RAUNVÍSINDASTOFNUN HÁSKÓLANS
Science Institute, University of Iceland
RH-13-2011

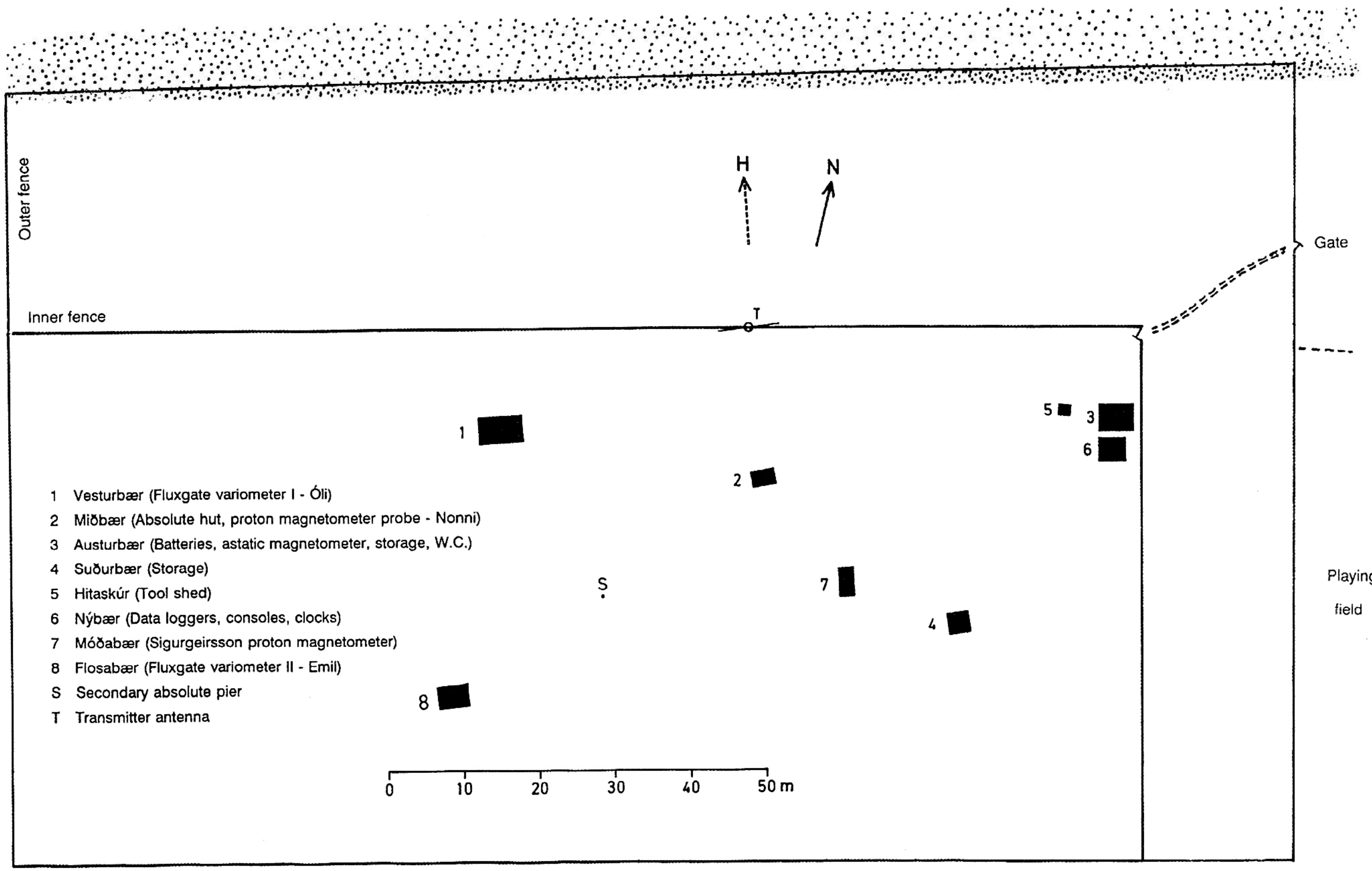
LEIRVOGUR

MAGNETIC RESULTS

2010

REYKJAVÍK 2011

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 2010. 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

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

The geomagnetic coordinates relative to a pole position of $79.°4$ N, $71.°7$ W are $69.°4$ N, $71.°8$ E. The McIlwain L-parameter of the observatory in 2010 was approximately 5.5 earth-radii, the corresponding corrected geomagnetic latitude being $64.°6$. The geomagnetic conjugate point at 100 km altitude was at $69.°0$ S, $29.°0$ E geographic, about 420 km from the Japanese Antarctic station Syowa.

PERSONNEL

In 2010, the Upper Atmosphere Section had a staff of two: Gunnlaugur Björnsson, director and Pálmi Ingólfsson, research assistant, who as of November 1, retired to 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.

Marian Siarov, a technician from the Faculty of Science, and Kristján Jónsson an electrical engineer from the Science Institute, helped diagnose and repair problems with the proton magnetometer Móði.

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

Valdimar Kristinsson, representing the recreational horse owners in Mosfellsbær visited on February 10 to discuss continued use of a part of the observatory land.

DEVELOPMENTS

The staff made 77 trips to the observatory in 2010, a rather high number compared to previous years. This was mostly due to persistent problems with the signal feed from Móði to Geó. 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 very little snow that did not cause any problems. The lowest temperature was -13°C in January and December, and the highest was $+25$°C in August. On December 22, the absolute measurements were made at -12°C, the lowest at which such measurements have been made at the observatory. It should be noted that the absolute hut is not heated.

Due to the continuing economic crisis, very little construction work took place in the nearby housing project. It remains unclear when this will continue. So far, no major problems have been caused by the new neighbours that have already moved in.

The electrical supply was interrupted on February 5 when a constructor accidentally cut the high voltage line to the residential area. The outage lasted almost 5 hours. The new power supply (UPS) for System II handled the situation well and no data was lost.

A new UPS for System I was installed on February 17. Both systems now operate on identical UPS's.

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 logger were still being written, improved and tested. They are essentially fully operational and are expected to be implemented in 2011 when the old dataloggers are to be retired. This was originally scheduled to happen in 2010, but problems with the signal from Móði caused this to be delayed.

On June 2, 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 3.

The thermostat in Vesturbær which houses System I (Óli) was adjusted from winter level (13°C) to summer level (20°C) on May 26. Readjustment took place on November 10.

Móði

The proton magnetometer Móði worked without major problems most of the year. On December 6, however, it stopped working in cold temperature. The hut housing Móði is not heated. The detector fluid was at $-6°$C instead of the nominal $28°$C as the heater that keeps it warm had stopped working. As the temperature rose to near the freezing point, the heater kicked in again and the signal reappeared. The following week the signal was lost again in cold conditions. It turned out that the thermostat that controls the fluid heater was at fault, it stopped working if the air temperature dropped too low. A new thermostat was ordered. In total 1381 minutes of data were lost due to this problem.

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 Móði was not detectable. It took a long time to sort out the cause for this, as the signal came and went irregularly. The cause was finally found to be in aging electronics that was used to prepare the Móði-signal for use with Geó. No documentation exists on the old electronics so a trial and error approach had to be used to correct the problem.

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. 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. Data from both systems are transferred regularly to the Institute.

Software development

Work continued on porting the various data handling routines from *Comal* to *Python*. A procedure to simplify the regular analysis and correction of the raw measurements to provide absolute data is being tested. This is a time-consuming work that must be carefully checked. Both systems are expected to be on-line with one second time resolution and semi-automatic data handling in the near future.

General maintenance and modifications

Trees and hedges were pruned and fertilizer applied in the spring. Because of the warm weather, tree growth was more vigorous than usual. 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 instrument 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 will be 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 eight times in 2010. 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.

The magnetometer Geó was used for measuring the total intensity (F) on the absolute pier. The crystal oscillator correction for Geó was checked regularly in 2010 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 2010, the correction varied between -3.2 nT and -3.9 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 20. 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

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

where Z_0, H_0, and D_0 are the base-line values. The adopted base-line values for 2010 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 9	-1.5
Jan 10	– Jan 23	-1.0
Jan 24	– May 26 (16:40)	-1.5
May 26	– May 26 (19:10)	-1.0
May 26	– May 26 (21:10)	-0.5
May 26	– Aug 14	0.0
Aug 15	– Oct 22	-0.5
Oct 23	– Nov 10 (16:40)	0.0
Nov 10	– Nov 10 (17:40)	-0.5
Nov 10	– Nov 10 (18:40)	-1.0
Nov 10	– Dec 31	-1.5

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 9	-5.5
Jan 10	– Feb 12	-6.0
Feb 13	– Mar 12	-5.5
Mar 13	– Mar 26	-6.0
Mar 27	– Apr 23	-5.5
Apr 24	– May 26 (14:10)	-6.0
May 26	– May 26 (15:10)	-5.5
May 26	– May 26 (16:10)	-5.0
May 26	– May 26 (17:10)	-4.5
May 26	– May 26 (18:10)	-4.0
May 26	– May 26 (19:10)	-3.5
May 26	– May 26 (20:10)	-3.0

		nT
May 26	– Nov 10 (16:40)	-2.5
Nov 10	– Nov 10 (17:20)	-3.0
Nov 10	– Nov 10 (18:00)	-3.5
Nov 10	– Nov 10 (18:40)	-4.0
Nov 10	– Nov 10 (19:20)	-4.5
Nov 10	– Nov 10 (20:00)	-5.0
Nov 10	– Dec 31	-5.5

Declination (D_0):

Jan 1	– Jan 2	$345^\circ\ 09.'1$
Jan 3	– Jan 31	$345^\circ\ 09.'0$
Feb 1	– Mar 12	$345^\circ\ 08.'9$
Mar 13	– Apr 2	$345^\circ\ 09.'0$
Apr 3	– May 26 (16:10)	$345^\circ\ 08.'9$
May 26	– May 26 (19:10)	$345^\circ\ 08.'8$
May 26	– May 26 (21:10)	$345^\circ\ 08.'7$
May 26	– Jul 17	$345^\circ\ 08.'6$
Jul 18	– Sep 10	$345^\circ\ 08.'8$
Sep 11	– Oct 22	$345^\circ\ 08.'7$
Oct 23	– Nov 10 (16:40)	$345^\circ\ 08.'5$
Nov 10	– Nov 10 (17:30)	$345^\circ\ 08.'6$
Nov 10	– Nov 10 (18:20)	$345^\circ\ 08.'7$
Nov 10	– Nov 10 (19:10)	$345^\circ\ 08.'8$
Nov 10	– Nov 10 (20:00)	$345^\circ\ 08.'9$
Nov 10	– Dec 31	$345^\circ\ 09.'0$

The changes in base lines on May 26 and November 10 were caused by adjustments of the thermostat in the variometer building Vesturbær. The temperature coefficient is about 0.25 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 21. With the new fluxgate being nearly identical to System I, the data are now handled in the same way as the data for that system. 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 2010 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 9	0.0
Jan 10	– May 23	-0.5
May 24	– Jun 2 (17:30)	-1.0
Jun 2	– Jul 14	-1.5
Jul 15	– Aug 6	-2.0
Aug 7	– Sep 17	-2.5
Sep 18	– Nov 3 (15:50)	-2.0
Nov 3	– Nov 3 (19:10)	-1.5
Nov 3	– Nov 3 (21:40)	-1.0
Nov 3	– Nov 30	-0.5
Dec 1	– Dec 25	0.0
Dec 26	– Dec 31	-0.5

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 9	-6.5
Jan 10	– Jan 23	-6.0
Jan 24	– Jun 2 (14:10)	-6.5
Jun 2	– Jun 2 (15:50)	-7.0
Jun 2	– Jun 2 (17:30)	-7.5
Jun 2	– Jun 2 (19:10)	-8.0
Jun 2	– Nov 3 (15:50)	-8.5
Nov 3	– Nov 3 (17:30)	-8.0

		nT
Nov 3	– Nov 3 (20:00)	-7.5
Nov 3	– Nov 3 (20:50)	-7.0
Nov 3	– Dec 31	-6.5

Declination (D_0):

Jan 1	– Jan 16	$345° 5\overset{'}{.}9$
Jan 17	– Jan 31	$345° 6\overset{'}{.}0$
Feb 1	– Feb 5	$345° 5\overset{'}{.}8$
Feb 6	– Mar 20	$345° 5\overset{'}{.}9$
Mar 21	– Apr 2	$345° 6\overset{'}{.}0$
Apr 3	– May 23	$345° 5\overset{'}{.}9$
May 24	– Jun 2 (15:50)	$345° 6\overset{'}{.}0$
Jun 2	– Jun 2 (17:30)	$345° 5\overset{'}{.}9$
Jun 2	– Jun 2 (19:10)	$345° 5\overset{'}{.}8$
Jun 2	– Jul 26	$345° 5\overset{'}{.}7$
Jul 27	– Aug 12	$345° 5\overset{'}{.}8$
Aug 13	– Oct 3	$345° 5\overset{'}{.}7$
Oct 4	– Oct 16	$345° 5\overset{'}{.}9$
Oct 17	– Nov 3 (19:10)	$345° 5\overset{'}{.}8$
Nov 3	– Nov 3 (22:30)	$345° 5\overset{'}{.}9$
Nov 3	– Nov 13	$345° 6\overset{'}{.}0$
Nov 14	– Dec 10	$345° 5\overset{'}{.}9$
Dec 11	– Dec 25	$345° 6\overset{'}{.}0$
Dec 26	– Dec 31	$345° 5\overset{'}{.}9$

The steps in the base lines on June 2 and November 3 were caused by adjustments of the thermostat in the variometer house. The temperature coefficients are approximately 0.1 nT/°C for Z, 0.2 nT/°C for 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, $02^{\mathrm{s}} - 09^{\mathrm{s}}$, $12^{\mathrm{s}} - 19^{\mathrm{s}}$, $22^{\mathrm{s}} - 29^{\mathrm{s}}$, $32^{\mathrm{s}} - 39^{\mathrm{s}}$, $42^{\mathrm{s}} - 49^{\mathrm{s}}$and $52^{\mathrm{s}} - 59^{\mathrm{s}}$ 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 $12^{\mathrm{s}} - 17^{\mathrm{s}}$ 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:

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

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 the signal from Móði with that from the proton magnetometer Geó, the probe of which is situated on the pier. This comparison is made once a week.

The adopted values of δF in 2010 were as follows:

		δF (nT)
Jan 1	– Jan 9	-3.2
Jan 10	– Feb 19	-3.3
Feb 20	– Mar 11	-3.4
Mar 12	– Mar 26	-3.5
Mar 27	– Apr 9	-3.3
Apr 10	– Jun 25	-3.4
Jun 26	– Aug 21	-3.5
Aug 22	– Sep 3	-3.7
Sep 4	– Nov 13	-3.8
Nov 14	– Nov 30	-3.9
Dec 1	– Dec 18	-3.8
Dec 19	– Dec 31	-3.7

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 -0.1 nT. Most of the values (99.91%) were in the range -1 to $+1$ nT, 0.09% reached ± 2 nT, and there was 1 case 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 2010, 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 1381 or 0.26% of the total time. Most of this was due problems with the thermostat near the end 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 2010, 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 2010 was the second lowest ever recorded at Leirvogur and there were no highly disturbed days. The most significant disturbances occurred on the following days:

Date	*K-sum*	*C9*	*L9*
Apr 5-7	(43,48,38)	(7,7,5)	(6,8,6)
May 3	(39)	(6)	(6)
May 29-30	(42,38)	(6,5)	(6,5)
Aug 4	(45)	(7)	(7)
Aug 24-25	(34,38)	(5,5)	(6,5)

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 2010, and the value 8 only twice. The year was the second quietest on record at Leirvogur as is evident from the tables on pages 28 and 29. The quietest time of the year was on January 1, when the field kept steady to the nearest nanotesla in all elements for 209 consecutive 10-second readings (35 minutes). January was in fact the least disturbed month of the year, K reaching the value of 6 only once during the entire month and the value of 5 only three times.

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:

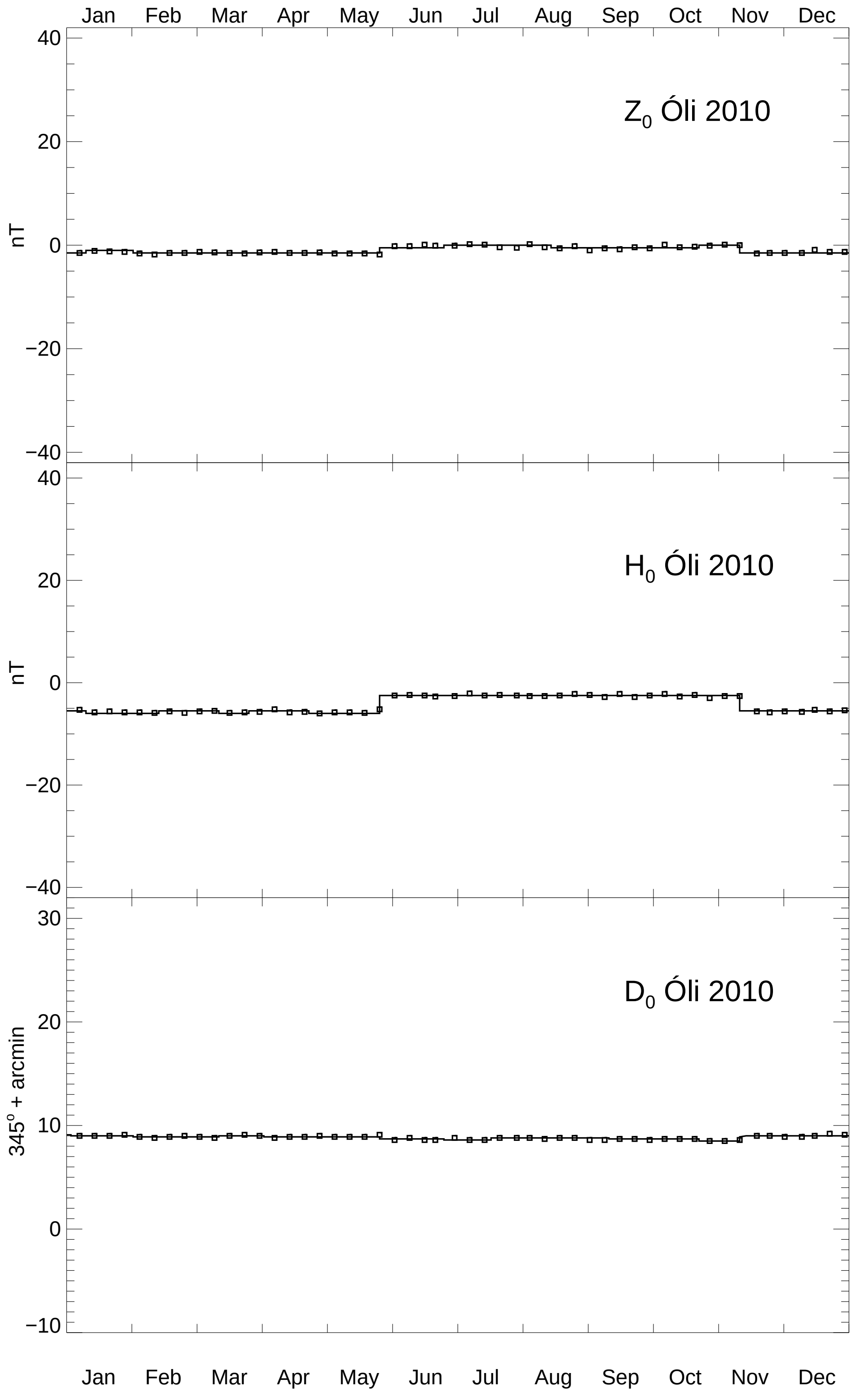
http://wdc.kugi.kyoto-u.ac.jp/

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.

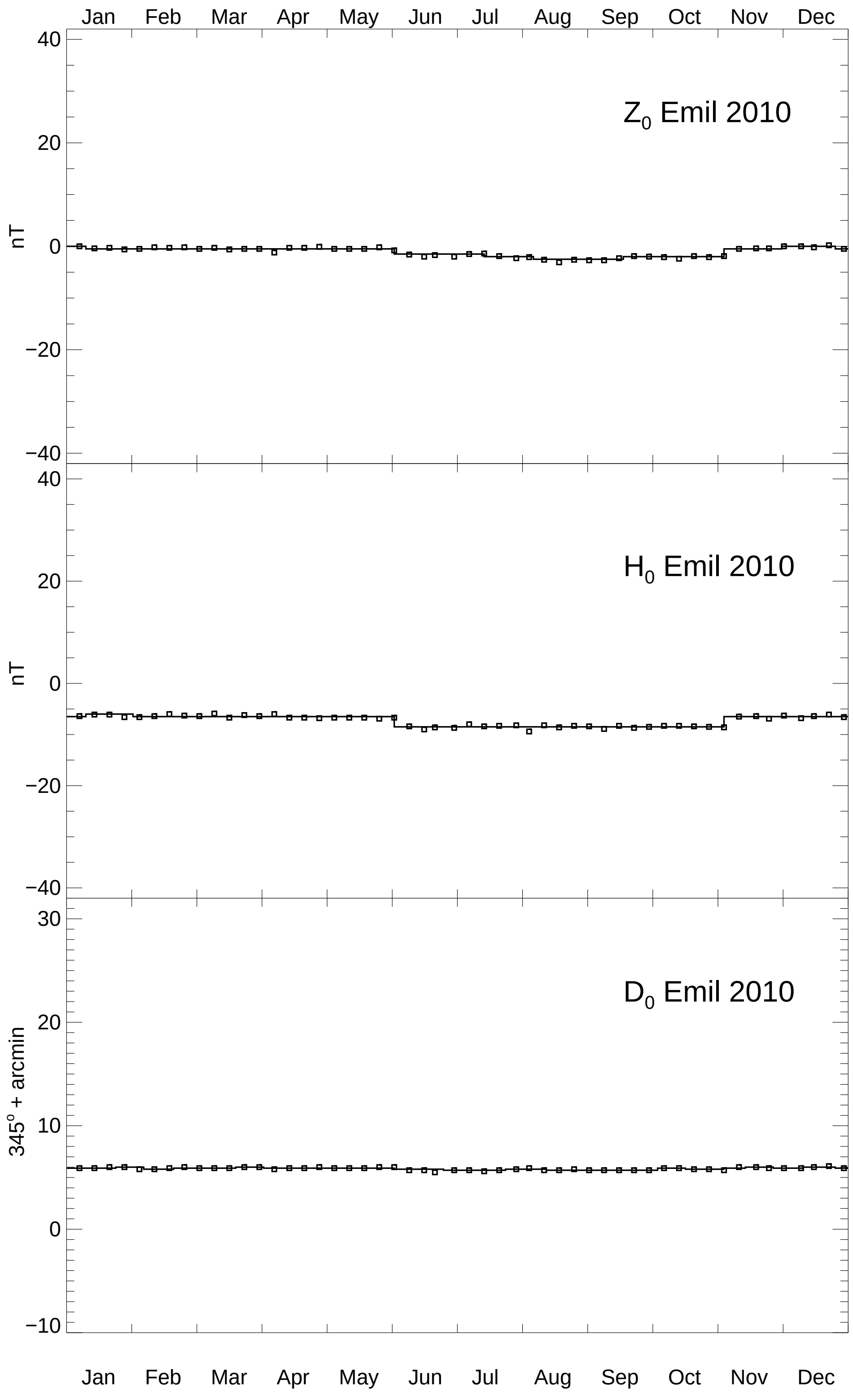
Both preliminary and final data are available over the Internet by ftp-transfer. The address is *ftp.raunvis.hi.is* logging in as "anonymous". The files are kept in the directory "pub/lrv". The annual means are sent to WDC-C2 in Kyoto, WDC-C1 in Edinburgh and the Analytical Centre on Secular Variations 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 2011

Gunnlaugur Björnsson



Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Z_0 Óli 2010
nT
40
20
0
−20
−40
H_0 Óli 2010
D_0 Óli 2010
345° + arcmin
30
10
−10


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Z_0 Emil 2010
H_0 Emil 2010
D_0 Emil 2010
nT
345° + arcmin
40
20
0
−20
−40
30
10
−10

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 123-124.

Diurnal variations

The tables on pages 24-25 show the mean diurnal inequalities of the magnetic elements Z, H, D and F at Leirvogur in 2010. 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 26. The daily K-sums are shown on page 27 in runs of 27 days. The table on page 28 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 29.

LEIRVOGUR 2010
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	190	190	188	620	622	623	197	193	199	753	753	752
FEB	196	195	195	619	622	614	211	211	201	758	758	756
MAR	190	193	188	620	622	618	228	227	228	752	755	750
APR	194	199	182	605	622	567	250	247	249	752	761	731
MAY	192	195	187	618	625	596	265	263	273	754	758	744
JUN	193	198	189	622	632	592	281	276	309	756	763	745
JUL	193	197	187	625	631	606	294	290	302	756	762	746
AUG	197	200	198	617	625	598	310	314	306	759	763	755
SEP	197	199	194	624	625	621	322	324	319	760	762	757
OCT	195	197	180	625	628	615	339	333	341	758	761	742
NOV	201	200	201	627	631	615	354	350	357	765	764	762
DEC	201	199	203	632	633	633	368	366	370	765	764	768
MEAN	195	197	191	621	627	608	285	283	288	757	760	751

LEIRVOGUR 2010

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		-13	-19	-22	-18	-15	-15	-10	-6	-5	-4	-1	0	3	7	12	17	20	21	19	16	12	7	0	-6	3.	18.	43
ZW		-7	-15	-15	-13	-8	-5	-4	-4	-4	-3	-3	-2	-1	1	4	7	11	12	14	14	10	7	3	0	2.	99.	29
ZE		-17	-19	-22	-18	-17	-18	-14	-8	-7	-4	-1	1	4	8	13	19	21	23	21	19	15	8	-2	-7	3.	18.	45
ZS		-17	-23	-28	-25	-22	-22	-12	-8	-5	-4	-1	2	6	12	20	25	29	29	23	17	11	5	-3	-12	3.	17.	58
ZQ		-5	-8	-9	-5	-3	-1	0	0	-1	-2	-3	-2	-2	0	3	7	9	9	7	5	3	1	0	-2	3.	18.	18
ZQW		-2	-3	-4	-2	0	0	0	0	-1	-2	-2	-3	-3	-2	1	3	4	4	4	4	3	1	1	-1	3.	99.	8
ZQE		-4	-7	-8	-8	-6	-2	-2	-1	-2	-2	-2	-1	0	2	4	7	10	10	7	5	3	2	0	-3	4.	18.	18
ZQS		-10	-14	-15	-5	-2	-1	1	1	-1	-3	-5	-4	-2	1	5	10	14	14	11	7	2	0	-1	-4	3.	99.	29
ZD		-5	-7	-22	-23	-32	-48	-33	-21	-15	-9	1	6	13	20	27	36	37	34	26	22	12	3	-10	-10	6.	17.	86
ZDW		-11	-19	-27	-27	-16	-15	-14	-15	-10	-9	-2	1	3	7	12	22	29	30	30	27	12	6	-10	-6	4.	19.	57
ZDE		-12	-5	-27	-26	-32	-53	-47	-27	-23	-12	0	7	15	24	28	41	34	37	31	31	25	6	-9	-5	6.	16.	94
ZDS		9	3	-12	-17	-48	-77	-39	-22	-13	-7	6	11	19	28	43	45	48	36	18	8	0	-4	-11	-19	6.	17.	126
H		-29	-34	-35	-27	-15	-7	-1	1	0	-4	-7	-9	-8	-2	9	18	26	31	32	32	27	19	1	-17	3.	19.	67
HW		-8	-16	-15	-11	-5	-1	2	3	4	2	-1	-4	-6	-4	-1	4	8	9	10	11	12	12	1	-7	2.	99.	28
HE		-29	-37	-38	-22	-11	-9	-2	2	1	-4	-7	-10	-9	-3	6	18	26	32	36	34	27	17	-1	-20	3.	19.	74
HS		-50	-49	-52	-48	-28	-12	-4	-3	-5	-10	-13	-14	-10	2	21	32	43	51	51	50	42	27	3	-25	3.	99.	103
HQ		1	-2	-3	0	0	2	1	-1	-5	-10	-14	-16	-16	-12	-6	0	6	10	12	13	12	10	9	7	12.	20.	29
HQW		0	-2	-3	-1	0	0	1	2	1	-1	-4	-6	-6	-5	-2	1	2	3	4	3	4	3	3	3	13.	99.	10
HQE		4	3	1	-1	1	3	3	1	-2	-8	-14	-18	-20	-17	-11	-4	5	9	11	12	13	11	10	8	13.	21.	33
HQS		1	-6	-6	1	1	2	-1	-7	-13	-20	-24	-24	-22	-14	-6	3	11	19	22	23	20	17	14	9	12.	20.	48
HD		-65	-84	-108	-92	-54	-37	-19	-5	3	-2	6	8	14	30	51	69	82	86	76	70	51	21	-29	-72	3.	18.	194
HDW		-17	-35	-47	-40	-15	-6	-3	2	7	3	5	3	0	4	6	16	29	31	30	34	32	30	-18	-52	24.	20.	85
HDE		-73	-96	-110	-58	-45	-60	-37	-16	-4	-7	1	7	18	38	46	79	91	92	83	69	49	9	-28	-49	3.	18.	203
HDS		-107	-120	-167	-178	-103	-46	-16	-2	7	-1	13	13	25	48	101	113	124	133	114	106	73	26	-41	-115	4.	18.	312

LEIRVOGUR 2010

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	19	28	26	29	35	42	41	39	35	29	17	-2	-25	-46	-59	-59	-52	-39	-29	-20	-11	-7	0	10	16.	6.	101
DW	22	24	17	16	18	19	18	16	11	6	2	-8	-18	-29	-36	-35	-31	-24	-16	-8	2	4	10	18	15.	2.	60
DE	20	38	34	31	38	43	36	30	27	28	16	-1	-26	-52	-67	-67	-55	-41	-27	-17	-7	-2	8	16	99.	6.	110
DS	13	22	26	41	49	64	69	71	67	52	33	3	-30	-58	-73	-75	-69	-53	-45	-36	-29	-24	-18	-3	16.	8.	146
DQ	7	8	8	11	18	24	32	37	39	35	23	2	-19	-38	-48	-45	-36	-25	-15	-9	-5	-3	0	2	15.	9.	87
DQW	11	9	7	5	5	7	11	13	13	12	7	-2	-13	-22	-28	-23	-16	-11	-7	-2	2	6	9	10	15.	9.	41
DQE	9	12	12	14	21	23	27	30	33	34	25	8	-14	-38	-52	-50	-40	-26	-15	-9	-7	-5	-1	5	15.	10.	86
DQS	-1	2	5	14	26	41	57	69	70	59	36	2	-31	-54	-65	-63	-53	-38	-24	-15	-10	-8	-8	-9	15.	9.	134
DD	32	55	58	75	74	83	61	40	26	19	4	-11	-32	-53	-69	-74	-73	-69	-57	-51	-33	-24	-2	21	16.	6.	157
DDW	32	43	31	31	28	38	35	22	10	-4	-9	-18	-24	-38	-52	-54	-51	-36	-23	-10	1	1	10	36	16.	2.	97
DDE	23	69	66	68	84	84	53	21	3	16	-6	-16	-36	-60	-74	-77	-71	-76	-48	-42	-16	7	8	19	16.	5.	162
DDS	41	53	76	124	110	126	95	78	65	44	27	0	-36	-62	-80	-91	-97	-94	-101	-100	-84	-80	-24	9	19.	6.	227
F	-20	-27	-29	-24	-18	-16	-10	-6	-5	-5	-3	-2	1	6	14	21	26	28	27	24	18	11	0	-10	3.	18.	58
FW	-8	-19	-18	-15	-9	-6	-3	-4	-3	-3	-3	-3	-2	0	3	8	12	14	16	16	13	10	3	-1	2.	99.	35
FE	-23	-27	-31	-22	-19	-19	-13	-7	-6	-5	-3	-2	1	7	14	23	27	30	29	26	21	12	-1	-11	3.	18.	61
FS	-29	-34	-40	-36	-28	-23	-12	-8	-6	-6	-4	-1	4	12	24	32	39	41	35	29	21	12	-2	-18	3.	18.	81
FQ	-5	-8	-9	-5	-3	-1	0	-1	-2	-4	-6	-6	-5	-2	2	6	10	11	10	8	5	4	2	-1	3.	18.	20
FQW	-2	-4	-4	-2	0	0	0	0	0	-2	-3	-4	-4	-3	0	2	4	4	4	4	3	2	1	0	3.	20.	9
FQE	-3	-6	-8	-8	-6	-2	-1	-1	-2	-4	-5	-6	-5	-2	2	6	11	11	9	8	6	5	3	-1	99.	18.	19
FQS	-10	-15	-16	-5	-2	0	1	-1	-4	-8	-10	-9	-7	-2	4	11	16	18	16	12	7	4	3	-2	3.	18.	34
FD	-21	-27	-48	-45	-44	-56	-37	-22	-14	-10	3	8	16	26	39	51	56	54	44	38	25	8	-17	-27	6.	17.	112
FDW	-15	-27	-37	-36	-19	-16	-15	-13	-8	-7	-1	2	3	8	13	25	36	37	37	35	20	13	-14	-18	3.	18.	75
FDE	-30	-28	-53	-39	-42	-66	-55	-30	-24	-14	0	8	19	32	39	59	56	58	51	46	36	8	-16	-17	6.	16.	125
FDS	-18	-26	-52	-60	-72	-86	-41	-22	-11	-8	9	14	25	39	66	71	77	67	45	33	17	3	-21	-47	6.	17.	163

LEIRVOGUR MAGNETIC OBSERVATORY 2010
K-INDICES FOR THREE HOUR INTERVALS IN U.T.
LOWER LIMIT FOR K-9 = 1500 NANOTESLAS IN H

DAYS	K-INDICES						
1- 7	00000000	00000000	11122100	10110000	00001000	11000000	00000000
8- 14	11000000	00000000	00011100	11222122	21010111	52211123	22011022
15- 21	11001133	00000001	00001000	01001000	00001000	10112556	44311100
22- 28	12011003	42121102	32311112	20111003	21111010	00001001	21101121
29- 35	10010001	33001114	40001112	31112324	63221217	50322332	32000101
36- 42	00011000	00012332	10000014	52110000	21111101	21010012	12112201
43- 49	24211212	33011133	20011114	54221356	44321236	54110004	00012330
50- 56	21011121	00000100	00001110	23011223	42110100	12110122	30010114
57- 63	40000000	00011100	00011102	21012212	00012213	34122235	24222211
64- 70	10122103	51011113	43311100	12111111	10011200	20122334	64421221
71- 77	54312223	40011122	41112224	00011230	11112113	04311115	53011123
78- 84	10112212	23222320	10111100	00011100	00012200	00012213	23112332
85- 91	11112113	32111110	04321211	21022215	52122223	42121214	44224424
92- 98	54432345	42113465	44423347	65565655	76655676	73643456	64222237
99-105	55322323	20011212	31113566	65421431	00111214	22011338	65112210
106-112	12111120	10111122	11011211	22122212	11122223	33322221	01122333
113-119	76322236	56221221	13111201	01121200	41222211	00121203	66121211
120-126	21112112	10012221	11237566	76434447	72333336	52222332	04423435
127-133	64222334	45323121	32122220	22122221	31122222	21132212	21111210
134-140	01122221	43112110	11122331	44123323	43222220	01124333	62223316
141-147	62121211	02122210	00121110	01122210	02122214	11222213	31121100
148-154	13223224	66655554	54633566	43445546	75323354	35222322	33223336
155-161	67432223	33222226	42122224	32122222	21111210	11112211	32232223
162-168	32122211	01121220	02222314	23222123	32222336	66333444	43322243
169-175	21222321	01212222	10122212	11222222	02222313	11212221	00112232
176-182	51122324	25532446	66333335	44222322	35322336	77433344	56223435
183-189	53222234	44123323	41111321	01122212	32012211	01122102	00111222
190-196	33212212	01011211	01013213	11122222	10121113	21122225	75212322
197-203	02222211	00112111	11121110	11112210	11212222	11222321	21123212
204-210	23222222	11112323	43123324	44222223	56442446	74333335	44223223
211-217	33123425	42123321	11122121	23123223	34322457	76356486	65213225
218-224	44223332	23221201	11122220	54322332	44122225	53322223	43121212
225-231	24222221	11022211	43122223	33212332	32122222	34112211	11121211
232-238	00112212	01222101	00121101	00122225	65434435	77334437	66323322
239-245	34533425	62322223	31122210	10121100	00112112	01021224	33223321
246-252	30111100	01011112	00121224	54321225	54133423	65224444	10123312
253-259	22112110	00111110	00112200	00111210	22312345	62121112	20112452
260-266	23322321	52111211	00111112	21112121	32221101	10111210	21122222
267-273	23313446	54222222	20122334	40013344	31333220	23111101	00011101
274-280	10011100	00011100	21011010	00011111	22231211	30212442	21021113
281-287	43121113	31111110	00012213	22235556	64422325	42221101	20011001
288-294	11122245	62111233	35422244	40011234	44212213	52112112	41011110
295-301	13111224	65335436	56324333	33222232	43121243	11121141	00121120
302-308	22111100	00002200	00013100	00011001	00211100	22122222	32011101
309-315	10011101	00011102	10001010	00011120	11101001	00000134	63133347
316-322	66534225	41012143	13112334	45231115	52121210	12211102	22112212
323-329	21011000	00221100	30011111	21122223	32211243	21111122	22111000
330-336	00001010	00001165	43111232	11011130	21011112	20000010	32100001
337-343	00000001	00000000	00000002	10100112	10111122	32101232	11010001
344-350	00000000	10000000	00101223	43211143	34222456	55211210	31231112
351-357	31101121	13001002	30000102	13322224	21110010	00000000	10000000
358-364	02111110	22100122	11000021	30000002	11013531	32111120	00011221
365	41111110						

LEIRVOGUR MAGNETIC OBSERVATORY 2010

K-SUMS IN 27-DAY RUNS

DAYS	K-SUMS																										
1- 27	0	0	8	3	1	2	0	2	0	3	13	7	17	10	10	1	1	2	1	21	14	8	13	14	8	7	2
28- 54	9	3	13	9	17	24	20	7	2	11	6	9	8	7	10	15	15	10	28	25	15	9	9	1	3	14	9
55- 81	10	10	4	3	5	11	9	22	16	10	13	13	9	5	17	22	22	11	17	7	11	16	16	10	16	5	3
82-108	5	9	17	11	10	14	15	19	17	26	30	26	31	43	48	38	28	25	9	26	26	10	20	18	9	9	8
109-135	14	14	18	15	31	21	10	7	15	9	20	11	9	31	39	30	21	25	26	21	14	14	15	14	9	11	13
136-162	14	22	17	17	25	16	10	6	9	14	14	9	19	42	38	35	32	21	25	29	22	19	16	9	10	19	14
163-189	9	16	17	23	33	23	15	12	11	14	15	12	11	20	31	32	21	27	35	30	23	22	14	11	12	9	9
190-216	16	7	11	13	10	17	24	12	7	8	9	13	14	14	17	14	22	21	35	31	22	23	18	11	18	30	45
217-243	26	23	13	11	24	22	22	16	17	10	19	19	16	15	10	9	9	6	14	34	38	27	29	22	12	6	8
244-270	12	19	7	7	12	24	25	31	13	10	5	6	6	22	16	17	18	14	7	11	12	7	14	26	21	17	19
271-297	17	10	4	4	3	6	5	14	18	11	16	9	9	30	28	13	5	18	19	26	15	19	15	9	15	35	29
298-324	19	20	12	7	8	4	5	3	5	15	9	5	5	3	5	5	8	30	33	16	18	22	14	10	13	5	6
325-351	8	15	18	11	7	2	13	17	8	9	3	7	1	0	2	6	9	14	4	0	1	9	19	28	17	14	10
352-365	7	6	19	6	0	1	7	10	5	5	15	11	7	10													

LEIRVOGUR MAGNETIC OBSERVATORY 2010

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	125	77	27	10	5	3	1	0	0	0	0	0.8	4
FEB	75	69	38	21	12	5	3	1	0	0	0	1.4	8
MAR	43	91	66	26	14	7	1	0	0	0	0	1.6	8
APR	17	67	64	27	21	17	20	6	1	0	0	2.6	21
MAY	19	58	80	37	23	12	15	4	0	0	0	2.4	17
JUN	9	39	102	50	18	8	10	4	0	0	0	2.5	16
JUL	16	74	91	36	18	8	3	2	0	0	0	2.0	11
AUG	18	56	89	40	19	12	8	5	1	0	0	2.3	16
SEP	36	80	66	29	18	8	3	0	0	0	0	1.8	9
OCT	46	82	55	28	21	10	6	0	0	0	0	1.8	10
NOV	64	90	47	19	9	6	4	1	0	0	0	1.4	8
DEC	108	73	38	18	6	4	1	0	0	0	0	1.0	5
YEAR	576	856	763	341	184	100	75	23	2	0	0	1.8	11
%	19.7	29.3	26.1	11.7	6.3	3.4	2.6	0.8	0.1	0.0			

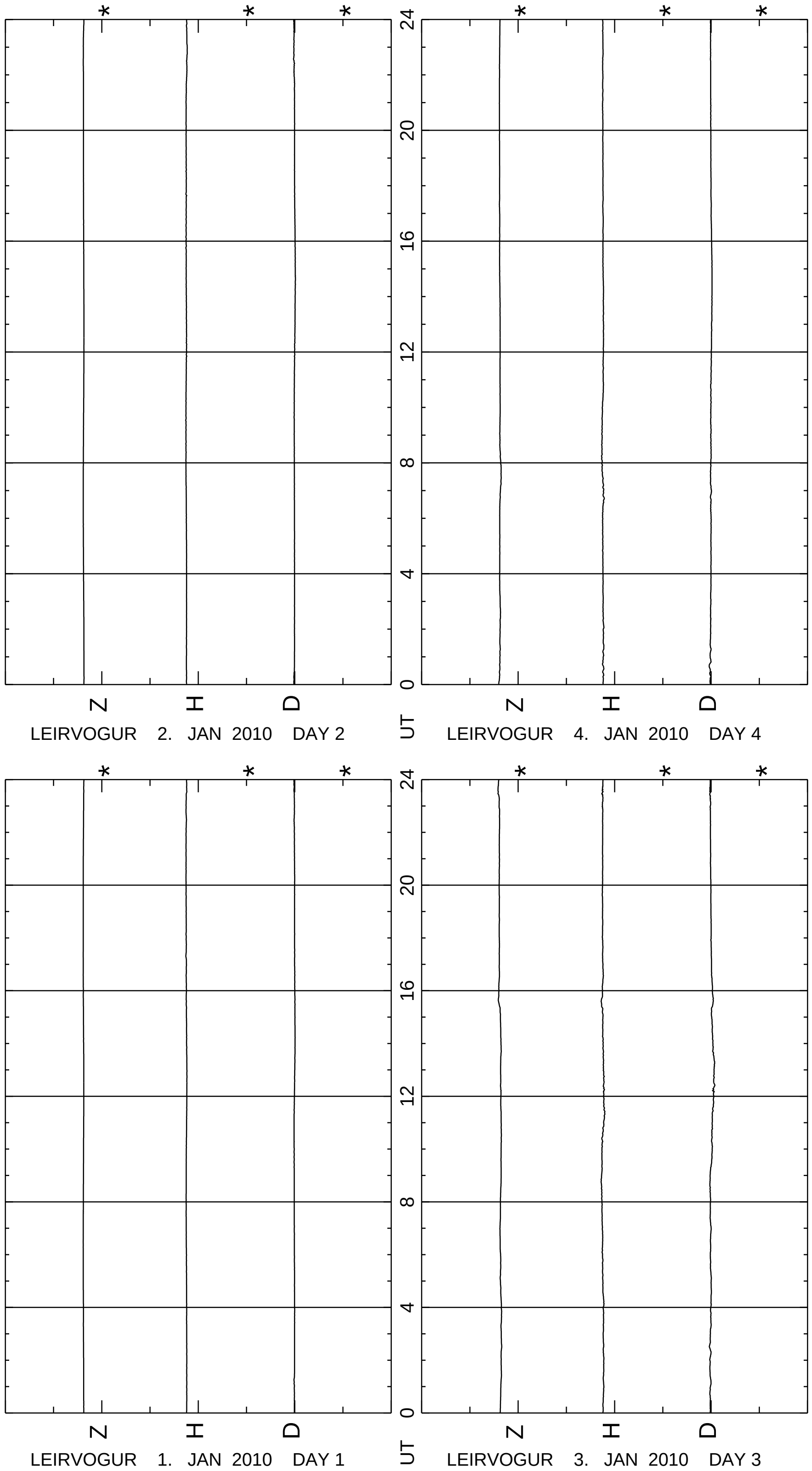
	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\overline{K}$	$\overline{Ak}$
1958	76	267	459	591	510	488	328	87	12	2	100	3.6	33
1959	46	260	360	567	562	547	388	138	33	8	11	3.9	39
1960	75	275	399	539	468	492	304	165	32	4	175	3.7	38
1961	224	477	475	518	482	351	222	87	19	1	64	3.1	27
1962	17	346	592	569	444	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

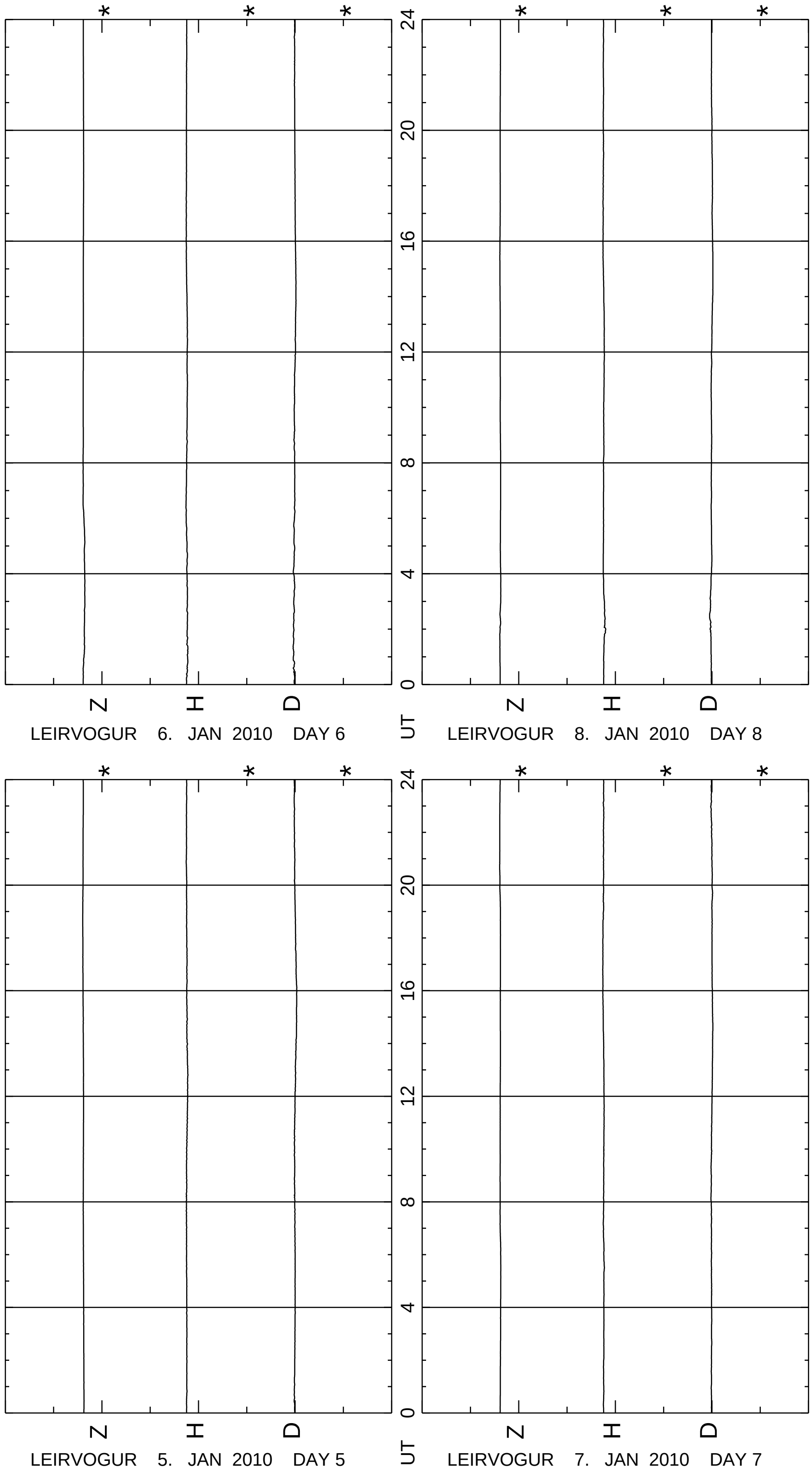
EXPLANATION OF DAILY GRAPHS

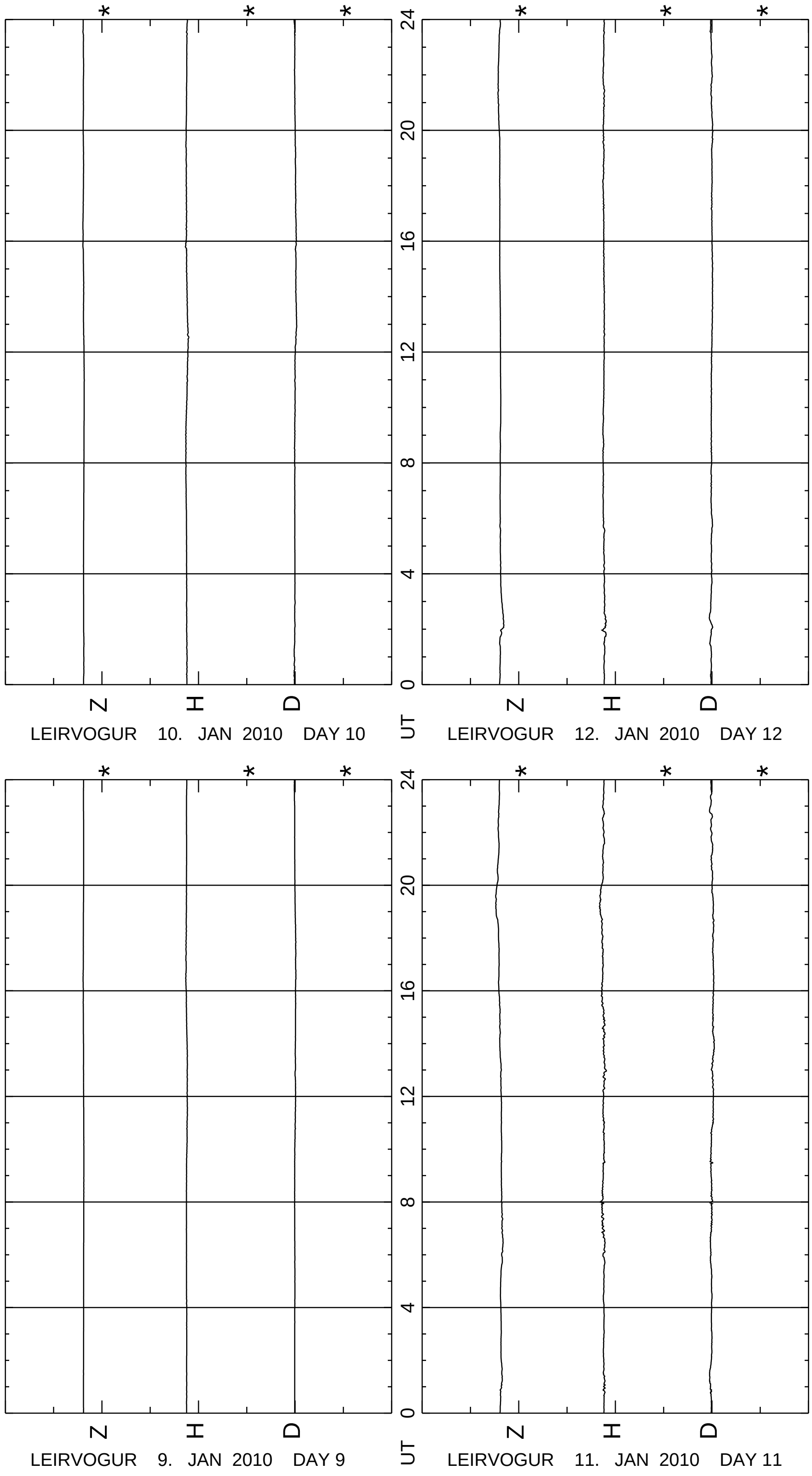
The graphs on pages 31–122 show the 1-minute means of the magnetic elements Z, H, and D at Leirvogur in 2010. Vertical divisions are spaced at intervals of 500 nT in Z and H and $2^\circ\!.31$ in D. The last figure is equivalent to 500 nT in the direction of magnetic east for average values of H at Leirvogur.

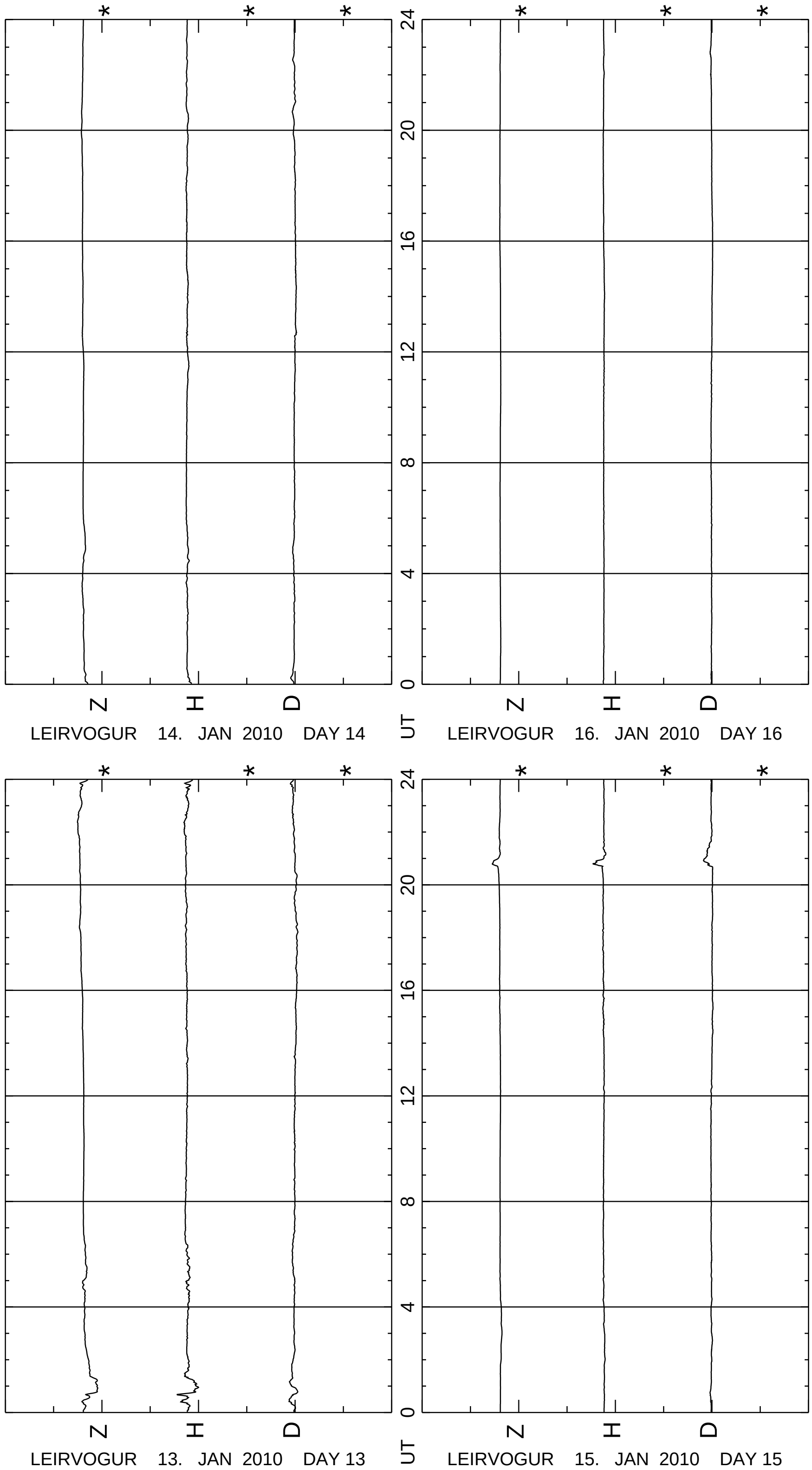
Levels marked with asterisk (*) are as follows:
Z: 50000 nT
H: 12000 nT
D: 344° E

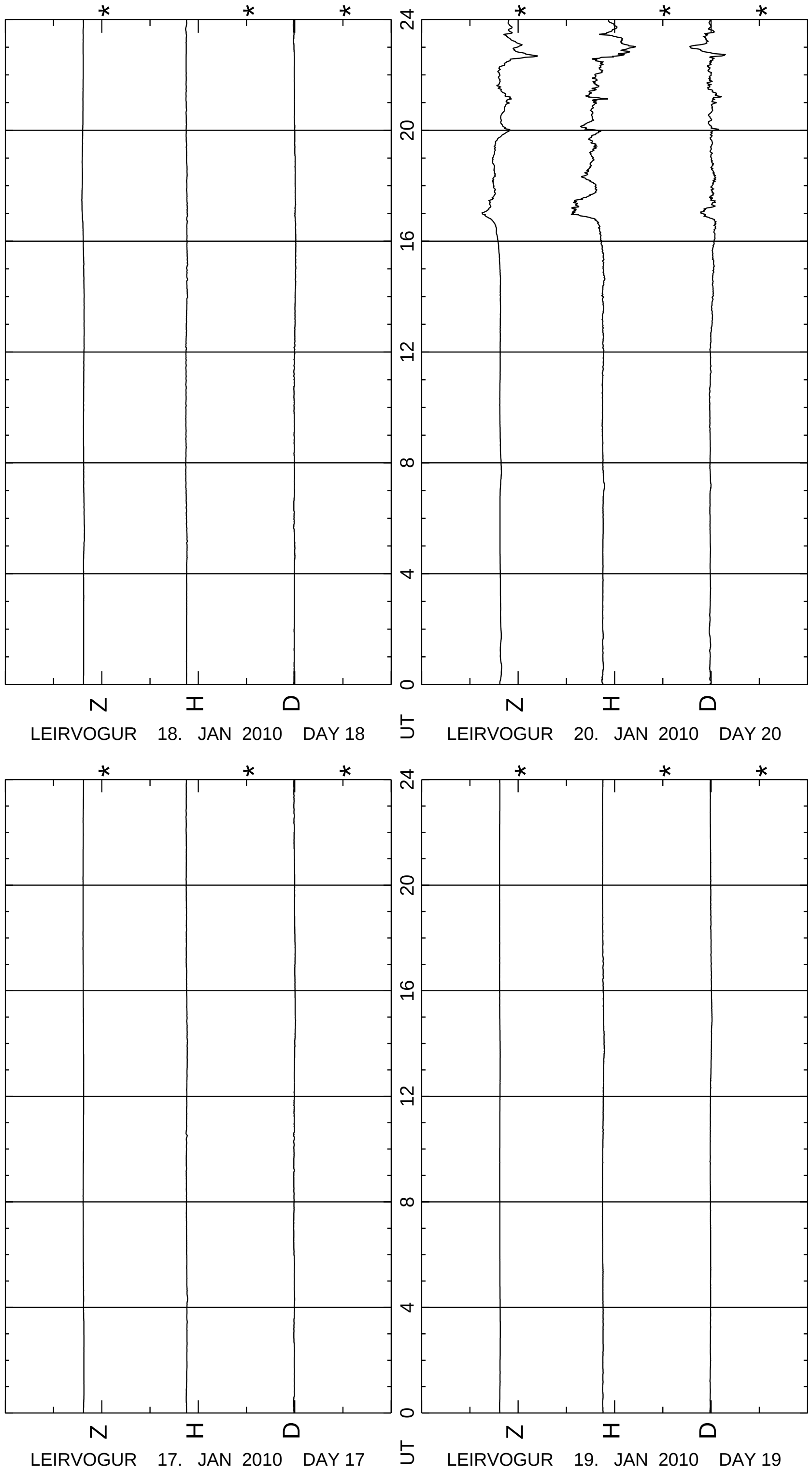
In several cases the H and D components had to be shifted upwards or downwards by one interval (500 nT) to disentangle the lines or prevent them from disappearing off scale.

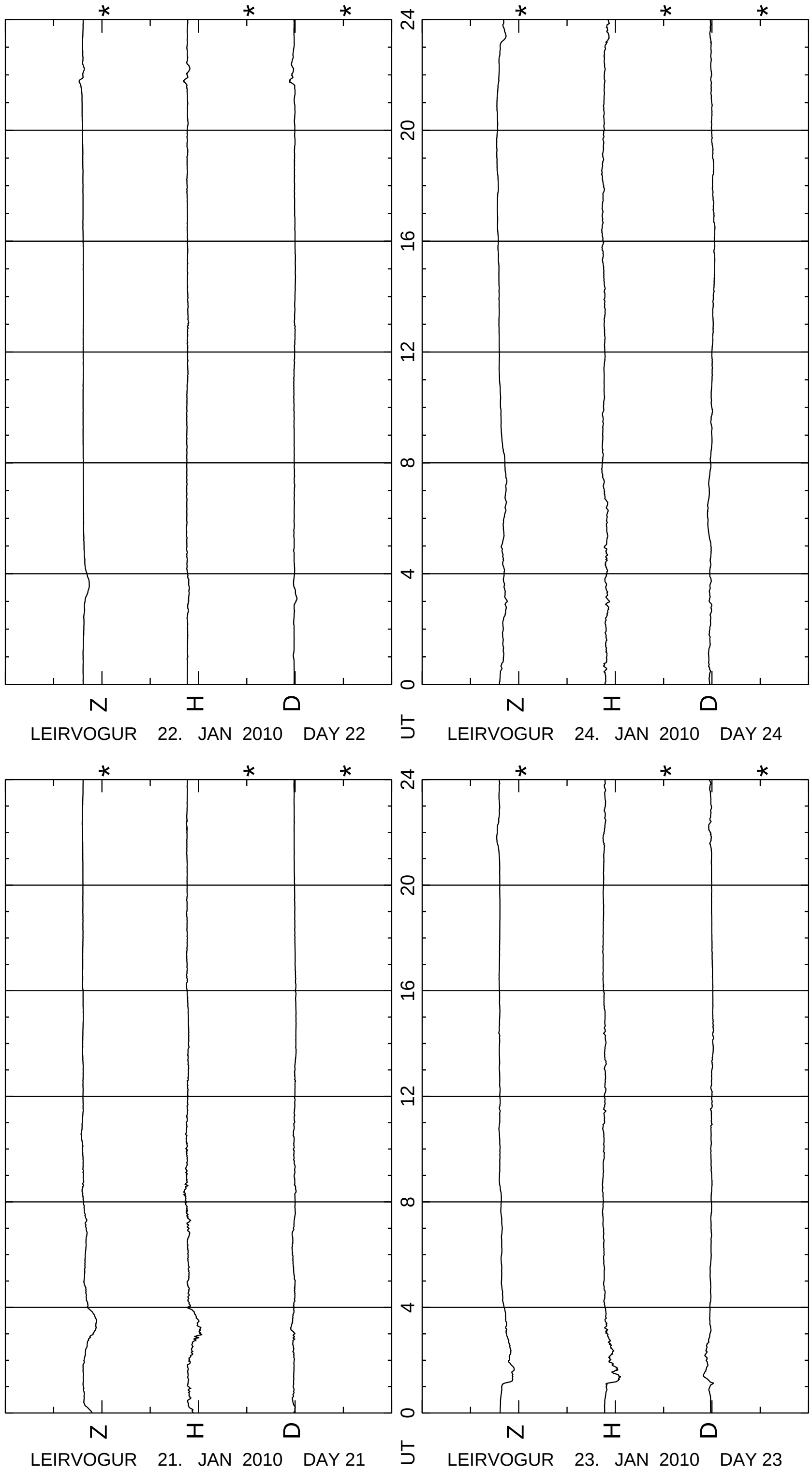

Z H D
LEIRVOGUR 2. JAN 2010 DAY 2
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 4. JAN 2010 DAY 4
Z H D
LEIRVOGUR 1. JAN 2010 DAY 1
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 3. JAN 2010 DAY 3


Z H D
LEIRVOGUR 6. JAN 2010 DAY 6
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 8. JAN 2010 DAY 8
Z H D
LEIRVOGUR 5. JAN 2010 DAY 5
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 7. JAN 2010 DAY 7

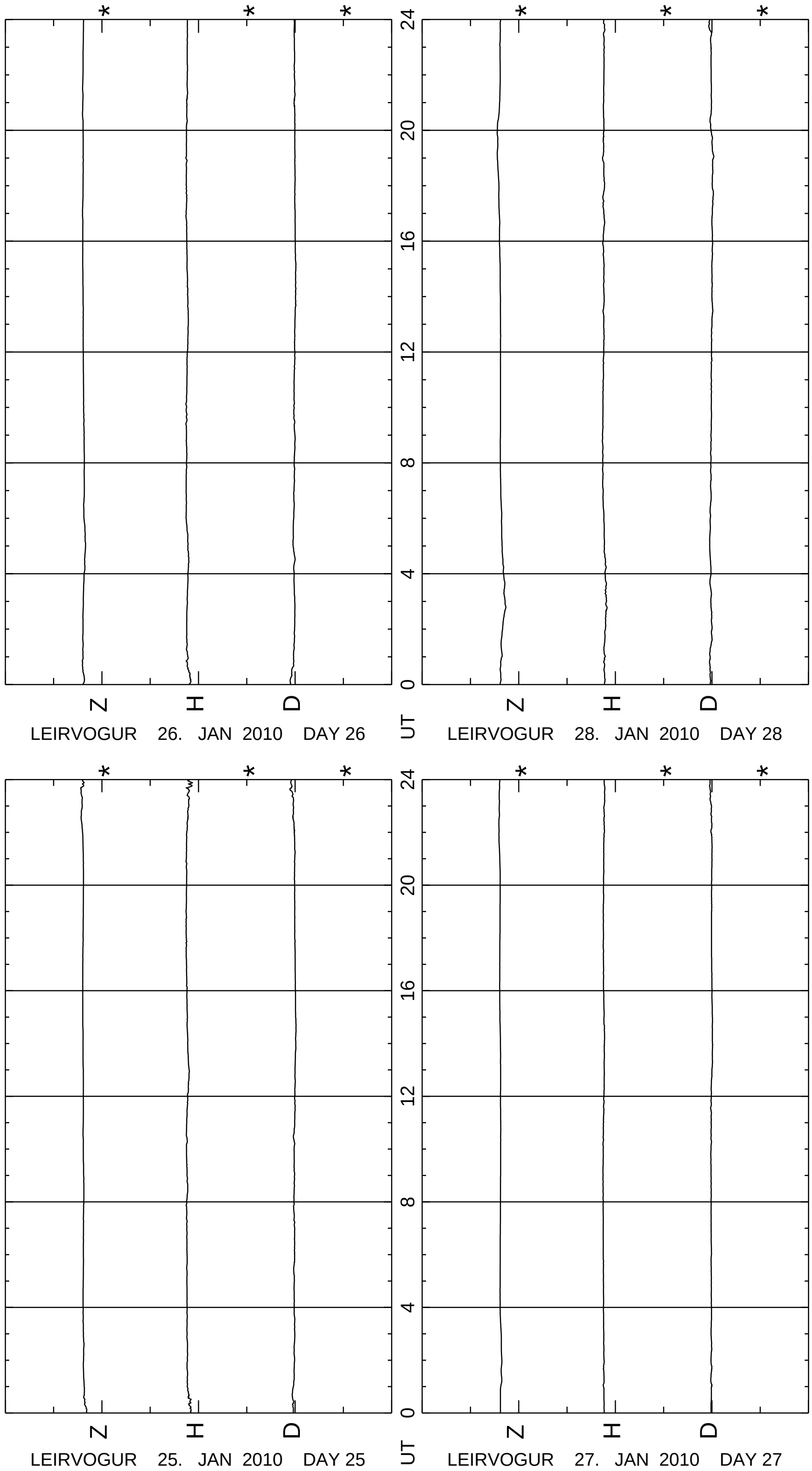

LEIRVOGUR 10. JAN 2010 DAY 10
LEIRVOGUR 12. JAN 2010 DAY 12
LEIRVOGUR 9. JAN 2010 DAY 9
LEIRVOGUR 11. JAN 2010 DAY 11
Z H D
UT
0 4 8 12 16 20 24

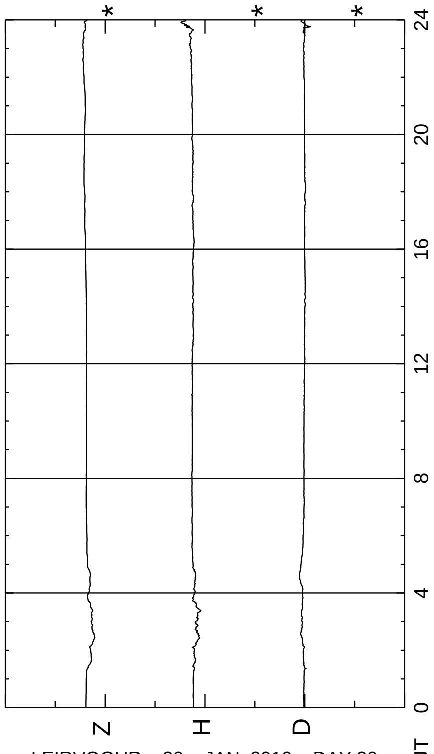

LEIRVOGUR 14. JAN 2010 DAY 14
LEIRVOGUR 16. JAN 2010 DAY 16
LEIRVOGUR 13. JAN 2010 DAY 13
LEIRVOGUR 15. JAN 2010 DAY 15
Z
H
D
UT
0
4
8
12
16
20
24


Z H D
LEIRVOGUR 18. JAN 2010 DAY 18
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 20. JAN 2010 DAY 20
Z H D
LEIRVOGUR 17. JAN 2010 DAY 17
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 19. JAN 2010 DAY 19

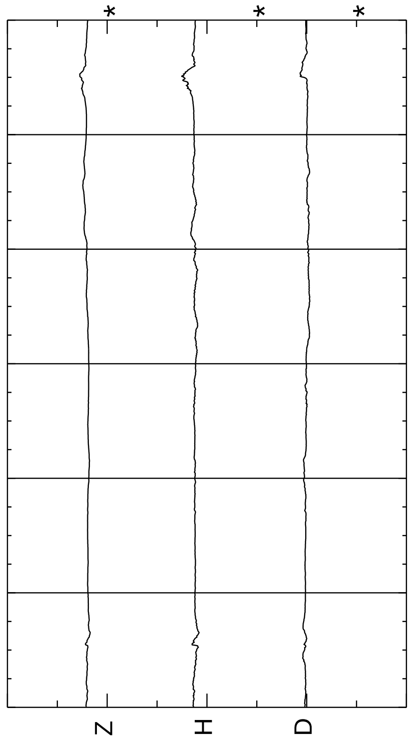


LEIRVOGUR 22. JAN 2010 DAY 22
LEIRVOGUR 24. JAN 2010 DAY 24
LEIRVOGUR 21. JAN 2010 DAY 21
LEIRVOGUR 23. JAN 2010 DAY 23
Z
H
D
UT
0
4
8
12
16
20
24

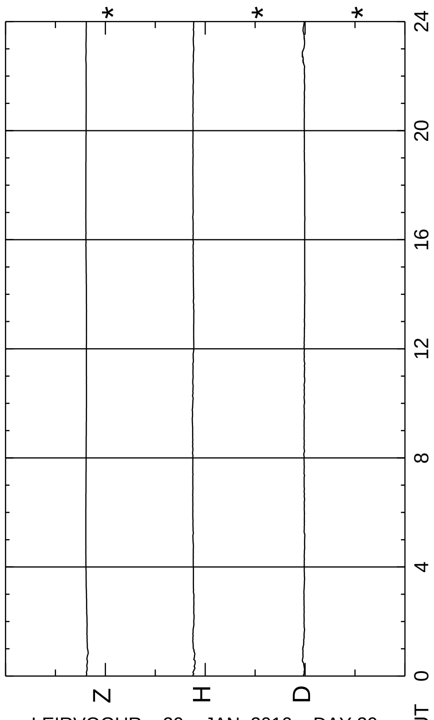

Z H D
LEIRVOGUR 26. JAN 2010 DAY 26
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 28. JAN 2010 DAY 28
Z H D
LEIRVOGUR 25. JAN 2010 DAY 25
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 27. JAN 2010 DAY 27



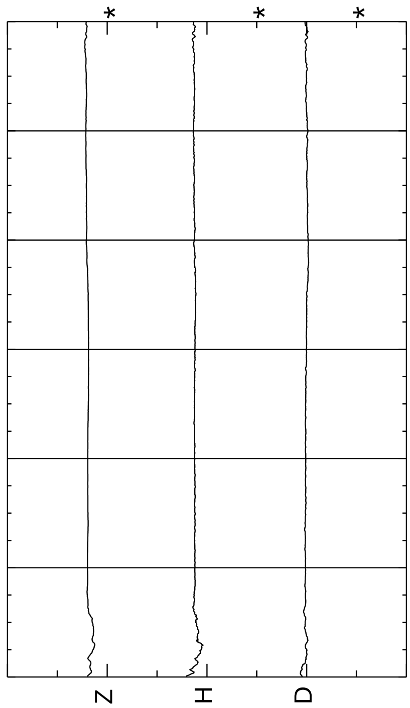
LEIRVOGUR 30. JAN 2010 DAY 30



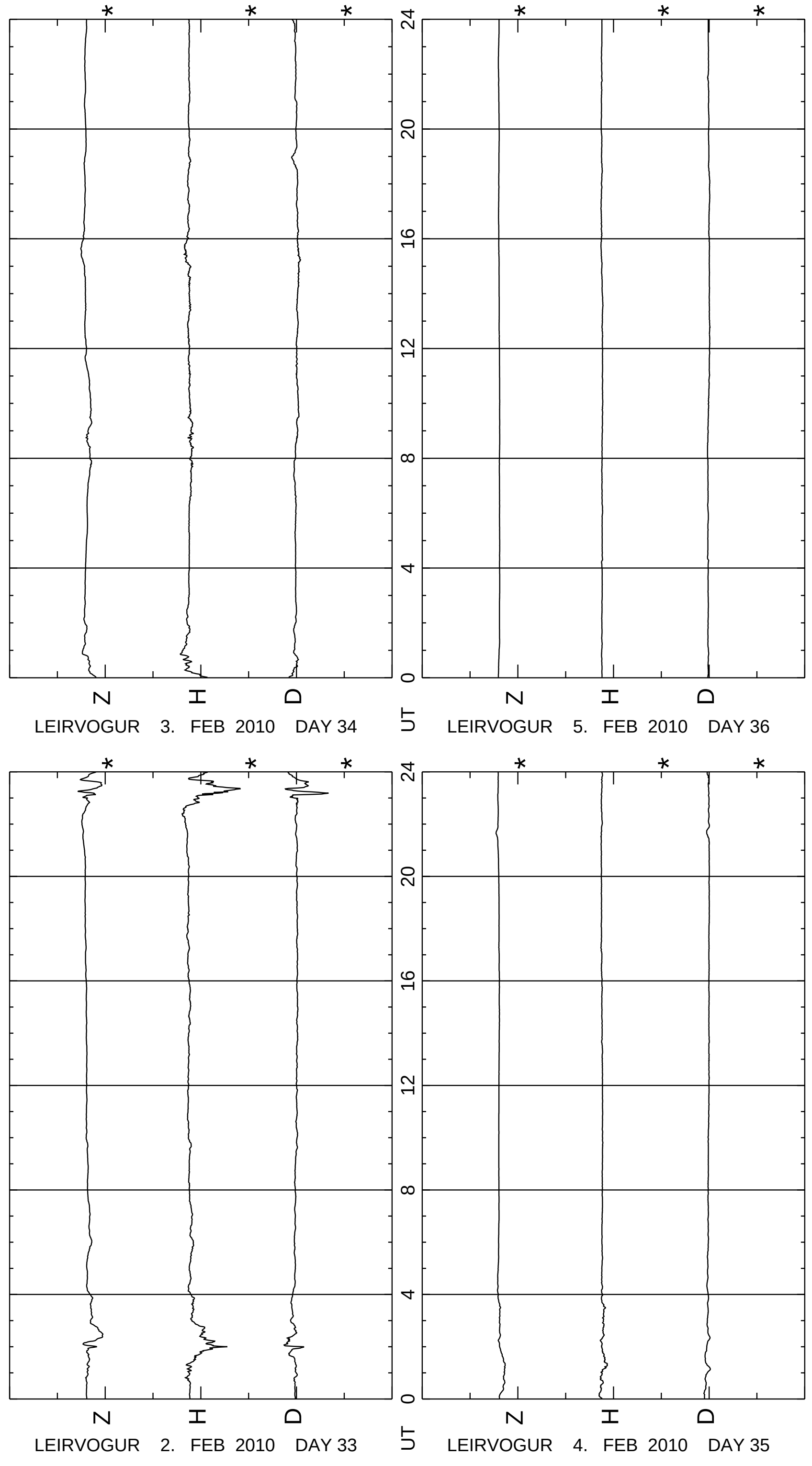
UT LEIRVOGUR 1. FEB 2010 DAY 32

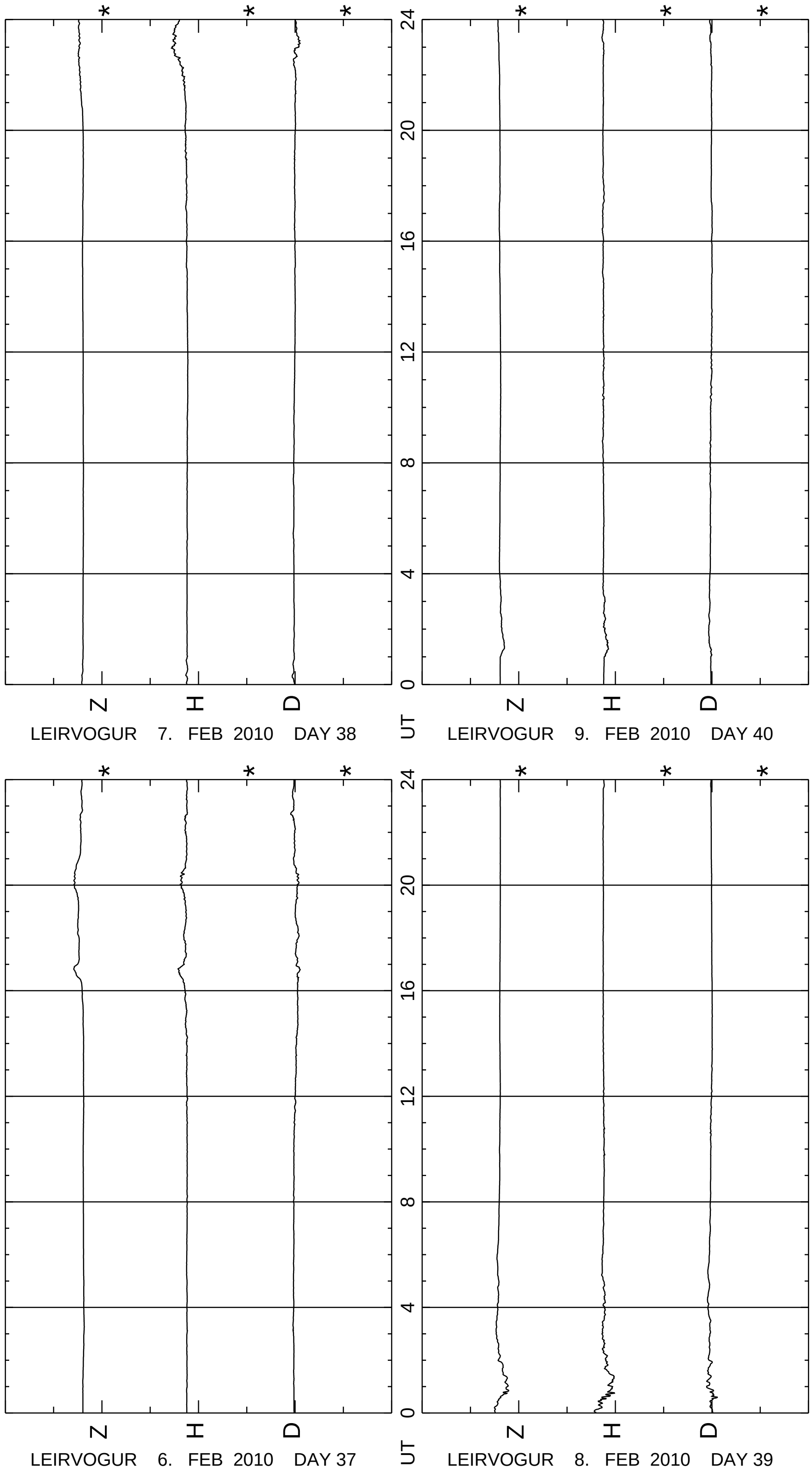


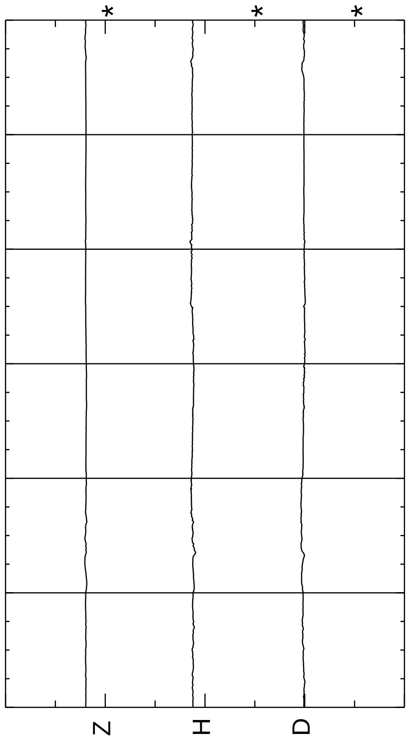
LEIRVOGUR 29. JAN 2010 DAY 29



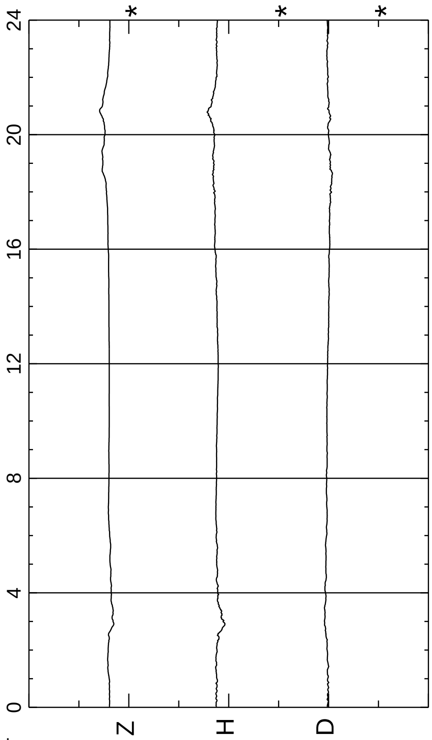
UT LEIRVOGUR 31. JAN 2010 DAY 31


LEIRVOGUR 3. FEB 2010 DAY 34
LEIRVOGUR 5. FEB 2010 DAY 36
LEIRVOGUR 2. FEB 2010 DAY 33
LEIRVOGUR 4. FEB 2010 DAY 35
Z
H
D
UT
0
4
8
12
16
20
24

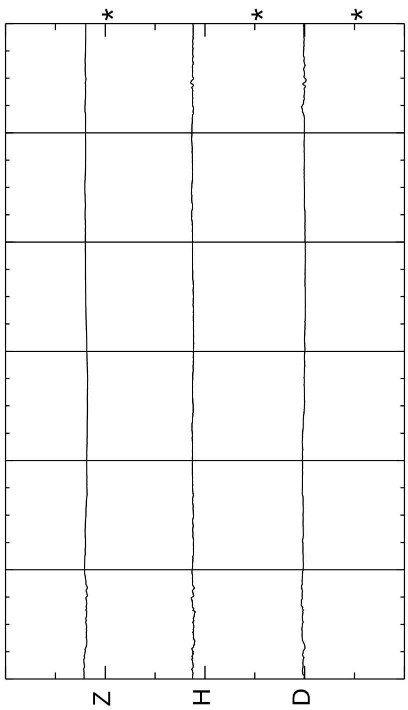

LEIRVOGUR 7. FEB 2010 DAY 38
LEIRVOGUR 9. FEB 2010 DAY 40
LEIRVOGUR 6. FEB 2010 DAY 37
LEIRVOGUR 8. FEB 2010 DAY 39
Z H D
UT
0 4 8 12 16 20 24



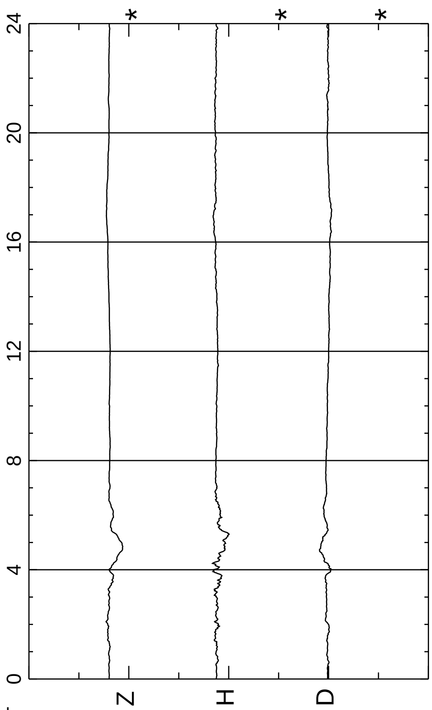
LEIRVOGUR 11. FEB 2010 DAY 42



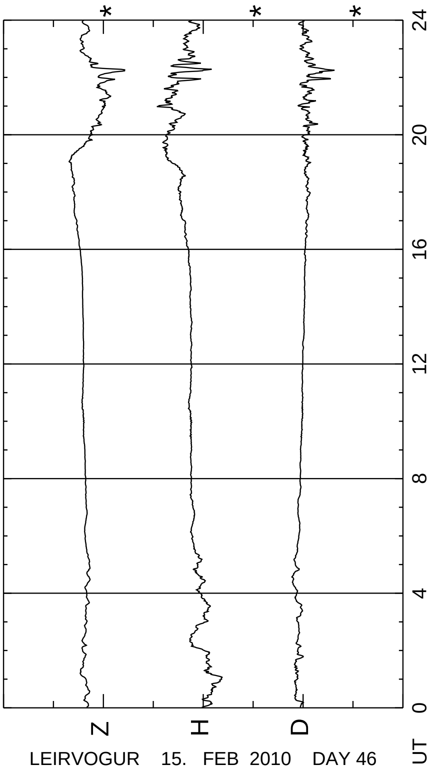
LEIRVOGUR 13. FEB 2010 DAY 44



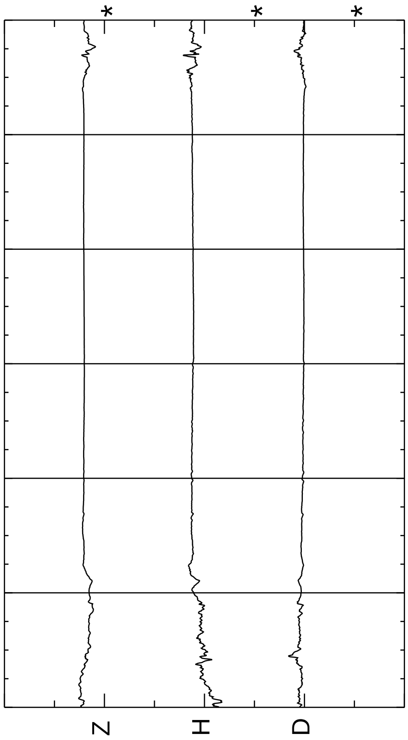
LEIRVOGUR 10. FEB 2010 DAY 41



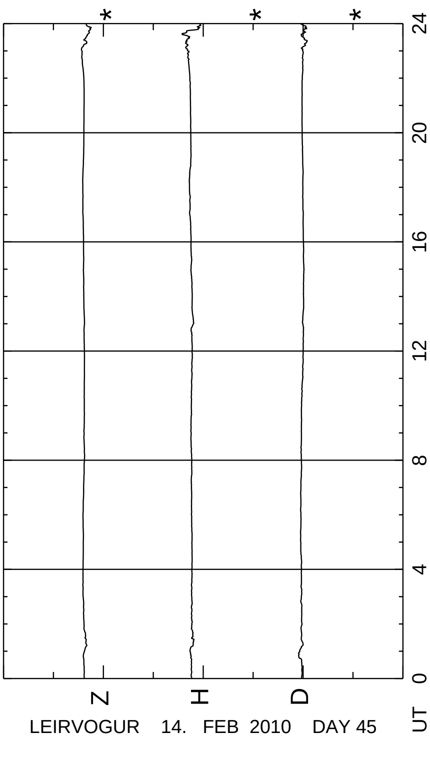
LEIRVOGUR 12. FEB 2010 DAY 43



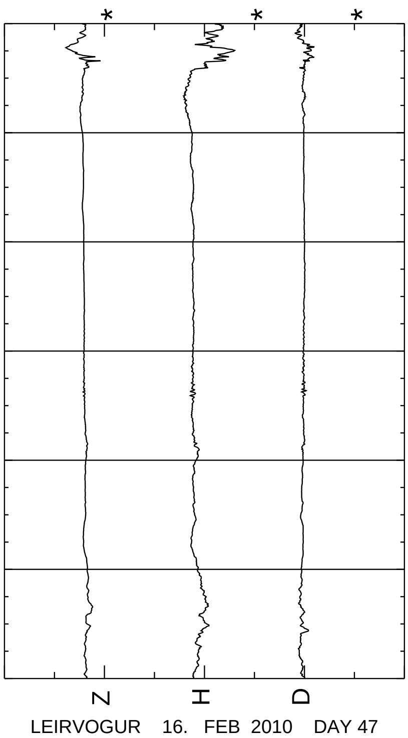
LEIRVOGUR 15. FEB 2010 DAY 46



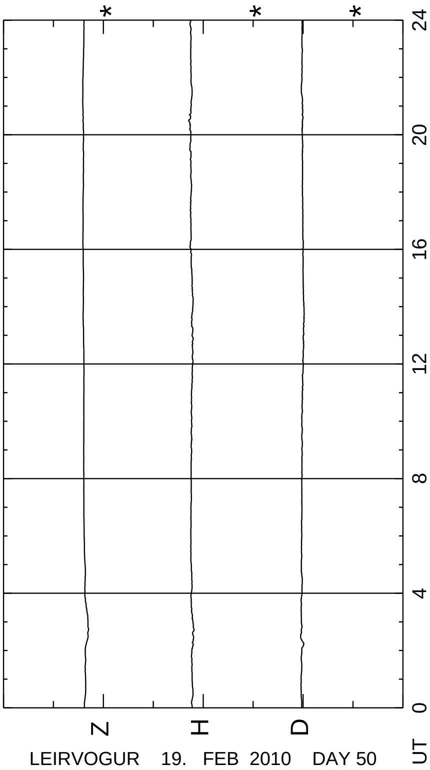
LEIRVOGUR 17. FEB 2010 DAY 48



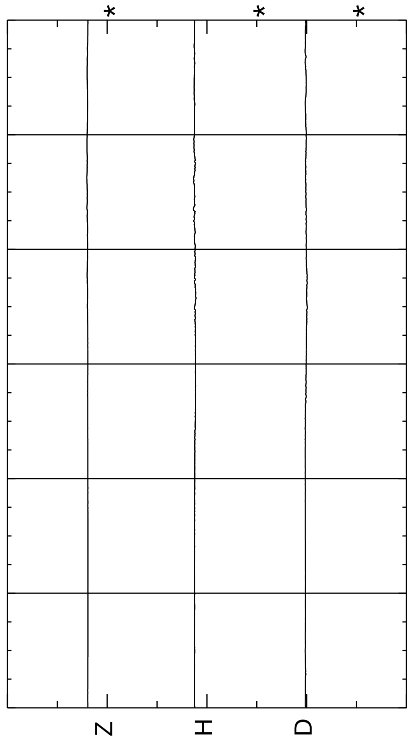
LEIRVOGUR 14. FEB 2010 DAY 45



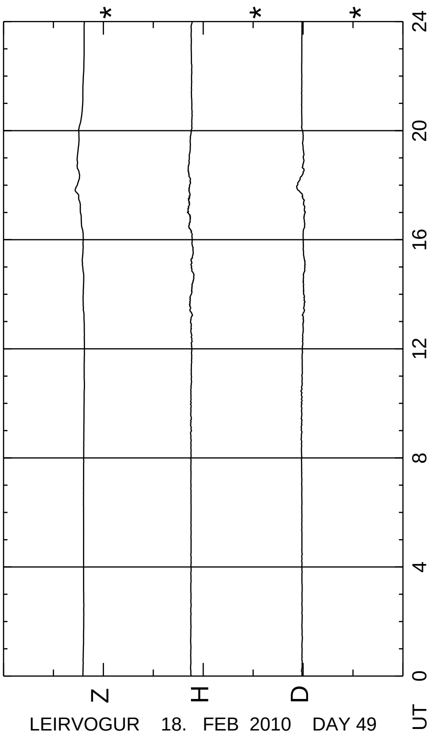
LEIRVOGUR 16. FEB 2010 DAY 47



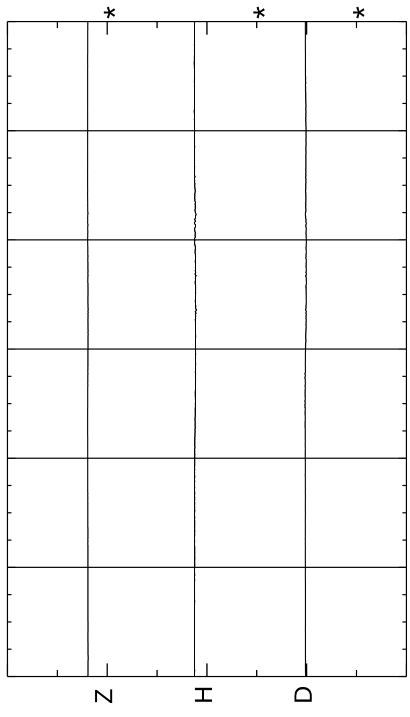
LEIRVOGUR 19. FEB 2010 DAY 50



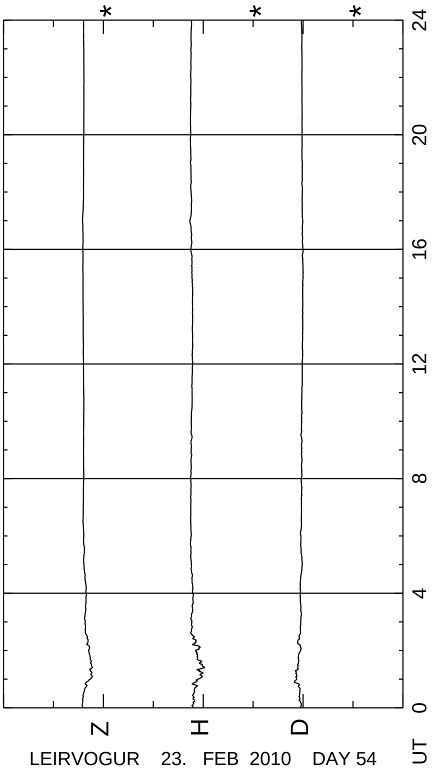
LEIRVOGUR 21. FEB 2010 DAY 52



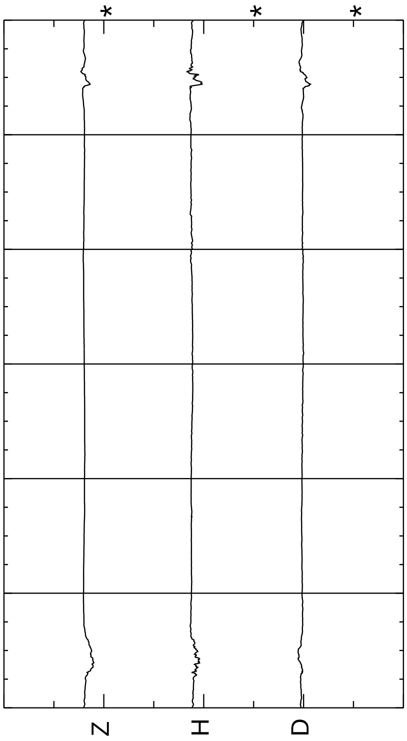
LEIRVOGUR 18. FEB 2010 DAY 49



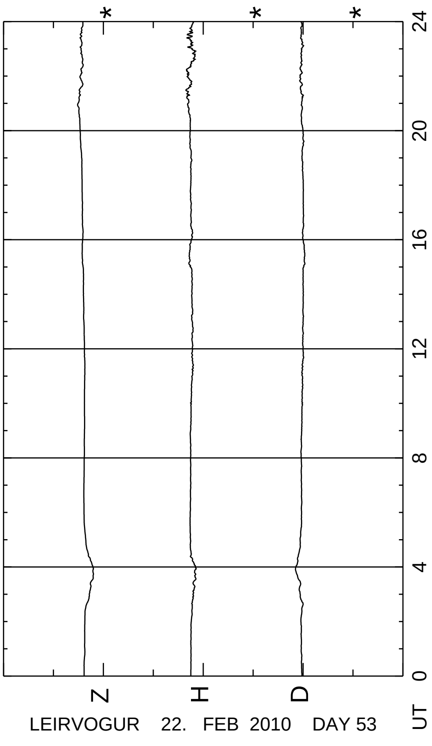
LEIRVOGUR 20. FEB 2010 DAY 51



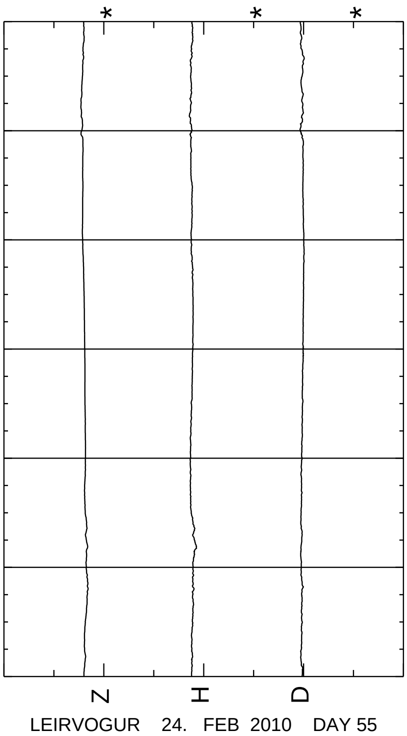
LEIRVOGUR 23. FEB 2010 DAY 54



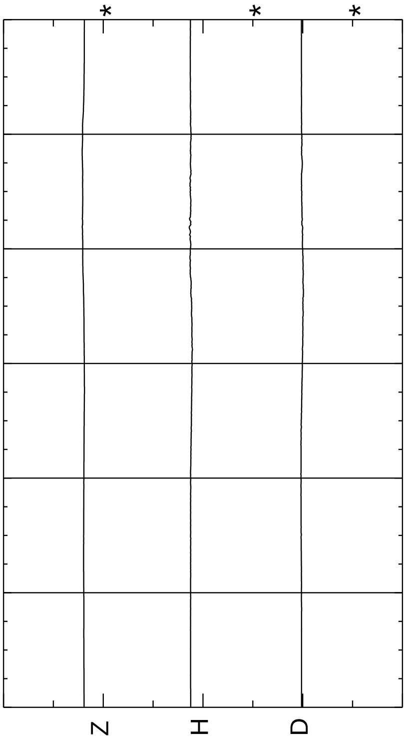
LEIRVOGUR 25. FEB 2010 DAY 56



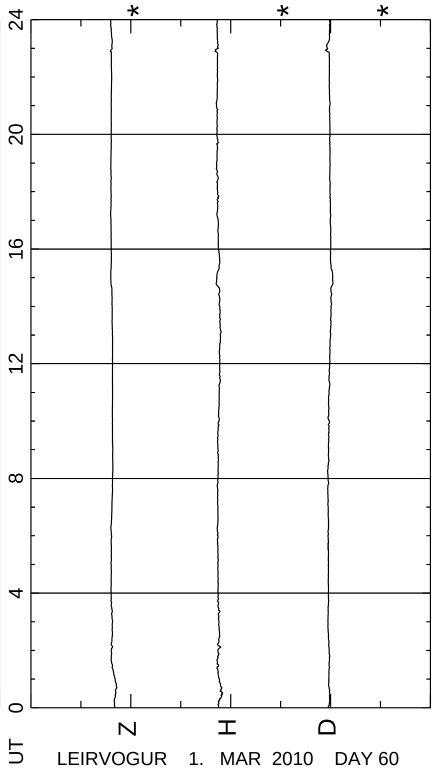
LEIRVOGUR 22. FEB 2010 DAY 53



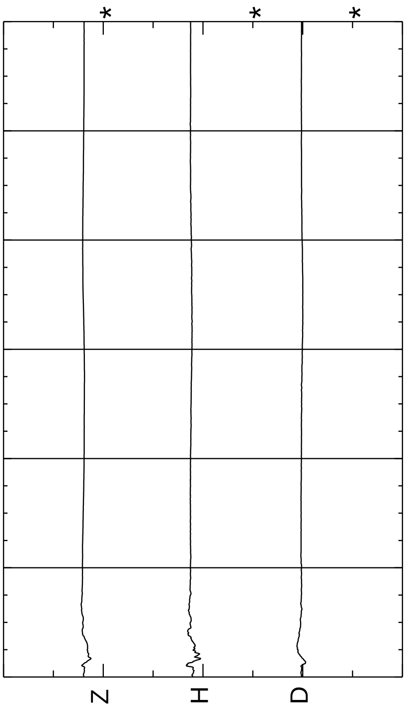
LEIRVOGUR 24. FEB 2010 DAY 55



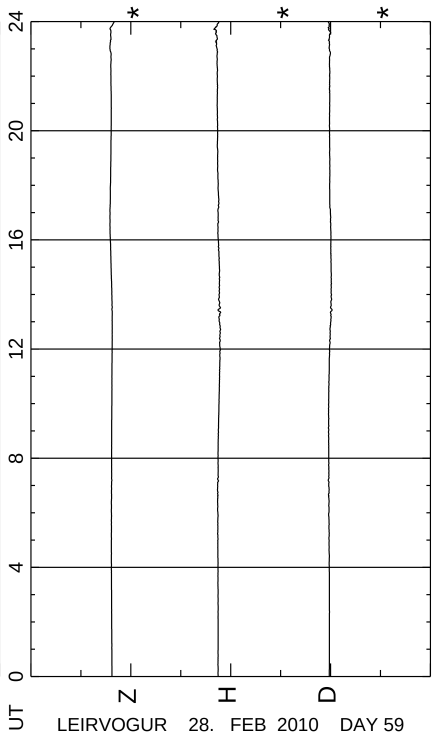
LEIRVOGUR 27. FEB 2010 DAY 58



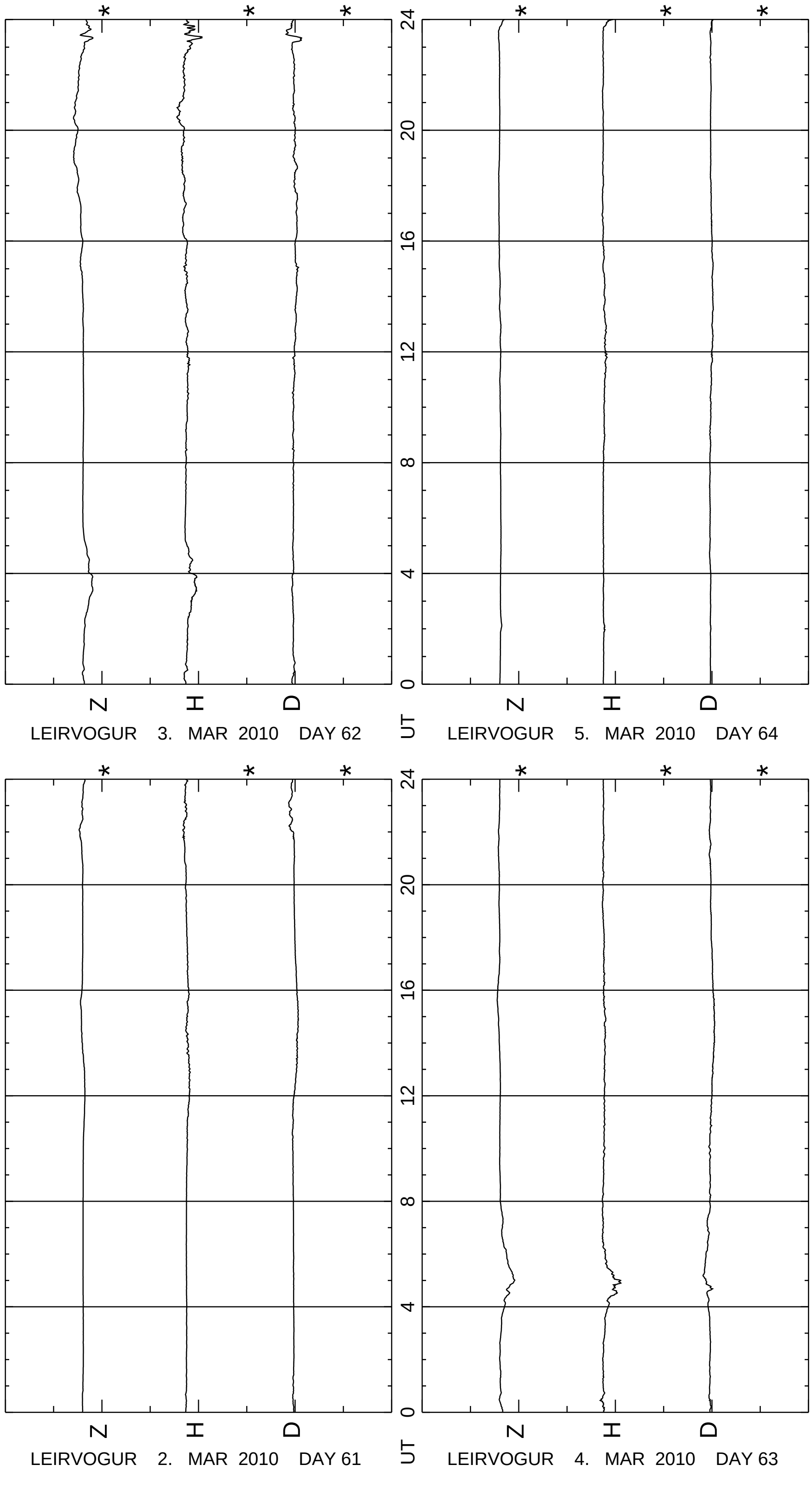
LEIRVOGUR 1. MAR 2010 DAY 60

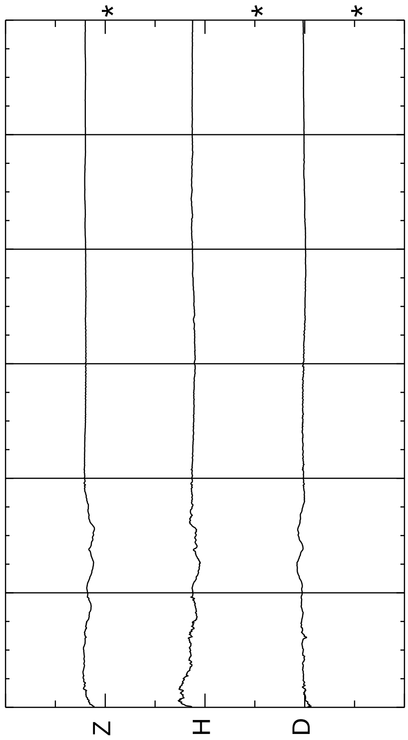


LEIRVOGUR 26. FEB 2010 DAY 57

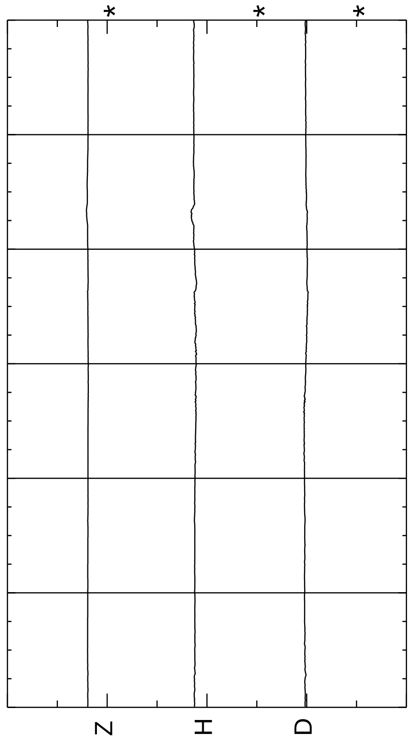


LEIRVOGUR 28. FEB 2010 DAY 59

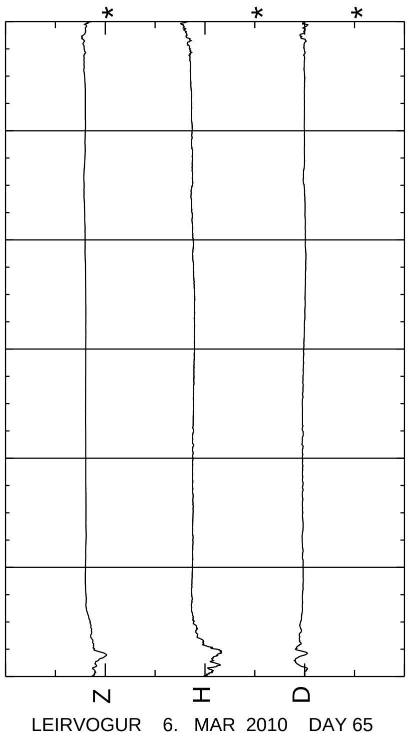

LEIRVOGUR 3. MAR 2010 DAY 62
LEIRVOGUR 5. MAR 2010 DAY 64
LEIRVOGUR 2. MAR 2010 DAY 61
LEIRVOGUR 4. MAR 2010 DAY 63
Z
H
D
UT



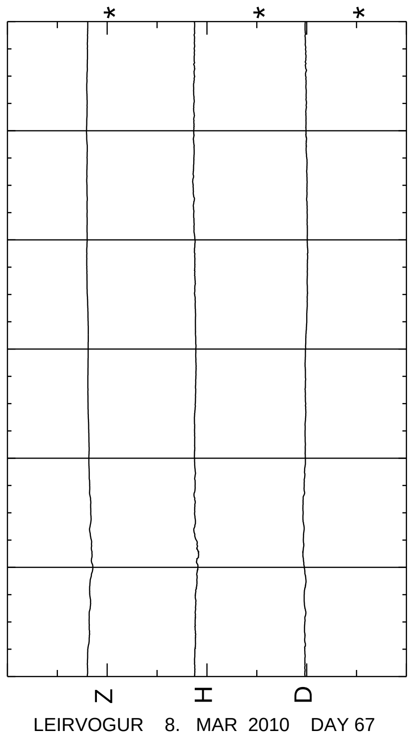
LEIRVOGUR 7. MAR 2010 DAY 66



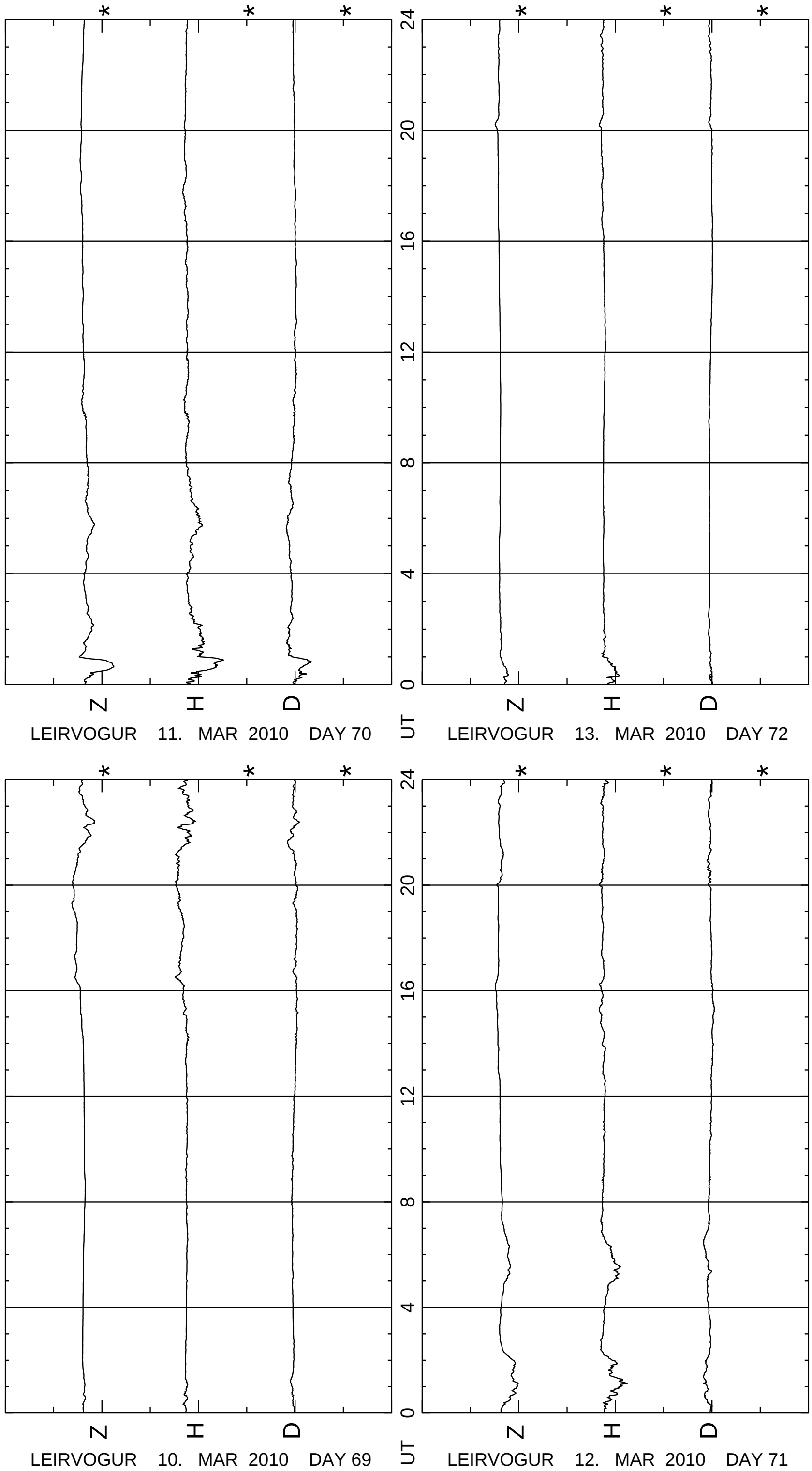
LEIRVOGUR 9. MAR 2010 DAY 68

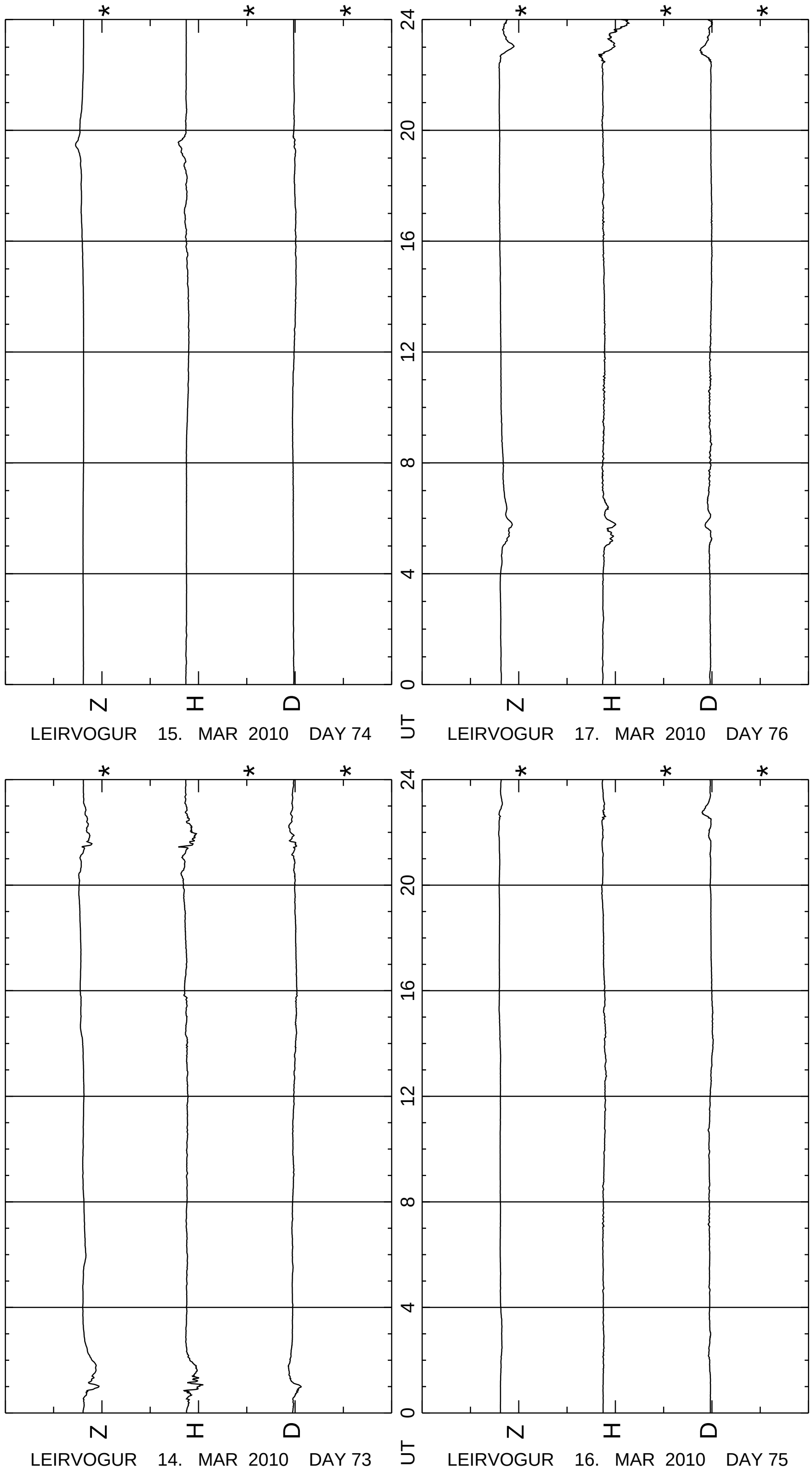


LEIRVOGUR 6. MAR 2010 DAY 65

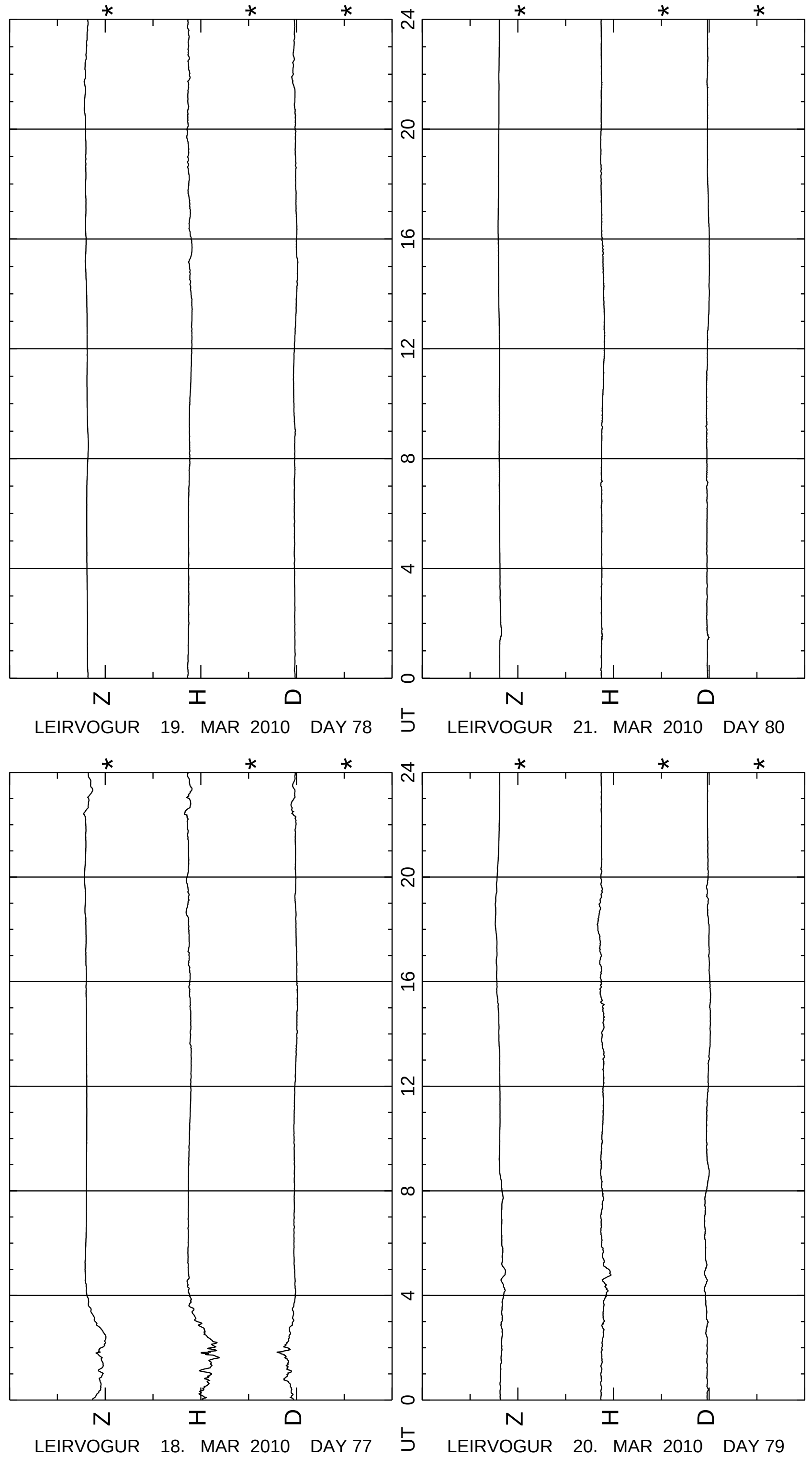


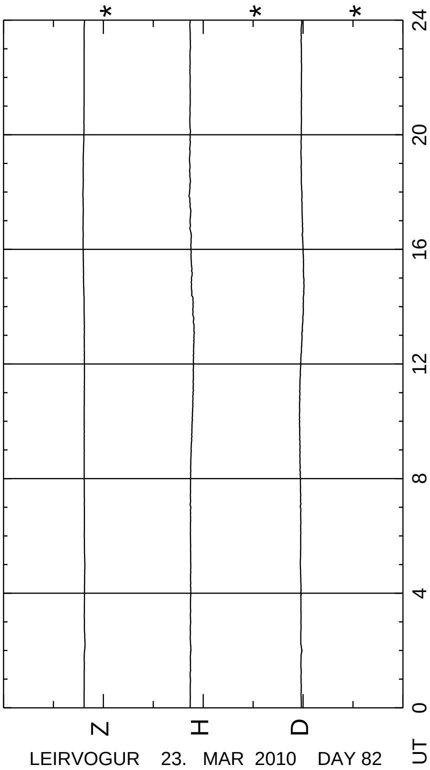
LEIRVOGUR 8. MAR 2010 DAY 67


24
20
16
12
8
4
0
UT
Z
H
D
LEIRVOGUR 11. MAR 2010 DAY 70
LEIRVOGUR 13. MAR 2010 DAY 72
LEIRVOGUR 10. MAR 2010 DAY 69
LEIRVOGUR 12. MAR 2010 DAY 71

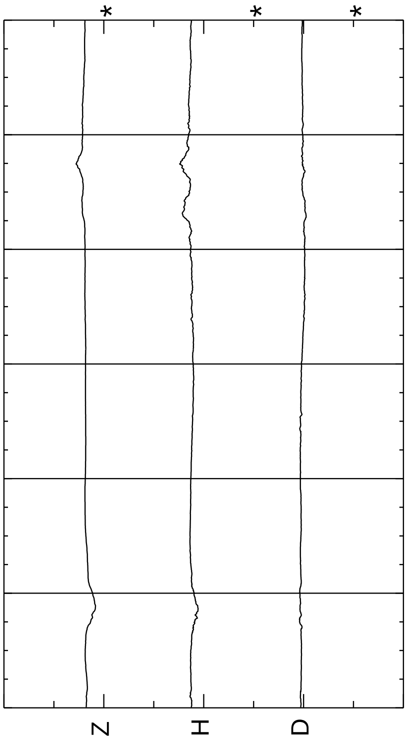


Z H D
LEIRVOGUR 15. MAR 2010 DAY 74
Z H D
LEIRVOGUR 17. MAR 2010 DAY 76
Z H D
LEIRVOGUR 14. MAR 2010 DAY 73
Z H D
LEIRVOGUR 16. MAR 2010 DAY 75
UT
0
4
8
12
16
20
24

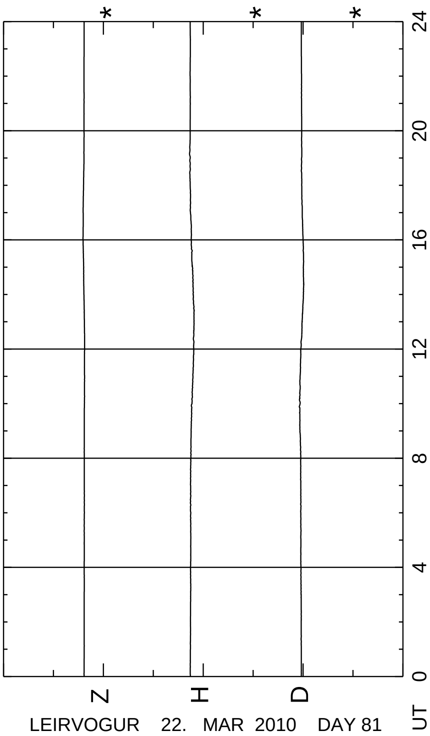

LEIRVOGUR 19. MAR 2010 DAY 78
LEIRVOGUR 21. MAR 2010 DAY 80
LEIRVOGUR 18. MAR 2010 DAY 77
LEIRVOGUR 20. MAR 2010 DAY 79
Z
H
D
UT
0
4
8
12
16
20
24



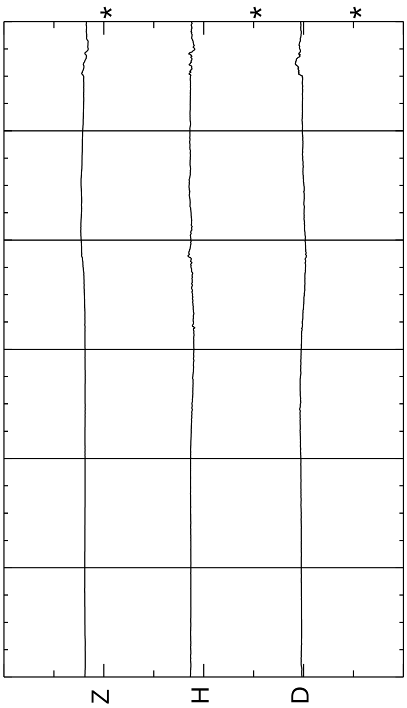
LEIRVOGUR 23. MAR 2010 DAY 82



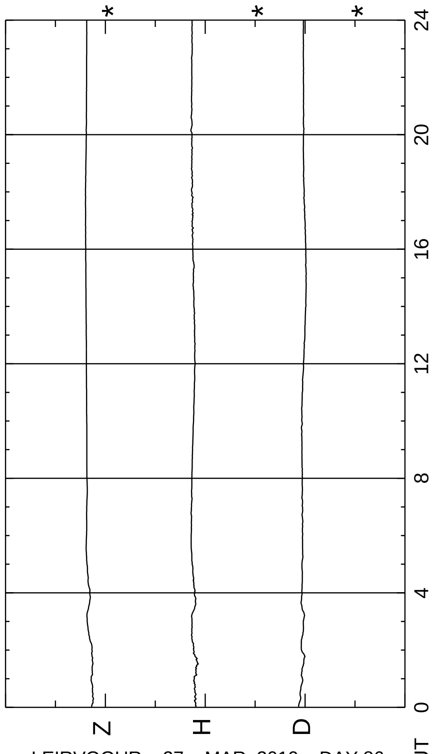
LEIRVOGUR 25. MAR 2010 DAY 84



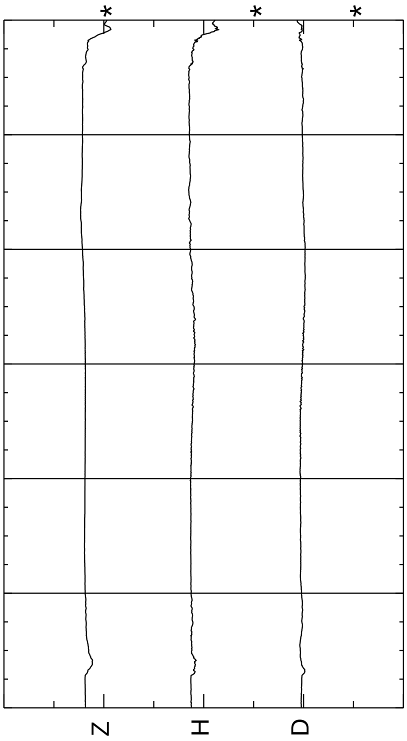
LEIRVOGUR 22. MAR 2010 DAY 81



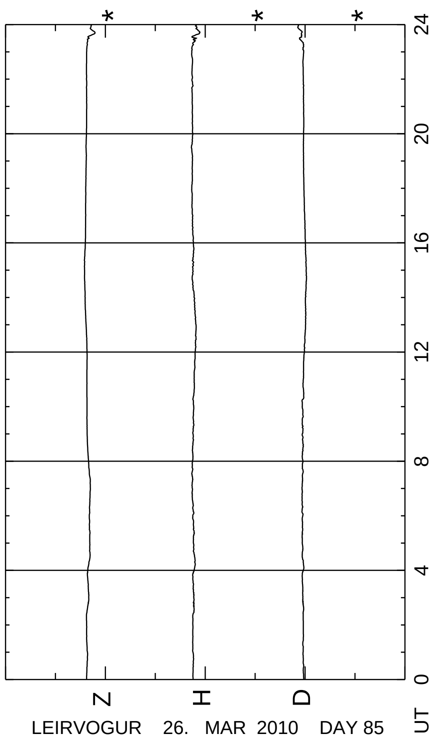
LEIRVOGUR 24. MAR 2010 DAY 83



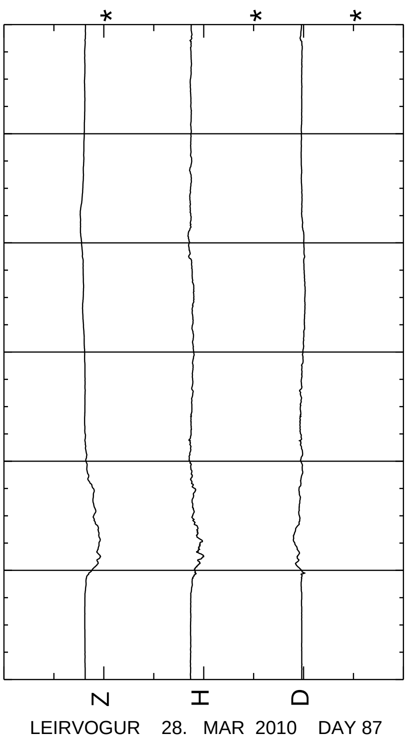
LEIRVOGUR 27. MAR 2010 DAY 86



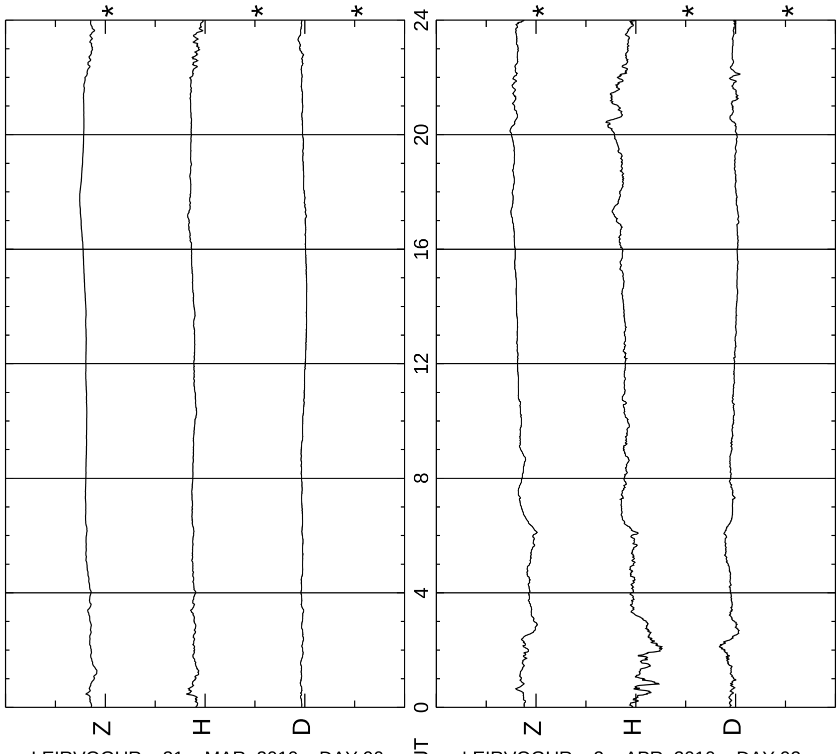
LEIRVOGUR 29. MAR 2010 DAY 88



LEIRVOGUR 26. MAR 2010 DAY 85

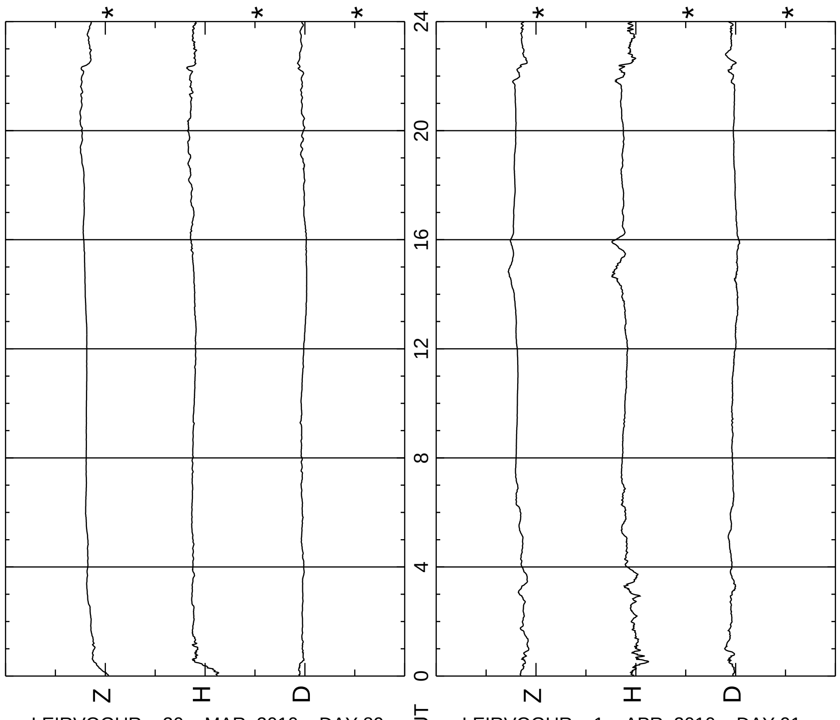


LEIRVOGUR 28. MAR 2010 DAY 87



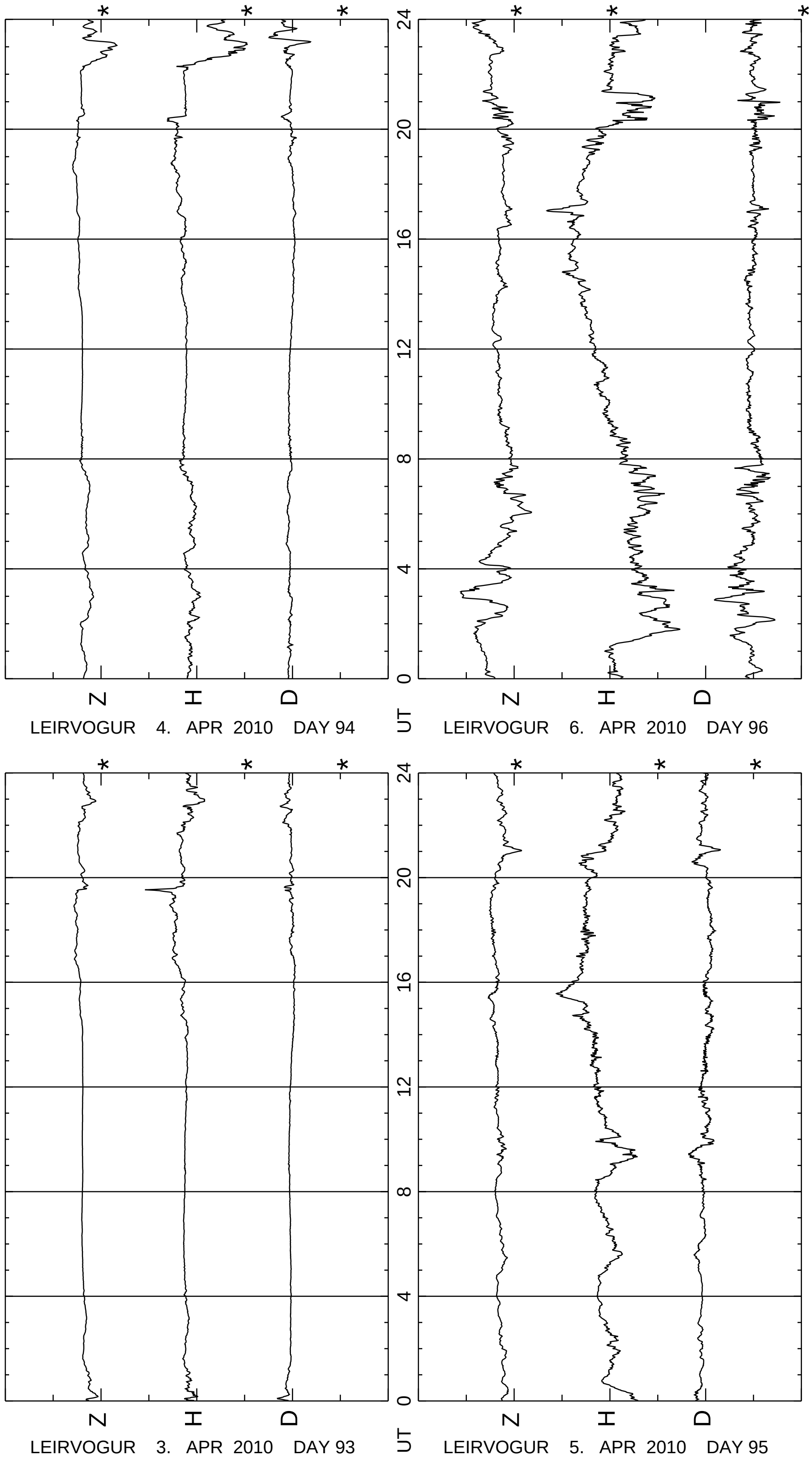
LEIRVOGUR 31. MAR 2010 DAY 90

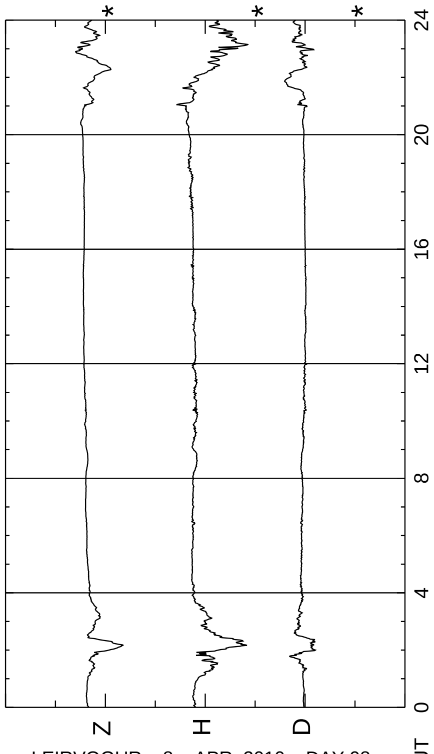
LEIRVOGUR 2. APR 2010 DAY 92



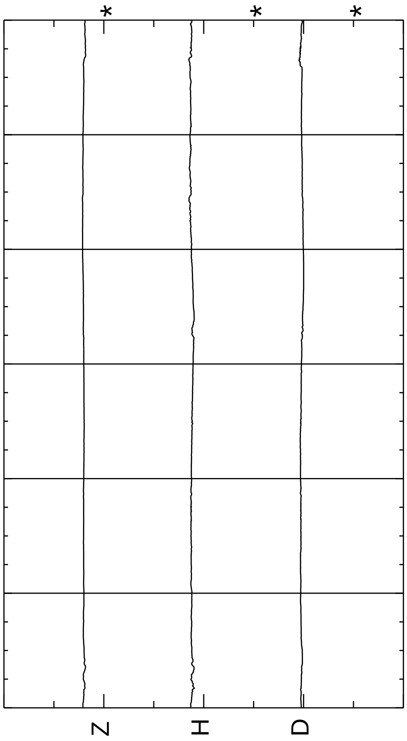
LEIRVOGUR 30. MAR 2010 DAY 89

LEIRVOGUR 1. APR 2010 DAY 91

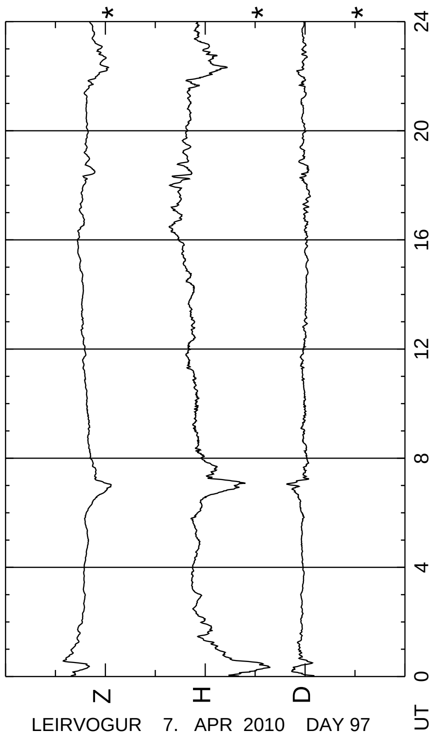

LEIRVOGUR 4. APR 2010 DAY 94
LEIRVOGUR 6. APR 2010 DAY 96
LEIRVOGUR 3. APR 2010 DAY 93
LEIRVOGUR 5. APR 2010 DAY 95
Z
H
D
UT
0
4
8
12
16
20
24



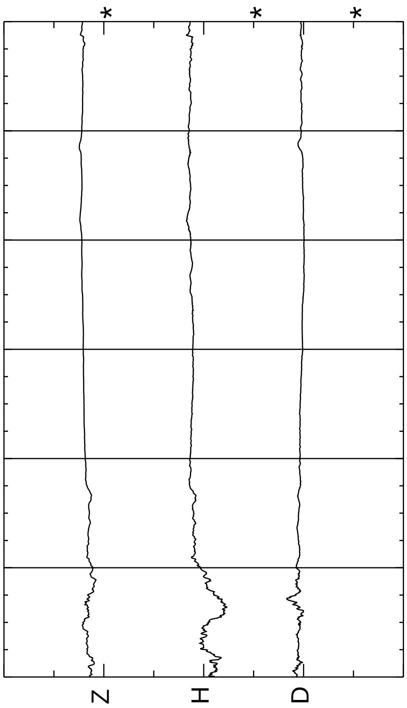
LEIRVOGUR 8. APR 2010 DAY 98



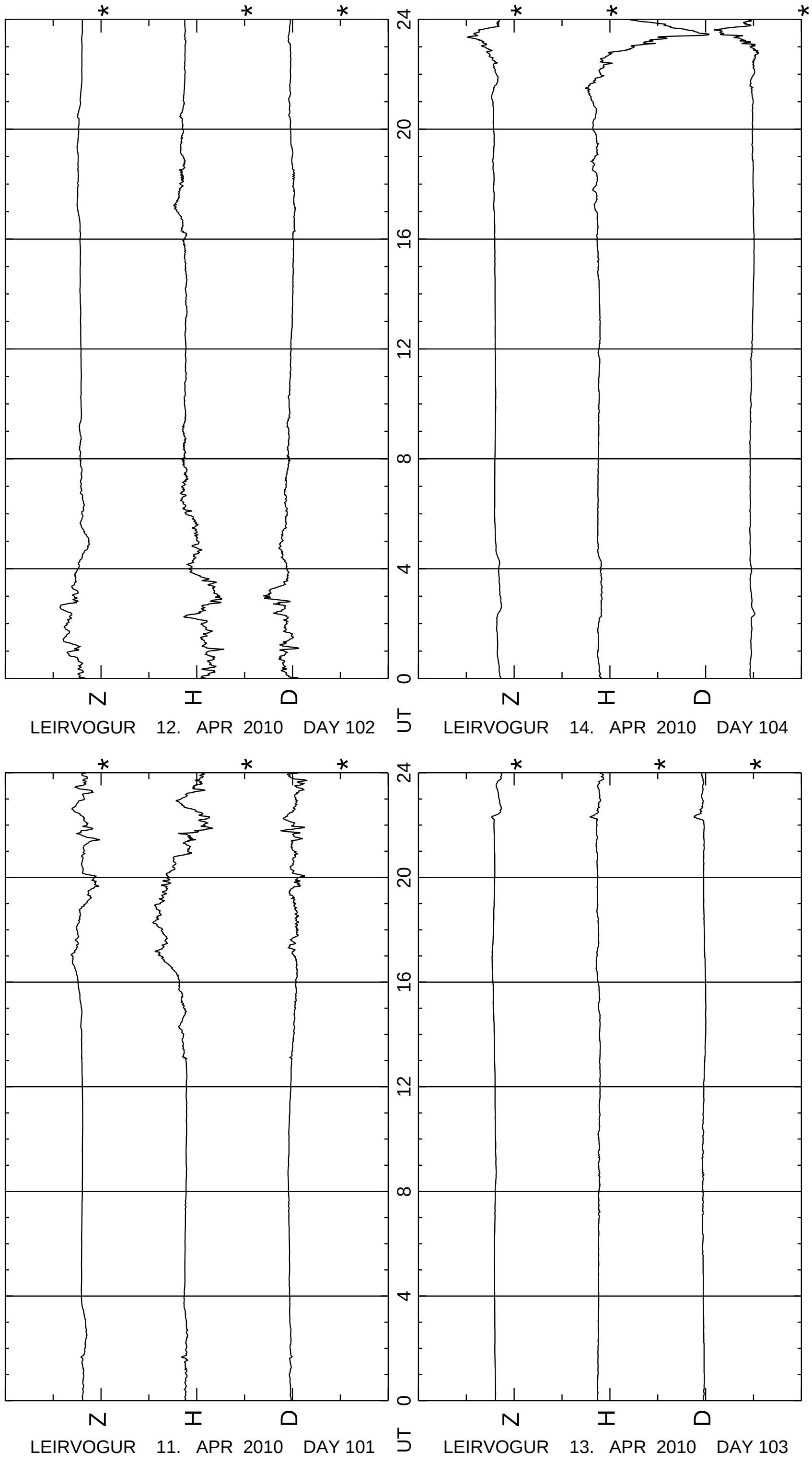
LEIRVOGUR 10. APR 2010 DAY 100

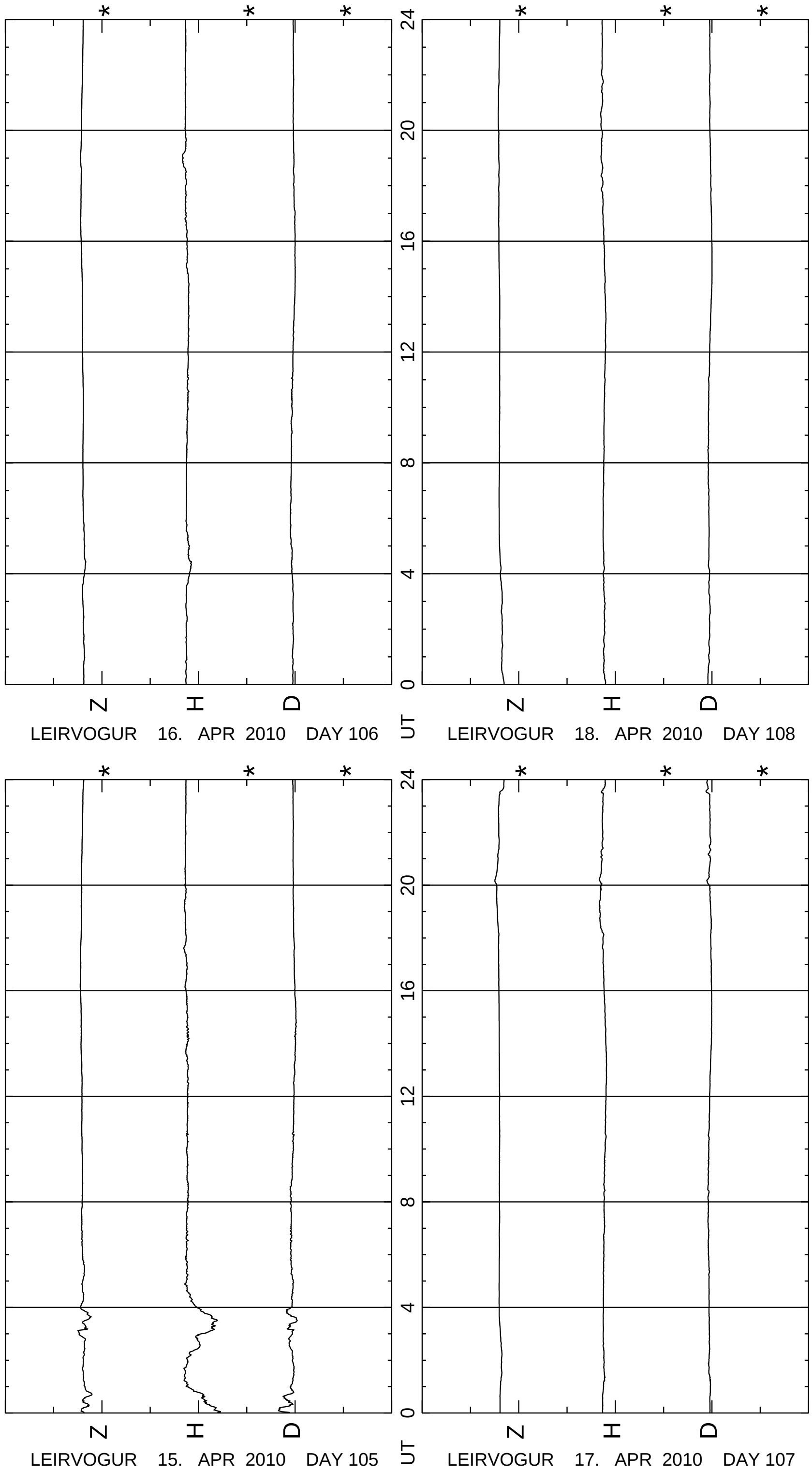


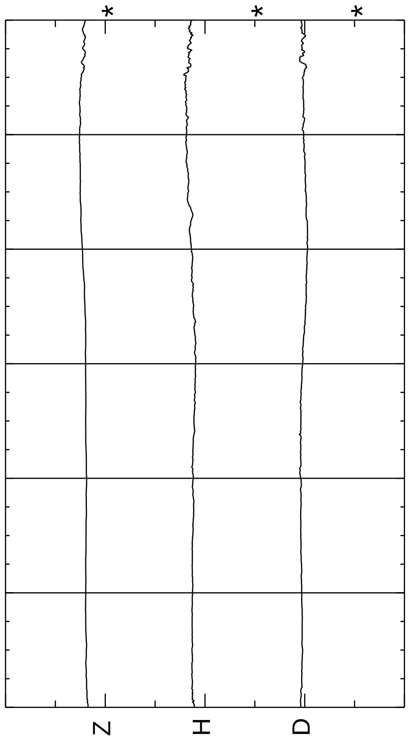
LEIRVOGUR 7. APR 2010 DAY 97



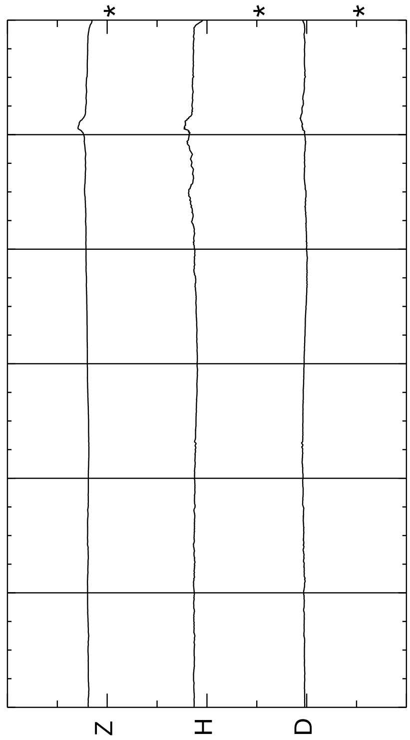
LEIRVOGUR 9. APR 2010 DAY 99


Z H D
LEIRVOGUR 12. APR 2010 DAY 102
UT
Z H D
LEIRVOGUR 14. APR 2010 DAY 104
Z H D
LEIRVOGUR 11. APR 2010 DAY 101
UT
Z H D
LEIRVOGUR 13. APR 2010 DAY 103
0 4 8 12 16 20 24

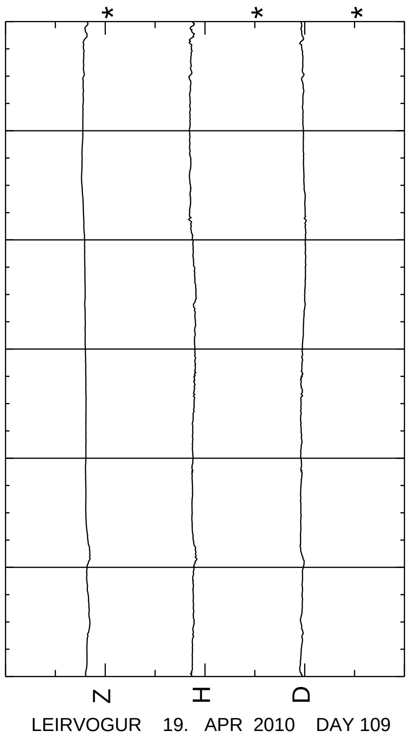

LEIRVOGUR 16. APR 2010 DAY 106
LEIRVOGUR 18. APR 2010 DAY 108
LEIRVOGUR 15. APR 2010 DAY 105
LEIRVOGUR 17. APR 2010 DAY 107
Z
H
D
UT
0
4
8
12
16
20
24



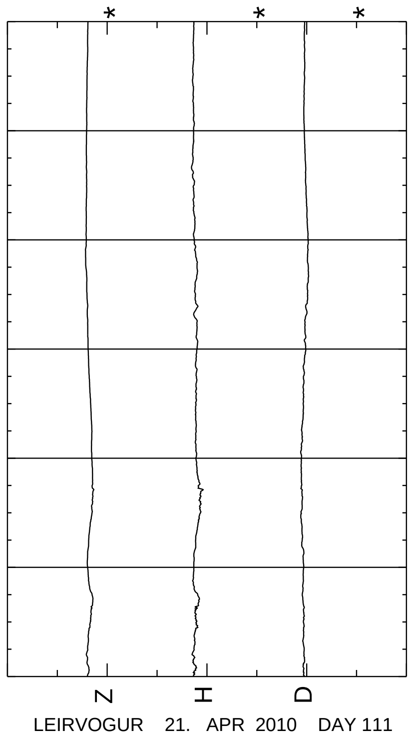
LEIRVOGUR 20. APR 2010 DAY 110



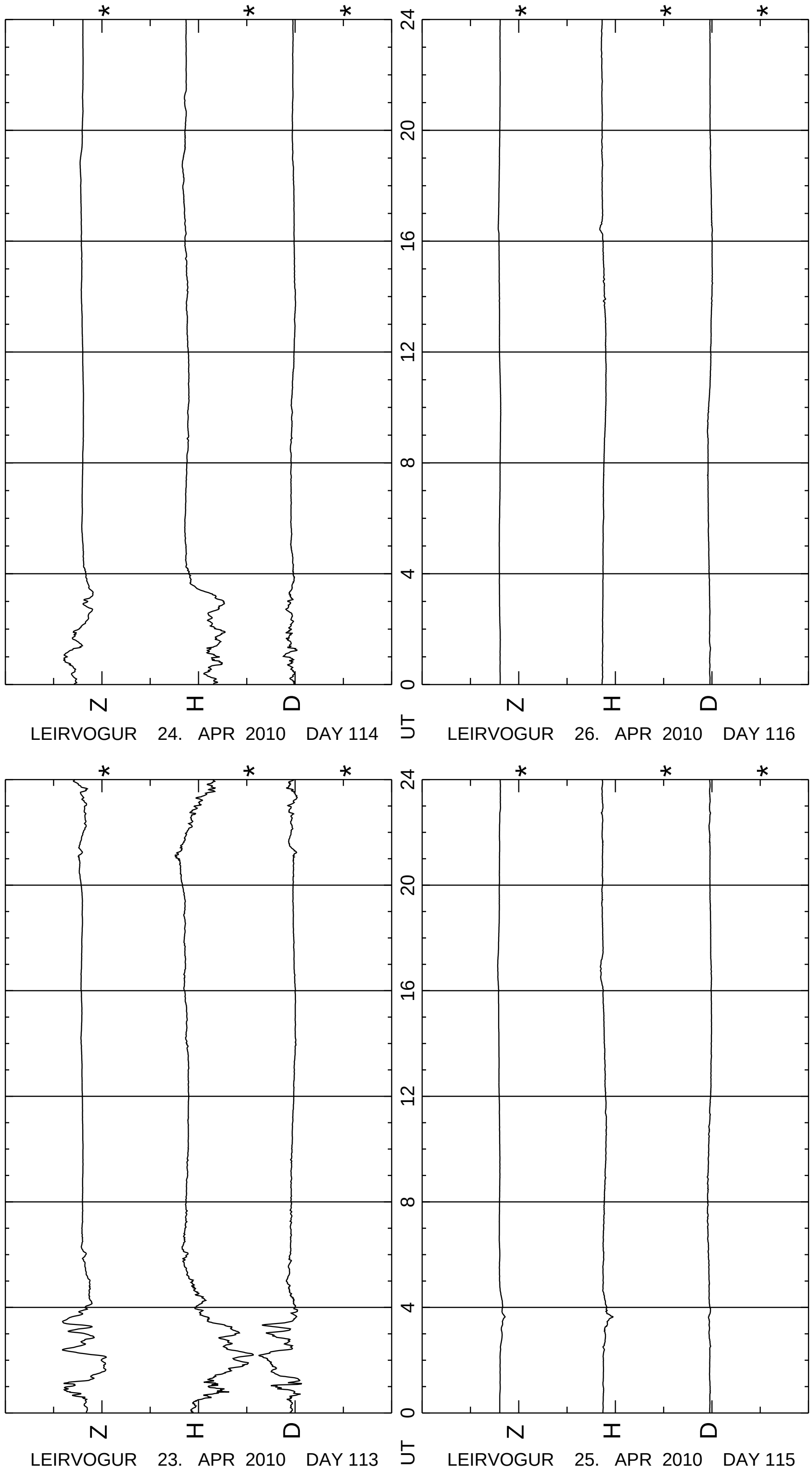
LEIRVOGUR 22. APR 2010 DAY 112

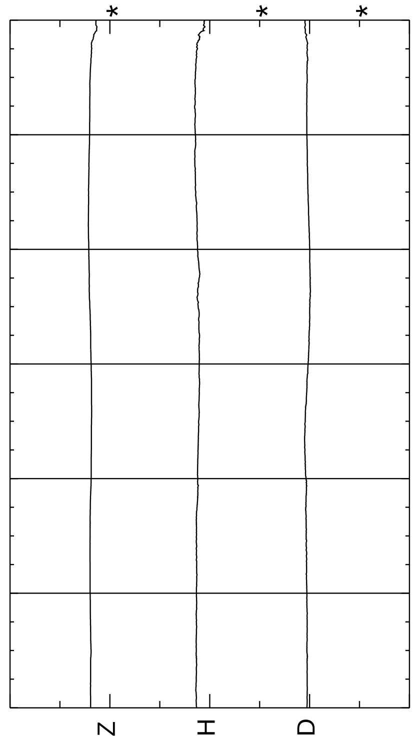


LEIRVOGUR 19. APR 2010 DAY 109

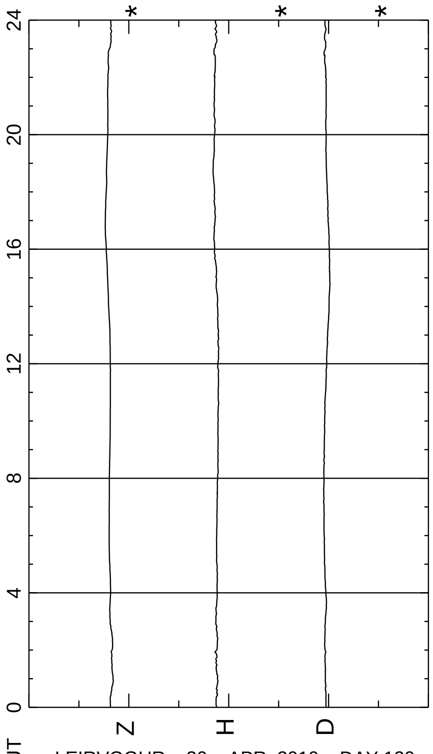


LEIRVOGUR 21. APR 2010 DAY 111

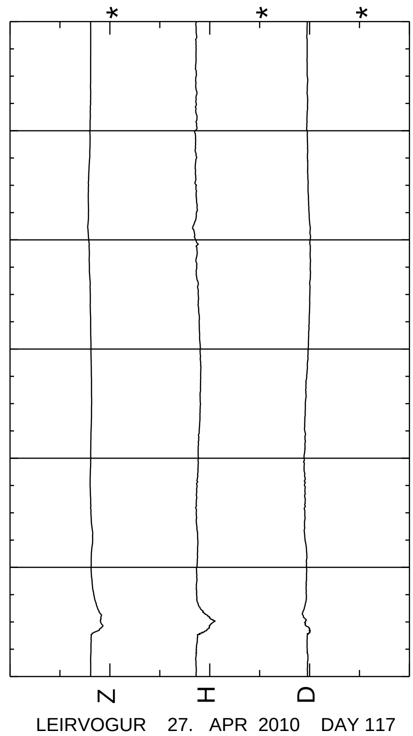

Z H D
LEIRVOGUR 24. APR 2010 DAY 114
UT
Z H D
LEIRVOGUR 26. APR 2010 DAY 116
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 23. APR 2010 DAY 113
UT
Z H D
LEIRVOGUR 25. APR 2010 DAY 115



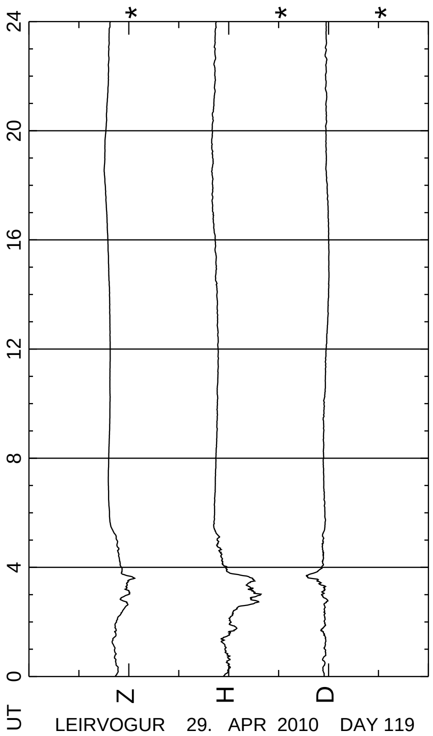
LEIRVOGUR 28. APR 2010 DAY 118



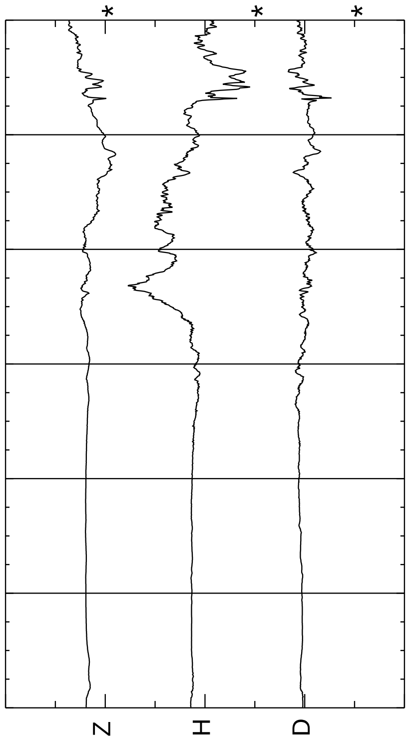
LEIRVOGUR 30. APR 2010 DAY 120



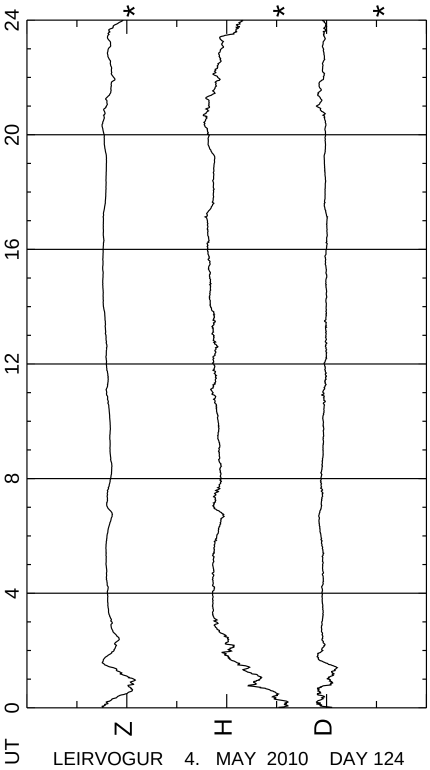
LEIRVOGUR 27. APR 2010 DAY 117



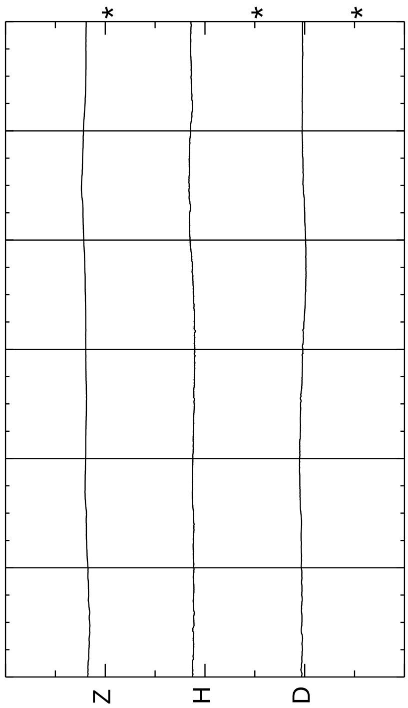
LEIRVOGUR 29. APR 2010 DAY 119



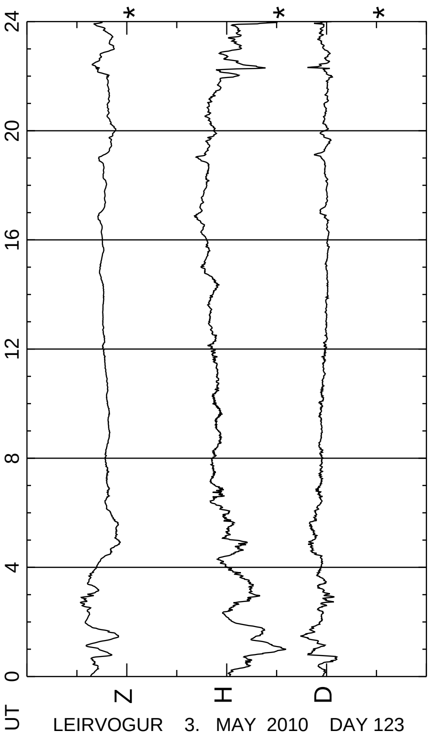
LEIRVOGUR 2. MAY 2010 DAY 122



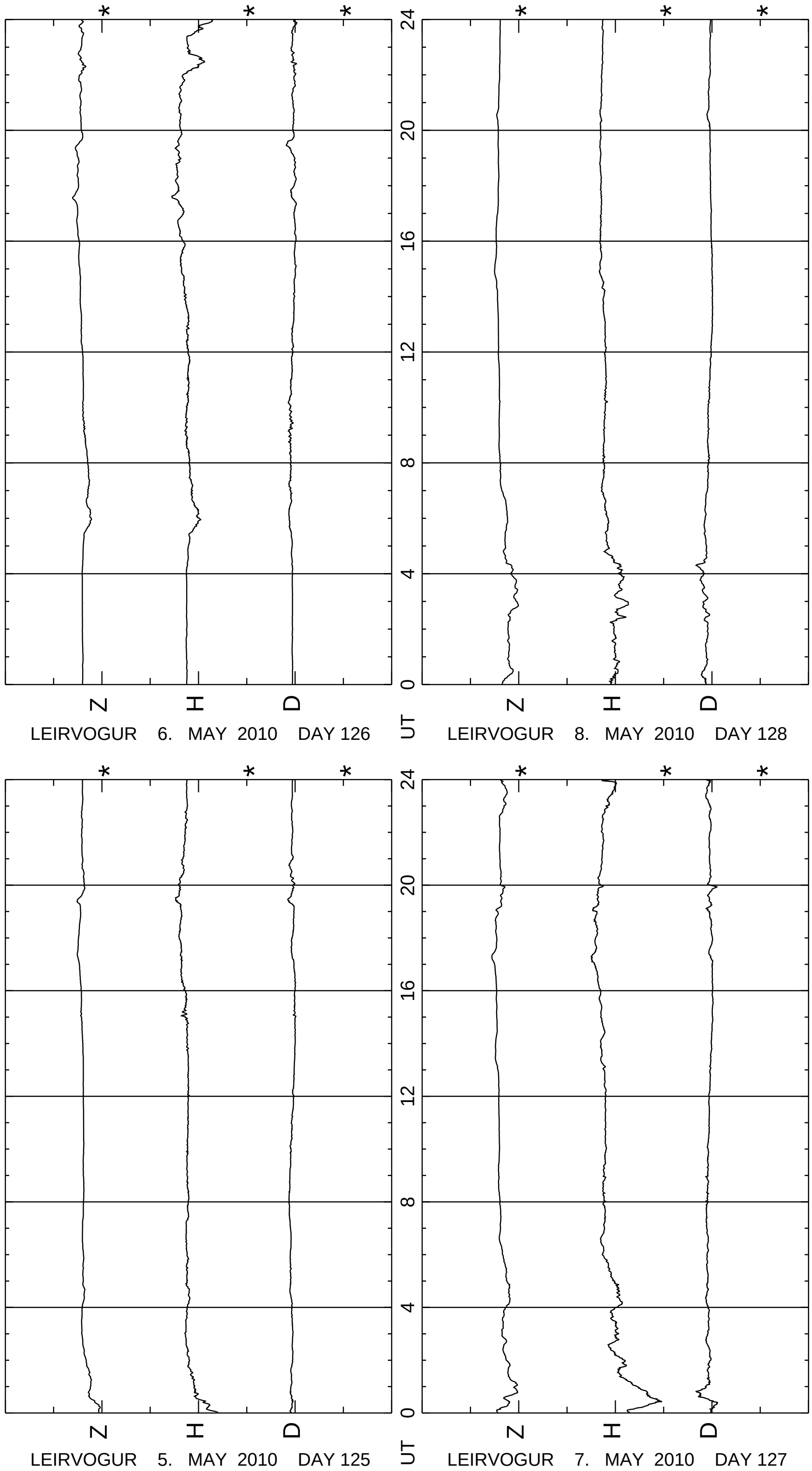
LEIRVOGUR 4. MAY 2010 DAY 124

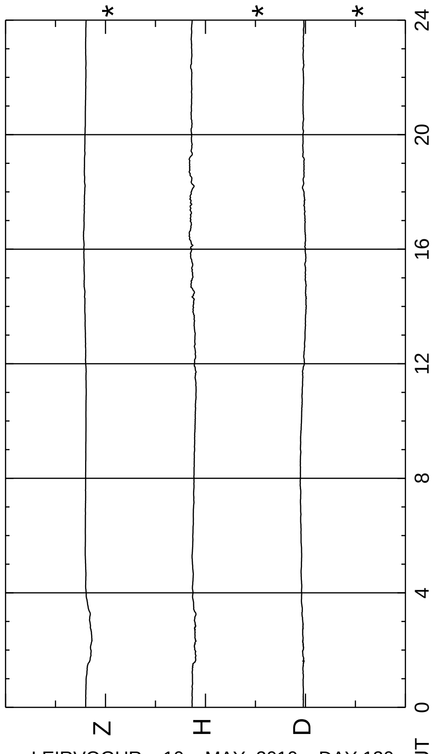


LEIRVOGUR 1. MAY 2010 DAY 121

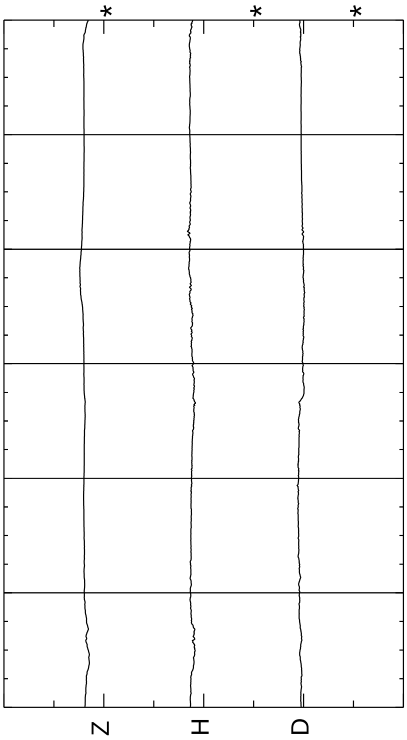


LEIRVOGUR 3. MAY 2010 DAY 123

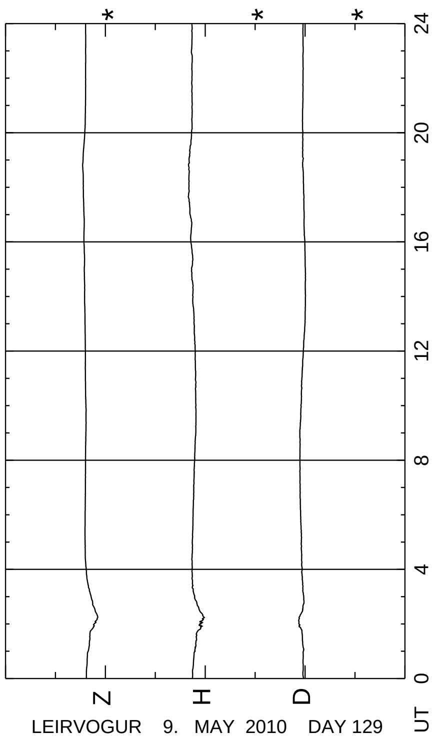

LEIRVOGUR 6. MAY 2010 DAY 126
LEIRVOGUR 8. MAY 2010 DAY 128
LEIRVOGUR 5. MAY 2010 DAY 125
LEIRVOGUR 7. MAY 2010 DAY 127
Z H D
UT
0 4 8 12 16 20 24



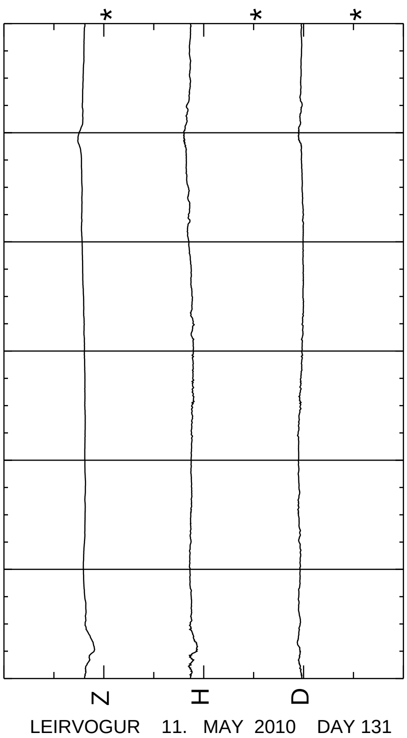
LEIRVOGUR 10. MAY 2010 DAY 130



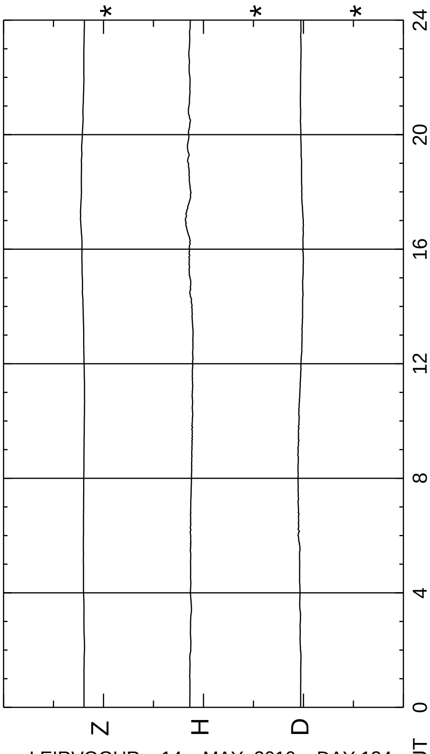
LEIRVOGUR 12. MAY 2010 DAY 132



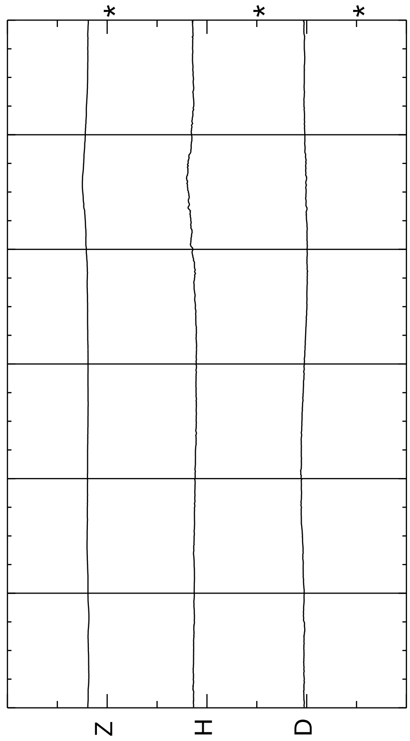
LEIRVOGUR 9. MAY 2010 DAY 129



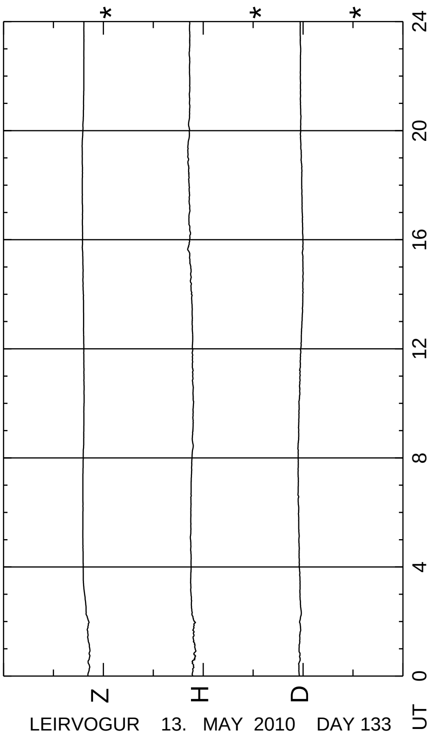
LEIRVOGUR 11. MAY 2010 DAY 131



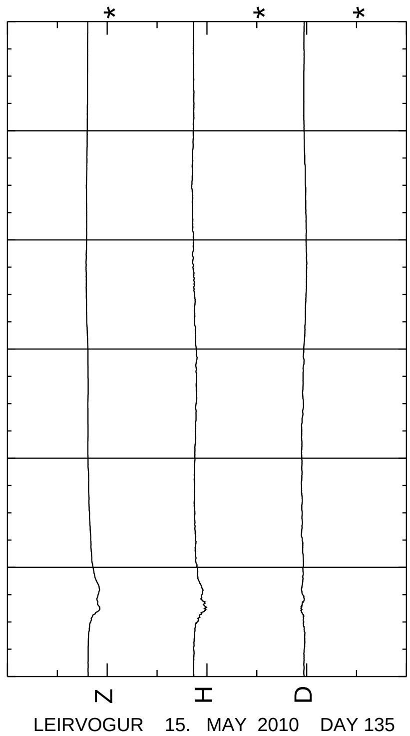
LEIRVOGUR 14. MAY 2010 DAY 134



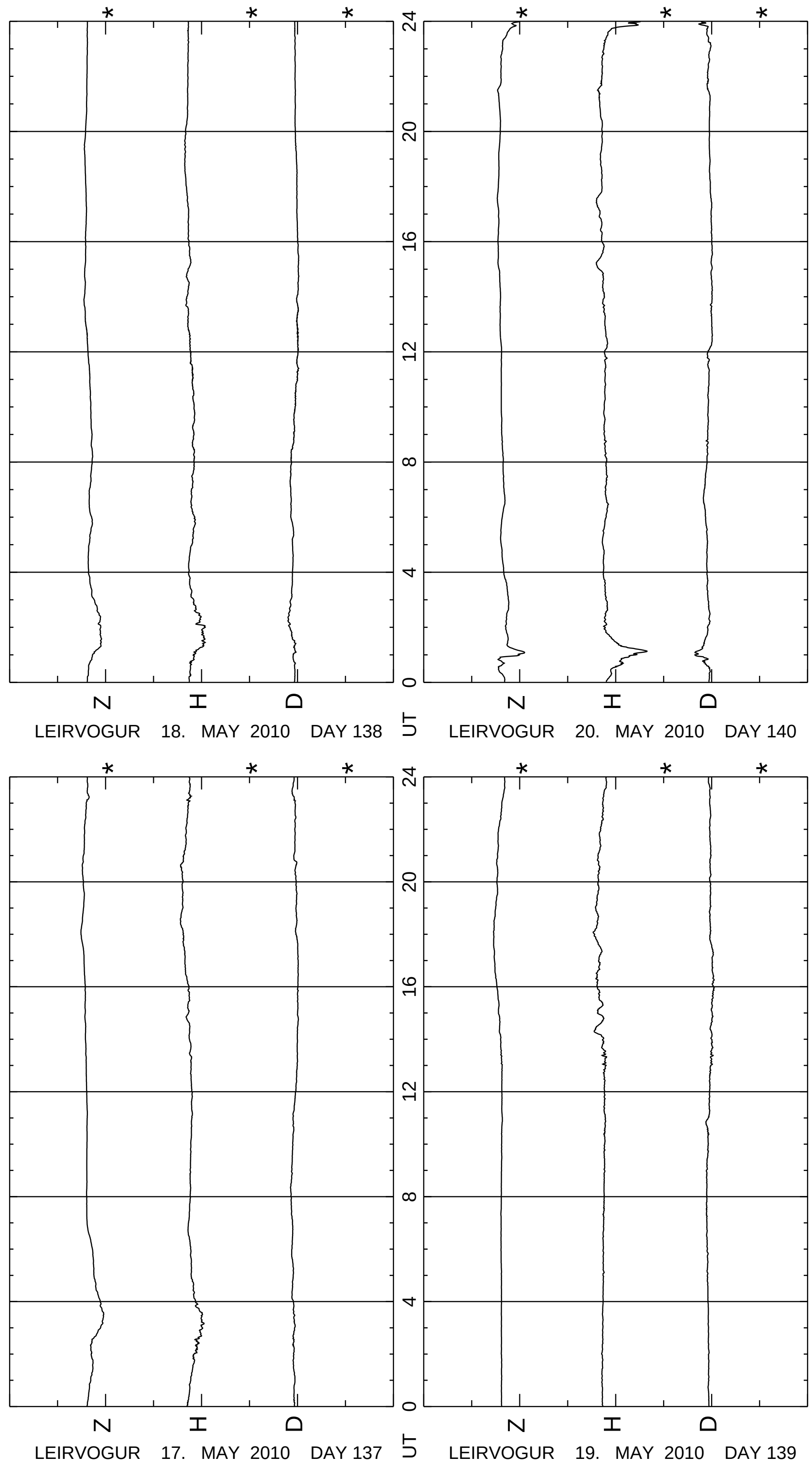
LEIRVOGUR 16. MAY 2010 DAY 136

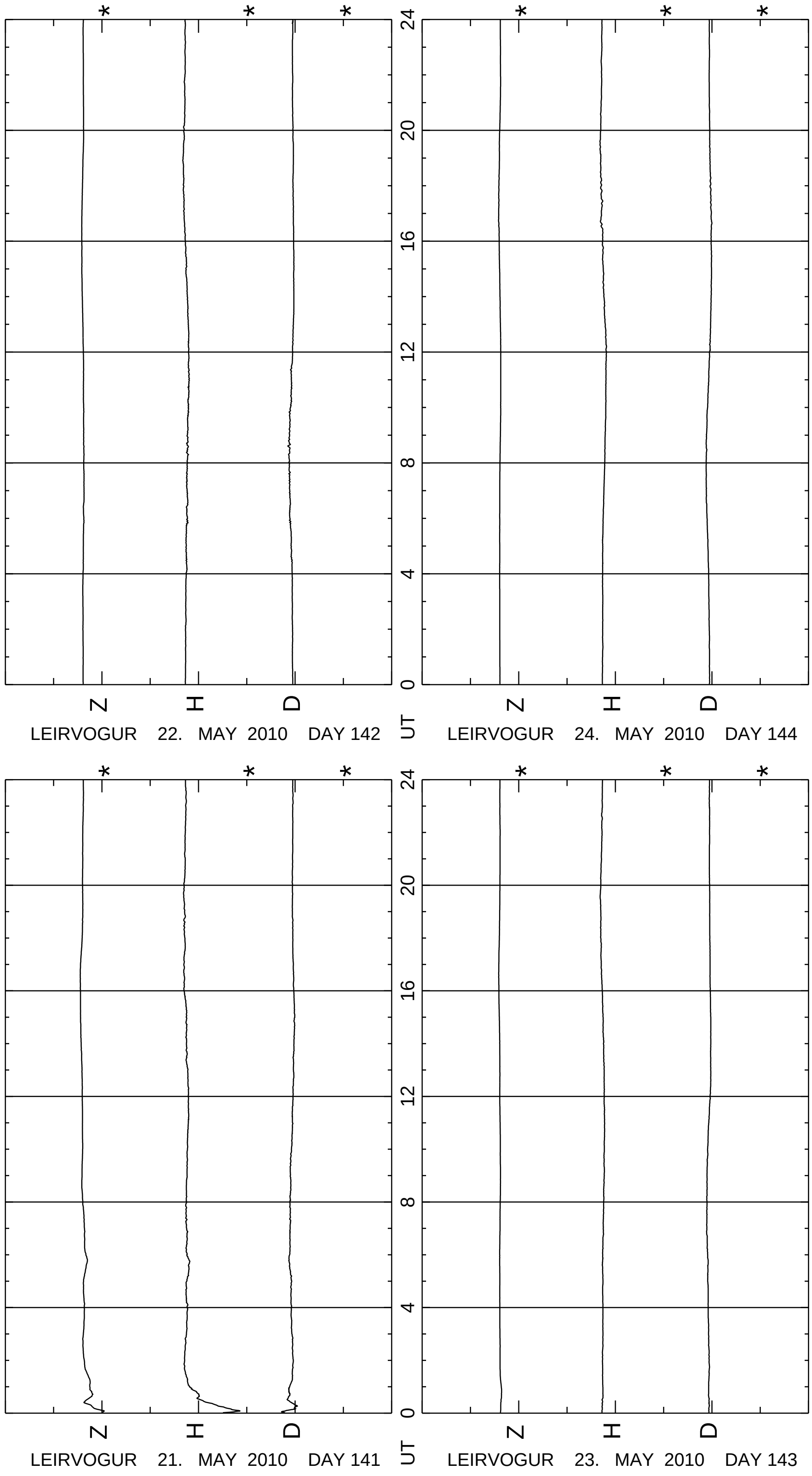


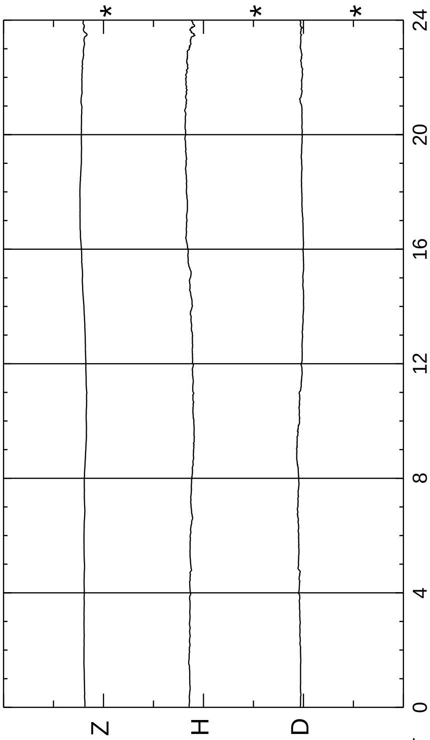
LEIRVOGUR 13. MAY 2010 DAY 133



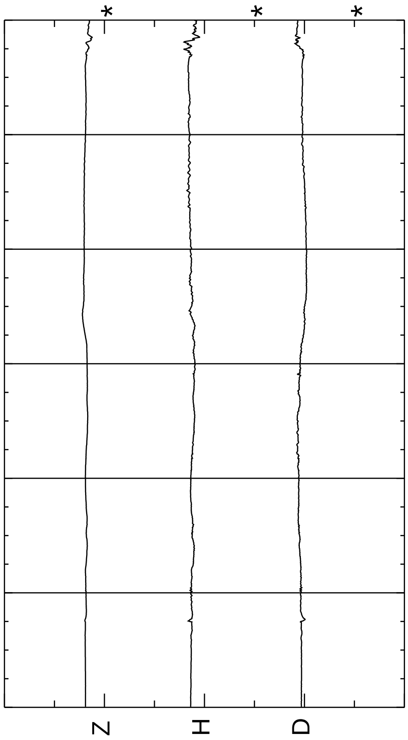
LEIRVOGUR 15. MAY 2010 DAY 135


LEIRVOGUR 18. MAY 2010 DAY 138
LEIRVOGUR 20. MAY 2010 DAY 140
LEIRVOGUR 17. MAY 2010 DAY 137
LEIRVOGUR 19. MAY 2010 DAY 139
Z
H
D
UT

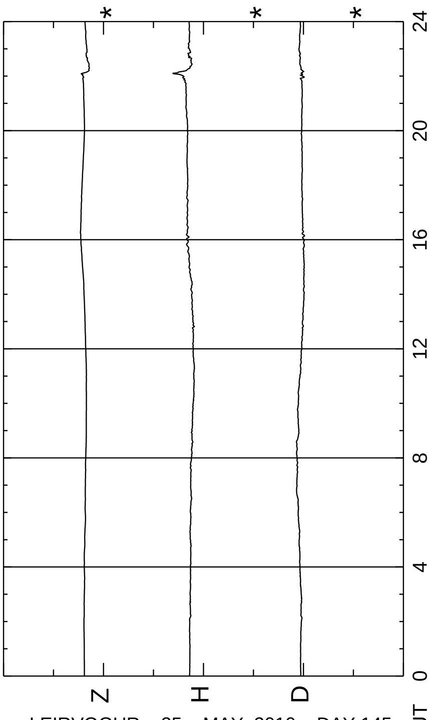

Z H D
LEIRVOGUR 22. MAY 2010 DAY 142
Z H D
LEIRVOGUR 24. MAY 2010 DAY 144
Z H D
LEIRVOGUR 21. MAY 2010 DAY 141
Z H D
LEIRVOGUR 23. MAY 2010 DAY 143
UT
0
4
8
12
16
20
24



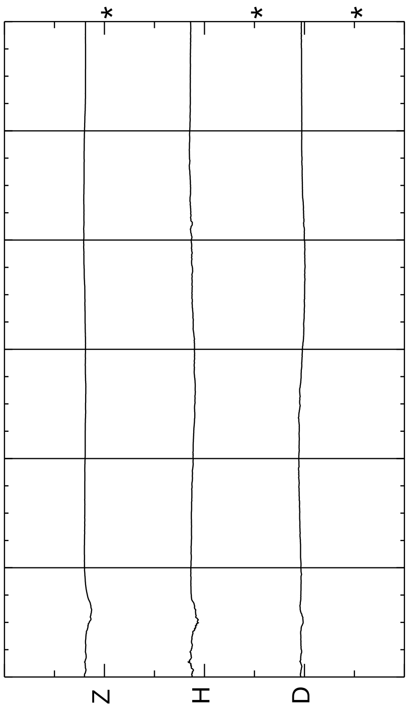
LEIRVOGUR 26. MAY 2010 DAY 146



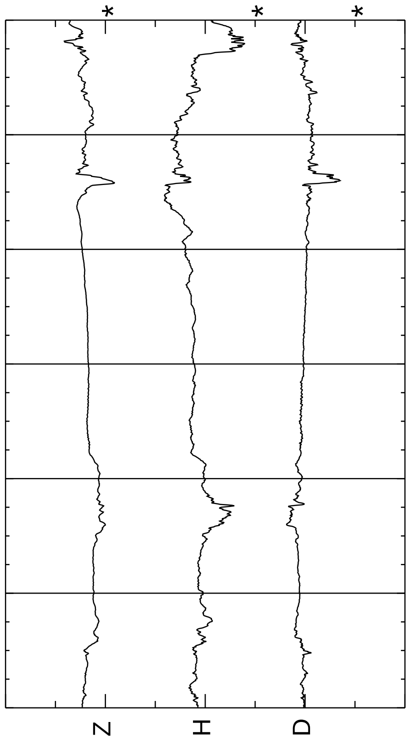
LEIRVOGUR 28. MAY 2010 DAY 148



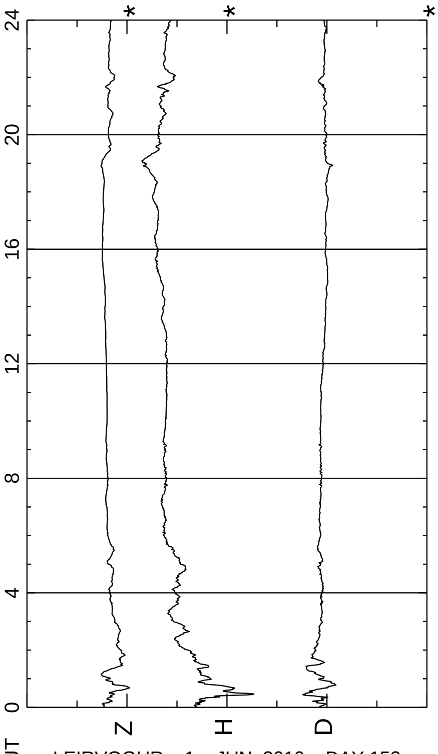
LEIRVOGUR 25. MAY 2010 DAY 145



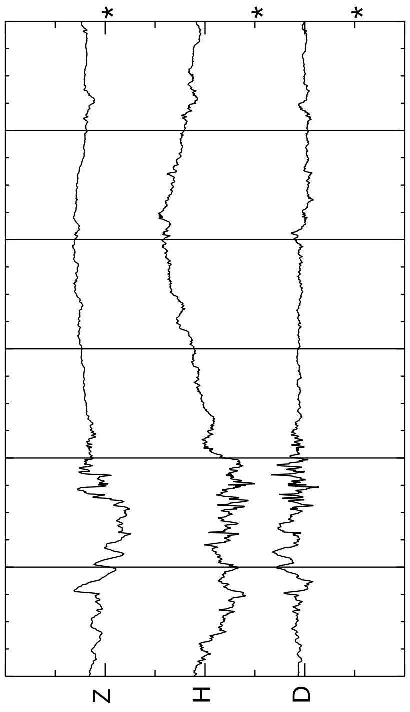
LEIRVOGUR 27. MAY 2010 DAY 147



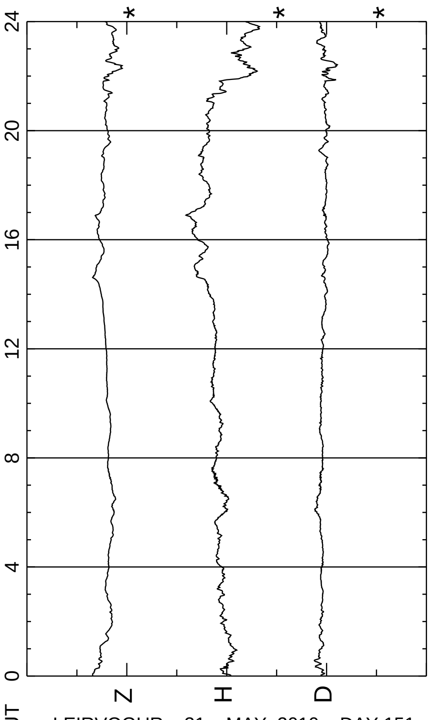
LEIRVOGUR 30. MAY 2010 DAY 150



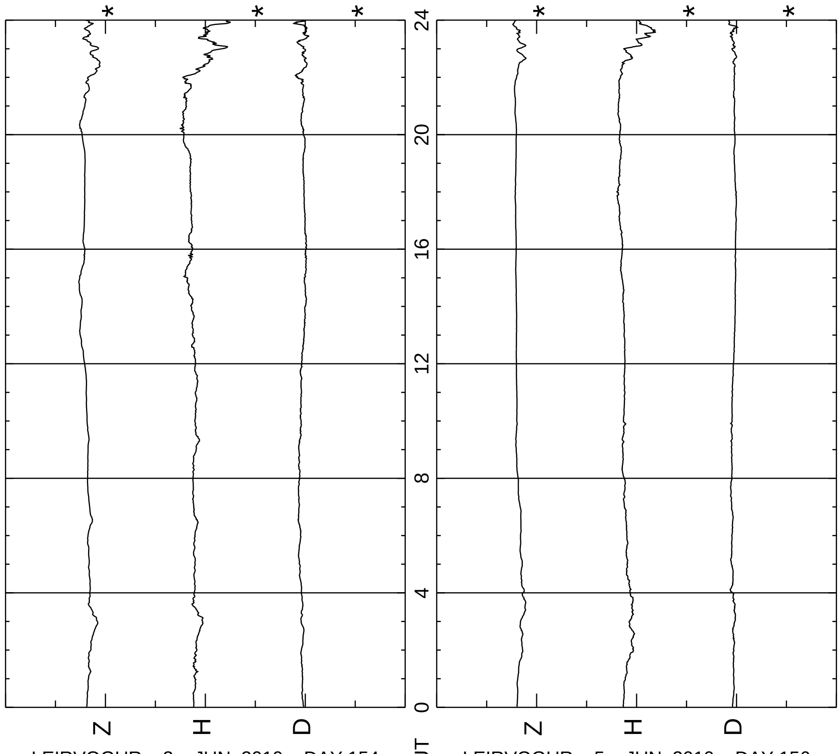
LEIRVOGUR 1. JUN 2010 DAY 152



LEIRVOGUR 29. MAY 2010 DAY 149

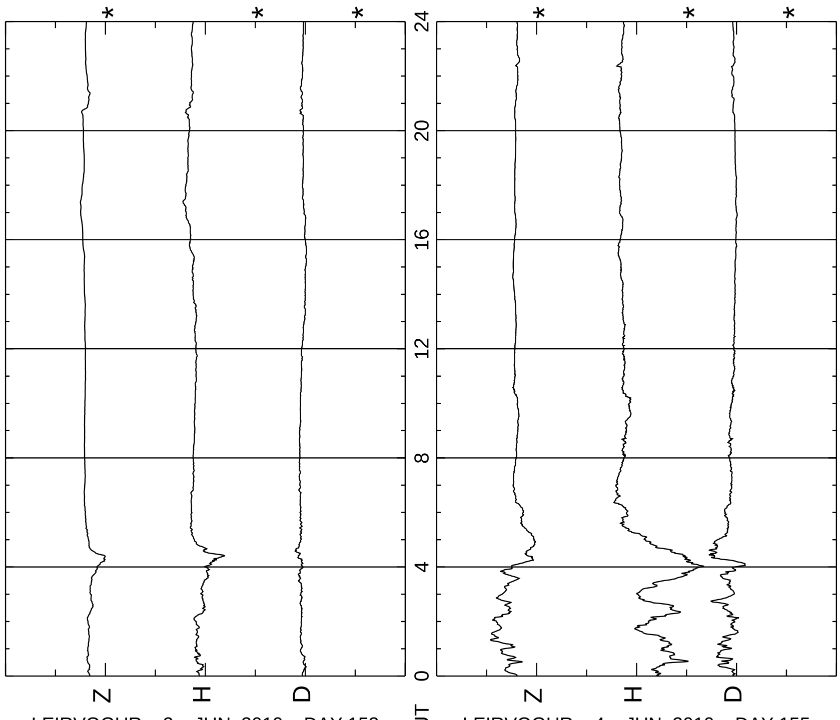


LEIRVOGUR 31. MAY 2010 DAY 151



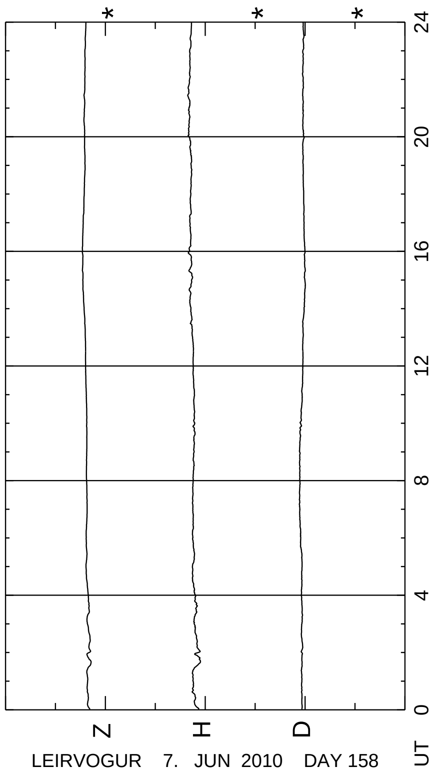
LEIRVOGUR 3. JUN 2010 DAY 154

LEIRVOGUR 5. JUN 2010 DAY 156

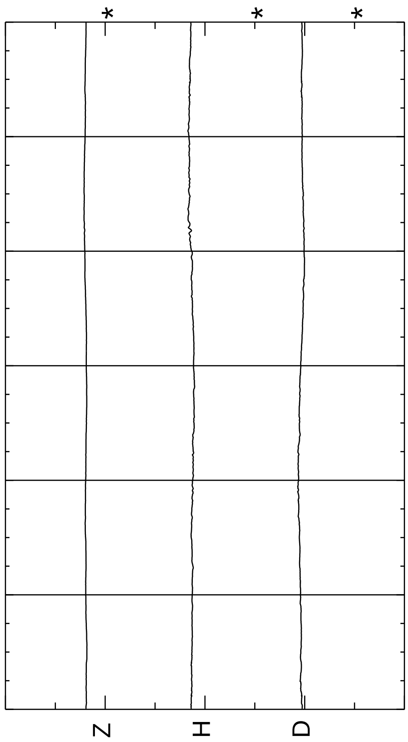


LEIRVOGUR 2. JUN 2010 DAY 153

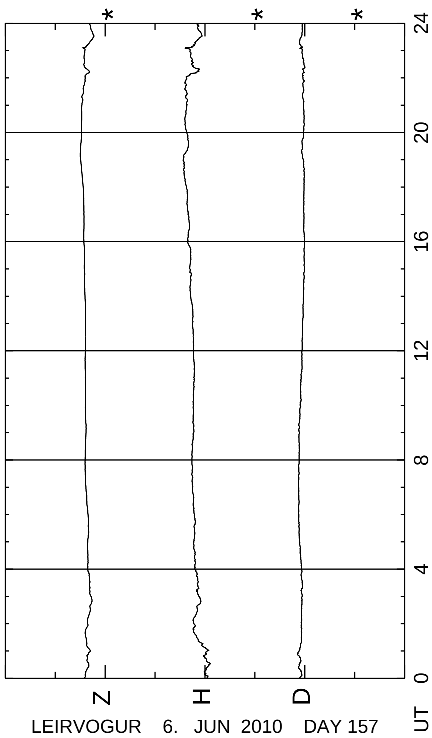
LEIRVOGUR 4. JUN 2010 DAY 155



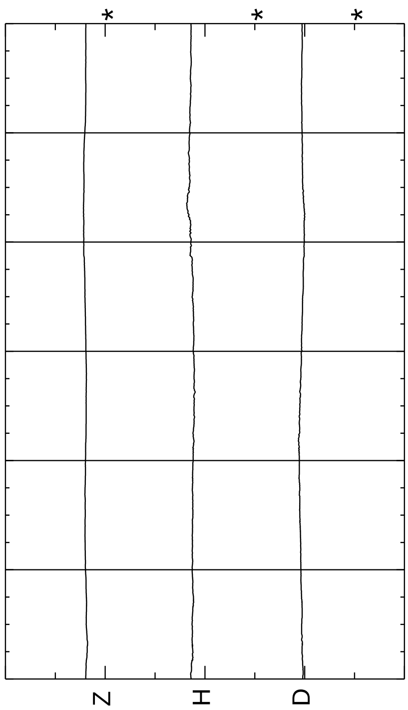
LEIRVOGUR 7. JUN 2010 DAY 158



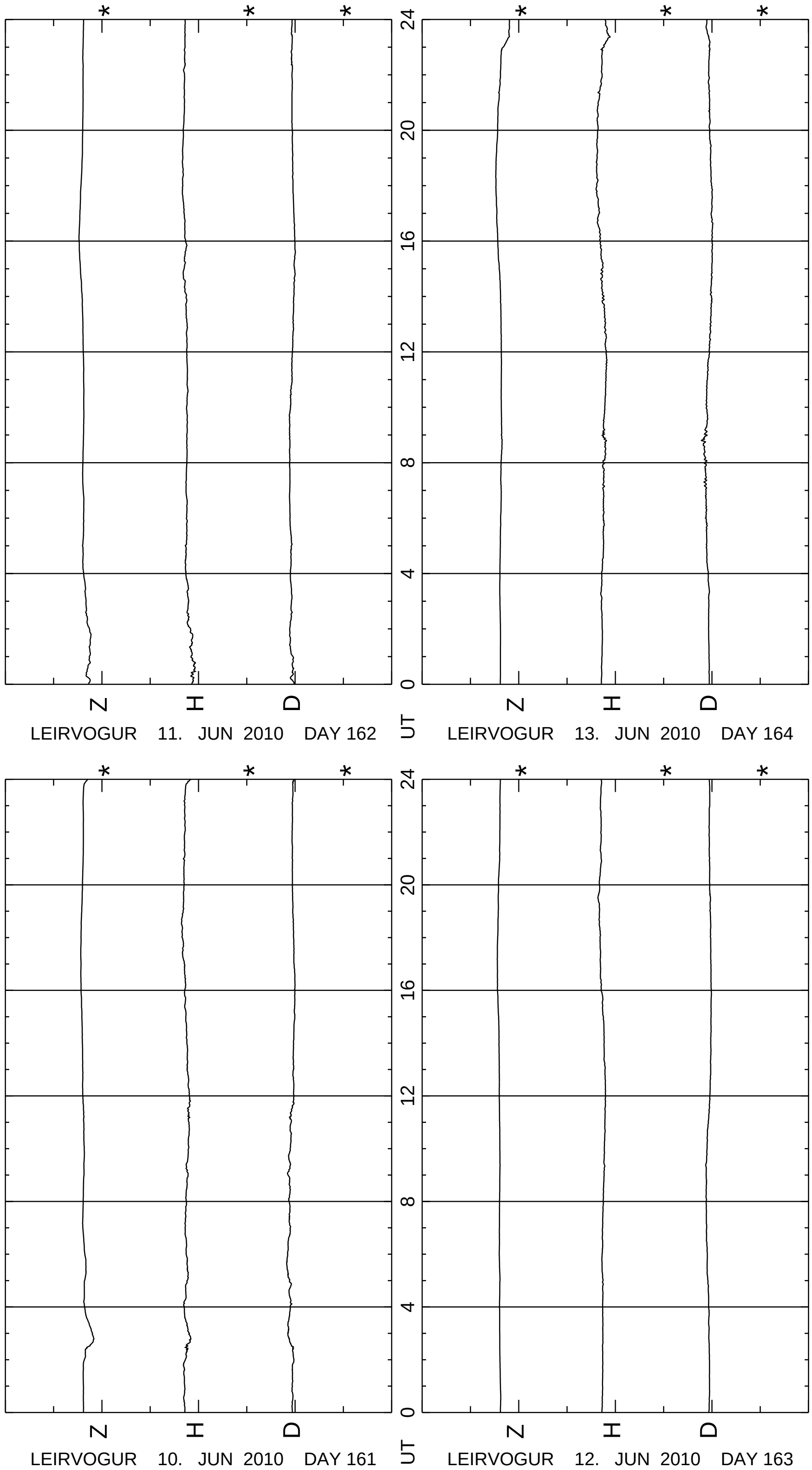
LEIRVOGUR 9. JUN 2010 DAY 160

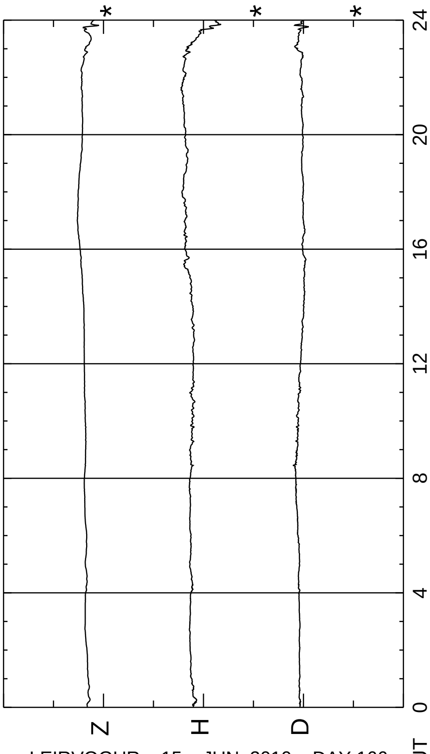


LEIRVOGUR 6. JUN 2010 DAY 157

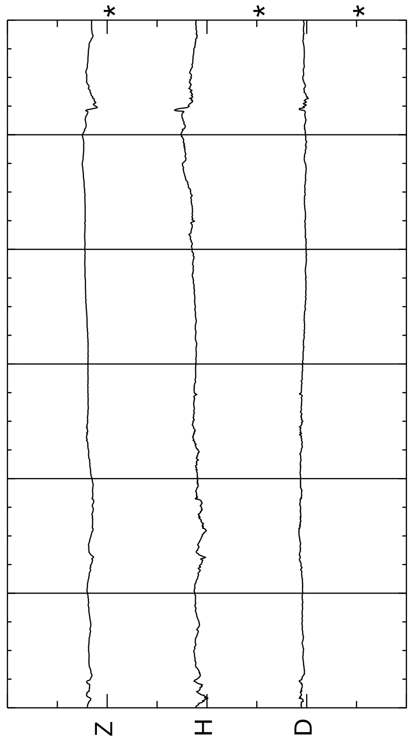


LEIRVOGUR 8. JUN 2010 DAY 159

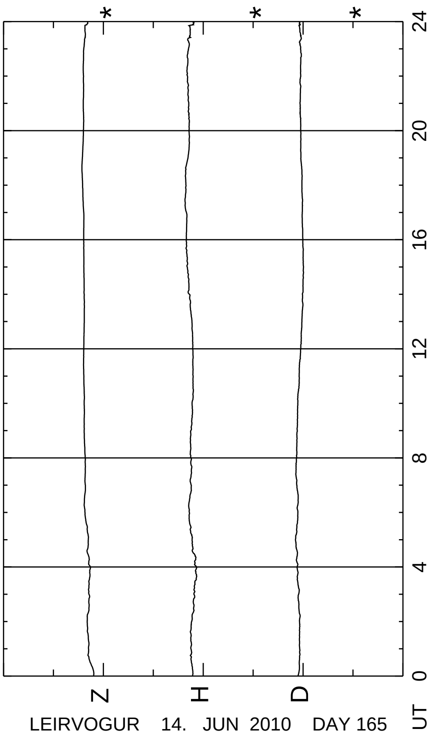

LEIRVOGUR 11. JUN 2010 DAY 162
LEIRVOGUR 13. JUN 2010 DAY 164
LEIRVOGUR 10. JUN 2010 DAY 161
LEIRVOGUR 12. JUN 2010 DAY 163
Z
H
D
UT
0
4
8
12
16
20
24



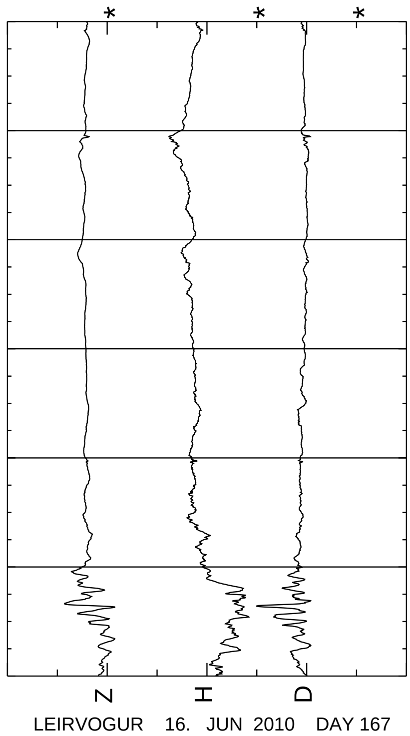
LEIRVOGUR 15. JUN 2010 DAY 166



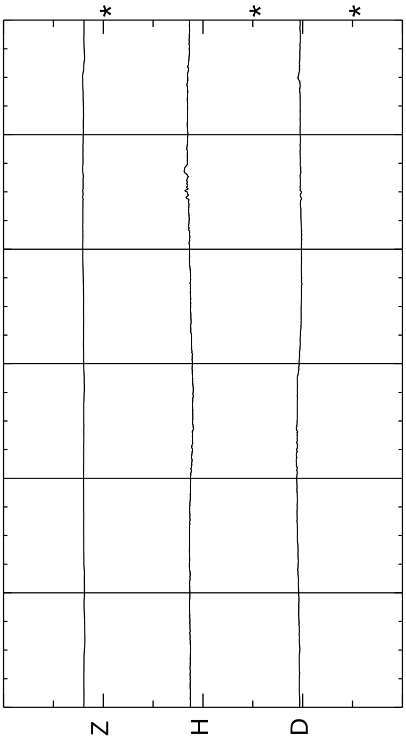
LEIRVOGUR 17. JUN 2010 DAY 168

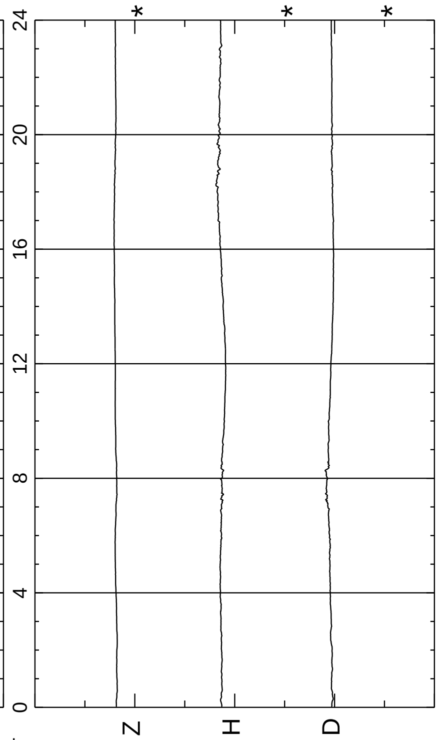


LEIRVOGUR 14. JUN 2010 DAY 165



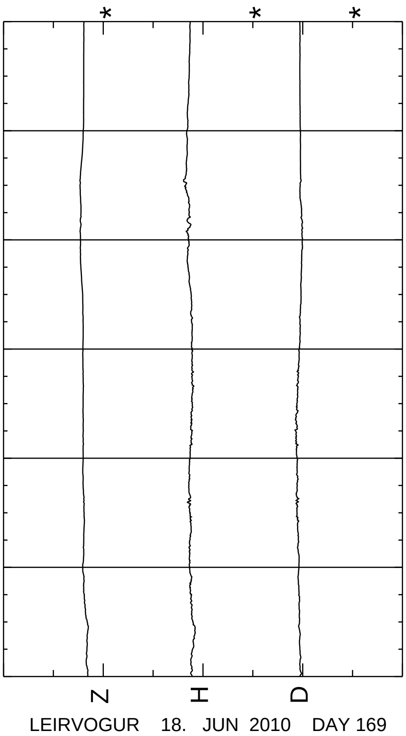
LEIRVOGUR 16. JUN 2010 DAY 167

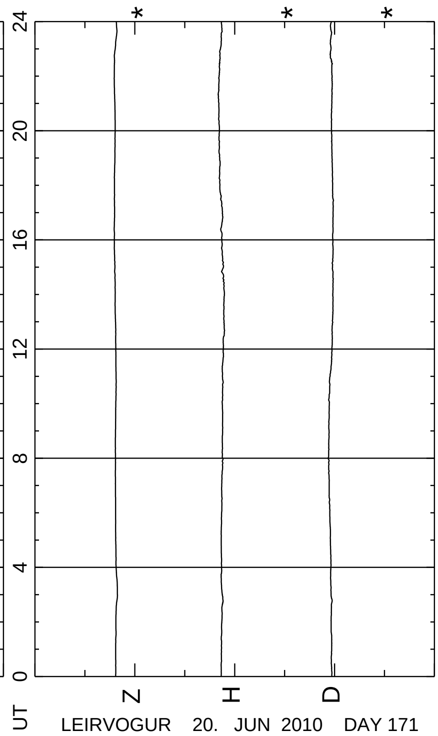




LEIRVOGUR 19. JUN 2010 DAY 170

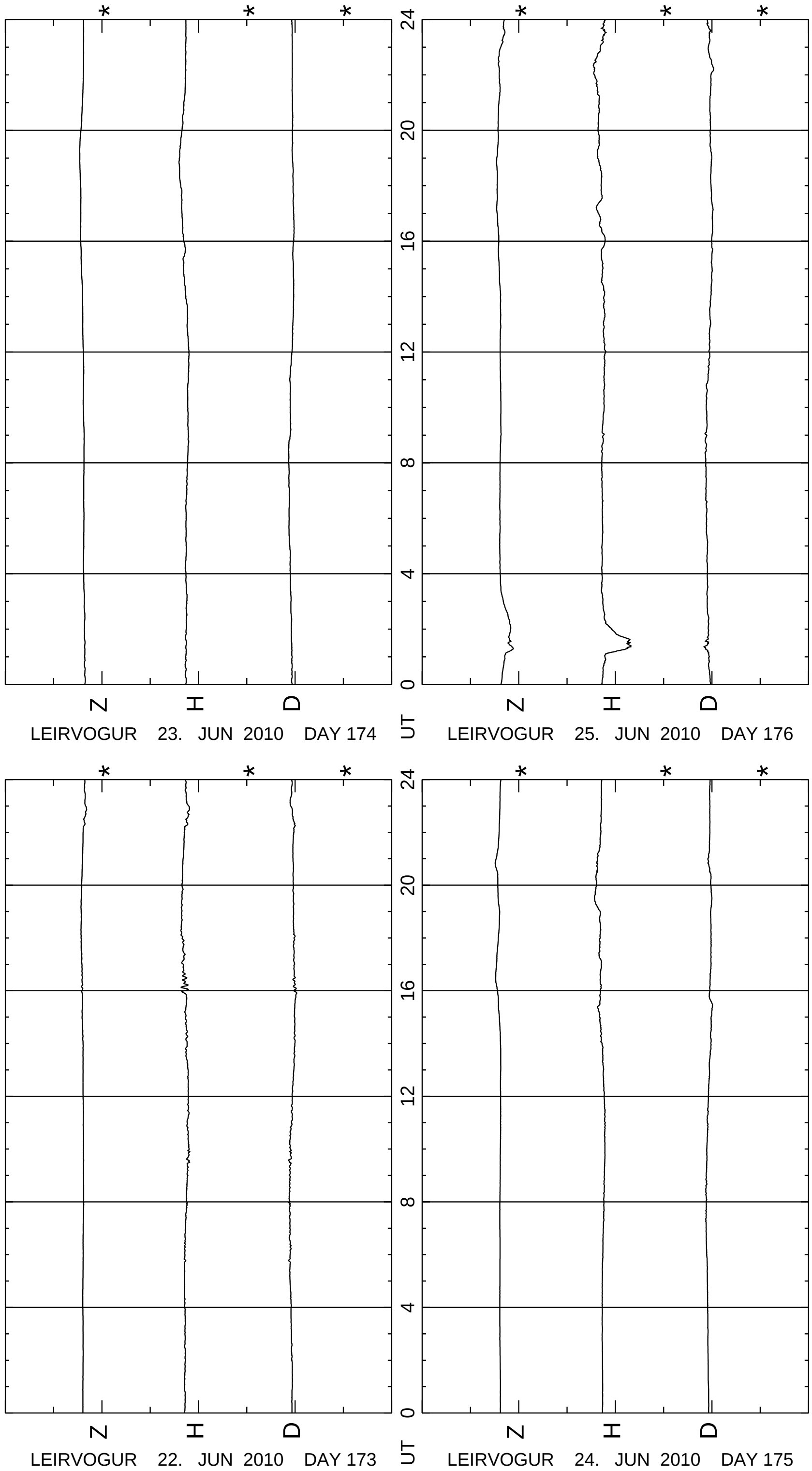
LEIRVOGUR 21. JUN 2010 DAY 172

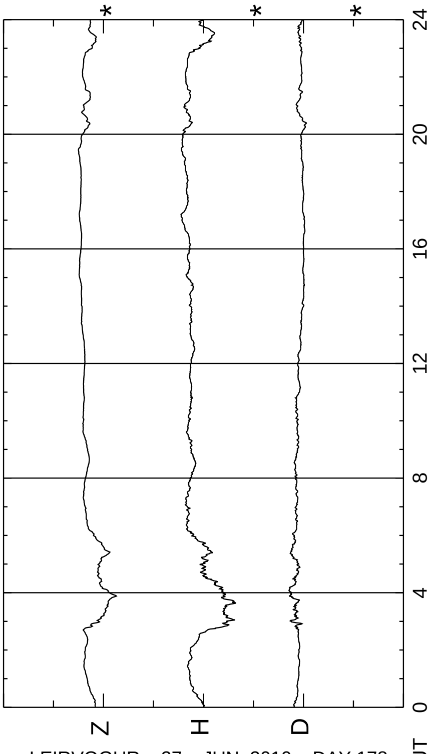




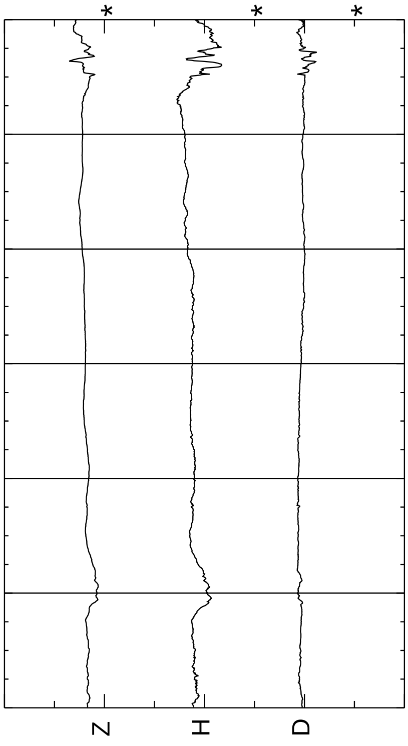
LEIRVOGUR 18. JUN 2010 DAY 169

LEIRVOGUR 20. JUN 2010 DAY 171

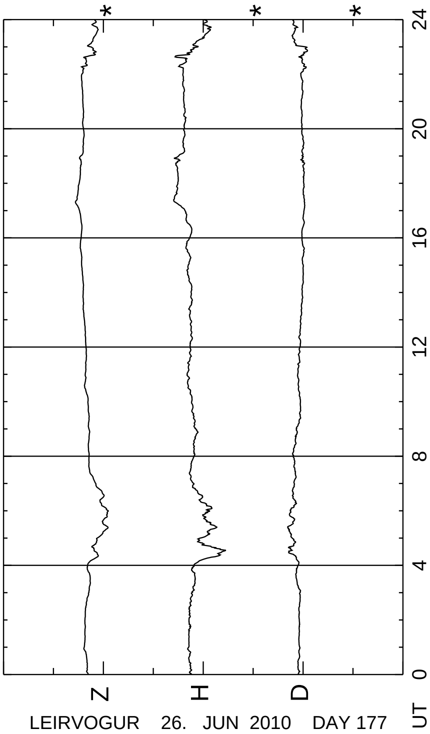

LEIRVOGUR 23. JUN 2010 DAY 174
LEIRVOGUR 25. JUN 2010 DAY 176
LEIRVOGUR 22. JUN 2010 DAY 173
LEIRVOGUR 24. JUN 2010 DAY 175
Z H D
UT
0 4 8 12 16 20 24



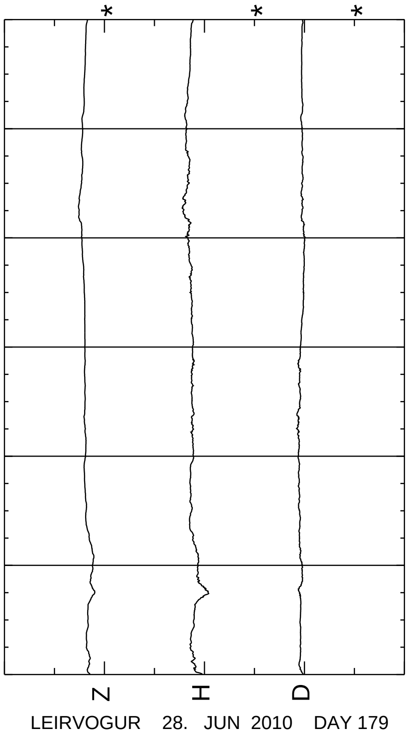
LEIRVOGUR 27. JUN 2010 DAY 178



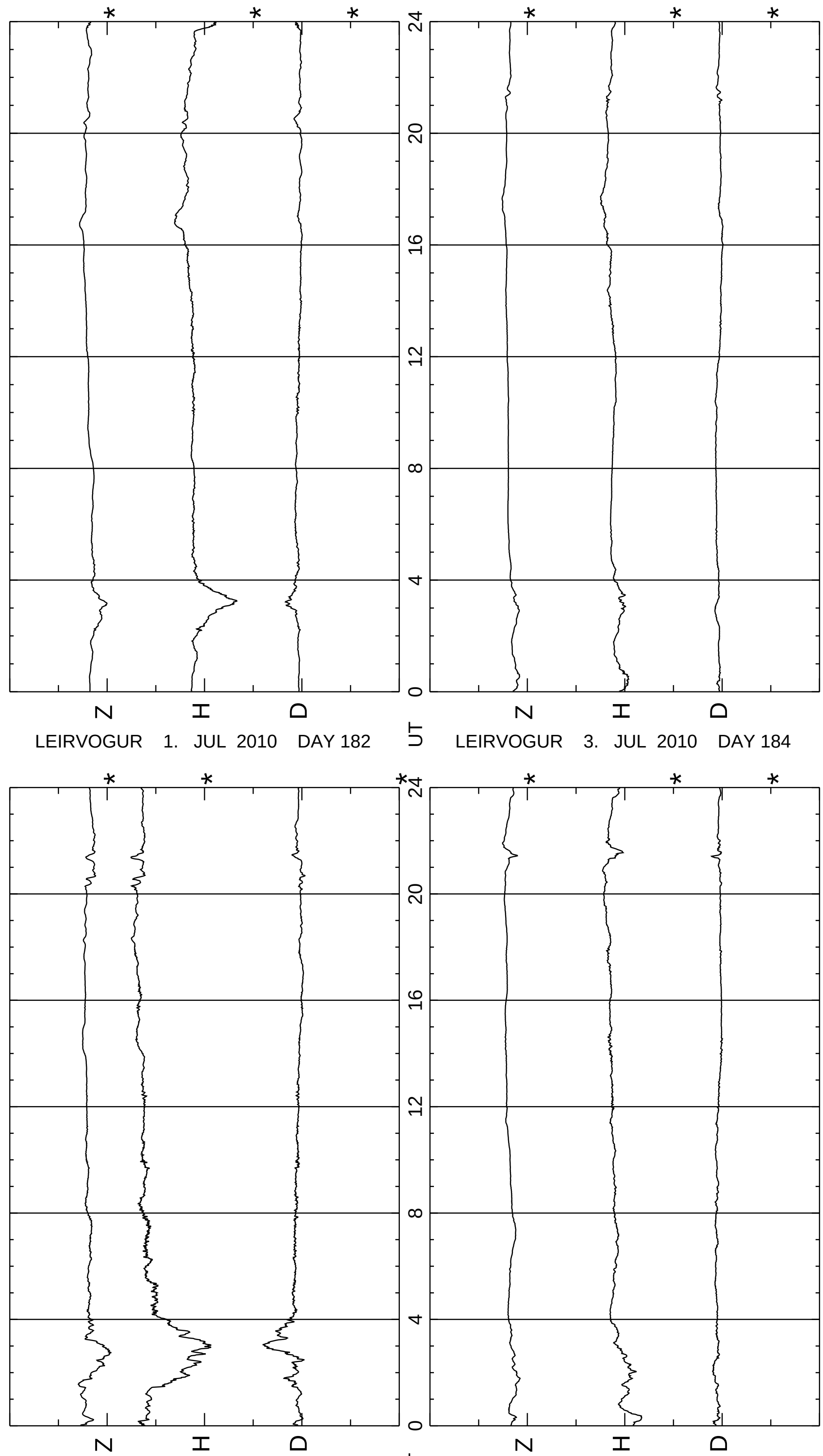
LEIRVOGUR 29. JUN 2010 DAY 180

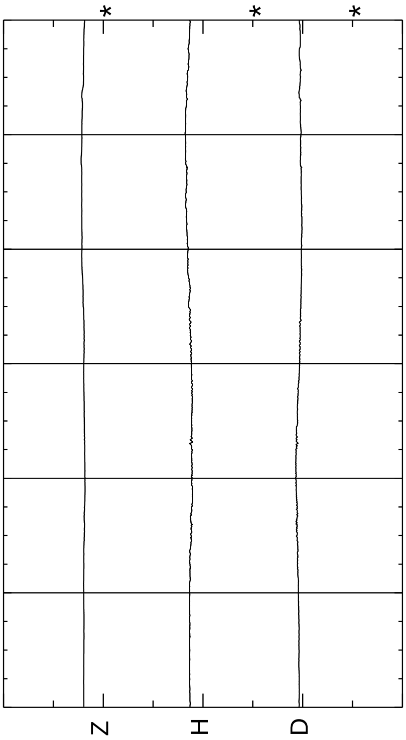


LEIRVOGUR 26. JUN 2010 DAY 177

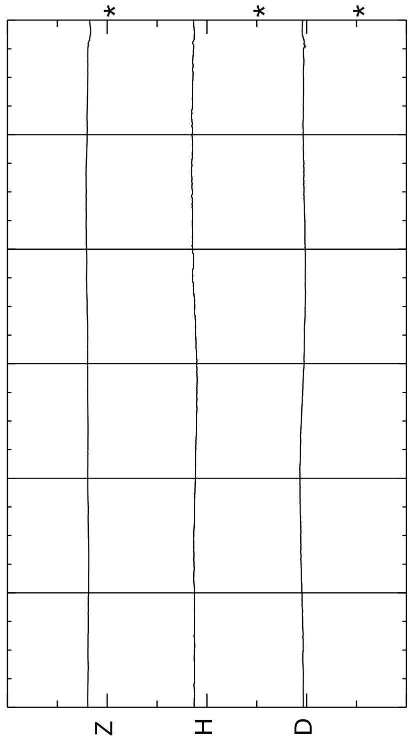


LEIRVOGUR 28. JUN 2010 DAY 179

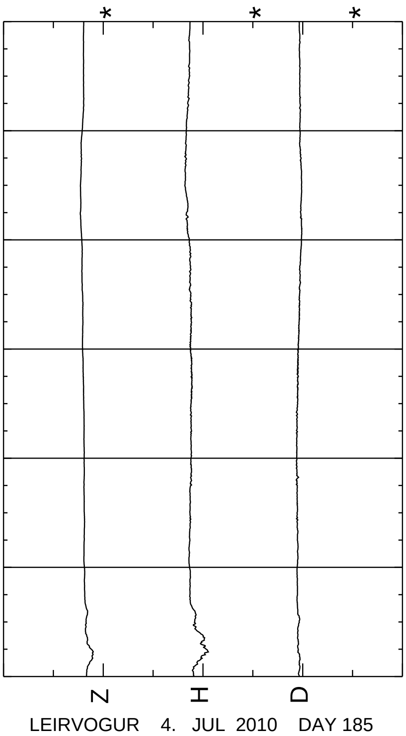

Z H D
LEIRVOGUR 1. JUL 2010 DAY 182
UT
Z H D
LEIRVOGUR 3. JUL 2010 DAY 184
Z H D
LEIRVOGUR 30. JUN 2010 DAY 181
UT
Z H D
LEIRVOGUR 2. JUL 2010 DAY 183



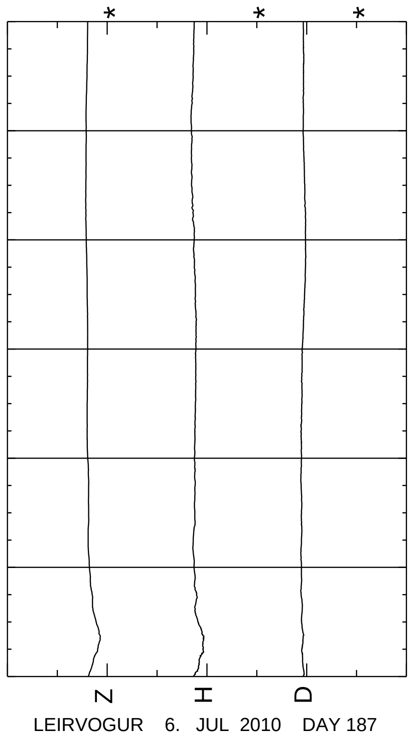
LEIRVOGUR 5. JUL 2010 DAY 186



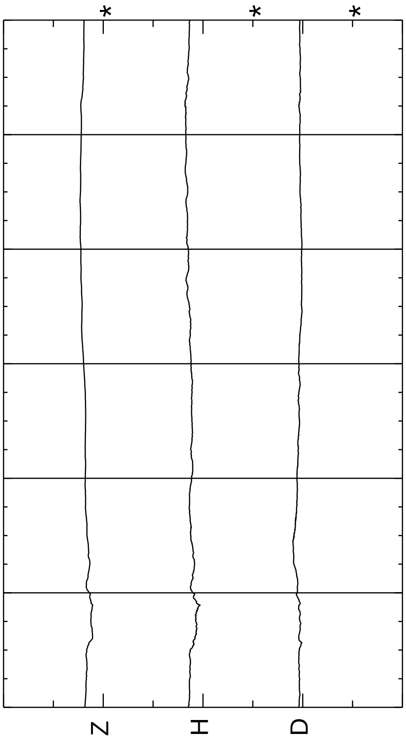
LEIRVOGUR 7. JUL 2010 DAY 188



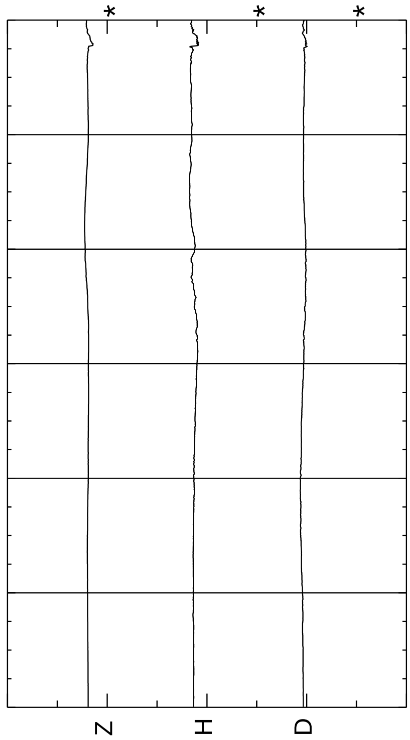
LEIRVOGUR 4. JUL 2010 DAY 185



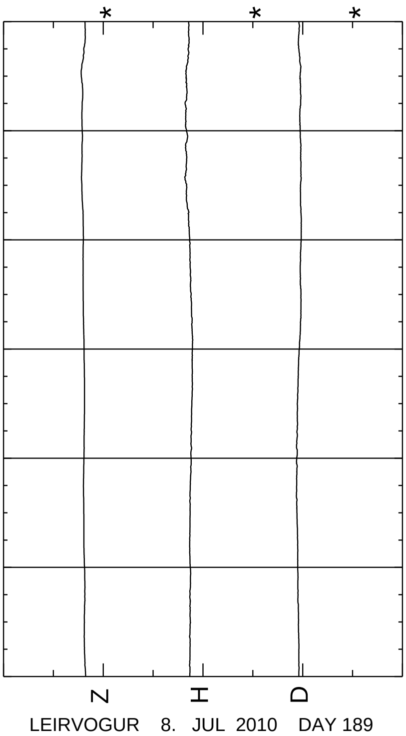
LEIRVOGUR 6. JUL 2010 DAY 187



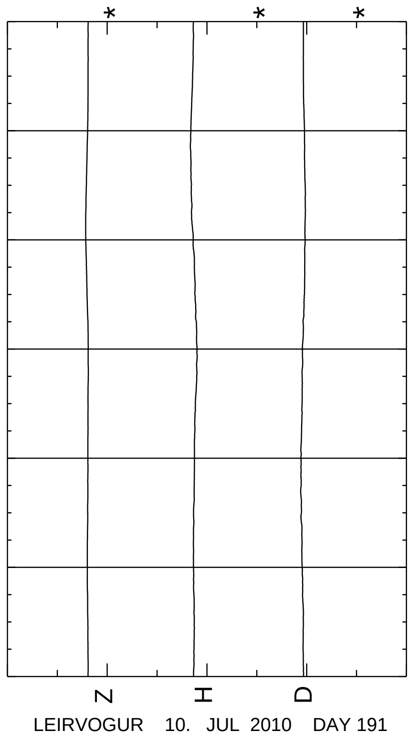
LEIRVOGUR 9. JUL 2010 DAY 190



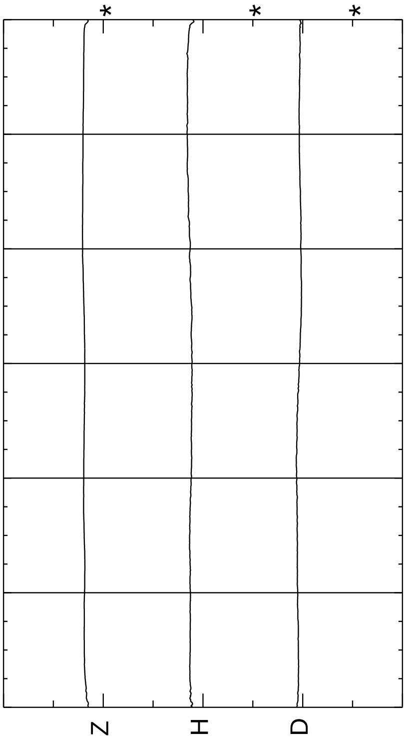
LEIRVOGUR 11. JUL 2010 DAY 192



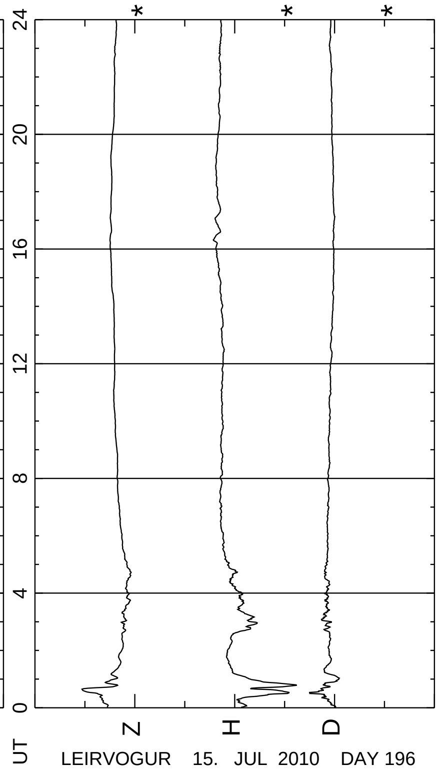
LEIRVOGUR 8. JUL 2010 DAY 189



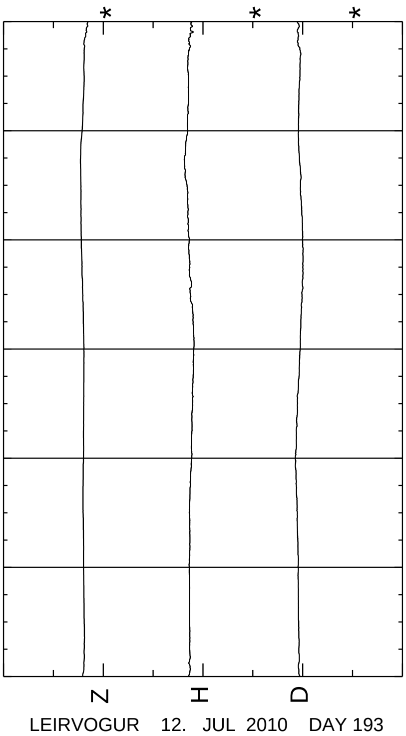
LEIRVOGUR 10. JUL 2010 DAY 191



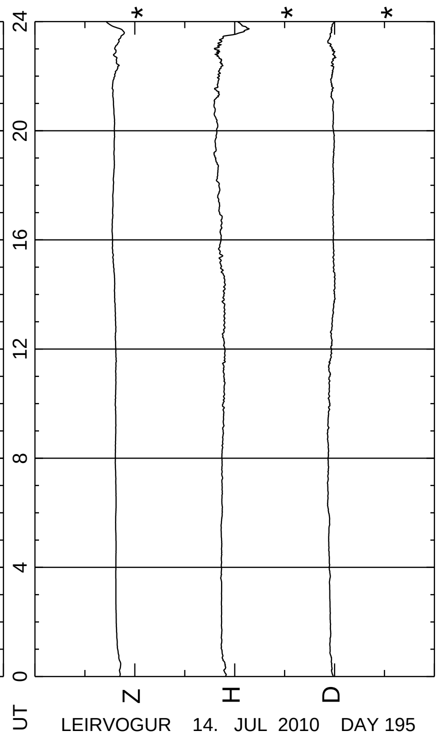
LEIRVOGUR 13. JUL 2010 DAY 194



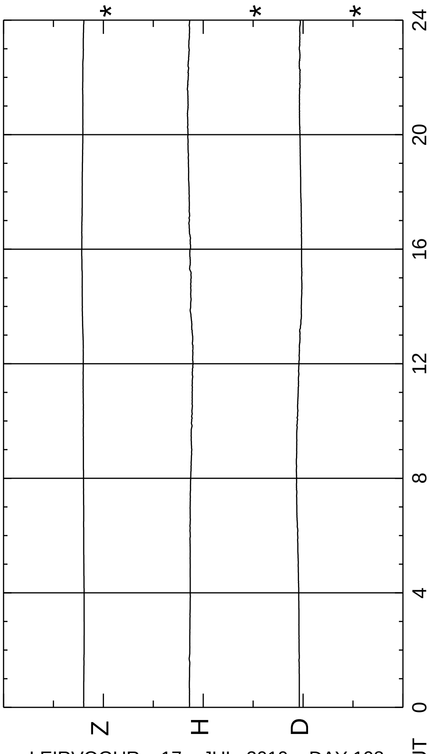
LEIRVOGUR 15. JUL 2010 DAY 196



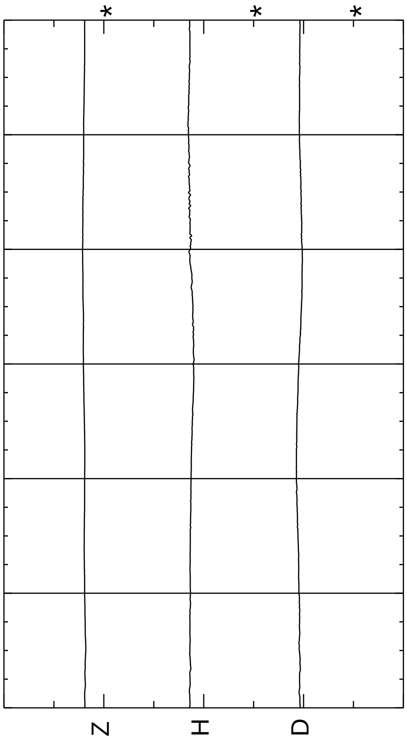
LEIRVOGUR 12. JUL 2010 DAY 193



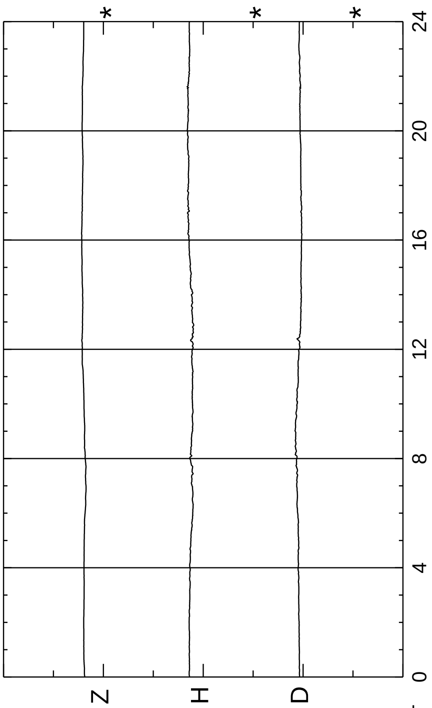
LEIRVOGUR 14. JUL 2010 DAY 195



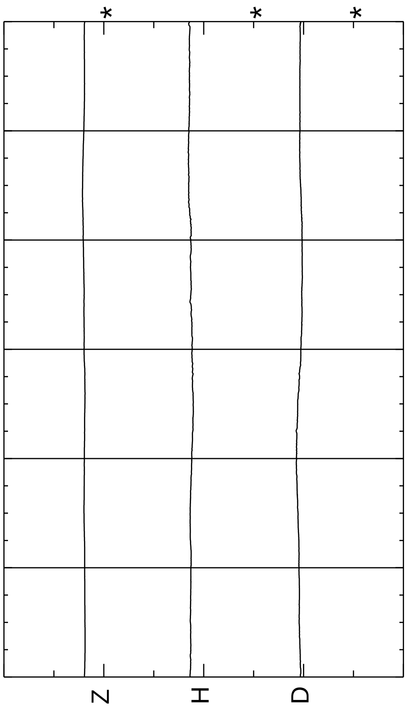
LEIRVOGUR 17. JUL 2010 DAY 198



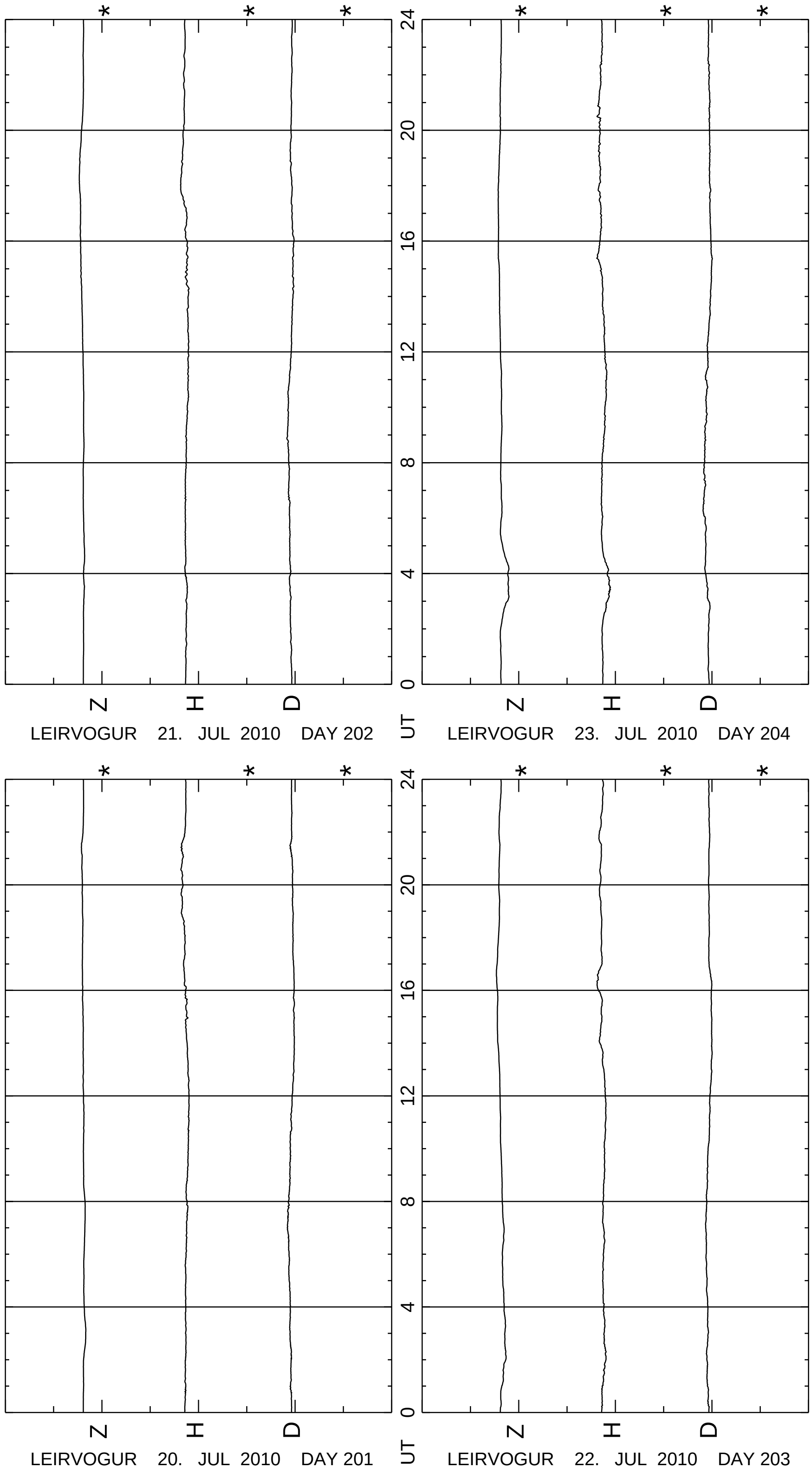
LEIRVOGUR 19. JUL 2010 DAY 200



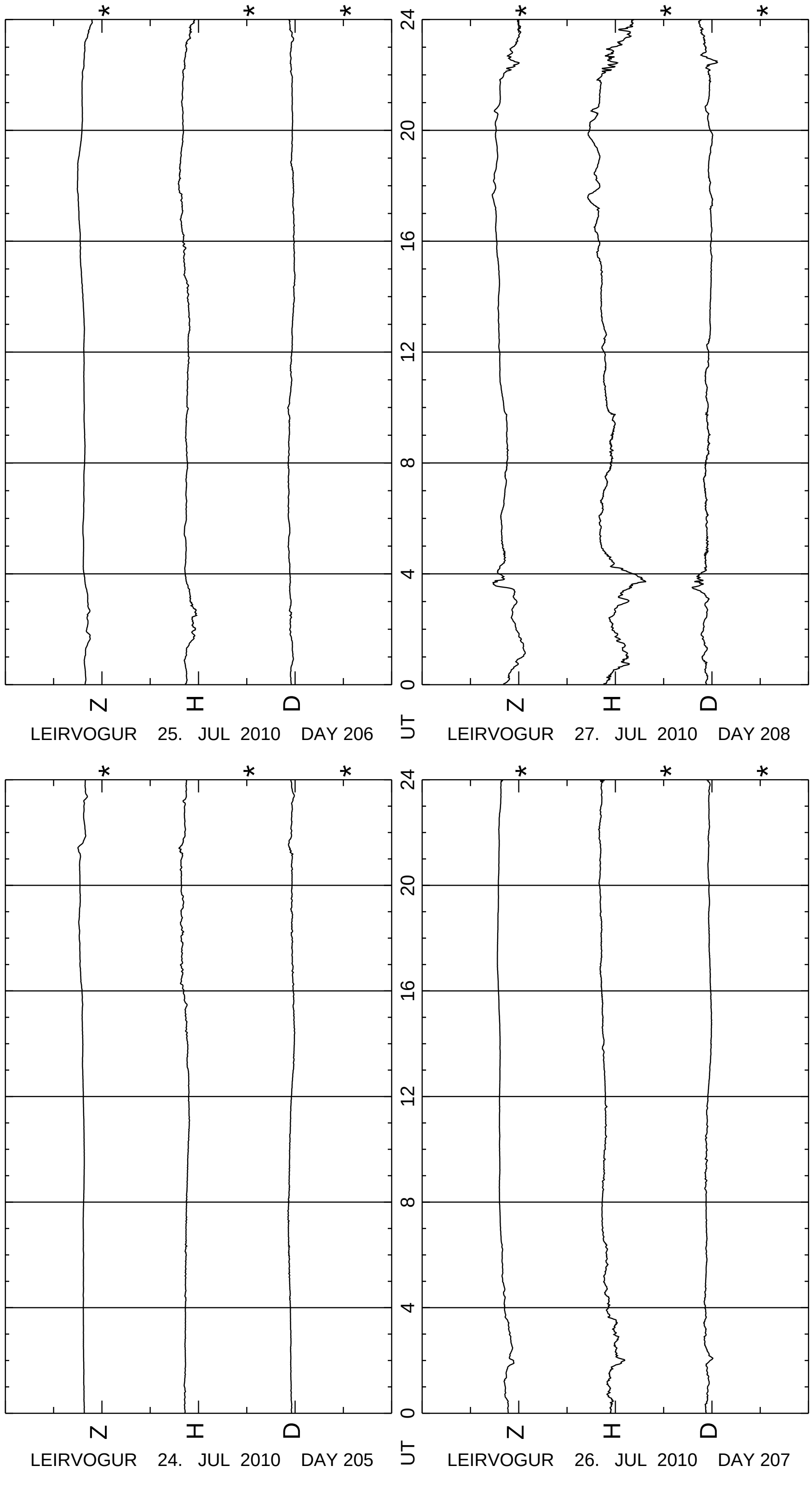
LEIRVOGUR 16. JUL 2010 DAY 197

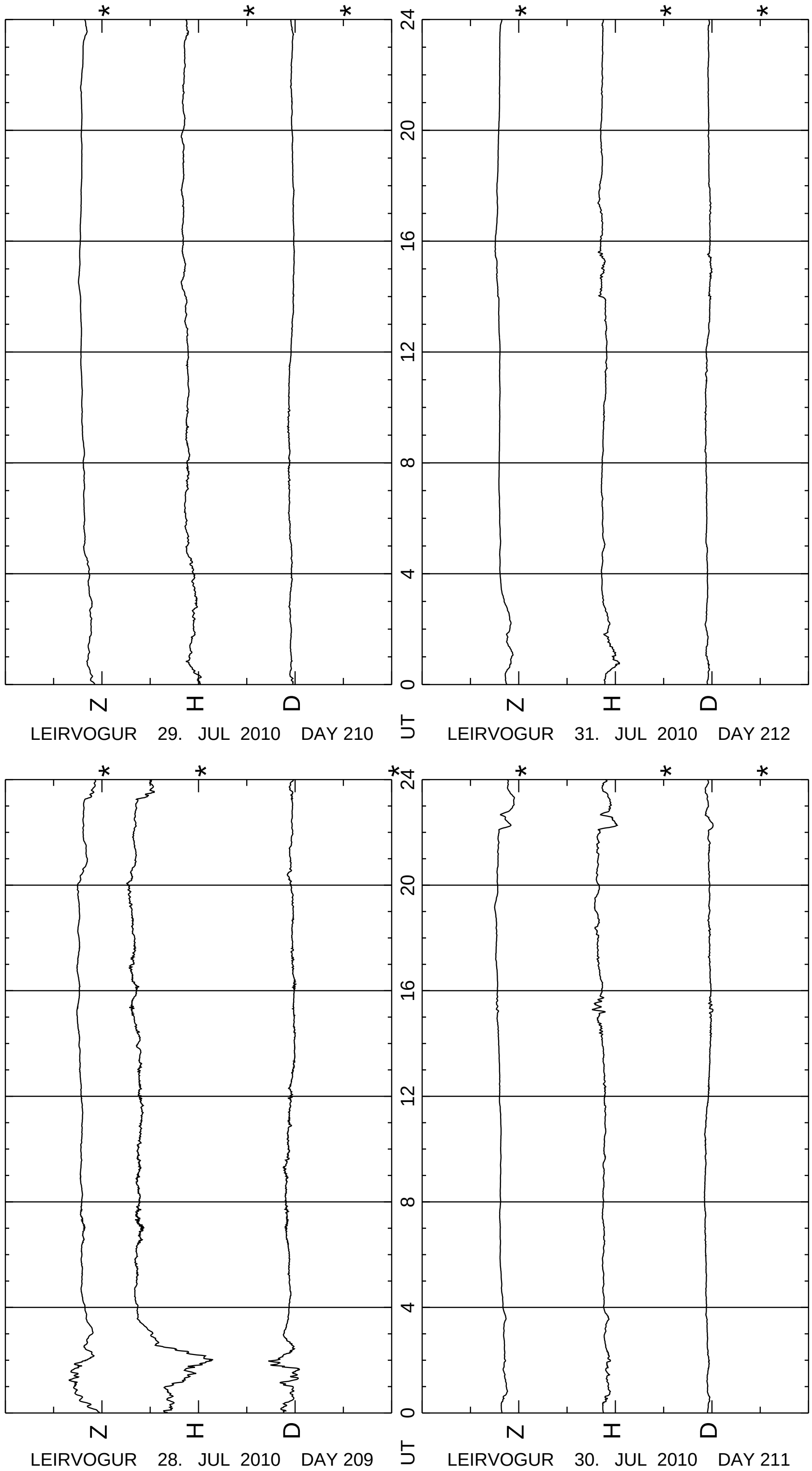


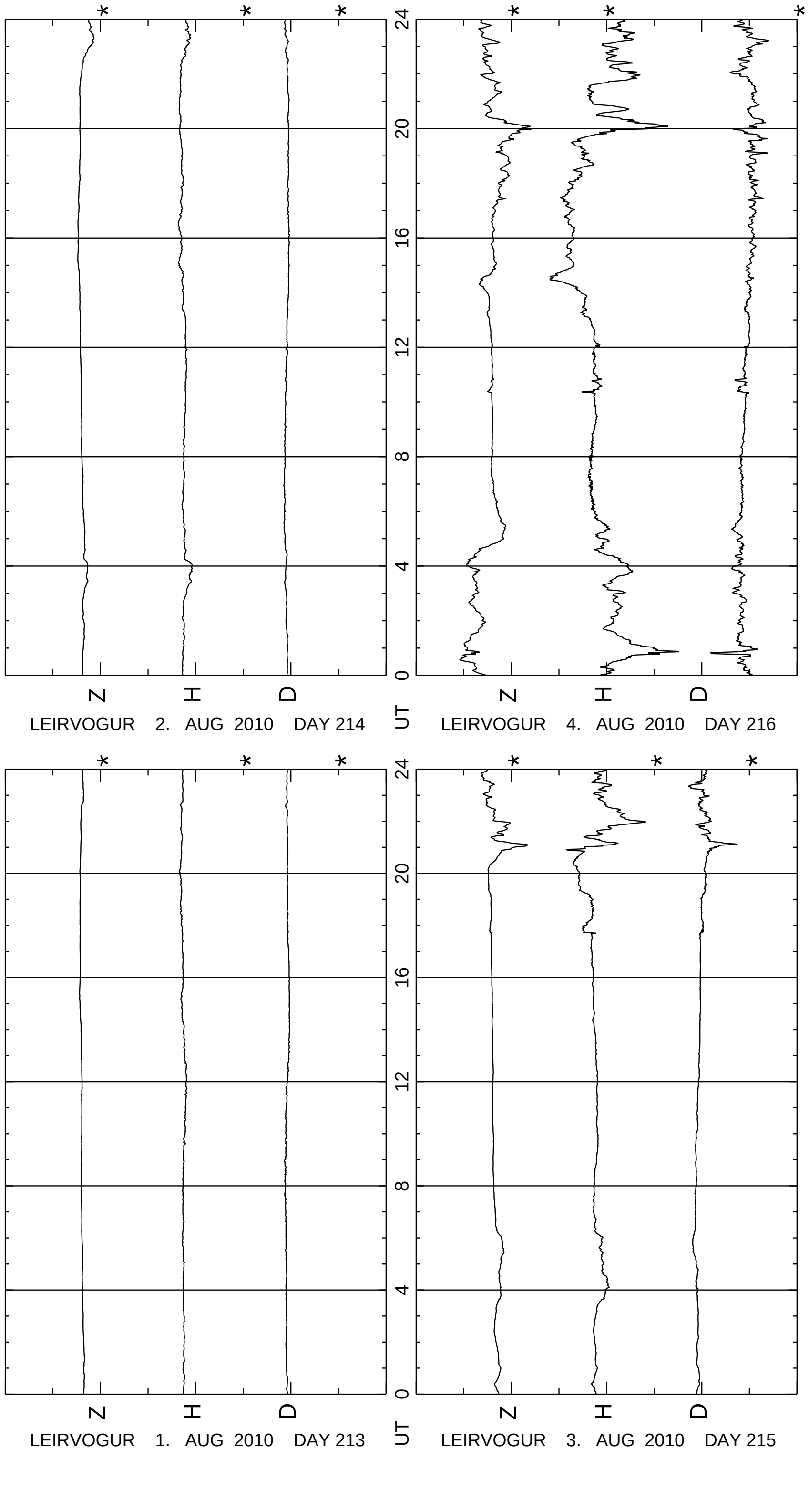
LEIRVOGUR 18. JUL 2010 DAY 199

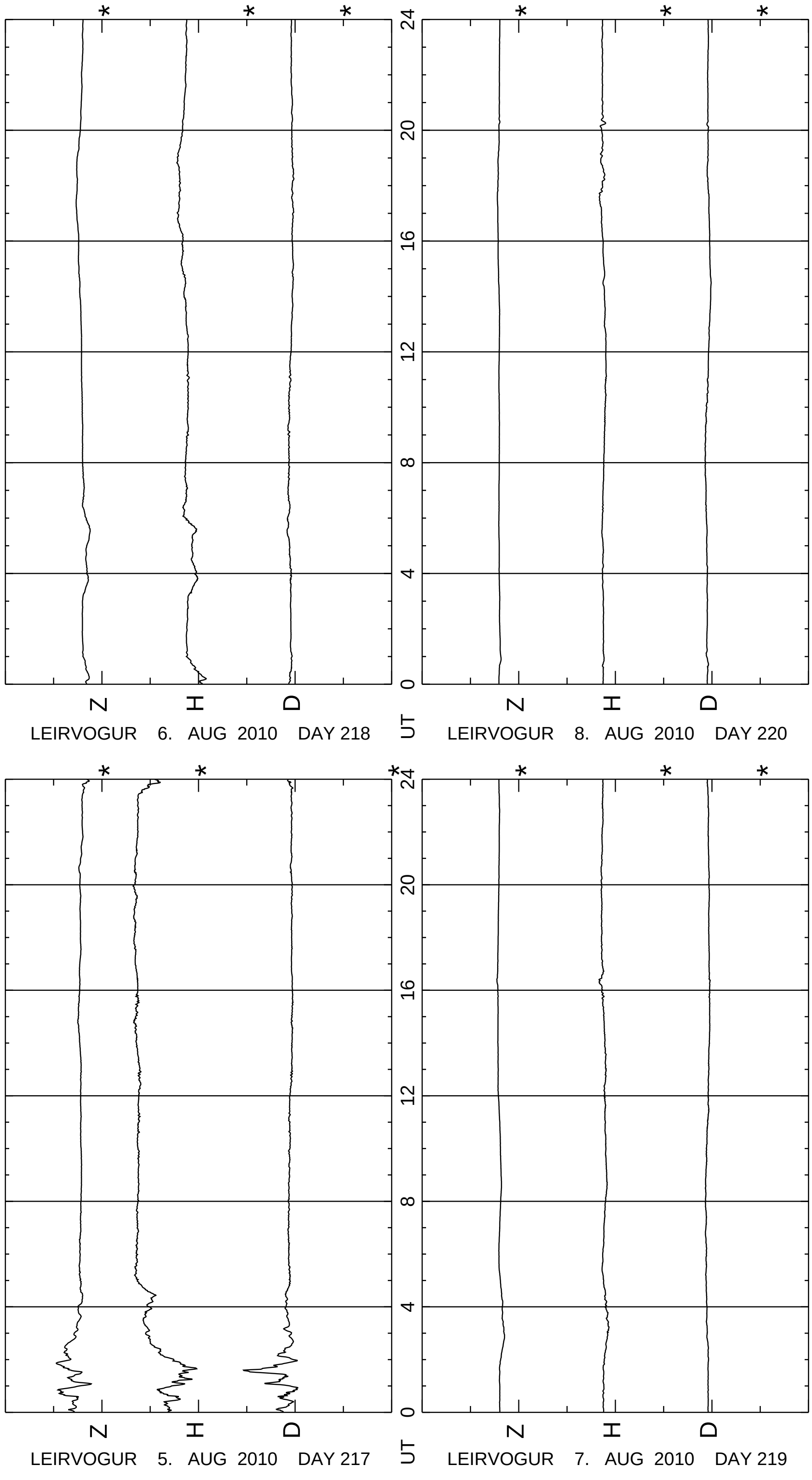


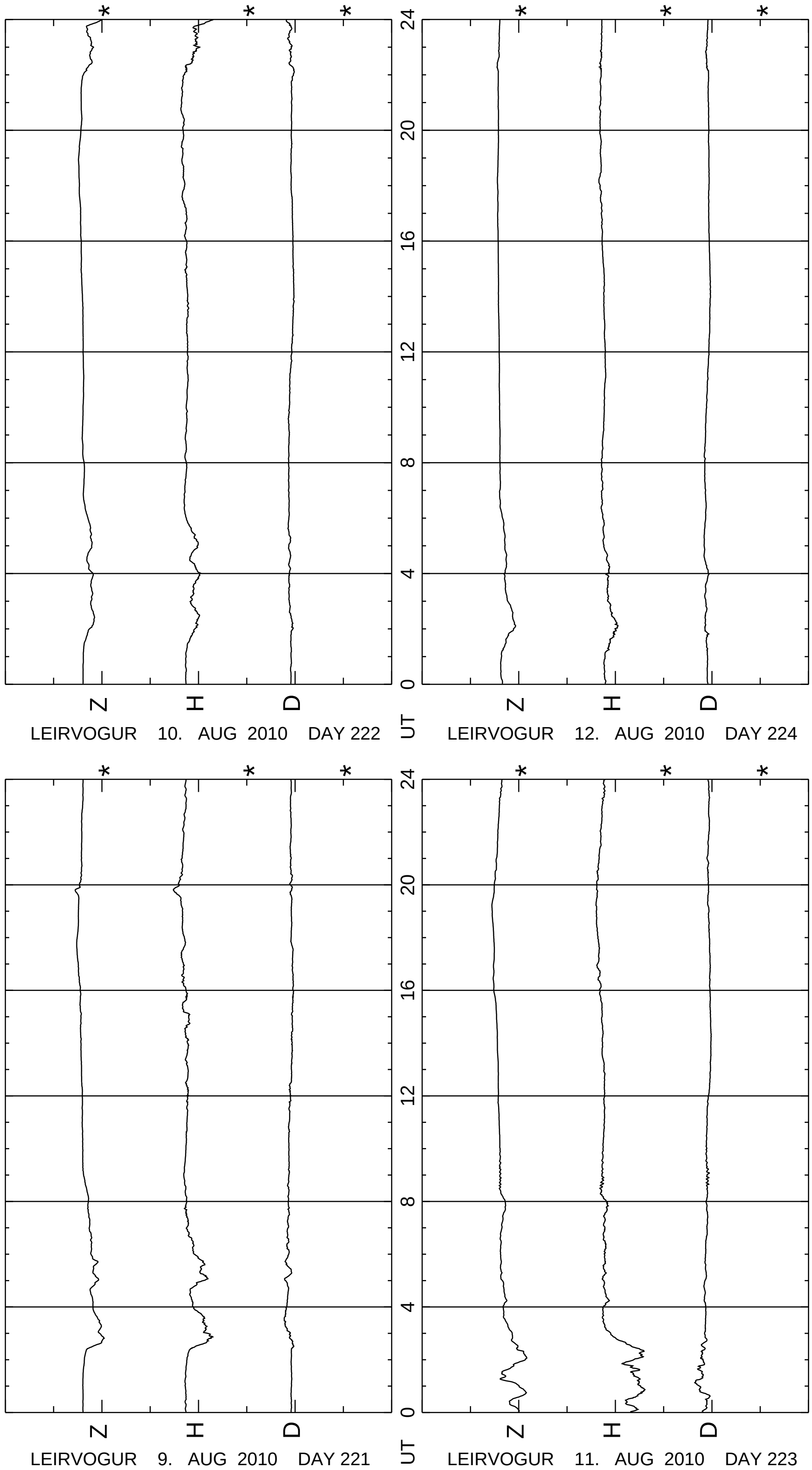
LEIRVOGUR 21. JUL 2010 DAY 202
LEIRVOGUR 23. JUL 2010 DAY 204
LEIRVOGUR 20. JUL 2010 DAY 201
LEIRVOGUR 22. JUL 2010 DAY 203
Z H D
UT
0 4 8 12 16 20 24


LEIRVOGUR 25. JUL 2010 DAY 206
LEIRVOGUR 27. JUL 2010 DAY 208
LEIRVOGUR 24. JUL 2010 DAY 205
LEIRVOGUR 26. JUL 2010 DAY 207
Z
H
D
UT
0
4
8
12
16
20
24

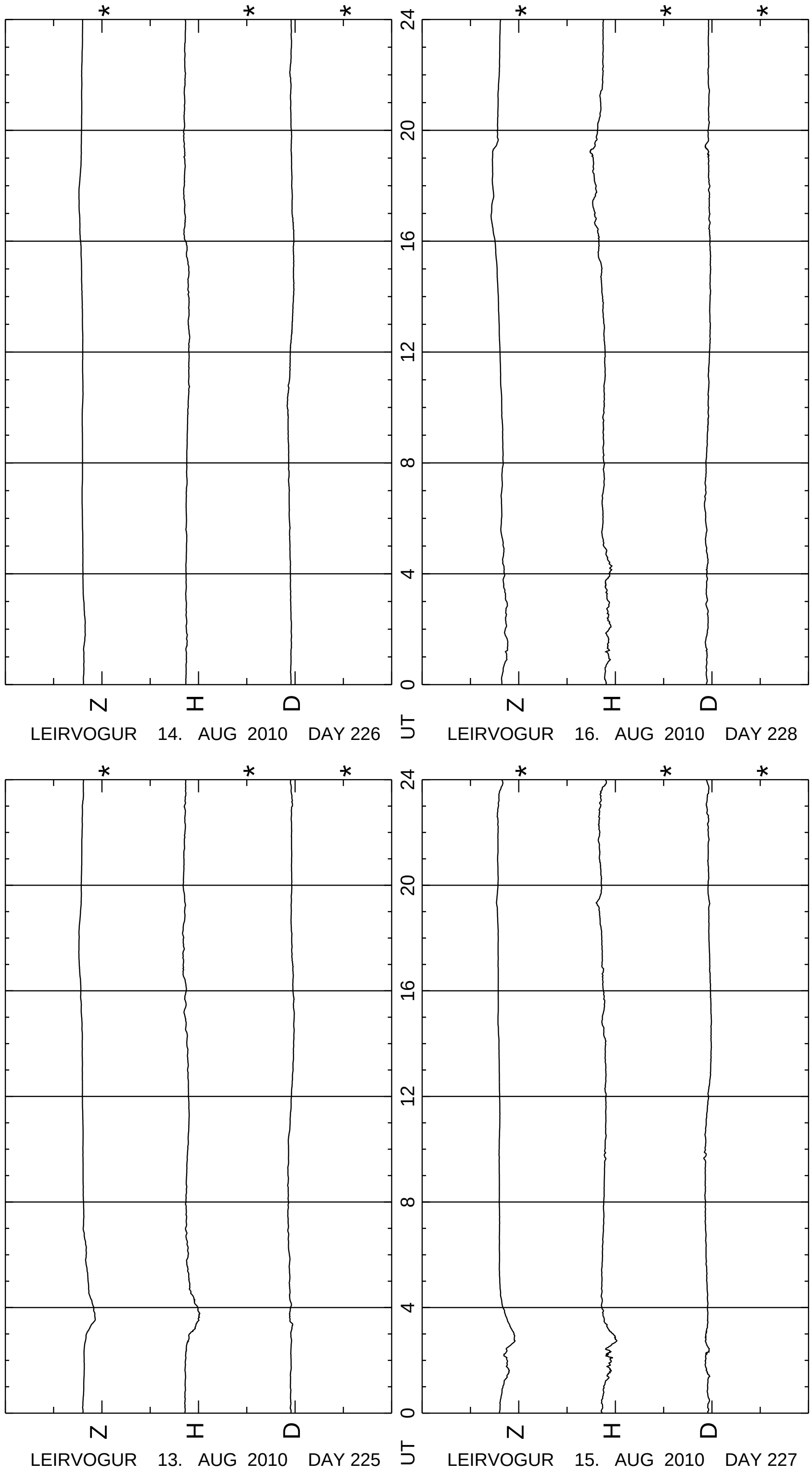

LEIRVOGUR 29. JUL 2010 DAY 210
LEIRVOGUR 31. JUL 2010 DAY 212
LEIRVOGUR 28. JUL 2010 DAY 209
LEIRVOGUR 30. JUL 2010 DAY 211
Z
H
D
UT
0
4
8
12
16
20
24

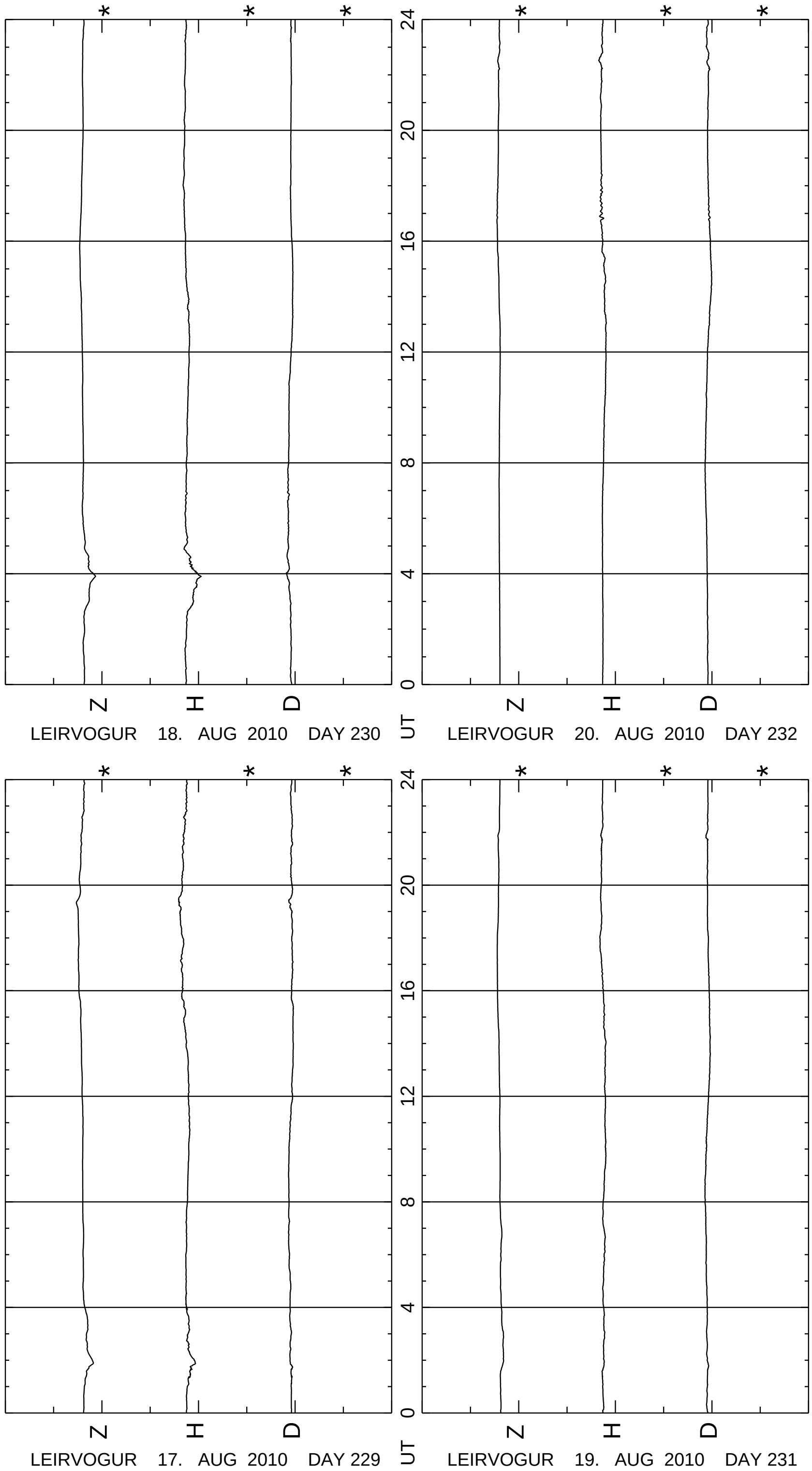

LEIRVOGUR 2. AUG 2010 DAY 214
LEIRVOGUR 4. AUG 2010 DAY 216
LEIRVOGUR 1. AUG 2010 DAY 213
LEIRVOGUR 3. AUG 2010 DAY 215
Z
H
D
UT
0
4
8
12
16
20
24

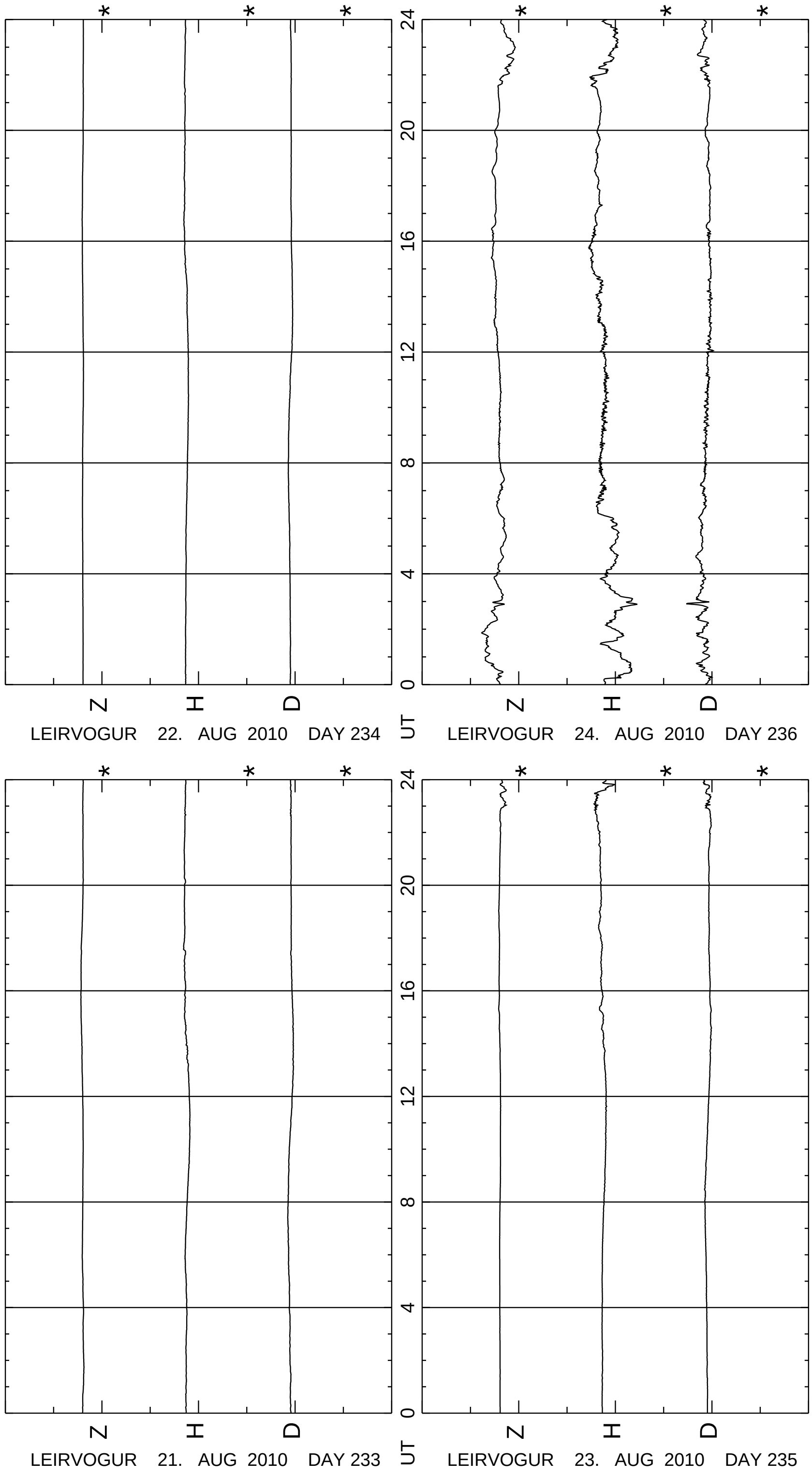

Z H D
LEIRVOGUR 6. AUG 2010 DAY 218
UT
Z H D
LEIRVOGUR 8. AUG 2010 DAY 220
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 5. AUG 2010 DAY 217
UT
Z H D
LEIRVOGUR 7. AUG 2010 DAY 219
0 4 8 12 16 20 24

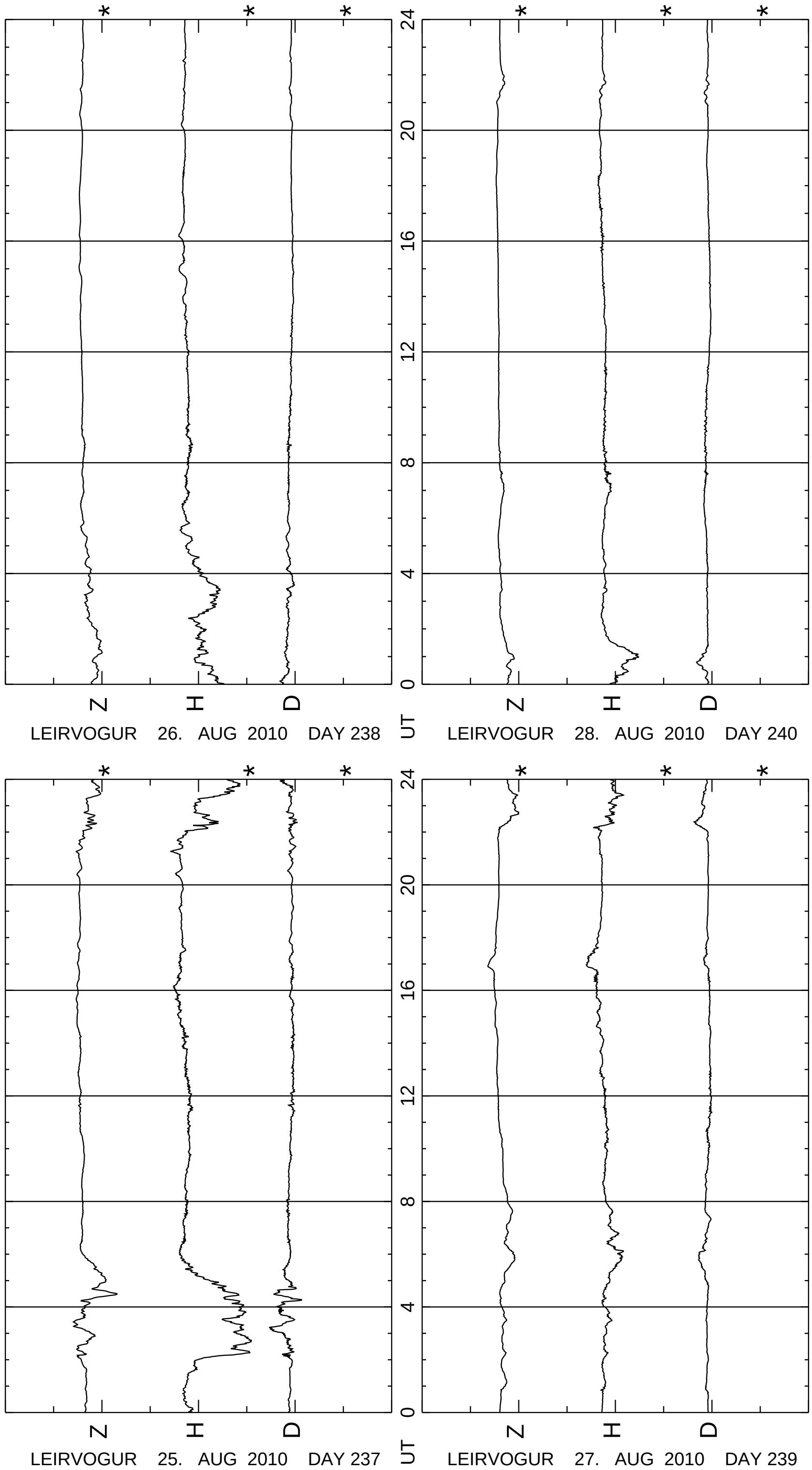


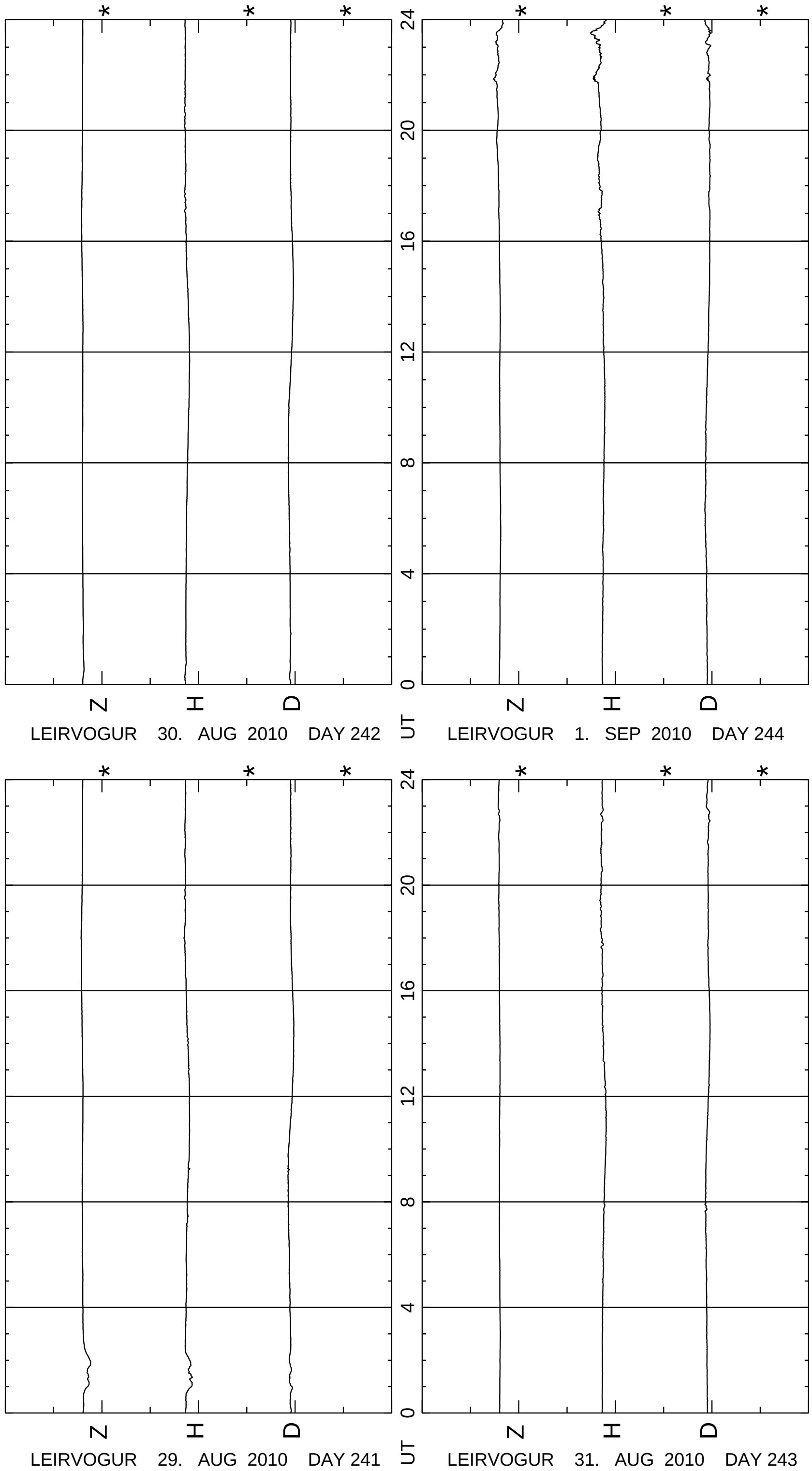
Z
H
D
LEIRVOGUR 10. AUG 2010 DAY 222
UT
0
4
8
12
16
20
24
LEIRVOGUR 12. AUG 2010 DAY 224
LEIRVOGUR 9. AUG 2010 DAY 221
LEIRVOGUR 11. AUG 2010 DAY 223

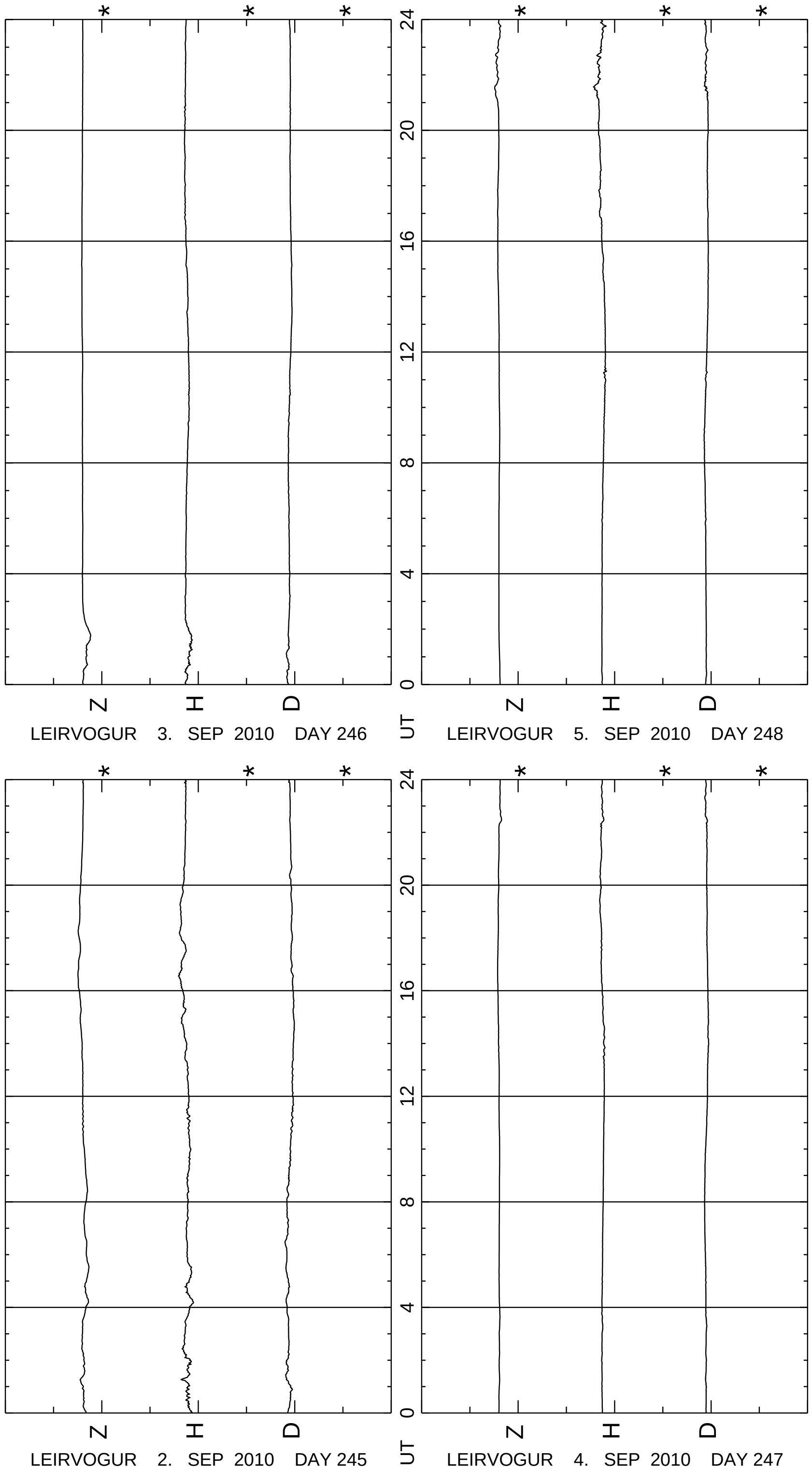

LEIRVOGUR 14. AUG 2010 DAY 226
LEIRVOGUR 16. AUG 2010 DAY 228
LEIRVOGUR 13. AUG 2010 DAY 225
LEIRVOGUR 15. AUG 2010 DAY 227
Z H D
UT
0 4 8 12 16 20 24

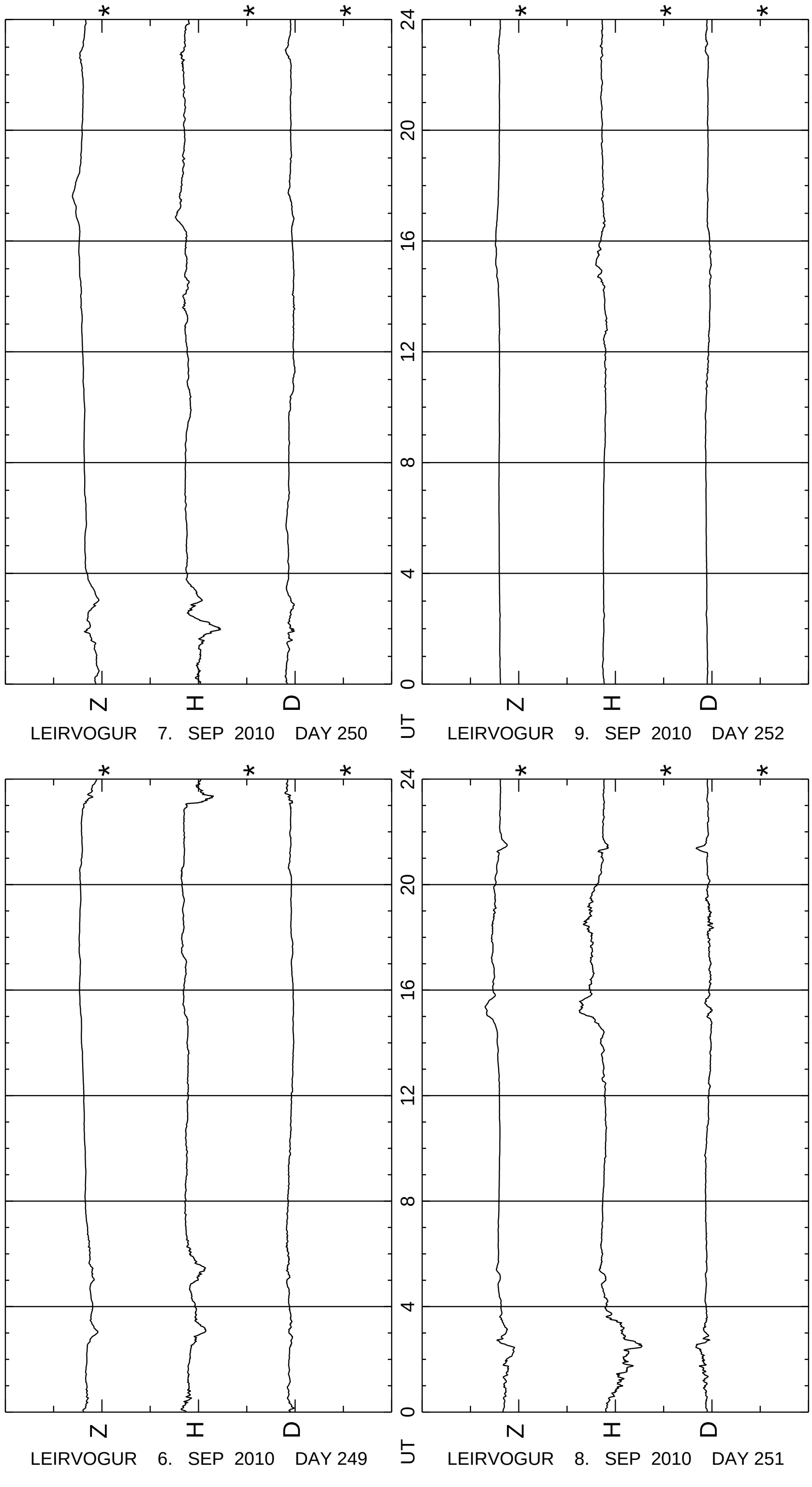

LEIRVOGUR 18. AUG 2010 DAY 230
LEIRVOGUR 20. AUG 2010 DAY 232
LEIRVOGUR 17. AUG 2010 DAY 229
LEIRVOGUR 19. AUG 2010 DAY 231
Z H D
UT
0 4 8 12 16 20 24

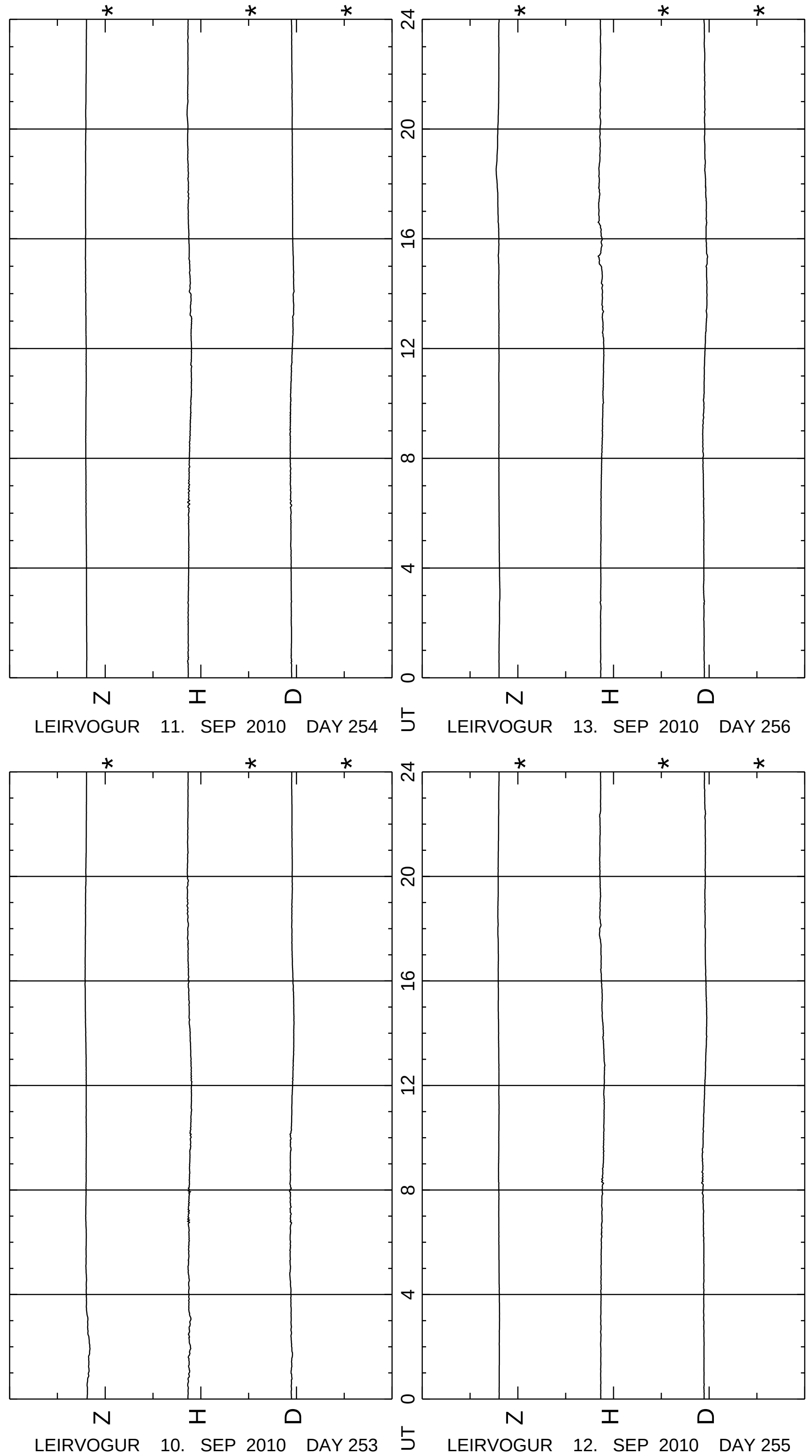

LEIRVOGUR 22. AUG 2010 DAY 234
LEIRVOGUR 24. AUG 2010 DAY 236
LEIRVOGUR 21. AUG 2010 DAY 233
LEIRVOGUR 23. AUG 2010 DAY 235
Z
H
D
UT
0
4
8
12
16
20
24

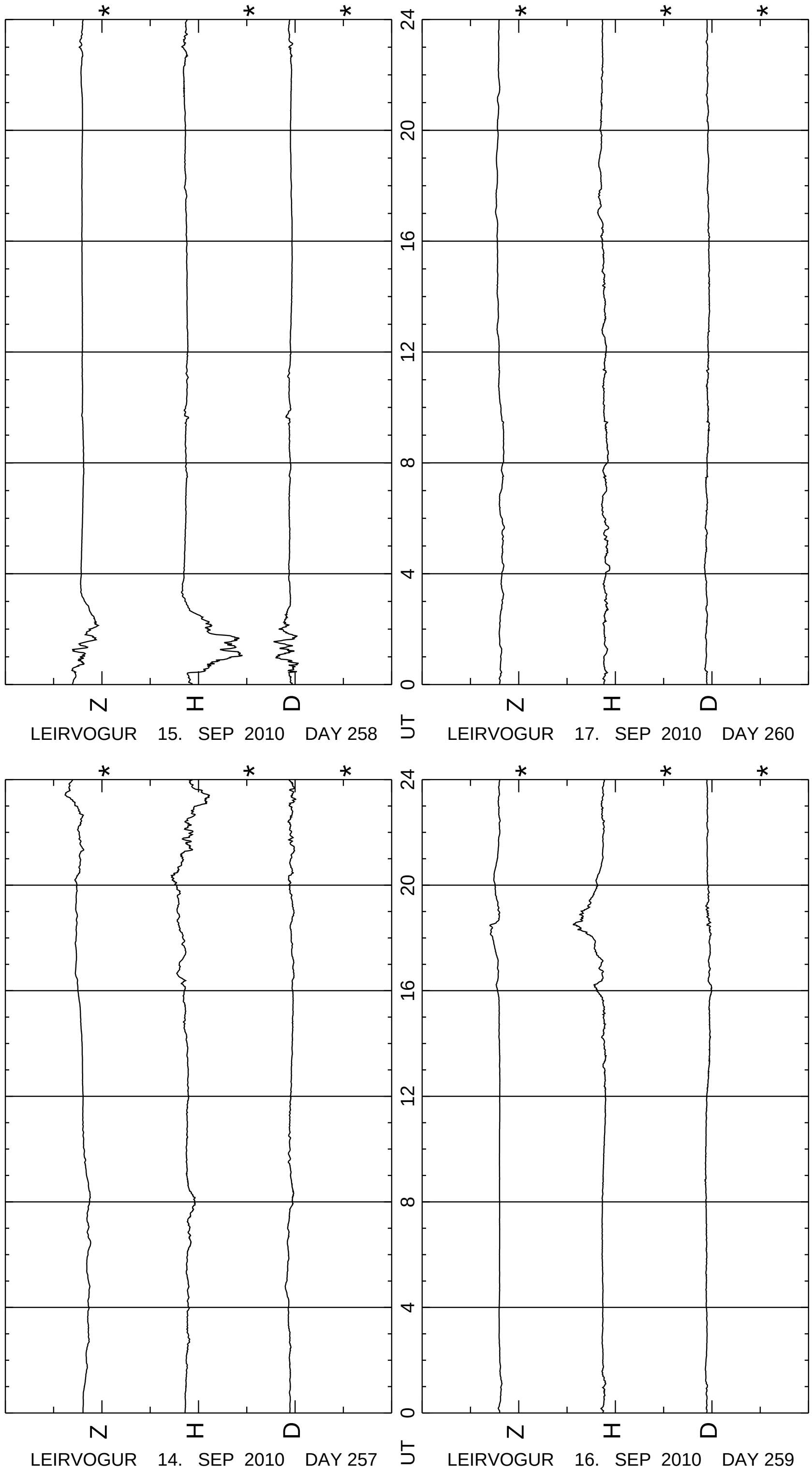

LEIRVOGUR 26. AUG 2010 DAY 238
LEIRVOGUR 28. AUG 2010 DAY 240
LEIRVOGUR 25. AUG 2010 DAY 237
LEIRVOGUR 27. AUG 2010 DAY 239
Z
H
D
UT
0
4
8
12
16
20
24

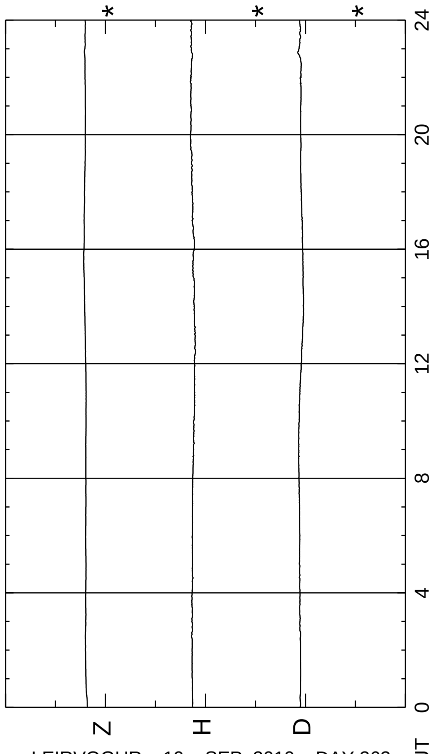

LEIRVOGUR 30. AUG 2010 DAY 242
LEIRVOGUR 1. SEP 2010 DAY 244
LEIRVOGUR 29. AUG 2010 DAY 241
LEIRVOGUR 31. AUG 2010 DAY 243
Z H D
UT
0 4 8 12 16 20 24


LEIRVOGUR 3. SEP 2010 DAY 246
LEIRVOGUR 5. SEP 2010 DAY 248
LEIRVOGUR 2. SEP 2010 DAY 245
LEIRVOGUR 4. SEP 2010 DAY 247
Z
H
D
UT
0
4
8
12
16
20
24

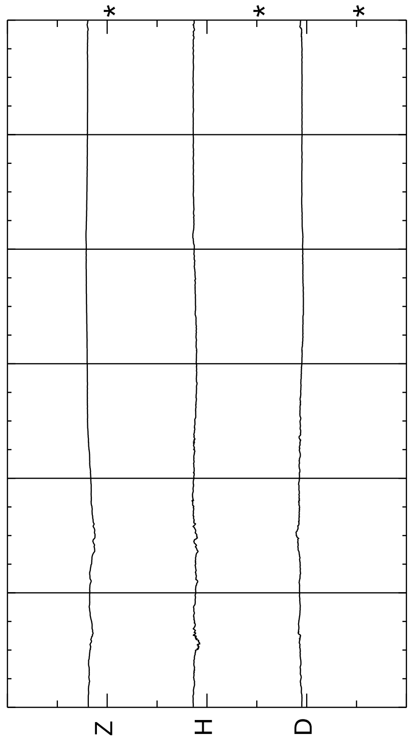

LEIRVOGUR 7. SEP 2010 DAY 250
LEIRVOGUR 9. SEP 2010 DAY 252
LEIRVOGUR 6. SEP 2010 DAY 249
LEIRVOGUR 8. SEP 2010 DAY 251
Z H D
UT
0 4 8 12 16 20 24


LEIRVOGUR 11. SEP 2010 DAY 254
LEIRVOGUR 13. SEP 2010 DAY 256
LEIRVOGUR 10. SEP 2010 DAY 253
LEIRVOGUR 12. SEP 2010 DAY 255
Z
H
D
UT
0
4
8
12
16
20
24

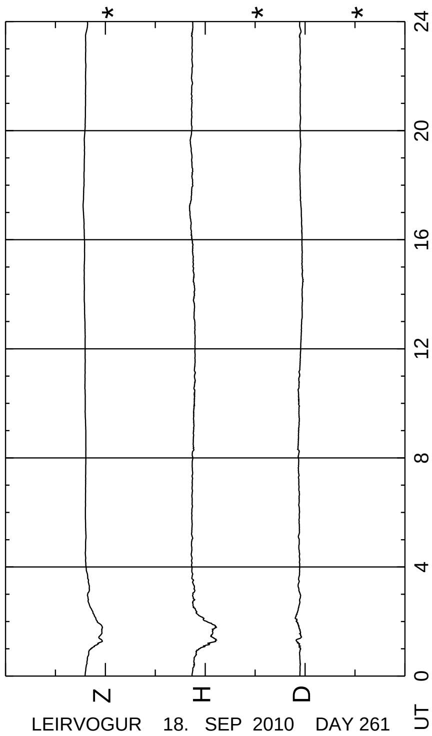

LEIRVOGUR 15. SEP 2010 DAY 258
LEIRVOGUR 17. SEP 2010 DAY 260
LEIRVOGUR 14. SEP 2010 DAY 257
LEIRVOGUR 16. SEP 2010 DAY 259
Z H D
UT
0 4 8 12 16 20 24



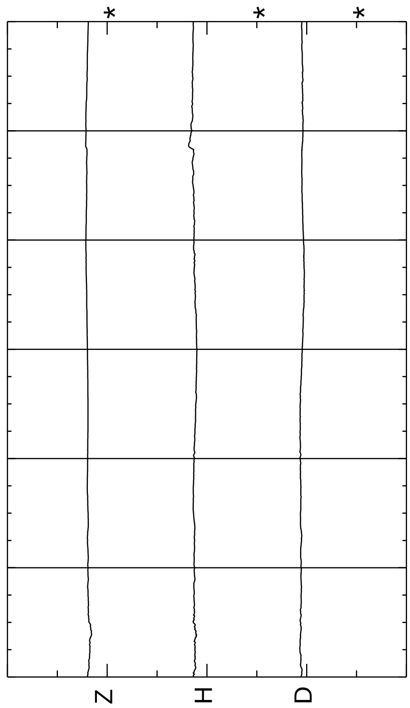
LEIRVOGUR 19. SEP 2010 DAY 262



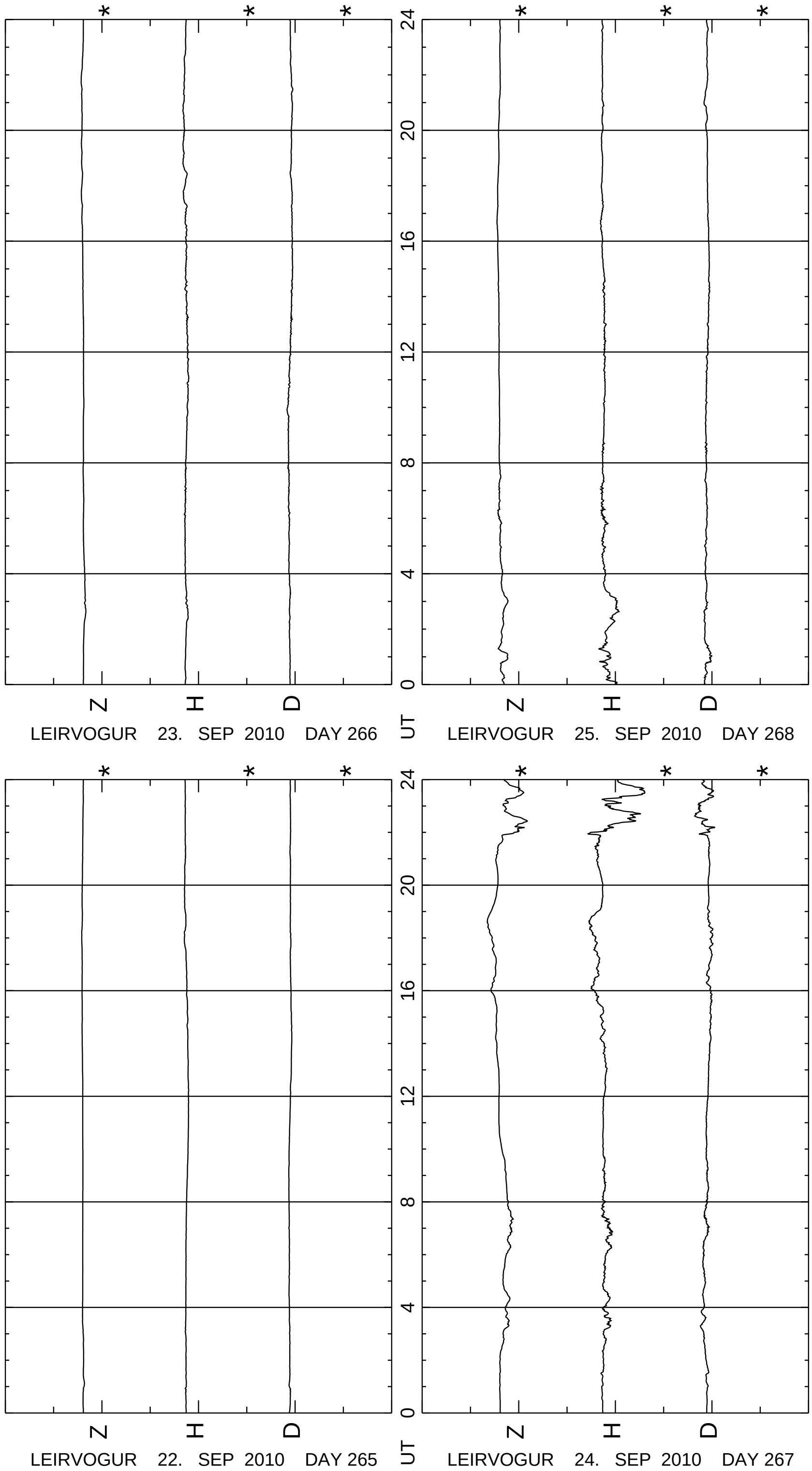
LEIRVOGUR 21. SEP 2010 DAY 264

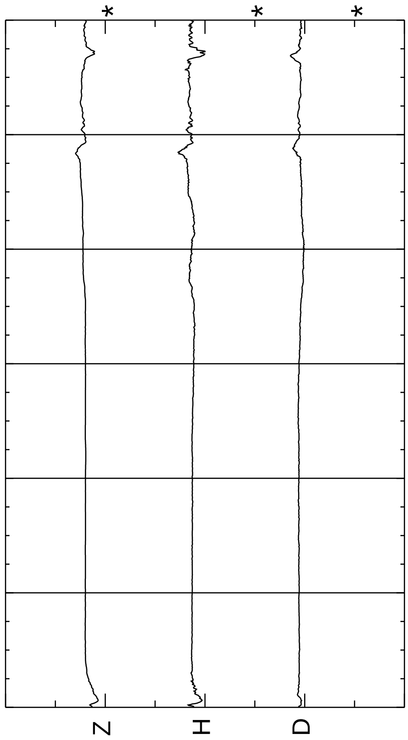


LEIRVOGUR 18. SEP 2010 DAY 261

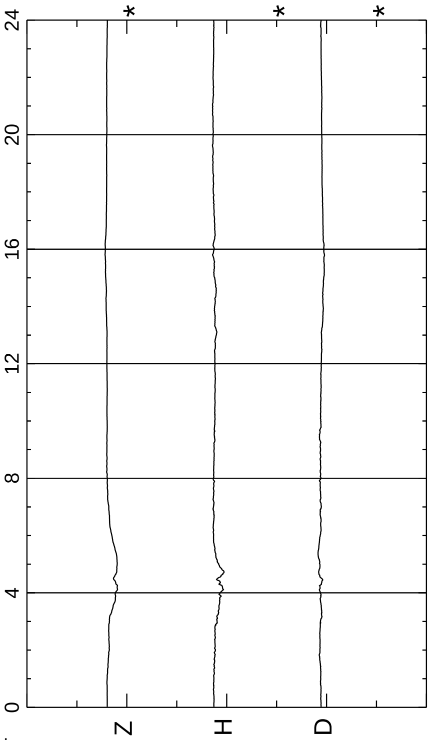


LEIRVOGUR 20. SEP 2010 DAY 263

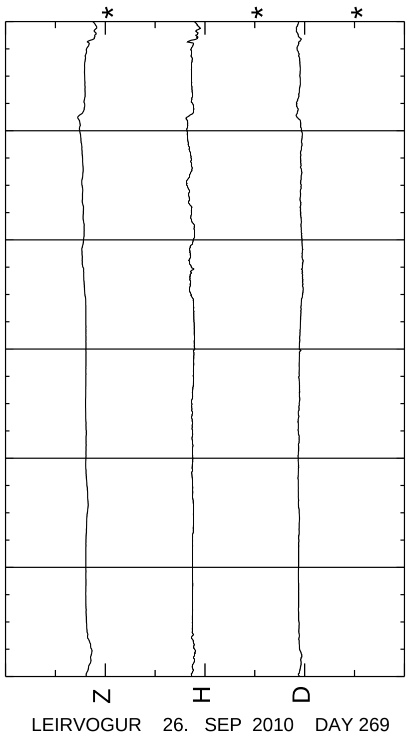

Z H D
LEIRVOGUR 23. SEP 2010 DAY 266
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 25. SEP 2010 DAY 268
Z H D
LEIRVOGUR 22. SEP 2010 DAY 265
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 24. SEP 2010 DAY 267



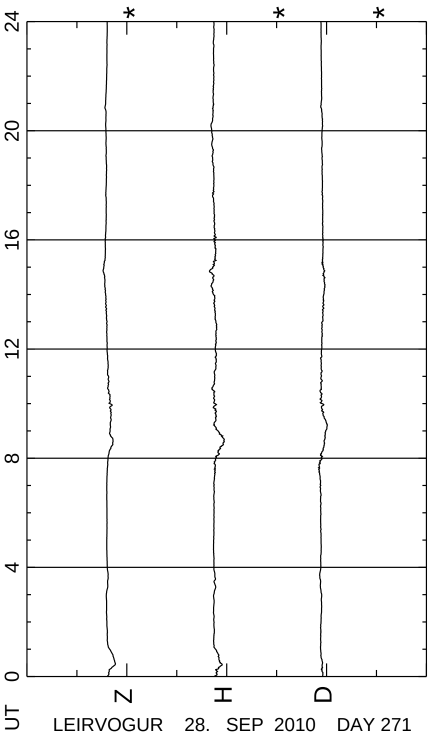
LEIRVOGUR 27. SEP 2010 DAY 270



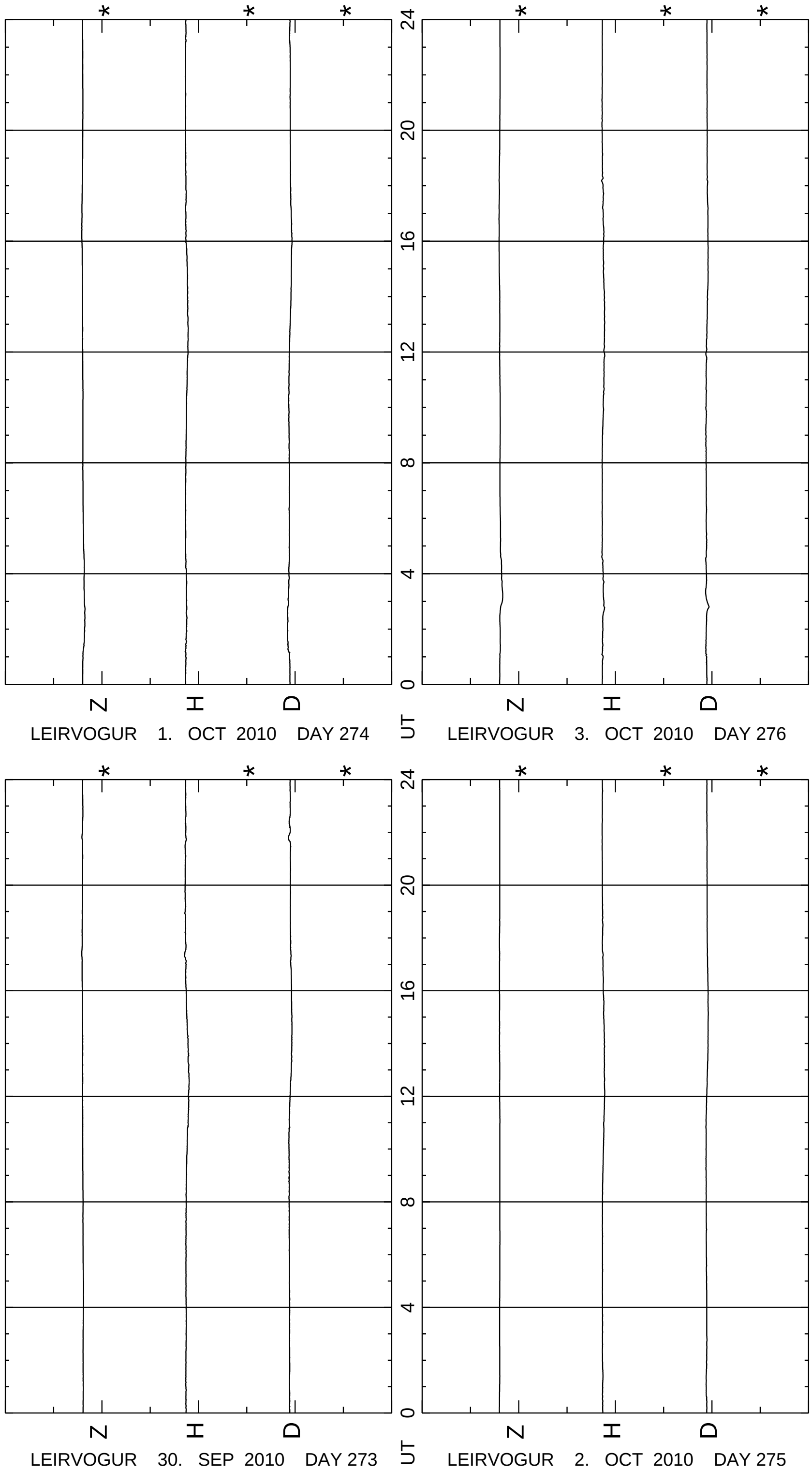
UT LEIRVOGUR 29. SEP 2010 DAY 272

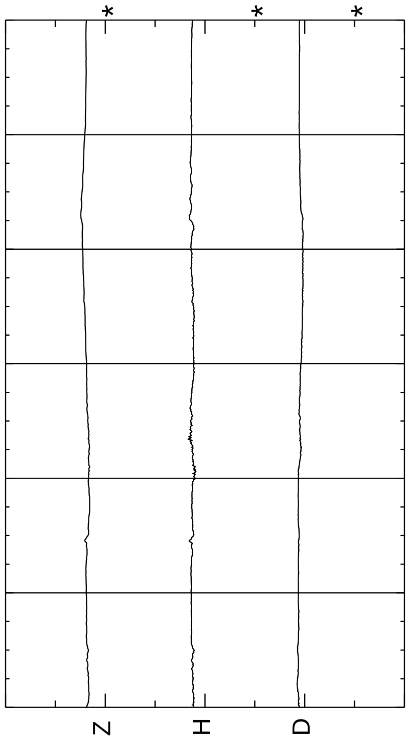


LEIRVOGUR 26. SEP 2010 DAY 269

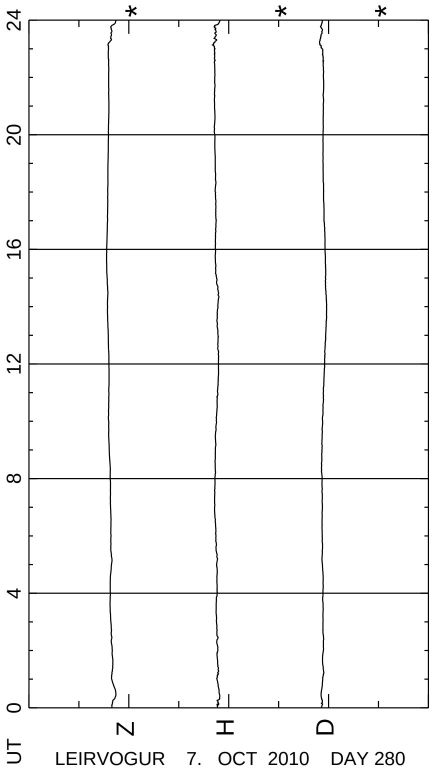


UT LEIRVOGUR 28. SEP 2010 DAY 271

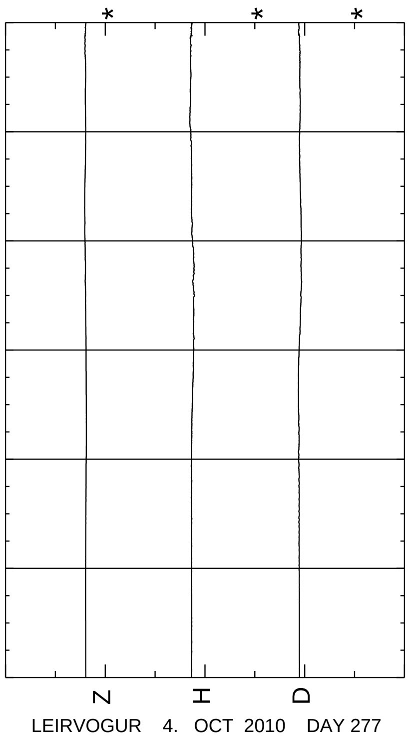

24
20
16
12
8
4
0
UT
Z H D
LEIRVOGUR 1. OCT 2010 DAY 274
LEIRVOGUR 3. OCT 2010 DAY 276
LEIRVOGUR 30. SEP 2010 DAY 273
LEIRVOGUR 2. OCT 2010 DAY 275



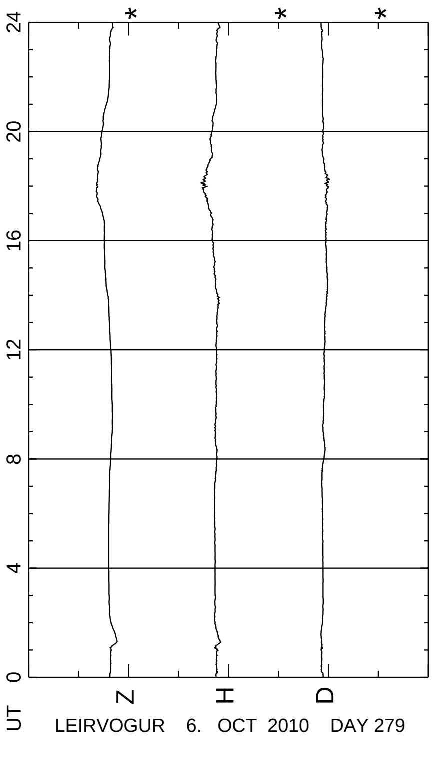
LEIRVOGUR 5. OCT 2010 DAY 278



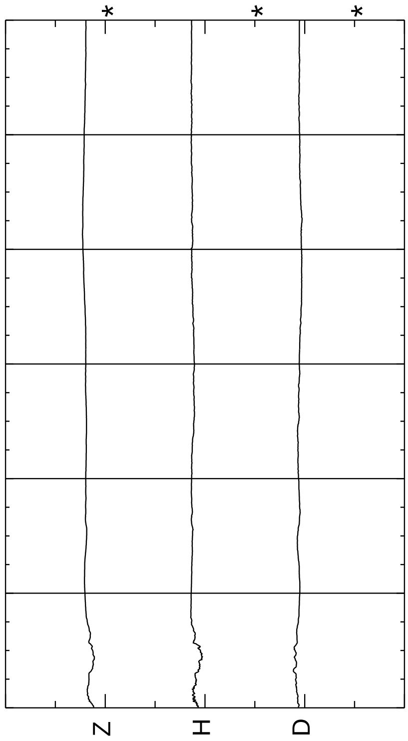
LEIRVOGUR 7. OCT 2010 DAY 280



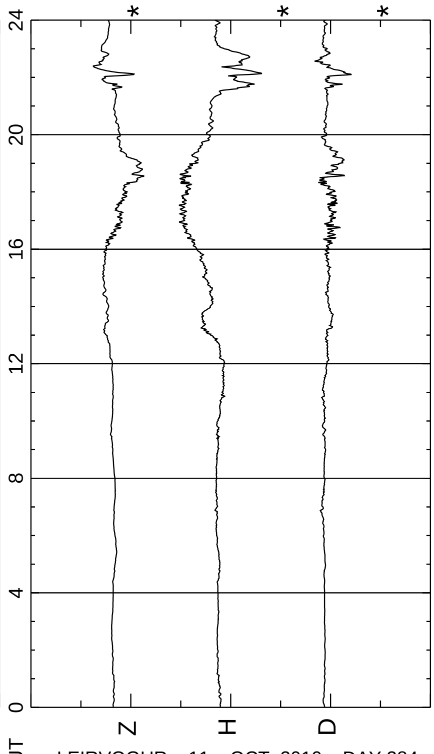
LEIRVOGUR 4. OCT 2010 DAY 277



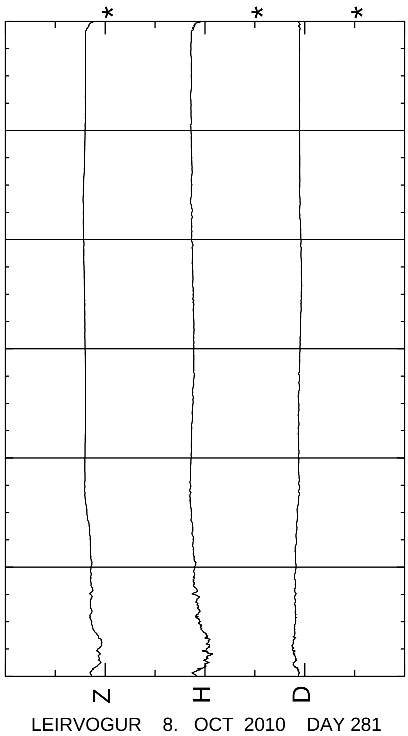
LEIRVOGUR 6. OCT 2010 DAY 279



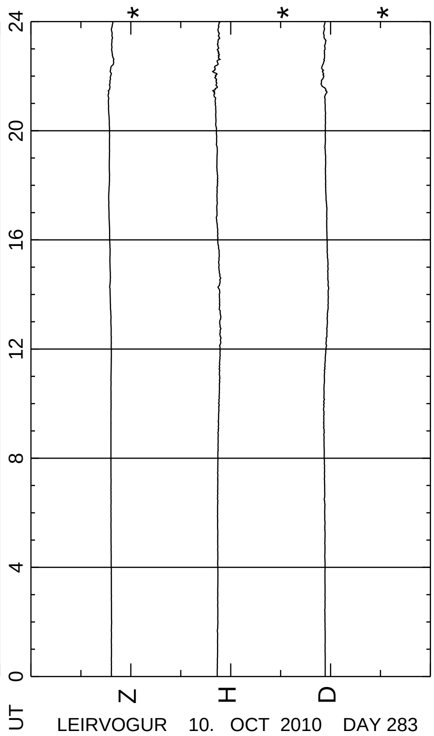
LEIRVOGUR 9. OCT 2010 DAY 282



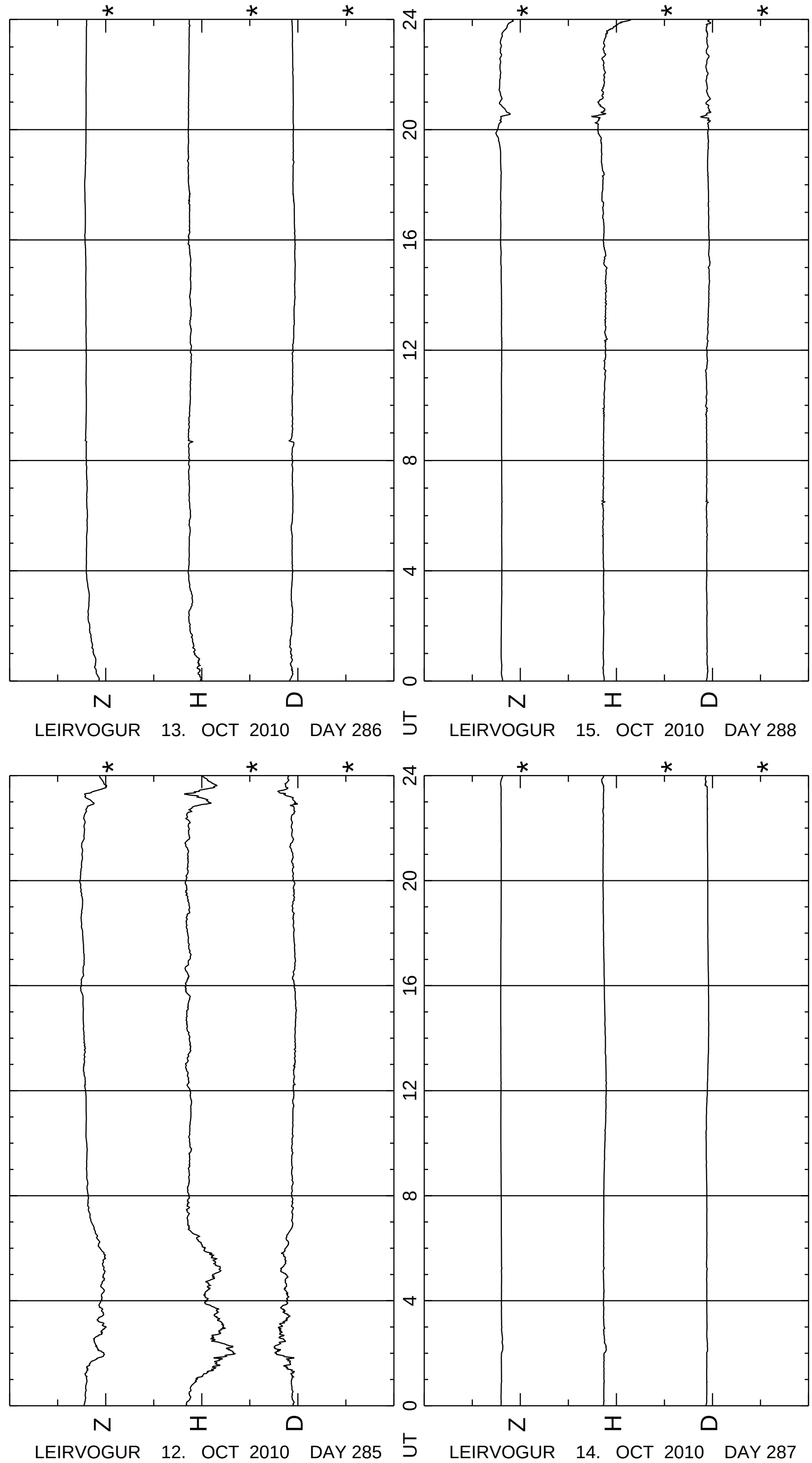
LEIRVOGUR 11. OCT 2010 DAY 284

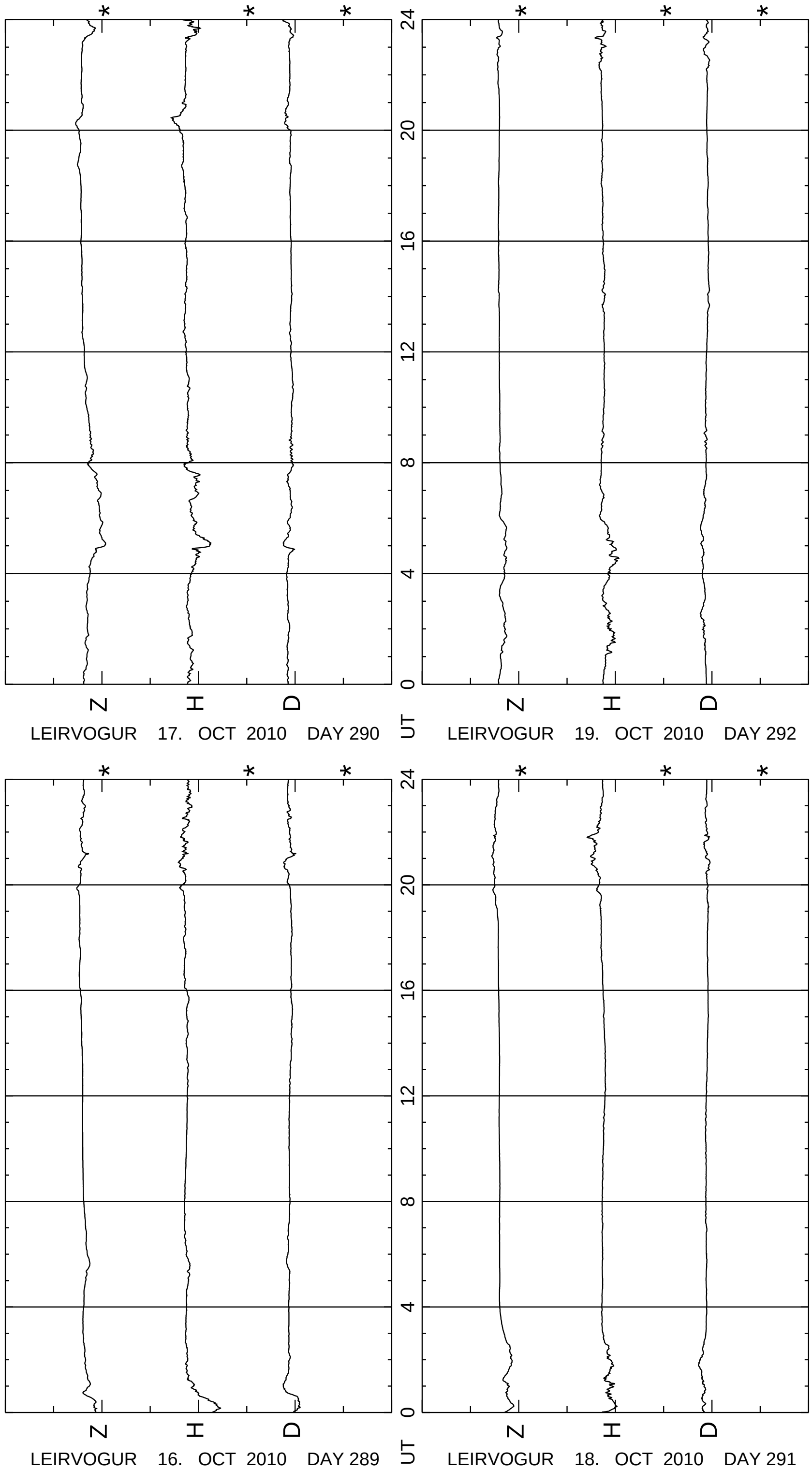


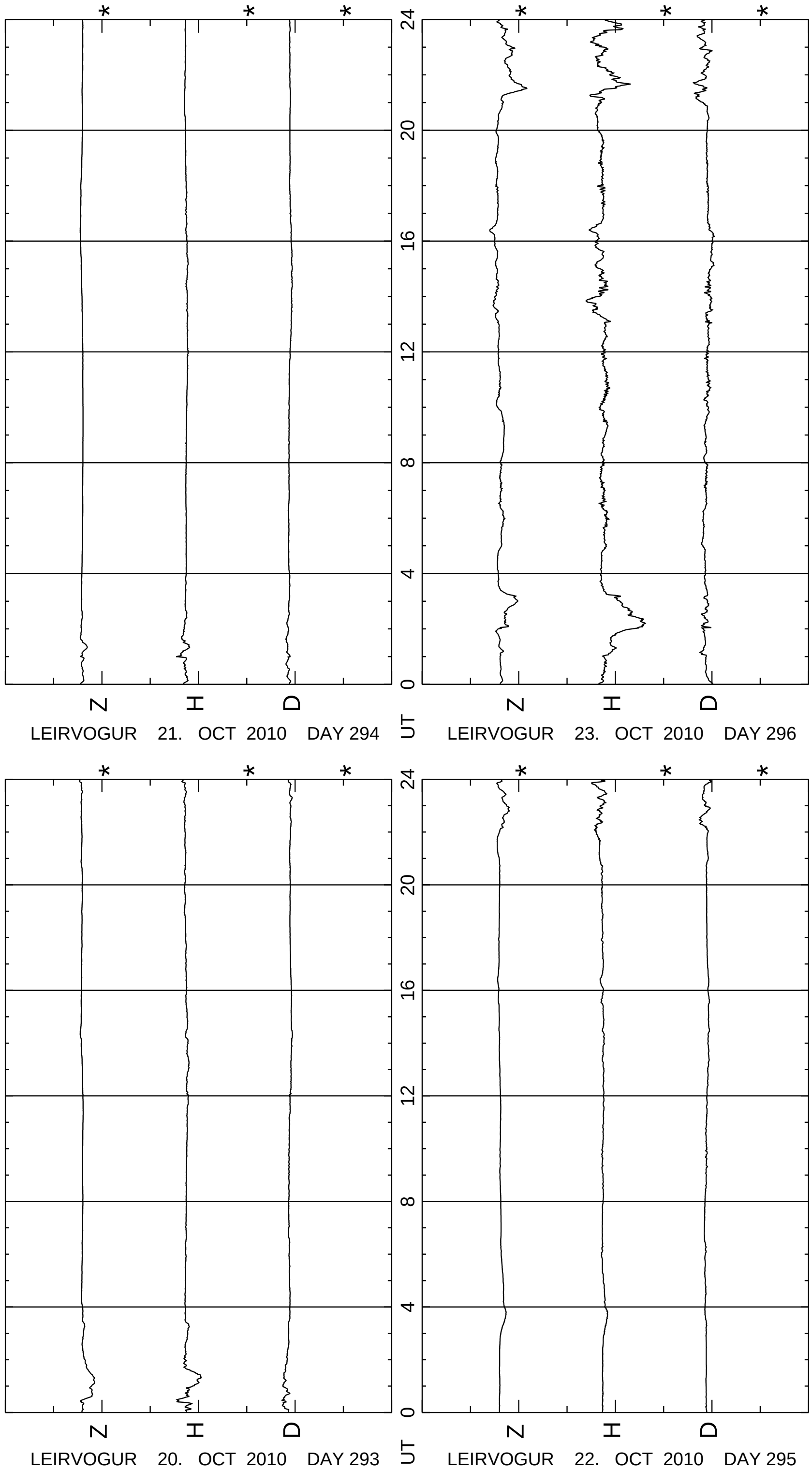
LEIRVOGUR 8. OCT 2010 DAY 281



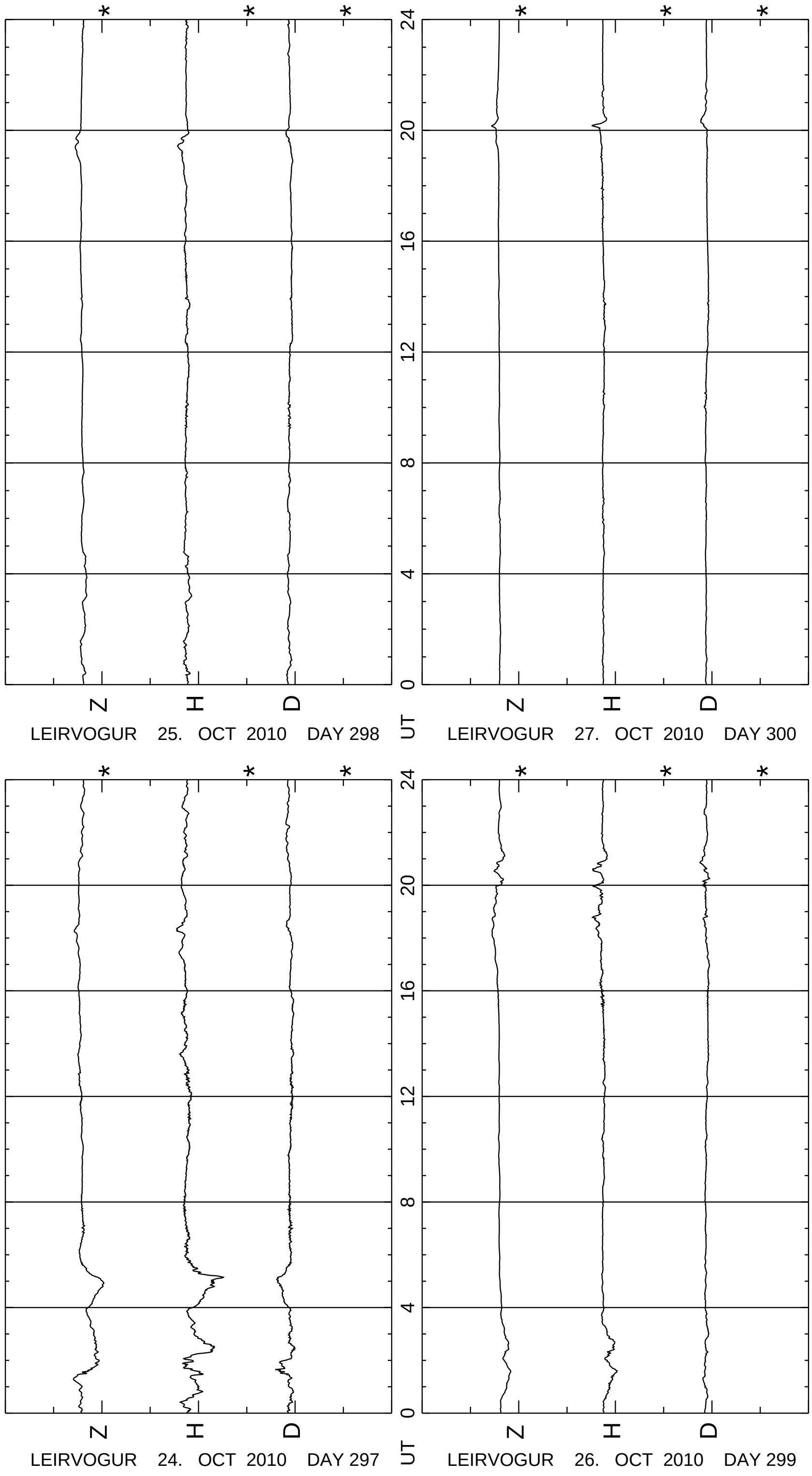
LEIRVOGUR 10. OCT 2010 DAY 283

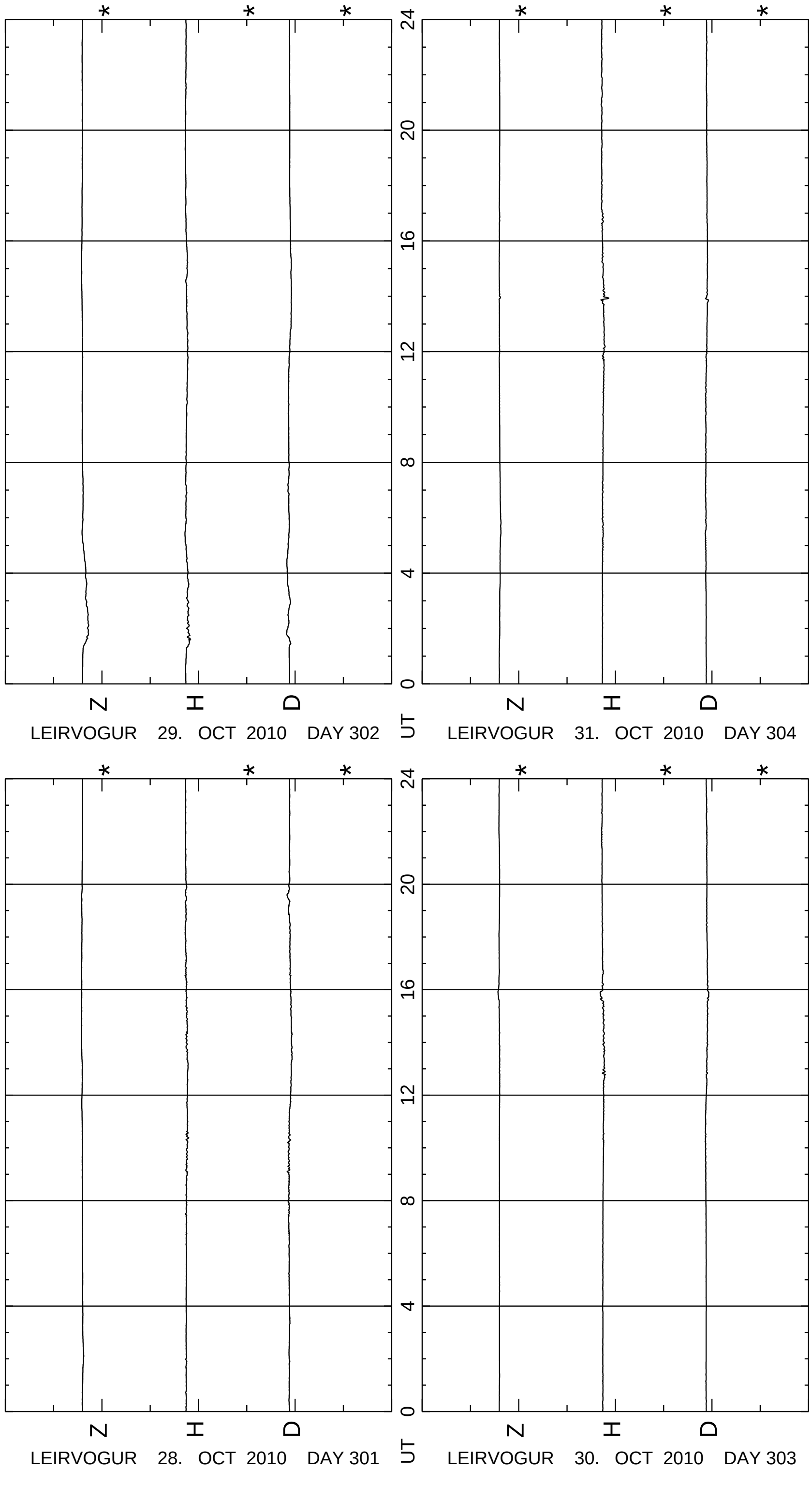

LEIRVOGUR 13. OCT 2010 DAY 286
LEIRVOGUR 15. OCT 2010 DAY 288
LEIRVOGUR 12. OCT 2010 DAY 285
LEIRVOGUR 14. OCT 2010 DAY 287
Z
H
D
UT
0
4
8
12
16
20
24

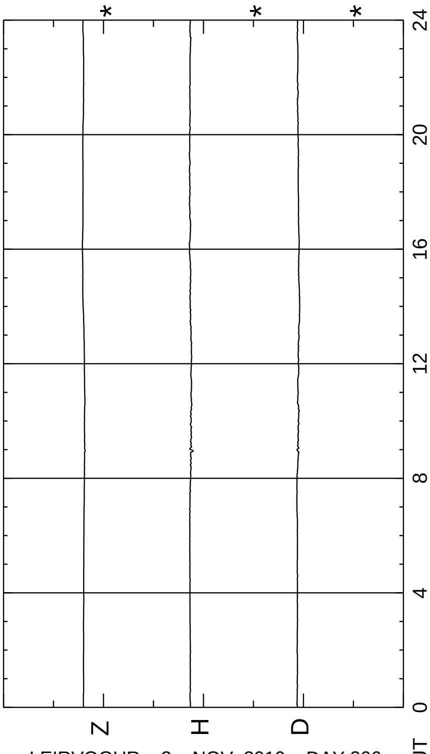

LEIRVOGUR 17. OCT 2010 DAY 290
LEIRVOGUR 19. OCT 2010 DAY 292
LEIRVOGUR 16. OCT 2010 DAY 289
LEIRVOGUR 18. OCT 2010 DAY 291
UT
Z
H
D



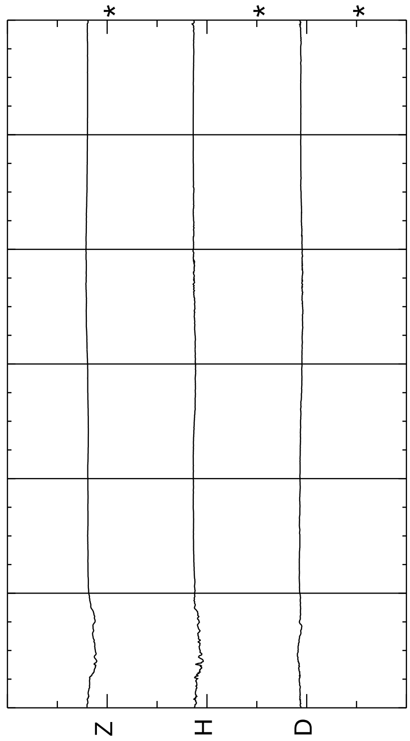
LEIRVOGUR 21. OCT 2010 DAY 294
LEIRVOGUR 23. OCT 2010 DAY 296
LEIRVOGUR 20. OCT 2010 DAY 293
LEIRVOGUR 22. OCT 2010 DAY 295
Z
H
D
UT
0
4
8
12
16
20
24


LEIRVOGUR 25. OCT 2010 DAY 298
LEIRVOGUR 27. OCT 2010 DAY 300
LEIRVOGUR 24. OCT 2010 DAY 297
LEIRVOGUR 26. OCT 2010 DAY 299
Z
H
D
UT
0
4
8
12
16
20
24

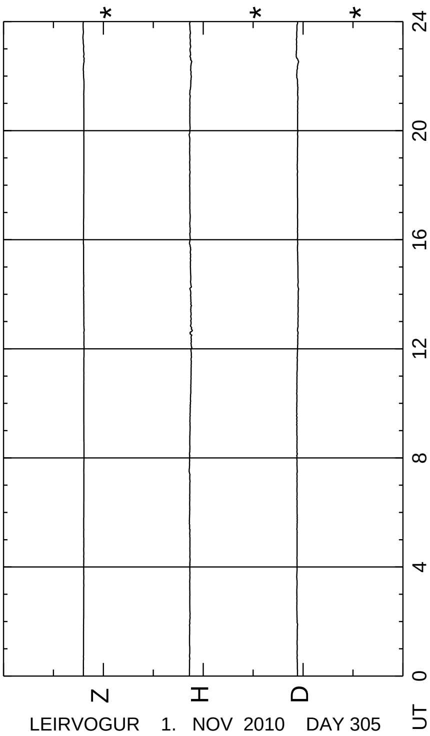

Z
H
D
UT
0
4
8
12
16
20
24
LEIRVOGUR 29. OCT 2010 DAY 302
LEIRVOGUR 31. OCT 2010 DAY 304
LEIRVOGUR 28. OCT 2010 DAY 301
LEIRVOGUR 30. OCT 2010 DAY 303



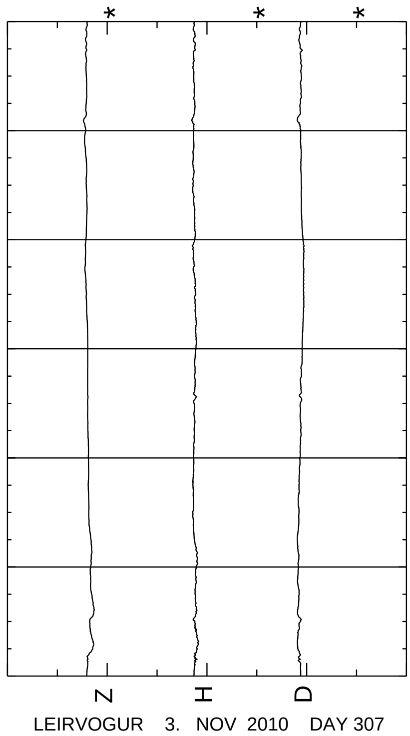
LEIRVOGUR 2. NOV 2010 DAY 306



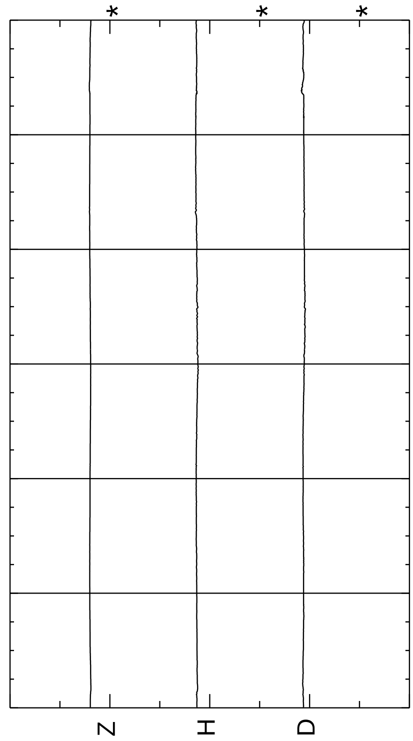
LEIRVOGUR 4. NOV 2010 DAY 308



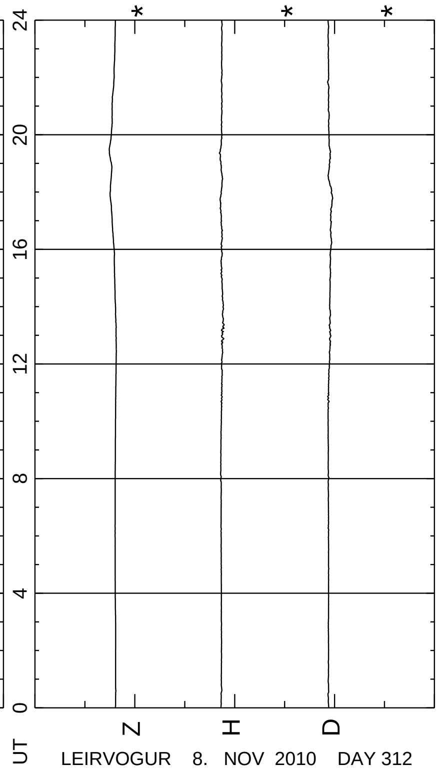
LEIRVOGUR 1. NOV 2010 DAY 305



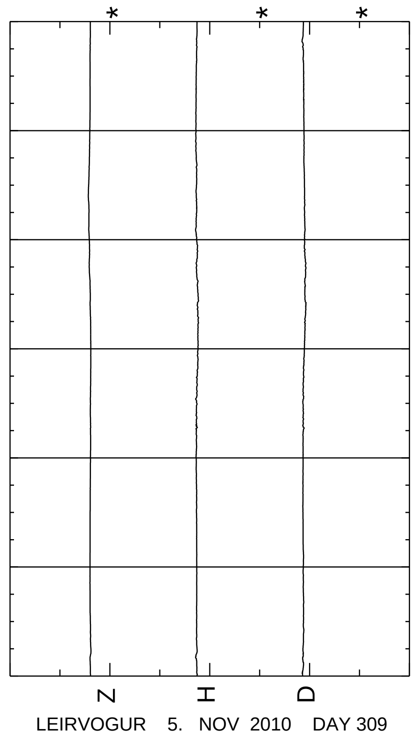
LEIRVOGUR 3. NOV 2010 DAY 307



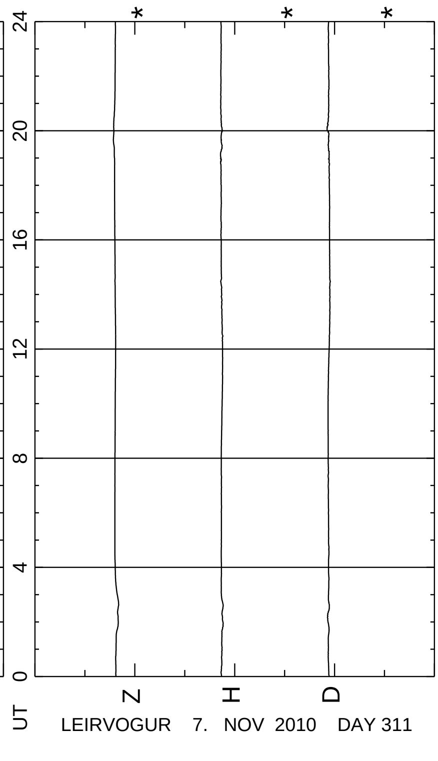
LEIRVOGUR 6. NOV 2010 DAY 310



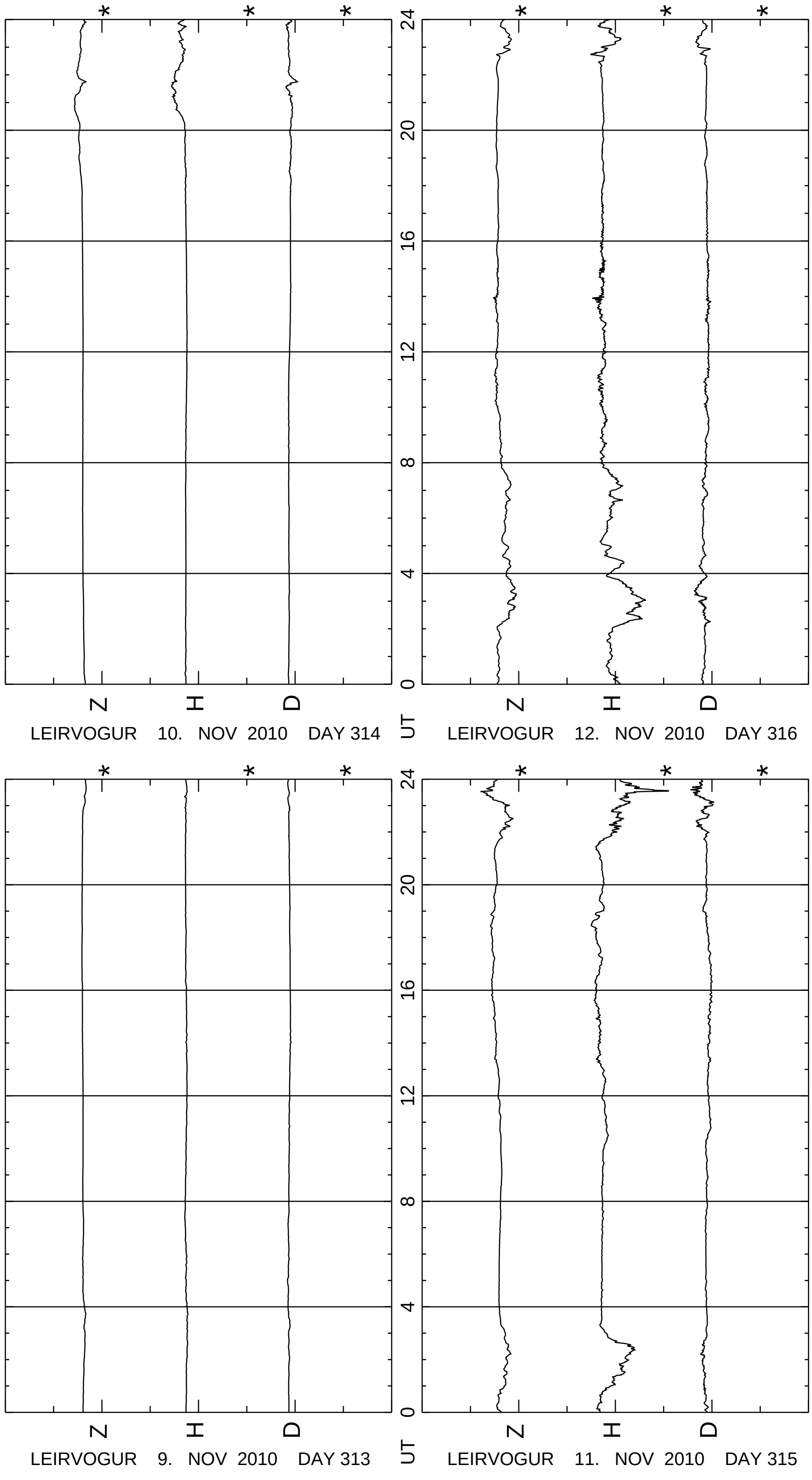
LEIRVOGUR 8. NOV 2010 DAY 312



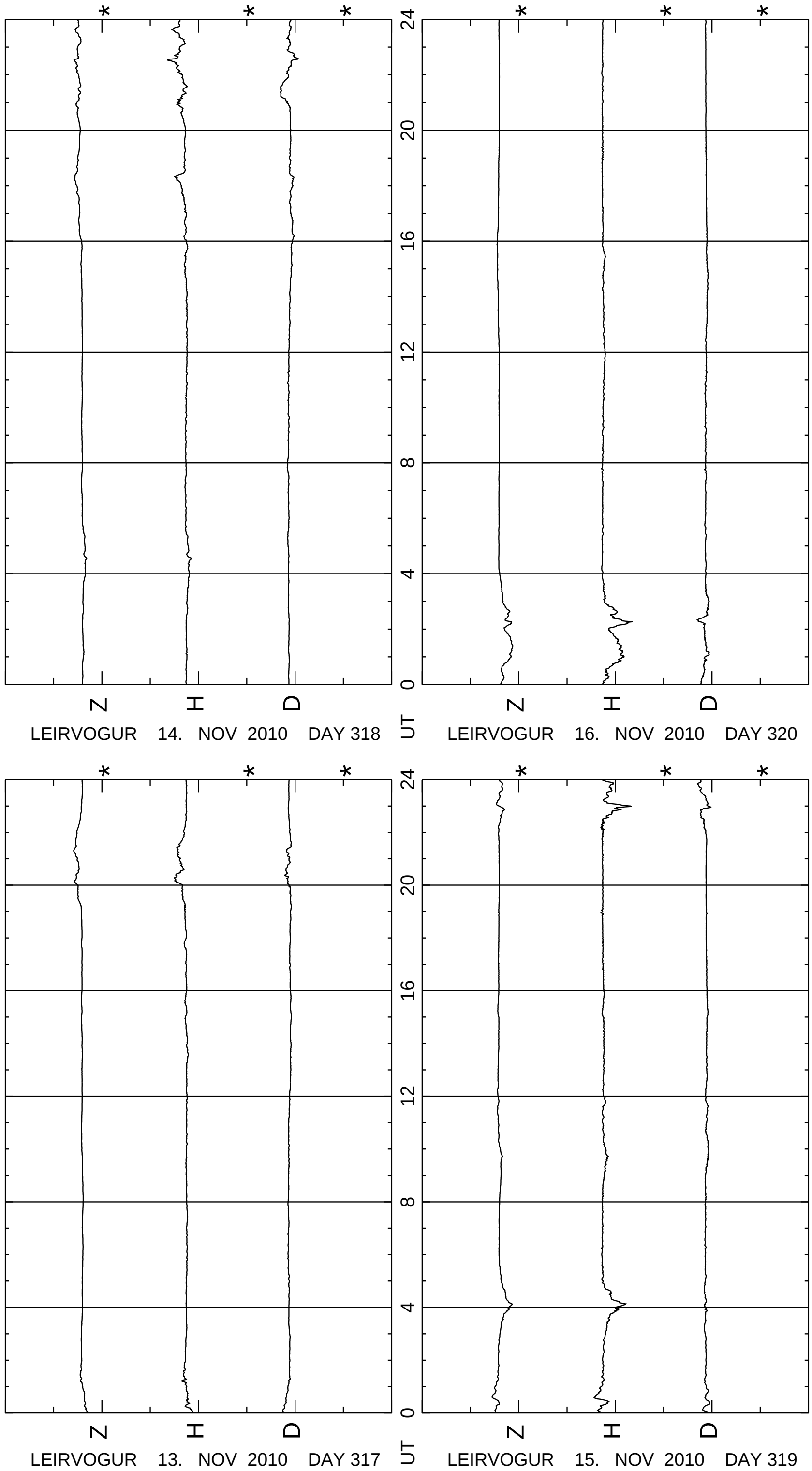
LEIRVOGUR 5. NOV 2010 DAY 309

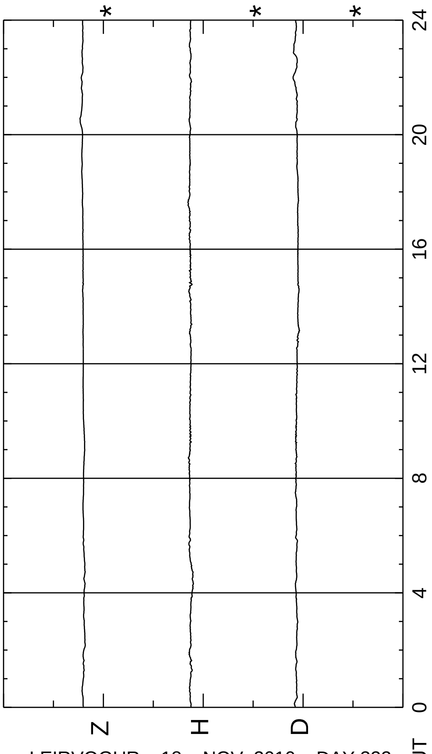


LEIRVOGUR 7. NOV 2010 DAY 311

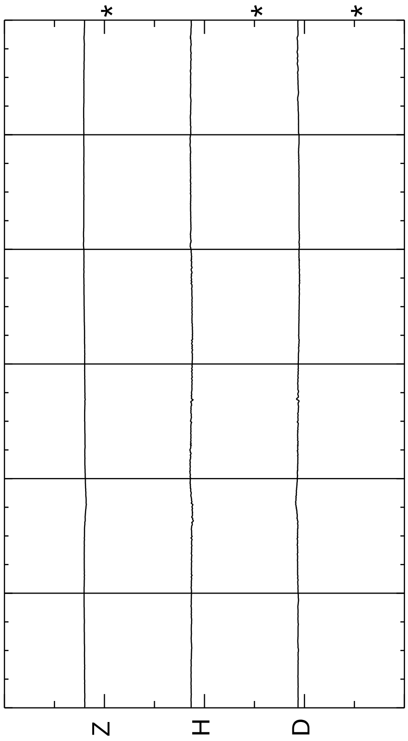


LEIRVOGUR 10. NOV 2010 DAY 314
LEIRVOGUR 12. NOV 2010 DAY 316
LEIRVOGUR 9. NOV 2010 DAY 313
LEIRVOGUR 11. NOV 2010 DAY 315
Z
H
D
UT
0
4
8
12
16
20
24

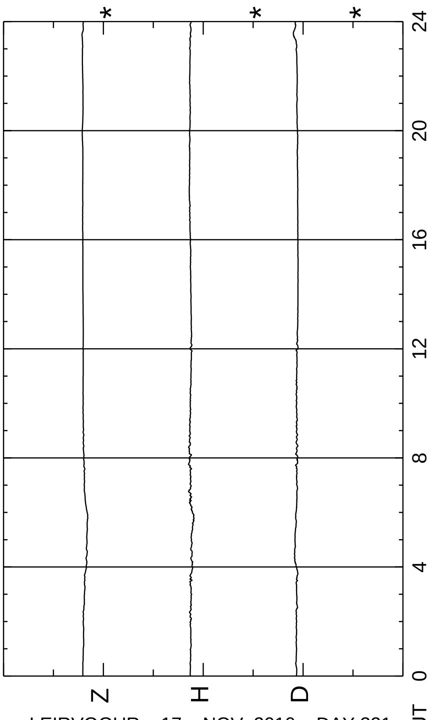

24
20
16
12
8
4
0
UT
Z
H
D
LEIRVOGUR 14. NOV 2010 DAY 318
LEIRVOGUR 16. NOV 2010 DAY 320
LEIRVOGUR 13. NOV 2010 DAY 317
LEIRVOGUR 15. NOV 2010 DAY 319



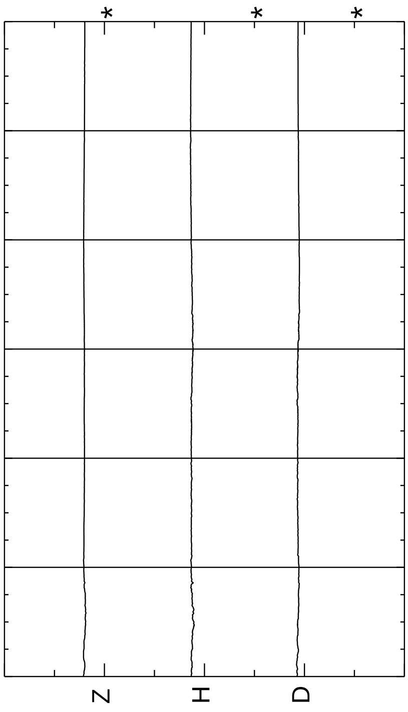
LEIRVOGUR 18. NOV 2010 DAY 322



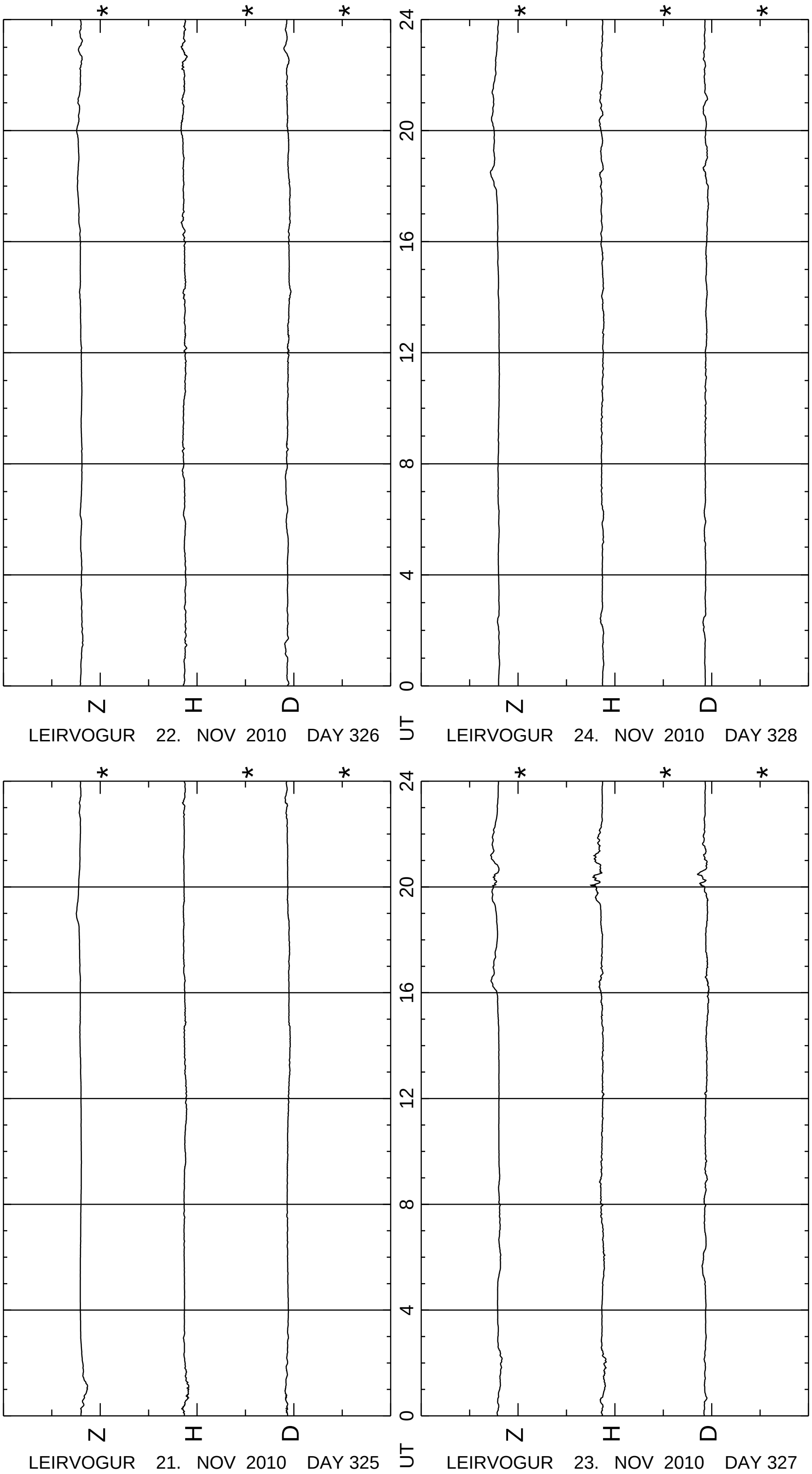
LEIRVOGUR 20. NOV 2010 DAY 324

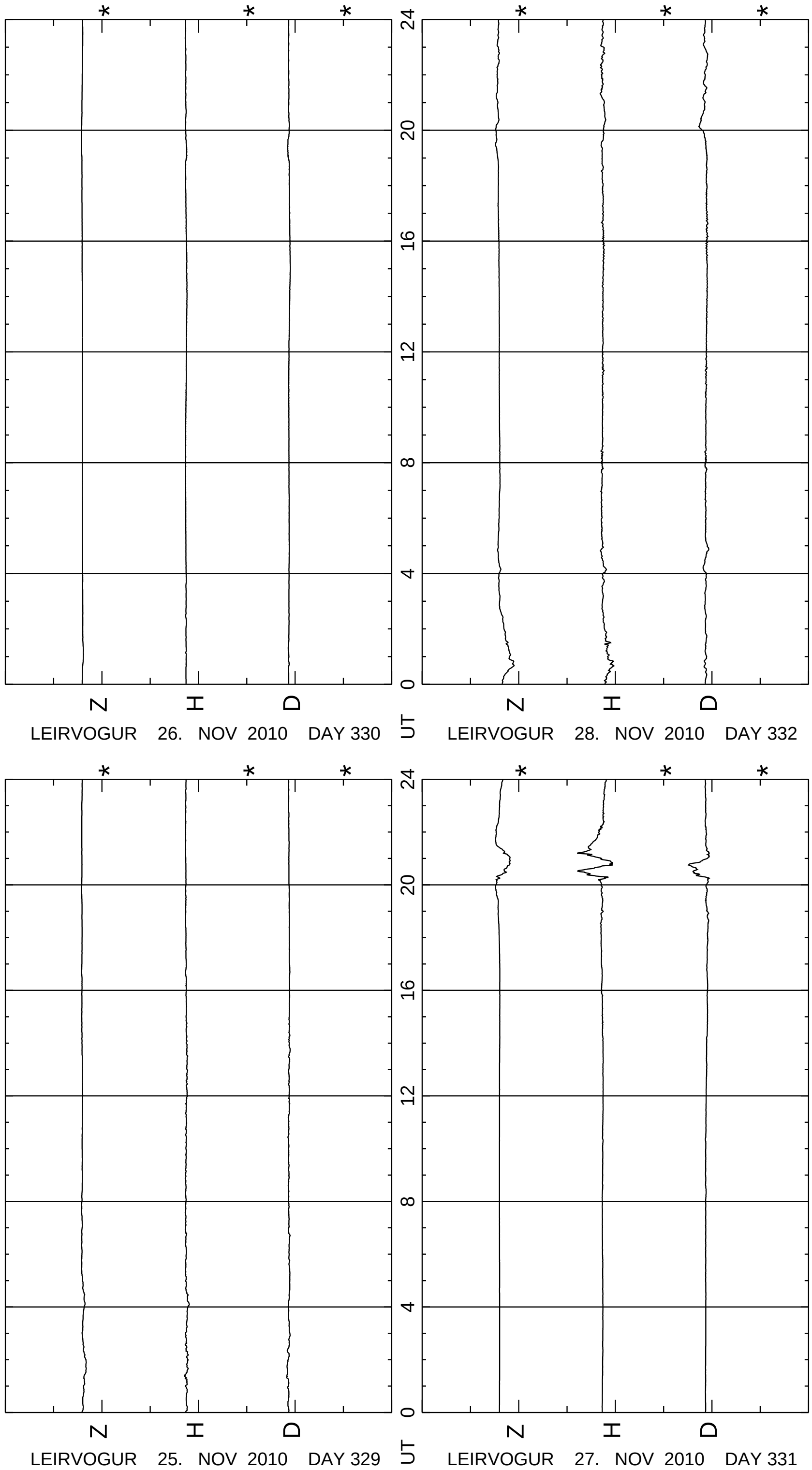


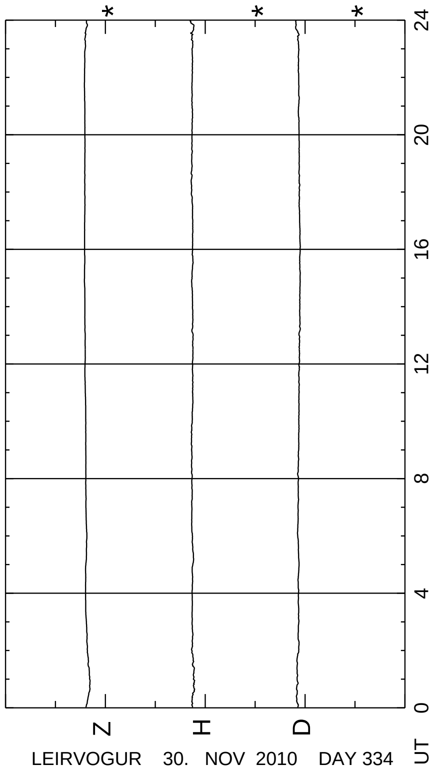
LEIRVOGUR 17. NOV 2010 DAY 321



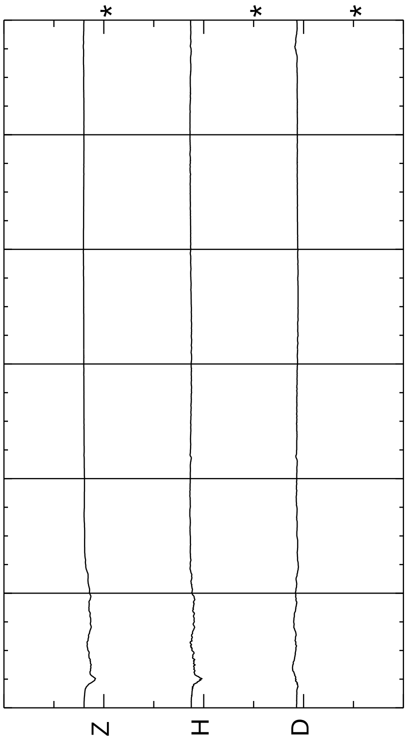
LEIRVOGUR 19. NOV 2010 DAY 323


LEIRVOGUR 22. NOV 2010 DAY 326
LEIRVOGUR 24. NOV 2010 DAY 328
LEIRVOGUR 21. NOV 2010 DAY 325
LEIRVOGUR 23. NOV 2010 DAY 327
Z H D
UT

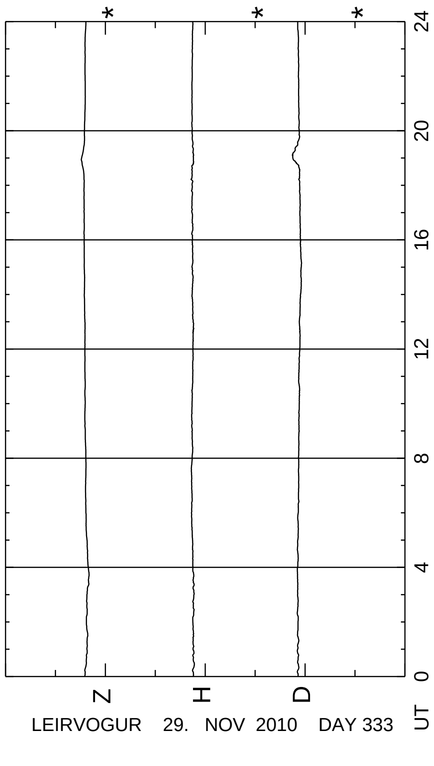

LEIRVOGUR 26. NOV 2010 DAY 330
LEIRVOGUR 28. NOV 2010 DAY 332
LEIRVOGUR 25. NOV 2010 DAY 329
LEIRVOGUR 27. NOV 2010 DAY 331
Z
H
D
UT
0
4
8
12
16
20
24



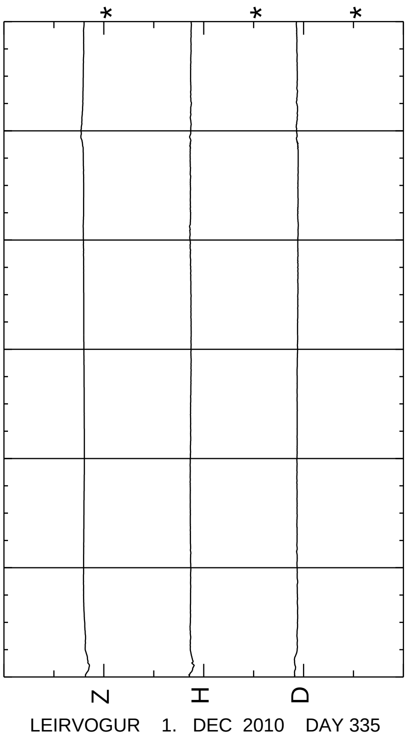
LEIRVOGUR 30. NOV 2010 DAY 334



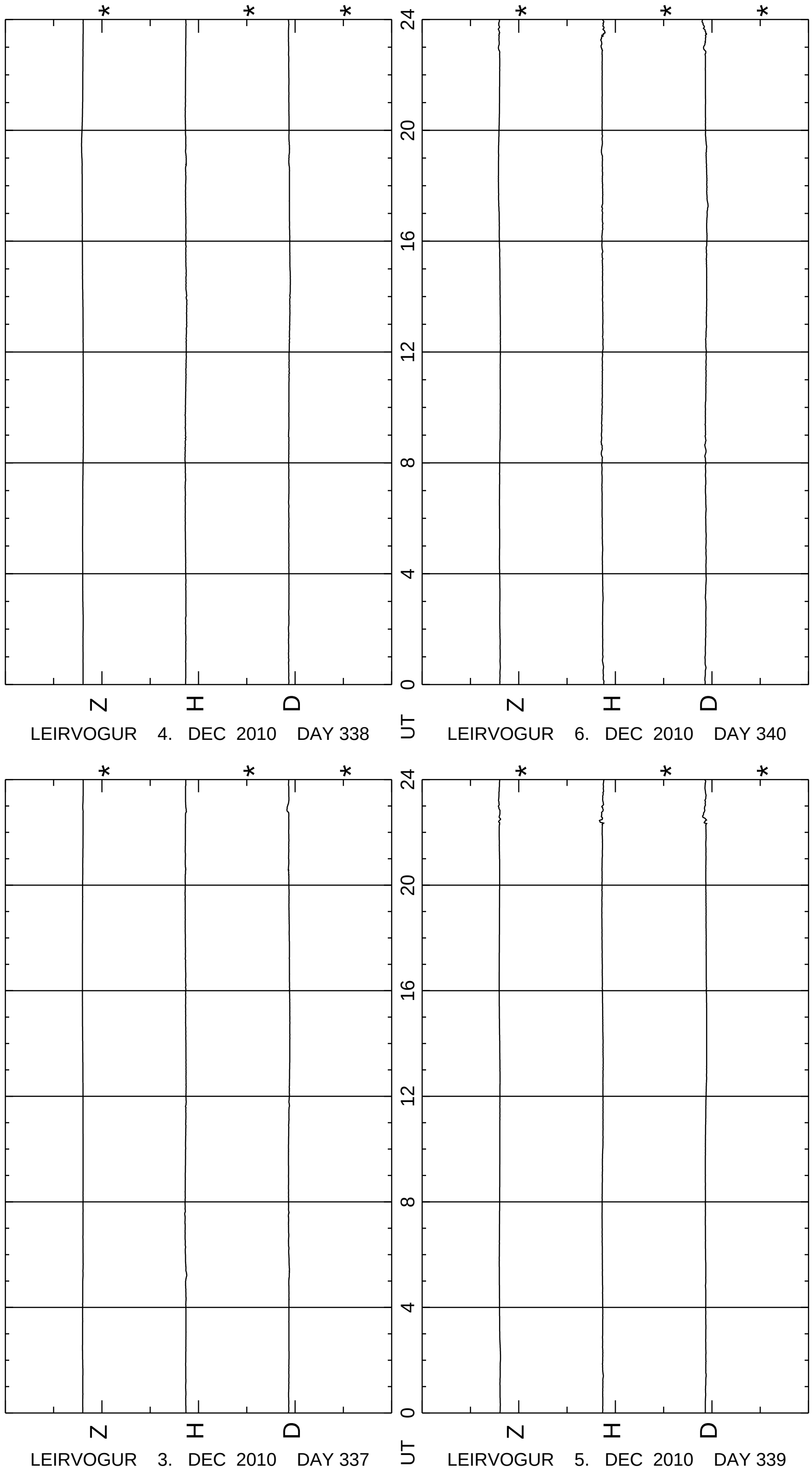
LEIRVOGUR 2. DEC 2010 DAY 336

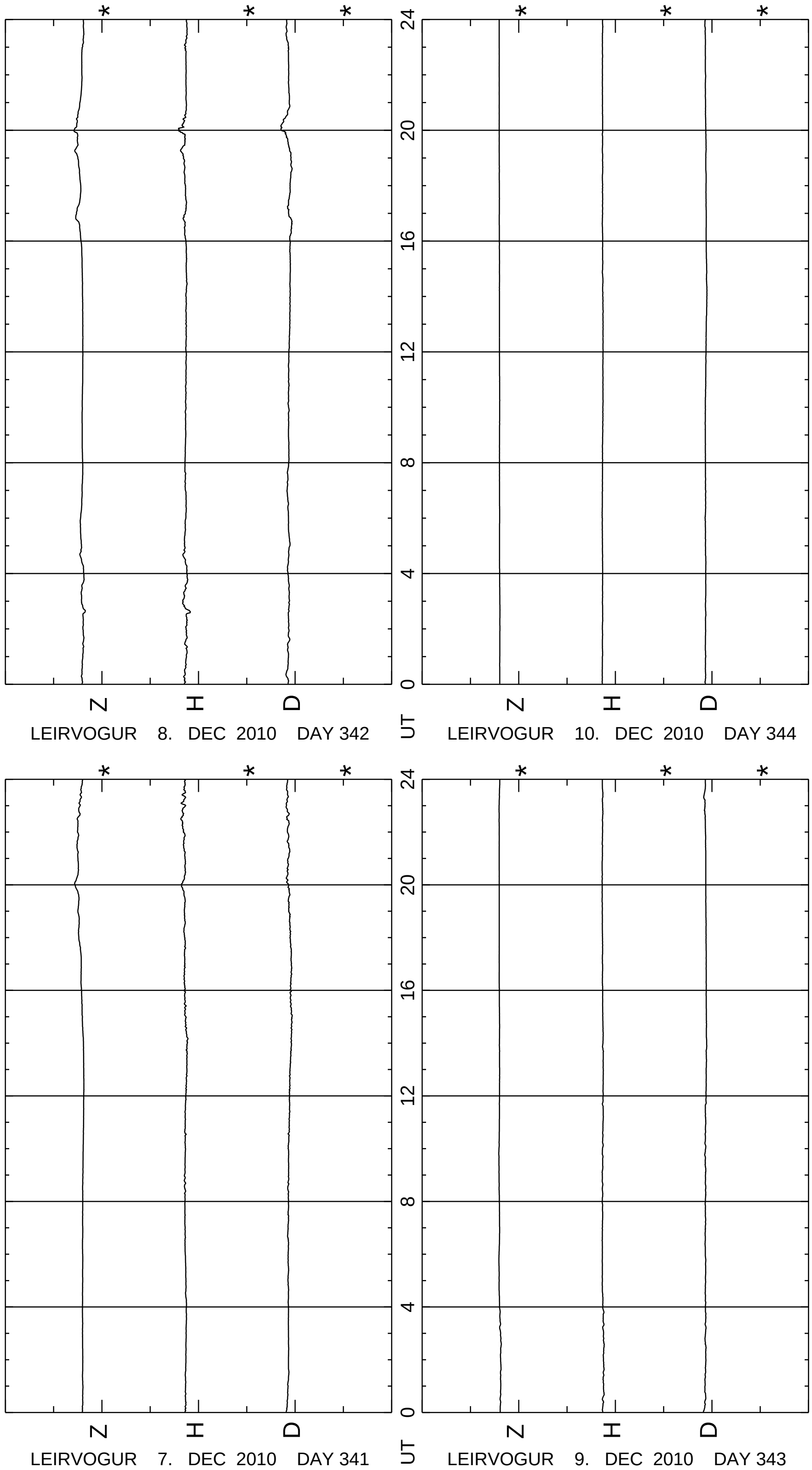


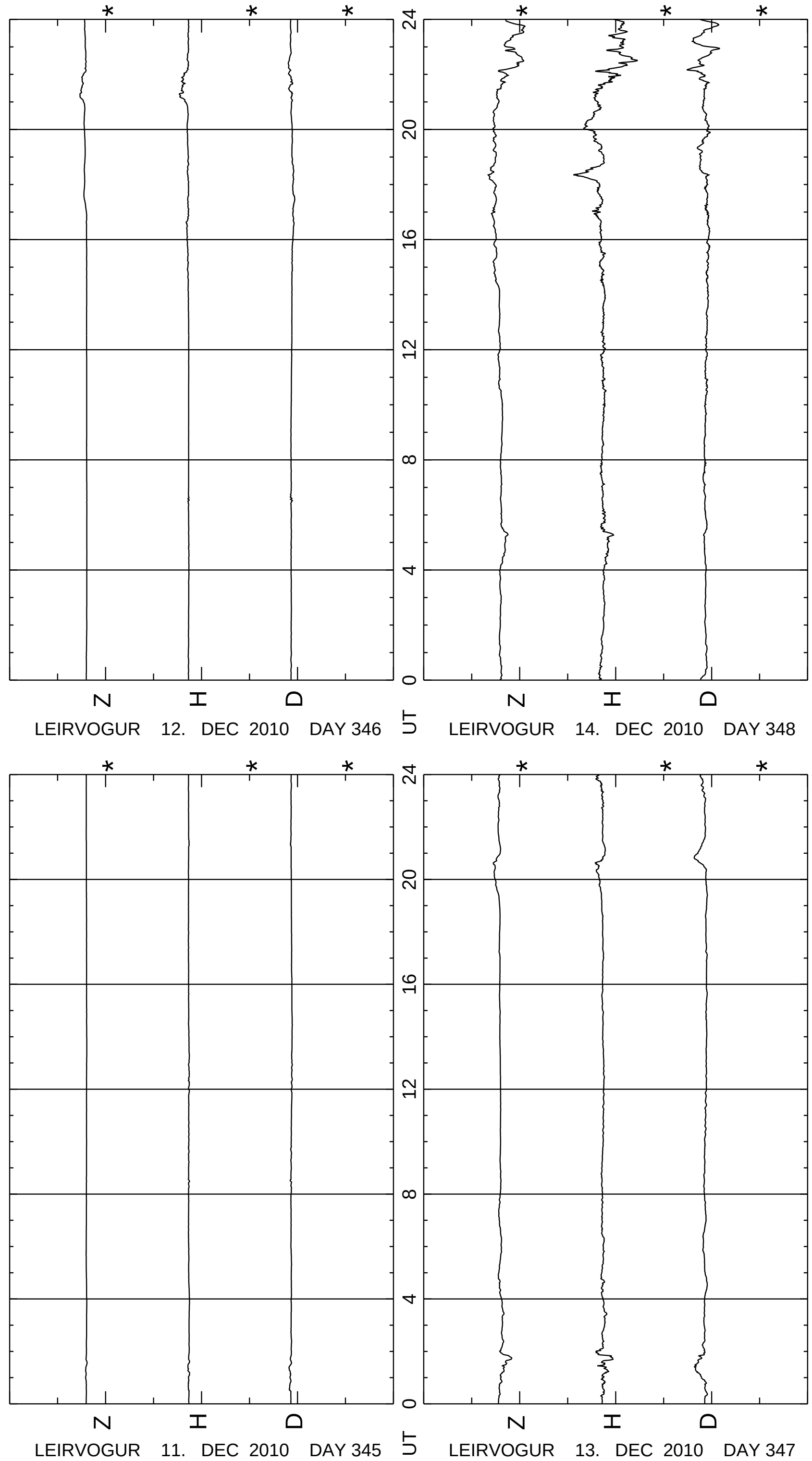
LEIRVOGUR 29. NOV 2010 DAY 333

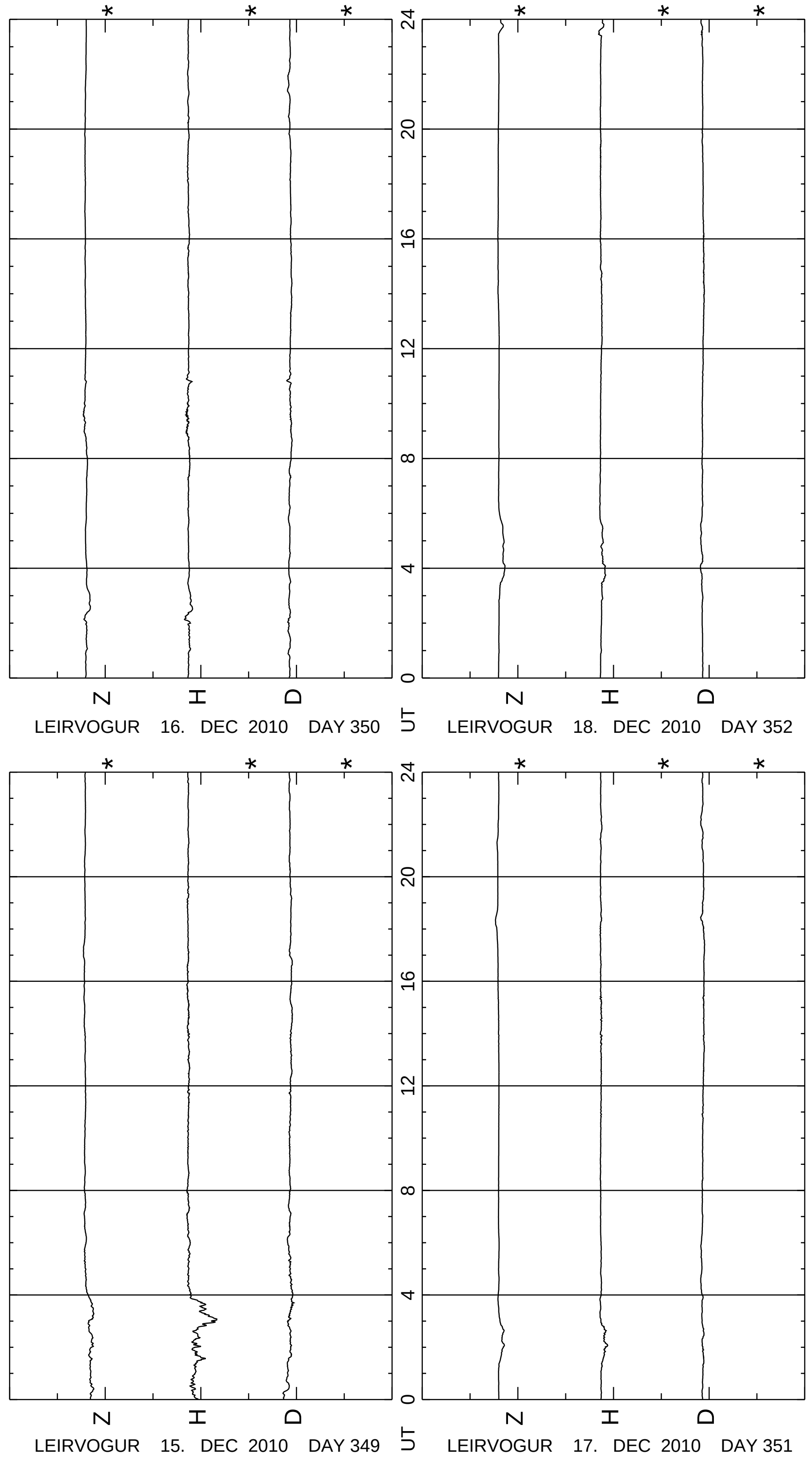


LEIRVOGUR 1. DEC 2010 DAY 335

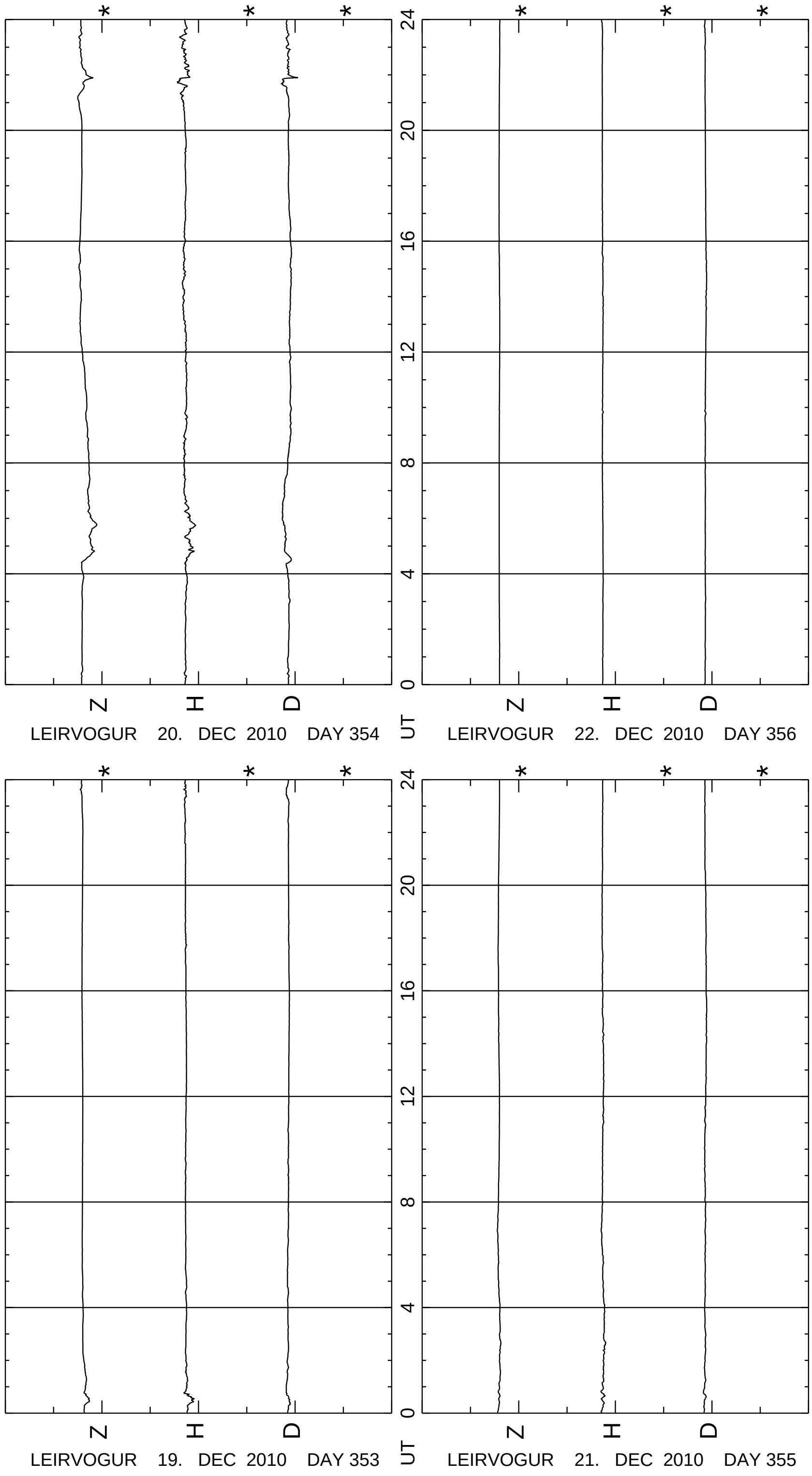

LEIRVOGUR 4. DEC 2010 DAY 338
LEIRVOGUR 6. DEC 2010 DAY 340
LEIRVOGUR 3. DEC 2010 DAY 337
LEIRVOGUR 5. DEC 2010 DAY 339
Z H D
UT
0 4 8 12 16 20 24

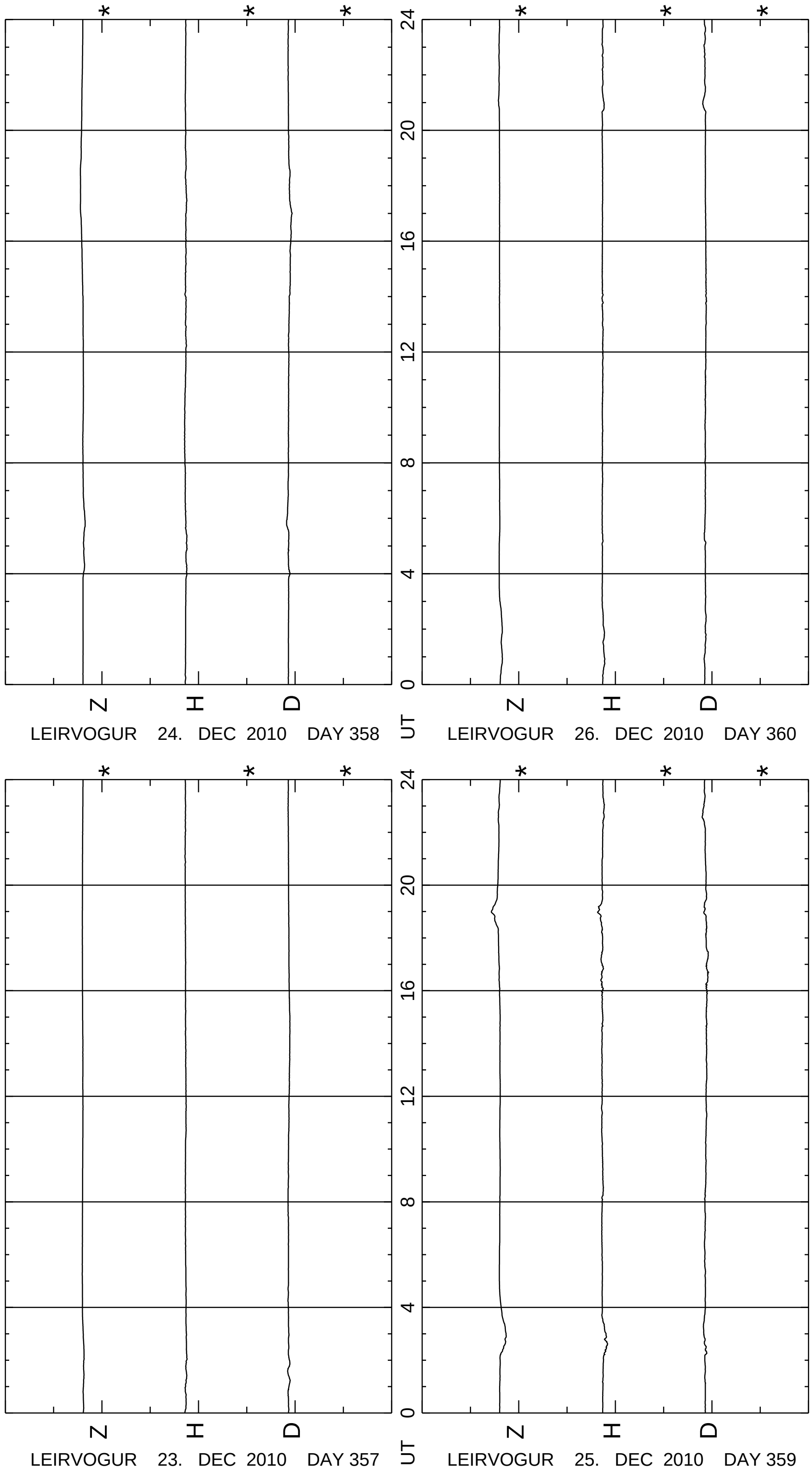

LEIRVOGUR 8. DEC 2010 DAY 342
LEIRVOGUR 10. DEC 2010 DAY 344
LEIRVOGUR 7. DEC 2010 DAY 341
LEIRVOGUR 9. DEC 2010 DAY 343
Z
H
D
UT
0
4
8
12
16
20
24

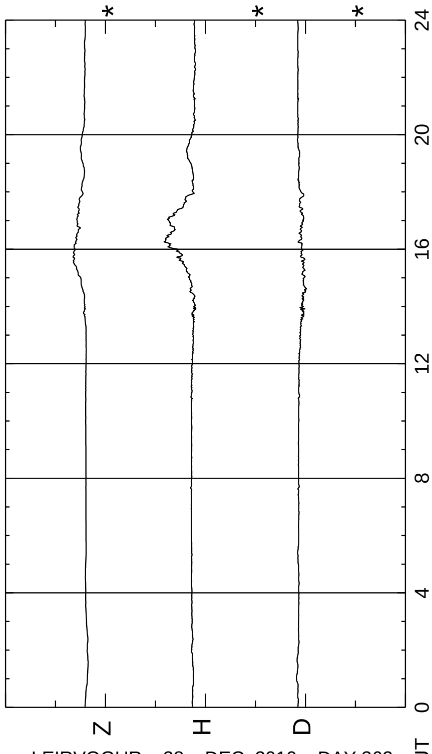

LEIRVOGUR 12. DEC 2010 DAY 346
LEIRVOGUR 14. DEC 2010 DAY 348
LEIRVOGUR 11. DEC 2010 DAY 345
LEIRVOGUR 13. DEC 2010 DAY 347
Z
H
D
UT
0
4
8
12
16
20
24



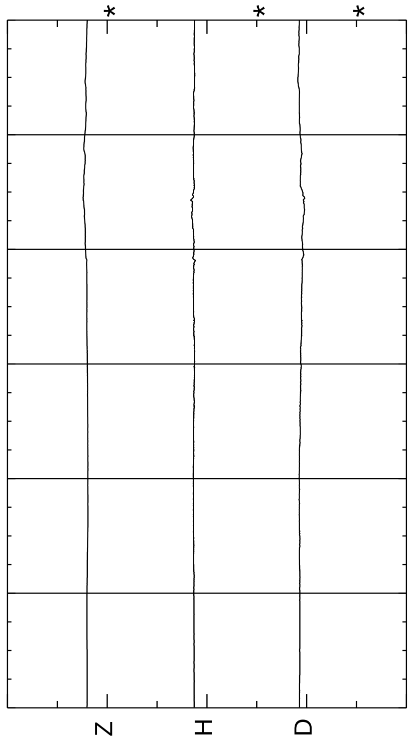
Z H D
LEIRVOGUR 16. DEC 2010 DAY 350
UT
Z H D
LEIRVOGUR 18. DEC 2010 DAY 352
Z H D
LEIRVOGUR 15. DEC 2010 DAY 349
UT
Z H D
LEIRVOGUR 17. DEC 2010 DAY 351


Z
H
D
UT
LEIRVOGUR 20. DEC 2010 DAY 354
LEIRVOGUR 22. DEC 2010 DAY 356
LEIRVOGUR 19. DEC 2010 DAY 353
LEIRVOGUR 21. DEC 2010 DAY 355
0
4
8
12
16
20
24

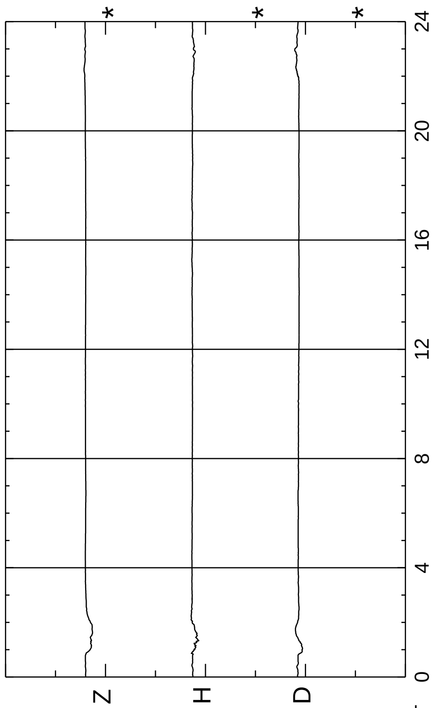

Z H D
LEIRVOGUR 24. DEC 2010 DAY 358
UT
Z H D
LEIRVOGUR 26. DEC 2010 DAY 360
Z H D
LEIRVOGUR 23. DEC 2010 DAY 357
UT
Z H D
LEIRVOGUR 25. DEC 2010 DAY 359
0 4 8 12 16 20 24



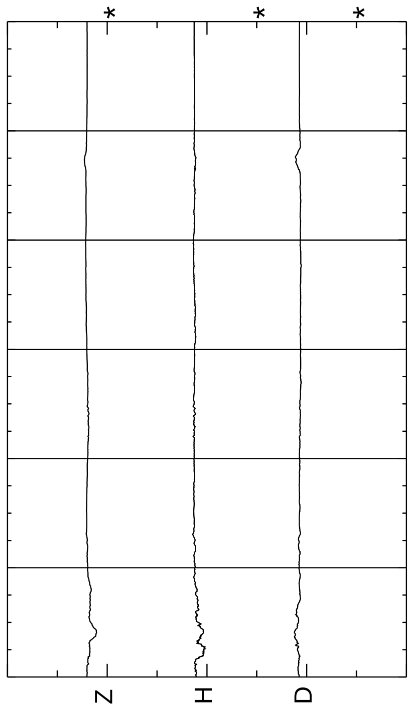
LEIRVOGUR 28. DEC 2010 DAY 362



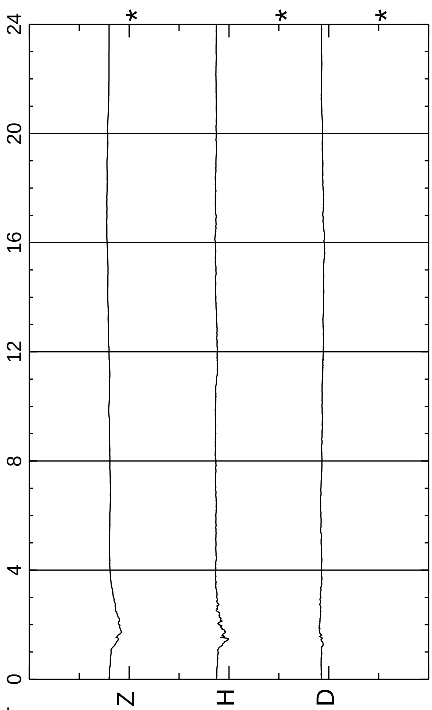
LEIRVOGUR 30. DEC 2010 DAY 364



LEIRVOGUR 27. DEC 2010 DAY 361



LEIRVOGUR 29. DEC 2010 DAY 363



UT
0
4
8
12
16
20
24
Z
H
D
LEIRVOGUR 31. DEC 2010 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)

	-3	-1		12.1	-3	14	41		0.0
1984	49991	12406	339	50.4	51508	11646	-4276	76	3.8
	-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