

BRITISH GEOLOGICAL SURVEY

Fort

McMurray

Observatory

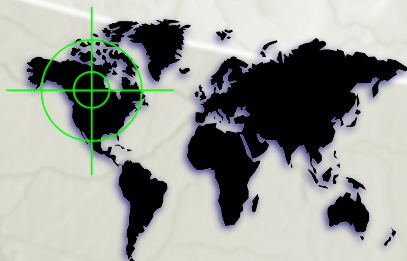
Monthly

Magnetic

Bulletin

December 2016

I6/I2/FM



British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

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° 30'25"N 309° 45'40" 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 2016.5. 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.'

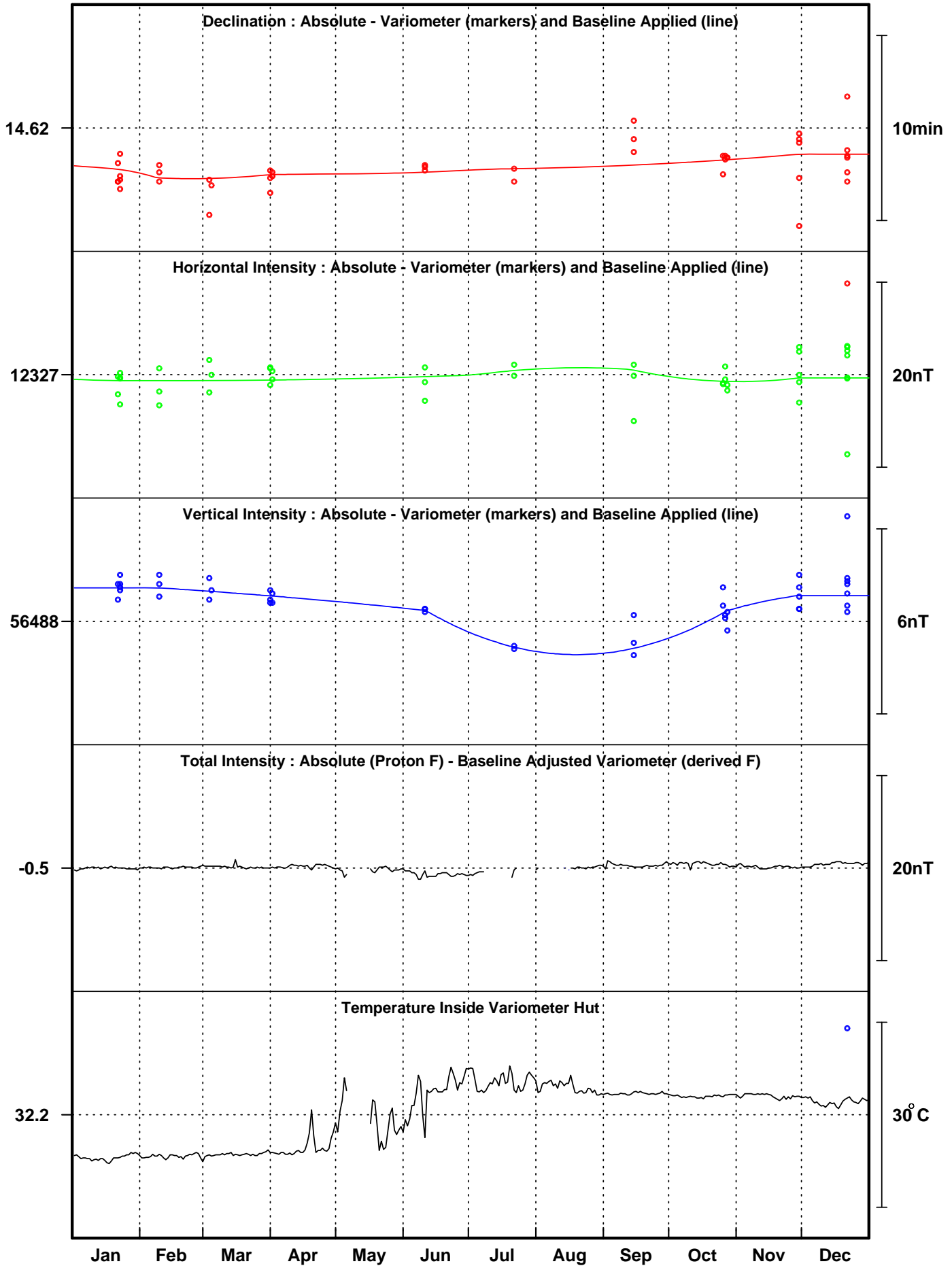
Commercial users can contact the geomagnetism team for information on the range of applications and services offered. Full contact details are available at www.geomag.bgs.ac.uk/contactus/staff

FORT McMURRAY OBSERVATORY

ABSOLUTE OBSERVATIONS

| Date | Day Number | Declination | | | Inclination | | Total Field | | Horizontal Intensity | | Vertical Intensity | | Observer |
|-----------|------------|-------------|--------------|--------------|-------------|--------------|----------------------|-------------------------|----------------------|---------------|--------------------|---------------|----------|
| | | Time (UT) | Absolute (°) | Baseline (°) | Time (UT) | Absolute (°) | Site difference (nT) | Absolute corrected (nT) | Absolute (nT) | Baseline (nT) | Absolute (nT) | Baseline (nT) | |
| 21-Dec-16 | 356 | 17:16 | 14.5240 | 14.9350 | 17:26 | 77.5756 | 0.5 | 57574.0 | 12387.2 | 12393.1 | 56225.6 | 56474.4 | RG |
| 21-Dec-16 | 356 | 17:39 | 14.5643 | 14.6450 | 17:48 | 77.6075 | 0.5 | 57609.2 | 12363.4 | 12318.0 | 56267.0 | 56491.0 | RG |
| 21-Dec-16 | 356 | 18:24 | 14.6373 | 14.5917 | 18:35 | 77.5867 | 0.5 | 57614.6 | 12385.0 | 12329.2 | 56267.7 | 56488.8 | RG |
| 21-Dec-16 | 356 | 19:39 | 14.5513 | 14.5683 | 19:50 | 77.6157 | 0.5 | 57622.0 | 12358.1 | 12326.3 | 56281.2 | 56489.0 | RG |
| 21-Dec-16 | 356 | 20:02 | 14.5572 | 14.5967 | 20:13 | 77.6256 | 0.5 | 57608.5 | 12345.5 | 12328.7 | 56270.2 | 56488.5 | RG |
| 21-Dec-16 | 356 | 20:24 | 14.4700 | 14.5767 | 20:34 | 77.6063 | 0.5 | 57623.9 | 12367.8 | 12329.7 | 56281.1 | 56487.9 | RG |
| 21-Dec-16 | 356 | 20:46 | 14.3429 | 14.4767 | 20:58 | 77.6163 | 0.5 | 57641.9 | 12361.8 | 12329.6 | 56300.7 | 56488.1 | RG |
| 21-Dec-16 | 356 | 21:24 | 14.5778 | 14.5900 | 21:32 | 77.6004 | 0.5 | 57653.2 | 12379.8 | 12326.2 | 56308.3 | 56488.9 | RG |

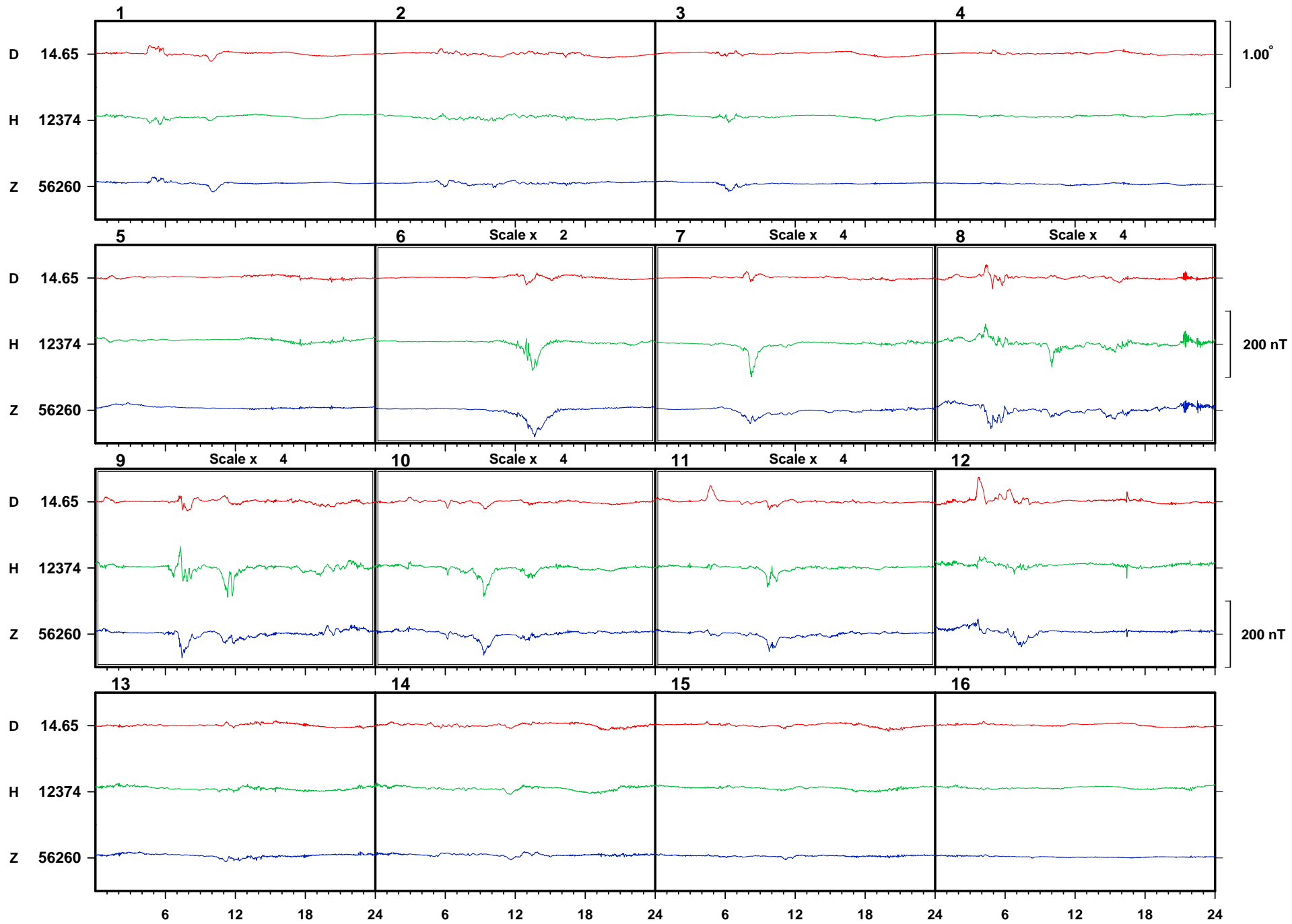
Fort McMurray 2016

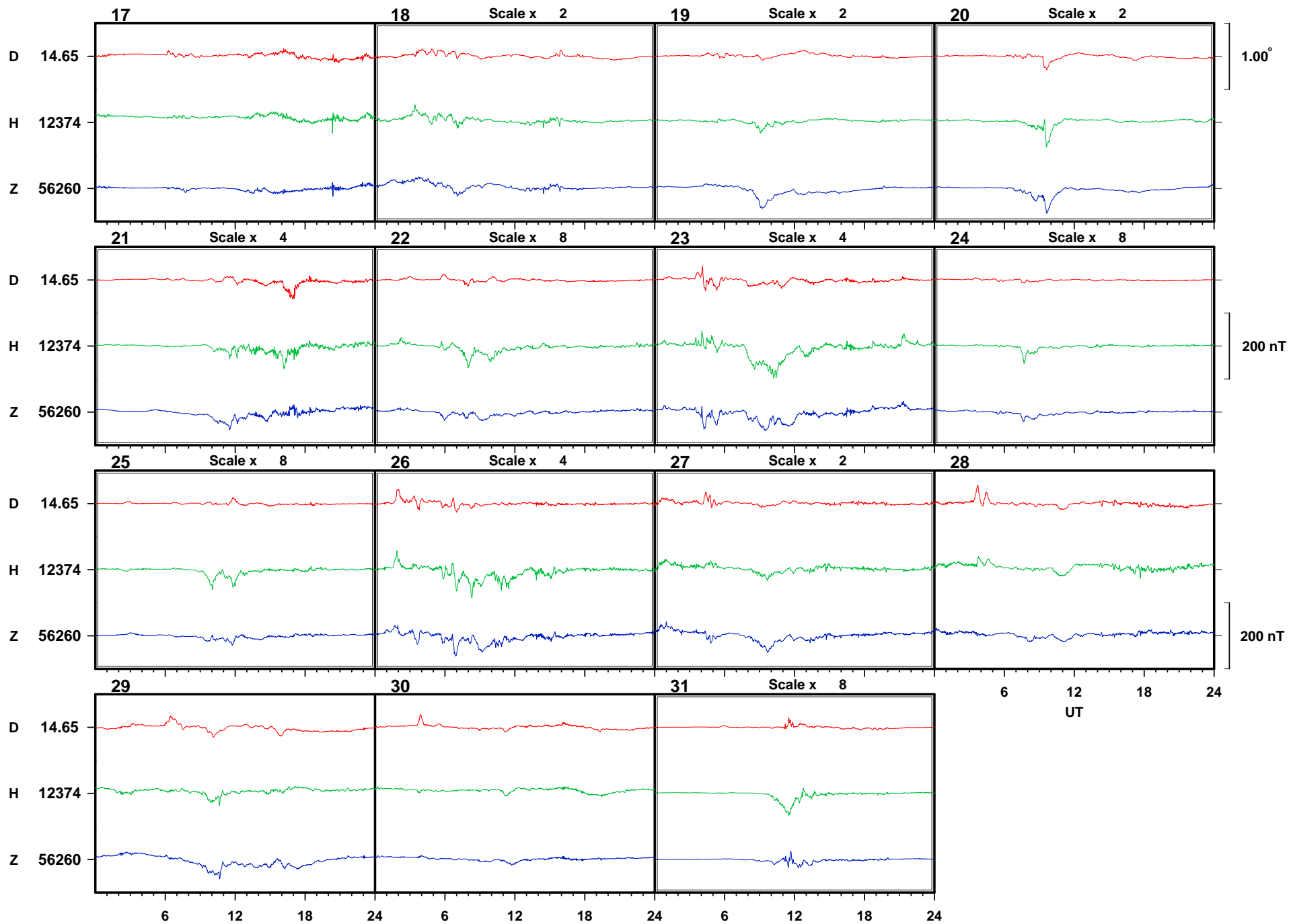


Fort McMurray

December

2016



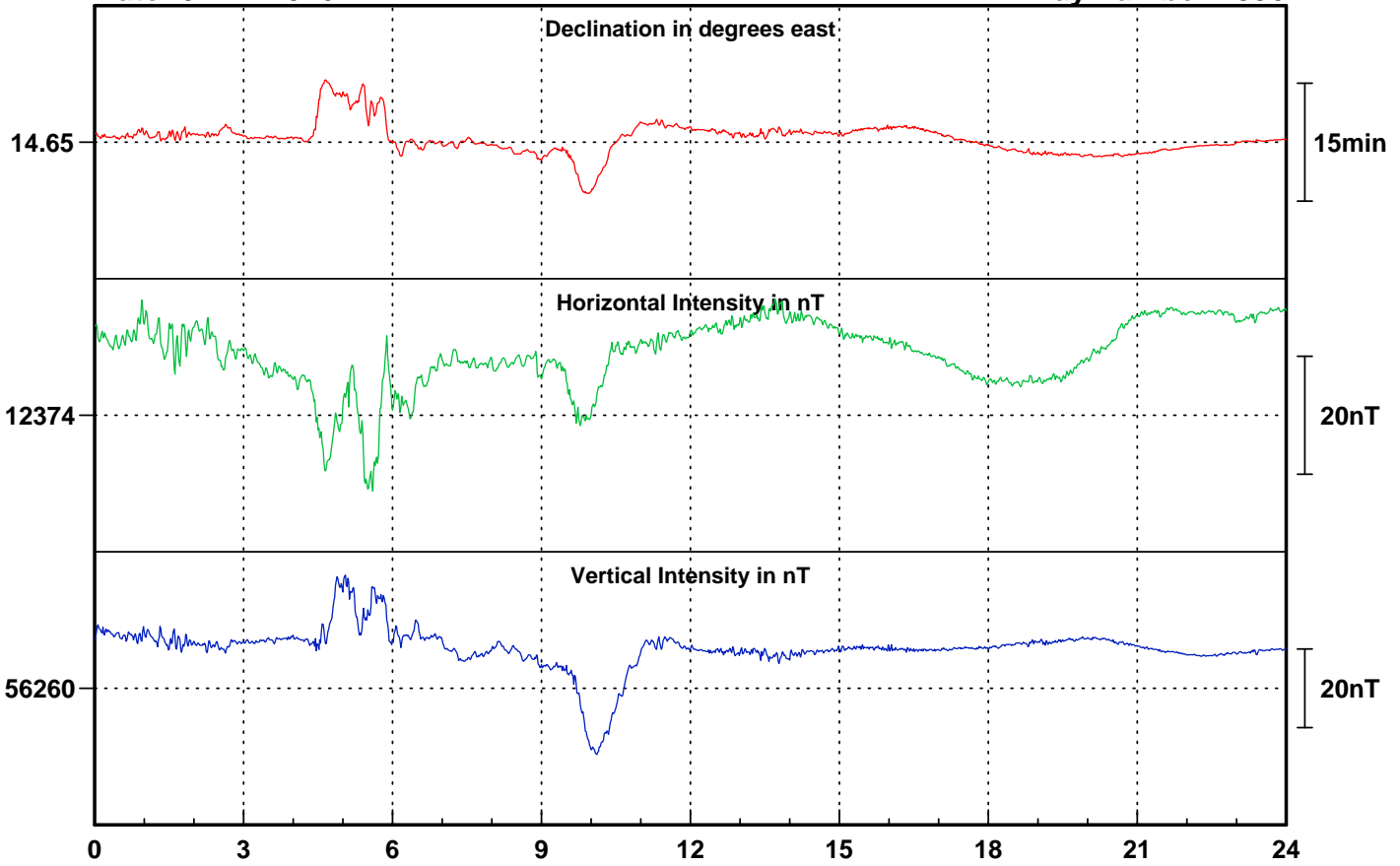


Fort McMurray December 2016

Date: 01-12-2016

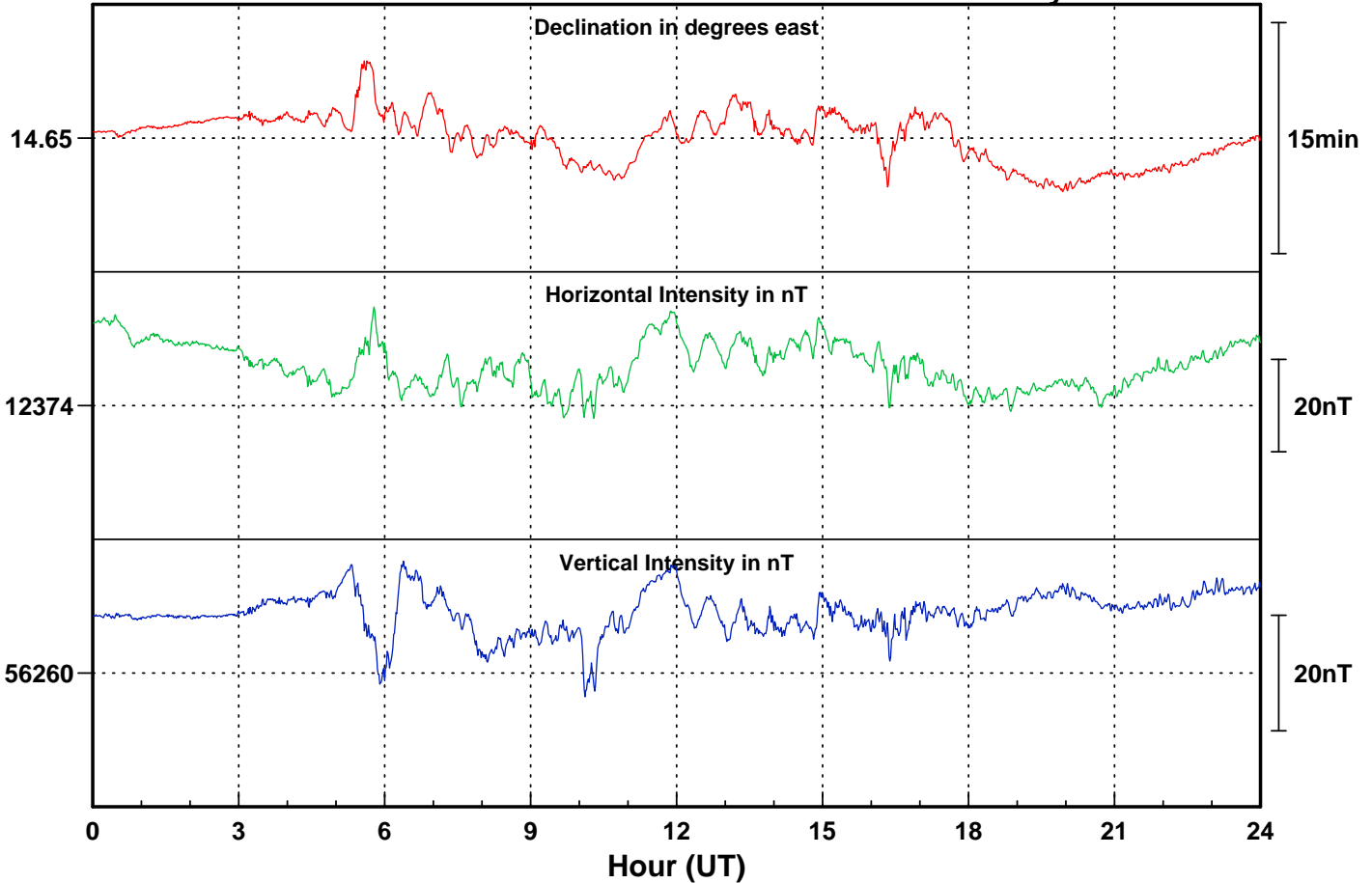
Fort McMurray

Day number: 336



Date: 02-12-2016

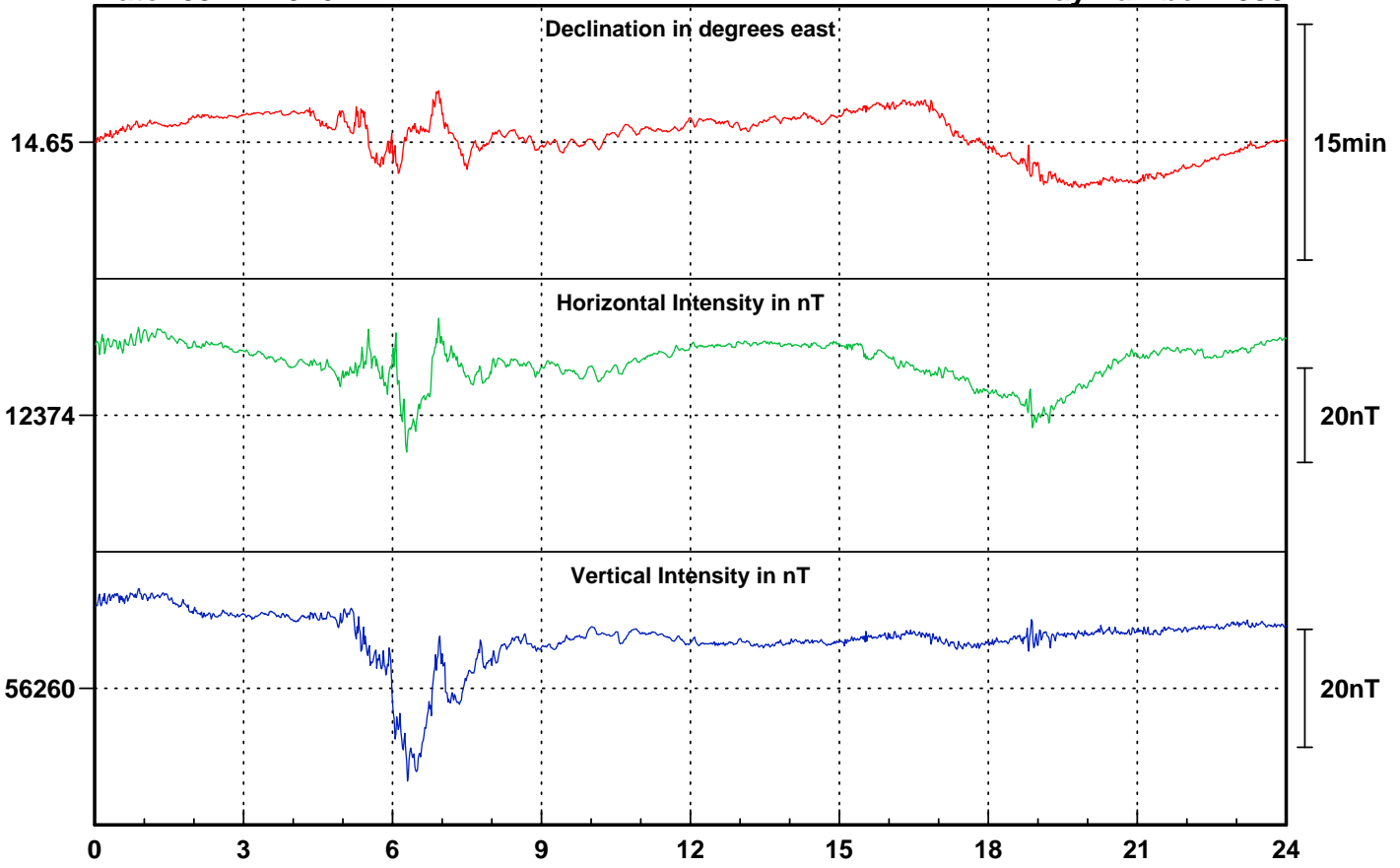
Day number: 337



Date: 03-12-2016

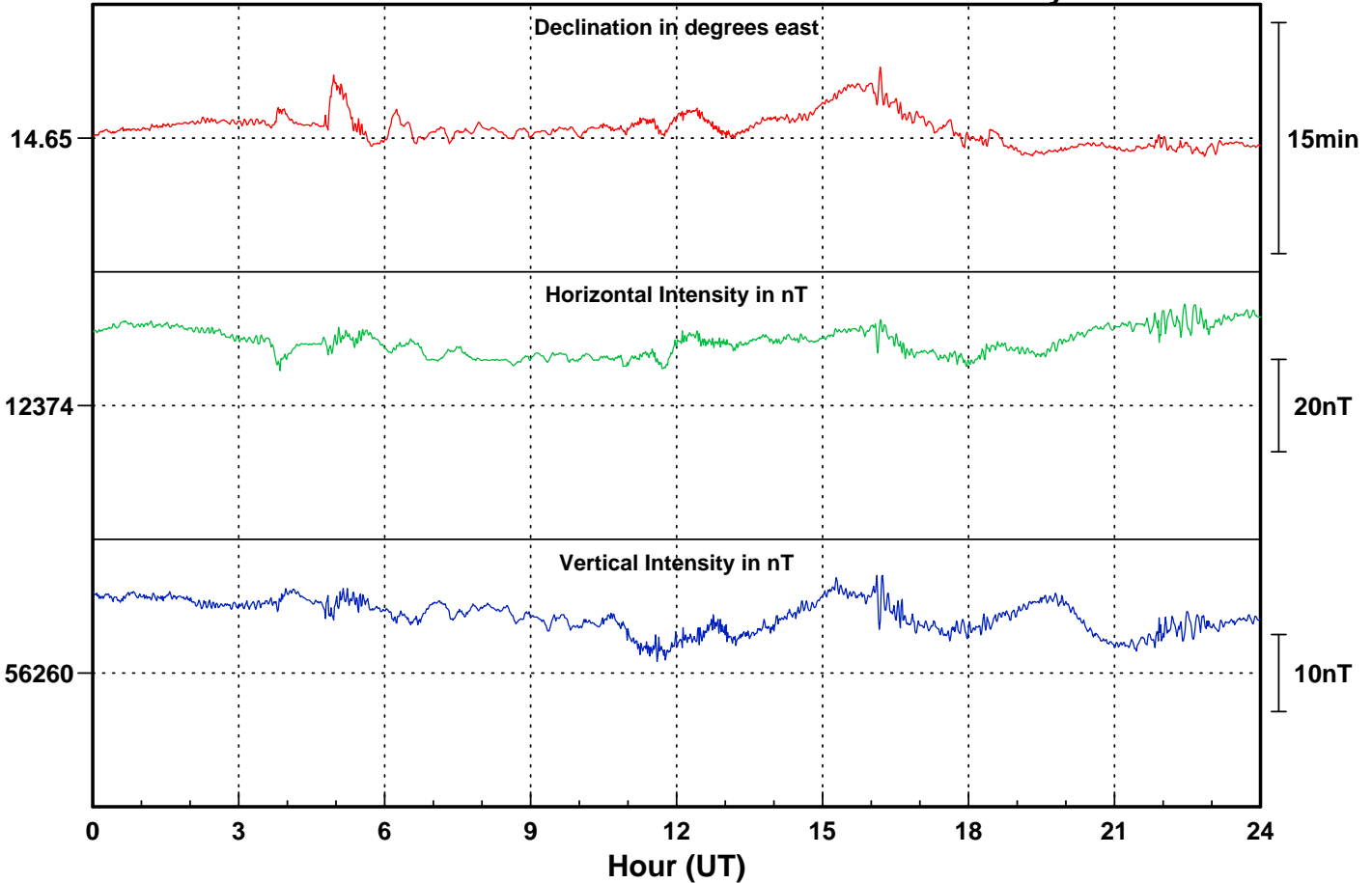
Fort McMurray

Day number: 338



Date: 04-12-2016

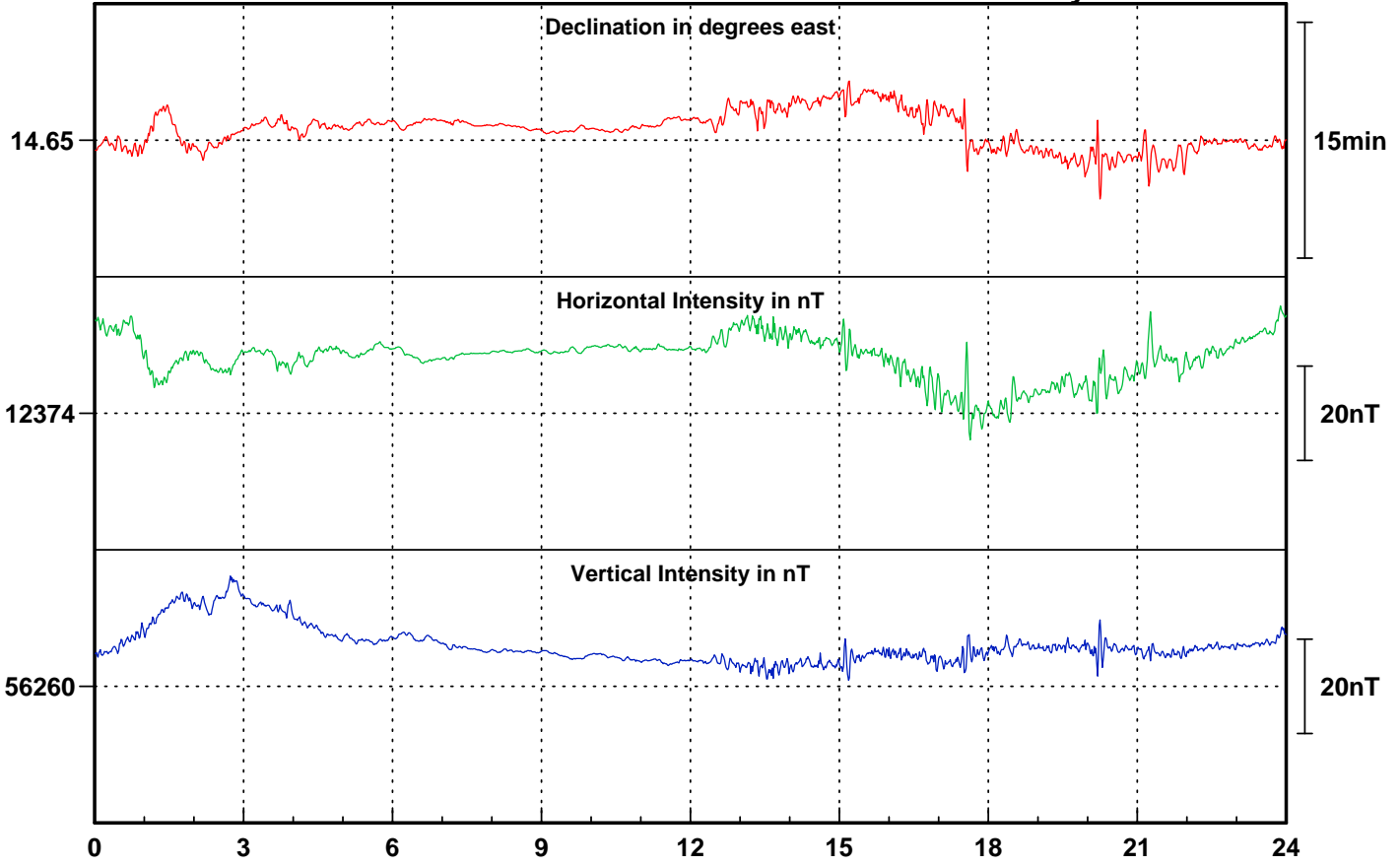
Day number: 339



Date: 05-12-2016

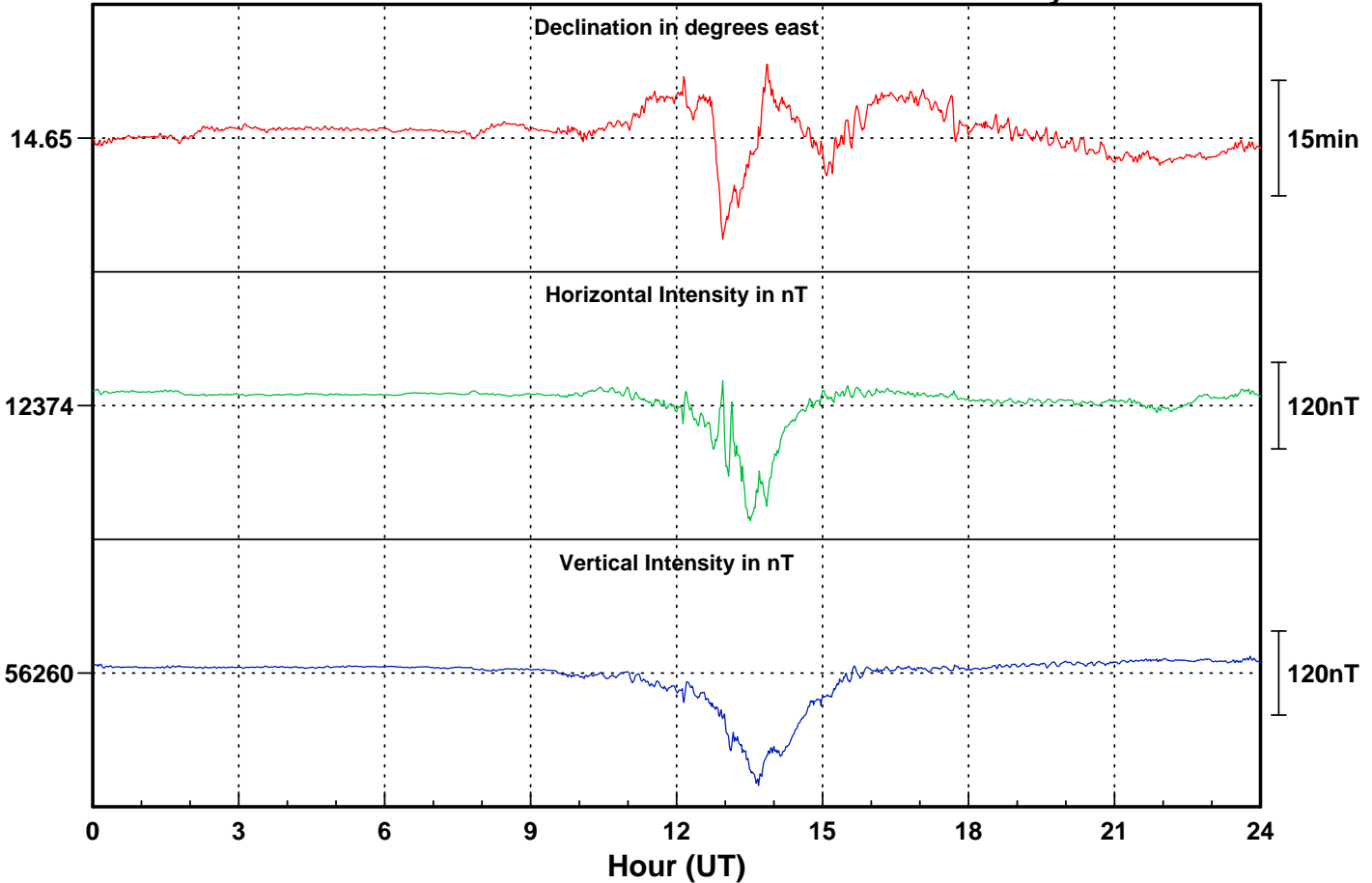
Fort McMurray

Day number: 340



Date: 06-12-2016

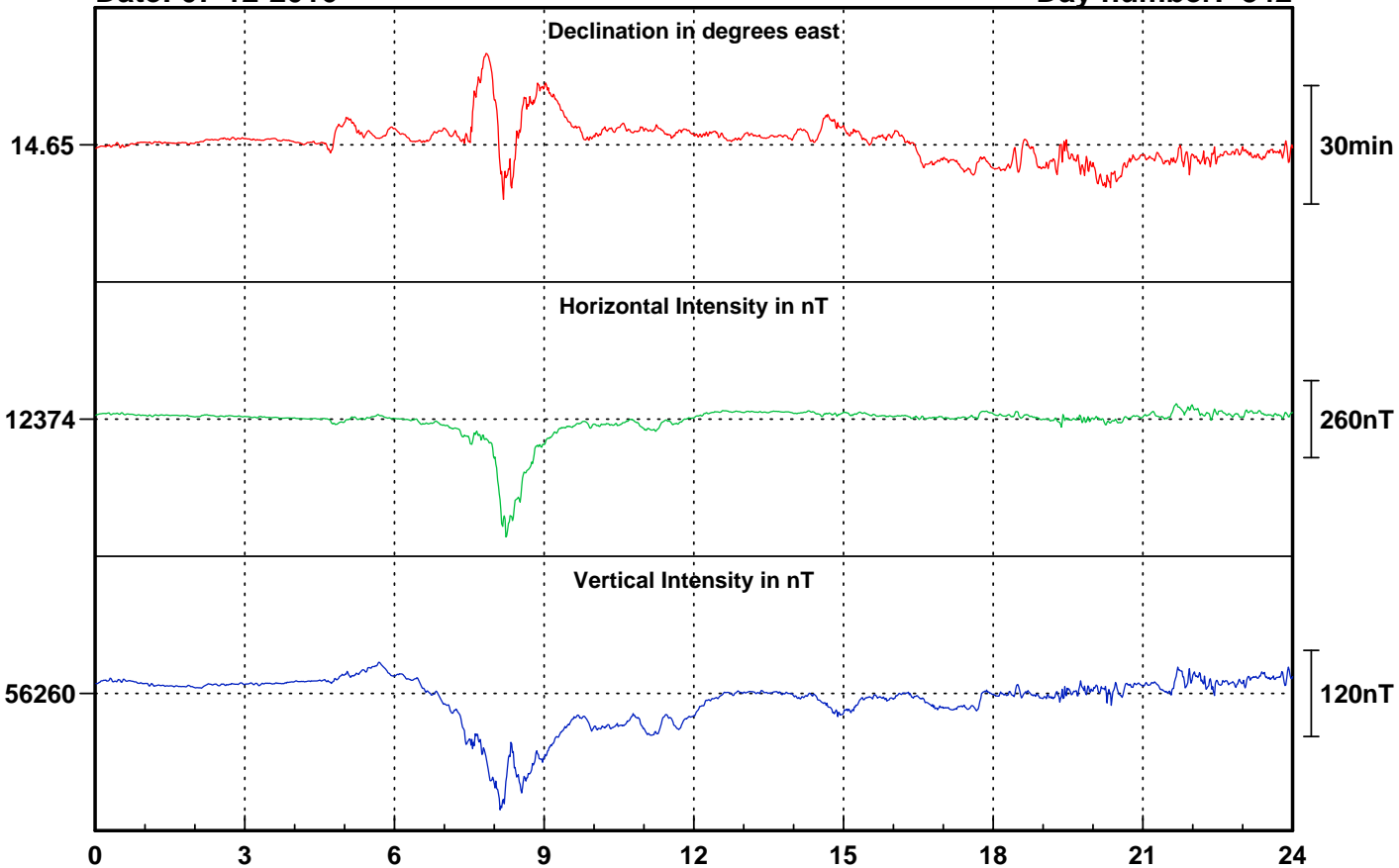
Day number: 341



Date: 07-12-2016

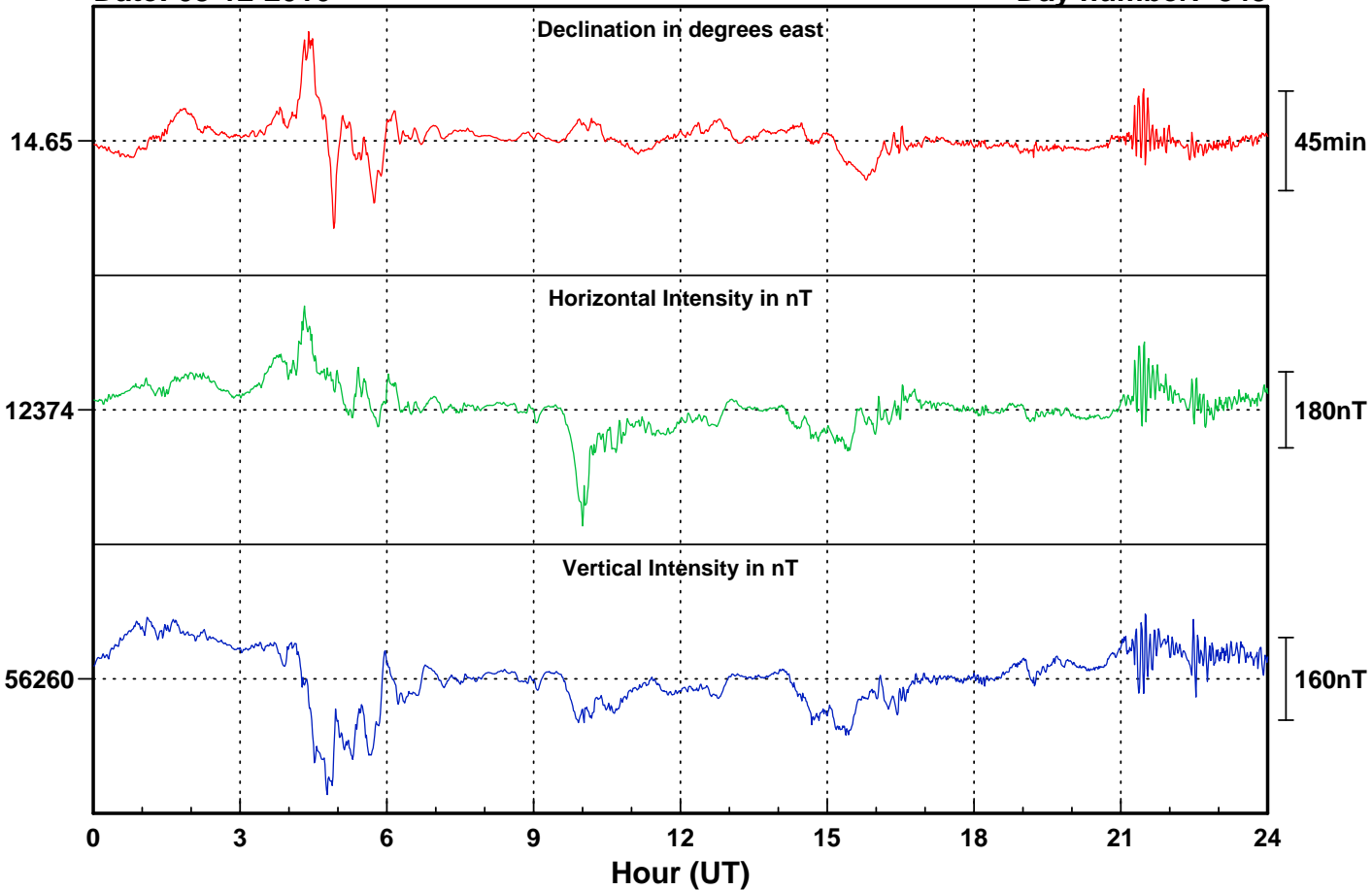
Fort McMurray

Day number: 342



Date: 08-12-2016

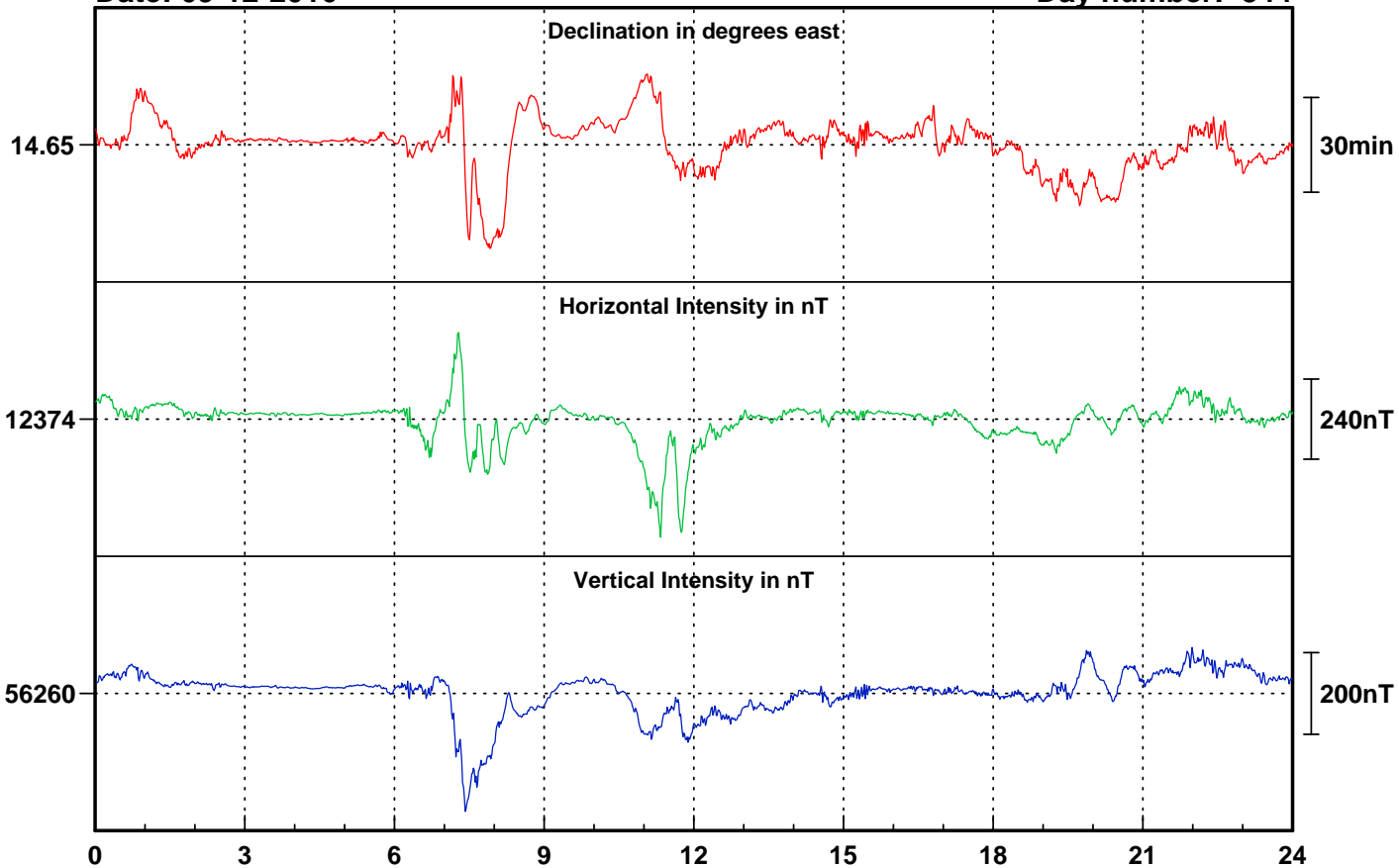
Day number: 343



Date: 09-12-2016

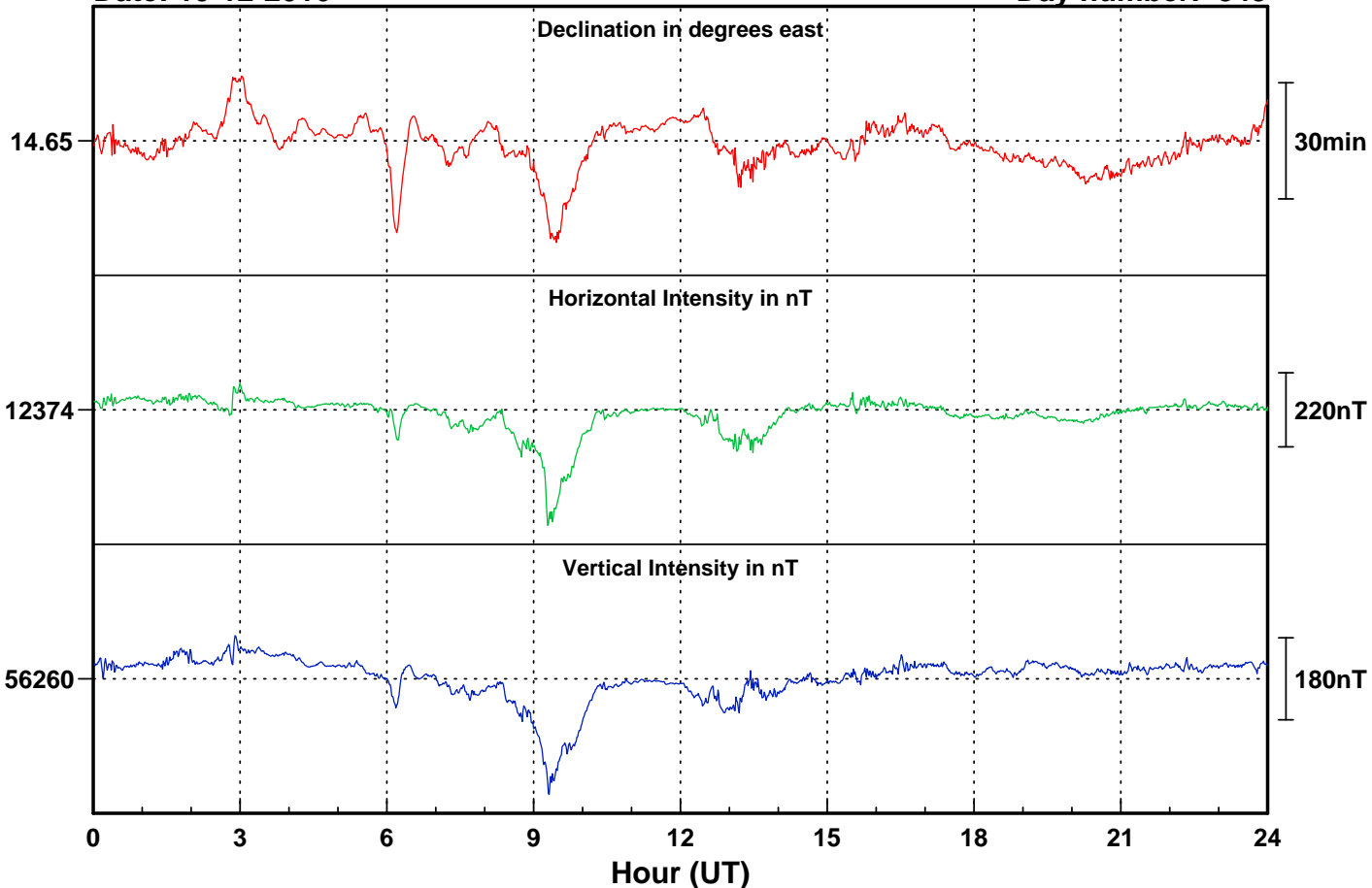
Fort McMurray

Day number: 344



Date: 10-12-2016

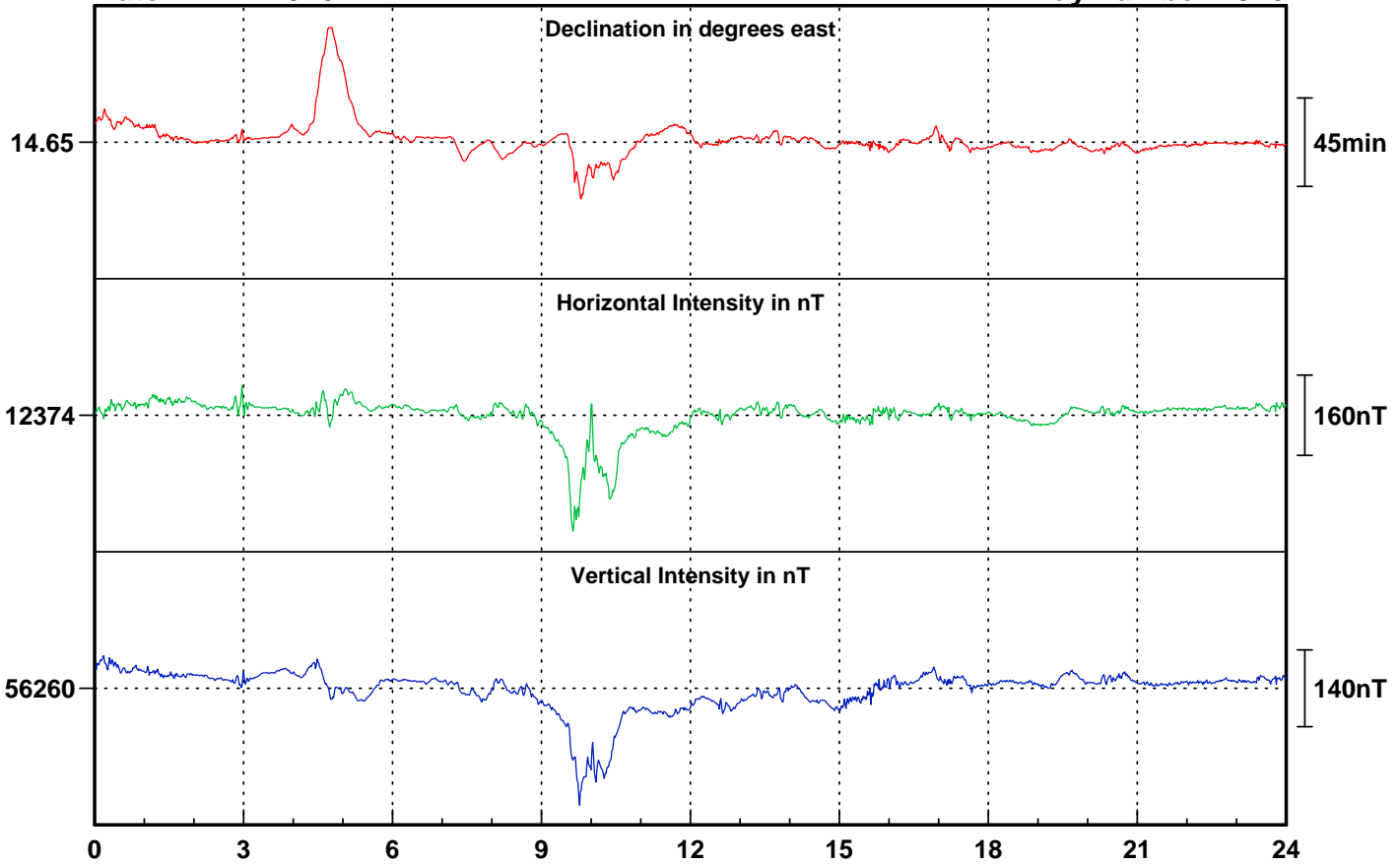
Day number: 345



Date: 11-12-2016

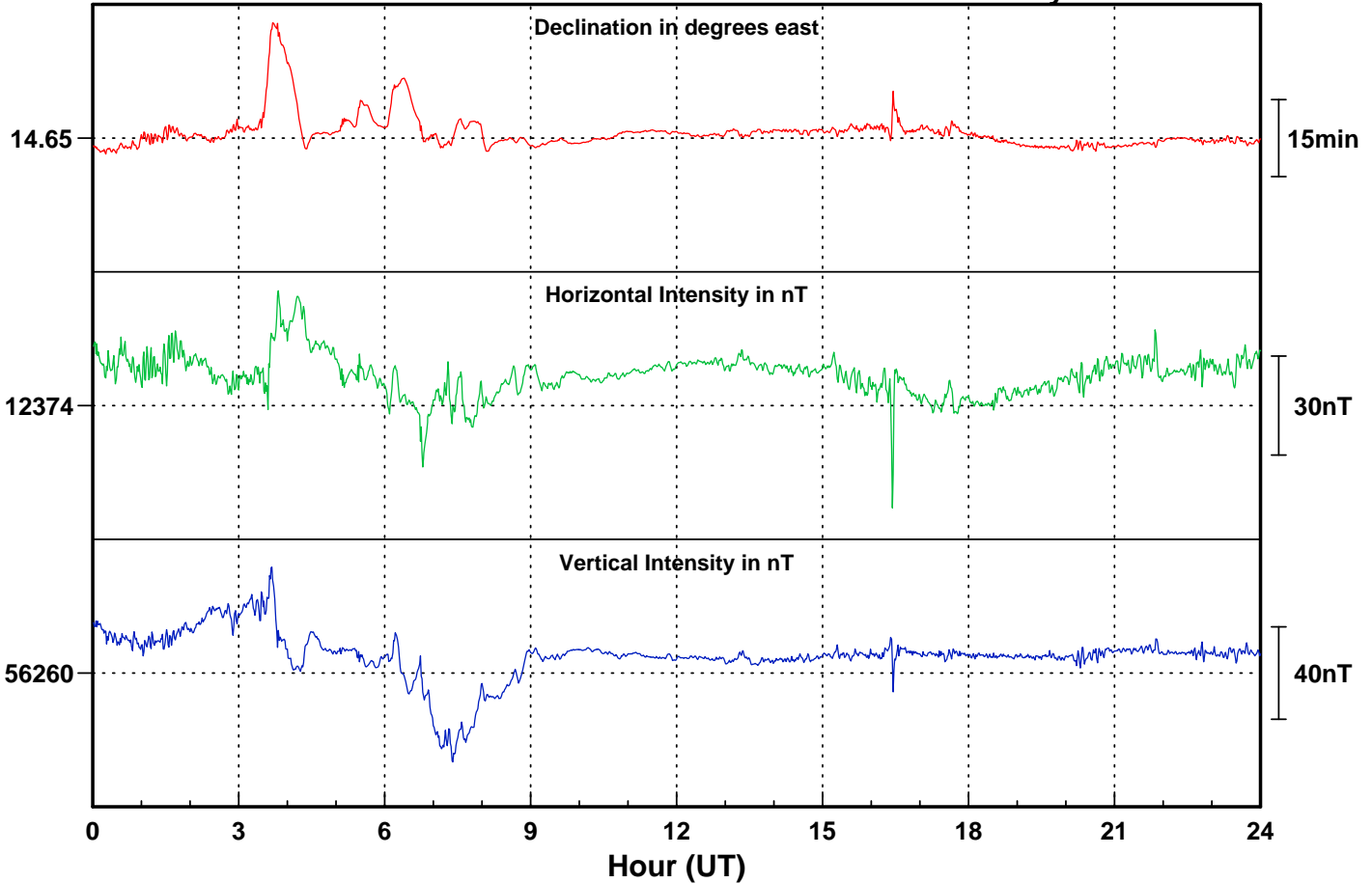
Fort McMurray

Day number: 346



Date: 12-12-2016

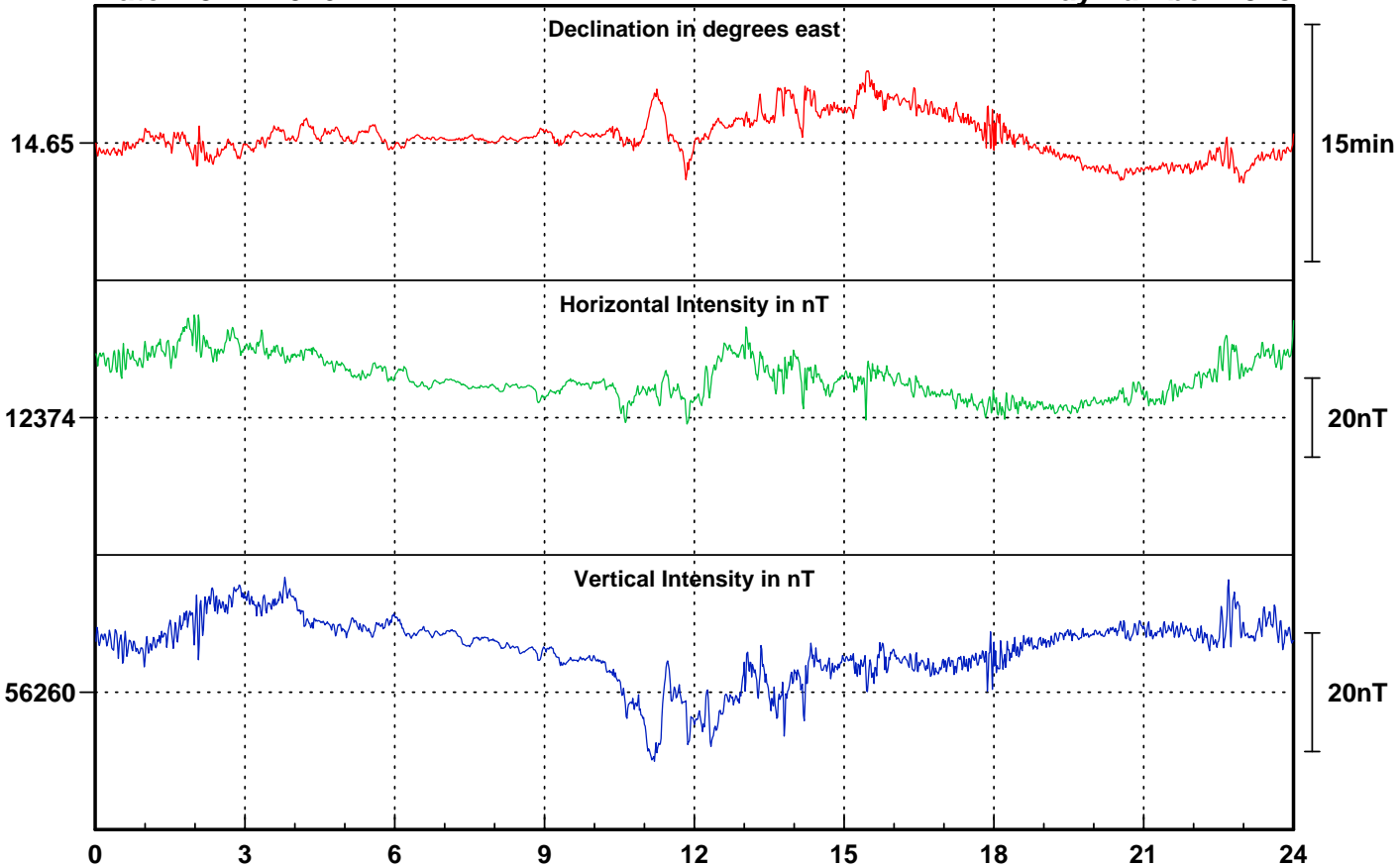
Day number: 347



Date: 13-12-2016

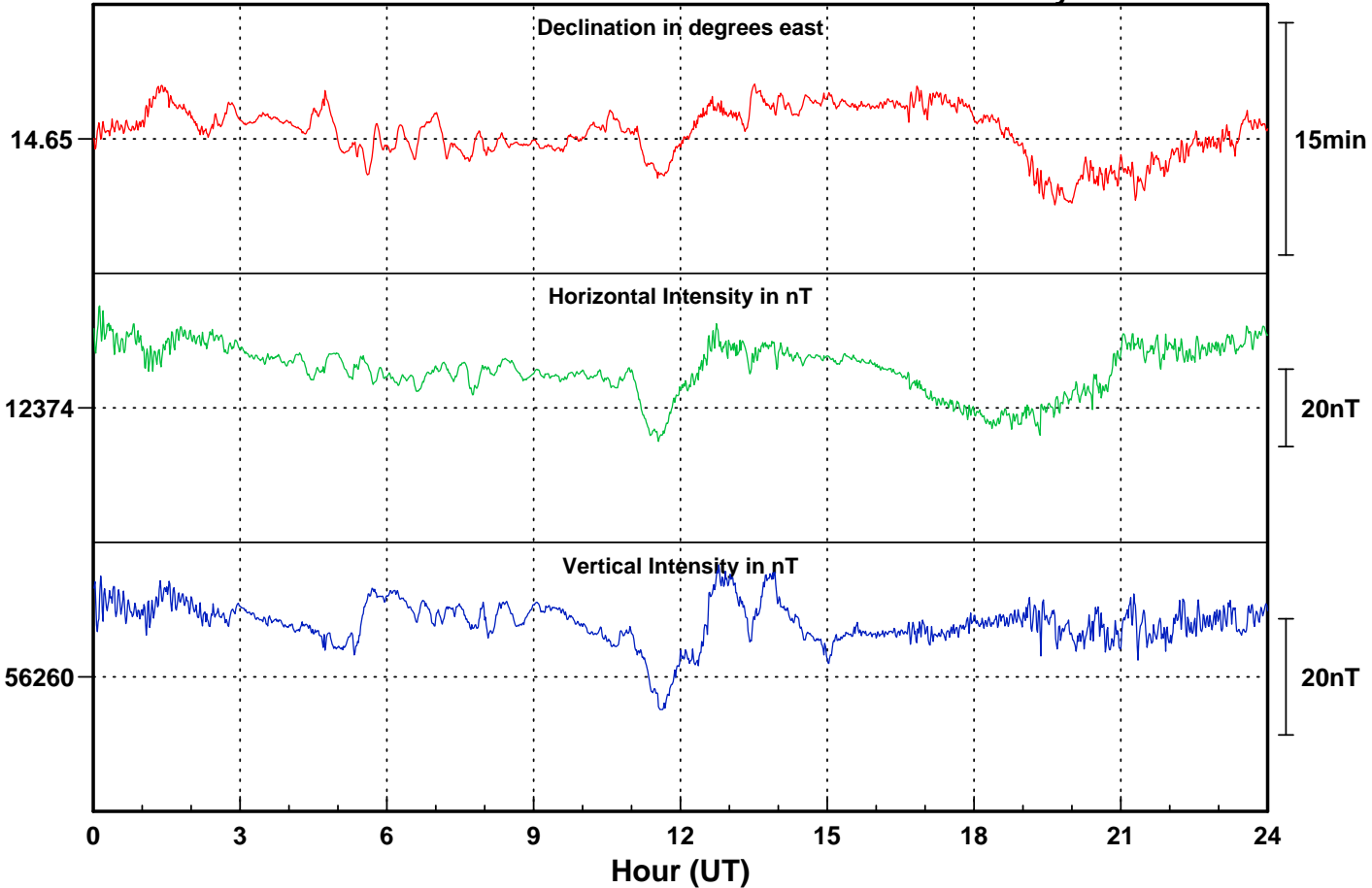
Fort McMurray

Day number: 348



Date: 14-12-2016

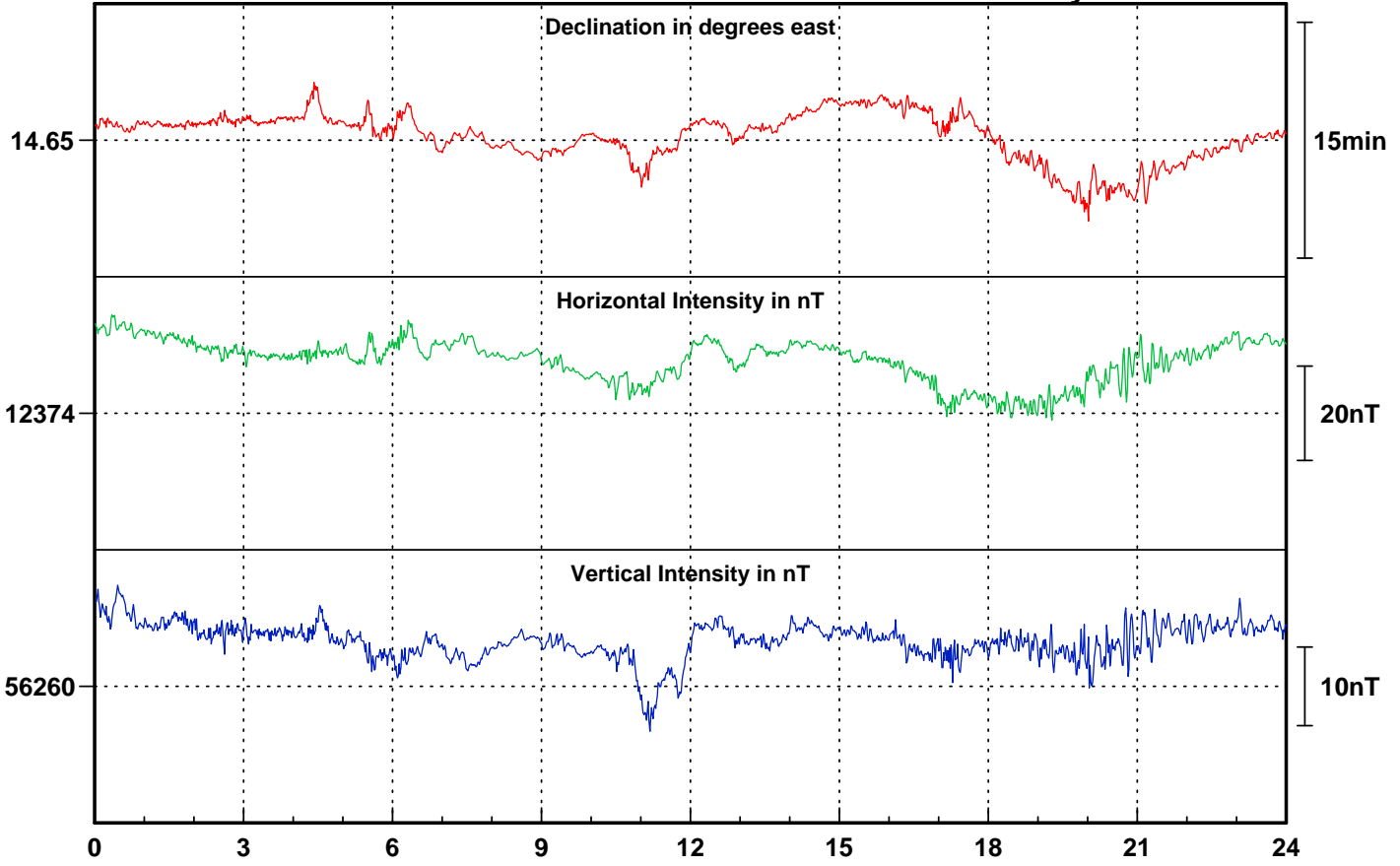
Day number: 349



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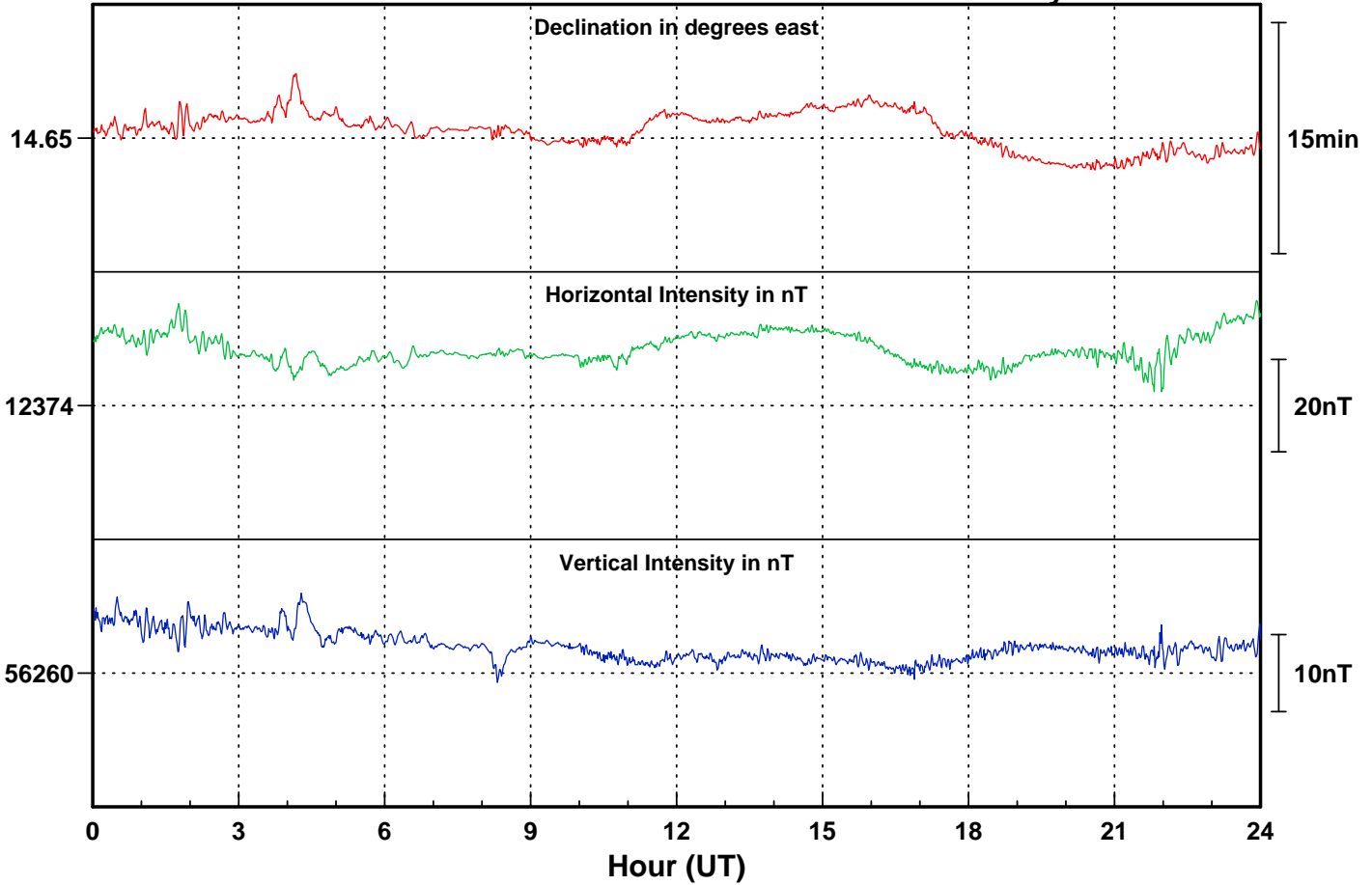
Fort McMurray

Day number: 350



Date: 16-12-2016

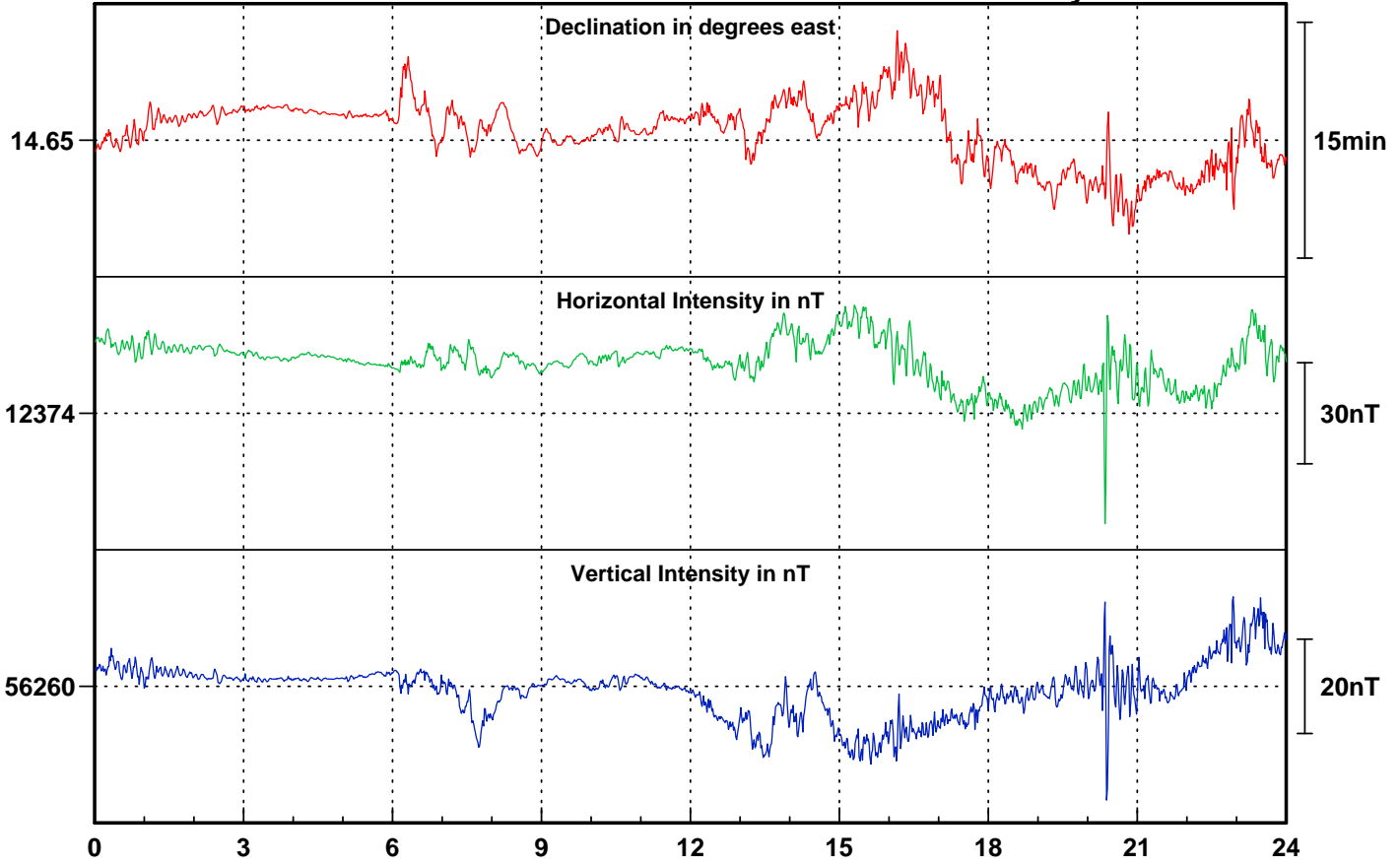
Day number: 351



Date: 17-12-2016

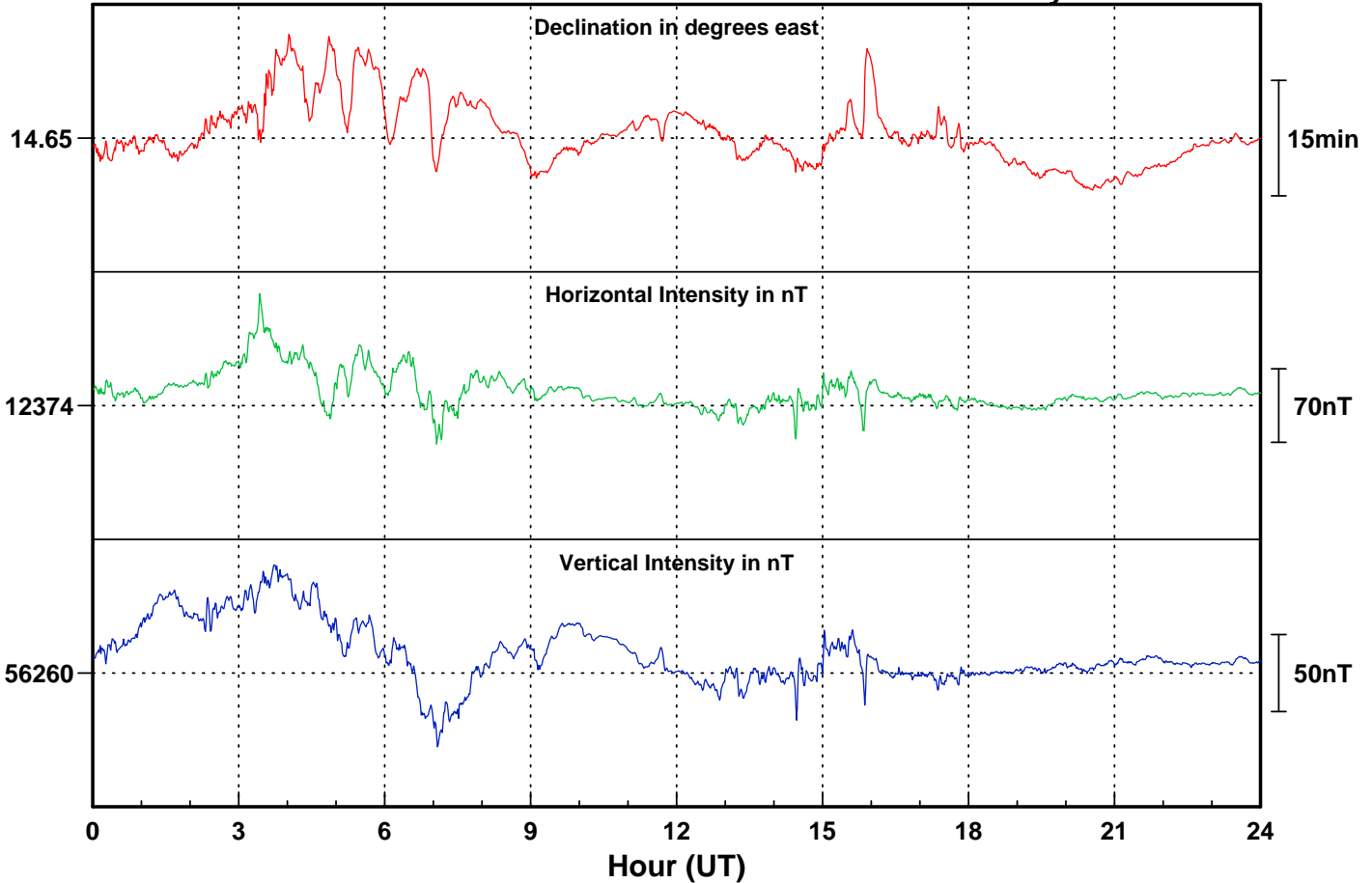
Fort McMurray

Day number: 352



Date: 18-12-2016

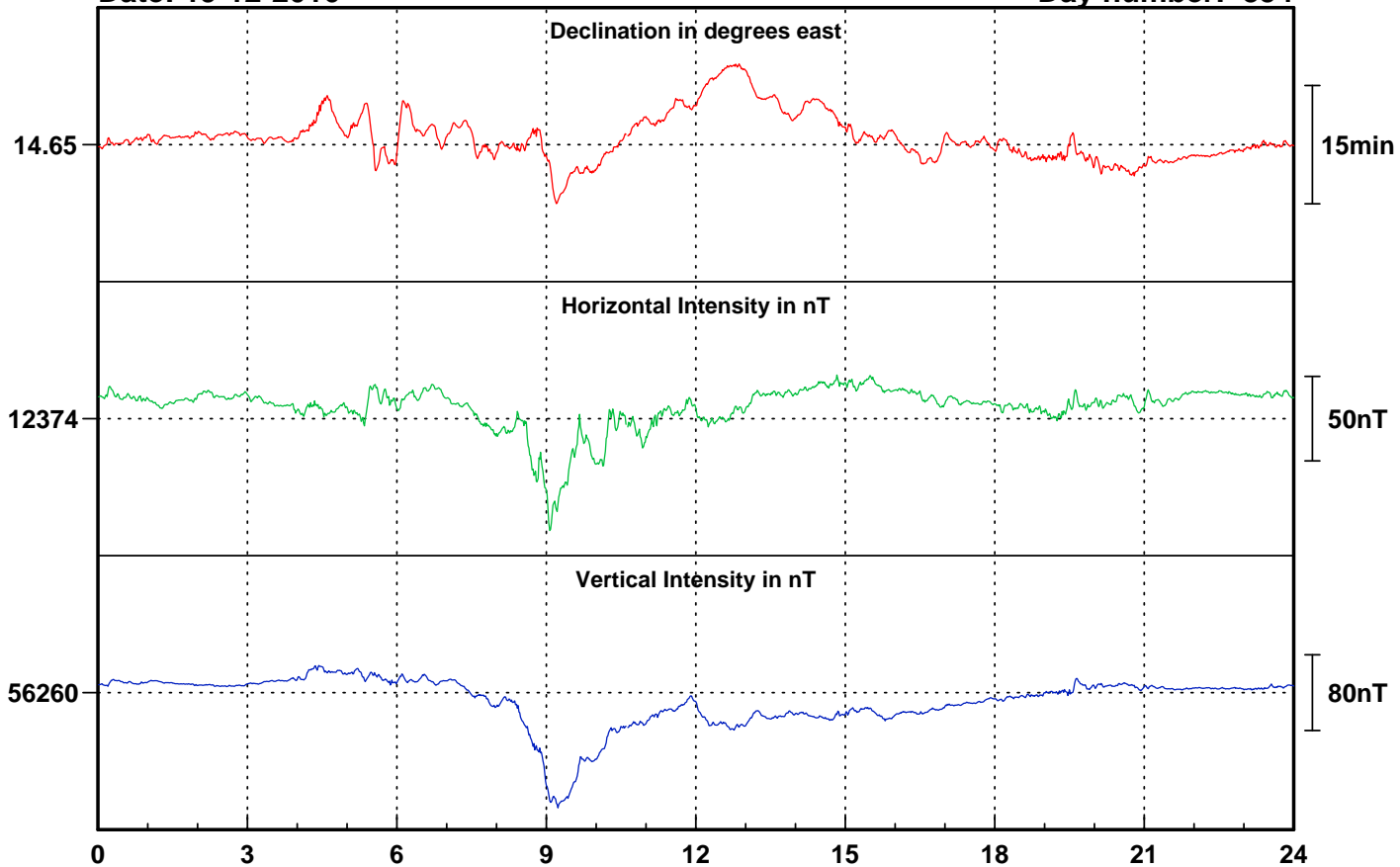
Day number: 353



Date: 19-12-2016

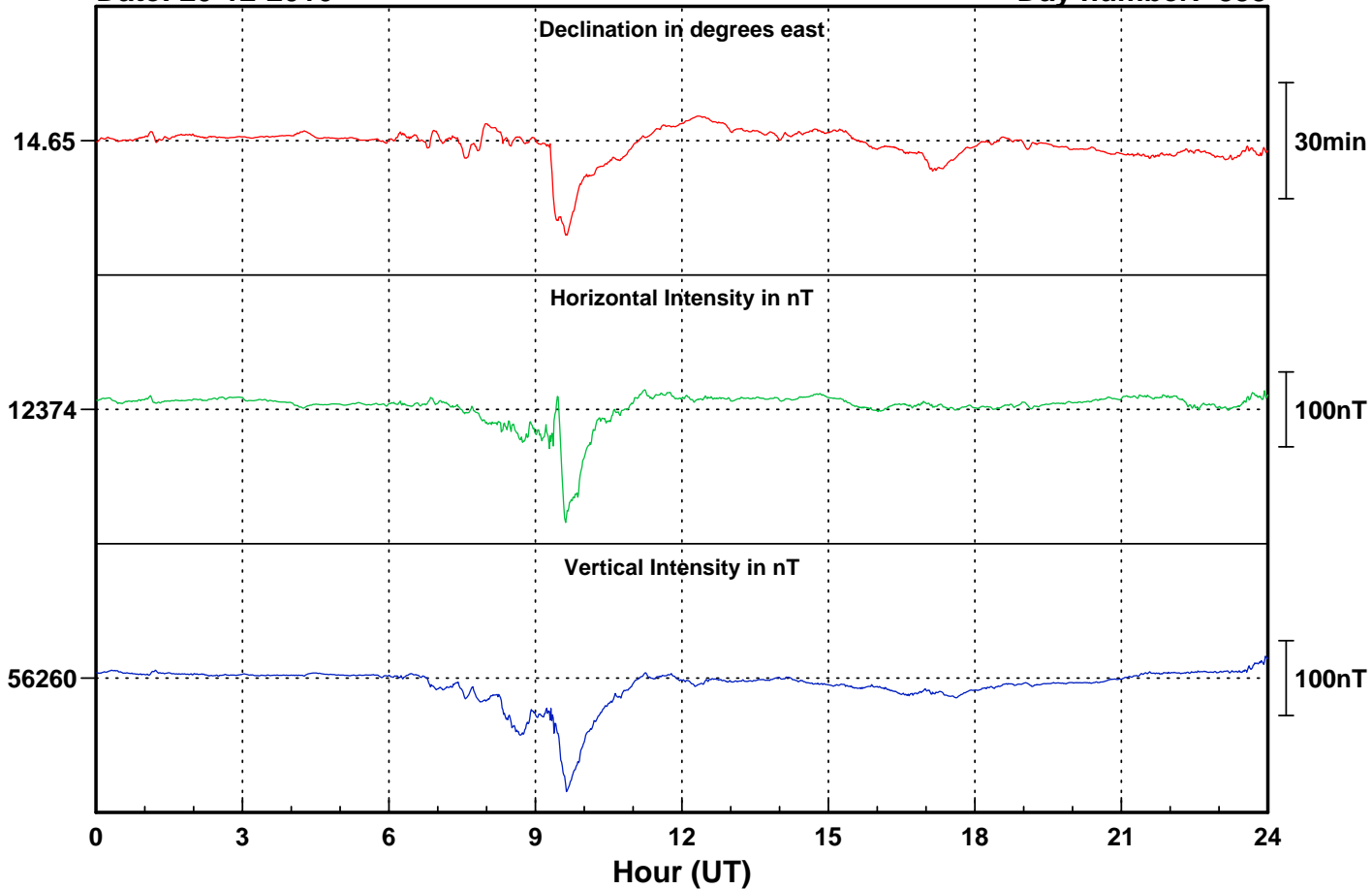
Fort McMurray

Day number: 354



Date: 20-12-2016

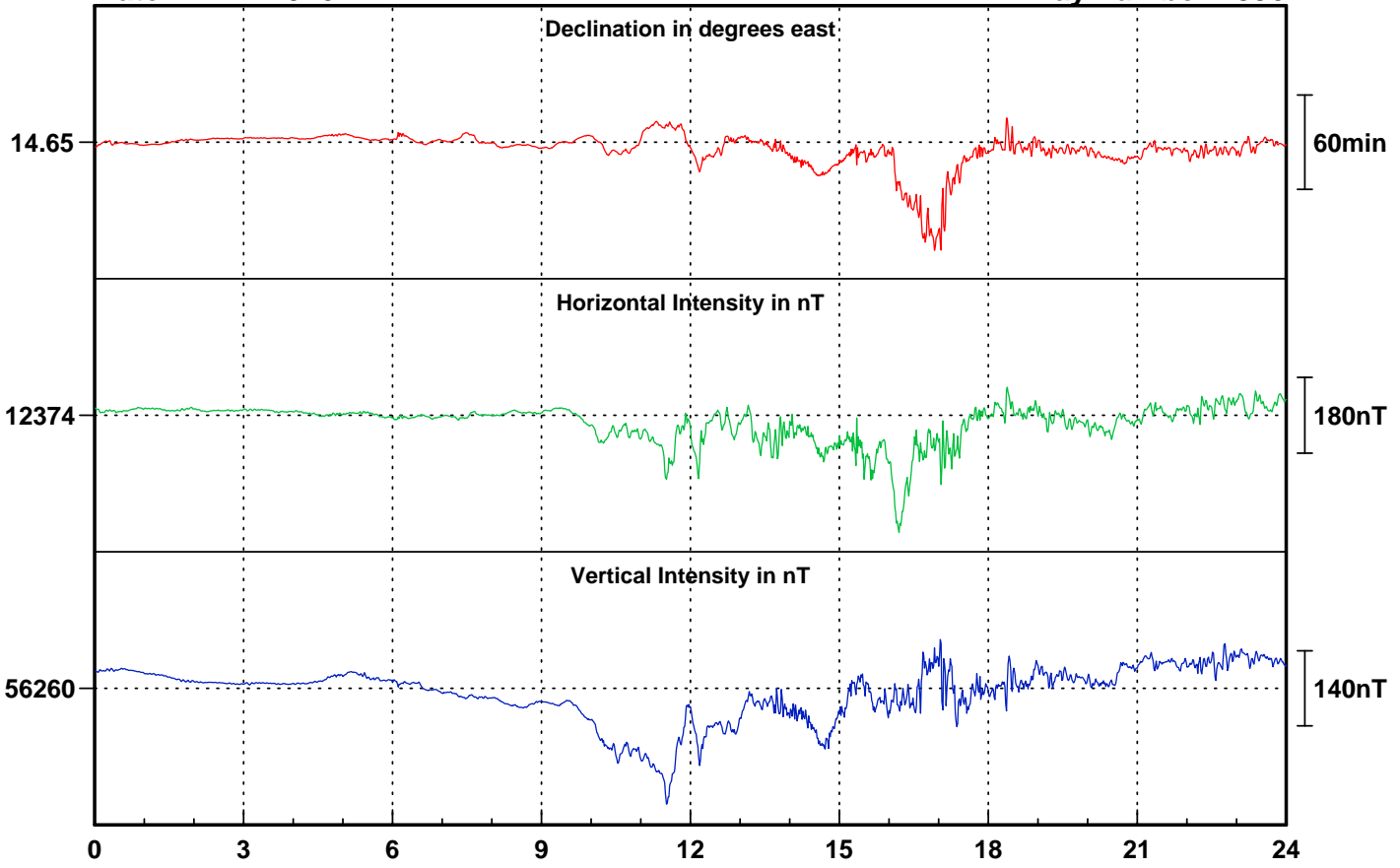
Day number: 355



Date: 21-12-2016

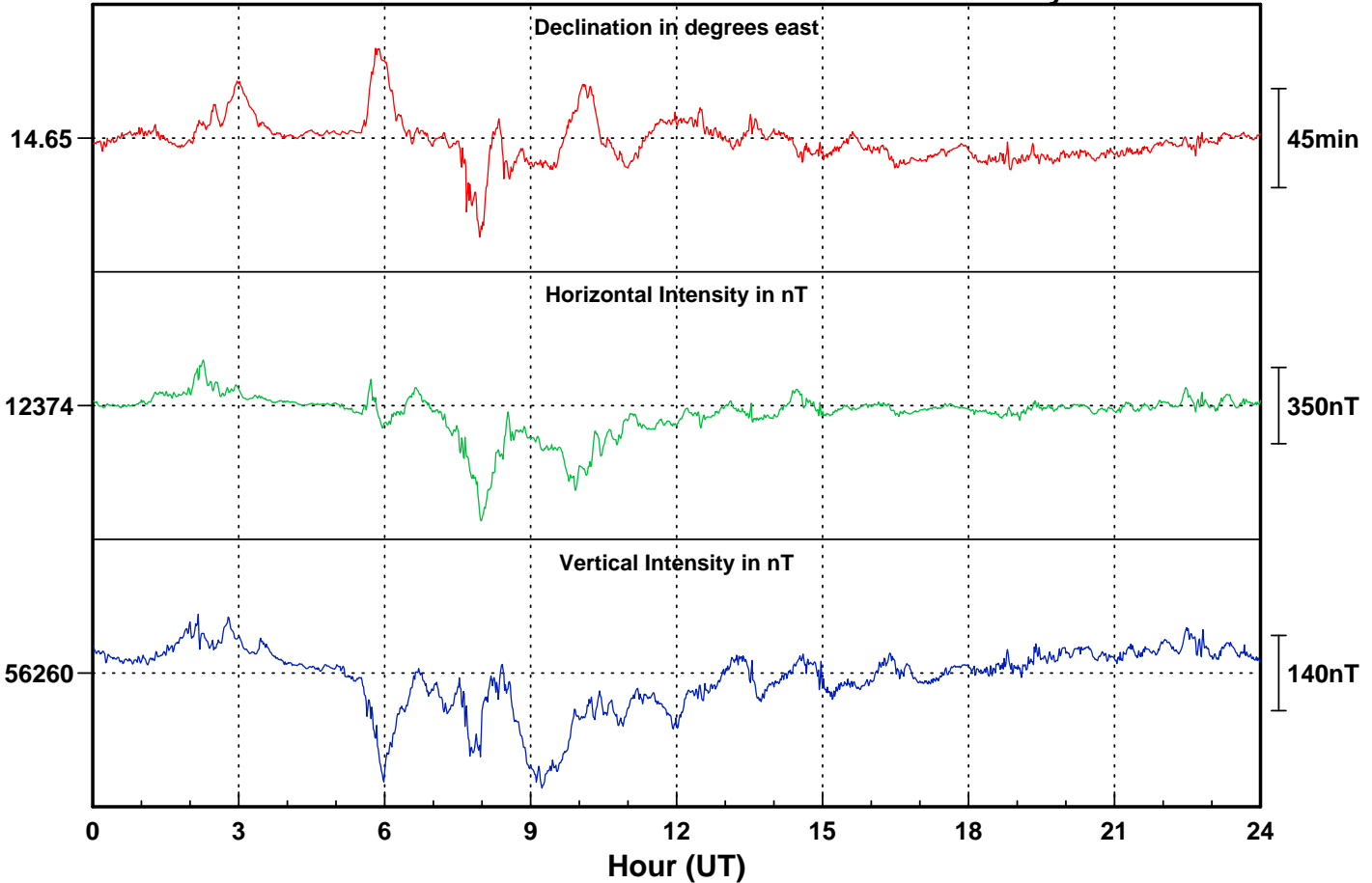
Fort McMurray

Day number: 356



Date: 22-12-2016

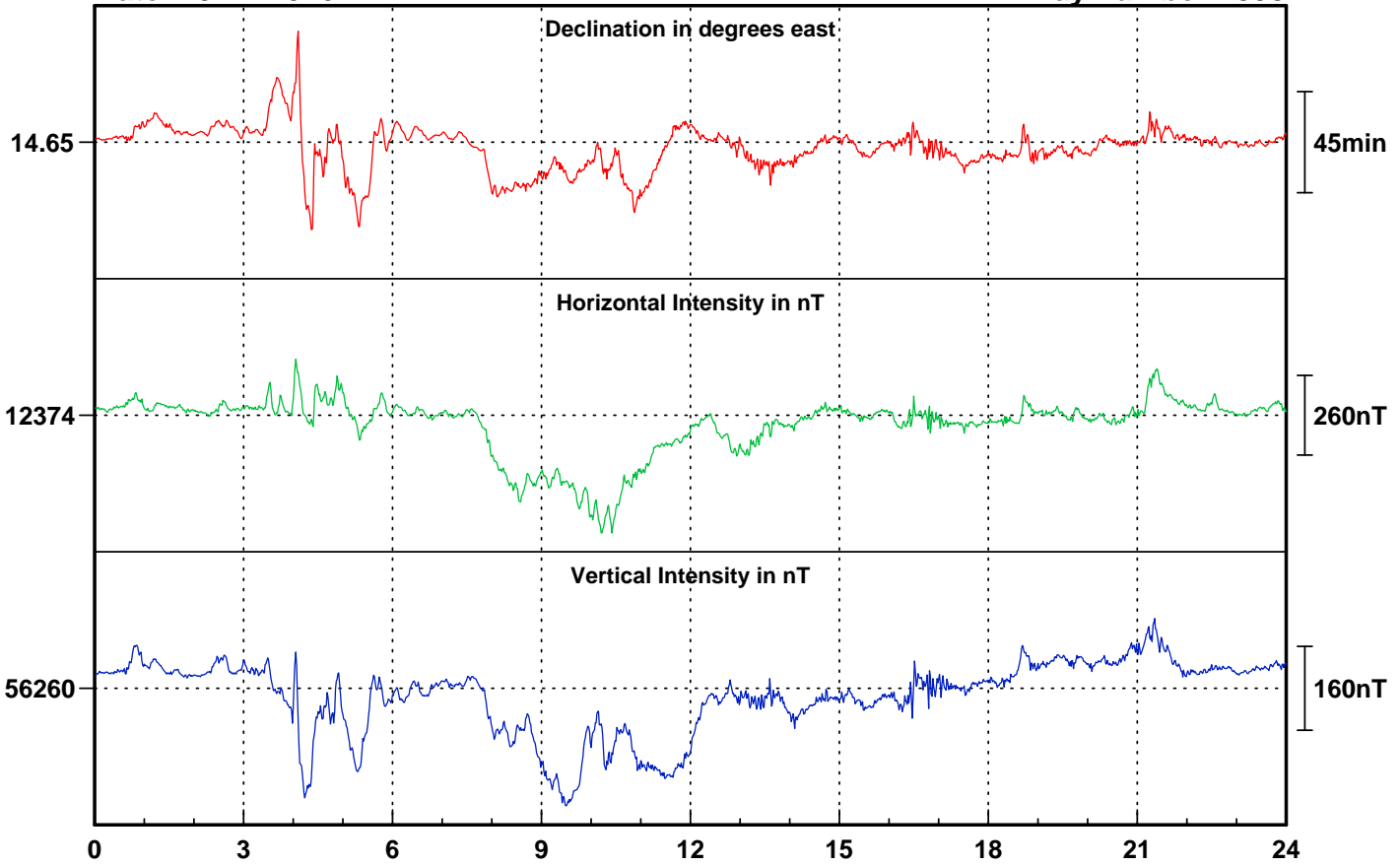
Day number: 357



Date: 23-12-2016

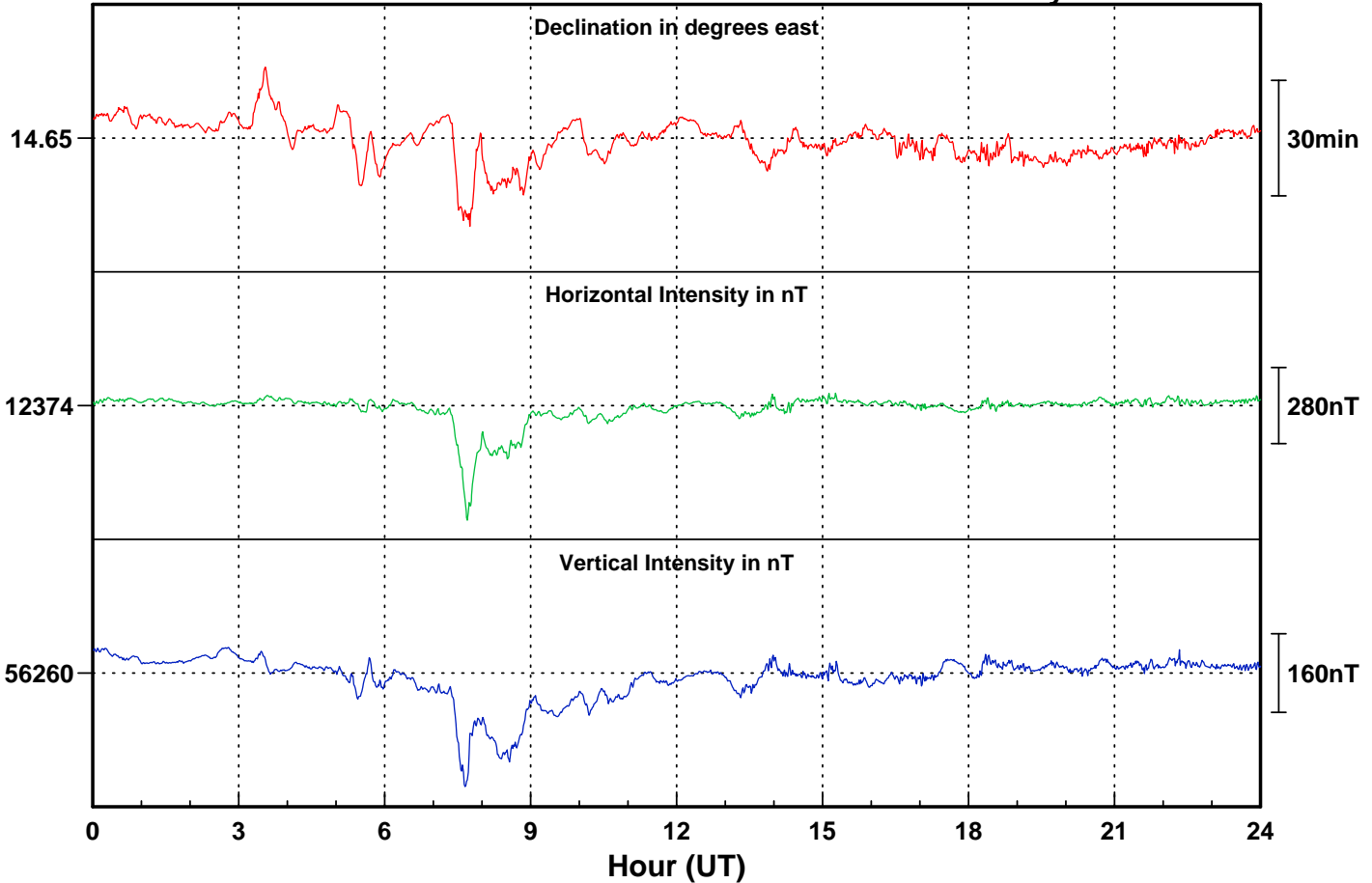
Fort McMurray

Day number: 358



Date: 24-12-2016

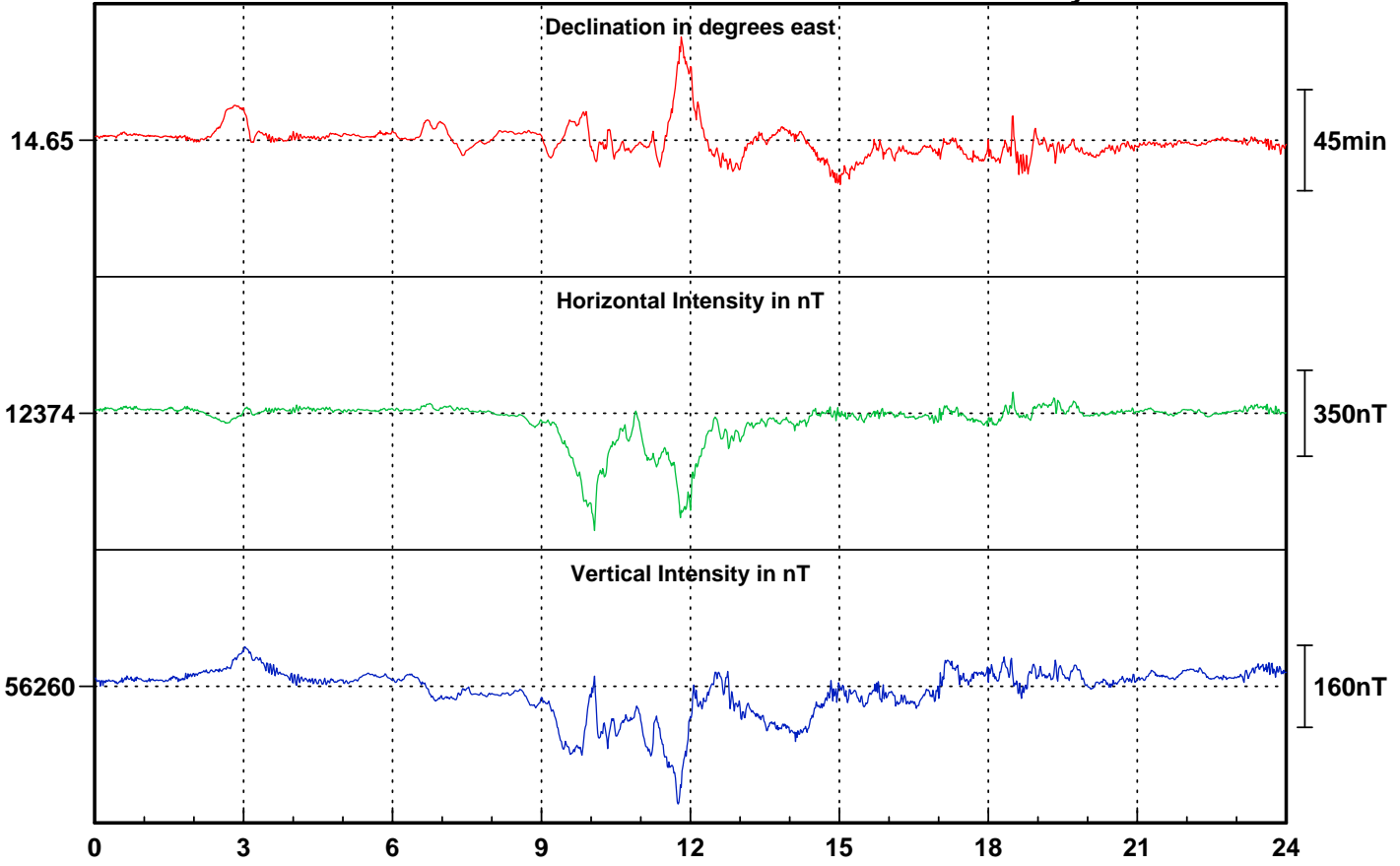
Day number: 359



Date: 25-12-2016

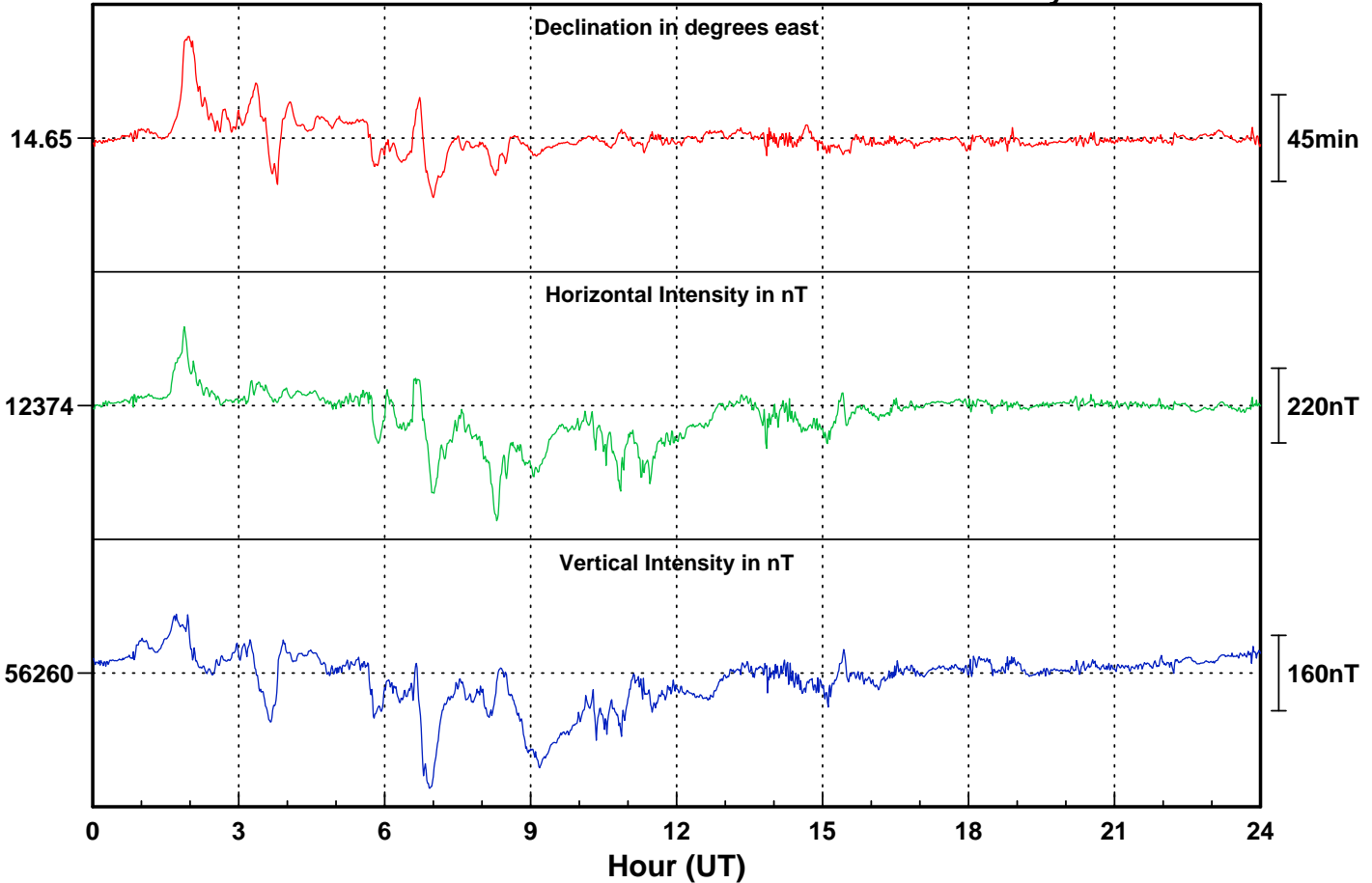
Fort McMurray

Day number: 360



Date: 26-12-2016

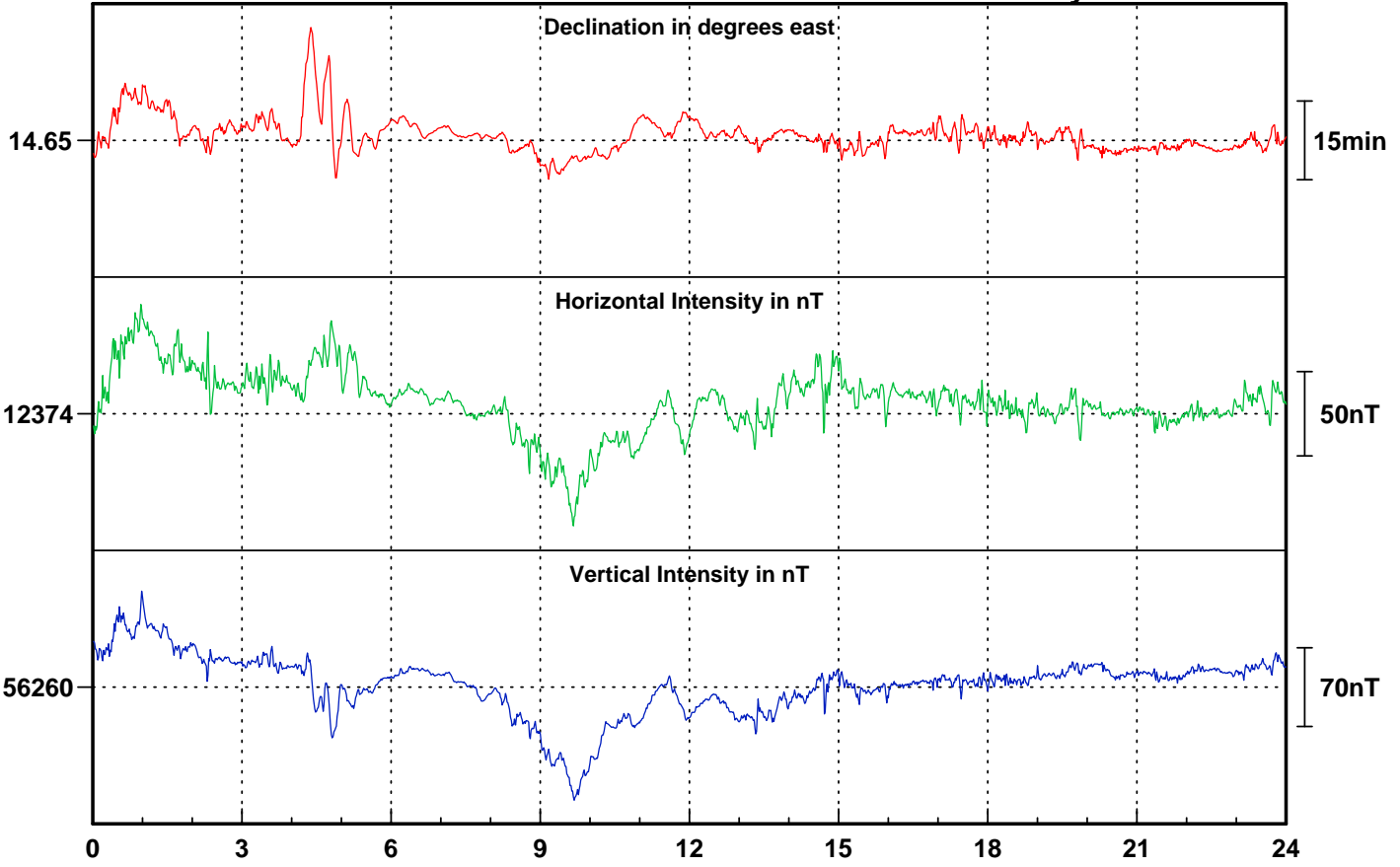
Day number: 361



Date: 27-12-2016

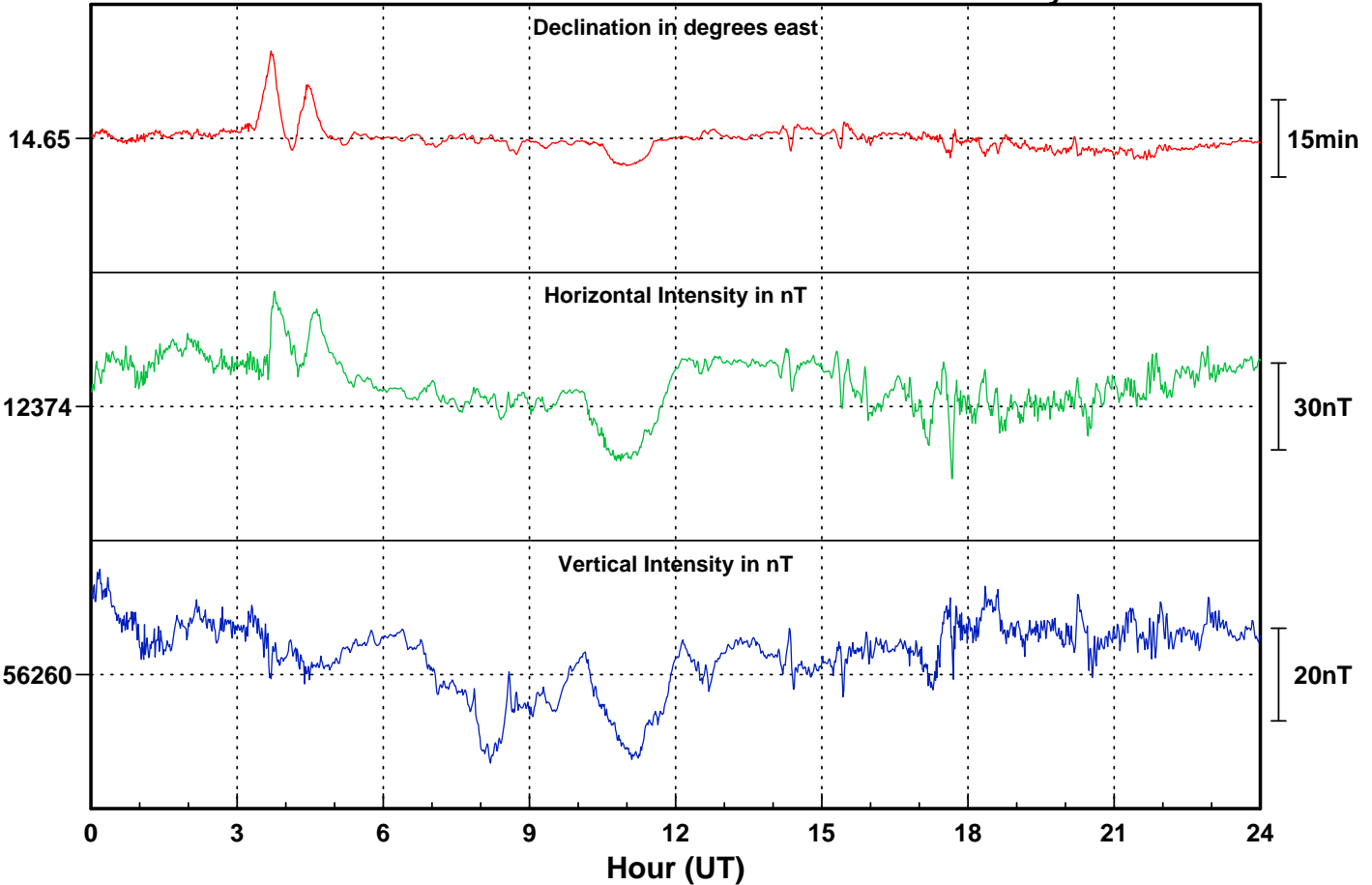
Fort McMurray

Day number: 362



Date: 28-12-2016

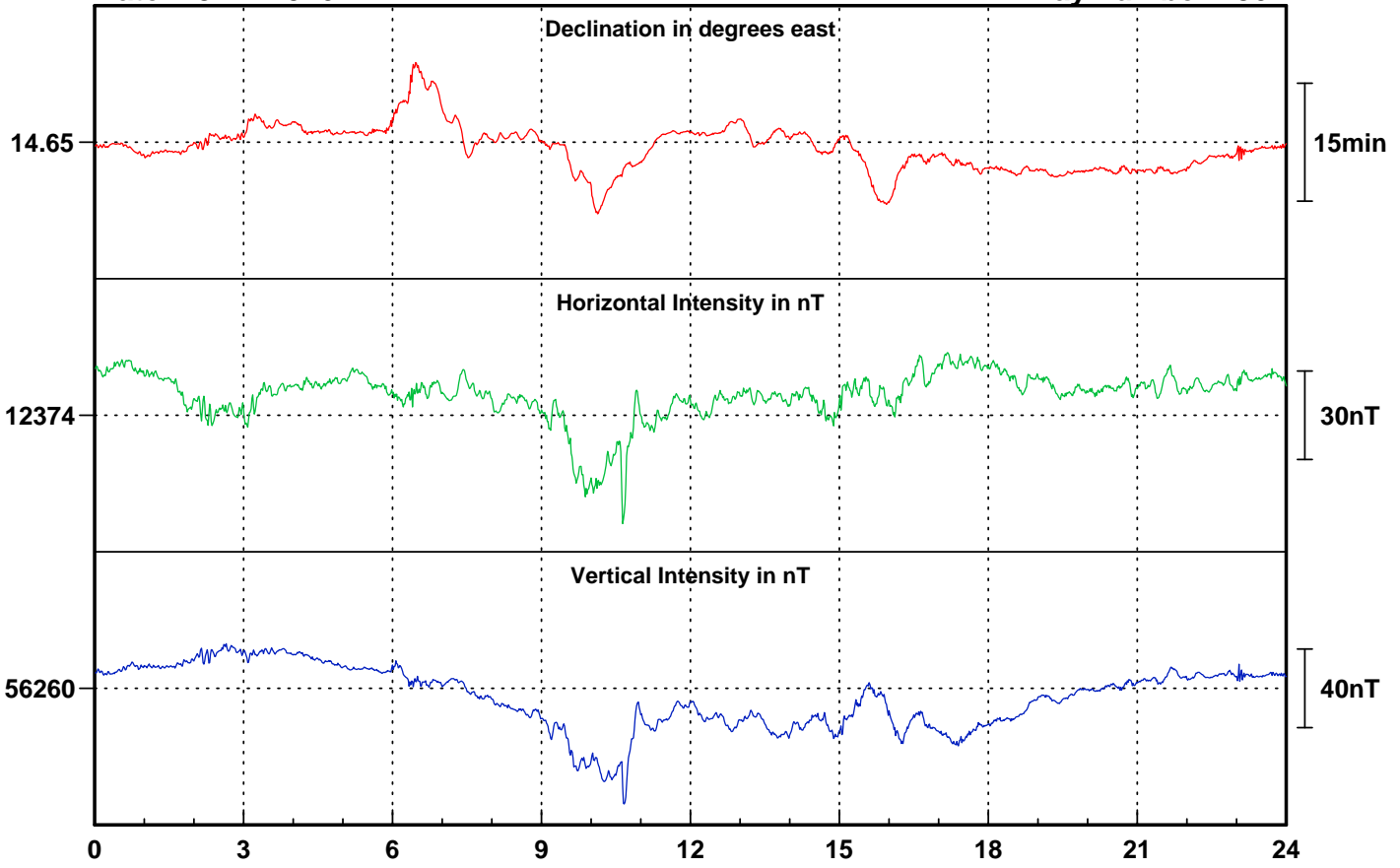
Day number: 363



Date: 29-12-2016

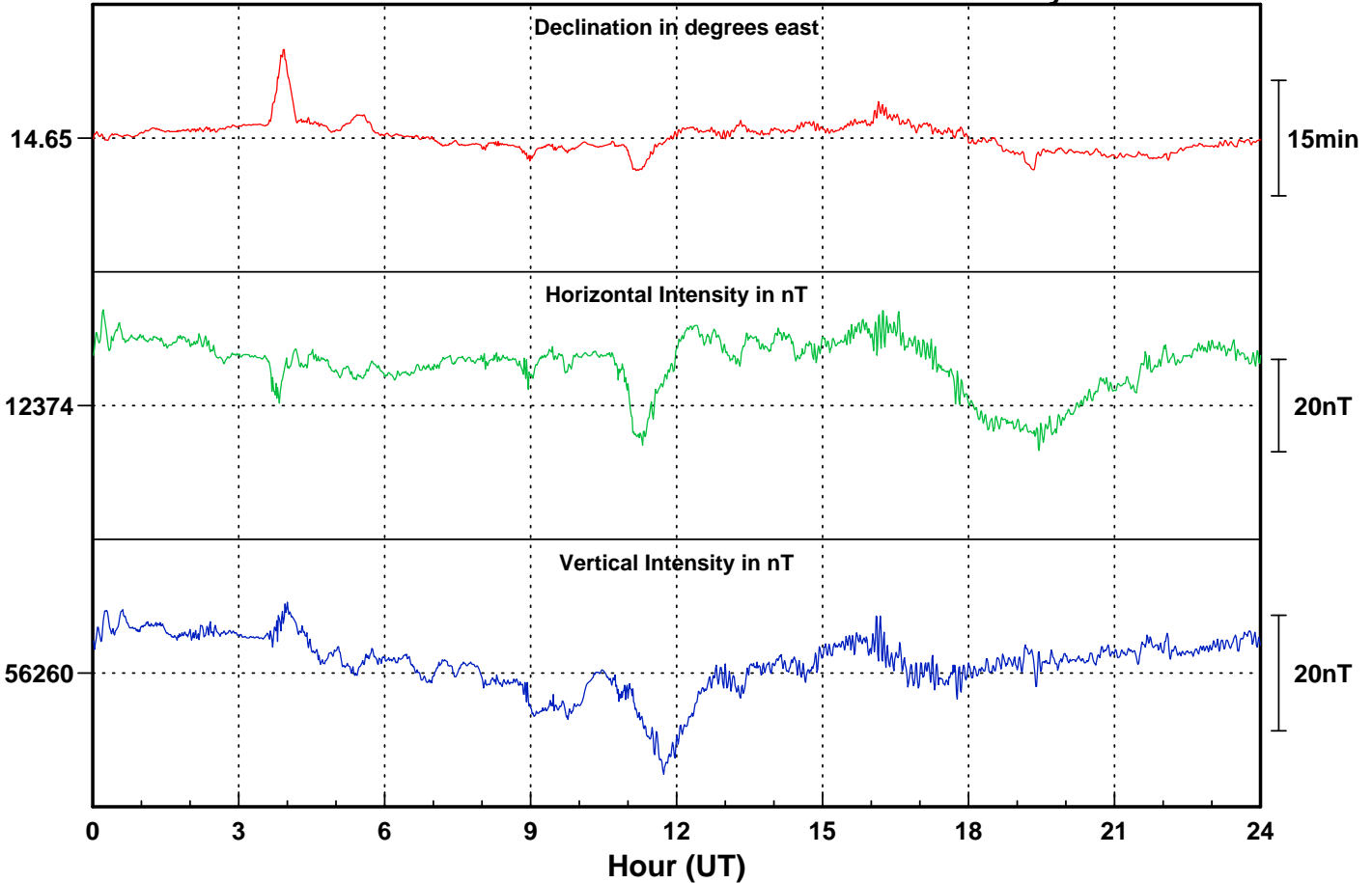
Fort McMurray

Day number: 364



Date: 30-12-2016

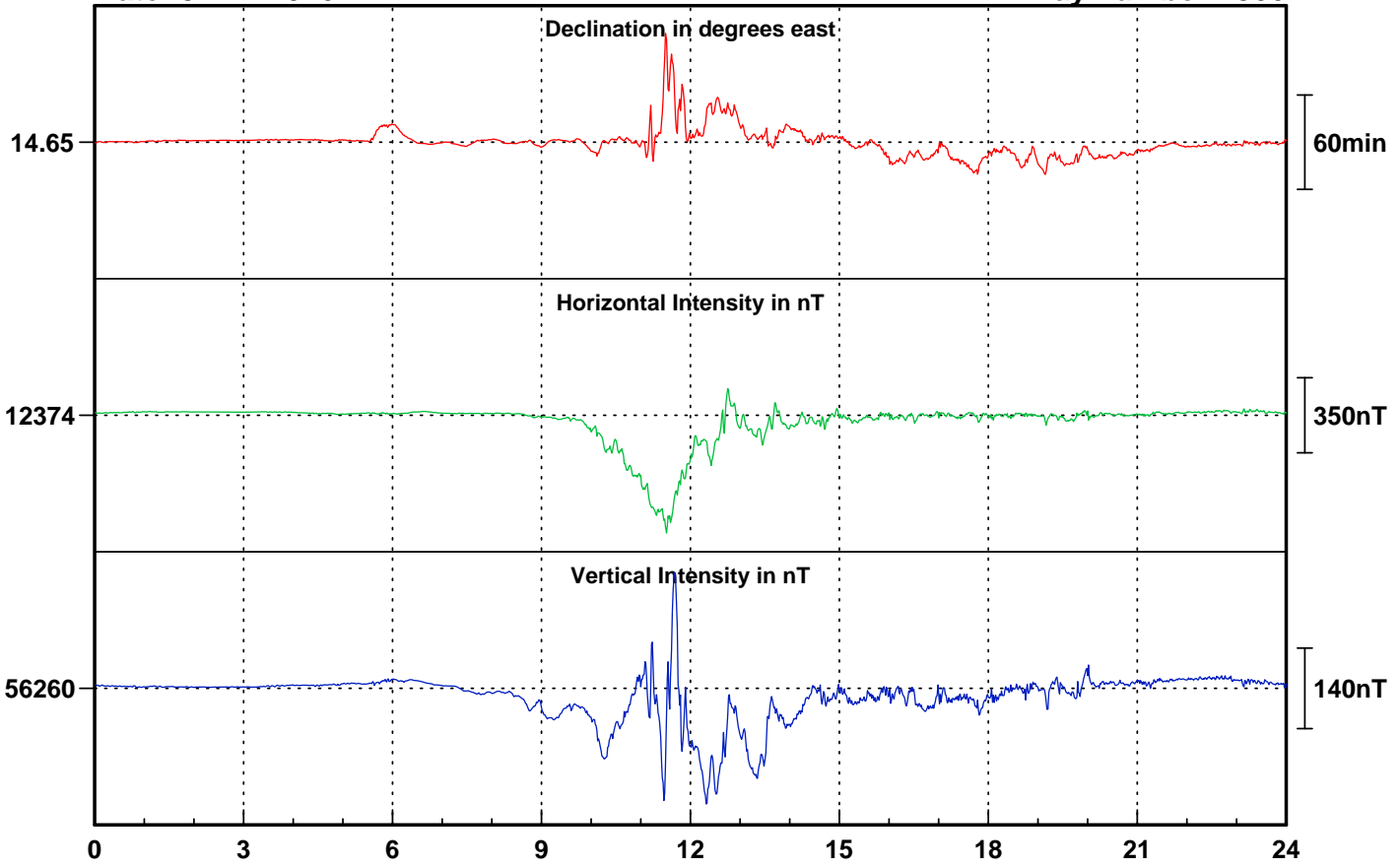
Day number: 365



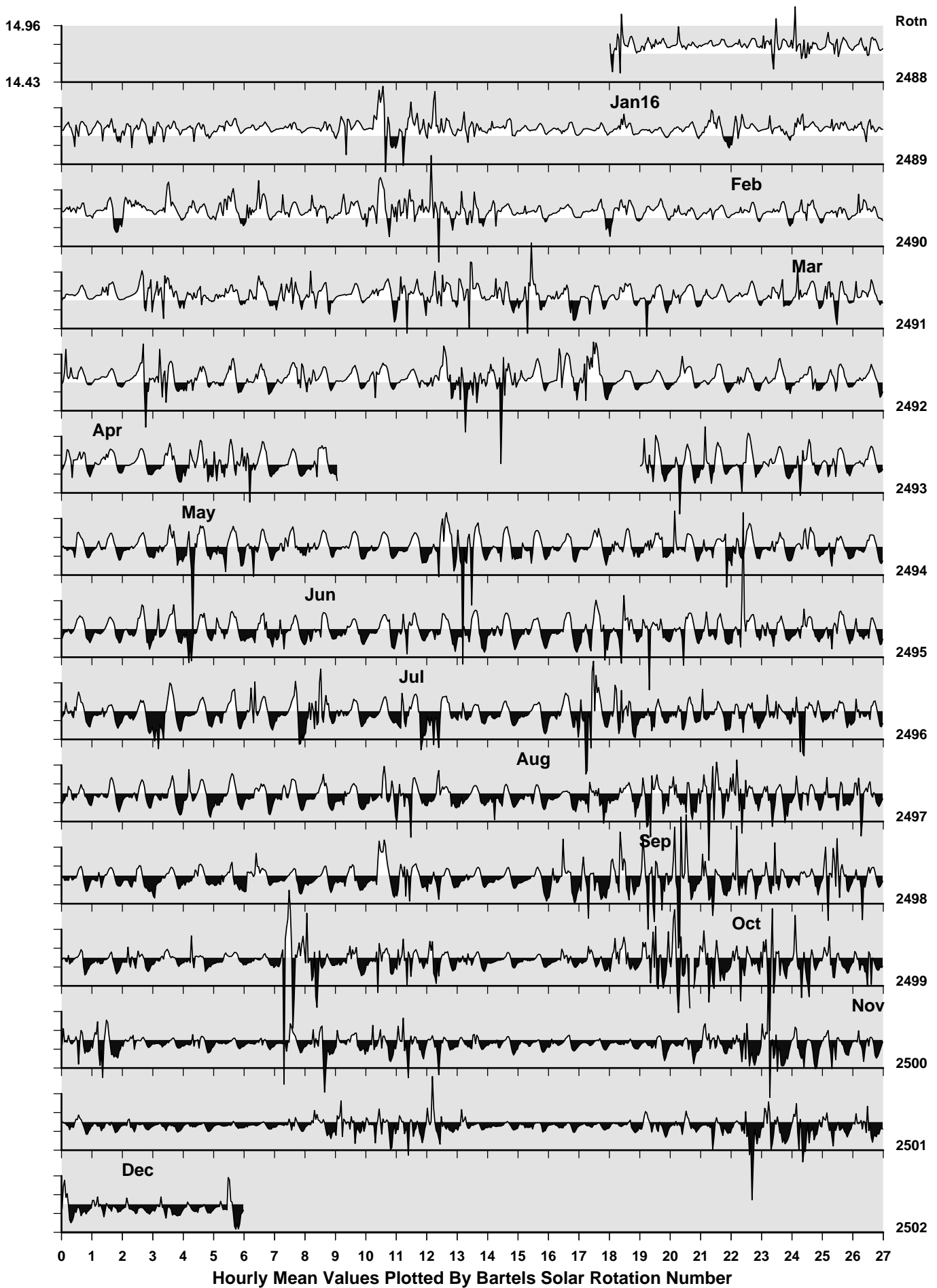
Date: 31-12-2016

Fort McMurray

Day number: 366

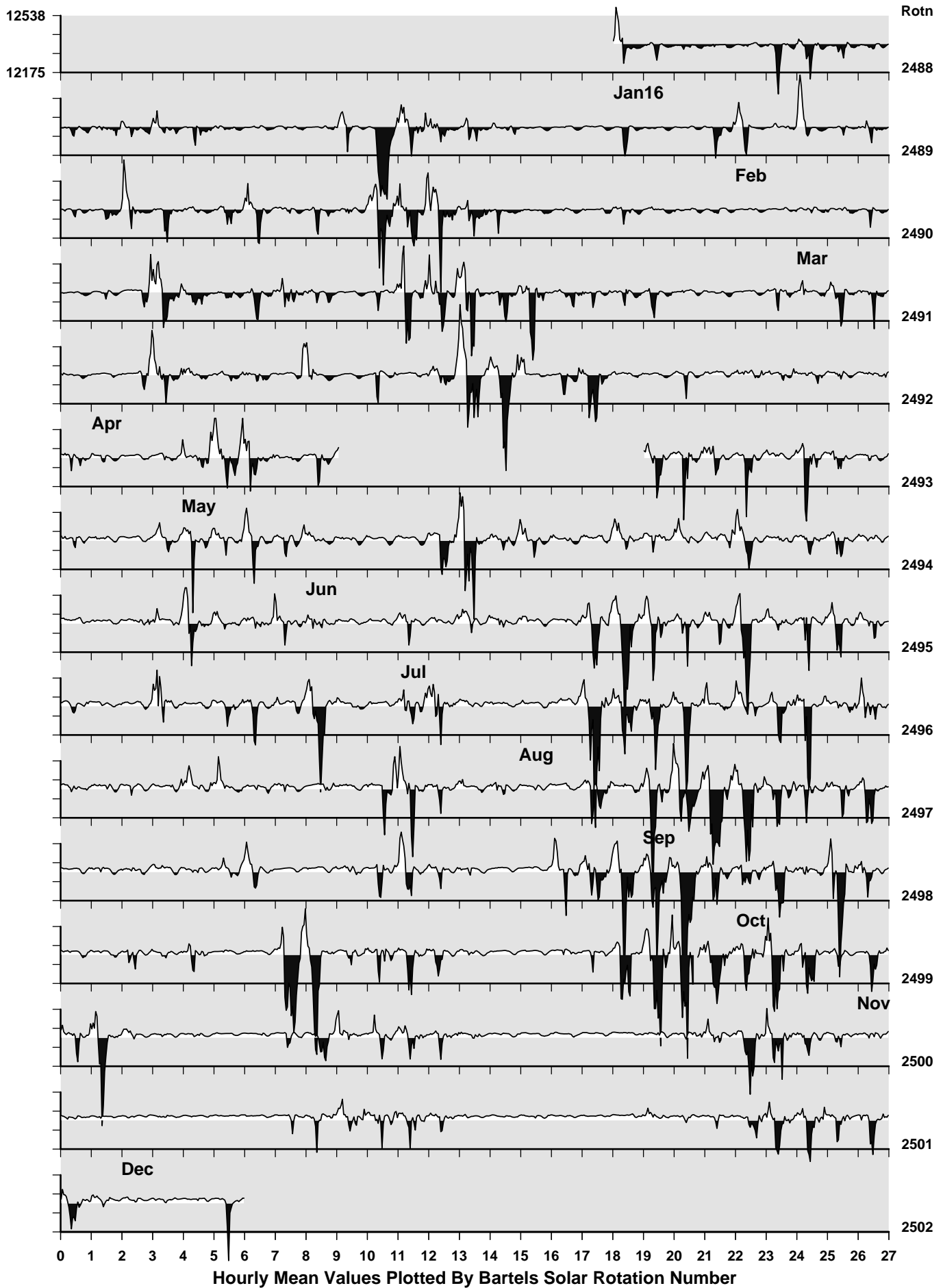


Fort McMurray Observatory: Declination (degrees)



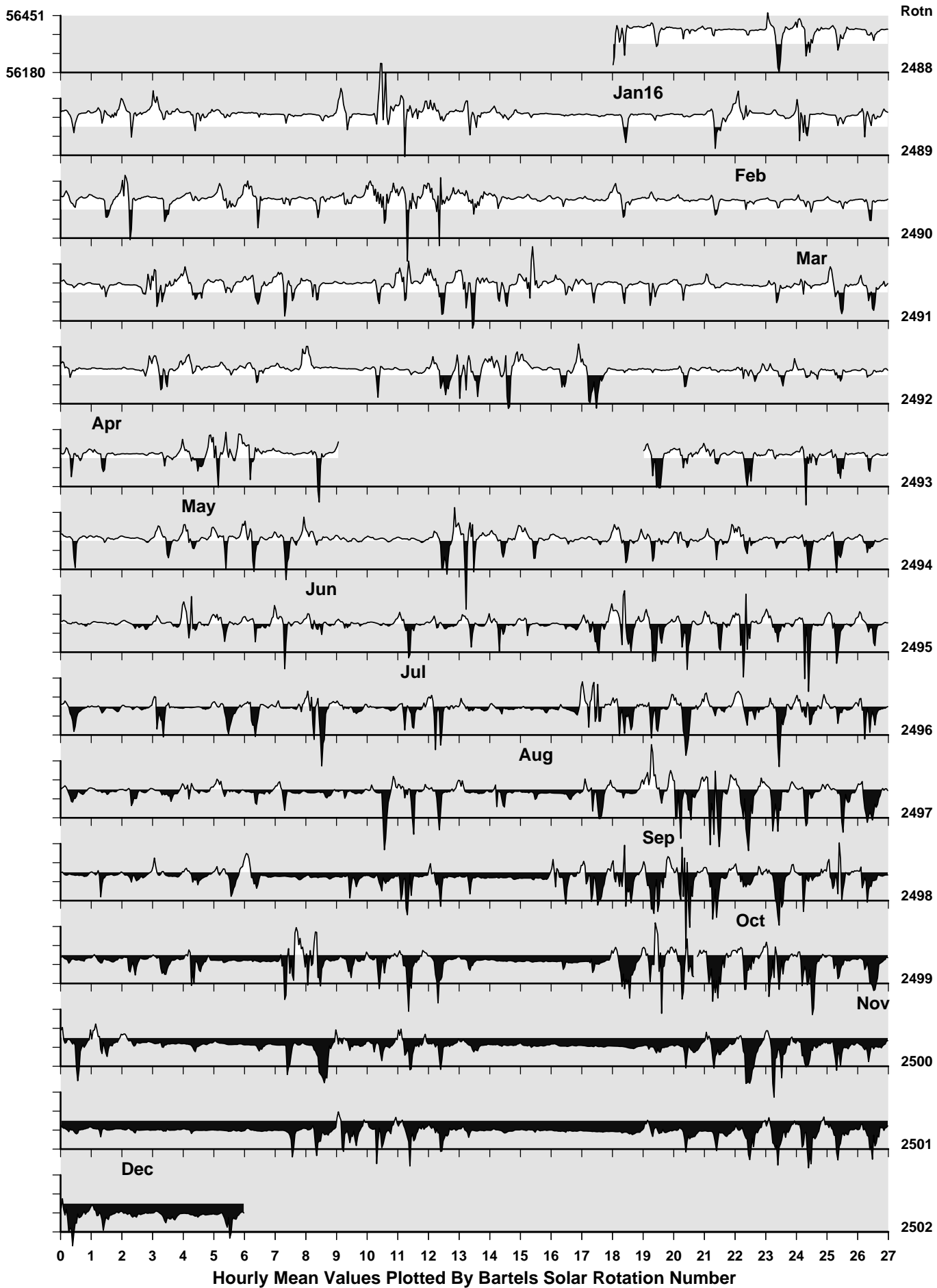
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Horizontal Intensity (nT)

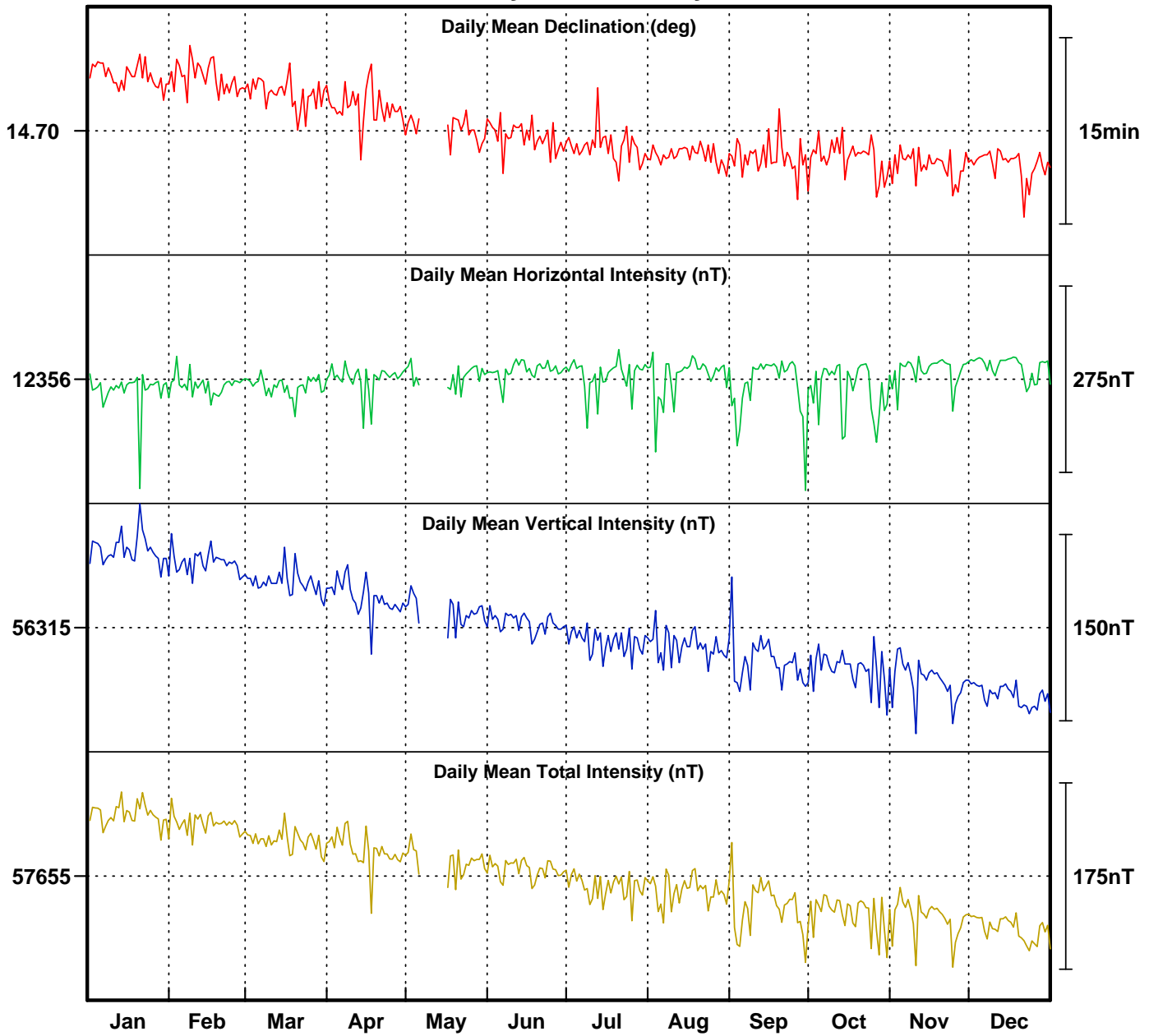


Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Vertical Intensity (nT)



Fort McMurray Observatory 2016



Monthly Mean Values for Fort McMurray Observatory 2016

| Month | <i>D</i> | <i>H</i> | <i>I</i> | <i>X</i> | <i>Y</i> | <i>Z</i> | <i>F</i> |
|-----------|-----------|----------|-----------|----------|----------|----------|----------|
| January | 14° 46.2′ | 12340 nT | 77° 39.2′ | 11932 nT | 3146 nT | 56378 nT | 57712 nT |
| February | 14° 46.0′ | 12348 nT | 77° 38.6′ | 11940 nT | 3147 nT | 56368 nT | 57705 nT |
| March | 14° 44.5′ | 12347 nT | 77° 38.5′ | 11940 nT | 3142 nT | 56351 nT | 57688 nT |
| April | 14° 43.6′ | 12357 nT | 77° 37.7′ | 11951 nT | 3141 nT | 56340 nT | 57679 nT |
| May | *** **' | ***** nT | *** **' | ***** nT | **** nT | ***** nT | ***** nT |
| June | 14° 41.2′ | 12369 nT | 77° 36.8′ | 11965 nT | 3136 nT | 56319 nT | 57662 nT |
| July | 14° 40.4′ | 12362 nT | 77° 37.0′ | 11959 nT | 3131 nT | 56304 nT | 57645 nT |
| August | 14° 39.8′ | 12361 nT | 77° 37.0′ | 11958 nT | 3129 nT | 56300 nT | 57641 nT |
| September | 14° 39.6′ | 12346 nT | 77° 37.7′ | 11945 nT | 3125 nT | 56287 nT | 57625 nT |
| October | 14° 39.7′ | 12343 nT | 77° 37.9′ | 11941 nT | 3124 nT | 56282 nT | 57620 nT |
| November | 14° 39.0′ | 12369 nT | 77° 36.2′ | 11967 nT | 3128 nT | 56272 nT | 57616 nT |
| December | 14° 39.0′ | 12374 nT | 77° 35.7′ | 11972 nT | 3130 nT | 56260 nT | 57605 nT |

Note

- i. The values shown here are provisional.
- ii. Observatory power out from 6-16 May due to wild fires.