



British
Geological
Survey



MONTHLY MAGNETIC BULLETIN

Fort McMurray Observatory

December 2023



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: 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° 17'13.2"N 310° 05'56.4"E
Height above mean sea level: 386 m

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 13th generation International Geomagnetic

Reference Field (IGRF) at epoch 2022.5. On-line access to models (including IGRF), charts and navigational data are available at 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 ©UKRI. 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 geomag.bgs.ac.uk/contactus/staff

Fort McMurray 2023

Declination : Absolute - Variometer (markers) and Baseline Applied (line)

14.14

10min

Horizontal Intensity : Absolute - Variometer (markers) and Baseline Applied (line)

12338

20nT

Vertical Intensity : Absolute - Variometer (markers) and Baseline Applied (line)

56485

8nT

Total Intensity : Absolute (Proton F) - Baseline Adjusted Variometer (derived F)

1.0

20nT

Temperature Inside Variometer Hut

31.6

20°C

Jan

Feb

Mar

Apr

May

Jun

Jul

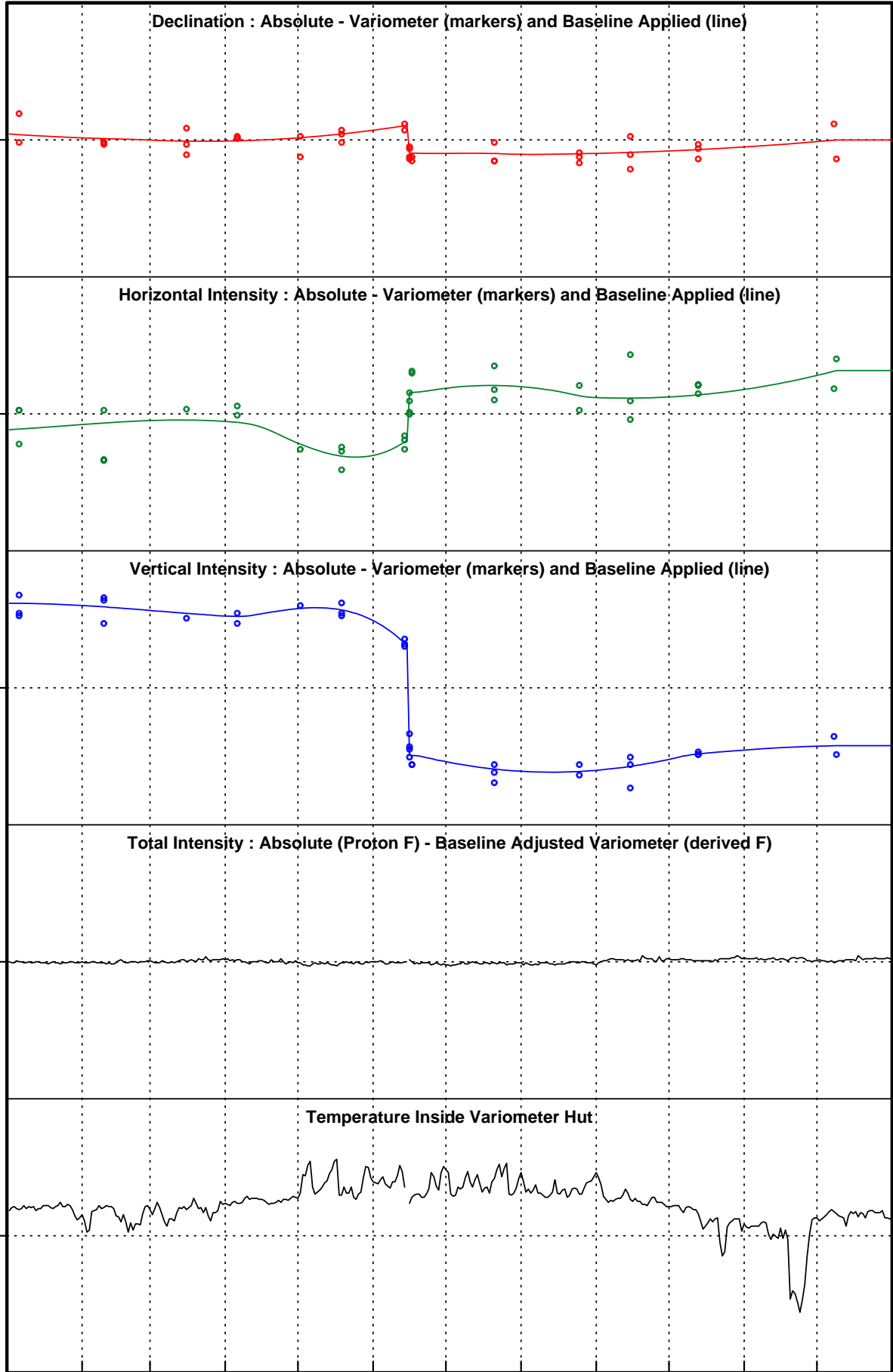
Aug

Sep

Oct

Nov

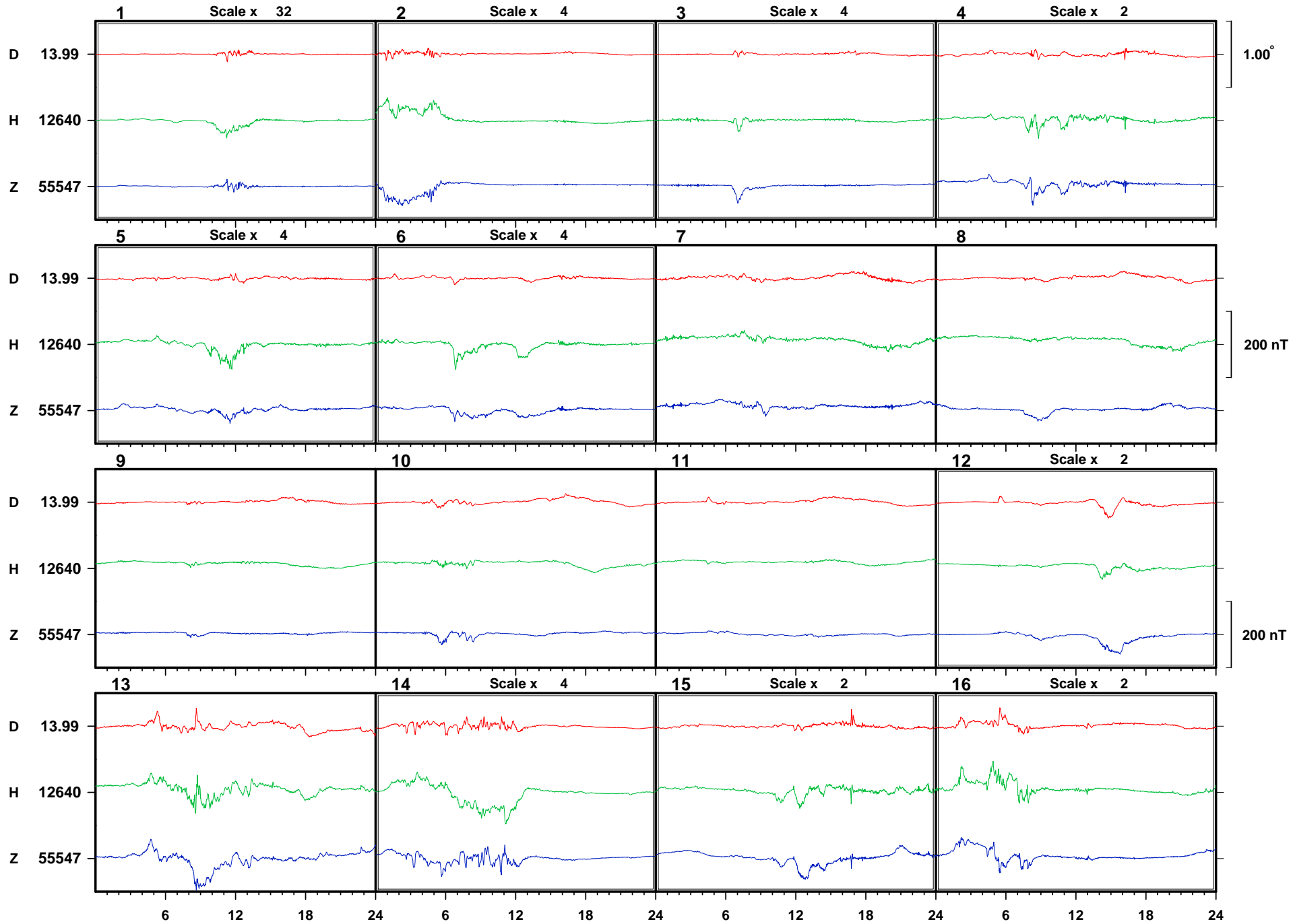
Dec

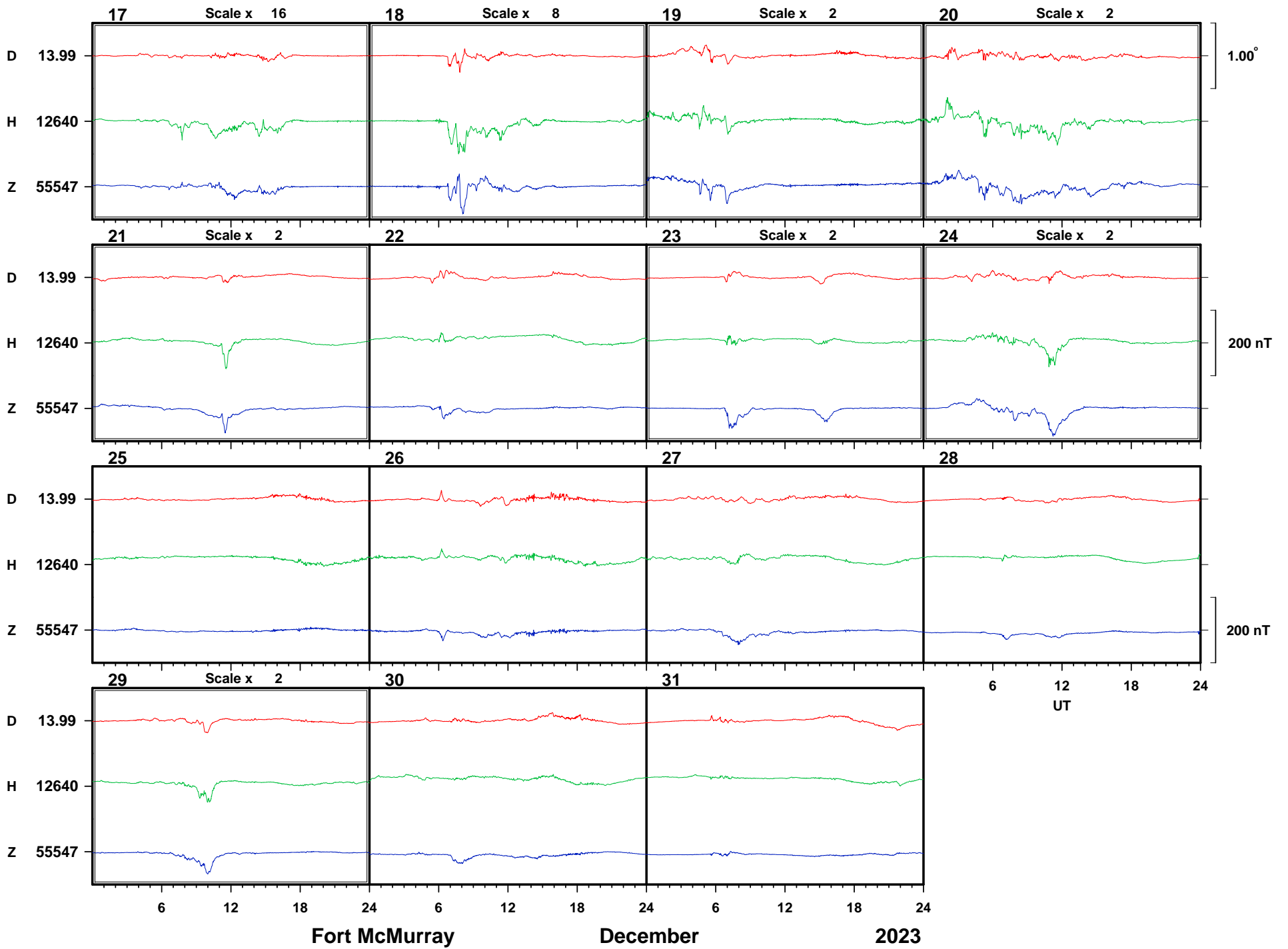


Fort McMurray

December

2023

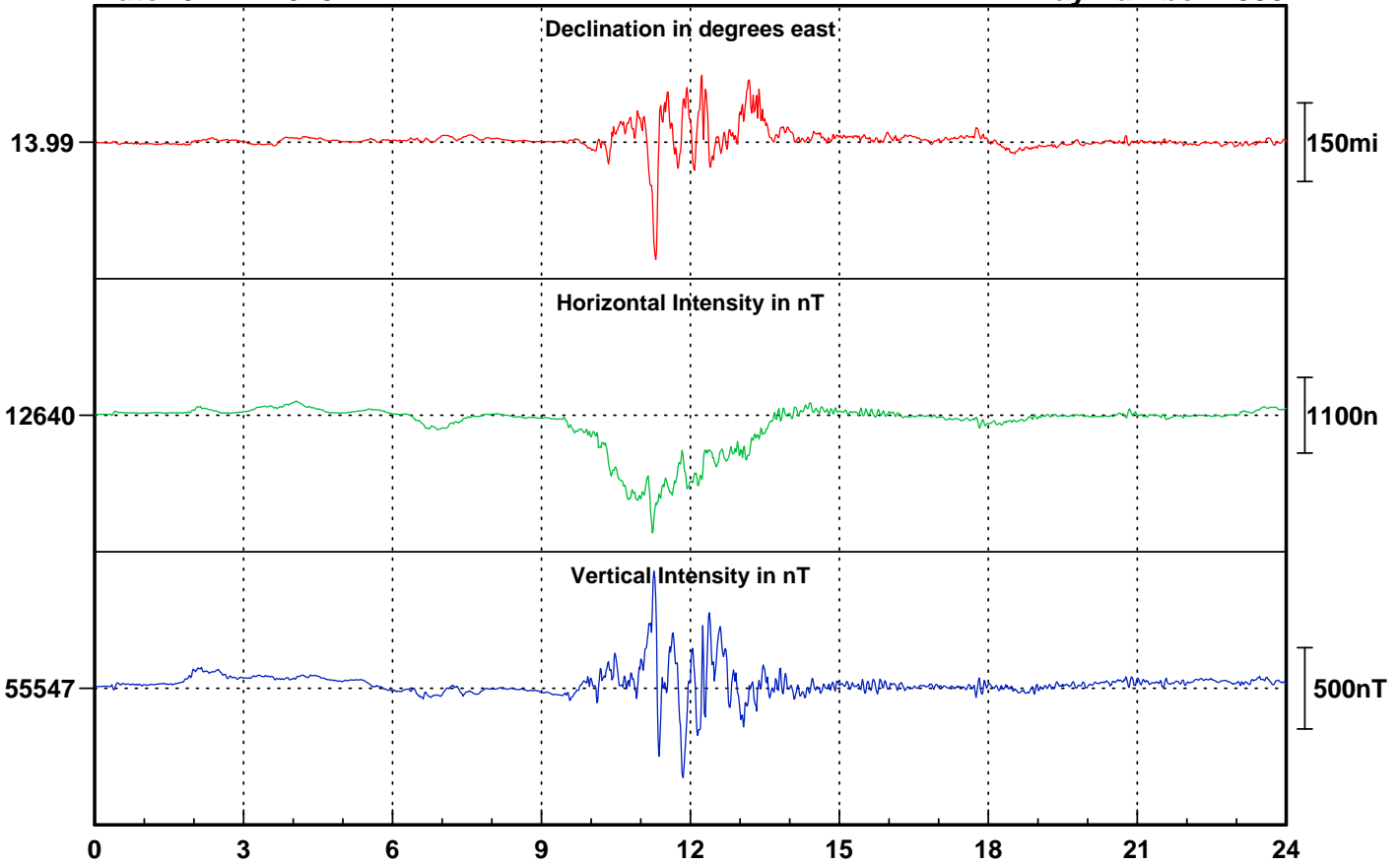




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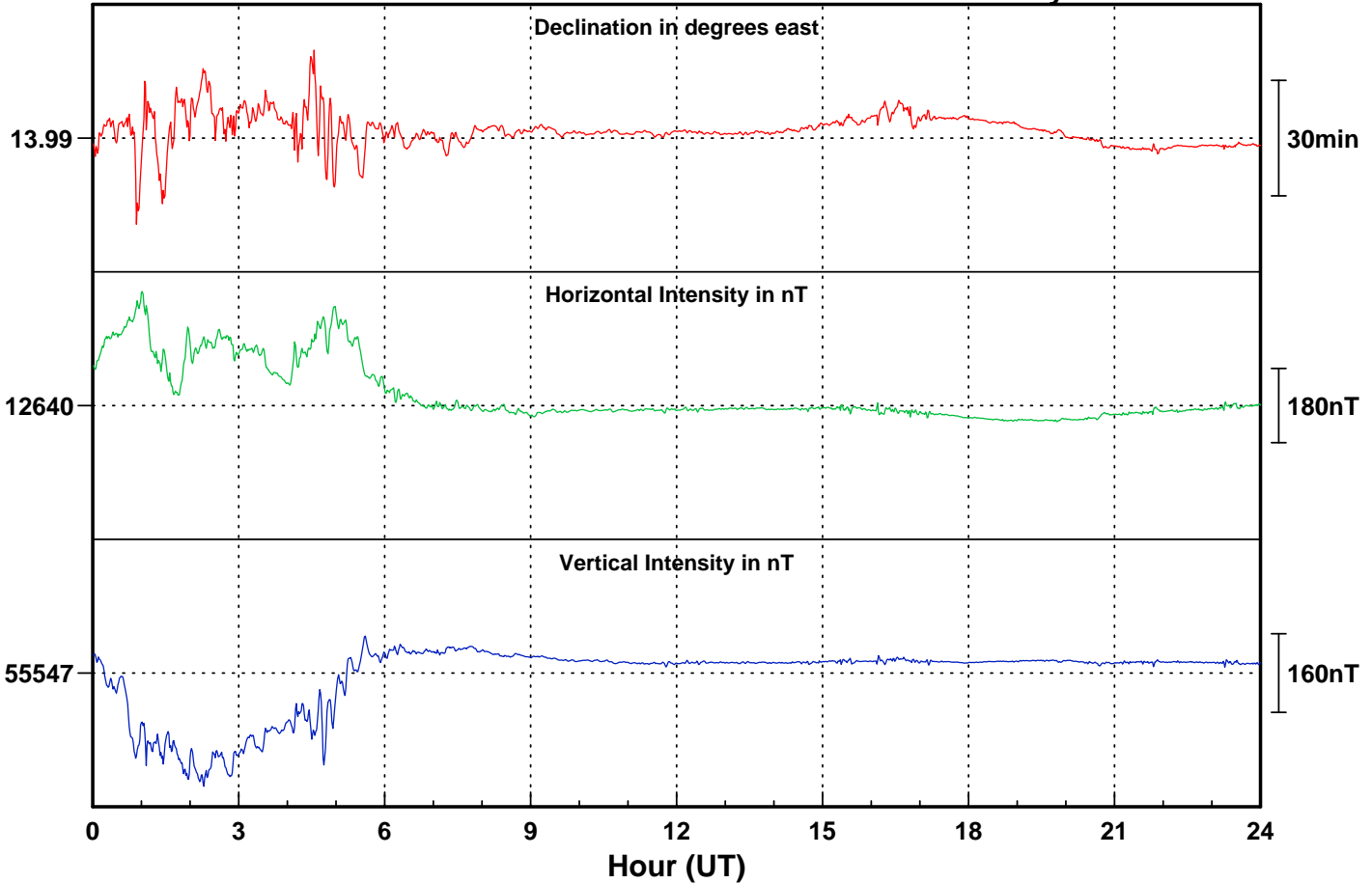
Fort McMurray

Day number: 335



Date: 02-12-2023

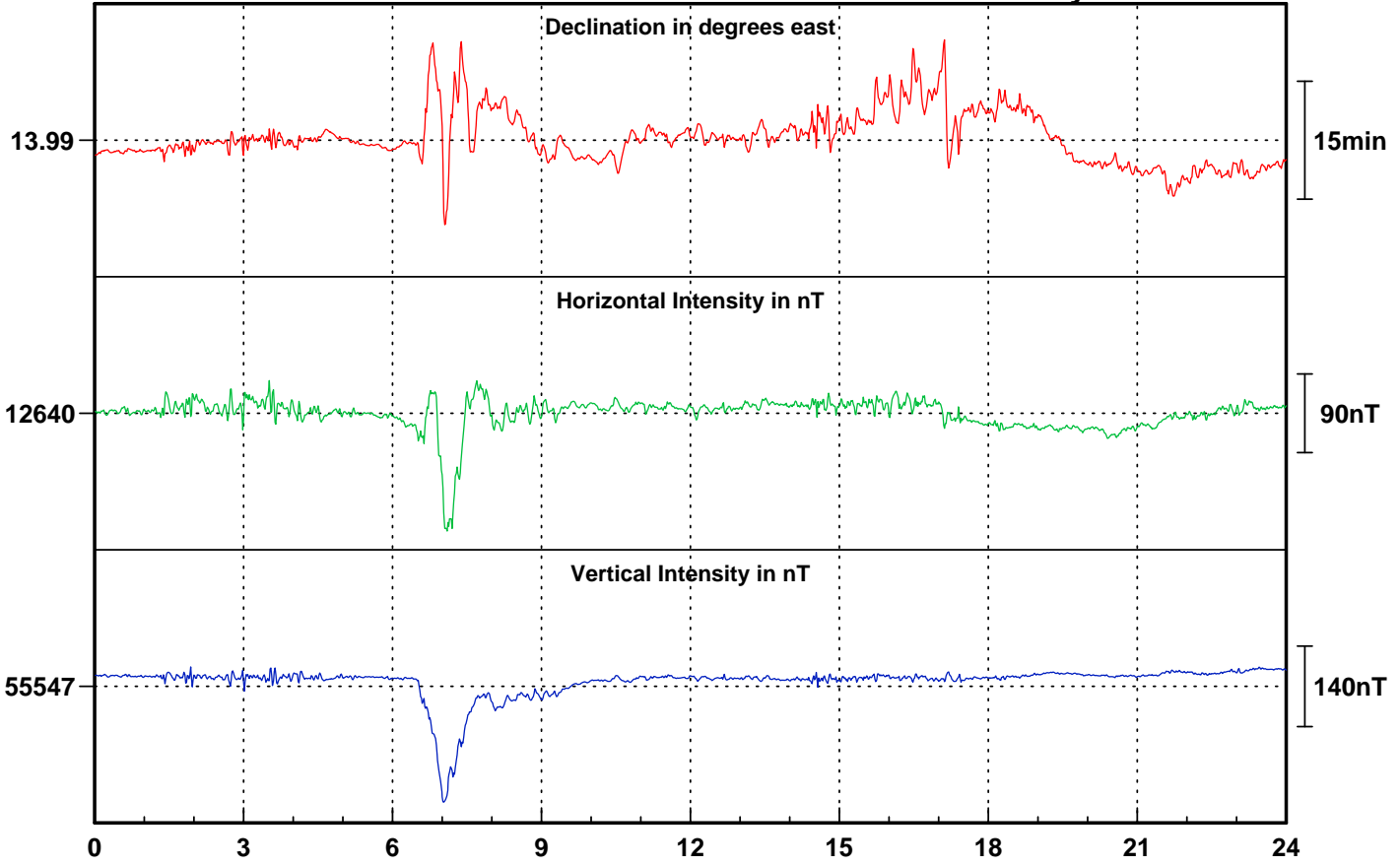
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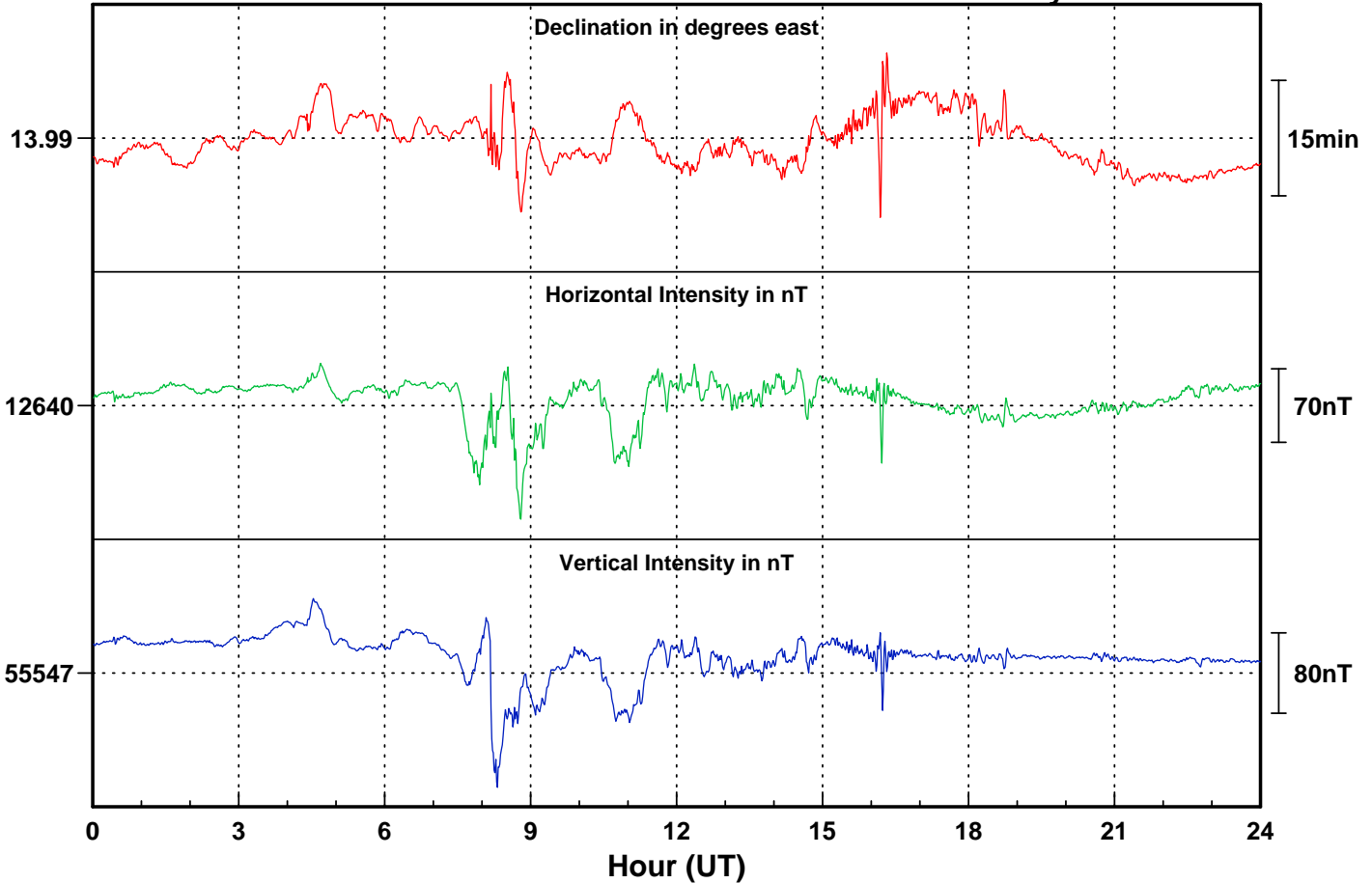
Fort McMurray

Day number: 337



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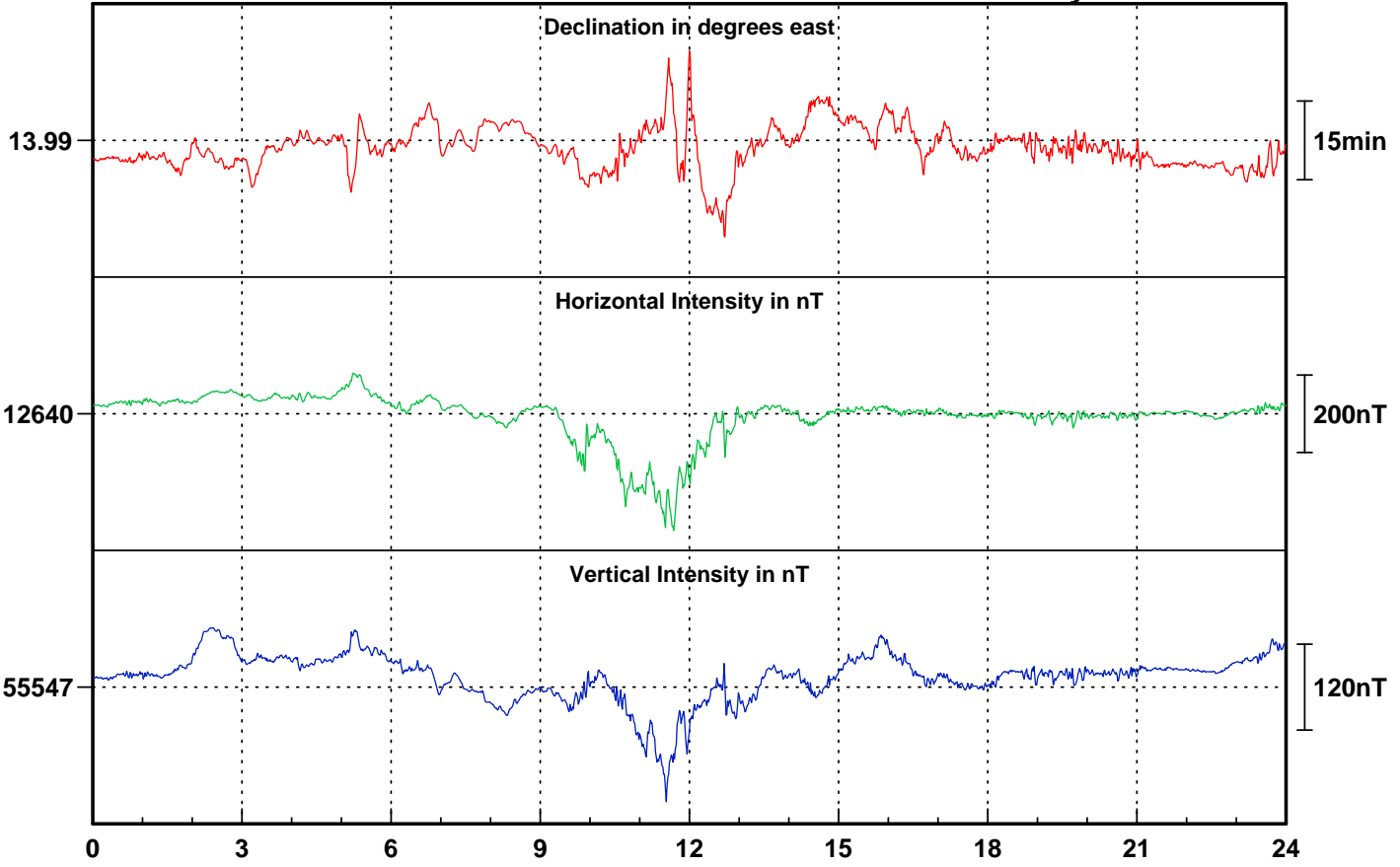
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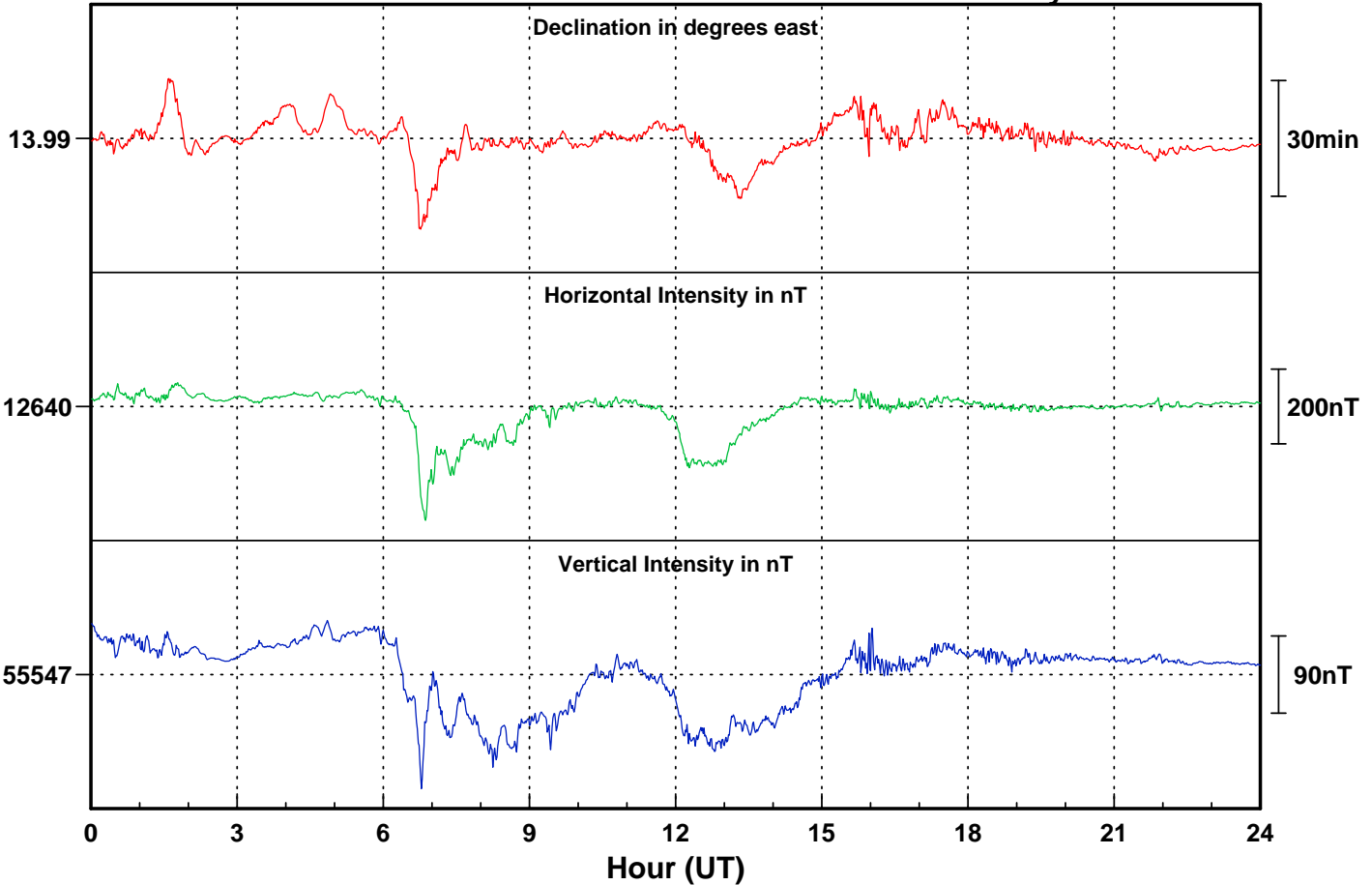
Fort McMurray

Day number: 339



Date: 06-12-2023

Day number: 340

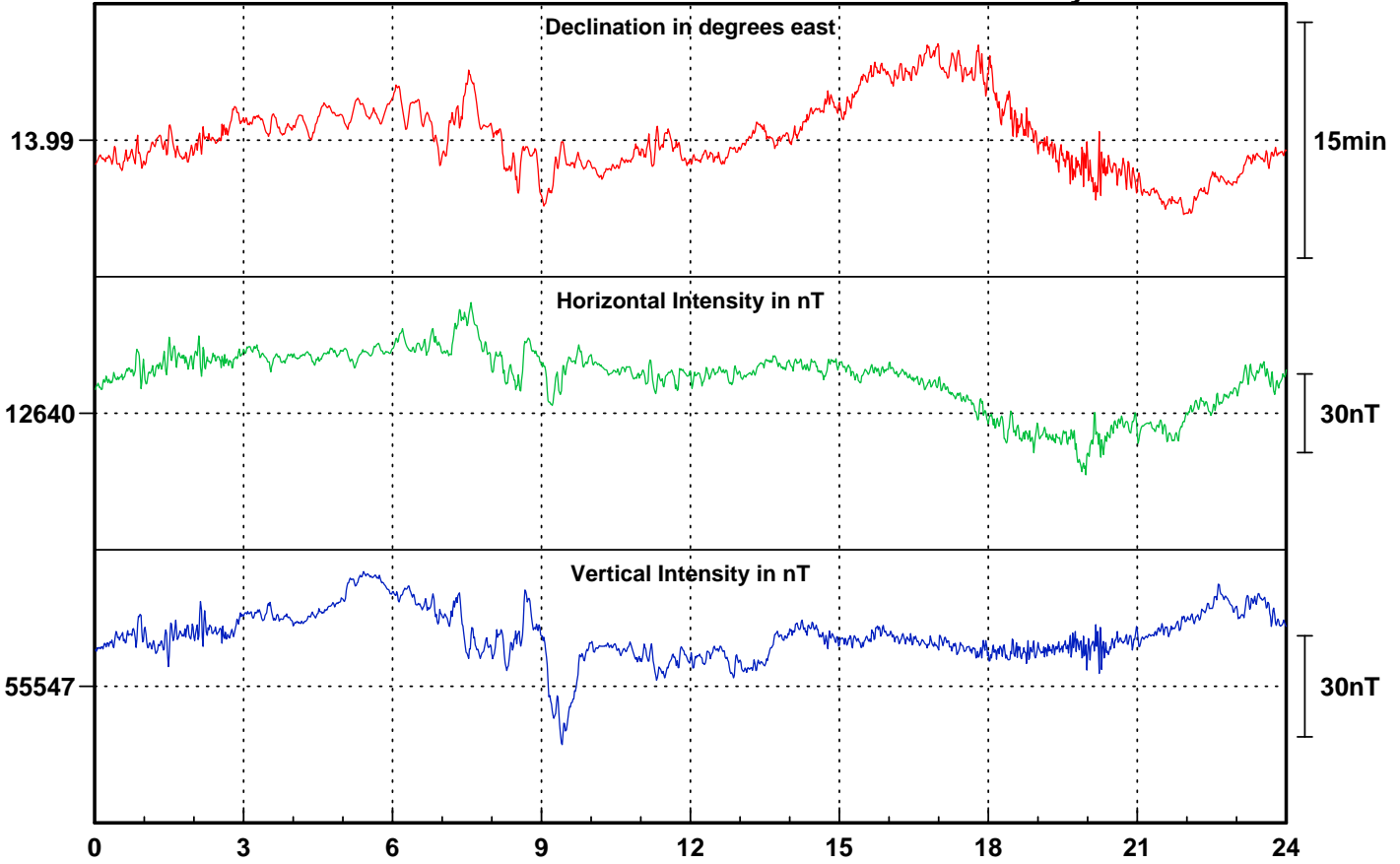


Hour (UT)

Date: 07-12-2023

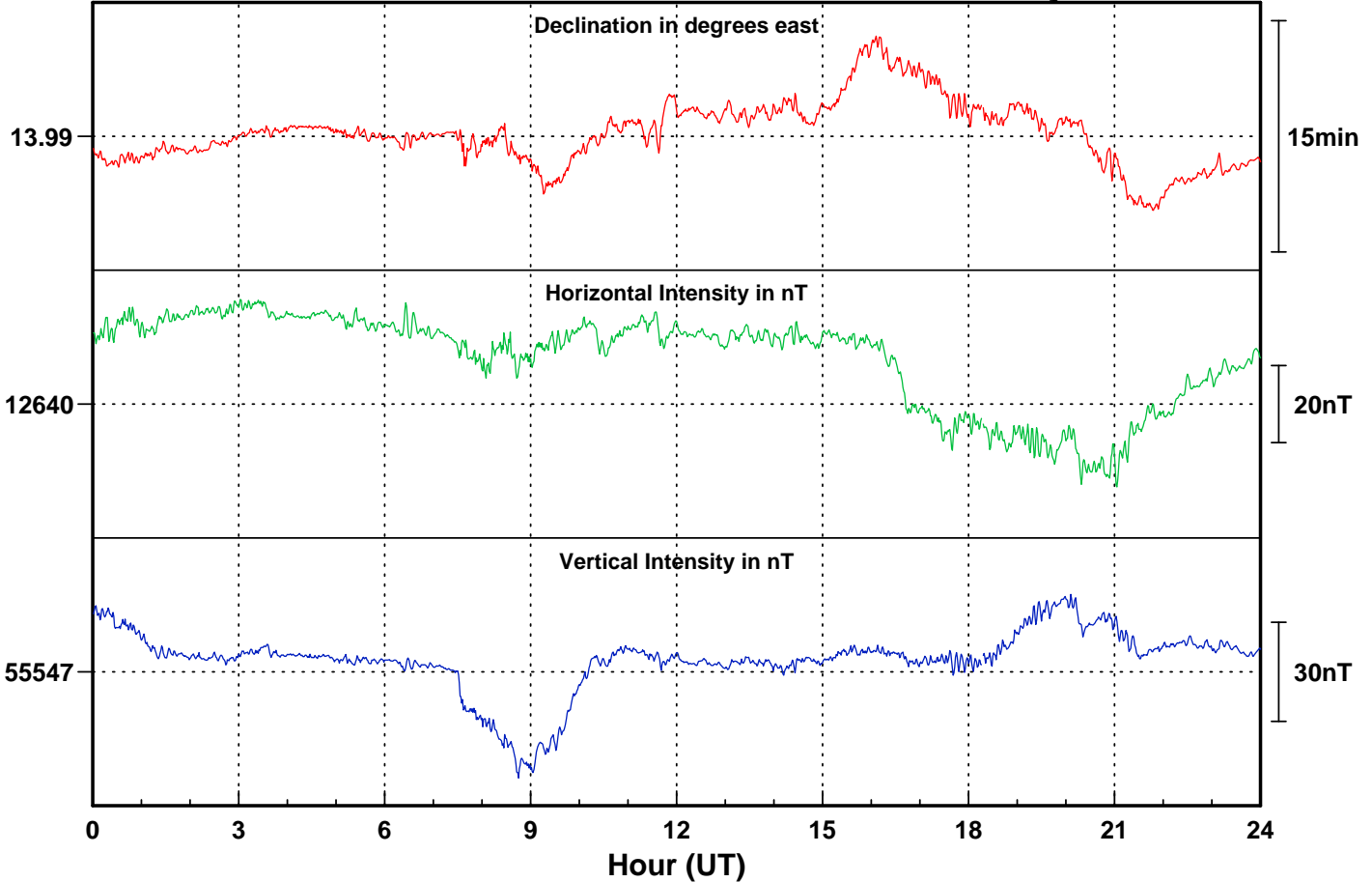
Fort McMurray

Day number: 341



Date: 08-12-2023

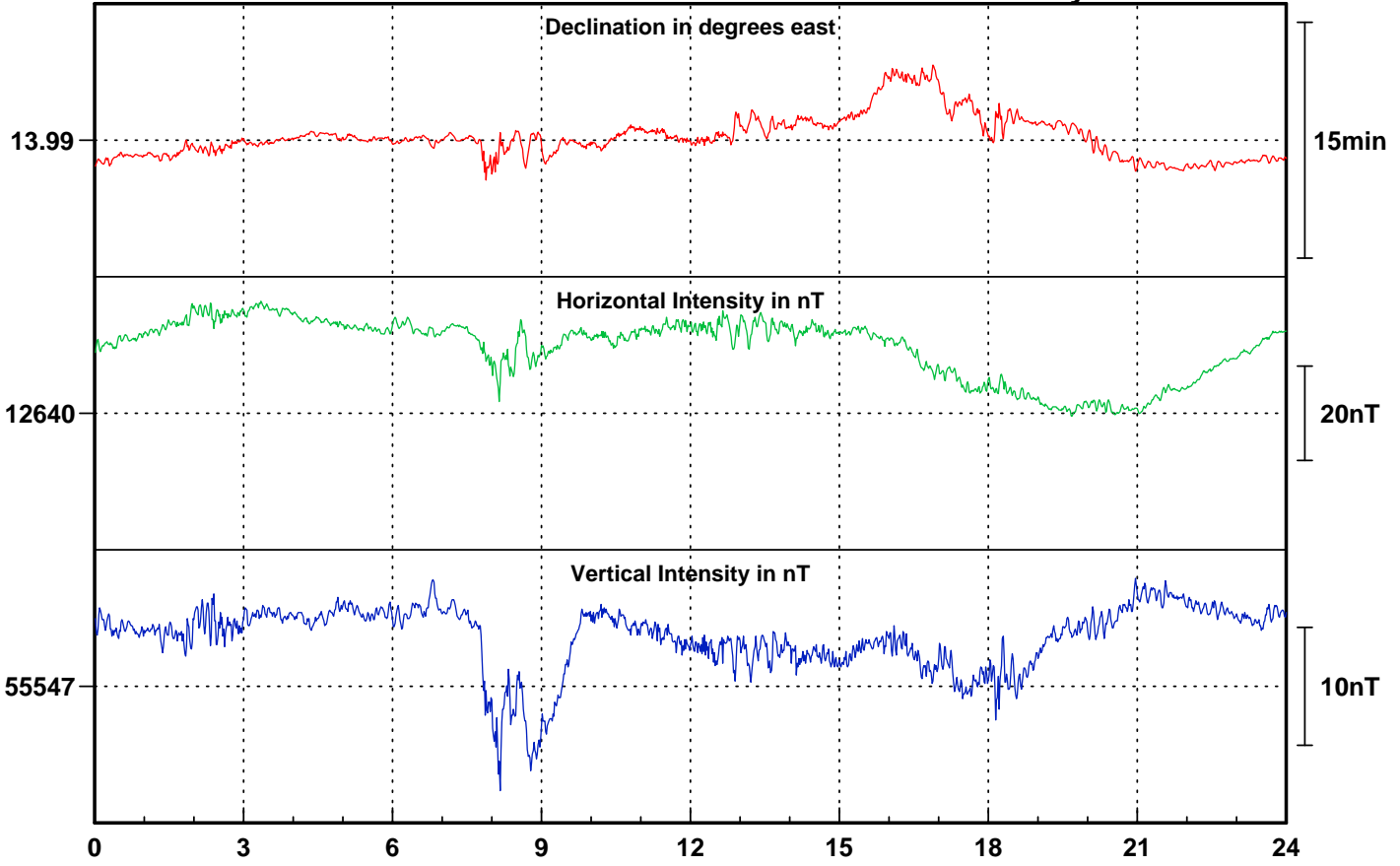
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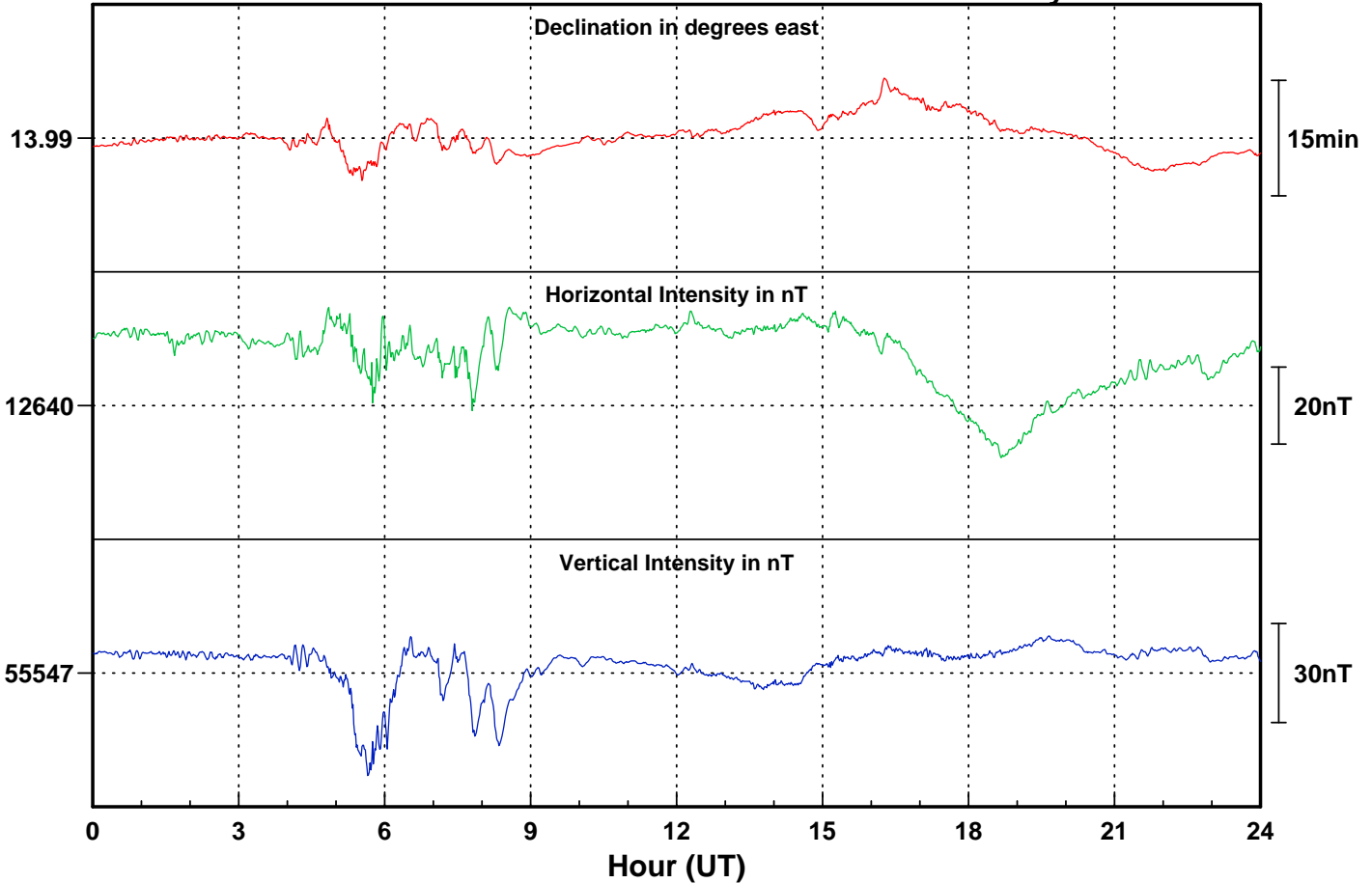
Fort McMurray

Day number: 343



Date: 10-12-2023

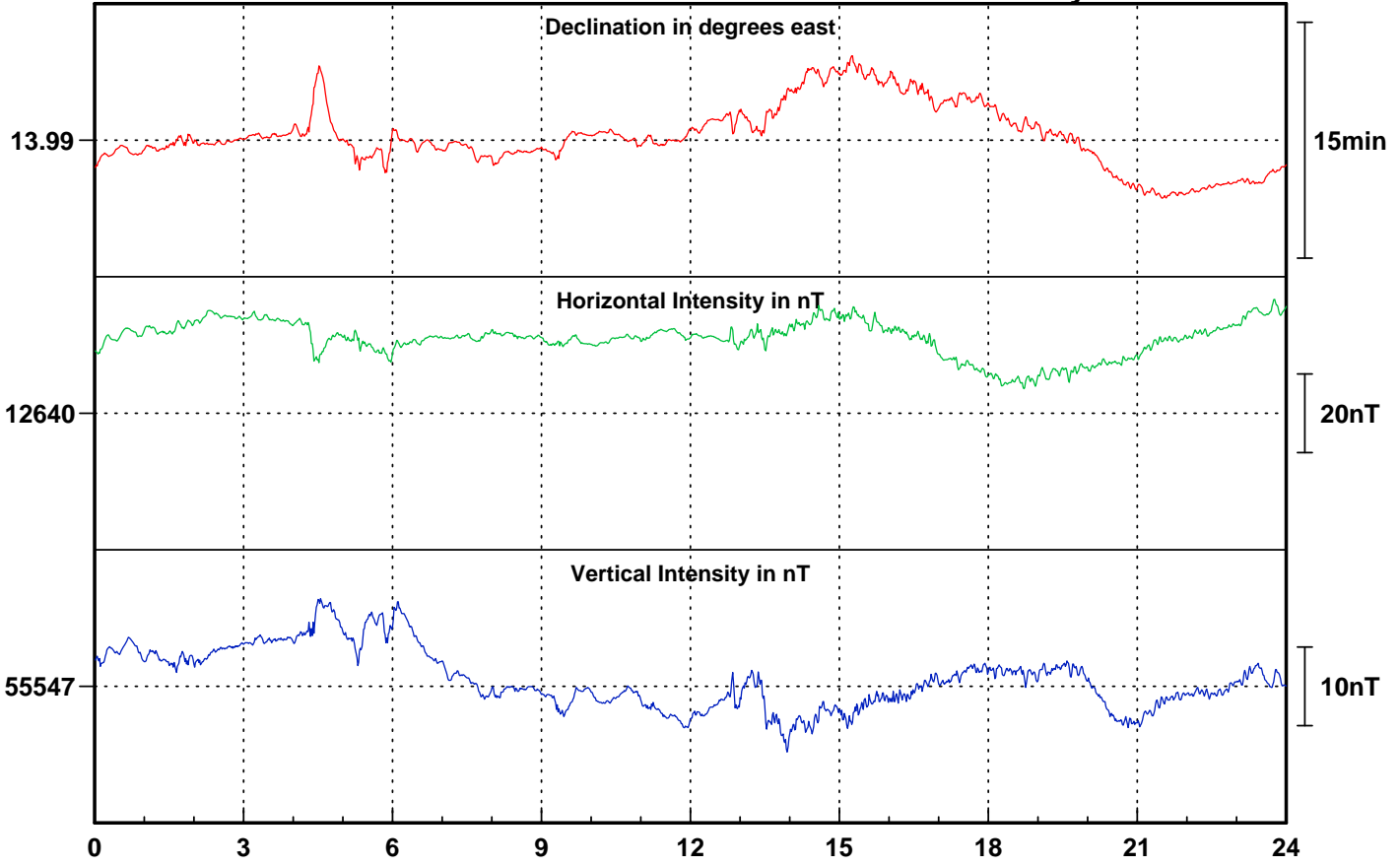
Day number: 344



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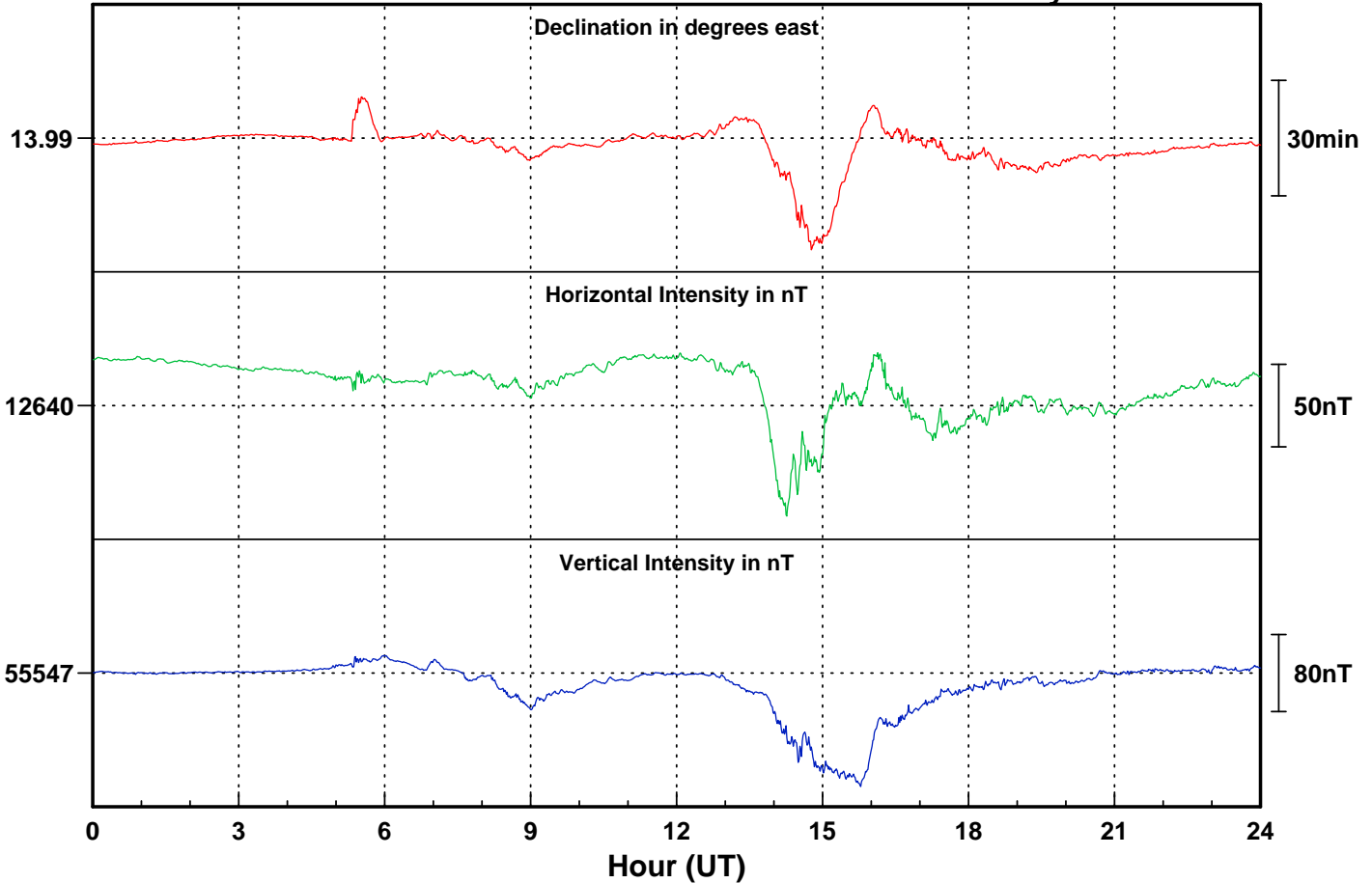
Fort McMurray

Day number: 345



Date: 12-12-2023

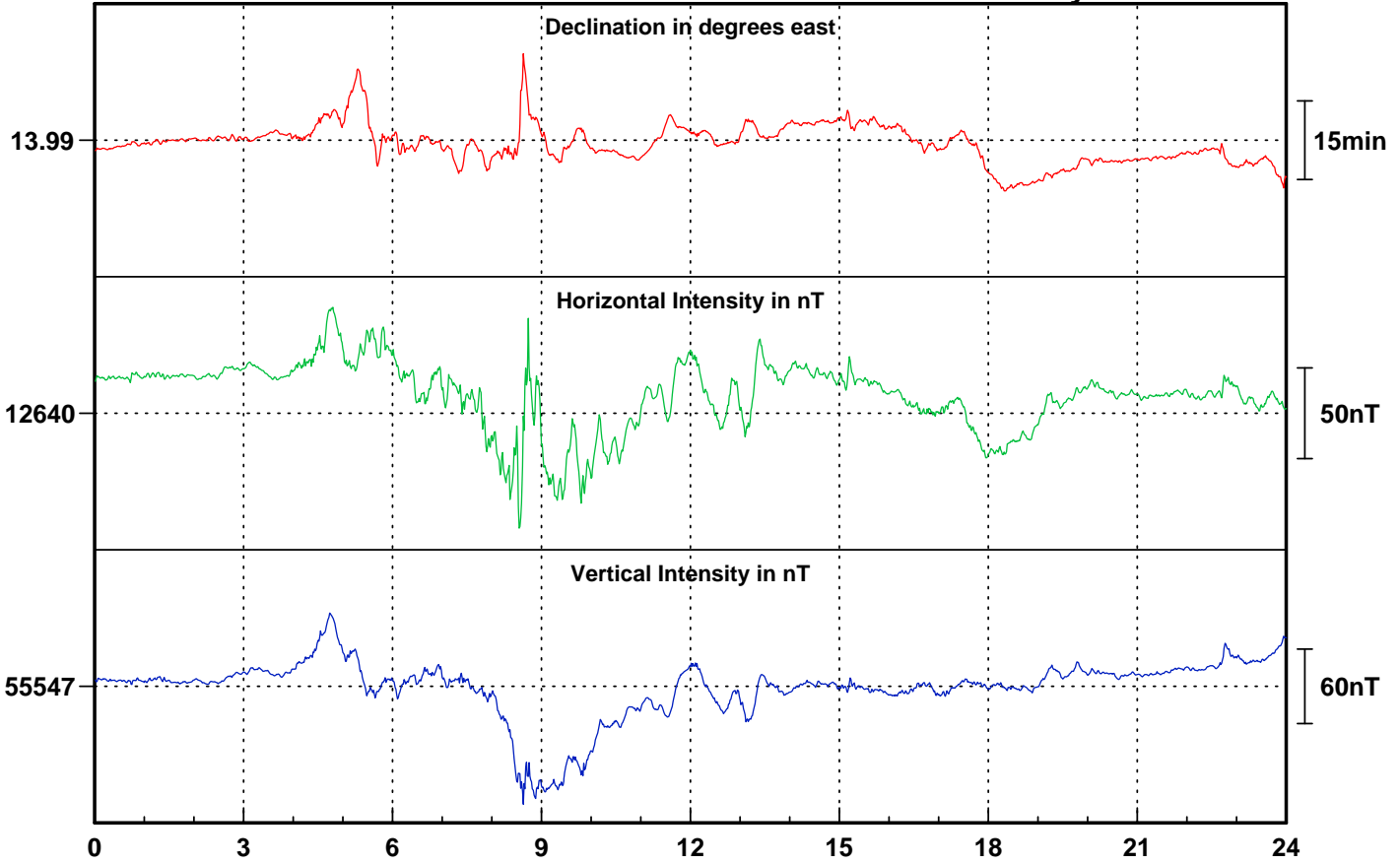
Day number: 346



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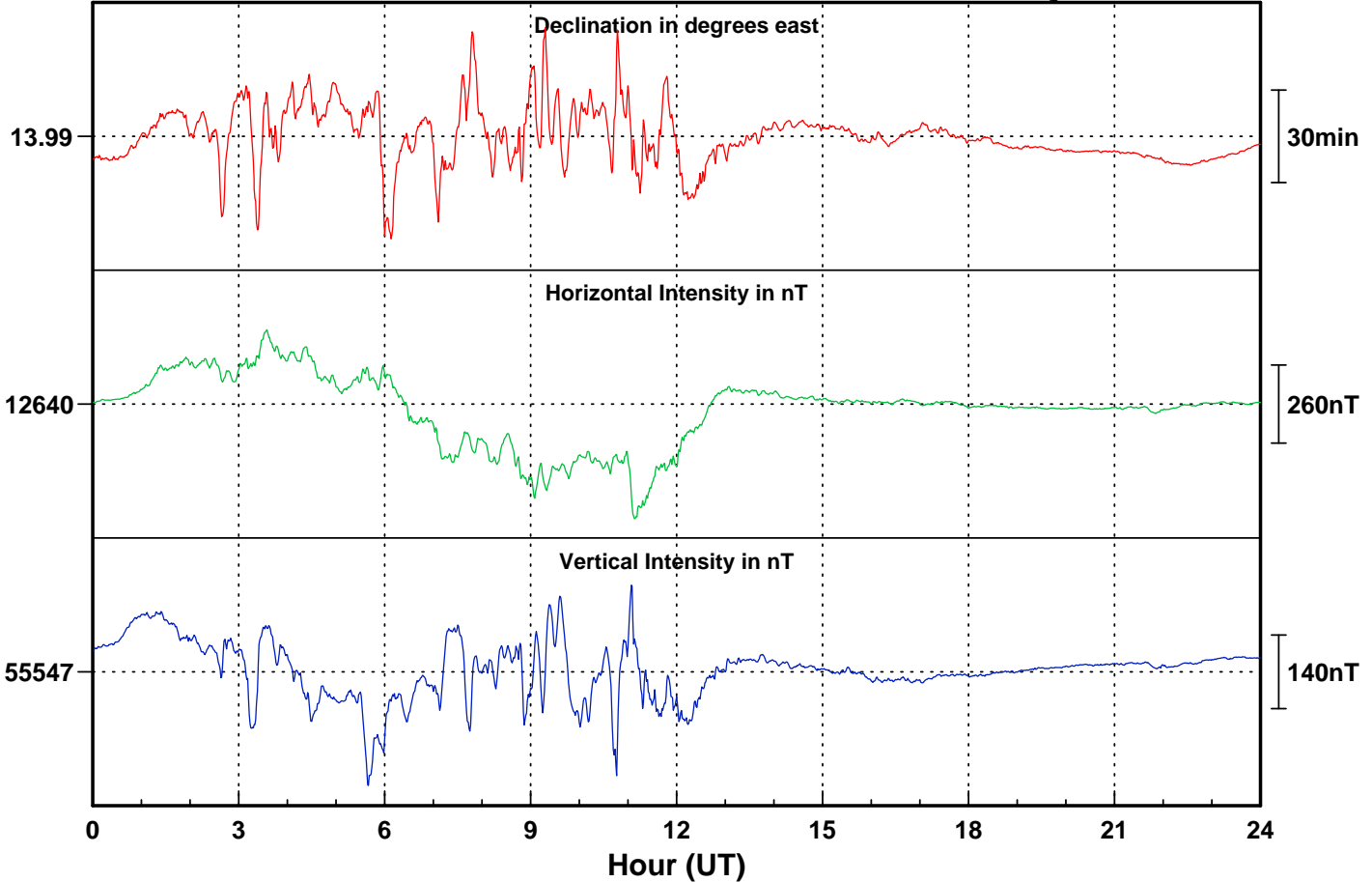
Fort McMurray

Day number: 347



Date: 14-12-2023

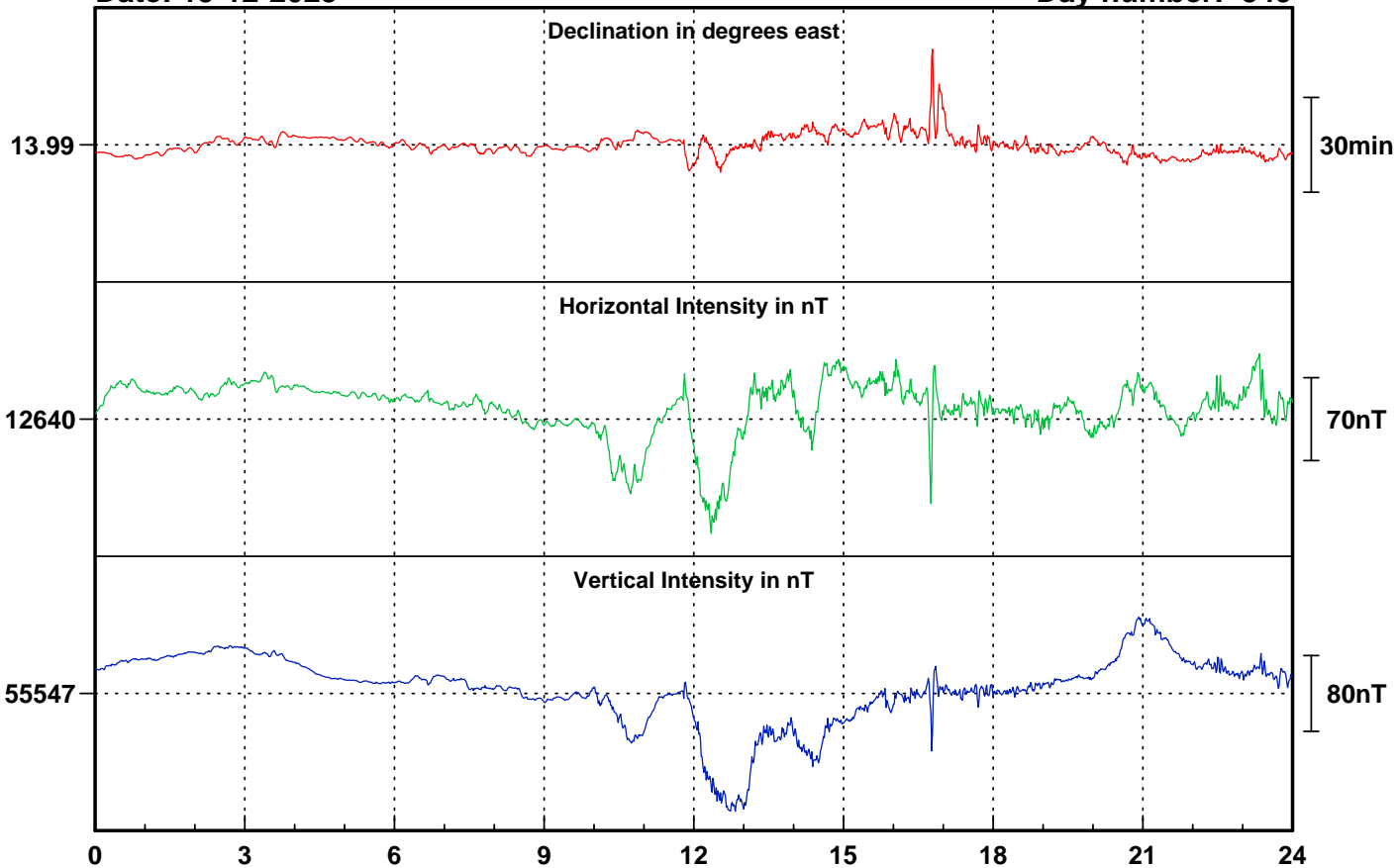
Day number: 348



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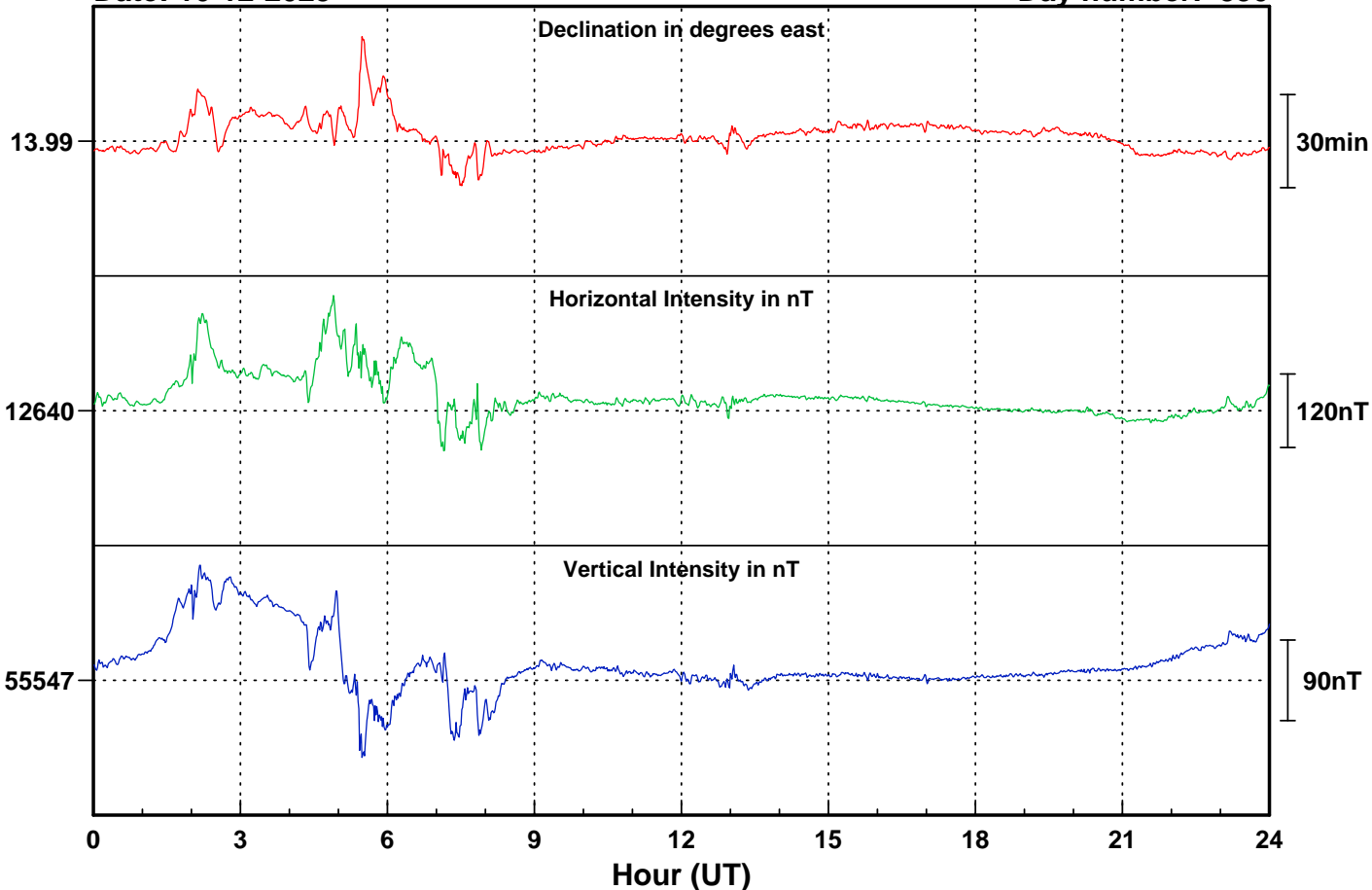
Fort McMurray

Day number: 349



Date: 16-12-2023

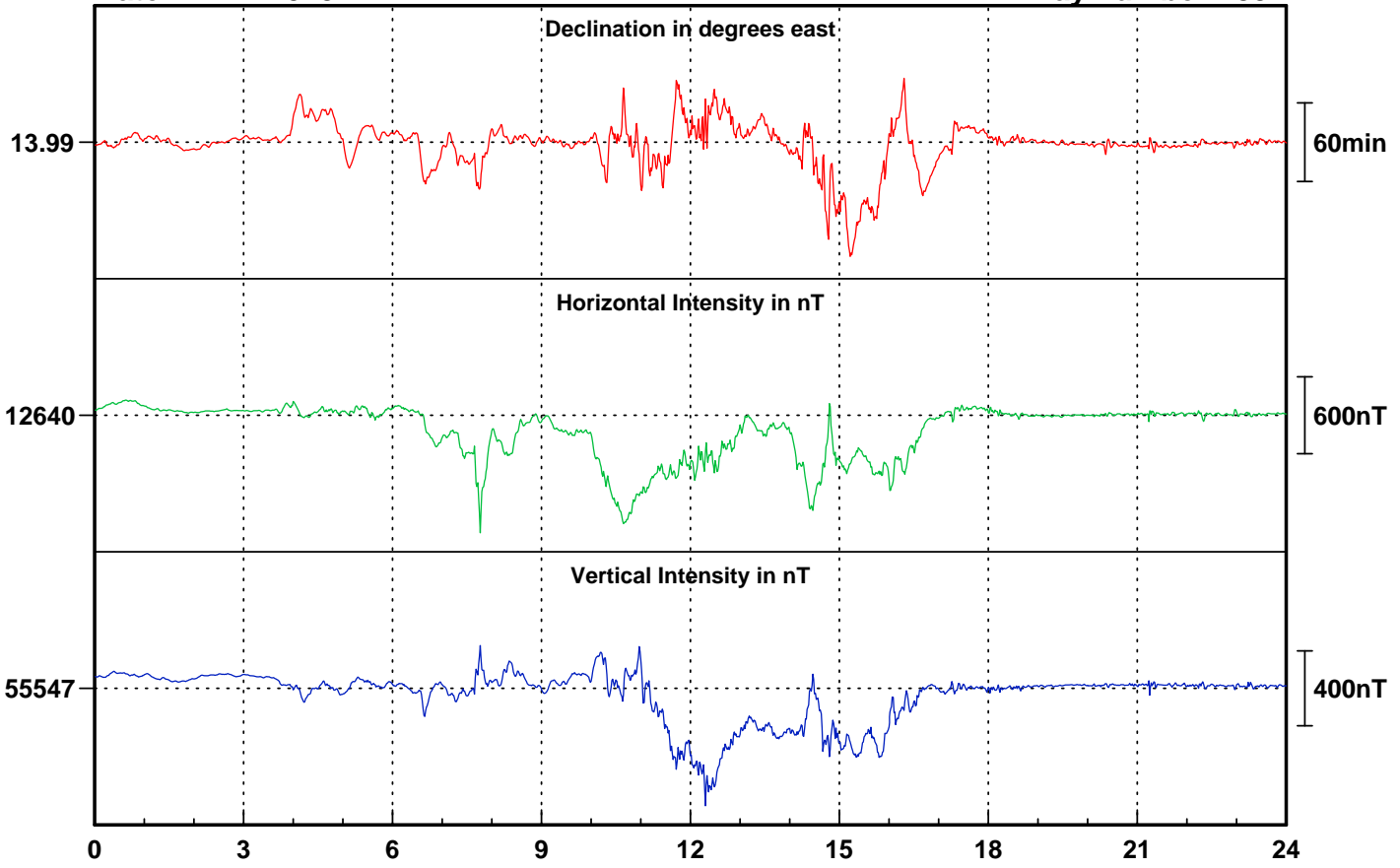
Day number: 350



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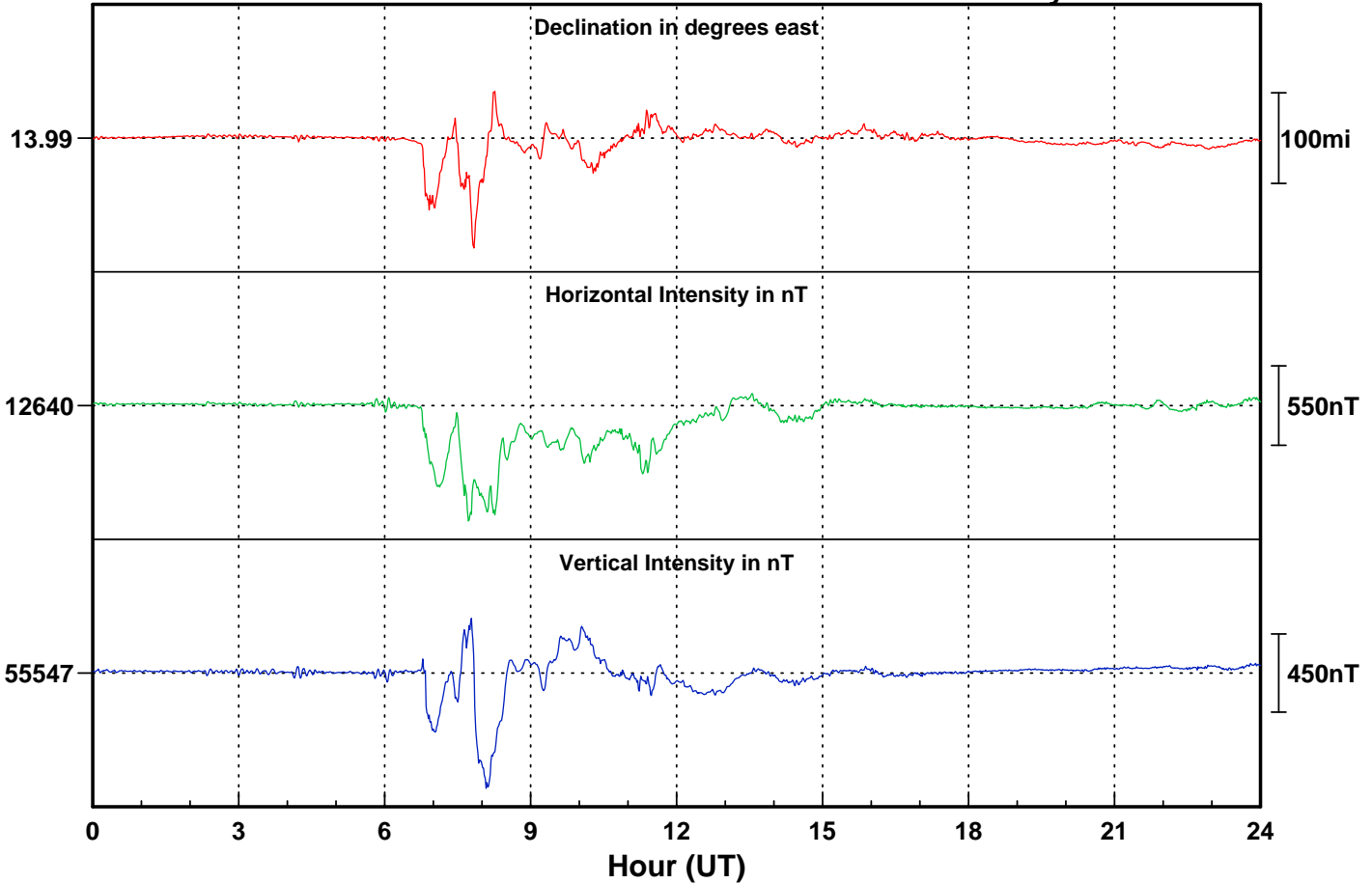
Fort McMurray

Day number: 351

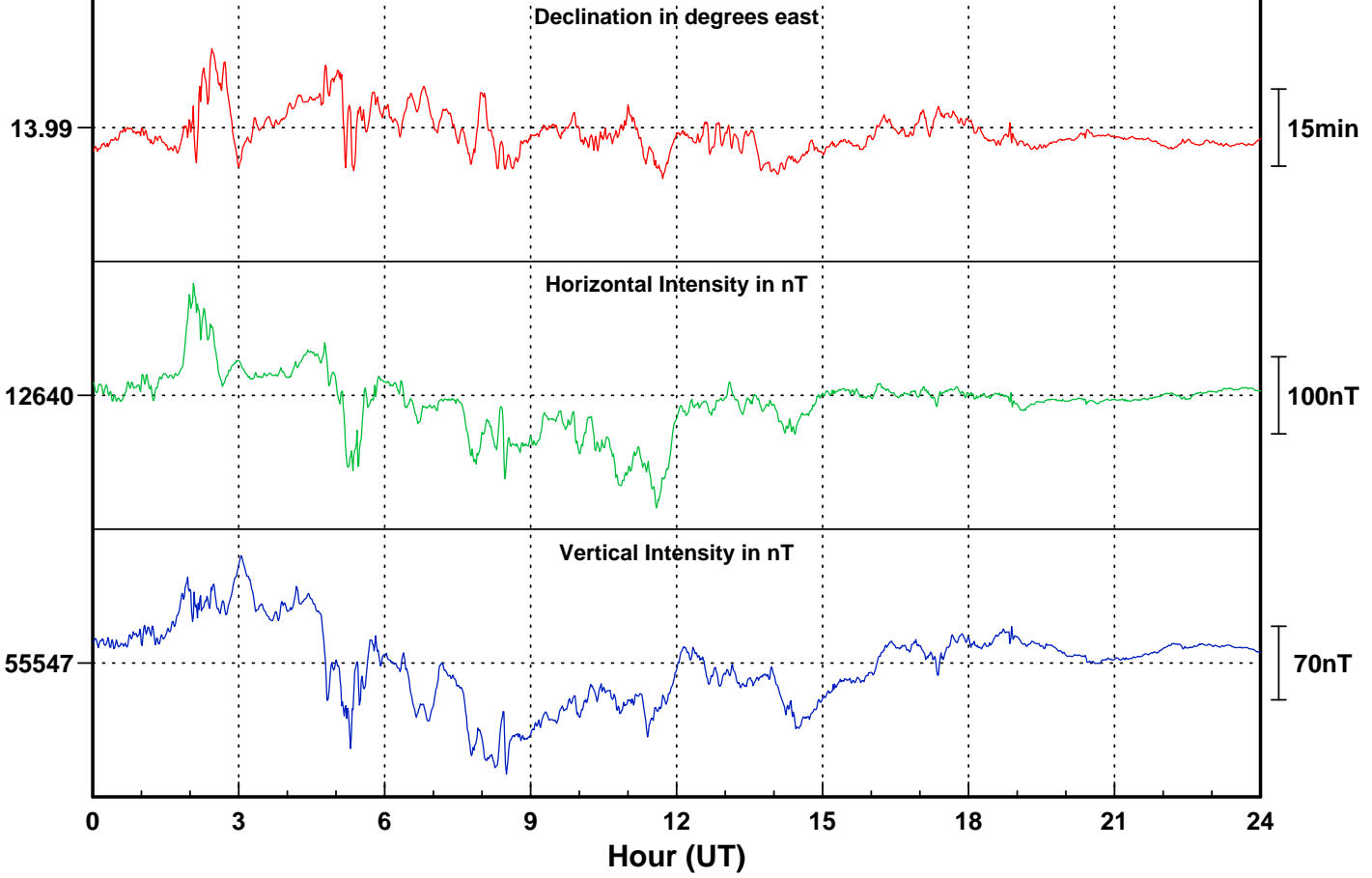
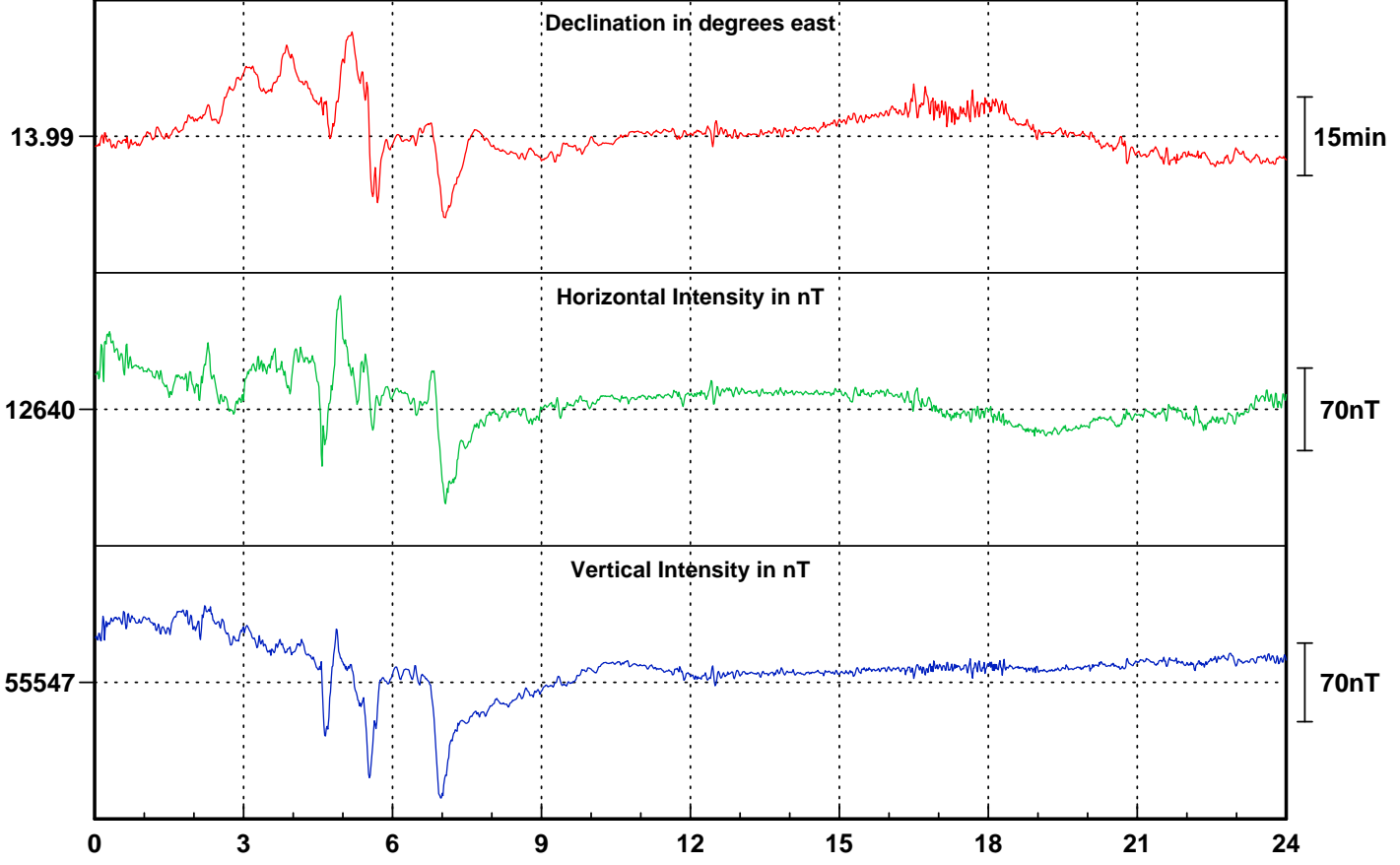


Date: 18-12-2023

Day number: 352



Hour (UT)

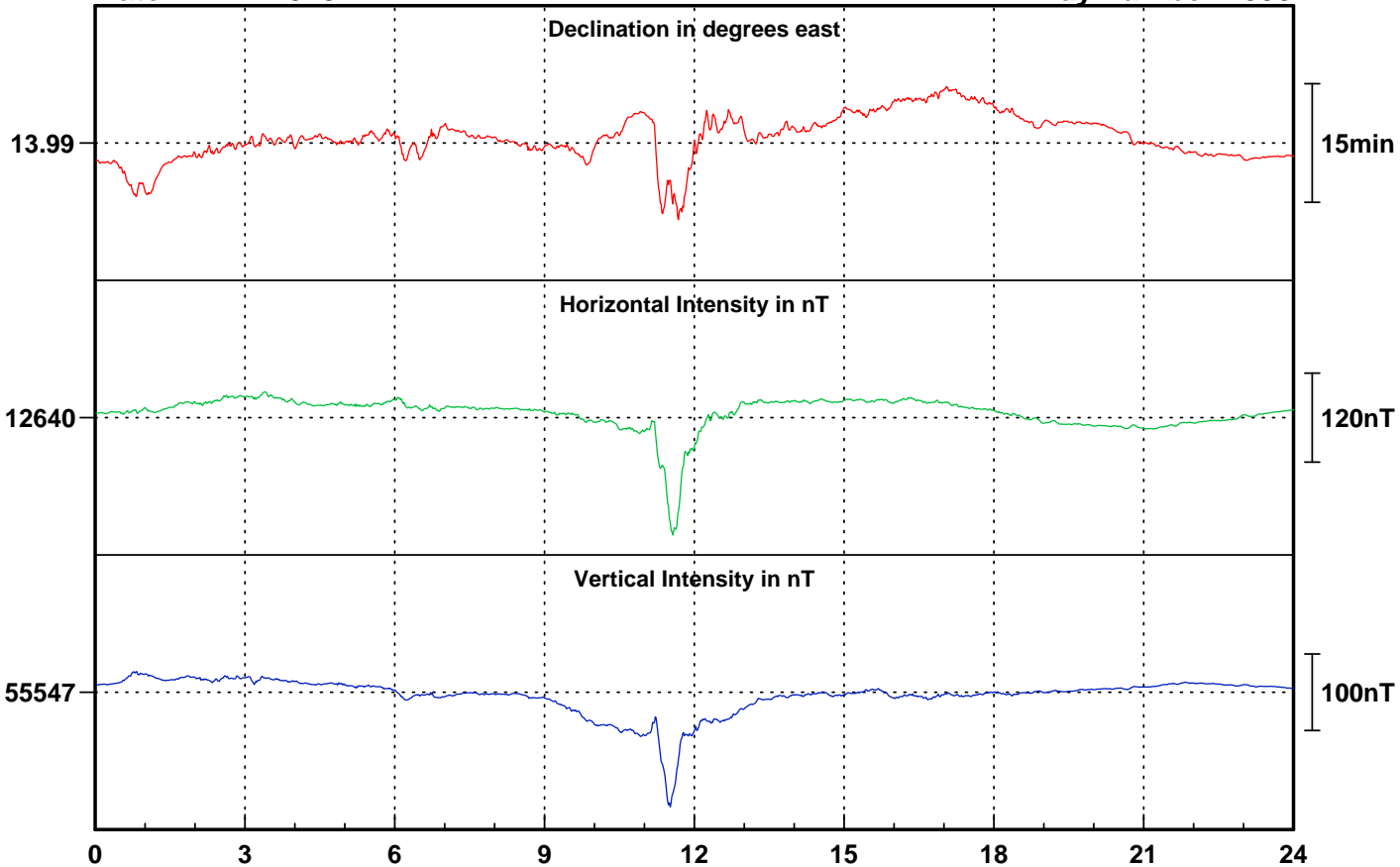


Hour (UT)

Date: 21-12-2023

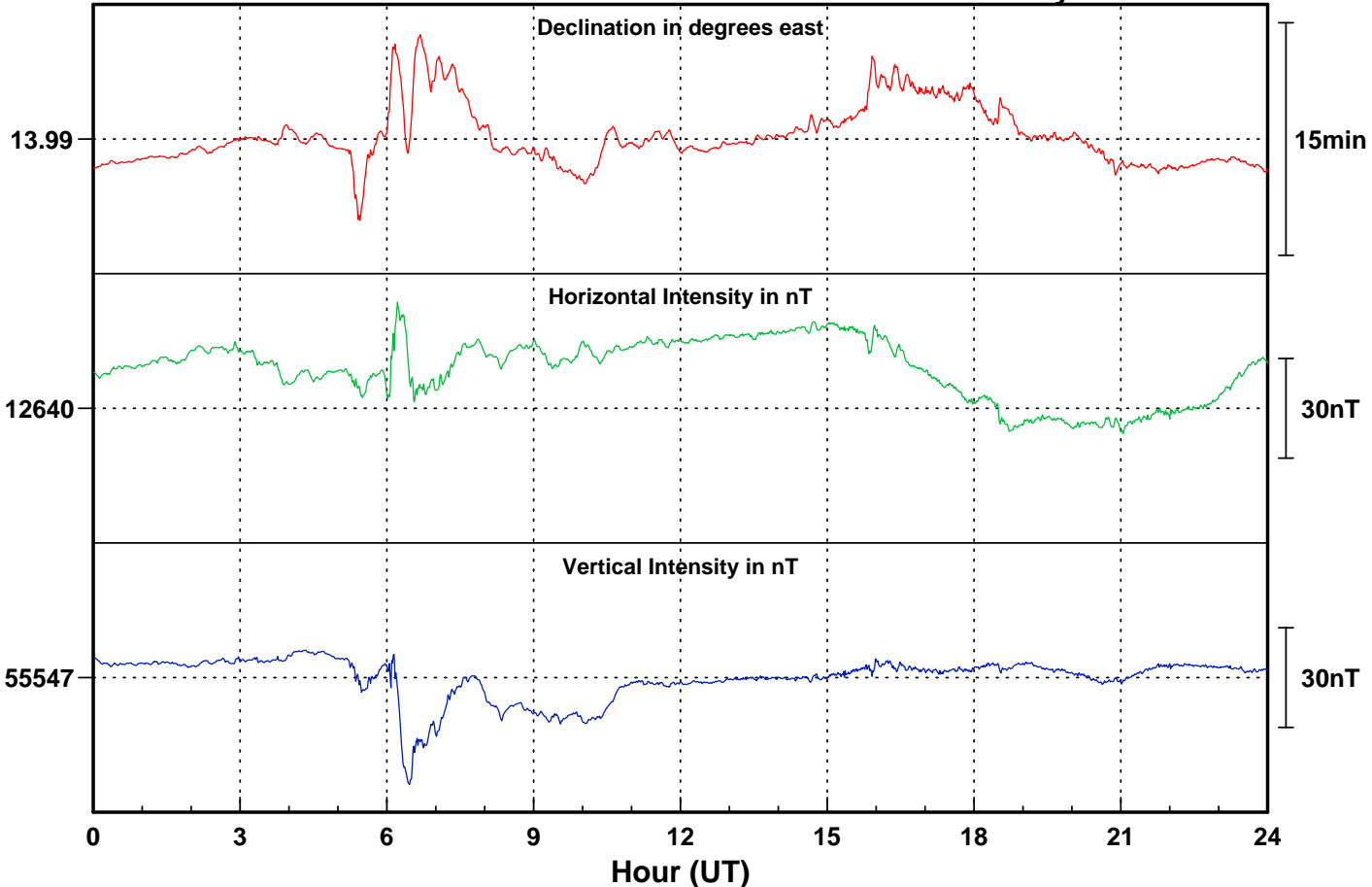
Fort McMurray

Day number: 355



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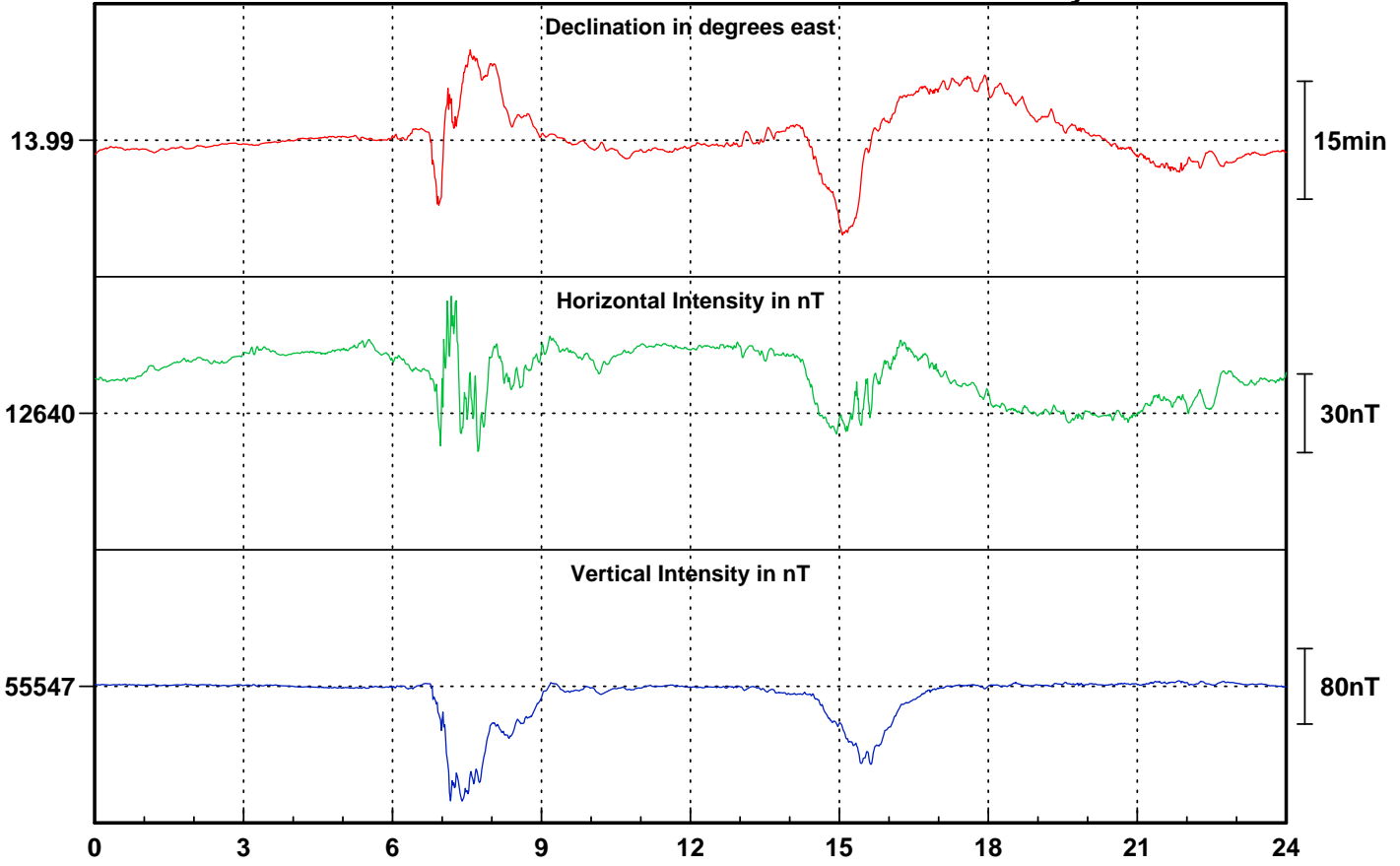
Day number: 356



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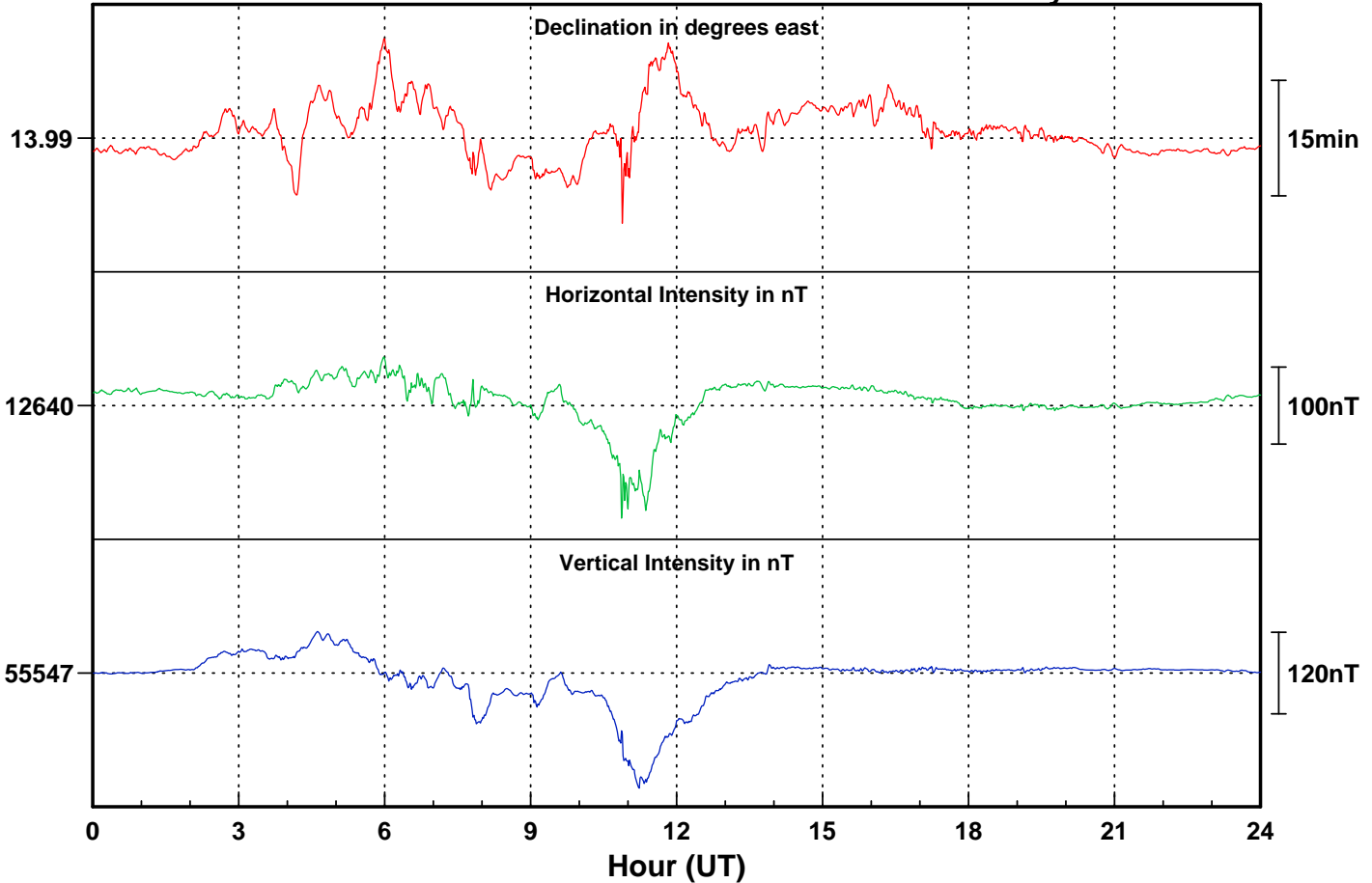
Fort McMurray

Day number: 357



Date: 24-12-2023

Day number: 358

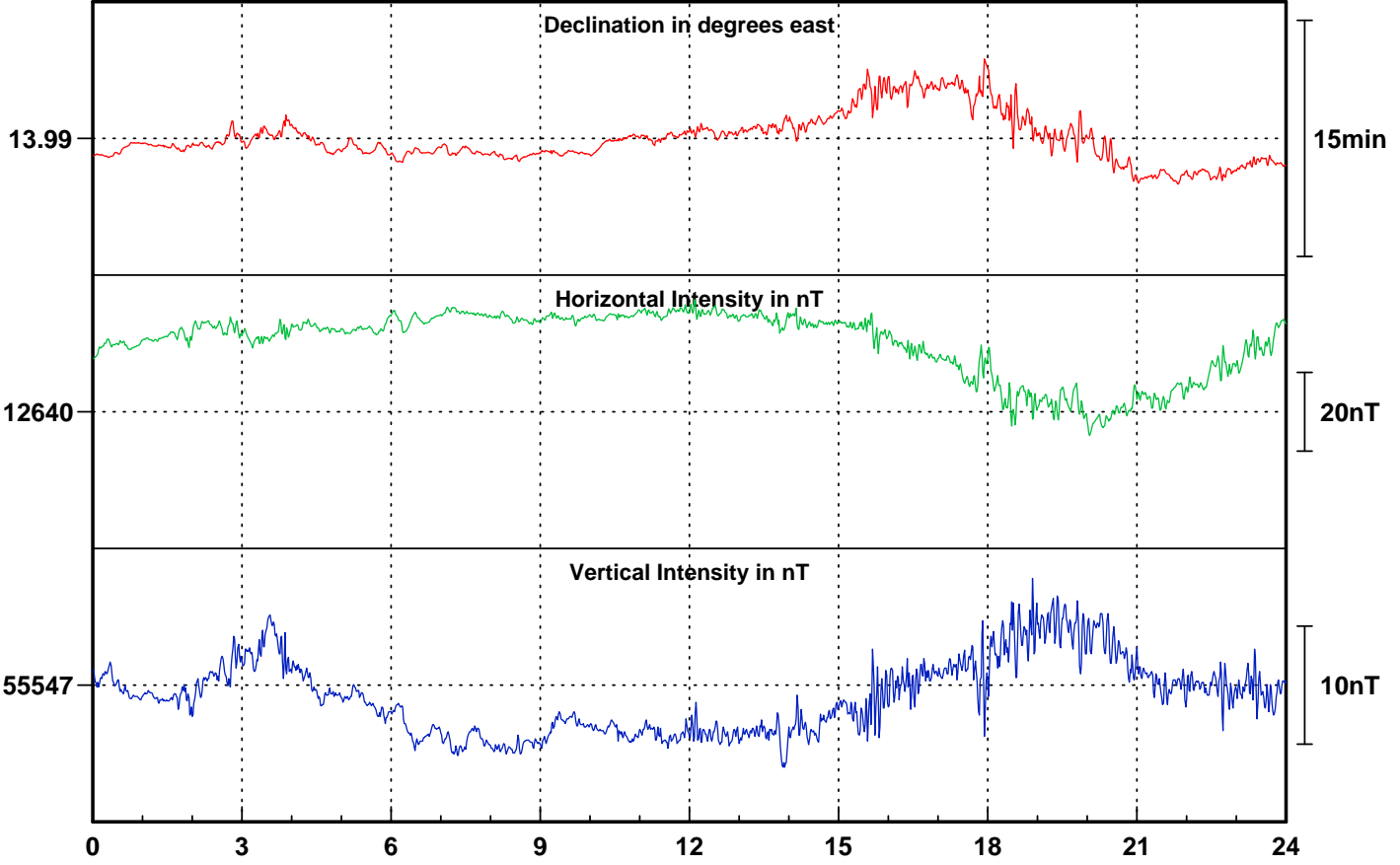


Hour (UT)

Date: 25-12-2023

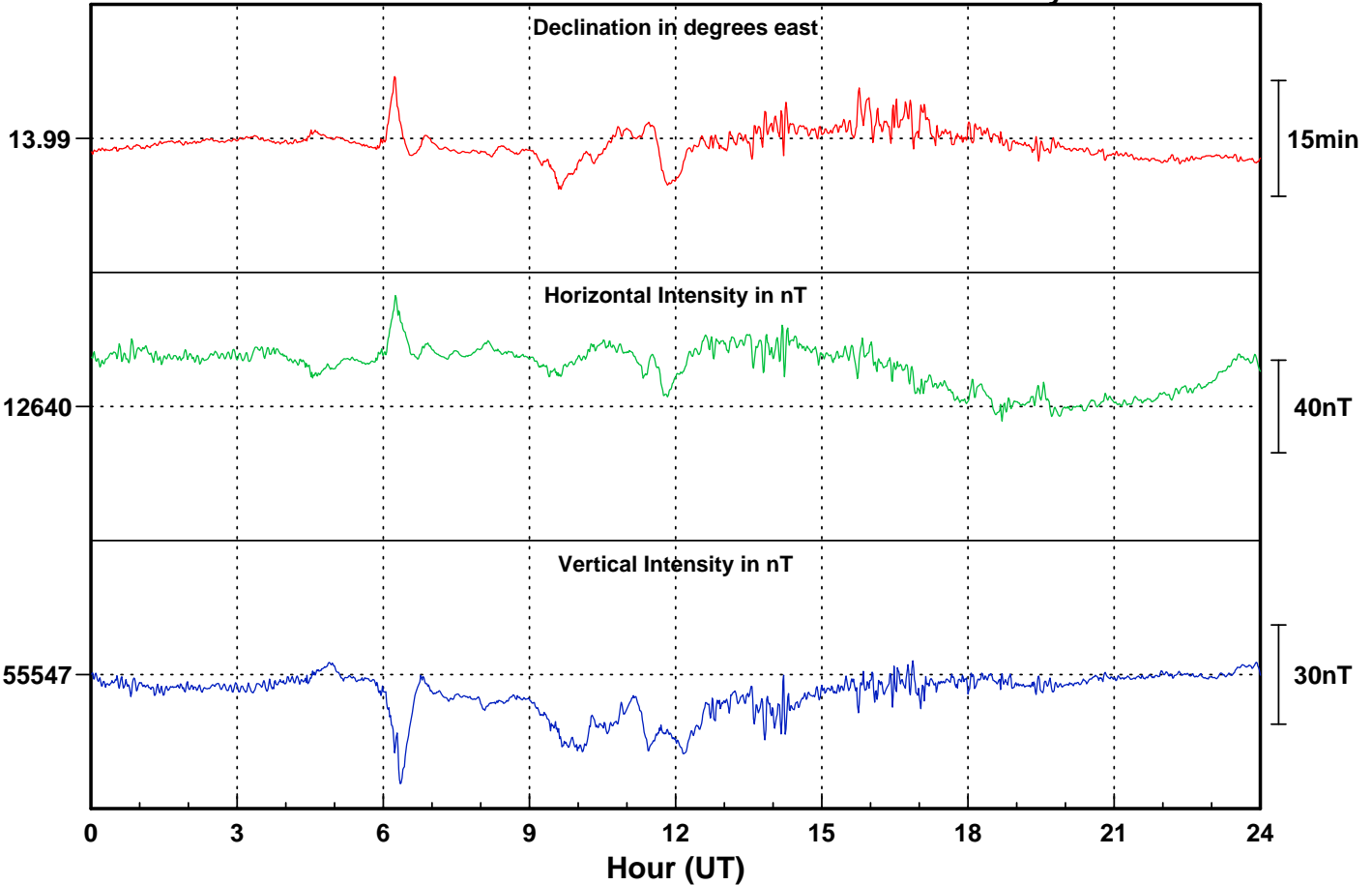
Fort McMurray

Day number: 359



Date: 26-12-2023

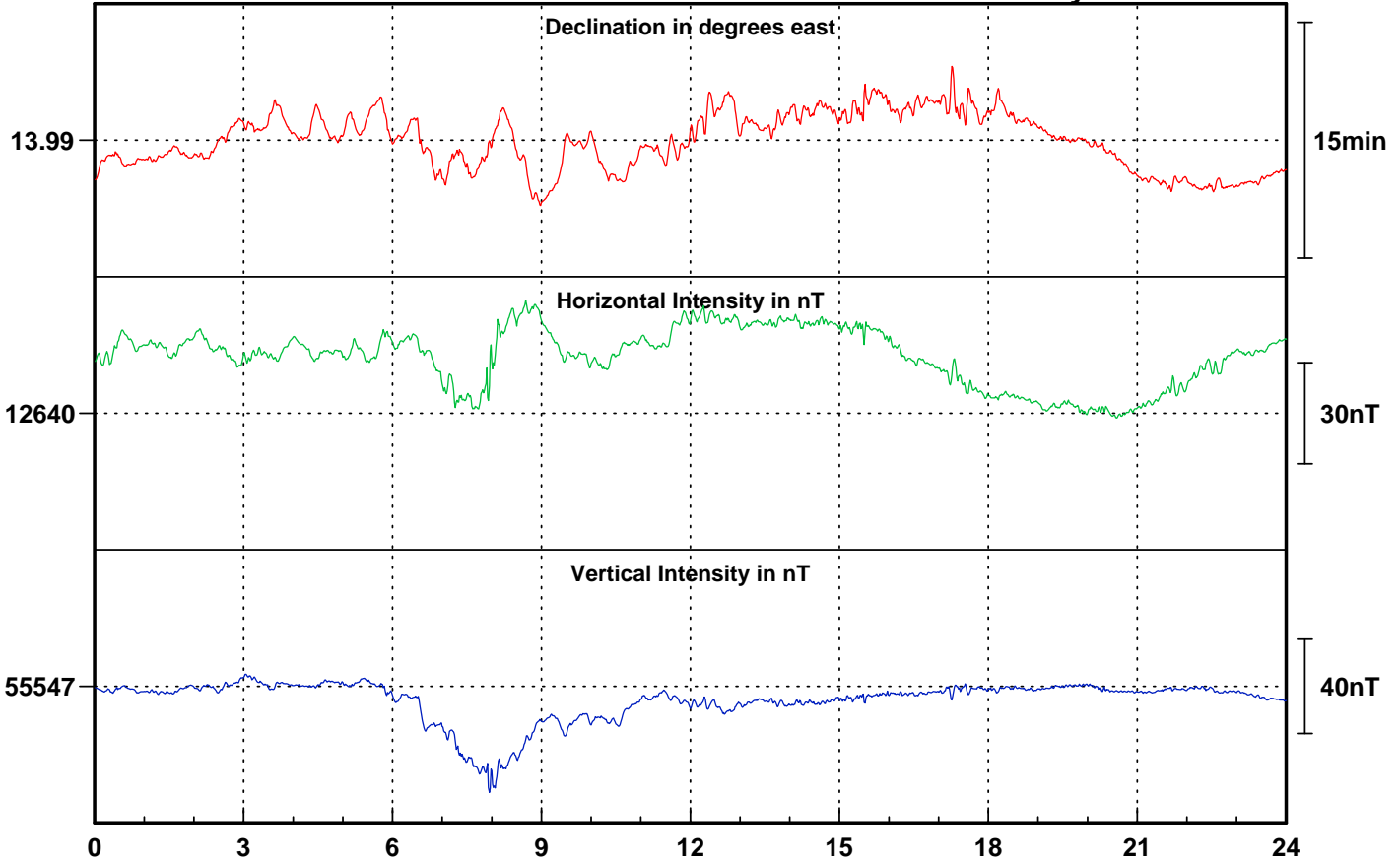
Day number: 360



Date: 27-12-2023

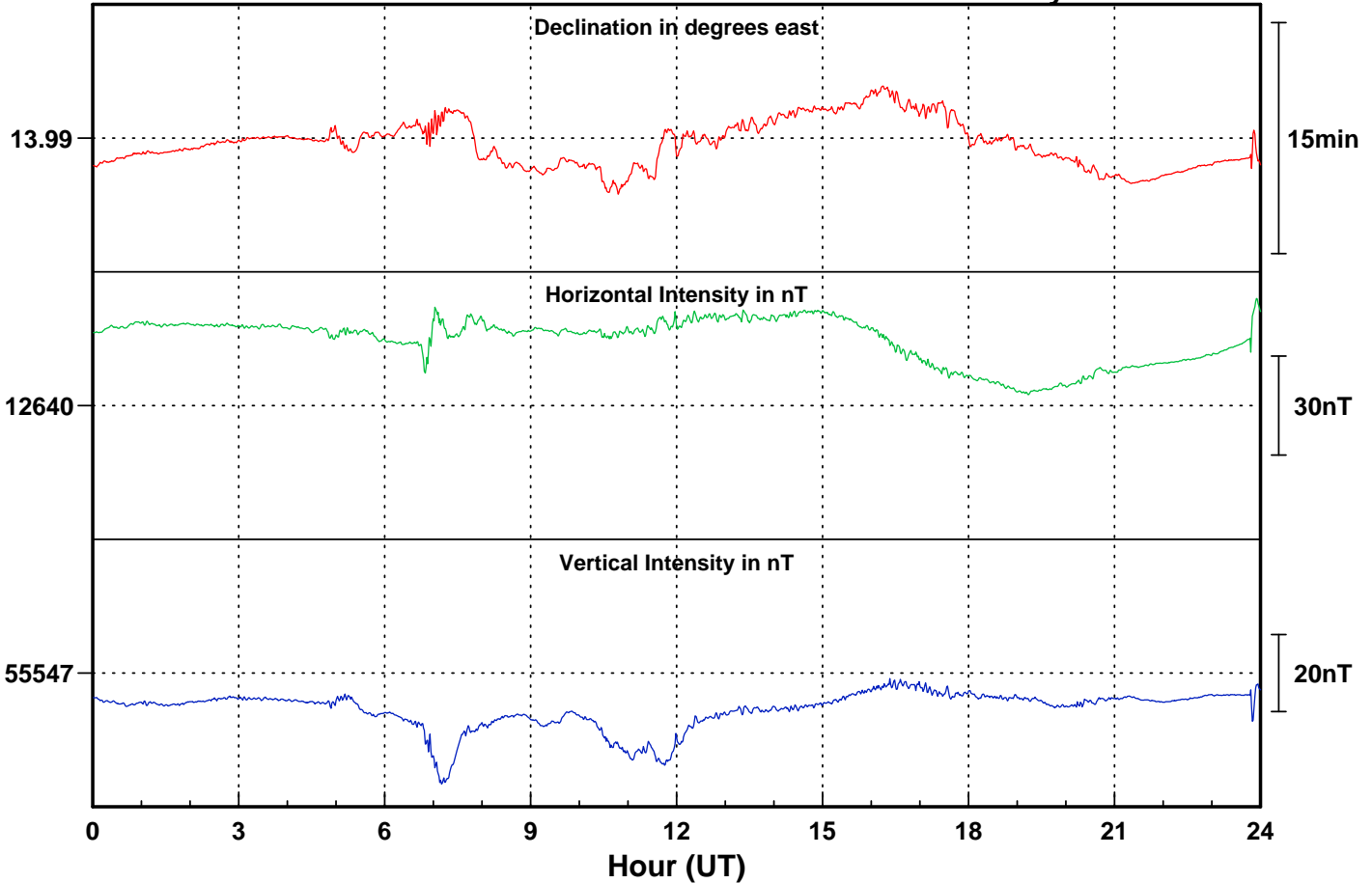
Fort McMurray

Day number: 361



Date: 28-12-2023

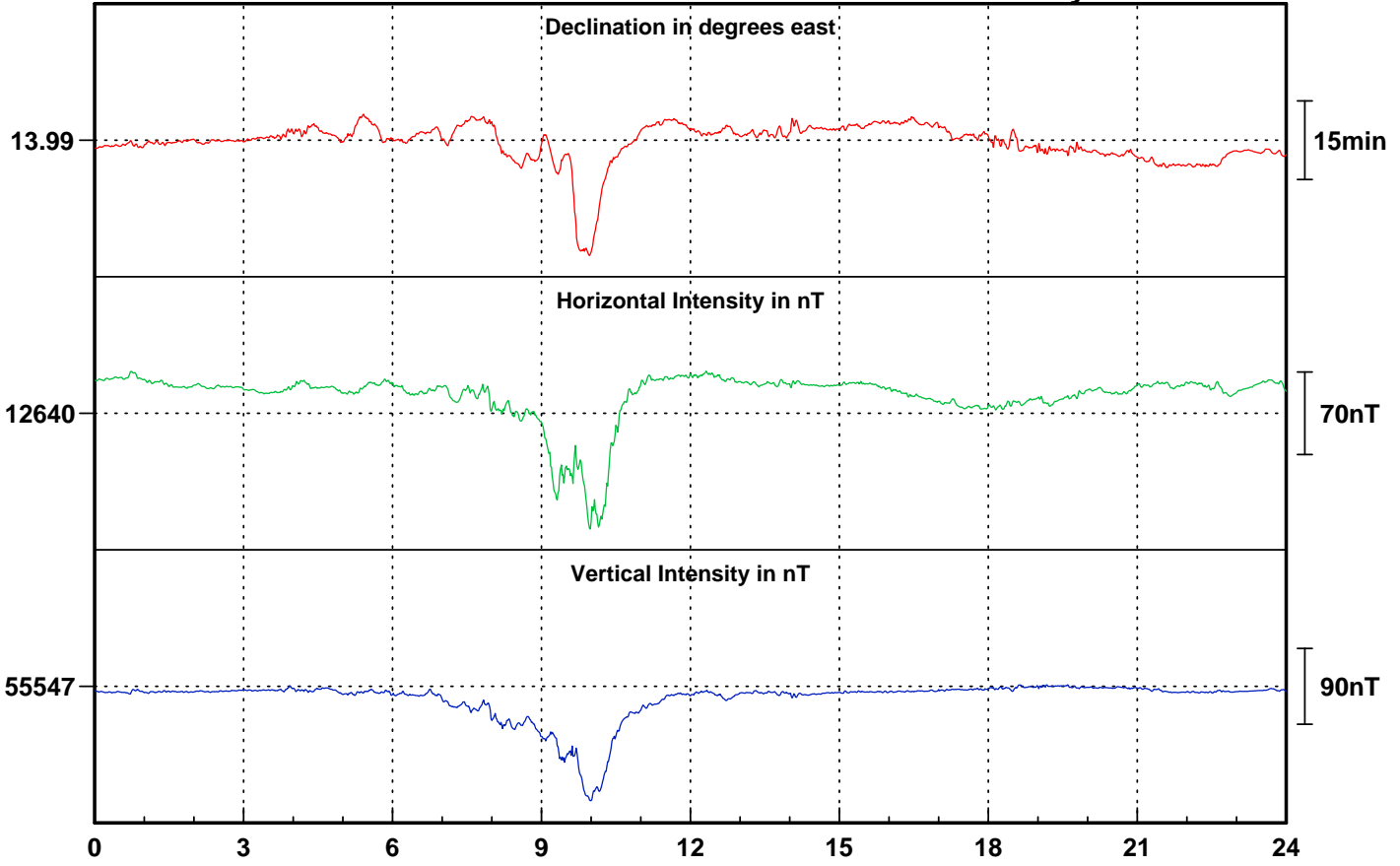
Day number: 362



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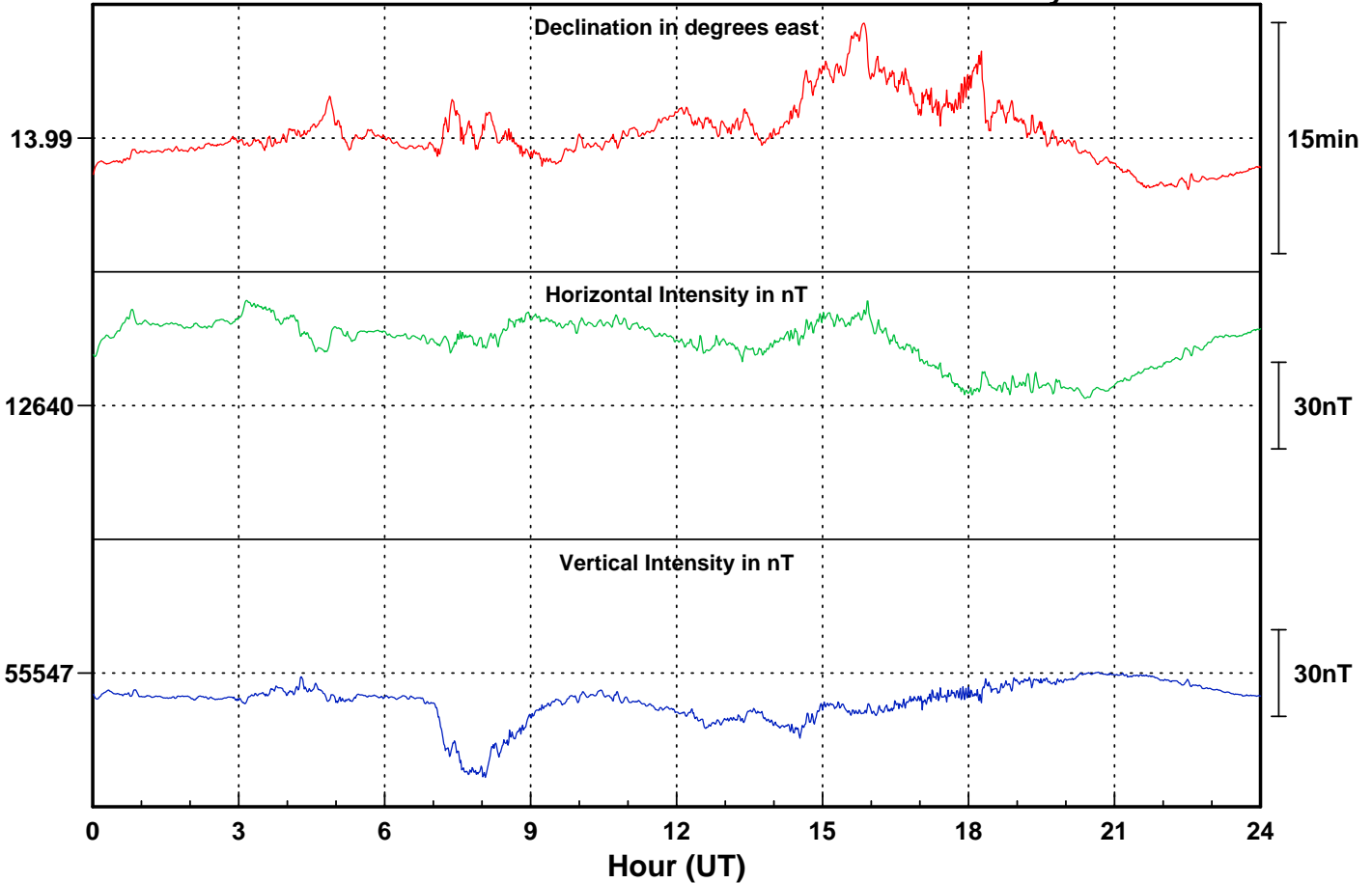
Fort McMurray

Day number: 363



Date: 30-12-2023

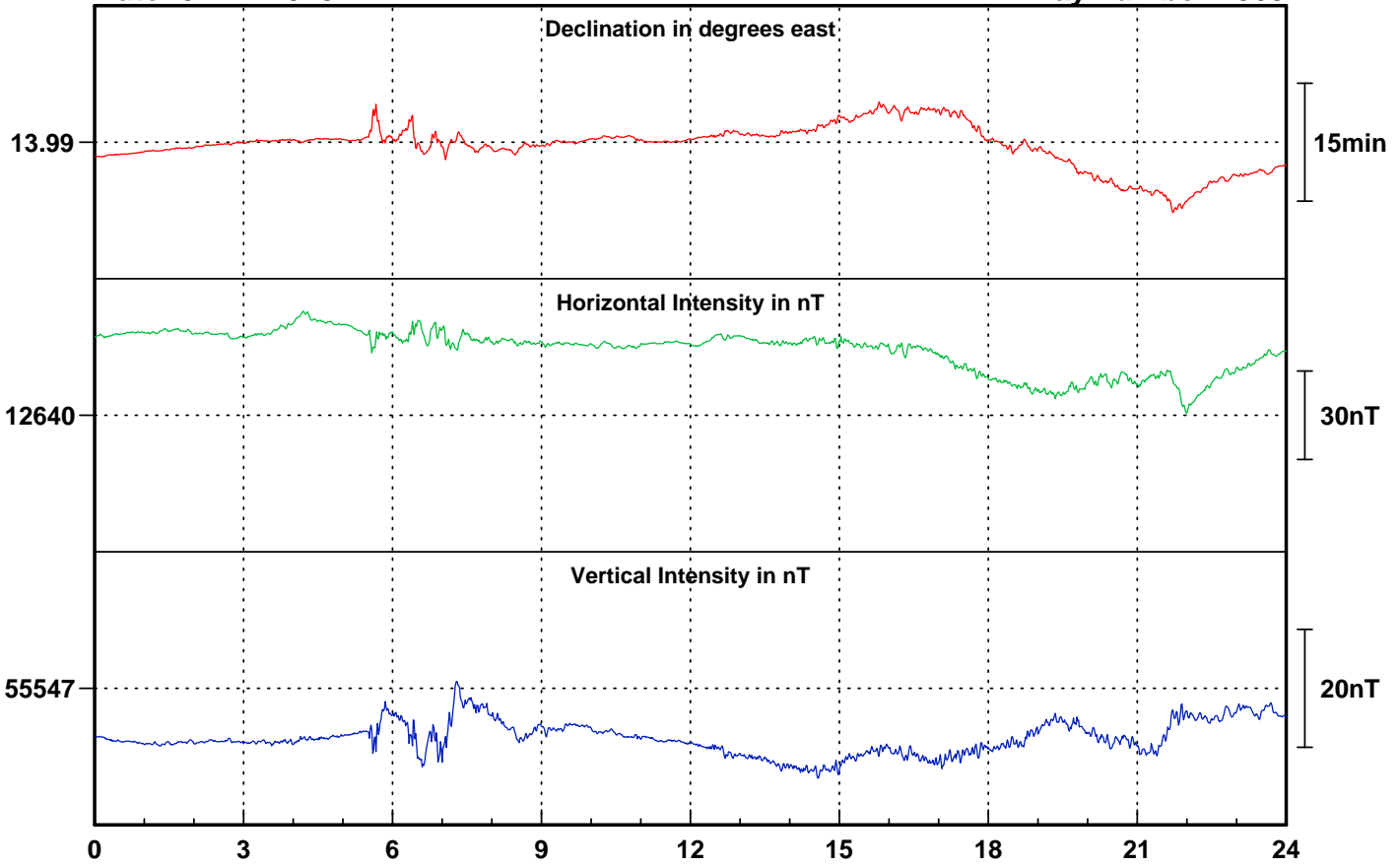
Day number: 364



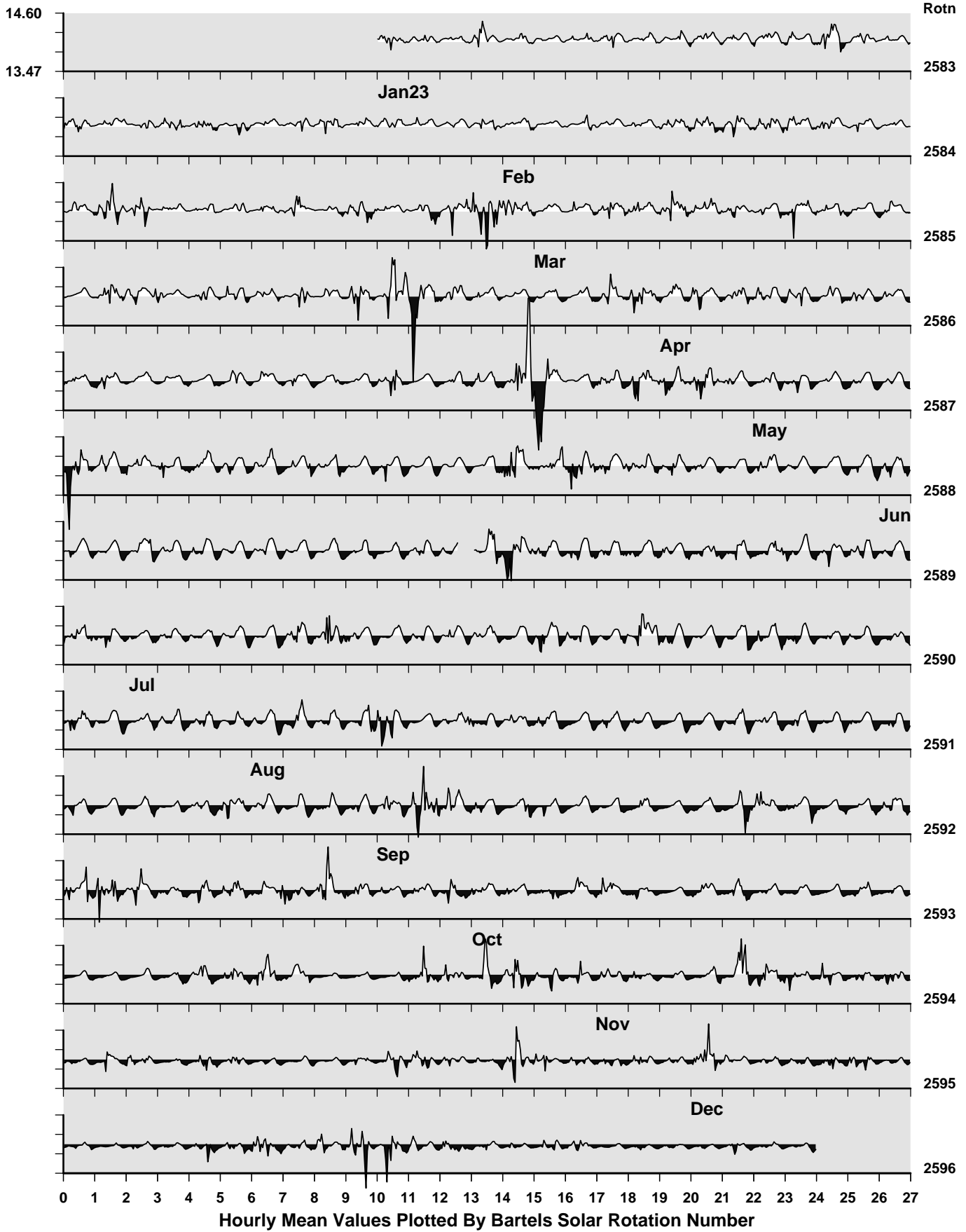
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Fort McMurray

Day number: 365

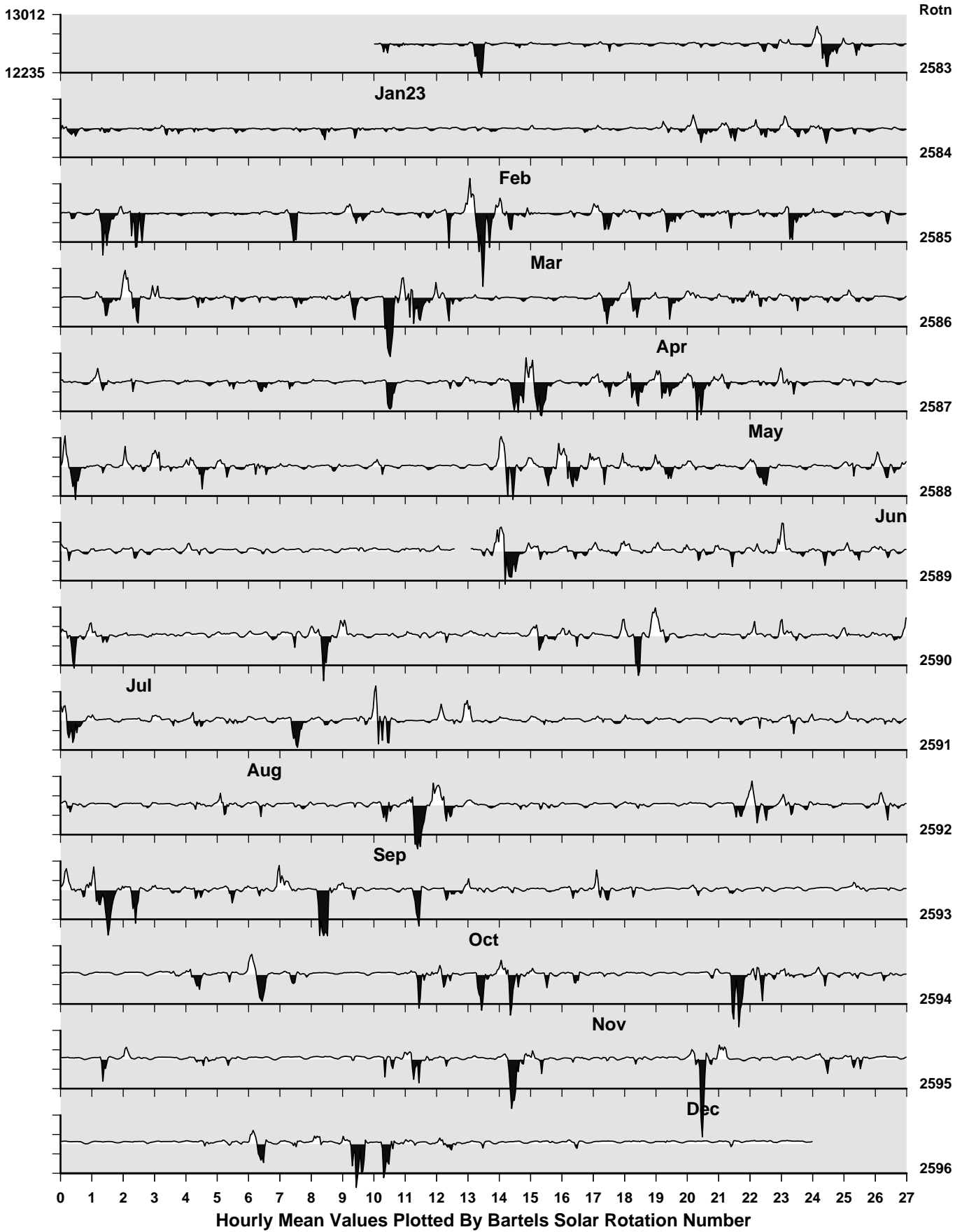


Fort McMurray Observatory: Declination (degrees)



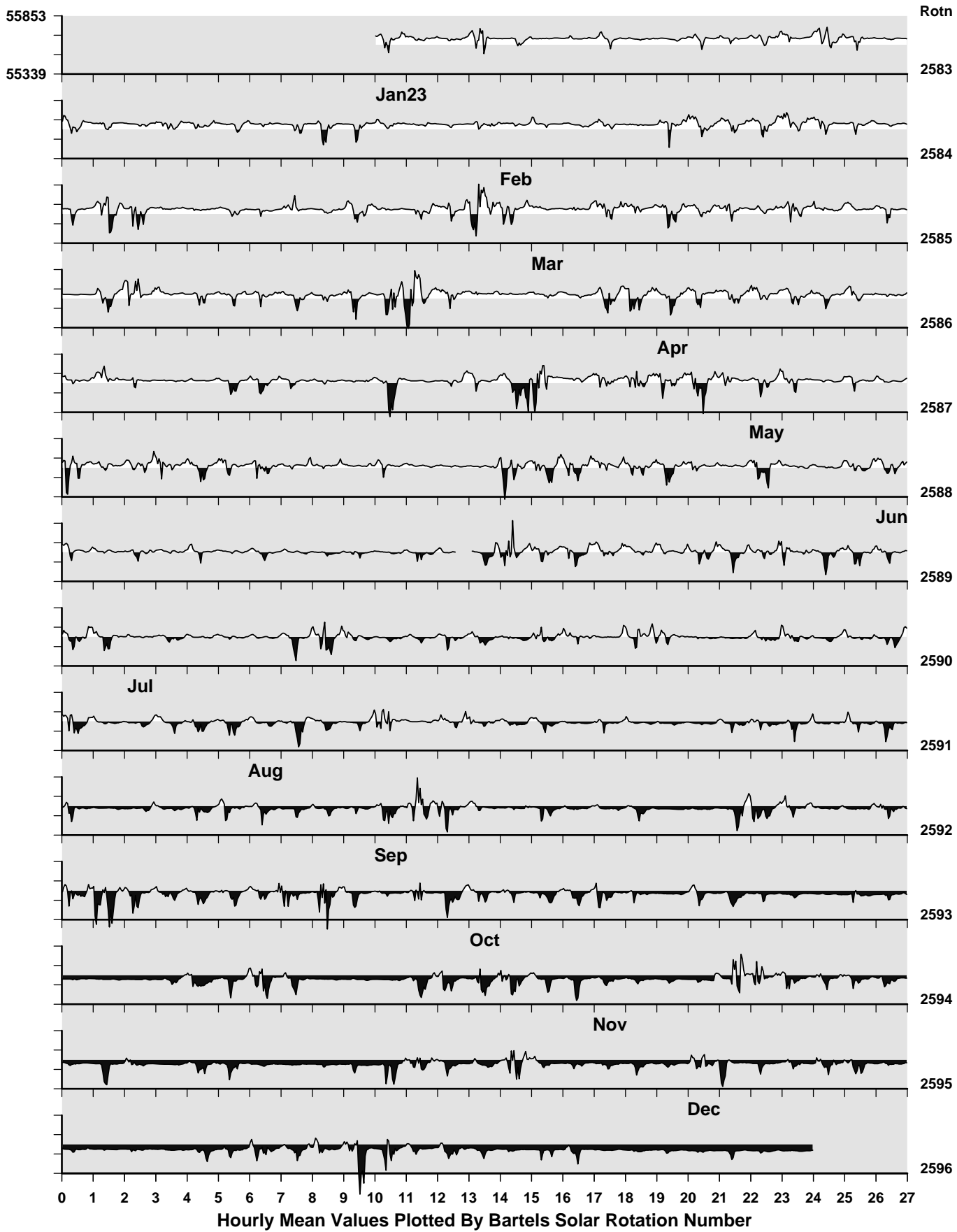
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Horizontal Intensity (nT)

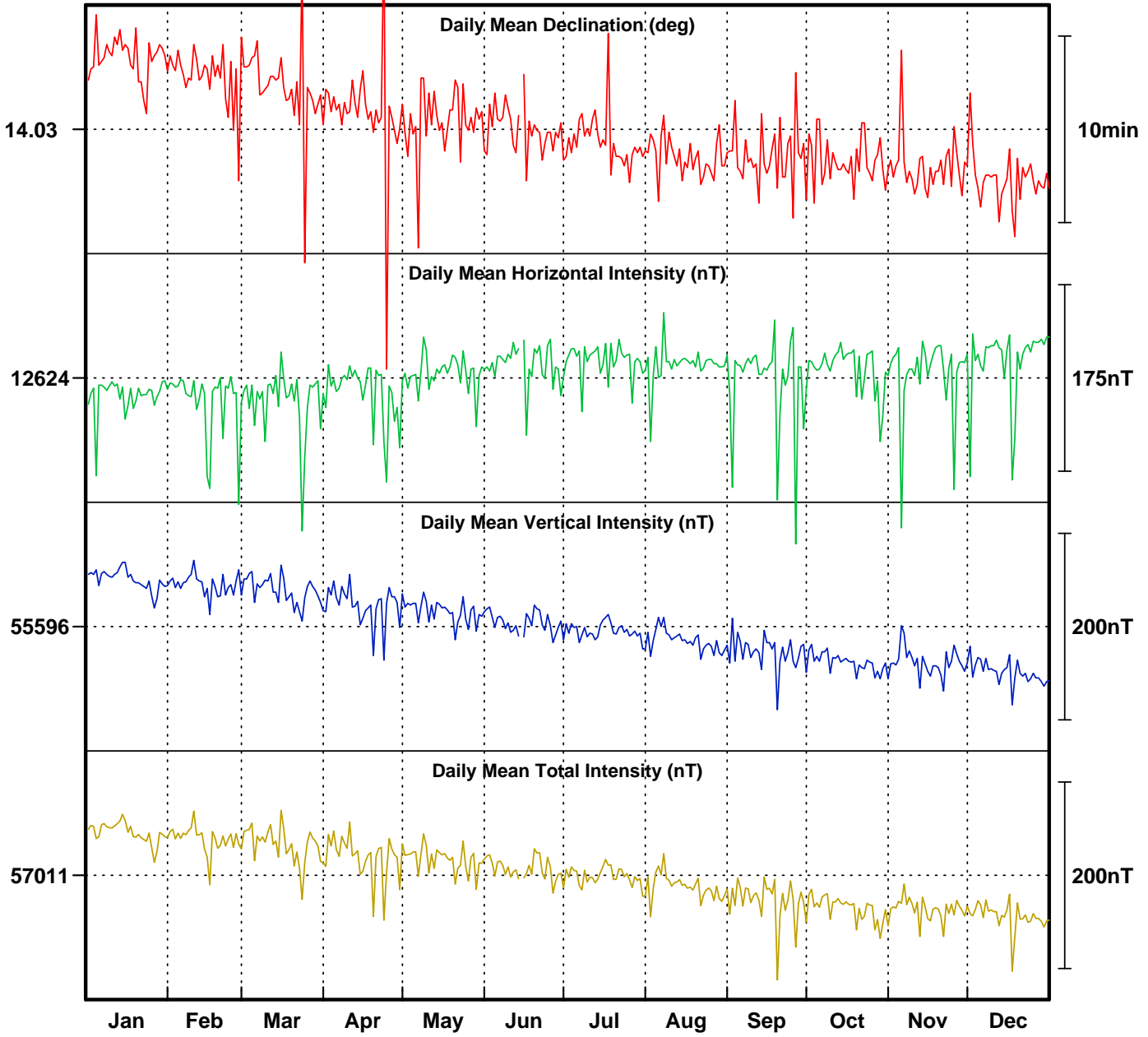


Hourly Mean Values Plotted By Bartels Solar Rotation Number

Fort McMurray Observatory: Vertical Intensity (nT)



Fort McMurray Observatory 2023



Monthly mean values for Fort McMurray Observatory 2023

Month	<i>D</i>	<i>H</i>	<i>I</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>F</i>
January	14° 5.9′	12607 nT	77° 14.1′	12228 nT	3071 nT	55647 nT	57057 nT
February	14° 4.9′	12602 nT	77° 14.3′	12223 nT	3066 nT	55641 nT	57050 nT
March	14° 4.3′	12602 nT	77° 14.2′	12224 nT	3064 nT	55634 nT	57044 nT
April	14° 3.0′	12610 nT	77° 13.5′	12233 nT	3061 nT	55619 nT	57031 nT
May	14° 2.4′	12628 nT	77° 12.4′	12251 nT	3064 nT	55612 nT	57028 nT
June	14° 2.1′	12637 nT	77° 11.7′	12260 nT	3065 nT	55600 nT	57018 nT
July	14° 1.4′	12640 nT	77° 11.4′	12263 nT	3063 nT	55591 nT	57010 nT
August	14° 0.6′	12637 nT	77° 11.5′	12261 nT	3059 nT	55581 nT	56999 nT
September	14° 0.6′	12619 nT	77° 12.3′	12244 nT	3055 nT	55568 nT	56983 nT
October	14° 0.4′	12632 nT	77° 11.4′	12257 nT	3057 nT	55558 nT	56976 nT
November	14° 0.1′	12628 nT	77° 11.7′	12253 nT	3055 nT	55558 nT	56975 nT
December	13° 59.4′	12640 nT	77° 10.8′	12265 nT	3056 nT	55547 nT	56967 nT

Note:

i. The values shown here are provisional.