



British  
Geological  
Survey



MONTHLY MAGNETIC BULLETIN

# Fort McMurray Observatory

March 2021



# 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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Email: [enquiries@bgs.ac.uk](mailto:enquiries@bgs.ac.uk)  
Internet: [geomag.bgs.ac.uk](http://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° 19'08.4"N 310° 01'58.8"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 2021.5. On-line access to models (including IGRF), charts and navigational data are available at [geomag.bgs.ac.uk/data\\_service/models\\_compass/home](http://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

The outputs presented in this bulletin are provided for personal, academic, educational, non-commercial research or other non-commercial use and are not for sale or distribution to third parties without written permission from BGS.

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](http://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)	
03-Mar-21	62	20:28	14.1799	14.3217	20:37	77.3442	-2.1	57222.2	12537.1	12332.3	55832.0	56487.4	TM
03-Mar-21	62	21:12	14.1554	14.3117	21:19	77.3421	-2.1	57228.7	12540.5	12336.4	55837.8	56486.6	TM
03-Mar-21	62	21:27	14.1525	14.3233	21:33	77.3354	-2.1	57234.9	12548.4	12333.3	55842.4	56487.2	TM
09-Mar-21	68	23:19	14.2163	14.1983	23:25	77.3391	-2.1	57218.9	12541.3	12330.8	55827.6	56487.8	TM
09-Mar-21	68	23:34	14.2083	14.1867	23:42	77.3396	-2.1	57218.1	12540.6	12330.2	55826.9	56487.8	TM
10-Mar-21	69	16:39	14.2892	14.1733	16:45	77.3417	-2.1	57213.9	12537.7	12334.1	55823.3	56487.1	TM
10-Mar-21	69	16:55	14.3004	14.1717	17:08	77.3426	-2.1	57211.6	12536.2	12334.8	55821.3	56486.9	TM
10-Mar-21	69	19:25	14.1908	14.2033	19:31	77.3442	-2.1	57208.4	12534.0	12335.2	55818.4	56486.8	TM
10-Mar-21	69	19:38	14.1804	14.1967	19:44	77.3425	-2.1	57209.5	12535.9	12333.2	55819.2	56487.3	TM
10-Mar-21	69	19:51	14.1858	14.1917	19:57	77.3404	-2.1	57212.8	12538.6	12334.2	55821.9	56487.0	TM
18-Mar-21	77	19:18	14.2242	14.1800	19:26	77.3479	-2.1	57207.6	12530.2	12337.6	55818.5	56486.1	TM
18-Mar-21	77	19:55	14.2225	14.2067	20:01	77.3475	-2.1	57207.9	12530.7	12333.4	55818.7	56486.9	TM
18-Mar-21	77	20:09	14.1863	14.1817	20:15	77.3450	-2.1	57208.3	12533.2	12332.6	55818.5	56487.3	TM

# Fort McMurray 2021

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

14.26

10min

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

12333

20nT

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

56487

6nT

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

2.1

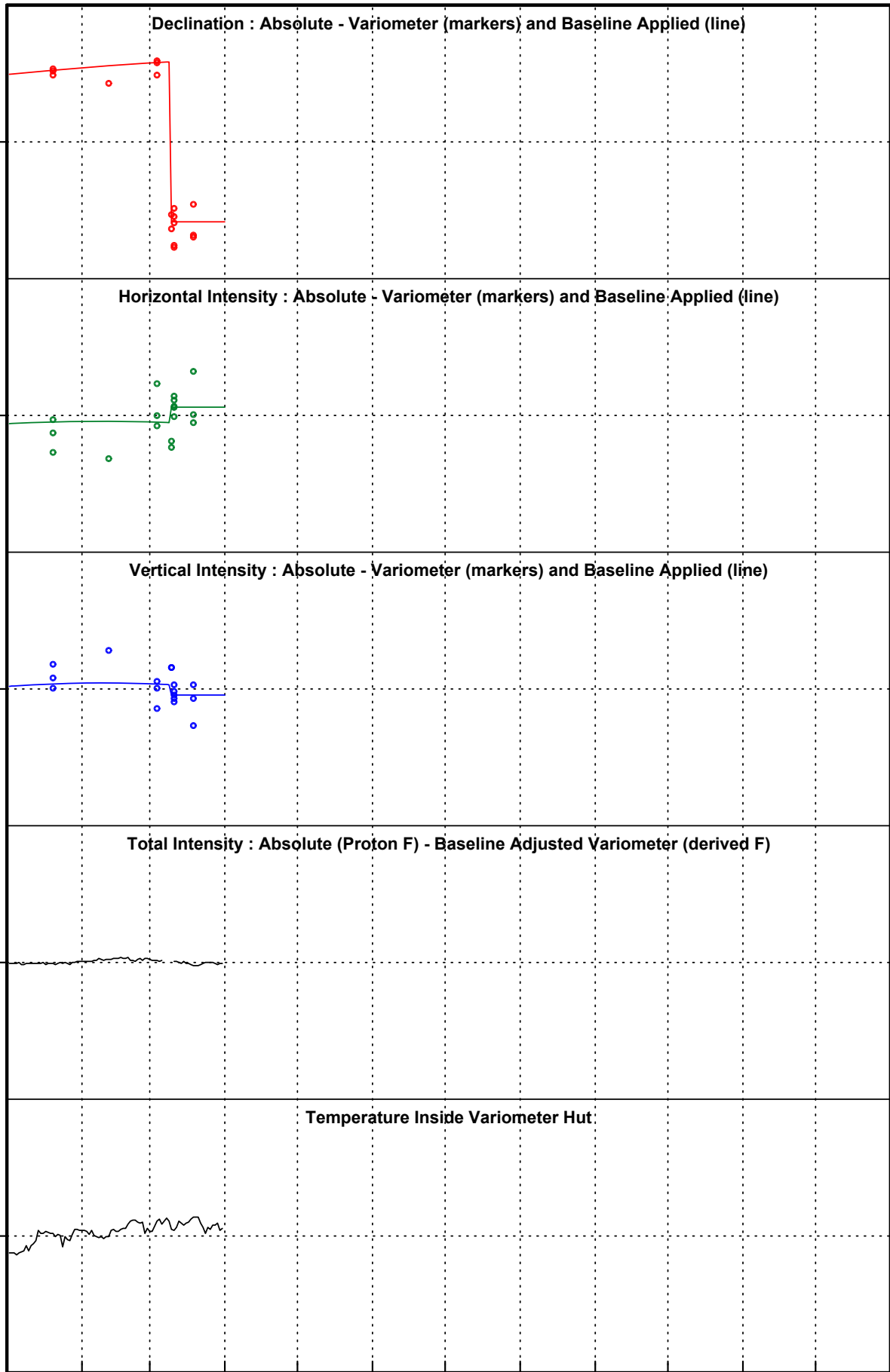
20nT

Temperature Inside Variometer Hut

33.8

20°C

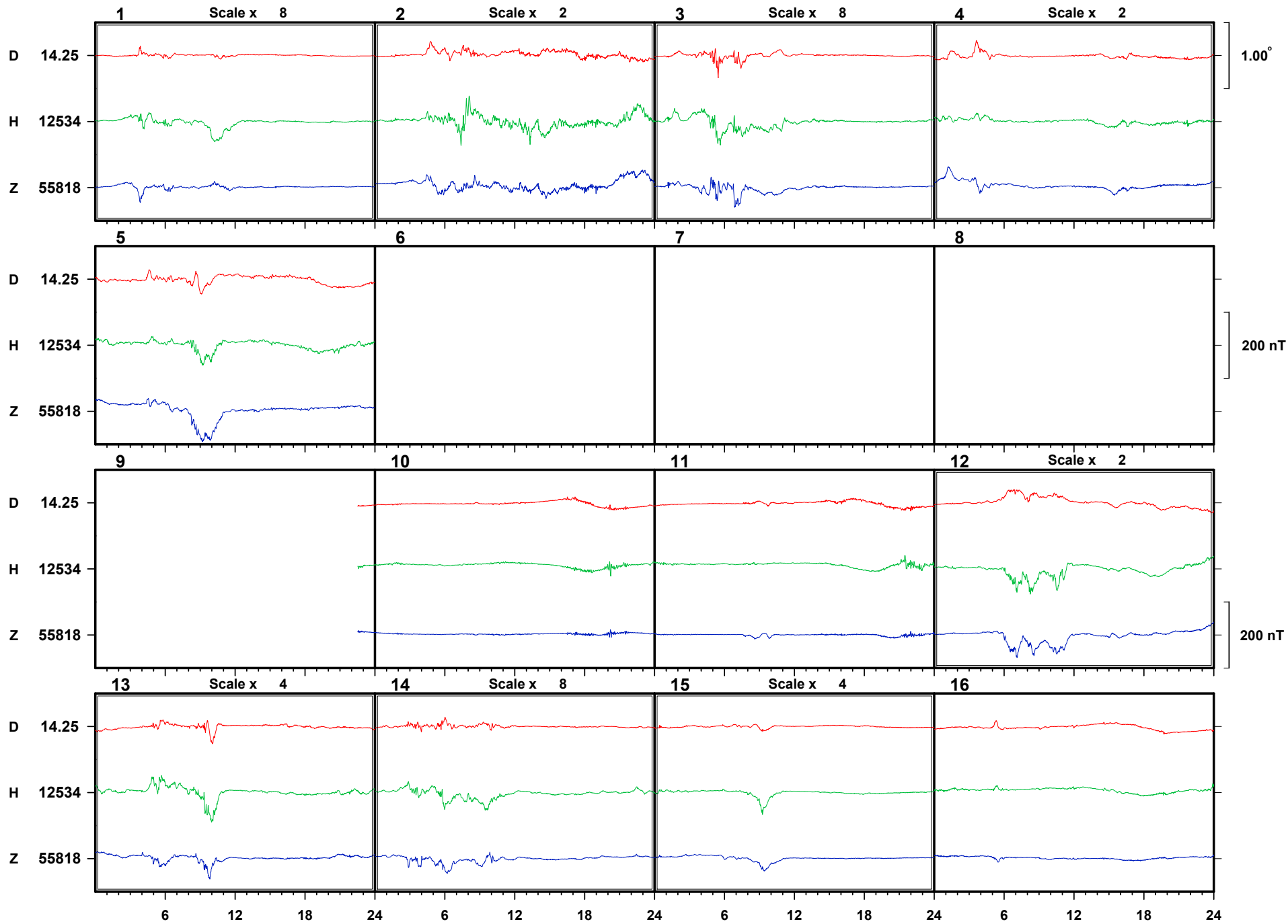
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec



# Fort McMurray

# March

# 2021



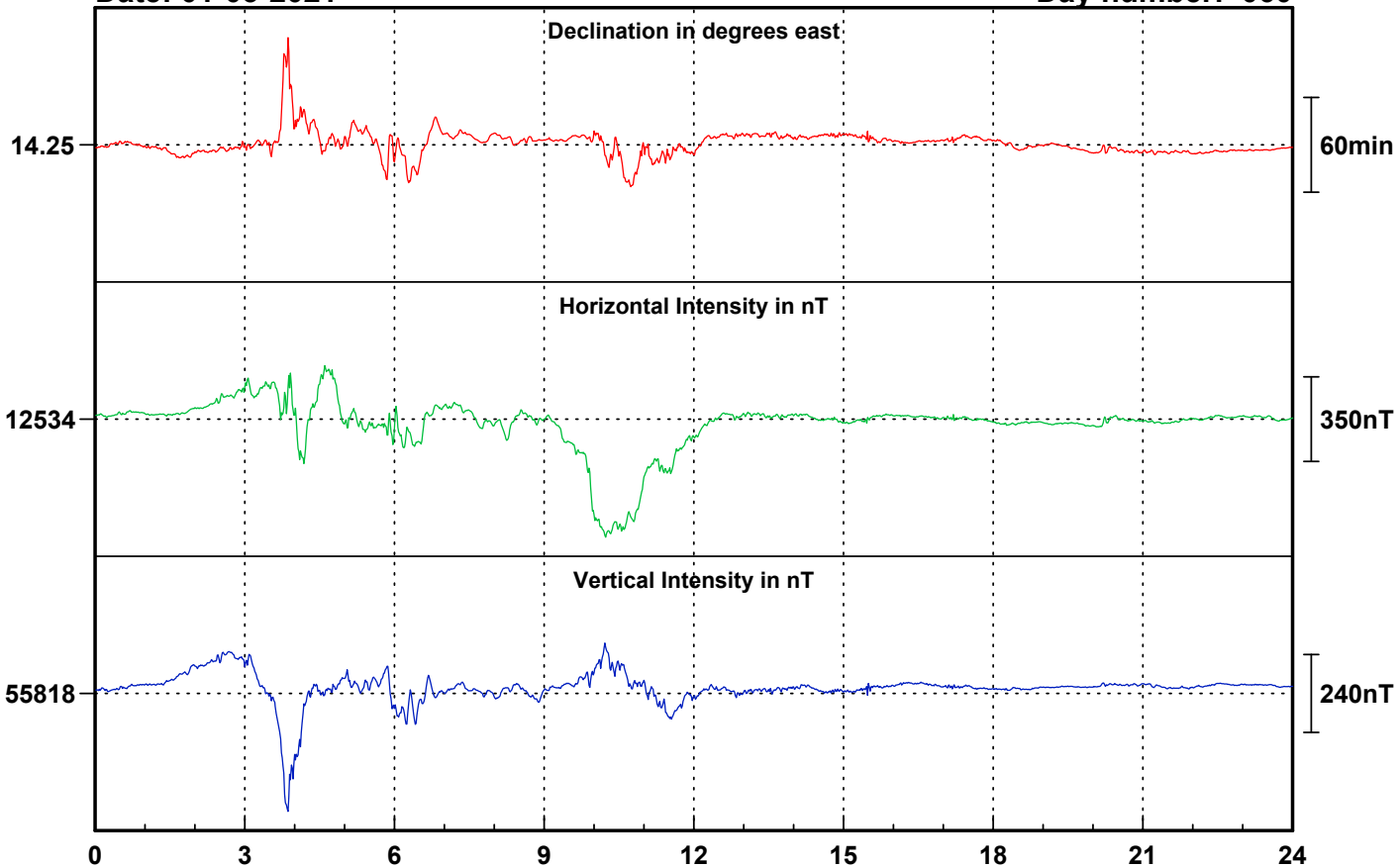




Date: 01-03-2021

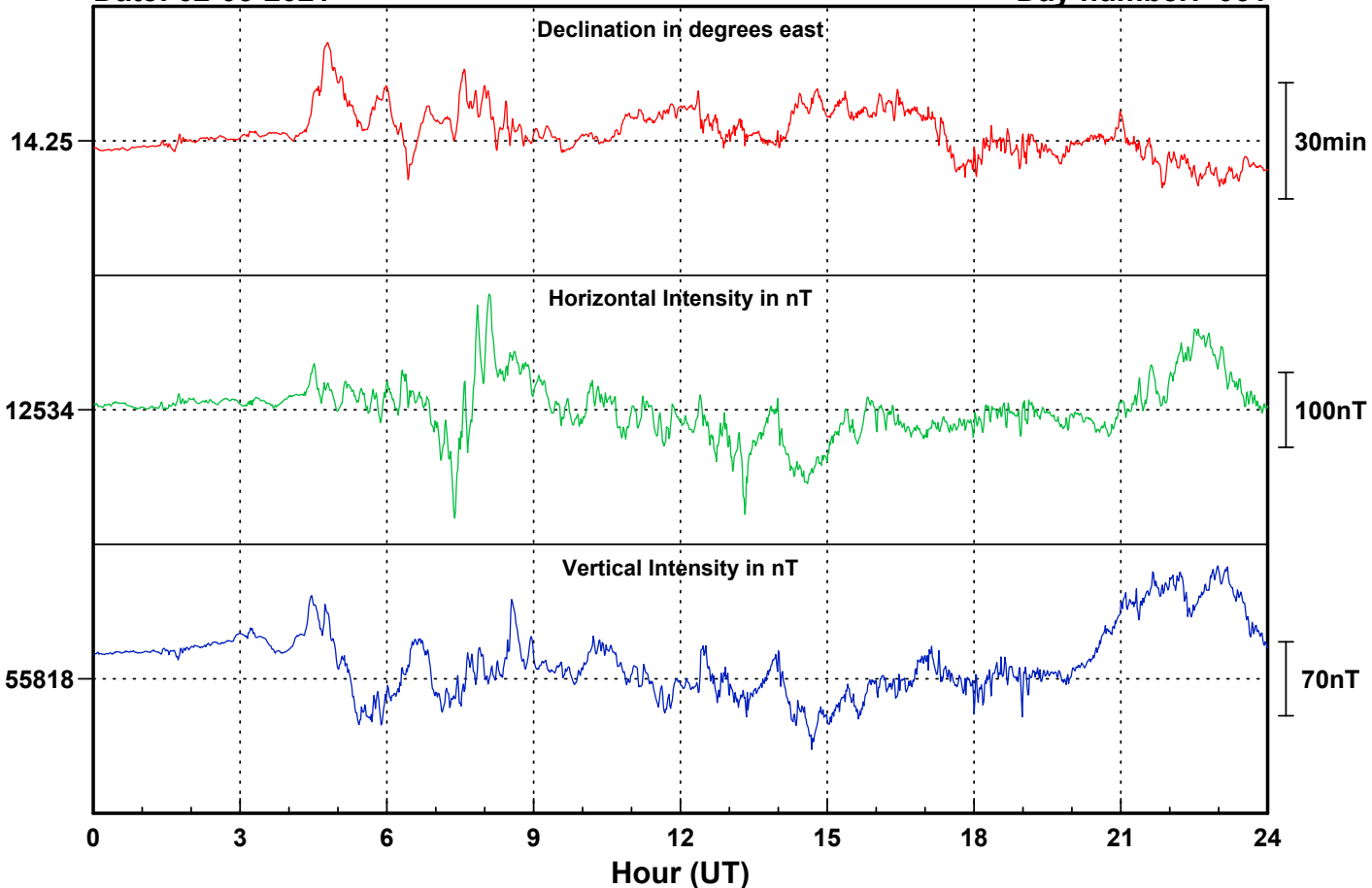
# Fort McMurray

Day number: 060



Date: 02-03-2021

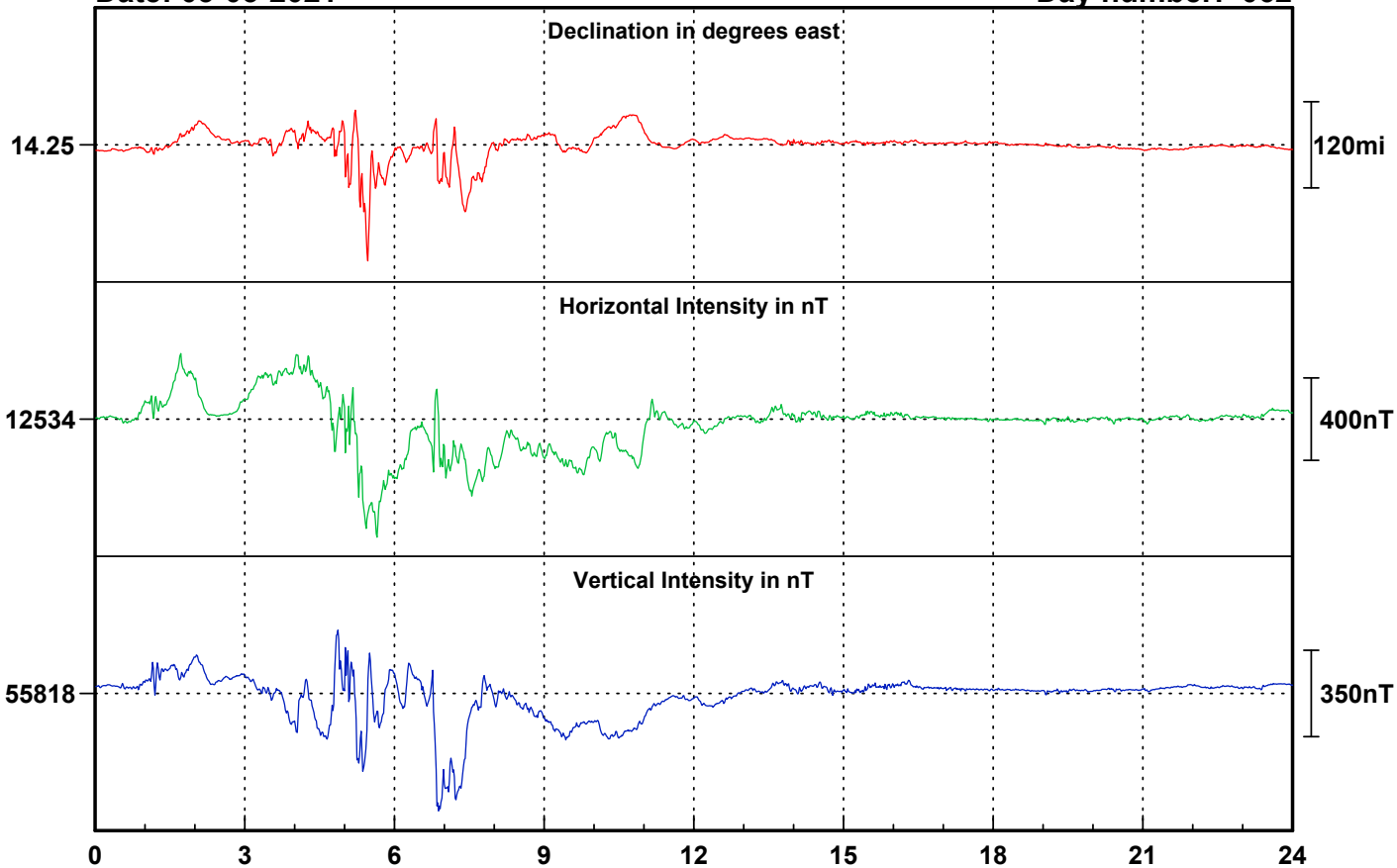
Day number: 061



Date: 03-03-2021

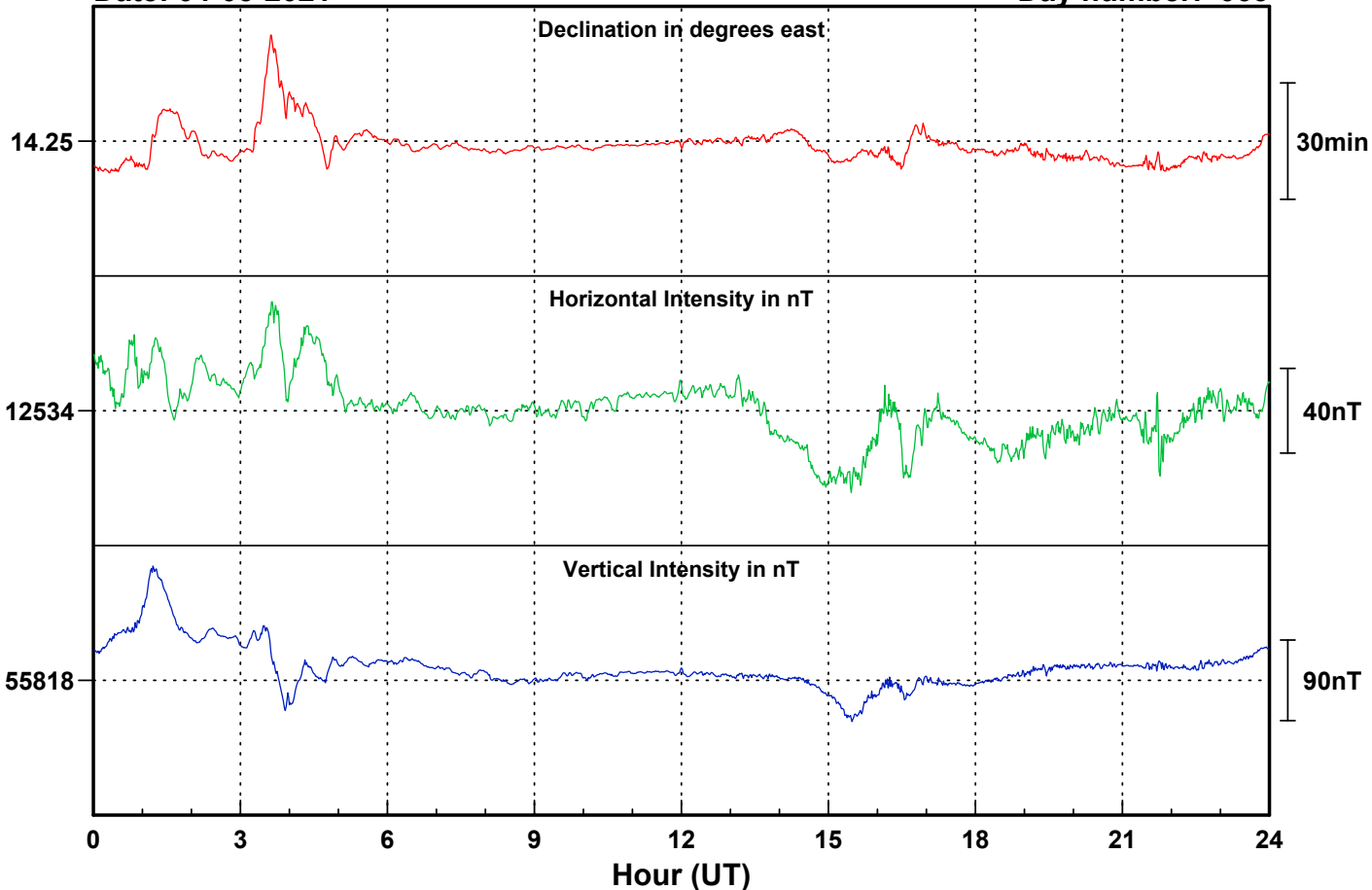
# Fort McMurray

Day number: 062



Date: 04-03-2021

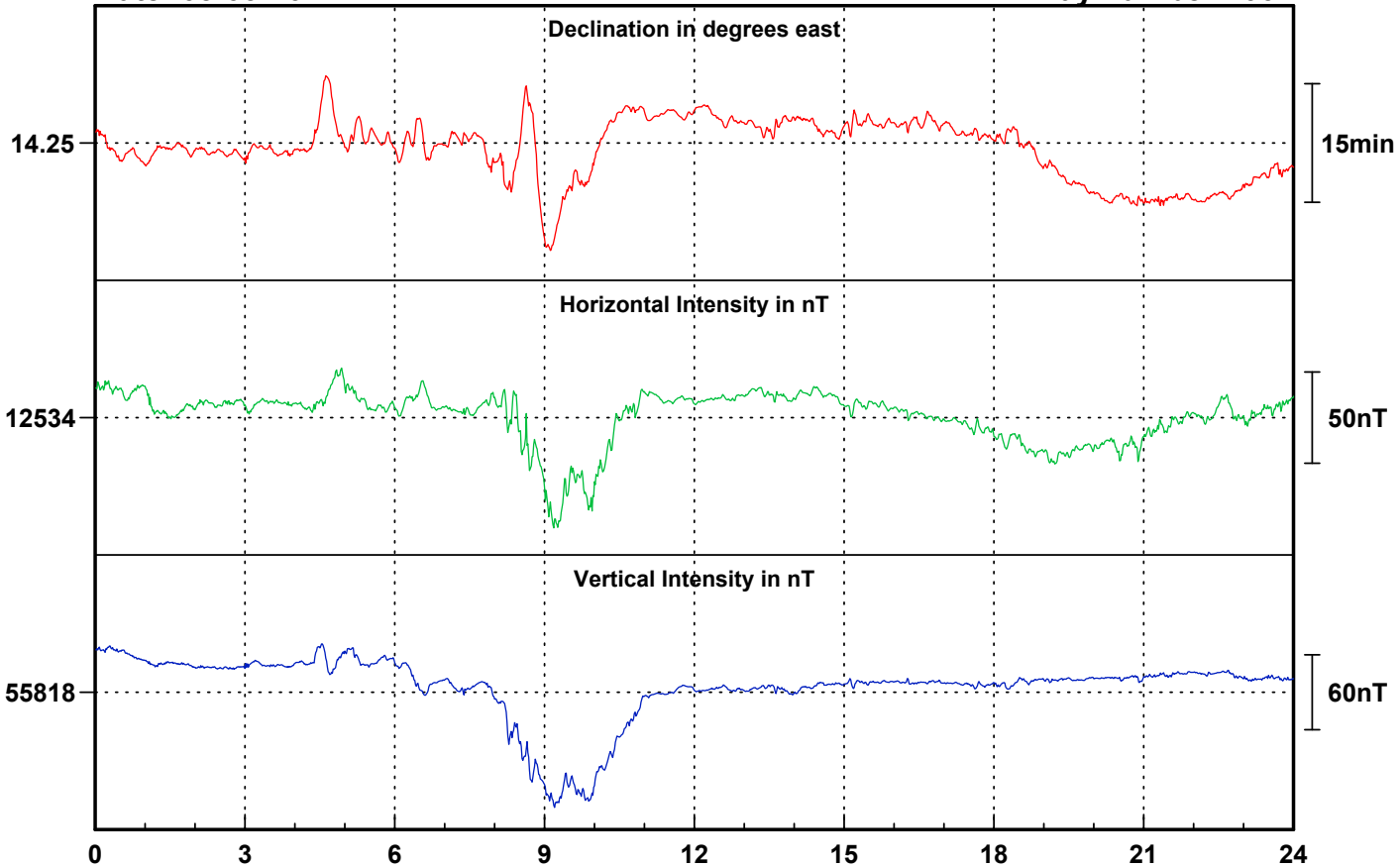
Day number: 063



Date: 05-03-2021

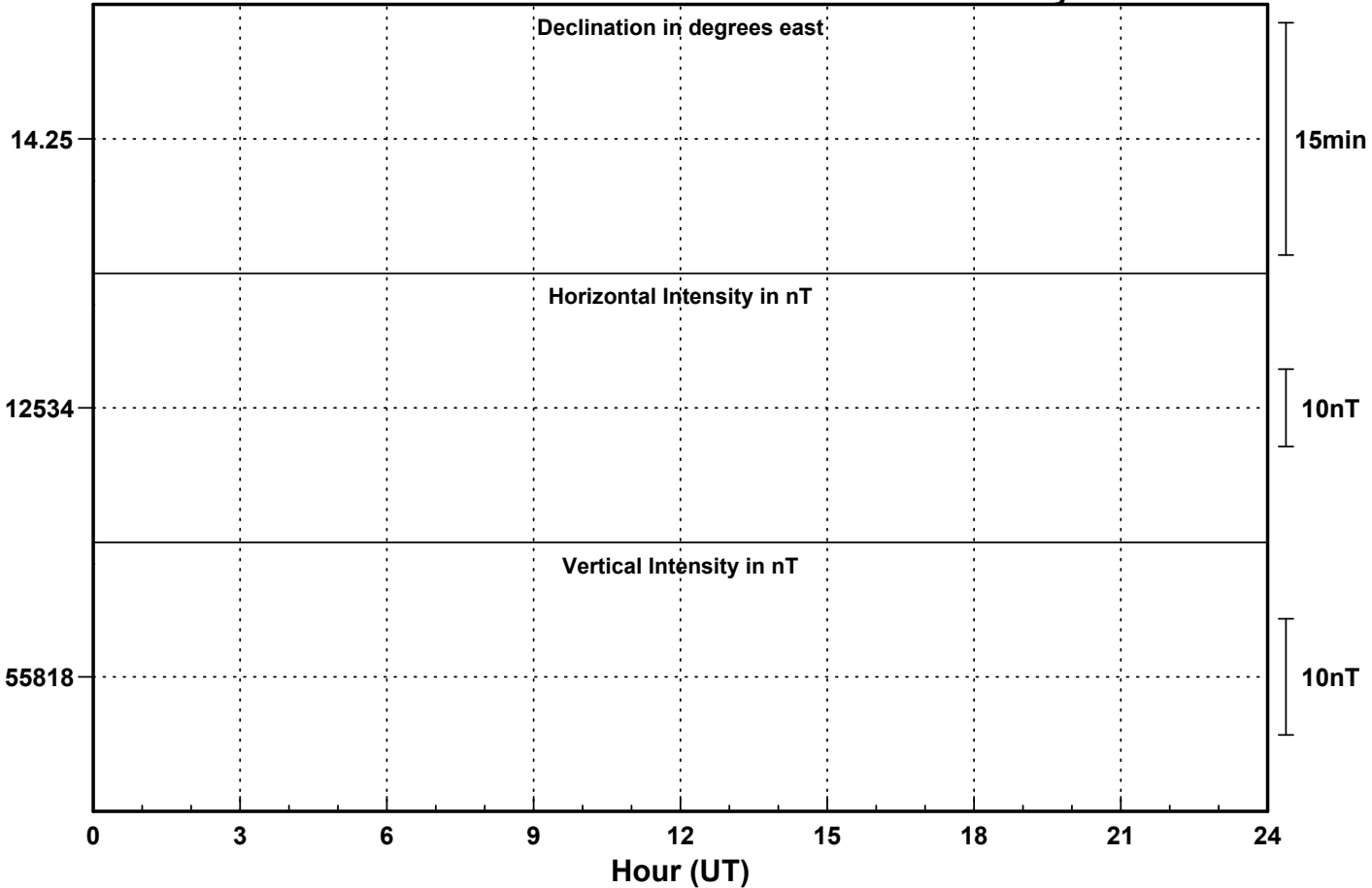
# Fort McMurray

Day number: 064



Date: 06-03-2021

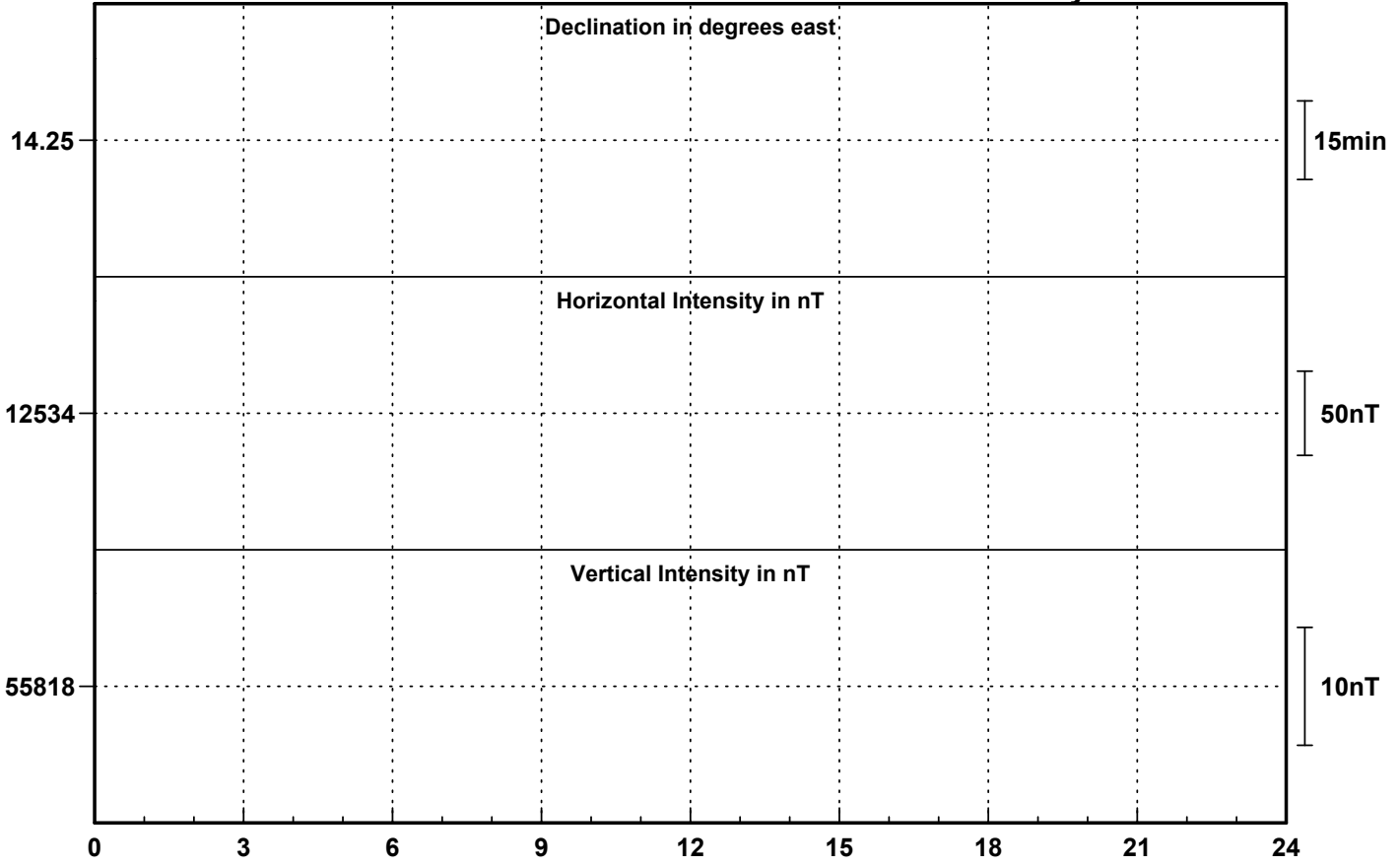
Day number: 065



Date: 07-03-2021

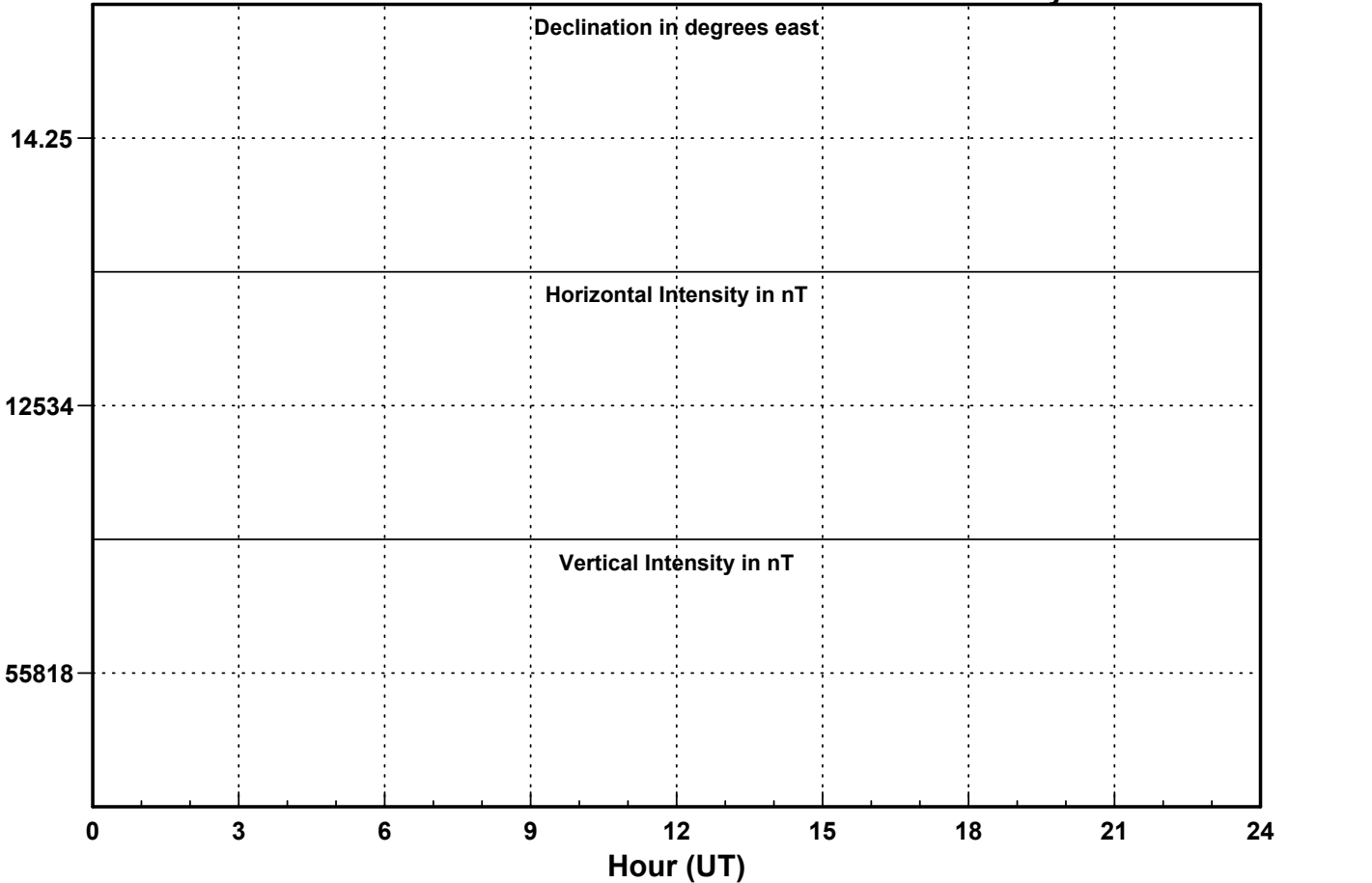
# Fort McMurray

Day number: 066



Date: 08-03-2021

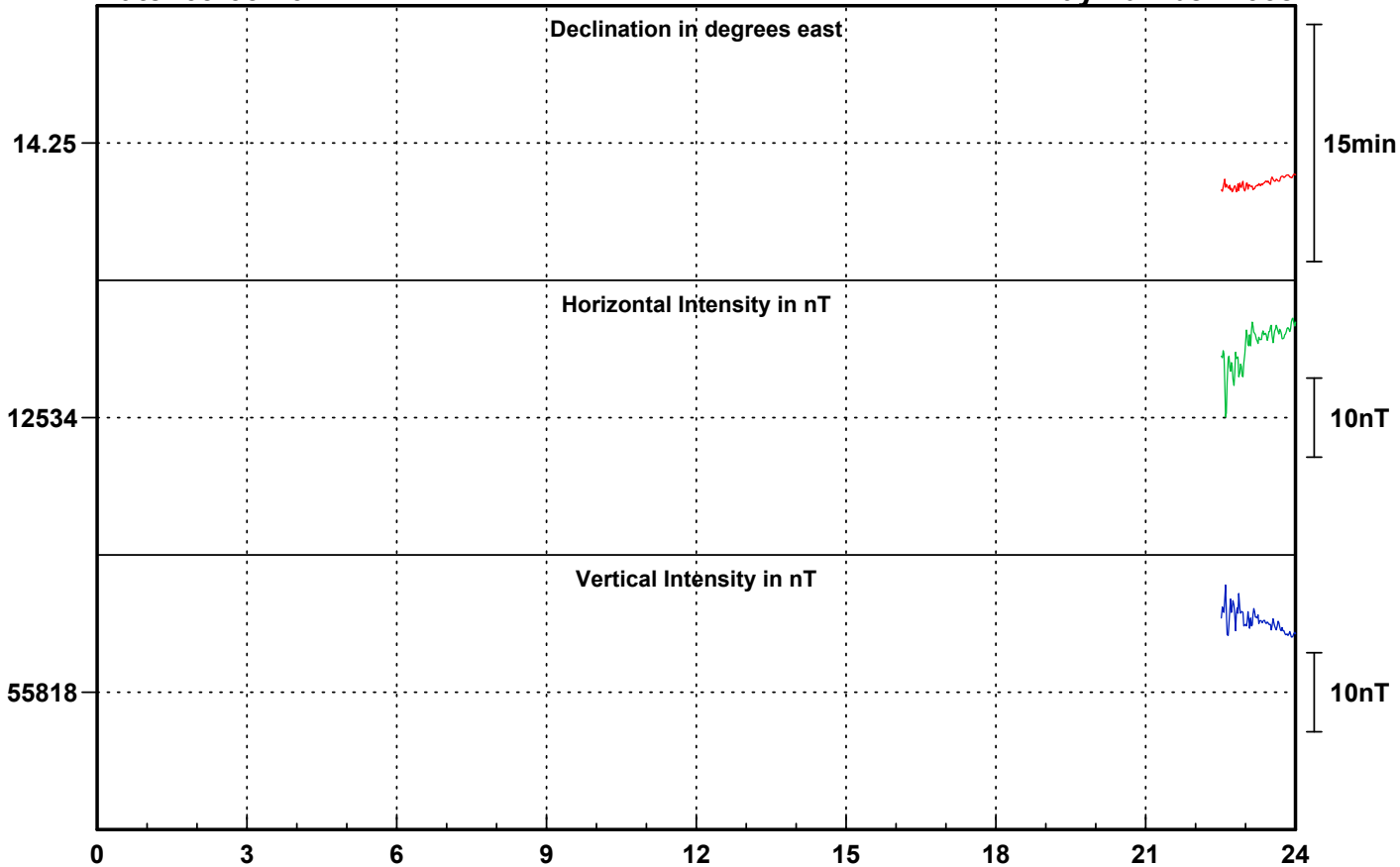
Day number: 067



Date: 09-03-2021

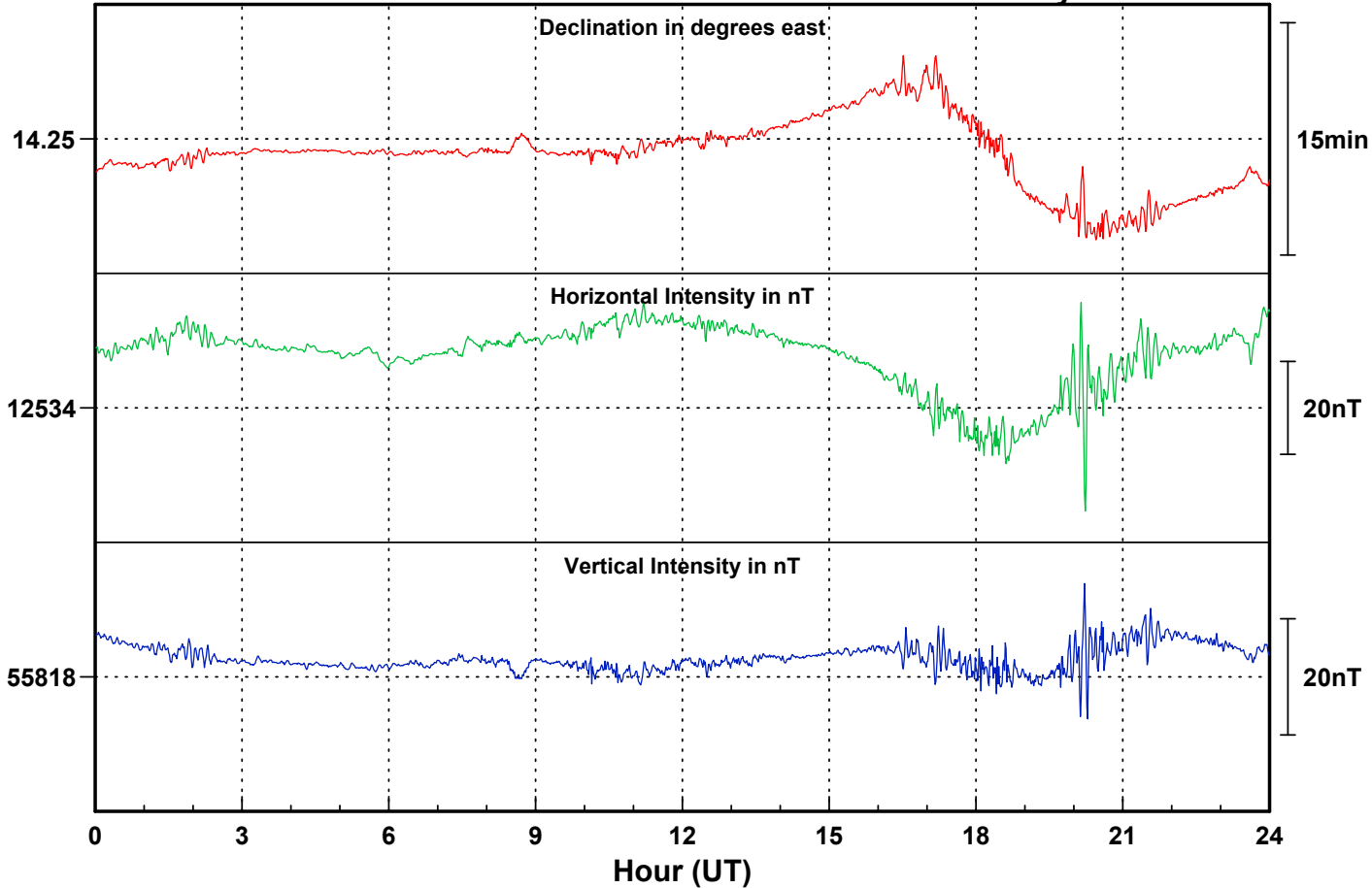
# Fort McMurray

Day number: 068



Date: 10-03-2021

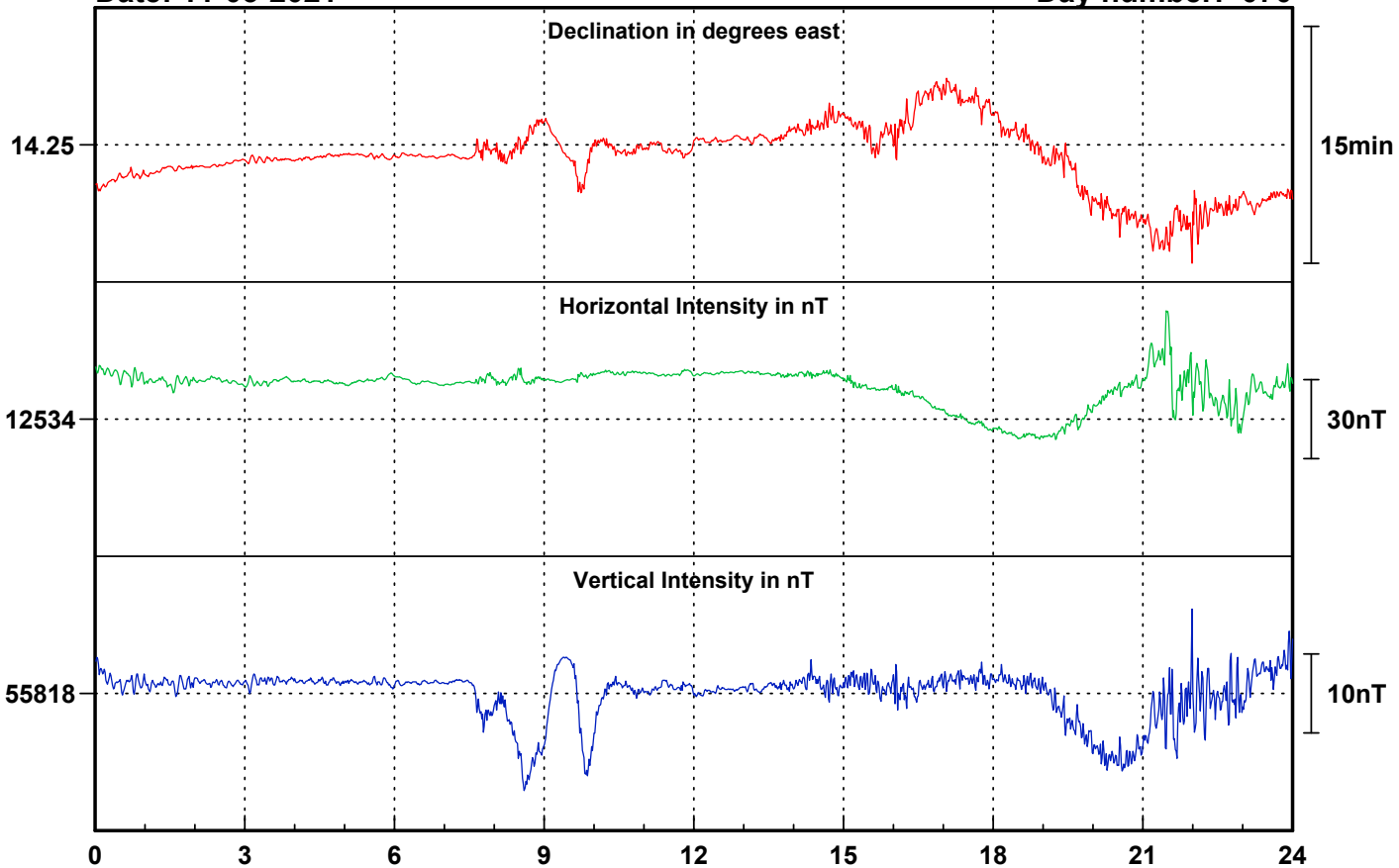
Day number: 069



Date: 11-03-2021

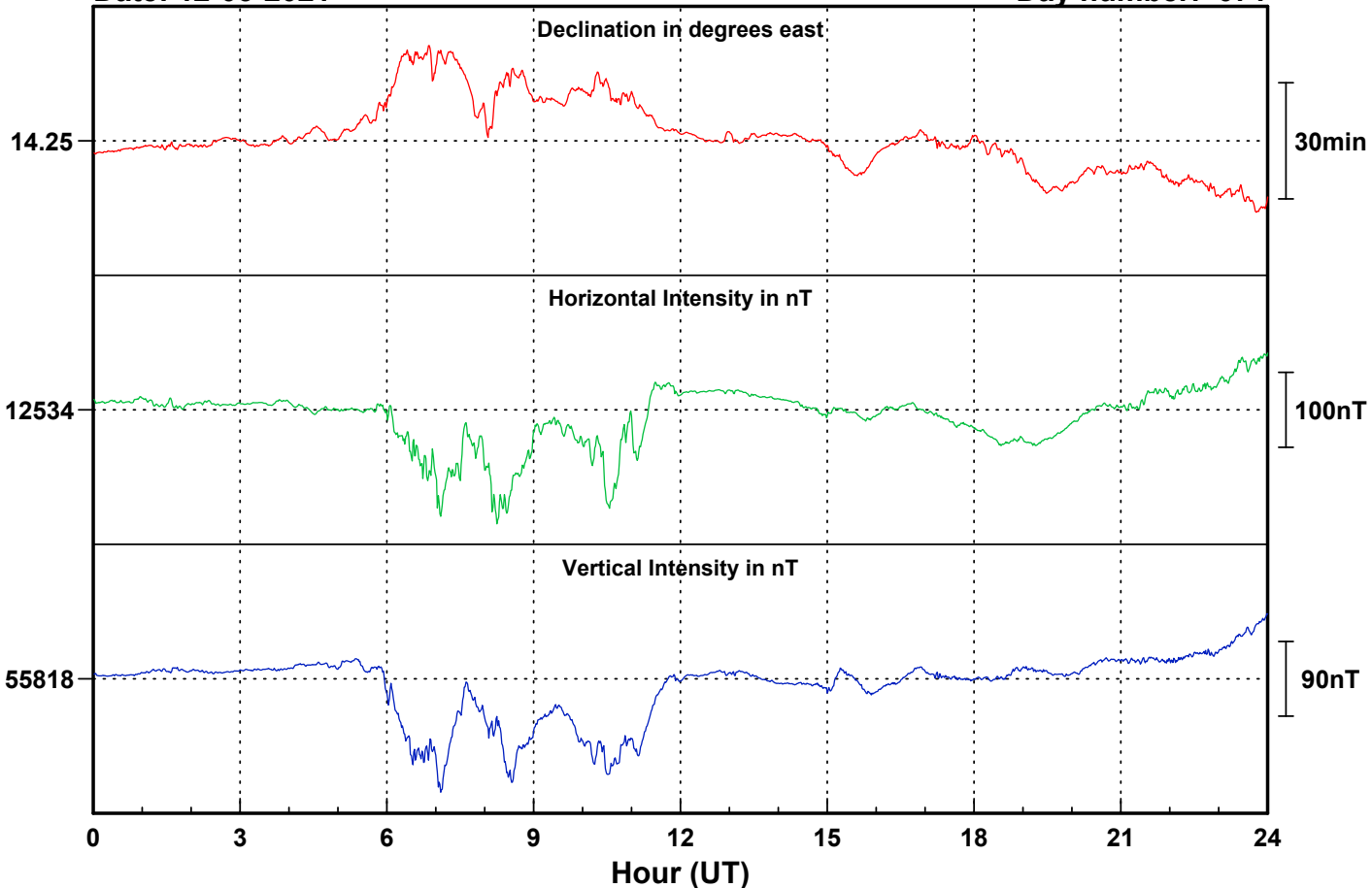
# Fort McMurray

Day number: 070



Date: 12-03-2021

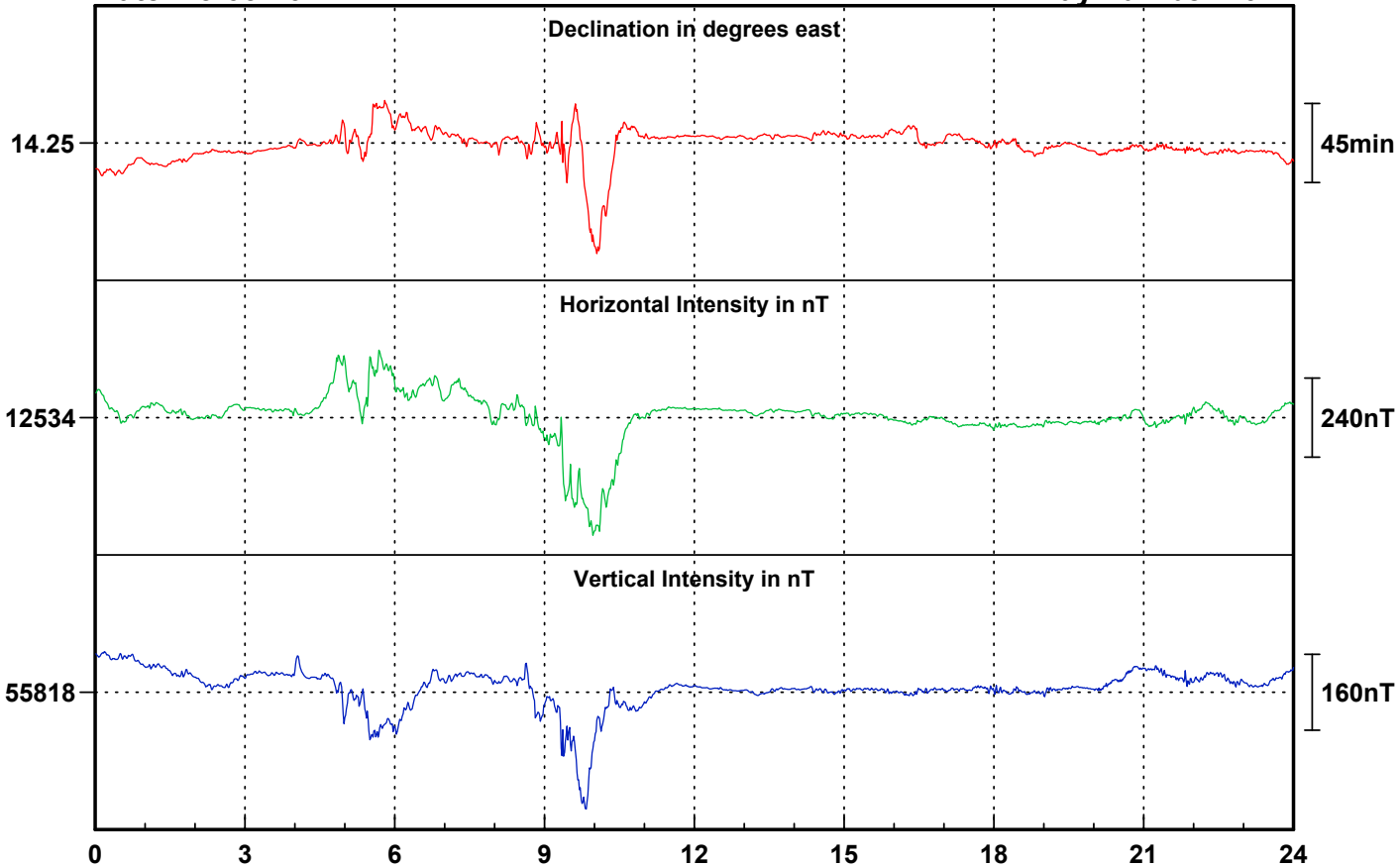
Day number: 071



Date: 13-03-2021

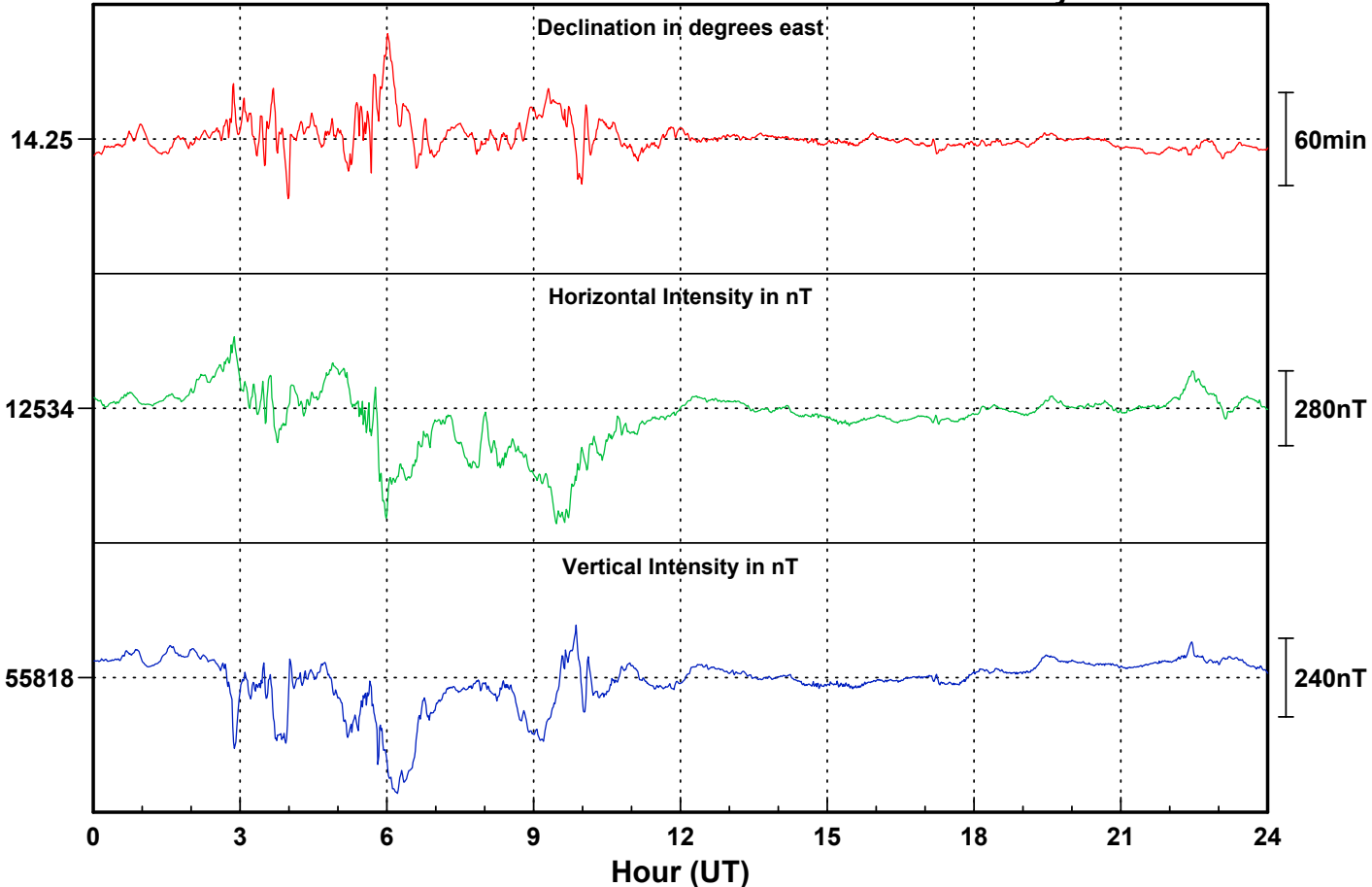
# Fort McMurray

Day number: 072



Date: 14-03-2021

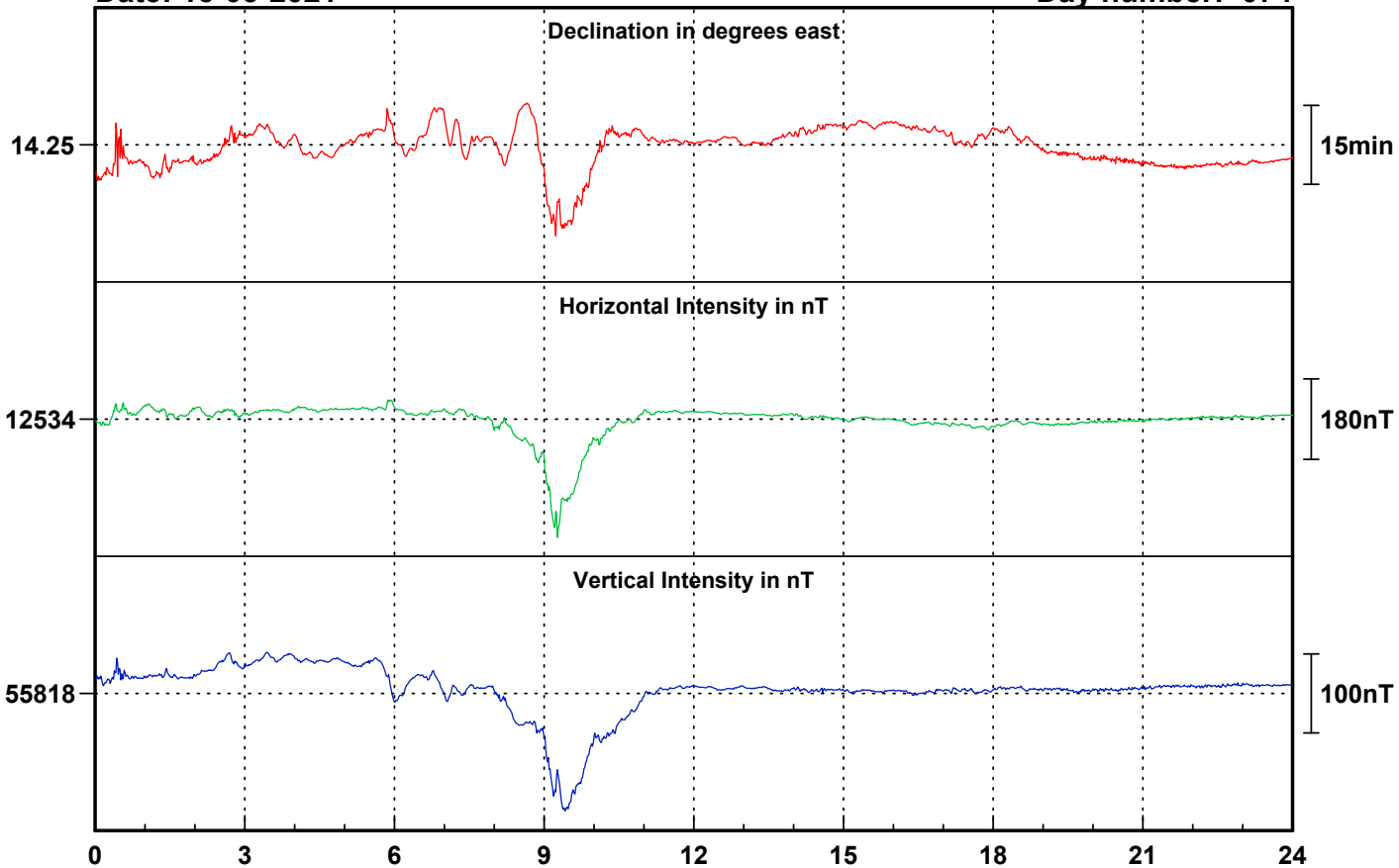
Day number: 073



Date: 15-03-2021

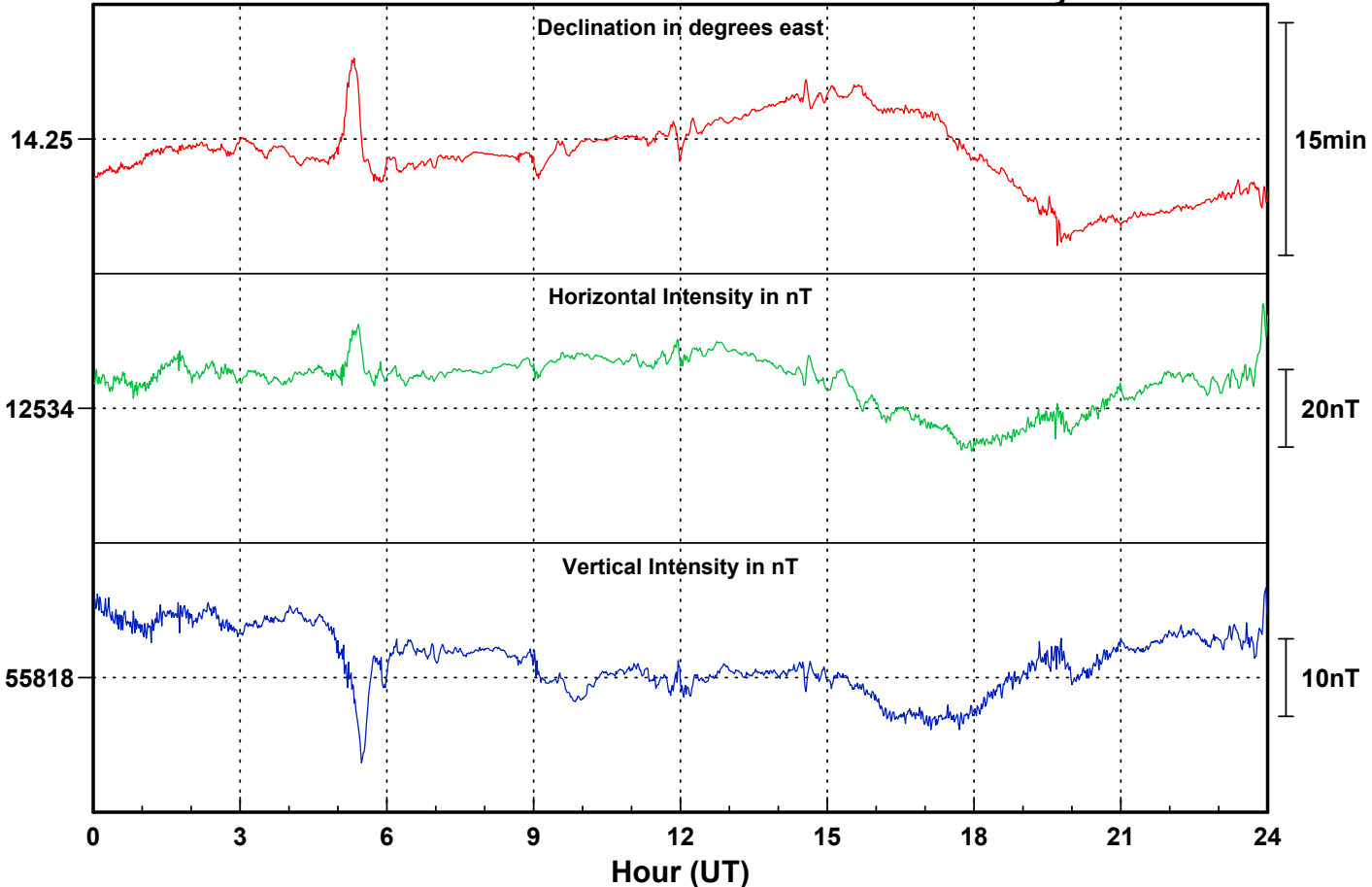
# Fort McMurray

Day number: 074



Date: 16-03-2021

Day number: 075

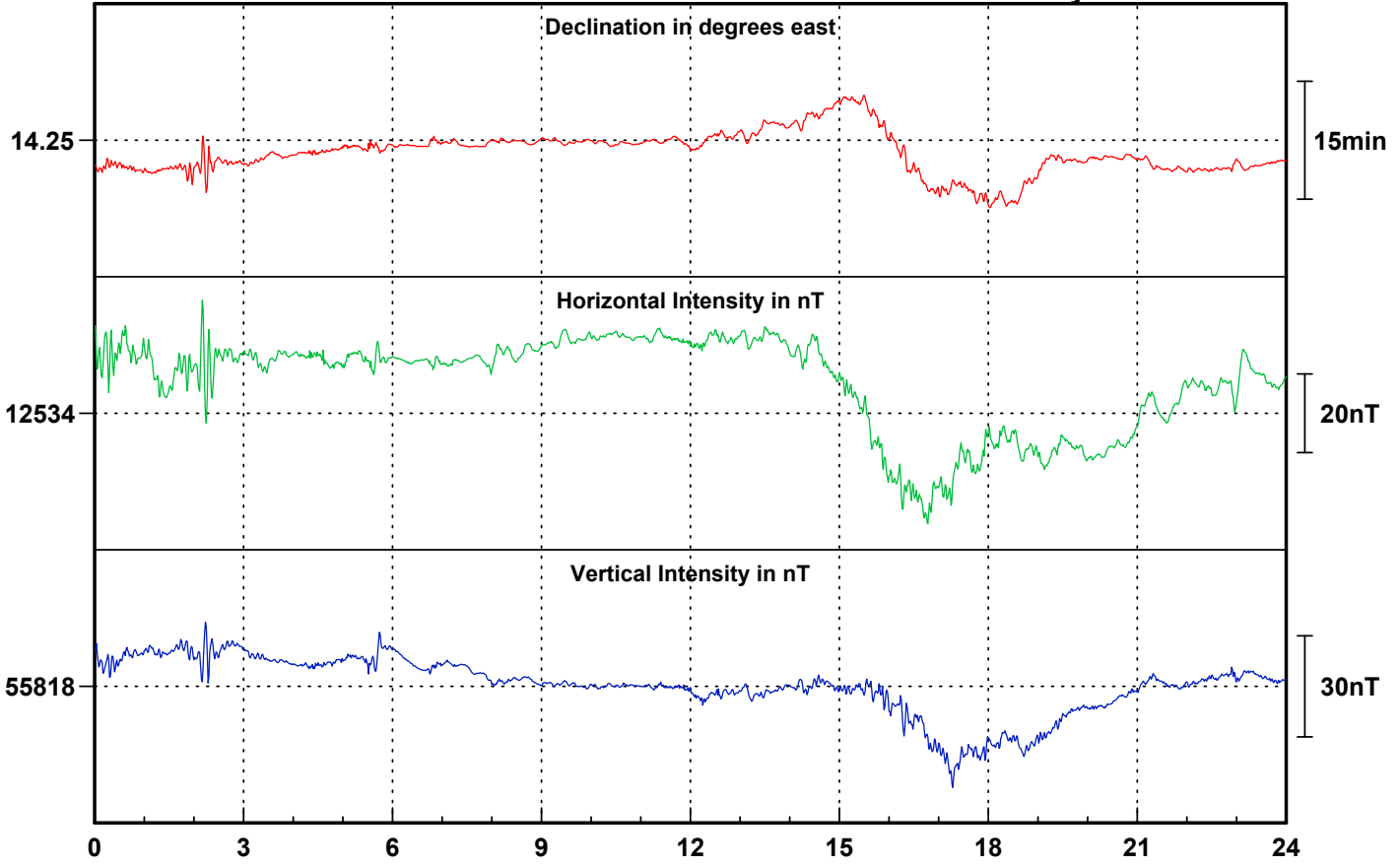




Date: 17-03-2021

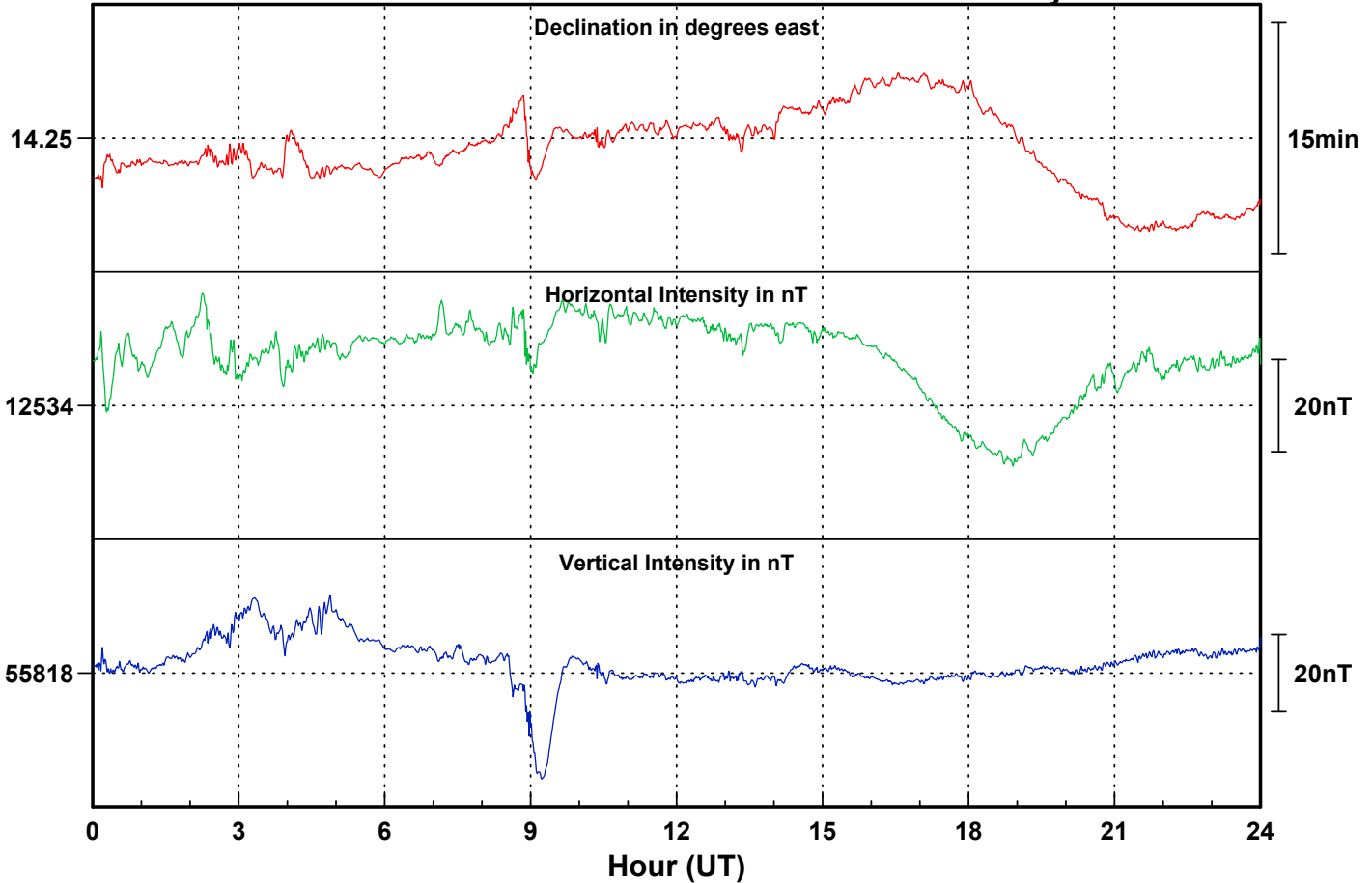
# Fort McMurray

Day number: 076



Date: 18-03-2021

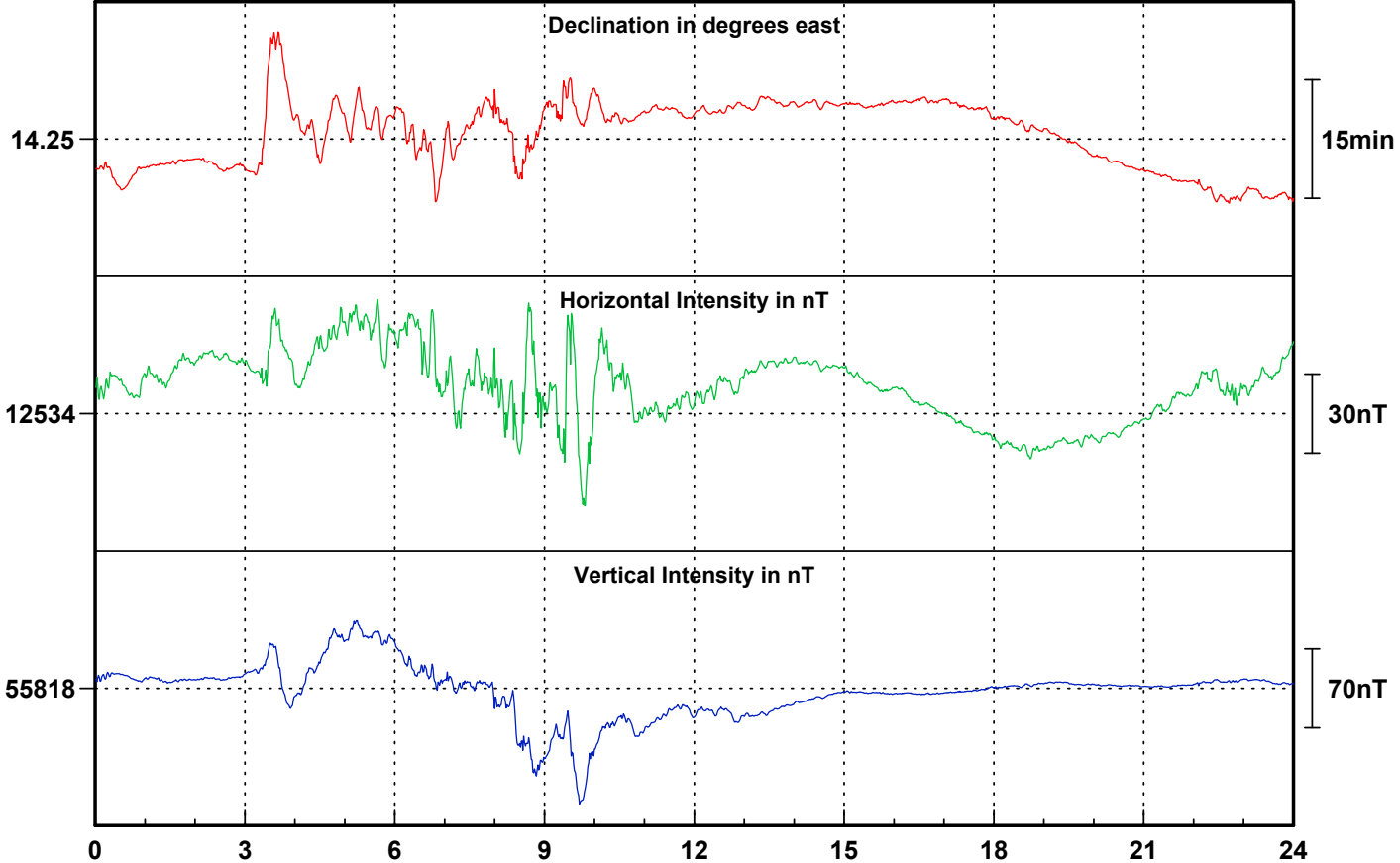
Day number: 077



Date: 19-03-2021

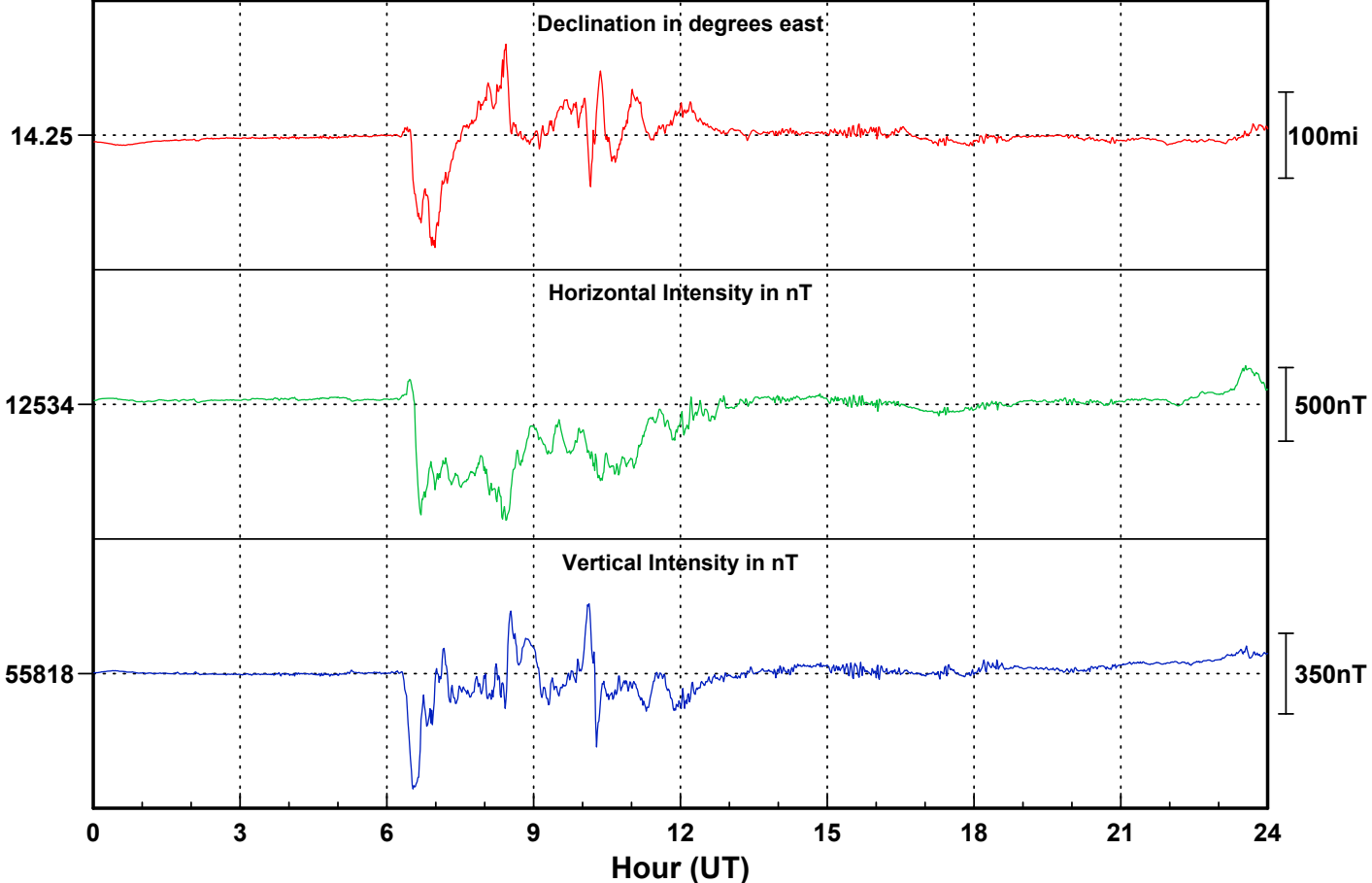
# Fort McMurray

Day number: 078



Date: 20-03-2021

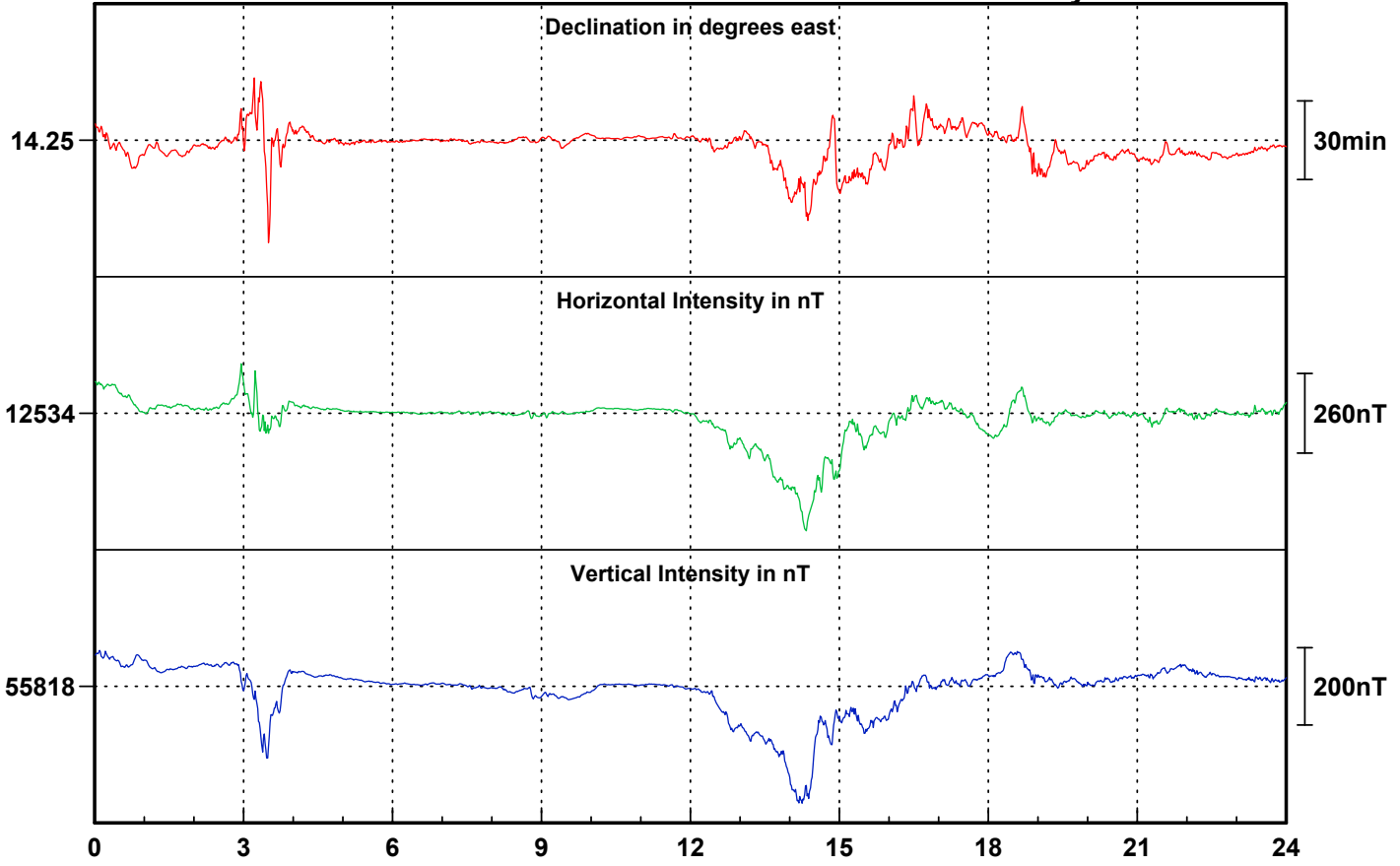
Day number: 079



Date: 21-03-2021

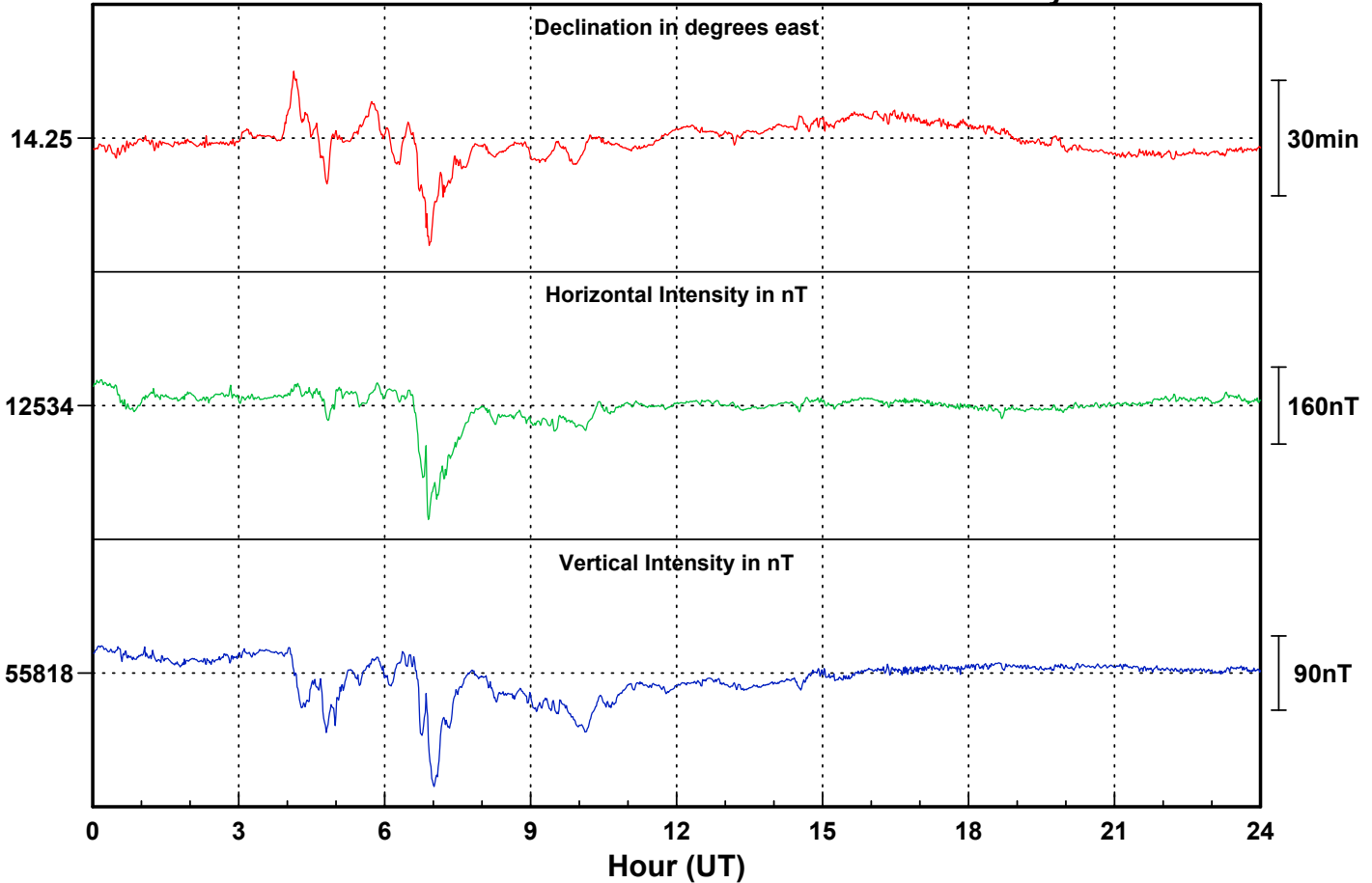
# Fort McMurray

Day number: 080



Date: 22-03-2021

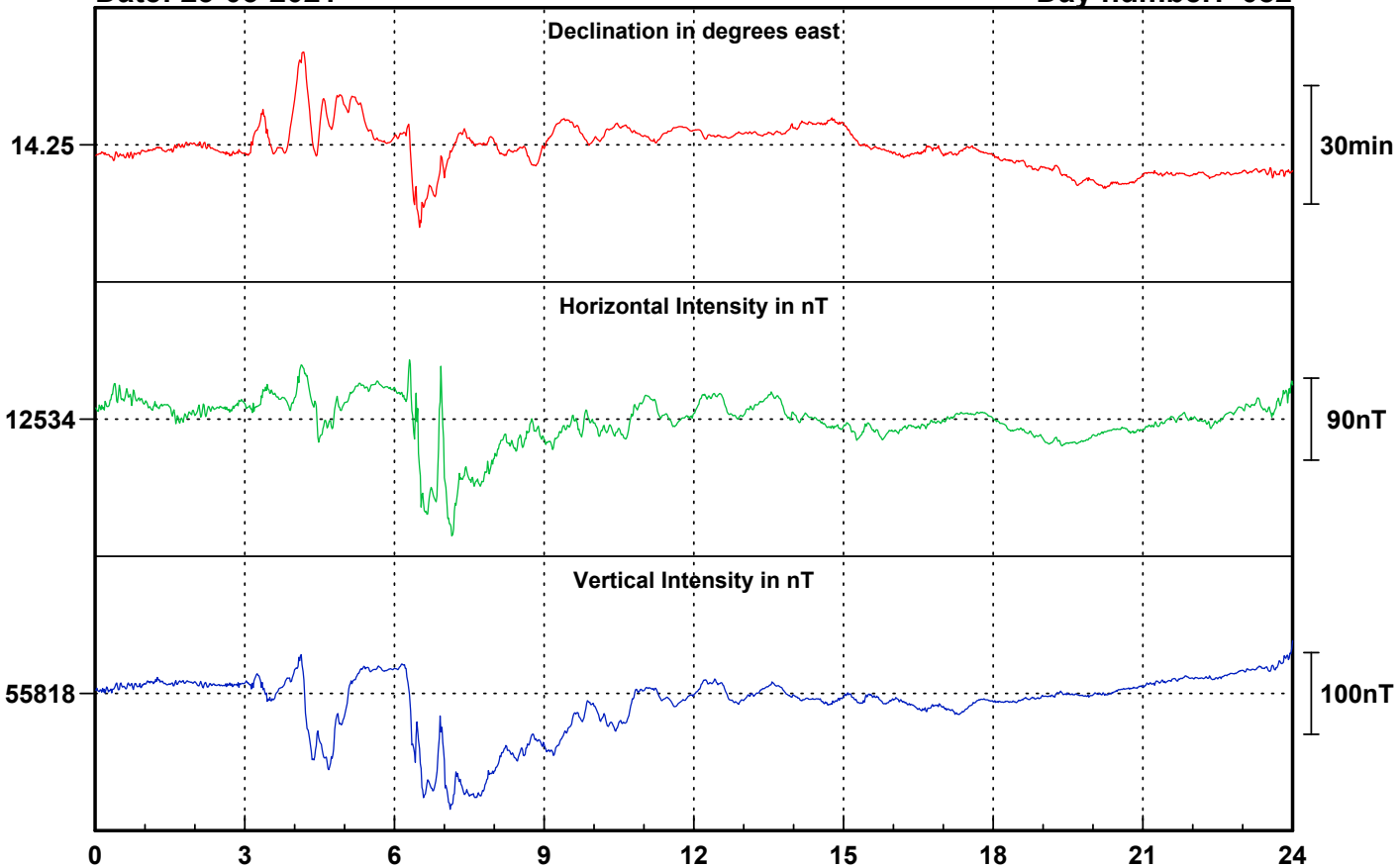
Day number: 081



Date: 23-03-2021

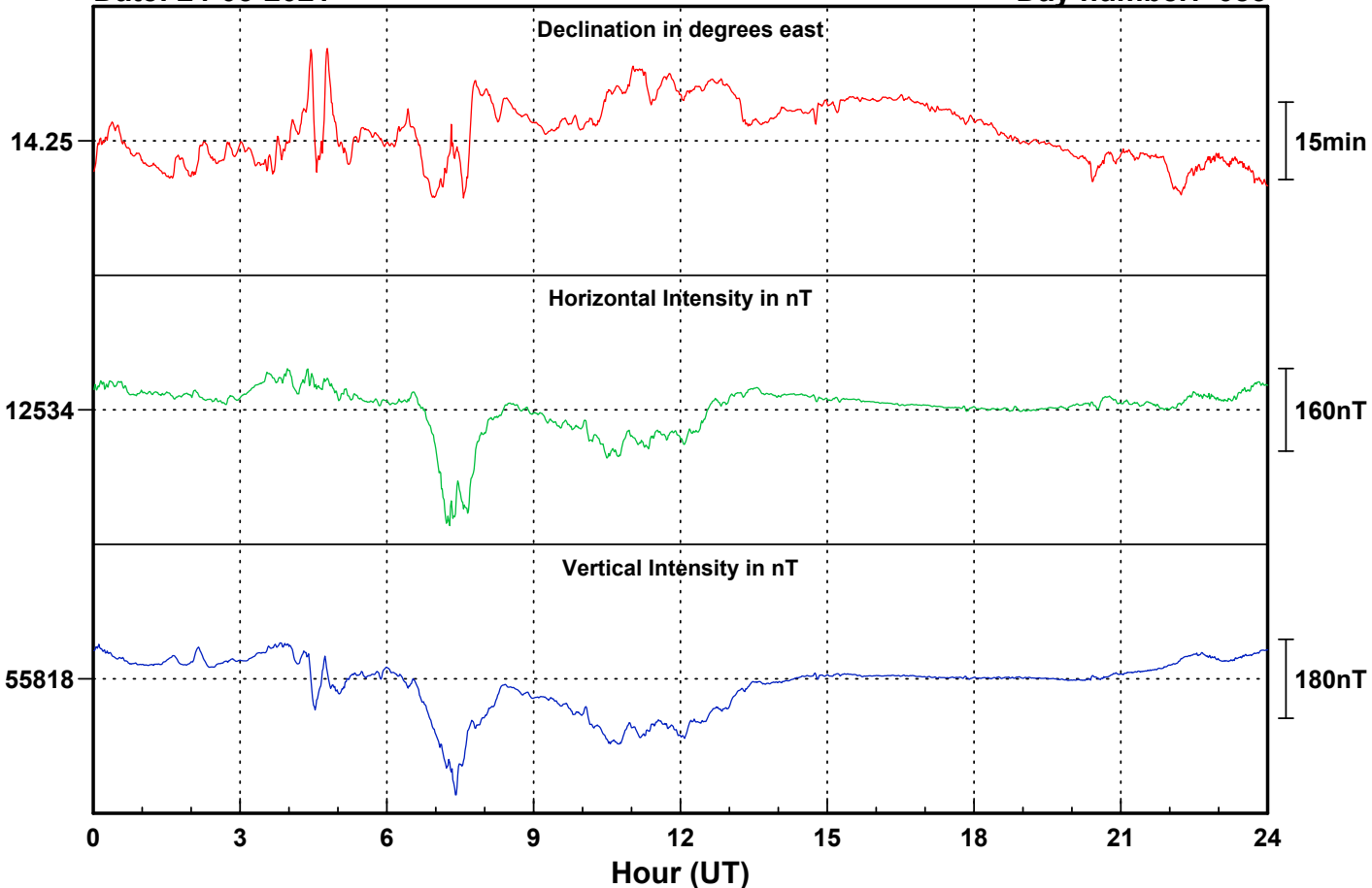
# Fort McMurray

Day number: 082



Date: 24-03-2021

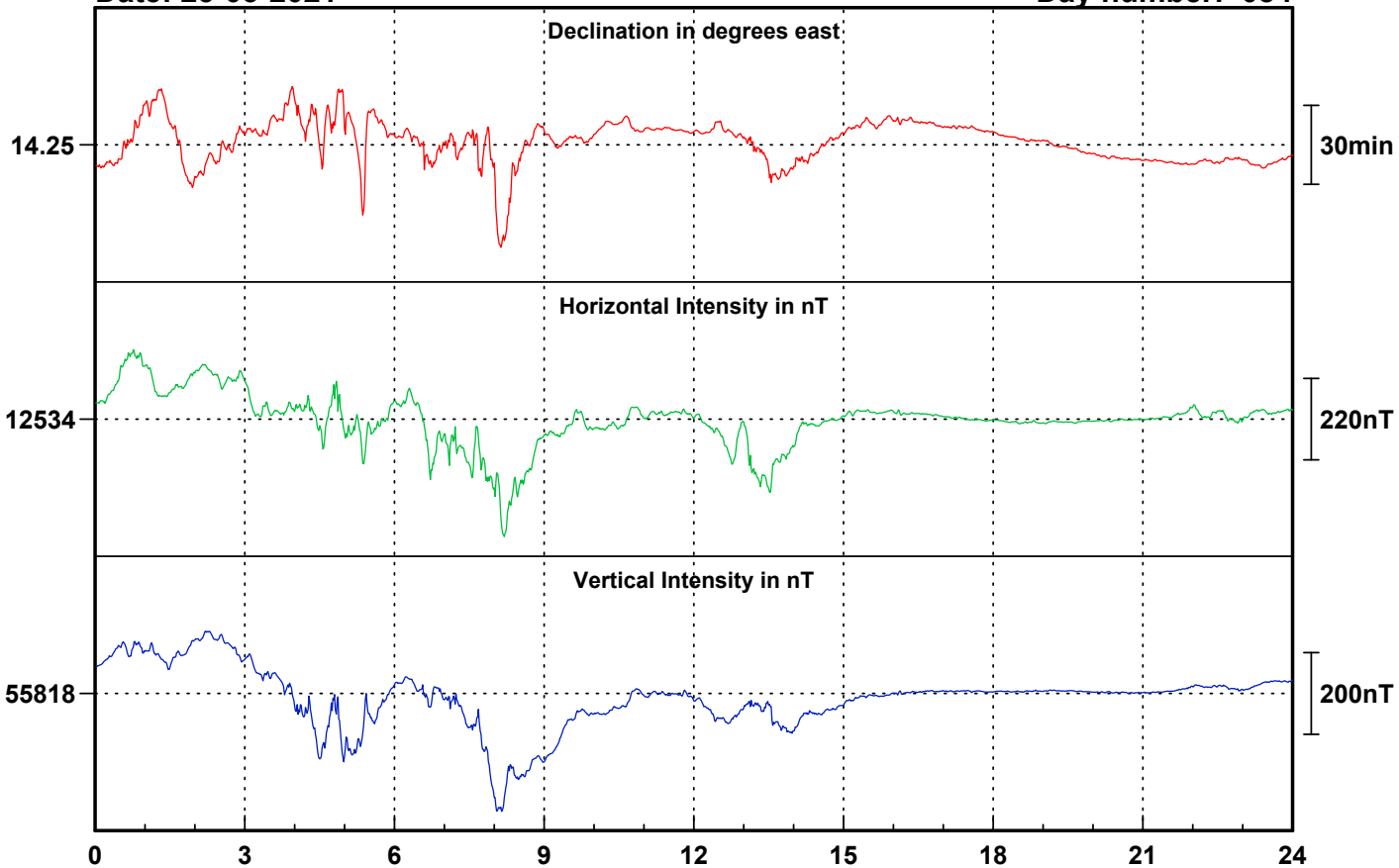
Day number: 083



Date: 25-03-2021

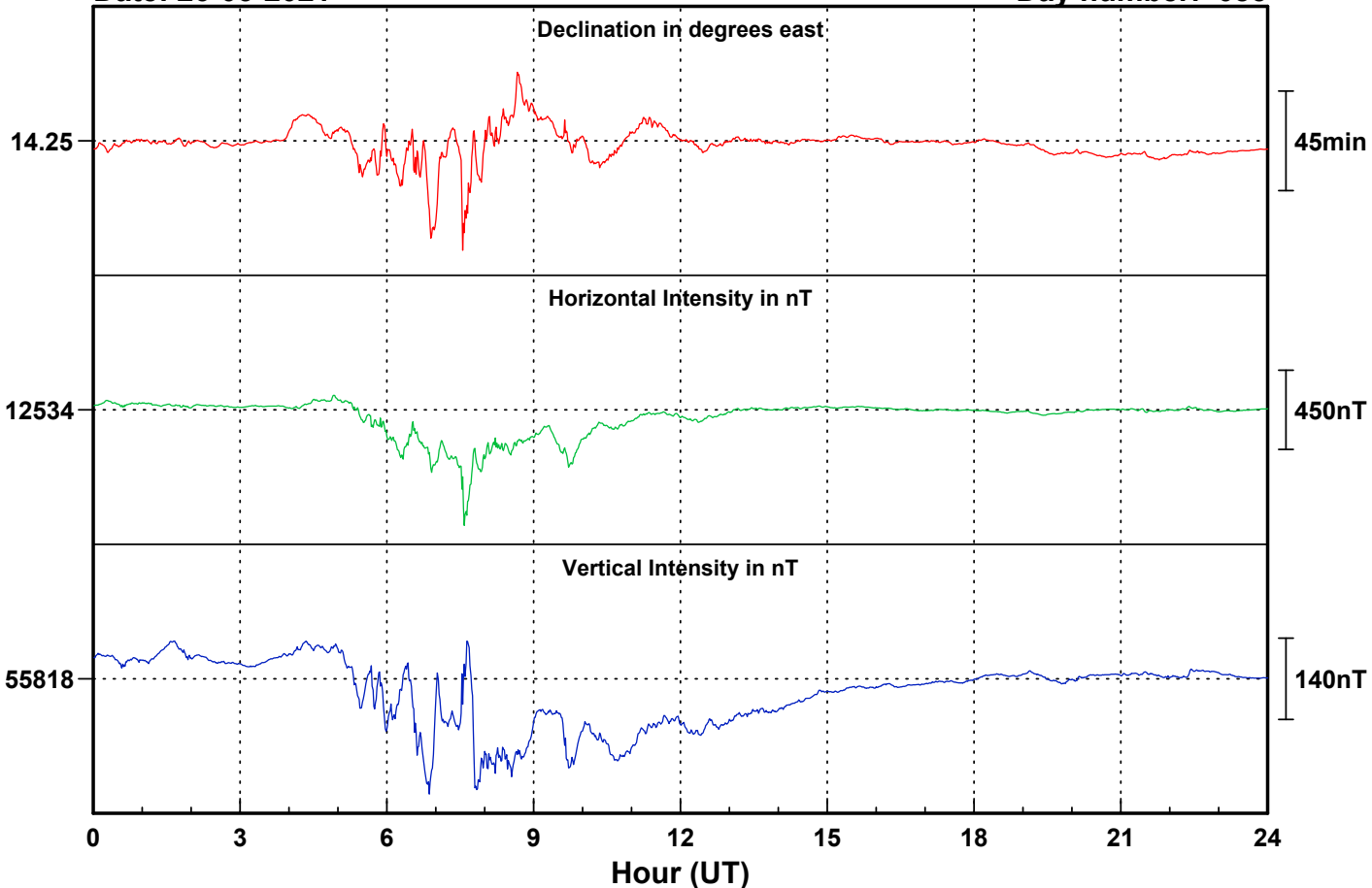
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Day number: 084



Date: 26-03-2021

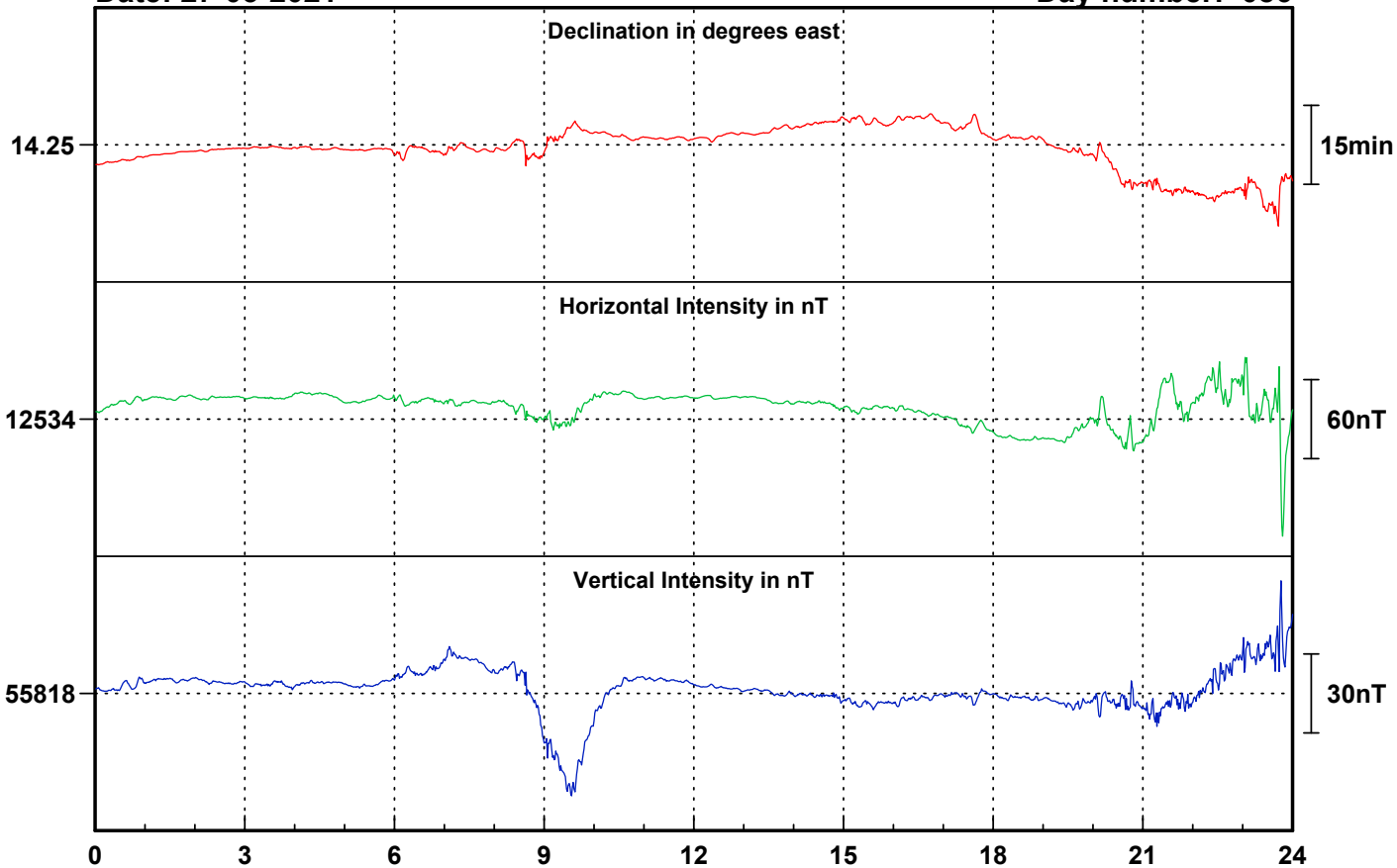
Day number: 085



Date: 27-03-2021

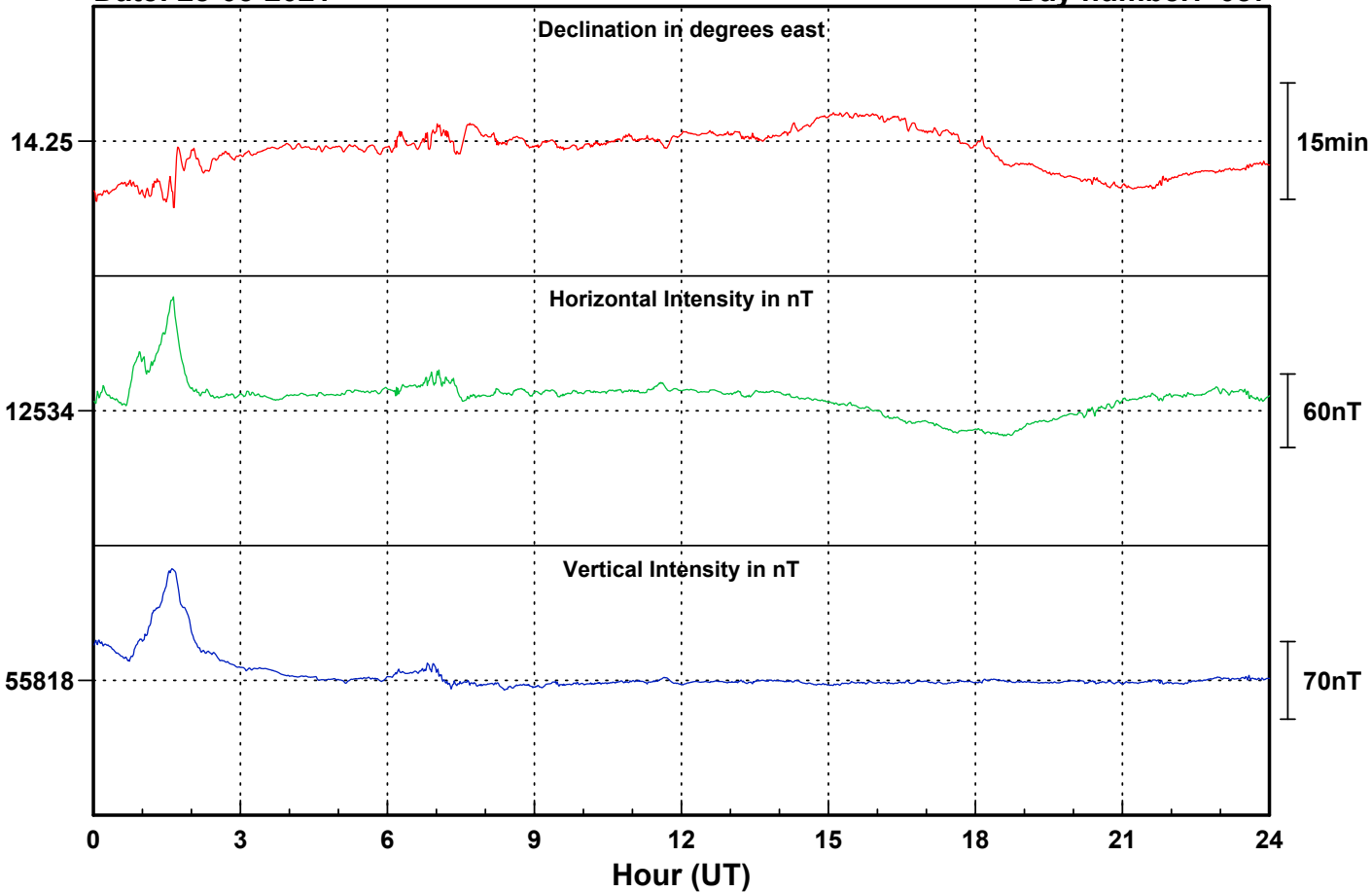
# Fort McMurray

Day number: 086



Date: 28-03-2021

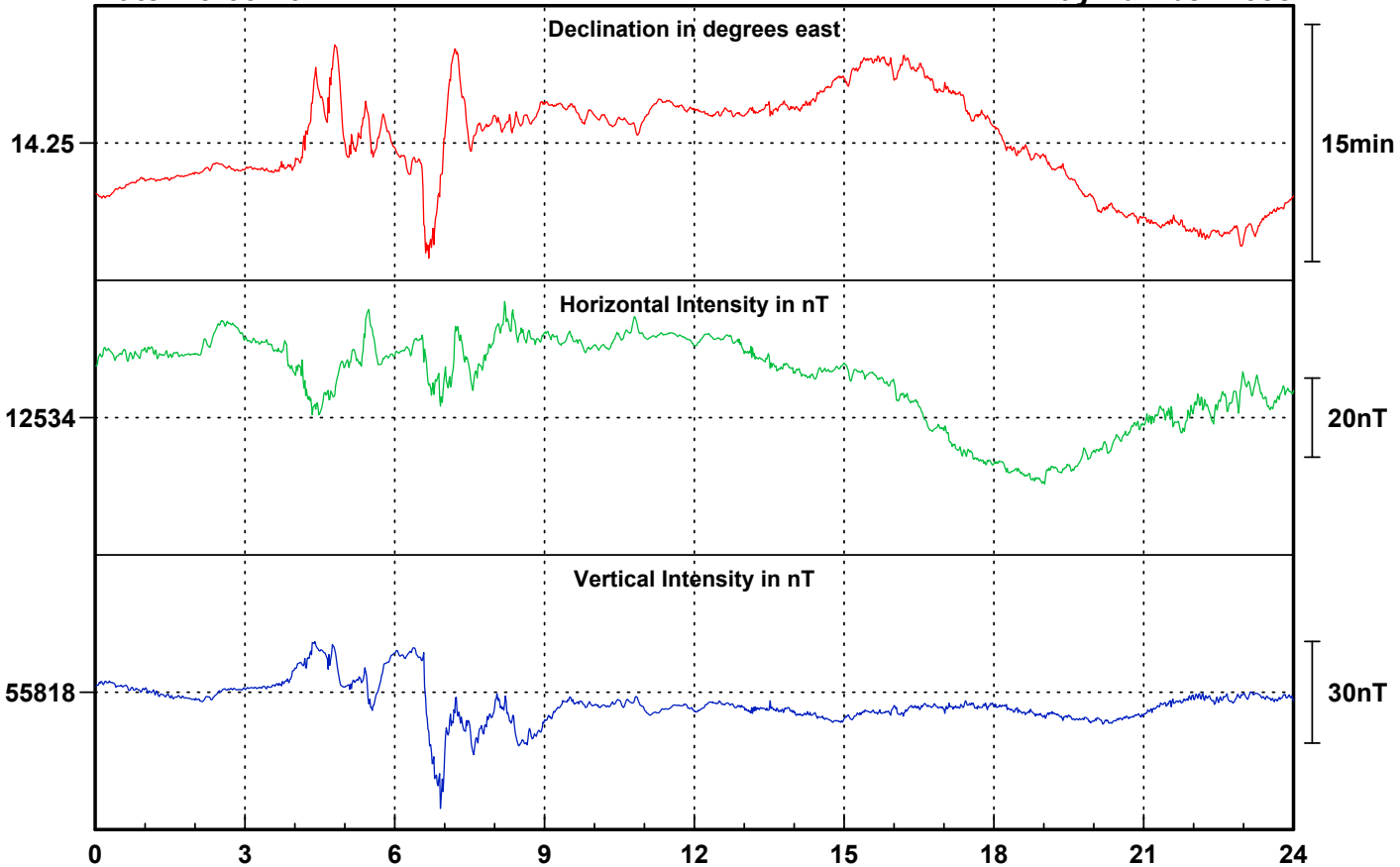
Day number: 087



Date: 29-03-2021

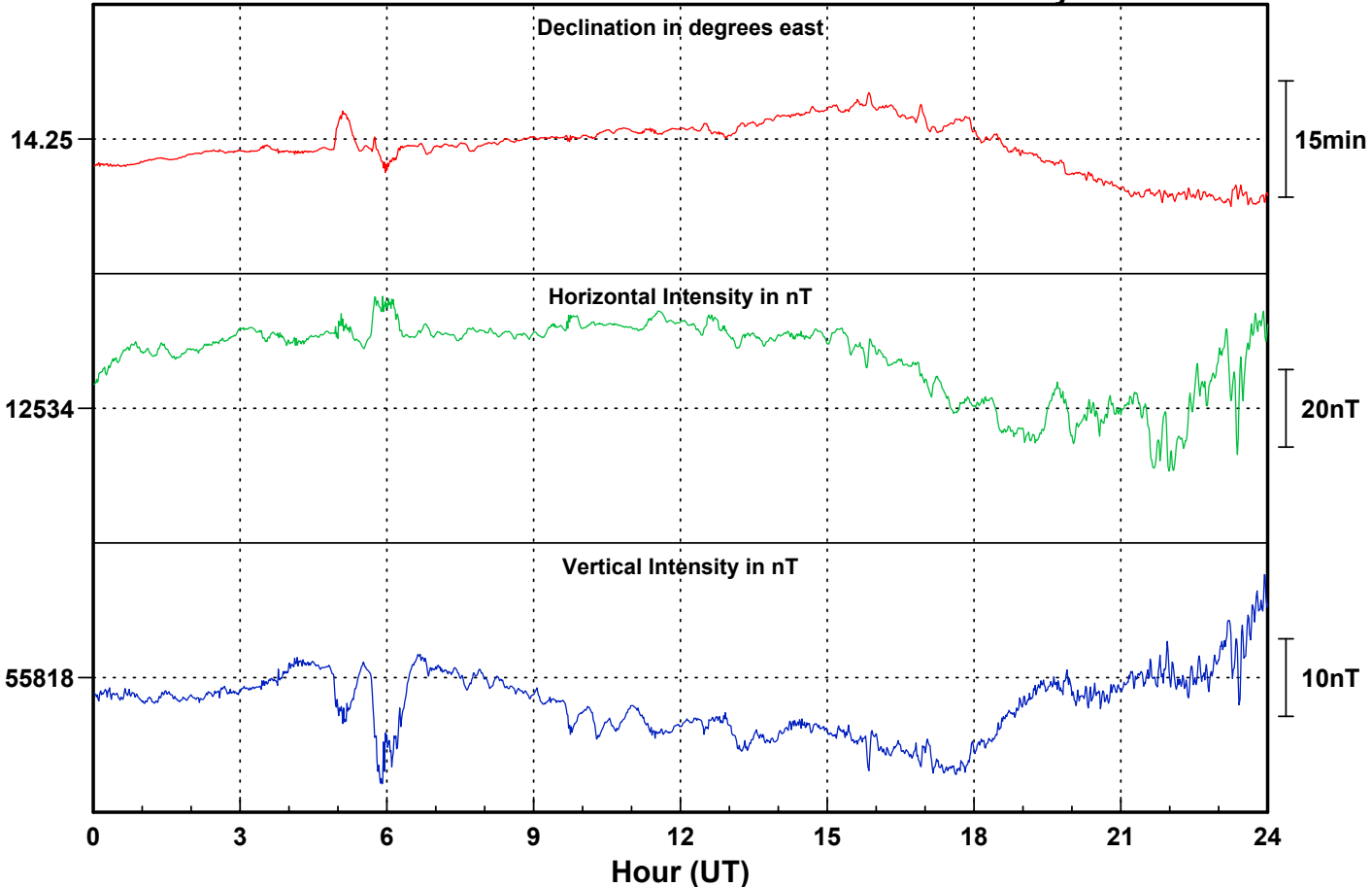
# Fort McMurray

Day number: 088



Date: 30-03-2021

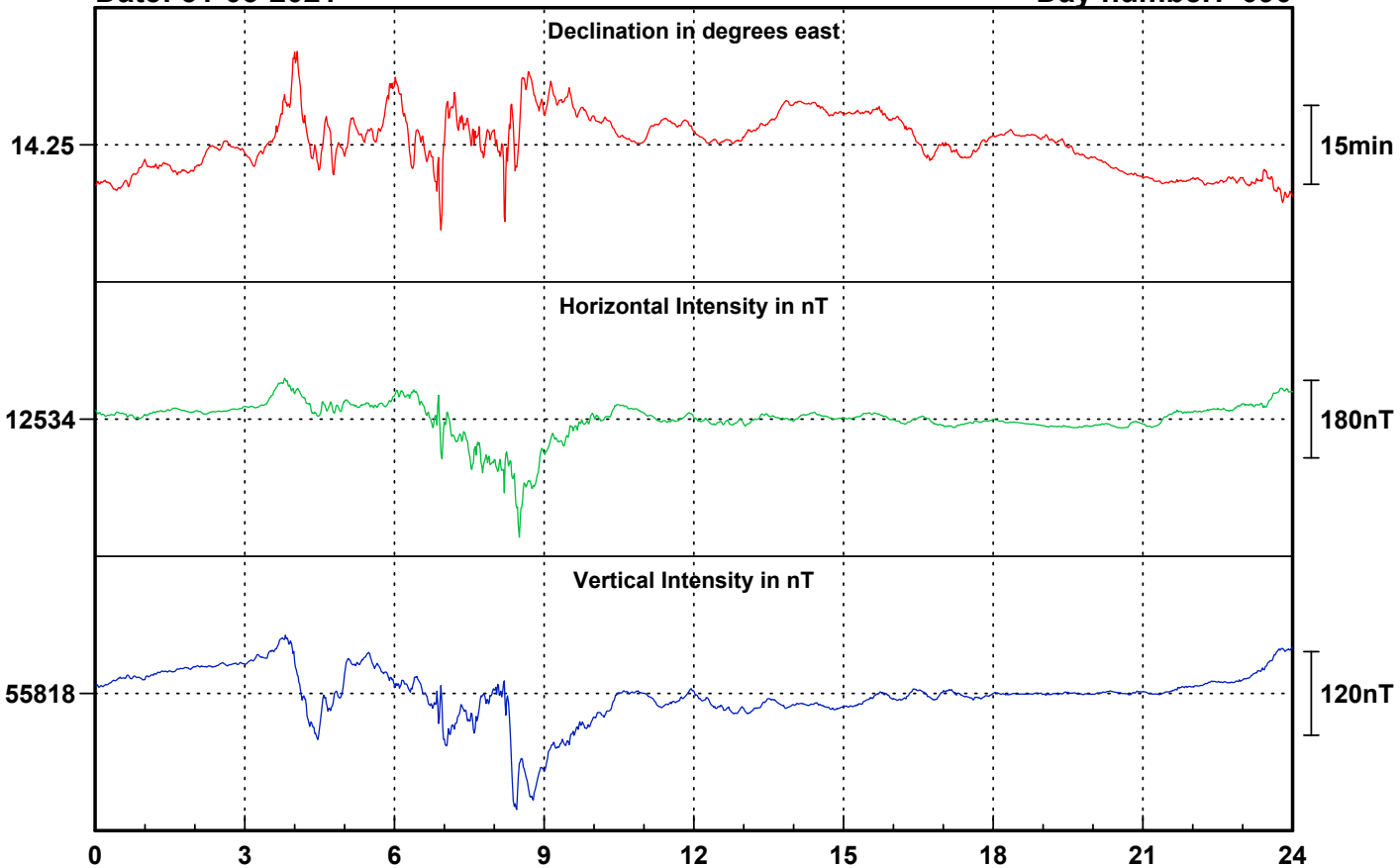
Day number: 089



Date: 31-03-2021

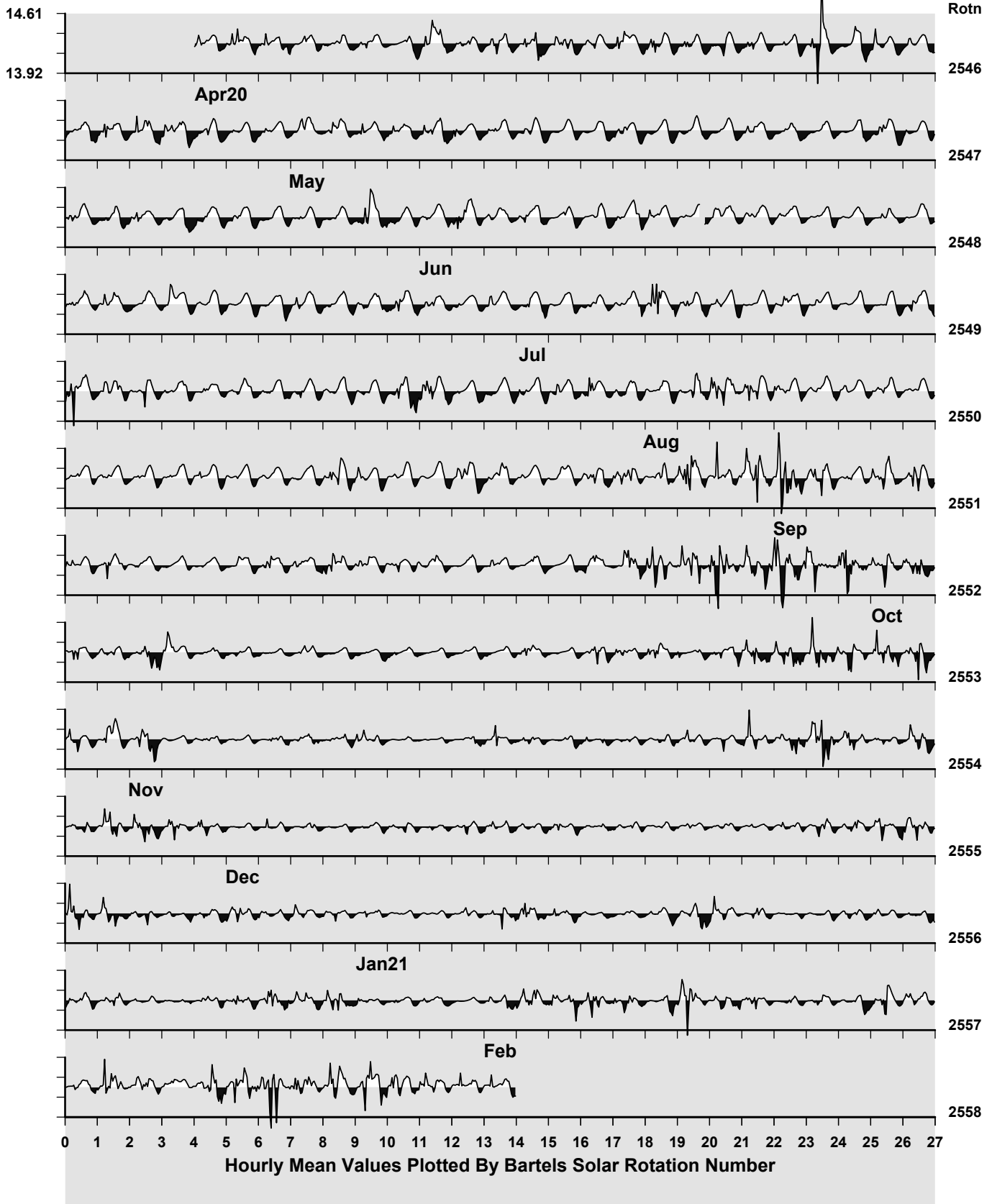
# Fort McMurray

Day number: 090

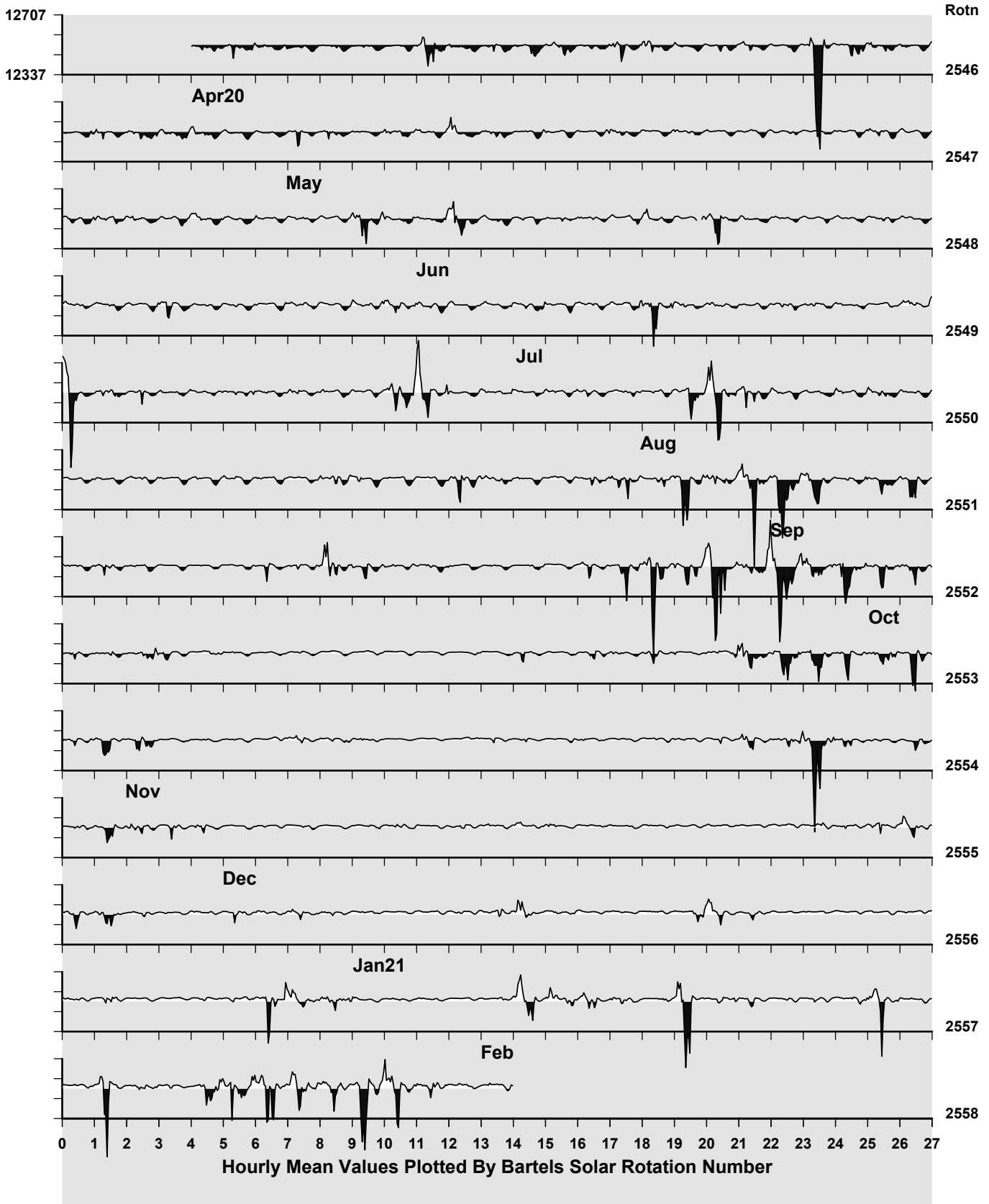




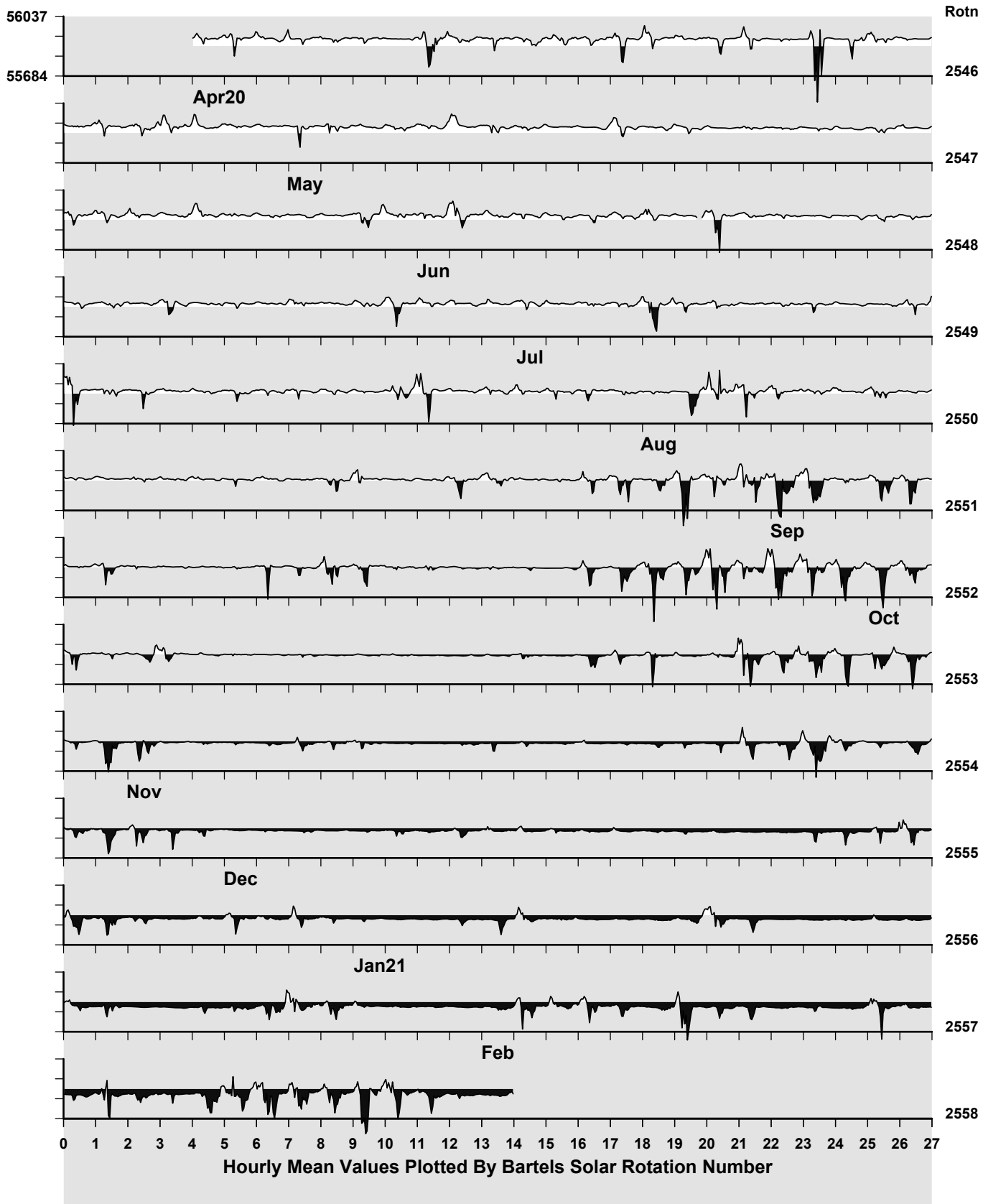
# Fort McMurray Observatory: Declination (degrees)



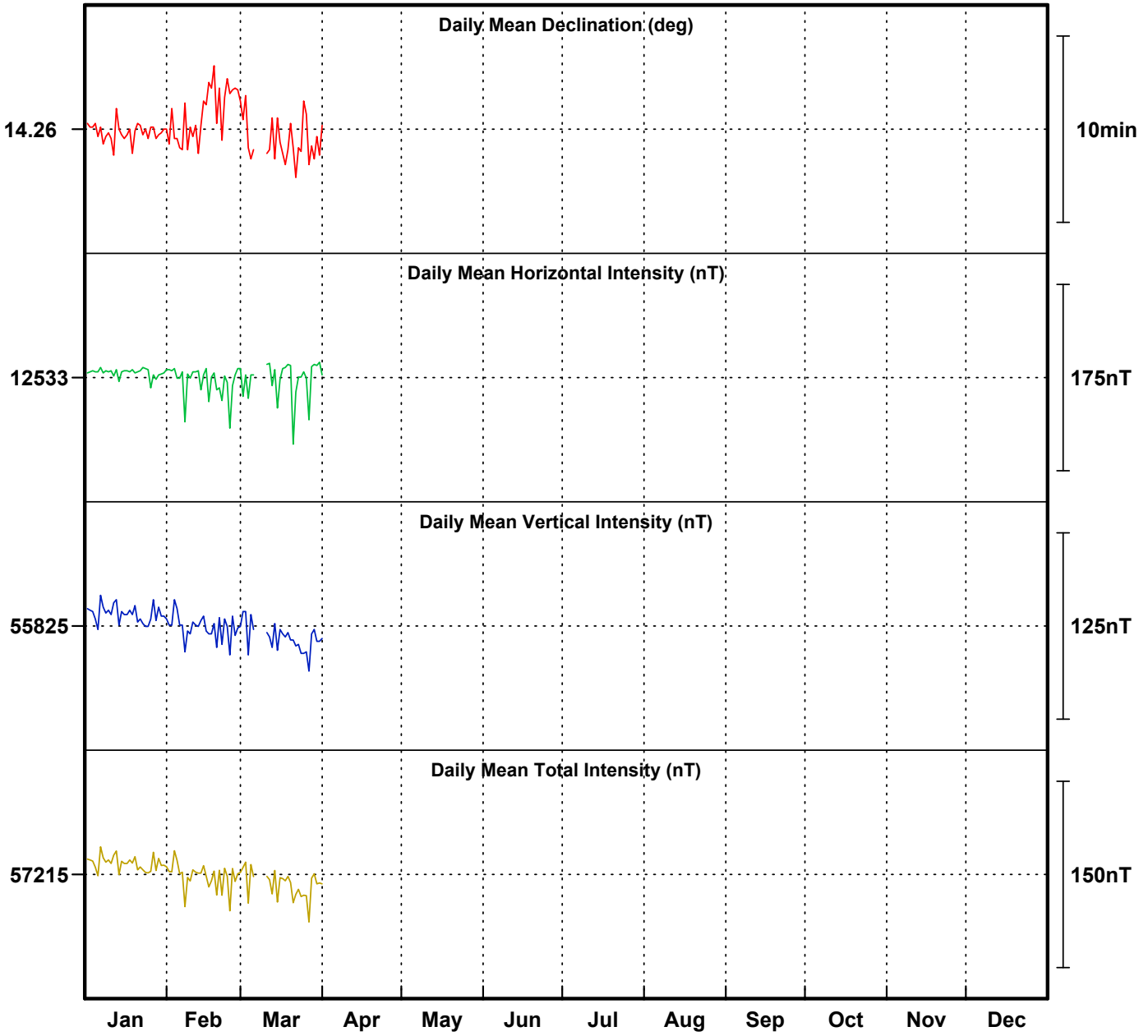
# Fort McMurray Observatory: Horizontal Intensity (nT)



# Fort McMurray Observatory: Vertical Intensity (nT)



# Fort McMurray Observatory 2021



## Monthly mean values for Fort McMurray Observatory 2021

Month	<i>D</i>	<i>H</i>	<i>I</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>F</i>
January	14° 15.3′	12537 nT	77° 20.7′	12151 nT	3087 nT	55833 nT	57224 nT
February	14° 16.3′	12529 nT	77° 21.0′	12143 nT	3089 nT	55824 nT	57213 nT
March	14° 15.2′	12534 nT	77° 20.6′	12148 nT	3086 nT	55818 nT	57208 nT

### Note:

i. The values shown here are provisional.