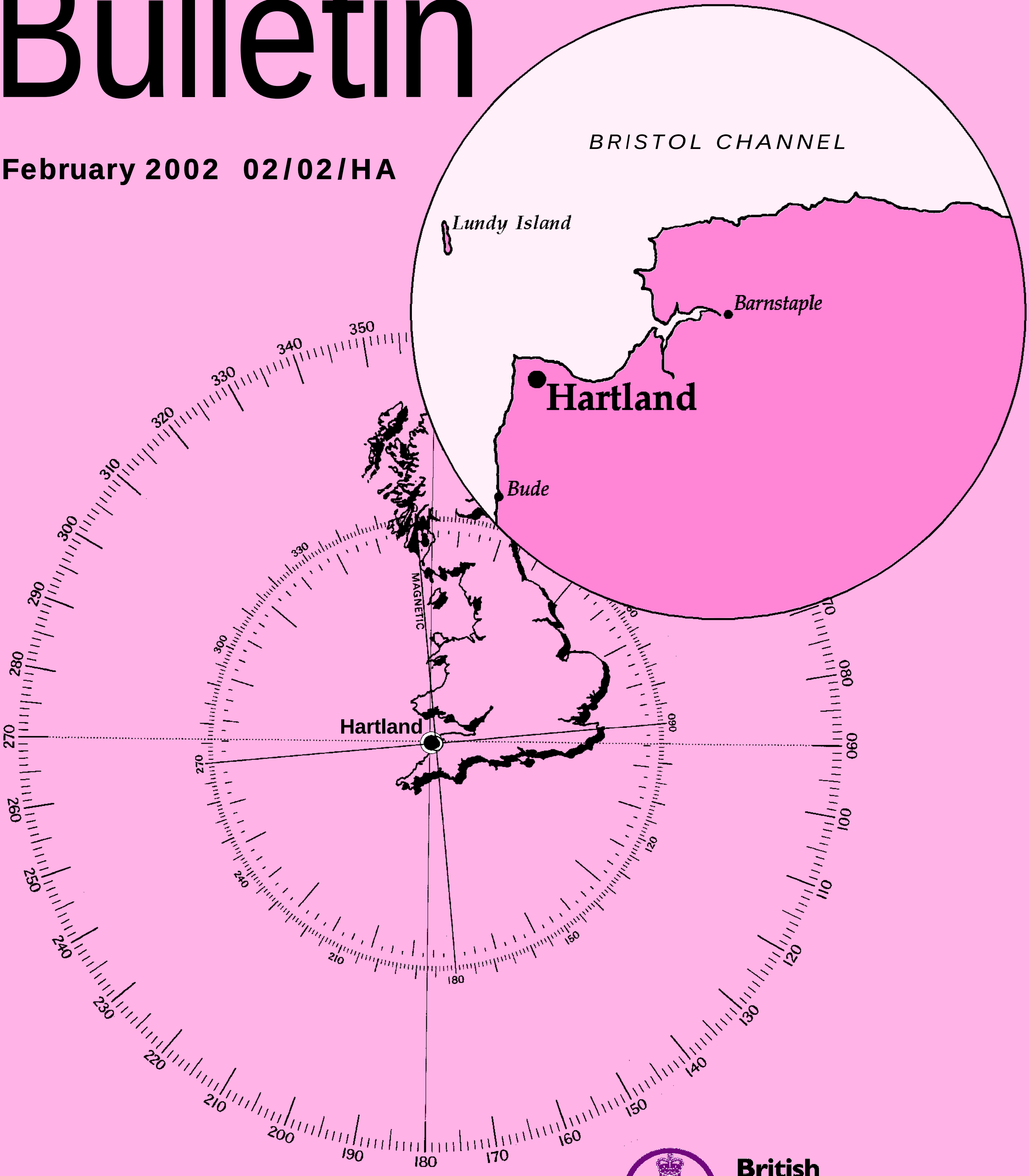
HARTLAND OBSERVATORY

Monthly Geomagnetic Bulletin

February 2002 02/02/HA



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

1. HARTLAND OBSERVATORY MAGNETIC DATA

1.1 Introduction

This bulletin is published to meet the needs of some commercial and academic users of geomagnetic data. The bulletin is organised in two main parts. The first part presents the magnetic observatory data as a series of plots of one-minute, hourly and daily values, followed by tabulations of monthly values, geomagnetic activity indices and reports of rapid variations. The second part of the bulletin presents information concerning the quality control of the observatory operation. This is primarily for the benefit of staff of the British Geological Survey (BGS), but may be of interest to some users. The operation of the observatory and presentation of data are described in the rest of this section. A description of the quality control data is provided in the second part of the bulletin. Enquiries about the data should be addressed to:

National Geomagnetic Service
British Geological Survey
Murchison House, West Mains Road
Edinburgh EH9 3LA
Scotland, UK

Tel:	+44 (0) 131 667 1000
Fax:	+44 (0) 131 668 4368
E-mail:	s.reay@bgs.ac.uk
World-Wide Web:	*http://www.geomag.bgs.ac.uk/*

1.2 Position

Hartland Observatory, one of the three geomagnetic observatories operated and maintained in the UK by BGS, is situated on the NW boundary of the village of Hartland in North Devon. The observatory co-ordinates are:-

Geographic:	*50°59.7′N*	*355°31.0′E*
Geomagnetic:	*53°56.0′N*	*80°10.1′E*
Height above mean sea level:		*95 m*

The geomagnetic co-ordinates are calculated using the 8th generation International Geomagnetic Reference Field at epoch 2002.5.

1.3 The Observatory Operation

1.3.1 GAUSS

The observatory operates under the control of the Geomagnetic Automatic Unmanned Sampling System (GAUSS), which was developed by BGS staff, was installed in 1996, and became operational in January 1997. The system is based on two IBM-compatible personal computers (PCs), which control the data-logging and communications. There are two sets of sensors used for making magnetic measurements. A triaxial linear-core fluxgate magnetometer, manufactured by the Danish Meteorological Institute 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, and are filtered to produce one-minute values using a 61-point cosine filter.

In addition to the fluxgate sensors there is a proton precession magnetometer with its sensor mounted at the centre of two sets of orthogonal Helmholtz coils, which is used to make measurements each minute of the absolute total field intensity (*F*) and the variations in declination and inclination (*I*). This system is described in more detail in the section on observatory quality control at the end of this bulletin.

The data are retrieved via telephone to the BGS office in Edinburgh. In normal operation this is performed automatically every three hours by an IBM-compatible PC located in Edinburgh, but data can be retrieved on demand if required.

The data sets are used to update the Geomagnetism Information and Forecast Service (GIFS), an on-line information system accessed via the World-Wide Web at the address given in Section 1.1. GIFS also provides information on geomagnetic and solar activity.

1.3.2 Back-up System

This system is an independent three-component fluxgate magnetometer measuring *D*, *H* and *Z*. Samples are taken every 10 seconds from which one-minute mean values are derived, and these values are logged by an IBM-compatible PC. The data are returned to Edinburgh every hour by satellite link, and are also logged to a disk, which is mailed every week. The data are used to fill any gaps in the GAUSS records.

1.4 Data Presentation

The data presented in the bulletin are in the form of plots and tabulations described in the following sections.

1.4.1 Summary magnetograms

Small-scale magnetograms are plotted which allow the month's data to be viewed at a glance. They are plotted with 16 days on a page, showing the variations in *D*, *H* and Z. The scales are shown on the right-hand side of the page. Occasionally the amplitude of disturbance requires that the scales be multiplied by a factor throughout the course of one day, 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.

1.4.2 Magnetograms

The magnetograms are plotted using one-minute values of *D*, *H* and *Z* from the GAUSS fluxgate sensors, with any gaps filled using the back-up data. 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.

1.4.3 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 on the surface of the Sun may recur after 27 days: the same is true for geomagnetically quiet intervals. Plotting the data in this way highlights this recurrence, and also illustrates seasonal and diurnal variations throughout the year.

1.4.4 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. Provisional and definitive values are indicated in the table as **P** or **D** respectively. It is anticipated that provisional values will not be altered by more than a few nT or tenths of arcminutes, if at all, before being made definitive.

1.4.5 Geomagnetic activity indices

The Observatory K index. This summarises geomagnetic activity at an observatory by assigning a code, an integer in the range 0 to 9, to each 3-hour Universal Time (UT) interval. The index for each 3-hour UT interval is determined from the ranges in *H* and in *D* (scaled in nT), with allowance made for the regular (undisturbed) diurnal variation. The conversion from range to an index value is made using a quasi-logarithmic scale, with the scale values dependent on the geomagnetic latitude of the observatory. The *K* index retains the local time (LT) and seasonal dependence of activity associated with the position of the observatory.

The provisional aa index. A number of 3-hour geomagnetic indices are computed by combining *K* indices from networks of observatories to characterise global activity levels and to eliminate LT and seasonal effects. The simplest of these is the *aa* index, computed using the *K* indices from two approximately antipodal observatories: Hartland in the UK and Canberra in Australia. The *aa* index is calculated from linearisations of the Hartland and Canberra *K* indices, and has units of nT. The daily mean value of *aa* (denoted *Aa*), the mean values of *aa* for the intervals 00-12UT and 12-24UT and the daily mean values for Hartland alone (Aa_n) and Canberra alone (Aa_s) are tabulated.

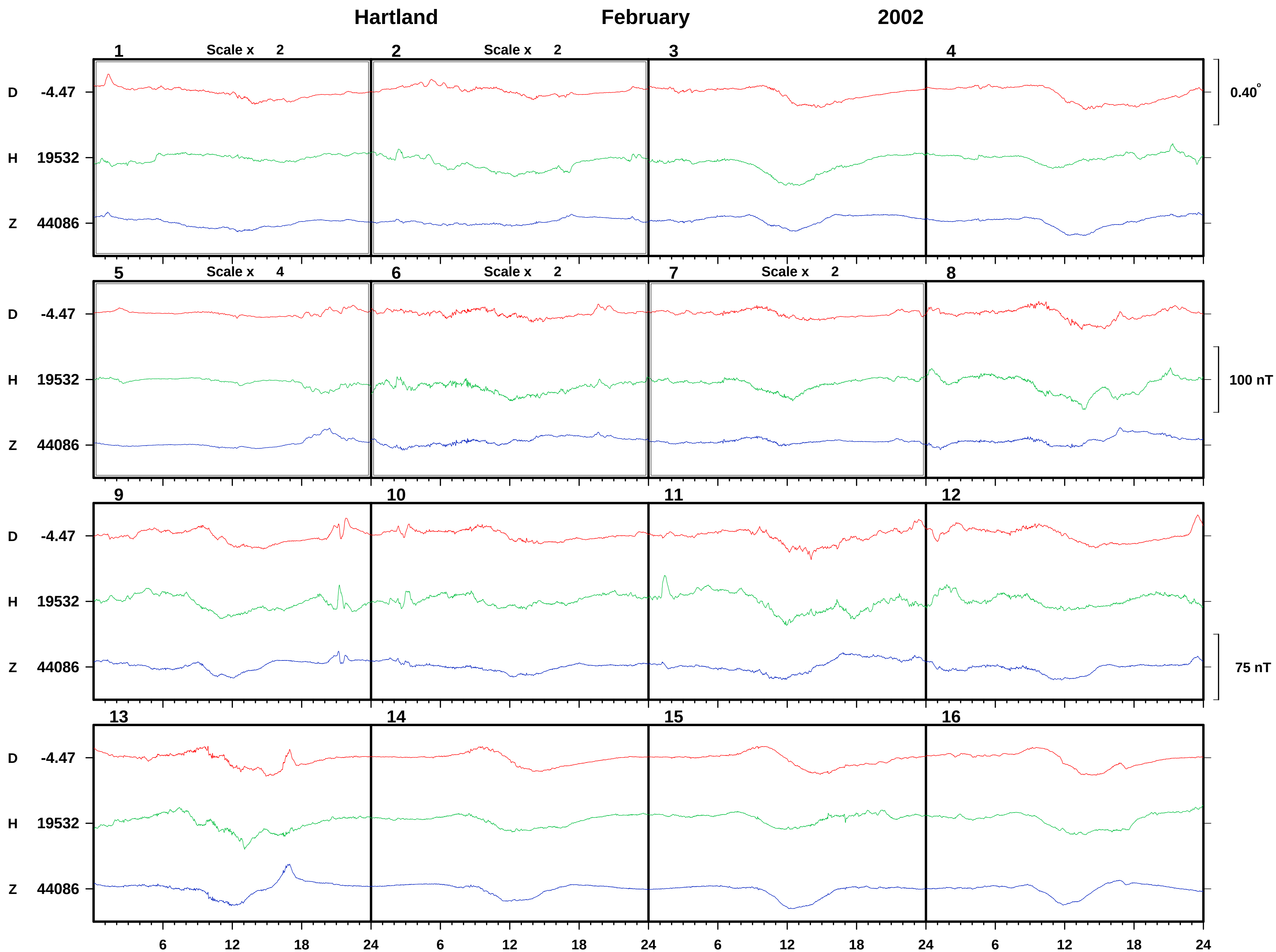
Although the *aa* index is based on data from only two observatories, provided averages over 12 hours or longer are used, the index is strongly correlated with the *ap* and *am* indices, which are derived using data from more extensive observatory networks.

The *aa* indices listed in this publication are provisional only; the definitive values are published by the International Service for Geomagnetic Indices, CRPE/CNET - CNRS, 4 Avenue de Neptune, F-94107 Saint Maur Cedex, France.

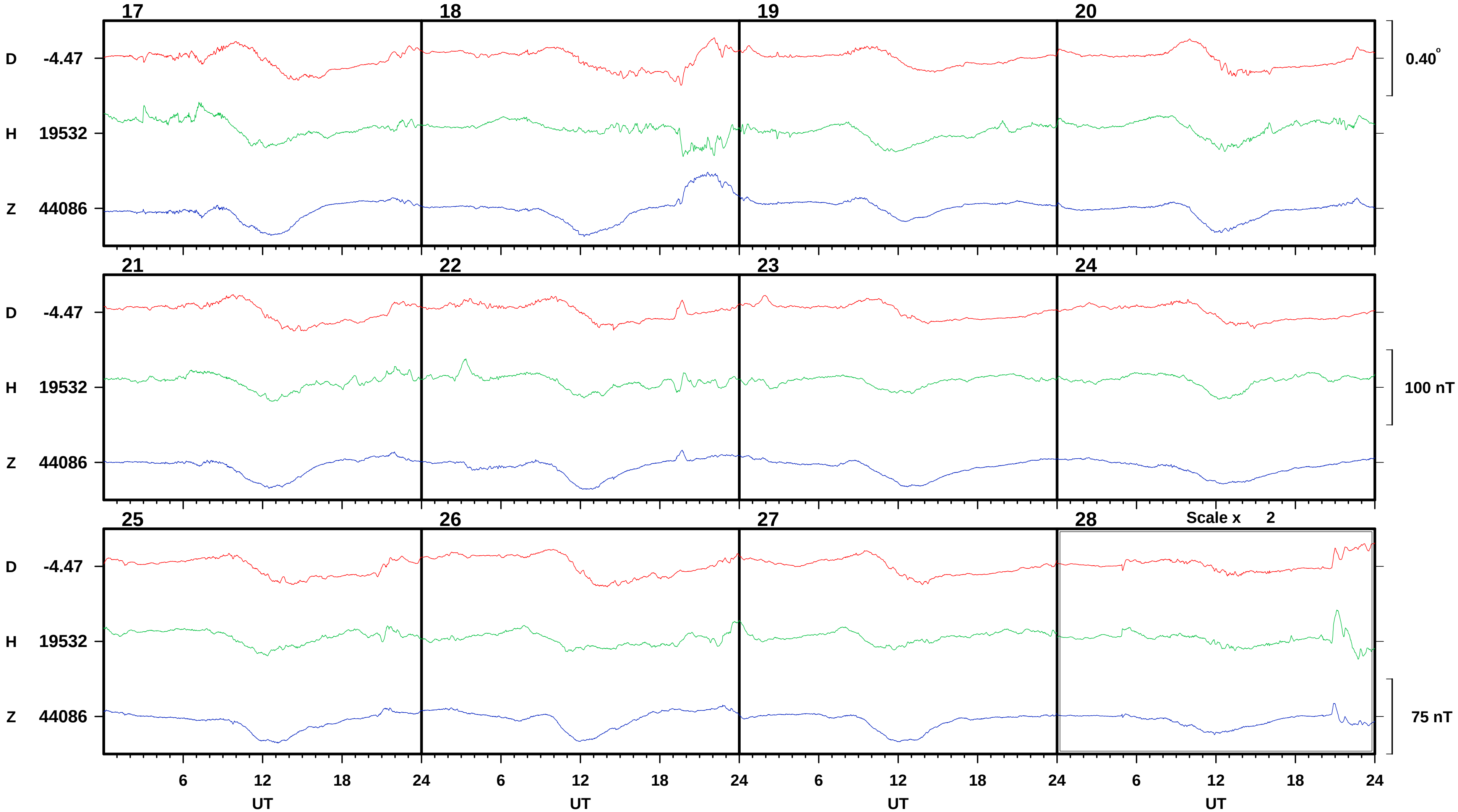
1.4.6 Rapid Variations

Charged particles stream from the Sun in the solar wind. The solar wind interacts with the geomagnetic field to create a cavity, the magnetosphere, in which the field is confined. When a region of enhanced velocity and/or density in the solar wind arrives at the day-side boundary of the magnetosphere (at about 10 earth radii) the boundary is pushed towards the Earth. Currents set up on the boundary of the magnetosphere can cause an abrupt change in the geomagnetic field measured on the ground and this is recorded on observatory magnetograms as a Sudden Impulse (SI). If, following a SI, there is a change in the rhythm of activity, the SI is termed a Storm Sudden Commencement (SSC). A classical magnetic storm exhibiting initial, main and recovery phases (shown by, for instance, the *Dst* ring current index) can often occur after a SSC, in which case the start of the storm is taken as the time of the SSC.

Solar flares, seen at optical wavelengths as a sudden brightening of a small region of the Sun's surface, are also responsible for increased X-ray emissions. The X-rays cause increased ionisation in the ionosphere, which leads to absorption of short-wave radio signals. On an observatory magnetogram a Solar Flare Effect (SFE) or "crochet" may be observed. This is an enhancement to the diurnal variation of the order of 10 nT, lasting about an hour.

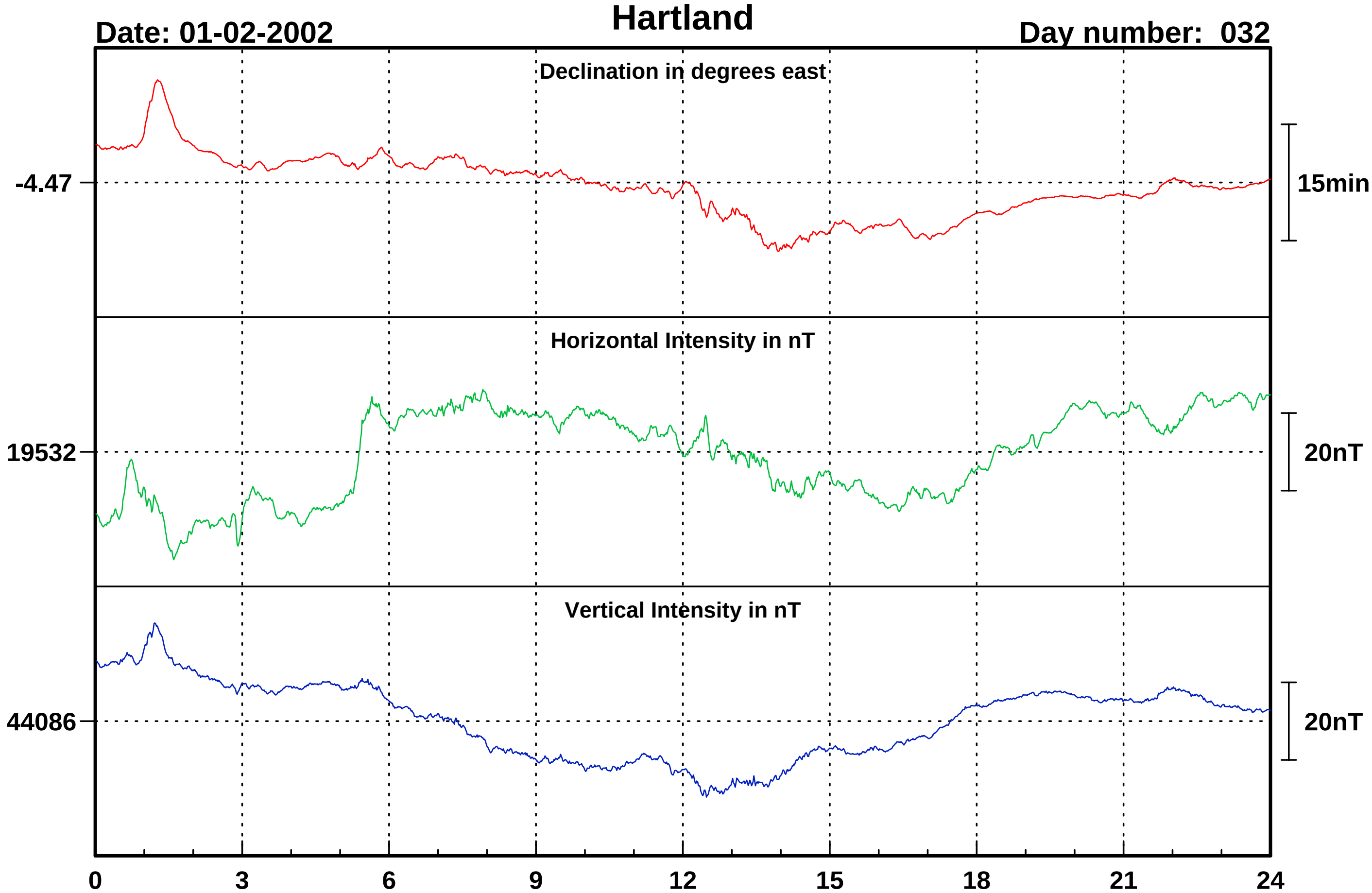


Hartland
February
2002
1
Scale x 2
2
Scale x 2
3
4
5
Scale x 4
6
Scale x 2
7
Scale x 2
8
9
10
11
12
13
14
15
16
D -4.47
H 19532
Z 44086
0.40°
100 nT
75 nT
6
12
18
24

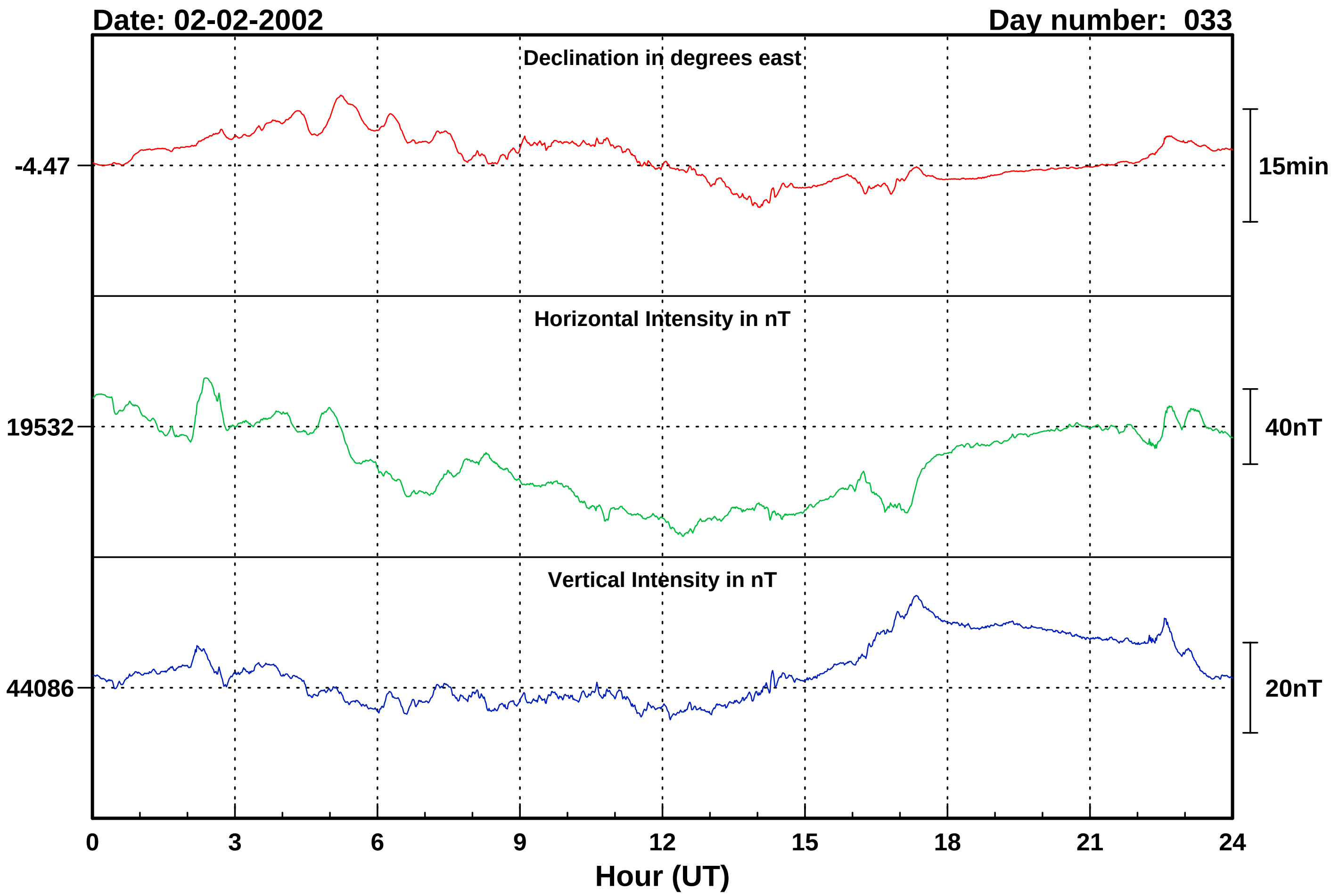


Hartland February 2002

Hartland



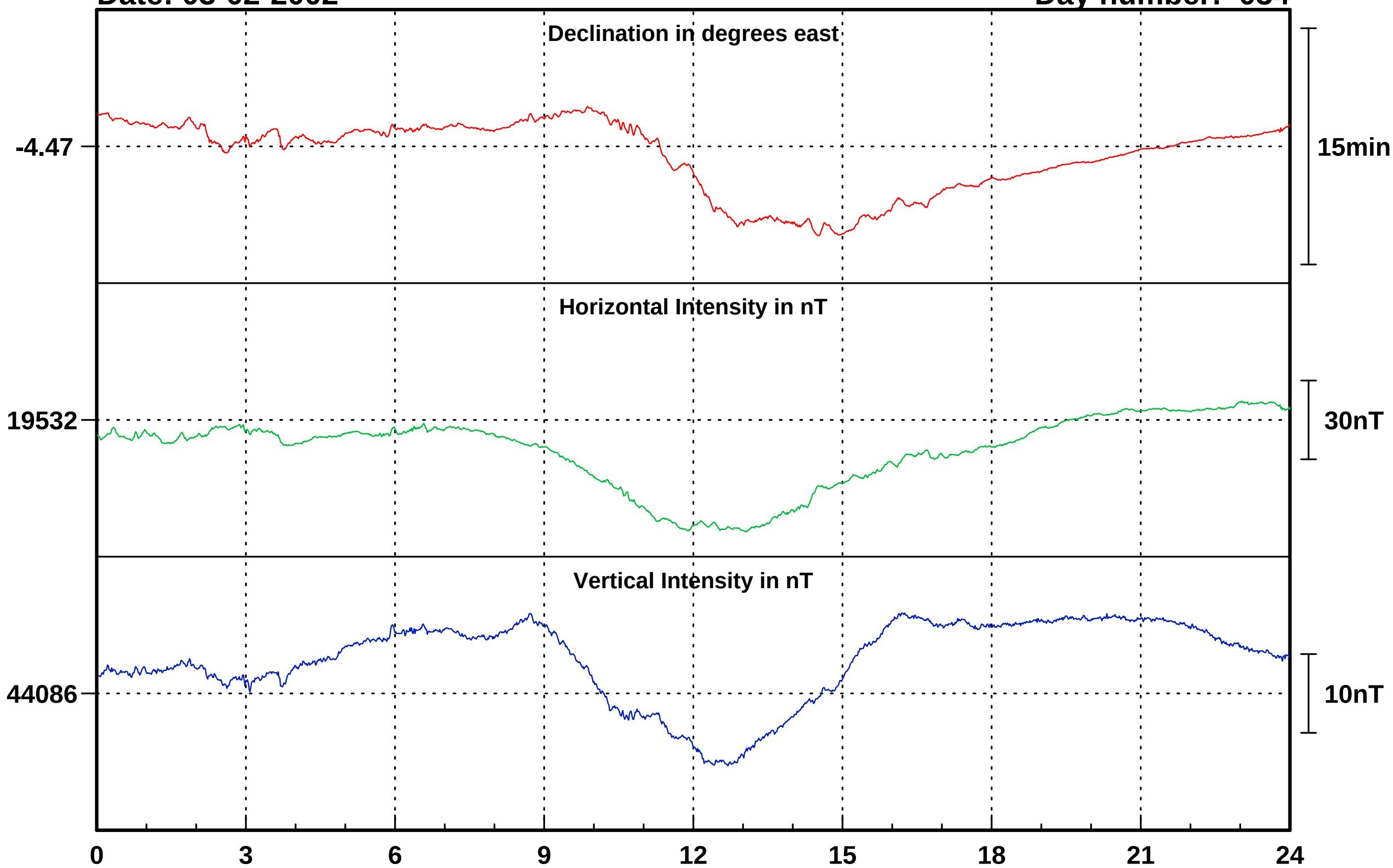
Date: 01-02-2002
Day number: 032
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24



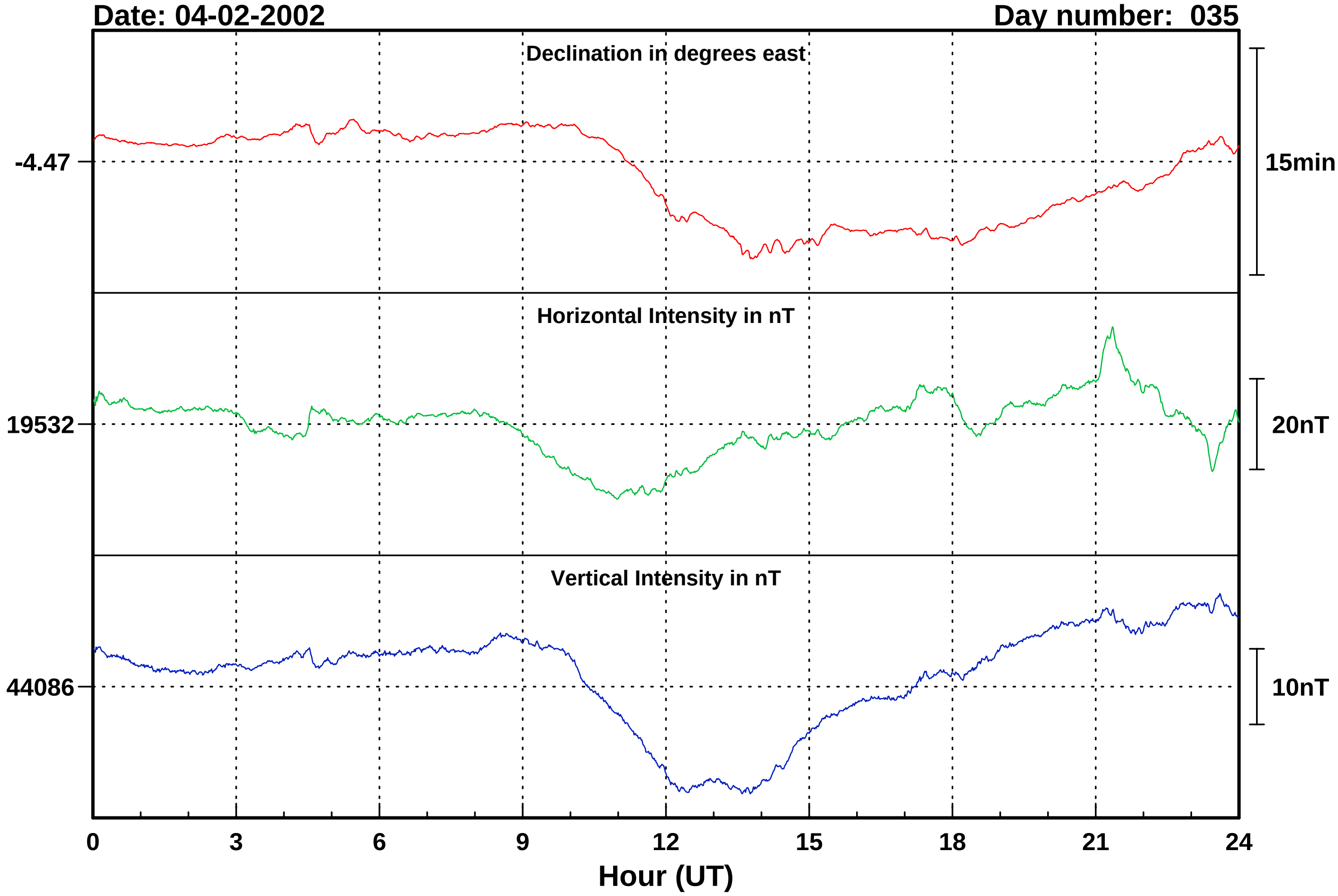
Date: 02-02-2002
Day number: 033
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
40nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

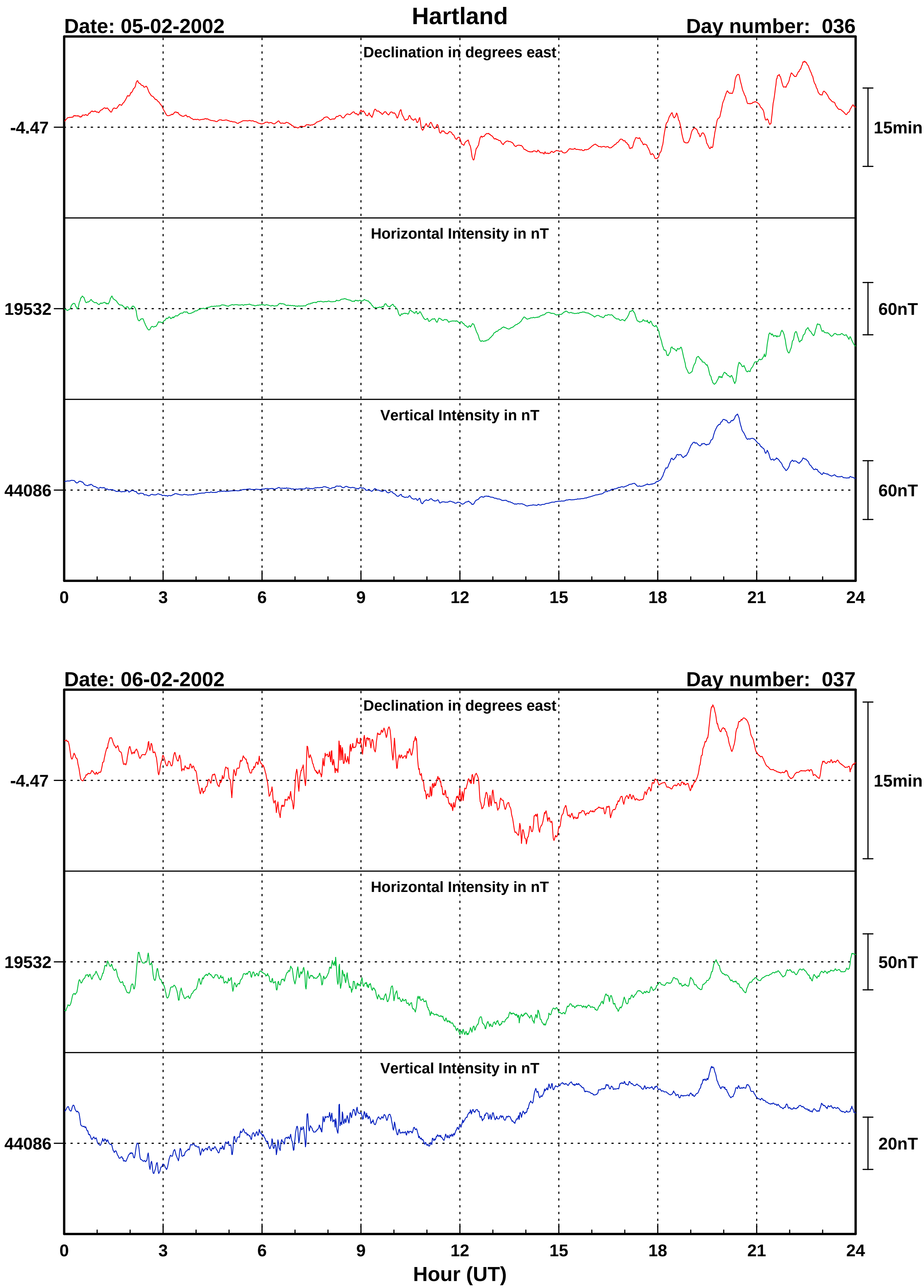
Hartland

Date: 03-02-2002 **Day number: 034**

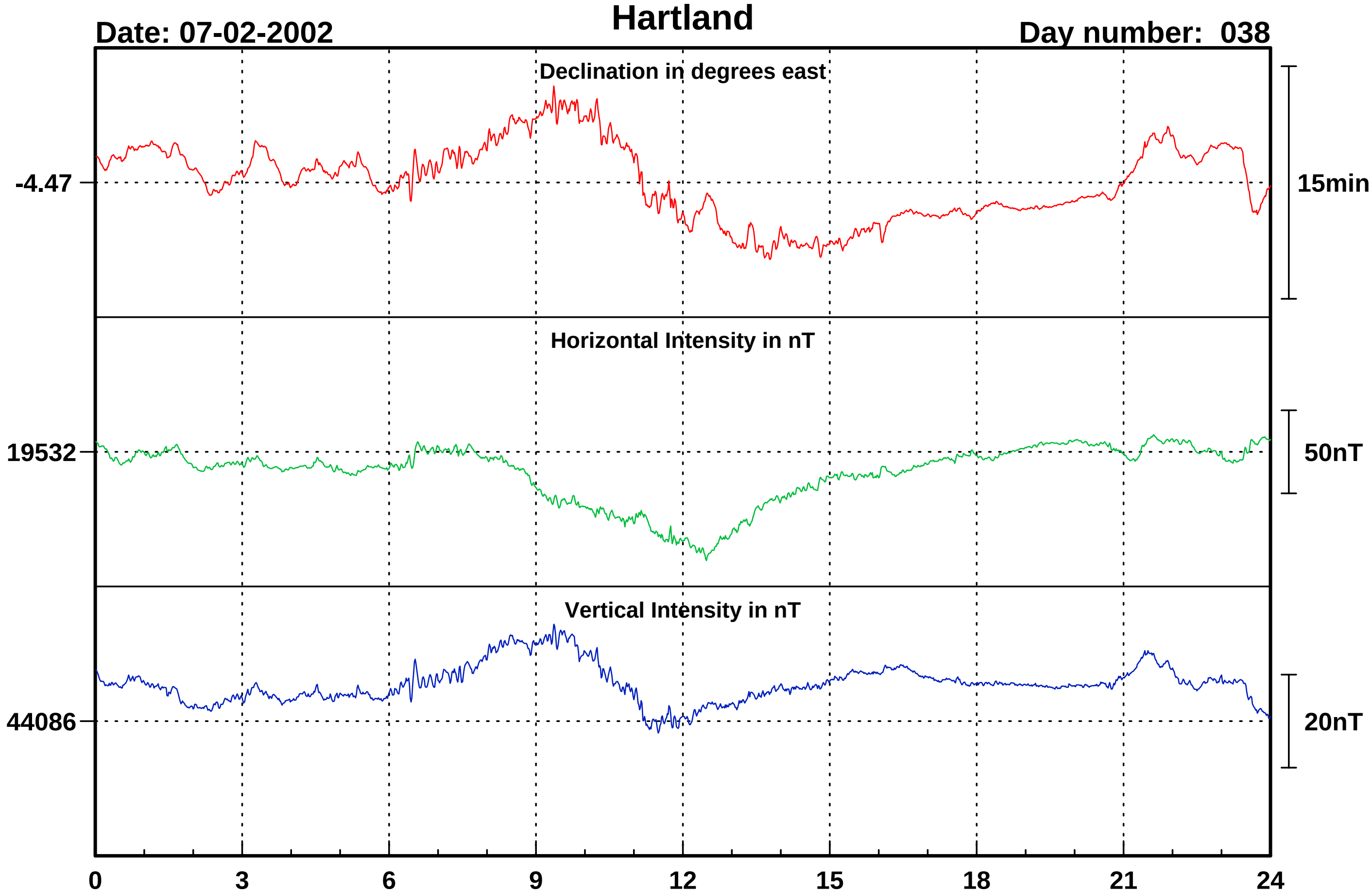


Date: 04-02-2002 **Day number: 035**




Hartland
Date: 05-02-2002
Day number: 036
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
60nT
Vertical Intensity in nT
44086
60nT
0
3
6
9
12
15
18
21
24
Date: 06-02-2002
Day number: 037
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
50nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

Hartland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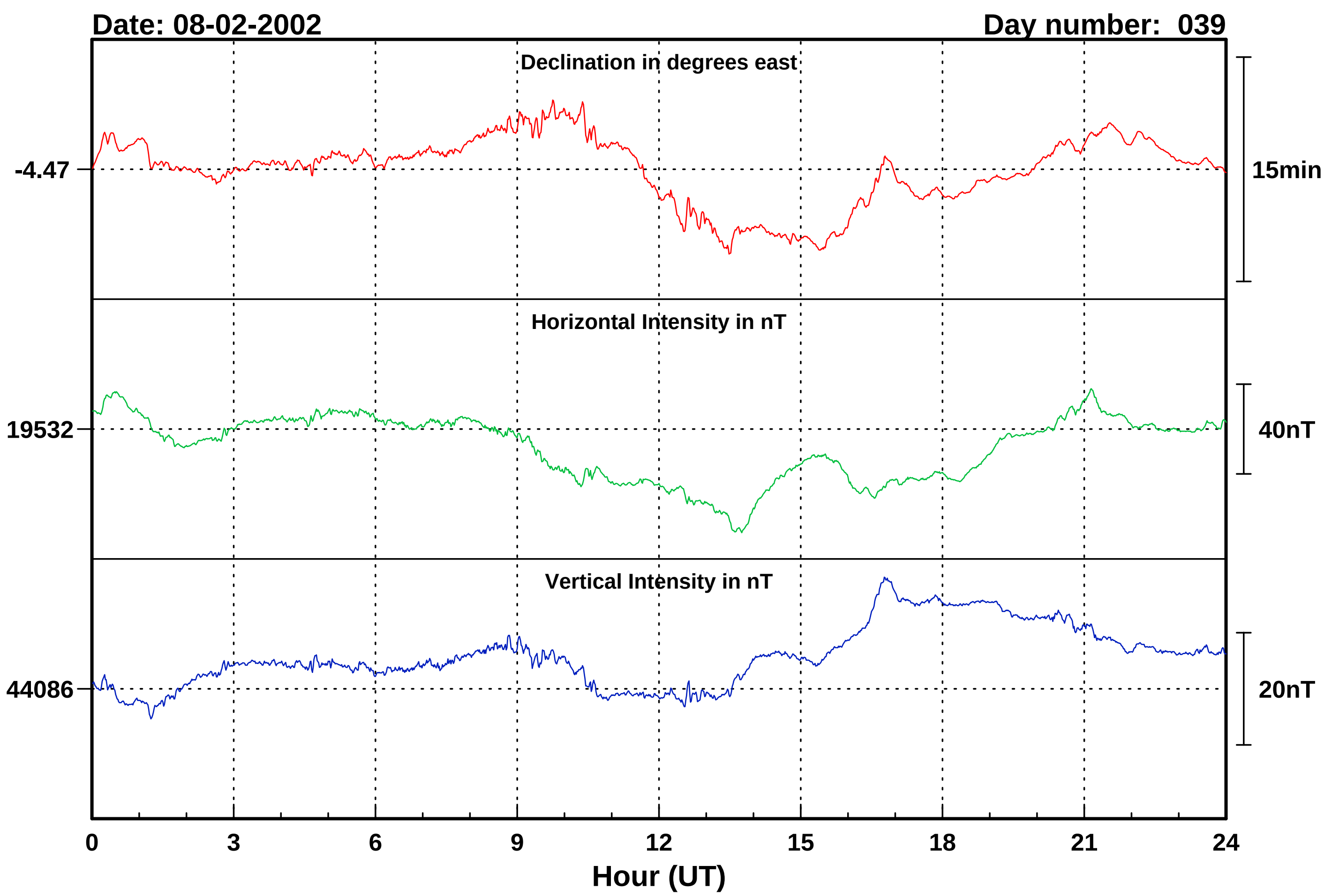
Day number: 038
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
50nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24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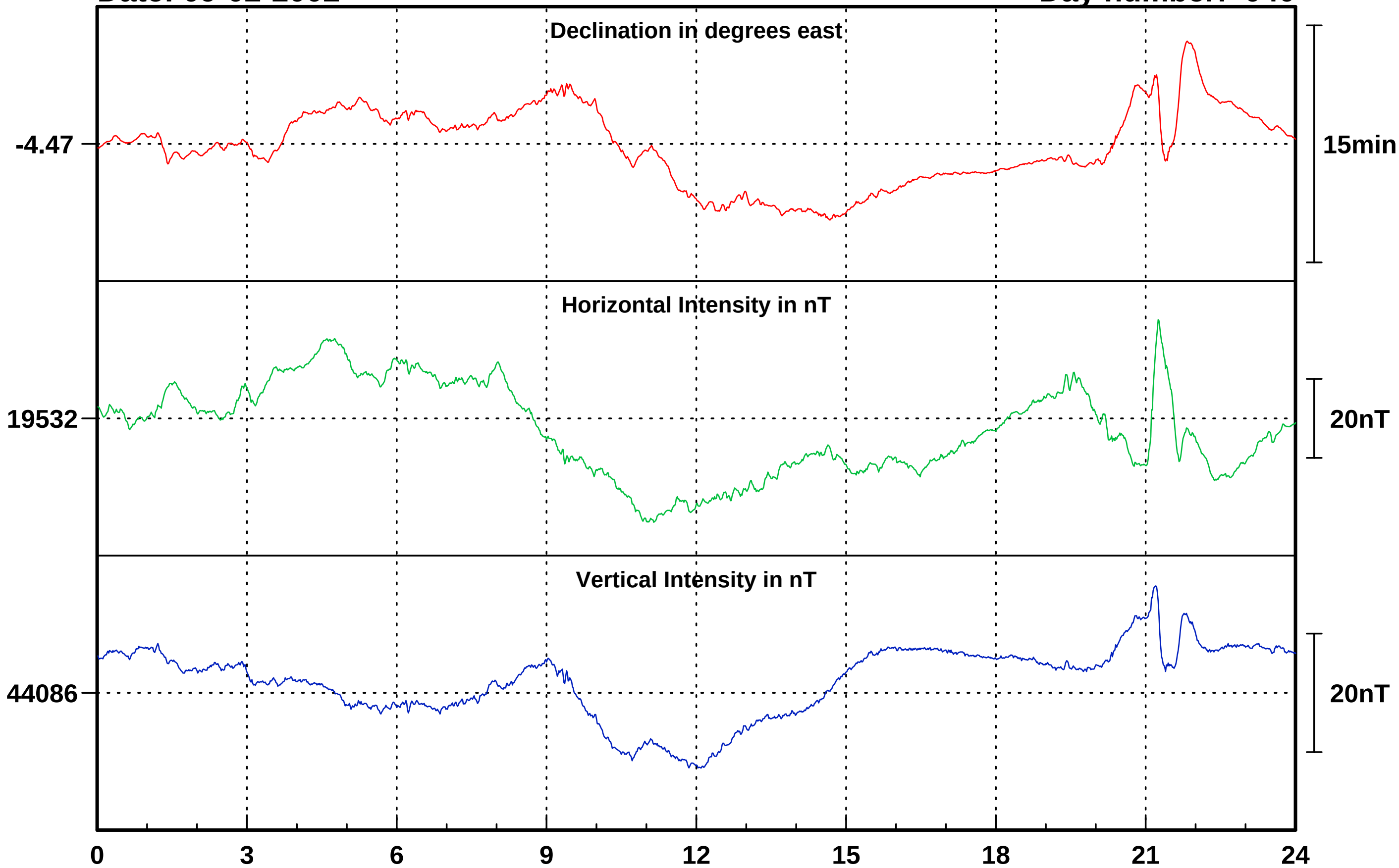
Day number: 039
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
40nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

Hartland

Date: 09-02-2002 **Day number: 040**



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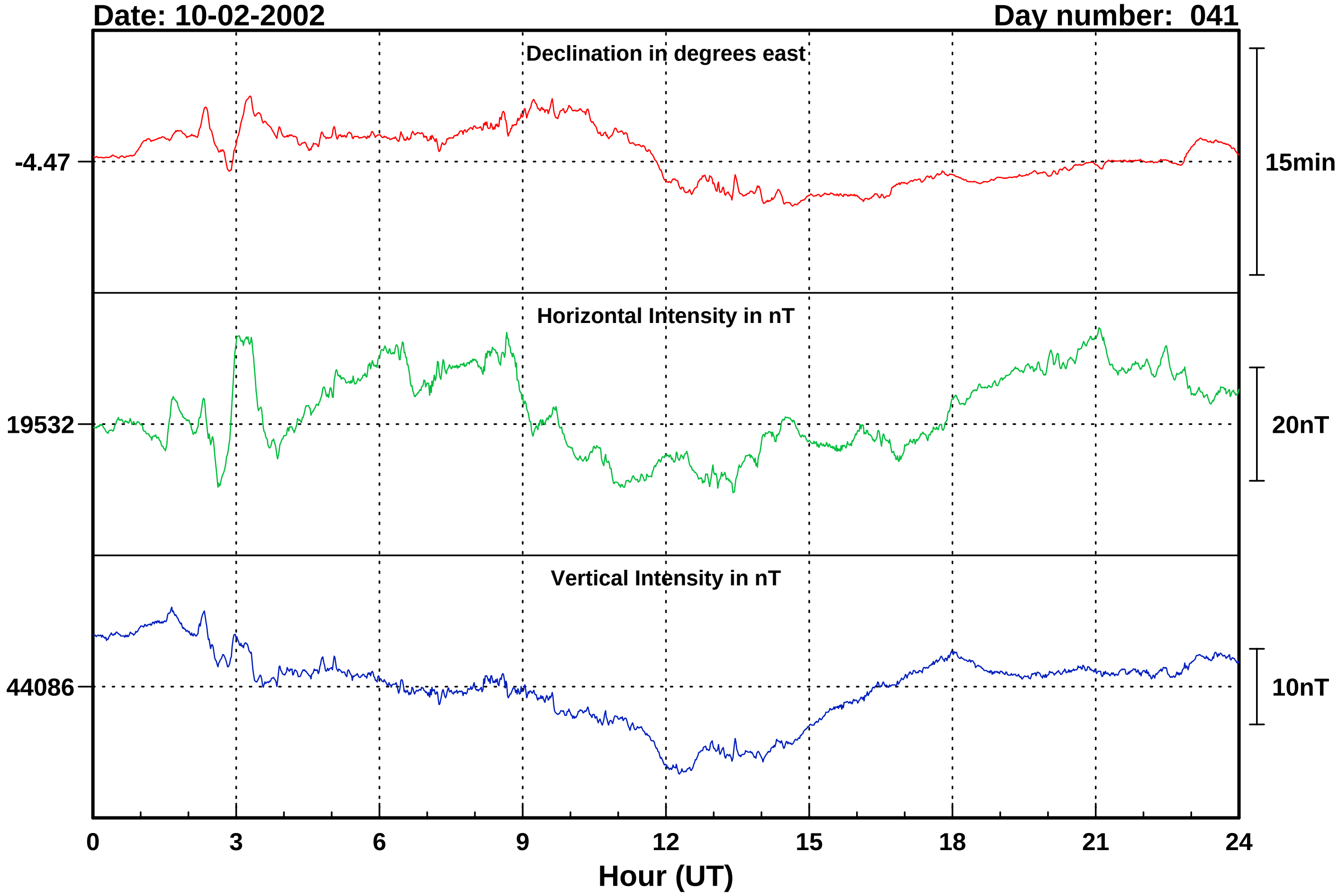
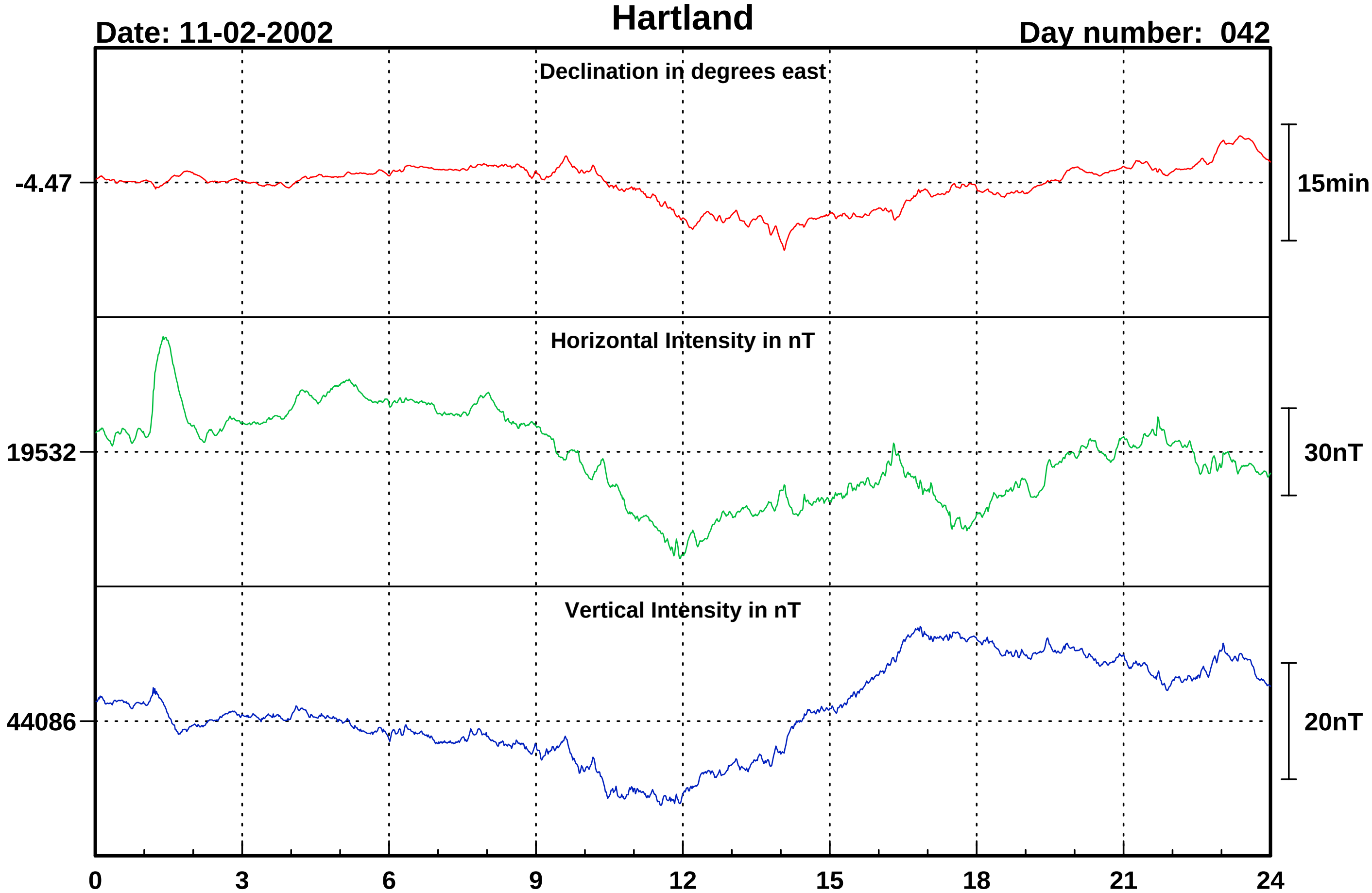
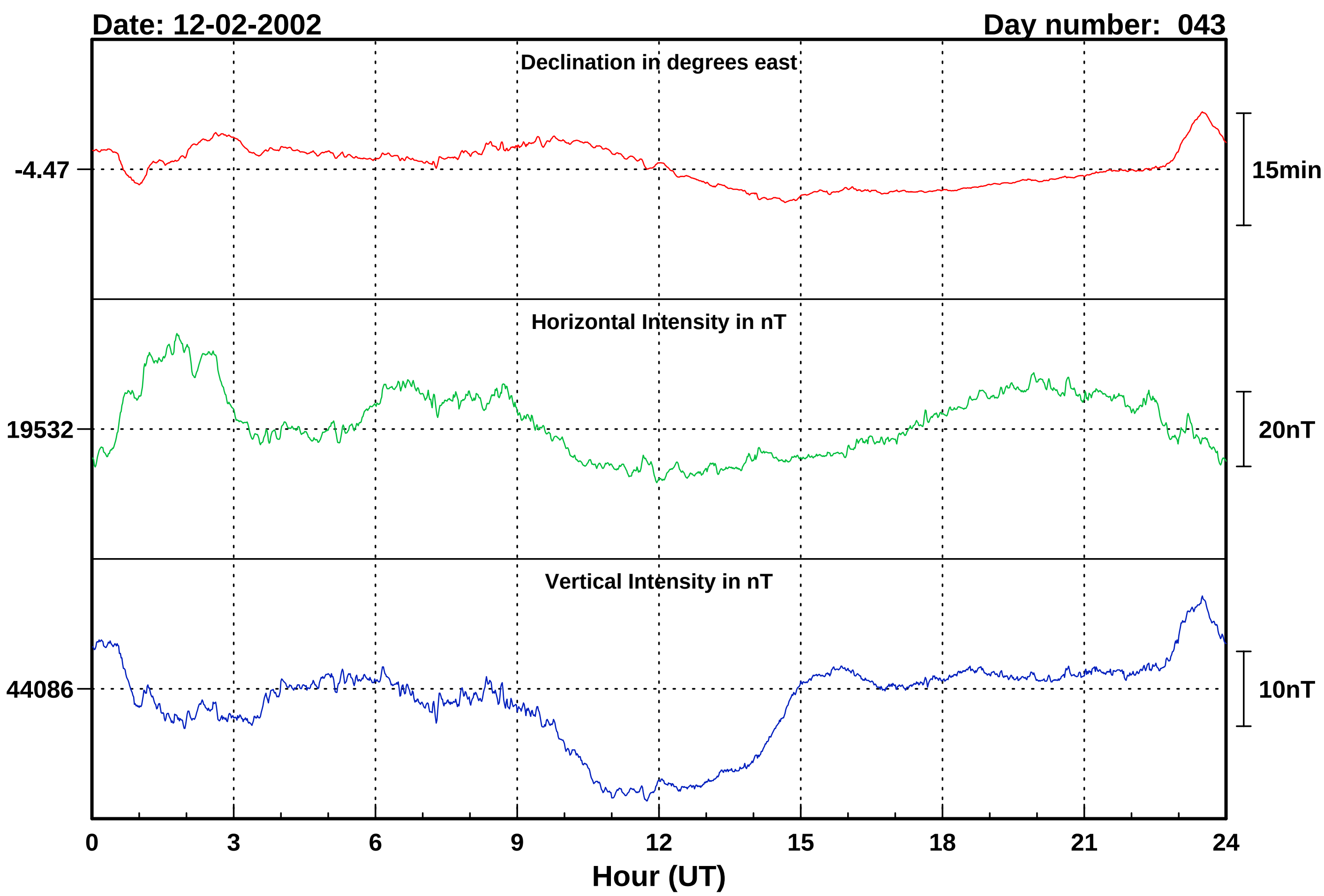


Hartland



Date: 11-02-2002
Day number: 042
Declination in degrees east
Horizontal Intensity in nT
Vertical Intensity in nT
-4.47
19532
44086
15min
30nT
20nT
0
3
6
9
12
15
18
21
24

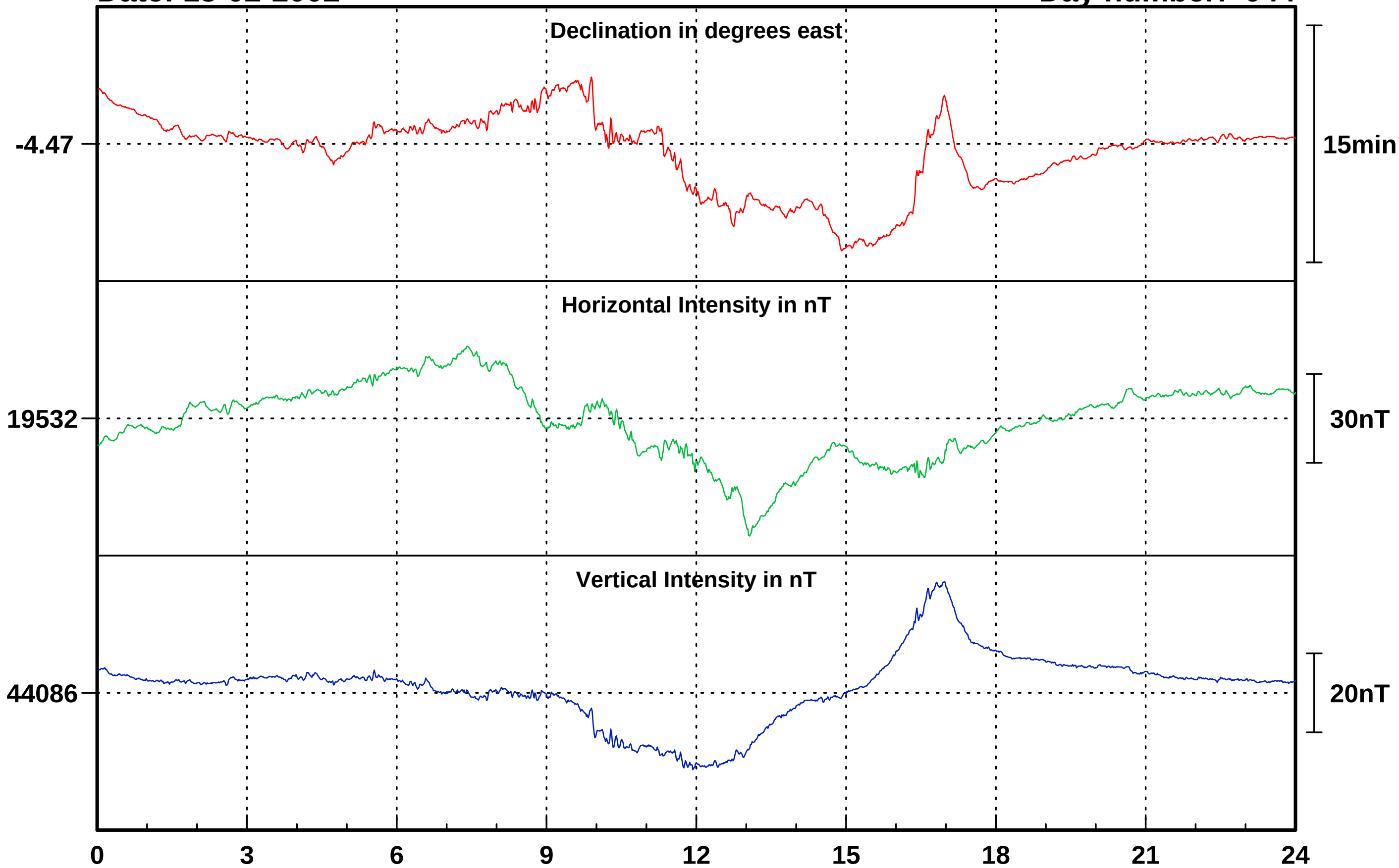


Date: 12-02-2002
Day number: 043
Declination in degrees east
Horizontal Intensity in nT
Vertical Intensity in nT
-4.47
19532
44086
15min
20nT
10nT
0
3
6
9
12
15
18
21
24
Hour (UT)

Date: 13-02-2002

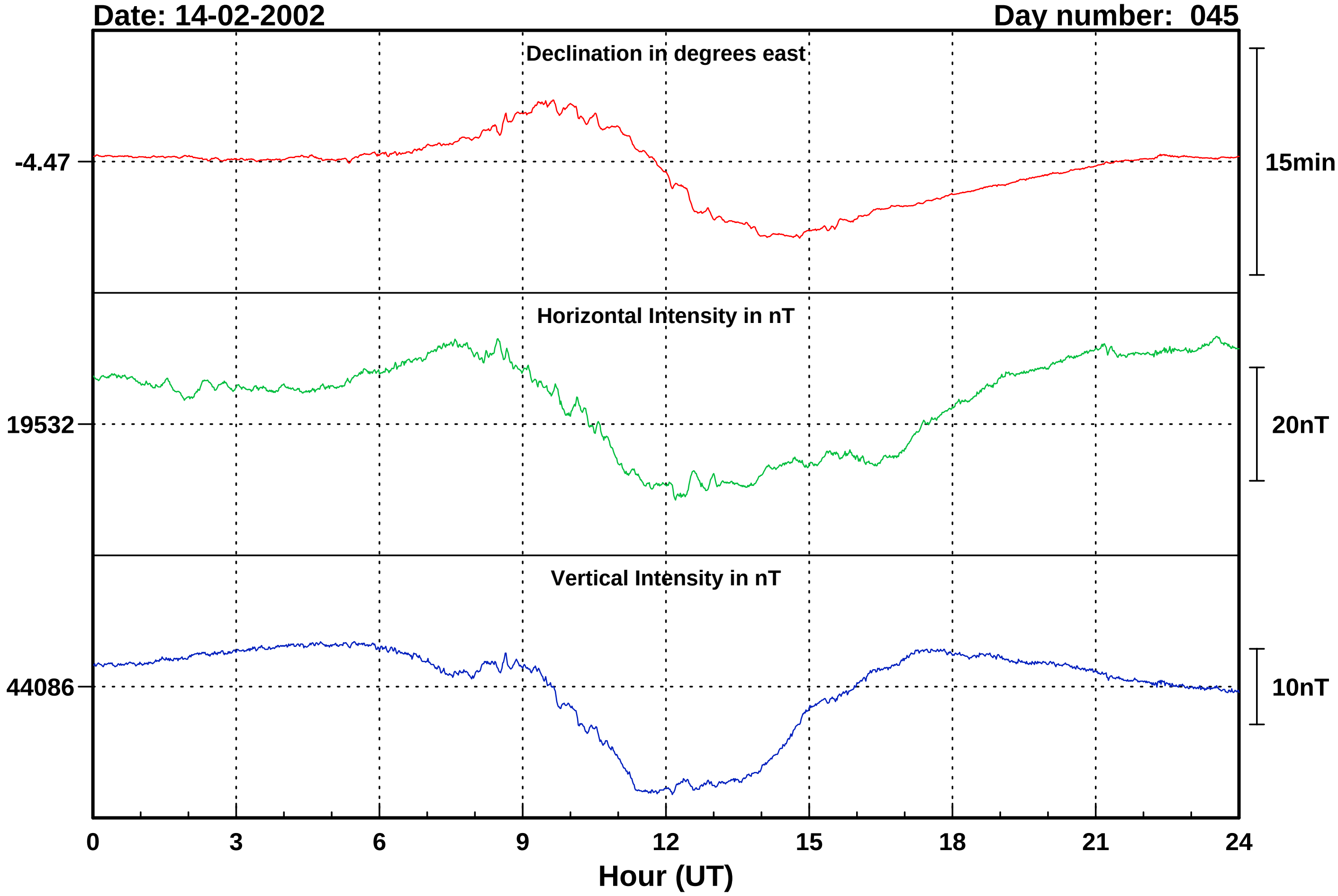
Hartland

Day number: 044



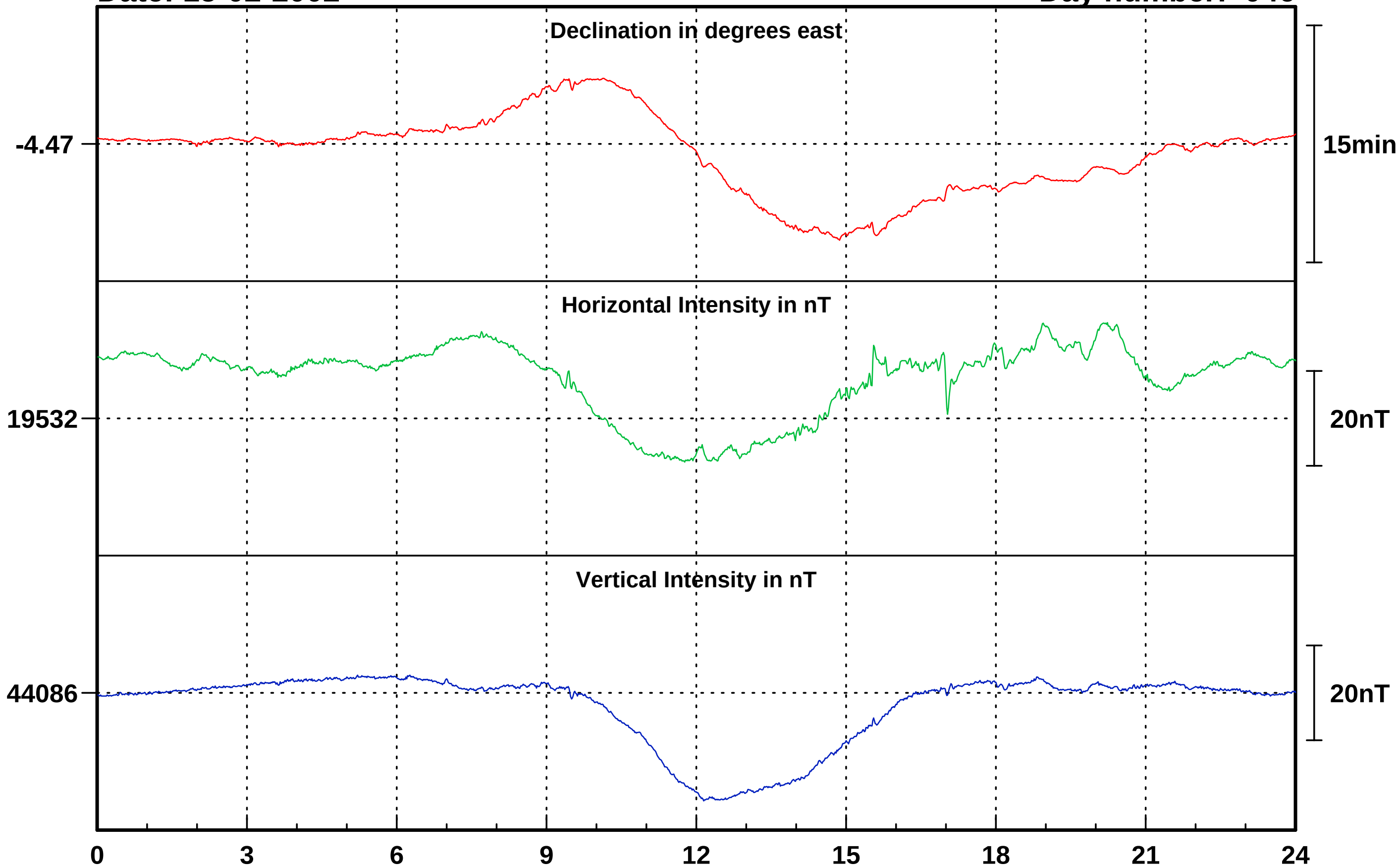
Date: 14-02-2002

Day number: 045



Hartland

Date: 15-02-2002 Day number: 046



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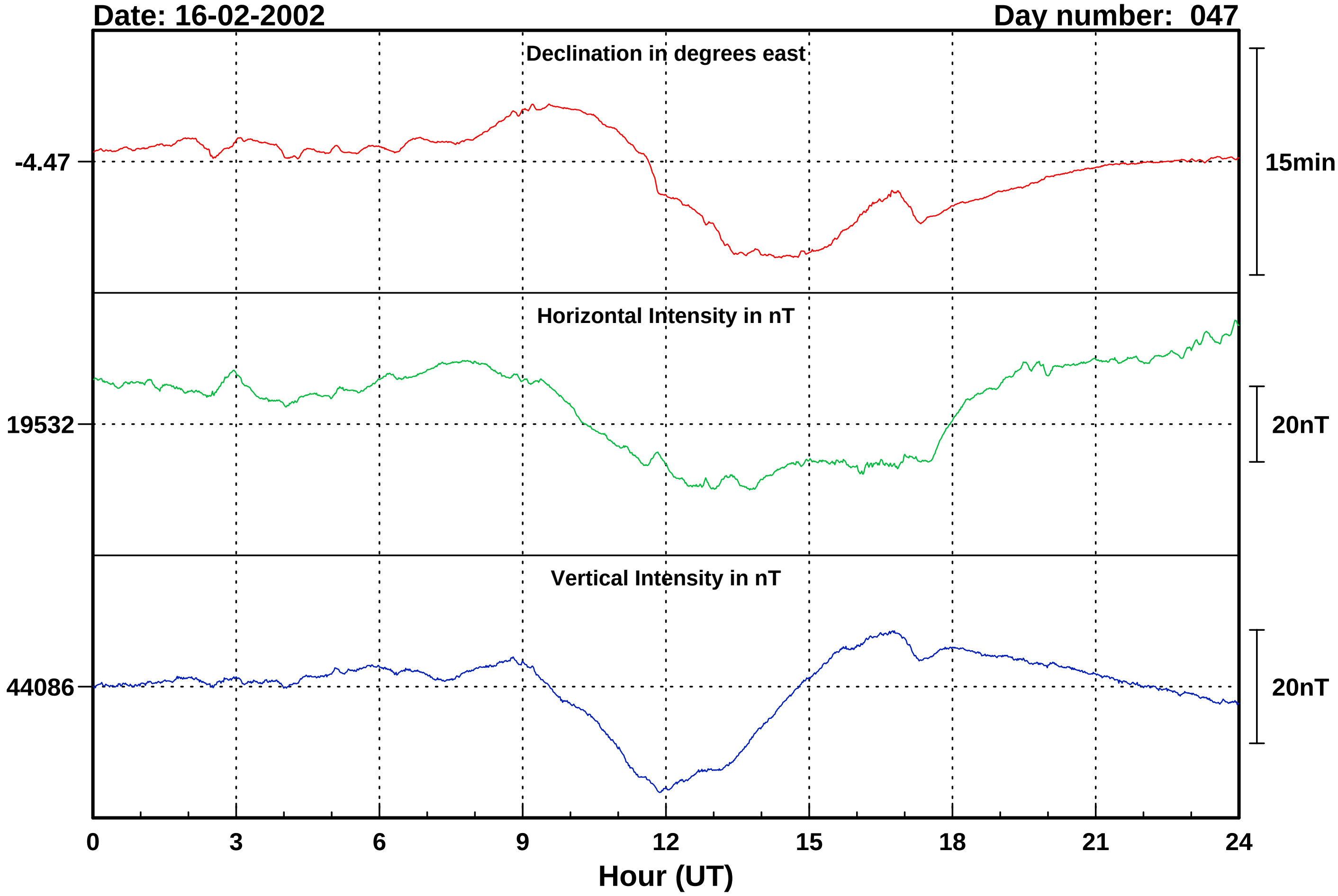
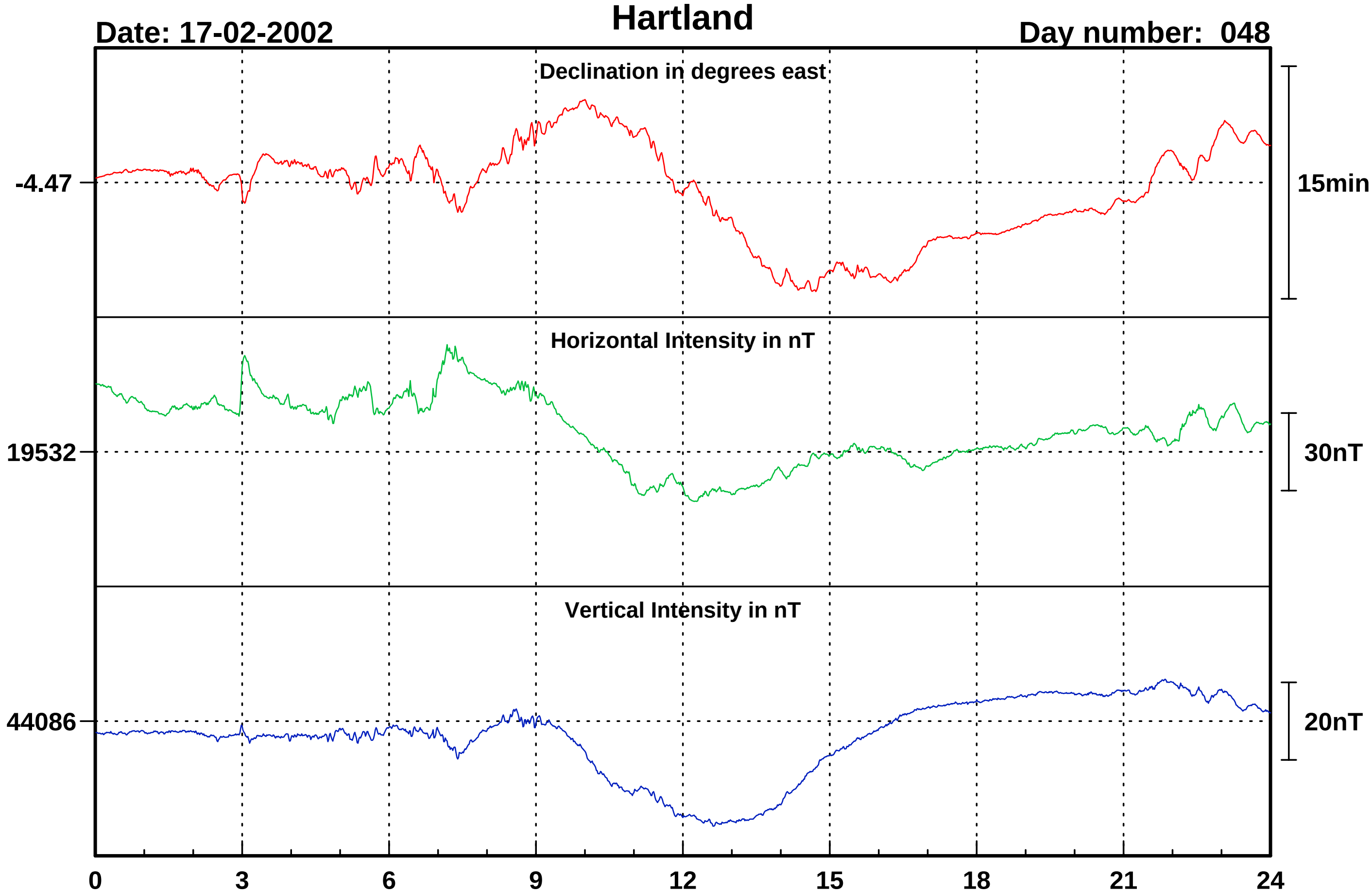
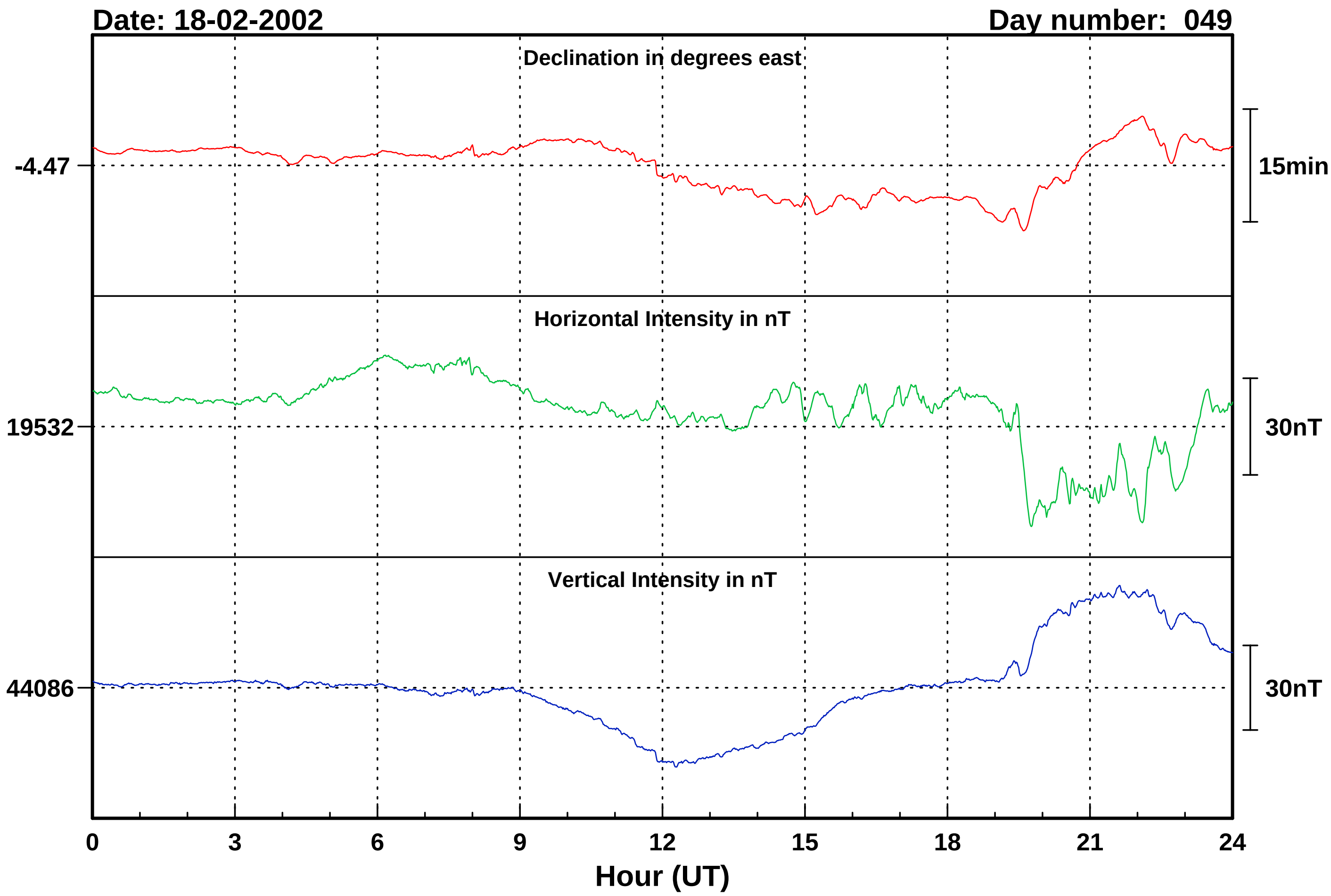
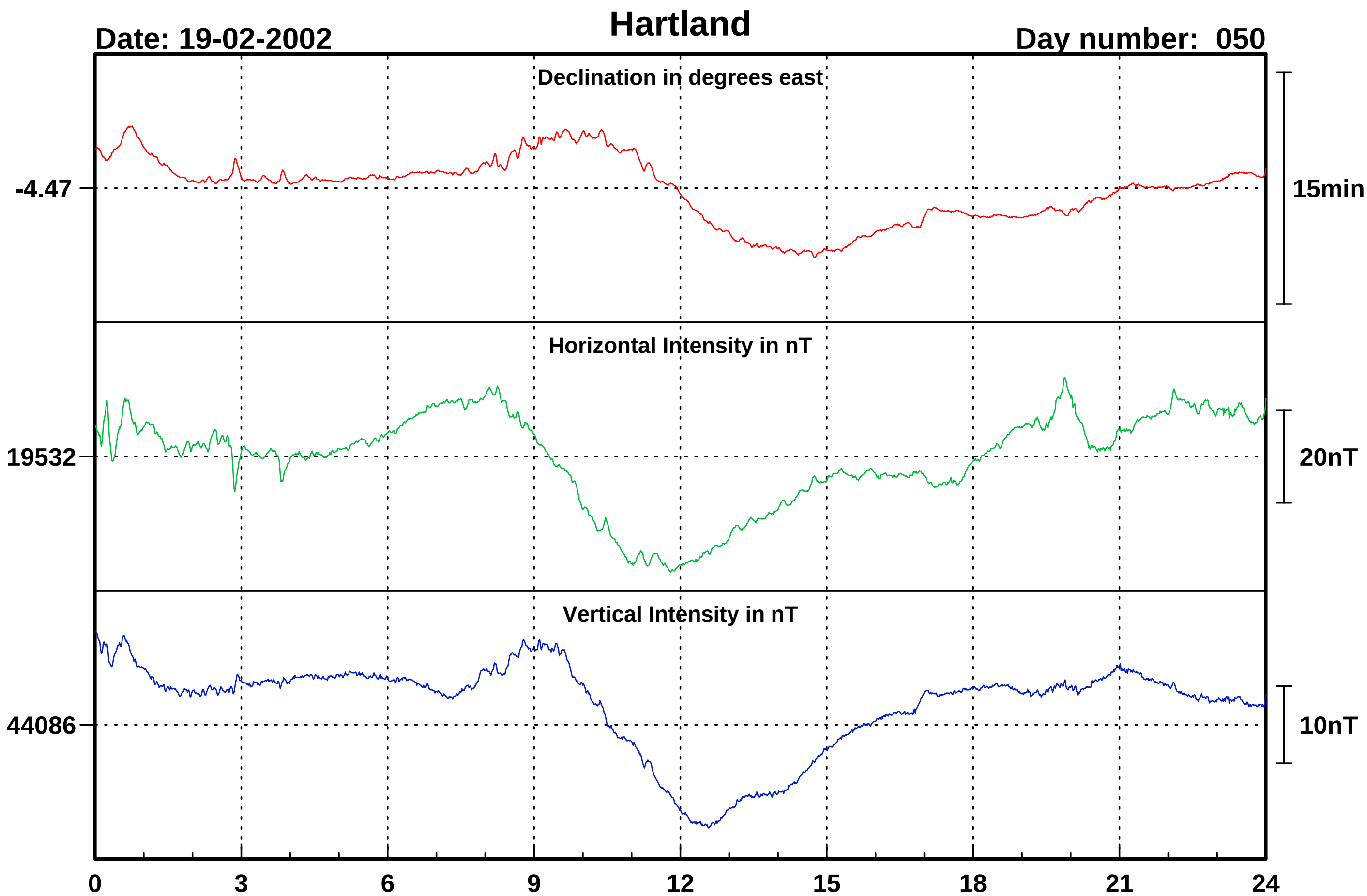


Hartland


Date: 17-02-2002
Day number: 048
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
30nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24


Date: 18-02-2002
Day number: 049
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
30nT
Vertical Intensity in nT
44086
30nT
0
3
6
9
12
15
18
21
24
Hour (UT)


Hartland
Date: 19-02-2002
Day number: 050
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
10nT
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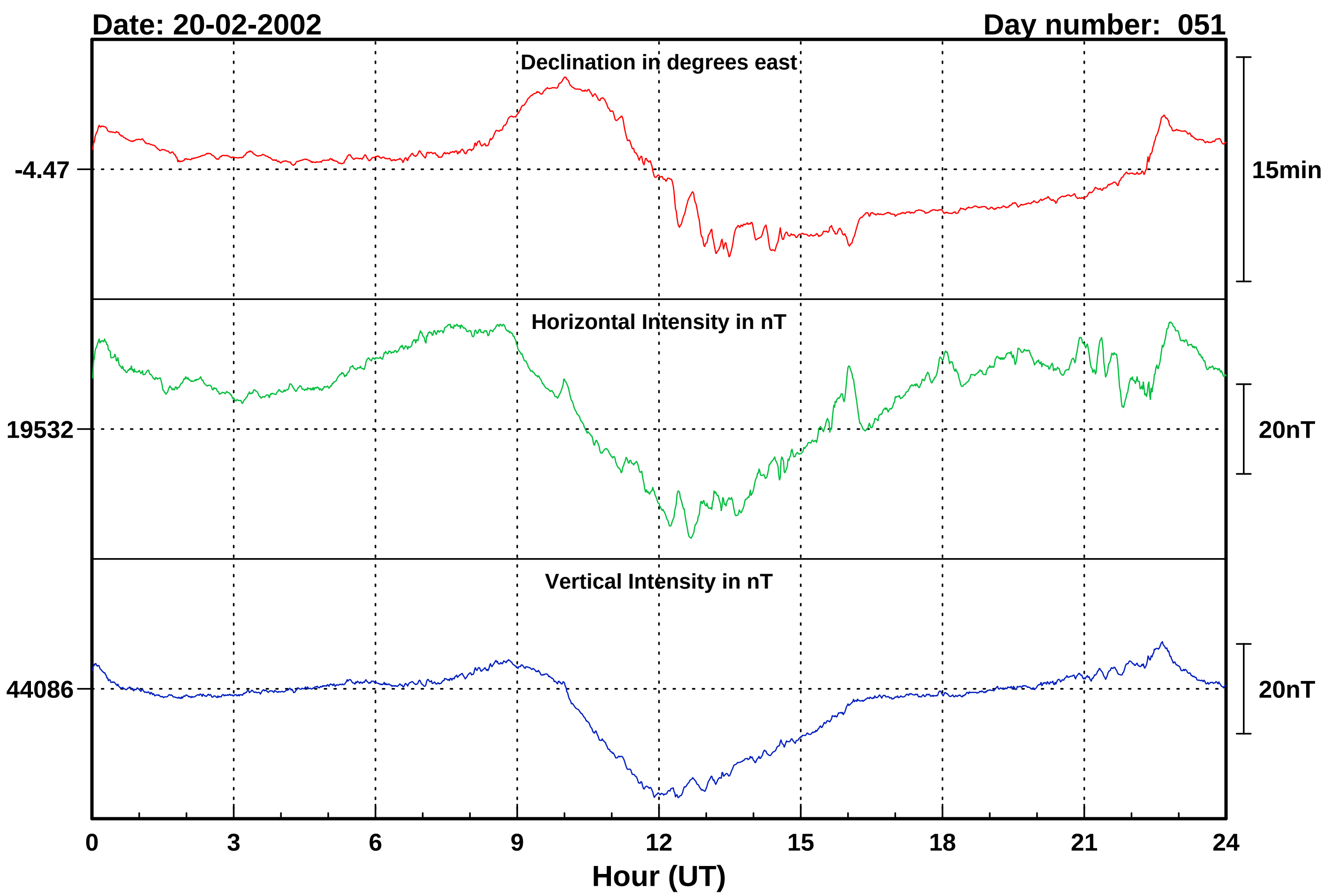
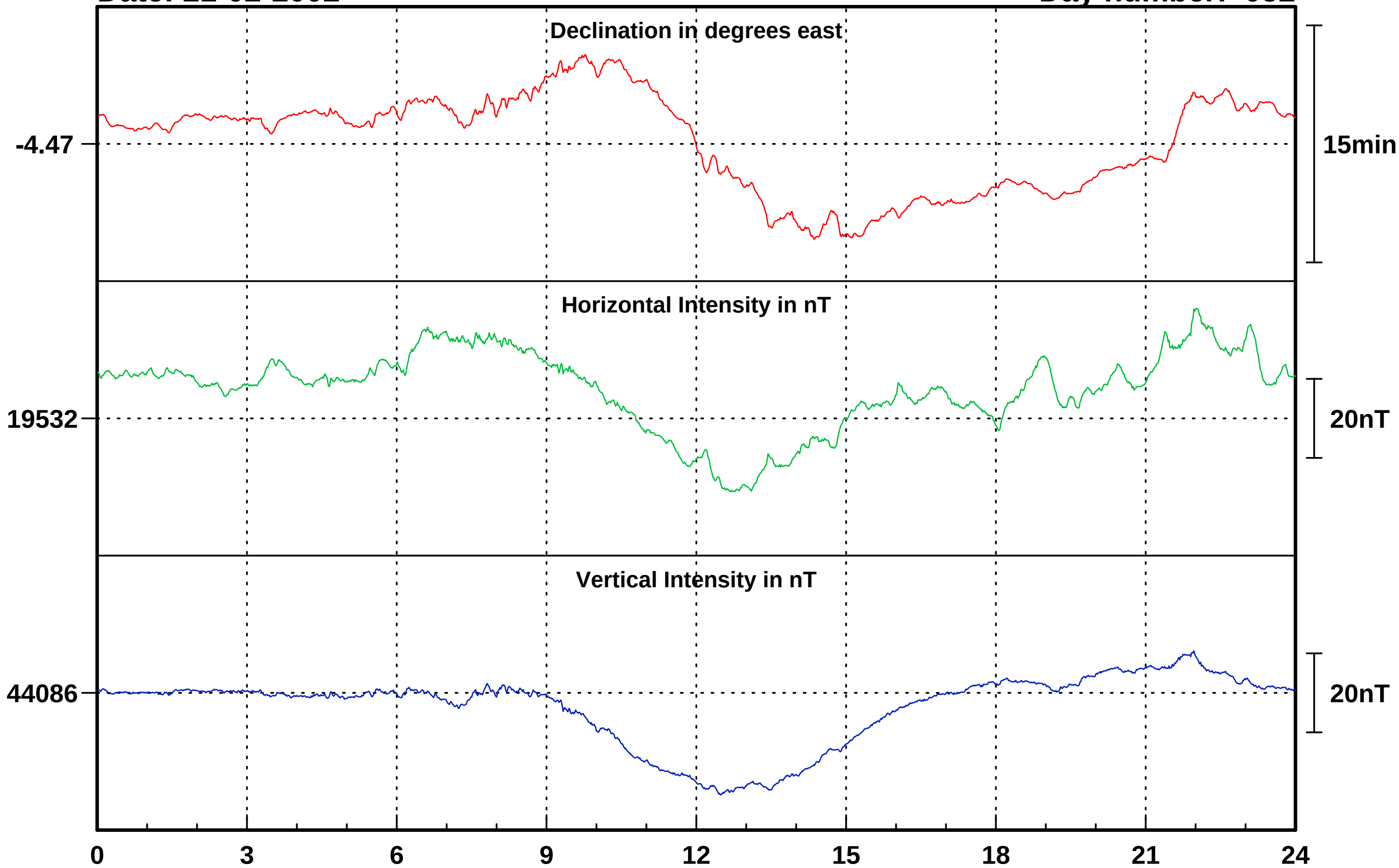
3
6
9
12
15
18
21
24

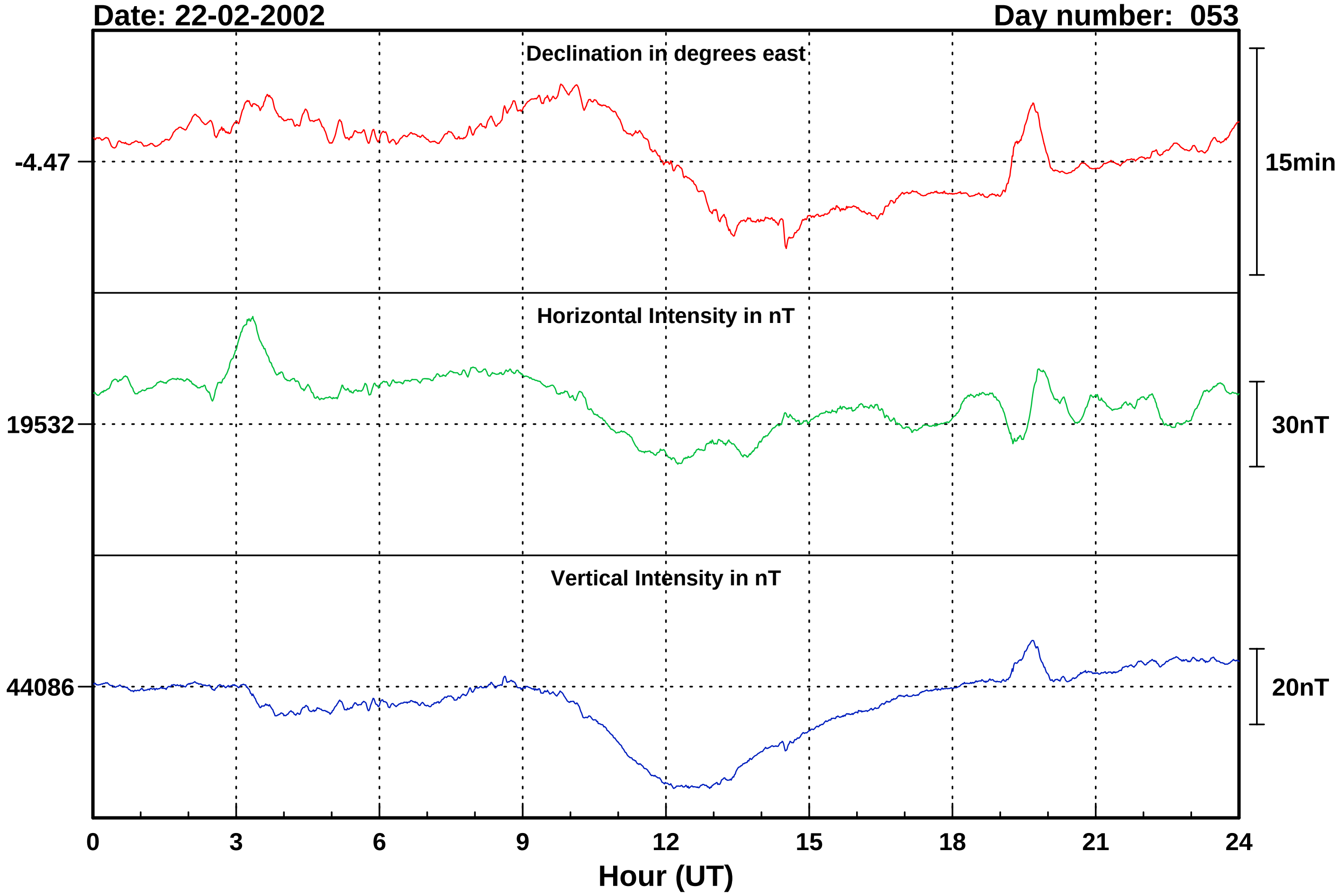

Date: 20-02-2002
Day number: 051
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

Hartland

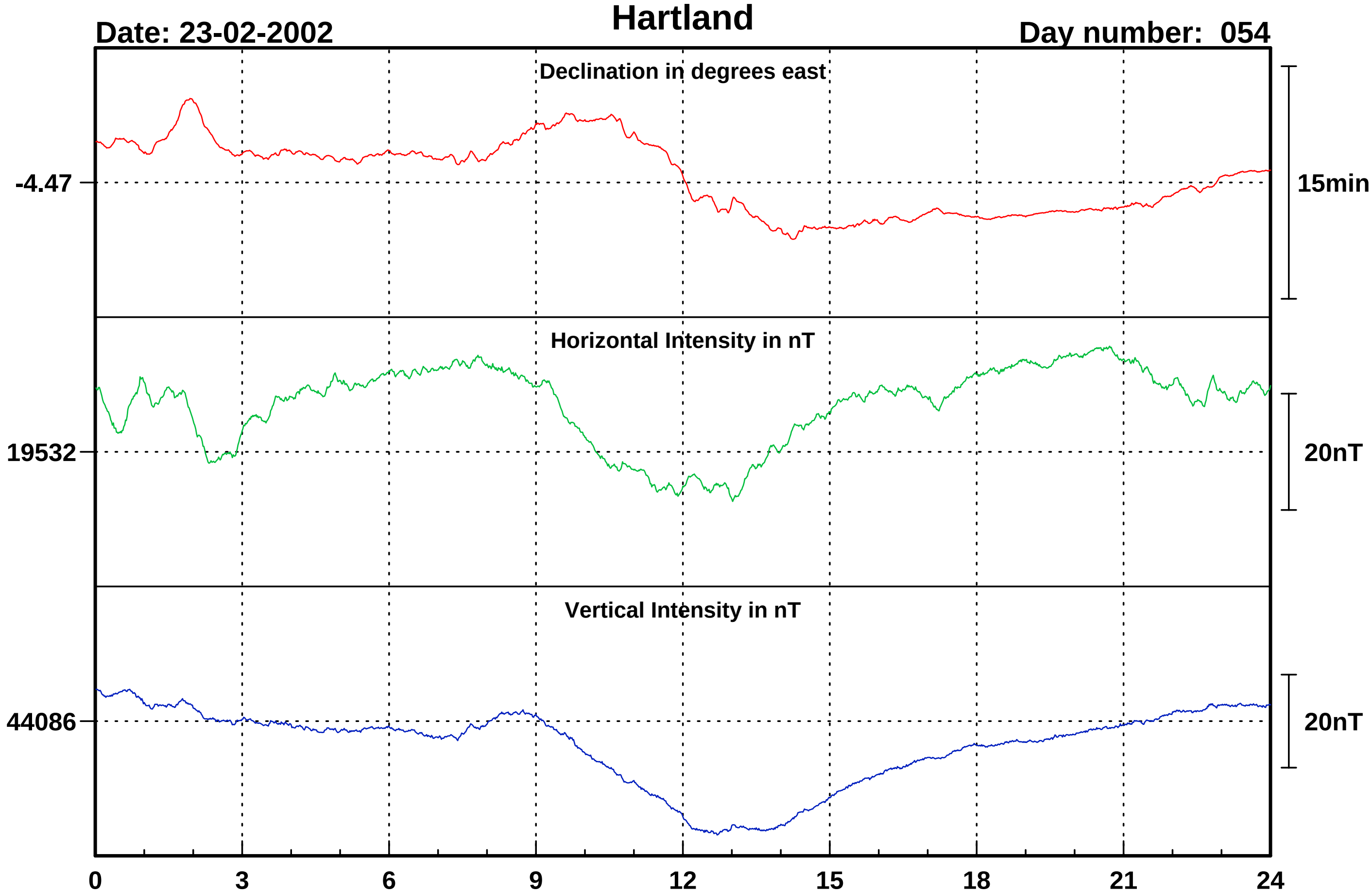
Date: 21-02-2002 Day number: 052

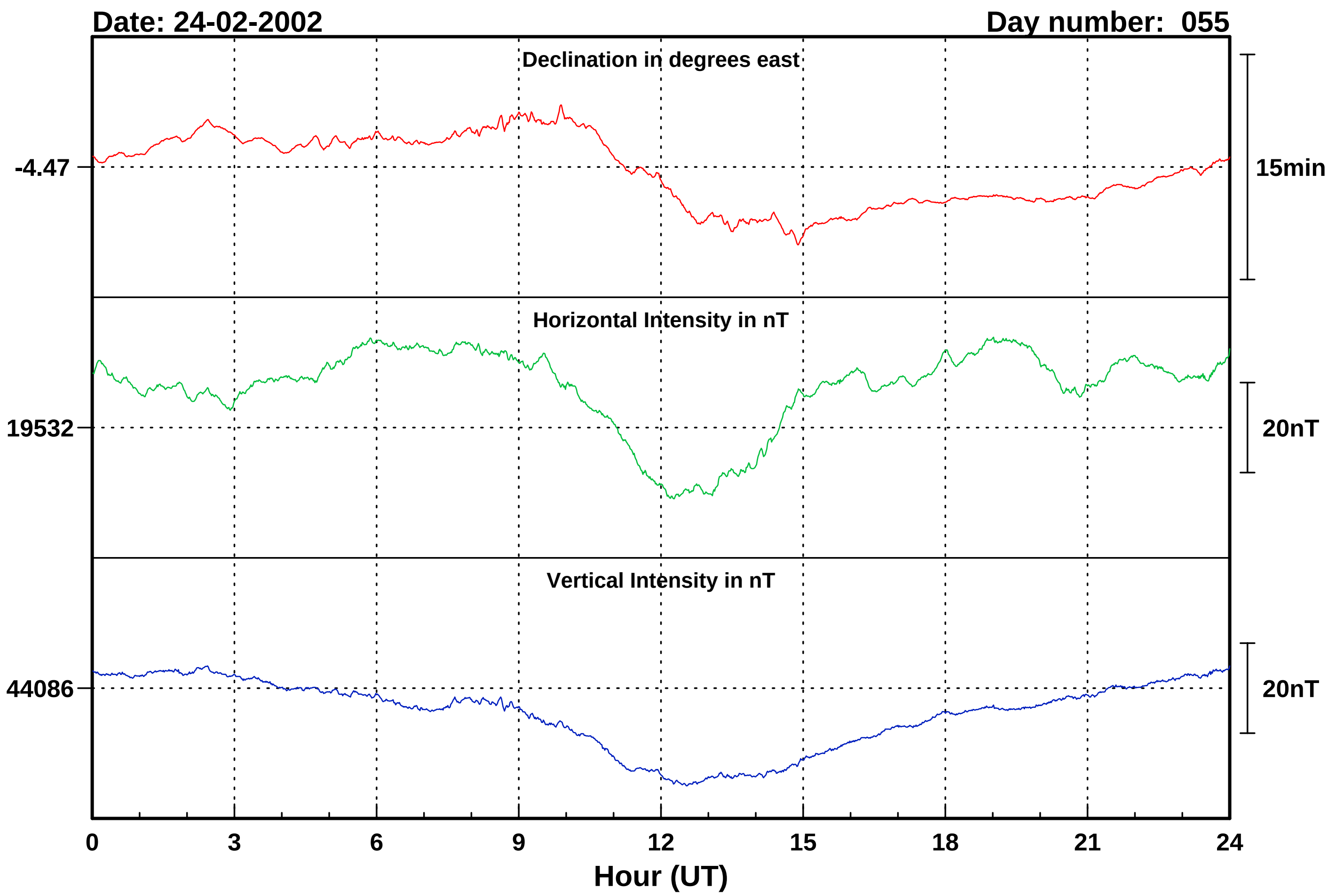


Date: 22-02-2002 Day number: 053



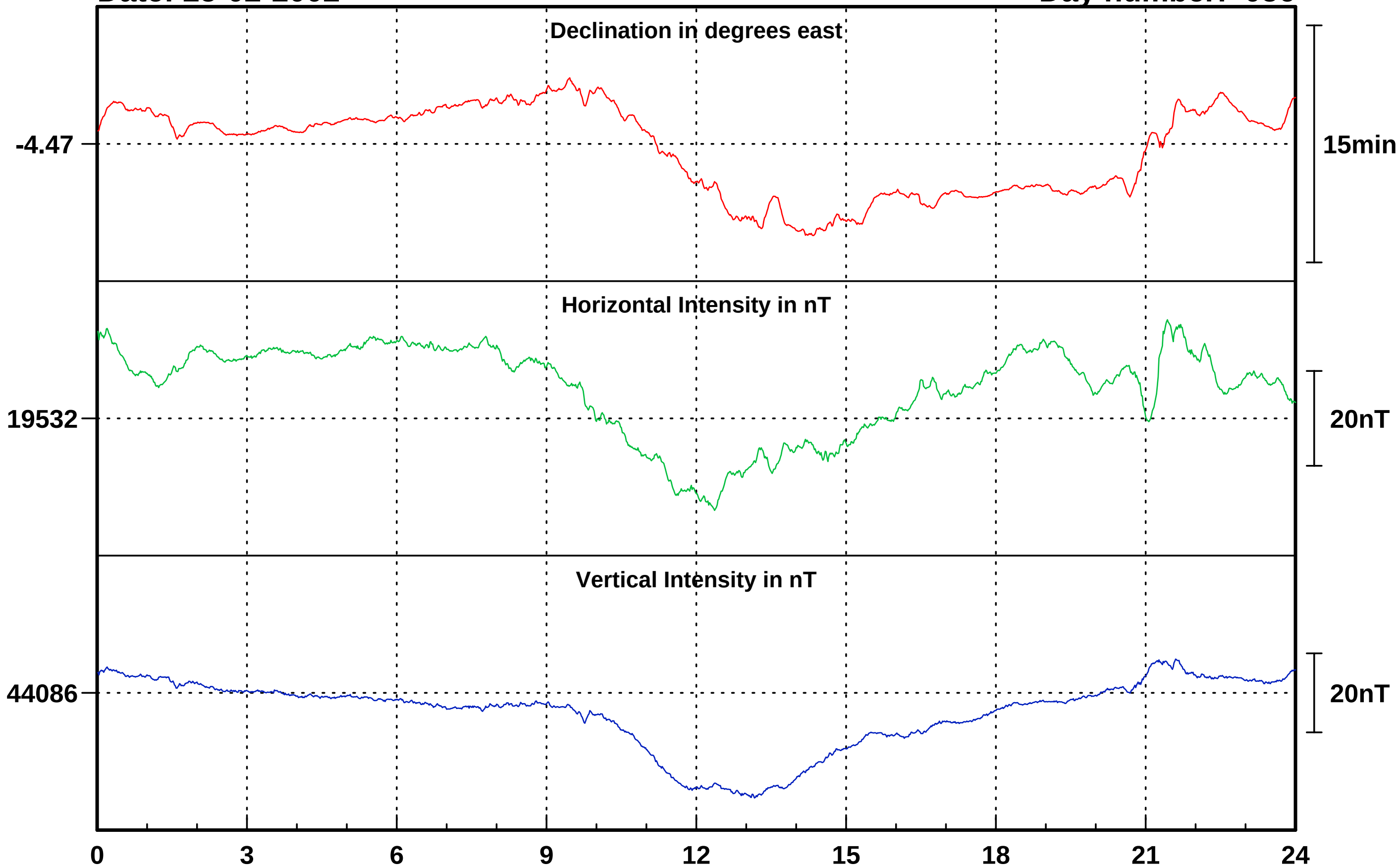
Hartland


Date: 23-02-2002
Day number: 054
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24

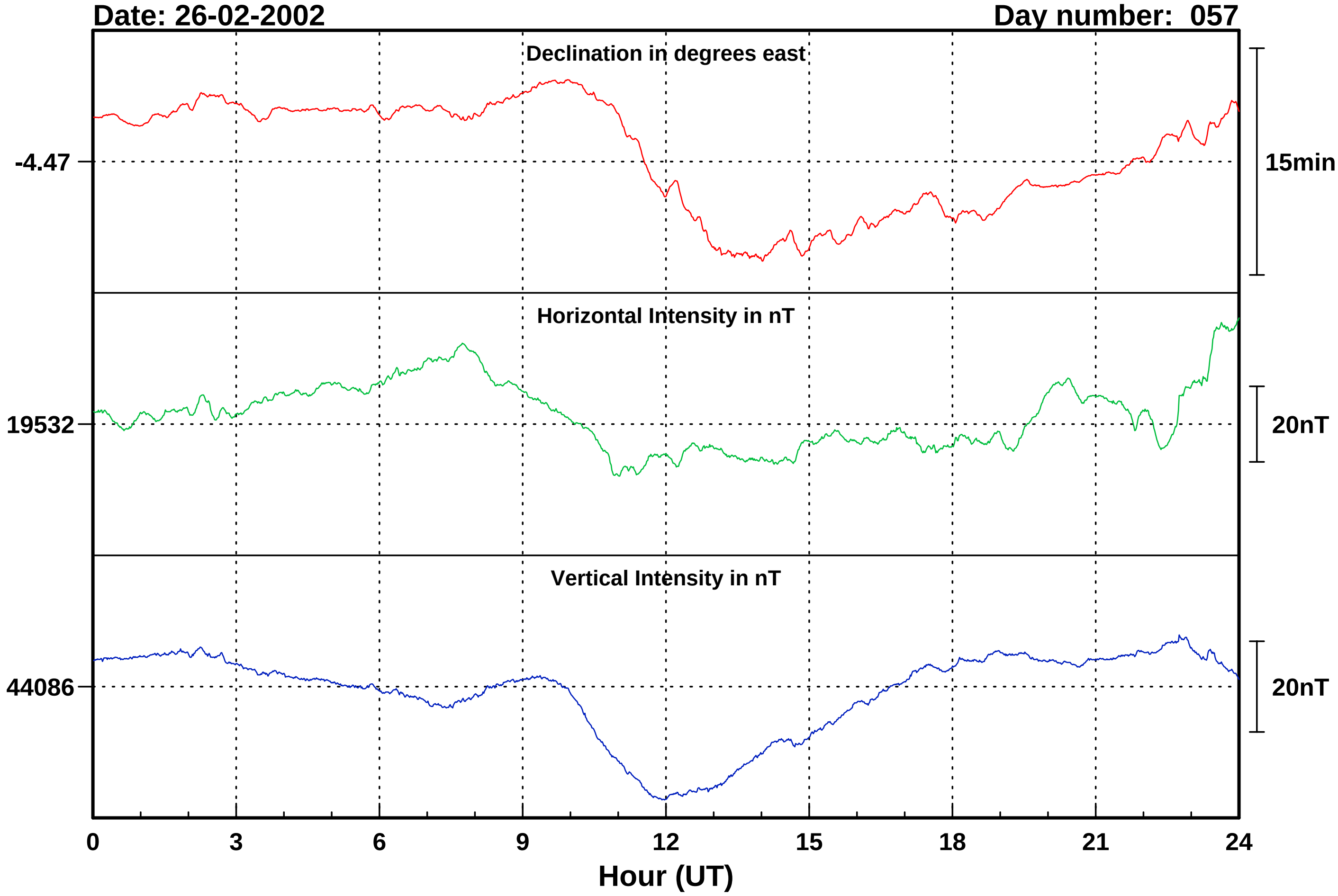

Date: 24-02-2002
Day number: 055
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24
Hour (UT)

Hartland

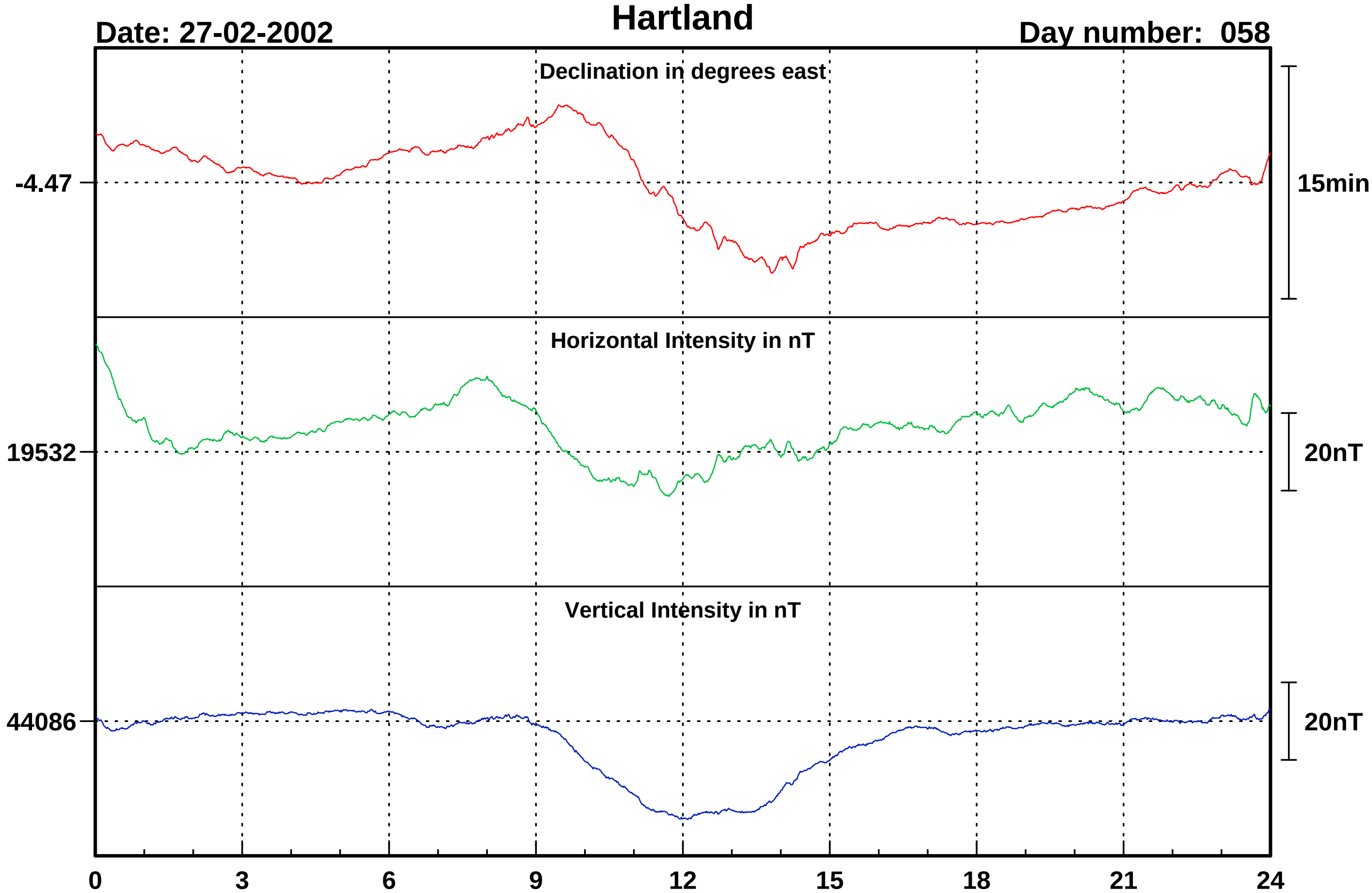
Date: 25-02-2002 Day number: 056

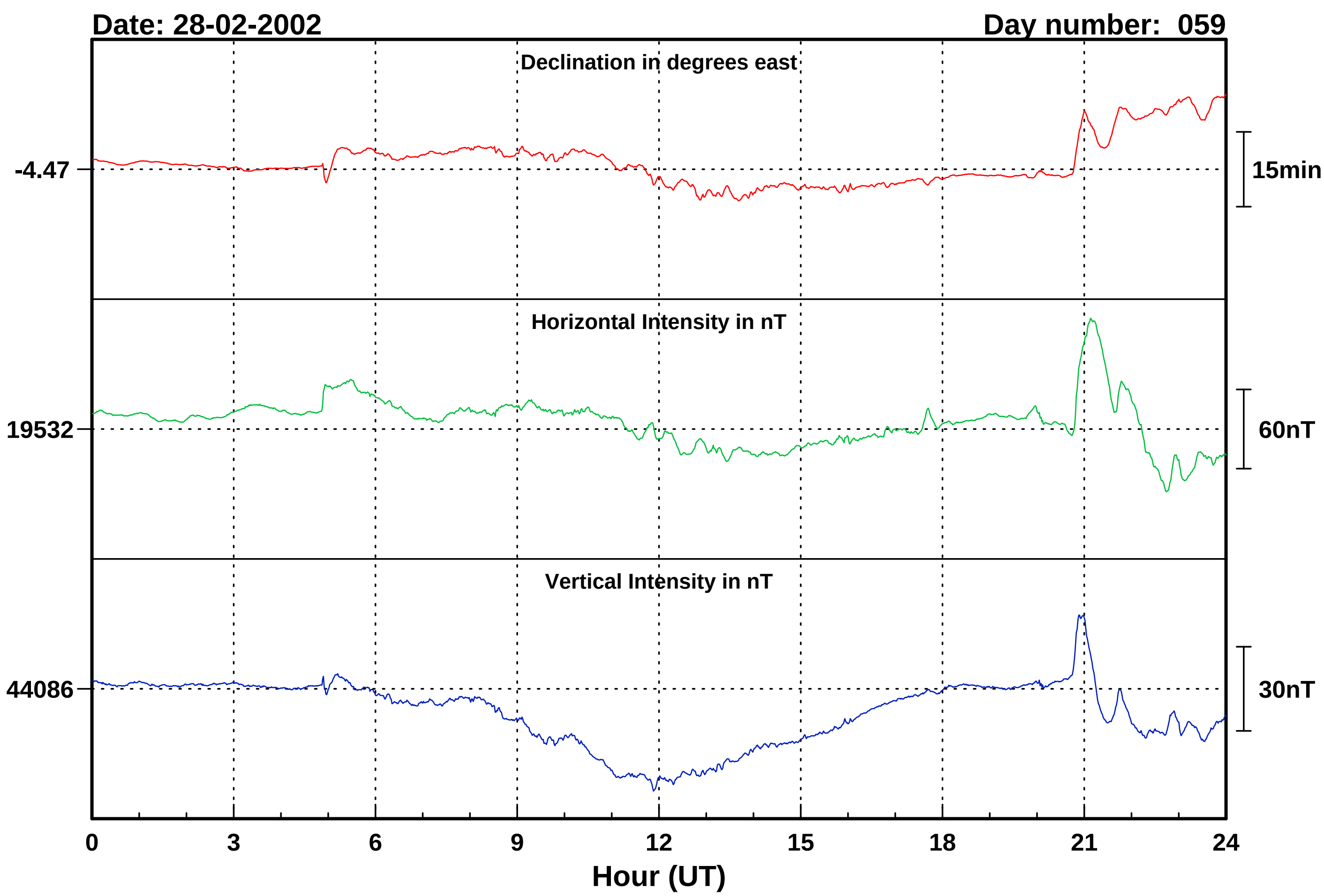


Date: 26-02-2002 Day number: 057



Hartland


Date: 27-02-2002
Day number: 058
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
20nT
Vertical Intensity in nT
44086
20nT
0
3
6
9
12
15
18
21
24


Date: 28-02-2002
Day number: 059
Declination in degrees east
-4.47
15min
Horizontal Intensity in nT
19532
60nT
Vertical Intensity in nT
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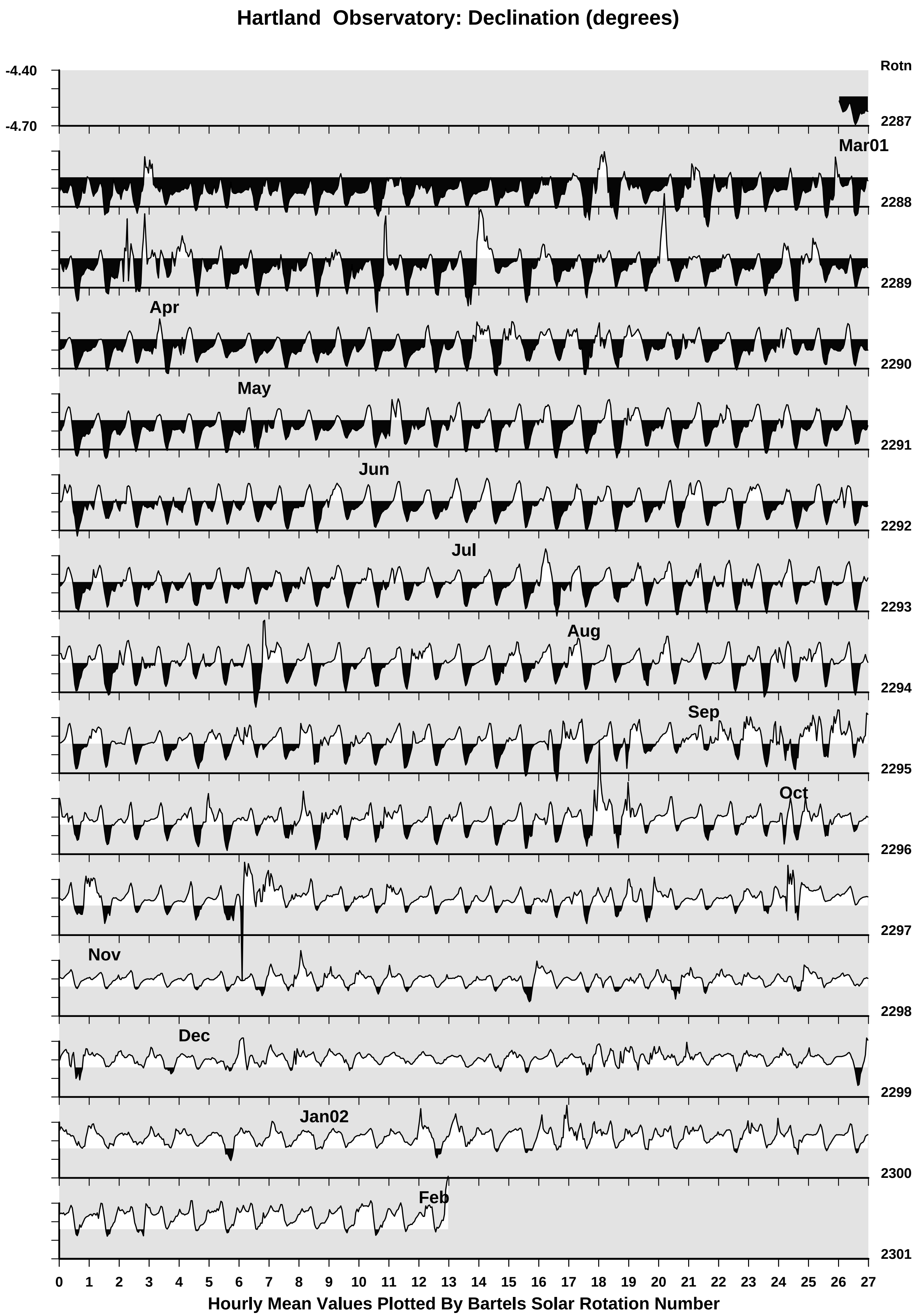
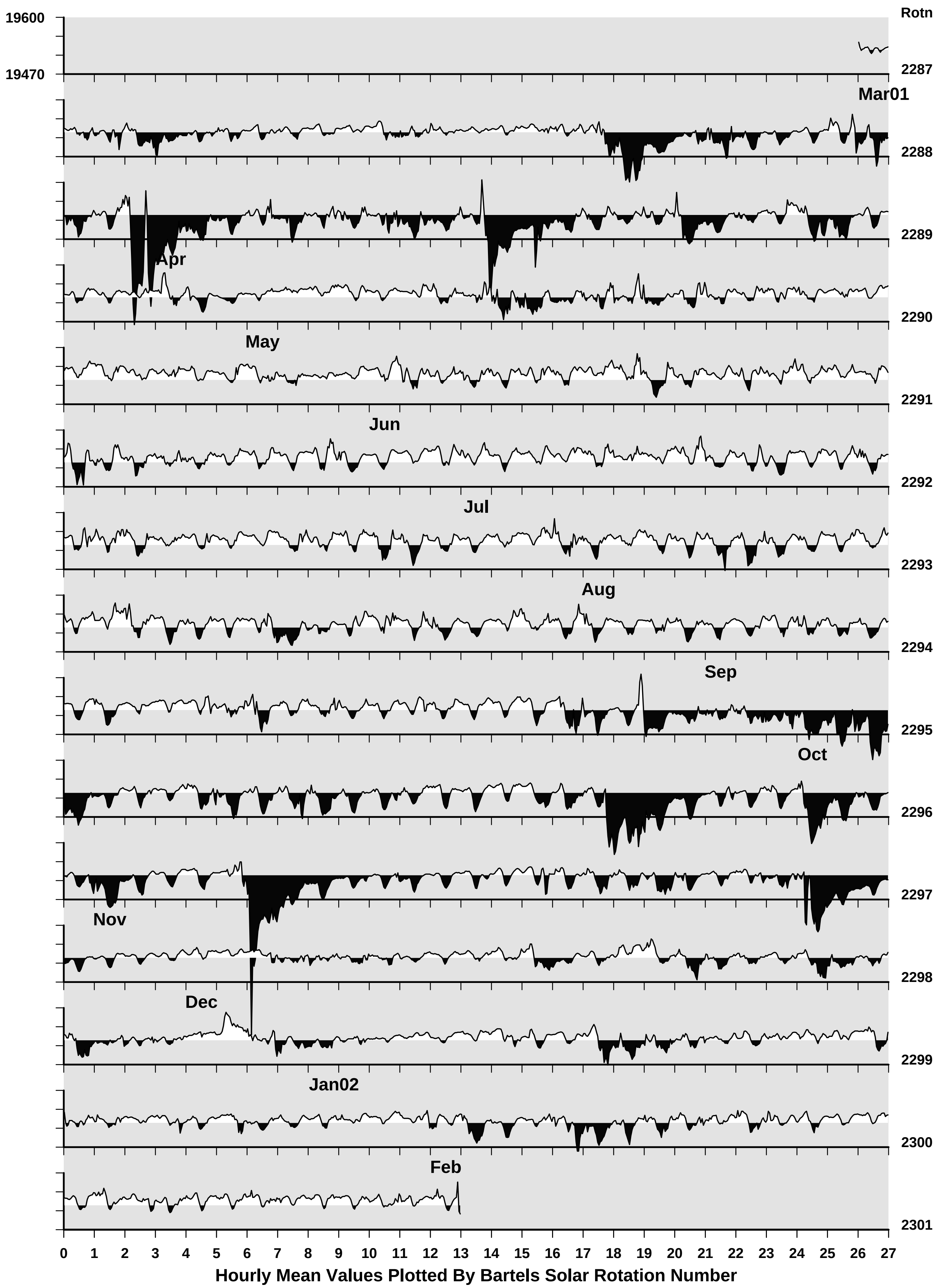
30nT
0
3
6
9
12
15
18
21
24
Hour (UT)

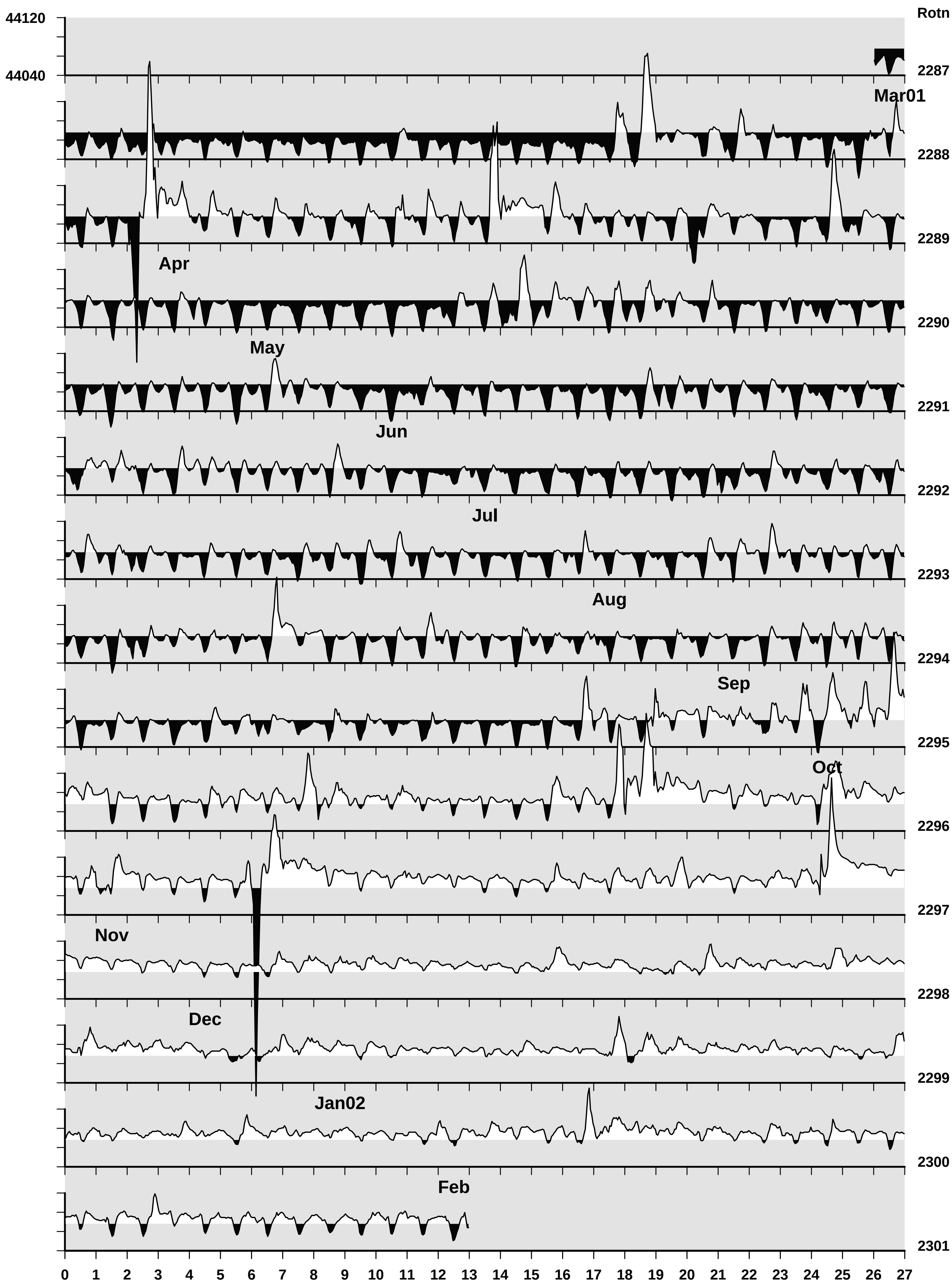


Hartland Observatory: Declination (degrees)
-4.40
-4.70
Rotn
2287
2288
2289
2290
2291
2292
2293
2294
2295
2296
2297
2298
2299
2300
2301
Mar01
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan02
Feb
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted By Bartels Solar Rotation Number

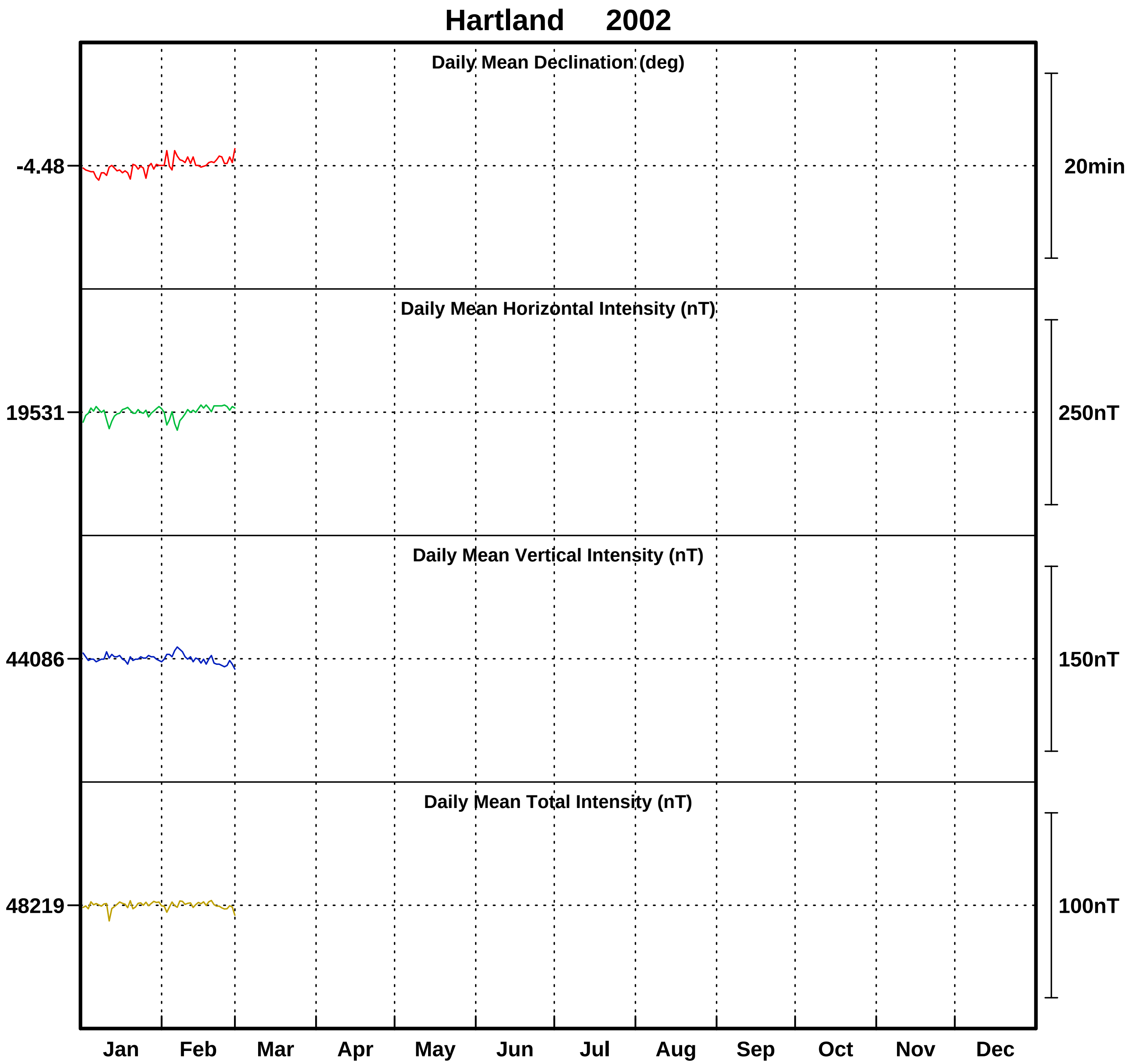
Hartland Observatory: Horizontal Intensity (nT)



Hartland Observatory: Vertical Intensity (nT)



Hourly Mean Values Plotted By Bartels Solar Rotation Number



Hartland 2002
Daily Mean Declination (deg)
-4.48
20min
Daily Mean Horizontal Intensity (nT)
19531
250nT
Daily Mean Vertical Intensity (nT)
44086
150nT
Daily Mean Total Intensity (nT)
48219
100nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Monthly Mean Values for Hartland Observatory 2002

Month	*D*	*H*	*I*	*X*	*Y*	*Z*	*F*	Data
January	-4° 29.3´	19531 nT	66° 6.4´	19471 nT	-1528 nT	44087 nT	48219 nT	**P**
February	-4° 28.3´	19532 nT	66° 6.3´	19473 nT	-1523 nT	44086 nT	48219 nT	**P**

INDICES OF GEOMAGNETIC ACTIVITY

The K Index

Hartland Observatory February 2002

Day	K - INDICES FOR THREE-HOUR INTERVAL								SUM
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	
1	4	3	2	2	4	2	1	2	20
2	3	3	3	2	3	3	1	3	21
3	2	1	1	1	2	2	0	0	9
4	0	1	0	1	2	2	2	3	11
5	4	2	2	3	3	3	5	4	26
6	4	3	4	4	3	2	4	3	27
7	2	3	3	4	4	2	2	3	23
8	3	1	2	3	3	3	3	3	21
9	2	3	2	3	2	1	3	4	20
10	3	3	2	2	2	1	1	1	15
11	3	2	2	3	3	3	3	3	22
12	3	3	2	1	1	1	1	4	16
13	2	2	3	4	3	4	1	0	19
14	0	0	1	1	1	1	0	0	4
15	0	0	1	1	1	2	2	1	8
16	1	1	1	1	1	2	1	1	9
17	2	3	3	2	3	2	1	2	18
18	1	2	2	2	2	3	4	4	20
19	3	1	2	1	1	1	2	1	12
20	1	1	2	3	2	2	2	3	16
21	1	1	2	2	2	2	2	3	15
22	2	3	1	2	2	2	3	2	17
23	3	1	1	1	1	1	0	1	9
24	2	1	1	2	2	2	2	1	13
25	2	0	1	1	2	2	2	3	13
26	2	1	1	3	2	2	2	3	16
27	3	1	1	3	2	1	1	2	14
28	2	4	2	3	3	3	5	6	28

Lower bound (nT) for the range for each index value at Lerwick Observatory

K-Index

0	1	2	3	4	5	6	7	8	9
0	10	20	40	80	140	240	400	660	1000

The aa Index

Date	Day	K-North	K-South	(a)	(b)	(c)	(d)	(e)
01-02-02	32	4 3 2 2 4 2 1 2	2 3 3 1 3 4 1 1	27	25	26	26	26
02-02-02	33	3 3 3 2 3 3 1 3	3 3 3 3 3 3 1 2	27	27	30	24	27
03-02-02	34	2 1 1 1 2 2 0 0	1 2 1 1 2 1 0 0	9	9	10	8	9
04-02-02	35	0 1 0 1 2 2 2 3	1 2 1 0 1 1 1 3	12	11	7	17	12
05-02-02	36	4 2 2 3 3 3 5 4	3 1 2 3 3 3 4 4	43	34	26	51	39
06-02-02	37	4 3 4 4 3 2 4 3	3 4 3 3 3 2 3 3	43	34	45	31	38
07-02-02	38	2 3 3 4 4 2 2 3	2 3 2 2 3 1 2 2	32	19	27	24	26
08-02-02	39	3 1 2 3 3 3 3 3	2 2 2 2 3 3 2 2	27	20	19	28	24
09-02-02	40	2 3 2 3 2 1 3 4	2 2 2 2 2 2 2 2	26	16	20	22	21
10-02-02	41	3 3 2 2 2 1 1 1	1 1 2 2 2 0 2 2	17	12	18	11	15
11-02-02	42	3 2 2 3 3 3 3 3	2 2 3 3 3 3 2 3	28	26	24	30	27
12-02-02	43	3 3 2 1 1 1 1 4	2 2 3 2 2 2 1 2	21	17	21	17	19
13-02-02	44	2 2 3 4 3 4 1 0	1 1 2 2 3 3 1 2	28	17	21	24	22
14-02-02	45	0 0 1 1 1 1 0 0	1 1 1 1 0 0 0 1	5	6	6	4	5
15-02-02	46	0 0 1 1 1 2 2 1	1 0 1 0 1 2 1 1	8	8	5	11	8
16-02-02	47	1 1 1 1 1 2 1 1	0 0 0 0 2 2 0 1	9	7	5	10	8
17-02-02	48	2 3 3 2 3 2 1 2	3 3 5 2 2 2 1 2	21	30	35	16	25
18-02-02	49	1 2 2 2 2 3 4 4	1 1 2 2 2 3 3 4	27	24	13	38	26
19-02-02	50	3 1 2 1 1 1 2 1	3 2 2 1 1 1 1 2	13	14	17	10	13
20-02-02	51	1 1 2 3 2 2 2 3	1 1 3 2 2 2 3 3	18	20	16	22	19
21-02-02	52	1 1 2 2 2 2 2 3	1 2 3 2 2 2 2 3	16	19	15	20	18
22-02-02	53	2 3 1 2 2 2 3 2	2 2 2 1 2 1 2 3	19	16	16	19	18
23-02-02	54	3 1 1 1 1 1 0 1	2 2 1 0 1 0 0 2	10	9	12	7	10
24-02-02	55	2 1 1 2 2 2 2 1	1 1 1 2 3 1 1 1	13	12	11	14	12
25-02-02	56	2 0 1 1 2 2 2 3	1 2 2 3 3 2 3 2	14	21	13	22	18
26-02-02	57	2 1 1 3 2 2 2 3	1 1 3 2 2 2 2 3	18	18	16	20	18
27-02-02	58	3 1 1 3 2 1 1 2	1 1 1 1 2 1 1 1	16	9	14	11	12
28-02-02	59	2 4 2 3 3 3 5 6	2 4 3 3 3 3 3 3	57	34	33	58	45
Monthly mean value =			20.0					

(a) The northern daily mean value, Aa_n
(b) The southern daily mean value, Aa_s
(c) The mean value of aa for the interval 00-12 UT
(d) The mean value of aa for the interval 12-24 UT
(e) The daily mean value of aa (Aa)

<u>Notes</u>

i. The values are rounded to the nearest integer.
ii. The units of the aa index are nT.
iii. The values shown here are provisional. The definitive values are computed and published by the International Service for Geomagnetic Indices, Paris

HARLAND RAPID VARIATIONS

SIs and SSCs

Date	Time (UT)	Type	Quality	H (nT)	D (min)	Z (nT)
17-02-02	02:56	SSC	C	16.8	-1.63	2.2
28-02-02	04:51	SSC	B	19.6	-3.88	-6.8

SFEs

Date	Start (UT)	Maximum (UT)	End (UT)	H (nT)	D (min)	Z (nT)
NONE						

Notes

i. For SIs and SSCs a * indicates that the principal impulse was preceded by a smaller reversed impulse.

ii. The quality of SIs and SSCs are classified as follows :
A = very distinct
B = fair, ordinary, but unmistakable
C = doubtful

iii. The amplitudes given are for the first chief movement of the event.