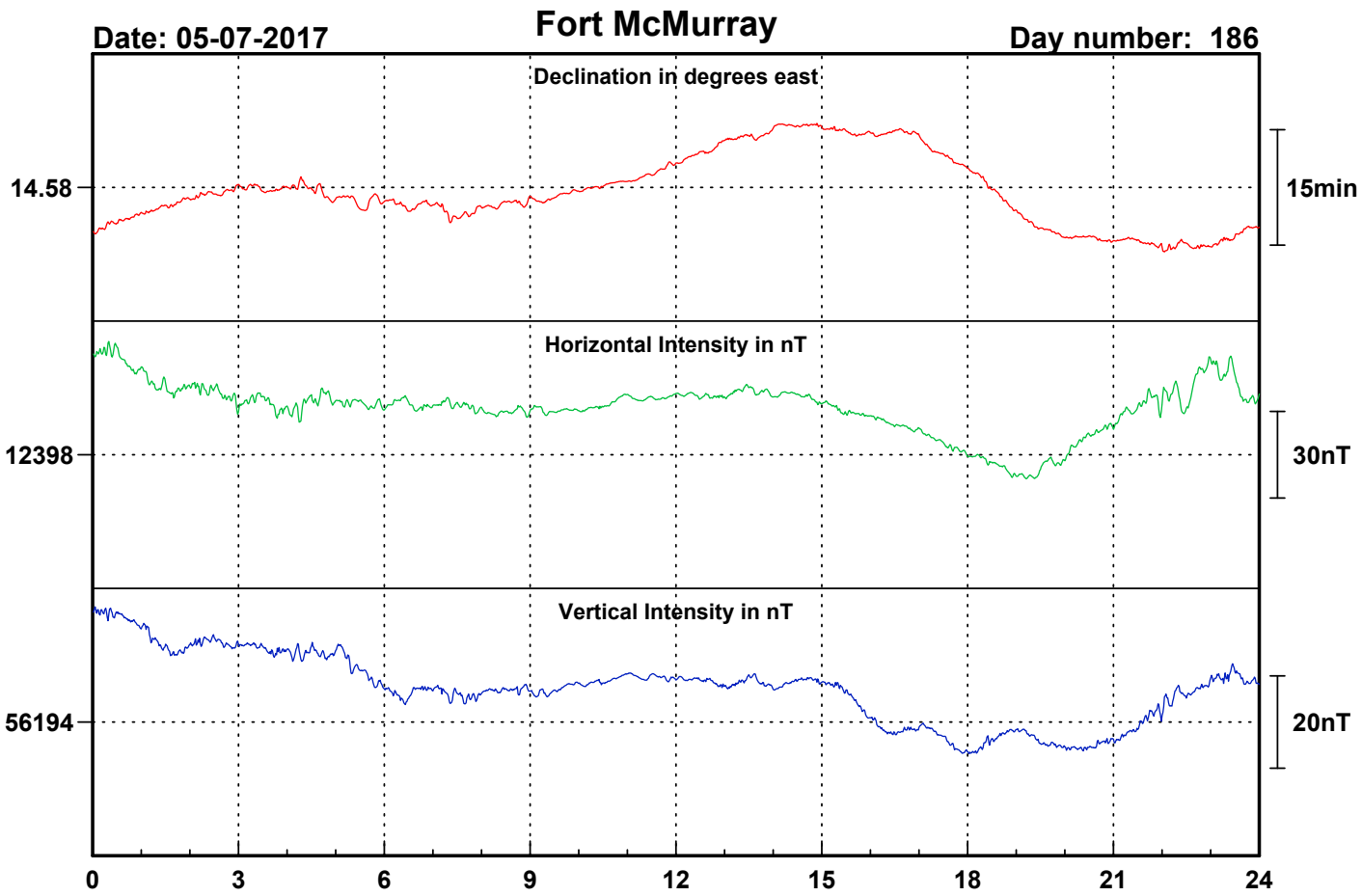

Fort McMurray 2017
Declination : Absolute - Variometer (markers) and Baseline Applied (line)
14.62
10min
Horizontal Intensity : Absolute - Variometer (markers) and Baseline Applied (line)
12326
20nT
Vertical Intensity : Absolute - Variometer (markers) and Baseline Applied (line)
56488
6nT
Total Intensity : Absolute (Proton F) - Baseline Adjusted Variometer (derived F)
-0.5
20nT
Temperature Inside Variometer Hut
36.6
30°C
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

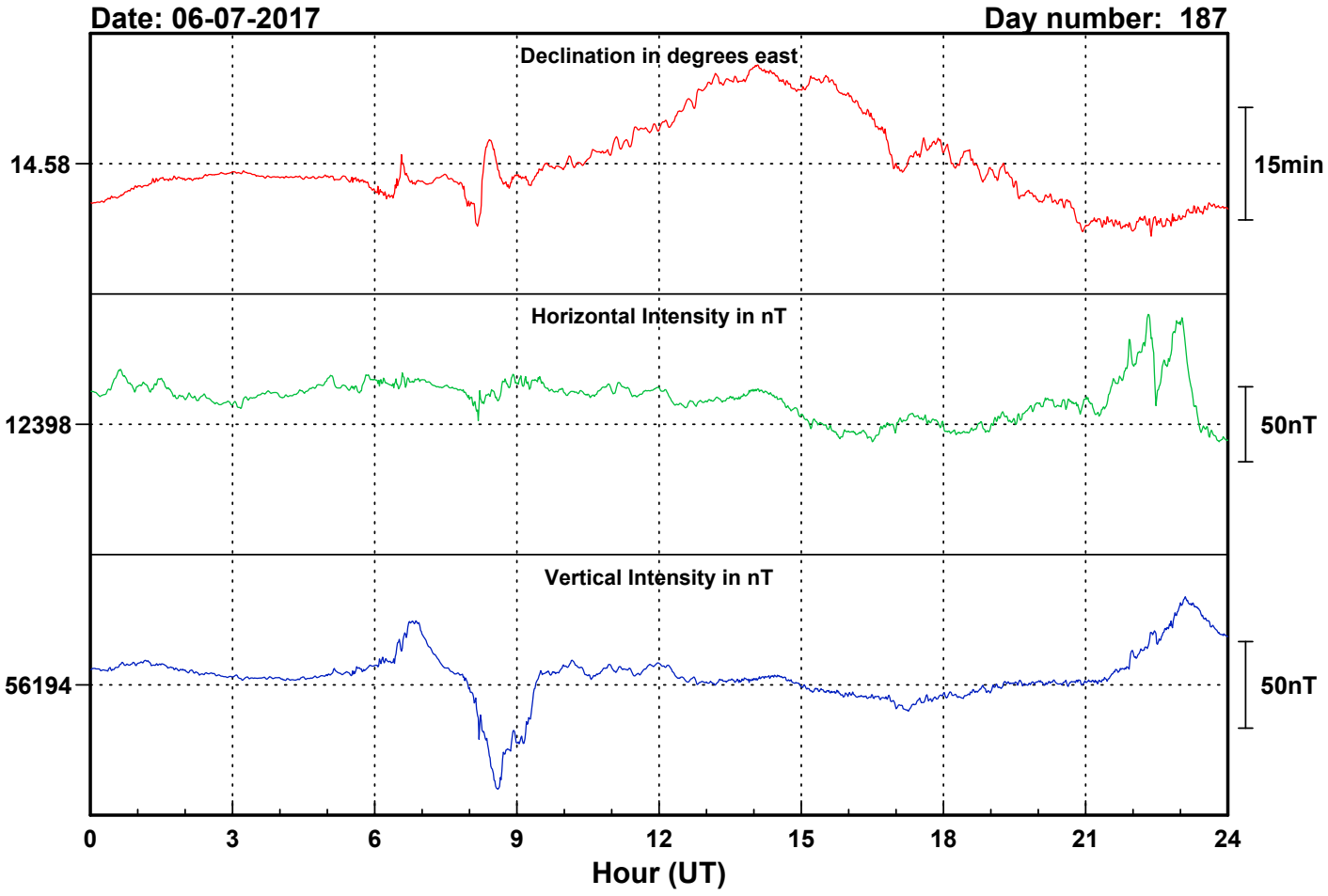

Fort McMurray
July
2017
1
Scale x 4
2
Scale x 8
3
4
D 14.58
H 12398
Z 56194
1.00°
5
6
7
8
200 nT
9
Scale x 16
10
Scale x 4
11
Scale x 8
12
13
14
15
16
Scale x 16
6
12
18
24

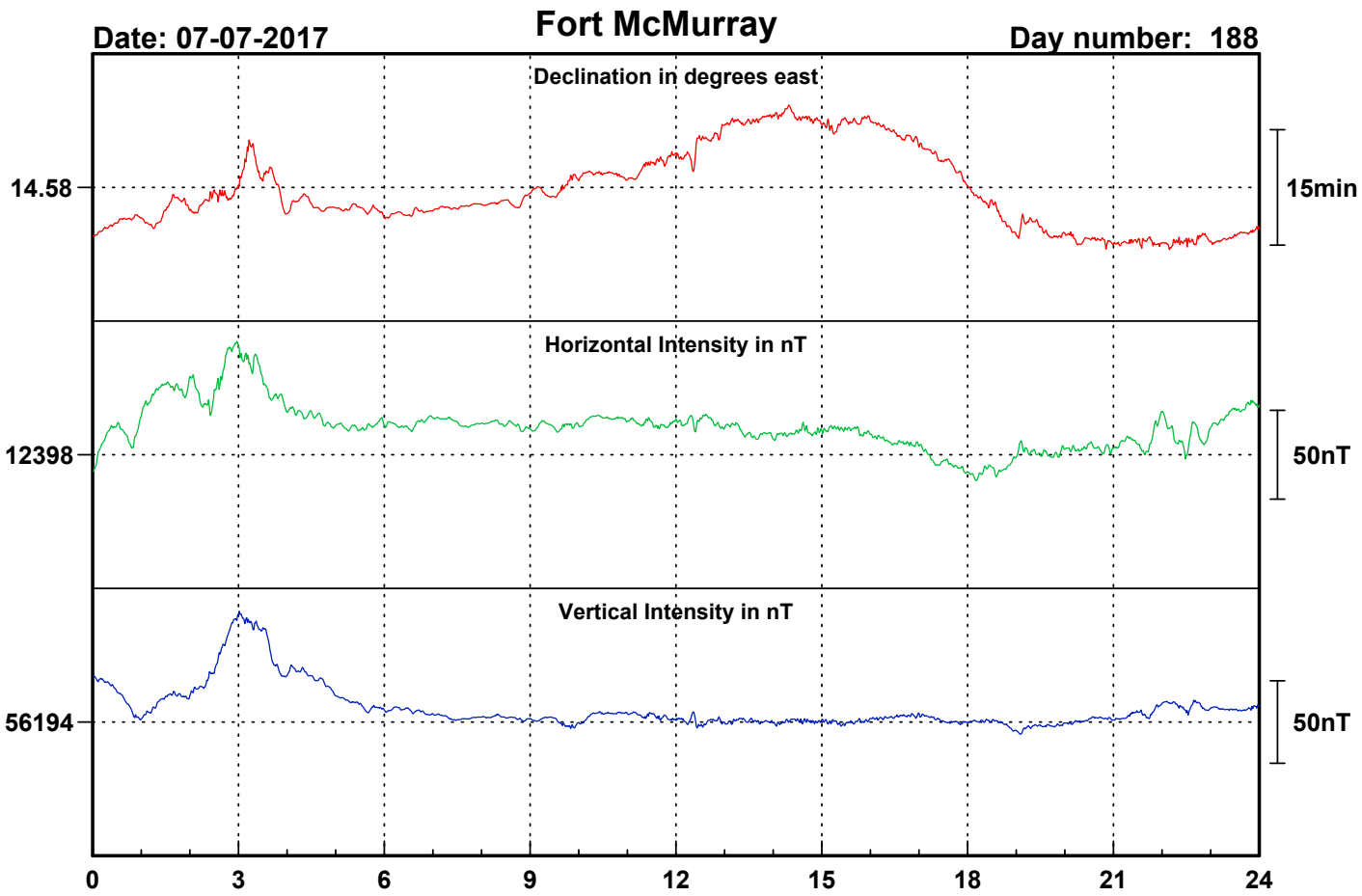

17
Scale x 16
18
Scale x 4
19
20
D 14.58
H 12398
Z 56194
1.00°
21
Scale x 4
22
Scale x 16
23
Scale x 8
24
Scale x 4
200 nT
25
Scale x 4
26
Scale x 8
27
28
200 nT
29
30
Scale x 2
31
6
12
18
24
UT
Fort McMurray
July
2017

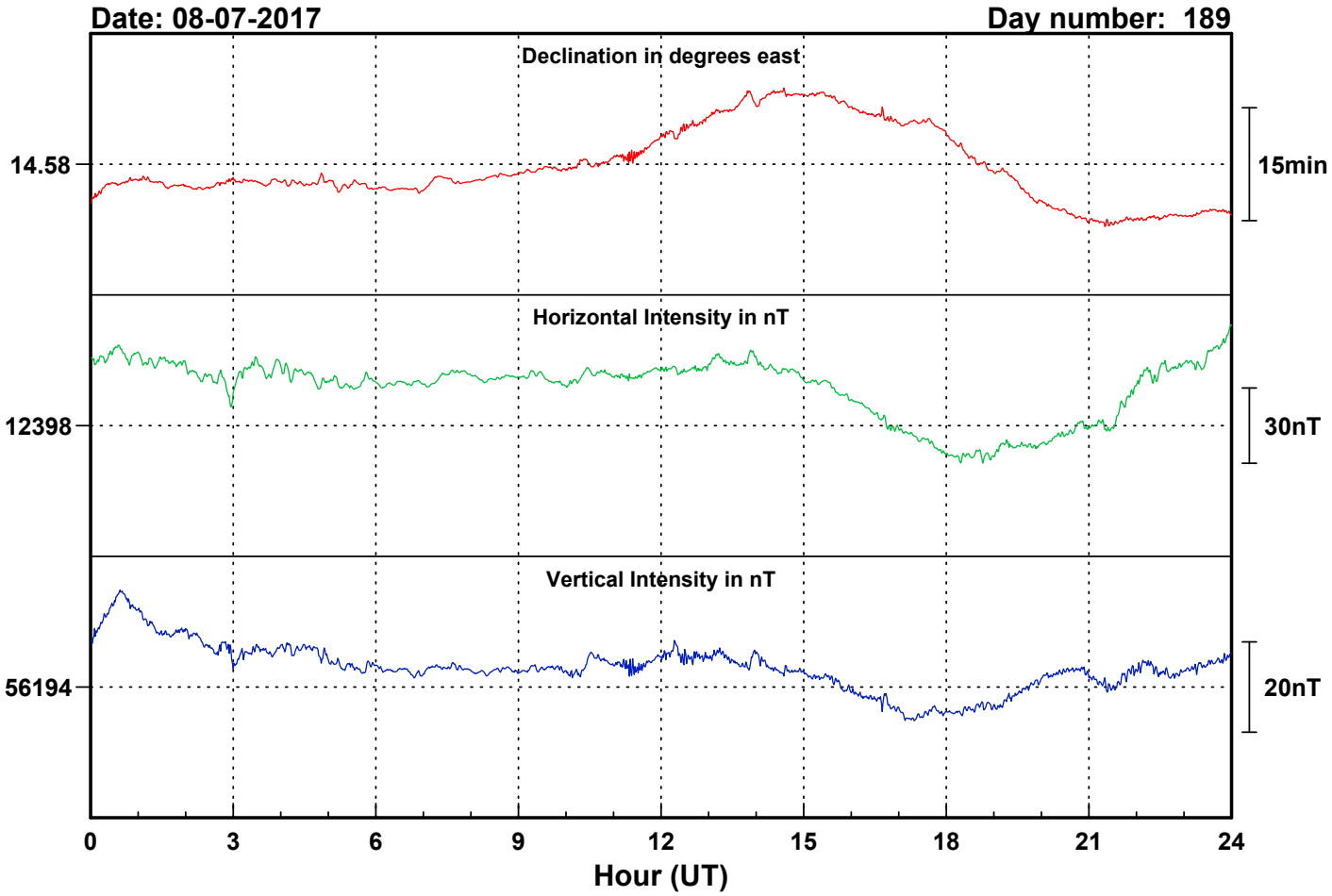

Fort McMurray
Date: 01-07-2017
Day number: 182
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
80nT
Vertical Intensity in nT
56194
160nT
0
3
6
9
12
15
18
21
24
Date: 02-07-2017
Day number: 183
Declination in degrees east
14.58
80min
Horizontal Intensity in nT
12398
450nT
Vertical Intensity in nT
56194
220nT
0
3
6
9
12
15
18
21
24
Hour (UT)

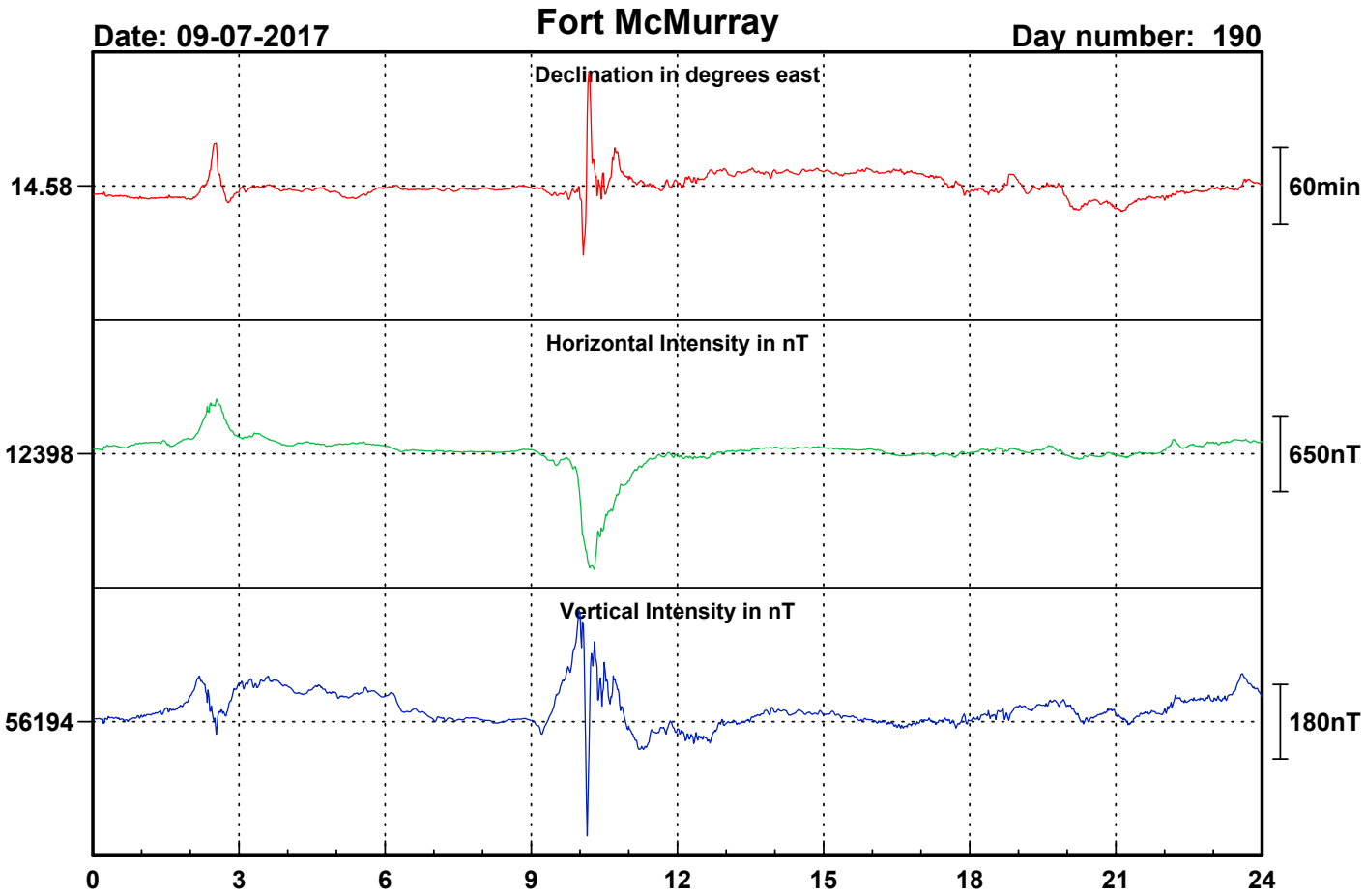

Fort McMurray
Date: 03-07-2017
Day number: 184
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
40nT
Vertical Intensity in nT
56194
60nT
0
3
6
9
12
15
18
21
24
Date: 04-07-2017
Day number: 185
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

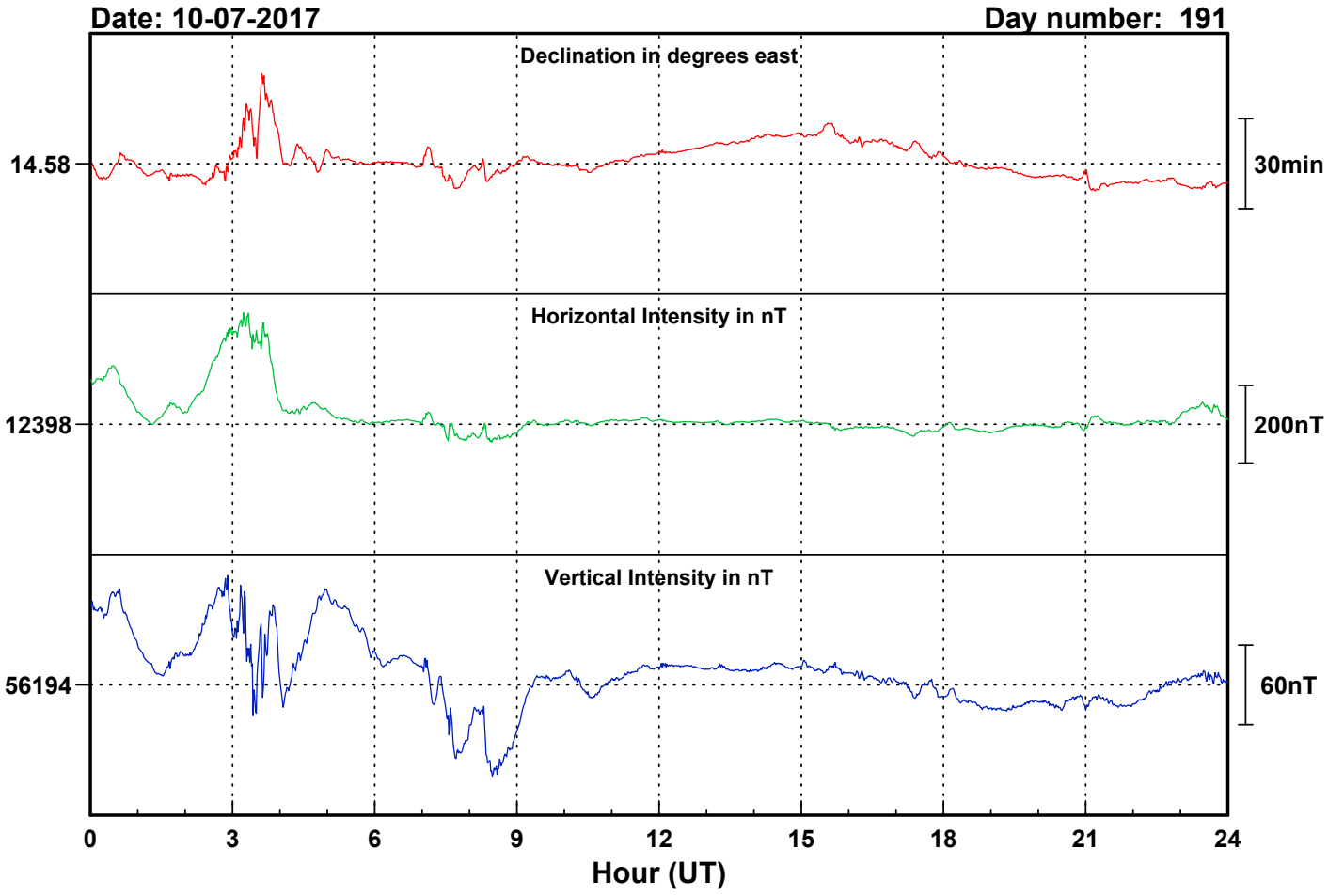

Fort McMurray
Date: 05-07-2017
Day number: 186
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
20nT
0
3
6
9
12
15
18
21
24

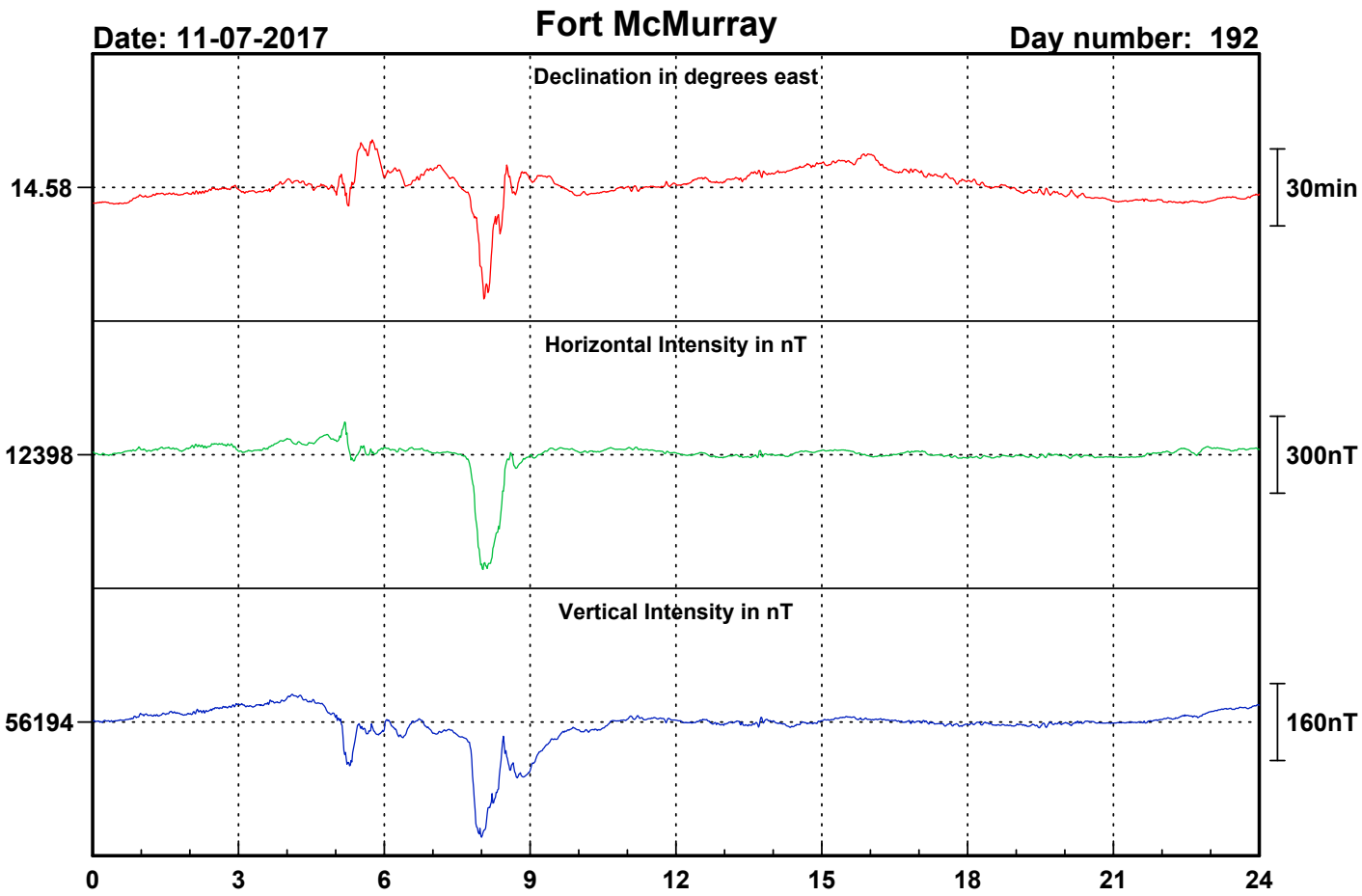

Date: 06-07-2017
Day number: 187
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
50nT
Vertical Intensity in nT
56194
50nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 07-07-2017
Day number: 188
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
50nT
Vertical Intensity in nT
56194
50nT
0
3
6
9
12
15
18
21
24


Date: 08-07-2017
Day number: 189
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 09-07-2017
Day number: 190
Declination in degrees east
14.58
60min
Horizontal Intensity in nT
12398
650nT
Vertical Intensity in nT
56194
180nT
0
3
6
9
12
15
18
21
24


Date: 10-07-2017
Day number: 191
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
200nT
Vertical Intensity in nT
56194
60nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 11-07-2017
Day number: 192
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
300nT
Vertical Intensity in nT
56194
160nT
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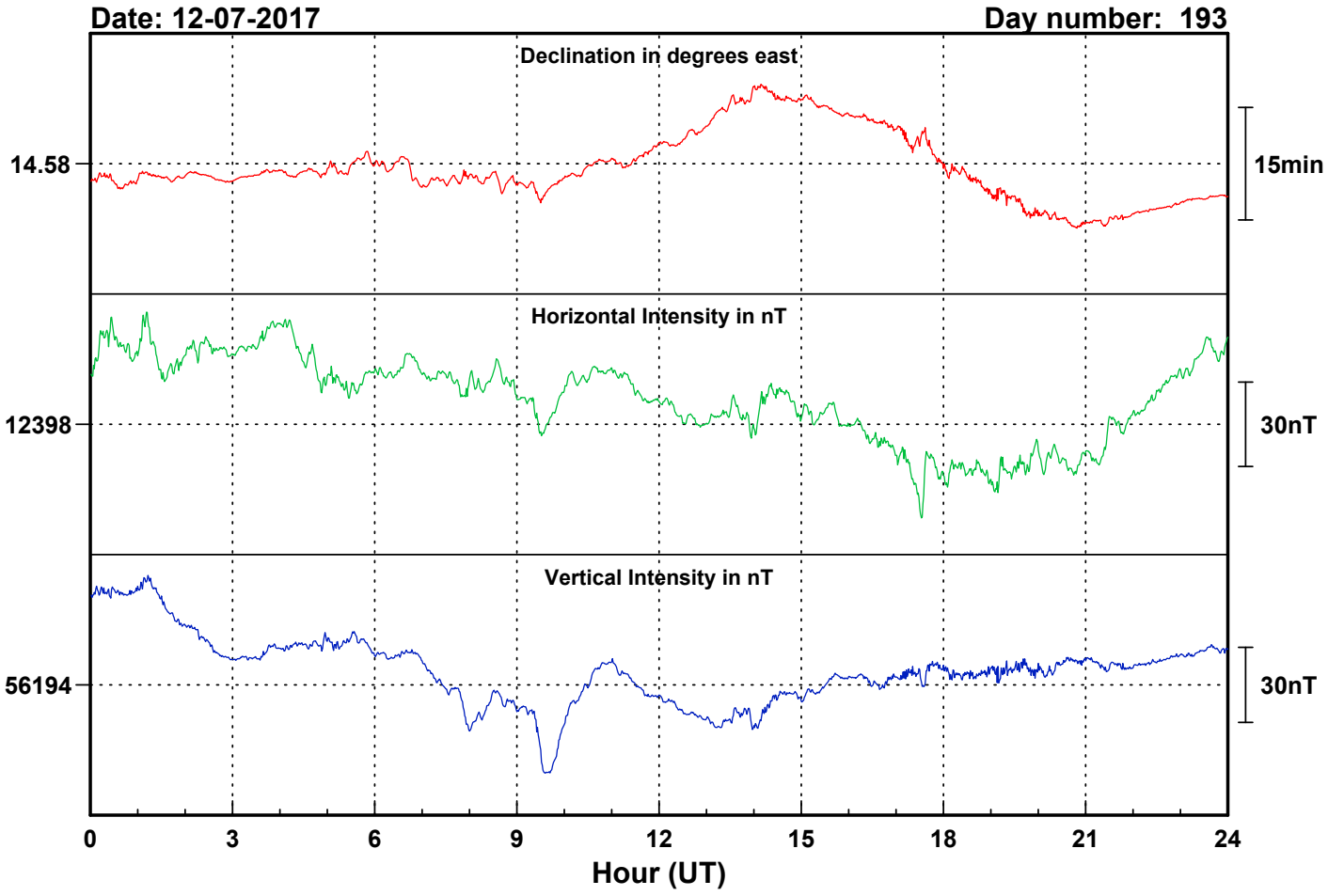
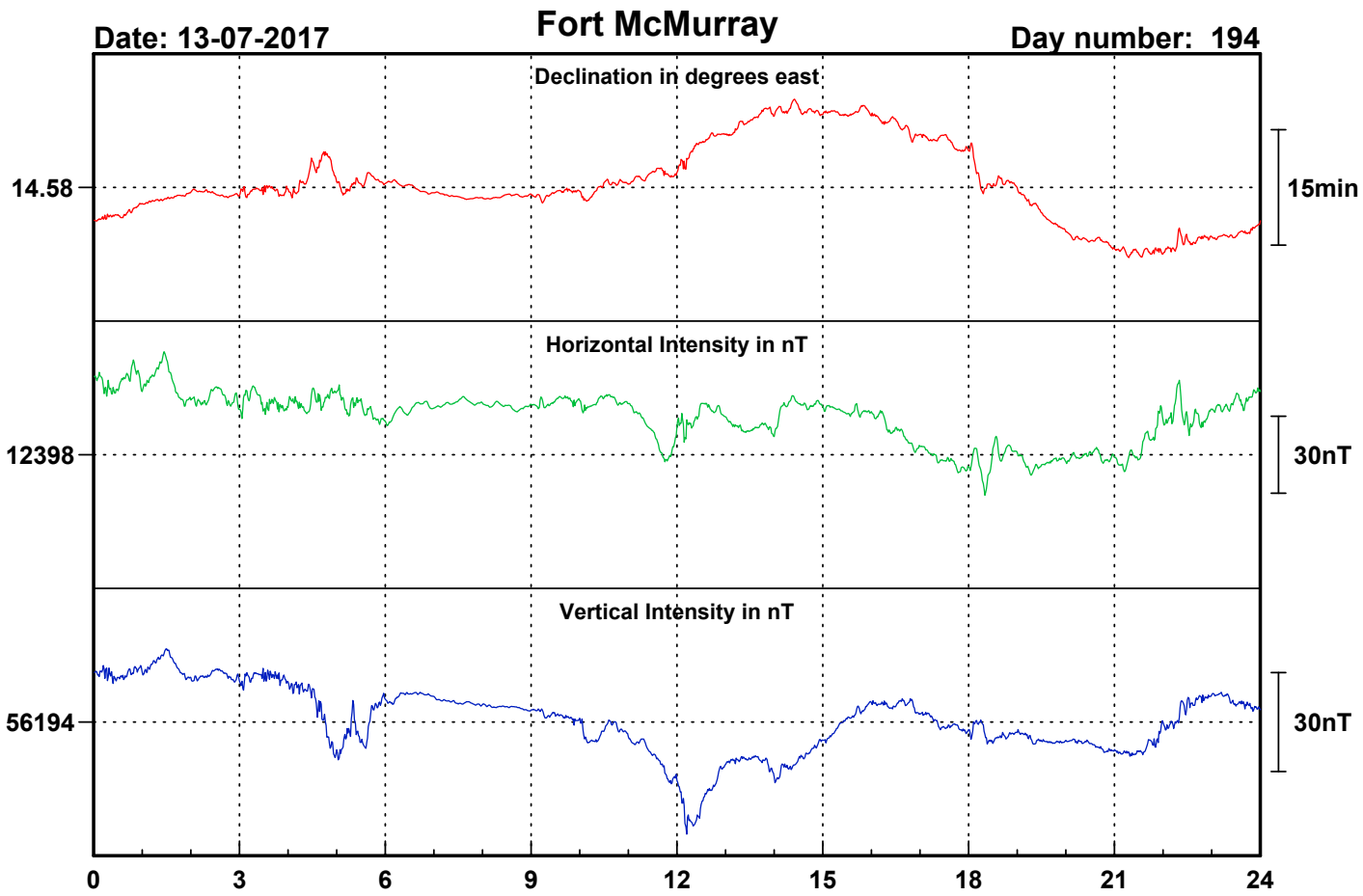
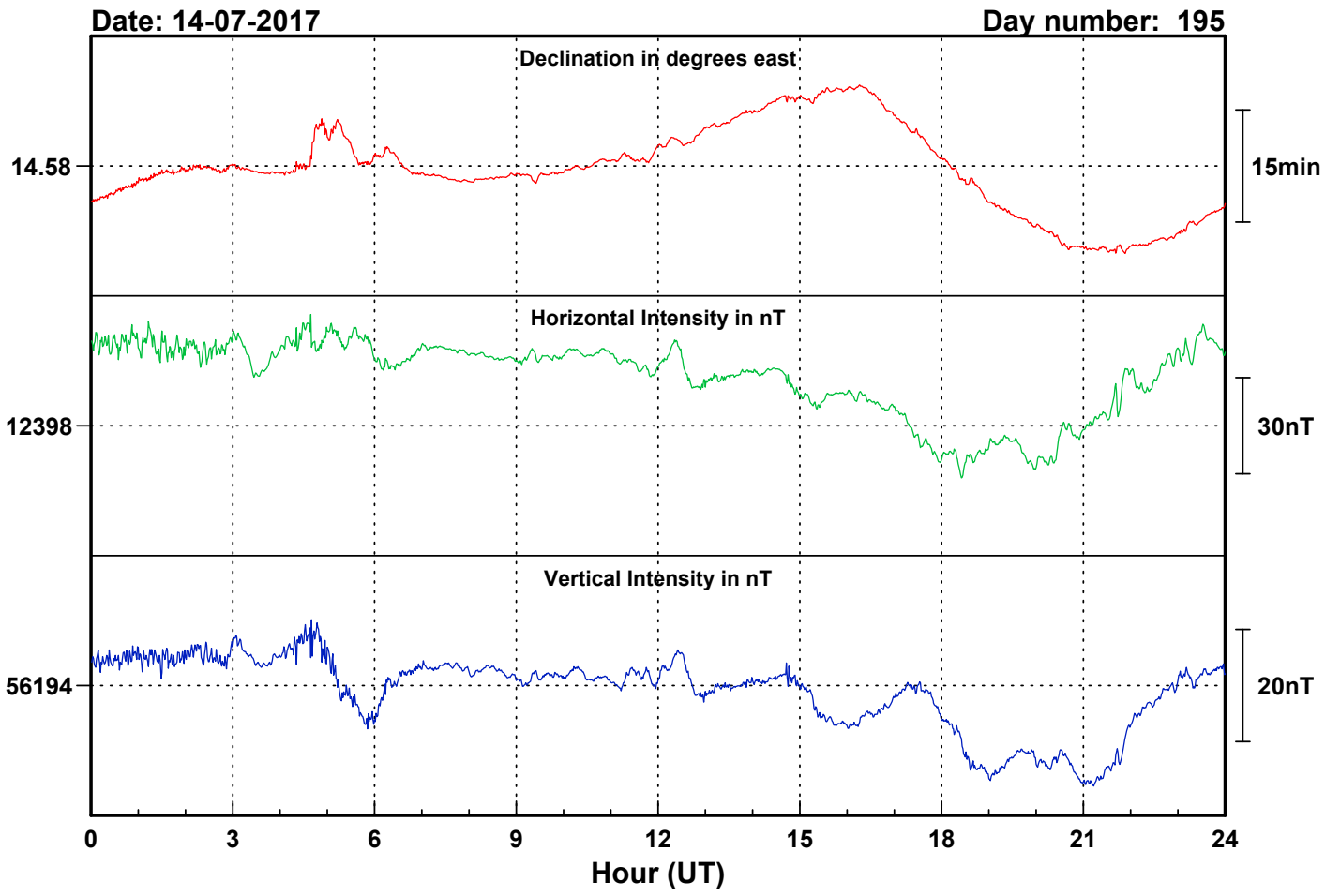
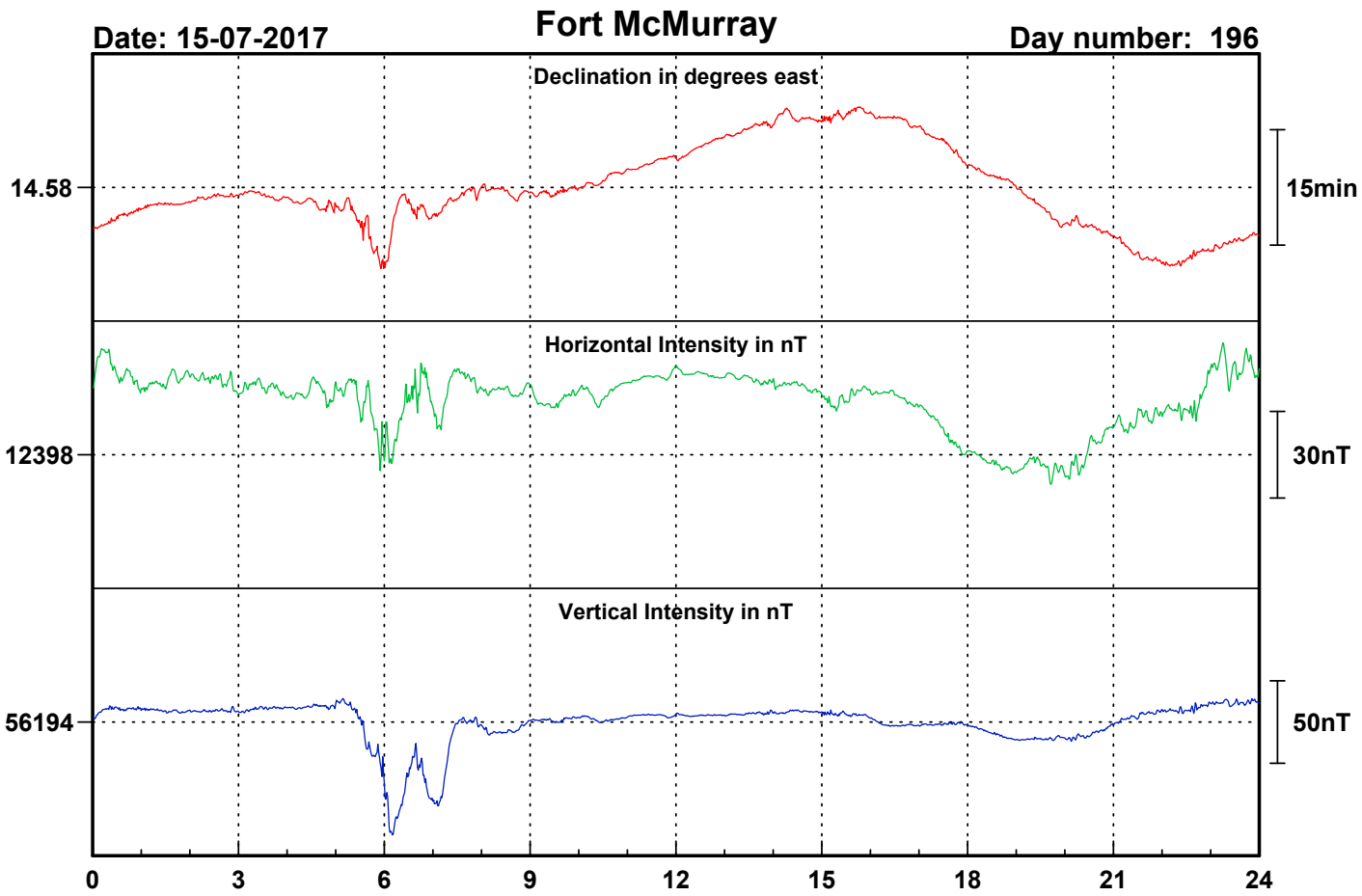
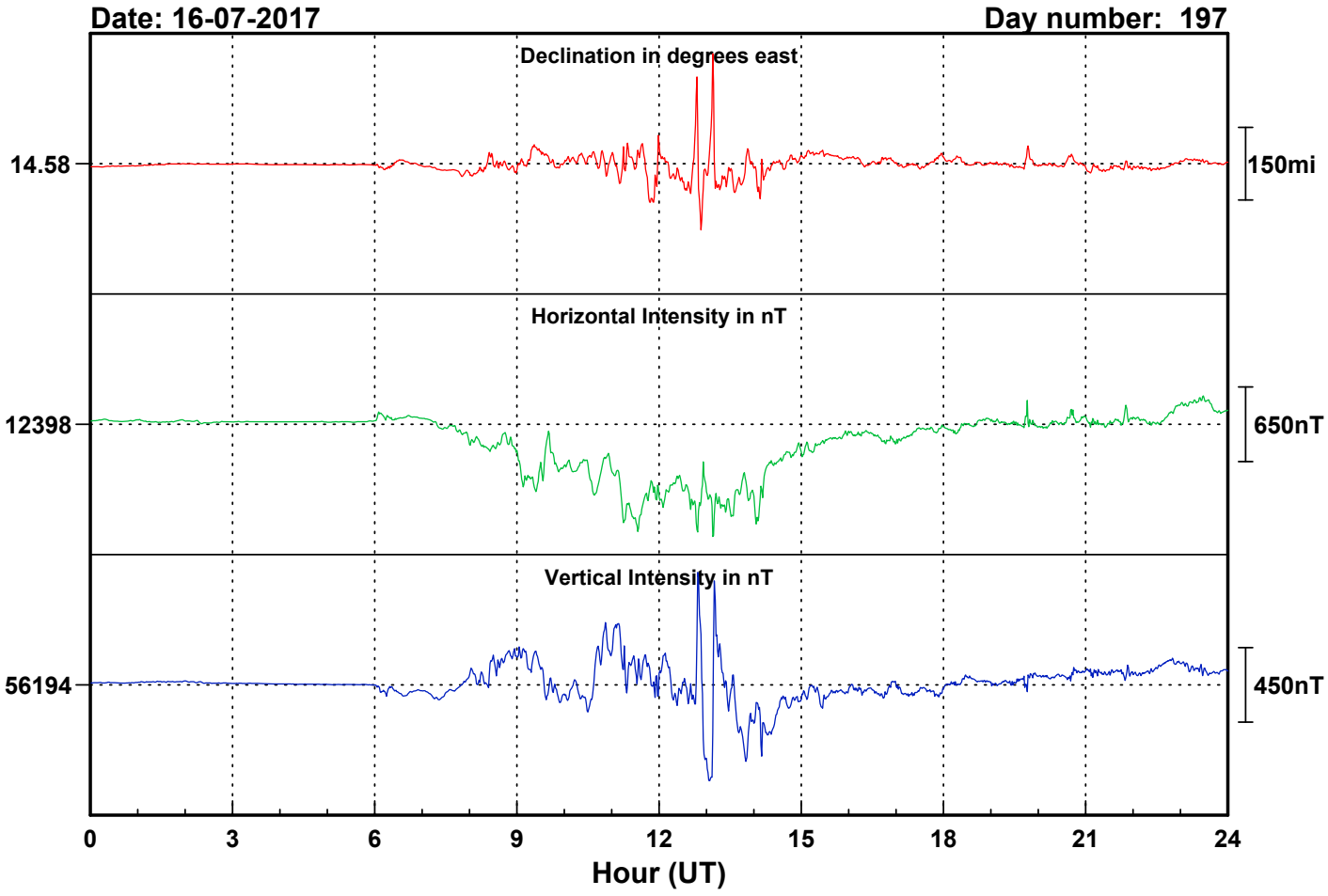
15
18
21
24

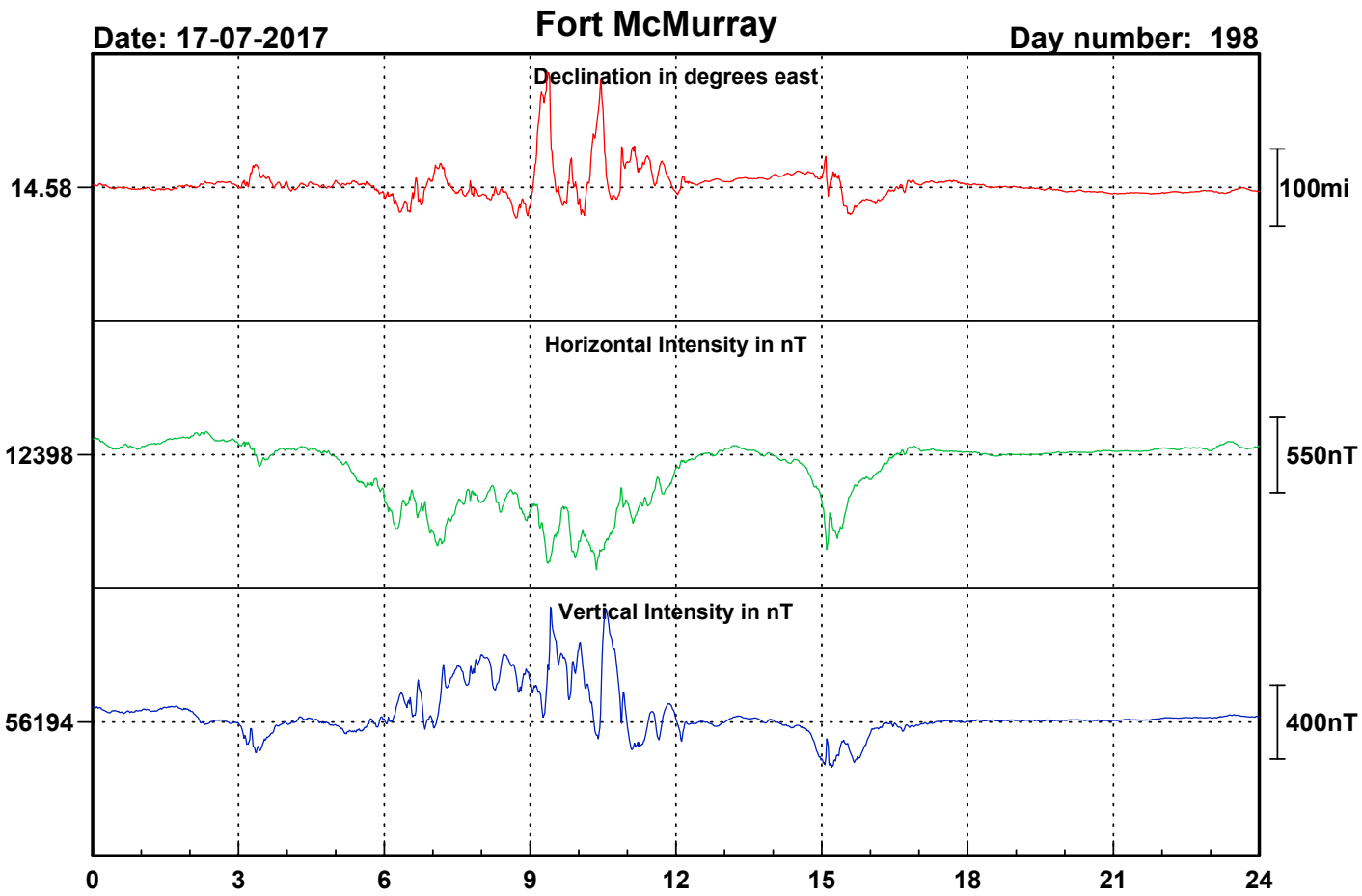

Date: 12-07-2017
Day number: 193
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
30nT
0
3
6
9
12
15
18
21
24
Hour (UT)

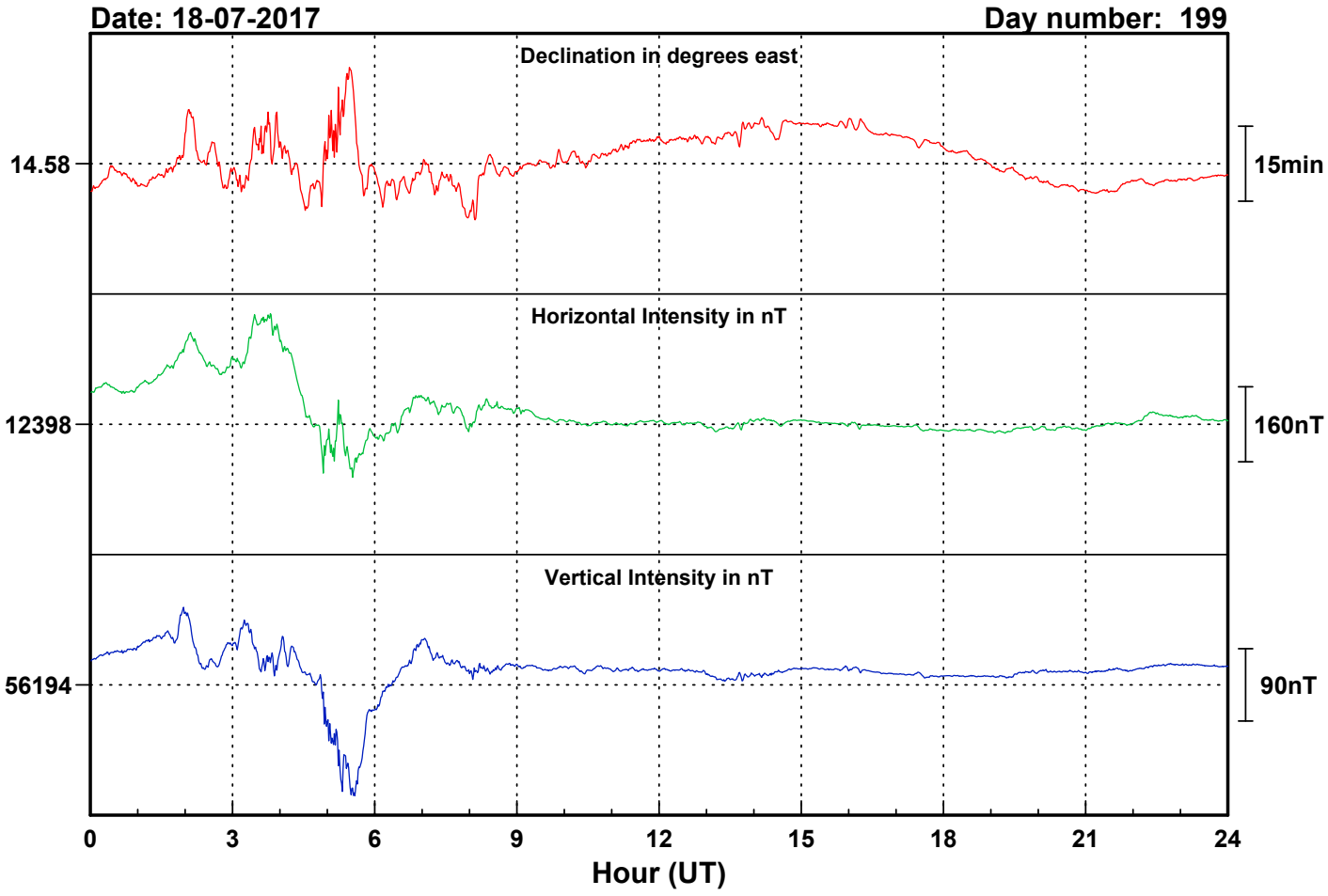

Fort McMurray
Date: 13-07-2017
Day number: 194
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
30nT
0
3
6
9
12
15
18
21
24

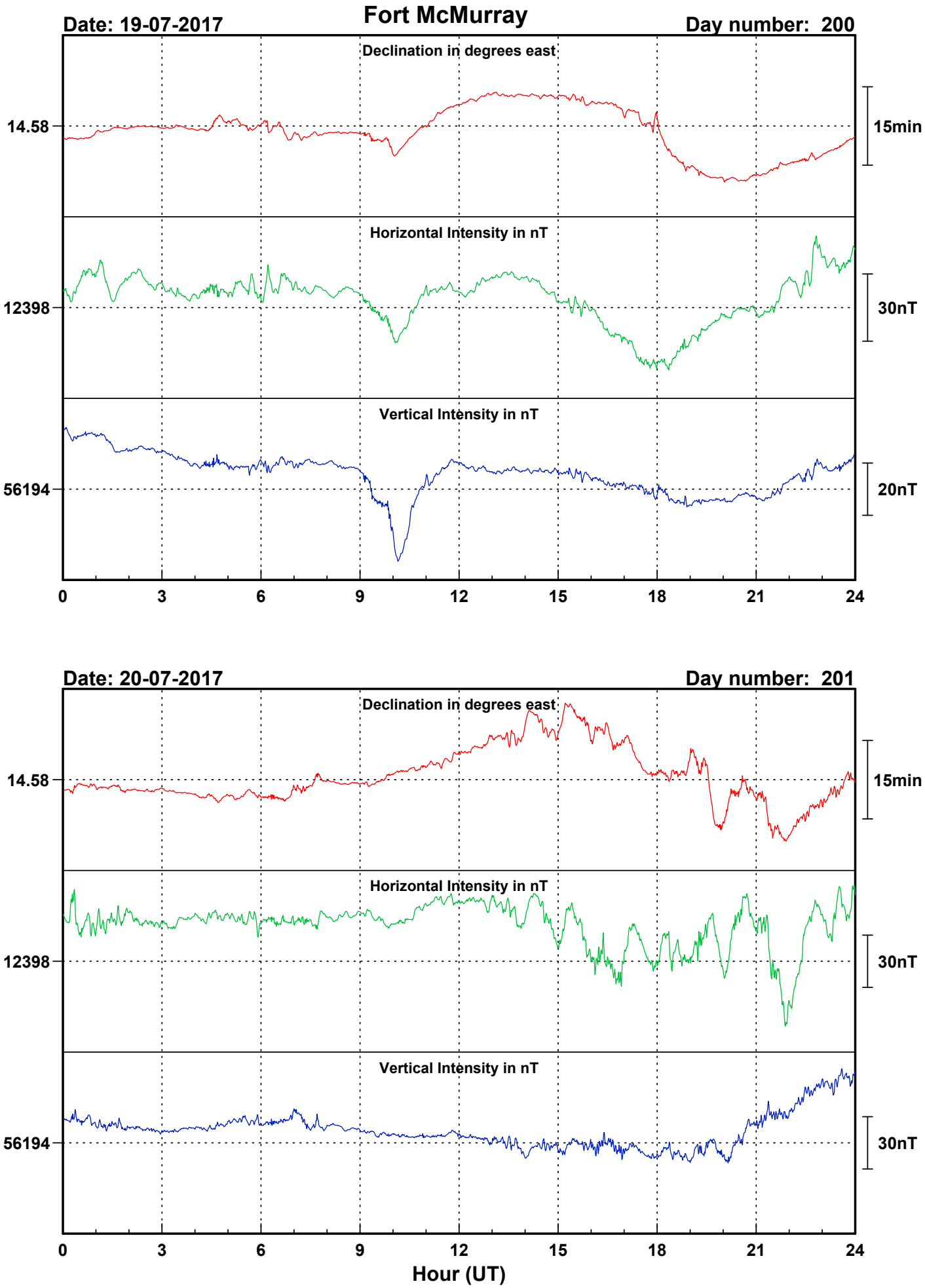

Date: 14-07-2017
Day number: 195
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

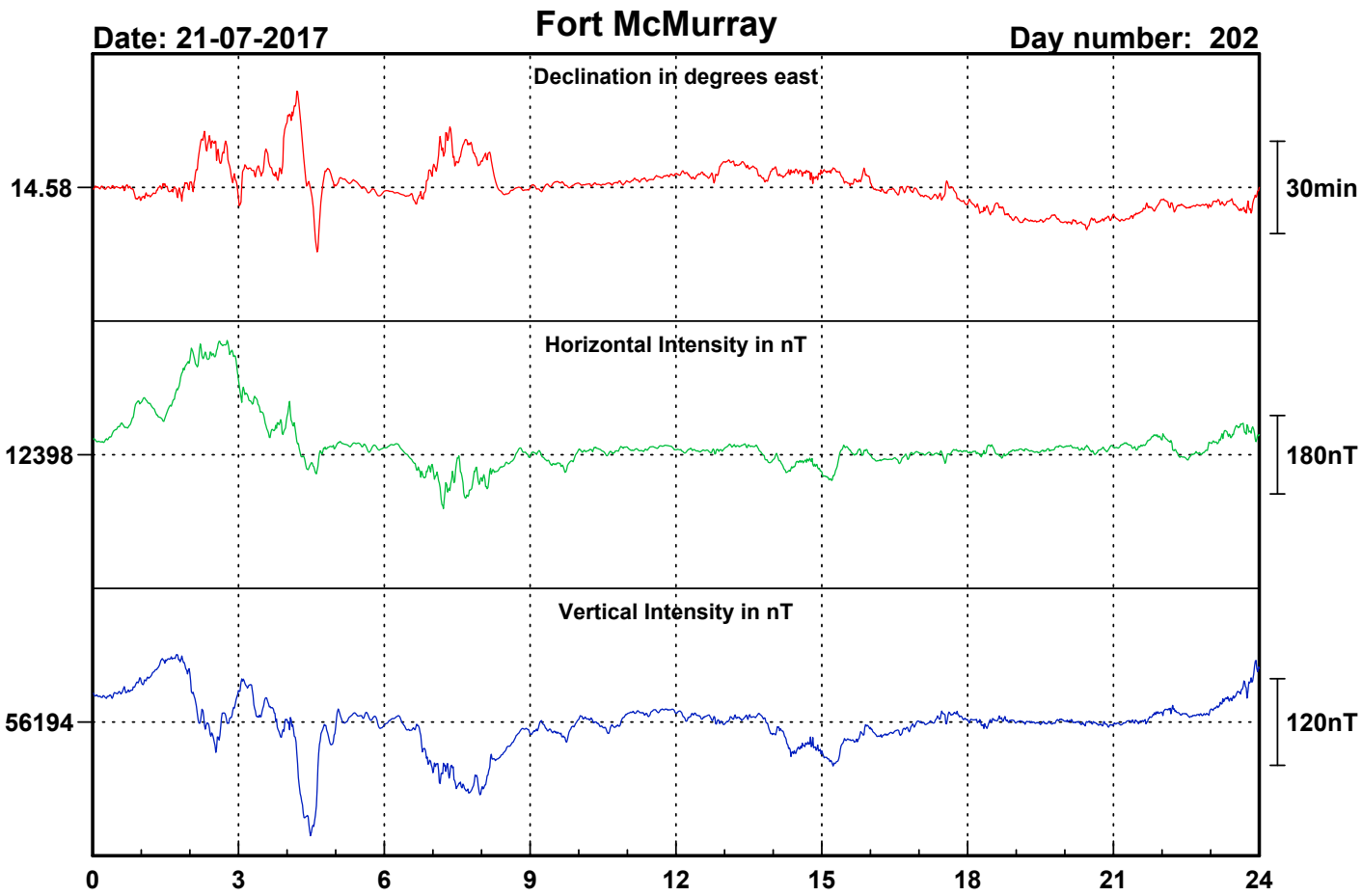

Fort McMurray
Date: 15-07-2017
Day number: 196
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
50nT
0
3
6
9
12
15
18
21
24

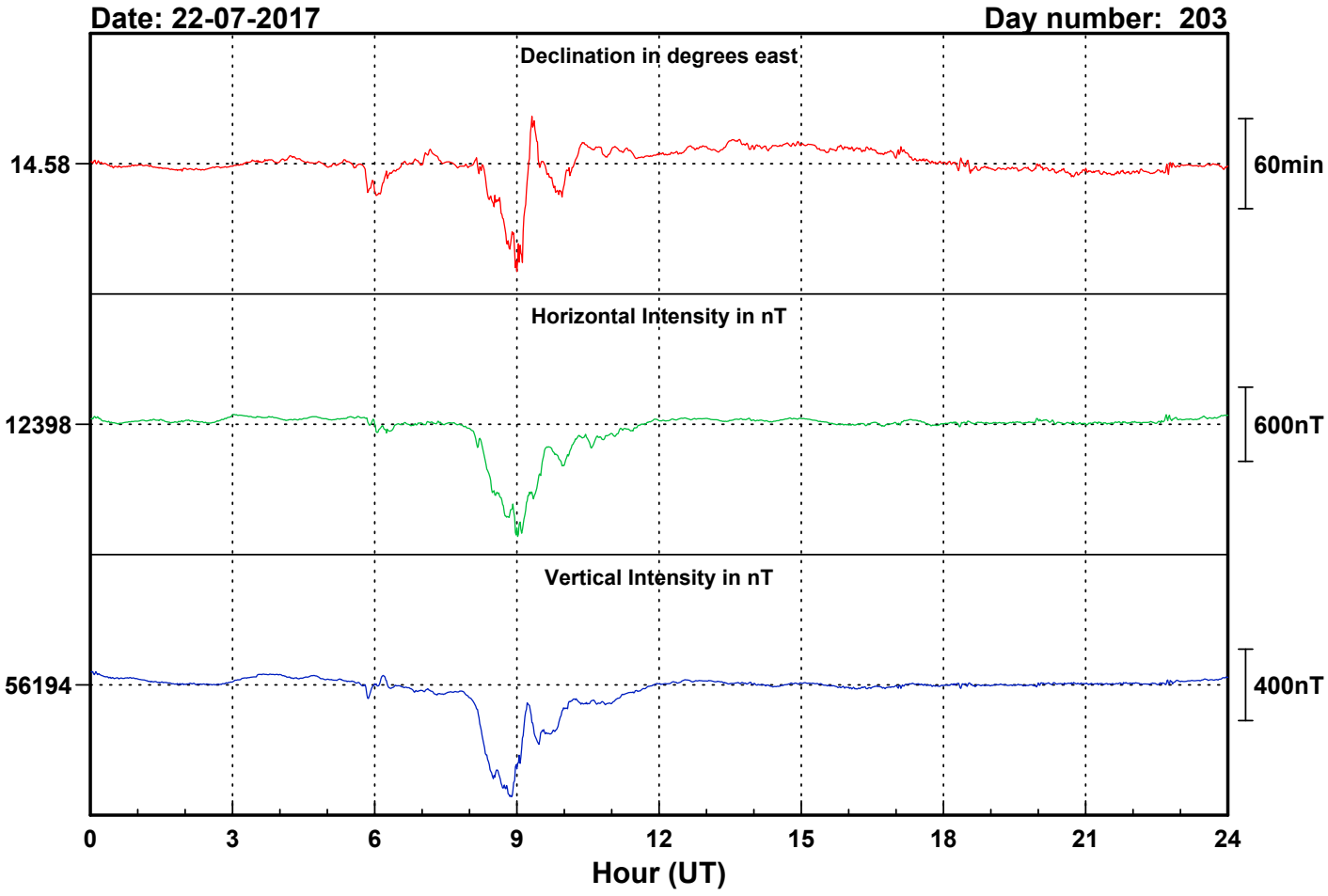

Date: 16-07-2017
Day number: 197
Declination in degrees east
14.58
150mi
Horizontal Intensity in nT
12398
650nT
Vertical Intensity in nT
56194
450nT
0
3
6
9
12
15
18
21
24
Hour (UT)

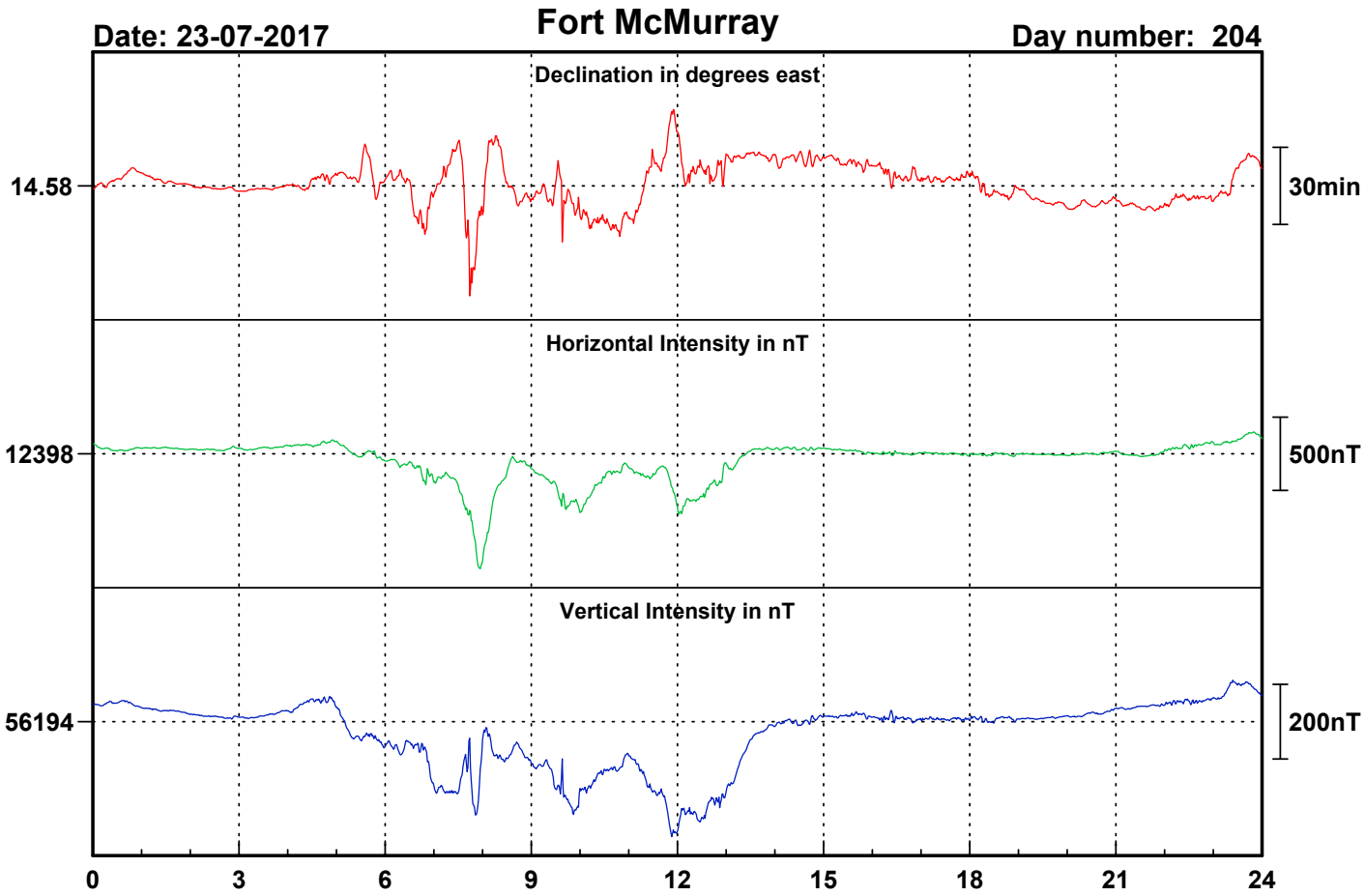

Fort McMurray
Date: 17-07-2017
Day number: 198
Declination in degrees east
14.58
100mi
Horizontal Intensity in nT
12398
550nT
Vertical Intensity in nT
56194
400nT
0
3
6
9
12
15
18
21
24

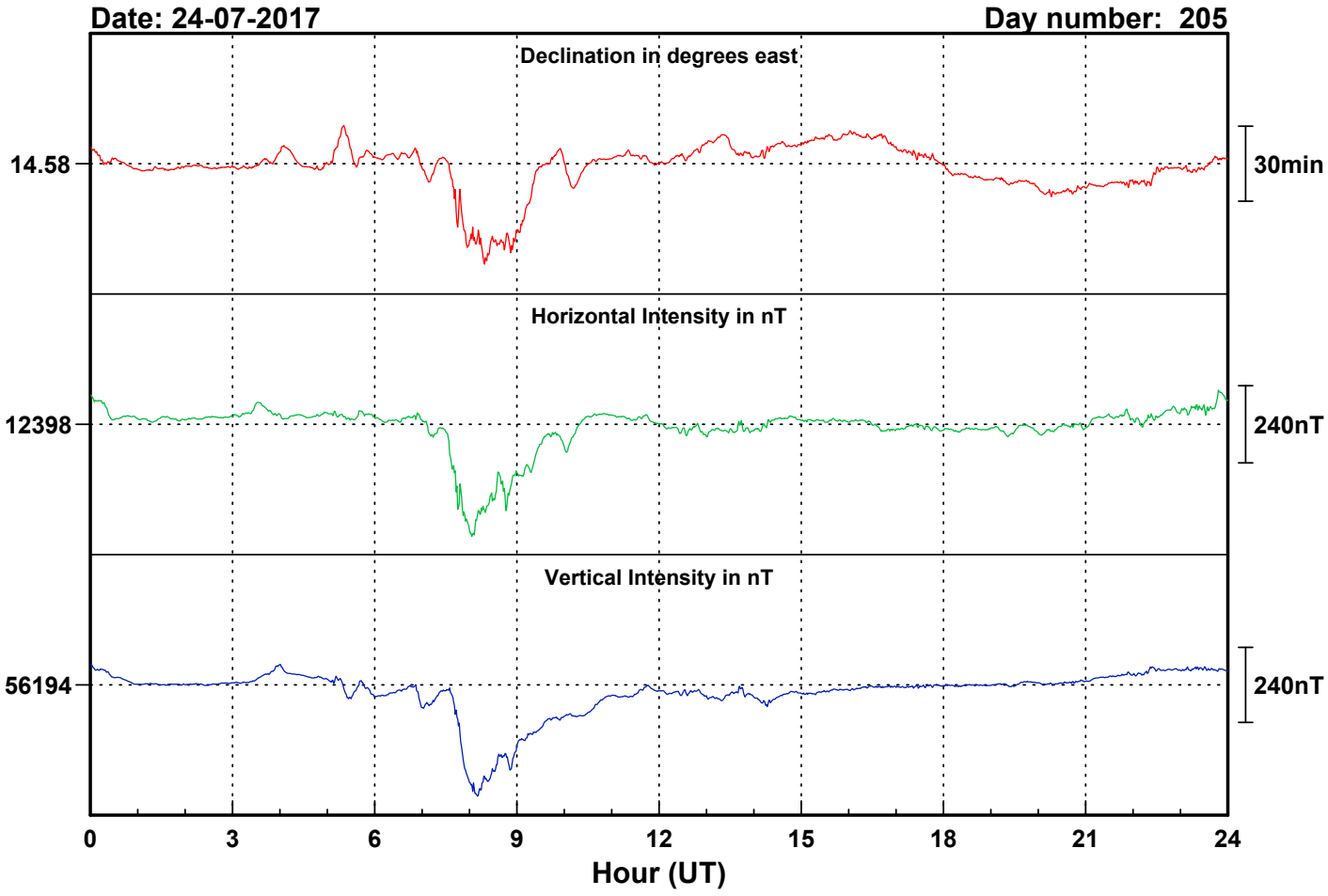

Date: 18-07-2017
Day number: 199
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
160nT
Vertical Intensity in nT
56194
90nT
0
3
6
9
12
15
18
21
24
Hour (UT)

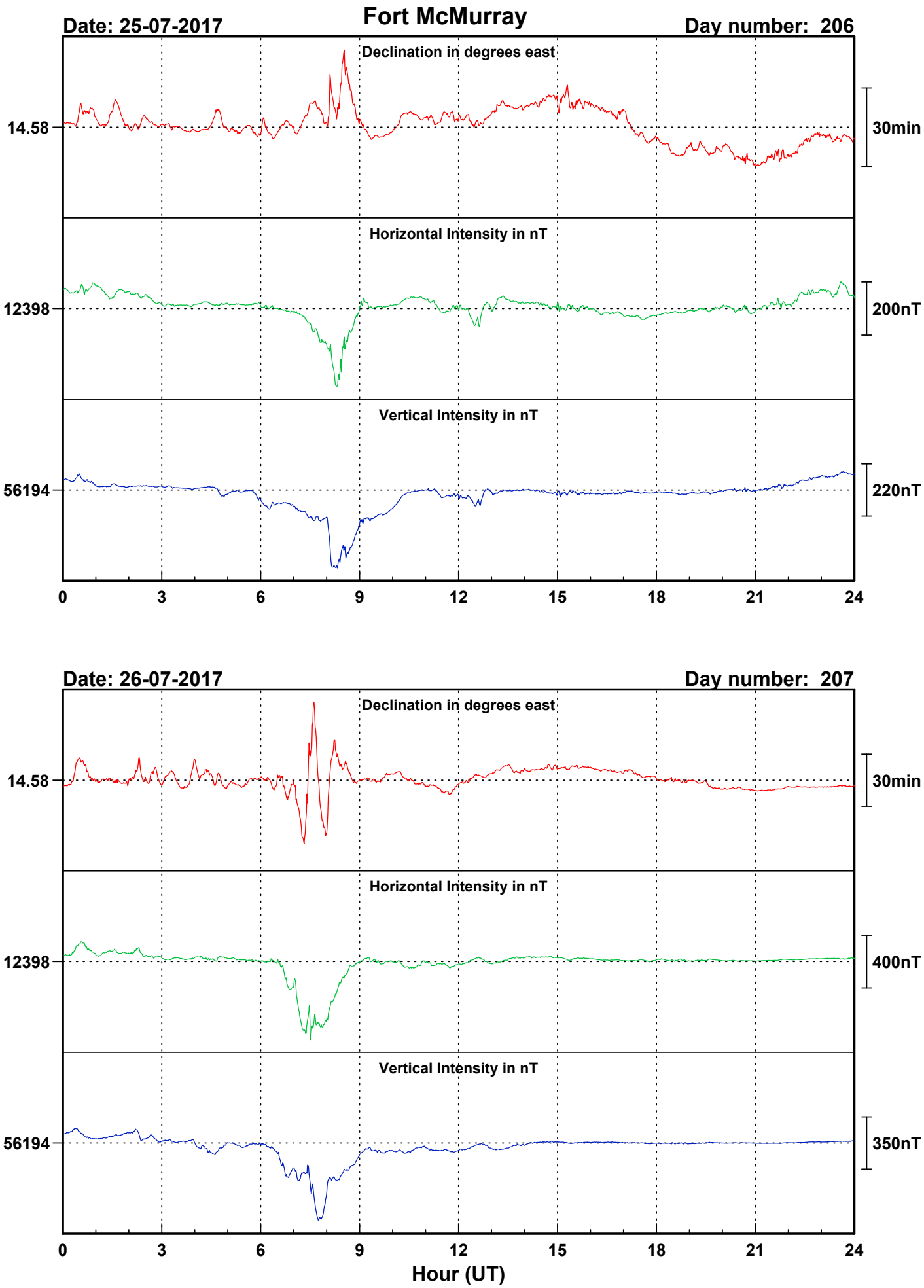

Fort McMurray
Date: 19-07-2017
Day number: 200
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
20nT
0
3
6
9
12
15
18
21
24
Date: 20-07-2017
Day number: 201
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
30nT
0
3
6
9
12
15
18
21
24
Hour (UT)

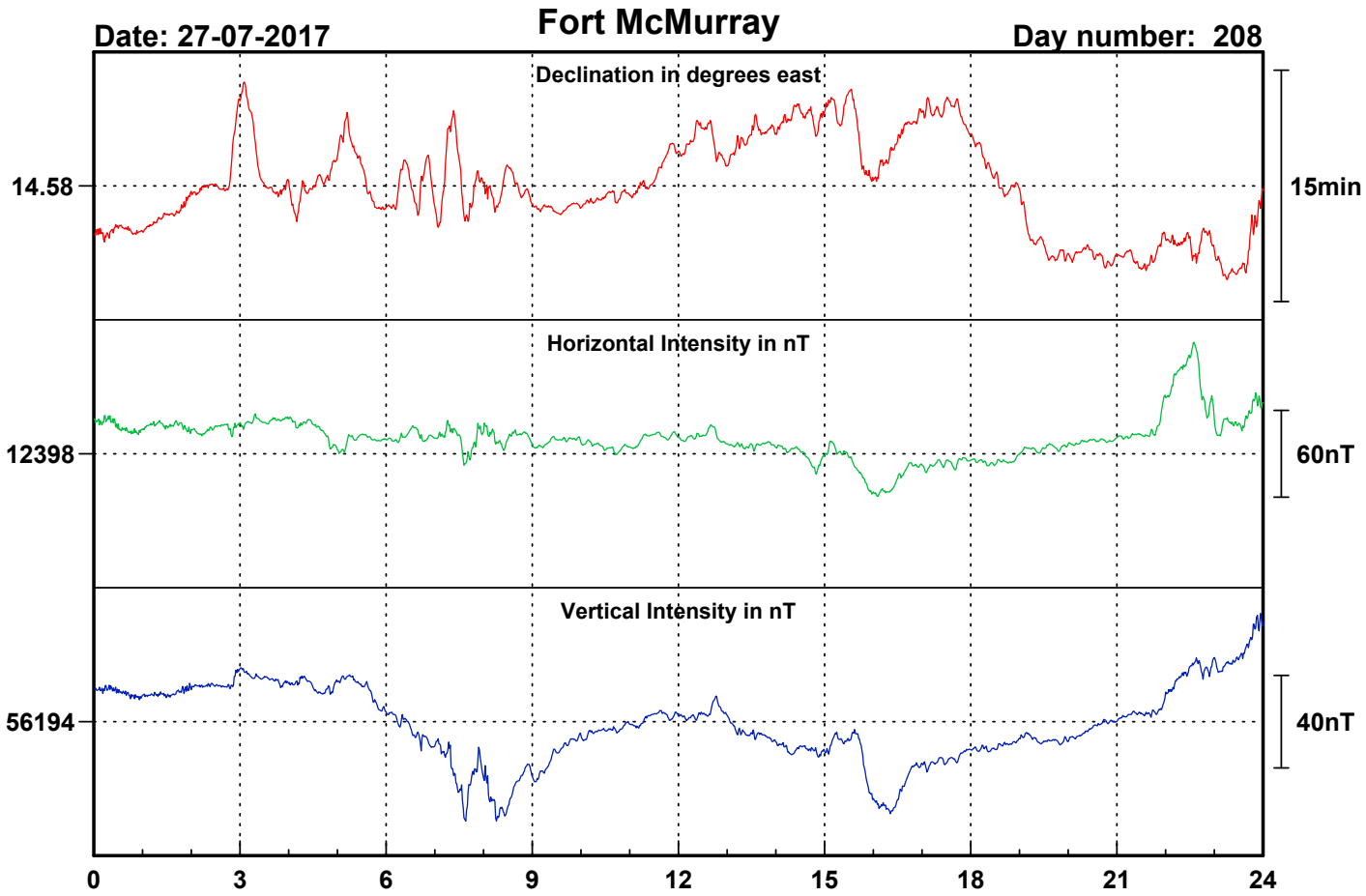

Fort McMurray
Date: 21-07-2017
Day number: 202
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
180nT
Vertical Intensity in nT
56194
120nT
0
3
6
9
12
15
18
21
24

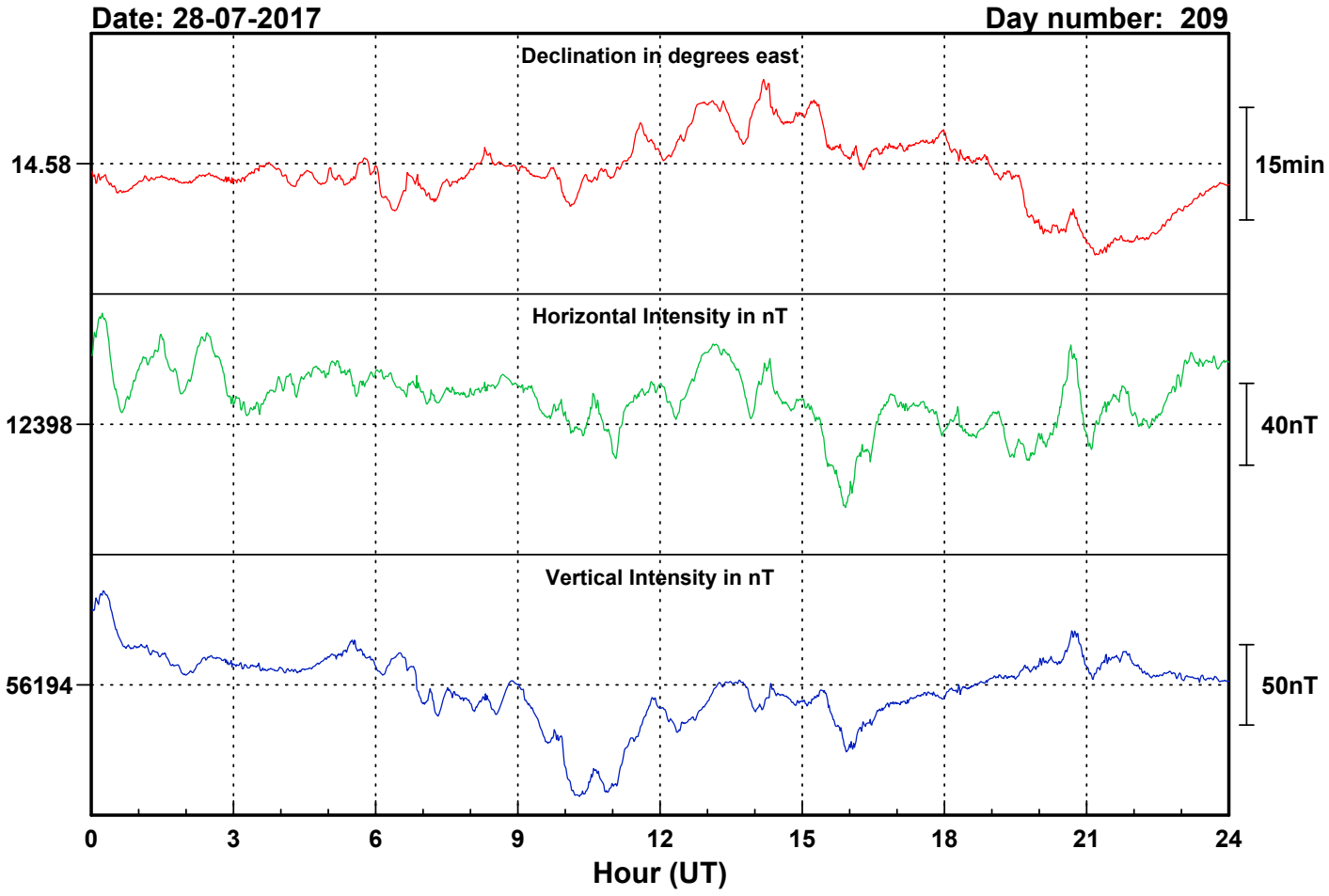

Date: 22-07-2017
Day number: 203
Declination in degrees east
14.58
60min
Horizontal Intensity in nT
12398
600nT
Vertical Intensity in nT
56194
400nT
0
3
6
9
12
15
18
21
24
Hour (UT)

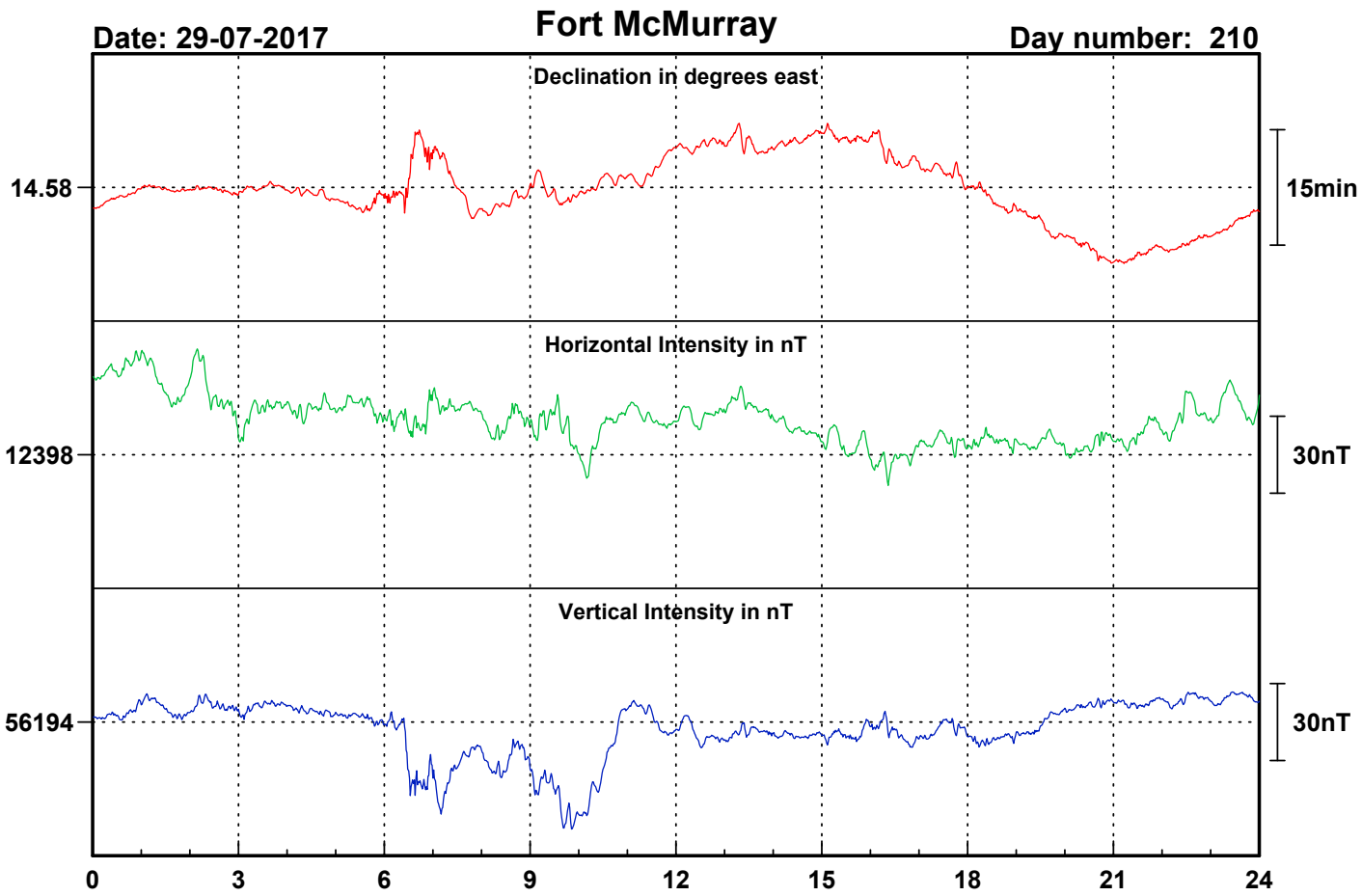

Fort McMurray
Date: 23-07-2017
Day number: 204
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
500nT
Vertical Intensity in nT
56194
200nT
0
3
6
9
12
15
18
21
24

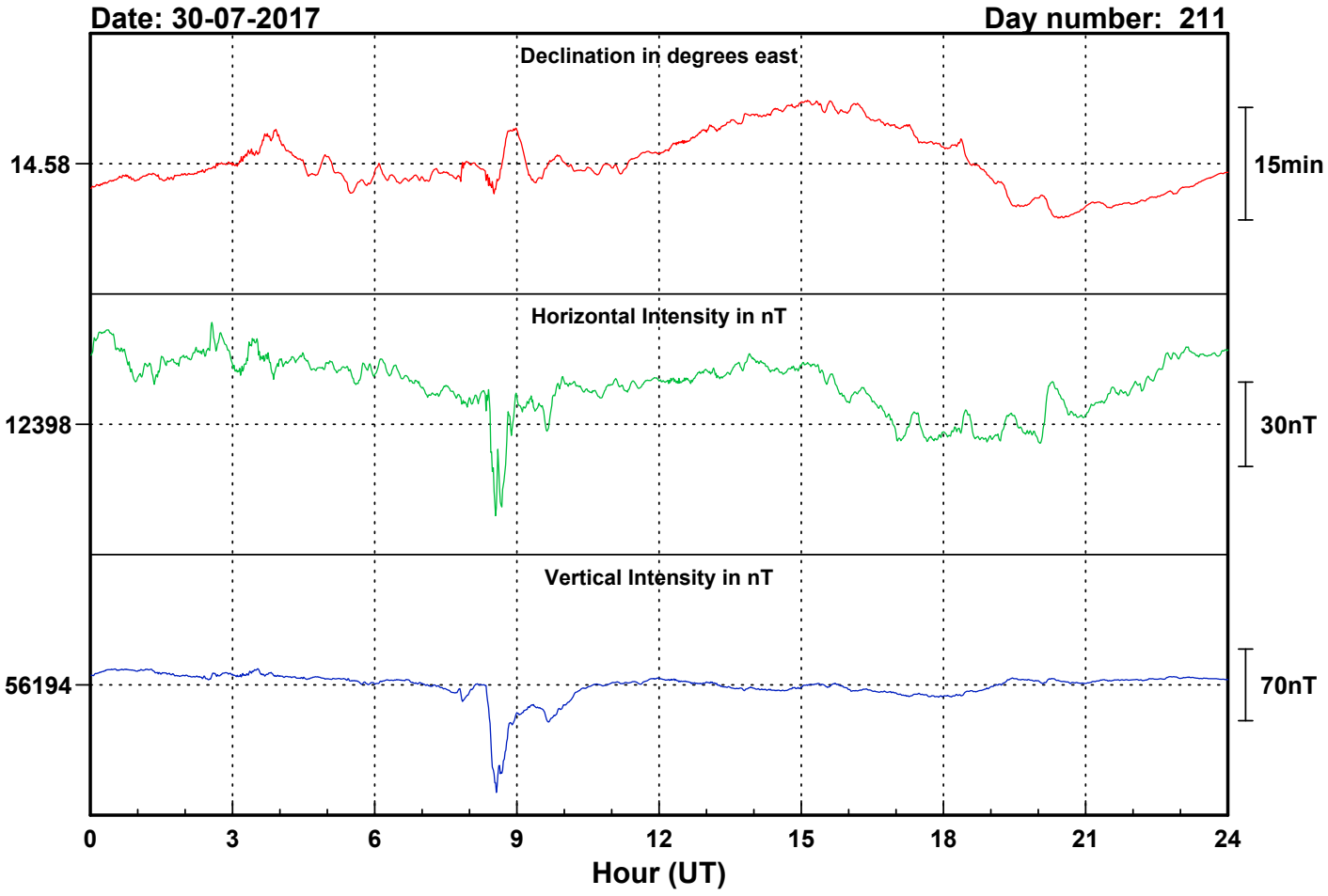

Date: 24-07-2017
Day number: 205
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
240nT
Vertical Intensity in nT
56194
240nT
0
3
6
9
12
15
18
21
24
Hour (UT)

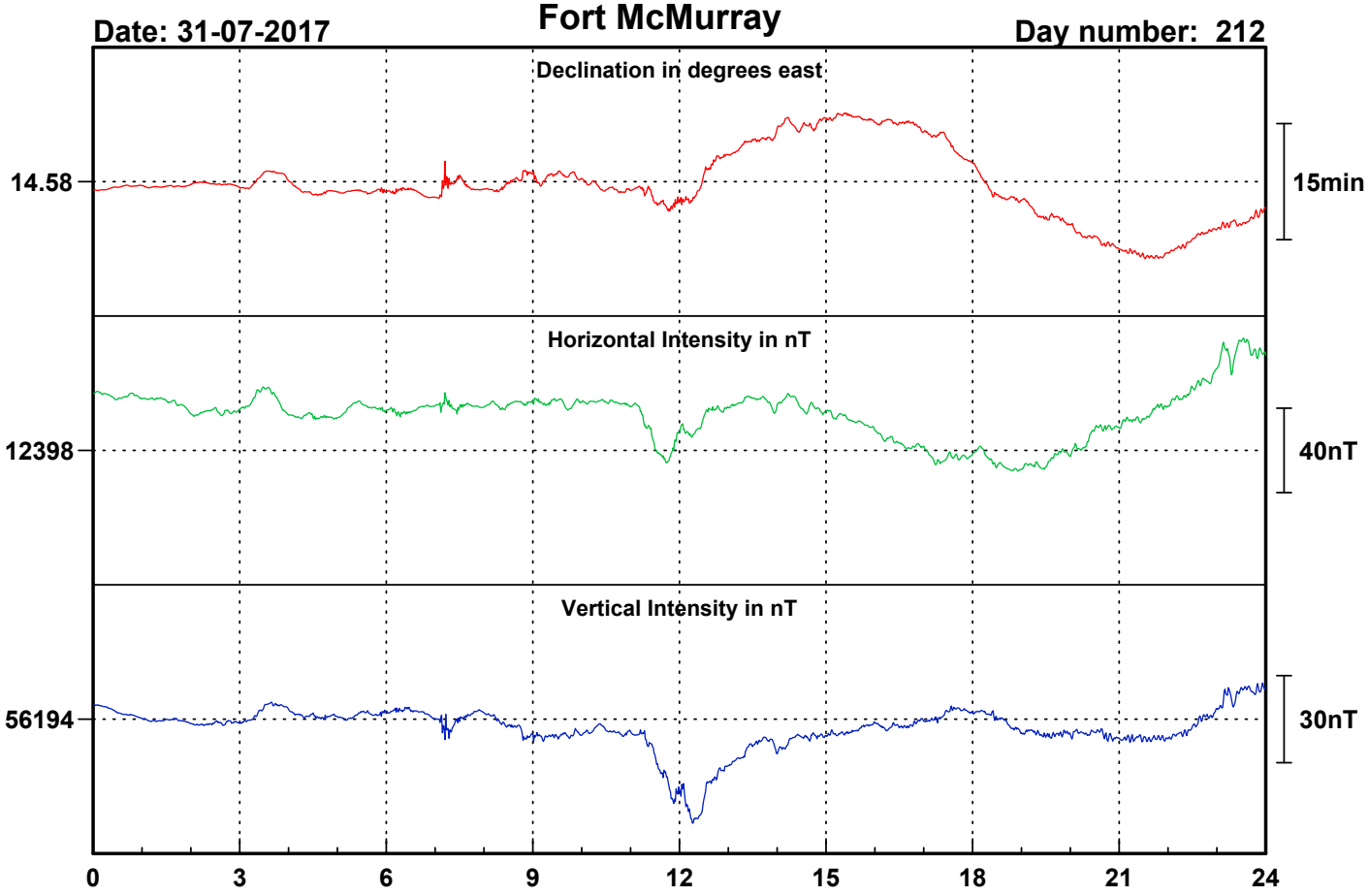

Fort McMurray
Date: 25-07-2017
Day number: 206
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
200nT
Vertical Intensity in nT
56194
220nT
0
3
6
9
12
15
18
21
24
Date: 26-07-2017
Day number: 207
Declination in degrees east
14.58
30min
Horizontal Intensity in nT
12398
400nT
Vertical Intensity in nT
56194
350nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 27-07-2017
Day number: 208
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
60nT
Vertical Intensity in nT
56194
40nT
0
3
6
9
12
15
18
21
24

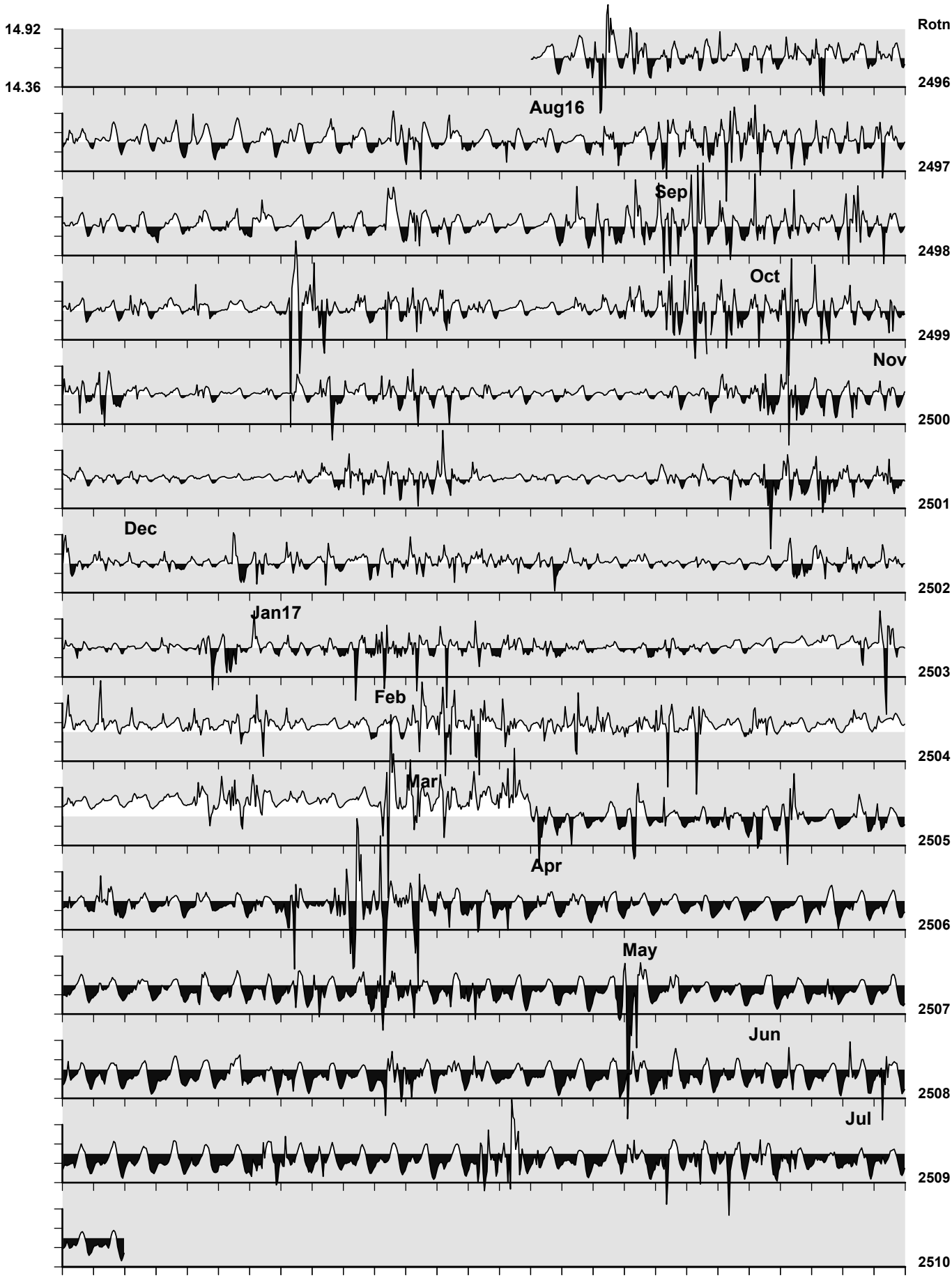

Date: 28-07-2017
Day number: 209
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
40nT
Vertical Intensity in nT
56194
50nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Fort McMurray
Date: 29-07-2017
Day number: 210
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
30nT
0
3
6
9
12
15
18
21
24


Date: 30-07-2017
Day number: 211
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
30nT
Vertical Intensity in nT
56194
70nT
0
3
6
9
12
15
18
21
24
Hour (UT)

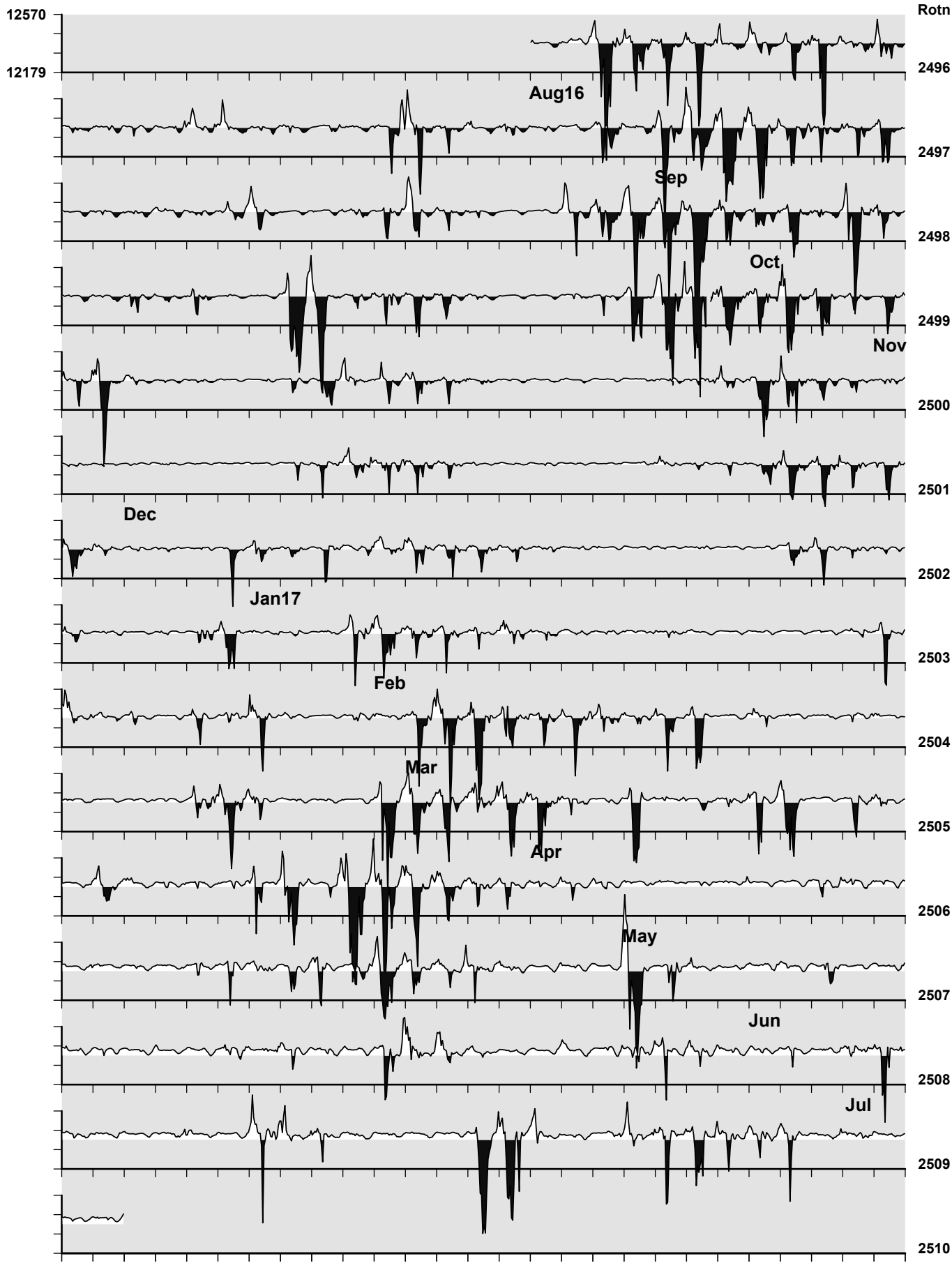

Fort McMurray
Date: 31-07-2017
Day number: 212
Declination in degrees east
14.58
15min
Horizontal Intensity in nT
12398
40nT
Vertical Intensity in nT
56194
30nT
0
3
6
9
12
15
18
21
24

Fort McMurray Observatory: Declination (degrees)

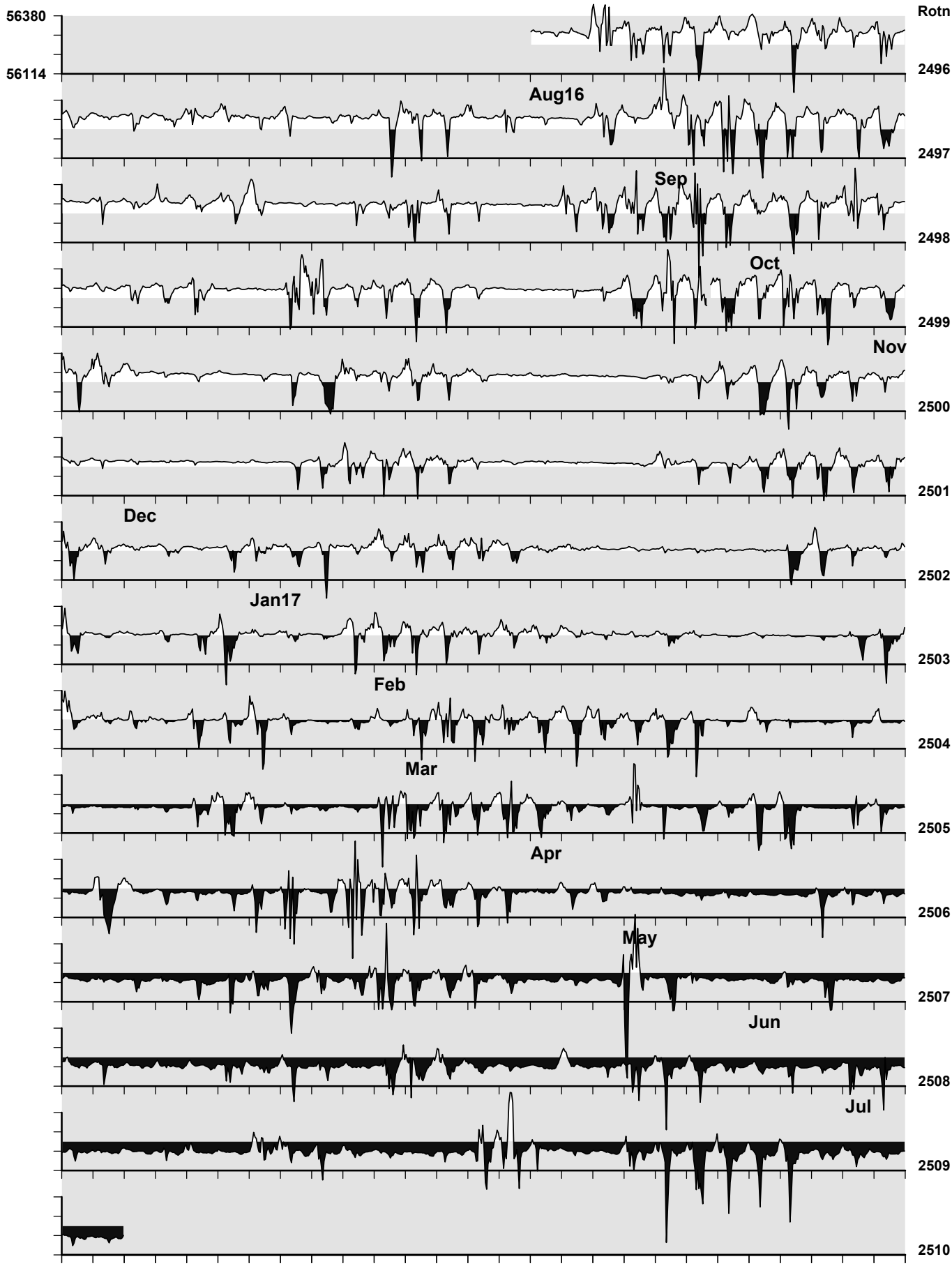


Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Horizontal Intensity (nT)

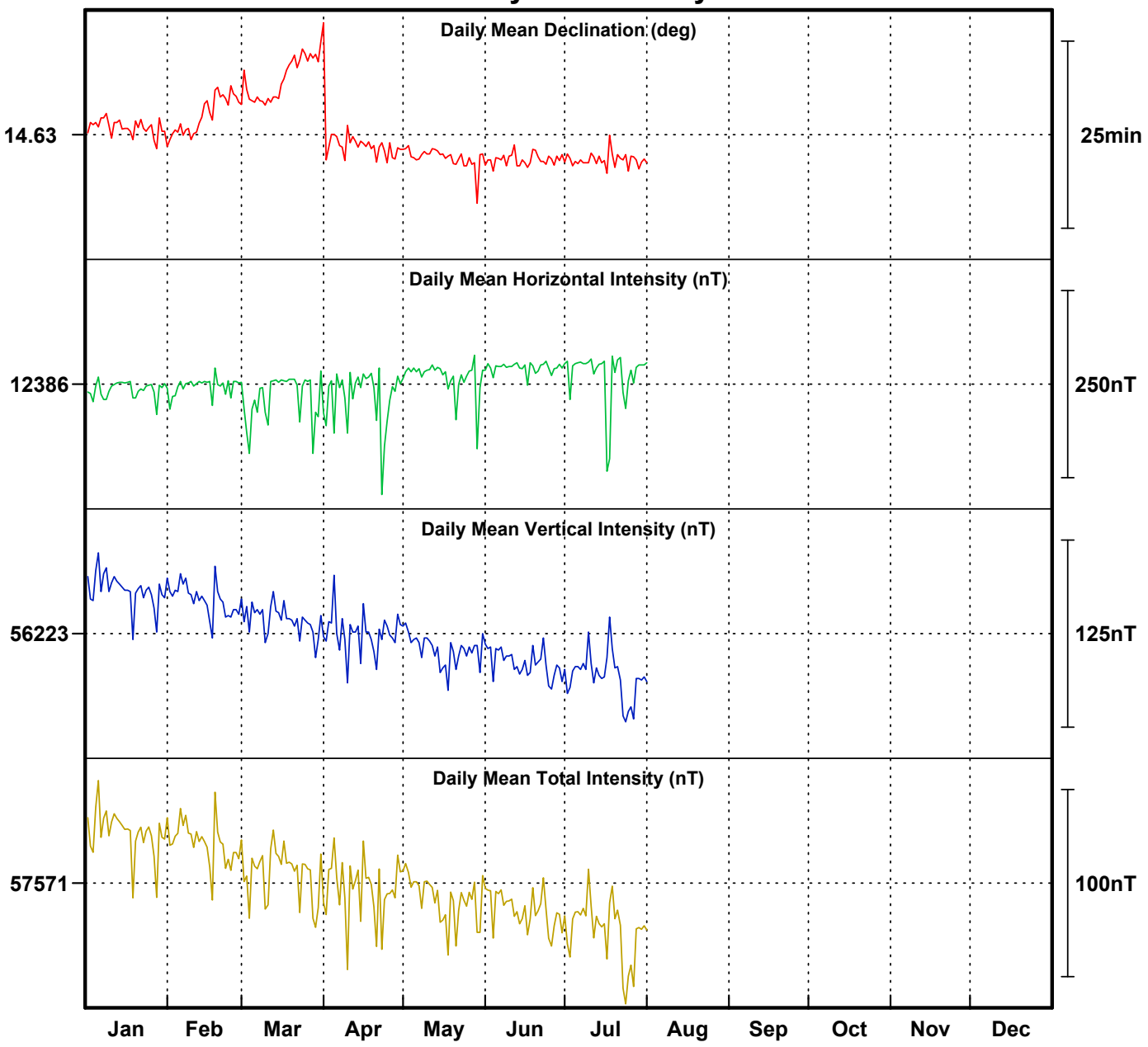


Fort McMurray Observatory: Vertical Intensity (nT)



Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory 2017



Monthly Mean Values for Fort McMurray Observatory 2017

Month	*D*	*H*	*I*	*X*	*Y*	*Z*	*F*
January	14° 39.0′	12379 nT	77° 35.3′	11977 nT	3131 nT	56252 nT	57598 nT
February	14° 40.8′	12384 nT	77° 35.0′	11979 nT	3138 nT	56246 nT	57593 nT
March	14° 45.9′	12368 nT	77° 35.7′	11960 nT	3152 nT	56232 nT	57576 nT
April	14° 36.5′	12371 nT	77° 35.5′	11971 nT	3120 nT	56223 nT	57568 nT
May	14° 34.9′	12396 nT	77° 33.8′	11997 nT	3121 nT	56212 nT	57563 nT
June	14° 34.7′	12409 nT	77° 33.0′	12009 nT	3123 nT	56203 nT	57556 nT
July	14° 34.7′	12398 nT	77° 33.5′	11999 nT	3121 nT	56194 nT	57546 nT

Note

i. The values shown here are provisional.