RAUNVÍSINDASTOFNUN HÁSKÓLANS
Science Institute, University of Iceland
RH-09-2012

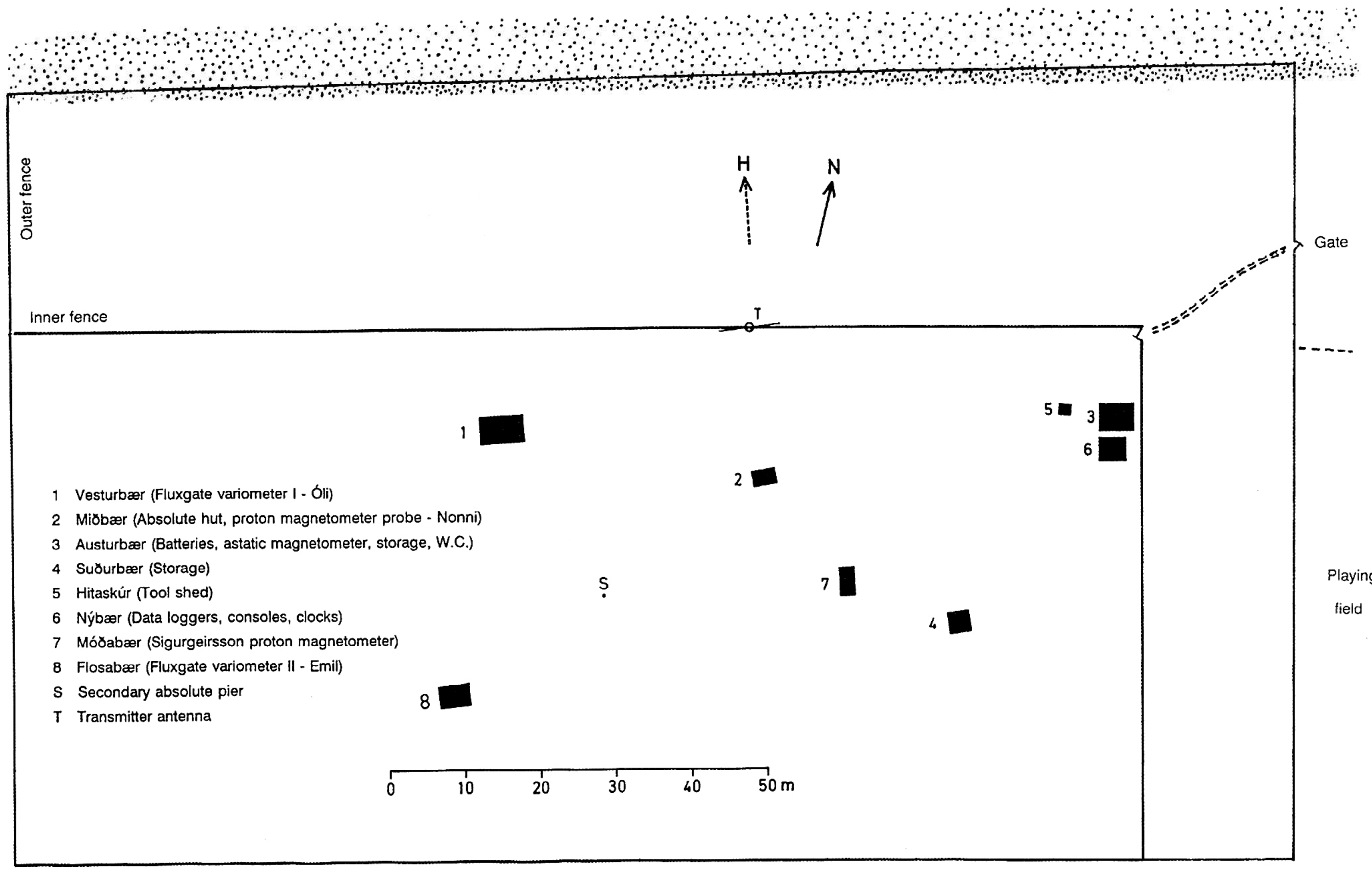
LEIRVOGUR

MAGNETIC RESULTS

2011

REYKJAVÍK 2012

CONTENTS


Outer fence
H
N
Gate
Inner fence
T
1
2
3
4
5
6
7
8
S
Playing
field
1 Vesturbær (Fluxgate variometer I - Óli)
2 Miðbær (Absolute hut, proton magnetometer probe - Nonni)
3 Austurbær (Batteries, astatic magnetometer, storage, W.C.)
4 Suðurbær (Storage)
5 Hitaskúr (Tool shed)
6 Nýbær (Data loggers, consoles, clocks)
7 Móðabær (Sigurgeirsson proton magnetometer)
8 Flosabær (Fluxgate variometer II - Emil)
S Secondary absolute pier
T Transmitter antenna
0
10
20
30
40
50 m

INTRODUCTION

This volume contains the results of geomagnetic measurements carried out at the Leirvogur Magnetic Observatory in Iceland during the year 2011. The observatory, which was established in 1957, is run by the Upper Atmosphere Section of the Science Institute, University of Iceland. A description of the observatory and its development up to 1968 may be found in a report published in 1969. More recent events are covered in the yearbooks.

The observatory is located on a river estuary, 5 m above mean sea level, 12 km ENE of Reykjavík (20 km by road). The geographic coordinates of the observatory's reference point are

$$64°10'\!.986\ \mathrm{N},\quad 21°41'\!.920\ \mathrm{W}\ \ (\mathrm{WGS84}).$$

The geomagnetic coordinates relative to a pole position of $79^\circ\!.4$ N, $71^\circ\!.7$ W are $69^\circ\!.4$ N, $71^\circ\!.8$ E. The McIlwain L-parameter of the observatory in 2011 was approximately 5.5 earth-radii, the corresponding corrected geomagnetic latitude being $64^\circ\!.6$. The geomagnetic conjugate point at 100 km altitude was at $69^\circ\!.0$ S, $28^\circ\!.7$ E geographic, about 440 km from the Japanese Antarctic station Syowa.

PERSONNEL

In 2011, the Upper Atmosphere Section had a staff of two: Gunnlaugur Björnsson, director and Pálmi Ingólfsson, research assistant in a part-time position. Former director, Þorsteinn Sæmundsson, continued to serve in an advisory capacity and made absolute measurements on occasions when Gunnlaugur was away.

Kristján Jónsson an electrical engineer from the Science Institute, helped diagnose and repair problems with the proton magnetometer Móði and move the Óli and and Móði electronics to an uninterruptible power supply.

Helgi Freyr Rúnarsson, a physics graduate from the University of Iceland, was hired part-time to continue to develop and test data handling programs in Python.

DEVELOPMENTS

The staff made 66 trips to the observatory in 2011, the second lowest on record. This reflects a very stable operation, the only instrument problems were due to a failing thermostat in Móði. A Skoda Fabia belonging to the Upper Atmosphere Section was used for transportation to and from Leirvogur.

The environment

Weather was mild most of the year with rather little snow that did not cause any problems. The lowest temperature was $-12°$C in December, and the highest was $+24°$C in July.

Due to the continuing slow economic recovery, construction work at the nearby housing project remained very modest. It is unclear when the project will be completed. So far, no major problems have been caused by the new neighbours that have already moved in. In May, a cat was spotted for the first time near the Observatory. It most likely comes from the new neighbourhood.

Near the end of June it was noticed that half of the corrugated roof plates on Austurbær had disappeared, most likely in a stormy weather. They were replaced in August.

Digital fluxgate systems I and II

Both the new and the old dataloggers ran perfectly during the year. The data handling routines for the new loggers were still being improved and tested. They are nearly fully operational and are expected to be implemented in 2012 when the old dataloggers will be retired.

To compensate for the secular variation in D, System II was turned by about $1.2°$ on June 29. System I was similarly turned on July 13.

On June 8, the thermostat in the variometer house Flosabær, where System II (Emil) is located, was adjusted from winter level ($13°$C) to summer level ($21°$C). Readjustment to winter level took place on November 16.

The thermostat in Vesturbær which houses System I (Óli) was adjusted from winter level ($13°$C) to summer level ($20°$C) on June 10. Readjustment took place on November 9.

Móði

The proton magnetometer Móði worked without major problems most of the year. The problems with the failing thermostat that had started in December 2010 continued intermittently until it was replaced with a new one on January 6. Móði ran without problems until the years end. On June 8 the pump, magnet and methanol were replaced.

Geó II

The conventional proton magnetometer Geó (G856-AX) was used in the absolute measurements. The setup has worked very well although on several occasions the signal from the probe in Miðbær was too weak to give reliable readings. In those cases Geó was moved to Miðbær and a shorter cable used.

Backup computer

The Linux-computer “Cygnus”, is used at the Science Institute for receiving and storing data from Leirvogur and worked without problems throughout the year. Data from both system I and II are transferred regularly to the Institute. In addition, a backup is taken from Cygnus to another Linux-computer once a day.

Real-time displays on the Web

The real-time display of the Leirvogur recordings on the World Wide Web were uninterrupted during the year. Transmissions at hourly intervals for display at the World Data Centre in Kyoto were occasionally affected due to temporary loss of network connection to the WDC.

Time control

A quartz clock of the type Omegaface is used for timing the data. Two clocks are maintained, a main clock and a backup unit. These are corrected by means of GPS signals once a week. This is generally sufficient for keeping the timings correct to within 1 second. On several occasions did the GPS not correctly adjust the clocks, leaving them 1 second late. This was checked against the Network Time Protocol (*NTP*)-service as well as other time signals. On these occasions, the clocks were adjusted manually. The reason for these errors are not known.

ADSL connection

The ADSL-connection worked without major problems most of the year. On September 2, the network connection was lost however, but the phone company claimed that the line was healthy and problem free. It turned out that the University Computing Service had closed the network account as it appeared ’orphaned’ in their system. This was promptly fixed when this was discovered. No data was lost, but the observatory was without a network connection for three days.

Software development

Work continued on porting and testing the various data handling routines that now are written in *Python*. This is a time-consuming work that must be carefully checked. It is now nearing completion. Both system I and II are now on-line with one second time resolution and the semi-automatic data handling routines continue to be monitored and their output compared to results from the older dataloggers.

General maintenance and modifications

Trees and hedges were pruned and fertilizer applied in the spring. Because of the warm weather, tree growth was almost as vigorous as in previous years. During the summer and autumn, the grass around the observatory was cut from time to time with a lawnmower and a brush cutter.

MAGNETOMETERS

The observatory possesses the following instruments:

1. A triaxial fluxgate variometer, “Óli” (Óli II), of the type FGE, version E, from the Danish Meteorological Institute, with suspended sensors and a digital data logger designed and built at the Science Institute. This is the primary recording instrument at Leirvogur. The sensor elements are oriented in the approximate directions of Z (vertical), H (magnetic north) and D (magnetic east). The logger uses an Acorn BBC B+ microcomputer with two floppy drives, each able to store 12 days of data. The records contain 1-minute means of the elements and show the extreme departures from the mean during each minute. Hourly means are both stored and printed out. Momentary values at 10-second intervals are recorded by a PC laptop computer linked to BBC monitoring and display computers. A Linux-based datalogger runs in parallel with the old logger. Data delivery from the new logger to the Institute is automatic every morning at 03:15.

2. A triaxial fluxgate variometer “Emil” (Emil II), of the type FGE, version K, from the Danish Meteorological Institute, with suspended sensors. The data logger is an industrial A/D converter connected to a laptop computer running Linux which runs in parallel with the old data logger and BBC computer. This will be continued while the data handling routines are being upgraded. This system serves as a backup for Óli. All the 1-minute data from this instru-

ment are fully processed. Data delivery to the Institute is automatic every morning at 02:15.

3. A triaxial fluxgate variometer, Emil I, of the type FG84C with a BBC+ data logger identical to that of Óli. This instrument was replaced by Emil II on December 18, 2006, but is kept in Flosabær as a reserve unit.

4. A triaxial fluxgate variometer, Óli I, of the same type as Emil I, superseded by Óli II in October 1998.

5. A Sigurgeirsson proton magnetometer ("Móði") producing an uninterrupted record of the total force F. The precession cycles are counted and 1-minute averages recorded using the data loggers serving the fluxgate variometers Óli and Emil. Hourly means are also printed out. 10-second averages are recorded on a PC computer at Leirvogur as well as on the System II laptop.

6. A Geometrics G856-AX proton magnetometer ("Geó II").

7. A Declination-Inclination fluxgate magnetometer (DI-flux, "Stefnir") based on a Zeiss Jena Theo 010 B theodolite, with electronics from the Auroral Observatory, Tromsø.

8. A second, identical DI-flux instrument, "Stefnir-II", also with electronics from Tromsø.

9. A portable fluxgate magnetometer ("Ferðaflosi") made by Fjarskiptatækni for diverse applications.

In addition, the observatory has an astatic magnetometer and access to two portable proton magnetometers, a Barringer GM-122 ("Barri") and a second Geometrics G856-AX ("Geó I"). These three instruments belong to Dr. Leó Kristjánsson of the Geophysics Division of the Science Institute.

The above list includes only those instruments that are in active use or are kept in reserve.

TIME CONTROL

The older digital fluxgate loggers are controlled by a quartz crystal clock which is adjusted using a signal from the Global Positioning System (GPS). The aim has been to keep the timing correct to within one second. This limit was exceeded three times in 2011. The *NTP* network service is used to correct the time on the laptop computers. It is typically accurate to within 10 milliseconds.

ABSOLUTE MEASUREMENTS

To determine the base-line values for the triaxial fluxgates Óli and Emil, absolute measurements were carried out by means of the proton magnetometers Geó and Móði and the DI-fluxgate magnetometer Stefnir. Traditionally, these measurements have been made once a week, on Wednesday afternoons, irrespective of the magnetic conditions.

Geó was used for measuring the total intensity (F) on the absolute pier. The crystal oscillator correction for Geó was checked regularly in 2011 and found quite stable, about -0.3 nT.

While measurements with Stefnir are in progress, the proton magnetometer probe must be removed from the absolute pier. Simultaneous measurements of the total field can be made, however, feeding the electronics with the signal from Móði. As the probe of Móði is situated some 15 meters from the absolute pier, a site correction must be applied. This correction is subject to changes whenever magnetic parts of the Móði system are moved or modified. Its value is checked by comparison measurements once a week. In 2011, the correction varied between -2.9 nT and -4.0 nT.

Stefnir measures the declination (D) and the inclination (I) of the geomagnetic field. The theory of the DI-fluxgate has been treated by Kring Lauridsen (Danish Meteorological Institute Geophysical Papers, R-71, 1985). For measurements of declination, the standard measuring scheme at Leirvogur involves four readings with the telescope facing west and four readings with the telescope facing east. For every reading with the telescope in an upright position (with the fluxgate sensor on top) there is a corresponding reading in an inverted position. From such a set of measurements the declination can be derived, along with the collimation angles of the sensor and the zero correction of the sensor output.

For the measurements of inclination, the adopted measuring scheme consists of eight measurements with the telescope oriented in the magnetic meridian and tilted at right angles to the total field vector. Four measurements are made with the telescope pointing south and four with the telescope pointing north. All readings are made with the telescope in the same (upright) position. In each case the total field is measured simultaneously. By combining the values of inclination and total intensity, both the vertical and horizontal intensities can be calculated.

BASE LINES

Digital Fluxgate I (Óli)

The base-line values derived from the absolute measurements are shown in graphic form on page 21. Individual measurements are indicated by squares. The solid lines which shift in steps are the adopted base-line values Z_0, H_0 and D_0, the definition of which will be given below.

The method used to derive Z, H, and D from the observed fluxgate readings will now be described. The first step occurs in the logging program where the raw values are multiplied by 0.16 to make the output unit correspond to 1 nT. Fixed constants are then added to give suitable base levels. For the electronics installed in 2002, these constants are 47802 nT for Z, 10164 nT for H and 2199 nT for D (see yearbook 2002, p. 14). The resulting outputs are the "observed" readings Z_1, H_1 and D_1. These readings are then corrected as follows (in units of nanotesla):

$$\begin{pmatrix} Z_2 \\ H_2 \\ D_2 \end{pmatrix} = \begin{pmatrix} 138 \\ 38 \\ -200 \end{pmatrix} + \begin{pmatrix} 1-3\epsilon & \epsilon & 0 \\ 0 & 1-3\epsilon & -\epsilon \\ 0 & 0 & 1-3\epsilon \end{pmatrix} \begin{pmatrix} Z_1 \\ H_1 \\ D_1 \end{pmatrix}$$

where $\epsilon = 0.001$. These corrections allow for the sensors' departure from orthogonality, found by rotating the instrument under controlled conditions. The fact that the scale values depart slightly from unity is also allowed for. The additive constants are adjusted to make the horizontal component similar to that in the absolute hut, Miðbær, both in size and direction.

The formulae giving the field in the absolute hut are then

$$\begin{aligned} Z &= Z_0 + Z_2 \\ H &= H_0 + \sqrt{H_2^2 + D_2^2} \\ D &= D_0 + \arctan\left(D_2/H_2\right) \end{aligned}$$

where Z_0, H_0, and D_0 are the base-line values. The adopted base-line values for 2011 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 8	-1.5
Jan 9	– Jan 28	-1.0
Jan 29	– Feb 4	-1.5
Feb 5	– Feb 19	-1.0
Feb 20	– Mar 4	-1.5
Mar 5	– Apr 2	-1.0
Apr 3	– May 13	-1.5
May 14	– Jun 3	-2.0
Jun 4	– Jun 10 (12:30)	-1.5
Jun 10	– Jun 10 (13:40)	-1.0
Jun 10	– Jun 10 (16:10)	0.0
Jun 10	– Jul 8	0.5
Jul 9	– Jul 22	0.0
Jul 23	– Aug 5	-0.5
Aug 6	– Aug 26	0.0
Aug 27	– Sep 10	-0.5
Sep 11	– Oct 7	0.0
Oct 8	– Nov 4	0.5
Nov 5	– Nov 9 (15:50)	0.0
Nov 9	– Nov 9 (18:20)	-0.5
Nov 9	– Nov 9 (20:50)	-1.0
Nov 9	– Nov 9 (23:20)	-1.5
Nov 9	– Nov 25	-2.0
Nov 26	– Dec 9	-1.5
Dec 10	– Dec 31	-1.0

Horizontal intensity (H_0):

		nT
Jan 1	– Feb 28	-5.5
Mar 1	– Apr 8	-6.0
Apr 9	– May 6	-5.5
May 7	– May 20	-5.0
May 21	– Jun 10 (09:30)	-5.5
Jun 10	– Jun 10 (10:40)	-5.0
Jun 10	– Jun 10 (12:30)	-4.5
Jun 10	– Jun 10 (13:40)	-4.0

		nT
Jun 10	– Jun 10 (15:00)	-3.5
Jun 10	– Jun 10 (16:10)	-3.0
Jun 10	– Jun 10 (17:20)	-2.5
Jun 10	– Jul 13 (13:09)	-2.0
Jul 13	– Aug 12	-4.5
Aug 13	– Oct 7	-5.0
Oct 8	– Oct 28	-4.5
Oct 29	– Nov 9 (15:00)	-5.0
Nov 9	– Nov 9 (16:40)	-5.5
Nov 9	– Nov 9 (18:20)	-6.0
Nov 9	– Nov 9 (20:00)	-6.5
Nov 9	– Nov 9 (21:40)	-7.0
Nov 9	– Nov 9 (23:20)	-7.5
Nov 9	– Dec 31	-8.0

Declination (D_0):

Jan 1	– Jan 3	$345° \; 09\overset{\prime}{.}0$
Jan 4	– Jan 22	$345° \; 08\overset{\prime}{.}9$
Jan 23	– Mar 4	$345° \; 09\overset{\prime}{.}0$
Mar 5	– Mar 19	$345° \; 08\overset{\prime}{.}8$
Mar 20	– Apr 2	$345° \; 08\overset{\prime}{.}9$
Apr 3	– May 6	$345° \; 09\overset{\prime}{.}0$
May 7	– May 20	$345° \; 09\overset{\prime}{.}1$
May 21	– Jun 10 (09:30)	$345° \; 09\overset{\prime}{.}0$
Jun 10	– Jun 10 (11:40)	$345° \; 08\overset{\prime}{.}9$
Jun 10	– Jun 10 (13:20)	$345° \; 08\overset{\prime}{.}8$
Jun 10	– Jun 10 (15:00)	$345° \; 08\overset{\prime}{.}7$
Jun 10	– Jul 1	$345° \; 08\overset{\prime}{.}6$
Jul 2	– Jul 13 (13:09)	$345° \; 08\overset{\prime}{.}7$
Jul 13	– Aug 26	$346° \; 23\overset{\prime}{.}8$
Aug 27	– Sep 10	$346° \; 23\overset{\prime}{.}7$
Sep 11	– Sep 24	$346° \; 23\overset{\prime}{.}8$
Sep 25	– Oct 7	$346° \; 23\overset{\prime}{.}7$
Oct 8	– Nov 4	$346° \; 23\overset{\prime}{.}6$

		nT
Nov 4	– Nov 9 (15:00)	$346° 23\rlap{.}'7$
Nov 9	– Nov 9 (16:40)	$346° 23\rlap{.}'8$
Nov 9	– Nov 9 (18:20)	$346° 23\rlap{.}'9$
Nov 9	– Nov 9 (20:00)	$346° 24\rlap{.}'0$
Nov 9	– Nov 9 (21:40)	$346° 24\rlap{.}'1$
Nov 9	– Dec 2	$346° 24\rlap{.}'2$
Dec 3	– Dec 31	$346° 24\rlap{.}'1$

The changes in the base lines on July 13 were caused by the turning of the instrument, while the changes in base lines on June 10 and November 9 were caused by adjustments of the thermostat in the variometer building Vesturbær. The temperature coefficient is about 0.3 nT/°C for Z and 0.4 nT/°C for H and D.

Scale values. The scale values of Óli are close to unity (1 nT/unit). This was confirmed by indirect tests in 1998 (see yearbook p. 18). The tests have not been repeated since a new electronic unit was installed in October 2002. The intrinsic sensitivity of the instrument is actually higher by a factor of 6.25 but is reduced by inserting a suitable term in the program of the logging computer as explained above.

Digital fluxgate II (Emil)

The base-line values derived from the absolute measurements are shown graphically on page 22. The fluxgate is nearly identical to System I, and the data are handled in the same way for both systems. The constants added to the output values are determined in the same fashion as for System I. They are 50204 nT for Z, 12640 nT for H and 39 nT for D. The "observed" readings Z_1, H_1 and D_1, are corrected as follows (in units of nanotesla):

$$\begin{pmatrix} Z_2 \\ H_2 \\ D_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ -200 \end{pmatrix} + \begin{pmatrix} 1 & 0 & \epsilon \\ 0 & 1 & -\epsilon \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} Z_1 \\ H_1 \\ D_1 \end{pmatrix}$$

where $\epsilon = 0.001$. Note that due to better alignment of this instrument, most of the correction coefficients are zero. The adopted base-line values for 2011 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 3	0.0
Jan 4	– Mar 1	-0.5
Mar 2	– Apr 23	0.0
Apr 24	– Apr 30	-0.5
May 1	– May 20	-1.0
May 21	– Jun 8 (12:30)	-0.5
Jun 8	– Jun 8 (14:30)	-1.0
Jun 8	– Jun 29 (13:30)	-1.5
Jun 29	– Oct 7	-2.0
Oct 8	– Oct 21	-1.5
Oct 22	– Nov 16 (13:20)	-2.0
Nov 16	– Nov 16 (15:00)	-1.5
Nov 16	– Nov 16 (16:40)	-1.0
Nov 16	– Dec 2	-0.5
Dec 3	– Dec 31	0.0

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 28	-6.5
Jan 29	– Feb 12	-6.0
Feb 13	– Mar 1	-6.5
Mar 2	– Mar 11	-7.0
Mar 12	– Apr 2	-6.5
Apr 3	– May 6	-7.0
May 7	– May 20	-6.5
May 21	– Jun 8 (12:30)	-7.0
Jun 8	– Jun 8 (13:40)	-7.5
Jun 8	– Jun 8 (14:30)	-8.0
Jun 8	– Jun 29 (13:30)	-8.5
Jun 29	– Nov 16 (13:20)	-12.0
Nov 16	– Nov 16 (15:00)	-11.5
Nov 16	– Nov 16 (16:40)	-11.0
Nov 16	– Dec 9	-10.5
Dec 10	– Dec 31	-10.0

Declination (D_0):

Jan 1	– Jan 3	$345° \ 6.'0$
Jan 4	– Jan 28	$345° \ 5.'9$
Jan 29 1	– Feb 19	$345° \ 6.'1$
Feb 20	– Mar 1	$345° \ 6.'0$
Mar 2	– Apr 2	$345° \ 5.'9$
Apr 3	– Apr 15	$345° \ 6.'0$
Apr 16	– May 6	$345° \ 5.'9$
May 7	– May 26	$345° \ 6.'0$
May 27	– Jun 8 (14:30)	$345° \ 5.'9$
Jun 8	– Jun 8 (13:40)	$345° \ 5.'8$
Jun 8	– Jun 8 (14:30)	$345° \ 5.'7$
Jun 8	– Jun 29 (13:30)	$345° \ 5.'6$
Jun 30	– Jul 16	$346° \ 20.'3$
Jul 17	– Aug 26	$346° \ 20.'4$
Aug 27	– Sep 10	$346° \ 20.'2$
Sep 11	– Oct 7	$346° \ 20.'3$
Oct 8	– Oct 31	$346° \ 20.'2$
Nov 1	– Nov 16 (15:00)	$346° \ 20.'3$
Nov 16	– Dec 31	$346° \ 20.'4$

The steps in the base lines on June 8 and November 16 were caused by adjustments of the thermostat in the variometer house, while the changes in the base lines on June 29 were caused by the turning of the instrument. The temperature coefficients are approximately 0.2 nT/°C for Z and H and less than 0.2 nT/°C for D.

ONE-MINUTE MEANS

Calculations of 1-minute means of Z, H, and D are based on measurements with the triaxial fluxgate variometers, chiefly system I (Óli). The magnetometers measure at 1-second intervals at, $02^s - 09^s$, $12^s - 19^s$, $22^s - 29^s$, $32^s - 39^s$, $42^s - 49^s$and $52^s - 59^s$ past each minute mark, giving a total of 48 measurements per minute. An exception occurs during the first minute of each quarter-hour, when measurements from 02^s to 07^s past the minute are left out, resulting in 42 measurements per minute. During the first minute of each day, measurements at $12^s - 17^s$ are left out as well.

The 10-second momentary recordings, which are made at 08^{s}, 18^{s}, 28^{s}, 38^{s}, 48^{s} and 58^{s}, are used to compensate for the gaps at the quarter-hours and the larger gap at the beginning of each day.

The 1-minute means of F are calculated from the number of proton precession cycles of the continuous proton magnetometer Móði. From the number, N, of precession cycles per minute, the mean value of F is found:

$$F = 0.3914534 \cdot N + \delta F \quad (\mathrm{in\ \ nT}).$$

The numerical constant corresponds to $(2\pi/\gamma_{\mathrm{p}})/60$, where γ_{p} is the proton gyromagnetic ratio and δF is the sum of a site reduction and a clock correction. A site reduction is needed because the probe of Móði is some distance away from the observatory reference pier as mentioned earlier. A clock correction arises if the Móði reference clock runs too slowly or too fast; this correction is generally small (< 0.1 nT). The value of δF is found by comparing once a week the signal from Móði with that from the proton magnetometer Geó, the probe of which is situated on the pier.

The adopted values of δF in 2011 were as follows:

		δF (nT)
Jan 1	– Jan 14	-3.7
Jan 15	– Feb 4	-3.6
Feb 5	– Feb 19	-3.4
Feb 20	– Mar 4	-3.6
Mar 5	– Mar 26	-3.2
Mar 27	– Apr 1	-3.3
Apr 2	– Apr 16	-3.5
Apr 17	– May 1	-3.6
May 2	– May 13	-3.5
May 14	– May 26	-3.3
May 27	– Jul 9	-3.4
Jul 10	– Aug 20	-3.6
Aug 21	– Sep 17	-3.8
Sep 18	– Nov 4	-3.7
Nov 5	– Nov 12	-3.8
Nov 13	– Nov 25	-3.9
Nov 26	– Dec 2	-3.7
Dec 2	– Dec 31	-3.6

On occasions when Móði was not functioning, F was calculated from the fluxgate components to fill the gaps in the records.

All 1-minute data were checked visually in graphic form on a computer screen. The 1-minute values of Z and H were also checked by comparing them with the 1-minute values of F. The expression

$$M = \sqrt{Z^2 + H^2} - F,$$

was evaluated for this purpose. The mean value of M over the year was 0.0 nT. Most of the values (99.92%) were in the range -1 to $+1$ nT, 0.08% reached ± 2 nT, and there were 5 cases of a higher value.

Non-zero values of M may be explained by a combination of several factors. To begin with, the field values of Z and H are only recorded to the nearest nanotesla. The base-line values are rounded to the nearest 0.5 nT. Finally, the fluxgate sensors are sampled at discrete intervals which are not spaced evenly within the minute. All these factors can cause M to depart from zero, especially during magnetic storms.

In 2011, the 1-minute data for Z, H and D were complete. Gaps or errors in the 1-minute data from the proton magnetometer Móði were 1824 or 0.35% of the total time. Most of this was due to problems with the thermostat at the beginning of the year.

HOURLY MEANS

The hourly mean values of the magnetic elements Z, H, D and F were found by averaging the 1-minute means from the fluxgate variometers and the proton magnetometer Móði.

The hourly means of Z and H were checked by comparing them with the hourly means of F and tabulating the difference M (see above). In 2011, individual rounded values of the difference rarely exceeded 1 nT.

K-INDICES

K-indices were derived from the digital 1-minute values by a straightforward measurement of the 3-hour ranges of H and D, as explained in the yearbook for 1993.

MAGNETIC ACTIVITY

As measured by Ak, the magnetic activity in 2011 was among the lowest recorded at Leirvogur and there were no highly disturbed days. The most significant disturbances occurred on the following days:

Date	*K-sum*	*C9*	*L9*
Mar 11	(44)	(6)	(7)
May 29	(45)	(7)	(6)
Aug 5-6	(32,34)	(7,6)	(3,5)
Sep 10, 12	(43,45)	(6,6)	(6,6)

These and other disturbances are displayed in the graphical records on pages 35-126. The index L9 was explained in the yearbook for 1998.

The index K never reached the extreme value 9 in 2011, and the value 8 only seven times. The year was among the quietest on record at Leirvogur as is evident from the tables on pages 29 and 30. The quietest time of the year was on April 27, when the field kept steady to the nearest nanotesla in all elements for 173 consecutive 10-second readings (29 minutes).

COMPUTER PROGRAMS

Approximately 100 programs are used for data handling and processing. Most are in Comal and Python, nine in Fortran, four in Turbo-Pascal, four in BBC-Basic with 6502 assembly language, one in C and ten in GNU-awk and Linux command scripts.

DATA DISTRIBUTION

Magnetic results from Leirvogur are sent to two data centres: WDC-C2 in Kyoto and WDC-A in Boulder. The data are transmitted over the Internet. Preliminary 10-second data are sent daily to Kyoto where they are displayed graphically on the World Wide Web. The address is:

http://wdc.kugi.kyoto-u.ac.jp/

Preliminary values of Z, H and D are sent every hour to Kyoto, to be displayed graphically on the World Wide Web, and also made available at the above address. The same preliminary data are also placed in graphical form on the Leirvogur website: *http://www.raunvis.hi.is/∼halo/leirvogur.html*. The data on this site cover the last 24 hours and are renewed every 10 minutes. Final 10-second values are sent to Kyoto after the end of each month along with the 1-minute means, hourly means, monthly means and K-indices. The 1-minute means and hourly means are converted from a special Leirvogur format to WDC format before transmission. Monthly transmissions to Boulder are restricted to 1-minute means and hourly means.

Both preliminary and final data are available over the Internet by ftp-transfer. The address is *ftp.raunvis.hi.is* logging in as "anonymous". The files are kept in the directory "pub/lrv". The annual means are sent to WDC-C2 in Kyoto, WDC-C1 in Edinburgh and the Analytical Centre on Secular Variations in Troitsk (IZMIRAN). The annual means are accessible by FTP at the above address under the file name ANNMEANS.LRV. Also kept in the same location is the file ADQMEANS.LRV which contains an extended list of annual means, including disturbed-day and quiet-day means.

September 2012

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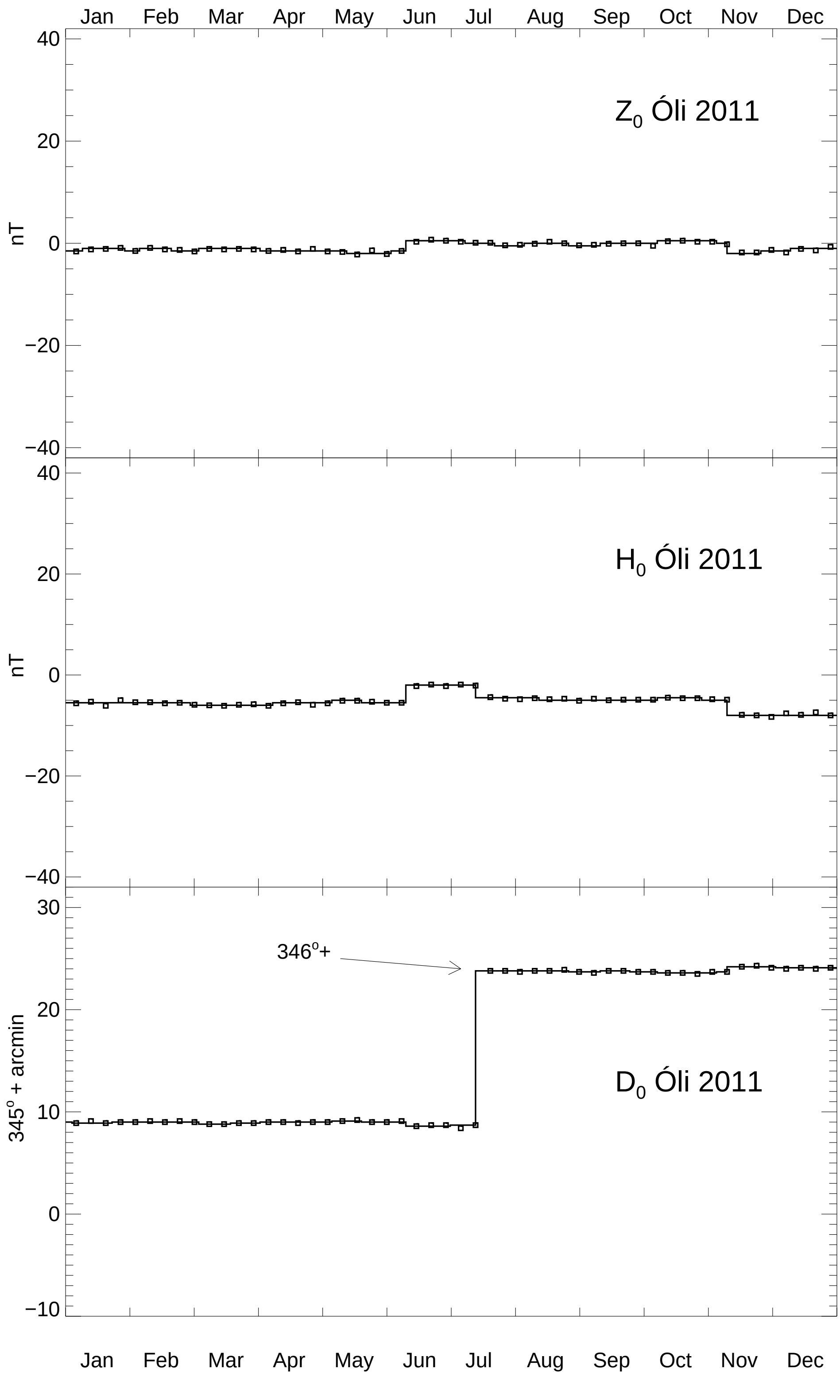
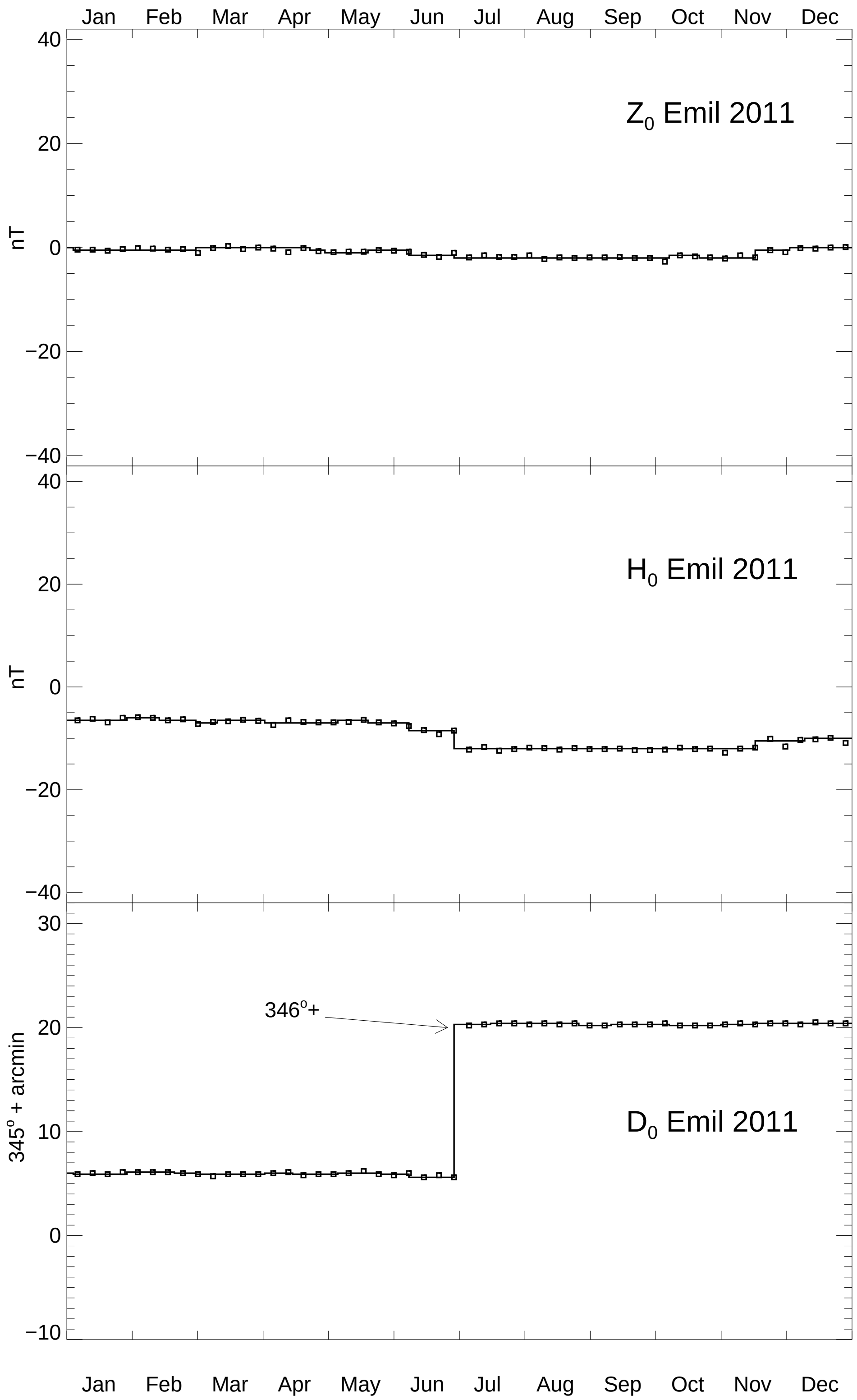

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
40
20
0
−20
−40
nT
Z0 Óli 2011
H0 Óli 2011
346o+
30
10
−10
345o + arcmin
D0 Óli 2011


Z$_0$ Emil 2011
H$_0$ Emil 2011
D$_0$ Emil 2011
346°+
nT
345° + arcmin
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

EXPLANATION OF TABLES

Monthly and annual means

In the table of monthly means on the following page, the declination is reckoned towards the east from 0 to 360 degrees. Thus $346°$ corresponds to $14°$ W. The letters Q and D mark the international quiet and disturbed days, respectively. The days were selected according to circulars from the International Service of Geomagnetic Indices in Potsdam.

Annual means (all days) since 1958 are given on pages 124-125.

Diurnal variations

The tables on pages 25-26 show the mean diurnal inequalities of the magnetic elements Z, H, D and F at Leirvogur in 2011. The units are nanoteslas (for Z, H and F) or tenths of a minute (for D). The top row in each group of four gives the mean of all months of the year, while the other rows show the mean for the winter months (W = January, February, November, December), the equinoctial months (E = March, April, September, and October) and summer months (S = May, June, July and August).

The averages for the international quiet and disturbed days are shown separately and are identified by Q or D as a second letter.

The last three columns give the positions of the minimum and the maximum values in each row, and the range. In cases where there are two or more extreme values of equal size, the number 99 is printed.

K-indices

The three-hourly K-indices, based on the components H and D, are shown in tabular from on page 27. The daily K-sums are shown on page 28 in runs of 27 days. The table on page 29 shows the distribution of K-indices for each month of the year. The columns give the number of cases when $K = 0$, $K = 1$ etc. The column marked "–" shows how many indices are missing owing to breaks in the record. The final columns give the average values of K and the equivalent amplitudes Ak. A summary for all years since 1958 is given on page 30.

LEIRVOGUR 2011
MEAN VALUES OF THE MAGNETIC ELEMENTS

VERTICAL INTENSITY (Z) IS 50000 PLUS TABULAR VALUES IN NANOTESLAS
HORIZONTAL INTENSITY (H) IS 12000 PLUS TABULAR VALUES IN NANOTESLAS
DECLINATION (D) IS 346 DEGREES PLUS TABULAR VALUES IN TENTH-MINUTES
TOTAL INTENSITY (F) IS 51000 PLUS TABULAR VALUES IN NANOTESLAS
Q=QUIET DAYS, D=DISTURBED DAYS

	Z	ZQ	ZD	H	HQ	HD	D	DQ	DD	F	FQ	FD
JAN	202	201	203	632	633	632	384	385	384	767	766	768
FEB	201	202	194	632	634	634	397	400	386	766	767	760
MAR	200	203	181	628	632	612	415	415	414	764	768	742
APR	200	207	196	626	639	621	436	431	450	763	773	758
MAY	197	196	186	629	638	586	455	451	478	761	762	741
JUN	199	199	207	636	644	618	468	467	486	764	767	768
JUL	196	199	194	634	645	633	485	480	485	762	767	760
AUG	204	204	211	632	639	614	498	494	507	769	771	771
SEP	204	206	196	621	634	596	510	509	507	766	772	753
OCT	208	210	211	628	638	612	528	527	529	771	776	770
NOV	211	209	217	640	640	643	539	539	538	778	776	784
DEC	207	206	208	643	644	646	557	559	556	775	774	777
MEAN	202	204	200	632	638	621	473	471	477	767	770	763

LEIRVOGUR 2011

MEAN DIURNAL INEQUALITIES

UT 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	MIN	MAX	RANGE
Z	-17	-20	-19	-17	-16	-14	-13	-12	-8	-4	-2	0	3	8	14	21	25	25	23	18	11	4	-2	-10	2.	18.	45
ZW	-9	-11	-14	-11	-8	-8	-8	-8	-7	-5	-3	-3	-1	2	5	9	12	15	14	15	13	9	7	-5	3.	99.	29
ZE	-16	-15	-11	-10	-13	-15	-13	-13	-10	-5	-2	0	4	10	18	26	27	22	19	13	5	-2	-8	-10	1.	17.	43
ZS	-27	-33	-31	-29	-27	-18	-17	-14	-6	-4	-2	2	7	11	19	28	37	39	37	27	16	4	-5	-15	2.	18.	72
ZQ	-10	-12	-9	-7	-4	-1	-1	-2	-2	-3	-3	-3	-2	1	4	8	11	11	10	8	6	4	1	-6	2.	18.	23
ZQW	-1	-4	-4	-2	-1	0	-1	-2	-2	-2	-2	-3	-3	-1	1	3	5	5	4	4	4	2	1	-2	2.	18.	9
ZQE	-11	-7	-6	-6	-4	-3	-2	-3	-3	-4	-4	-4	-2	2	5	10	12	13	12	9	5	3	0	-7	1.	18.	24
ZQS	-17	-23	-16	-13	-7	-1	0	-1	-2	-2	-4	-2	-1	1	5	10	15	16	15	11	10	8	3	-8	2.	18.	39
ZD	-11	-17	-9	-7	-16	-20	-30	-34	-20	-10	-1	5	13	22	32	41	41	31	22	11	-1	-14	-12	-15	8.	16.	75
ZDW	-13	-13	-16	-13	-18	-18	-21	-21	-19	-10	-4	0	6	10	15	22	24	32	27	22	15	0	4	-12	99.	18.	54
ZDE	-6	-8	16	14	6	-16	-23	-34	-27	-8	3	9	17	31	48	54	43	9	-7	-18	-27	-34	-30	-13	8.	16.	88
ZDS	-13	-29	-28	-21	-35	-25	-46	-45	-15	-11	-2	5	16	24	35	48	55	52	45	27	8	-10	-12	-19	7.	17.	102
H	-33	-43	-40	-35	-28	-14	-5	-1	1	-2	-7	-10	-8	-3	8	20	31	39	44	43	34	20	3	-15	2.	19.	87
HW	-11	-9	-9	-8	-7	-4	-1	2	3	1	-3	-7	-9	-7	-2	2	7	10	14	14	13	10	8	-7	1.	20.	25
HE	-39	-48	-46	-33	-33	-17	-5	-1	3	2	-5	-10	-8	-3	9	25	35	48	51	48	36	18	-5	-23	2.	19.	99
HS	-51	-72	-65	-63	-46	-22	-8	-4	-3	-9	-13	-13	-7	2	16	34	52	58	67	67	54	33	7	-15	2.	99.	139
HQ	-1	-2	-1	-2	0	2	2	-1	-4	-9	-15	-19	-20	-16	-10	-1	6	11	15	17	17	15	11	4	13.	20.	37
HQW	2	0	0	0	0	1	2	3	2	0	-3	-8	-11	-11	-8	-3	1	3	4	5	5	5	5	4	13.	99.	17
HQE	0	4	3	2	2	3	3	0	-3	-8	-17	-23	-25	-20	-13	-1	5	12	14	17	15	13	12	3	13.	20.	42
HQS	-6	-9	-7	-9	-3	2	0	-5	-11	-18	-24	-25	-22	-17	-8	0	10	19	26	29	29	26	16	4	12.	99.	54
HD	-84	-118	-102	-85	-73	-50	-30	-14	3	2	3	3	17	28	43	71	88	96	106	92	65	25	-21	-66	2.	19.	223
HDW	-35	-15	-12	-18	-25	-20	-12	-5	-4	-2	-5	-7	-5	1	8	14	20	26	39	35	27	16	13	-32	1.	19.	74
HDE	-109	-133	-109	-101	-107	-57	-41	-25	4	11	6	7	22	35	55	92	111	145	149	117	76	21	-49	-122	2.	19.	282
HDS	-108	-205	-185	-137	-87	-72	-36	-13	10	-2	7	9	34	49	66	105	133	117	129	124	93	37	-26	-44	2.	17.	337

LEIRVOGUR 2011

MEAN DIURNAL INEQUALITIES

UT	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	MIN	MAX	RANGE
D		17	25	31	35	45	46	50	47	42	38	26	3	-23	-48	-65	-67	-60	-48	-37	-26	-23	-15	-2	8	16.	7.	116
DW		24	18	19	16	16	22	24	21	14	13	12	1	-17	-30	-40	-42	-41	-31	-20	-12	-10	2	16	23	16.	7.	67
DE		19	31	35	45	54	49	53	44	38	37	23	0	-28	-55	-73	-73	-63	-51	-35	-24	-23	-16	-1	12	99.	5.	127
DS		9	27	39	45	65	68	72	76	73	64	44	9	-25	-60	-82	-84	-76	-62	-55	-42	-36	-32	-22	-10	16.	8.	160
DQ		6	8	10	12	19	27	36	42	45	42	33	13	-13	-38	-53	-55	-47	-35	-23	-16	-9	-5	-1	3	16.	9.	100
DQW		15	11	8	5	6	10	13	14	17	16	16	8	-7	-21	-29	-32	-28	-19	-13	-9	-2	5	10	10	16.	9.	49
DQE		6	6	9	13	17	25	30	39	44	43	35	15	-11	-37	-54	-57	-46	-33	-18	-12	-7	-5	-4	3	16.	9.	101
DQS		-1	8	13	19	33	46	64	73	75	67	48	15	-21	-55	-74	-75	-66	-53	-38	-27	-18	-15	-9	-5	16.	9.	150
DD		25	60	78	79	97	87	69	52	34	37	21	-6	-33	-54	-75	-79	-75	-68	-62	-56	-64	-54	-20	6	16.	5.	176
DDW		46	15	22	28	40	46	39	23	3	-1	9	-4	-25	-33	-45	-53	-58	-42	-11	-8	-23	-11	17	27	17.	99.	103
DDE		10	84	88	120	133	99	92	53	30	39	11	-18	-45	-63	-85	-84	-77	-75	-73	-80	-79	-67	-34	25	15.	5.	218
DDS		20	82	123	88	118	117	78	81	70	72	45	5	-29	-65	-96	-99	-90	-88	-103	-80	-91	-82	-44	-32	19.	3.	226
F		-25	-30	-28	-25	-23	-17	-13	-12	-7	-5	-4	-3	1	7	16	25	32	34	33	28	19	9	-1	-13	2.	18.	64
FW		-11	-14	-16	-13	-10	-9	-8	-8	-6	-4	-4	-4	-3	0	4	9	13	17	17	18	16	11	8	-7	3.	20.	34
FE		-25	-26	-21	-18	-20	-19	-14	-13	-8	-4	-3	-2	2	9	20	32	35	33	31	24	13	2	-9	-15	2.	17.	61
FS		-38	-49	-45	-43	-38	-23	-18	-14	-7	-6	-5	-1	5	11	22	36	48	52	52	43	28	12	-3	-18	2.	99.	102
FQ		-10	-12	-9	-7	-4	-1	-1	-2	-3	-5	-7	-7	-7	-3	1	7	12	14	14	12	10	8	4	-5	2.	18.	25
FQW		-1	-4	-4	-2	-1	0	-1	-1	-1	-2	-3	-5	-5	-4	-1	2	5	6	5	5	5	4	2	-1	13.	18.	11
FQE		-11	-7	-6	-6	-3	-3	-2	-2	-4	-5	-8	-9	-8	-4	2	9	13	15	15	13	8	6	3	-7	1.	18.	26
FQS		-18	-24	-18	-14	-8	0	0	-2	-5	-7	-9	-8	-7	-3	4	10	17	20	21	18	18	15	7	-6	2.	19.	45
FD		-31	-45	-34	-27	-33	-31	-37	-36	-19	-9	-1	5	17	28	42	58	61	54	47	33	14	-8	-17	-30	2.	17.	106
FDW		-21	-16	-19	-17	-23	-23	-24	-22	-19	-10	-5	-1	5	10	17	25	28	38	36	30	21	5	8	-20	7.	18.	62
FDE		-32	-40	-11	-11	-21	-29	-33	-39	-25	-5	4	10	22	38	60	75	69	44	30	11	-8	-28	-41	-42	24.	16.	117
FDS		-39	-77	-72	-54	-55	-42	-54	-47	-13	-11	-1	7	23	35	50	73	86	79	75	57	30	-1	-18	-29	2.	17.	164

LEIRVOGUR MAGNETIC OBSERVATORY 2011
K-INDICES FOR THREE HOUR INTERVALS IN U.T.
LOWER LIMIT FOR K-9 = 1500 NANOTESLAS IN H

DAYS	K-INDICES						
1- 7	30010103	22010121	11011132	21111110	00000012	31000117	64332246
8- 14	43222234	13111135	52211112	22011133	22221014	41101345	43222233
15- 21	03122110	11001122	32111212	41110113	42133221	11121122	10001221
22- 28	22001111	00001000	00110124	41111123	21100131	30011010	22011231
29- 35	41011100	10000000	00010222	12322442	43311211	10010001	15221377
36- 42	64332244	44333434	20021112	34121112	20000101	00221103	23012143
43- 49	32111110	00111101	00011356	31211212	02111000	00221110	15533333
50- 56	43222122	22433233	44122345	20011000	11101111	01010000	01011112
57- 63	01111212	00011100	00011111	63334565	65343456	64323446	53433365
64- 70	33121233	01013214	34112355	53112223	31121222	43443466	77632568
71- 77	73321266	20022452	21121110	00011100	00111100	01121240	01111200
78- 84	20022211	22012225	41111125	55112112	64322343	00012111	00022322
85- 91	01111100	00012112	20122221	10021212	31011110	00122211	31122555
92- 98	75543346	56423345	64222212	33221135	34145575	54222121	31123337
99-105	55422211	20113114	50122331	13744426	66533211	14221114	42112221
106-112	01222112	21122211	01333321	12122202	47533211	11122322	44122311
113-119	31121210	01123225	24122320	01111211	01121200	01112333	23222345
120-126	64444454	56434535	65644556	66323344	41223331	45223332	02122213
127-133	20122432	20012112	41112210	11323434	35222221	31111212	01122211
134-140	33122212	12233435	53323334	42333233	33223320	21212200	11122110
141-147	01222322	33122220	01122324	63222222	22122213	21113333	23322556
148-154	65565326	57744657	53323224	65332335	62322434	44422333	22222210
155-161	22111245	76333444	54323223	11112435	67323324	67323234	21332325
162-168	44423232	32234332	42133431	34332223	32223222	21123310	23123232
169-175	32222121	11112123	45322225	55223343	52223445	66335456	65323444
176-182	42222334	46223332	22112214	33122110	01122210	13222224	66734522
183-189	10222354	67322210	32223455	57322354	54422335	42223333	32222235
190-196	47232336	46213334	43342434	65223442	53222222	34323314	24121321
197-203	01122212	22121224	13222322	11233446	65433445	64323334	46323344
204-210	55222232	21111223	15334333	44223122	13111201	33121211	10122320
211-217	11223455	54422334	55322222	51122211	11122222	00112213	54122378
218-224	86633323	64311325	44322214	55422333	33322322	22112232	12122221
225-231	33122212	53223546	65323436	62223224	53222221	10122211	00121212
232-238	01122323	20111221	41222435	31124443	63222214	30122242	01122232
239-245	41122310	33222231	42222312	21122222	00122200	11112102	12122213
246-252	54334323	55323432	31112452	34422332	52121221	22111100	01114657
253-259	77443567	53223325	77534667	66432225	30122223	33323233	21122212
260-266	14346664	20122212	00112210	05222233	00112312	20122333	20011211
267-273	00112112	00032210	20134685	76434337	66534422	86422441	51121235
274-280	65223366	32423344	00112223	30212223	32234522	12222211	13321213
281-287	31012245	55421235	21011210	00112310	13222120	22111200	10011201
288-294	43023210	45122115	41122202	21211210	44022101	31012221	34211113
295-301	30022100	00012213	30121158	78633321	23211212	23122111	00011100
302-308	00011100	22012313	61121136	54344445	54333211	33121101	01122115
309-315	43121102	10012200	01211212	31212210	00011100	00011222	01021100
316-322	00111100	10011000	00011100	00222112	32010101	11111011	11111101
323-329	00010000	00000111	21121224	30112311	33211113	31112125	43111103
330-336	10111102	12322211	00011105	53222262	20023555	54222122	10011145
337-343	42232245	51112201	11011112	00001100	00011101	10011020	00012110
344-350	31321134	30112231	30111113	21012102	22011001	01000000	10000000
351-357	00000002	00000010	21111120	20011122	22012136	32001111	20010000
358-364	00000101	22110000	00001000	00000000	00001111	12232134	22101232
365	53111103						

LEIRVOGUR MAGNETIC OBSERVATORY 2011

K-SUMS IN 27-DAY RUNS

DAYS	K-SUMS																										
1- 27	8	9	10	8	3	13	30	22	16	15	13	14	19	21	10	8	13	12	18	11	7	8	1	9	14	9	6
28- 54	12	8	1	7	20	16	3	28	28	28	9	15	4	9	16	10	5	16	13	5	7	26	18	22	25	4	7
55- 81	2	7	9	3	5	35	36	32	32	18	12	24	19	14	34	44	30	17	9	3	4	11	6	10	16	16	18
82-108	27	6	11	5	7	12	9	8	9	24	37	32	21	20	34	19	23	22	13	17	31	27	16	15	11	12	16
109-135	12	26	14	18	11	16	16	8	7	14	23	35	35	41	31	19	24	13	16	9	12	21	19	12	10	16	23
136-162	26	23	18	10	9	14	15	15	21	15	17	28	38	45	24	30	26	25	13	18	34	24	18	30	30	21	24
163-189	22	21	22	18	13	18	15	12	25	27	27	38	31	22	25	15	13	9	18	35	19	23	26	31	28	22	21
190-216	30	26	27	28	20	23	16	11	16	17	24	34	28	29	23	13	25	20	10	14	11	23	27	23	15	13	10
217-243	32	34	25	22	27	20	15	13	16	30	32	23	19	10	9	14	10	23	22	22	16	13	14	18	18	14	7
244-270	9	14	27	27	19	23	16	8	25	43	25	45	30	15	22	13	34	12	7	19	10	16	8	8	8	29	37
271-297	32	31	20	33	25	11	15	23	13	16	18	27	8	8	13	9	6	15	21	14	10	14	12	16	8	9	21
298-324	33	14	13	3	3	14	21	33	22	12	13	14	6	10	12	3	8	5	4	3	3	10	8	7	7	1	3
325-351	15	12	15	16	14	7	14	8	24	22	20	13	24	13	8	2	4	5	5	18	13	11	9	7	1	1	2
352-365	1	9	9	17	9	3	2	6	1	0	4	18	13	15													

LEIRVOGUR MAGNETIC OBSERVATORY 2011

DISTRIBUTION OF K-INDICES AND AVERAGES OF K AND Ak

	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\overline{K}$	$\overline{Ak}$
JAN	61	92	51	25	13	3	2	1	0	0	0	1.4	7
FEB	53	77	40	28	17	5	2	2	0	0	0	1.6	9
MAR	41	69	56	31	18	15	14	3	1	0	0	2.2	16
APR	13	66	67	35	27	20	7	5	0	0	0	2.5	17
MAY	13	43	80	57	19	20	13	3	0	0	0	2.6	18
JUN	5	32	85	60	33	13	9	3	0	0	0	2.7	18
JUL	6	34	79	59	37	19	10	4	0	0	0	2.8	19
AUG	14	50	103	40	18	12	8	1	2	0	0	2.3	15
SEP	22	49	66	40	22	16	14	9	2	0	0	2.6	23
OCT	41	73	71	33	12	9	6	1	2	0	0	1.9	12
NOV	64	93	43	20	9	10	1	0	0	0	0	1.4	7
DEC	100	79	42	15	6	5	1	0	0	0	0	1.1	5
YEAR	433	757	783	443	231	147	87	32	7	0	0	2.1	14
%	14.8	25.9	26.8	15.2	7.9	5.0	3.0	1.1	0.2	0.0			

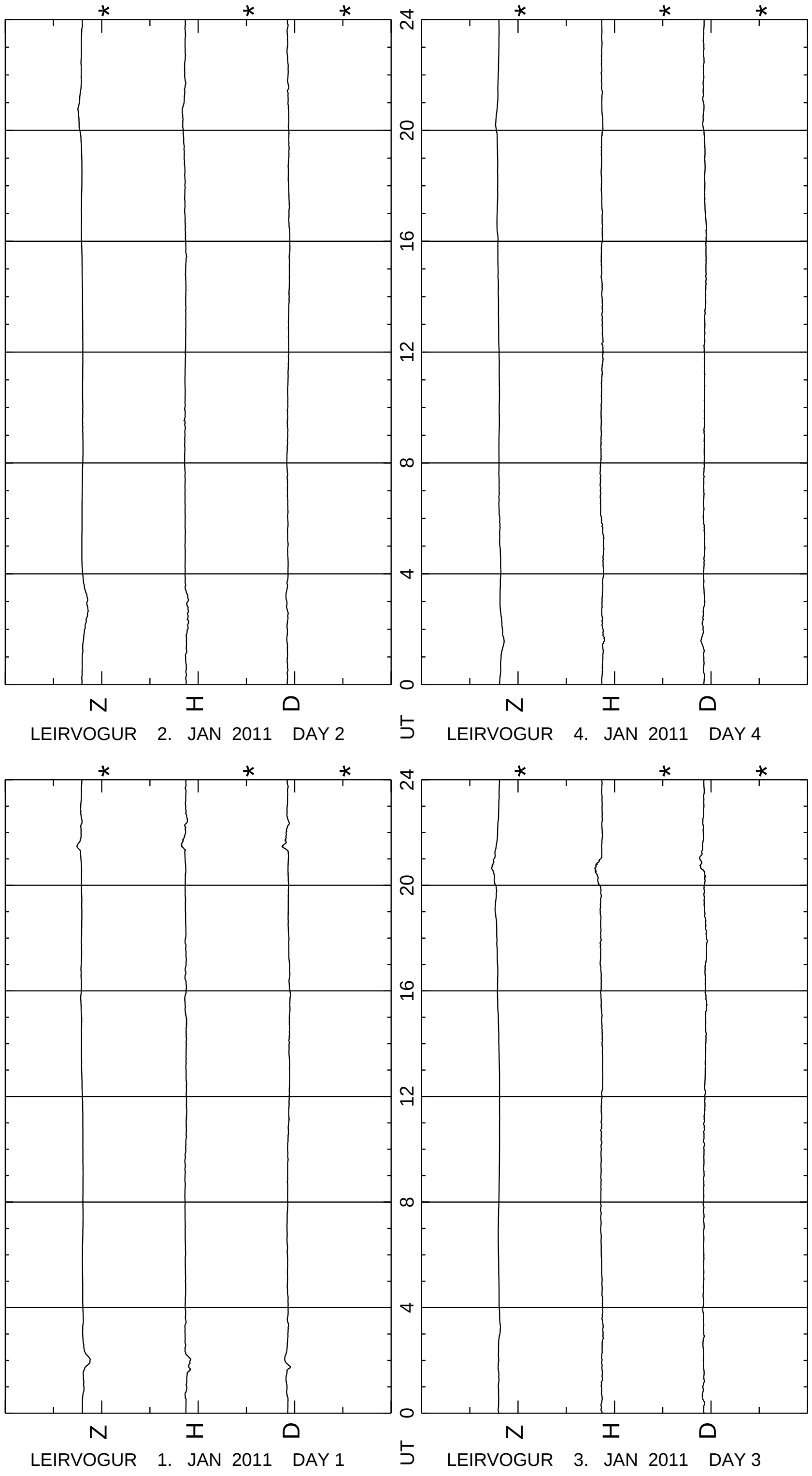
	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\overline{K}$	$\overline{Ak}$
1958	76	267	459	591	510	488	328	87	12	2	100	3.6	33
1959	46	260	360	567	562	547	388	138	33	8	11	3.9	39
1960	75	275	399	539	468	492	304	165	32	4	175	3.7	38
1961	224	477	475	518	482	351	222	87	19	1	64	3.1	27
1962	17	346	592	569	444	412	259	94	10	0	177	3.4	30
1963	181	494	543	550	371	353	259	99	10	0	60	3.1	27
1964	328	699	573	451	325	238	159	54	3	0	98	2.5	19
1965	416	799	567	455	247	199	111	35	0	0	91	2.2	15
1966	247	644	648	535	309	299	158	48	8	1	23	2.6	20
1967	178	561	685	523	386	294	189	58	7	3	36	2.8	23
1968	114	411	569	596	489	387	256	75	9	0	22	3.2	27
1969	174	469	619	610	418	351	195	52	4	2	26	3.0	23
1970	48	388	676	640	478	378	209	58	11	4	30	3.2	26
1971	13	316	768	684	448	367	215	81	8	0	20	3.3	26
1972	20	321	812	682	453	356	172	73	24	4	11	3.2	27
1973	55	213	603	586	484	459	326	171	17	0	6	3.7	35
1974	41	237	400	563	509	533	392	209	24	1	11	3.9	41
1975	81	364	621	603	432	425	260	111	19	3	1	3.4	30
1976	109	413	701	589	417	377	223	84	12	3	0	3.1	27
1977	131	460	757	547	396	337	189	91	10	2	0	3.0	25
1978	135	352	601	569	458	392	270	122	17	4	0	3.3	31
1979	87	270	644	680	492	441	227	70	9	0	0	3.3	27
1980	142	448	826	612	400	303	160	35	2	0	0	2.8	20
1981	33	301	573	663	585	440	241	67	15	2	0	3.4	29
1982	20	182	366	648	566	554	389	156	29	10	0	4.0	41
1983	10	150	494	595	596	585	330	137	17	6	0	3.9	37
1984	9	117	516	676	568	497	367	151	24	3	0	3.9	38
1985	2	231	806	695	454	386	237	85	23	1	0	3.4	29
1986	14	300	927	645	399	322	194	96	20	3	0	3.2	27
1987	17	371	931	687	385	314	143	55	5	1	11	3.0	22
1988	14	249	814	694	495	374	182	63	10	0	25	3.3	26
1989	3	122	601	711	520	475	346	111	19	4	8	3.8	35
1990	16	230	665	661	527	444	246	98	12	2	19	3.5	30
1991	10	186	531	620	505	497	375	134	37	5	20	3.8	38
1992	98	293	669	655	469	402	242	77	23	0	0	3.3	28
1993	92	372	712	598	437	361	234	95	19	0	0	3.2	28
1994	100	368	546	546	445	409	322	157	26	1	0	3.5	34
1995	200	547	638	493	389	339	212	82	12	1	7	2.9	25
1996	206	557	845	578	304	231	148	52	7	0	0	2.6	19
1997	398	659	737	482	265	214	124	33	8	0	0	2.3	17
1998	228	516	729	525	361	295	186	61	13	5	1	2.8	23
1999	163	440	687	583	397	355	213	71	7	0	4	3.0	24
2000	157	321	673	616	446	399	219	75	13	5	4	3.2	27
2001	182	479	747	591	408	275	165	59	9	5	0	2.8	22
2002	133	356	720	647	420	367	198	60	8	0	11	3.1	24
2003	43	197	406	588	530	519	414	186	30	7	0	4.0	41
2004	154	431	706	599	415	323	212	71	11	6	0	3.0	25
2005	218	463	676	557	366	305	232	75	20	8	0	3.0	26
2006	389	768	703	413	290	185	120	44	5	3	0	2.3	17
2007	469	722	724	454	240	158	112	40	1	0	0	2.1	15
2008	524	734	713	463	223	154	84	29	4	0	0	2.0	13
2009	836	1036	663	222	77	57	25	4	0	0	0	1.3	6
2010	576	856	763	341	184	100	75	23	2	0	0	1.8	11
2011	433	757	783	443	231	147	87	32	7	0	0	2.1	14

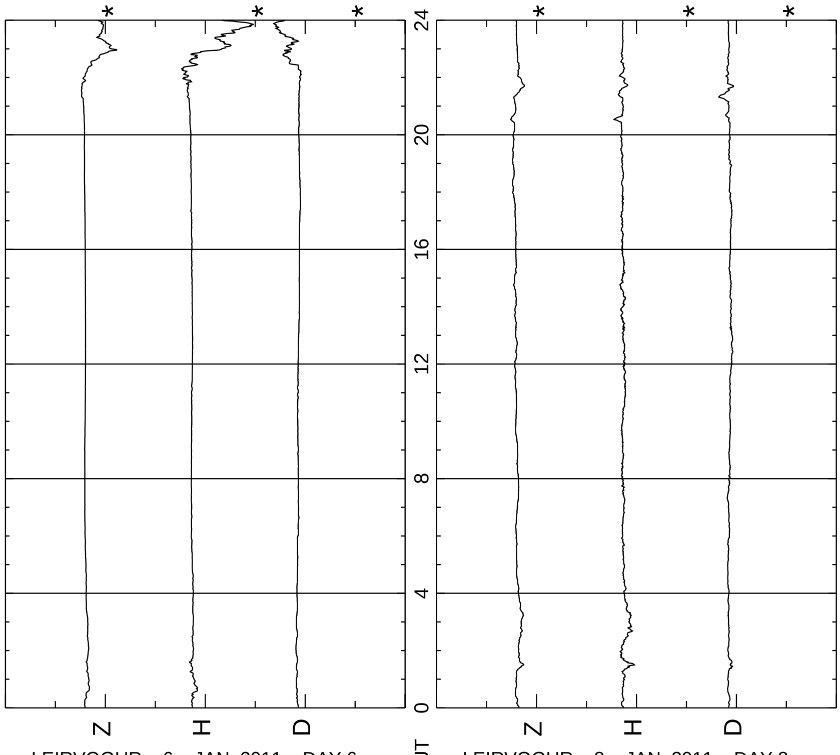
EXPLANATION OF DAILY GRAPHS

The graphs on pages 32–123 show the 1-minute means of the magnetic elements Z, H, and D at Leirvogur in 2011. Vertical divisions are spaced at intervals of 500 nT in Z and H and $2.^{\circ}31$ in D. The last figure is equivalent to 500 nT in the direction of magnetic east for average values of H at Leirvogur.

Levels marked with asterisk (*) are as follows:
Z: 50000 nT
H: 12000 nT
D: 344° E

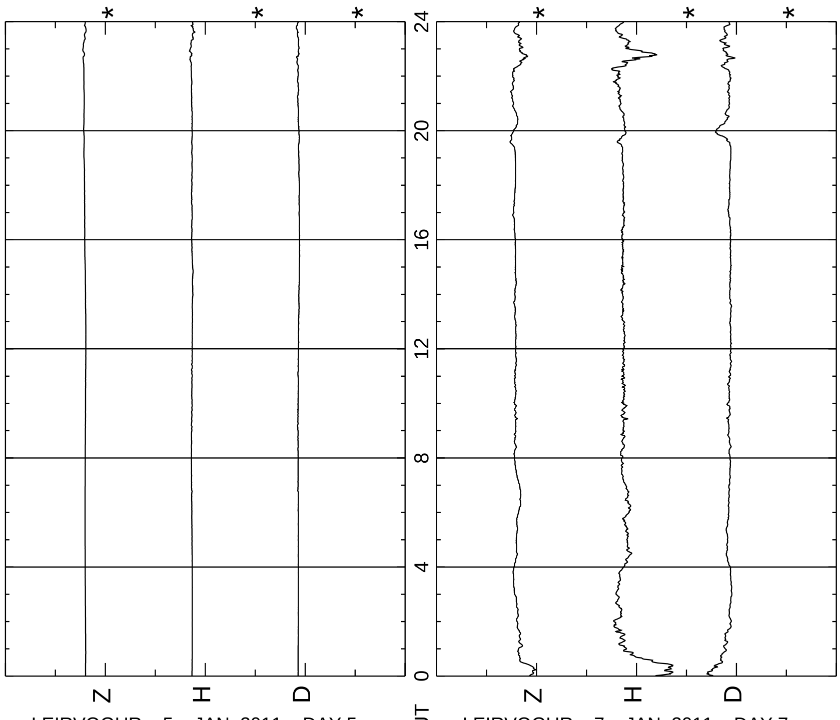
In several cases the H and D components had to be shifted upwards or downwards by one interval (500 nT) to disentangle the lines or prevent them from disappearing off scale.


LEIRVOGUR 2. JAN 2011 DAY 2
LEIRVOGUR 4. JAN 2011 DAY 4
LEIRVOGUR 1. JAN 2011 DAY 1
LEIRVOGUR 3. JAN 2011 DAY 3
Z H D
UT
0 4 8 12 16 20 24



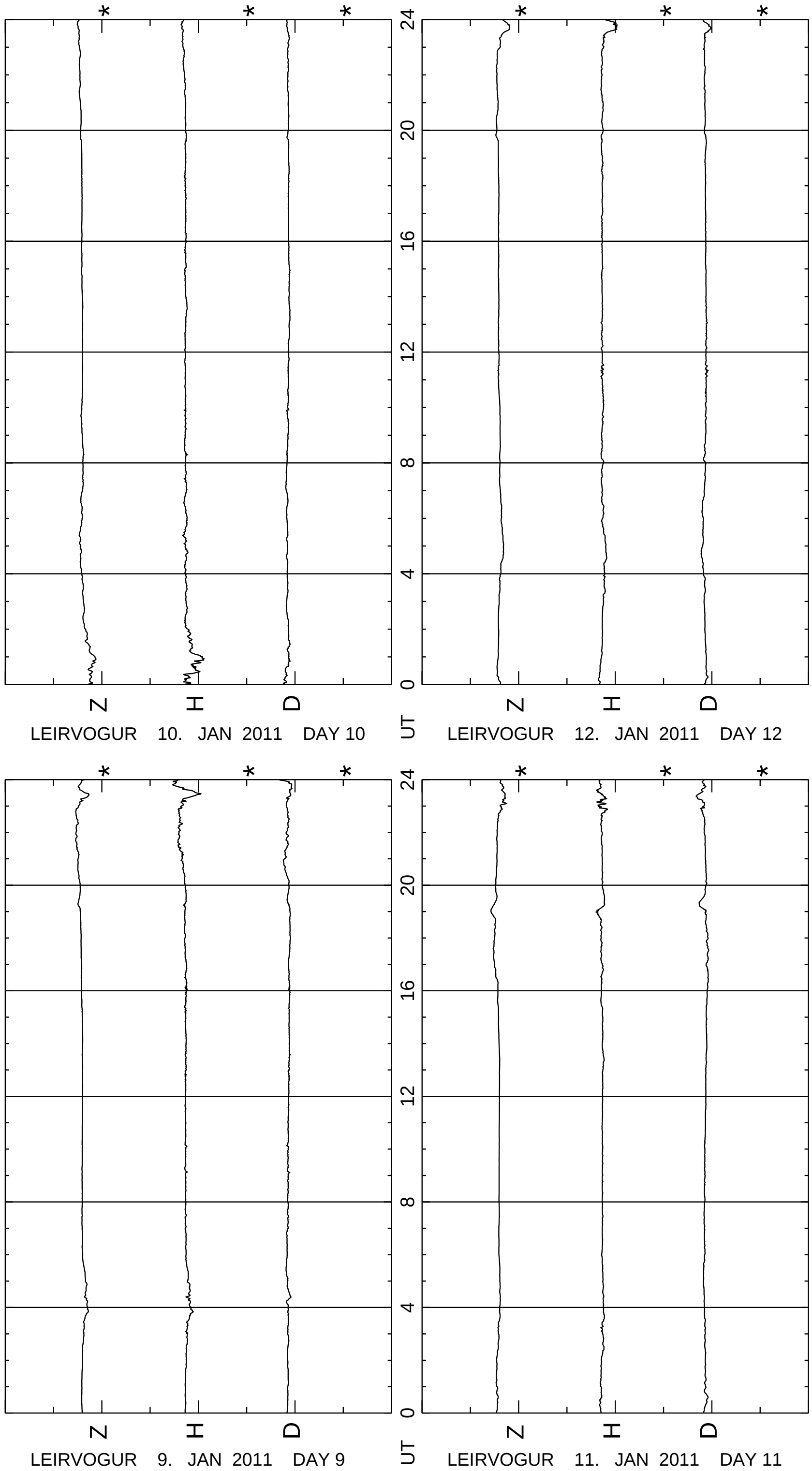
LEIRVOGUR 6. JAN 2011 DAY 6

LEIRVOGUR 8. JAN 2011 DAY 8



LEIRVOGUR 5. JAN 2011 DAY 5

LEIRVOGUR 7. JAN 2011 DAY 7


LEIRVOGUR 10. JAN 2011 DAY 10
LEIRVOGUR 12. JAN 2011 DAY 12
LEIRVOGUR 9. JAN 2011 DAY 9
LEIRVOGUR 11. JAN 2011 DAY 11
Z
H
D
UT
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16
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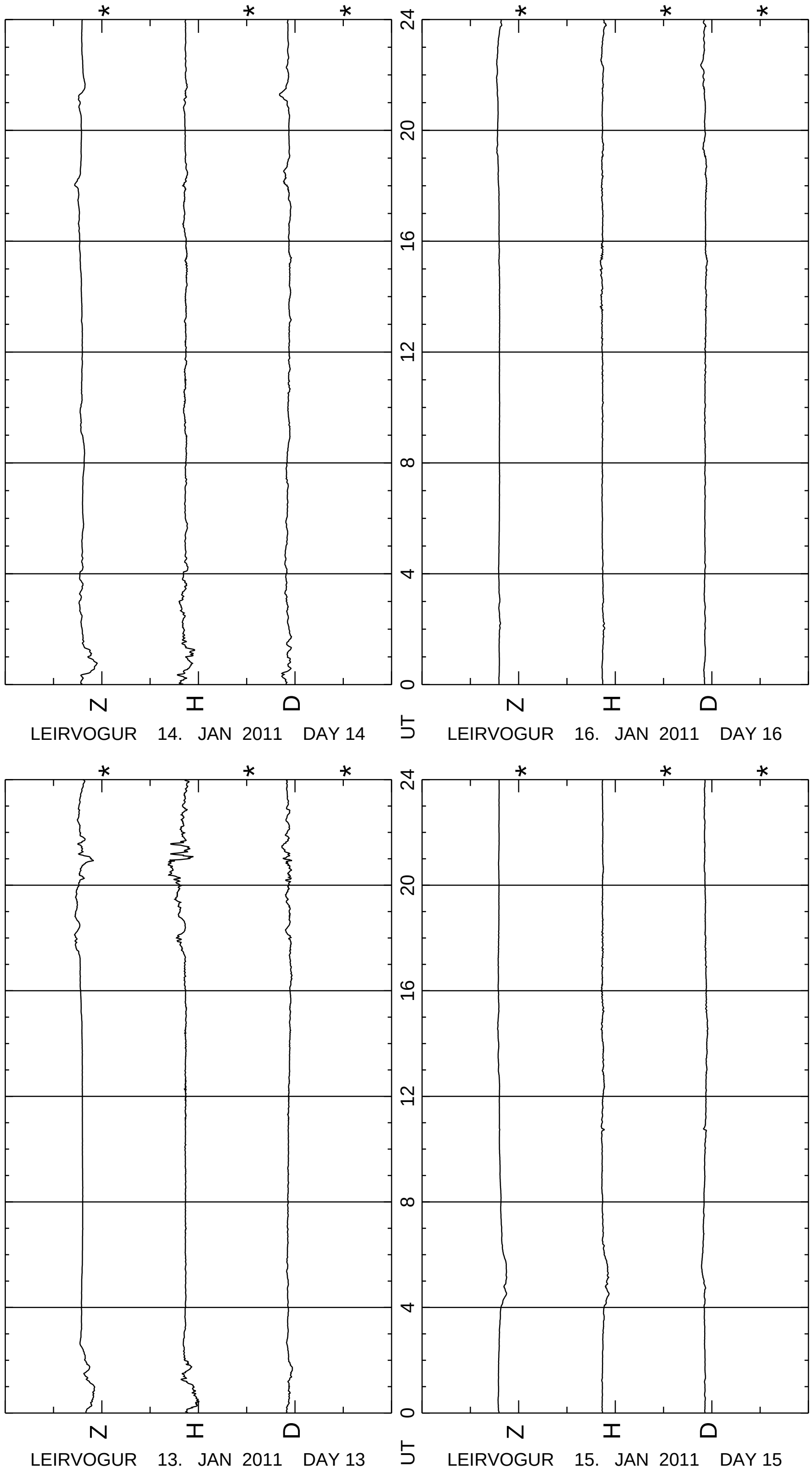
24


LEIRVOGUR 14. JAN 2011 DAY 14
LEIRVOGUR 16. JAN 2011 DAY 16
LEIRVOGUR 13. JAN 2011 DAY 13
LEIRVOGUR 15. JAN 2011 DAY 15
Z
H
D
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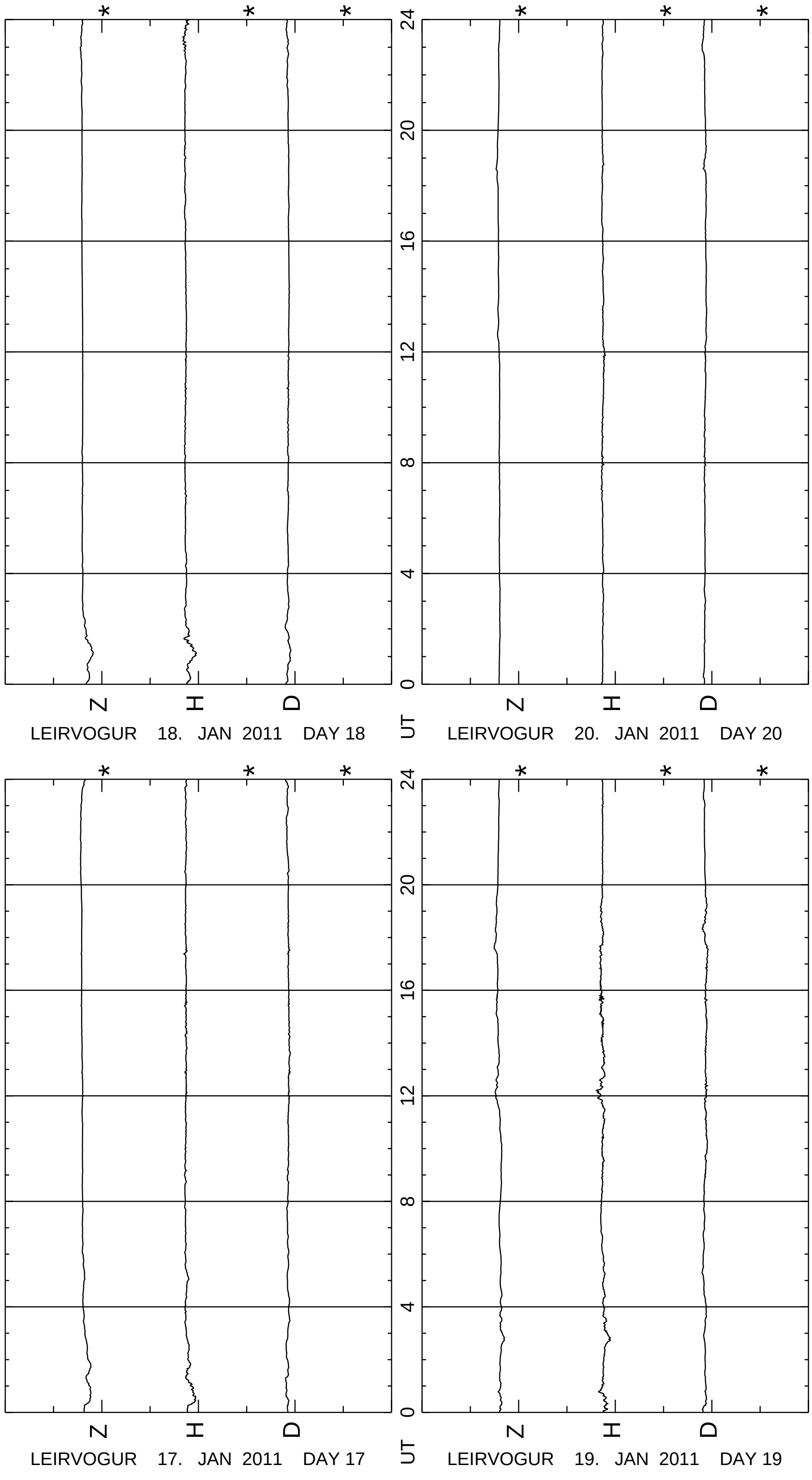
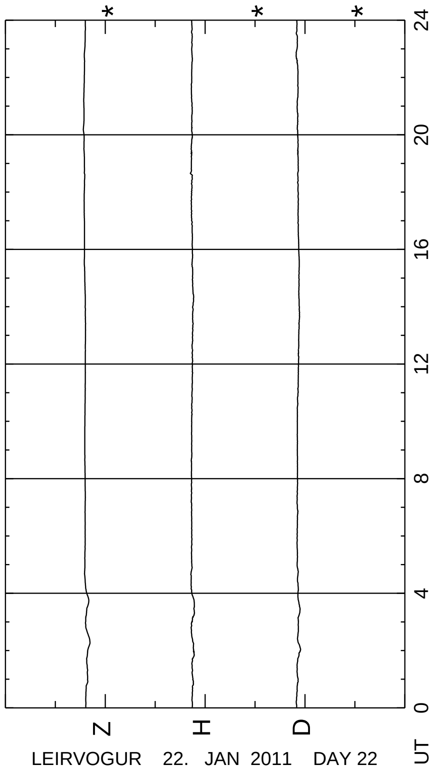
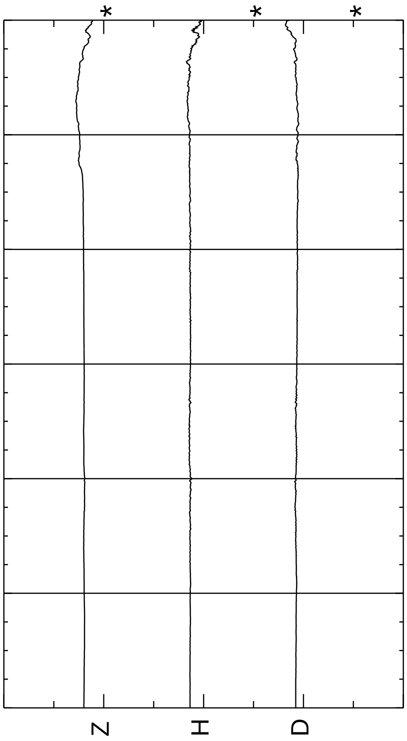
24

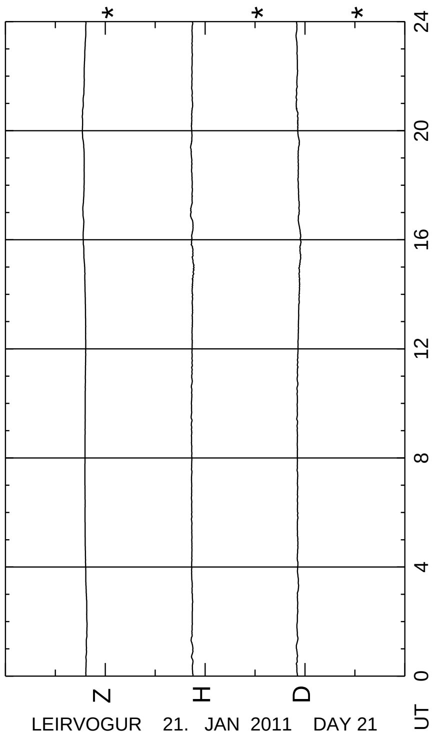

LEIRVOGUR 18. JAN 2011 DAY 18
LEIRVOGUR 20. JAN 2011 DAY 20
LEIRVOGUR 17. JAN 2011 DAY 17
LEIRVOGUR 19. JAN 2011 DAY 19
Z H D
UT
0 4 8 12 16 20 24



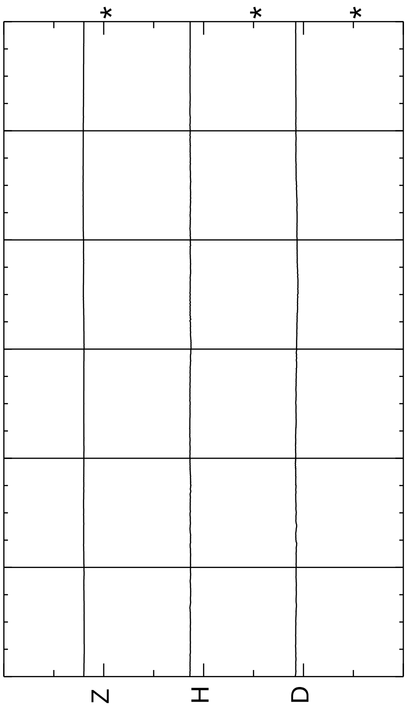
LEIRVOGUR 22. JAN 2011 DAY 22



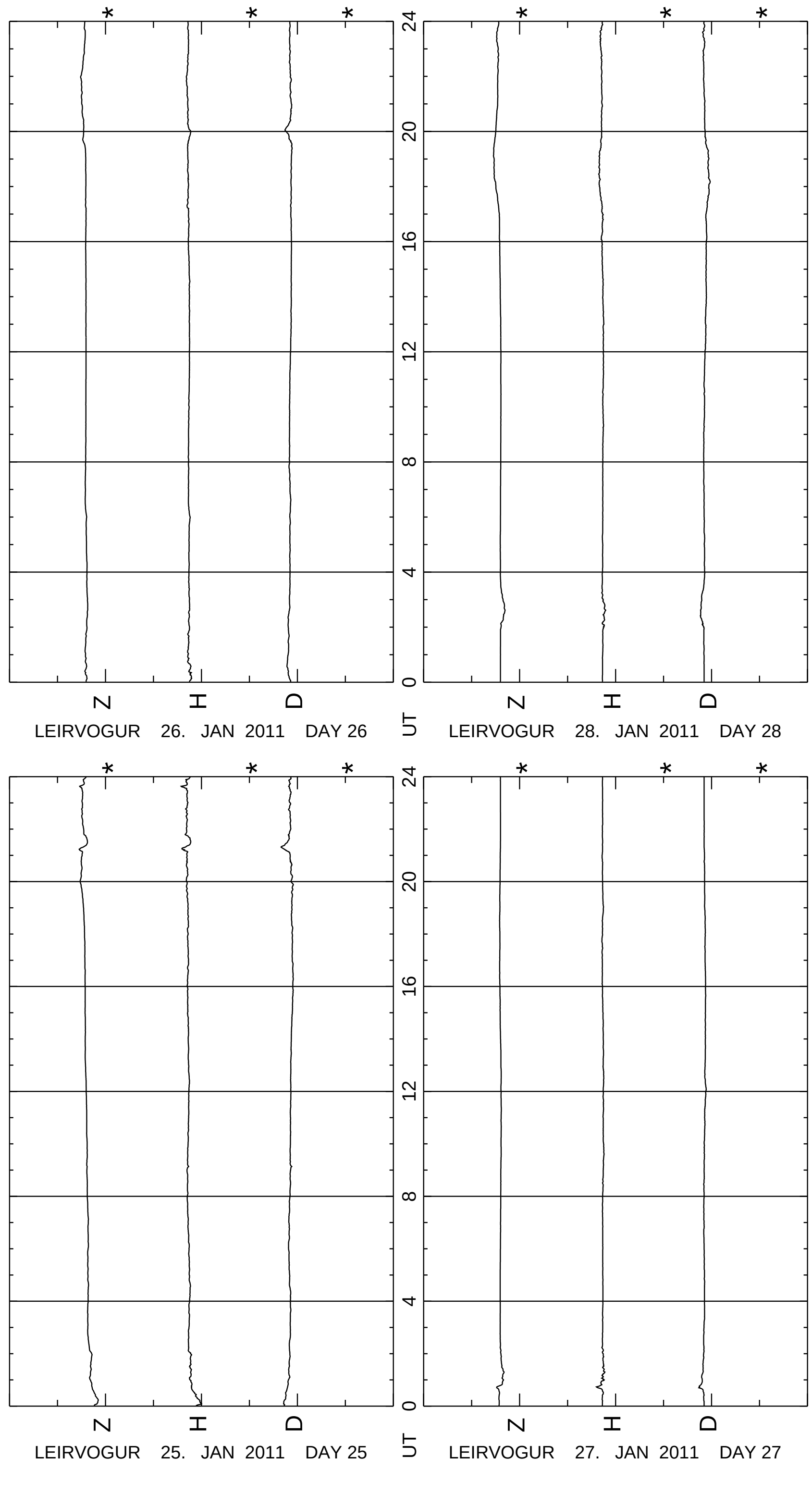
LEIRVOGUR 24. JAN 2011 DAY 24



LEIRVOGUR 21. JAN 2011 DAY 21



LEIRVOGUR 23. JAN 2011 DAY 23


LEIRVOGUR 26. JAN 2011 DAY 26
LEIRVOGUR 28. JAN 2011 DAY 28
LEIRVOGUR 25. JAN 2011 DAY 25
LEIRVOGUR 27. JAN 2011 DAY 27
Z
H
D
UT
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4
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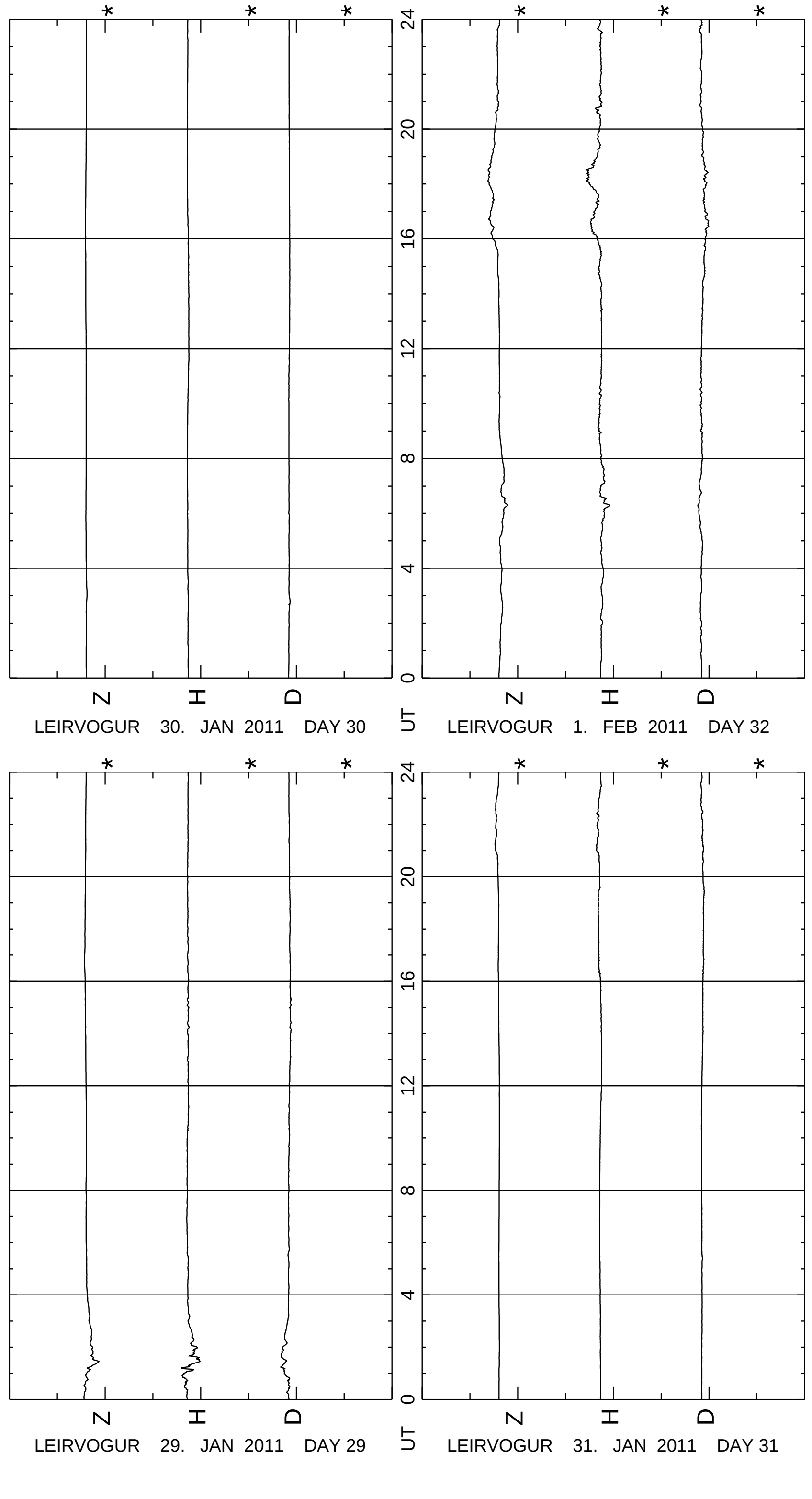
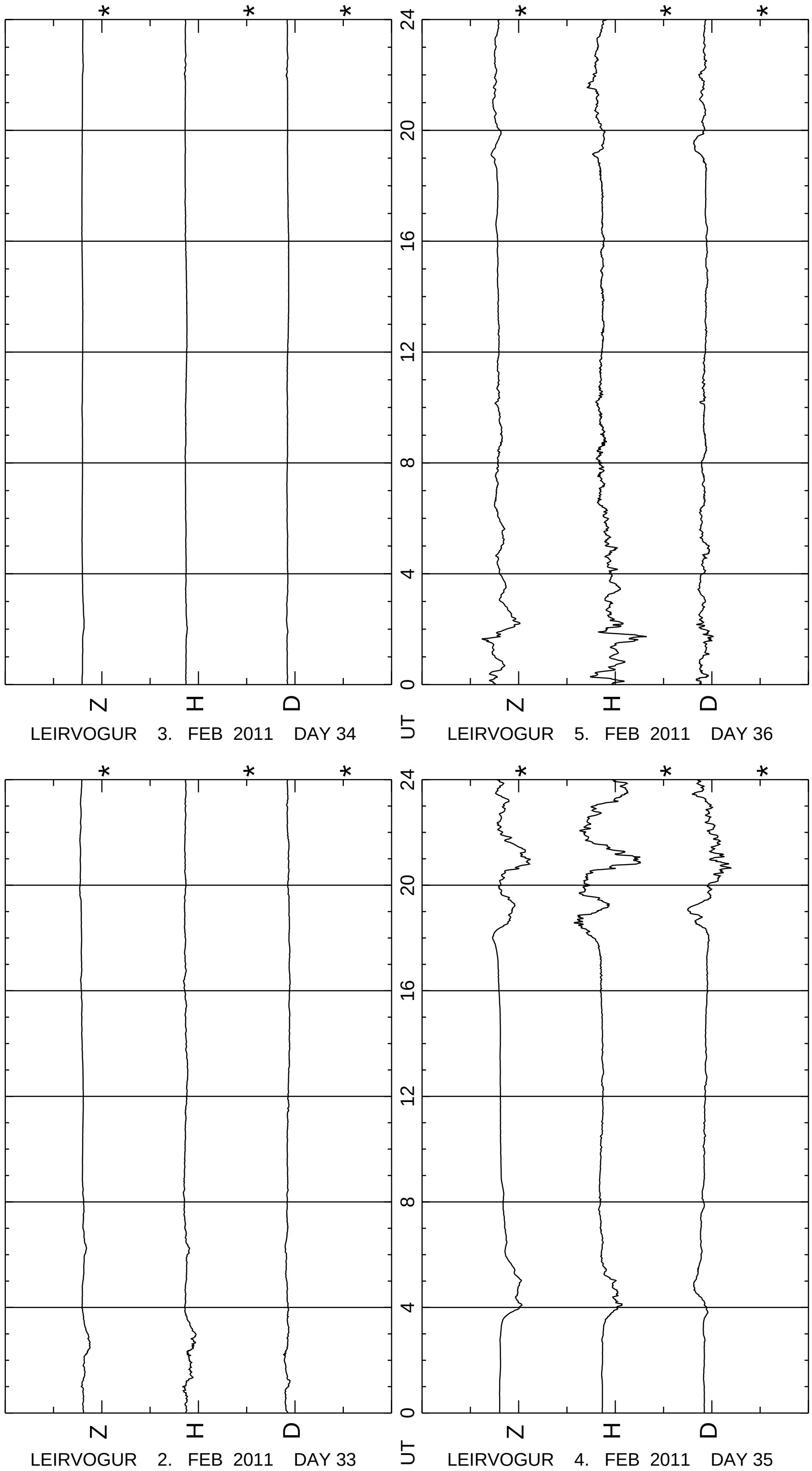
24


LEIRVOGUR 30. JAN 2011 DAY 30
LEIRVOGUR 1. FEB 2011 DAY 32
LEIRVOGUR 29. JAN 2011 DAY 29
LEIRVOGUR 31. JAN 2011 DAY 31
Z H D
UT
0 4 8 12 16 20 24


LEIRVOGUR 3. FEB 2011 DAY 34
LEIRVOGUR 5. FEB 2011 DAY 36
LEIRVOGUR 2. FEB 2011 DAY 33
LEIRVOGUR 4. FEB 2011 DAY 35
Z
H
D
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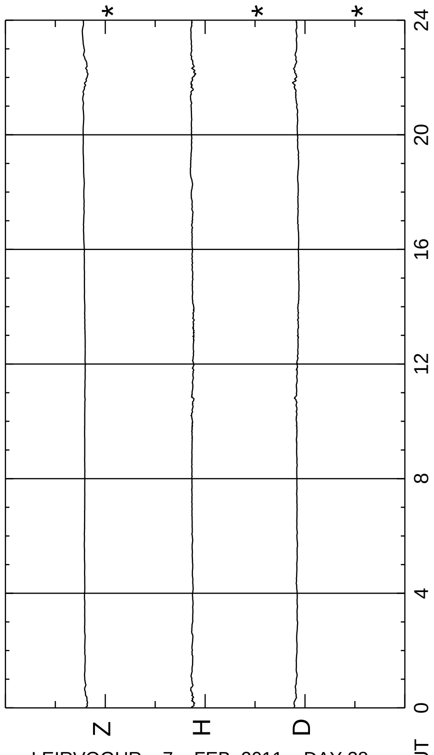
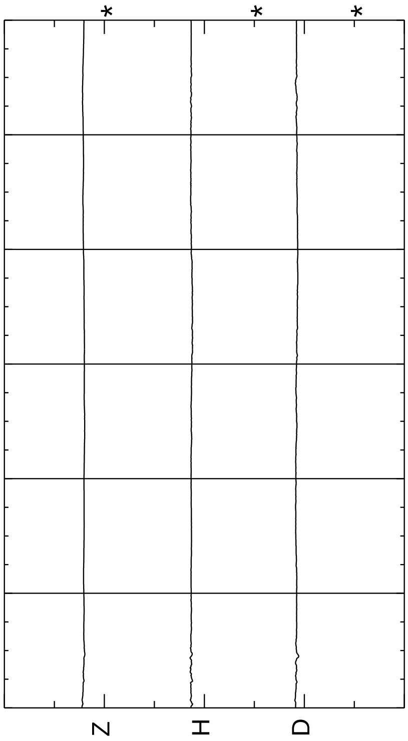
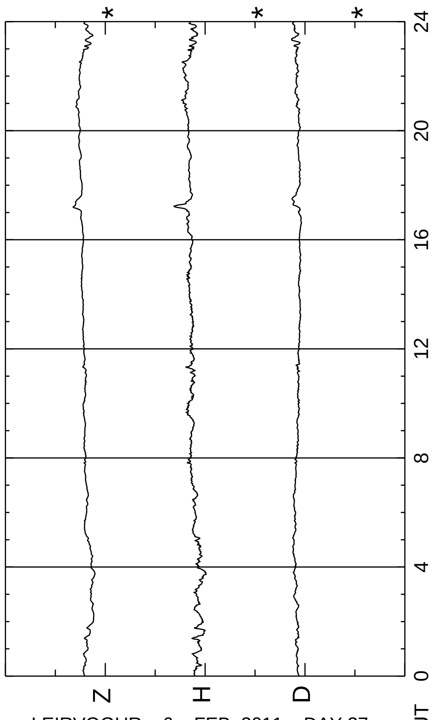
4
8
12
16
20
24



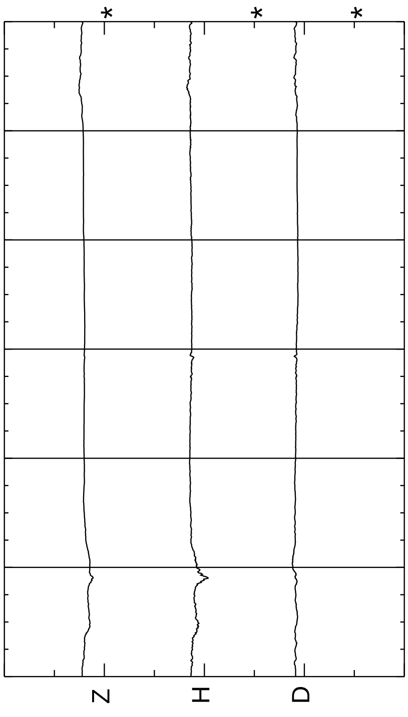
LEIRVOGUR 7. FEB 2011 DAY 38



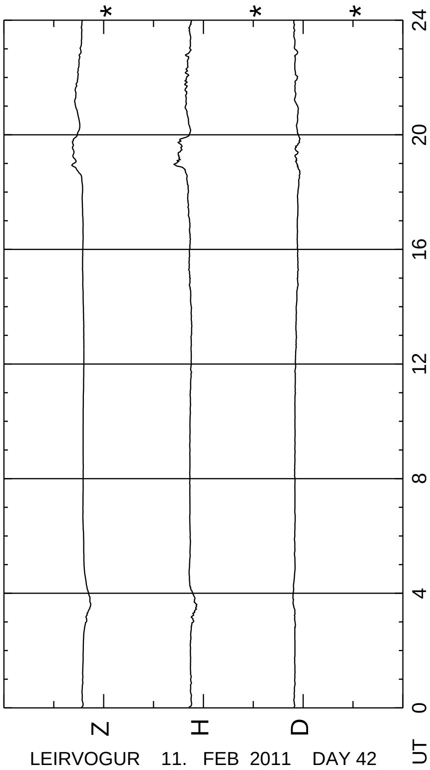
LEIRVOGUR 9. FEB 2011 DAY 40



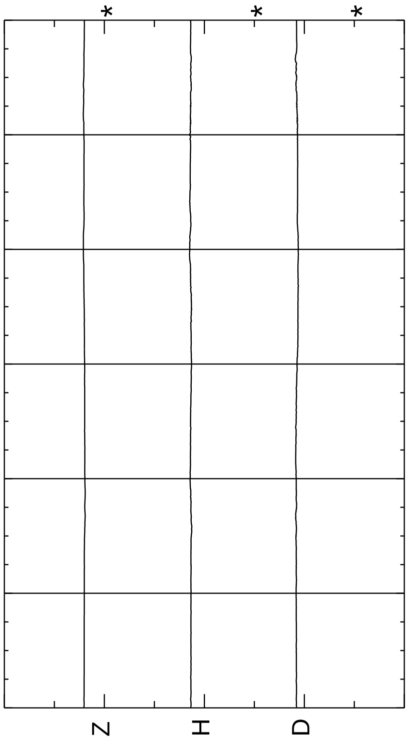
LEIRVOGUR 6. FEB 2011 DAY 37



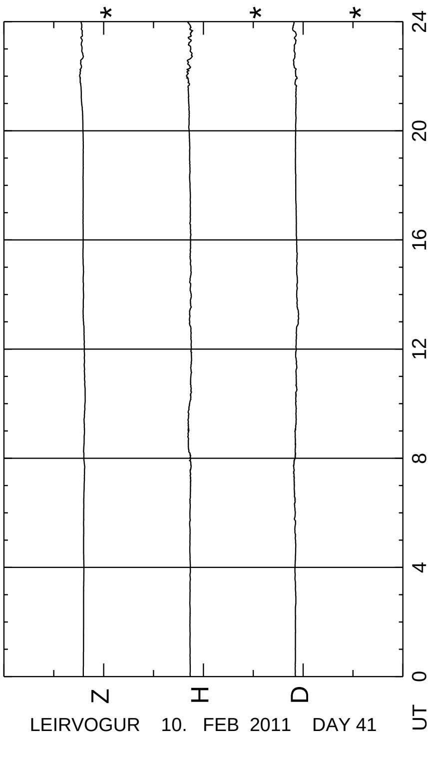
LEIRVOGUR 8. FEB 2011 DAY 39



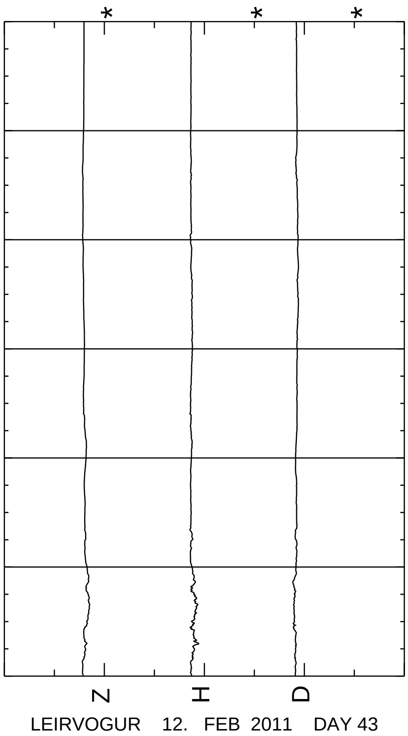
LEIRVOGUR 11. FEB 2011 DAY 42



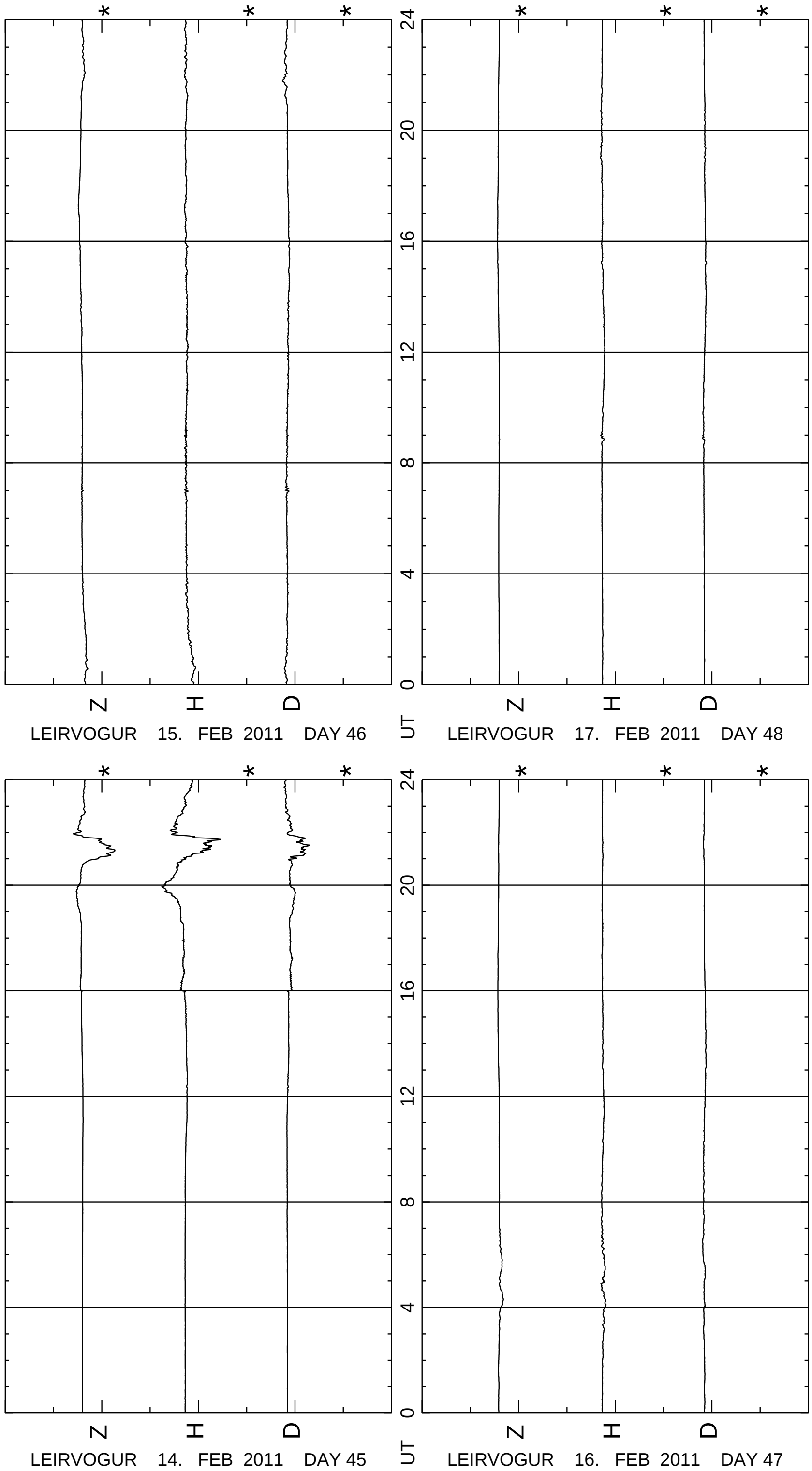
LEIRVOGUR 13. FEB 2011 DAY 44



LEIRVOGUR 10. FEB 2011 DAY 41



LEIRVOGUR 12. FEB 2011 DAY 43


LEIRVOGUR 15. FEB 2011 DAY 46
LEIRVOGUR 17. FEB 2011 DAY 48
LEIRVOGUR 14. FEB 2011 DAY 45
LEIRVOGUR 16. FEB 2011 DAY 47
Z
H
D
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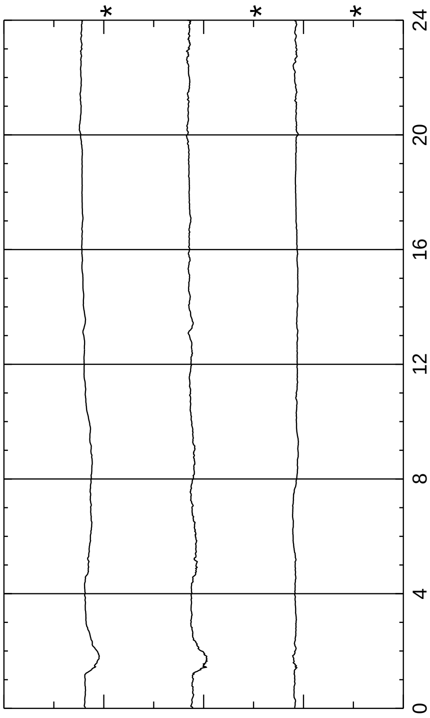
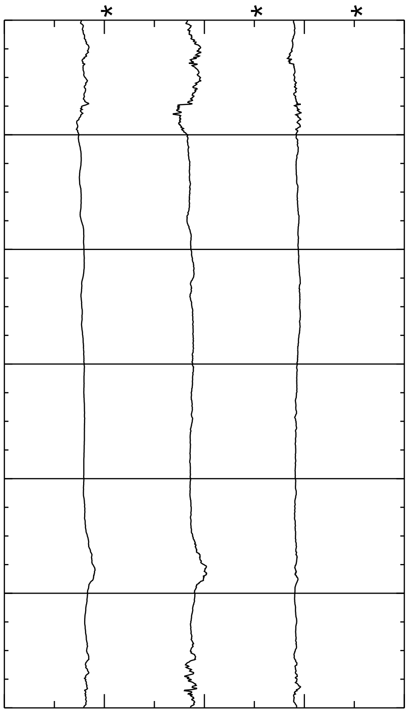


Z H D

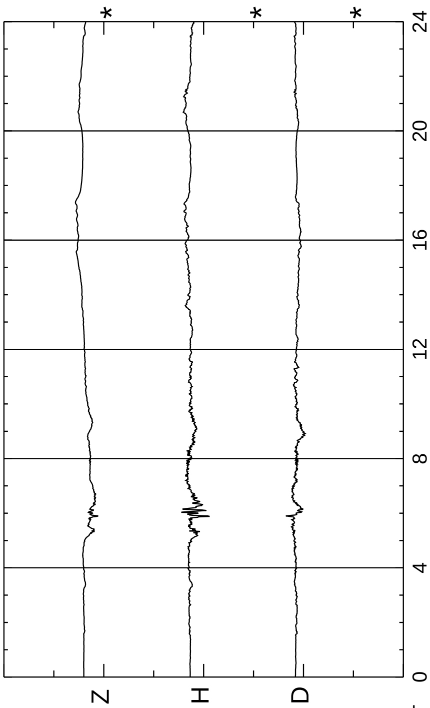
LEIRVOGUR 19. FEB 2011 DAY 50



UT

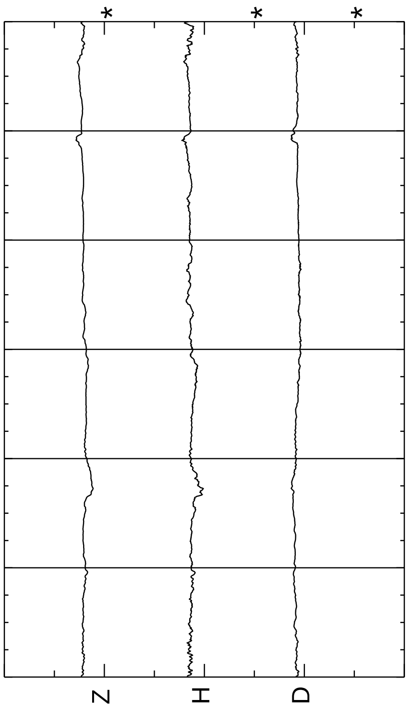
Z H D

LEIRVOGUR 21. FEB 2011 DAY 52



Z H D

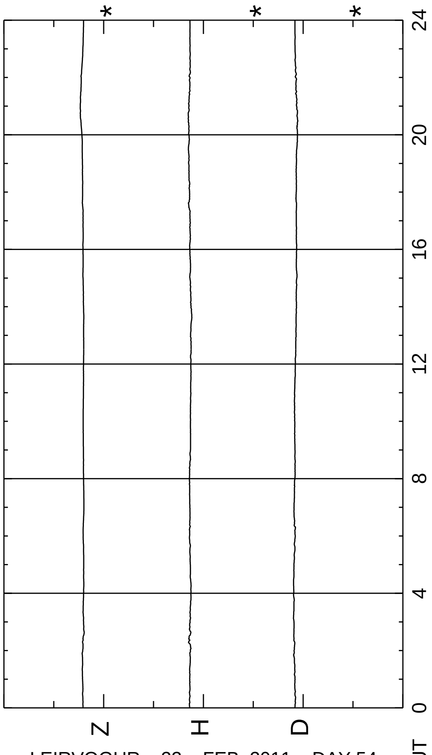
LEIRVOGUR 18. FEB 2011 DAY 49



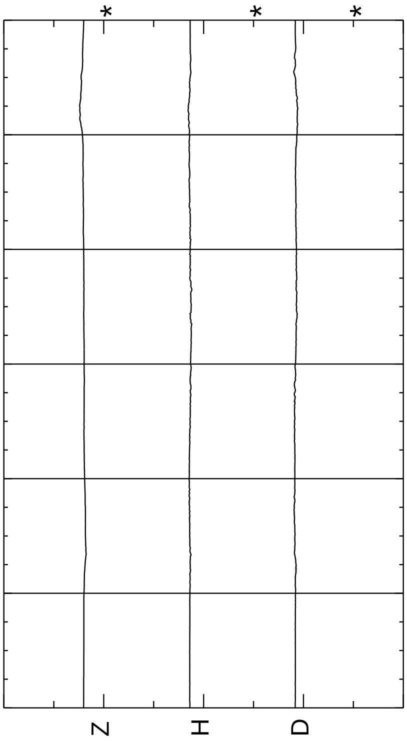
UT

Z H D

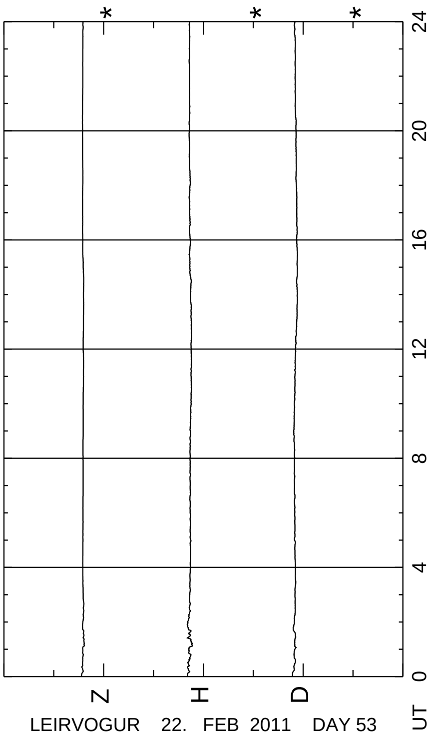
LEIRVOGUR 20. FEB 2011 DAY 51



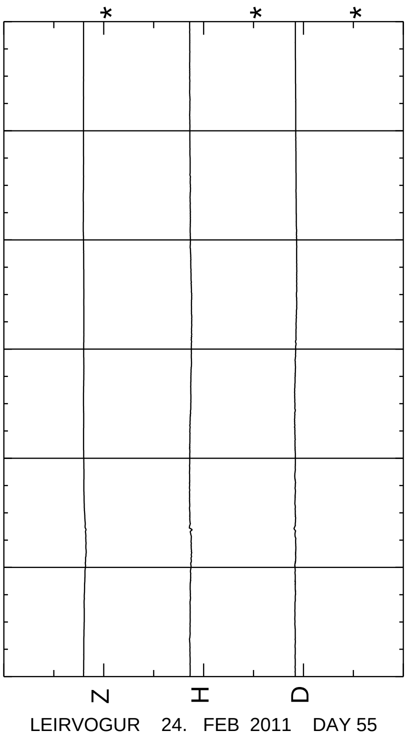
LEIRVOGUR 23. FEB 2011 DAY 54



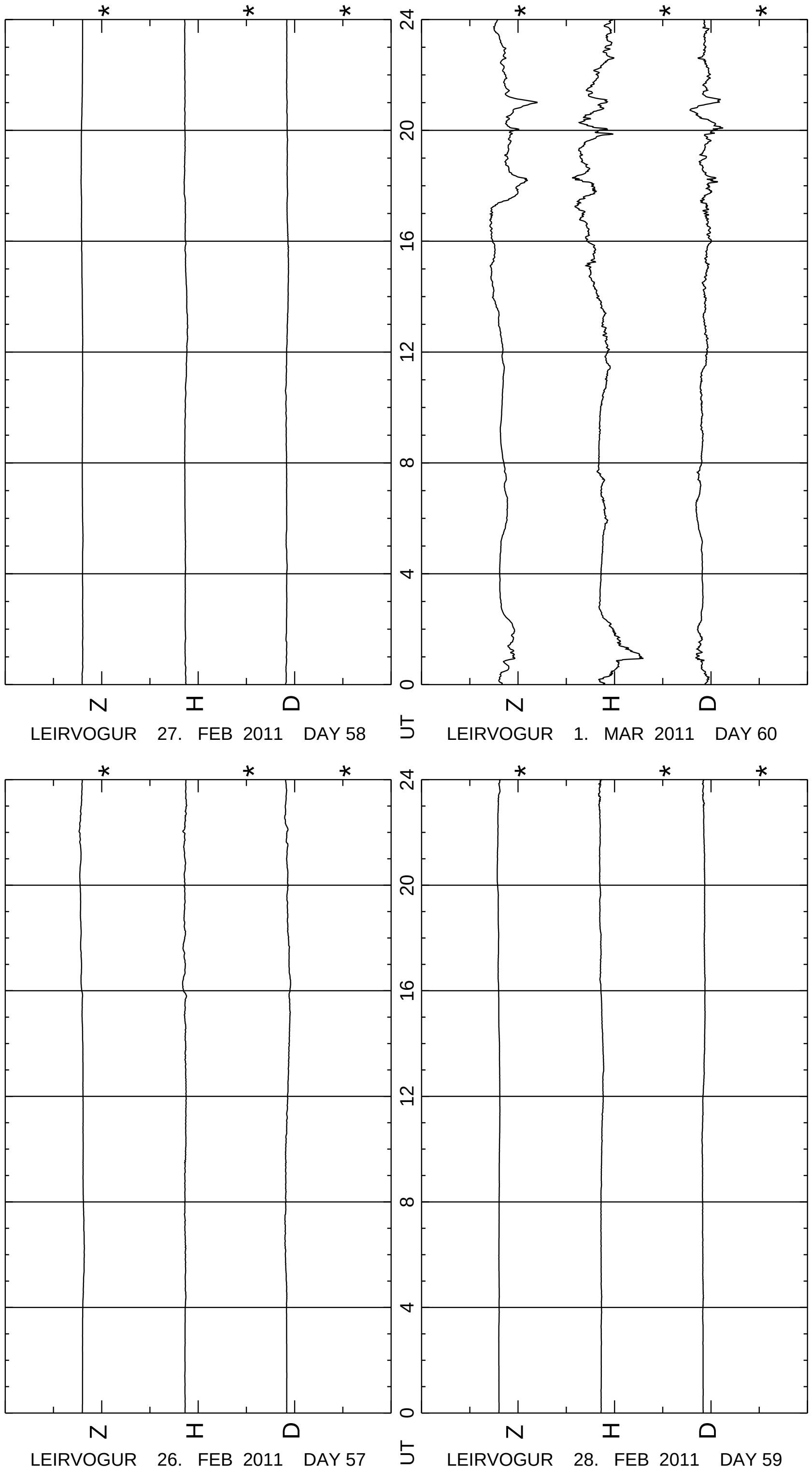
LEIRVOGUR 25. FEB 2011 DAY 56



LEIRVOGUR 22. FEB 2011 DAY 53



LEIRVOGUR 24. FEB 2011 DAY 55


LEIRVOGUR 27. FEB 2011 DAY 58
LEIRVOGUR 1. MAR 2011 DAY 60
LEIRVOGUR 26. FEB 2011 DAY 57
LEIRVOGUR 28. FEB 2011 DAY 59
Z
H
D
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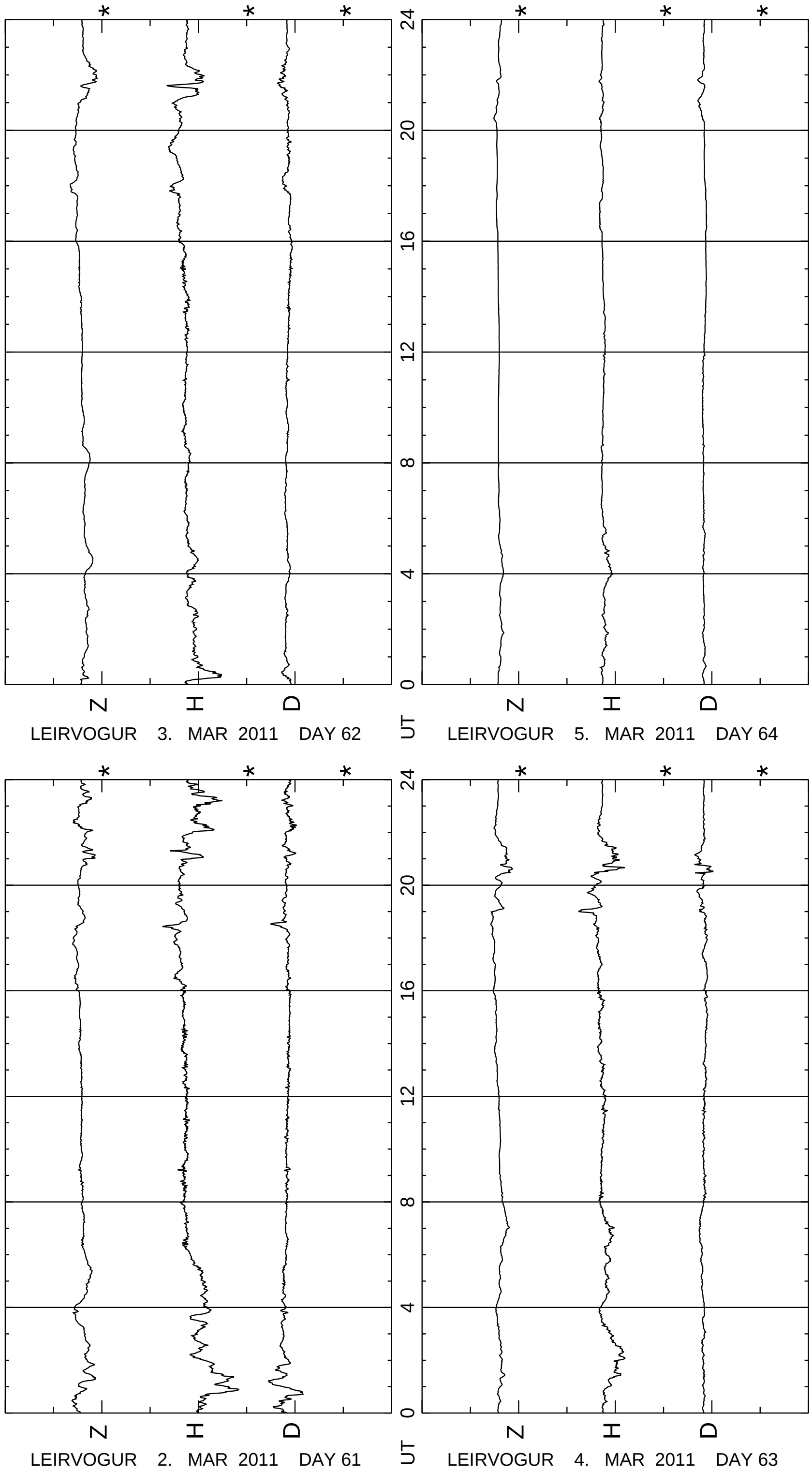
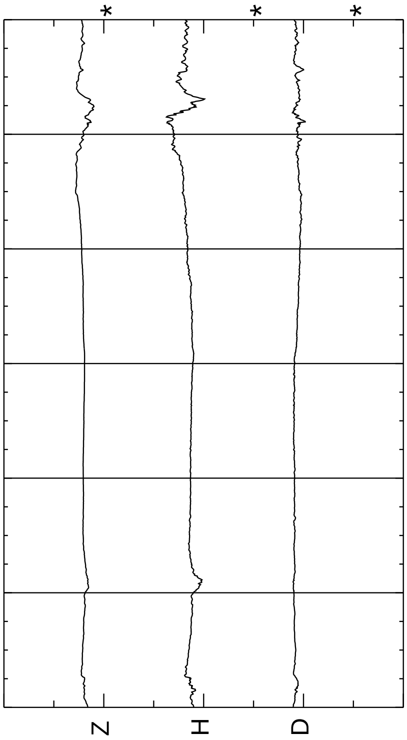
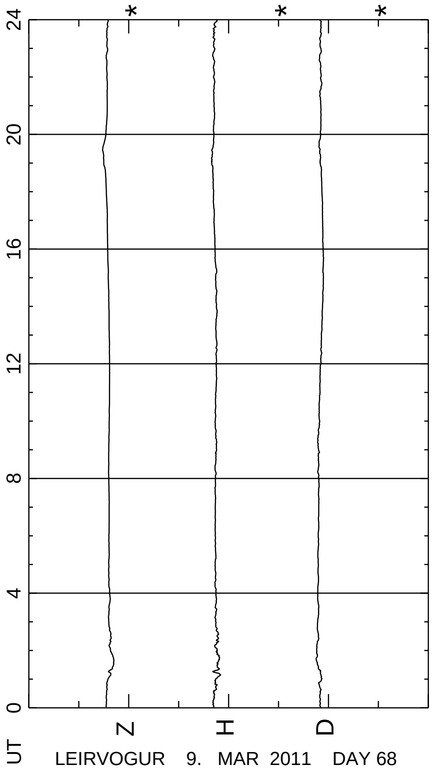
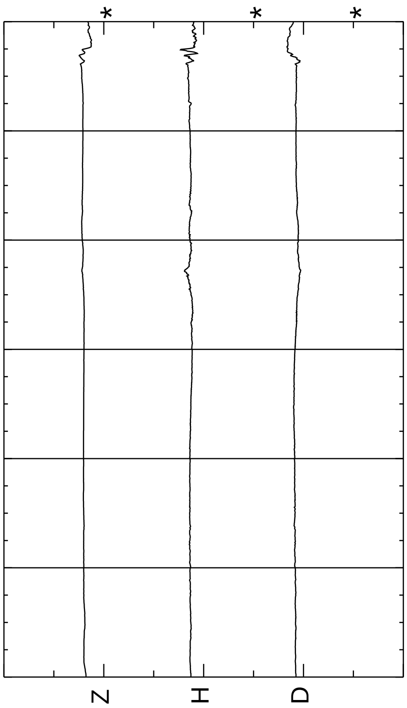

LEIRVOGUR 3. MAR 2011 DAY 62
LEIRVOGUR 5. MAR 2011 DAY 64
LEIRVOGUR 2. MAR 2011 DAY 61
LEIRVOGUR 4. MAR 2011 DAY 63
UT
Z
H
D



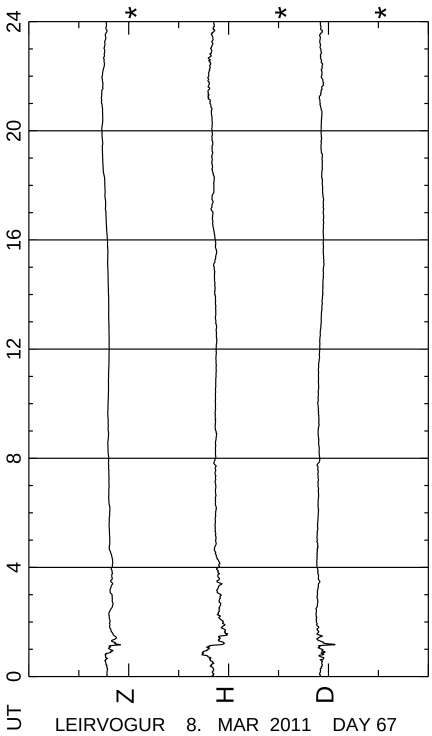
LEIRVOGUR 7. MAR 2011 DAY 66



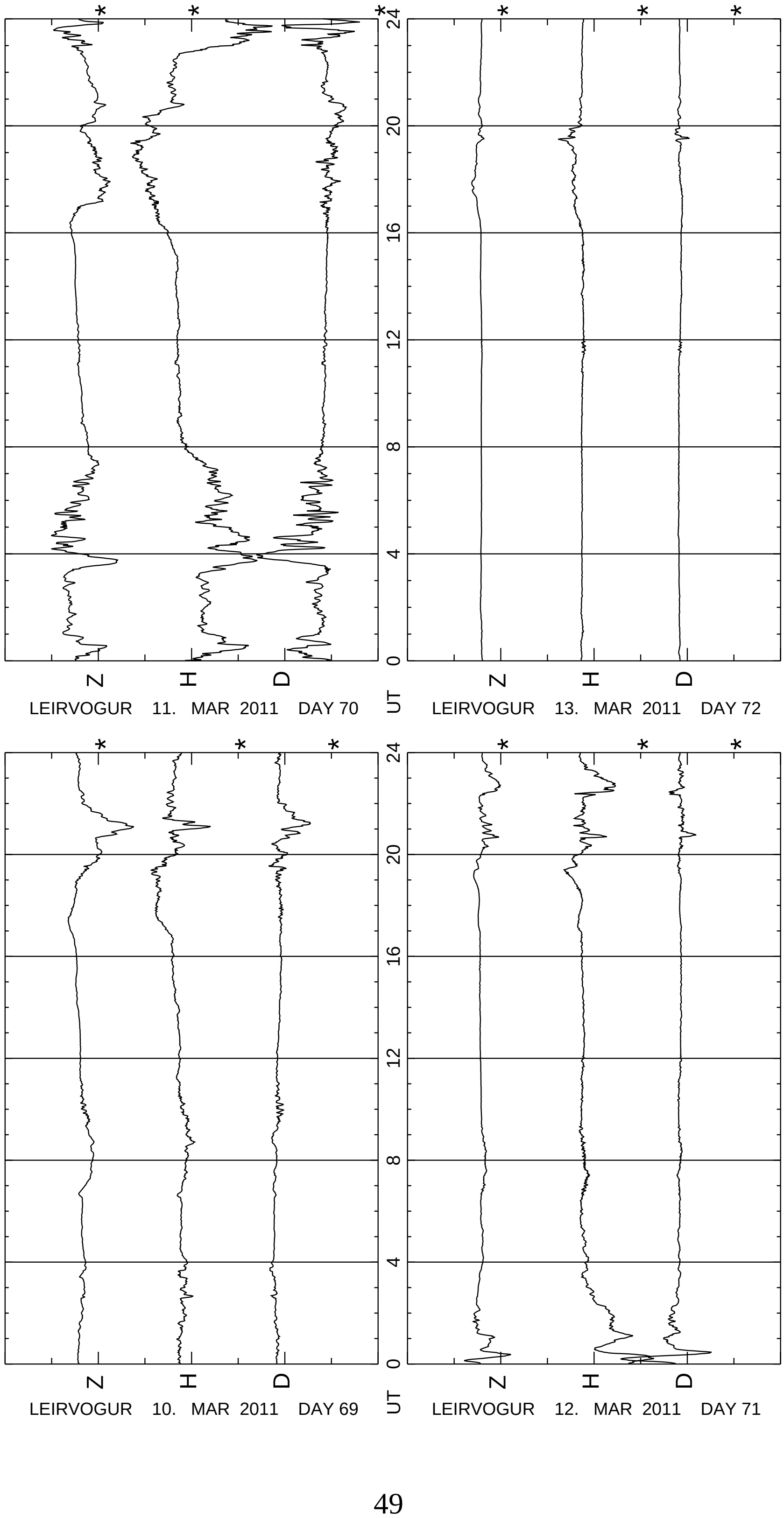
LEIRVOGUR 9. MAR 2011 DAY 68



LEIRVOGUR 6. MAR 2011 DAY 65



LEIRVOGUR 8. MAR 2011 DAY 67


LEIRVOGUR 11. MAR 2011 DAY 70
LEIRVOGUR 13. MAR 2011 DAY 72
LEIRVOGUR 10. MAR 2011 DAY 69
LEIRVOGUR 12. MAR 2011 DAY 71
Z
H
D
UT
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4
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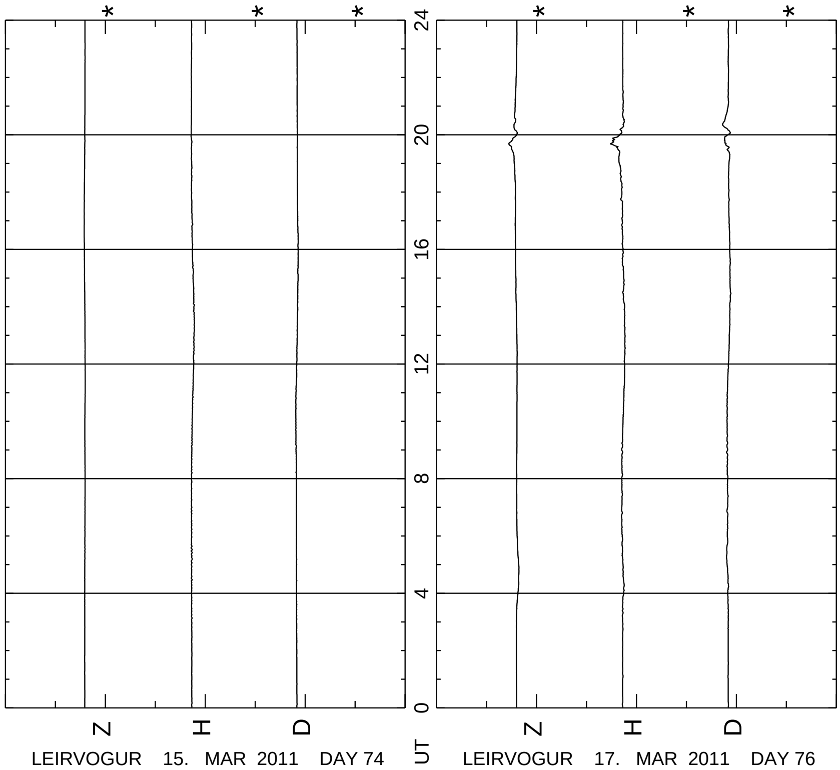
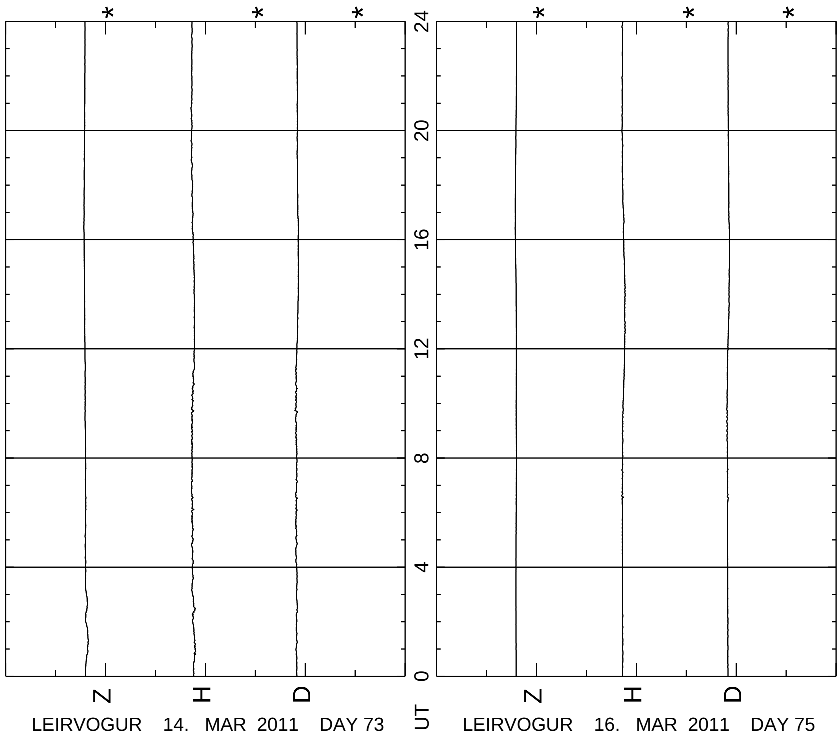
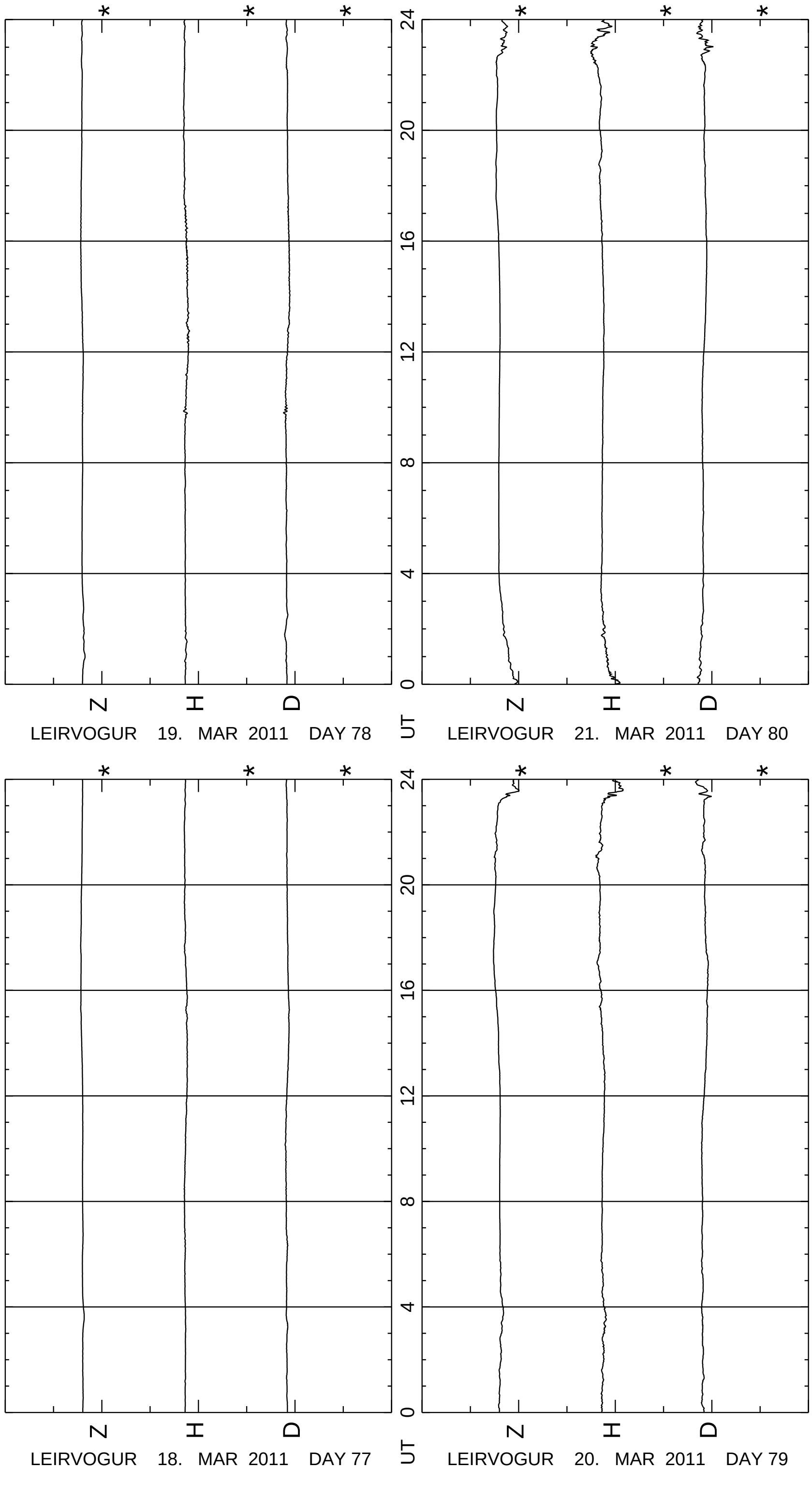
24

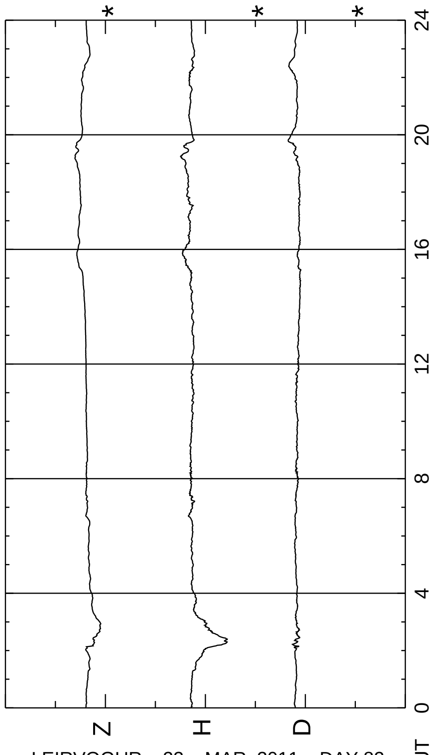


LEIRVOGUR 15. MAR 2011 DAY 74 LEIRVOGUR 17. MAR 2011 DAY 76

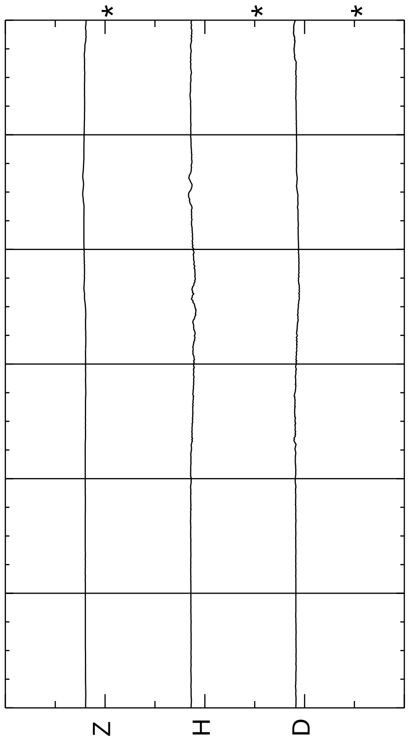


LEIRVOGUR 14. MAR 2011 DAY 73 LEIRVOGUR 16. MAR 2011 DAY 75

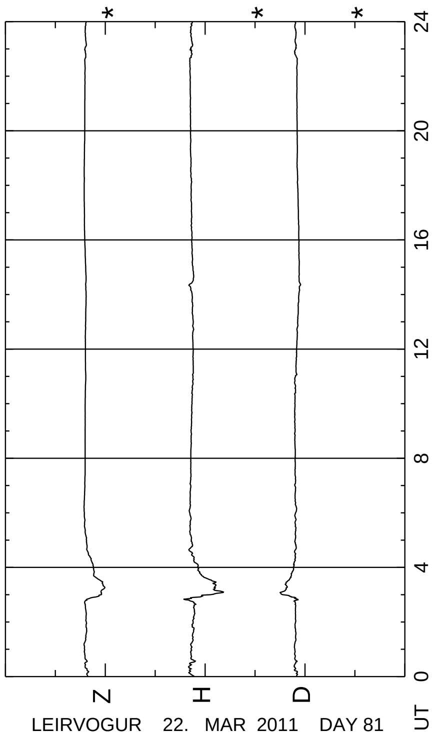

Z
H
D
UT
LEIRVOGUR 19. MAR 2011 DAY 78
LEIRVOGUR 21. MAR 2011 DAY 80
LEIRVOGUR 18. MAR 2011 DAY 77
LEIRVOGUR 20. MAR 2011 DAY 79



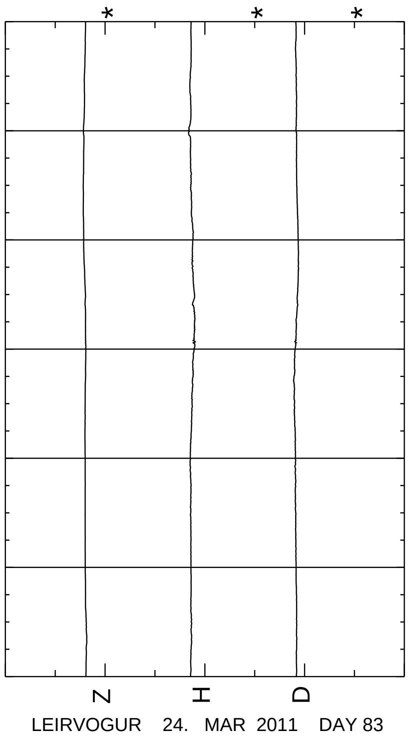
LEIRVOGUR 23. MAR 2011 DAY 82



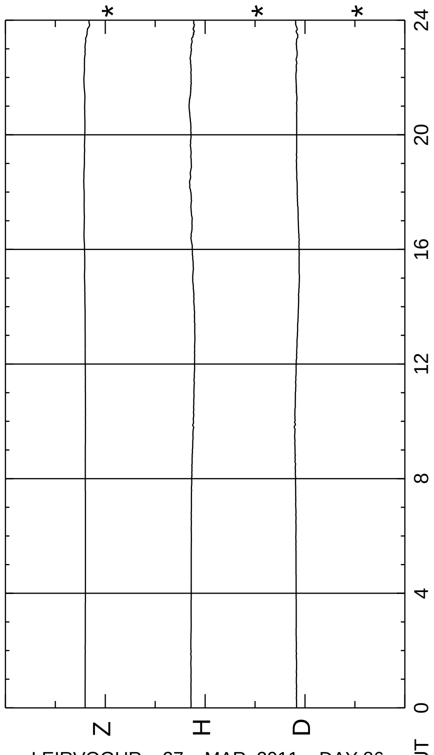
LEIRVOGUR 25. MAR 2011 DAY 84

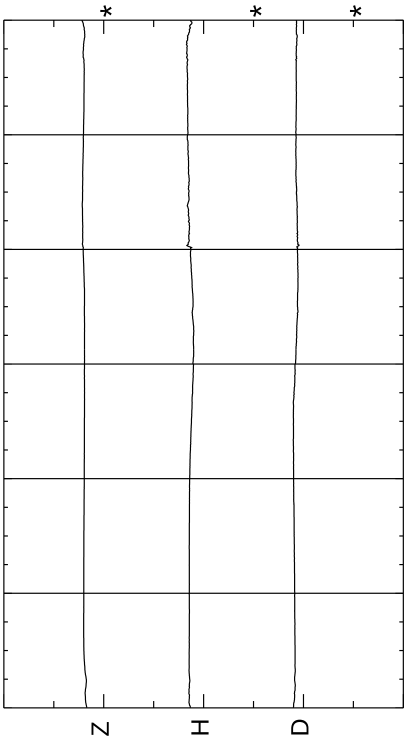


LEIRVOGUR 22. MAR 2011 DAY 81



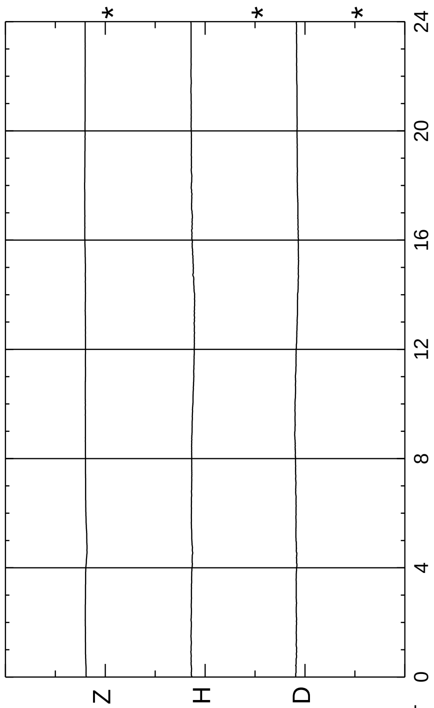
LEIRVOGUR 24. MAR 2011 DAY 83

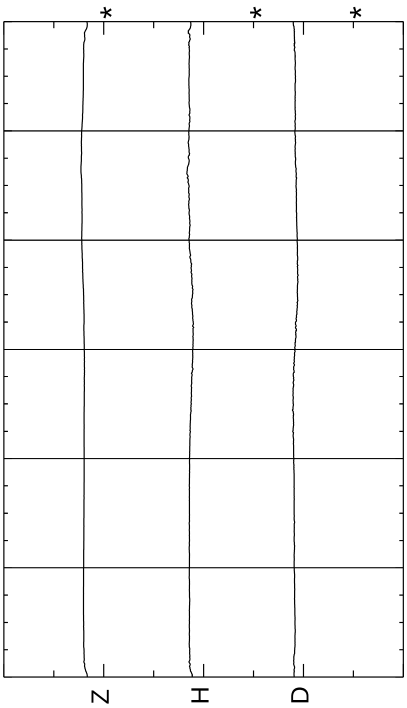




LEIRVOGUR 27. MAR 2011 DAY 86

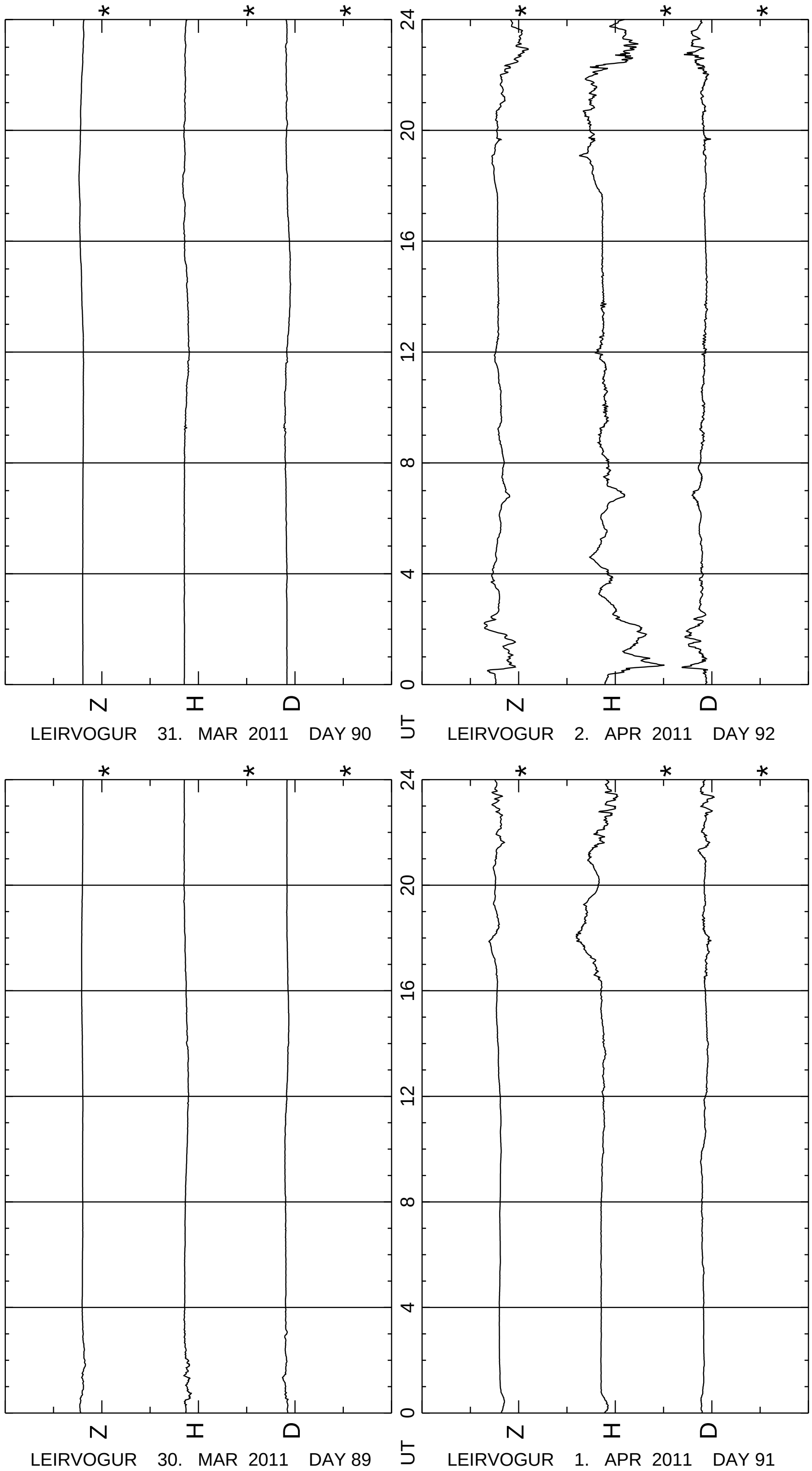
LEIRVOGUR 29. MAR 2011 DAY 88





LEIRVOGUR 26. MAR 2011 DAY 85

LEIRVOGUR 28. MAR 2011 DAY 87


LEIRVOGUR 31. MAR 2011 DAY 90
LEIRVOGUR 2. APR 2011 DAY 92
LEIRVOGUR 30. MAR 2011 DAY 89
LEIRVOGUR 1. APR 2011 DAY 91
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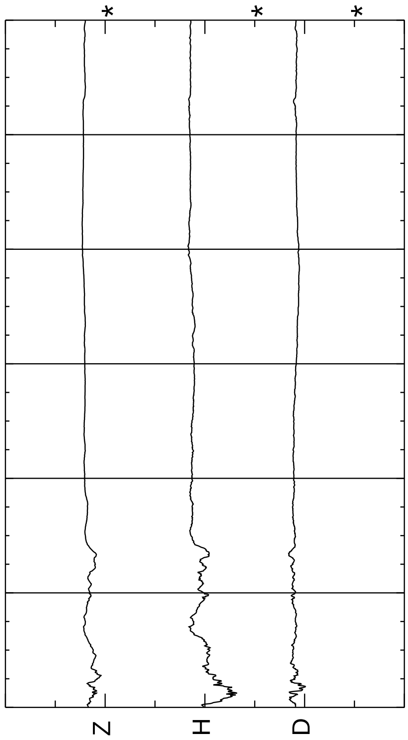
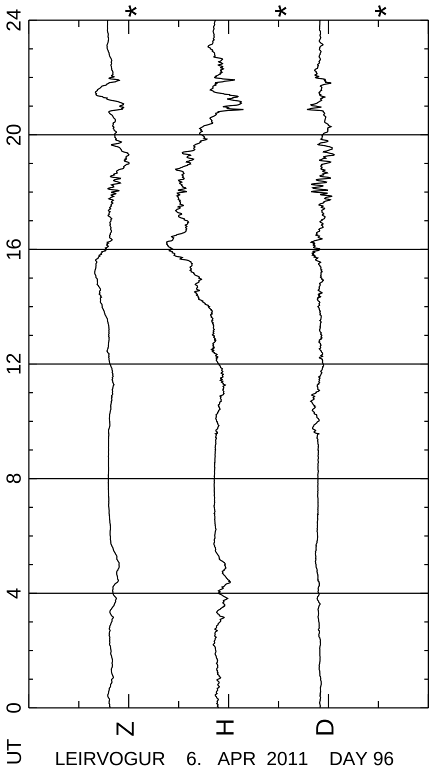


LEIRVOGUR 4. APR 2011 DAY 94



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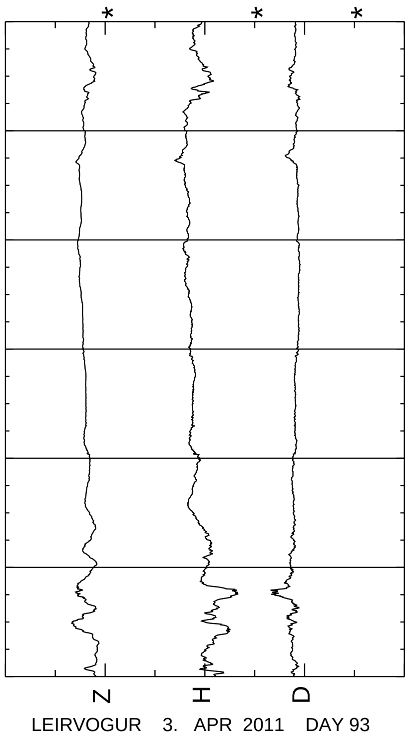
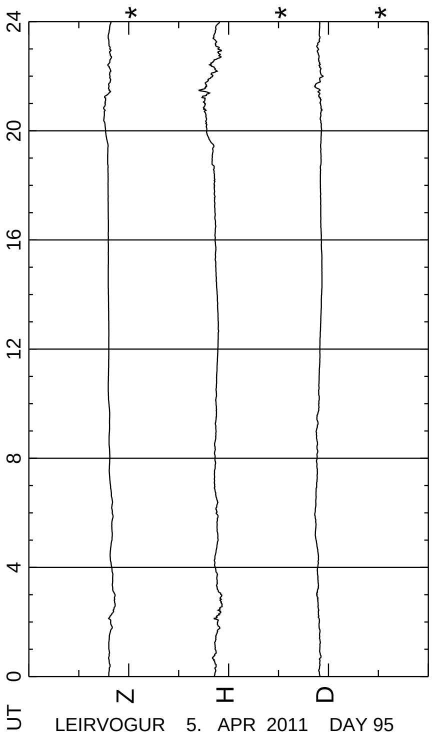


LEIRVOGUR 3. APR 2011 DAY 93



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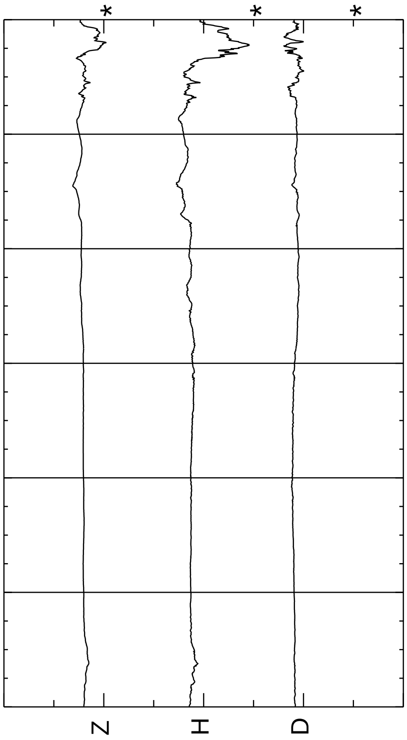

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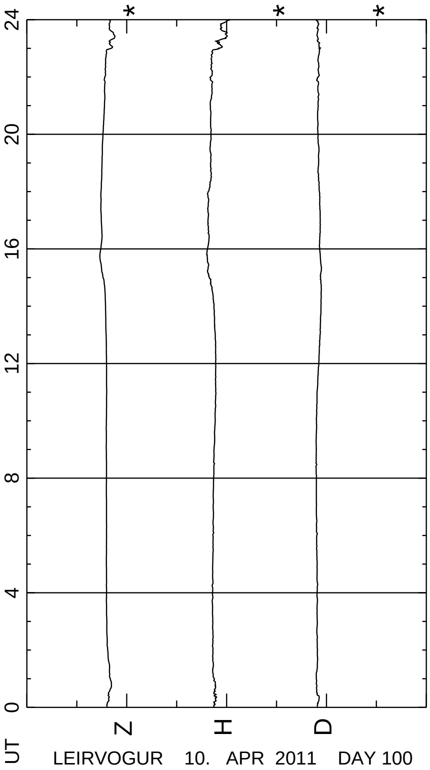

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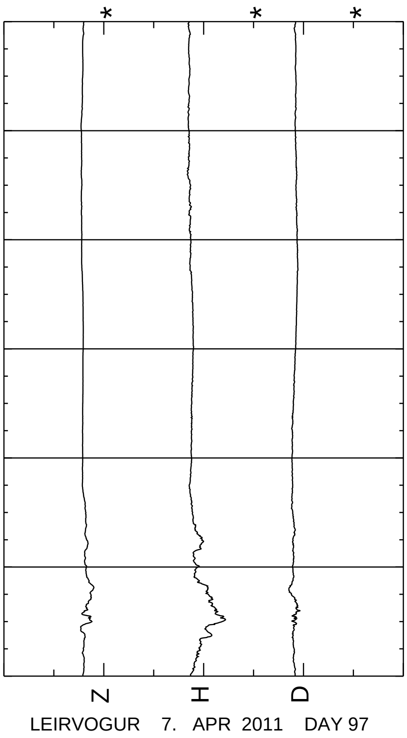
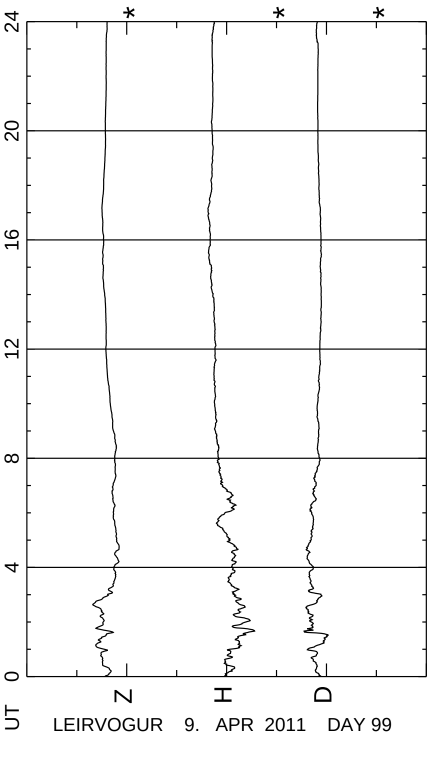
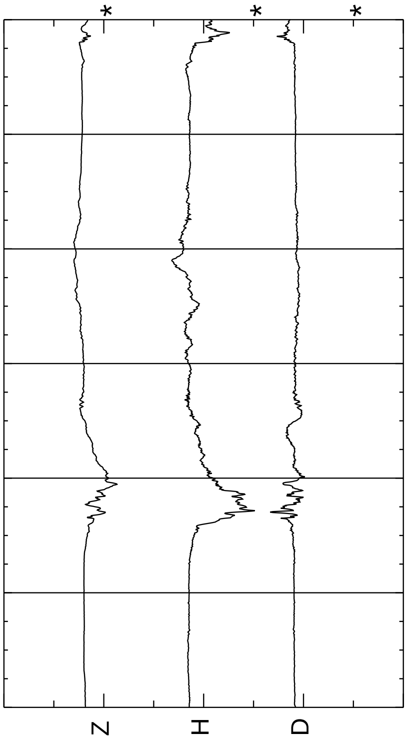


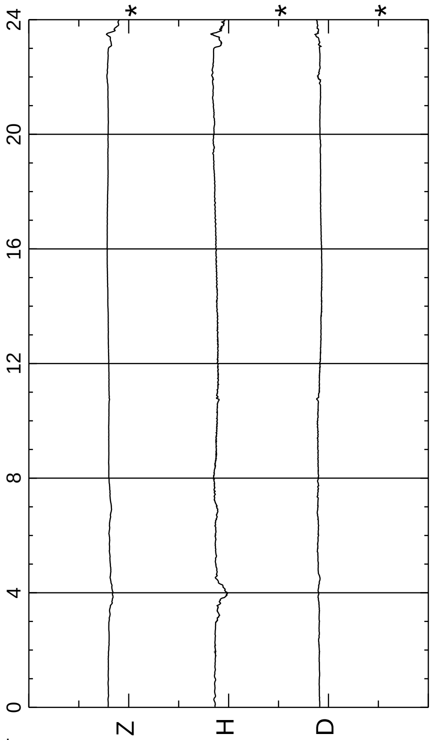
LEIRVOGUR 7. APR 2011 DAY 97



LEIRVOGUR 9. APR 2011 DAY 99



LEIRVOGUR 12. APR 2011 DAY 102



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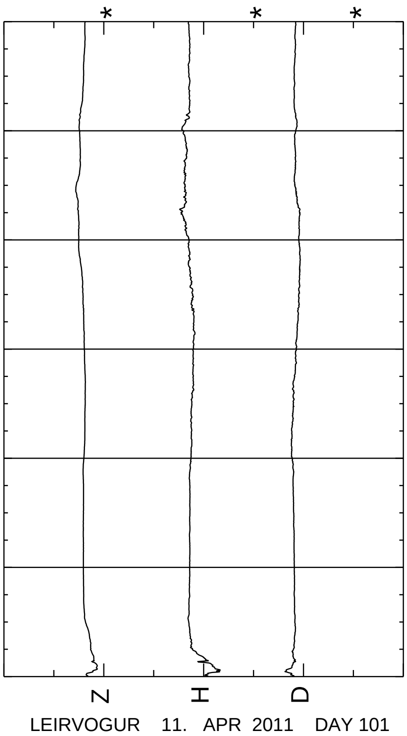
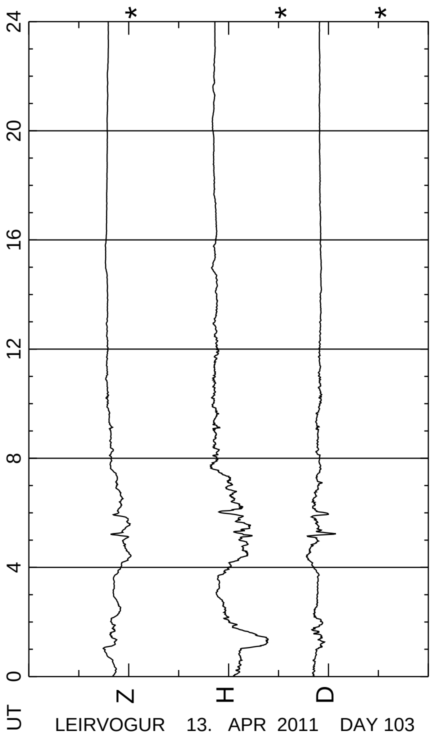
LEIRVOGUR 14. APR 2011 DAY 104



LEIRVOGUR 11. APR 2011 DAY 101



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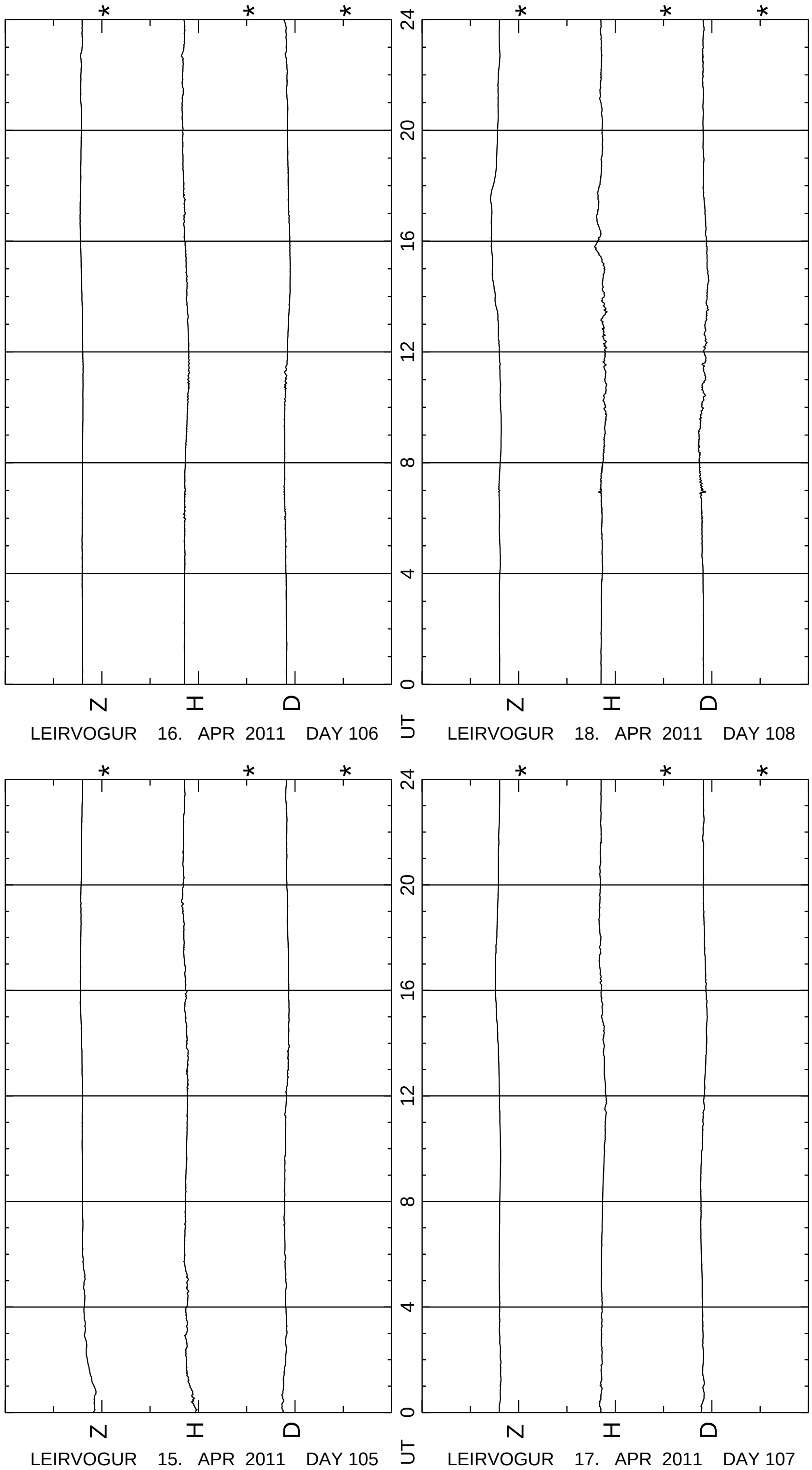
LEIRVOGUR 13. APR 2011 DAY 103


LEIRVOGUR 16. APR 2011 DAY 106
LEIRVOGUR 18. APR 2011 DAY 108
LEIRVOGUR 15. APR 2011 DAY 105
LEIRVOGUR 17. APR 2011 DAY 107
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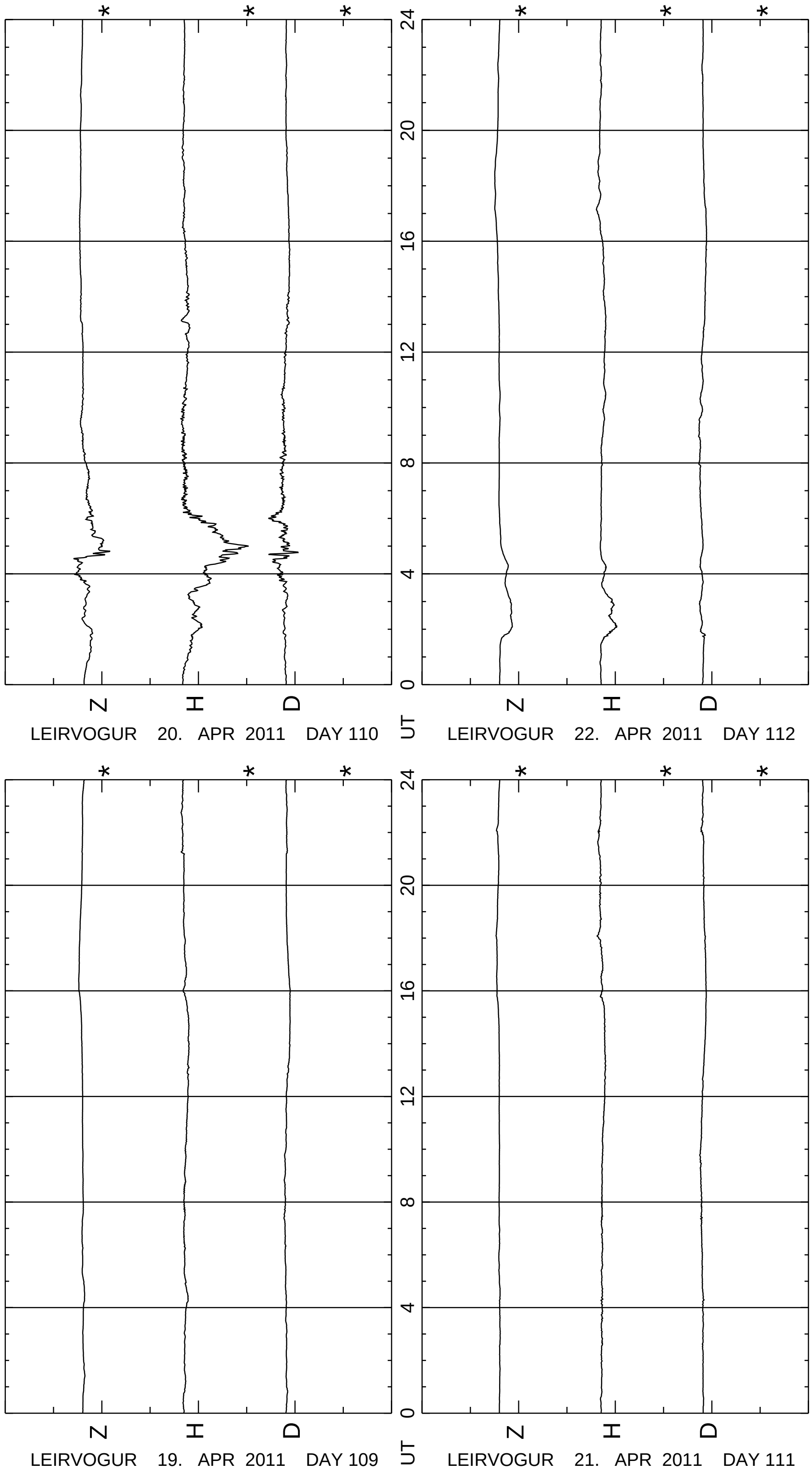
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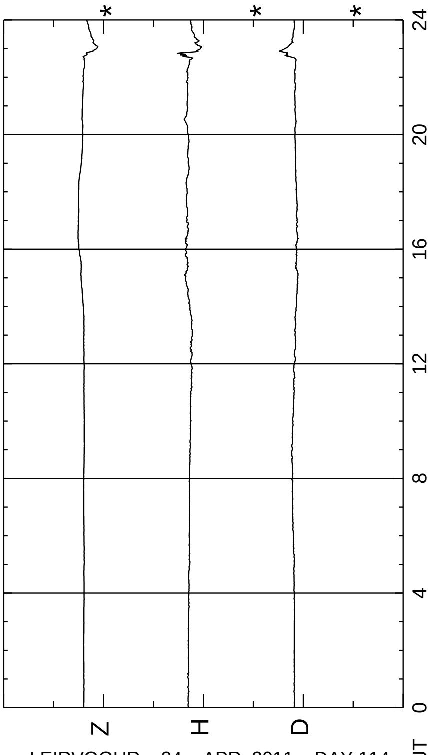
LEIRVOGUR 20. APR 2011 DAY 110
LEIRVOGUR 22. APR 2011 DAY 112
LEIRVOGUR 19. APR 2011 DAY 109
LEIRVOGUR 21. APR 2011 DAY 111



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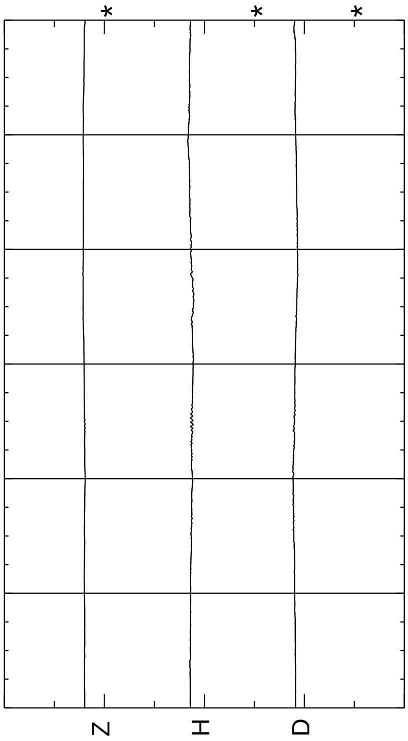

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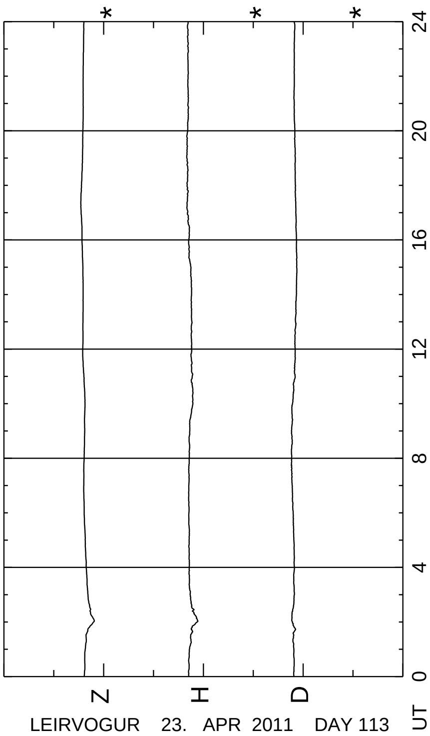

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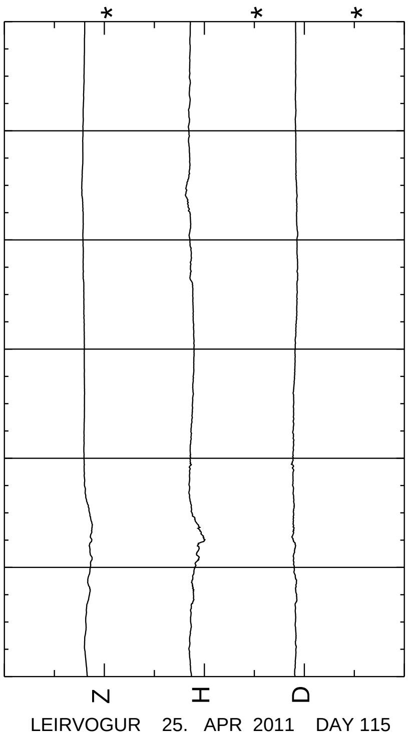
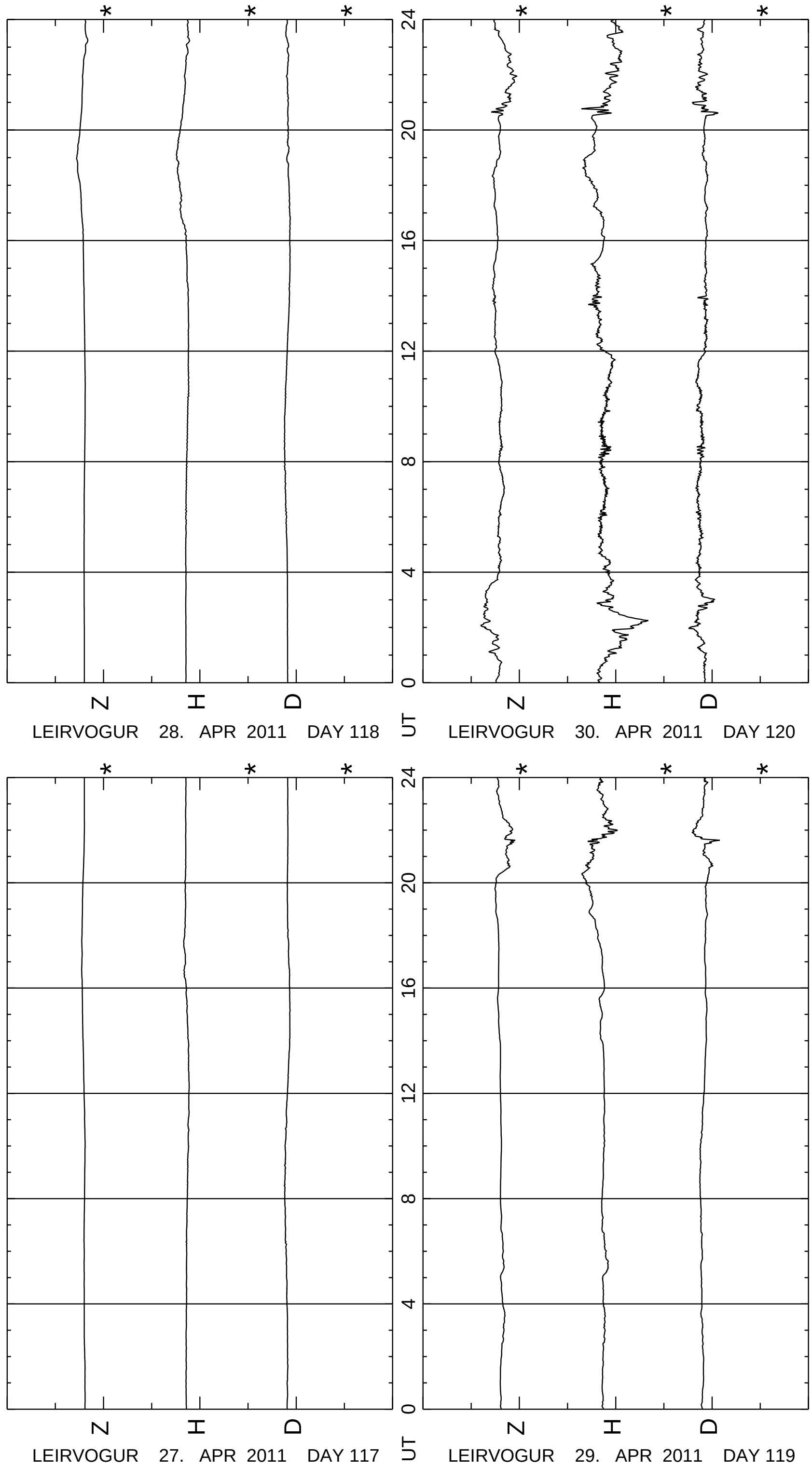


LEIRVOGUR 25. APR 2011 DAY 115


LEIRVOGUR 28. APR 2011 DAY 118
LEIRVOGUR 30. APR 2011 DAY 120
LEIRVOGUR 27. APR 2011 DAY 117
LEIRVOGUR 29. APR 2011 DAY 119
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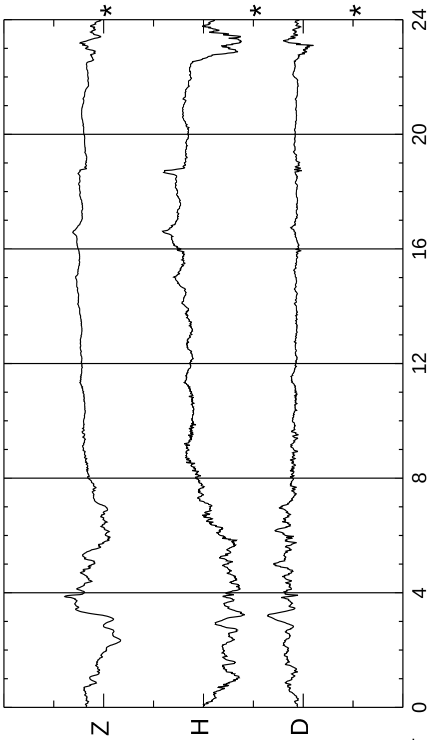

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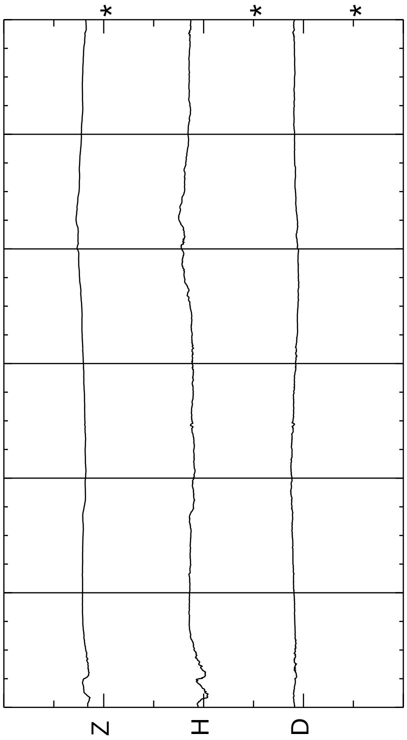
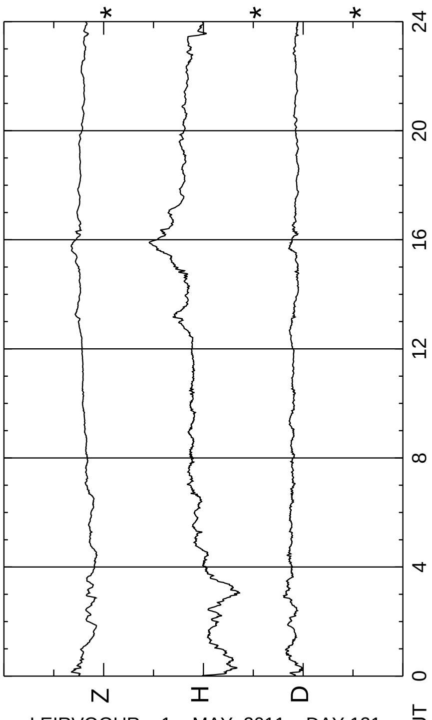


LEIRVOGUR 4. MAY 2011 DAY 124



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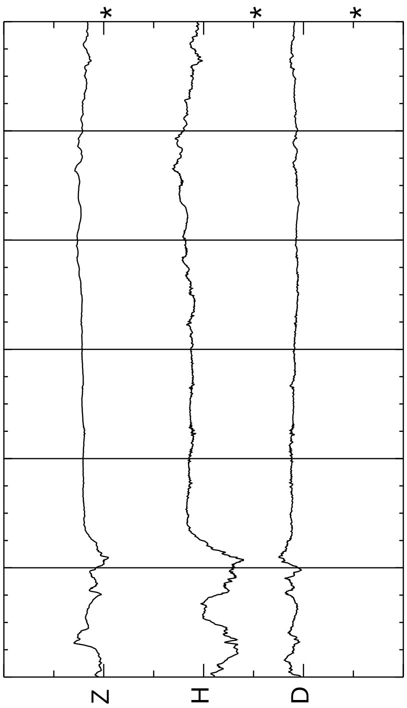
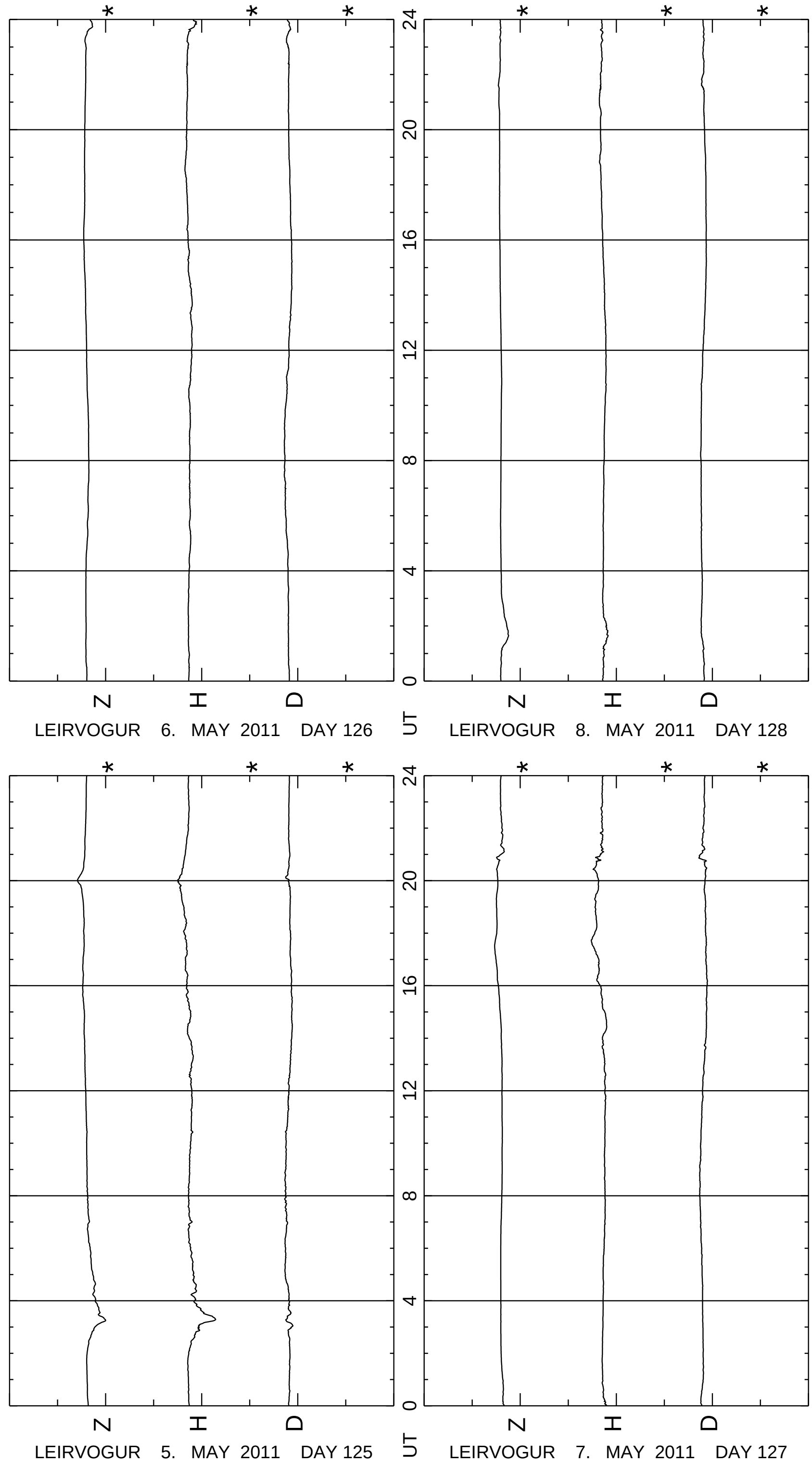


LEIRVOGUR 3. MAY 2011 DAY 123


LEIRVOGUR 6. MAY 2011 DAY 126
LEIRVOGUR 8. MAY 2011 DAY 128
LEIRVOGUR 5. MAY 2011 DAY 125
LEIRVOGUR 7. MAY 2011 DAY 127
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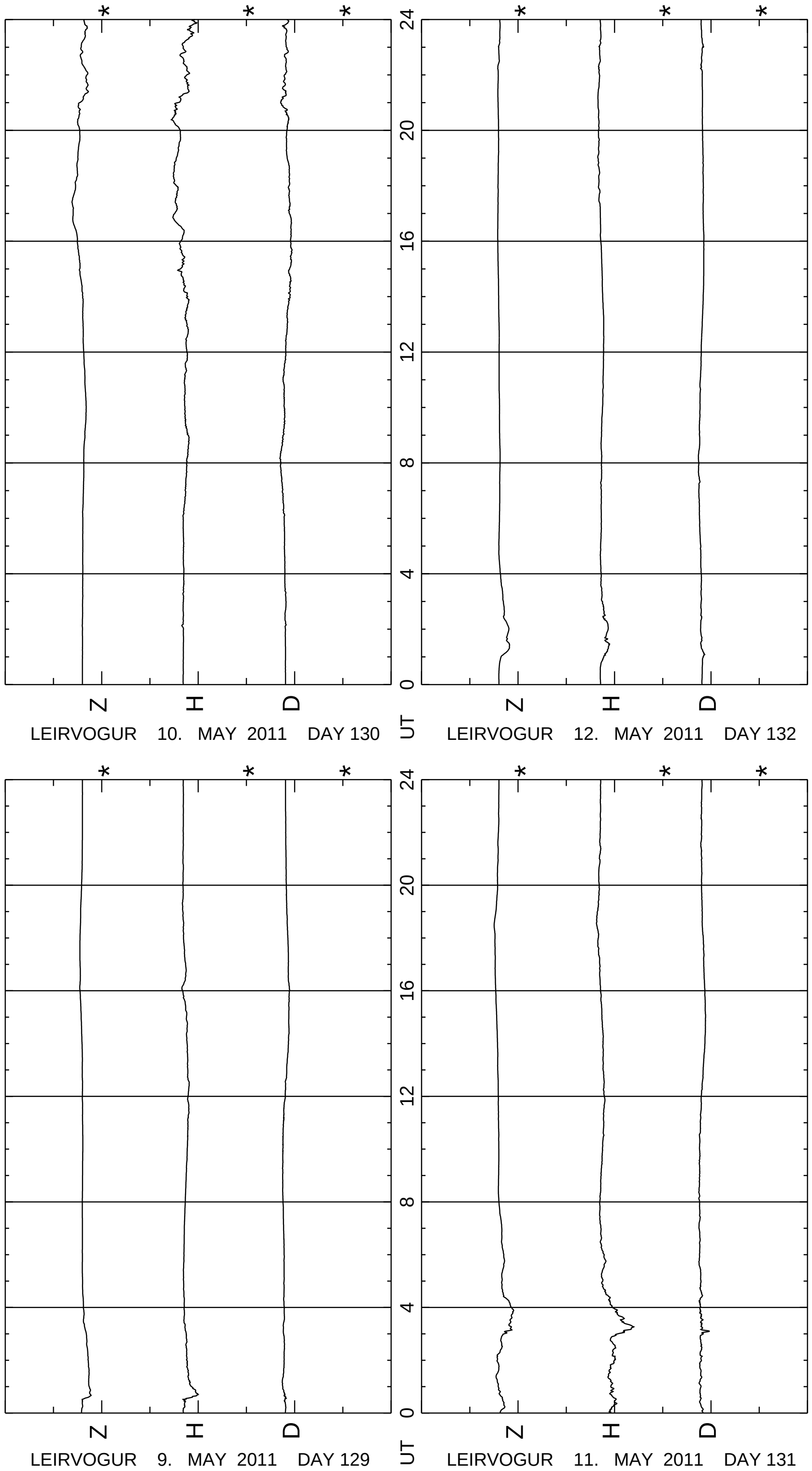
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LEIRVOGUR 12. MAY 2011 DAY 132
LEIRVOGUR 9. MAY 2011 DAY 129
LEIRVOGUR 11. MAY 2011 DAY 131
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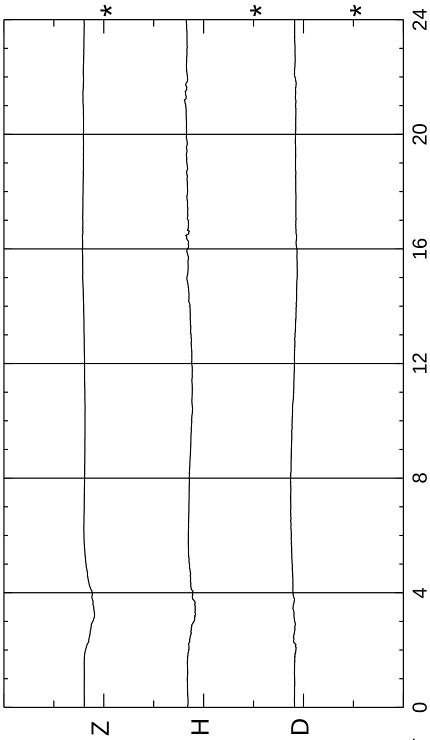

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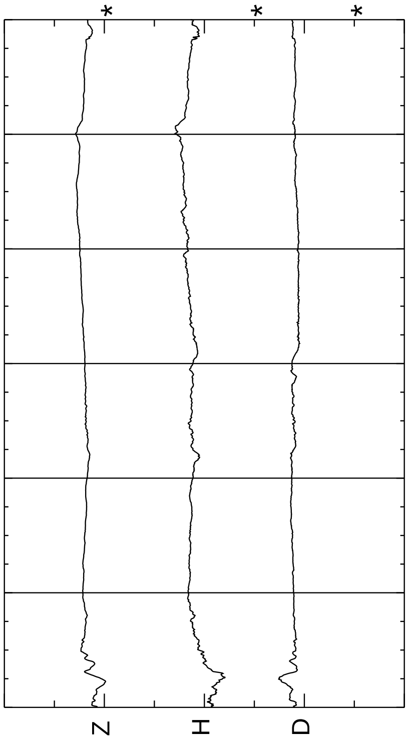

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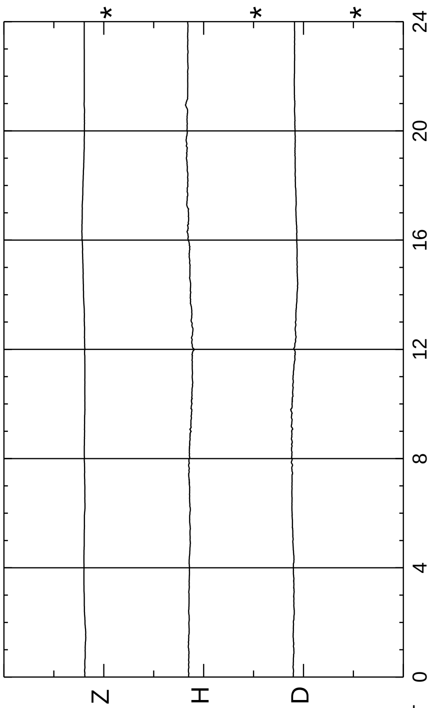
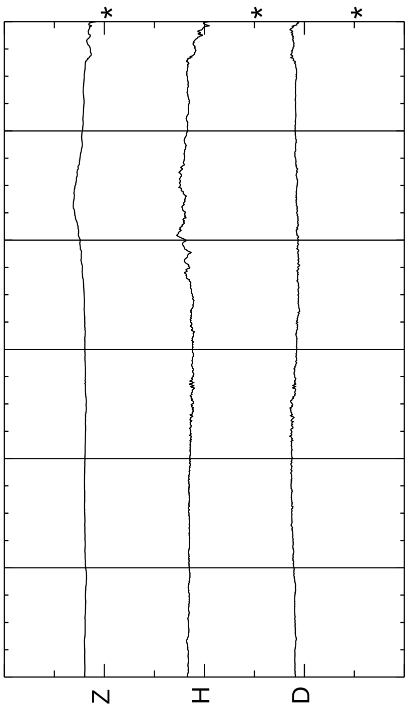
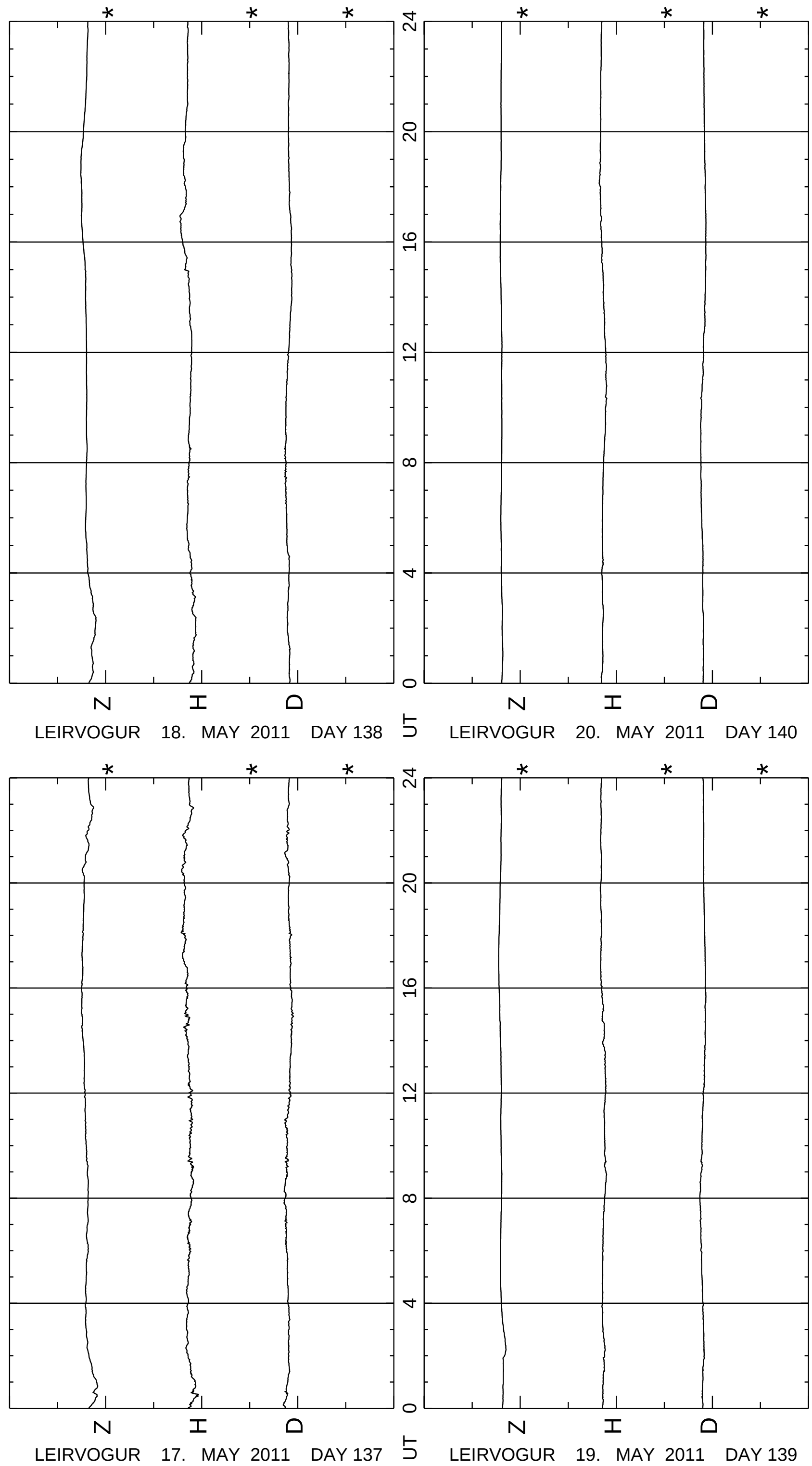


LEIRVOGUR 13. MAY 2011 DAY 133



LEIRVOGUR 15. MAY 2011 DAY 135


LEIRVOGUR 18. MAY 2011 DAY 138
LEIRVOGUR 20. MAY 2011 DAY 140
LEIRVOGUR 17. MAY 2011 DAY 137
LEIRVOGUR 19. MAY 2011 DAY 139
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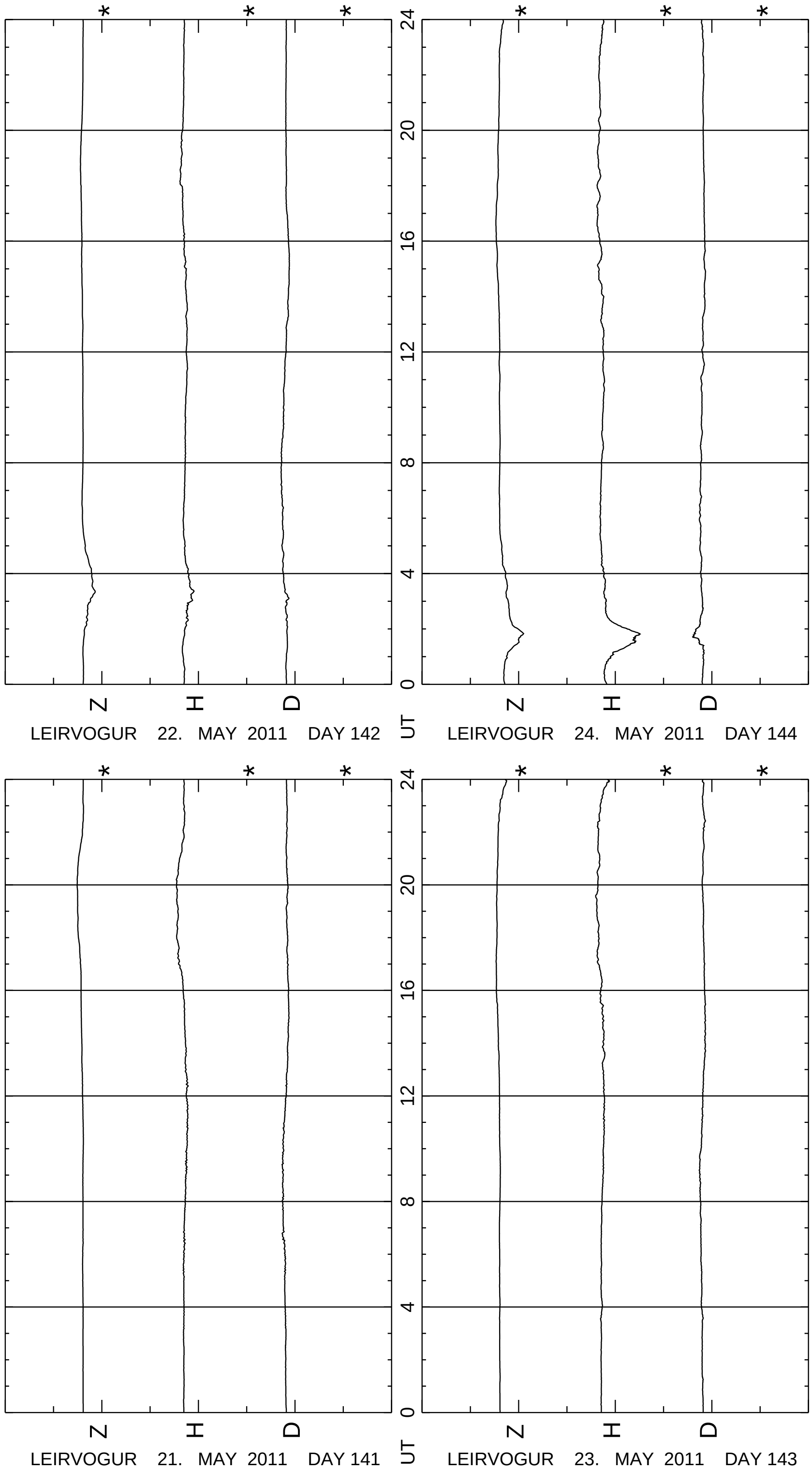
LEIRVOGUR 22. MAY 2011 DAY 142
LEIRVOGUR 24. MAY 2011 DAY 144
LEIRVOGUR 21. MAY 2011 DAY 141
LEIRVOGUR 23. MAY 2011 DAY 143
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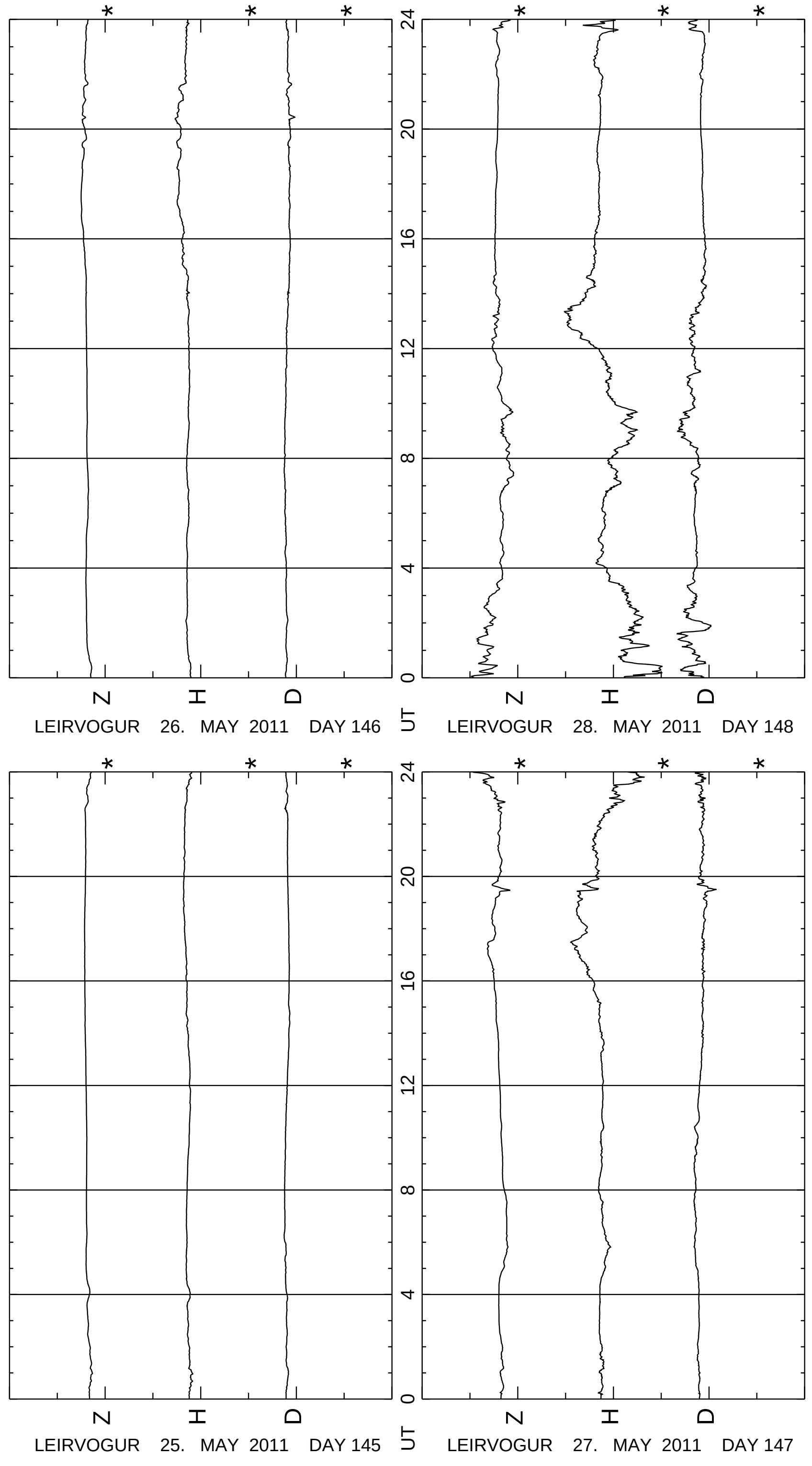
LEIRVOGUR 26. MAY 2011 DAY 146
LEIRVOGUR 28. MAY 2011 DAY 148
LEIRVOGUR 25. MAY 2011 DAY 145
LEIRVOGUR 27. MAY 2011 DAY 147
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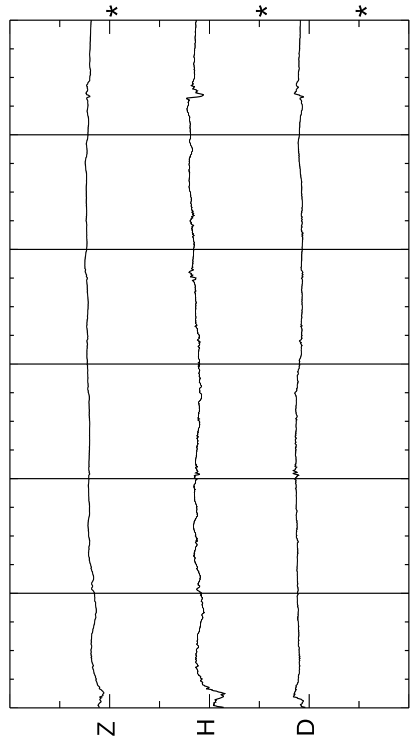

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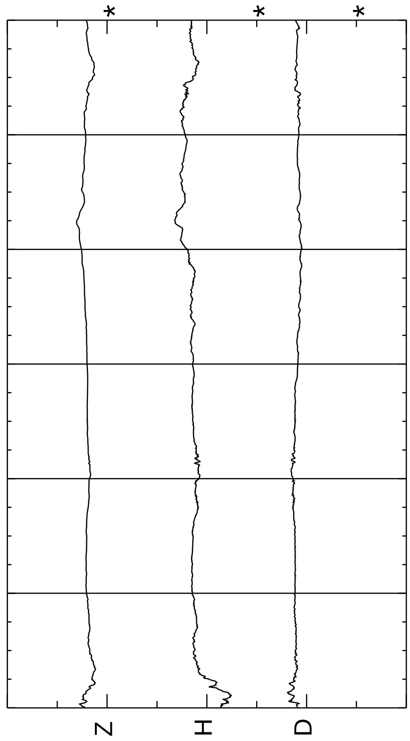
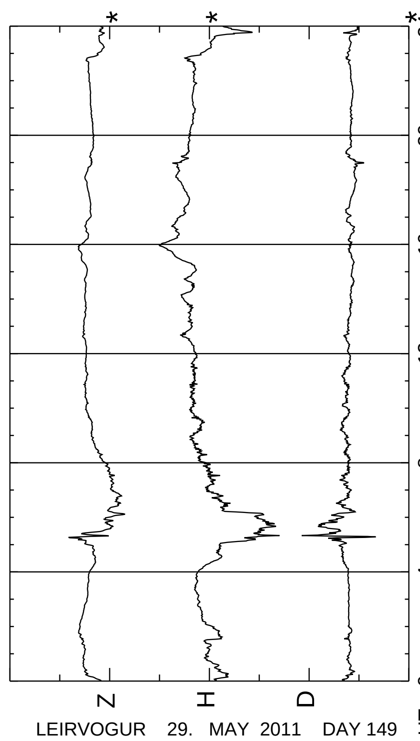
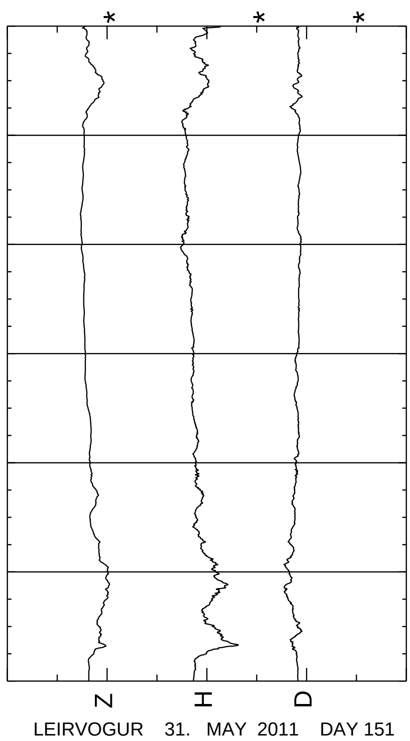


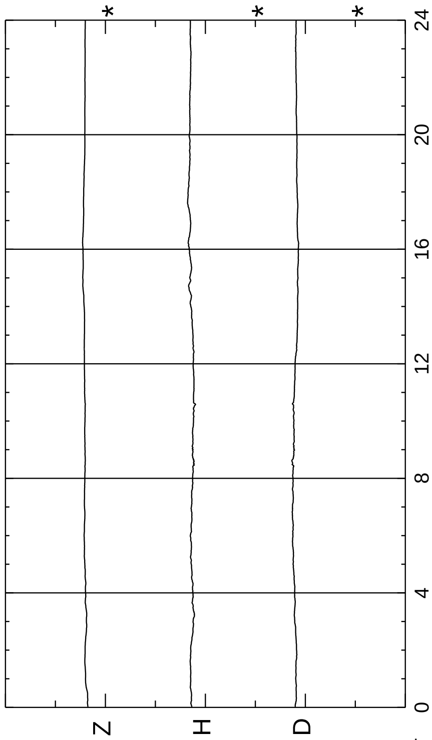
LEIRVOGUR 1. JUN 2011 DAY 152



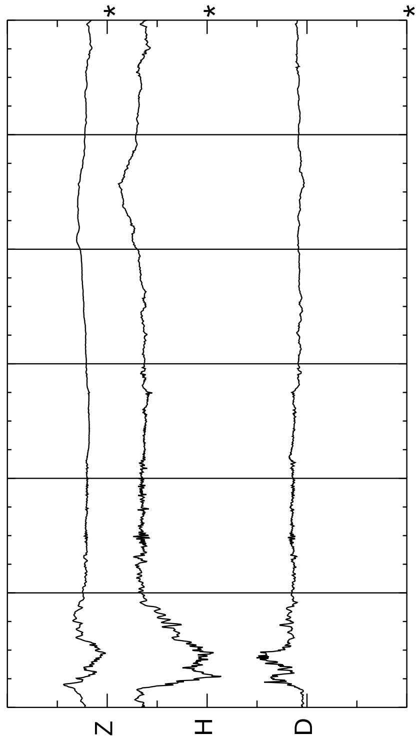
LEIRVOGUR 29. MAY 2011 DAY 149



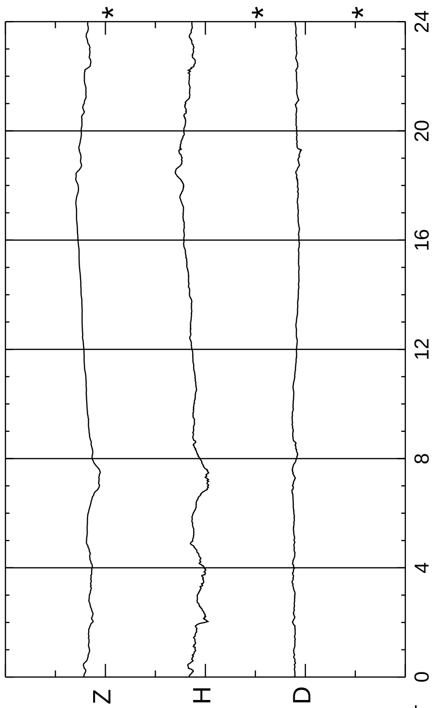
LEIRVOGUR 31. MAY 2011 DAY 151



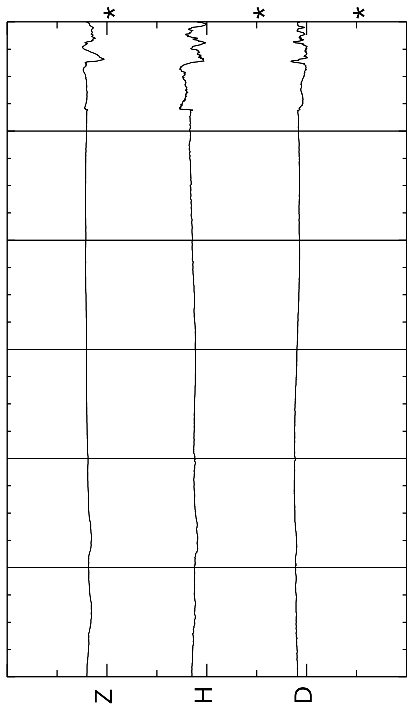
LEIRVOGUR 3. JUN 2011 DAY 154



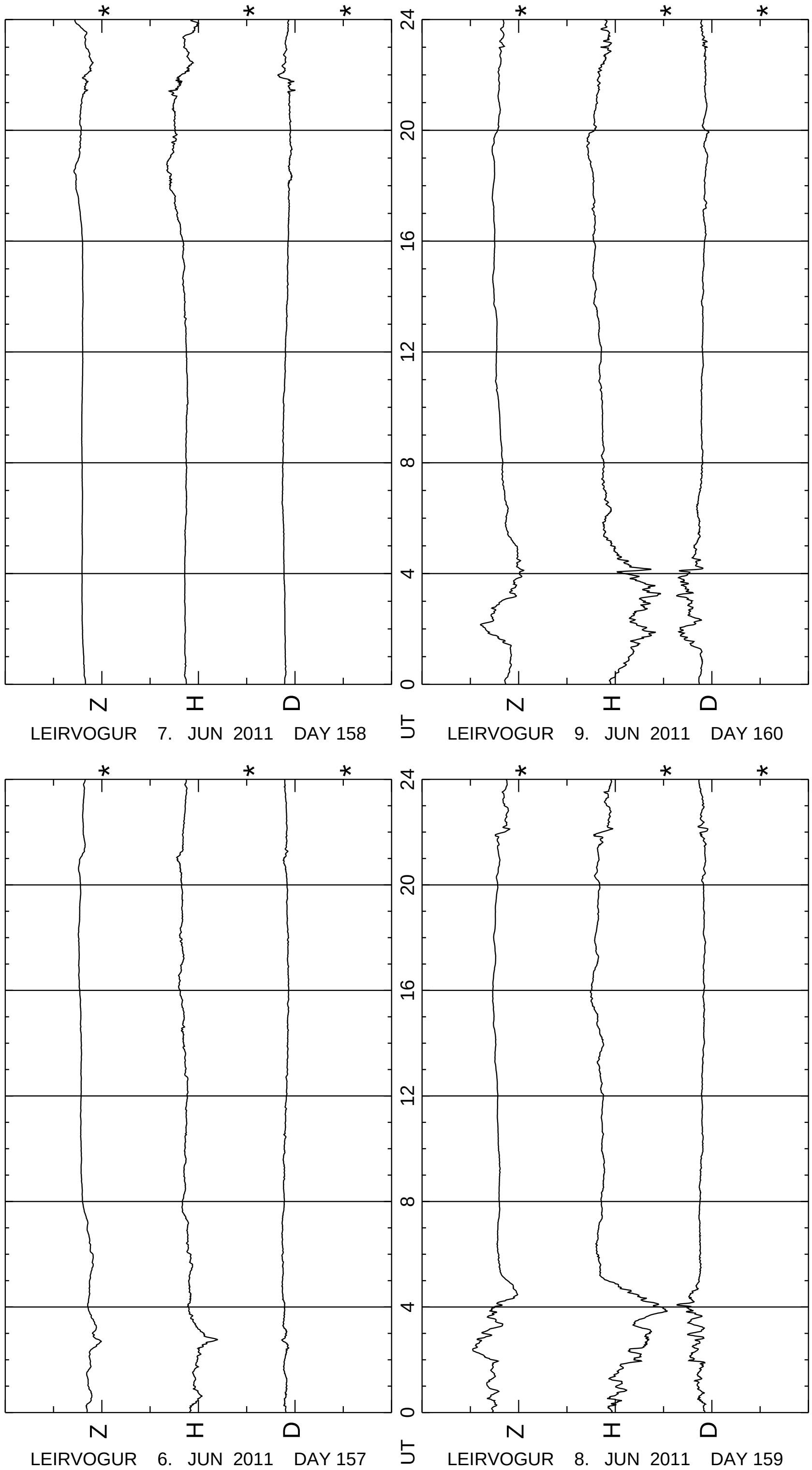
LEIRVOGUR 5. JUN 2011 DAY 156



LEIRVOGUR 2. JUN 2011 DAY 153



LEIRVOGUR 4. JUN 2011 DAY 155


LEIRVOGUR 7. JUN 2011 DAY 158
LEIRVOGUR 9. JUN 2011 DAY 160
LEIRVOGUR 6. JUN 2011 DAY 157
LEIRVOGUR 8. JUN 2011 DAY 159
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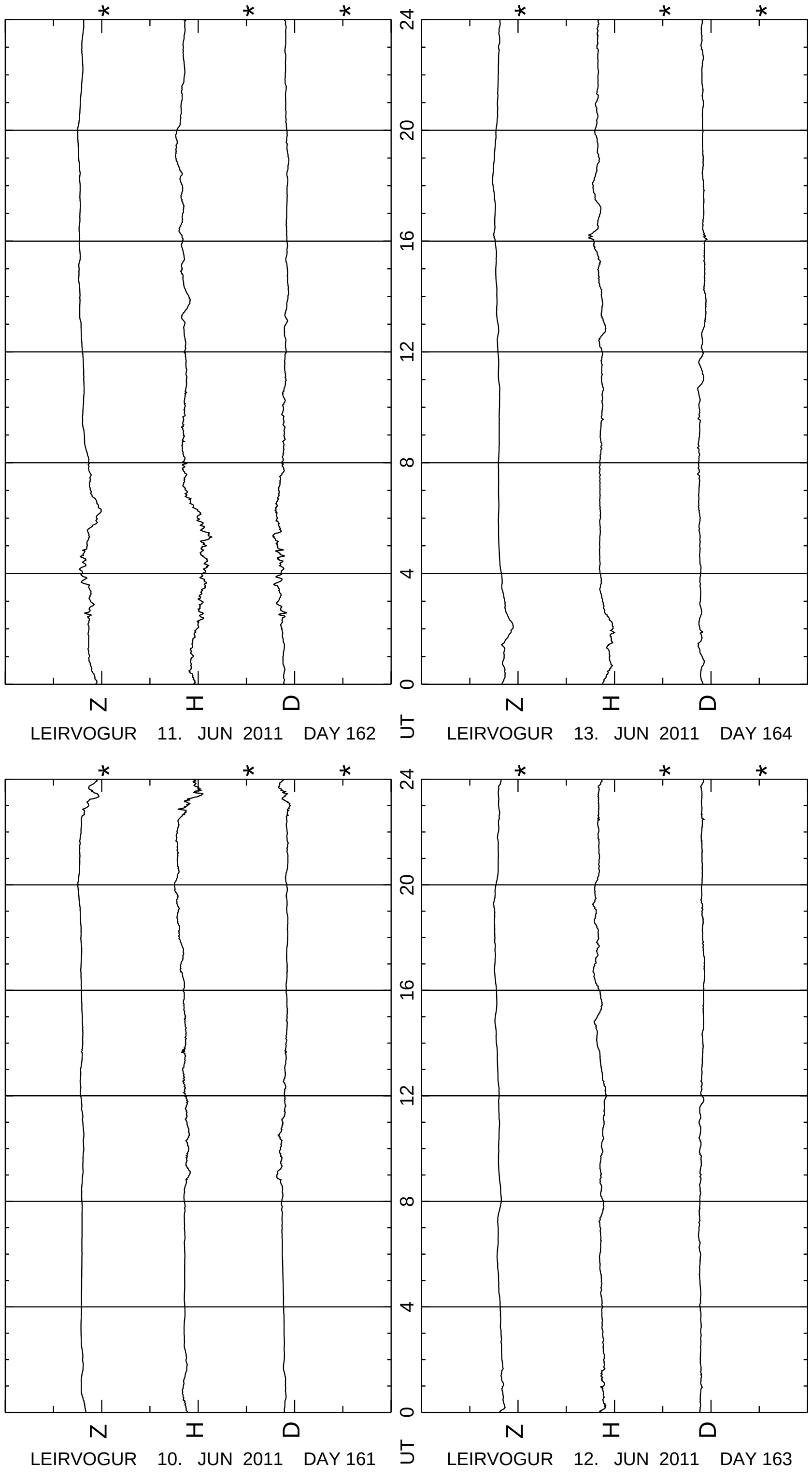
LEIRVOGUR 11. JUN 2011 DAY 162
LEIRVOGUR 13. JUN 2011 DAY 164
LEIRVOGUR 10. JUN 2011 DAY 161
LEIRVOGUR 12. JUN 2011 DAY 163
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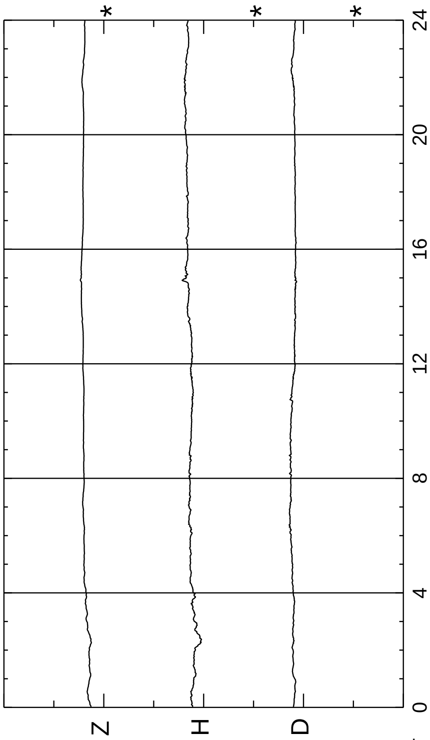
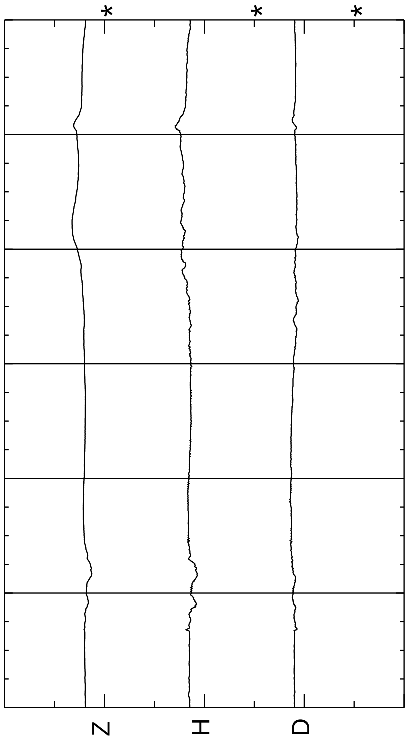
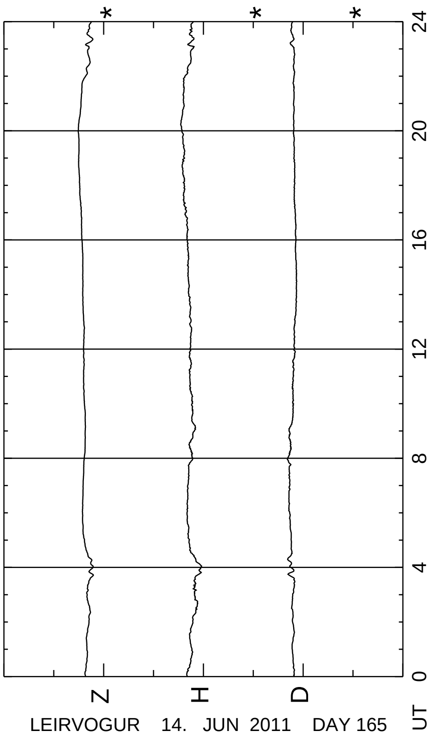


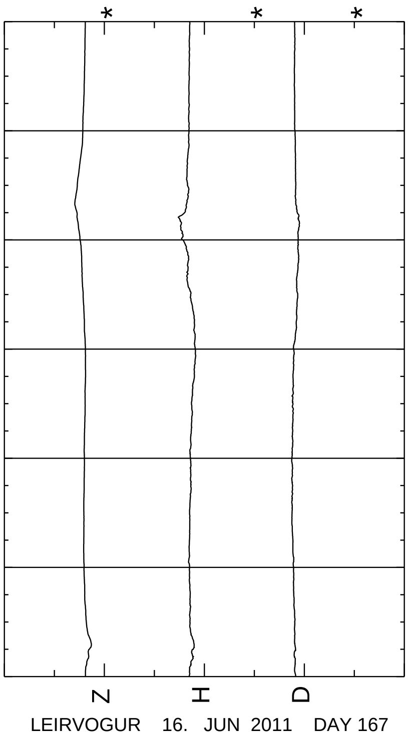
LEIRVOGUR 15. JUN 2011 DAY 166



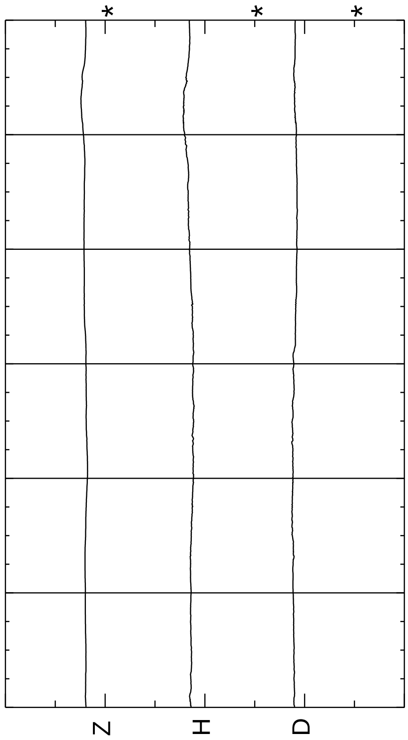
LEIRVOGUR 17. JUN 2011 DAY 168



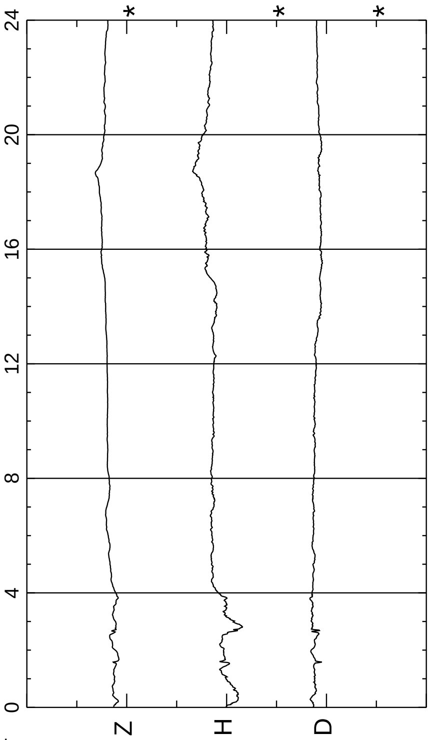
LEIRVOGUR 14. JUN 2011 DAY 165



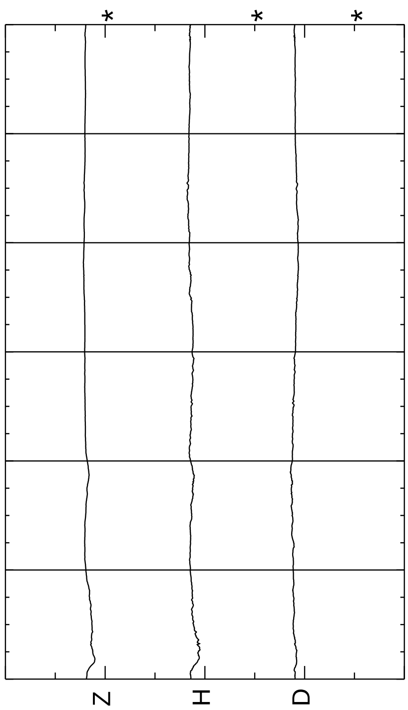
LEIRVOGUR 16. JUN 2011 DAY 167



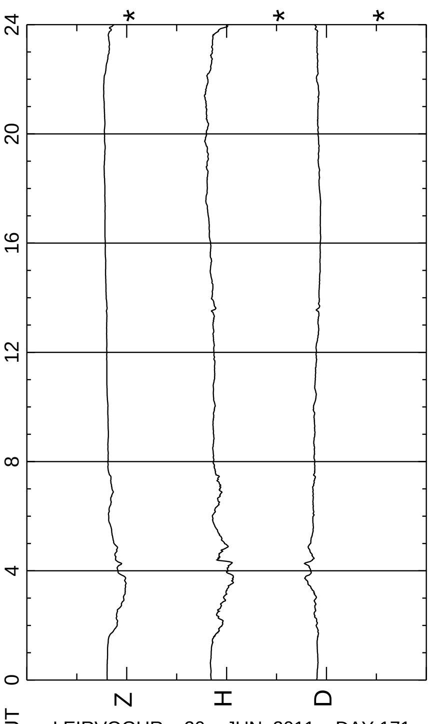
LEIRVOGUR 19. JUN 2011 DAY 170



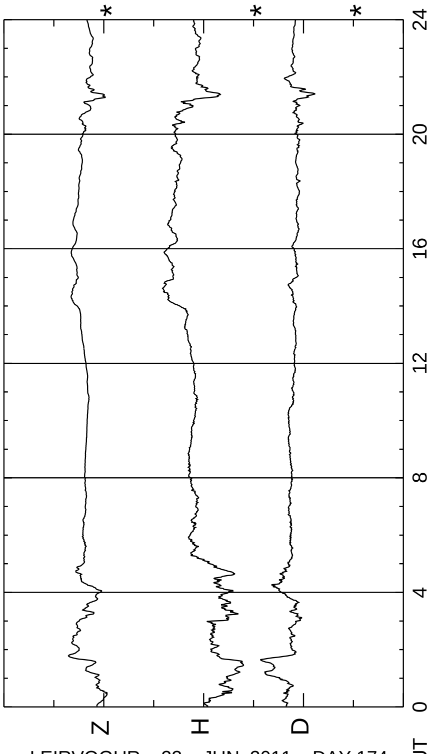
LEIRVOGUR 21. JUN 2011 DAY 172



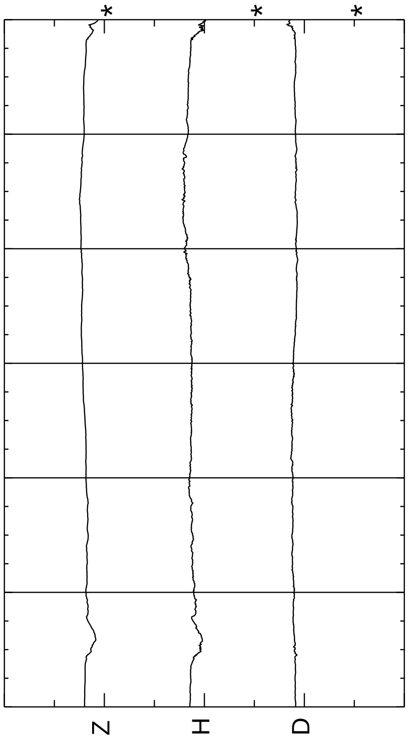
LEIRVOGUR 18. JUN 2011 DAY 169



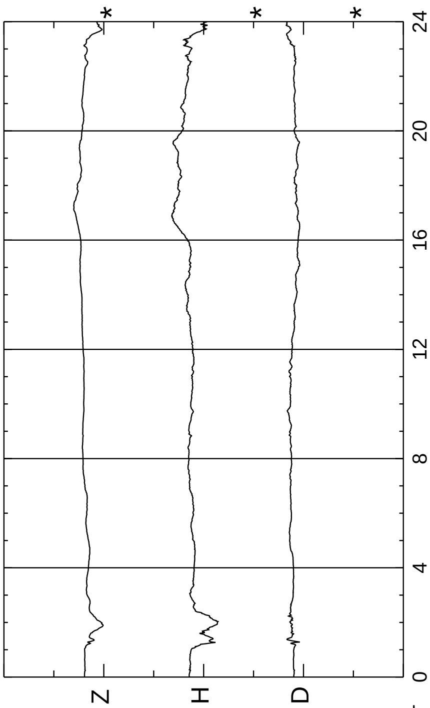
LEIRVOGUR 20. JUN 2011 DAY 171



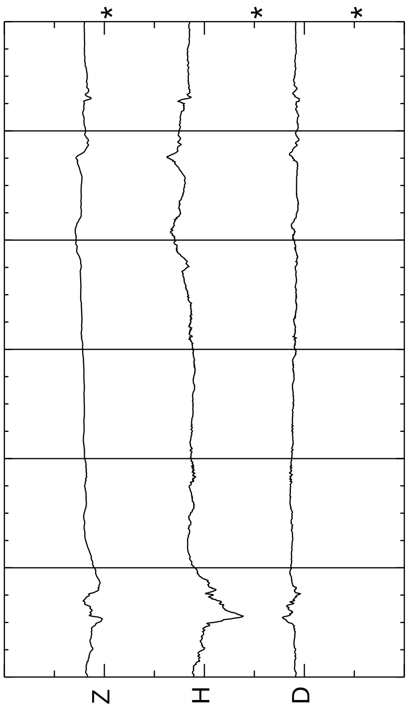
LEIRVOGUR 23. JUN 2011 DAY 174



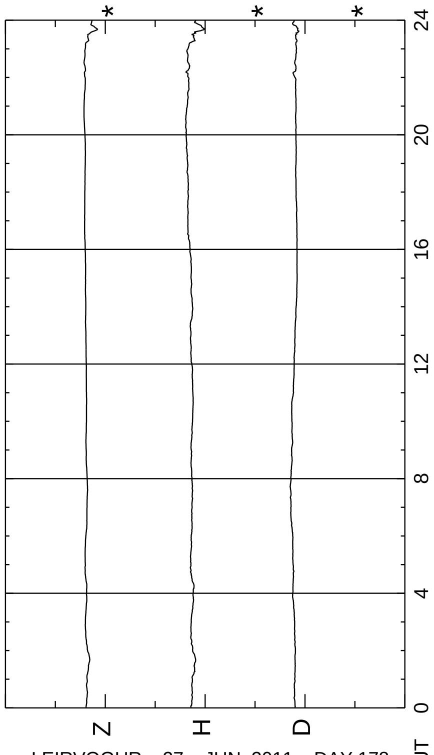
LEIRVOGUR 25. JUN 2011 DAY 176



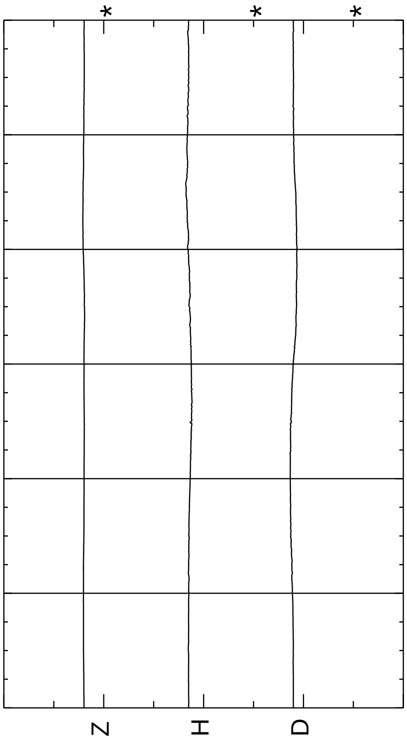
LEIRVOGUR 22. JUN 2011 DAY 173



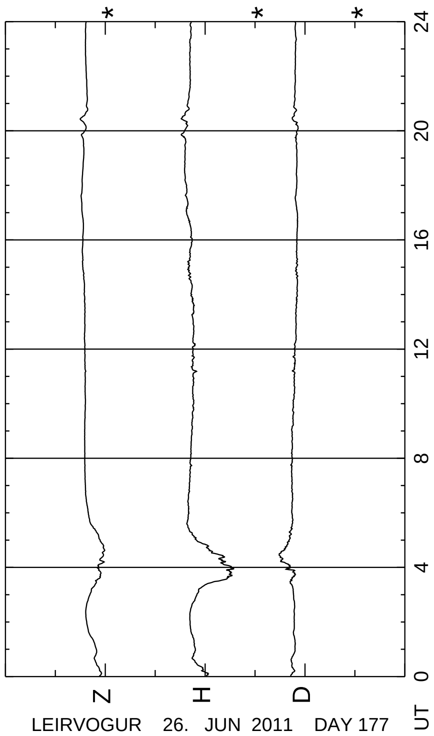
LEIRVOGUR 24. JUN 2011 DAY 175



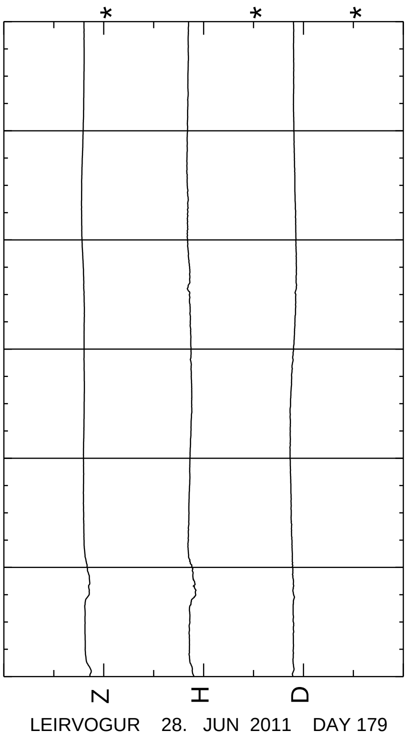
LEIRVOGUR 27. JUN 2011 DAY 178



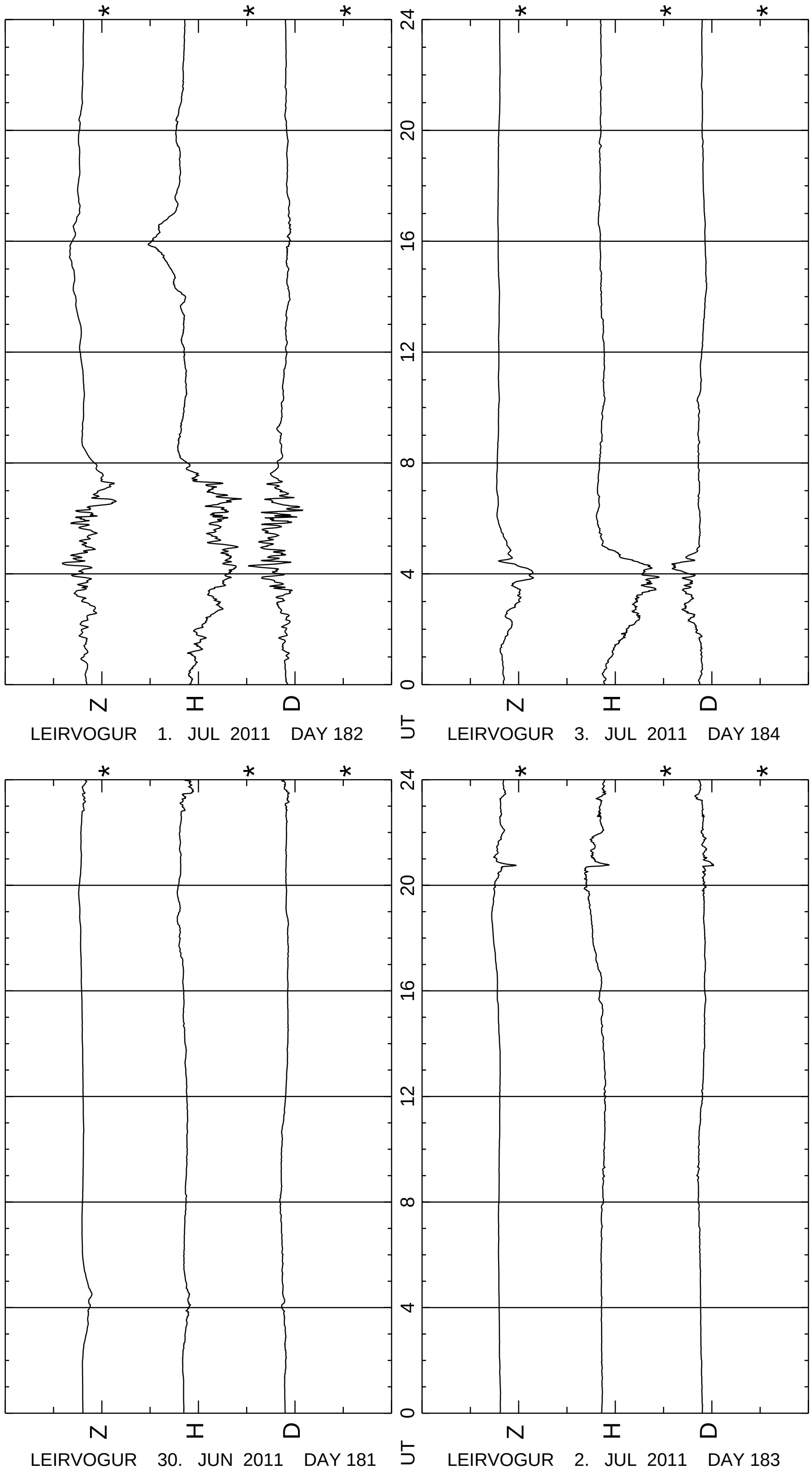
LEIRVOGUR 29. JUN 2011 DAY 180



LEIRVOGUR 26. JUN 2011 DAY 177



LEIRVOGUR 28. JUN 2011 DAY 179


LEIRVOGUR 1. JUL 2011 DAY 182
LEIRVOGUR 3. JUL 2011 DAY 184
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LEIRVOGUR 2. JUL 2011 DAY 183
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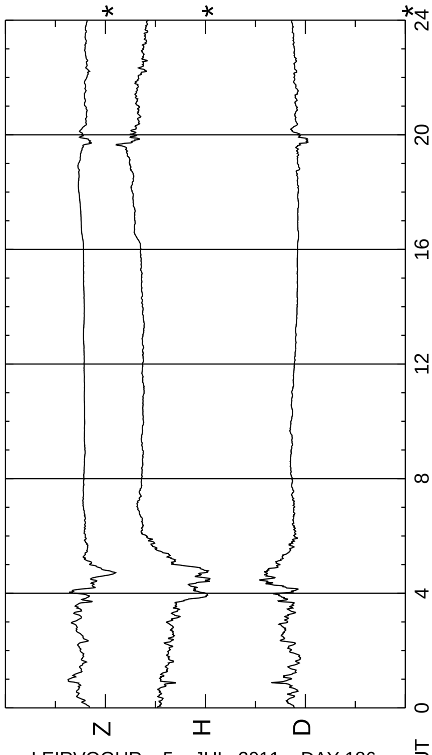

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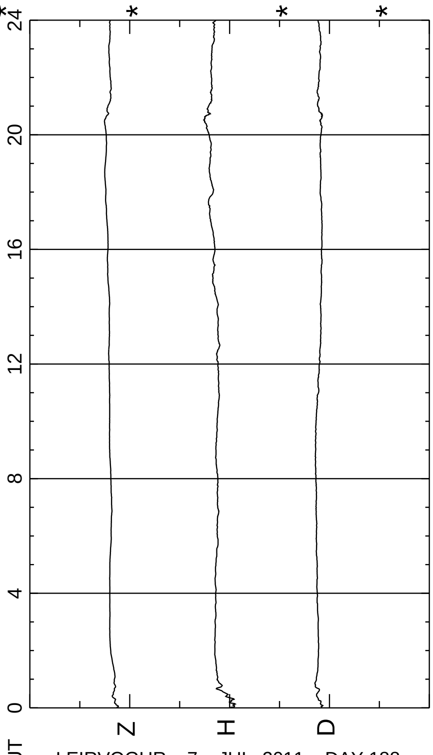
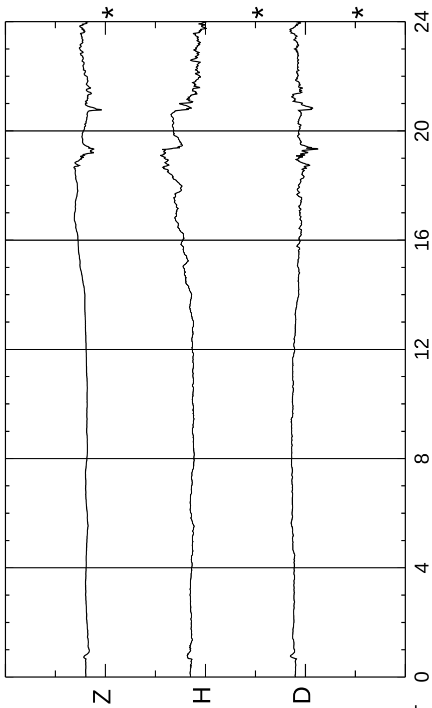
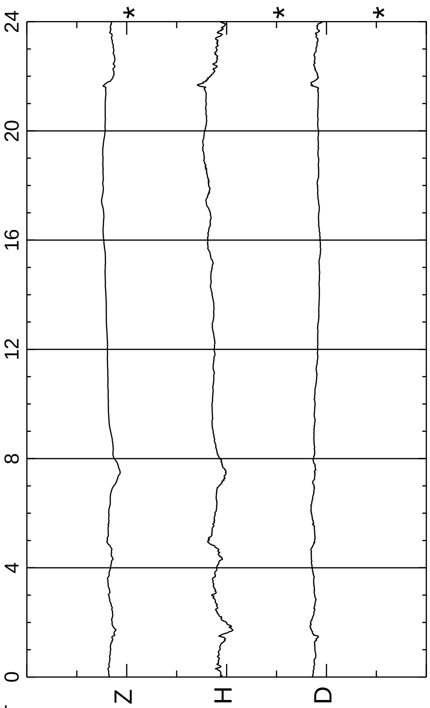


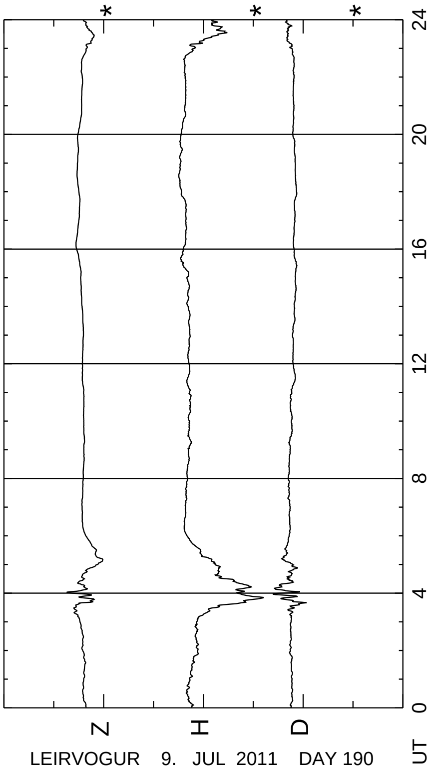
LEIRVOGUR 7. JUL 2011 DAY 188



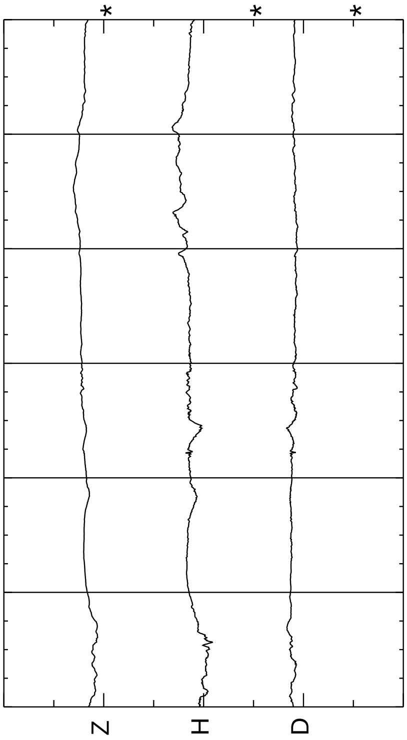
LEIRVOGUR 4. JUL 2011 DAY 185



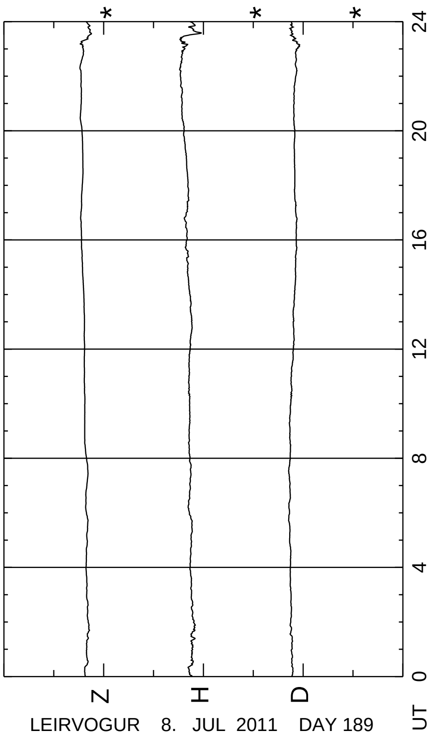
LEIRVOGUR 6. JUL 2011 DAY 187



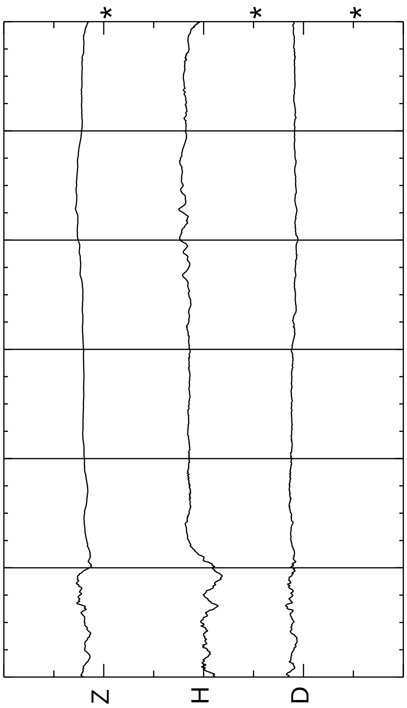
LEIRVOGUR 9. JUL 2011 DAY 190



LEIRVOGUR 11. JUL 2011 DAY 192



LEIRVOGUR 8. JUL 2011 DAY 189



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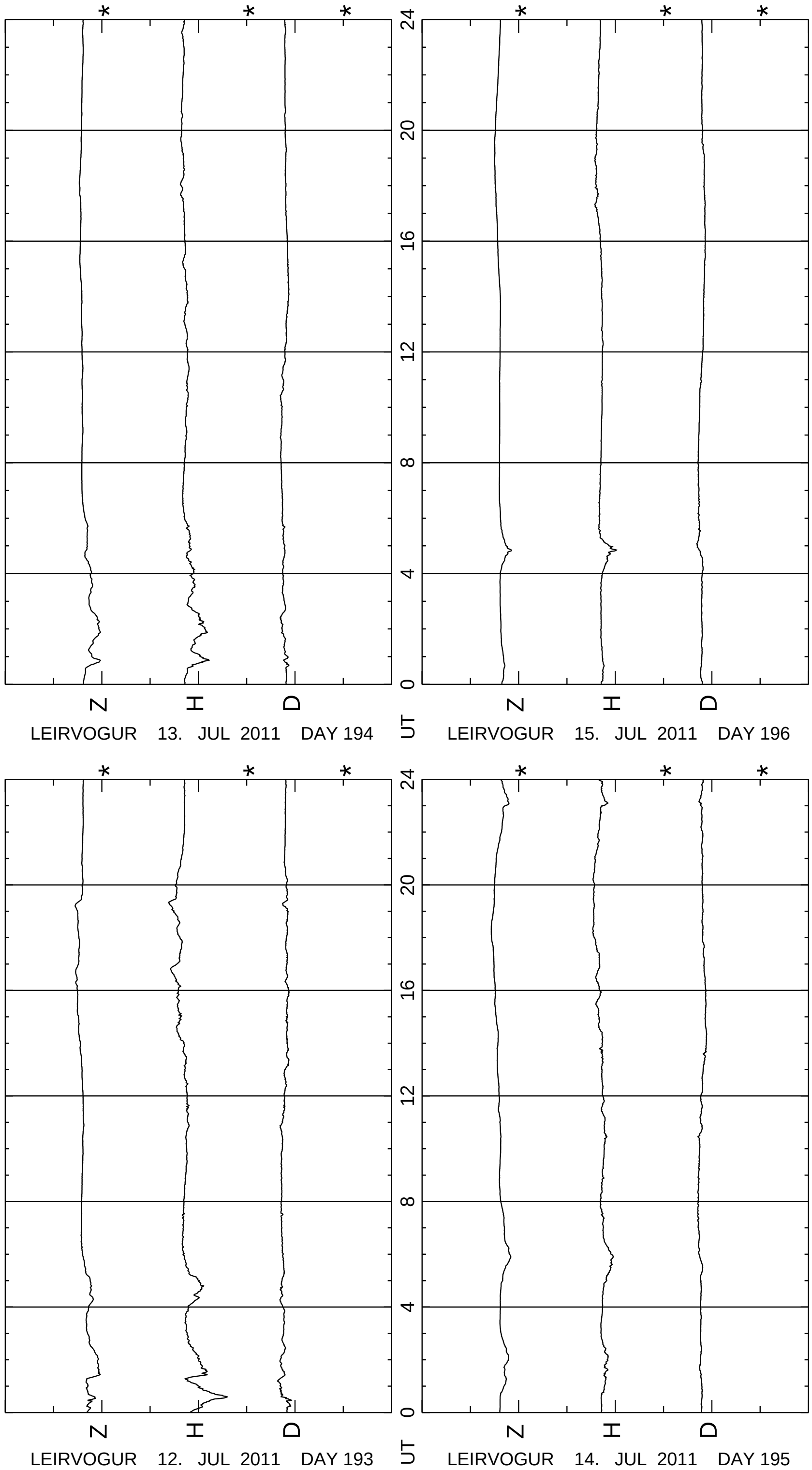
LEIRVOGUR 13. JUL 2011 DAY 194
LEIRVOGUR 15. JUL 2011 DAY 196
LEIRVOGUR 12. JUL 2011 DAY 193
LEIRVOGUR 14. JUL 2011 DAY 195
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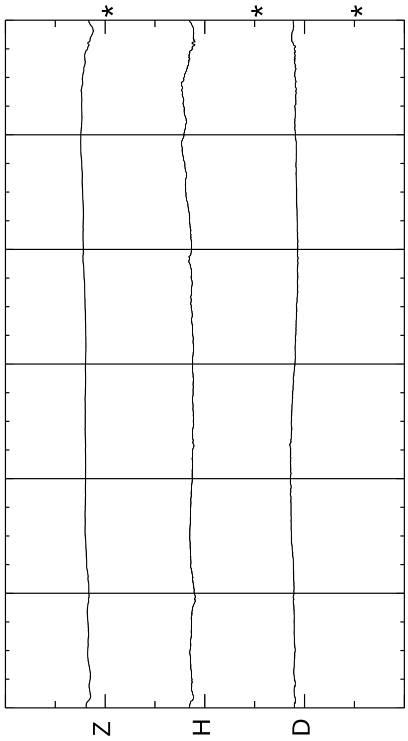
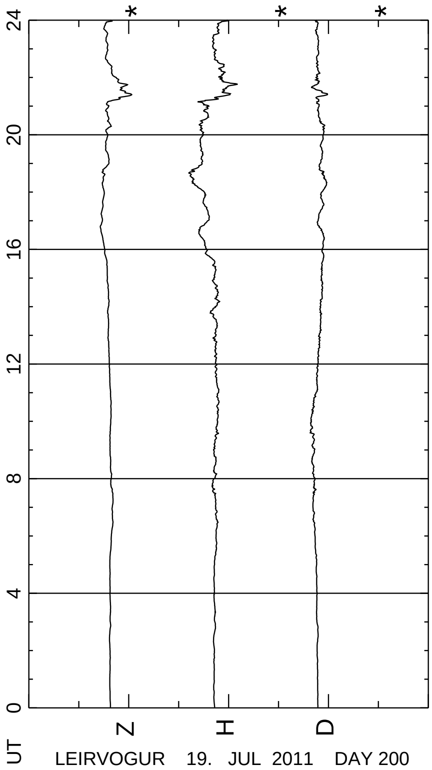


LEIRVOGUR 17. JUL 2011 DAY 198



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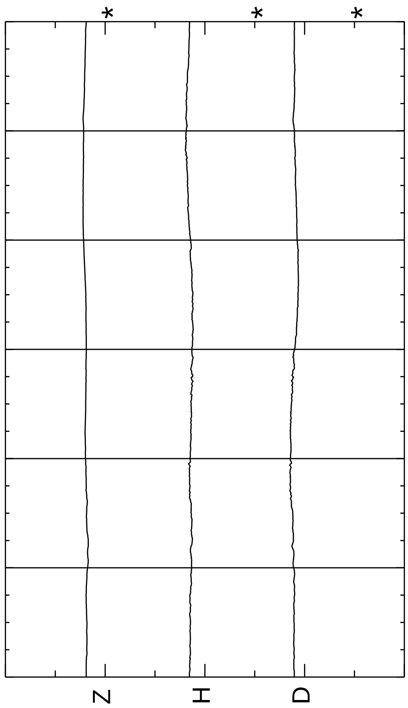
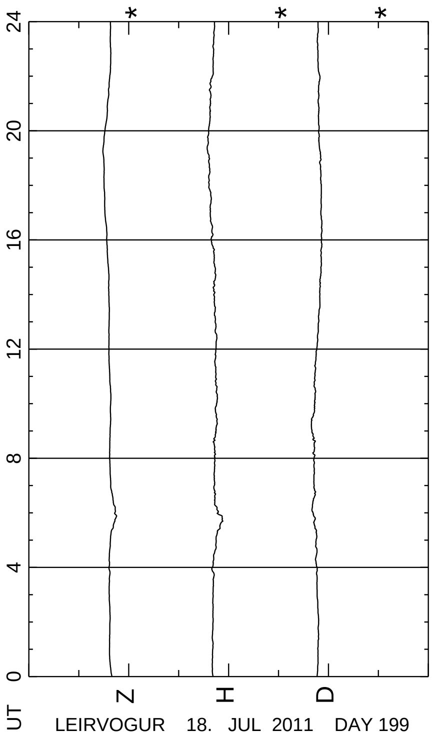
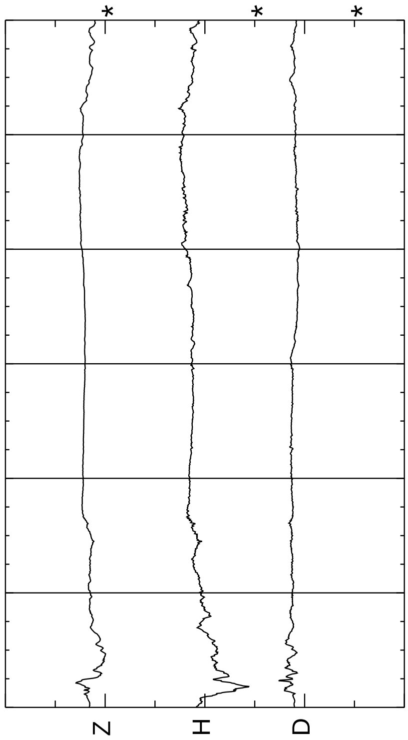


LEIRVOGUR 16. JUL 2011 DAY 197



LEIRVOGUR 18. JUL 2011 DAY 199



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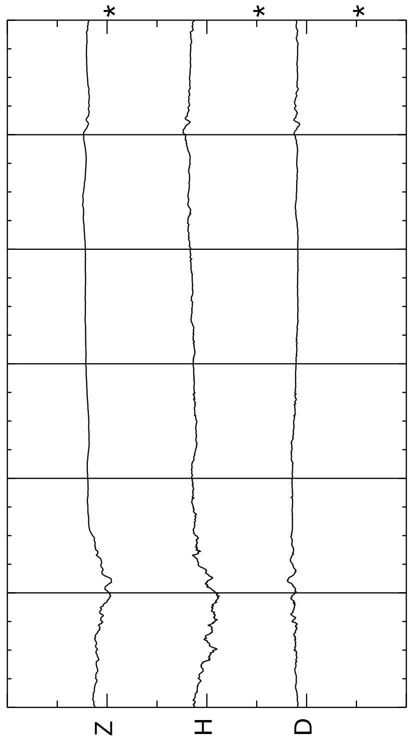

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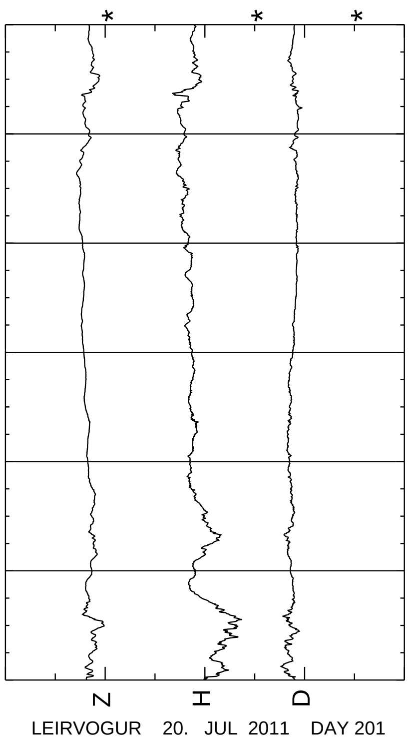

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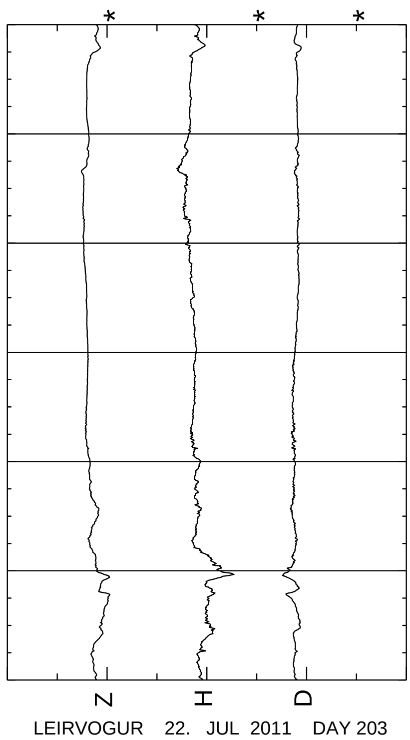

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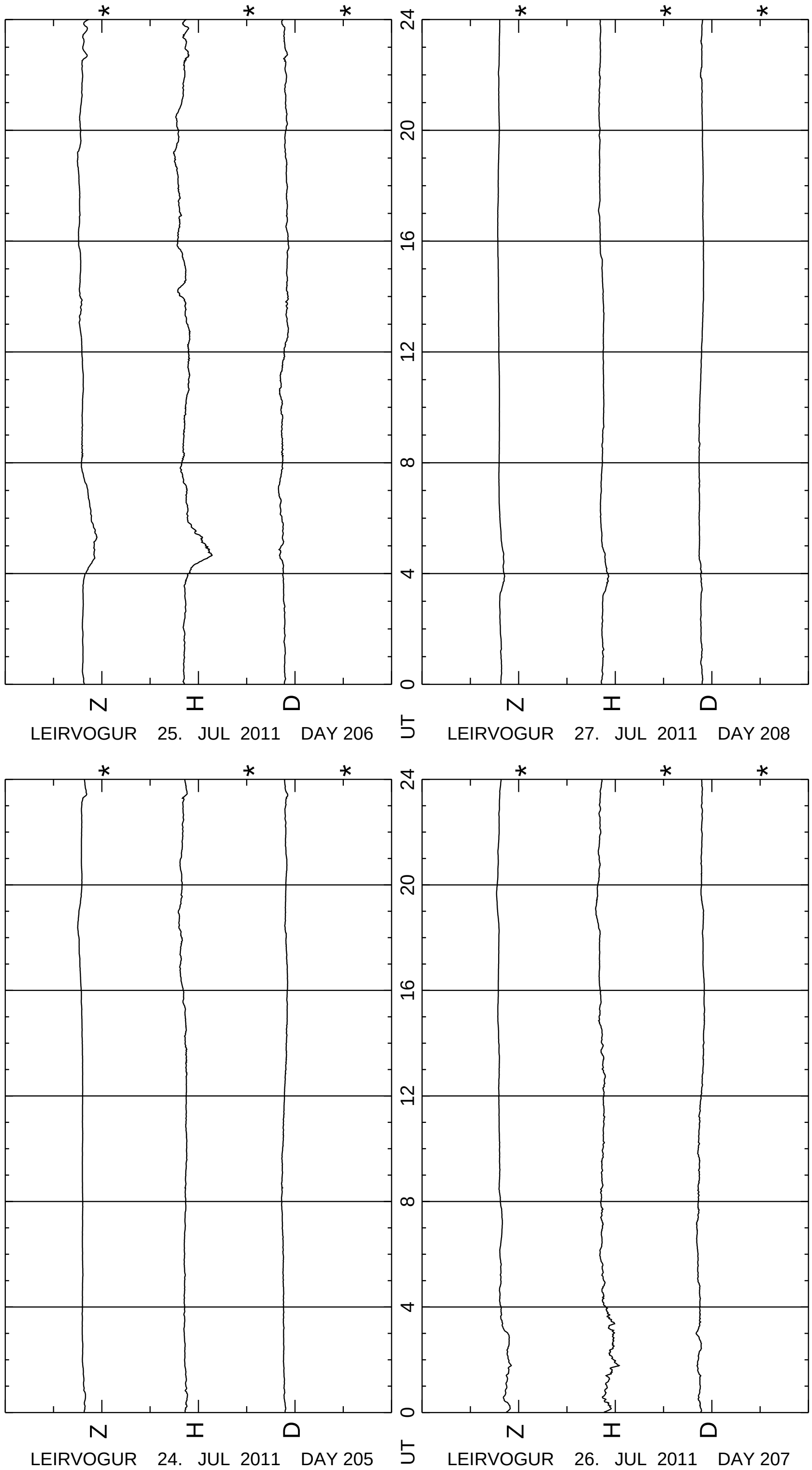
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LEIRVOGUR 27. JUL 2011 DAY 208
LEIRVOGUR 24. JUL 2011 DAY 205
LEIRVOGUR 26. JUL 2011 DAY 207
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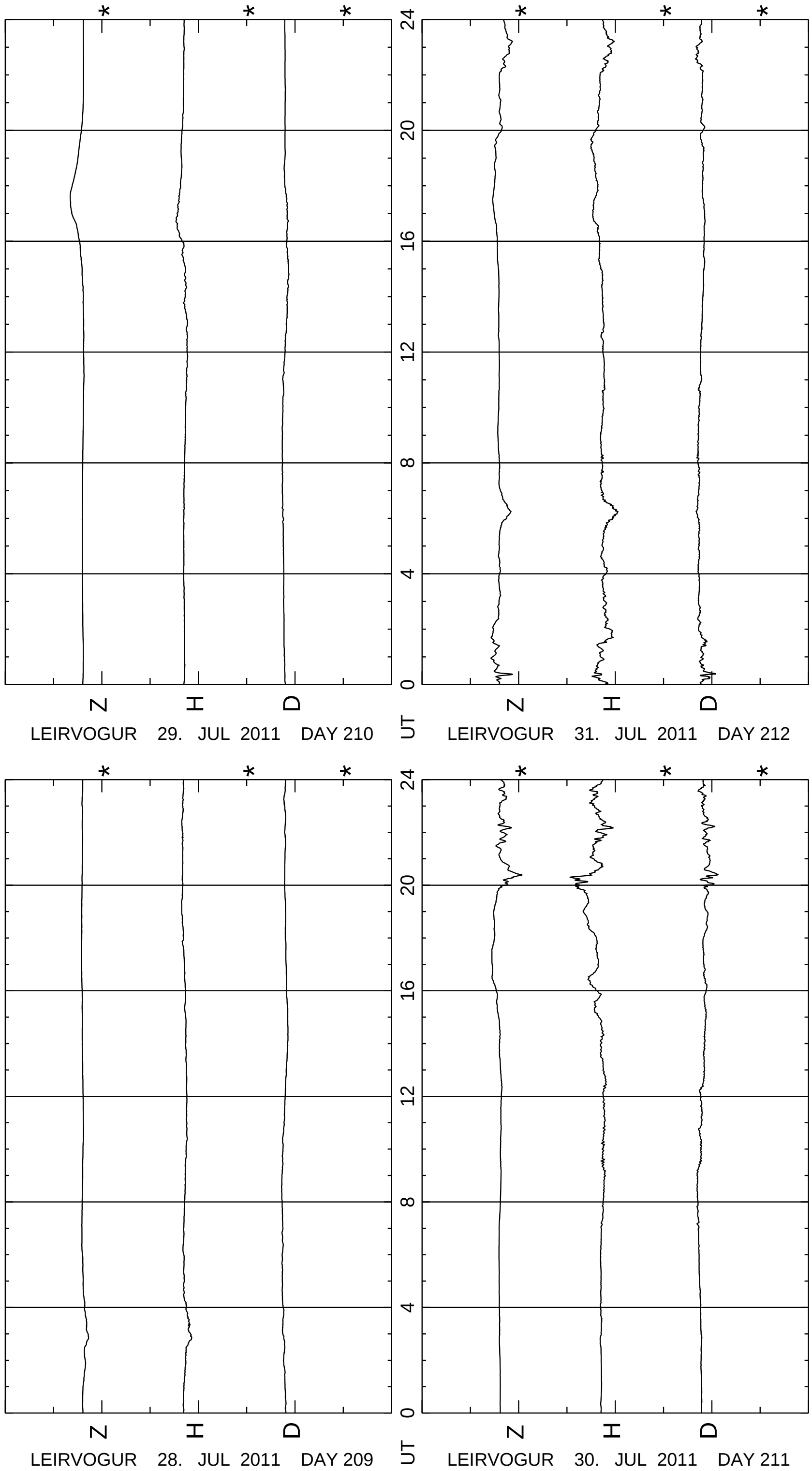

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LEIRVOGUR 29. JUL 2011 DAY 210
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LEIRVOGUR 31. JUL 2011 DAY 212
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LEIRVOGUR 28. JUL 2011 DAY 209
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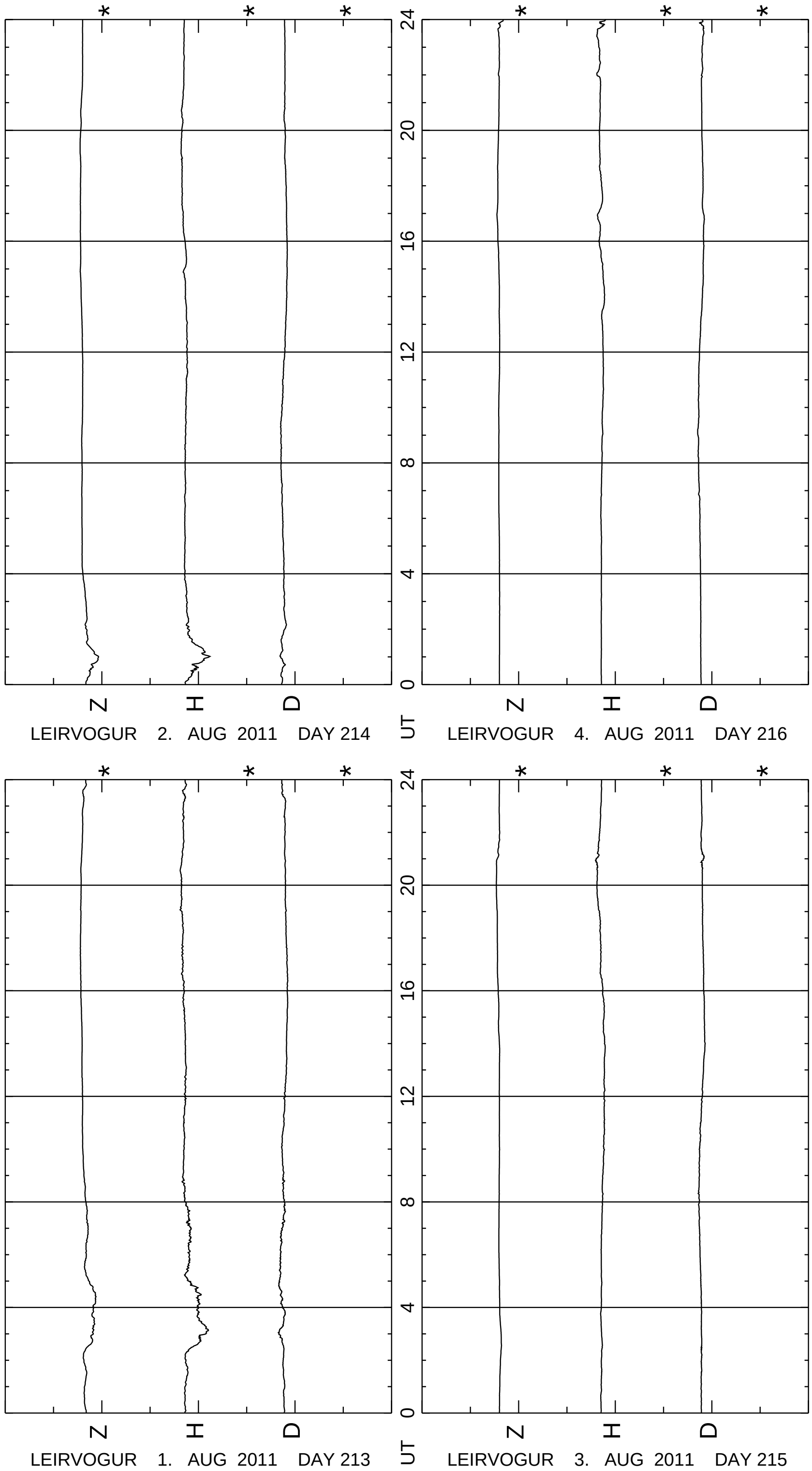
LEIRVOGUR 2. AUG 2011 DAY 214
LEIRVOGUR 4. AUG 2011 DAY 216
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LEIRVOGUR 3. AUG 2011 DAY 215
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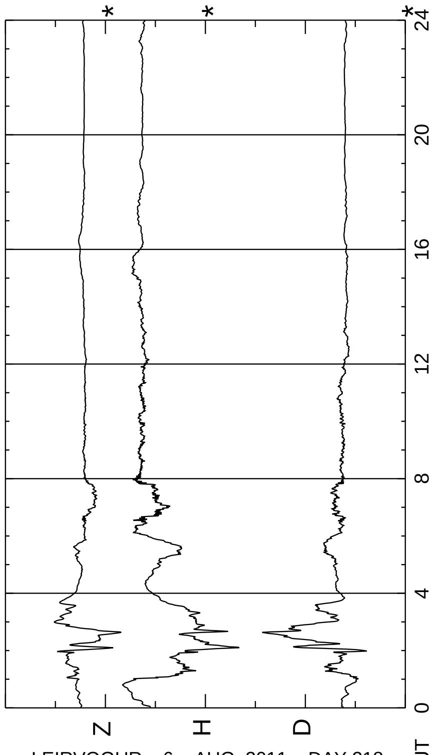

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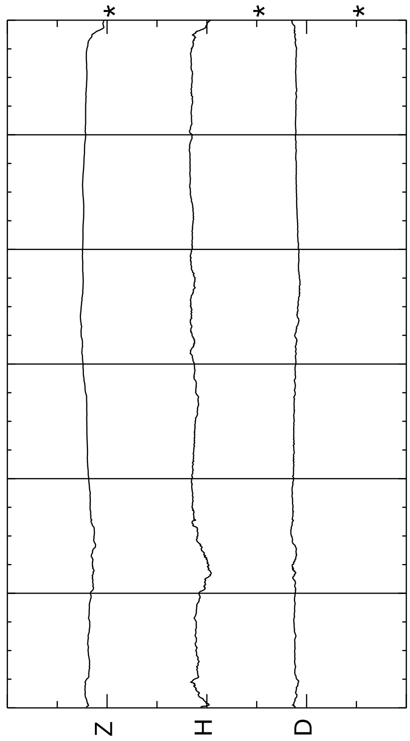

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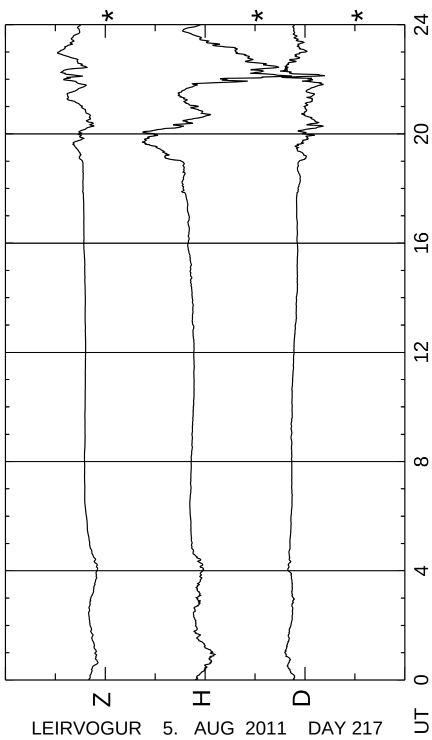

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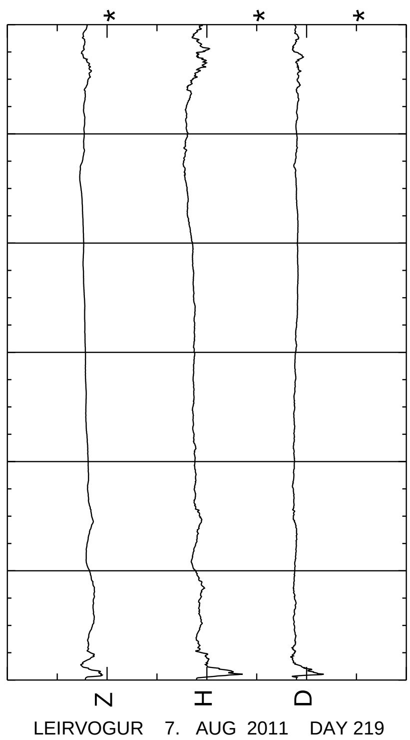
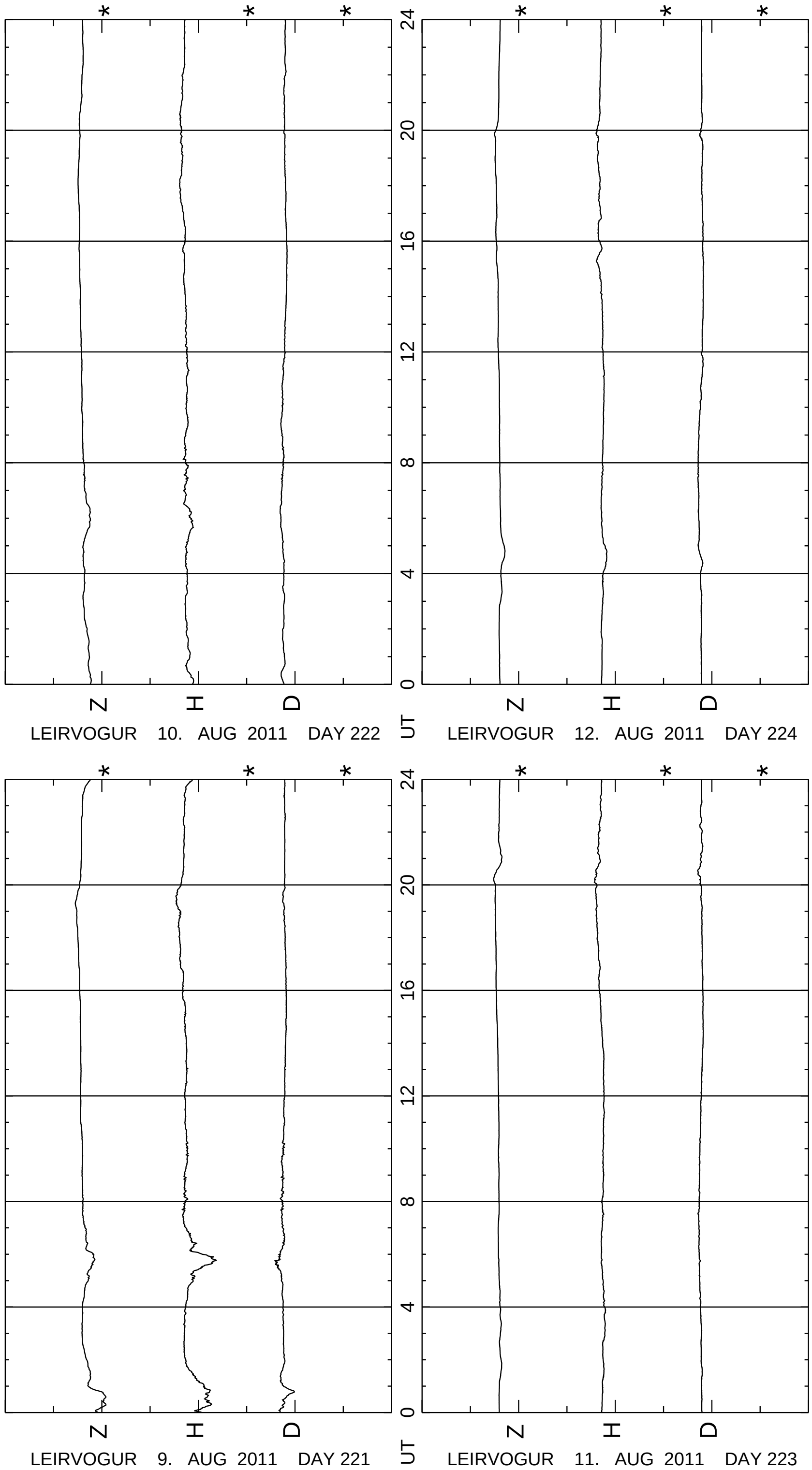


LEIRVOGUR 7. AUG 2011 DAY 219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LEIRVOGUR 11. AUG 2011 DAY 223
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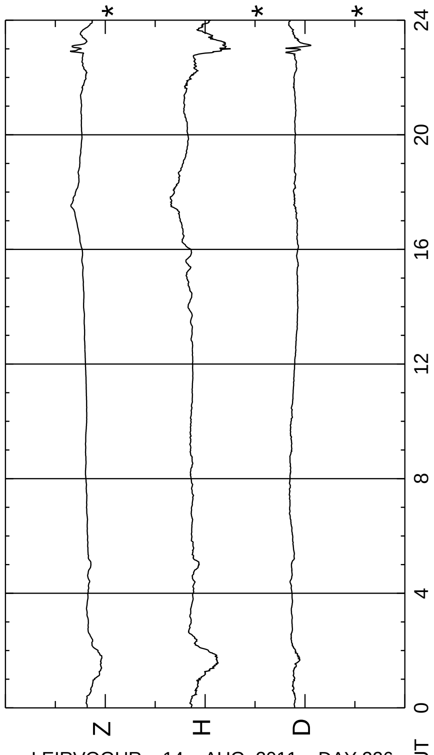

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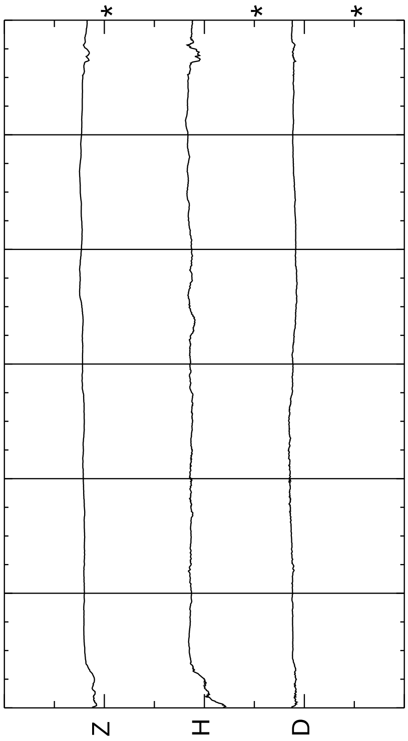
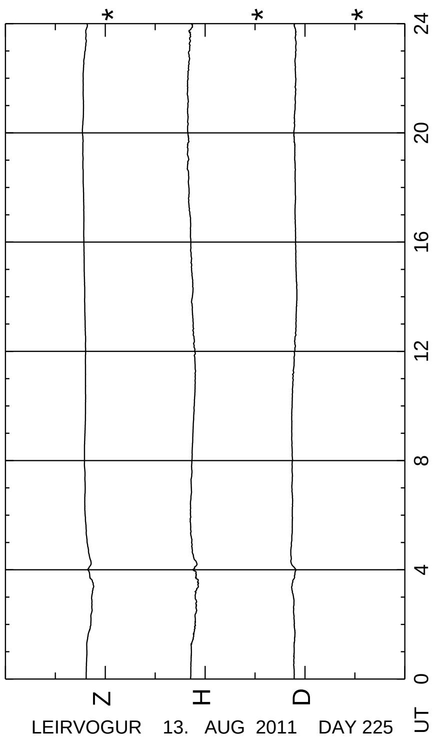


LEIRVOGUR 16. AUG 2011 DAY 228



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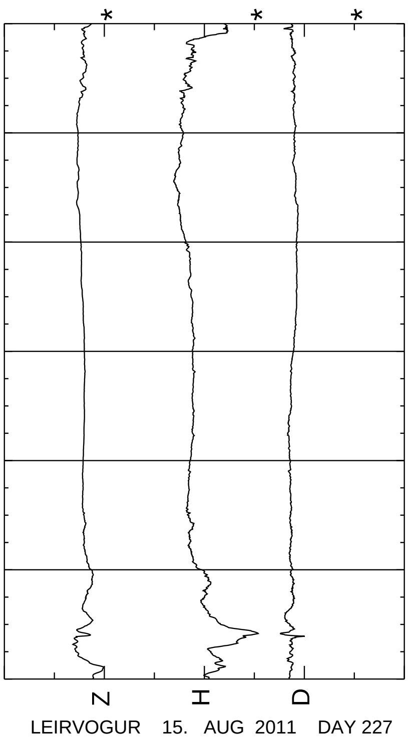

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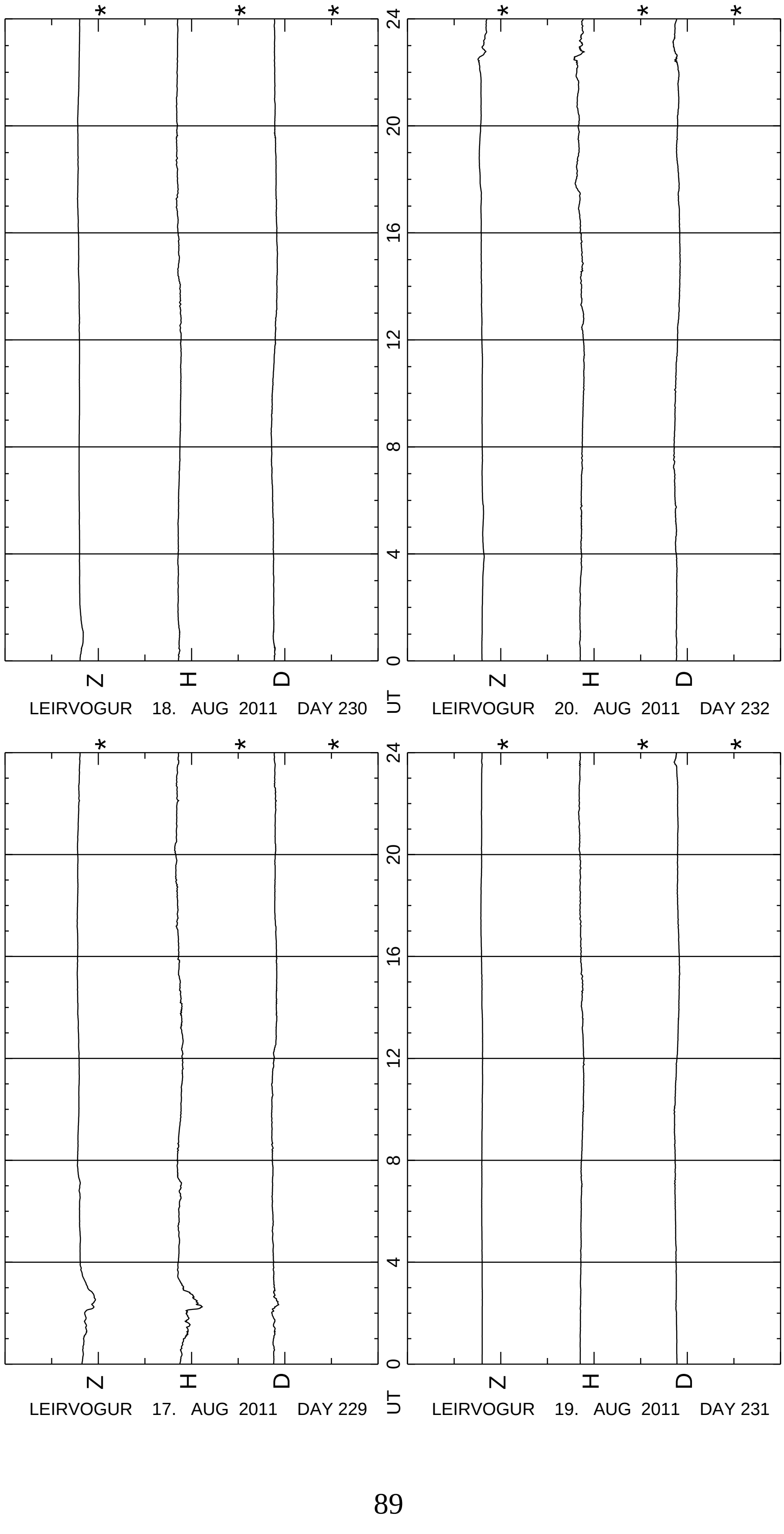
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LEIRVOGUR 19. AUG 2011 DAY 231
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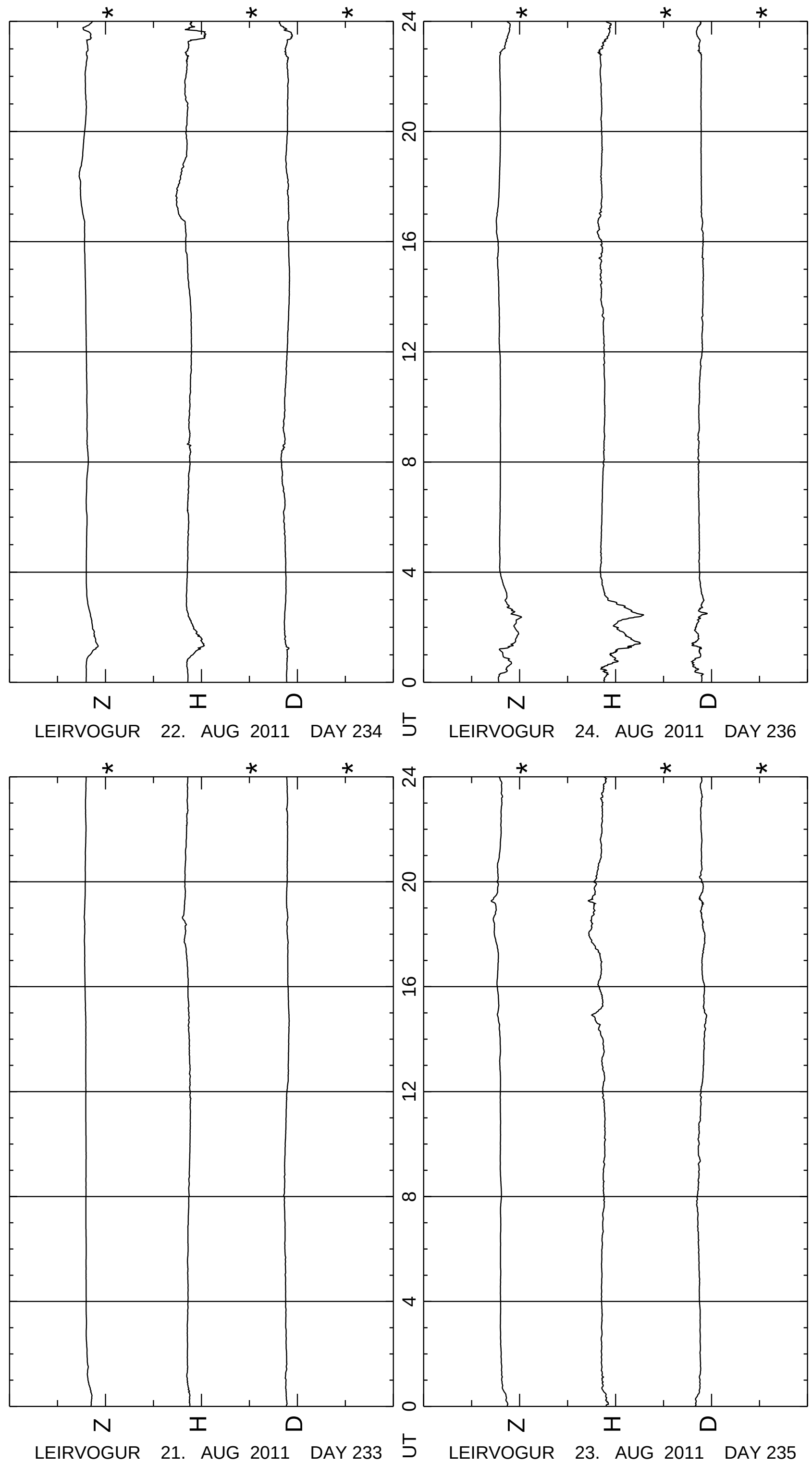
LEIRVOGUR 22. AUG 2011 DAY 234
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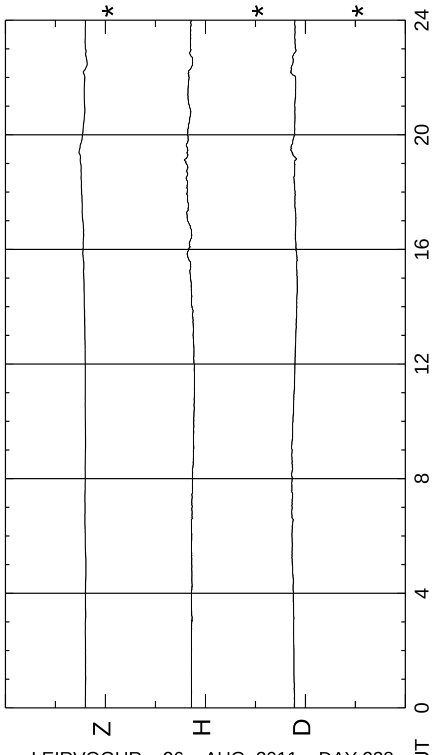

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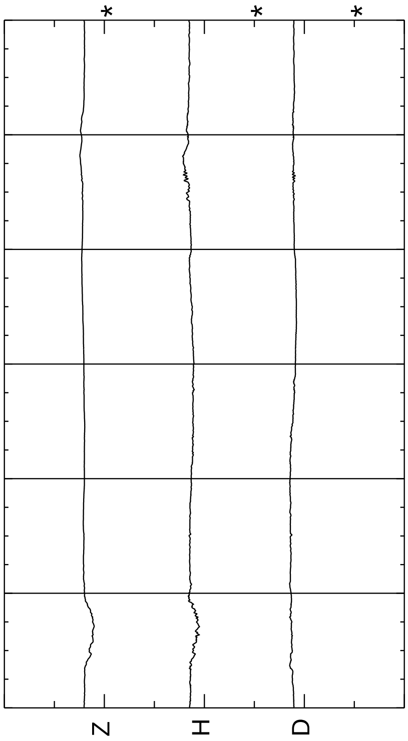

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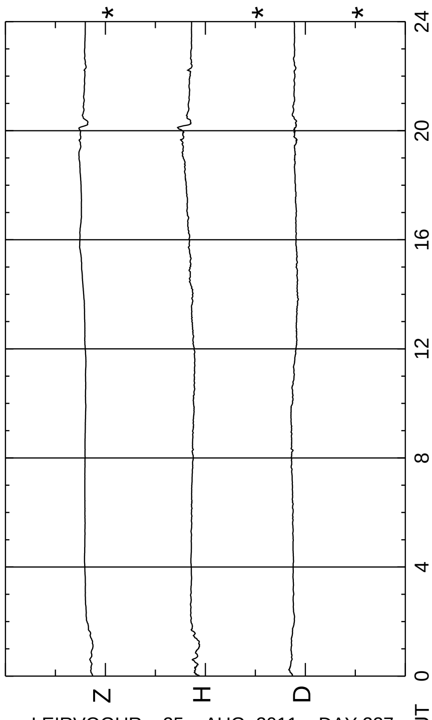
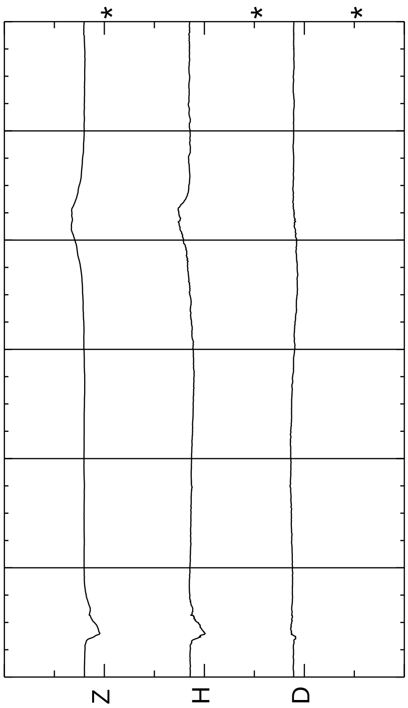


LEIRVOGUR 25. AUG 2011 DAY 237



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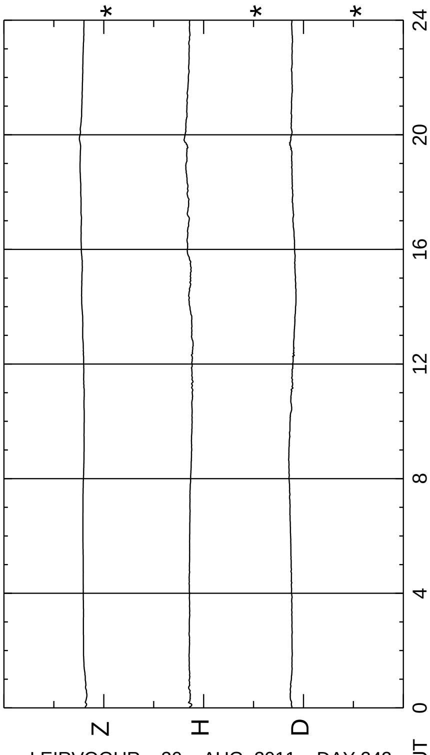

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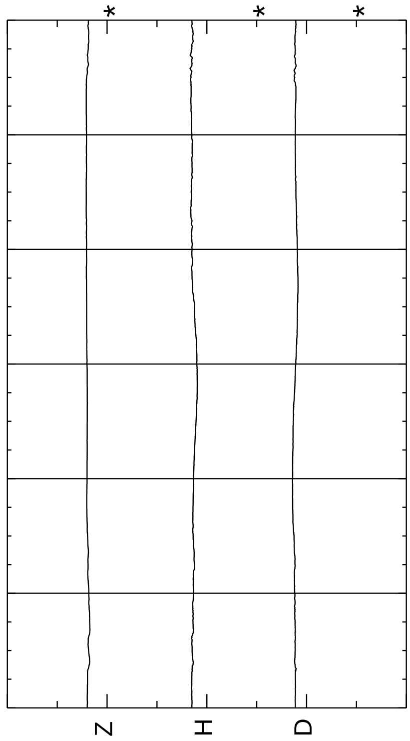
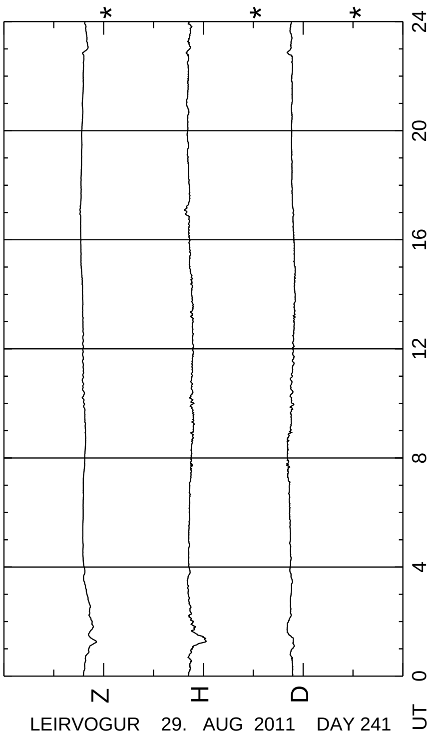
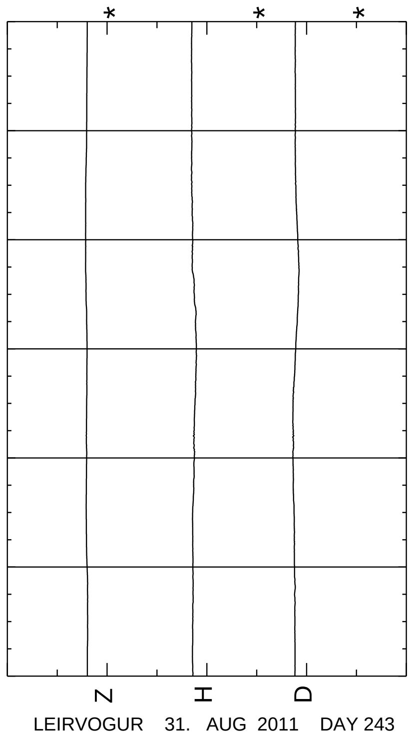


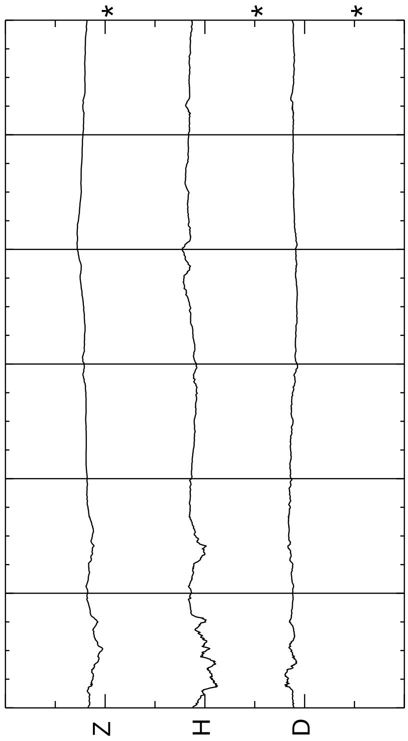
LEIRVOGUR 1. SEP 2011 DAY 244



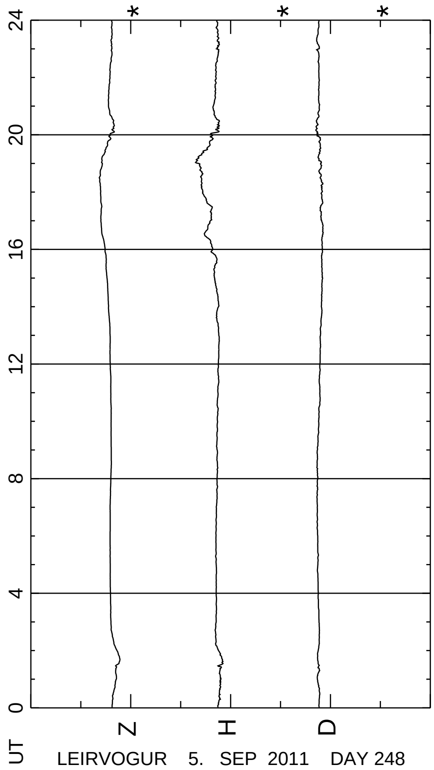
LEIRVOGUR 29. AUG 2011 DAY 241



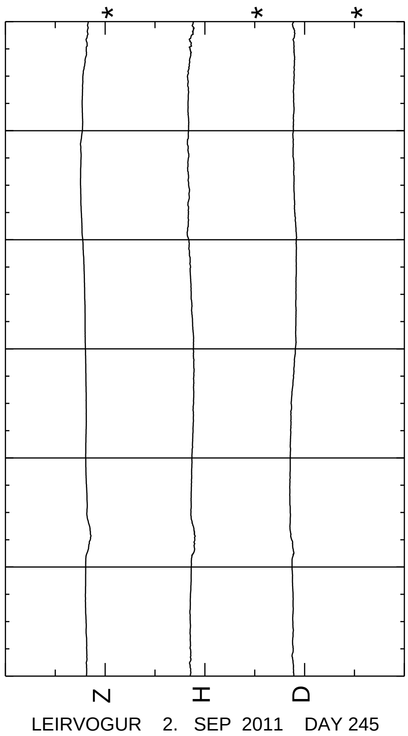
LEIRVOGUR 31. AUG 2011 DAY 243



LEIRVOGUR 3. SEP 2011 DAY 246



LEIRVOGUR 5. SEP 2011 DAY 248



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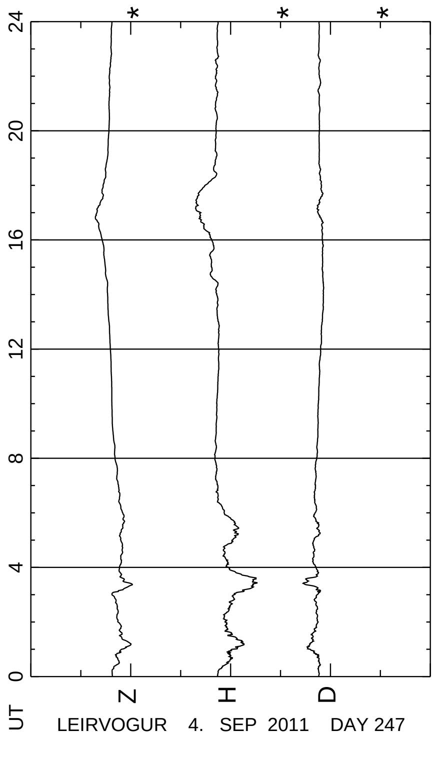
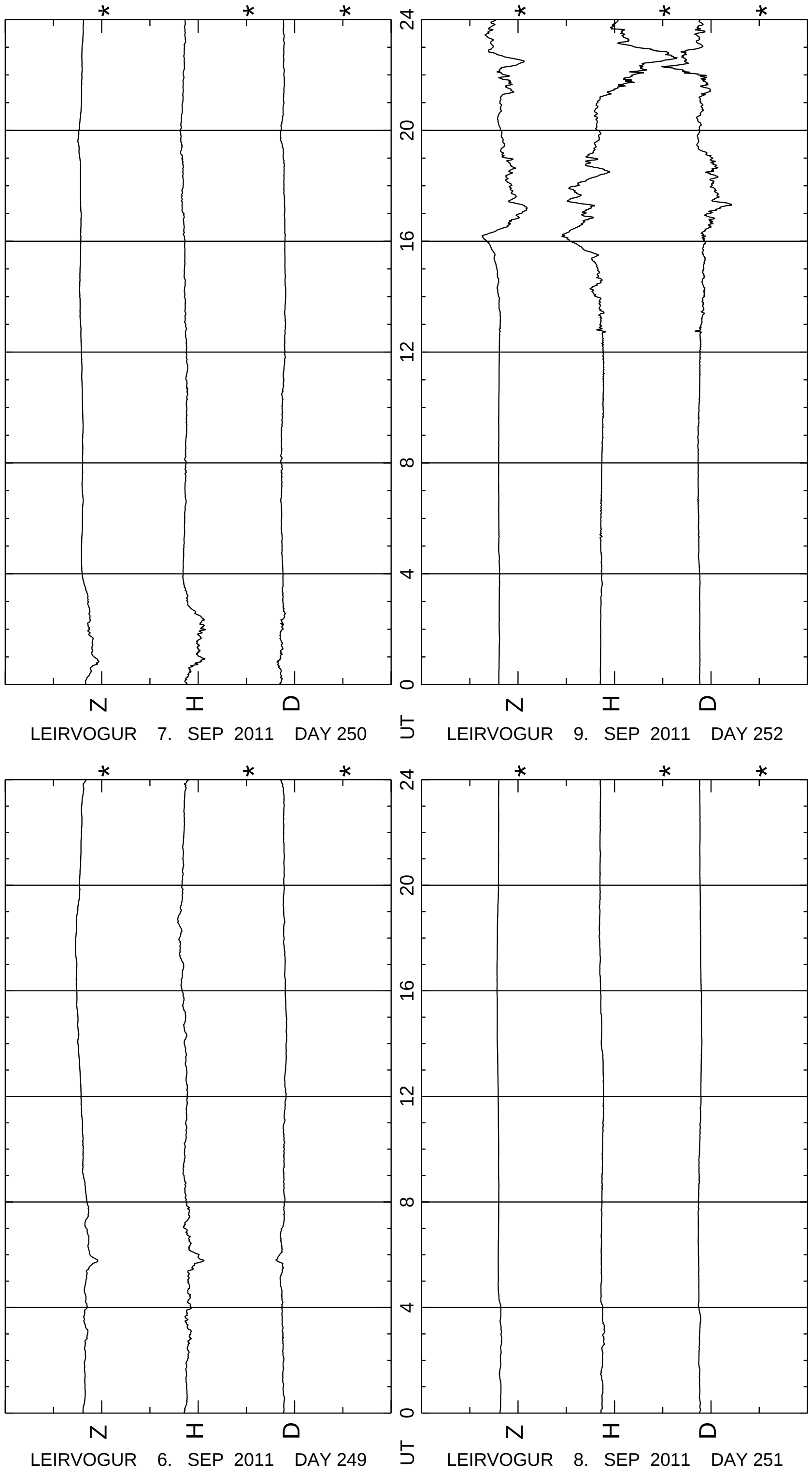


LEIRVOGUR 4. SEP 2011 DAY 247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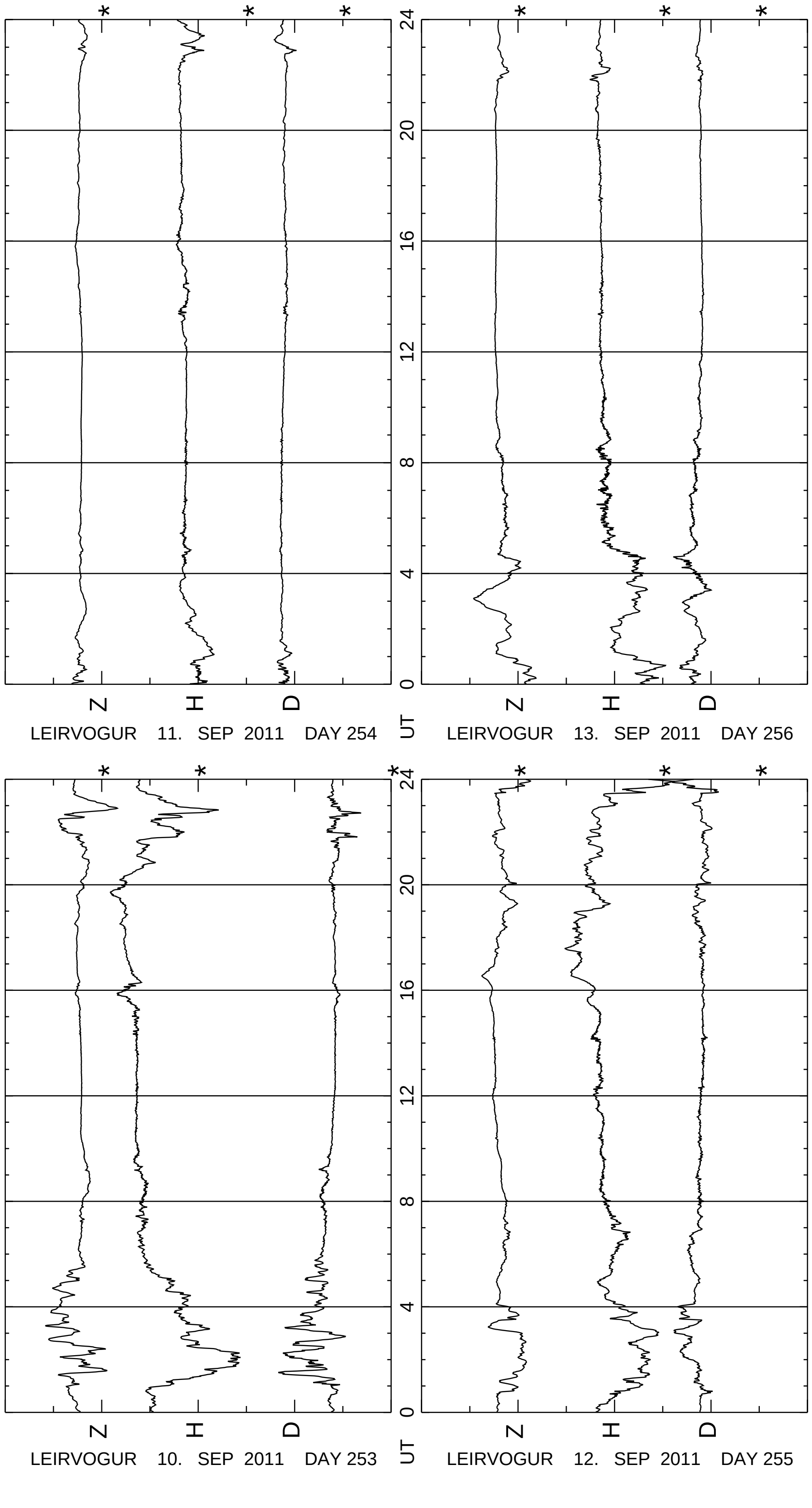
LEIRVOGUR 8. SEP 2011 DAY 251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LEIRVOGUR 12. SEP 2011 DAY 255
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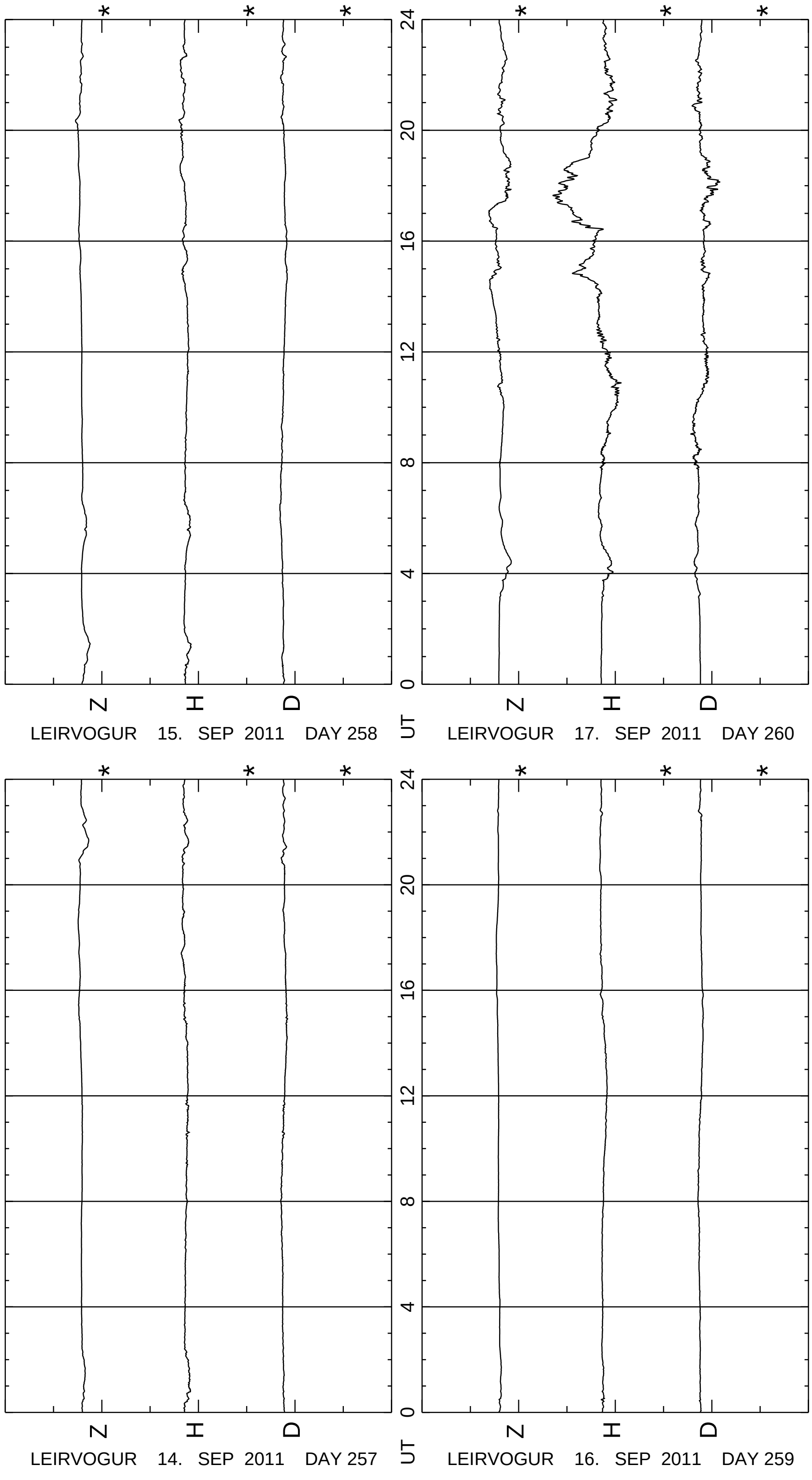
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LEIRVOGUR 17. SEP 2011 DAY 260
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LEIRVOGUR 16. SEP 2011 DAY 259
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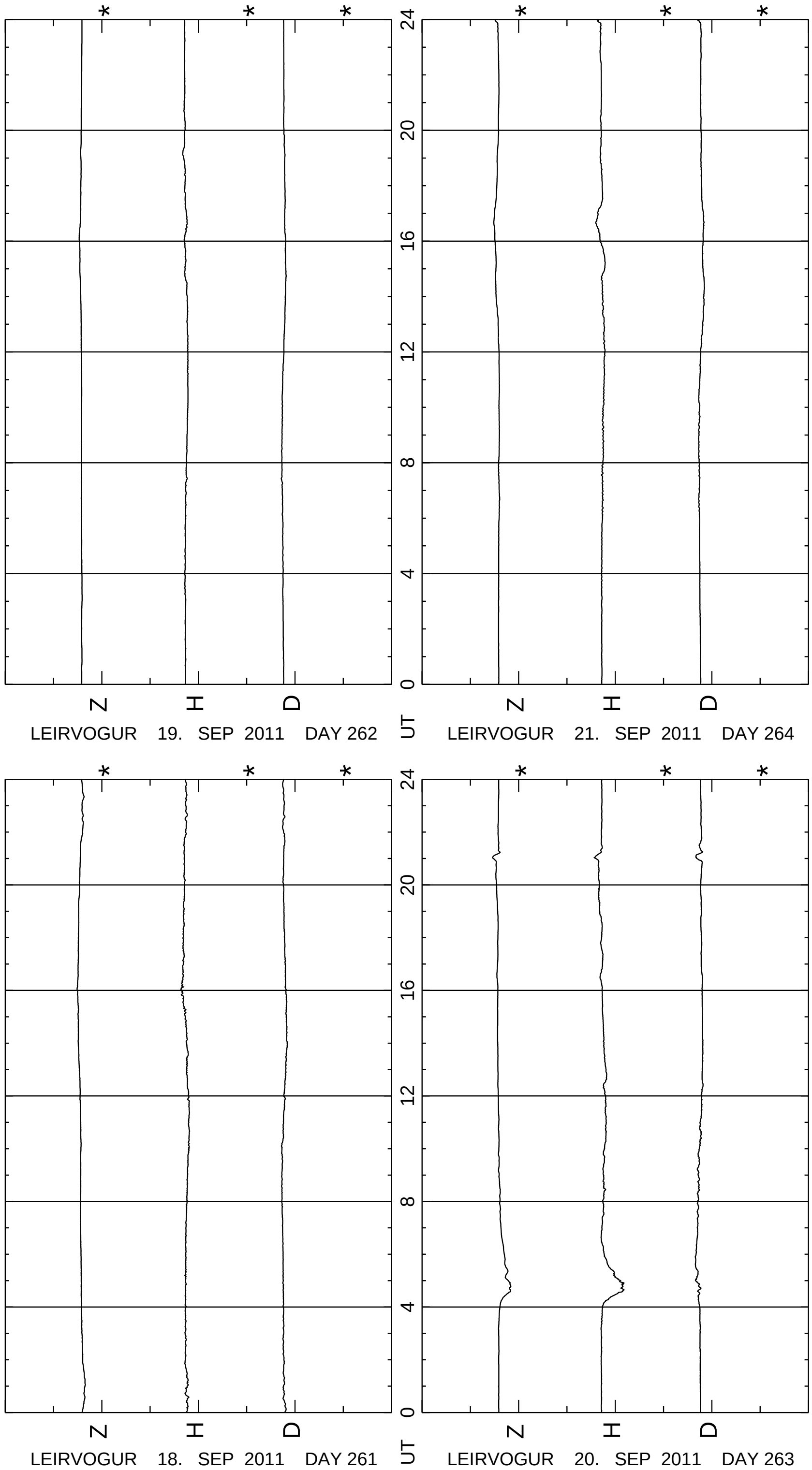

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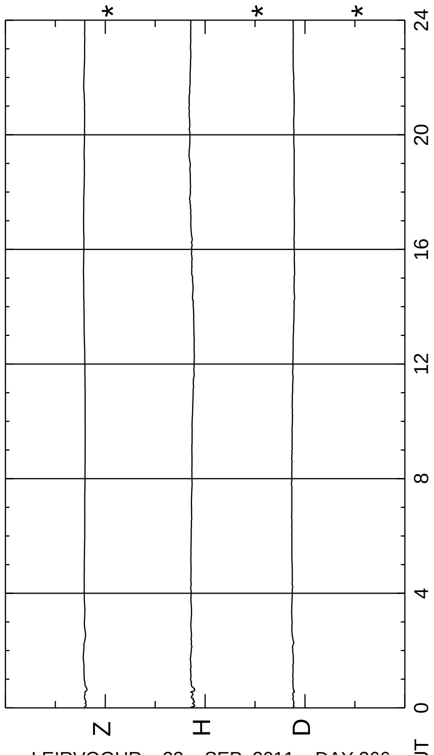
LEIRVOGUR 21. SEP 2011 DAY 264
LEIRVOGUR 18. SEP 2011 DAY 261
LEIRVOGUR 20. SEP 2011 DAY 263



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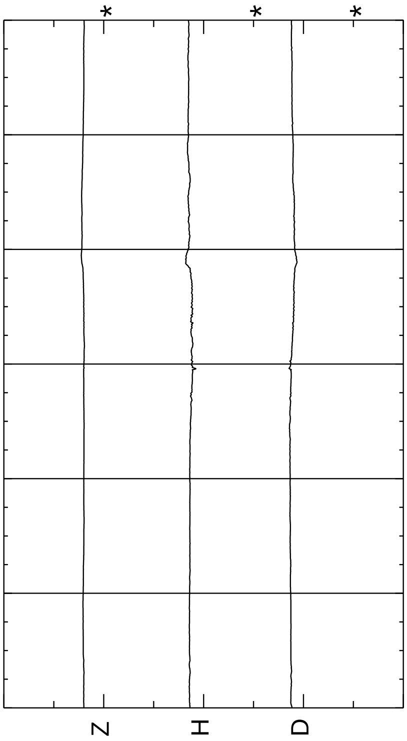

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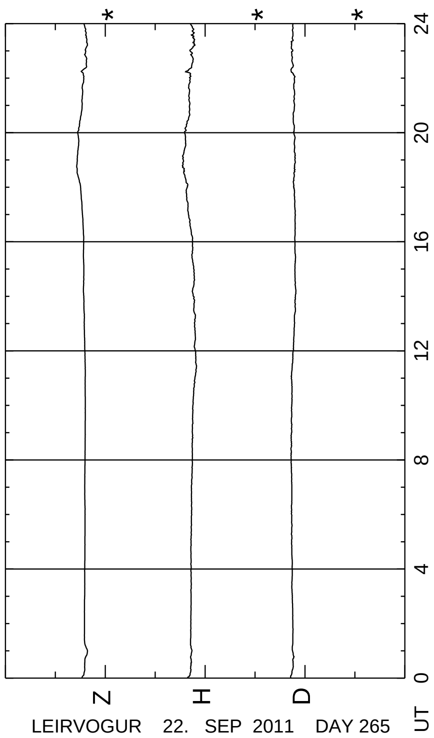
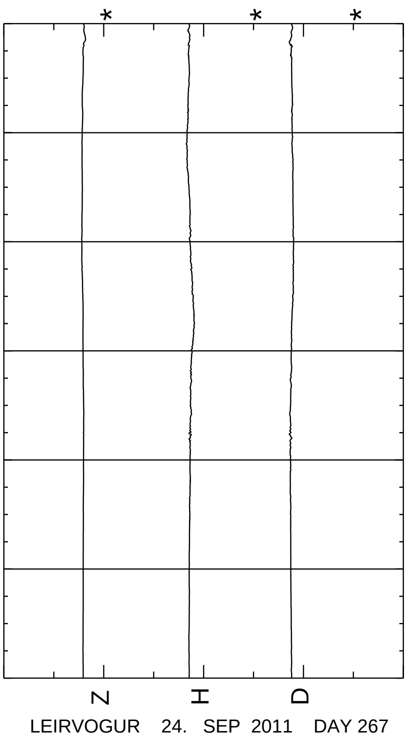


LEIRVOGUR 22. SEP 2011 DAY 265



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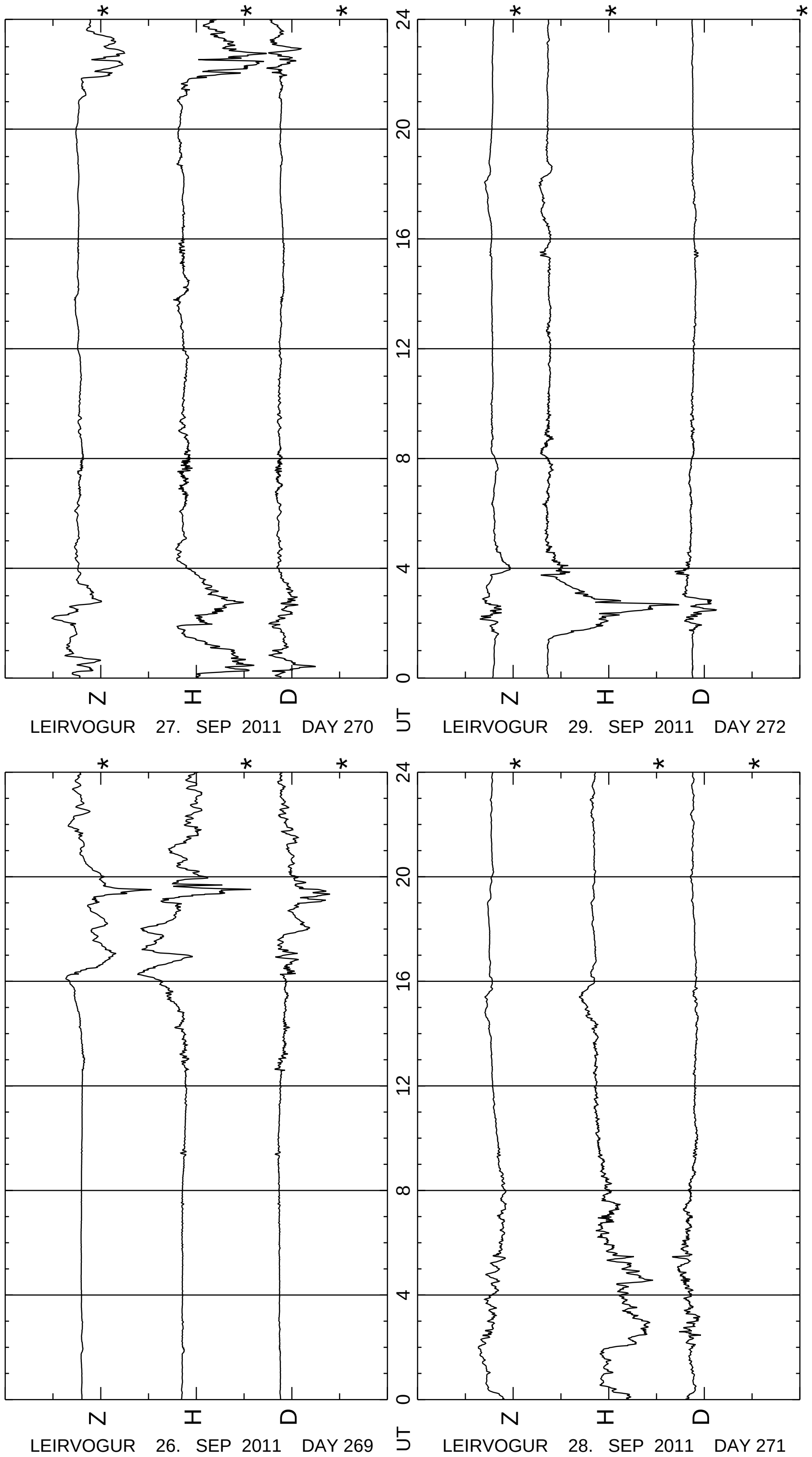
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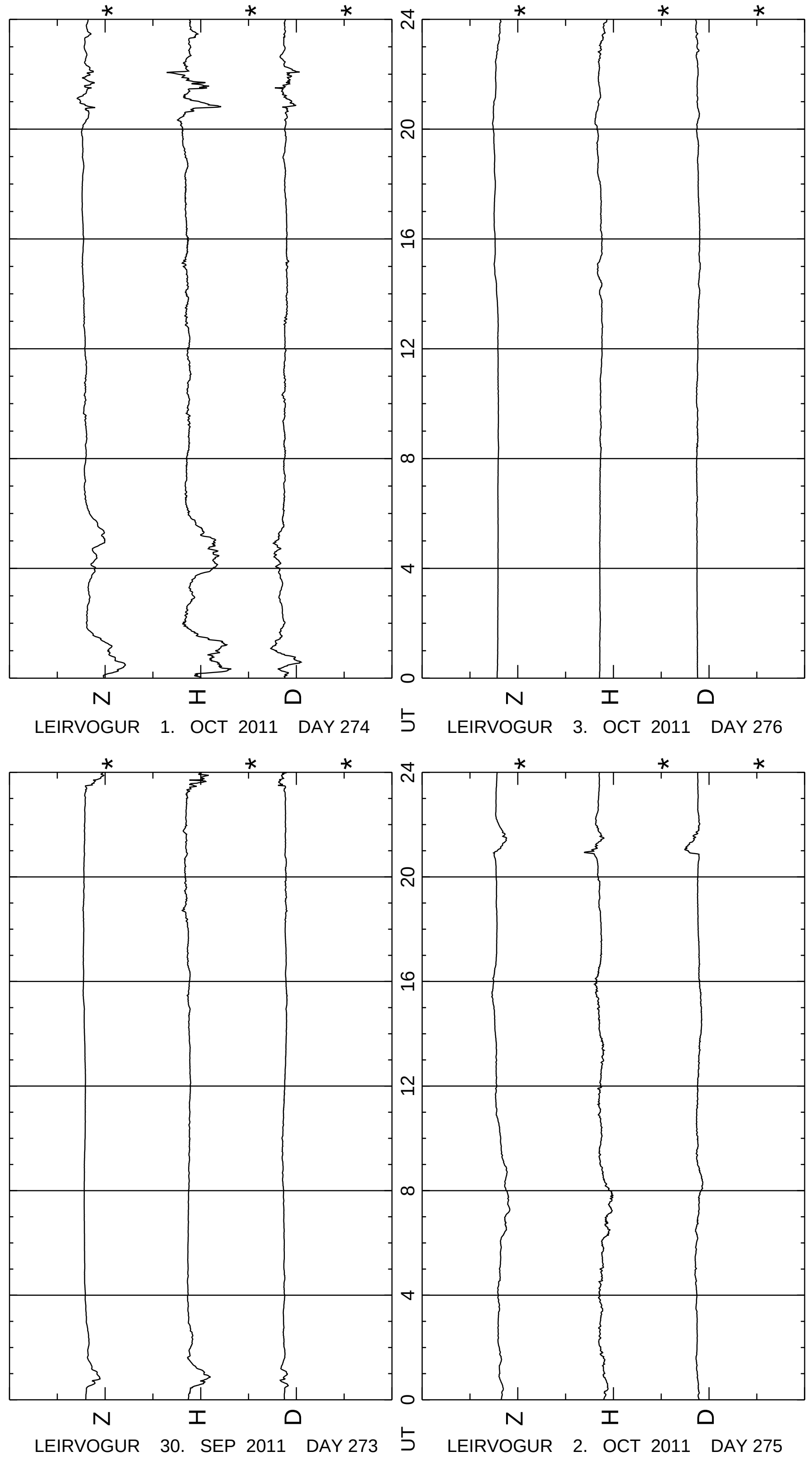
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LEIRVOGUR 3. OCT 2011 DAY 276
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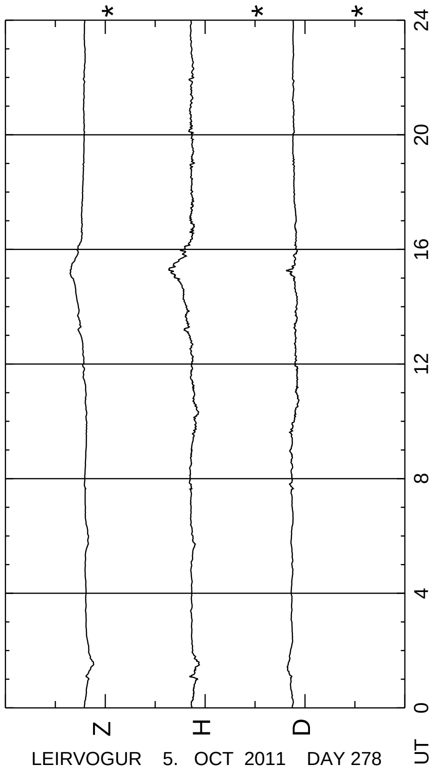
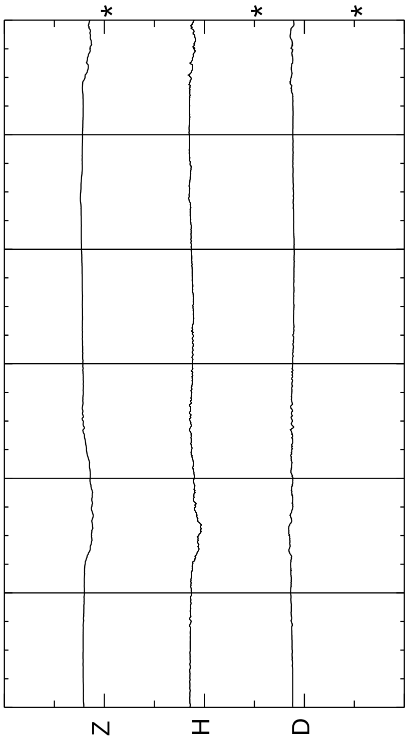
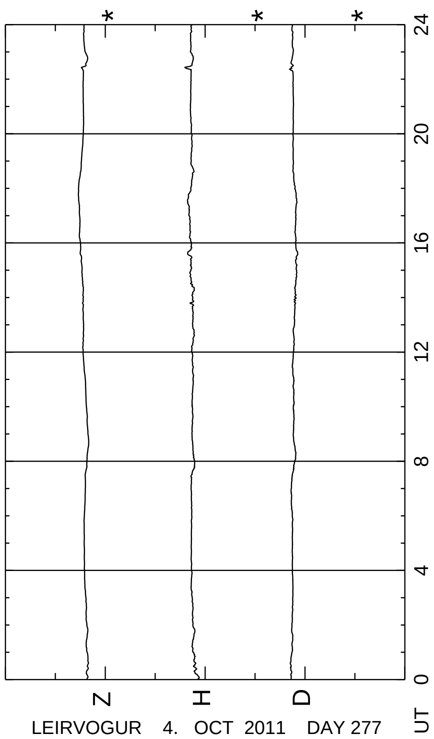


LEIRVOGUR 5. OCT 2011 DAY 278



LEIRVOGUR 7. OCT 2011 DAY 280



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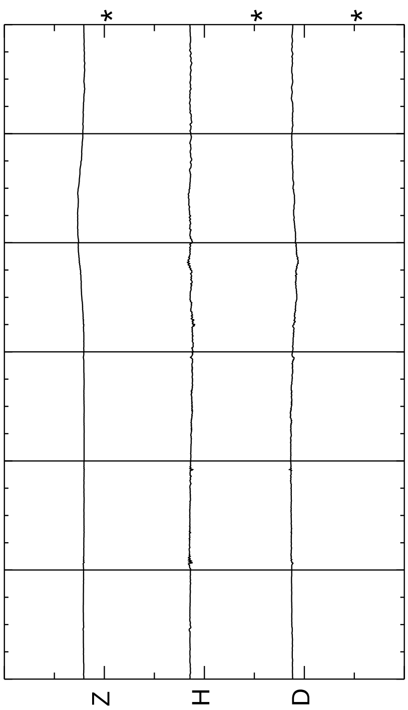

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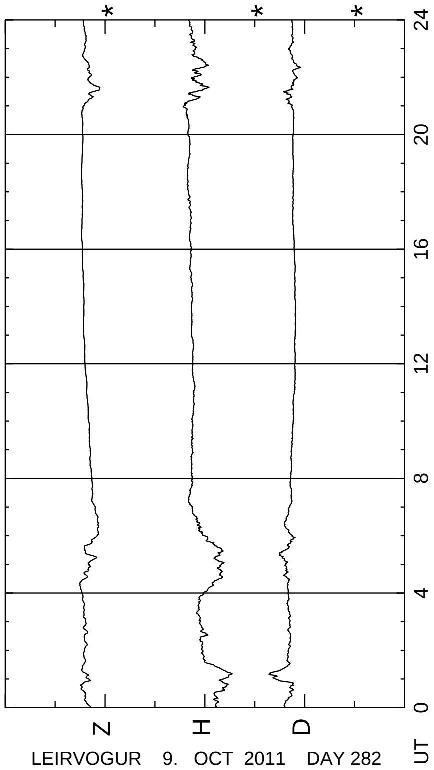

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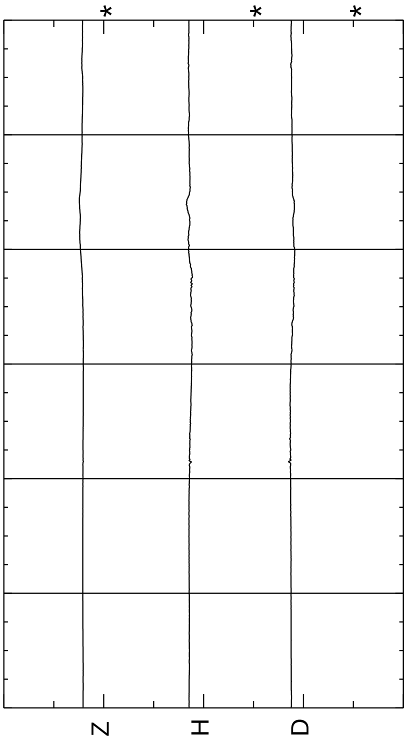
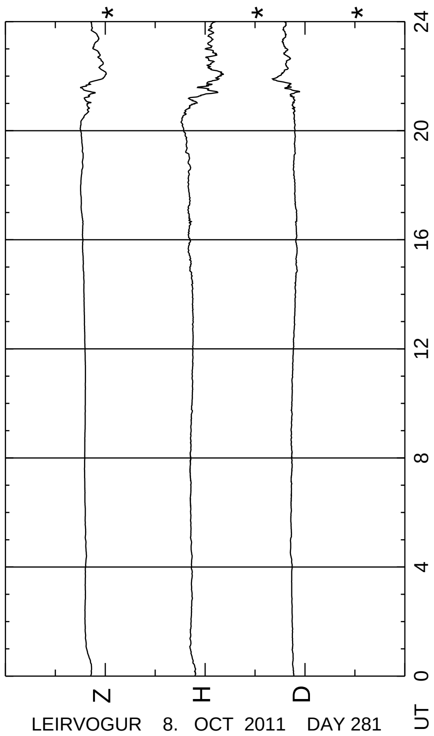
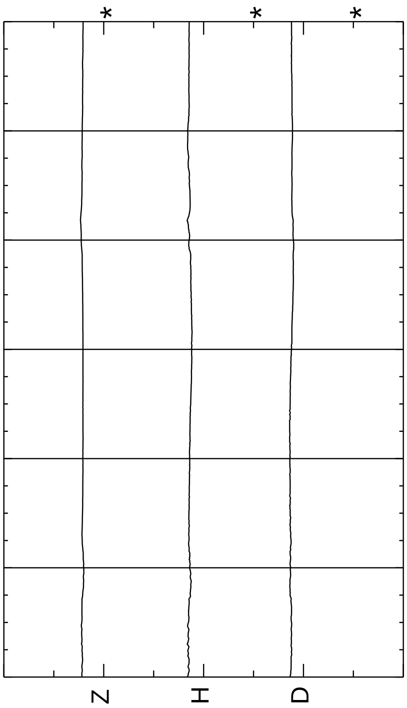


LEIRVOGUR 11. OCT 2011 DAY 284



LEIRVOGUR 8. OCT 2011 DAY 281



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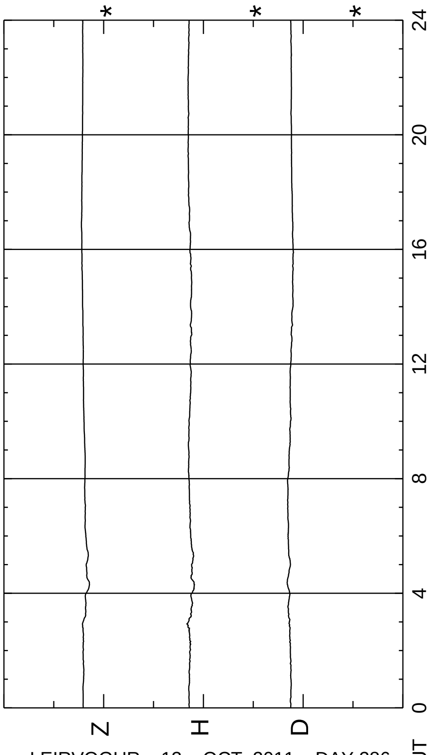

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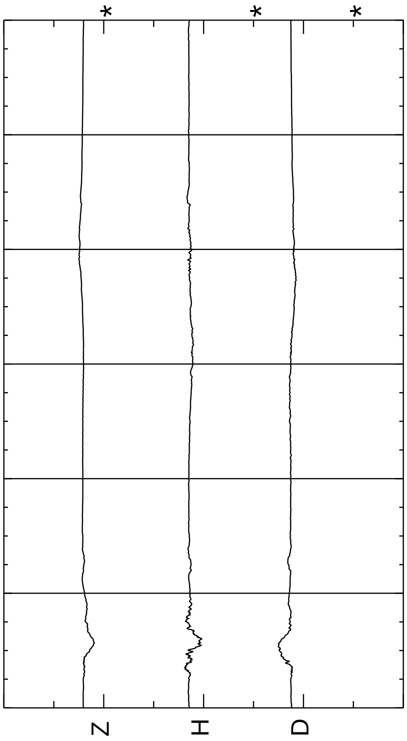

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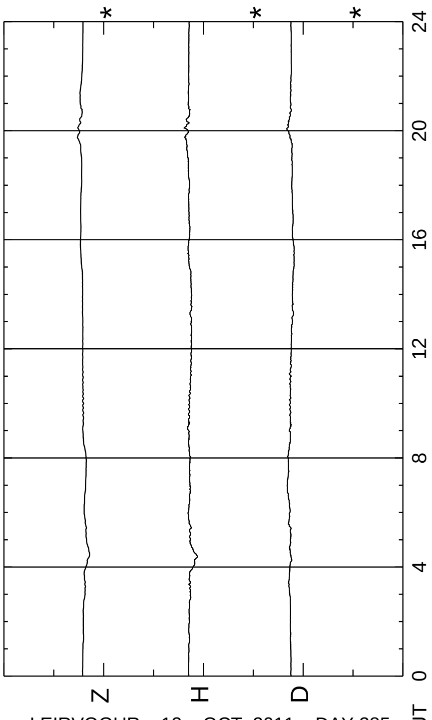

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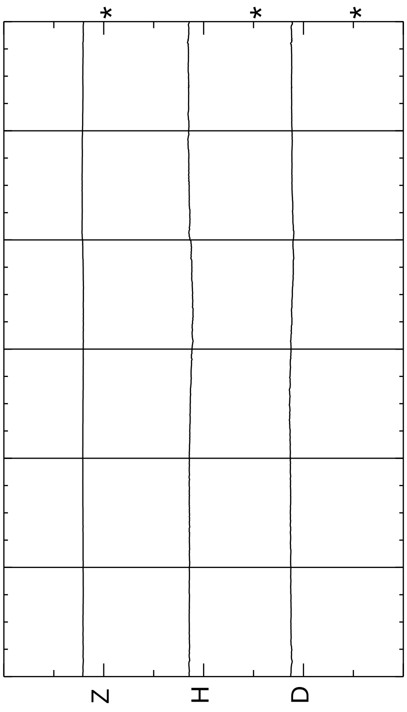

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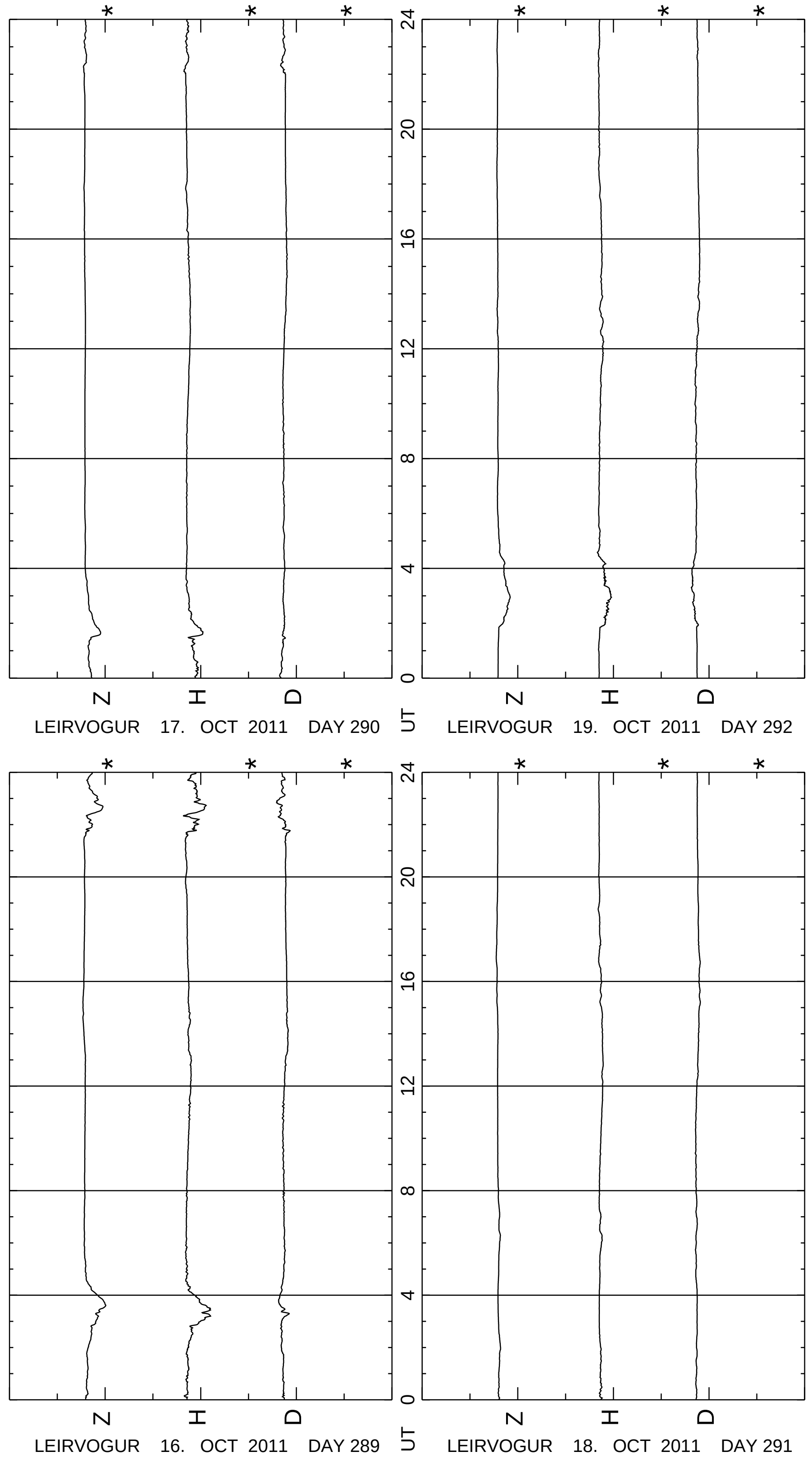
LEIRVOGUR 17. OCT 2011 DAY 290
LEIRVOGUR 19. OCT 2011 DAY 292
LEIRVOGUR 16. OCT 2011 DAY 289
LEIRVOGUR 18. OCT 2011 DAY 291
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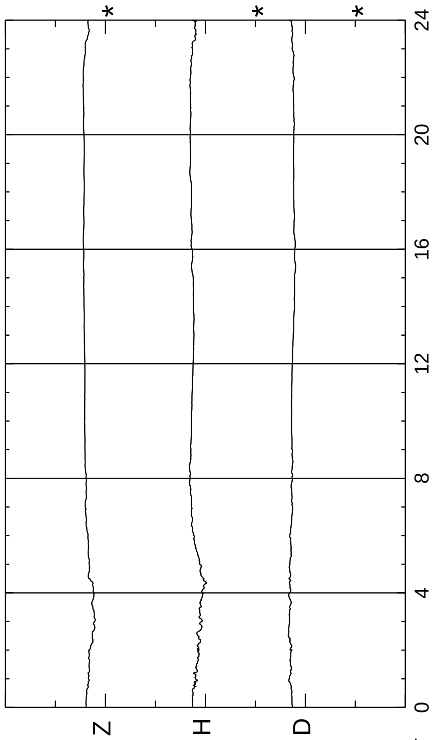

LEIRVOGUR 21. OCT 2011 DAY 294

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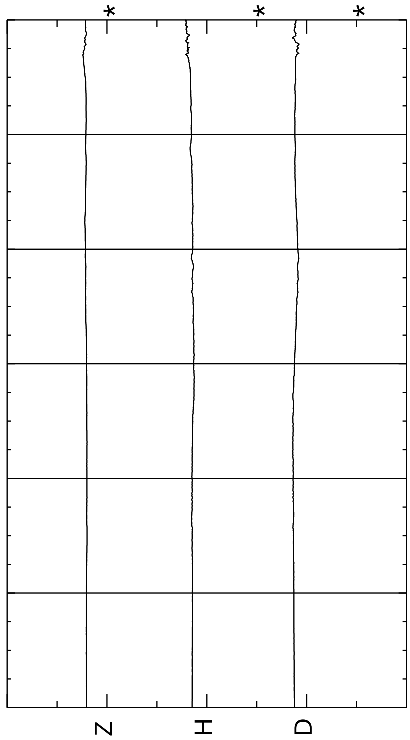

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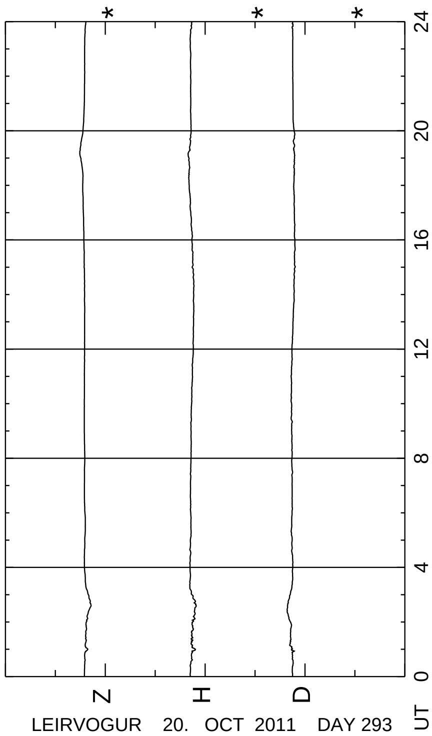

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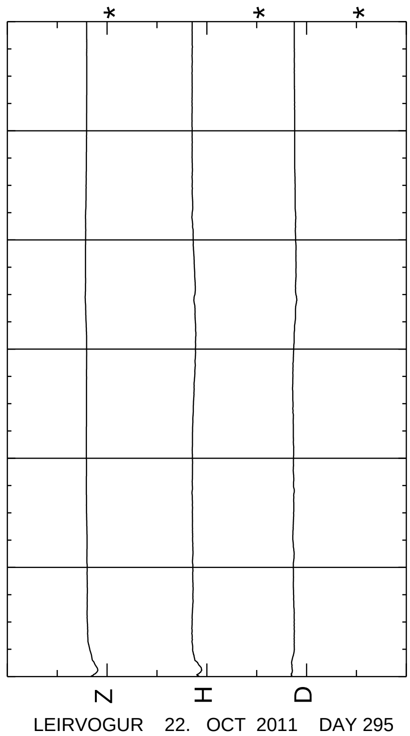

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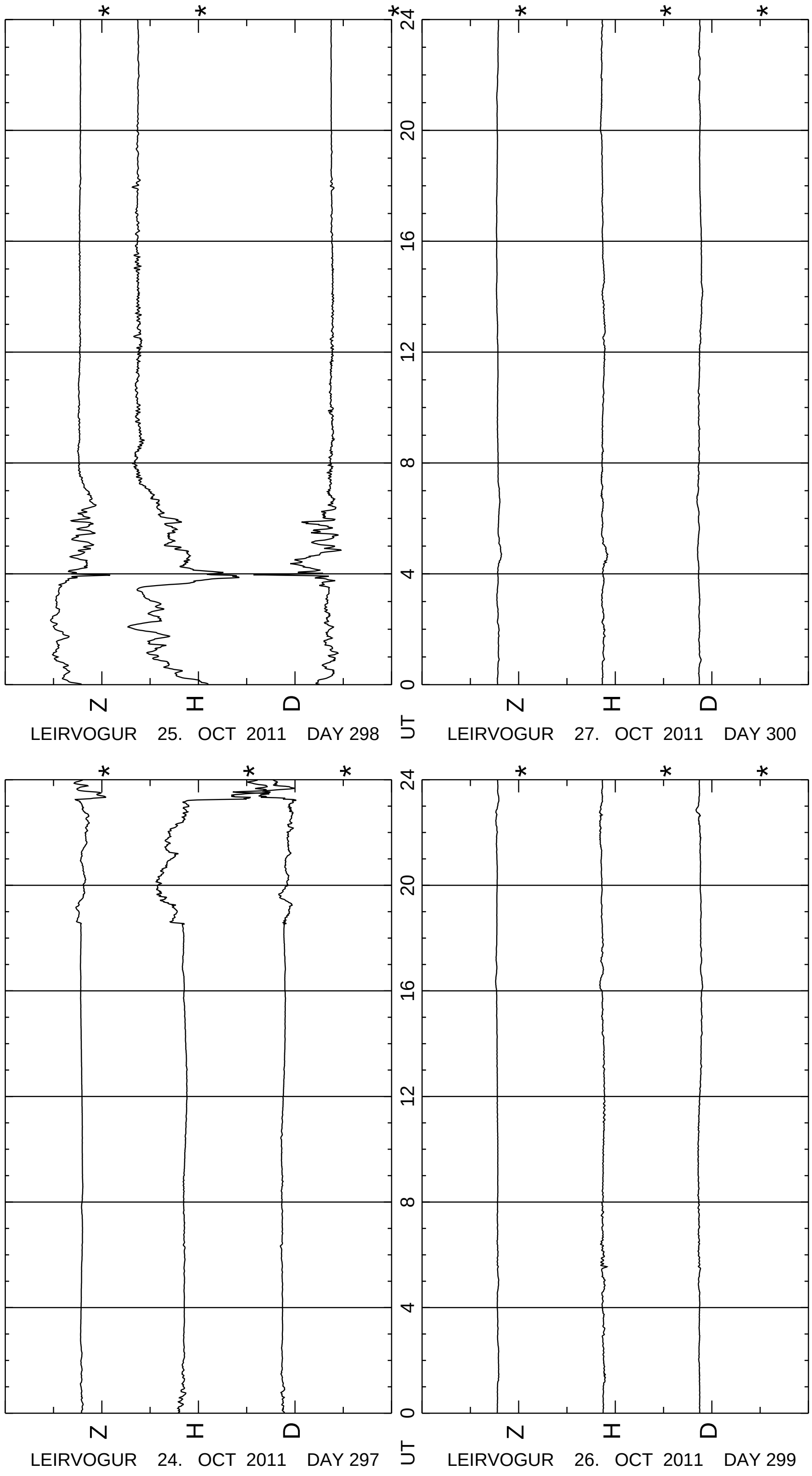
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LEIRVOGUR 27. OCT 2011 DAY 300
Z H D
LEIRVOGUR 24. OCT 2011 DAY 297
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LEIRVOGUR 26. OCT 2011 DAY 299
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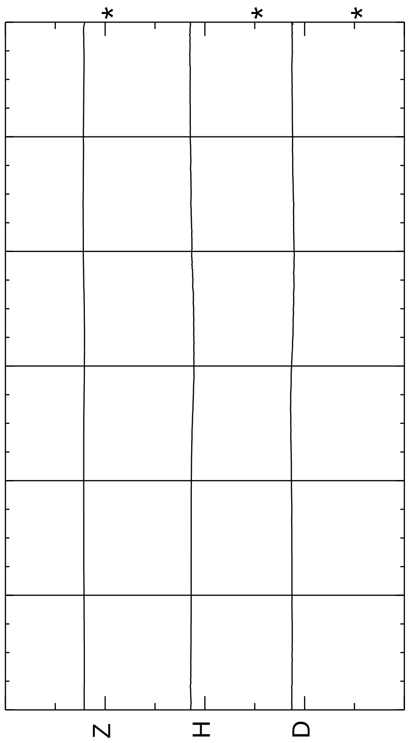

LEIRVOGUR 29. OCT 2011 DAY 302

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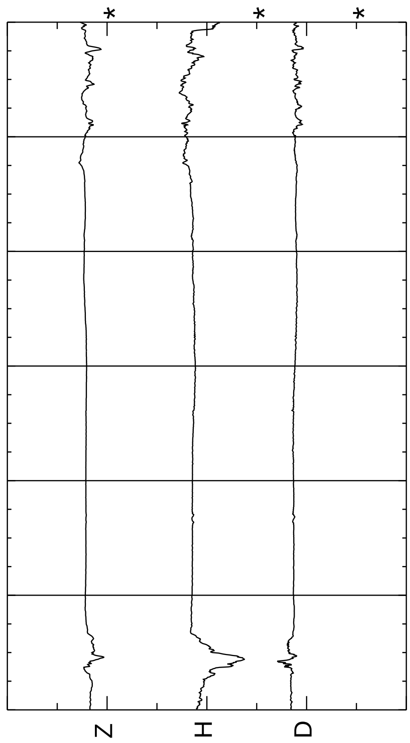
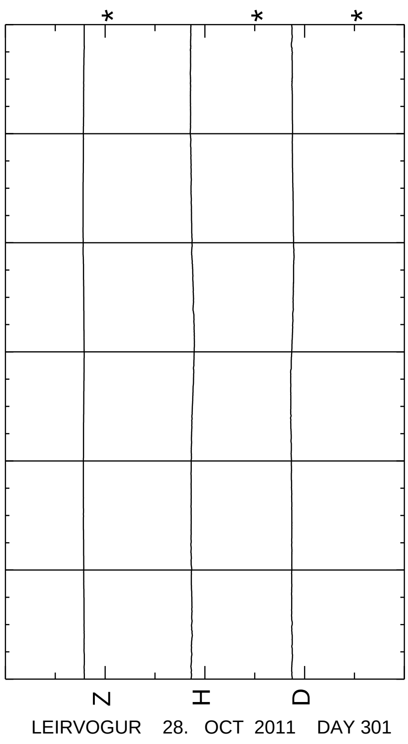


LEIRVOGUR 31. OCT 2011 DAY 304



LEIRVOGUR 28. OCT 2011 DAY 301

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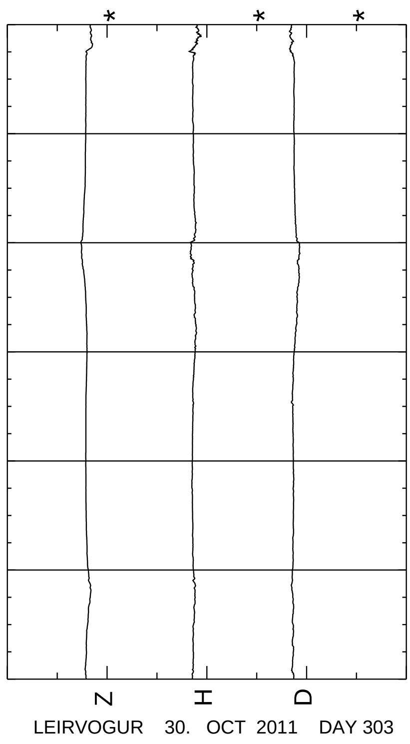
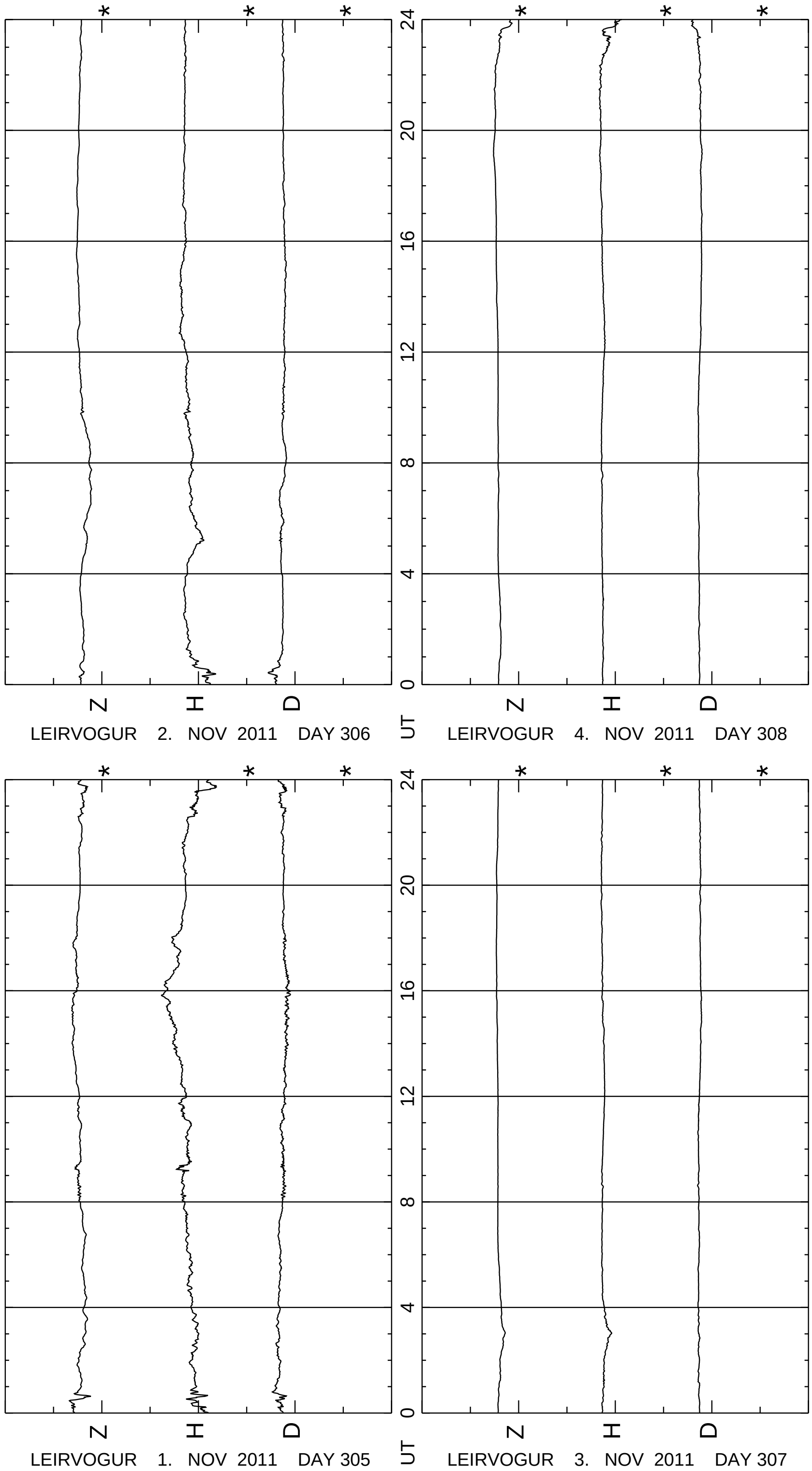


LEIRVOGUR 30. OCT 2011 DAY 303


LEIRVOGUR 2. NOV 2011 DAY 306
LEIRVOGUR 4. NOV 2011 DAY 308
LEIRVOGUR 1. NOV 2011 DAY 305
LEIRVOGUR 3. NOV 2011 DAY 307
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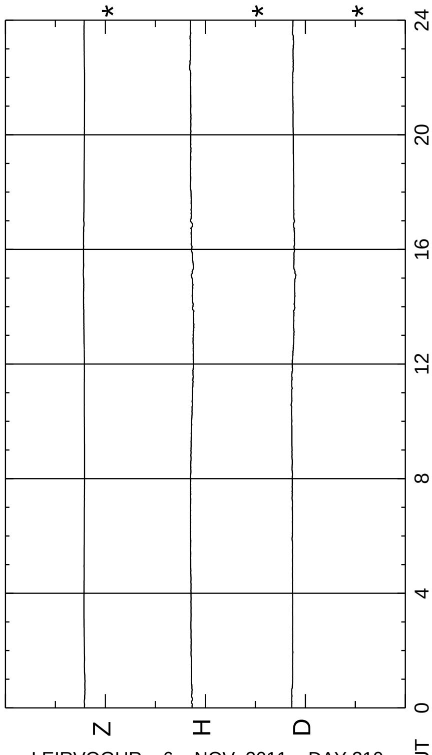
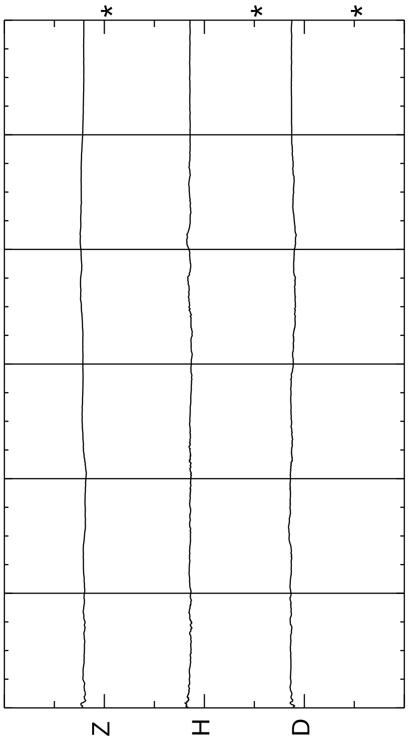
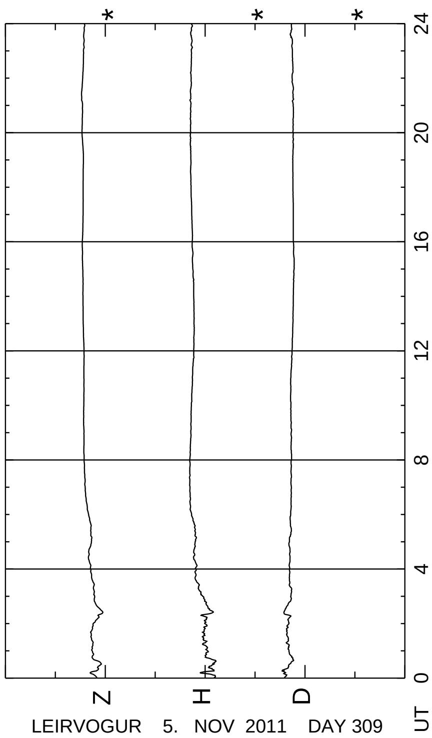


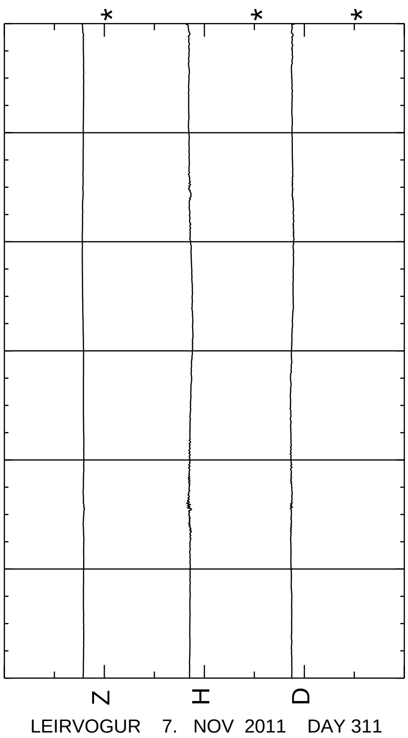
LEIRVOGUR 6. NOV 2011 DAY 310



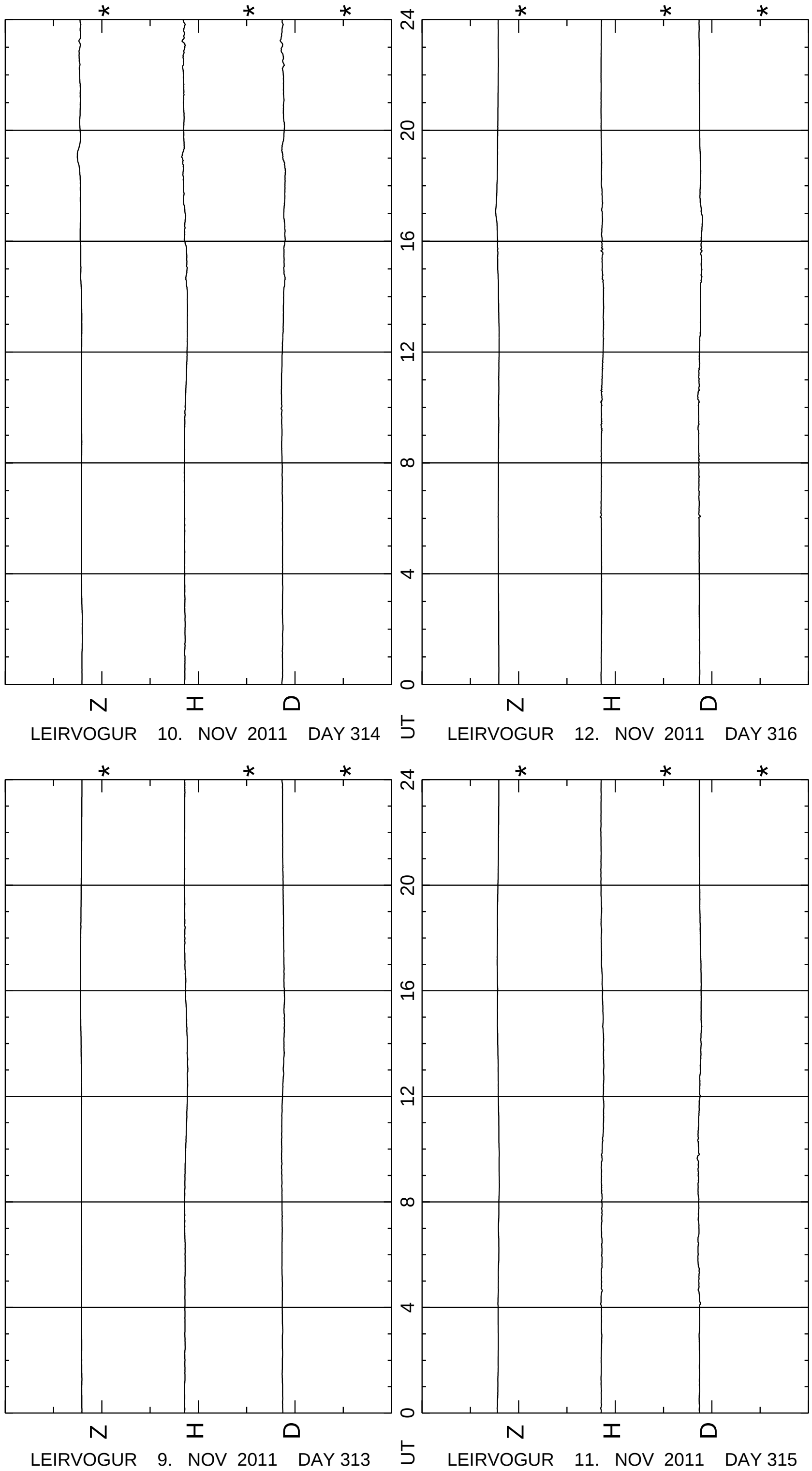
LEIRVOGUR 8. NOV 2011 DAY 312



LEIRVOGUR 5. NOV 2011 DAY 309



LEIRVOGUR 7. NOV 2011 DAY 311


LEIRVOGUR 10. NOV 2011 DAY 314
LEIRVOGUR 12. NOV 2011 DAY 316
LEIRVOGUR 9. NOV 2011 DAY 313
LEIRVOGUR 11. NOV 2011 DAY 315
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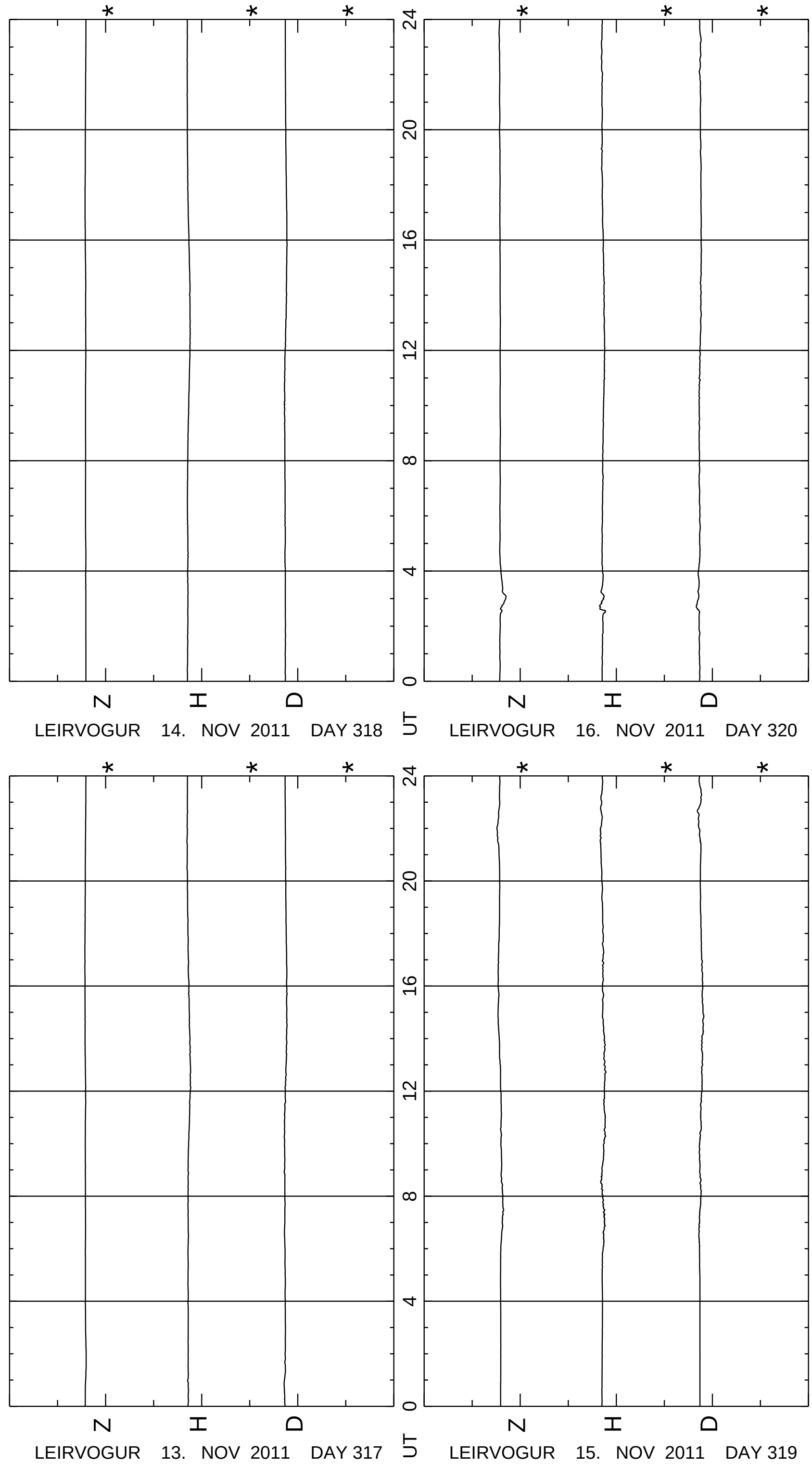
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LEIRVOGUR 16. NOV 2011 DAY 320
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LEIRVOGUR 15. NOV 2011 DAY 319
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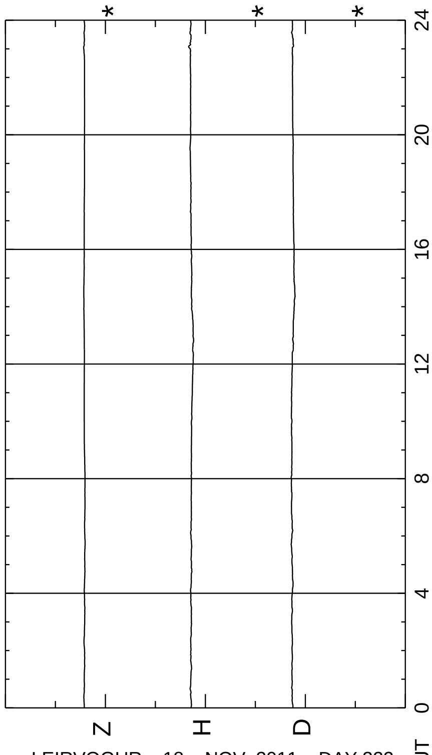
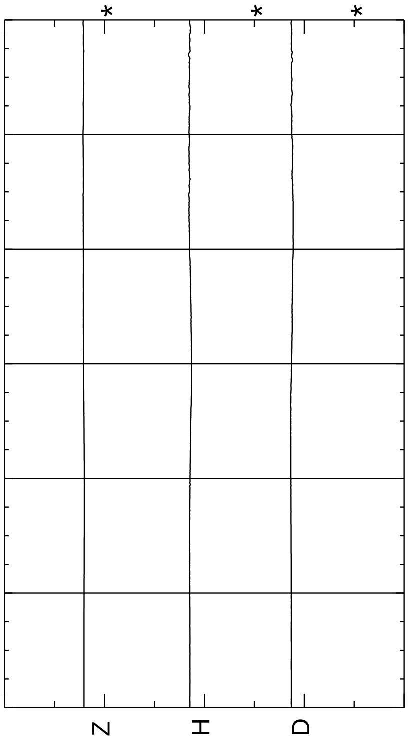
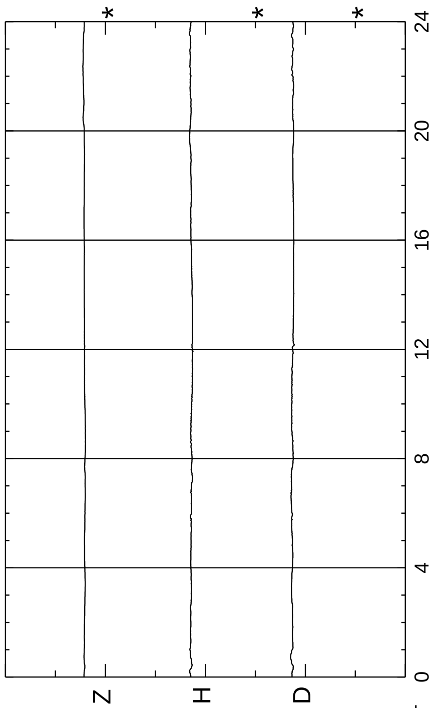


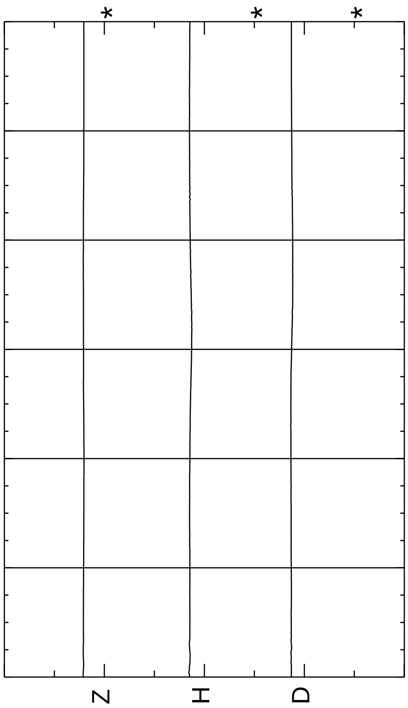
UT LEIRVOGUR 18. NOV 2011 DAY 322



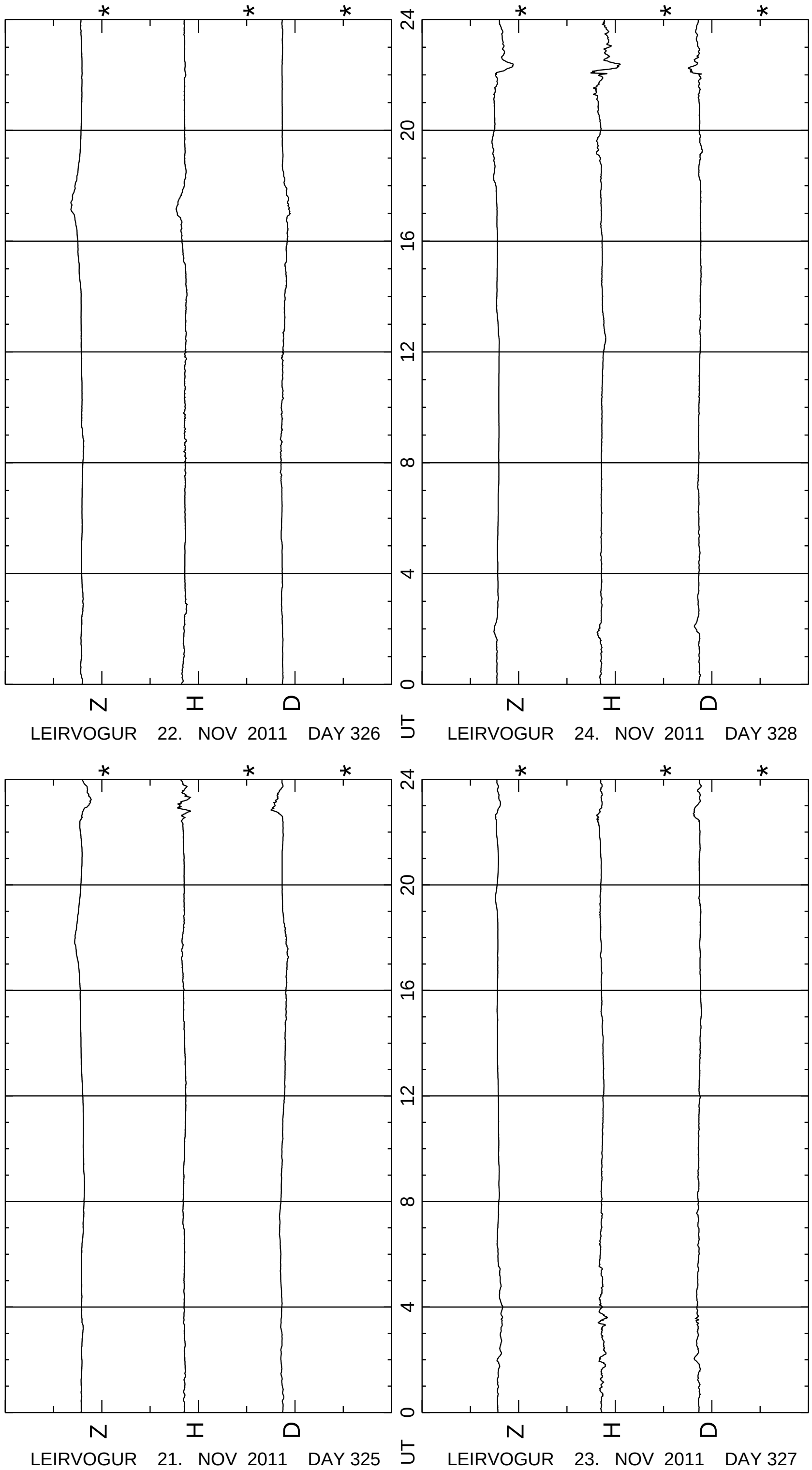
LEIRVOGUR 20. NOV 2011 DAY 324



UT LEIRVOGUR 17. NOV 2011 DAY 321



LEIRVOGUR 19. NOV 2011 DAY 323


LEIRVOGUR 22. NOV 2011 DAY 326
LEIRVOGUR 24. NOV 2011 DAY 328
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LEIRVOGUR 23. NOV 2011 DAY 327
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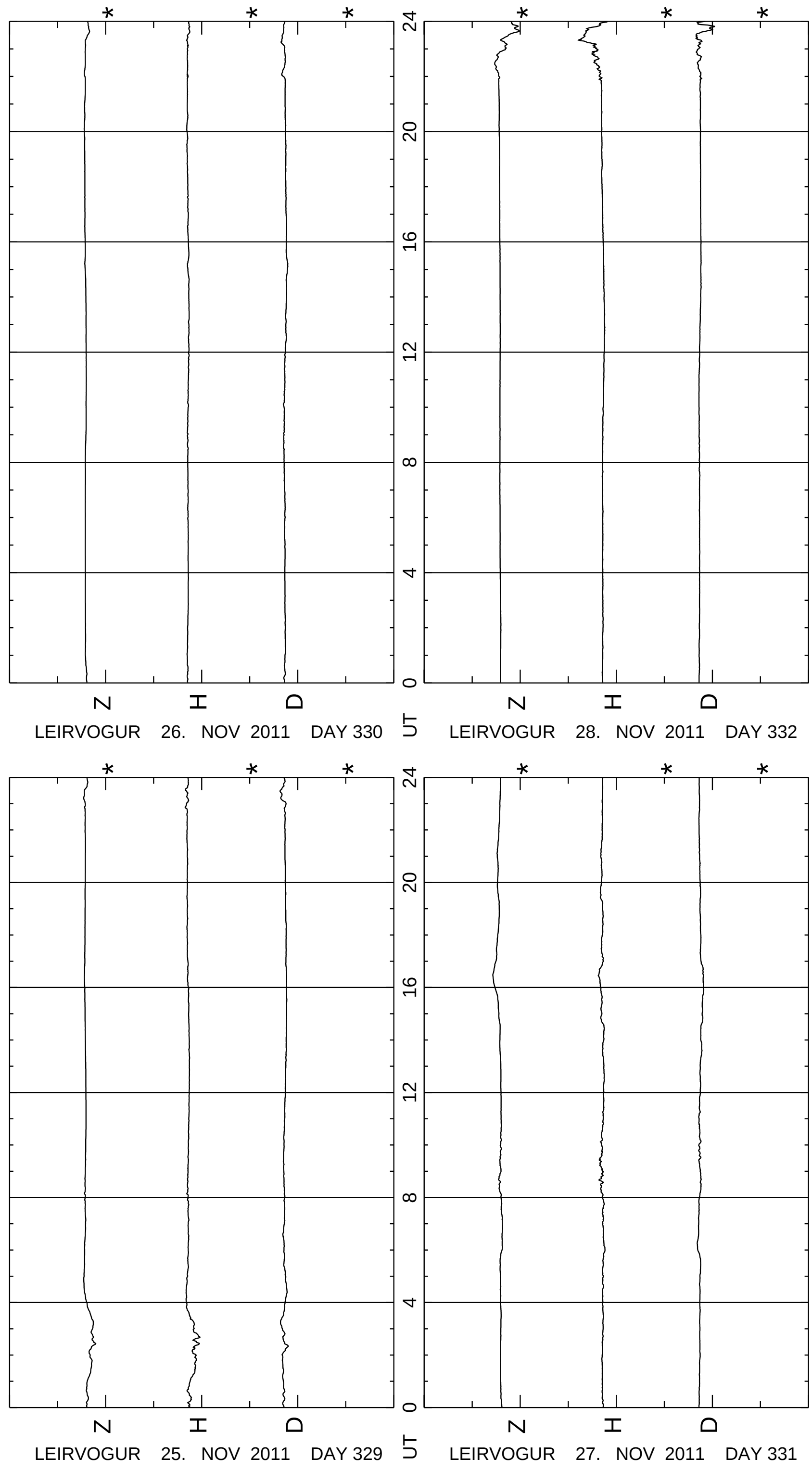

LEIRVOGUR 26. NOV 2011 DAY 330
LEIRVOGUR 28. NOV 2011 DAY 332
LEIRVOGUR 25. NOV 2011 DAY 329
LEIRVOGUR 27. NOV 2011 DAY 331
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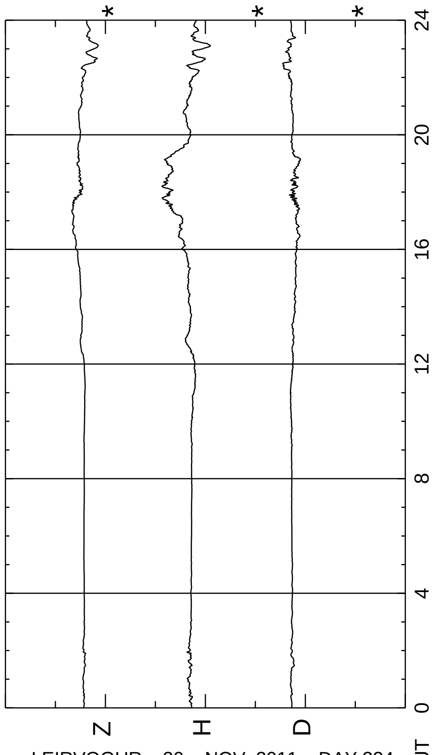

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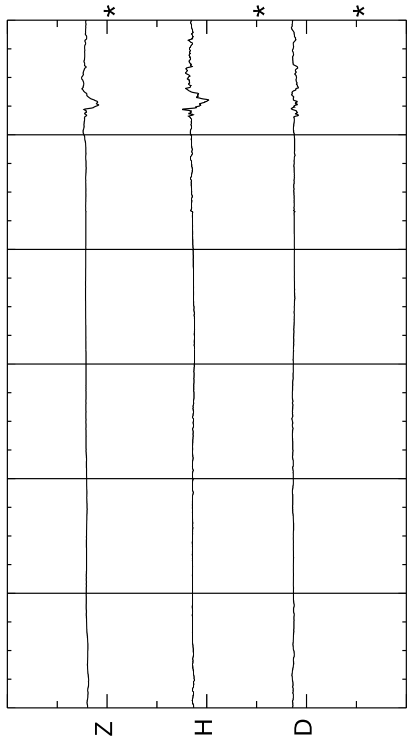

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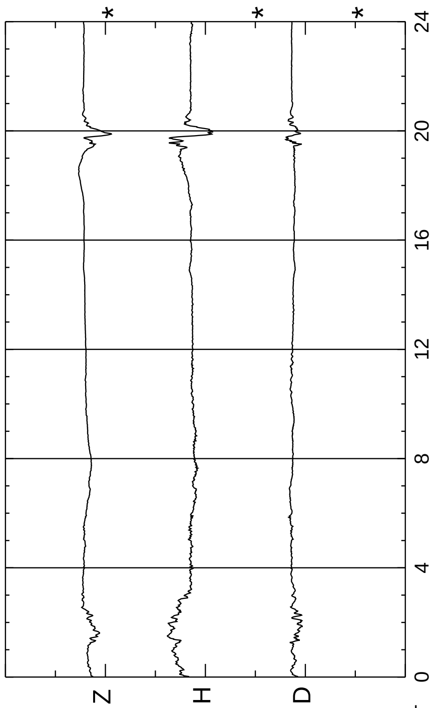
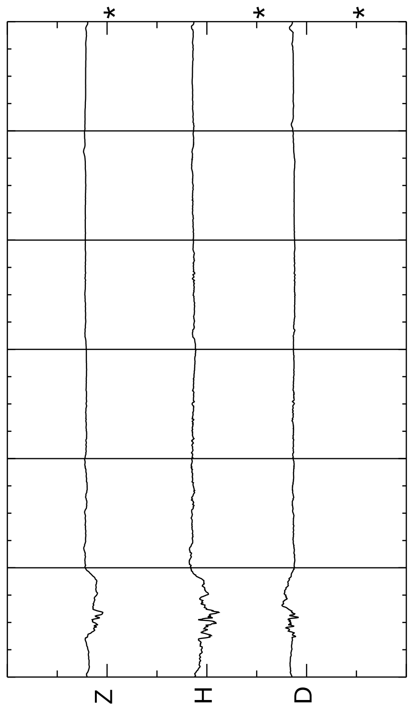
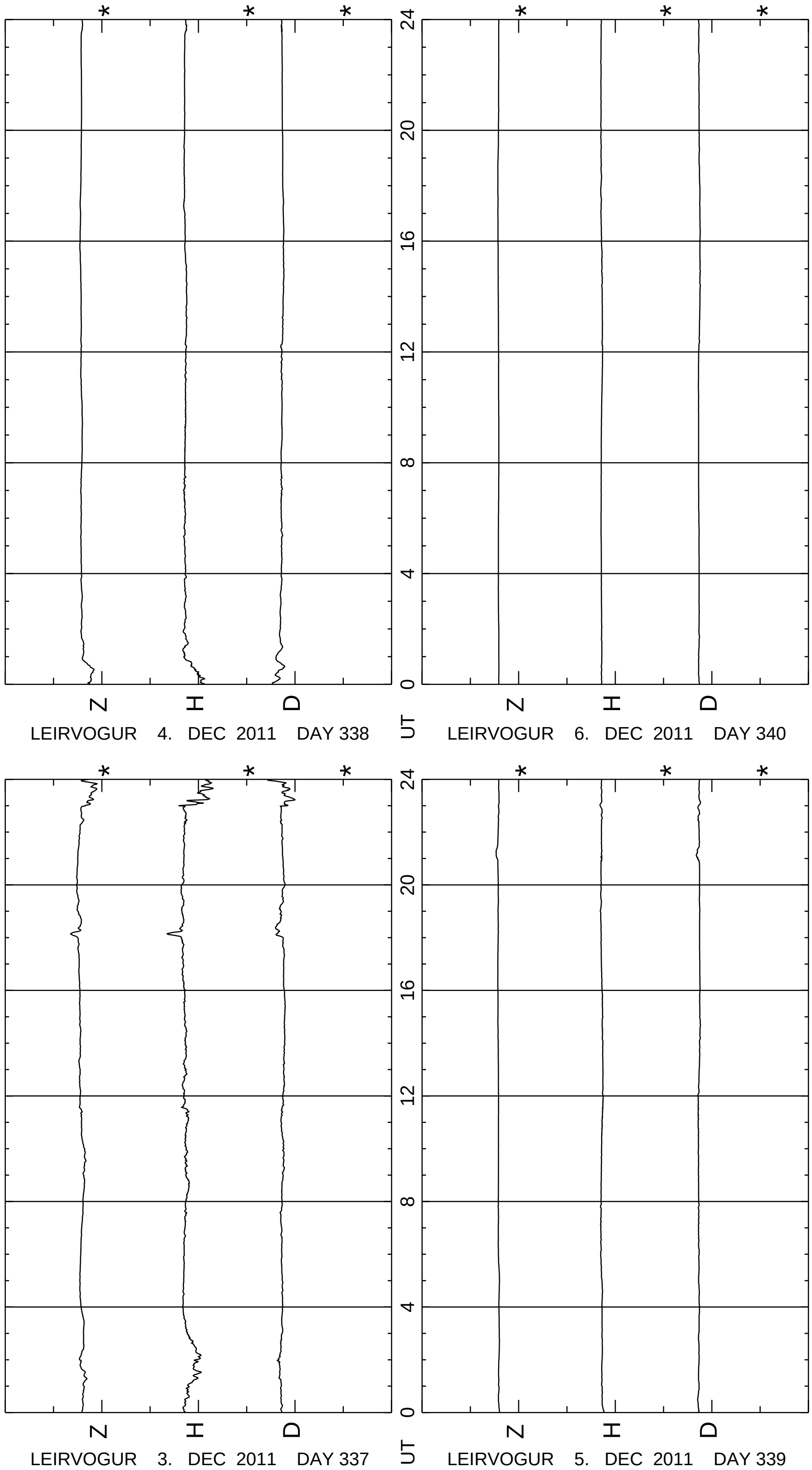


LEIRVOGUR 29. NOV 2011 DAY 333



LEIRVOGUR 1. DEC 2011 DAY 335



LEIRVOGUR 4. DEC 2011 DAY 338
LEIRVOGUR 6. DEC 2011 DAY 340
LEIRVOGUR 3. DEC 2011 DAY 337
LEIRVOGUR 5. DEC 2011 DAY 339
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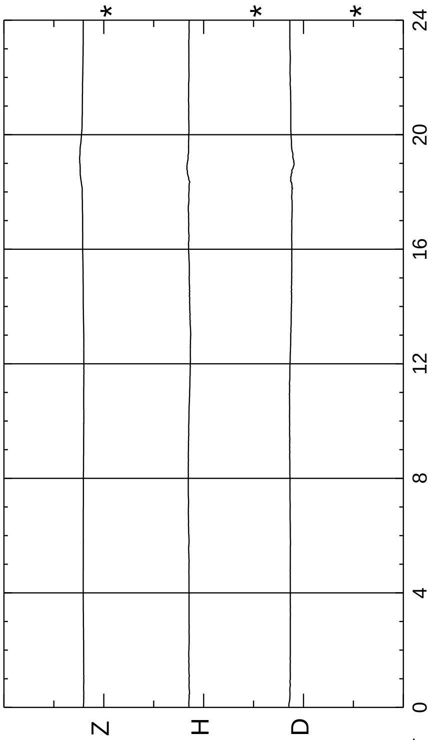
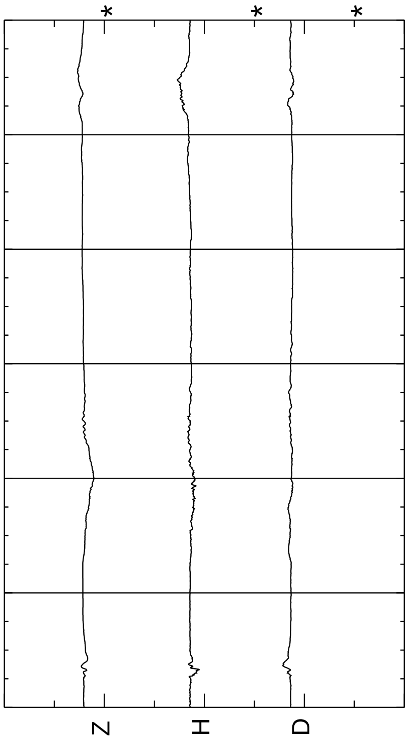
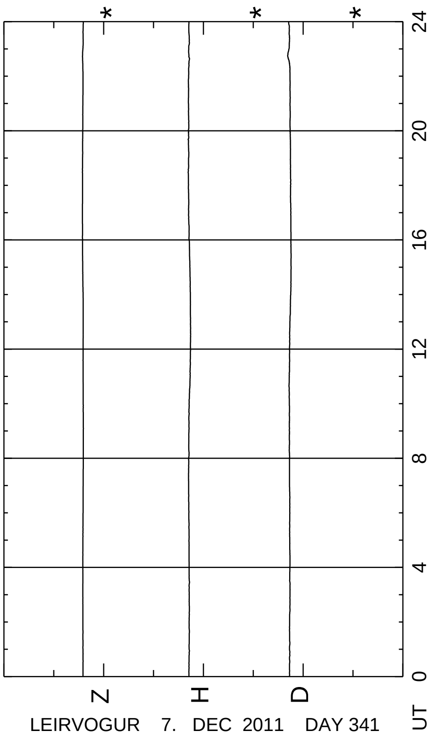


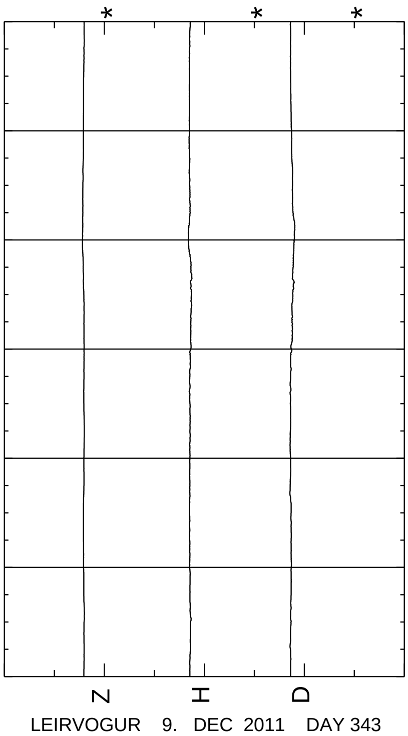
LEIRVOGUR 8. DEC 2011 DAY 342



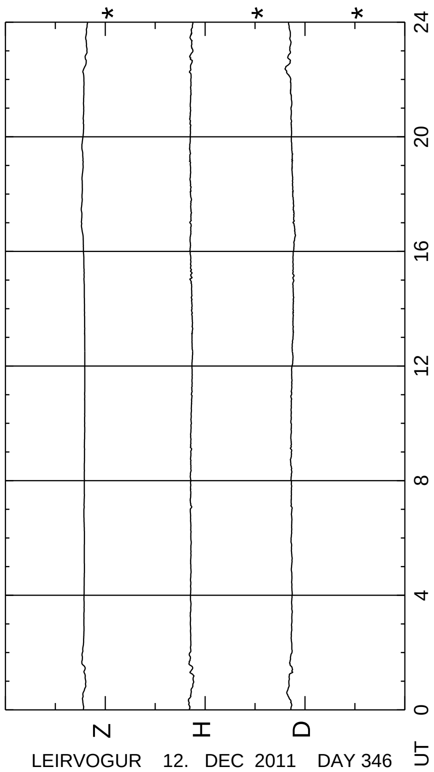
LEIRVOGUR 10. DEC 2011 DAY 344



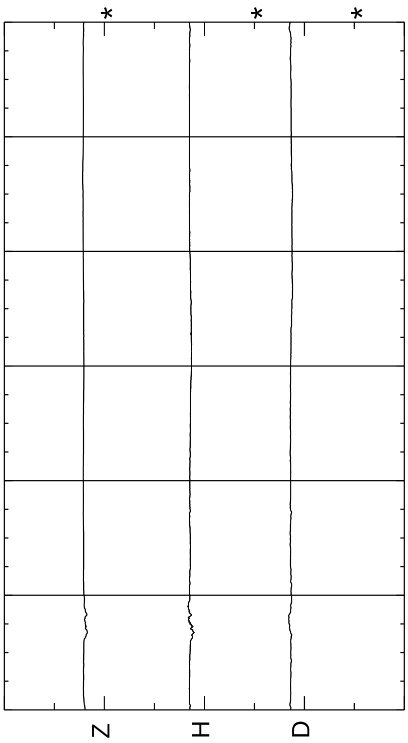
LEIRVOGUR 7. DEC 2011 DAY 341



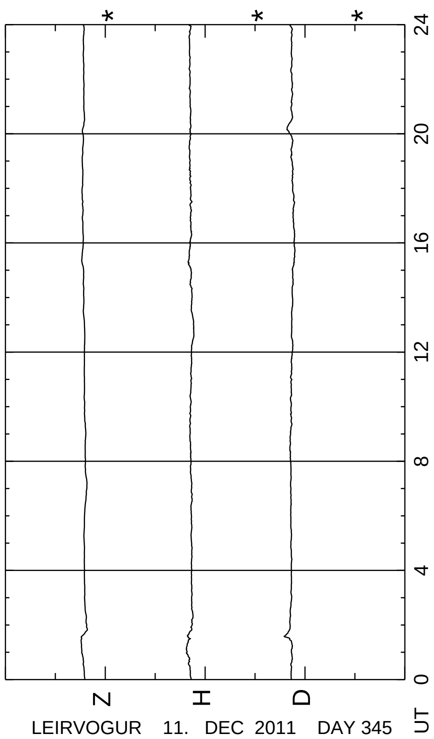
LEIRVOGUR 9. DEC 2011 DAY 343



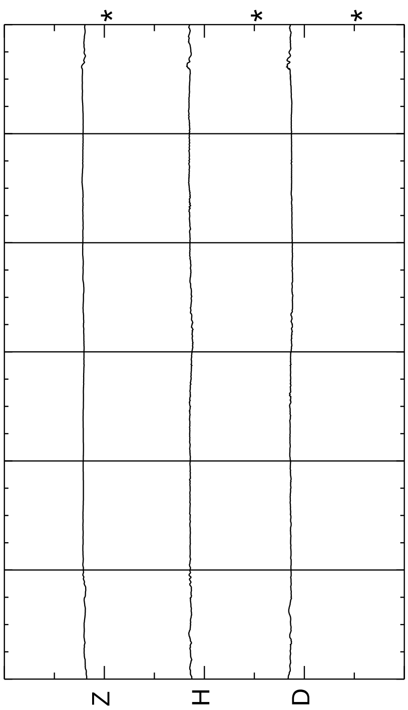
LEIRVOGUR 12. DEC 2011 DAY 346



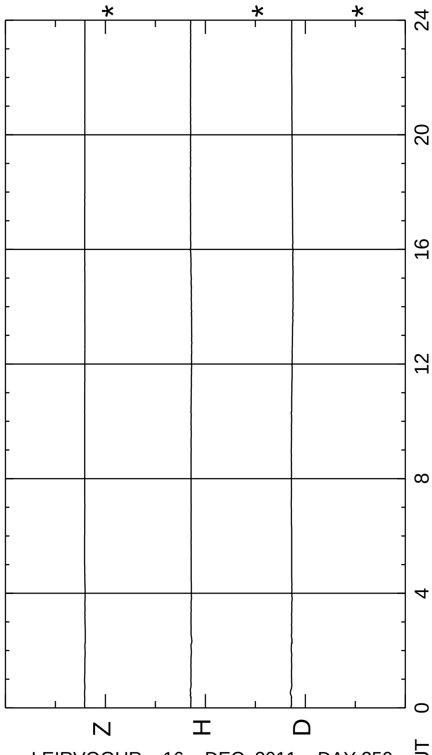
LEIRVOGUR 14. DEC 2011 DAY 348



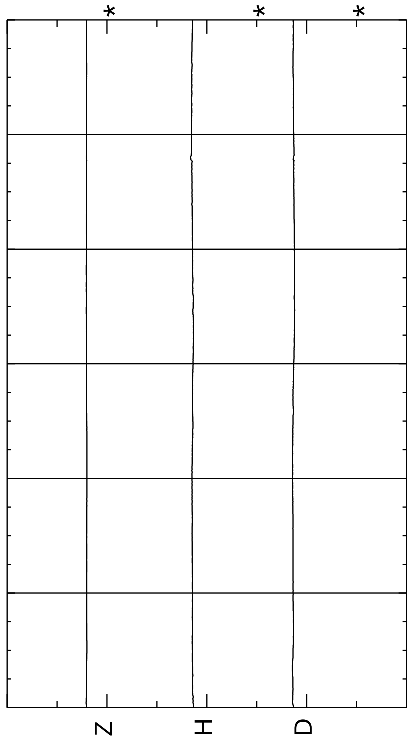
LEIRVOGUR 11. DEC 2011 DAY 345



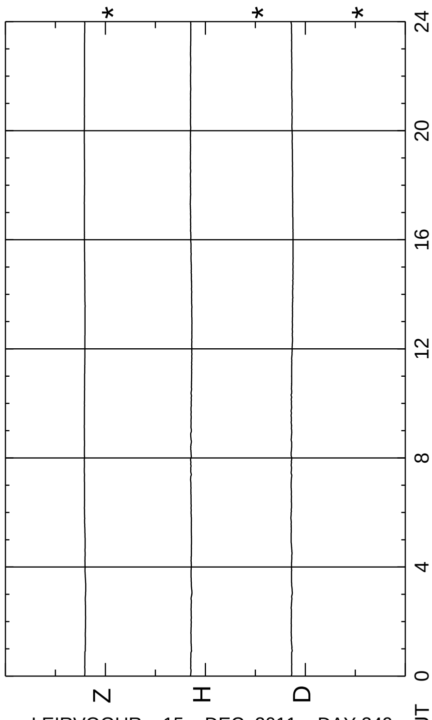
LEIRVOGUR 13. DEC 2011 DAY 347



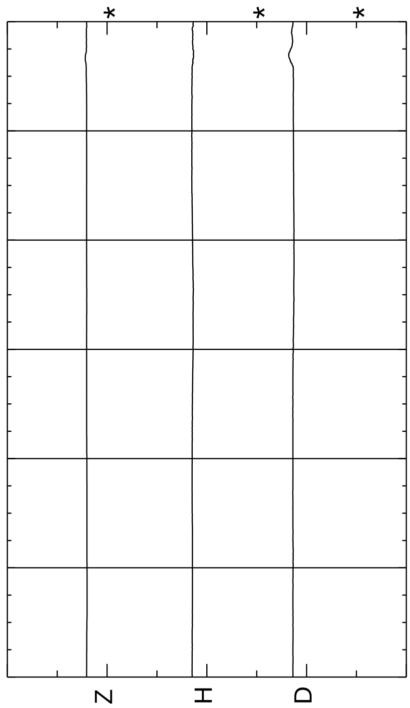
LEIRVOGUR 16. DEC 2011 DAY 350



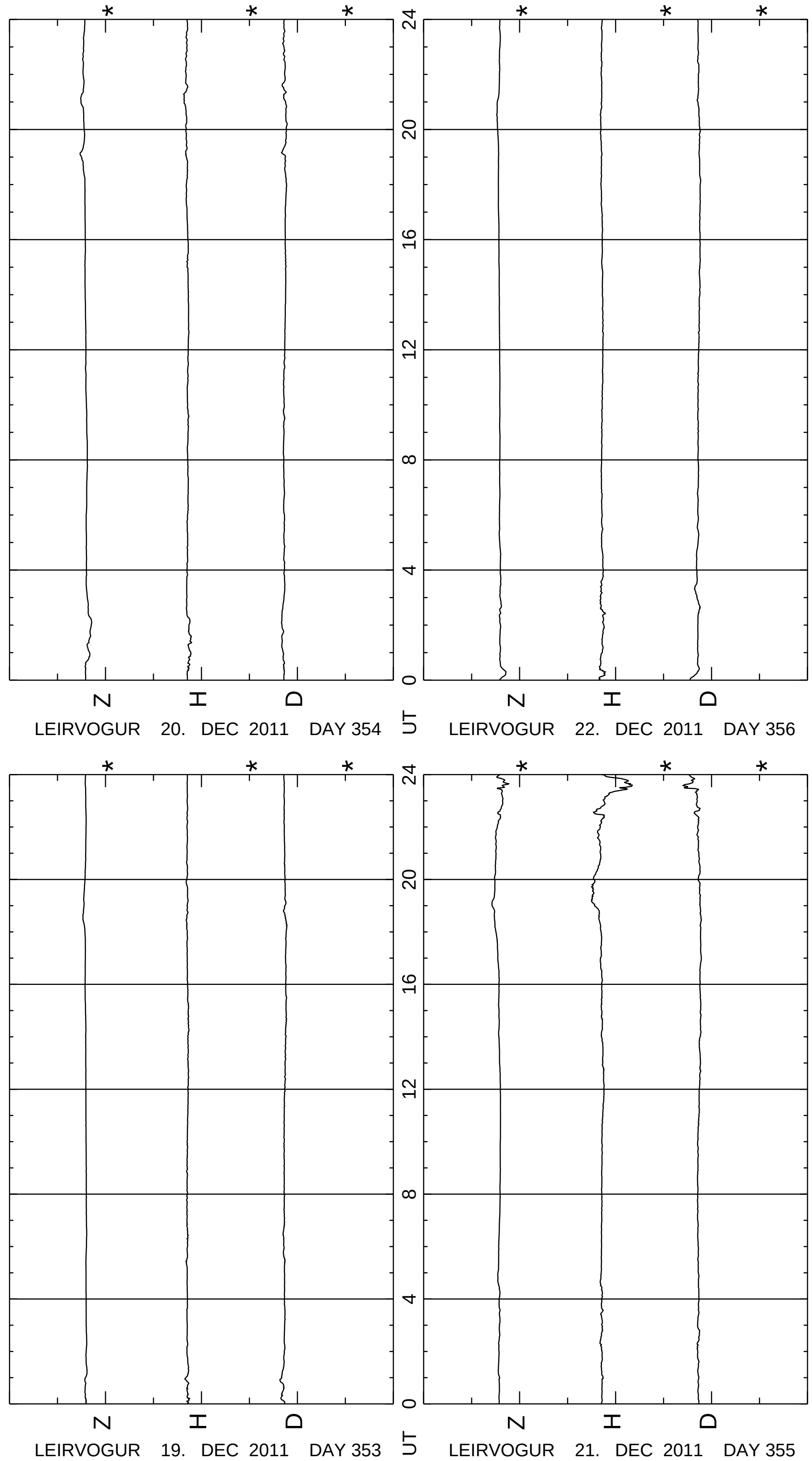
LEIRVOGUR 18. DEC 2011 DAY 352



LEIRVOGUR 15. DEC 2011 DAY 349



LEIRVOGUR 17. DEC 2011 DAY 351


LEIRVOGUR 20. DEC 2011 DAY 354
LEIRVOGUR 22. DEC 2011 DAY 356
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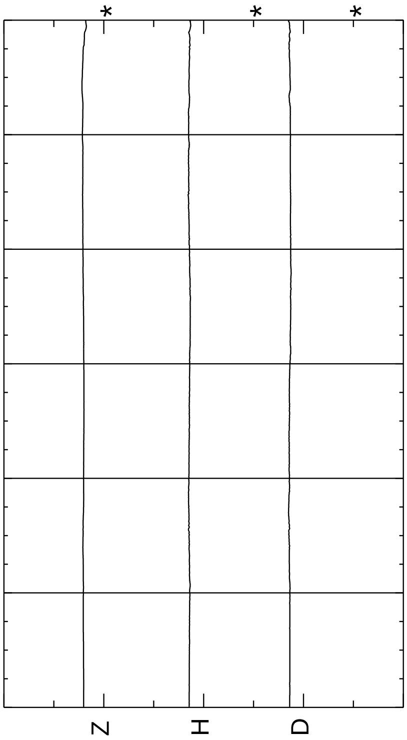

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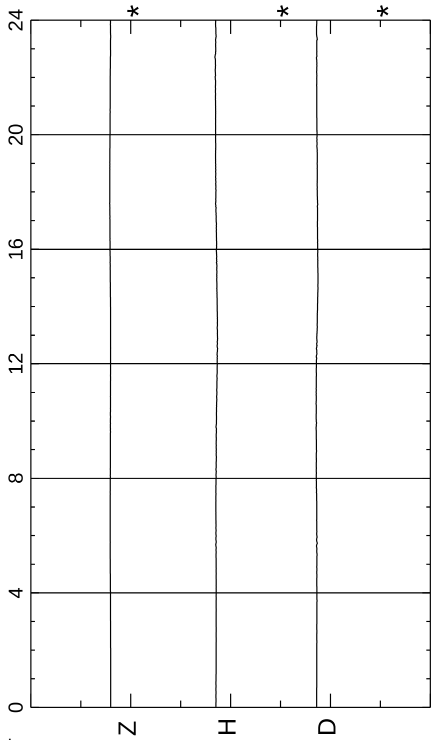
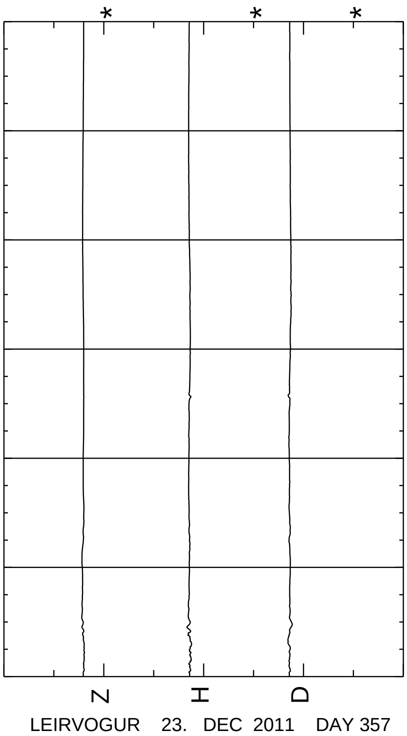
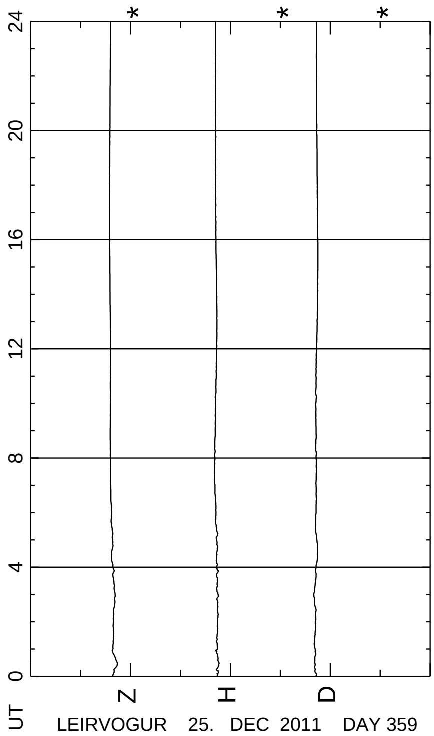


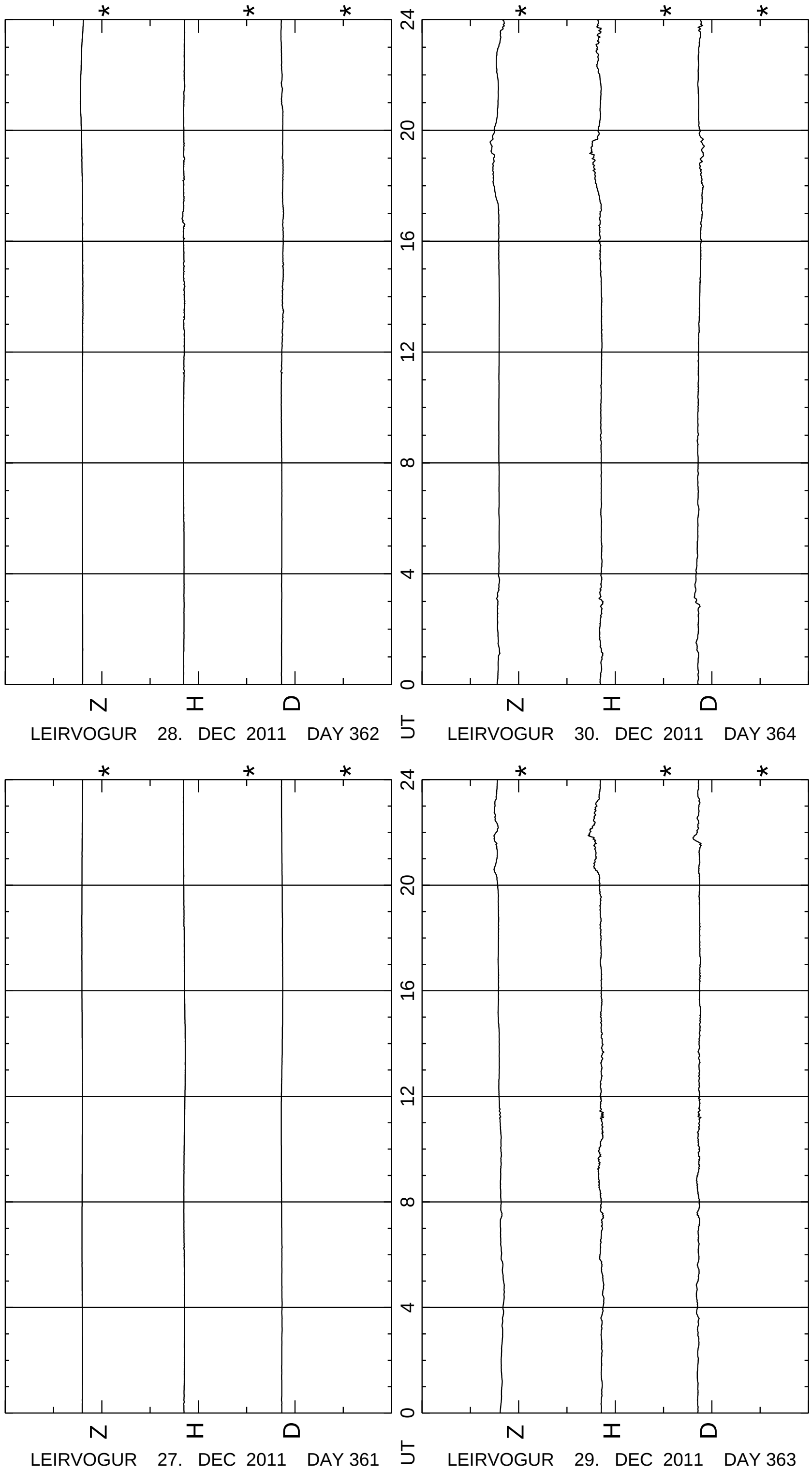
LEIRVOGUR 26. DEC 2011 DAY 360



LEIRVOGUR 23. DEC 2011 DAY 357



LEIRVOGUR 25. DEC 2011 DAY 359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LEIRVOGUR 28. DEC 2011 DAY 362
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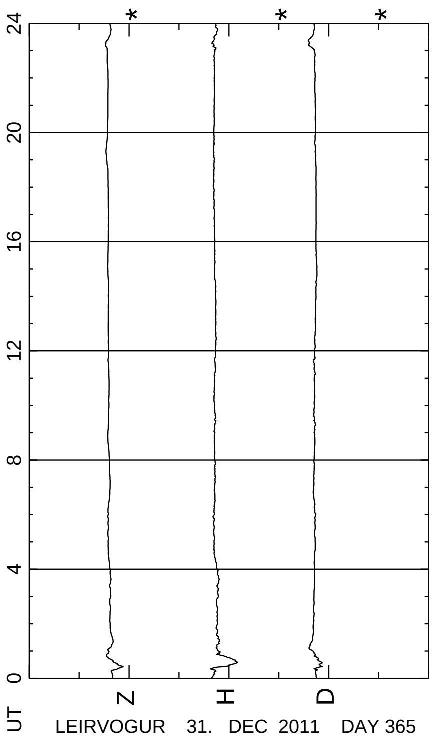

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LEIRVOGUR 31. DEC 2011 DAY 365

ANNUAL MEANS AT LEIRVOGUR

In the table below, D and I are given in degrees and minutes of arc. Other values are in nanoteslas. Z, H and D are measured values, as are the values of F since 1963.

	Z	H	D	F	X	Y	I
1958	49322	11872	336 15.3	50731	10867	-4780	76 28.0
	30	14	5.5	32	20	11	-0.5
1959	49352	11886	336 20.8	50763	10887	-4769	76 27.5
	51	11	5.3	52	18	13	0.1
1960	49403	11897	336 26.1	50815	10905	-4756	76 27.6
	26	32	6.9	33	39	9	-1.7
1961	49429	11929	336 33.0	50848	10944	-4747	76 25.9
	20	33	5.6	27	38	5	-1.8
1962	49449	11962	336 38.6	50875	10982	-4742	76 24.1
	31	18	5.0	37	23	8	-0.7
1963	49480	11980	336 43.6	50912	11005	-4734	76 23.4
	24	35	5.0	31	39	3	-1.9
1964	49504	12015	336 48.6	50943	11044	-4731	76 21.5
	26	27	3.7	33	30	1	-1.3
1965	49530	12042	336 52.3	50976	11074	-4730	76 20.2
	33	22	3.3	36	25	2	-1.0
1966	49563	12064	336 55.6	51012	11099	-4728	76 19.2
	50	21	3.6	51	24	3	-0.6
1967	49613	12085	336 59.2	51063	11123	-4725	76 18.6
	44	27	4.3	47	31	4	-1.1
1968	49657	12112	337 3.5	51110	11154	-4721	76 17.5
	44	28	2.6	53	29	-3	-1.1
1969	49701	12140	337 6.1	51163	11183	-4724	76 16.4
	53	29	3.6	58	32	1	-1.0
1970	49754	12169	337 9.7	51221	11215	-4723	76 15.4
	41	29	5.1	47	34	5	-1.3
1971	49795	12198	337 14.8	51268	11249	-4718	76 14.1
	46	31	6.8	51	38	11	-1.3
1972	49841	12229	337 21.6	51319	11287	-4707	76 12.8
	40	18	8.9	43	28	22	-0.5
1973	49881	12247	337 30.5	51362	11315	-4685	76 12.3
	41	24	10.5	45	37	25	-0.9
1974	49922	12271	337 41.0	51407	11352	-4660	76 11.4
	22	33	11.4	30	46	26	-1.8
1975	49944	12304	337 52.4	51437	11398	-4634	76 9.6
	23	28	13.3	29	44	33	-1.4
1976	49967	12332	338 5.7	51466	11442	-4601	76 8.2
	13	23	13.7	18	39	37	-1.3
1977	49980	12355	338 19.4	51484	11481	-4564	76 6.9
	23	11	14.7	25	30	46	-0.4
1978	50003	12366	338 34.1	51509	11511	-4518	76 6.5
	1	22	14.0	7	39	39	-1.4
1979	50004	12388	338 48.1	51516	11550	-4479	76 5.1
	-11	13	13.1	-7	29	39	-1.0
1980	49993	12401	339 1.2	51509	11579	-4440	76 4.1
	9	4	12.6	9	20	41	-0.1
1981	50002	12405	339 13.8	51518	11599	-4399	76 4.0
	2	-6	11.8	1	9	42	0.4
1982	50004	12399	339 25.6	51519	11608	-4357	76 4.4
	-10	8	12.7	-8	24	40	-0.6
1983	49994	12407	339 38.3	51511	11632	-4317	76 3.8

ANNUAL MEANS AT LEIRVOGUR
(Continued)

	-9	4		11.1	-8	17	37		-0.4
1985	49982	12410	340	1.5	51500	11663	-4239	76	3.4
	0	-4		12.0	0	11	42		0.2
1986	49982	12406	340	13.5	51500	11674	-4197	76	3.6
	-2	7		11.9	-2	21	38		-0.5
1987	49980	12413	340	25.4	51498	11695	-4159	76	3.1
	12	-5		11.7	10	10	41		0.5
1988	49992	12408	340	37.1	51508	11705	-4118	76	3.6
	20	-3		11.6	20	11	41		0.6
1989	50012	12405	340	48.7	51528	11716	-4077	76	4.2
	5	1		11.3	5	14	38		0.0
1990	50017	12406	341	0.0	51533	11730	-4039	76	4.2
	11	-1		11.4	11	12	39		0.2
1991	50028	12405	341	11.4	51544	11742	-4000	76	4.4
	-3	6		12.0	-3	20	39		-0.4
1992	50025	12411	341	23.4	51541	11762	-3961	76	4.0
	-2	6		13.0	0	21	43		-0.4
1993	50023	12417	341	36.4	51541	11783	-3918	76	3.6
	7	-4		14.4	6	12	51		0.3
1994	50030	12413	341	50.8	51547	11795	-3867	76	3.9
	0	18		14.8	4	34	45		-1.1
1995	50030	12431	342	5.6	51551	11829	-3822	76	2.8
	-1	14		16.2	3	31	51		-0.9
1996	50029	12445	342	21.8	51554	11860	-3771	76	1.9
	9	12		16.9	12	30	55		-0.7
1997	50038	12457	342	38.7	51566	11890	-3716	76	1.2
	19	5		17.8	19	24	60		0.0
1998	50057	12462	342	56.5	51585	11914	-3656	76	1.2
	12	11		17.6	14	29	58		-0.5
1999	50069	12473	343	14.1	51599	11943	-3598	76	0.7
	20	8		17.8	22	26	60		-0.2
2000	50089	12481	343	31.9	51621	11969	-3538	76	0.5
	10	16		17.8	13	34	57		-0.9
2001	50099	12497	343	49.7	51634	12003	-3481	75	59.6
	18	11		18.3	20	28	61		-0.4
2002	50117	12508	344	8.0	51654	12031	-3420	75	59.2
	23	-4		18.7	22	15	67		0.6
2003	50140	12504	344	26.7	51676	12046	-3353	75	59.8
	6	23		17.7	12	39	56		-1.3
2004	50146	12527	344	44.4	51688	12085	-3297	75	58.5
	12	10		17.4	13	27	59		-0.5
2005	50158	12537	345	1.8	51701	12112	-3238	75	58.0
	6	21		16.4	11	35	52		-1.3
2006	50164	12558	345	18.2	51712	12147	-3186	75	56.7
	14	17		16.8	17	32	55		-0.9
2007	50178	12575	345	35.0	51729	12179	-3131	75	55.8
	7	15		17.1	11	30	57		-0.8
2008	50185	12590	345	52.1	51740	12209	-3074	75	55.0
	3	22		17.6	8	37	57		-1.4
2009	50188	12612	346	9.7	51748	12246	-3017	75	53.6
	7	9		18.8	9	25	65		-0.4
2010	50195	12621	346	28.5	51757	12271	-2952	75	53.2
	7	11		18.8	10	27	65		-0.6
2011	50202	12632	346	47.3	51767	12298	-2887	75	52.6