



British  
Geological  
Survey



**MONTHLY MAGNETIC BULLETIN**

# Fort McMurray Observatory

**November 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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Edinburgh EH14 4AP  
Scotland, UK

Tel: +44 (0) 131 667 1000  
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

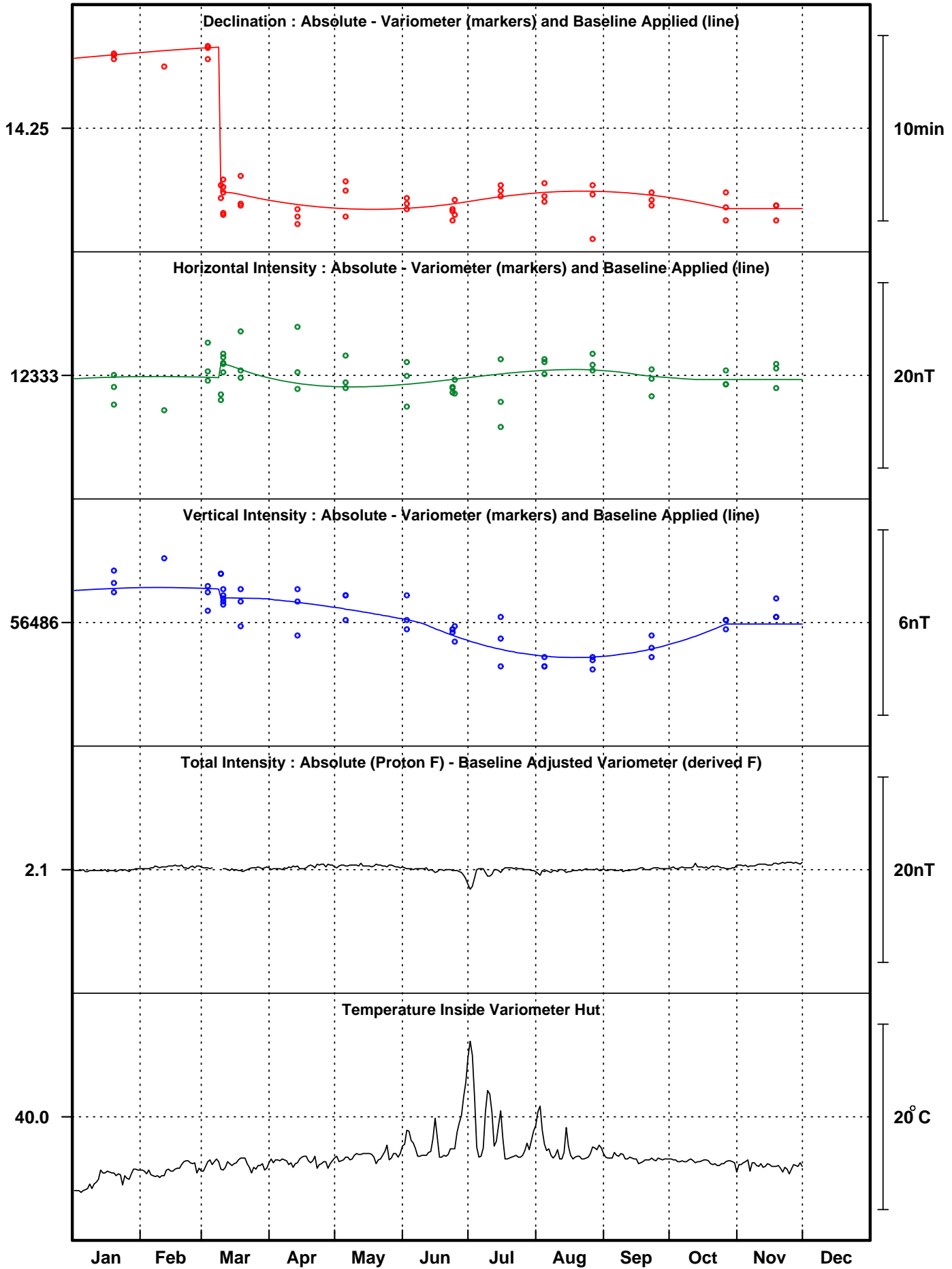
The outputs presented in this bulletin are provided for personal, academic, educational, non-commercial research or other non-commercial use and are not for sale or distribution to third parties without written permission from BGS.

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.'

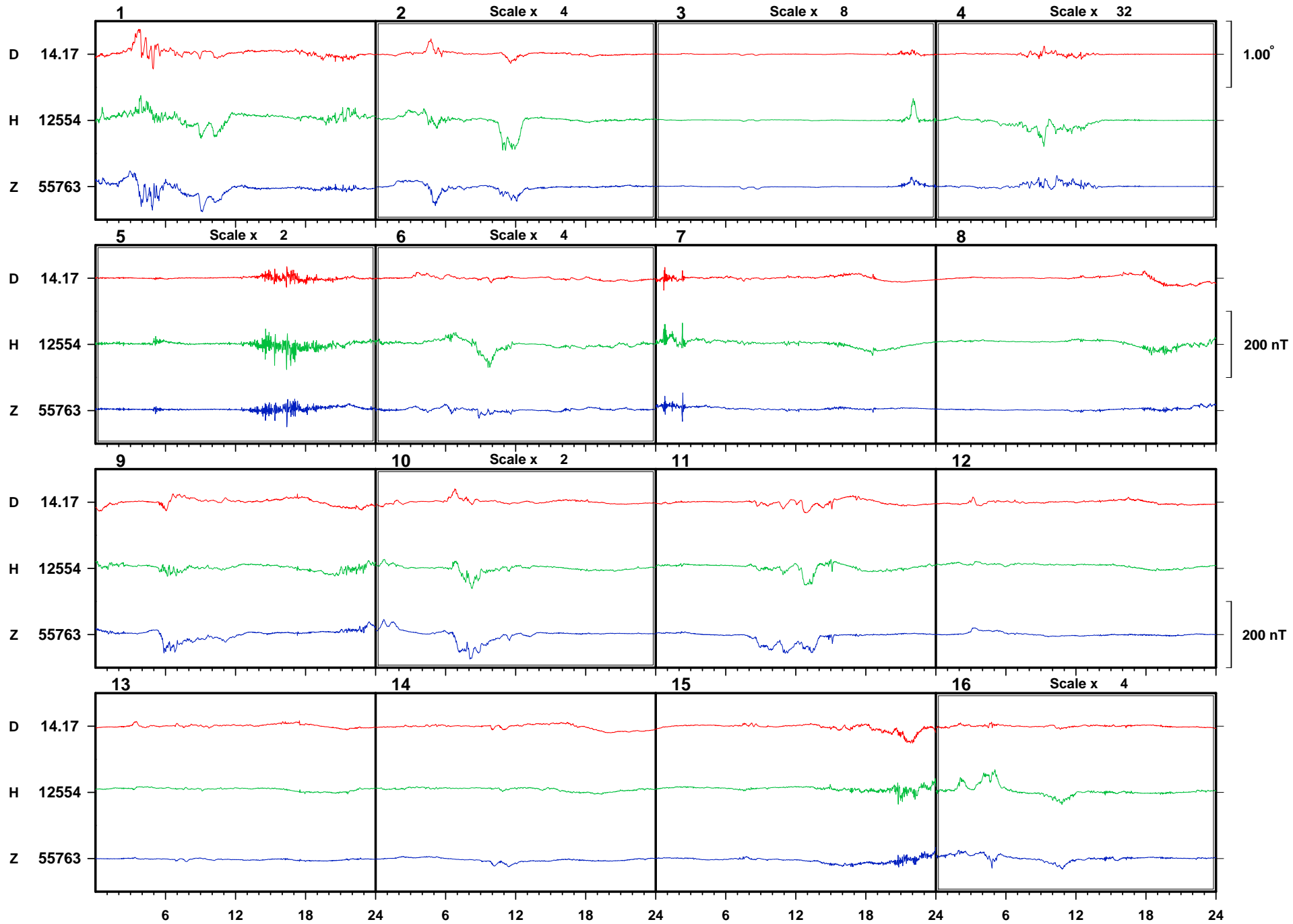
Commercial users can contact the geomagnetism team for information on the range of applications and services offered. Full contact details are available at [geomag.bgs.ac.uk/contactus/staff](http://geomag.bgs.ac.uk/contactus/staff)

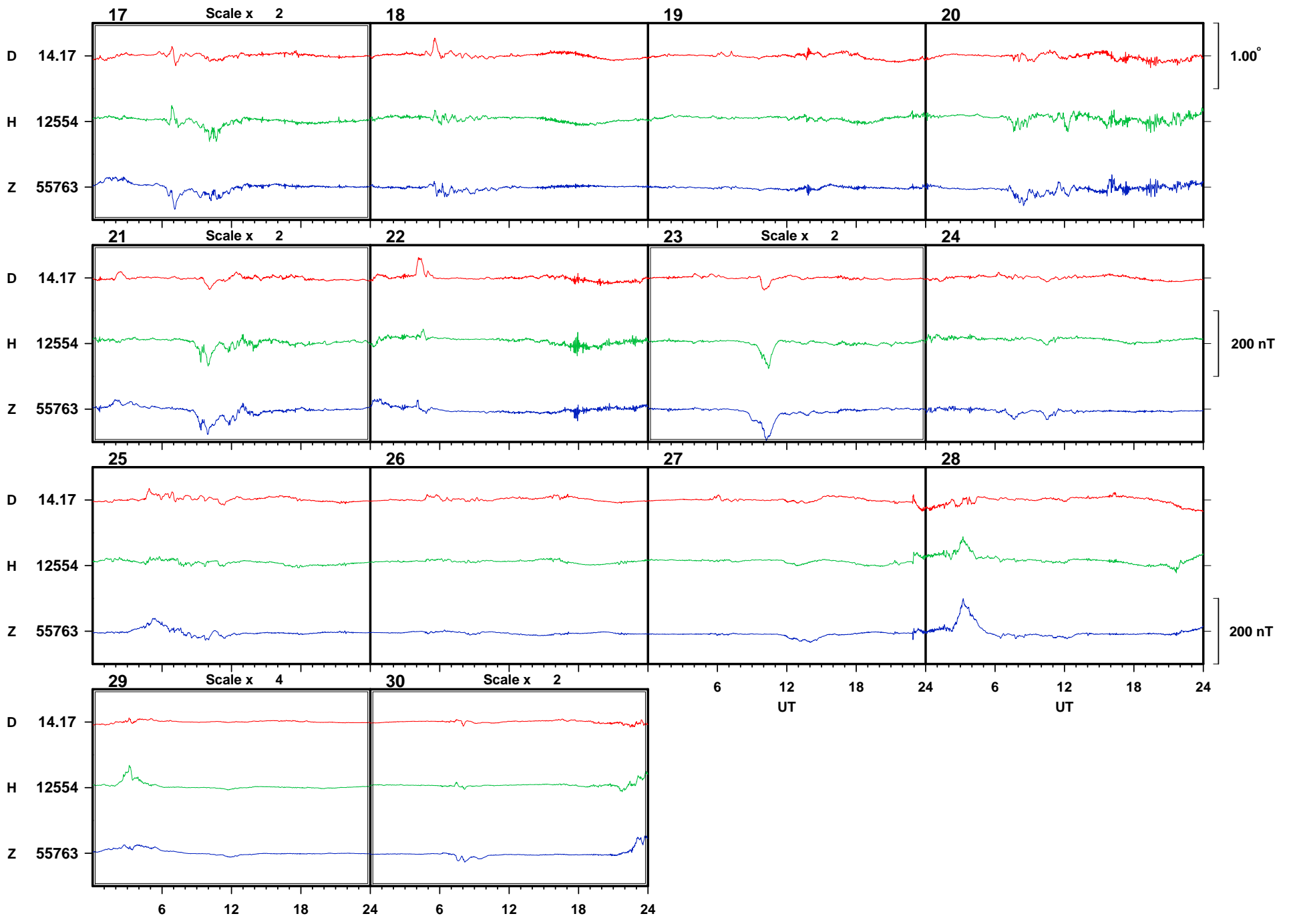


# Fort McMurray 2021



Fort McMurray November 2021





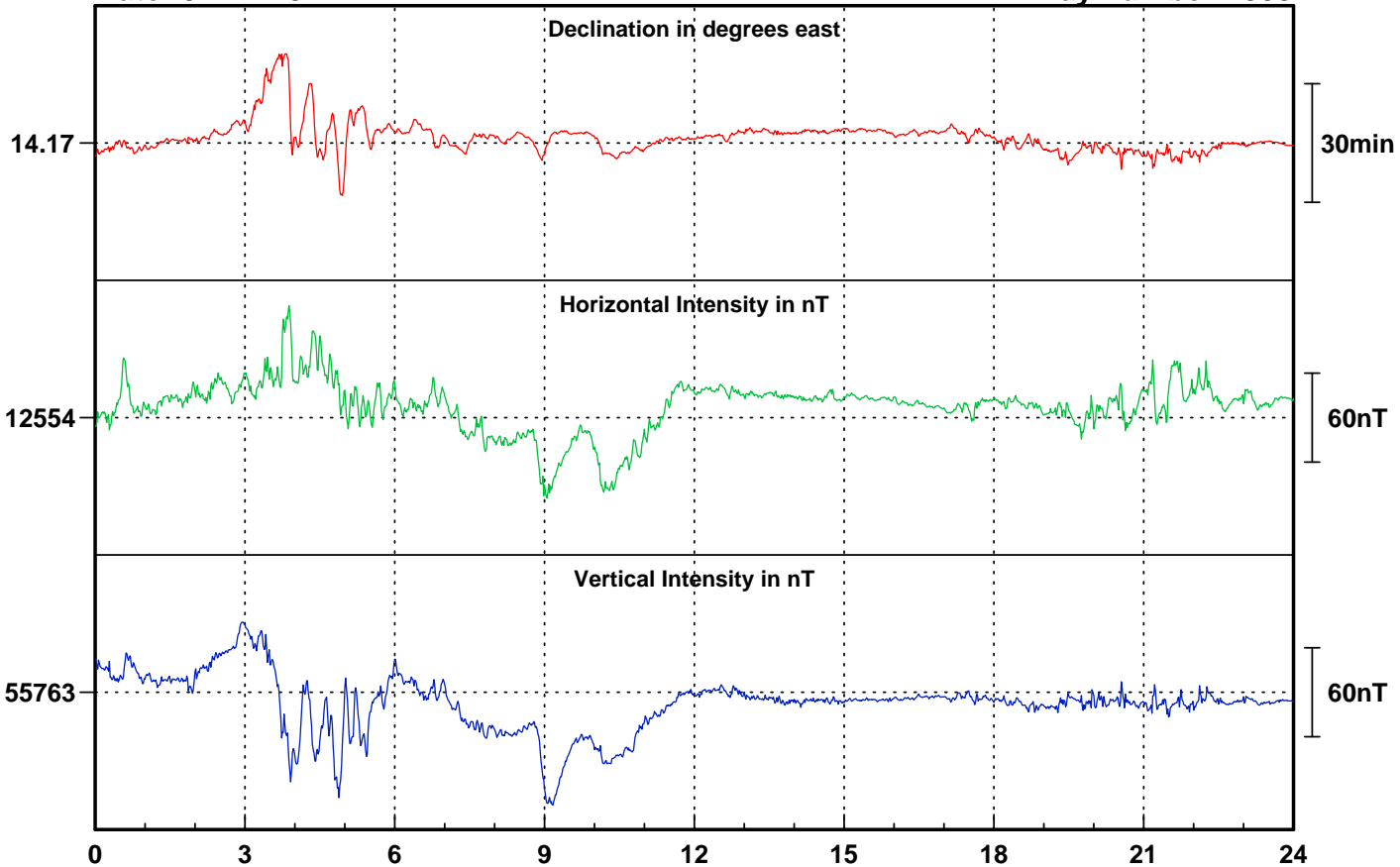
Fort McMurray November 2021



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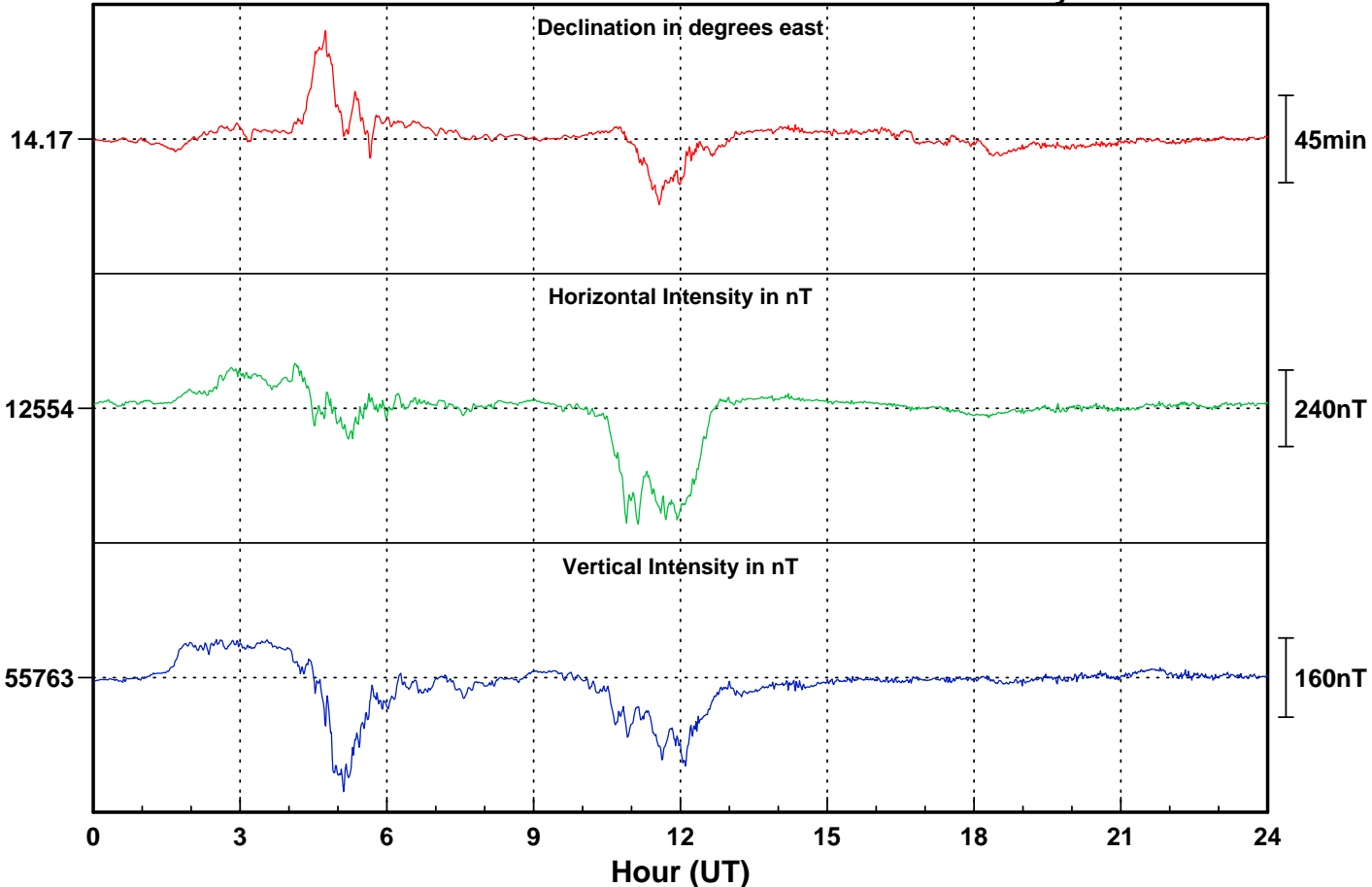
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Day number: 305



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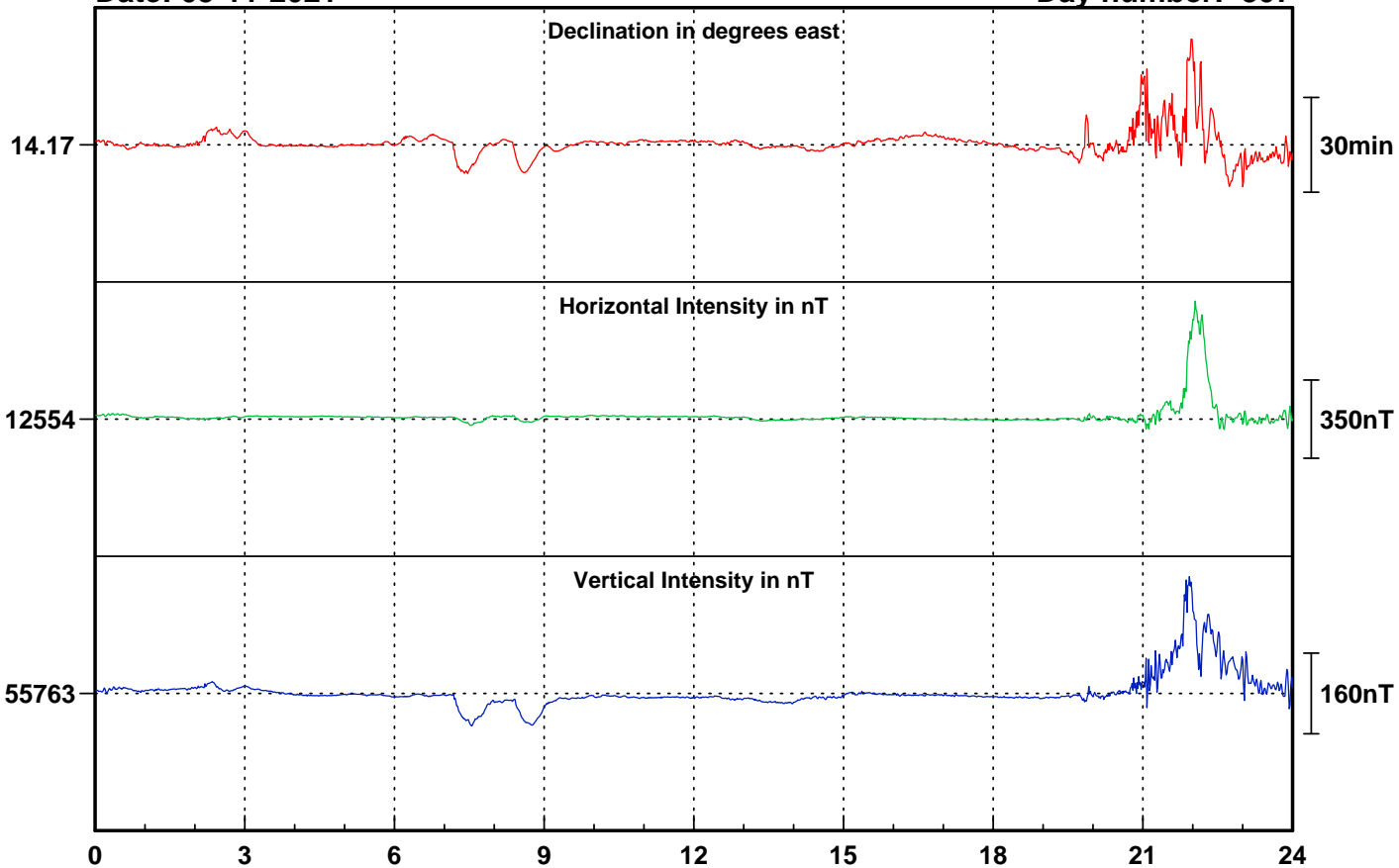
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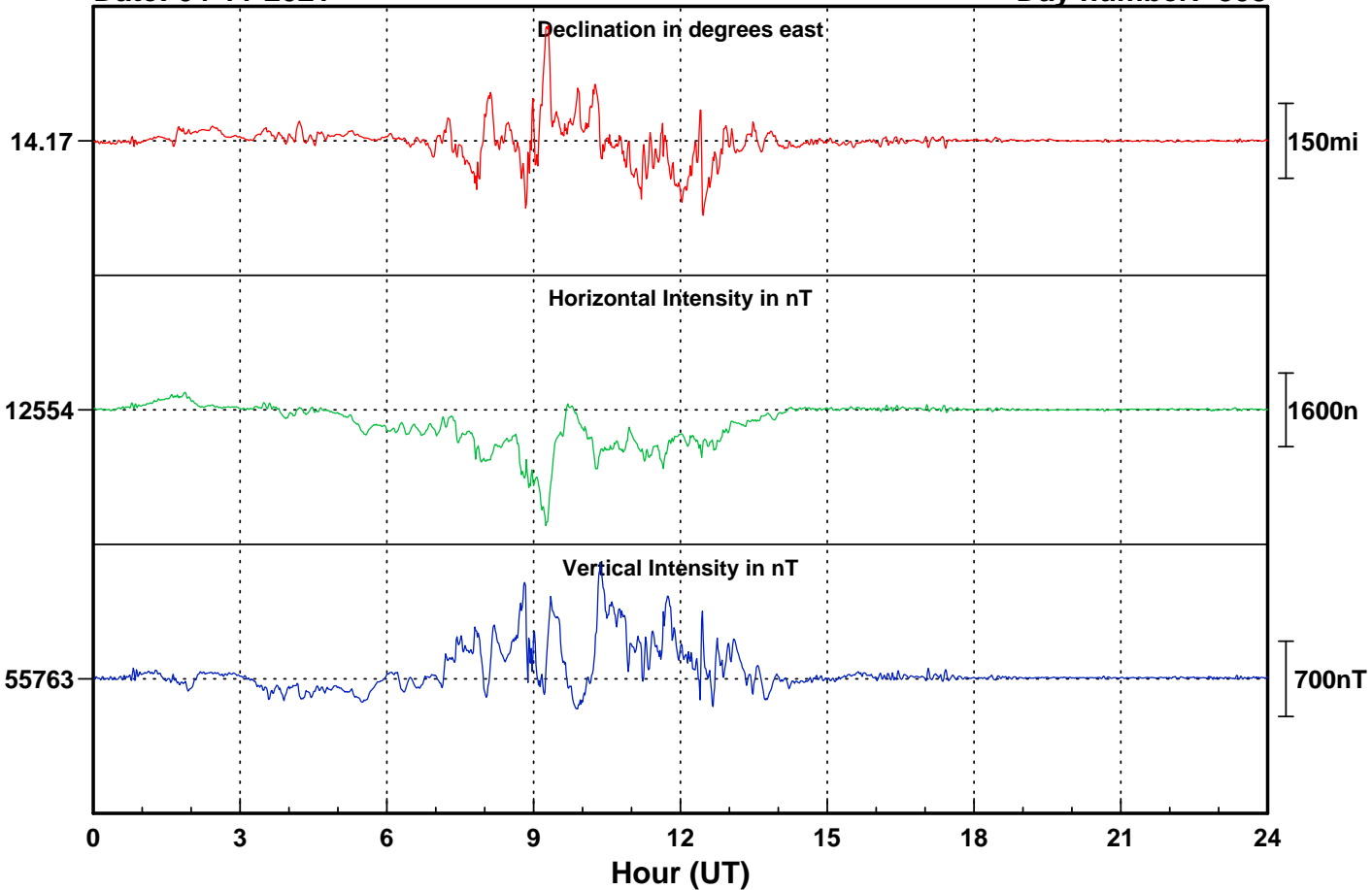
# Fort McMurray

Day number: 307



Date: 04-11-2021

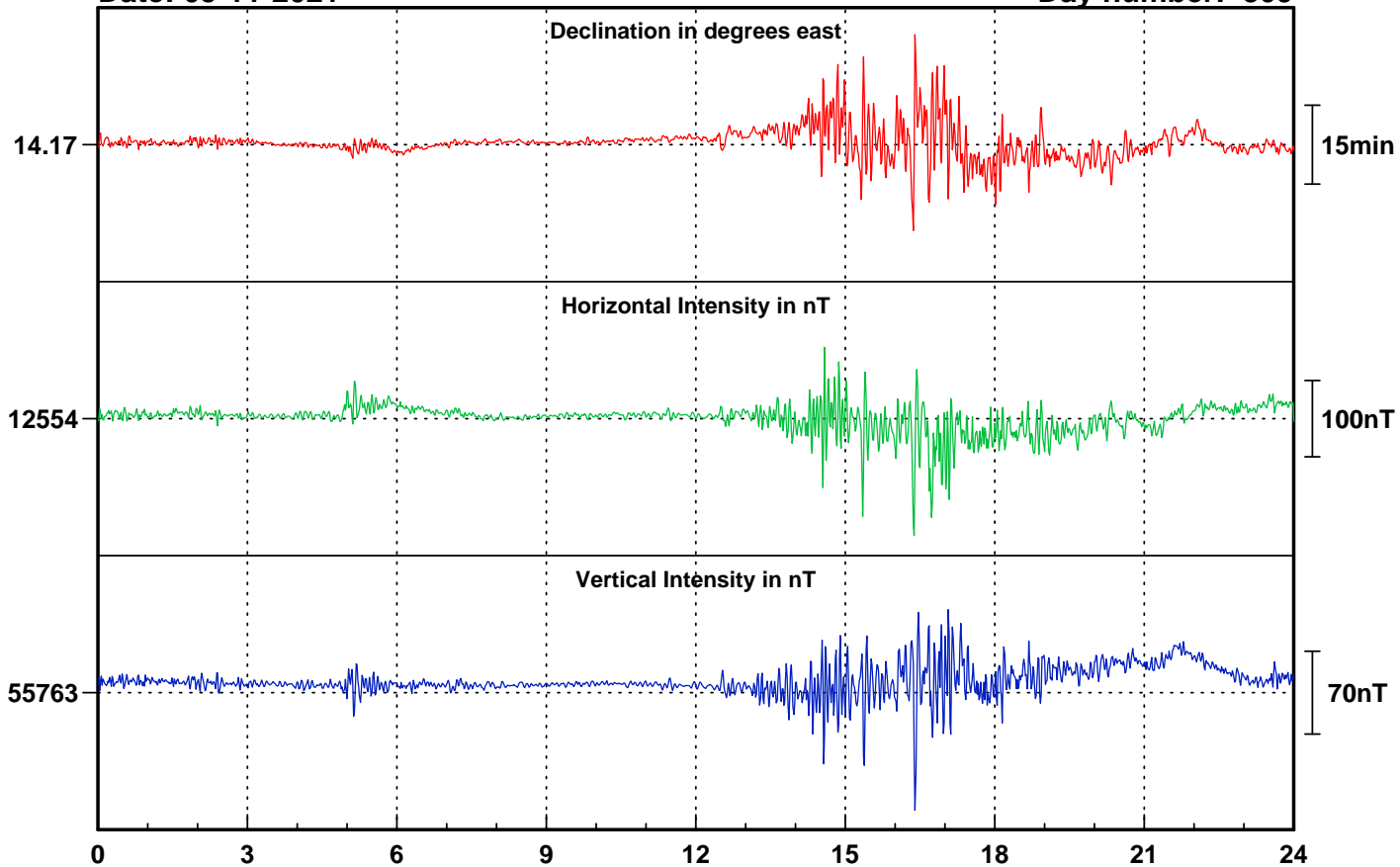
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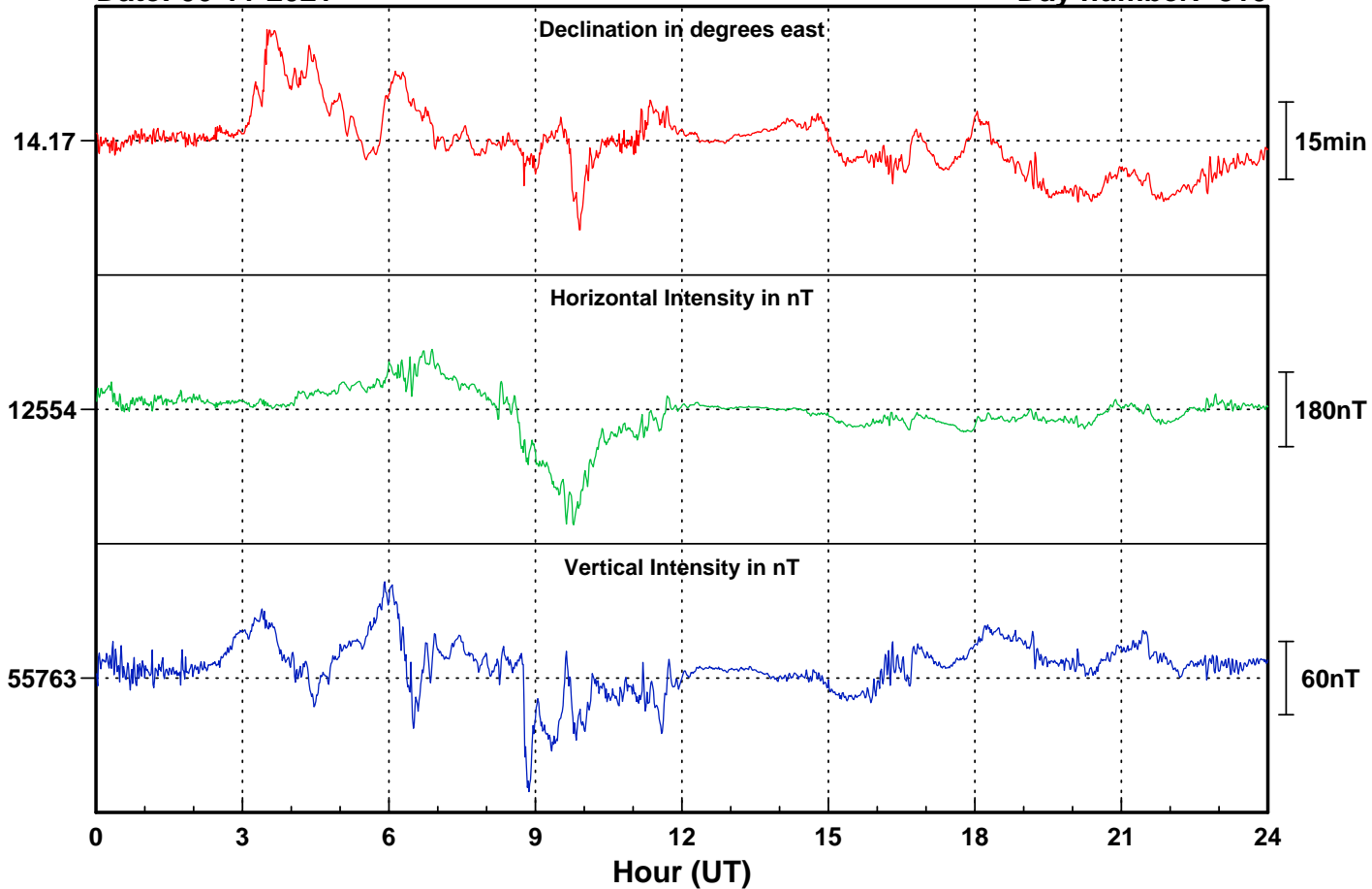
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Day number: 309



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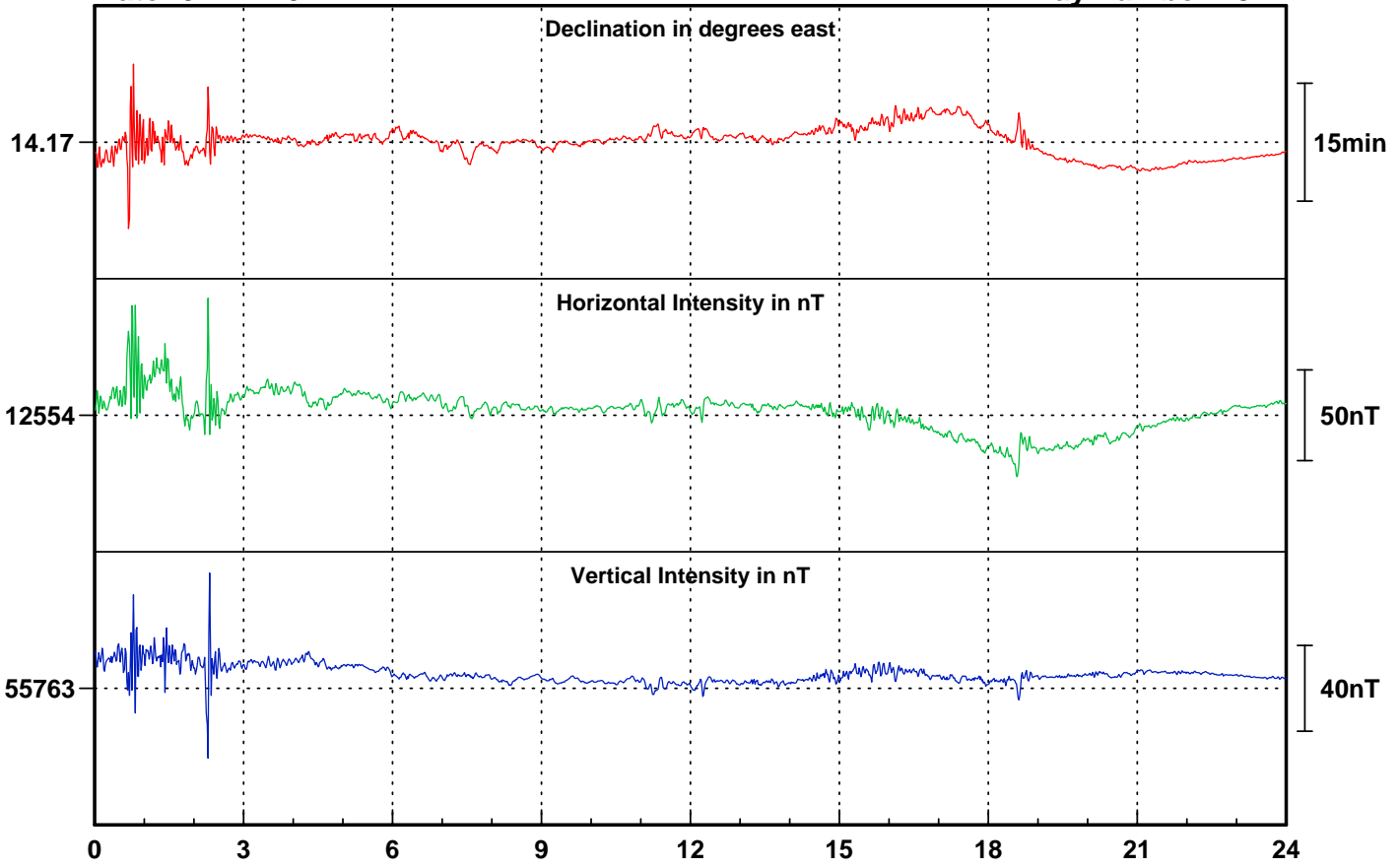
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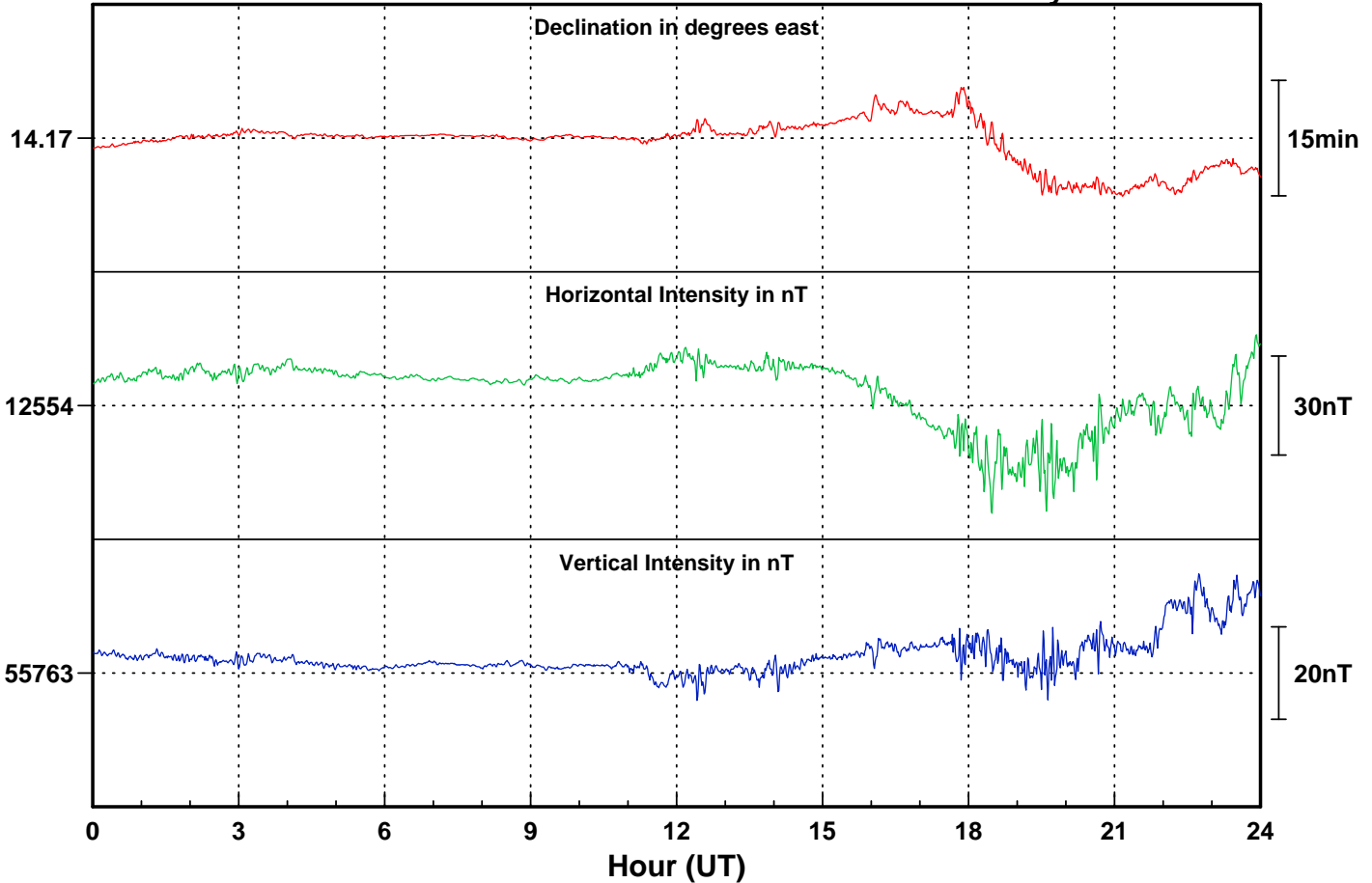
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Day number: 311



Date: 08-11-2021

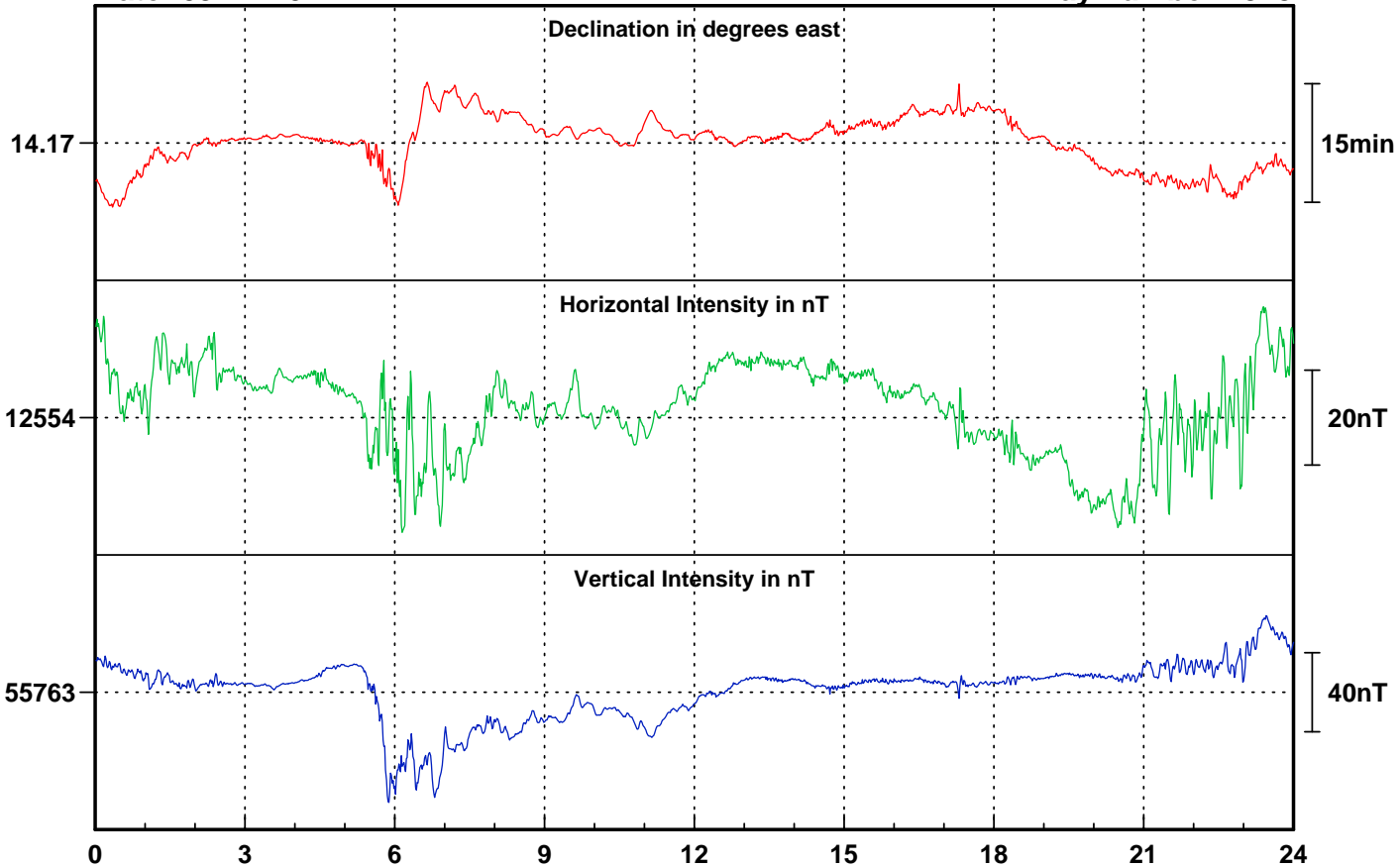
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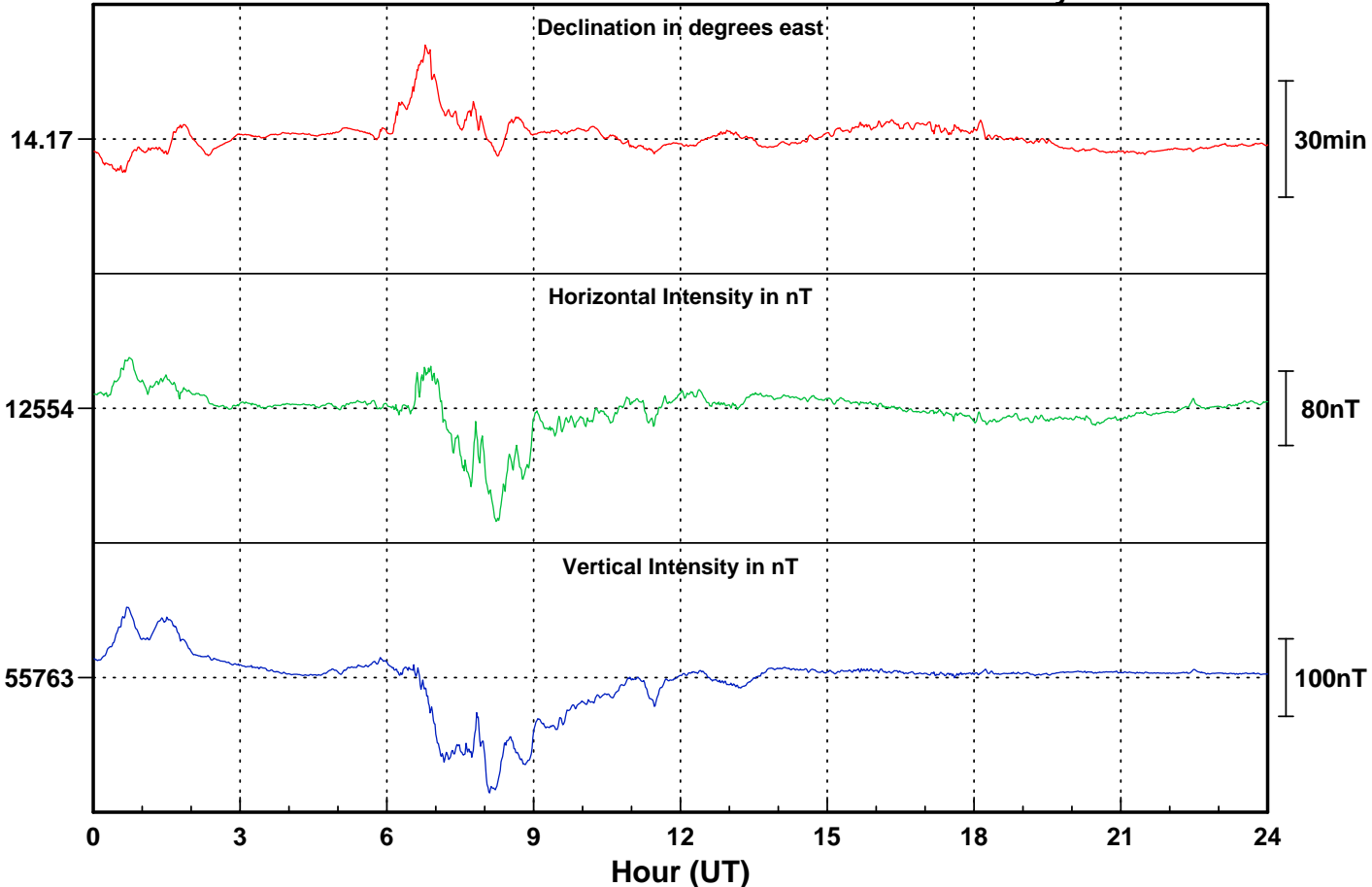
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Day number: 313



Date: 10-11-2021

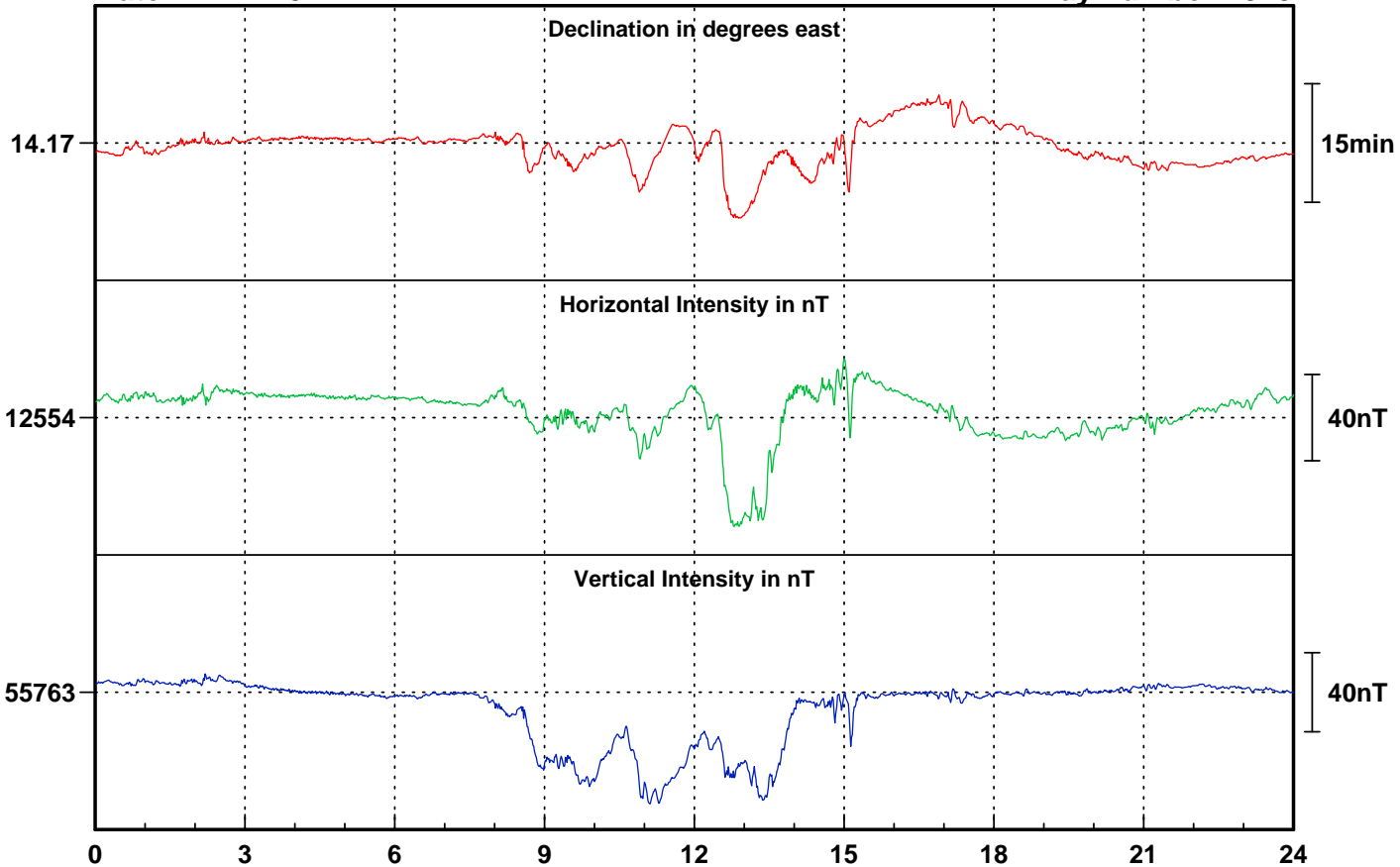
Day number: 314



Date: 11-11-2021

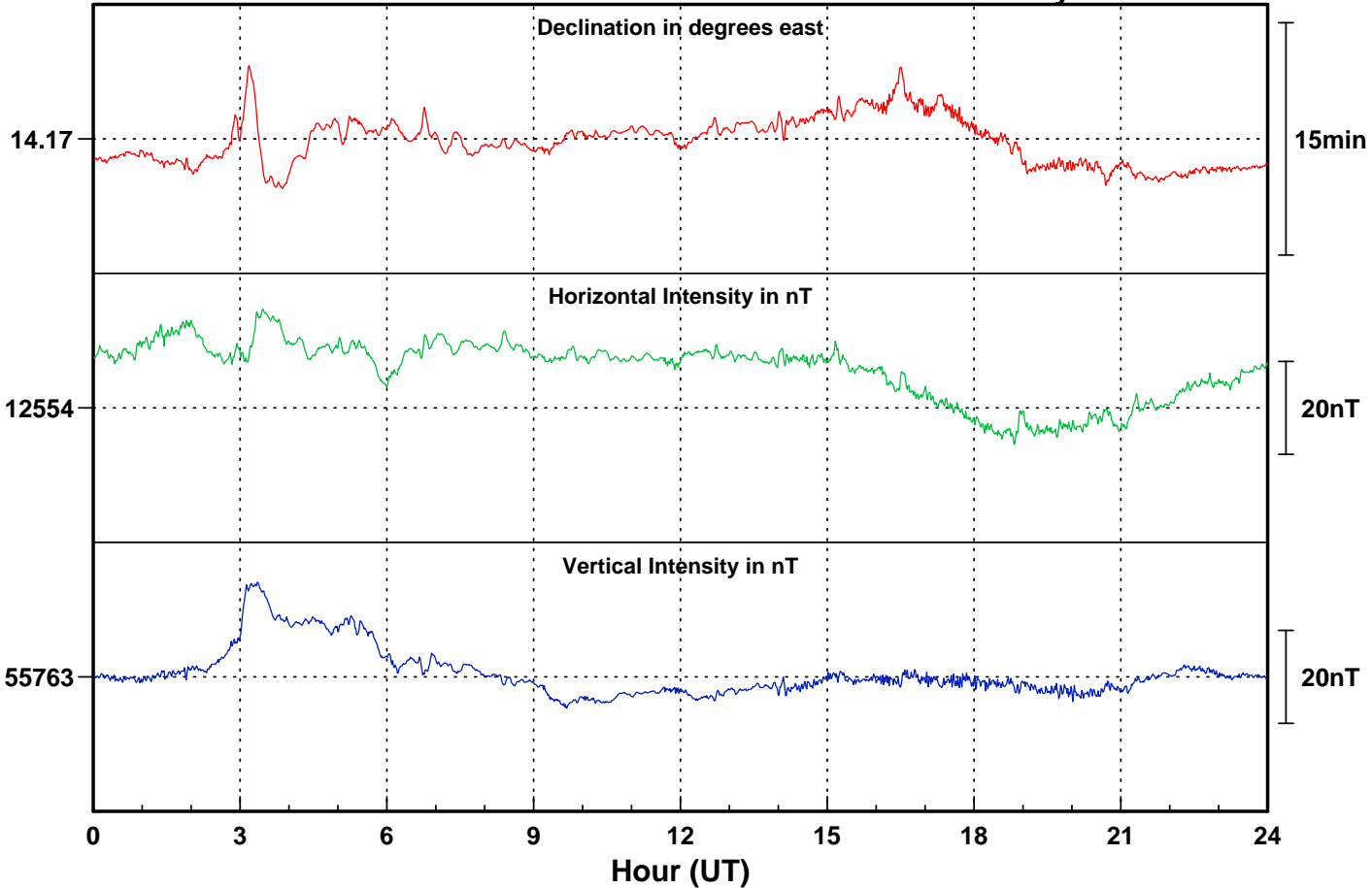
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Day number: 315



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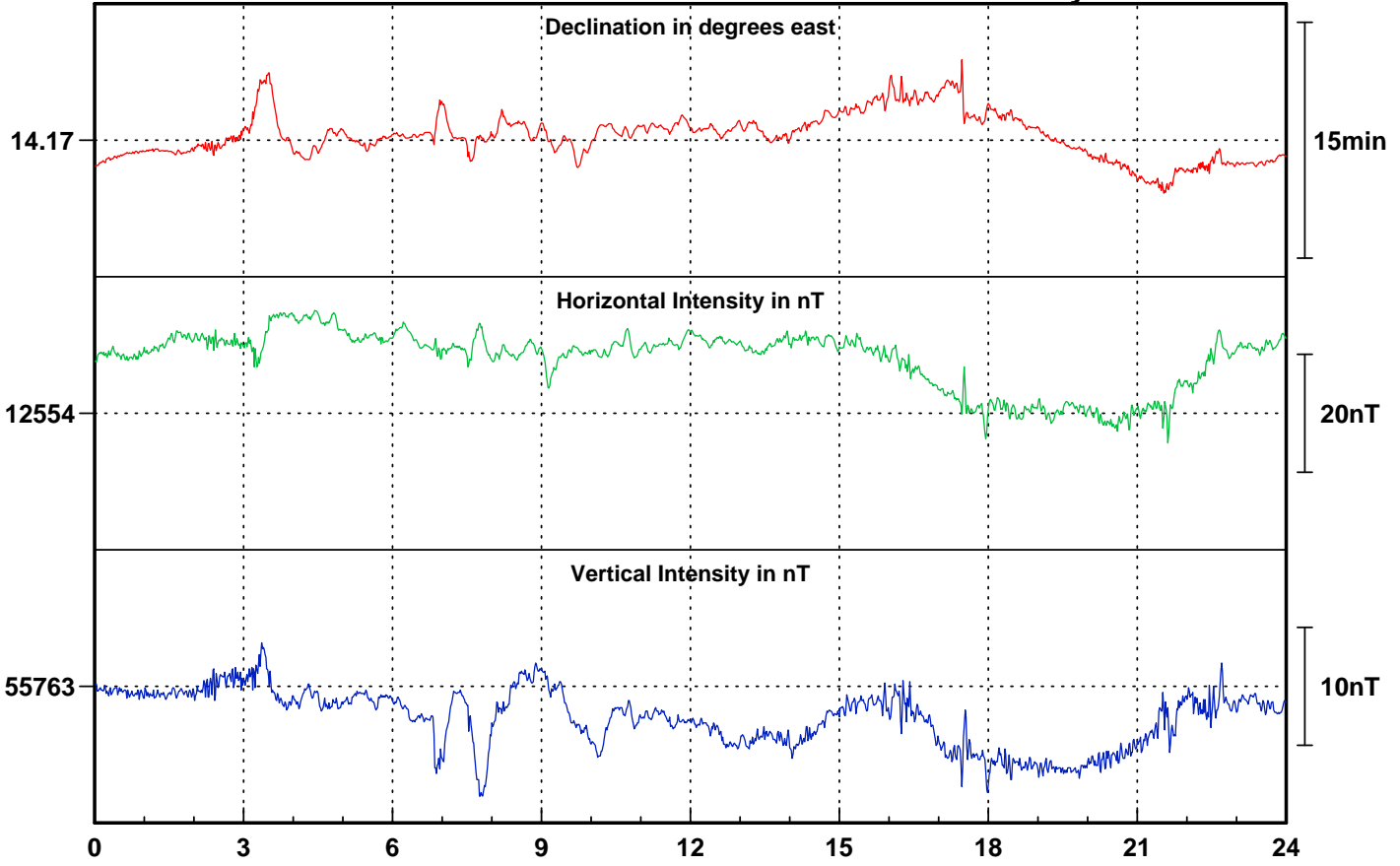
Day number: 316



Date: 13-11-2021

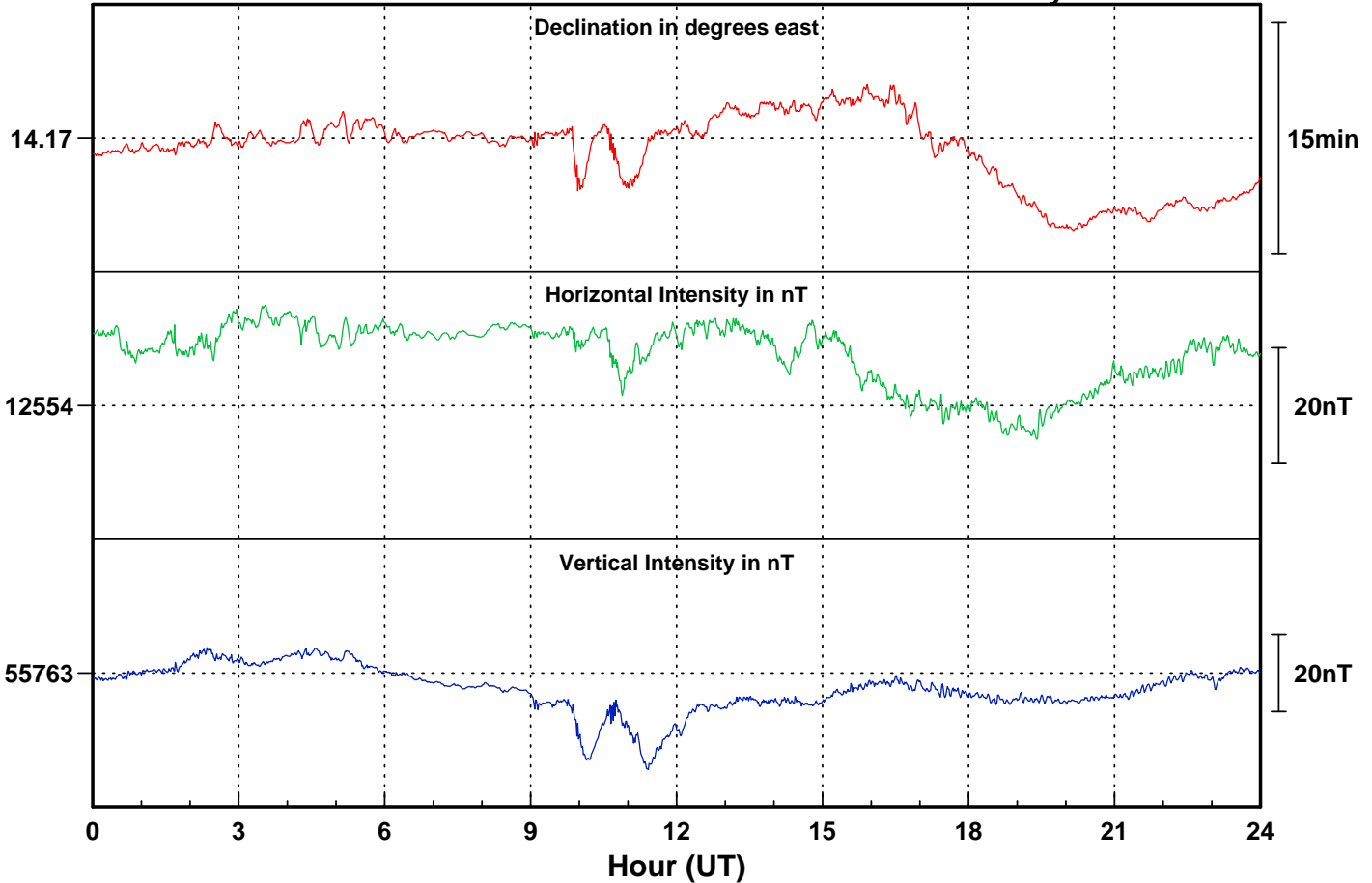
# Fort McMurray

Day number: 317



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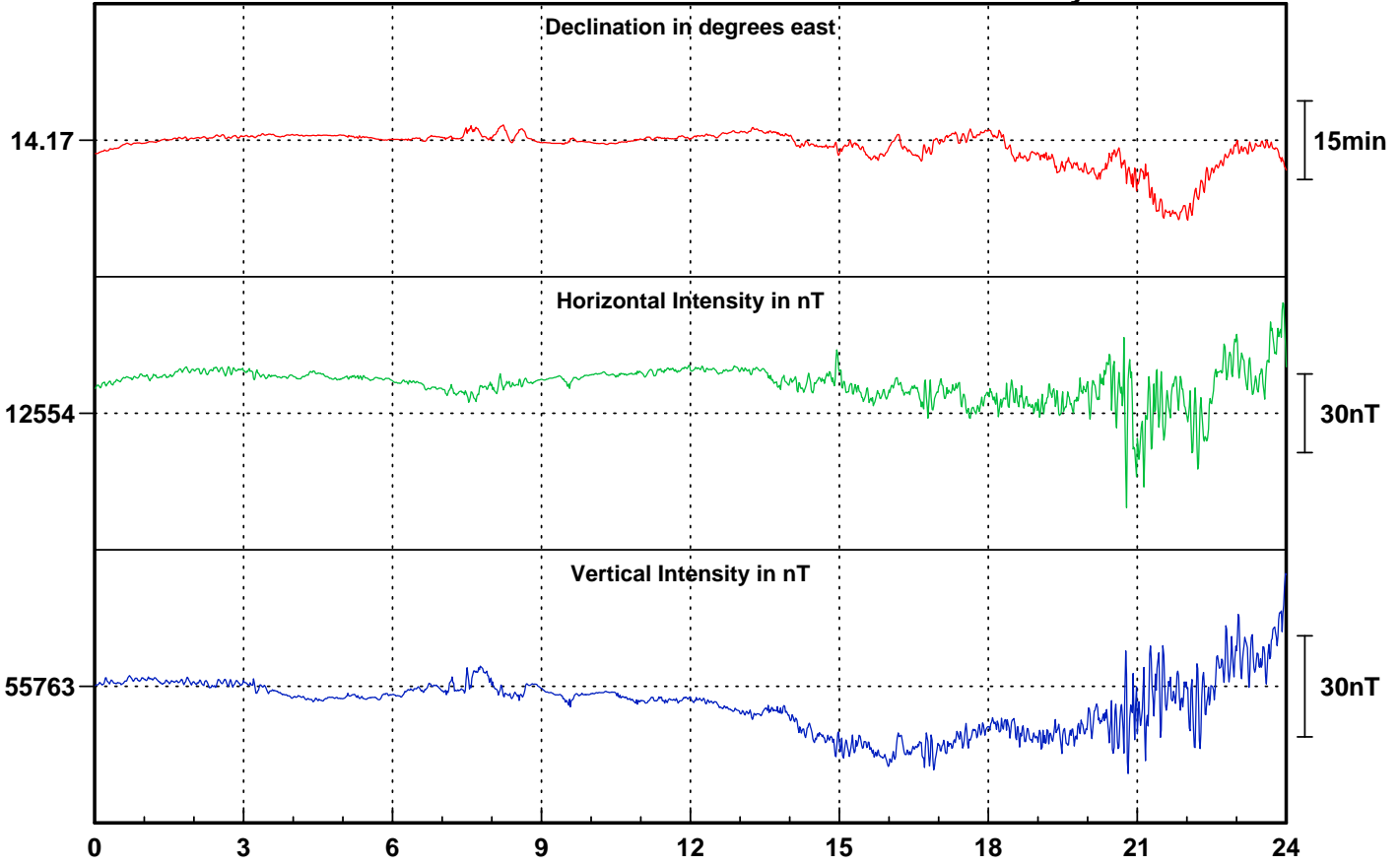
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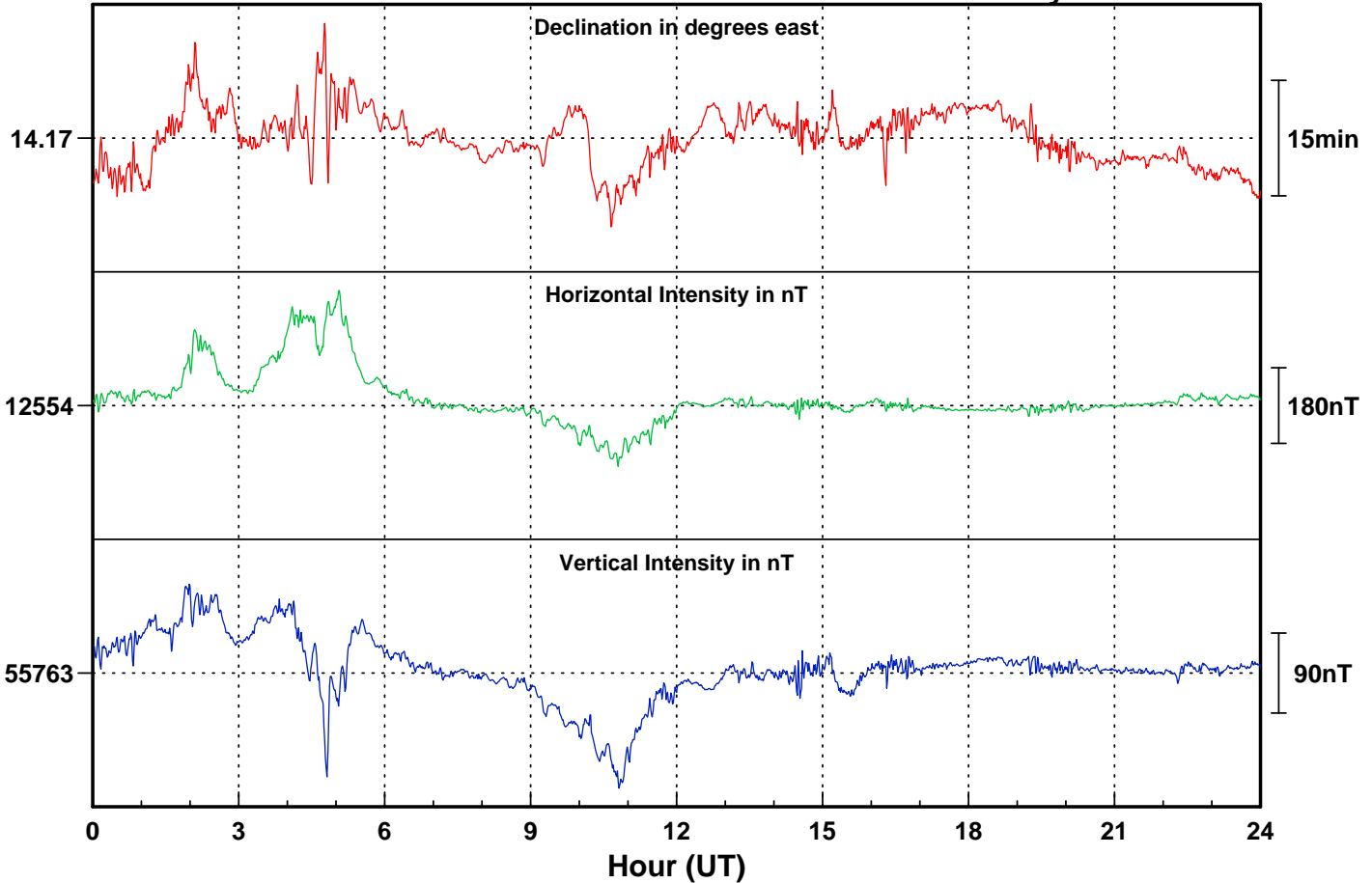
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Day number: 319



Date: 16-11-2021

Day number: 320

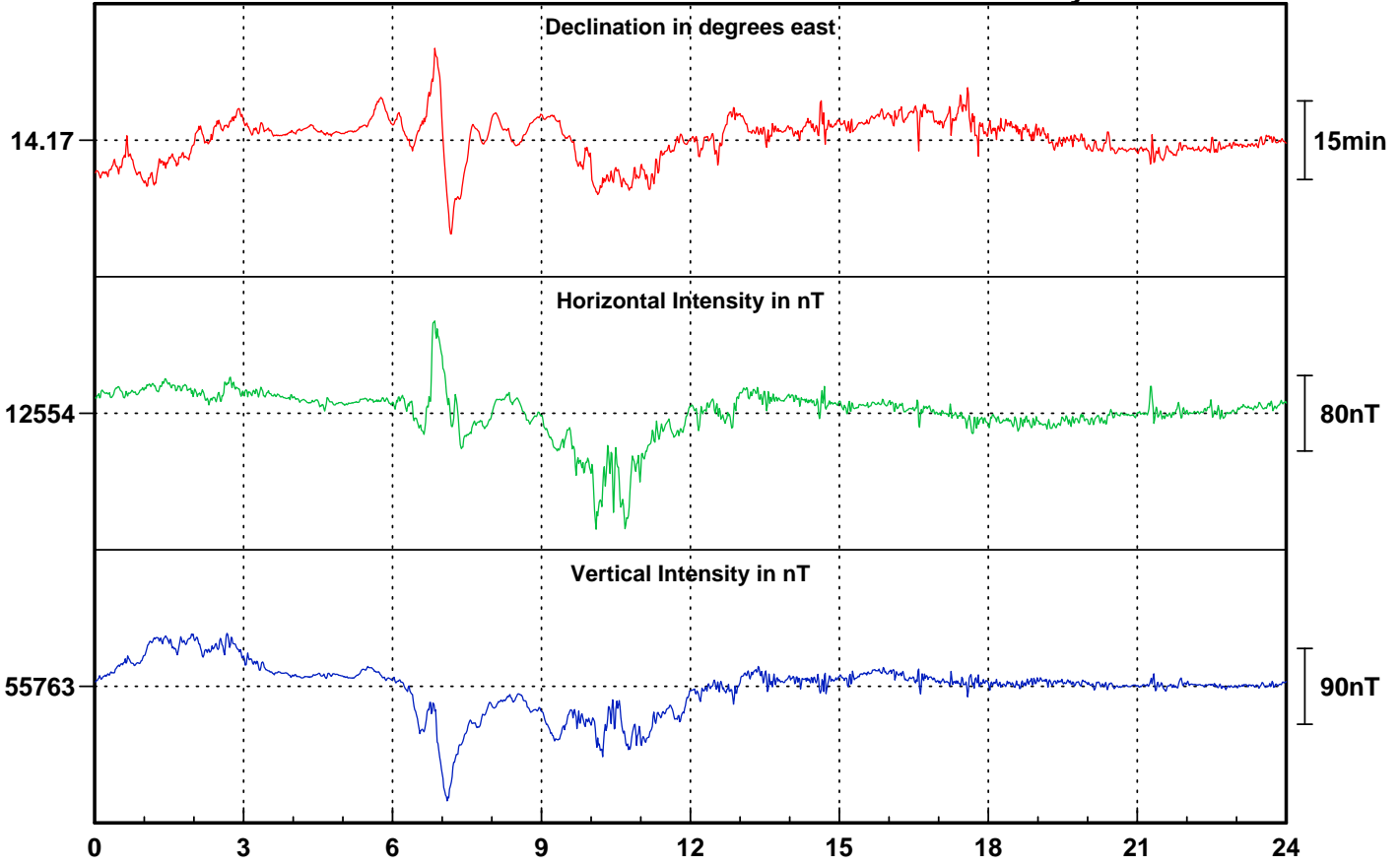




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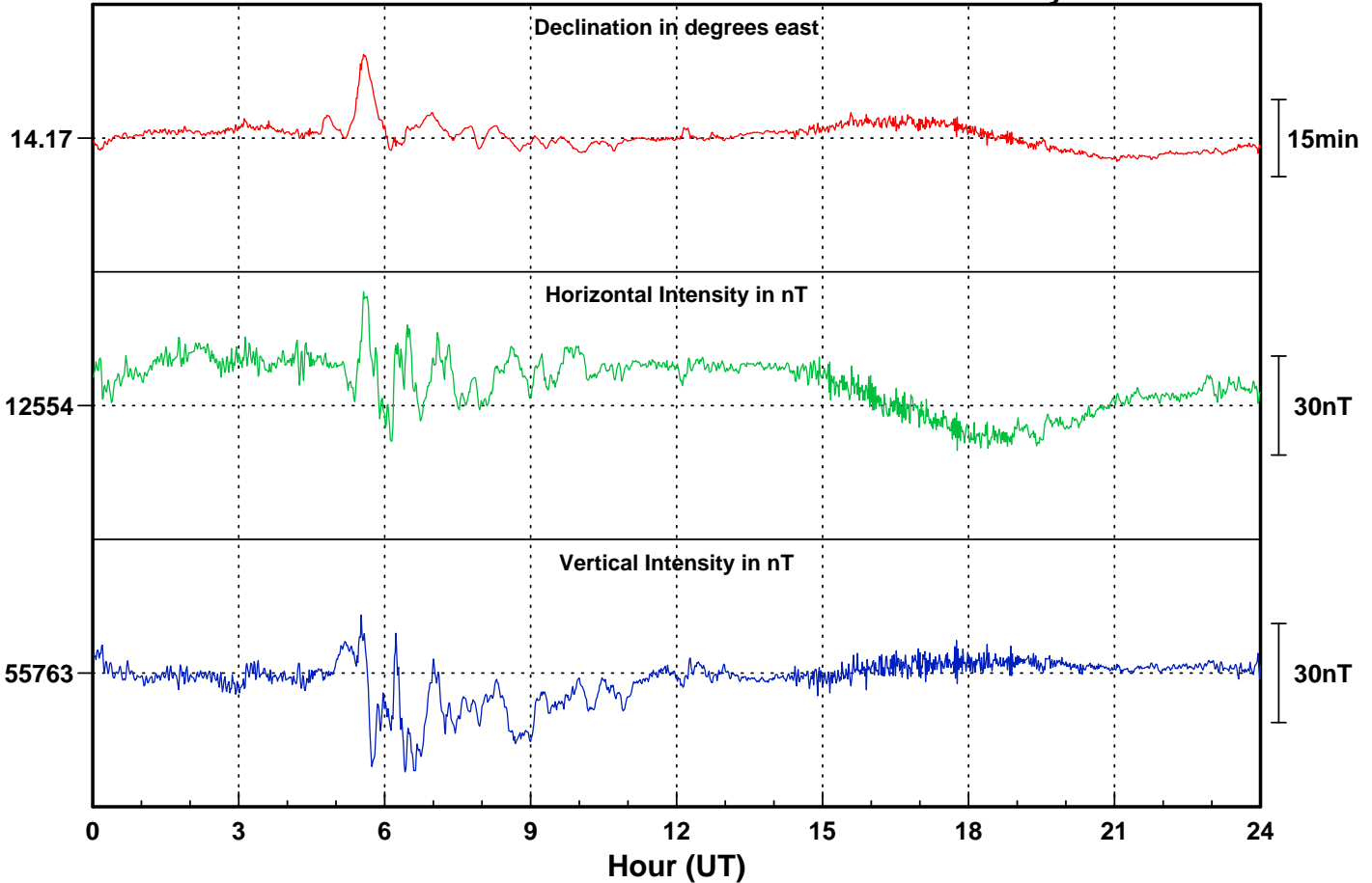
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Day number: 321



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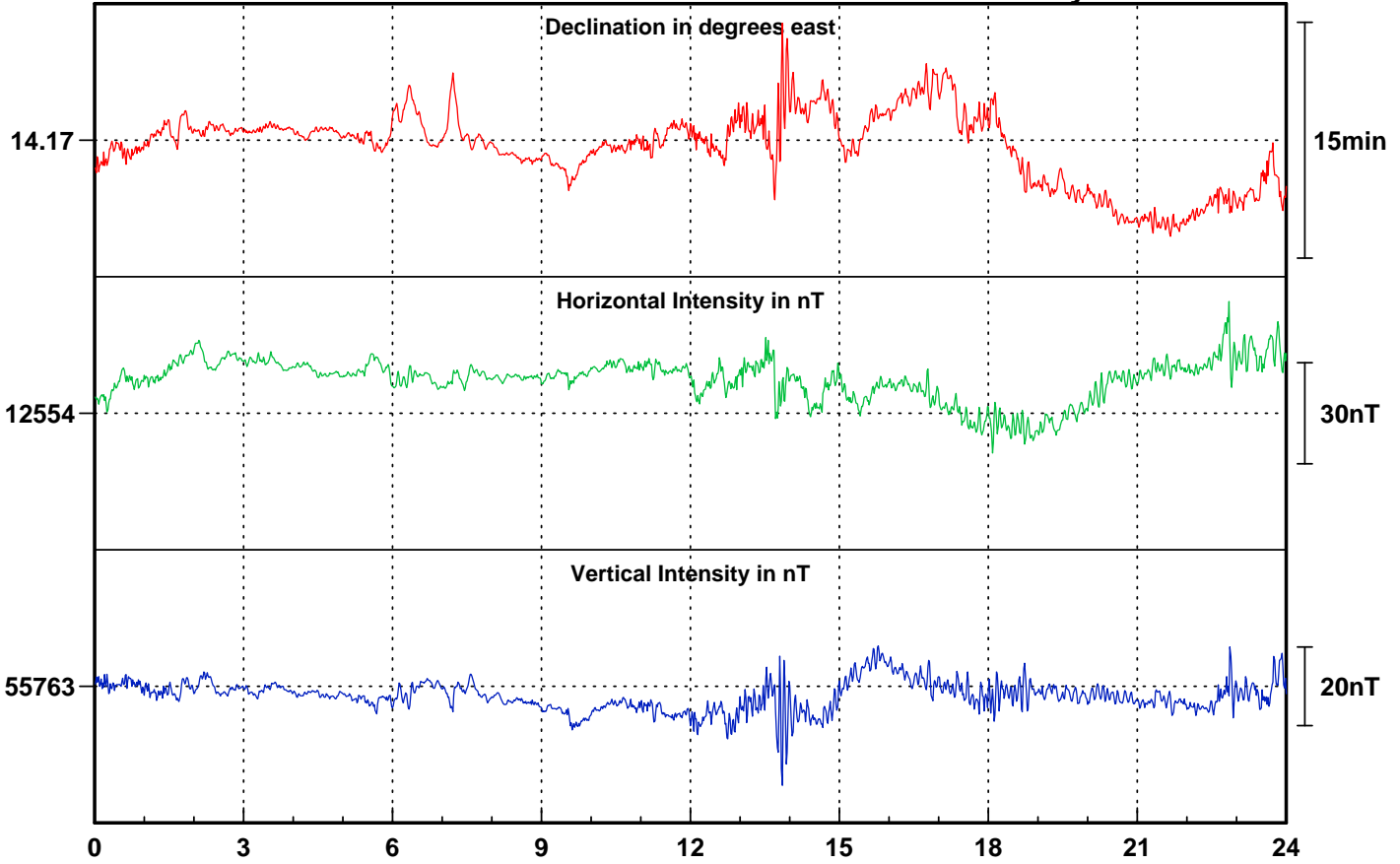
Day number: 322



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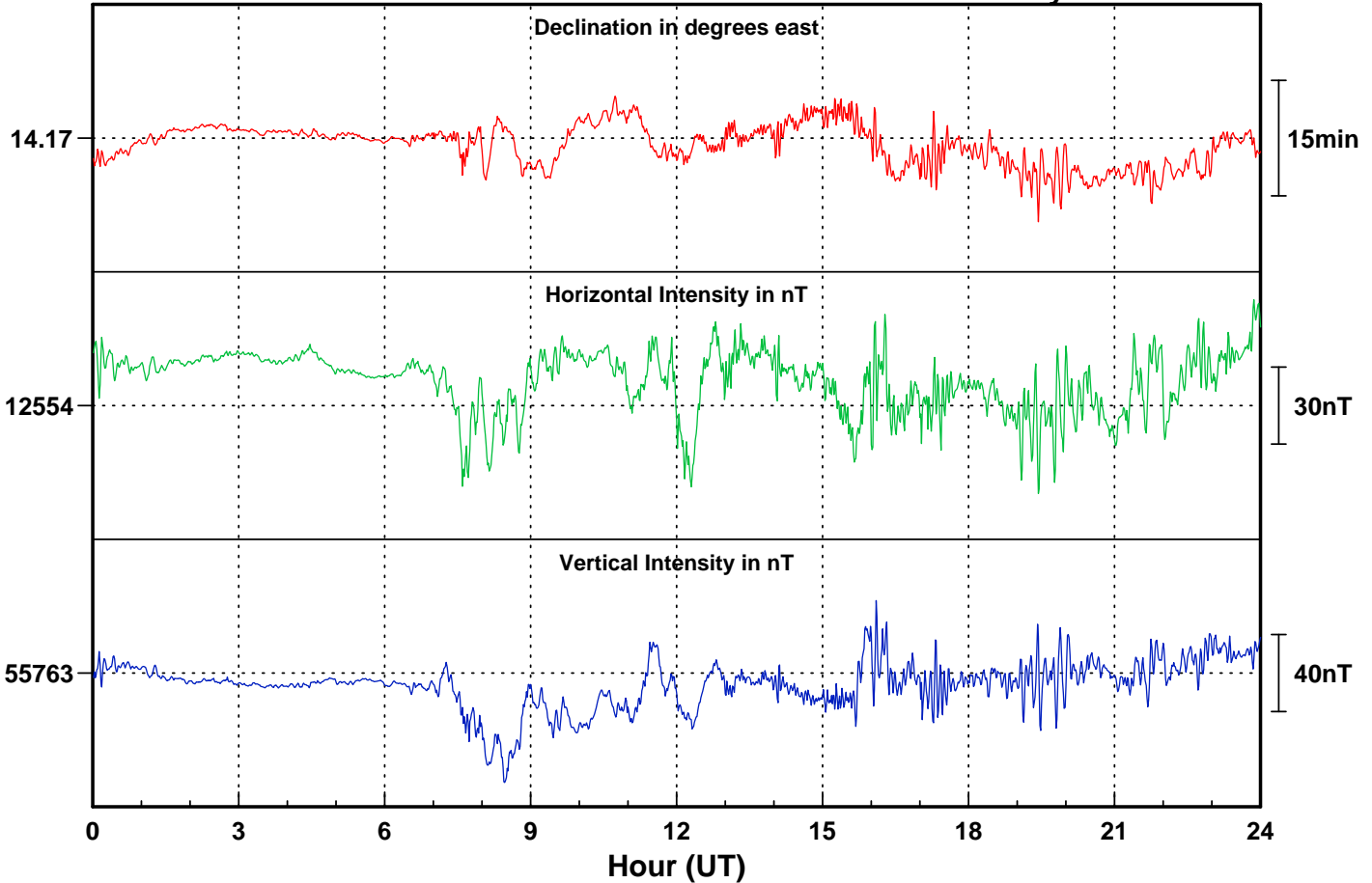
# Fort McMurray

Day number: 323



Date: 20-11-2021

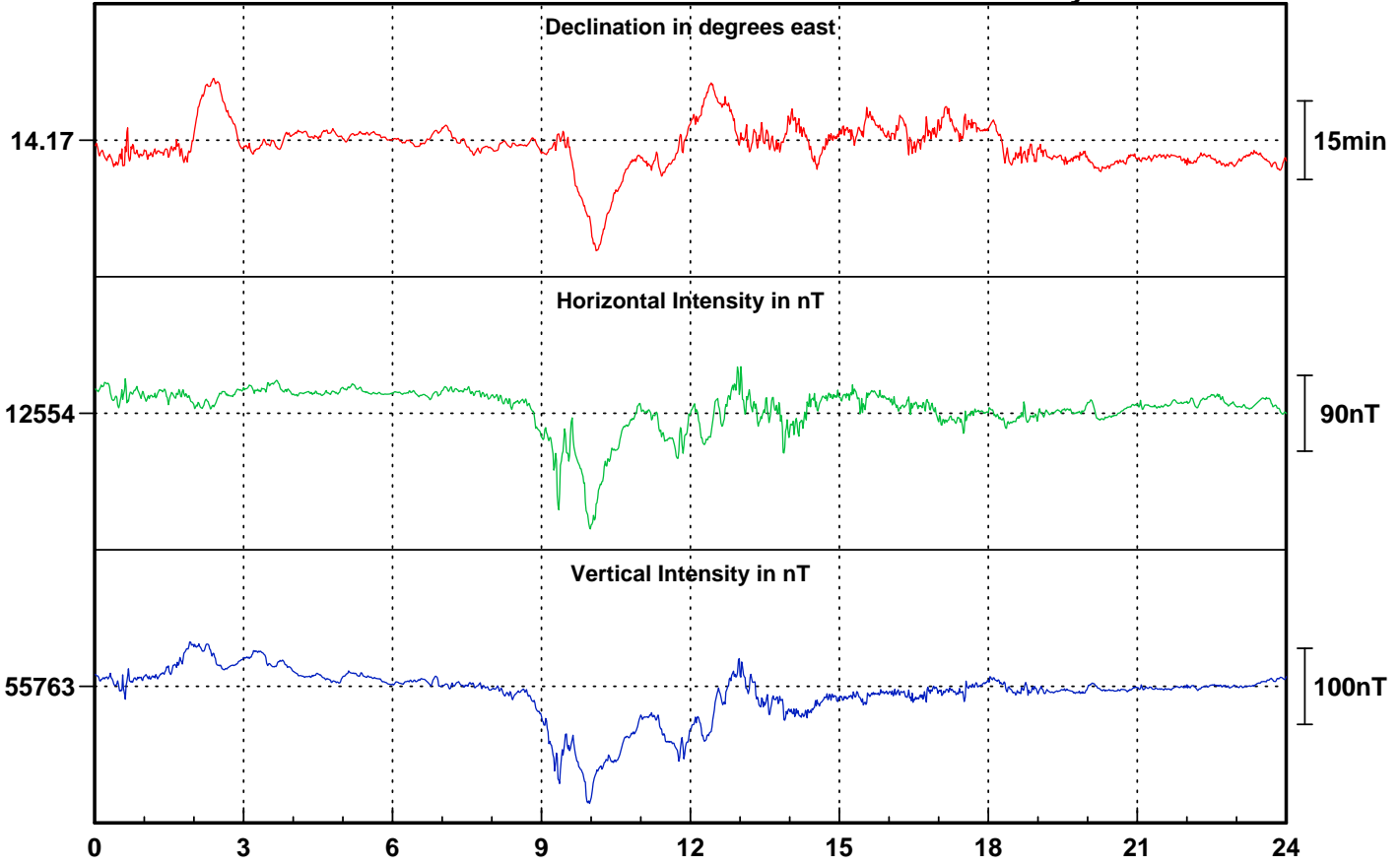
Day number: 324



Date: 21-11-2021

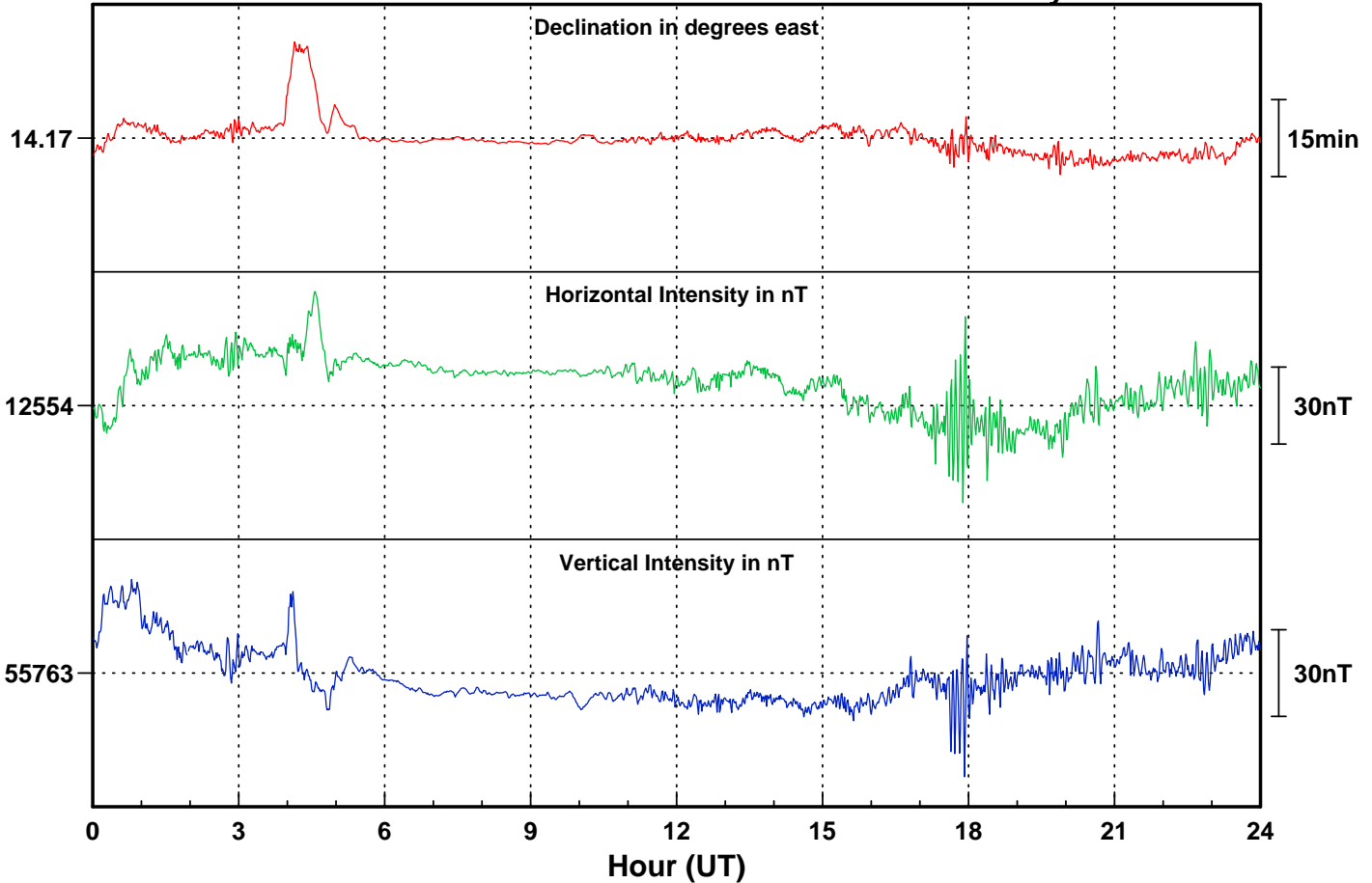
# Fort McMurray

Day number: 325



Date: 22-11-2021

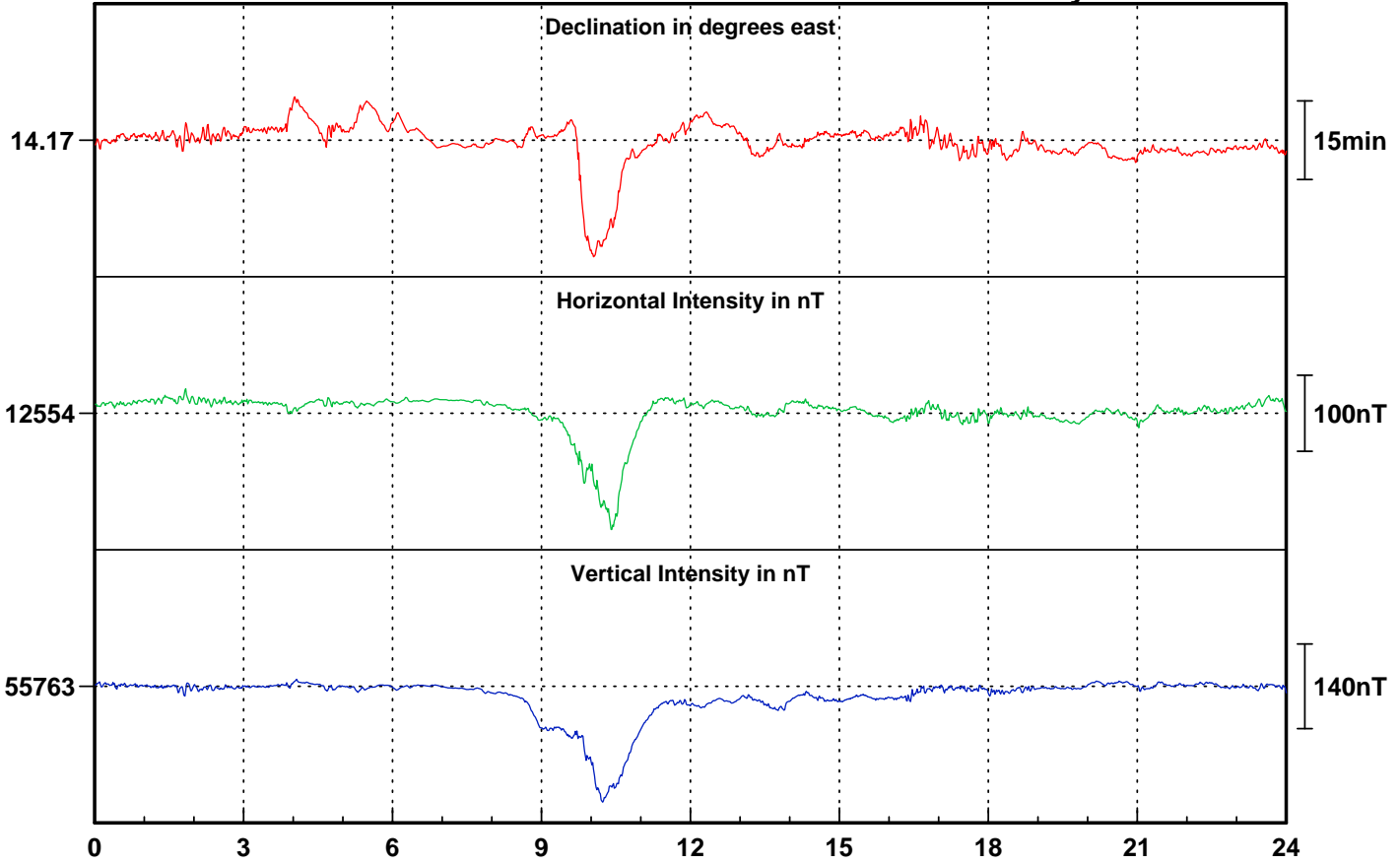
Day number: 326



Date: 23-11-2021

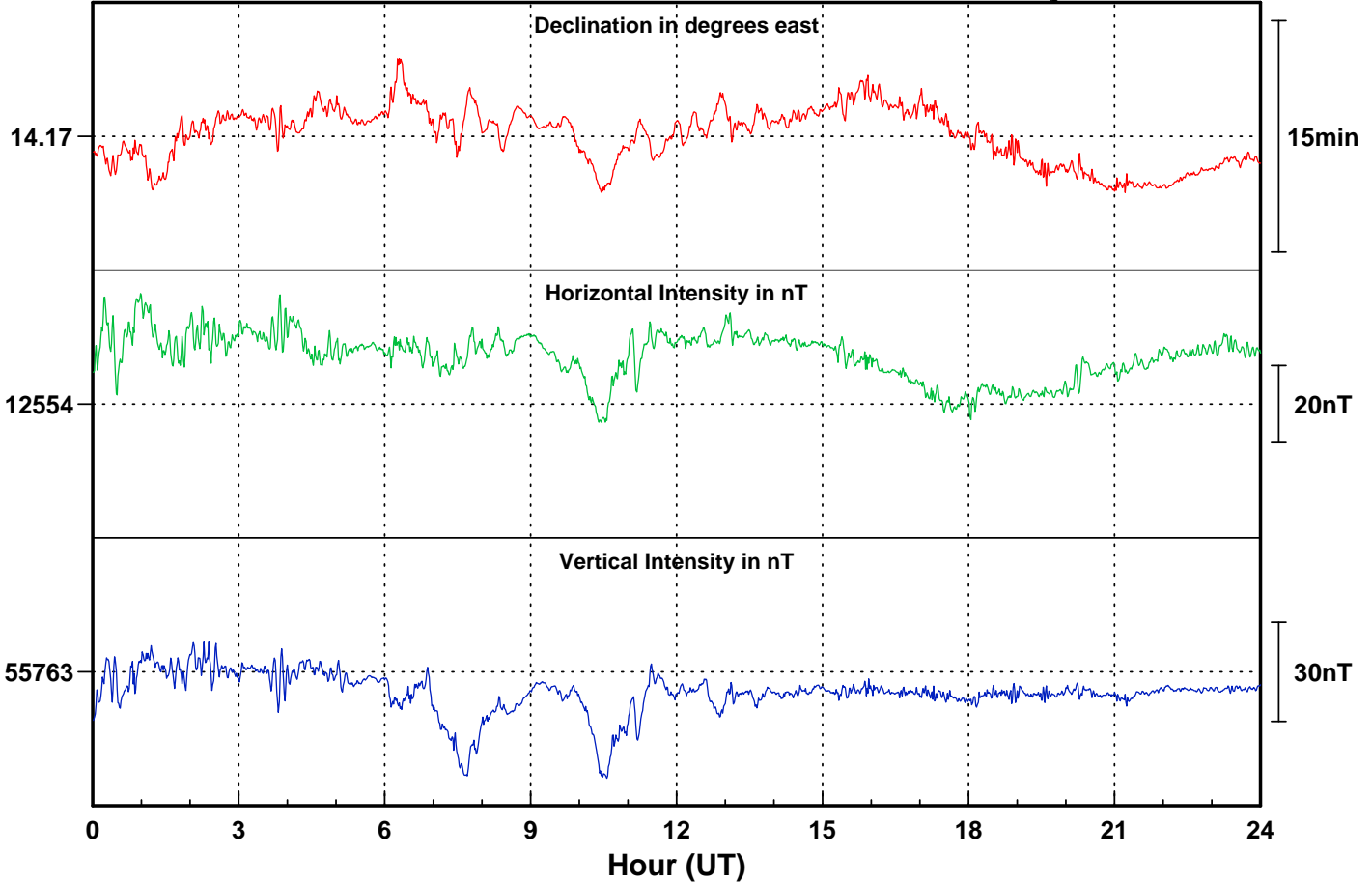
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Day number: 327



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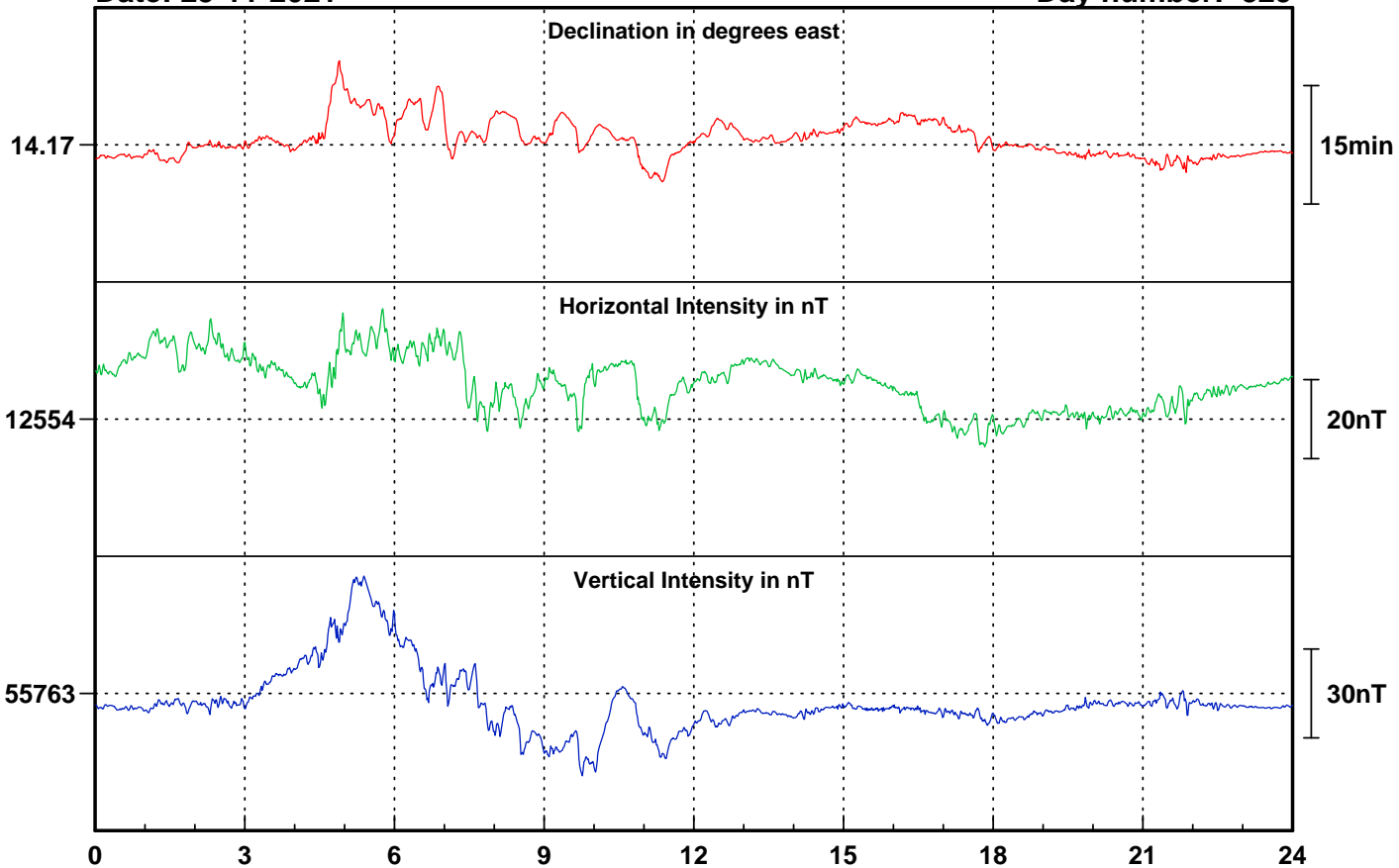
Day number: 328



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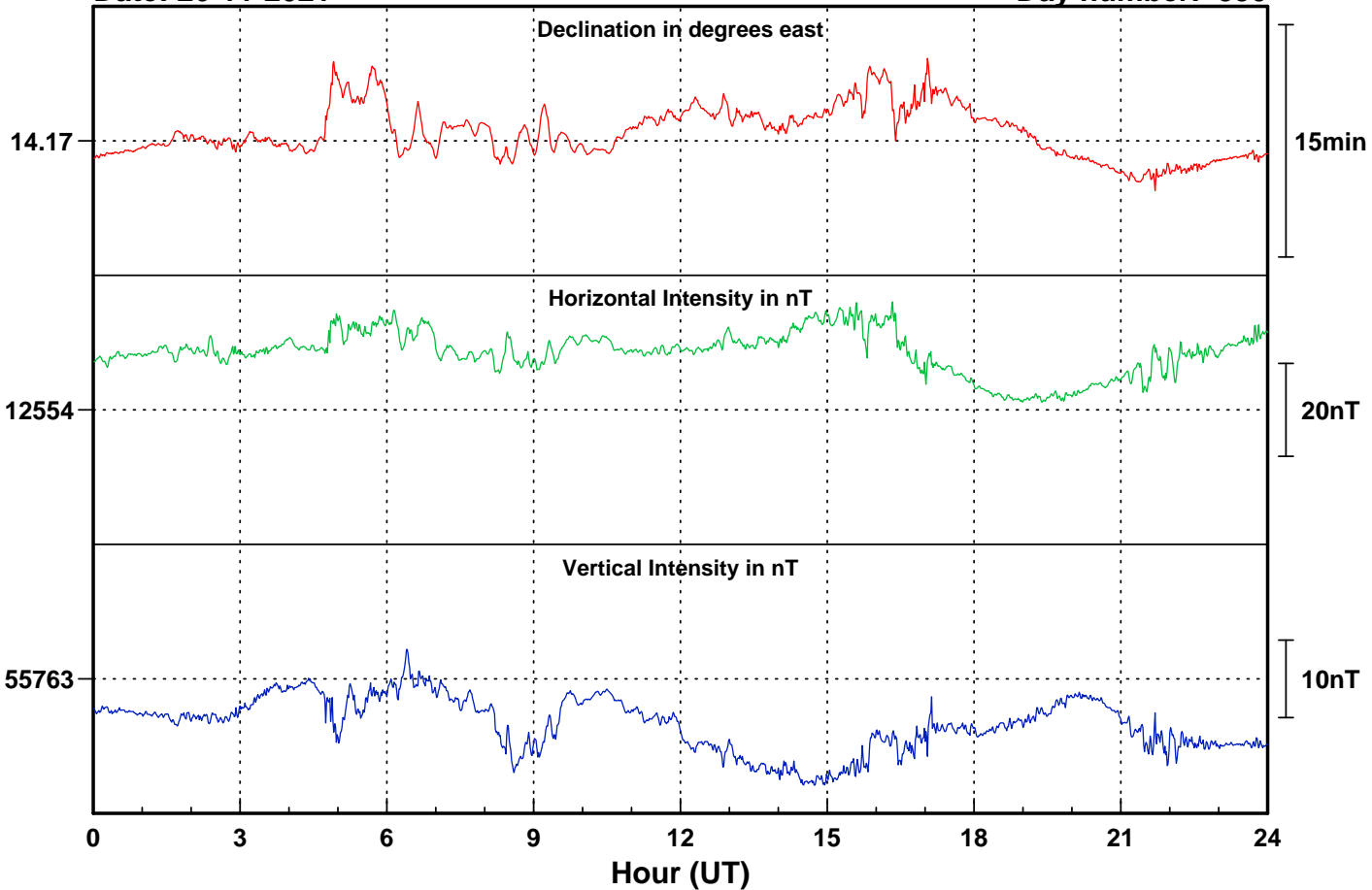
# Fort McMurray

Day number: 329



Date: 26-11-2021

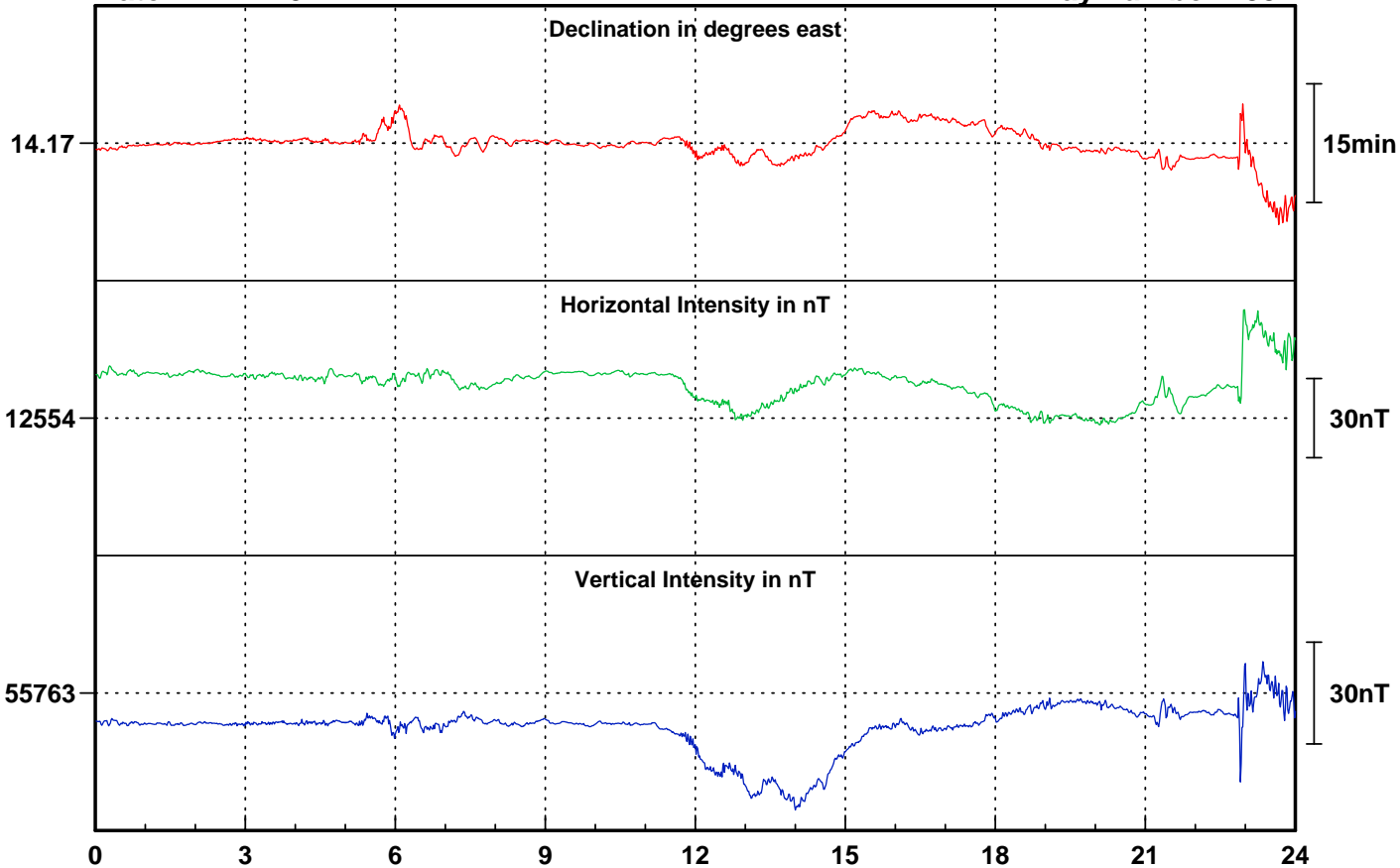
Day number: 330



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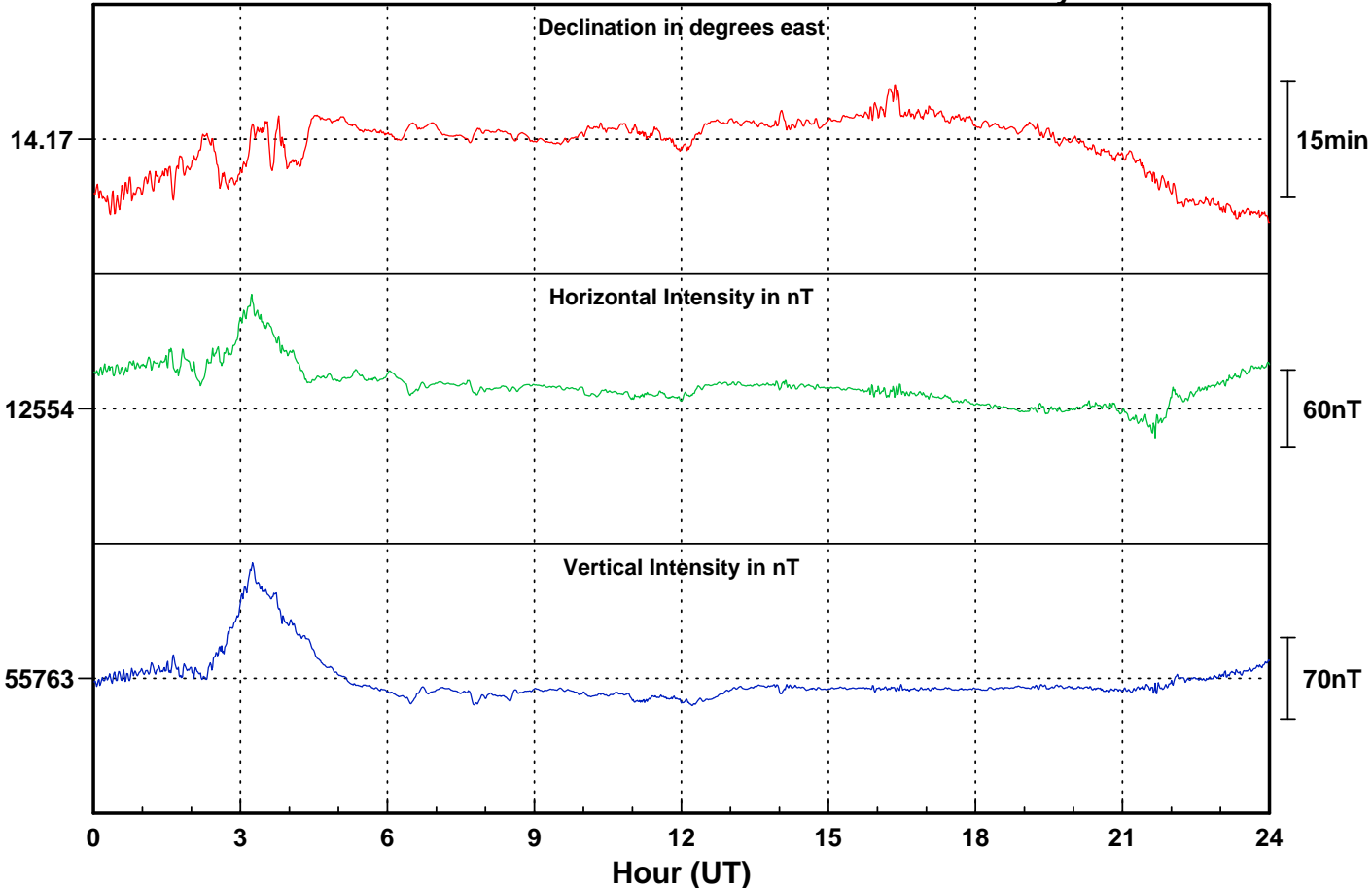
# Fort McMurray

Day number: 331



Date: 28-11-2021

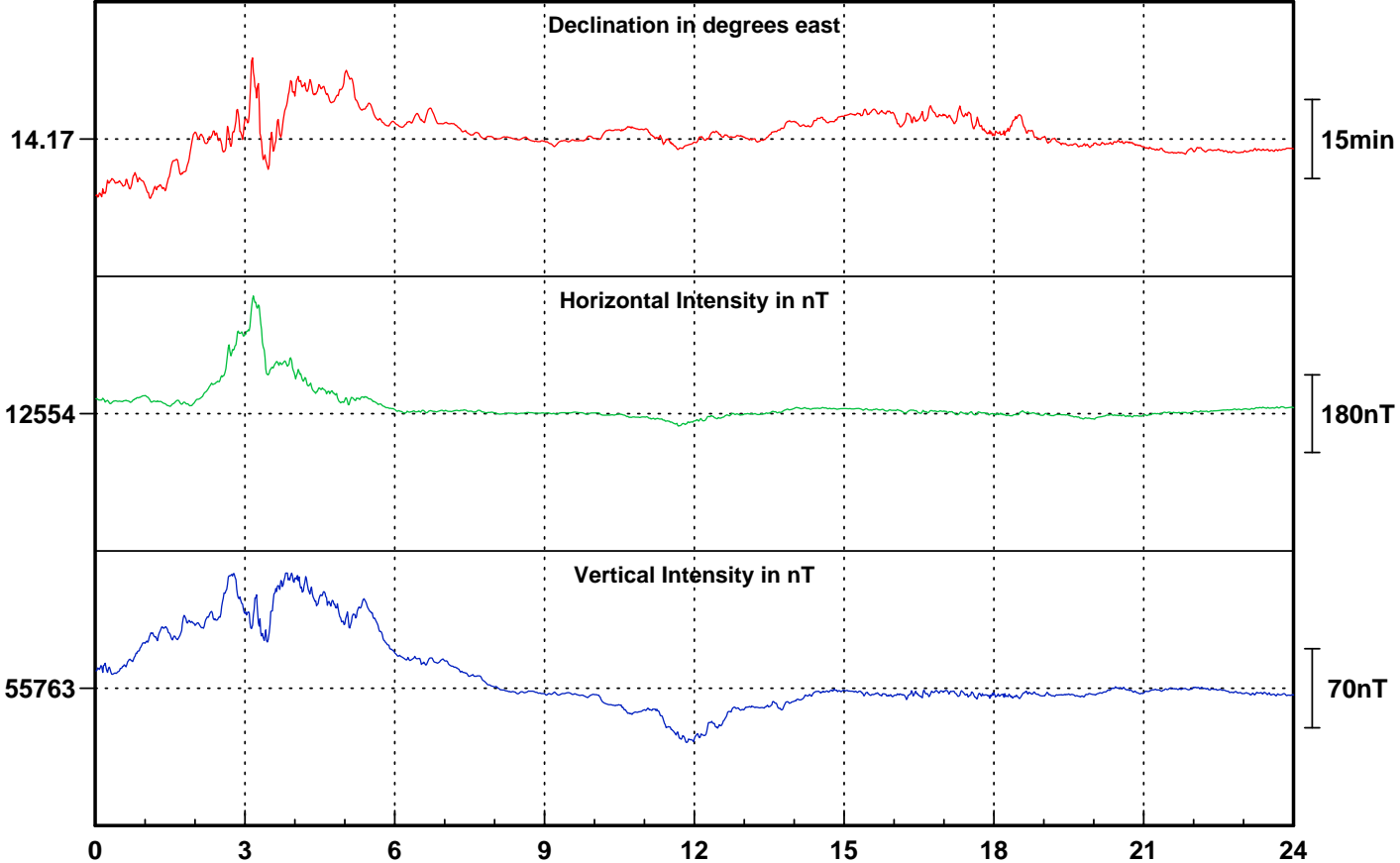
Day number: 332



Date: 29-11-2021

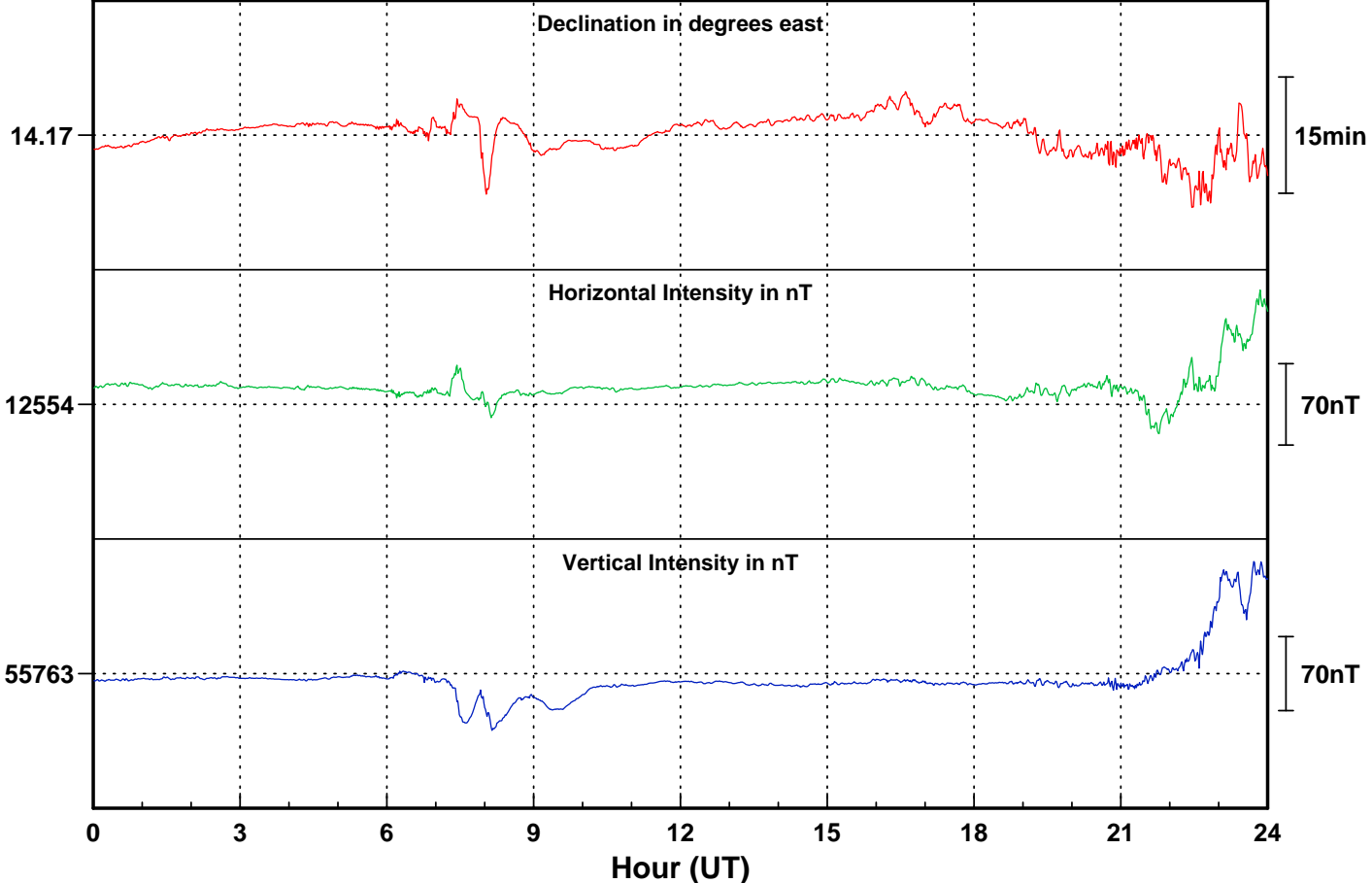
# Fort McMurray

Day number: 333

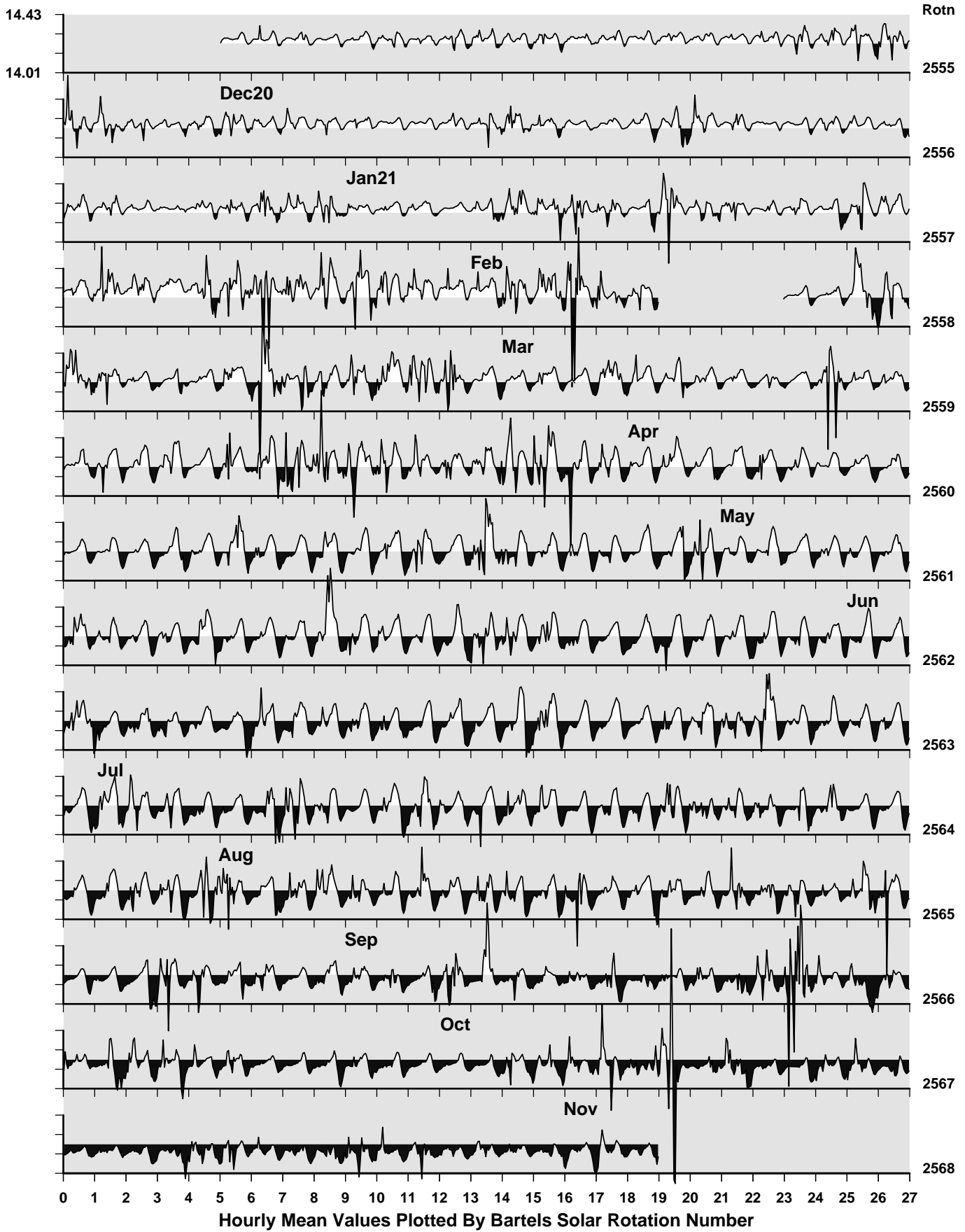


Date: 30-11-2021

Day number: 334



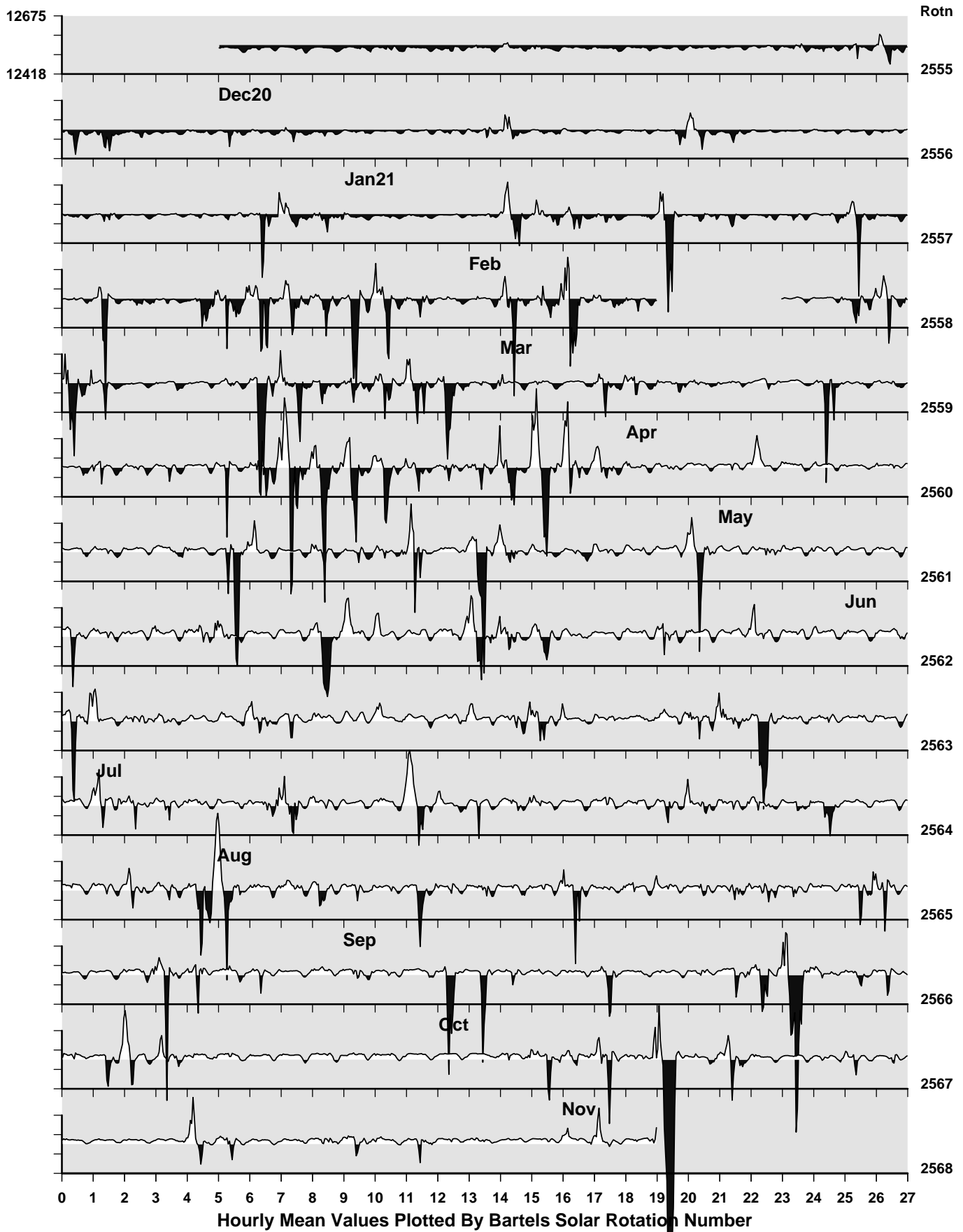
# Fort McMurray Observatory: Declination (degrees)



Hourly Mean Values Plotted By Bartels Solar Rotation Number

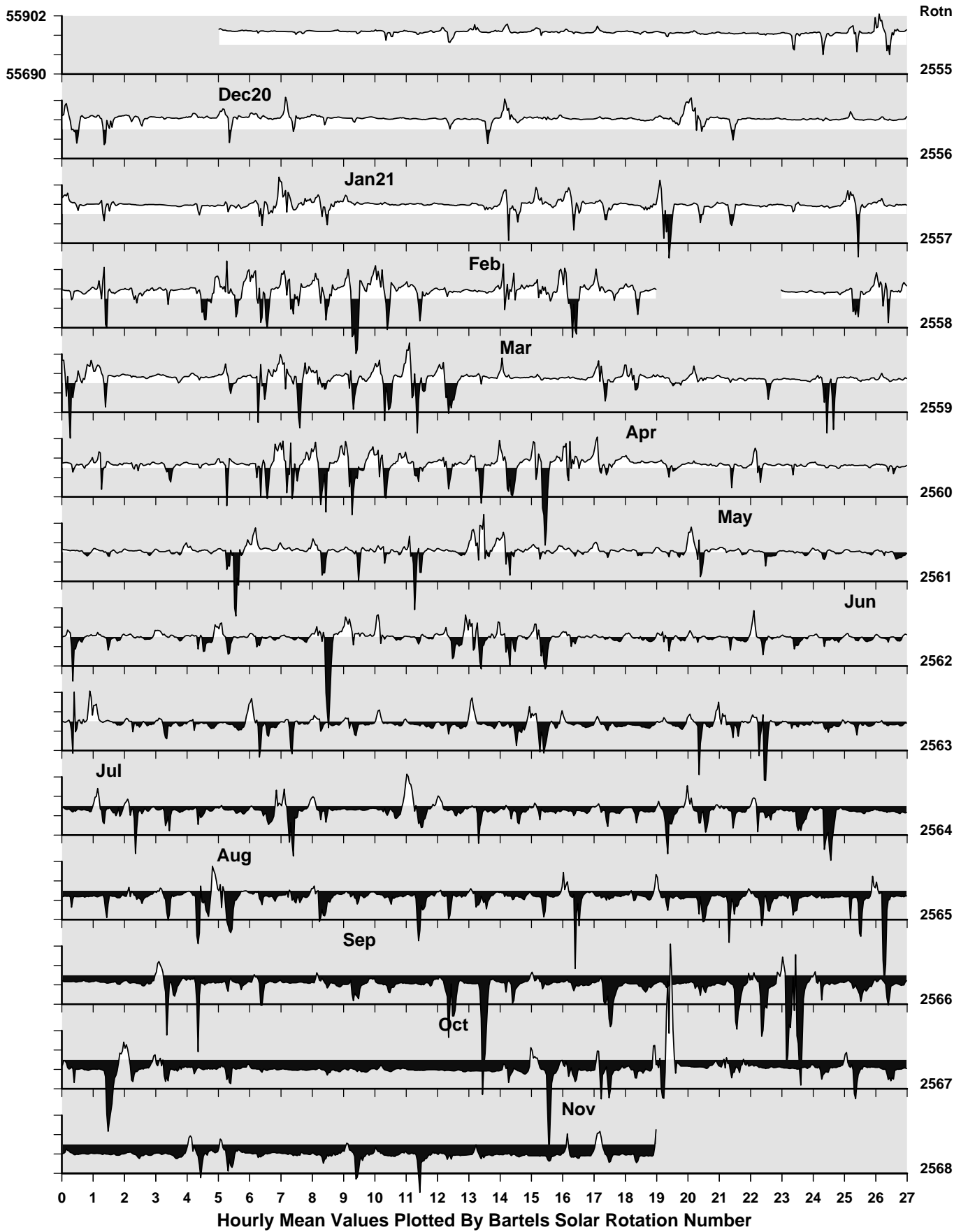


# Fort McMurray Observatory: Horizontal Intensity (nT)



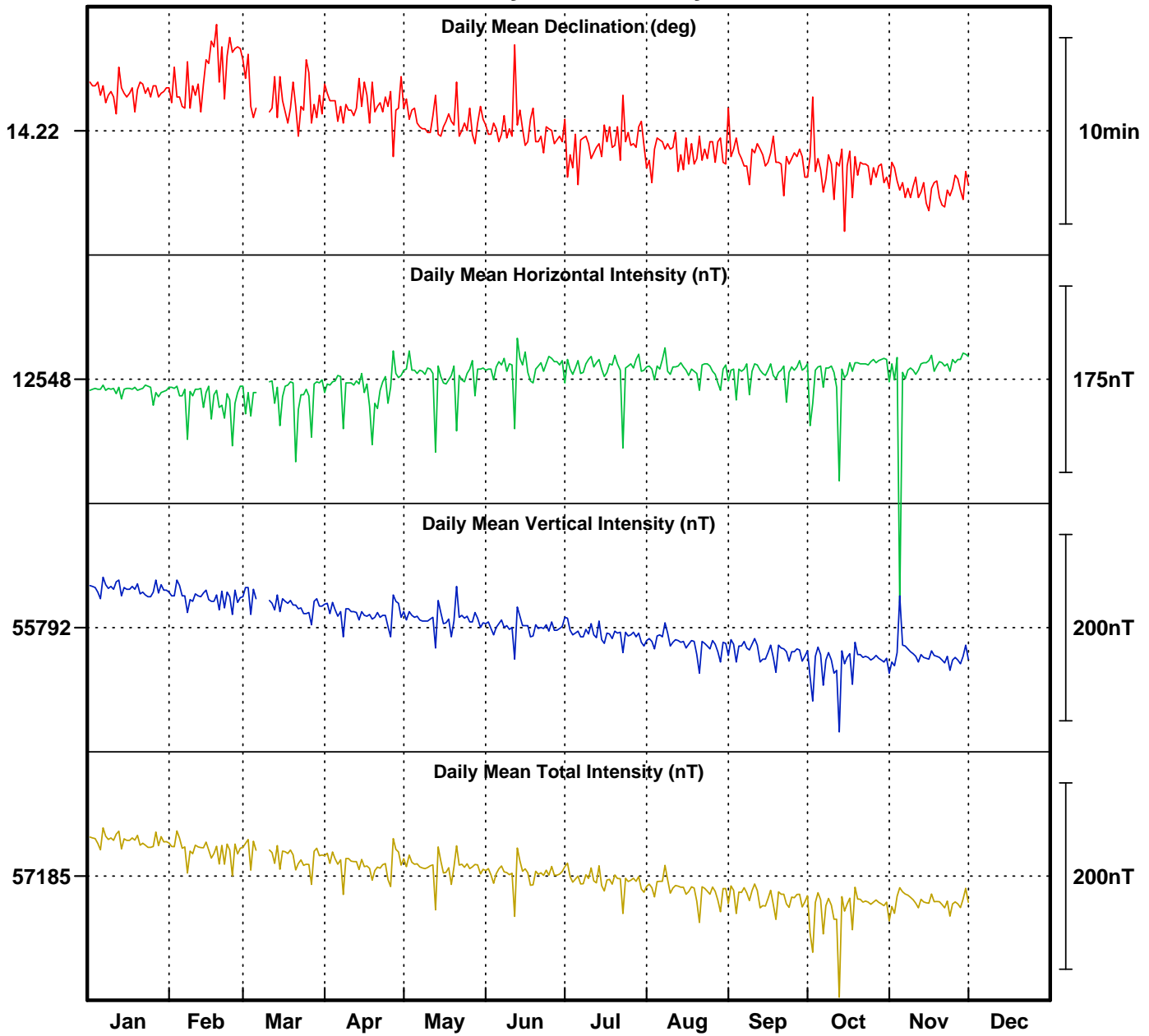
Hourly Mean Values Plotted By Bartels Solar Rotation Number

# Fort McMurray Observatory: Vertical Intensity (nT)



Hourly Mean Values Plotted By Bartels Solar Rotation Number

# Fort McMurray Observatory 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 |
| April     | 14° 14.6′ | 12540 nT | 77° 20.1′ | 12155 nT | 3085 nT  | 55807 nT | 57198 nT |
| May       | 14° 13.7′ | 12550 nT | 77° 19.5′ | 12165 nT | 3085 nT  | 55801 nT | 57195 nT |
| June      | 14° 13.3′ | 12558 nT | 77° 18.9′ | 12174 nT | 3085 nT  | 55792 nT | 57188 nT |
| July      | 14° 12.5′ | 12558 nT | 77° 18.8′ | 12174 nT | 3082 nT  | 55784 nT | 57180 nT |
| August    | 14° 12.1′ | 12556 nT | 77° 18.8′ | 12172 nT | 3081 nT  | 55774 nT | 57170 nT |
| September | 14° 11.7′ | 12554 nT | 77° 18.8′ | 12171 nT | 3078 nT  | 55766 nT | 57162 nT |
| October   | 14° 11.1′ | 12552 nT | 77° 18.7′ | 12169 nT | 3076 nT  | 55753 nT | 57148 nT |
| November  | 14° 10.1′ | 12554 nT | 77° 18.8′ | 12172 nT | 3073 nT  | 55763 nT | 57158 nT |

### Note:

i. The values shown here are provisional.