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LEIRVOGUR

MAGNETIC RESULTS

2012

REYKJAVÍK 2013

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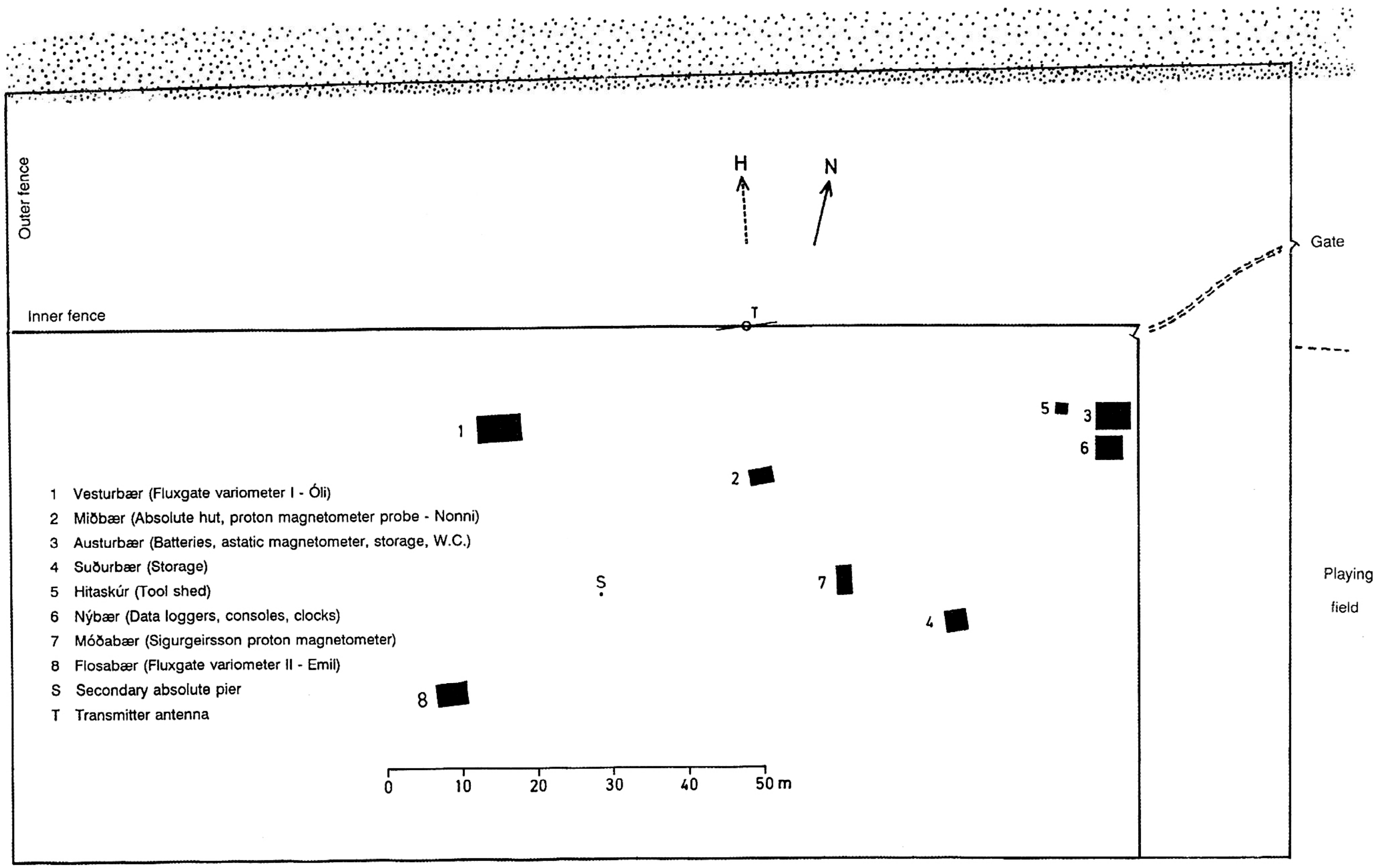
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INTRODUCTION

This volume contains the results of geomagnetic measurements carried out at the Leirvogur Magnetic Observatory in Iceland during the year 2012. 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 2012 was approximately 5.4 earth-radii, the corresponding corrected geomagnetic latitude being $64°.6$. The geomagnetic conjugate point at 100 km altitude was at $68°.9$ S, $28°.3$ E geographic, about 450 km from the Japanese Antarctic station Syowa.

PERSONNEL

In 2012, the Upper Atmosphere Section had a staff of two: Gunnlaugur Björnsson, director and Pálmi Ingólfsson, research assistant in a part-time position. Former director, Þorsteinn Sæmundsson, continued to serve in an advisory capacity. Edda Lína Gunnarsdóttir, a third year physics student, made absolute measurements on occasions when Gunnlaugur was away, in particular during the period of September-November when Gunnlaugur was on sabbatical leave.

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

Robert Chapman visited on April 4 and Alexandra Heimisdóttir visited on June 6.

DEVELOPMENTS

The staff made 84 trips to the observatory in 2012, considerably more than in previous years. Most of the additional trips were due to problems with Móði, mainly with the power supply and electronics. A Skoda Fabia belonging to the Upper Atmosphere Section was used for transportation to and from Leirvogur.

The environment

Weather was mild most of the year with rather little snow that did not cause any major problems. The lowest temperature was $-9°$C in January, and the highest was $+23°$C in July and August.

Construction work at the nearby housing project remained very modest. It remains unclear when the project will be completed. So far, no major problems have been caused by the new neighbours that have already moved in.

On January 25, shortly after arrival of staff at the Observatory, a snow storm hit the area, blocking entirely the view to the azimuth mark. As measurements were then not possible, the staff returned to Reykjavík, but the Skoda soon got stuck in the rapidly accumulating snow. A helpful driver on a 4x4 Jeep assisted in freeing the car, but the return trip to the Institute took twice as long as normal.

On April 17, the electrical power supply was interrupted for an unknown reason. The un-interruptible power supply (UPS) for both systems performed as expected and no data was lost. However, the power supply for Móði suffered a damage and needed repair and replacement of parts.

The electrical supply was interrupted for a short period on May 18, but the UPS handled the situation well and no data was lost.

In August, a new GEM Systems GSM90 Overhauser magnetometer ("Saxi") was installed. Since October 1, it has served as the main total field instrument, with Móði as a reserve.

On December 27, the spare Omega-clock showed symptoms of incipient failure, most likely due to the internal battery.

Digital fluxgate systems I and II

The new dataloggers ran perfectly during the entire year. One of the older loggers had series of failures in early August. Both BBC loggers were retired and turned off on August 27. They had been in continuous use since December 31, 1987 and provided nearly 25 years of very reliable and faithful service. All data are now handled by the new loggers.

On May 30, 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.

Gunnlaugur Björnsson and Þorsteinn Sæmundsson just before the old BBC dataloggers for Óli and Emil (in the background) were turned off for the first and last time on August 27, 2012.

The thermostat in Vesturbær which houses System I (Óli) was adjusted from winter level ($13°$C) to summer level ($20°$C) on June 8. Readjustment took place on November 7.

Móði

The proton magnetometer Móði worked mostly without problems during the year. During a power interruption on April 17, the power supply of the electronics failed. It took some time to locate and purchase spare parts, but the instrument was fully back to normal on May 8. In August it showed intermittent failures that disappeared when the pump and fluid were replaced. After checking all wiring connections, Móði worked without problems for the rest of the year.

Geó II

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

Backup computer

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

Real-time displays on the Web

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

Time control

A quartz clock of the type Omegaface is used for timing the data. Two clocks are maintained, a main clock and a backup unit. These are corrected by means of GPS signals once a week. This is generally sufficient for keeping the timings correct to within 1 second. On several occasions did the GPS not correctly adjust the clocks, leaving them 1 second late. This was checked against the Network Time Protocol (*NTP*)-service as well as other time signals. On these occasions, the clocks were adjusted manually. The reason for these errors are not known. On December 27, the internal battery in the reserve clock ran out, making the weekly correction of the main clock slightly more cumbersome than normal.

ADSL connection

The ADSL-connection worked without major problems most of the year. Backup data are transferred to the Science Institute from systems I and II every 10 minutes.

Software development

Work continued on improving the various data handling routines and procedures. Most of the programs in use are now written in *Python*. The improved procedures for analysis and correction of the raw measurements to provide absolute data are now routinely applied. Both systems are on-line with one second time resolution and semi-automatic data handling.

General maintenance and modifications

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

MAGNETOMETERS

The observatory possesses the following instruments:

1. A triaxial fluxgate variometer, “Óli” (Óli II), of the type FGE, version E, from the Danish Meteorological Institute, with suspended sensors and a digital data logger designed and built at the Science Institute. This is the primary recording instrument at Leirvogur. The sensor elements are oriented in the approximate directions of Z (vertical), H (magnetic north) and D (magnetic east). The logger uses an Acorn BBC B+ microcomputer with two floppy drives, each able to store 12 days of data. The records contain 1-minute means of the elements and show the extreme departures from the mean during each minute. Hourly means are both stored and printed out. Momentary values at 10-second intervals are recorded by a PC laptop computer linked to BBC monitoring and display computers. A Linux-based datalogger runs in parallel with the old logger. Data delivery from the new logger to the Institute is automatic every 10 minutes and 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 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 10 minutes and every morning at 02:15.

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

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

5. A Sigurgeirsson proton magnetometer (“Móði”) producing an uninterrupted record of the total force F. The precession cycles are counted and 1-minute averages recorded using the data loggers

serving the fluxgate variometers Óli and Emil. Hourly means are also printed out. 10-second averages are recorded on a PC computer at Leirvogur as well as on the System II laptop.

6. A new Gemsys GSM90 Overhauser magnetometer ("Saxi"). This provides a recording of the total force F every three seconds. Data delivery to the Institute is automatic every 10 minutes and every morning at 02:05.

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

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

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

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

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

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

TIME CONTROL

The older digital fluxgate loggers are controlled by a quartz crystal clock which is adjusted using a signal from the Global Positioning System (GPS). The aim has been to keep the timing correct to within one second. This limit was exceeded three times in 2012, until the older loggers were turned off. 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 2012 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 2012, the correction varied between -3.4 nT and -3.9 nT until September 30. From August 8, Saxi was used instead of Móði. Its probe is in a different location, and the site correction for it varied between -10.1 nT and -10.4 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 23. 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). On August 27, when the old loggers were turned off, the constants were adjusted to 47804 nT for Z, and 10166 nT for H, to prevent a jump in the baseline values. The difference is apparently due to different output from the old and the new A/D converters. The resulting outputs are the "observed" readings Z_1, H_1 and D_1. These readings are then corrected as follows (in units of nanotesla):

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

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

The formulae giving the field in the absolute hut are then

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

where Z_0, H_0, and D_0 are the base-line values. The adopted base-line values for 2012 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 27	-1.0
Jan 27	– Feb 11	-1.5
Feb 12	– Feb 18	-1.0
Feb 19	– Apr 5	-1.5
Apr 6	– Jun 8 (12:00)	-2.0
Jun 8	– Jun 8 (15:00)	-1.5
Jun 8	– Jun 8 (18:00)	-1.0
Jun 8	– Jun 8 (21:00)	-0.5
Jun 8	– Jul 28	0.0
Jul 29	– Sep 30	-0.5
Oct 1	– Nov 7 (12:00)	0.0
Nov 7	– Nov 7 (15:00)	-0.5
Nov 7	– Nov 10	-1.0
Nov 11	– Dec 31	-1.5

Horizontal intensity (H_0):

		nT
Jan 1	– Feb 25	-8.0
Feb 26	– Mar 3	-7.5
Mar 3	– Mar 31	-8.0
Apr 1	– May 11	-7.5
May 12	– Jun 8 (12:00)	-7.0
Jun 8	– Jun 8 (15:00)	-6.5
Jun 8	– Jun 8 (18:00)	-6.0
Jun 8	– Jun 8 (21:00)	-5.5
Jun 8	– Jun 8 (24:00)	-5.0
Jun 9	– Jul 28	-4.5
Jul 29	– Nov 7 (12:00)	-5.0
Nov 7	– Nov 7 (13:30)	-5.5
Nov 7	– Nov 7 (15:00)	-6.0
Nov 7	– Nov 7 (16:30)	-6.5
Nov 7	– Nov 7 (18:00)	-7.0
Nov 7	– Nov 7 (19:30)	-7.5
Nov 7	– Nov 7 (21:00)	-8.0
Nov 7	– Dec 31	-8.0

Declination (D_0):

Jan 1	– Feb 4	$346^\circ\ 24\overset{\prime}{.}1$
Feb 5	– Apr 5	$346^\circ\ 24\overset{\prime}{.}2$
Apr 6	– Apr 19	$346^\circ\ 24\overset{\prime}{.}0$
Apr 20	– May 4	$346^\circ\ 24\overset{\prime}{.}1$
May 5	– May 18	$346^\circ\ 24\overset{\prime}{.}2$
May 19	– Jun 8 (12:00)	$346^\circ\ 24\overset{\prime}{.}1$
Jun 8	– Jun 8 (15:00)	$346^\circ\ 24\overset{\prime}{.}0$
Jun 8	– Jun 8 (18:00)	$346^\circ\ 23\overset{\prime}{.}9$
Jun 8	– Jun 8 (21:00)	$346^\circ\ 23\overset{\prime}{.}8$
Jun 8	– Jun 8 (24:00)	$346^\circ\ 23\overset{\prime}{.}7$
Jun 9	– Jun 30	$346^\circ\ 23\overset{\prime}{.}8$
Jul 1	– Jul 28	$346^\circ\ 23\overset{\prime}{.}9$
Jul 29	– Aug 14 (12:00)	$346^\circ\ 23\overset{\prime}{.}8$
Aug 14	– Sep 22	$346^\circ\ 23\overset{\prime}{.}9$
Sep 23	– Sep 30	$346^\circ\ 23\overset{\prime}{.}8$
Oct 1	– Oct 20	$346^\circ\ 23\overset{\prime}{.}7$
Oct 21	– Nov 7 (12:00)	$346^\circ\ 23\overset{\prime}{.}8$
Nov 7	– Nov 7 (15:00)	$346^\circ\ 23\overset{\prime}{.}9$
Nov 7	– Nov 7 (18:00)	$346^\circ\ 24\overset{\prime}{.}0$
Nov 7	– Dec 23	$346^\circ\ 24\overset{\prime}{.}1$
Dec 24	– Dec 31	$346^\circ\ 24\overset{\prime}{.}0$

The changes in base lines on June 8 and November 7 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 24. 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 2012 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 27	0.0
Jan 28	– Jan 31	-0.5
Feb 1	– Feb 11	-1.0
Feb 12	– Mar 3	-0.5
Mar 4	– Mar 10	-1.0
Mar 11	– Apr 14	-0.5
Apr 15	– May 11	-1.0
May 12	– May 25	-0.5
May 26	– May 30 (15:50)	-1.0
May 30	– May 30 (18:20)	-1.5
May 30	– Aug 31	-2.0
Sep 1	– Sep 15	-1.5
Sep 16	– Sep 22	-2.0
Sep 23	– Nov 3 (12:00)	-1.5
Nov 3	– Nov 3 (13:30)	-1.0
Nov 3	– Nov 3 (15:00)	-0.5
Nov 3	– Dec 31	0.0

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 6	-10.0
Jan 7	– Feb 4	-10.5
Feb 5	– Feb 18	-11.5
Feb 19	– May 4	-10.5

		nT
May 5	– May 25	-11.0
May 26	– May 30 (15:50)	-11.5
May 30	– May 30 (18:20)	-12.0
May 30	– May 30 (20:50)	-12.5
May 30	– May 31	-13.0
Jun 1	– Jul 31	-12.5
Aug 1	– Aug 4	-12.0
Aug 5	– Aug 25	-12.5
Aug 26	– Nov 3 (12:00)	-12.0
Nov 3	– Nov 3 (13:30)	-11.5
Nov 3	– Nov 3 (15:00)	-11.0
Nov 3	– Nov 17	-10.5
Nov 18	– Dec 31	-10.0

Declination (D_0):

Jan 1	– Feb 4	$346° \, 20'.4$
Feb 5	– Feb 25	$346° \, 20'.5$
Feb 26	– Mar 3	$346° \, 20'.6$
Mar 4	– Mar 17	$346° \, 20'.5$
Mar 18	– Apr 5	$346° \, 20'.4$
Apr 6	– May 4	$346° \, 20'.3$
May 5	– May 25	$346° \, 20'.5$
May 26	– May 30 (18:20)	$346° \, 20'.4$
May 30	– Jun 6	$346° \, 20'.3$
Jun 7	– Jul 31	$346° \, 20'.2$
Aug 1	– Aug 14	$346° \, 20'.1$
Aug 15	– Aug 31	$346° \, 20'.2$
Sep 1	– Sep 8	$346° \, 20'.3$
Sep 9	– Sep 22	$346° \, 20'.4$
Sep 22	– Nov 3 (13:30)	$346° \, 20'.3$
Nov 3	– Dec 15	$346° \, 20'.4$
Dec 16	– Dec 31	$346° \, 20'.3$

The steps in the base lines on May 30 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.

From August 27, the 1-minute means are calculated from the 1-second data provided by the new data-loggers.

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

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

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

From August 8, Saxi replaced Móði as the main source of F. The 1-minute means are calculated from 20 measurements at 3-second intervals. The corresponding δF is also monitored by weekly comparisons with Geó.

The adopted values of δF in 2012 were as follows:

		δF (nT)
Jan 1	– Jan 27	-3.6
Jan 28	– Jan 31	-3.7
Feb 1	– Mar 10	-3.8
Mar 11	– Mar 31	-3.6
Apr 1	– May 4	-3.7
May 5	– May 31	-3.8
Jun 1	– Jun 23	-3.7
Jun 24	– Jul 8	-3.5
Jul 9	– Jul 16	-3.6
Jul 17	– Jul 28	-3.7
Jul 29	– Aug 8 (15:46)	-3.4
Aug 8	– Aug 14 (12:00)	-11.9
Aug 14	– Aug 18	-10.3
Aug 19	– Aug 31	-10.1
Sep 1	– Sep 8	-10.4
Sep 9	– Sep 22	-10.1
Sep 23	– Sep 30	-10.2
Oct 1	– Oct 13	-10.3
Oct 14	– Oct 20	-10.2
Oct 21	– Dec 8	-10.4
Dec 9	– Dec 31	-10.3

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

On August 14, the probe of Saxi was moved to a better location, explaining the changes in the δF.

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

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

was evaluated for this purpose. The mean value of M over the year was 0.0 nT. Most of the values (99.71%) were in the range -1 to $+1$ nT, 0.26% reached ± 2 nT, and there were 151 cases of a higher value.

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

In 2012, 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 43659 or 12.7% of the total time. Most of this was due to problems with the power supply in April and May and in August when the pump and fluid were replaced. The gaps in Saxi data from August 8 were 3070 or 1.48% of the total time until the end of the year. Most of these were due to testing and final adjustments of the setup.

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 2012, 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 2012 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*
Mar 7-9	(47,34,48)	(7,6,7)	(7,5,7)
Mar 15-17	(43,41,42)	(6,6,6)	(6,6,6)
Apr 24	(43)	(7)	(6)
Jun 17	(41)	(7)	(6)
Jul 9	(44)	(7)	(7)
Jul 15-16	(52,49)	(7,7)	(8,7)
Oct 8-9	(38,42	(7,7)	(6,6)
Oct 13-14	(48,38)	(7,5)	(7,6)

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

The index K reached the extreme value 9 only twice in 2012, and the value 8 only seven times. The year was one of the more quiet at Leirvogur as is evident from the tables on pages 31 and 32.

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.

FIELD STATION OBSERVATIONS

In 2012, observations were made at one field station, Guðnastaðir, at $63°34.'728$ N, $20°09.'567$ W. The above coordinates were measured with a GPS receiver and refer to WGS84. The observations were made on July 12 under magnetically quiet conditions. The DI-flux instrument Stefnir II and the proton magnetometer Barri were used to measure the magnetic field components. Three series of measurements were made with Stefnir II, and four with Barri. The result are as follows:

Guðnastaðir minus Leirvogur

	dF	dZ	dH	dD
2012	+667	+497	+741	$-52.'5$
2008	+662	+490	+751	$-49.'3$

The units of F, Z and H are nanoteslas. As can be seen from the graph on page 22, the results are in conformity with a previously established trend.

November 2013

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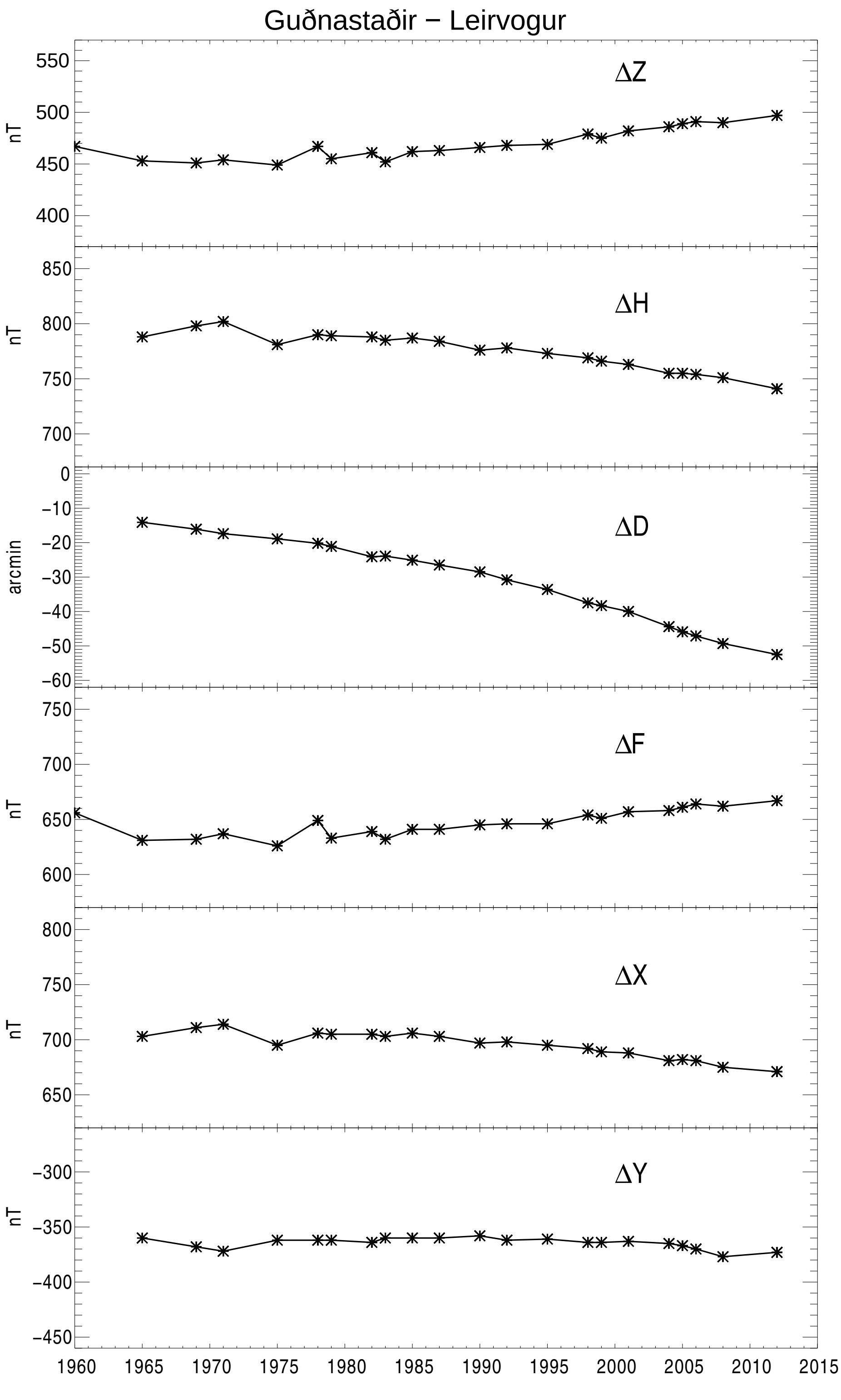
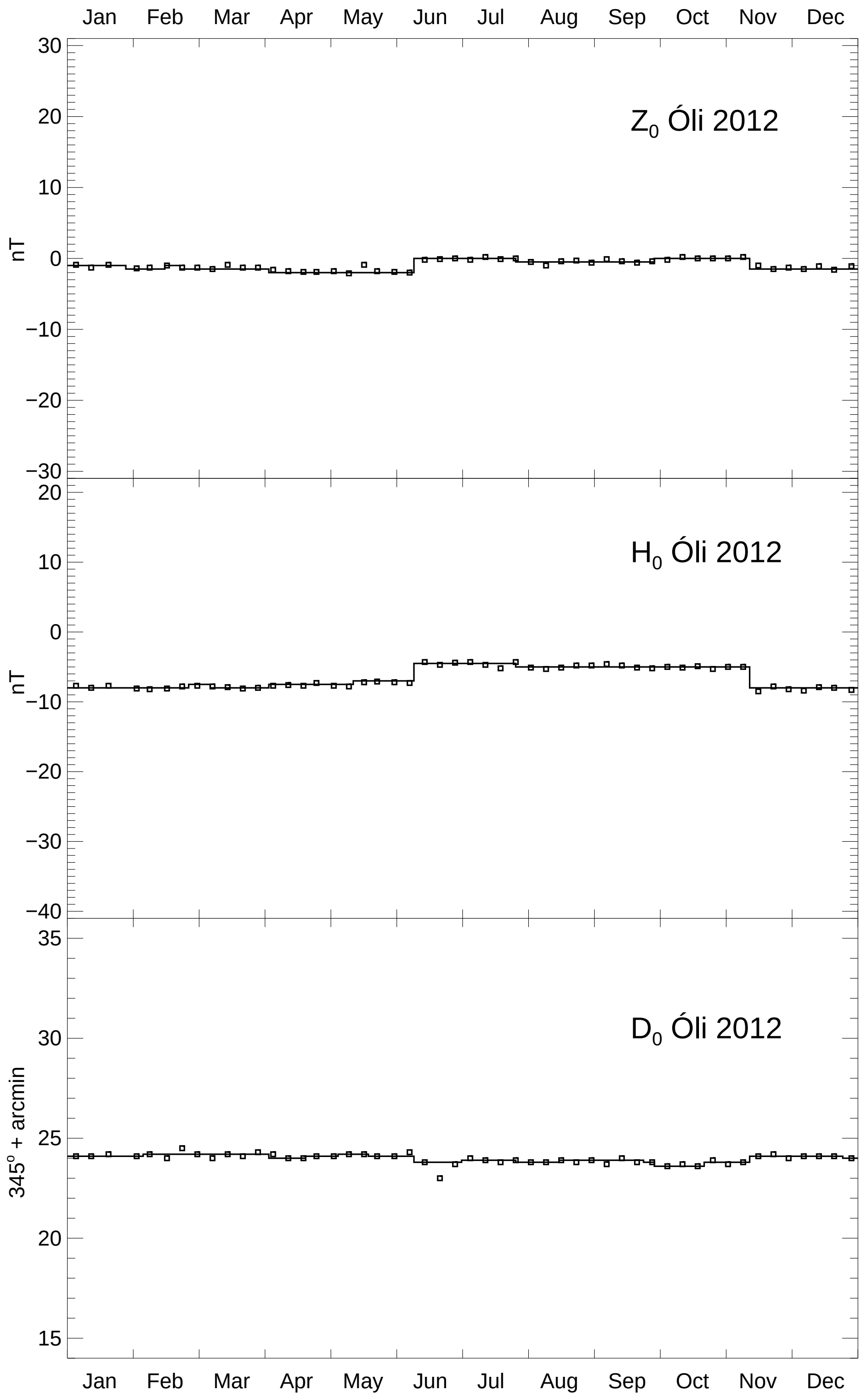
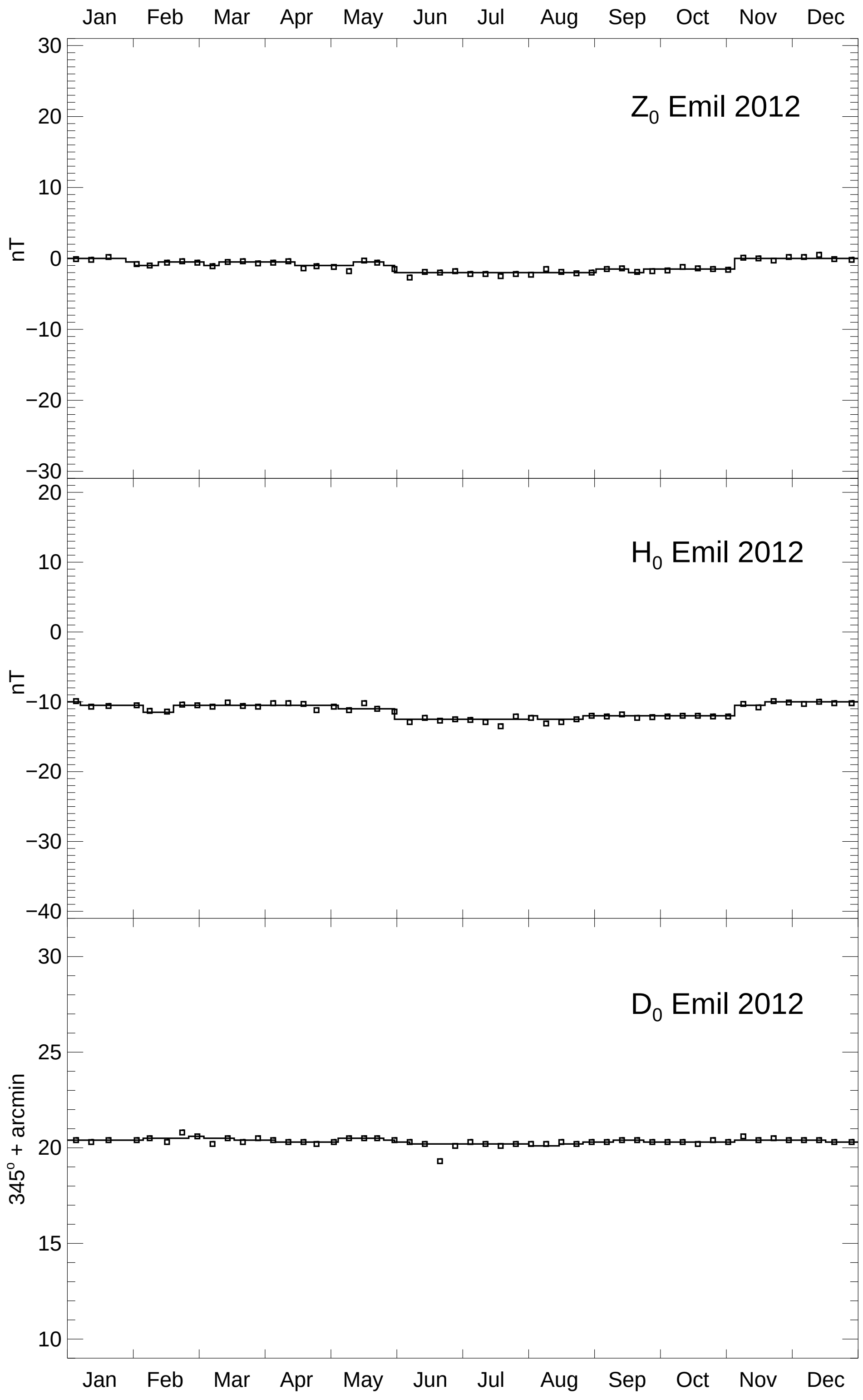


Guðnastaðir − Leirvogur
ΔZ
ΔH
ΔD
ΔF
ΔX
ΔY
nT
arcmin
550
500
450
400
850
800
750
700
0
−10
−20
−30
−40
−50
−60
750
700
650
600
800
750
700
650
−300
−350
−400
−450
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Z_0 Óli 2012
H_0 Óli 2012
D_0 Óli 2012
nT
nT
345° + arcmin


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Z_0 Emil 2012
nT
30
20
10
0
−10
−20
−30
H_0 Emil 2012
nT
20
10
0
−10
−20
−30
−40
D_0 Emil 2012
345° + arcmin
30
25
20
15
10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

EXPLANATION OF TABLES

Monthly and annual means

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

Annual means (all days) since 1958 are given on pages 126-128.

Diurnal variations

The tables on pages 27-28 show the mean diurnal inequalities of the magnetic elements Z, H, D and F at Leirvogur in 2012. 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 29. The daily K-sums are shown on page 30 in runs of 27 days. The table on page 31 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 32.

LEIRVOGUR 2012
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 347 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	205	205	203	643	644	645	-28	-27	-30	772	773	771
FEB	203	206	197	640	643	628	-9	-9	-1	770	774	761
MAR	213	209	211	621	640	584	19	13	40	775	776	765
APR	212	211	223	629	644	592	28	26	31	777	779	778
MAY	207	206	211	643	648	618	44	41	52	775	775	773
JUN	208	211	204	649	652	651	57	61	47	777	780	774
JUL	210	211	219	638	650	587	80	78	119	776	780	773
AUG	207	208	207	647	653	649	88	93	83	775	777	776
SEP	209	208	217	643	650	622	106	104	112	777	777	779
OCT	217	213	224	629	650	537	124	120	161	780	782	765
NOV	213	212	203	642	655	599	137	133	159	780	782	761
DEC	207	207	204	658	660	652	145	146	141	778	778	773
MEAN	209	209	210	640	649	614	66	65	76	776	778	771

LEIRVOGUR 2012

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	-14	-16	-17	-14	-16	-18	-19	-16	-11	-7	-3	1	5	10	17	22	27	27	22	13	9	4	0	-8	7.	17.	46
ZW	-11	-15	-15	-14	-10	-7	-6	-7	-7	-6	-2	0	2	6	10	13	16	17	13	9	11	10	3	-8	99.	18.	33
ZE	-15	-19	-18	-14	-18	-21	-24	-22	-12	-7	-3	2	7	11	19	26	32	31	26	13	5	1	3	-5	7.	17.	56
ZS	-15	-15	-18	-15	-21	-25	-27	-19	-12	-8	-4	1	7	13	22	29	33	31	27	19	10	2	-6	-11	7.	17.	60
ZQ	-13	-15	-10	-6	-4	-3	-1	-2	-3	-3	-3	-2	0	3	6	9	11	11	11	8	6	5	0	-7	2.	18.	26
ZQW	-7	-6	-4	-2	0	1	1	-2	-2	-2	-1	-2	-1	1	2	4	5	4	3	3	3	4	0	-3	1.	17.	12
ZQE	-16	-22	-15	-7	-3	-1	0	-3	-4	-4	-3	-2	0	3	6	10	13	14	15	12	10	7	0	-13	2.	19.	37
ZQS	-14	-16	-12	-10	-9	-8	-3	-2	-2	-4	-4	-2	1	5	10	14	16	16	14	11	6	3	0	-5	2.	17.	32
ZD	-8	6	8	5	-20	-29	-46	-38	-20	-11	1	11	18	26	37	37	40	19	6	-12	-11	-12	-4	-4	7.	17.	86
ZDW	-3	-12	-12	-8	-26	-23	-17	-11	-14	-10	7	13	16	22	29	32	38	27	5	-21	-2	-5	-13	-9	5.	17.	65
ZDE	6	21	24	13	-19	-34	-66	-65	-32	-16	-1	15	21	27	41	45	46	12	5	-24	-33	-15	18	9	7.	17.	112
ZDS	-28	8	12	11	-15	-30	-55	-39	-13	-8	-3	6	17	29	39	33	35	19	8	9	3	-14	-16	-11	7.	15.	95
H	-41	-53	-58	-58	-46	-28	-18	-10	-6	-6	-6	-6	-2	7	19	33	46	58	62	57	44	24	6	-21	4.	19.	120
HW	-24	-29	-40	-36	-20	-8	-1	2	3	4	3	-2	-4	0	6	13	19	27	30	27	21	14	6	-13	3.	19.	70
HE	-52	-71	-69	-68	-60	-38	-27	-14	0	1	1	-1	2	10	22	39	55	69	76	69	52	20	7	-24	2.	19.	147
HS	-46	-59	-64	-69	-58	-40	-27	-17	-20	-21	-21	-16	-4	11	30	49	64	78	81	74	60	37	4	-26	4.	19.	150
HQ	-7	-8	-2	0	0	0	2	1	-2	-7	-14	-18	-18	-14	-7	1	9	12	15	16	16	15	10	-1	12.	20.	34
HQW	-3	-7	-1	0	0	1	3	3	3	1	-3	-7	-9	-7	-4	0	3	4	5	6	5	6	1	-1	13.	22.	15
HQE	-6	-9	1	4	6	6	6	4	1	-4	-13	-20	-22	-19	-13	-6	3	8	15	16	19	19	12	-7	13.	22.	41
HQS	-13	-9	-5	-4	-6	-7	-3	-4	-11	-19	-26	-27	-22	-15	-2	10	21	23	26	26	23	20	15	6	12.	19.	53
HD	-79	-127	-166	-179	-158	-105	-95	-68	-38	-15	11	27	44	66	95	122	137	157	166	137	87	29	-3	-45	4.	19.	345
HDW	-73	-100	-146	-156	-97	-40	-14	0	4	6	22	19	13	27	43	59	75	93	111	84	49	28	3	-14	4.	19.	267
HDE	-84	-165	-198	-202	-207	-158	-162	-125	-42	-3	43	60	72	86	115	159	184	188	202	175	109	10	4	-63	5.	19.	409
HDS	-82	-116	-155	-180	-169	-116	-110	-78	-76	-48	-32	1	47	86	125	148	153	189	186	153	101	50	-18	-60	4.	18.	369

LEIRVOGUR 2012

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		14	29	43	57	62	63	56	47	46	39	24	0	-27	-55	-68	-70	-65	-55	-44	-39	-28	-19	-13	2	16.	6.	132
DW		29	32	36	34	34	33	22	14	11	9	4	-7	-22	-38	-45	-47	-41	-36	-22	-23	-8	2	7	23	16.	3.	84
DE		17	38	53	77	81	77	58	44	47	36	18	-5	-35	-64	-79	-79	-74	-56	-45	-41	-32	-22	-16	-2	16.	5.	161
DS		-4	18	38	61	70	77	88	83	81	73	50	12	-24	-63	-79	-83	-81	-72	-64	-54	-46	-38	-31	-15	16.	7.	171
DQ		5	10	9	12	20	30	38	43	44	43	31	9	-17	-43	-56	-54	-44	-30	-20	-13	-9	-8	-1	3	15.	9.	101
DQW		15	16	8	8	12	13	14	18	15	15	12	1	-15	-30	-33	-30	-22	-16	-10	-7	-3	0	9	9	15.	8.	51
DQE		8	13	10	11	17	26	35	38	43	45	36	16	-12	-40	-58	-61	-51	-35	-21	-14	-11	-11	3	11	16.	10.	106
DQS		-9	1	8	18	31	51	65	73	74	68	44	10	-24	-59	-78	-72	-57	-40	-29	-20	-14	-13	-13	-12	15.	9.	152
DD		13	56	103	143	167	136	84	37	50	31	22	0	-19	-63	-70	-82	-99	-96	-97	-106	-87	-60	-52	-11	20.	5.	273
DDW		31	59	111	109	116	90	36	0	1	-4	-6	-23	-39	-61	-69	-84	-73	-65	-39	-63	-44	-15	-1	32	16.	5.	200
DDE		9	79	116	204	221	199	112	41	67	9	-16	-26	-47	-88	-91	-84	-105	-85	-99	-124	-101	-70	-77	-42	20.	5.	346
DDS		0	32	81	117	164	118	104	71	83	90	88	48	29	-41	-51	-79	-119	-138	-154	-131	-116	-94	-76	-24	19.	5.	319
F		-23	-29	-31	-28	-27	-24	-23	-18	-12	-8	-4	-1	4	12	21	30	38	40	37	27	19	10	1	-13	3.	18.	71
FW		-17	-22	-25	-22	-15	-9	-6	-6	-7	-5	-1	-1	1	6	11	16	21	23	20	15	16	13	4	-11	3.	18.	48
FE		-26	-35	-34	-30	-32	-29	-29	-25	-12	-7	-3	2	7	13	24	35	45	47	44	30	18	6	4	-11	2.	18.	83
FS		-26	-29	-34	-31	-34	-34	-33	-23	-16	-13	-9	-3	6	16	29	40	48	50	46	37	25	11	-5	-17	99.	18.	84
FQ		-14	-16	-10	-6	-4	-2	0	-2	-3	-5	-6	-6	-4	0	4	9	13	14	14	12	10	8	2	-7	2.	99.	30
FQW		-8	-7	-4	-2	0	1	1	-1	-1	-1	-2	-3	-3	-1	1	4	6	6	5	4	4	6	0	-3	1.	99.	13
FQE		-17	-23	-14	-6	-2	1	2	-2	-3	-5	-6	-7	-5	-1	3	8	14	16	18	15	14	11	3	-15	2.	19.	41
FQS		-17	-18	-13	-11	-10	-9	-4	-3	-5	-9	-11	-9	-4	1	9	16	21	21	20	17	12	7	4	-4	2.	18.	39
FD		-27	-25	-33	-38	-57	-53	-68	-54	-29	-15	3	17	28	41	59	65	72	57	46	22	10	-5	-5	-15	7.	17.	140
FDW		-21	-36	-47	-46	-49	-32	-20	-11	-13	-9	12	17	18	28	39	45	55	49	32	0	9	1	-12	-13	5.	17.	105
FDE		-14	-20	-25	-36	-68	-71	-103	-93	-42	-16	9	29	38	48	68	82	89	58	54	20	-6	-13	18	-6	7.	17.	192
FDS		-47	-21	-26	-33	-55	-57	-80	-57	-31	-19	-11	7	28	49	69	69	72	64	53	46	27	-2	-20	-26	7.	17.	152

LEIRVOGUR MAGNETIC OBSERVATORY 2012
K-INDICES FOR THREE HOUR INTERVALS IN U.T.
LOWER LIMIT FOR K-9 = 1500 NANOTESLAS IN H

DAYS	K-INDICES						
1- 7	21111211	00001113	64321202	30011002	20011110	01111245	41111123
8- 14	22111112	34111122	11112222	43111122	21011222	32311101	20111000
15- 21	02001125	23123243	43011122	30011103	11101111	33100120	34221233
22- 28	10333566	56421123	65212665	55463223	41121223	33333210	33111125
29- 35	53211132	00000356	42000000	33212100	33221114	42212310	43323334
36- 42	52122243	34112543	45232255	54322132	20021243	30211124	60111110
43- 49	31011211	11313436	54422556	67534555	42122100	01211000	00001116
50- 56	77422224	66334424	64221104	55322220	00011104	34122210	01222222
57- 63	33222124	76114683	31531323	55211110	04433366	55323345	44322335
64- 70	65323453	54522345	53423225	67676555	42244666	69966633	77532343
71- 77	22222446	33254456	75323232	53122444	65325787	65553665	66643467
78- 84	66323236	66322235	31221224	30122232	22011135	41222210	34522333
85- 91	51221100	11011202	44234566	66533242	00012225	52112100	10112320
92- 98	22122335	54423435	45321333	44122335	66643312	21011115	55433223
99-105	31222221	11112234	43112225	31222113	16323566	66443325	56233231
106-112	13122322	12111214	40222453	65323323	31121244	35522313	31122356
113-119	54323343	35523466	86633557	55533575	67322333	54222335	41122345
120-126	43222221	12122011	11111225	42022215	44321234	21111310	01122210
127-133	11222320	02122210	02222325	56434666	55323337	66323433	63323335
134-140	66333366	63312223	23422212	31123446	44121111	53232436	52222221
141-147	66523211	01122232	46333446	56632434	43322321	31233314	42122110
148-154	22222100	02122331	12222315	42232331	22222331	24122220	01122446
155-161	44223663	24444445	46335445	76334455	43323345	33332220	22222232
162-168	11223323	53424357	56322331	23222322	21121212	00122211	01133435
169-175	55655546	77433423	11112112	33322220	01012111	11222210	11222221
176-182	31122221	32323424	35322212	01122322	12322212	22122223	55655456
183-189	66534346	56634544	54233414	56433212	32134422	45322454	44232232
190-196	13232317	65656565	54333446	56432336	67633212	10111220	11123466
197-203	66876766	67776646	67732434	32223213	33222211	33233554	43322332
204-210	14422213	34223235	56223332	51222211	21122100	01122202	01223345
211-217	43322221	35334655	42222321	22222323	01124445	45422211	32223323
218-224	11122323	56223545	51222235	62232222	64222211	01122101	01112224
225-231	34223343	12224431	33233324	51222323	55224456	65322223	34222445
232-238	11234225	55423334	41222223	12222225	64332341	53122245	33332336
239-245	22323333	34122212	11122201	12222200	00122211	00122110	32232212
246-252	64434566	45545565	65732436	77542435	66112332	26323364	45322442
253-259	21122222	31112210	00111111	33122222	42112320	11112214	33121324
260-266	44112333	41121114	44223320	24122556	62333323	22222321	32211212
267-273	00111100	01012211	11112210	00122233	31121211	00122100	00122212
274-280	20122546	77522211	10122311	53111211	21011100	00122224	52123223
281-287	03021146	56663255	87743346	52323444	53123212	54323322	67765656
288-294	65443466	54222113	12222212	44222205	40122221	41021100	00021101
295-301	10122100	20011100	12322231	32111110	32011102	10112113	43111100
302-308	01111111	11011002	31011000	00011324	43455465	42111222	00012111
309-315	01111100	00011222	20011312	56112464	10111001	00011000	00011103
316-322	00011100	20011236	53122256	88753312	23011113	23111233	14122234
323-329	32211104	20121102	44222466	54322131	21010002	10011116	66523211
330-336	11001102	41110120	11011121	11000021	10010110	00000101	11001043
337-343	44321100	22111112	21210000	10000001	00000000	00000000	00001000
344-350	01000123	51011100	22000010	00011102	42000001	11010012	33122144
351-357	21222212	42343310	42222102	23212110	02122222	31111001	00010000
358-364	00001110	00000210	10000012	02111002	10000000	00000012	20110002
365-366	20012221	00000000					

LEIRVOGUR MAGNETIC OBSERVATORY 2012

K-SUMS IN 27-DAY RUNS

DAYS	K-SUMS																										
1- 27	10	6	20	7	6	15	14	11	15	12	15	11	12	5	11	20	14	9	7	10	20	27	24	33	30	16	18
28- 54	17	18	14	6	12	17	15	25	21	23	28	22	14	14	11	10	22	33	40	12	5	9	30	32	20	21	7
55- 81	15	13	19	36	21	16	29	30	26	31	30	26	47	34	48	34	24	32	27	25	43	41	42	31	29	17	15
82-108	15	14	25	12	8	34	31	12	12	10	20	30	24	24	31	12	27	15	15	20	15	32	33	25	16	13	22
109-135	27	18	24	23	27	34	43	38	29	26	22	18	10	14	18	23	10	9	13	10	18	40	31	30	28	36	22
136-162	18	24	15	28	18	26	13	33	33	20	20	13	11	14	18	20	17	15	20	30	31	34	37	27	18	17	17
163-189	33	25	18	12	9	20	41	33	10	17	7	11	13	14	23	20	13	15	16	41	37	37	26	26	21	29	22
190-216	22	44	32	32	30	8	24	52	49	36	18	16	28	22	19	24	26	16	9	10	20	19	34	18	18	21	21
217-243	20	15	32	22	21	20	8	13	24	19	23	20	33	25	26	20	29	18	18	26	24	26	21	17	10	11	9
244-270	7	17	38	39	36	37	24	29	26	14	11	6	17	15	13	19	21	15	20	27	25	16	14	4	8	9	13
271-297	12	6	10	22	27	11	15	6	13	20	17	38	42	27	19	24	48	38	20	14	21	14	9	5	7	5	16
298-324	10	10	10	11	7	6	6	11	36	15	6	5	8	10	29	5	2	6	3	15	26	37	12	16	19	14	9
325-351	30	21	6	11	26	6	10	8	5	4	2	10	15	11	6	2	0	0	1	7	9	5	5	7	6	20	14
352-366	20	15	12	13	8	1	3	3	4	7	1	3	6	10	0												

LEIRVOGUR MAGNETIC OBSERVATORY 2012

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	-	$\bar{K}$	$\overline{Ak}$
JAN	43	86	51	36	12	11	9	0	0	0	0	1.8	11
FEB	28	53	57	34	27	18	10	4	1	0	0	2.4	18
MAR	15	23	59	46	29	33	32	8	1	2	0	3.4	33
APR	3	42	63	58	24	30	16	3	1	0	0	3.0	23
MAY	13	46	80	54	22	12	20	1	0	0	0	2.6	18
JUN	11	41	83	43	27	21	10	4	0	0	0	2.7	19
JUL	7	29	64	54	33	22	29	9	1	0	0	3.2	29
AUG	12	39	98	47	26	19	7	0	0	0	0	2.5	15
SEP	21	61	72	34	23	13	13	3	0	0	0	2.3	16
OCT	41	74	57	25	18	14	12	6	1	0	0	2.1	17
NOV	61	85	41	17	14	9	10	1	2	0	0	1.7	13
DEC	121	61	46	10	9	1	0	0	0	0	0	0.9	4
YEAR	376	640	771	458	264	203	168	39	7	2	0	2.4	18
%	12.8	21.9	26.3	15.6	9.0	6.9	5.7	1.3	0.2	0.1			

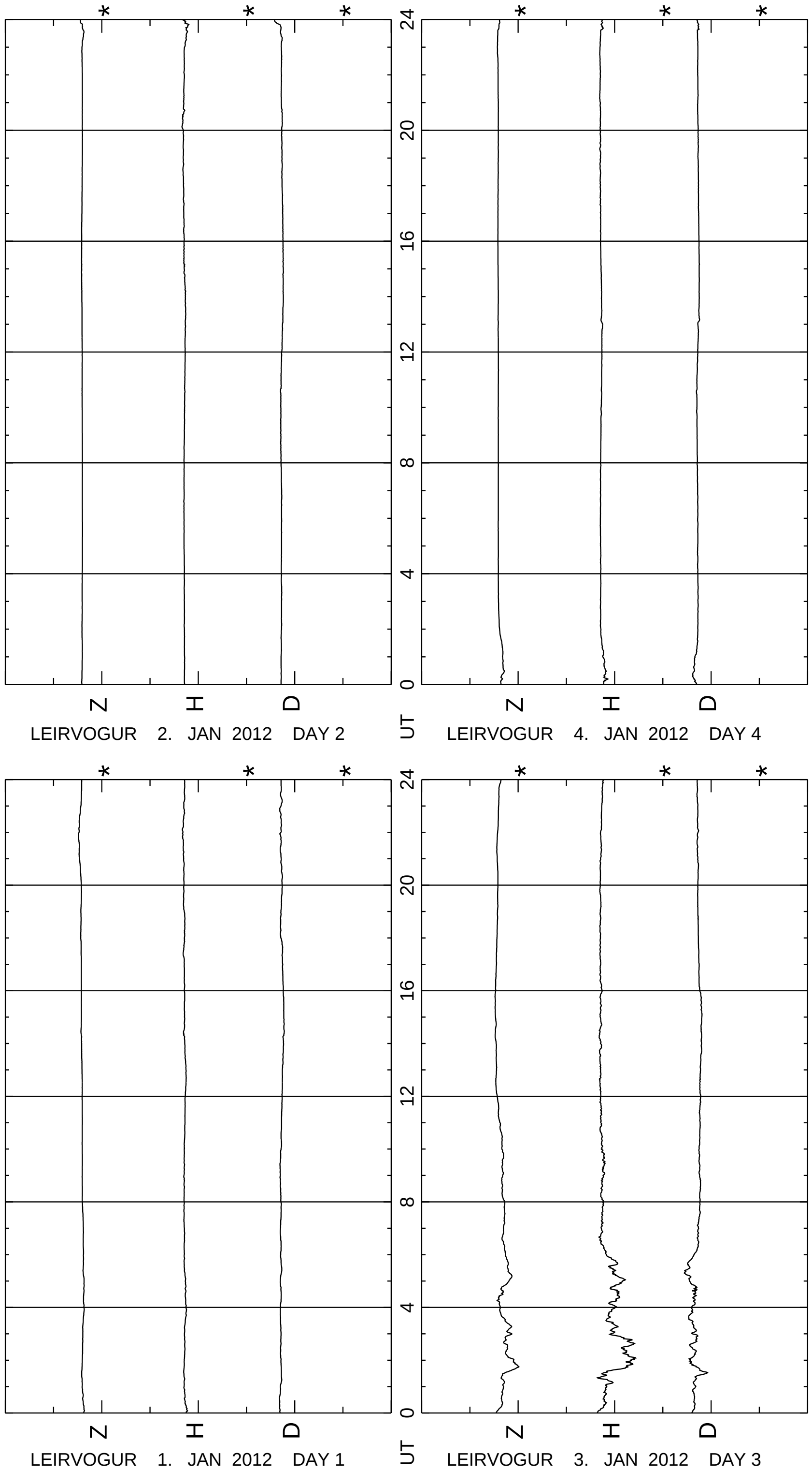
	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\bar{K}$	$\overline{Ak}$
1958	76	267	459	591	510	488	328	87	12	2	100	3.6	33
1959	46	260	360	567	562	547	388	138	33	8	11	3.9	39
1960	75	275	399	539	468	492	304	165	32	4	175	3.7	38
1961	224	477	475	518	482	351	222	87	19	1	64	3.1	27
1962	17	346	592	569	444	412	259	94	10	0	177	3.4	30
1963	181	494	543	550	371	353	259	99	10	0	60	3.1	27
1964	328	699	573	451	325	238	159	54	3	0	98	2.5	19
1965	416	799	567	455	247	199	111	35	0	0	91	2.2	15
1966	247	644	648	535	309	299	158	48	8	1	23	2.6	20
1967	178	561	685	523	386	294	189	58	7	3	36	2.8	23
1968	114	411	569	596	489	387	256	75	9	0	22	3.2	27
1969	174	469	619	610	418	351	195	52	4	2	26	3.0	23
1970	48	388	676	640	478	378	209	58	11	4	30	3.2	26
1971	13	316	768	684	448	367	215	81	8	0	20	3.3	26
1972	20	321	812	682	453	356	172	73	24	4	11	3.2	27
1973	55	213	603	586	484	459	326	171	17	0	6	3.7	35
1974	41	237	400	563	509	533	392	209	24	1	11	3.9	41
1975	81	364	621	603	432	425	260	111	19	3	1	3.4	30
1976	109	413	701	589	417	377	223	84	12	3	0	3.1	27
1977	131	460	757	547	396	337	189	91	10	2	0	3.0	25
1978	135	352	601	569	458	392	270	122	17	4	0	3.3	31
1979	87	270	644	680	492	441	227	70	9	0	0	3.3	27
1980	142	448	826	612	400	303	160	35	2	0	0	2.8	20
1981	33	301	573	663	585	440	241	67	15	2	0	3.4	29
1982	20	182	366	648	566	554	389	156	29	10	0	4.0	41
1983	10	150	494	595	596	585	330	137	17	6	0	3.9	37
1984	9	117	516	676	568	497	367	151	24	3	0	3.9	38
1985	2	231	806	695	454	386	237	85	23	1	0	3.4	29
1986	14	300	927	645	399	322	194	96	20	3	0	3.2	27
1987	17	371	931	687	385	314	143	55	5	1	11	3.0	22
1988	14	249	814	694	495	374	182	63	10	0	25	3.3	26
1989	3	122	601	711	520	475	346	111	19	4	8	3.8	35
1990	16	230	665	661	527	444	246	98	12	2	19	3.5	30
1991	10	186	531	620	505	497	375	134	37	5	20	3.8	38
1992	98	293	669	655	469	402	242	77	23	0	0	3.3	28
1993	92	372	712	598	437	361	234	95	19	0	0	3.2	28
1994	100	368	546	546	445	409	322	157	26	1	0	3.5	34
1995	200	547	638	493	389	339	212	82	12	1	7	2.9	25
1996	206	557	845	578	304	231	148	52	7	0	0	2.6	19
1997	398	659	737	482	265	214	124	33	8	0	0	2.3	17
1998	228	516	729	525	361	295	186	61	13	5	1	2.8	23
1999	163	440	687	583	397	355	213	71	7	0	4	3.0	24
2000	157	321	673	616	446	399	219	75	13	5	4	3.2	27
2001	182	479	747	591	408	275	165	59	9	5	0	2.8	22
2002	133	356	720	647	420	367	198	60	8	0	11	3.1	24
2003	43	197	406	588	530	519	414	186	30	7	0	4.0	41
2004	154	431	706	599	415	323	212	71	11	6	0	3.0	25
2005	218	463	676	557	366	305	232	75	20	8	0	3.0	26
2006	389	768	703	413	290	185	120	44	5	3	0	2.3	17
2007	469	722	724	454	240	158	112	40	1	0	0	2.1	15
2008	524	734	713	463	223	154	84	29	4	0	0	2.0	13
2009	836	1036	663	222	77	57	25	4	0	0	0	1.3	6
2010	576	856	763	341	184	100	75	23	2	0	0	1.8	11
2011	433	757	783	443	231	147	87	32	7	0	0	2.1	14
2012	376	640	771	458	264	203	168	39	7	2	0	2.4	18

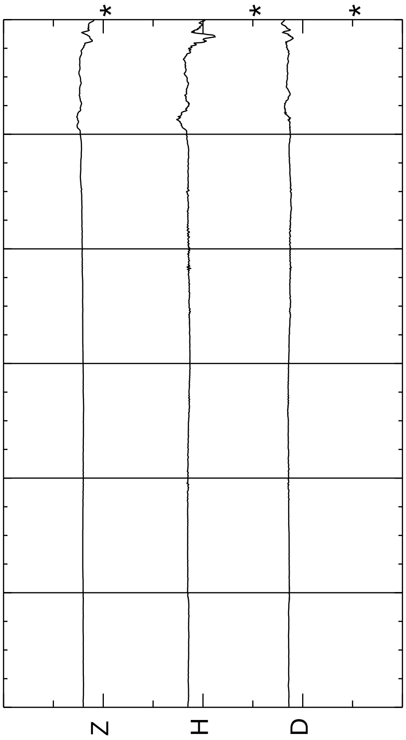
EXPLANATION OF DAILY GRAPHS

The graphs on pages 34–125 show the 1-minute means of the magnetic elements Z, H, and D at Leirvogur in 2012. Vertical divisions are spaced at intervals of 500 nT in Z and H and $2\overset{\circ}{.}31$ in D. The last figure is equivalent to 500 nT in the direction of magnetic east for average values of H at Leirvogur.

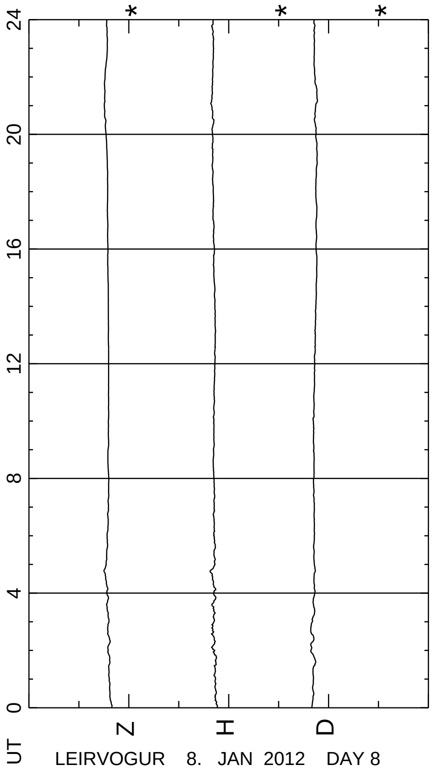
Levels marked with asterisk (*) are as follows:
Z: 50000 nT
H: 12000 nT
D: 344° E

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

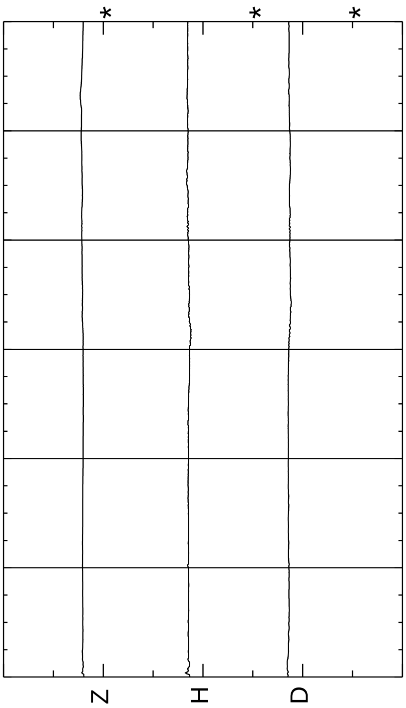

LEIRVOGUR 2. JAN 2012 DAY 2
LEIRVOGUR 4. JAN 2012 DAY 4
LEIRVOGUR 1. JAN 2012 DAY 1
LEIRVOGUR 3. JAN 2012 DAY 3
Z
H
D
UT
0
4
8
12
16
20
24



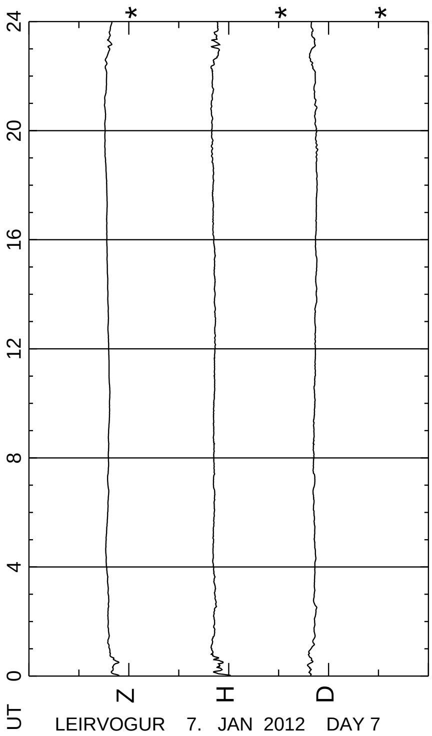
LEIRVOGUR 6. JAN 2012 DAY 6



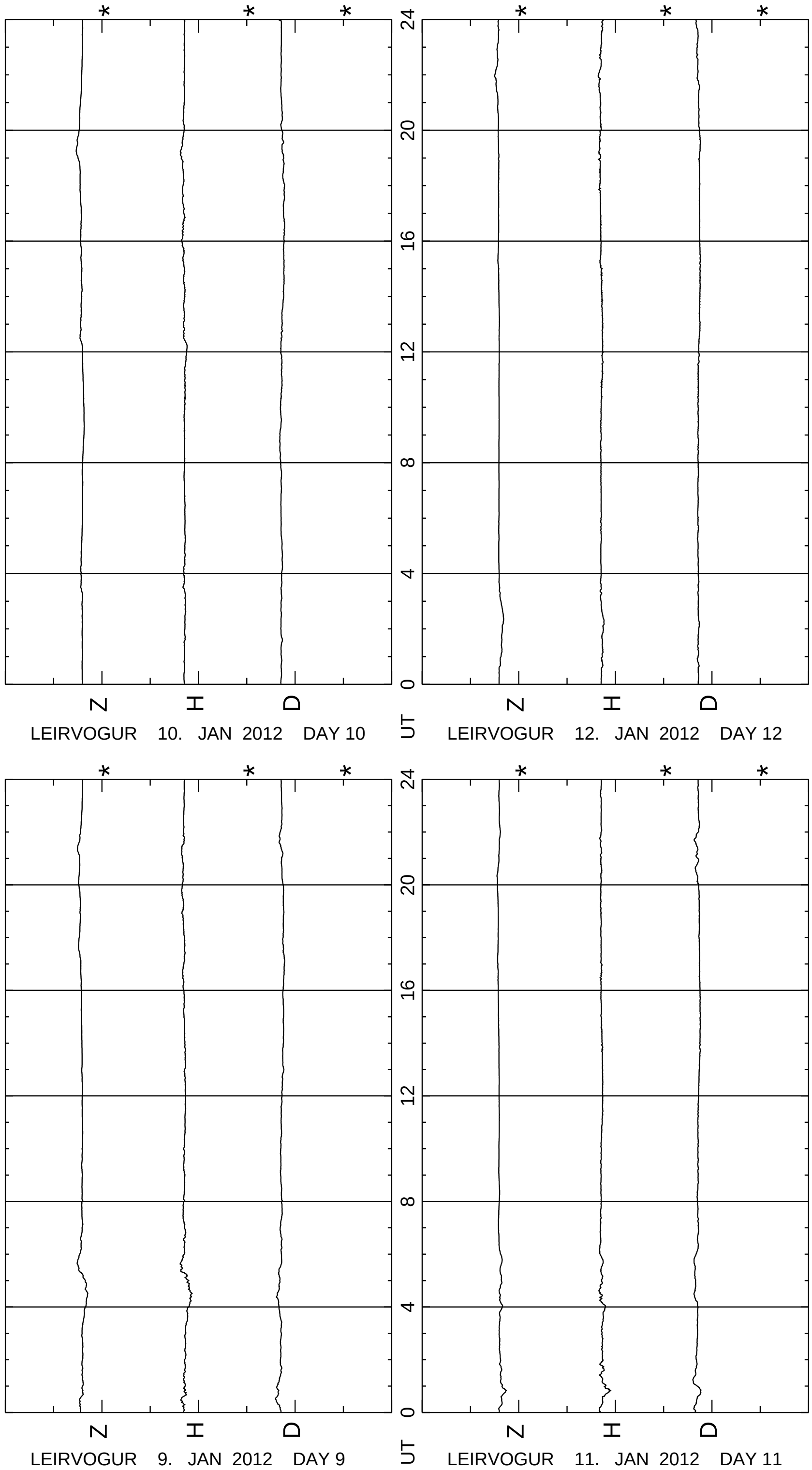
LEIRVOGUR 8. JAN 2012 DAY 8

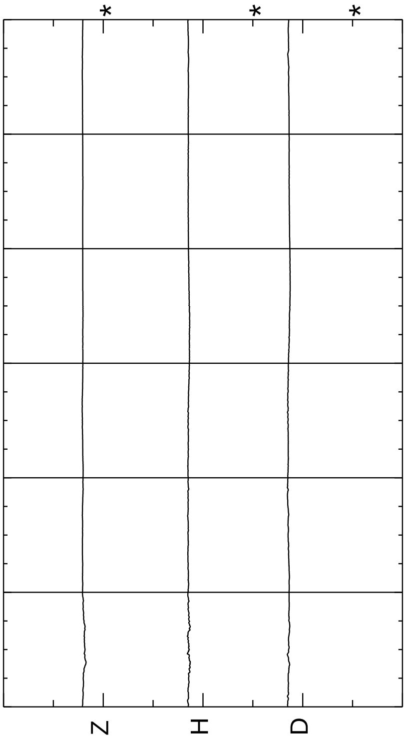


LEIRVOGUR 5. JAN 2012 DAY 5

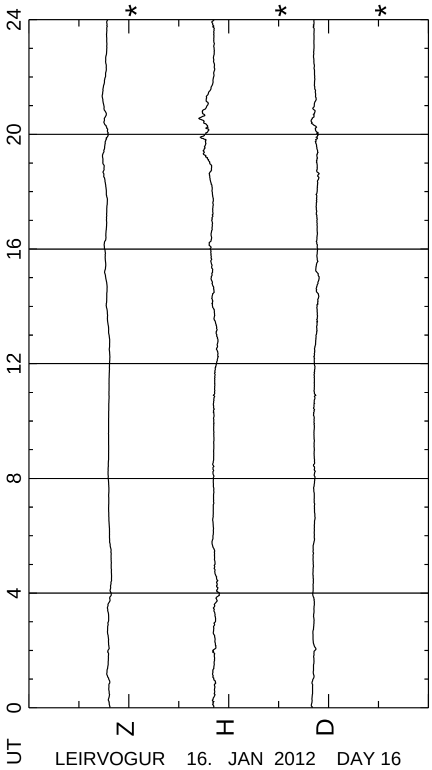


LEIRVOGUR 7. JAN 2012 DAY 7

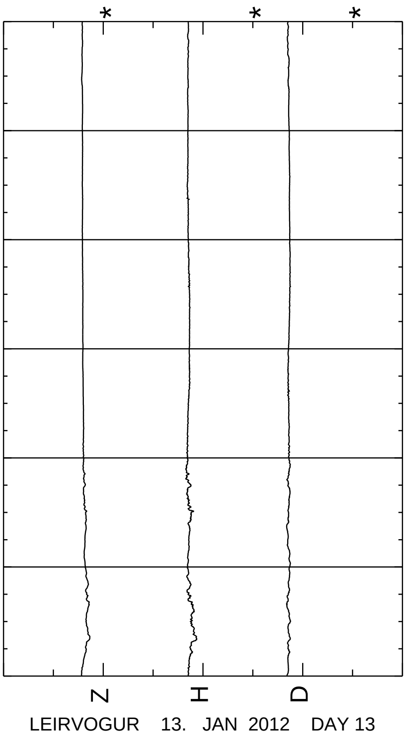

LEIRVOGUR 10. JAN 2012 DAY 10
LEIRVOGUR 12. JAN 2012 DAY 12
LEIRVOGUR 9. JAN 2012 DAY 9
LEIRVOGUR 11. JAN 2012 DAY 11
Z
H
D
UT
0
4
8
12
16
20
24



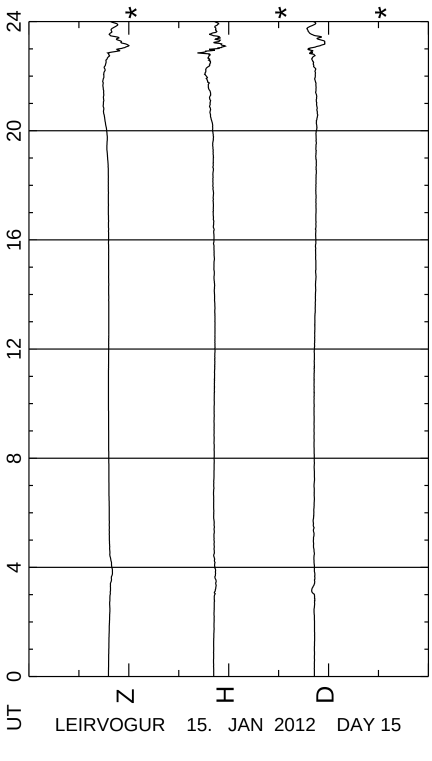
LEIRVOGUR 14. JAN 2012 DAY 14



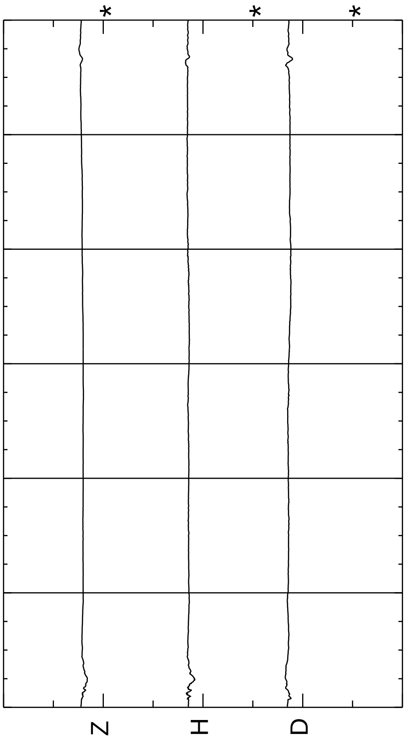
LEIRVOGUR 16. JAN 2012 DAY 16



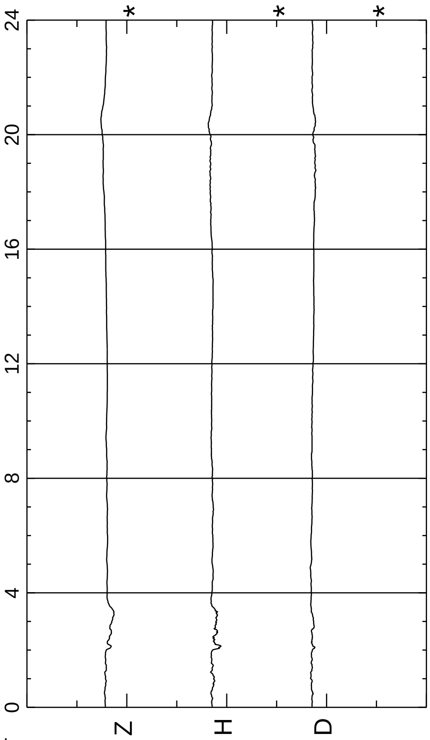
LEIRVOGUR 13. JAN 2012 DAY 13



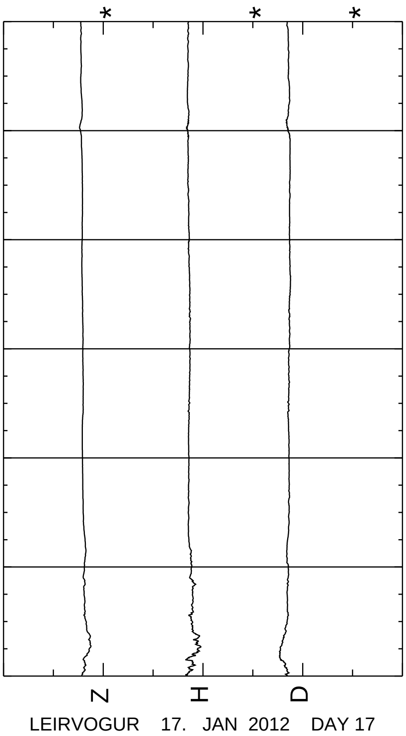
LEIRVOGUR 15. JAN 2012 DAY 15



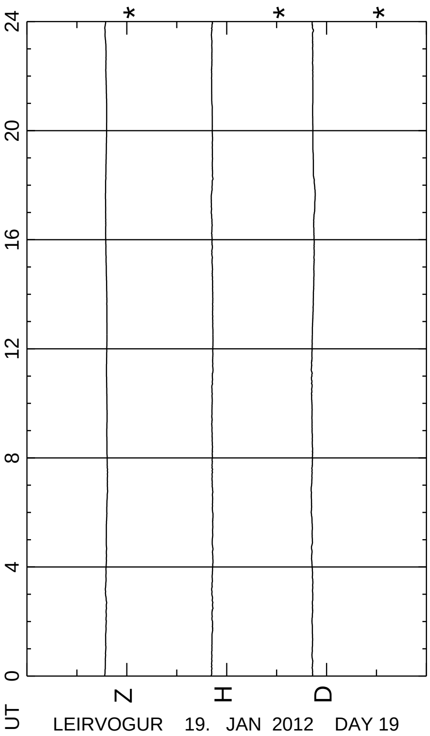
LEIRVOGUR 18. JAN 2012 DAY 18



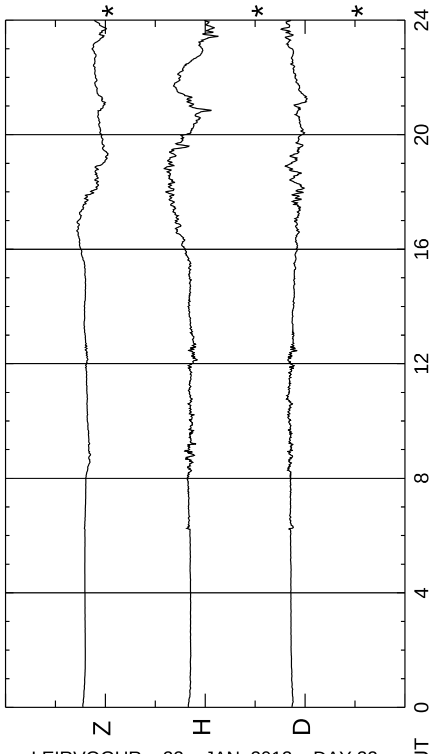
LEIRVOGUR 20. JAN 2012 DAY 20



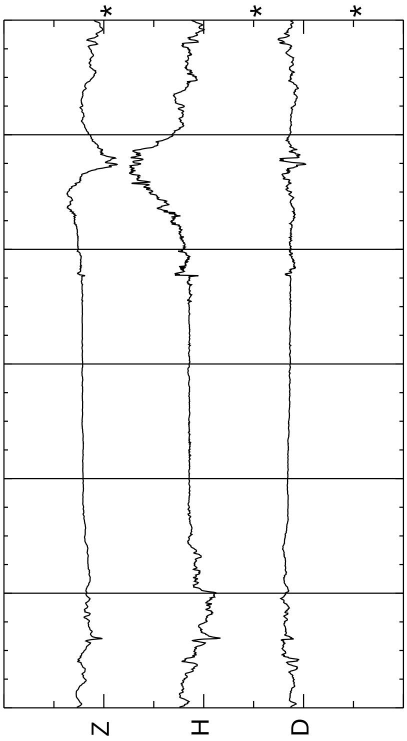
LEIRVOGUR 17. JAN 2012 DAY 17



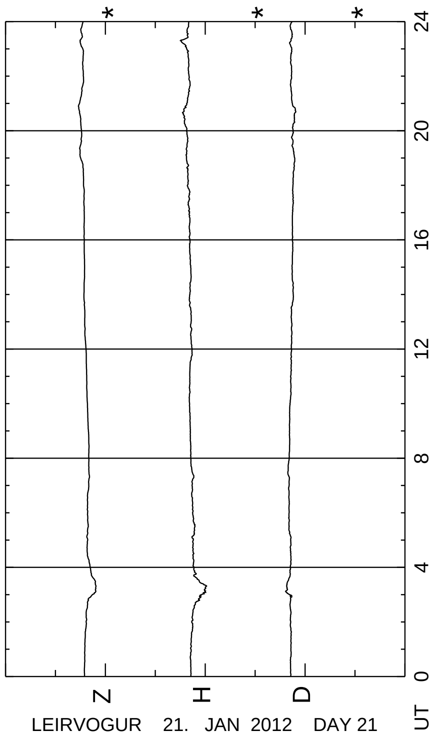
LEIRVOGUR 19. JAN 2012 DAY 19



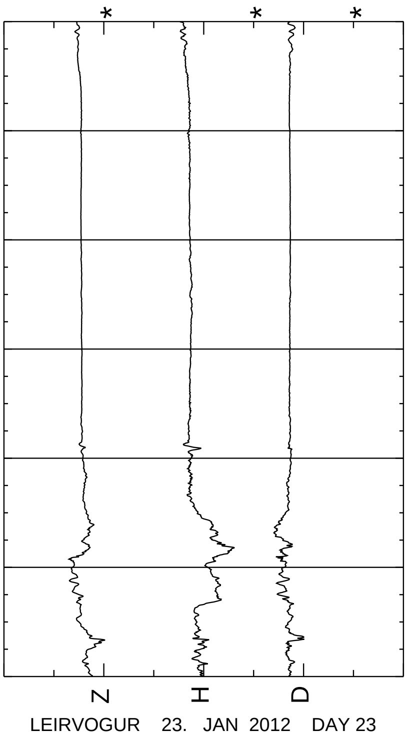
LEIRVOGUR 22. JAN 2012 DAY 22



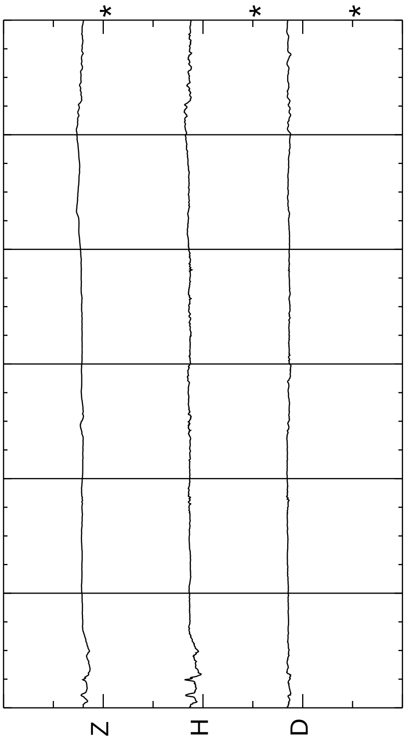
LEIRVOGUR 24. JAN 2012 DAY 24



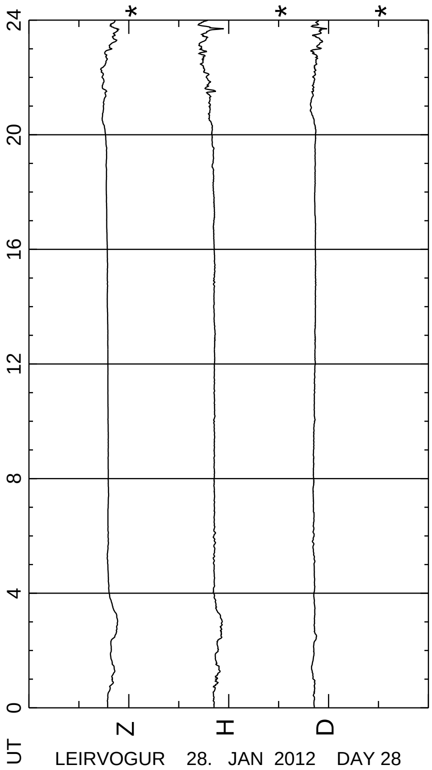
LEIRVOGUR 21. JAN 2012 DAY 21



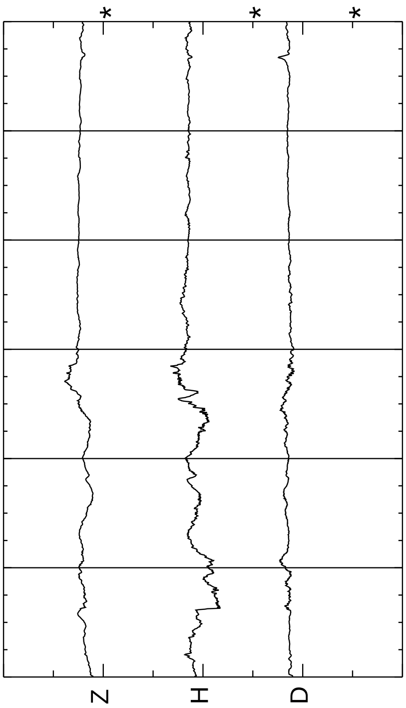
LEIRVOGUR 23. JAN 2012 DAY 23



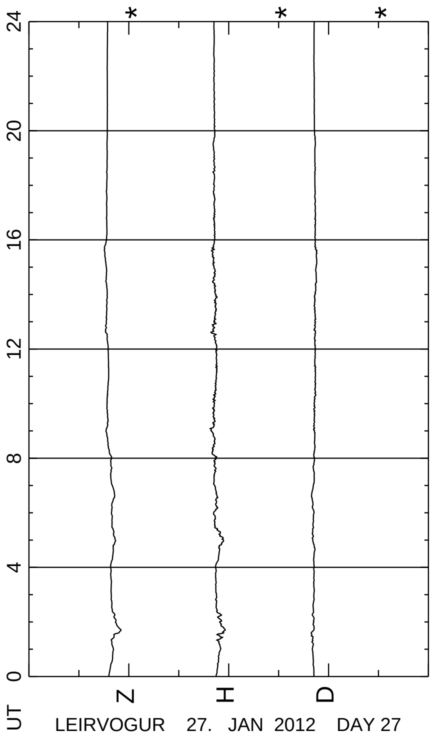
LEIRVOGUR 26. JAN 2012 DAY 26



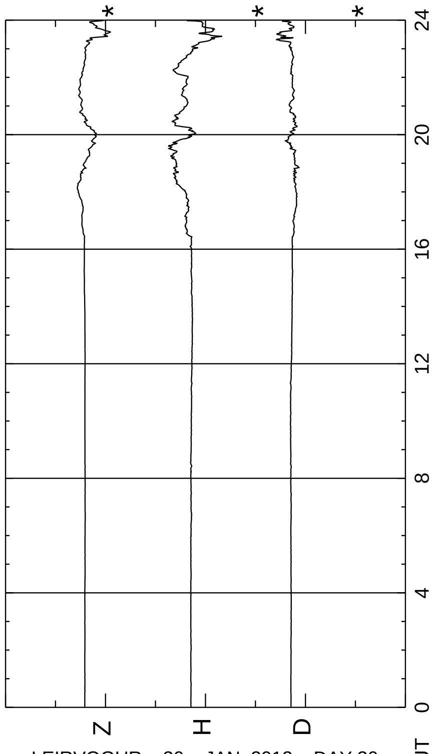
LEIRVOGUR 28. JAN 2012 DAY 28



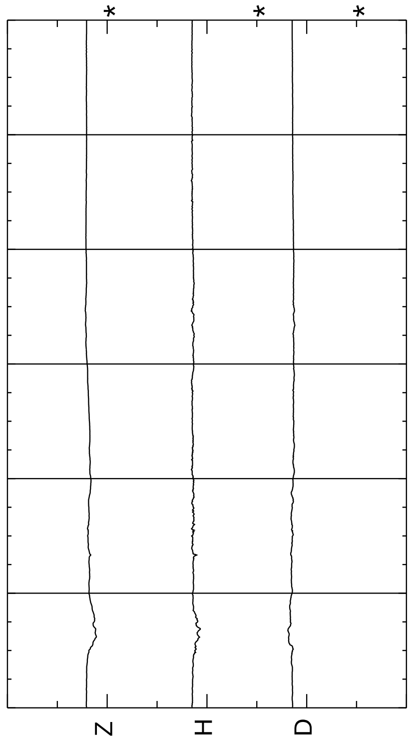
LEIRVOGUR 25. JAN 2012 DAY 25



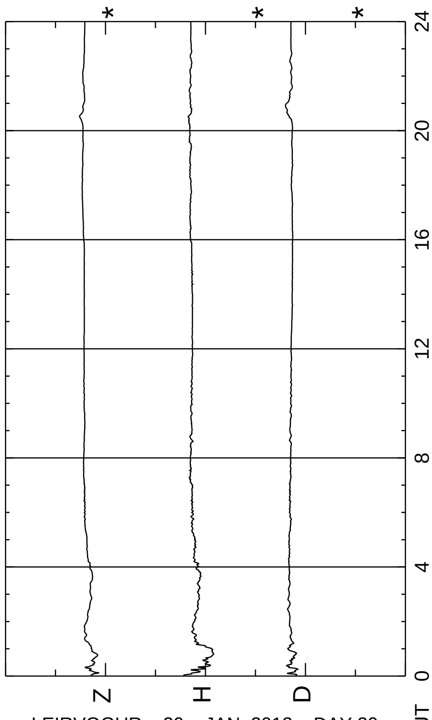
LEIRVOGUR 27. JAN 2012 DAY 27



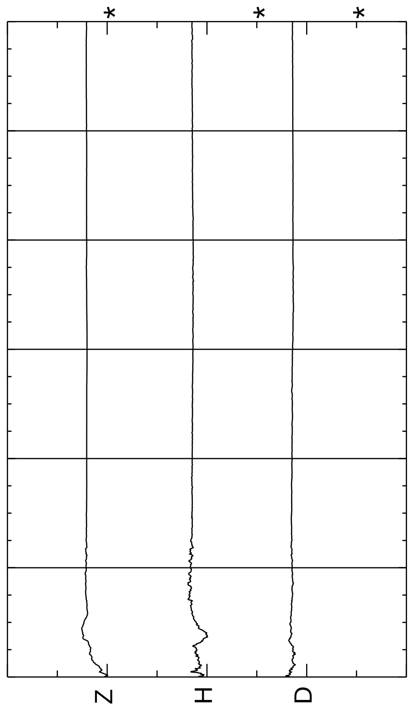
LEIRVOGUR 30. JAN 2012 DAY 30



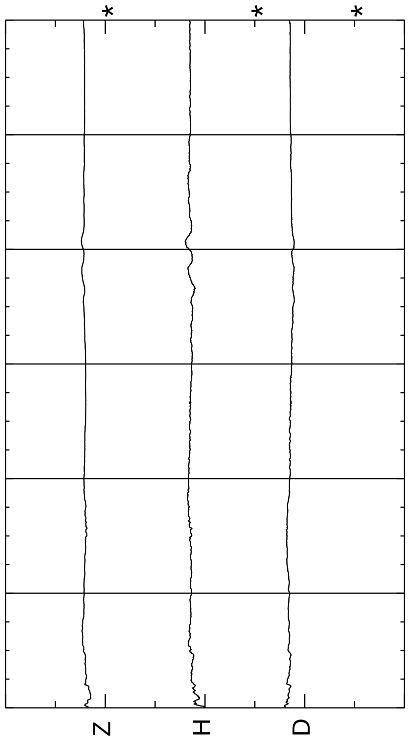
LEIRVOGUR 1. FEB 2012 DAY 32



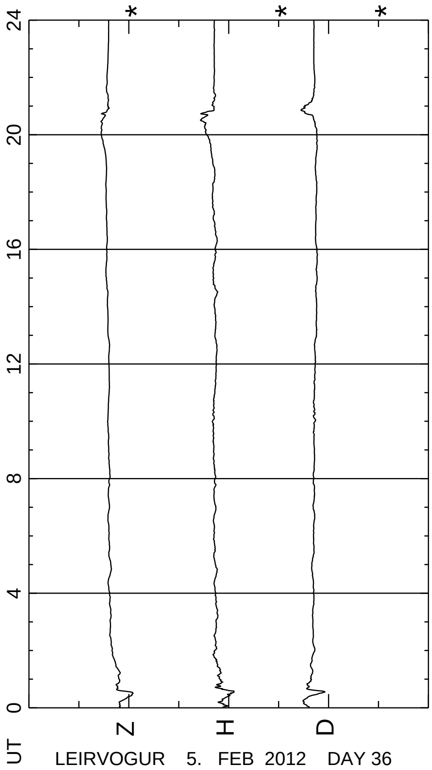
LEIRVOGUR 29. JAN 2012 DAY 29



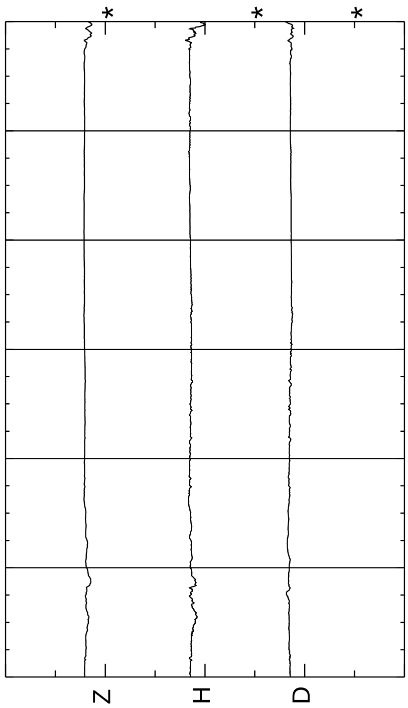
LEIRVOGUR 31. JAN 2012 DAY 31



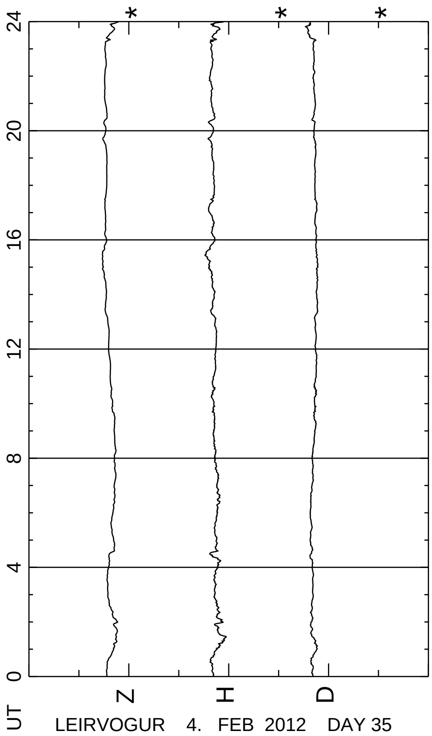
LEIRVOGUR 3. FEB 2012 DAY 34



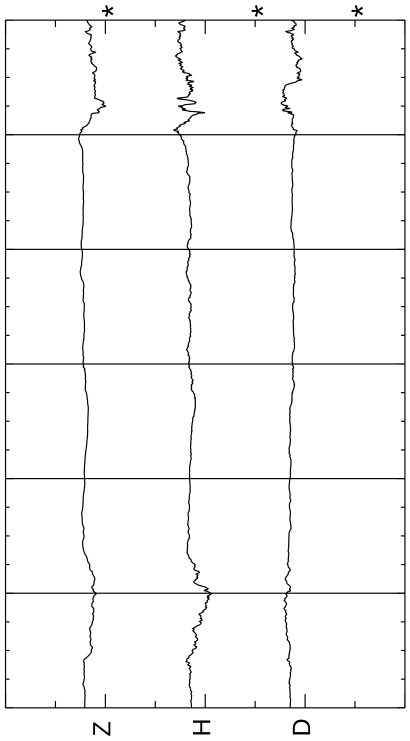
LEIRVOGUR 5. FEB 2012 DAY 36



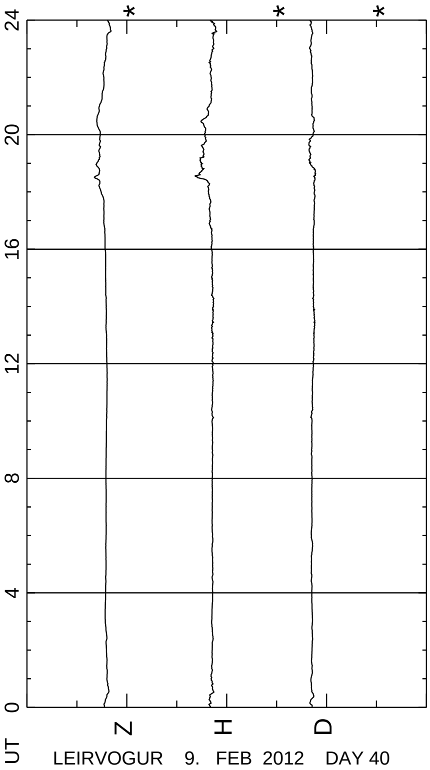
LEIRVOGUR 2. FEB 2012 DAY 33



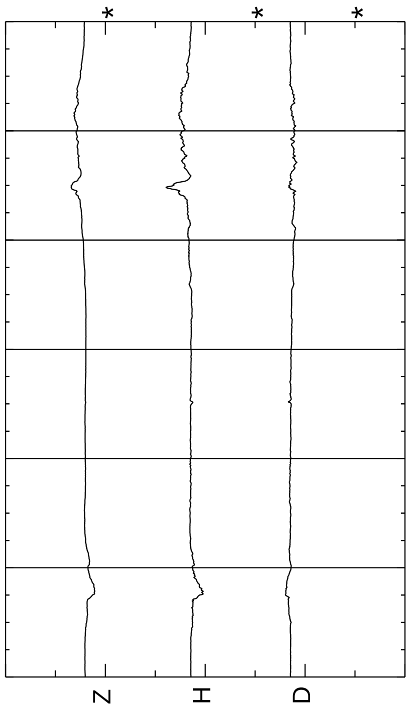
LEIRVOGUR 4. FEB 2012 DAY 35



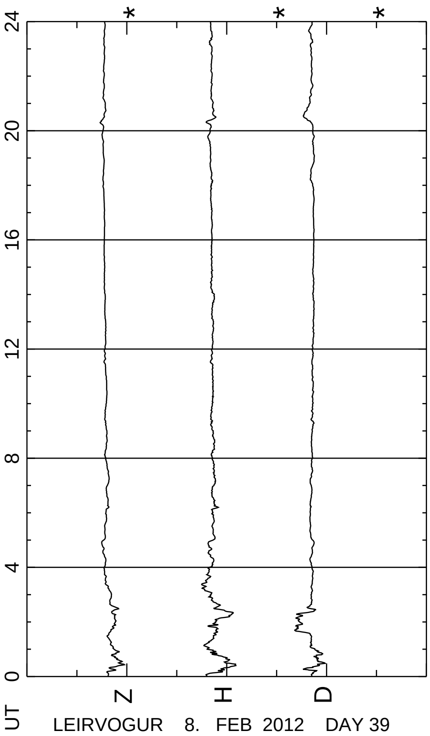
LEIRVOGUR 7. FEB 2012 DAY 38



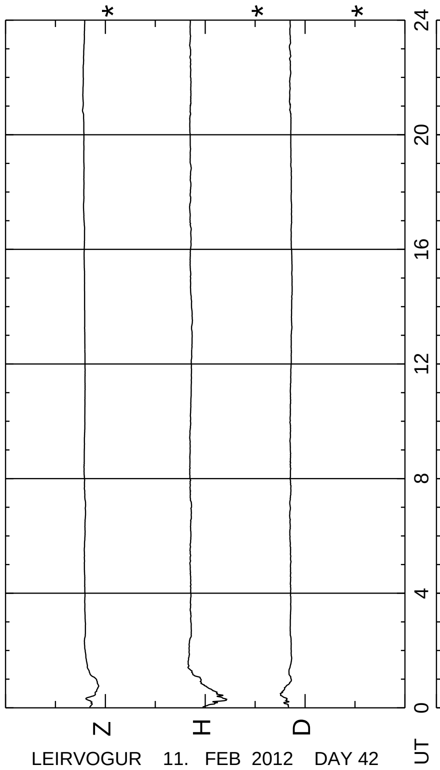
LEIRVOGUR 9. FEB 2012 DAY 40



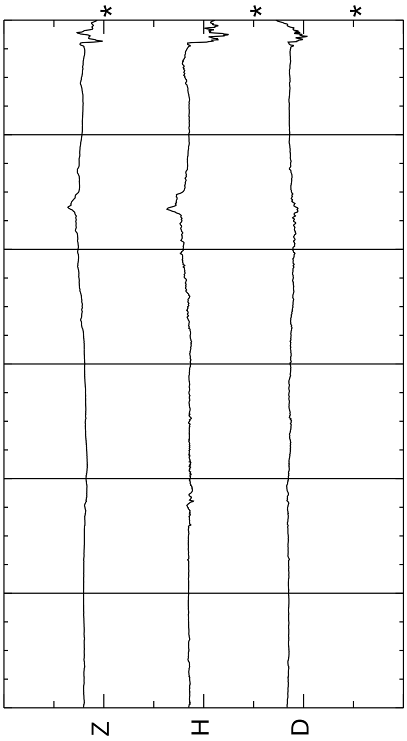
LEIRVOGUR 6. FEB 2012 DAY 37



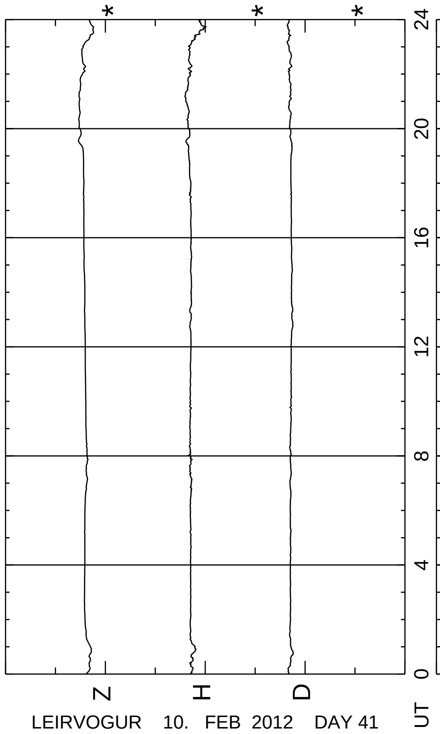
LEIRVOGUR 8. FEB 2012 DAY 39



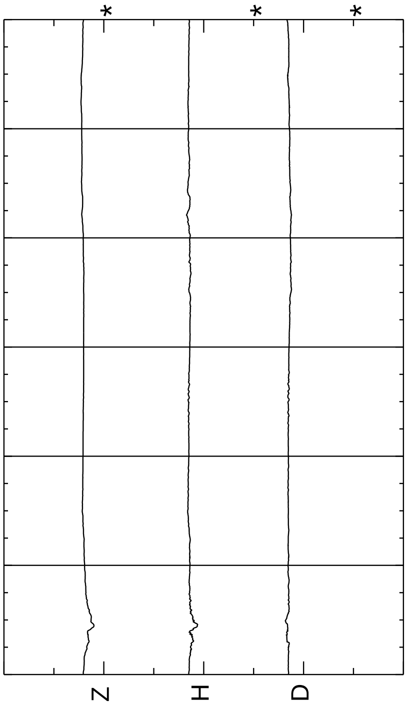
LEIRVOGUR 11. FEB 2012 DAY 42



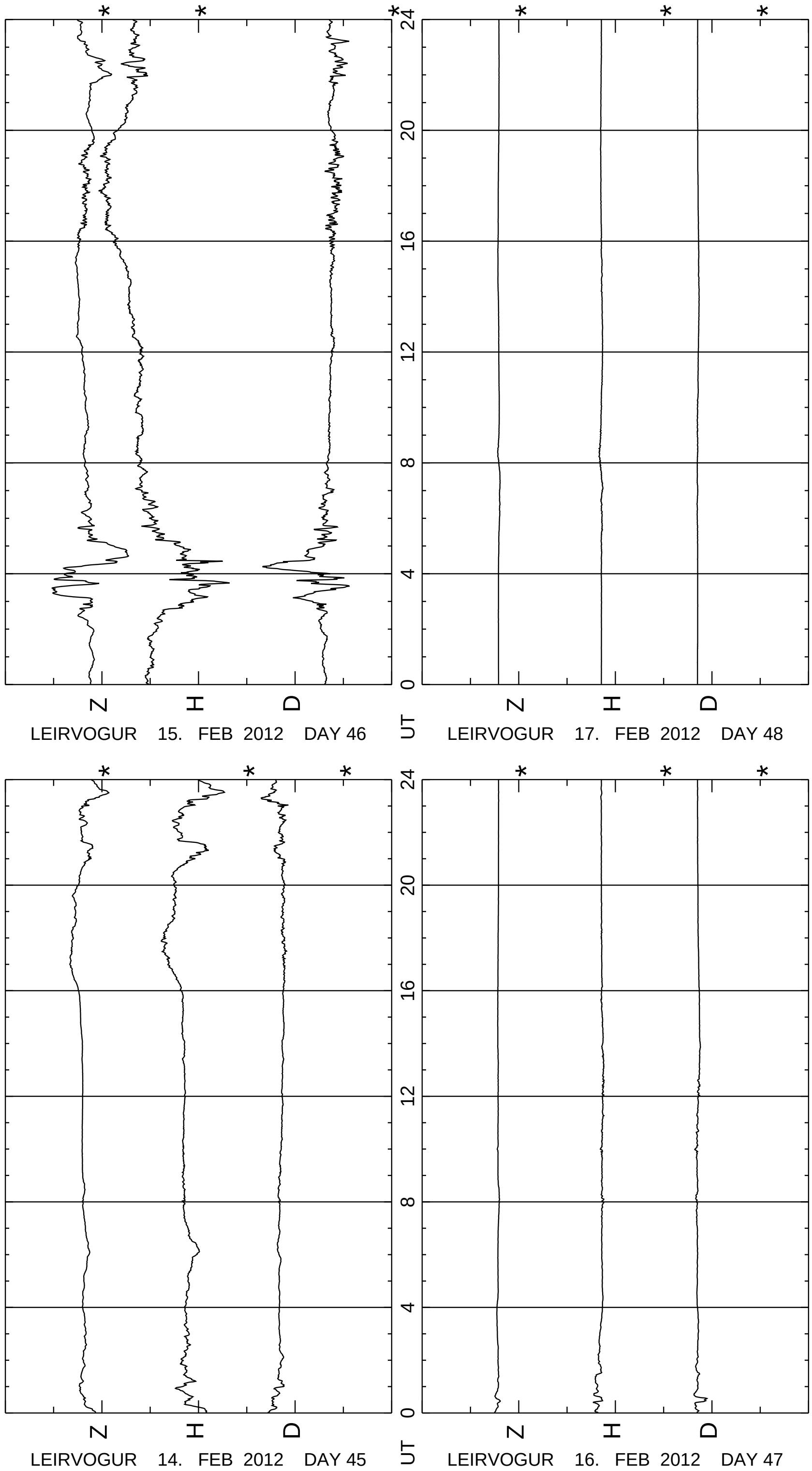
LEIRVOGUR 13. FEB 2012 DAY 44



LEIRVOGUR 10. FEB 2012 DAY 41



LEIRVOGUR 12. FEB 2012 DAY 43


LEIRVOGUR 15. FEB 2012 DAY 46
LEIRVOGUR 17. FEB 2012 DAY 48
LEIRVOGUR 14. FEB 2012 DAY 45
LEIRVOGUR 16. FEB 2012 DAY 47
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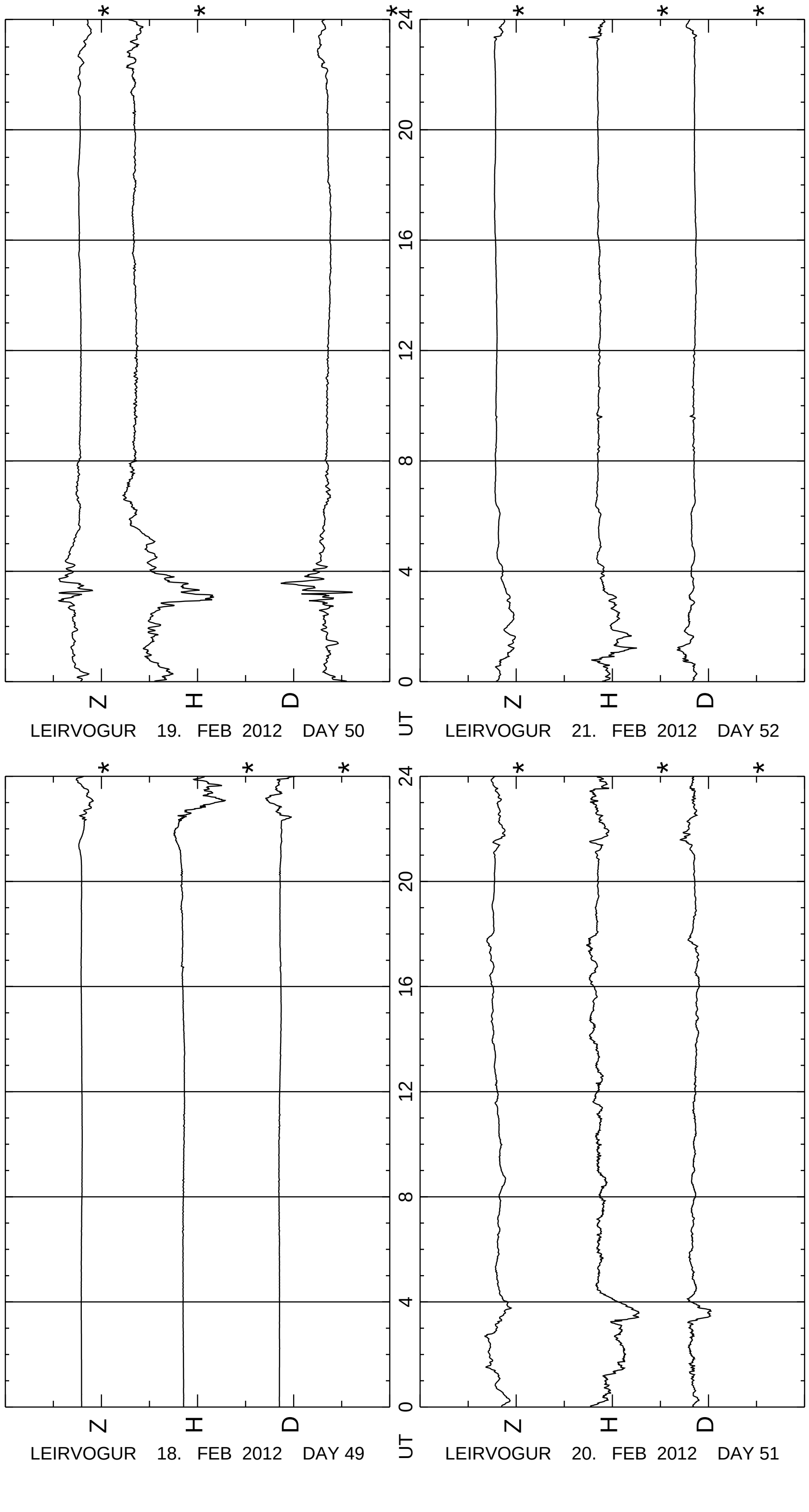
LEIRVOGUR 19. FEB 2012 DAY 50
LEIRVOGUR 21. FEB 2012 DAY 52
LEIRVOGUR 18. FEB 2012 DAY 49
LEIRVOGUR 20. FEB 2012 DAY 51
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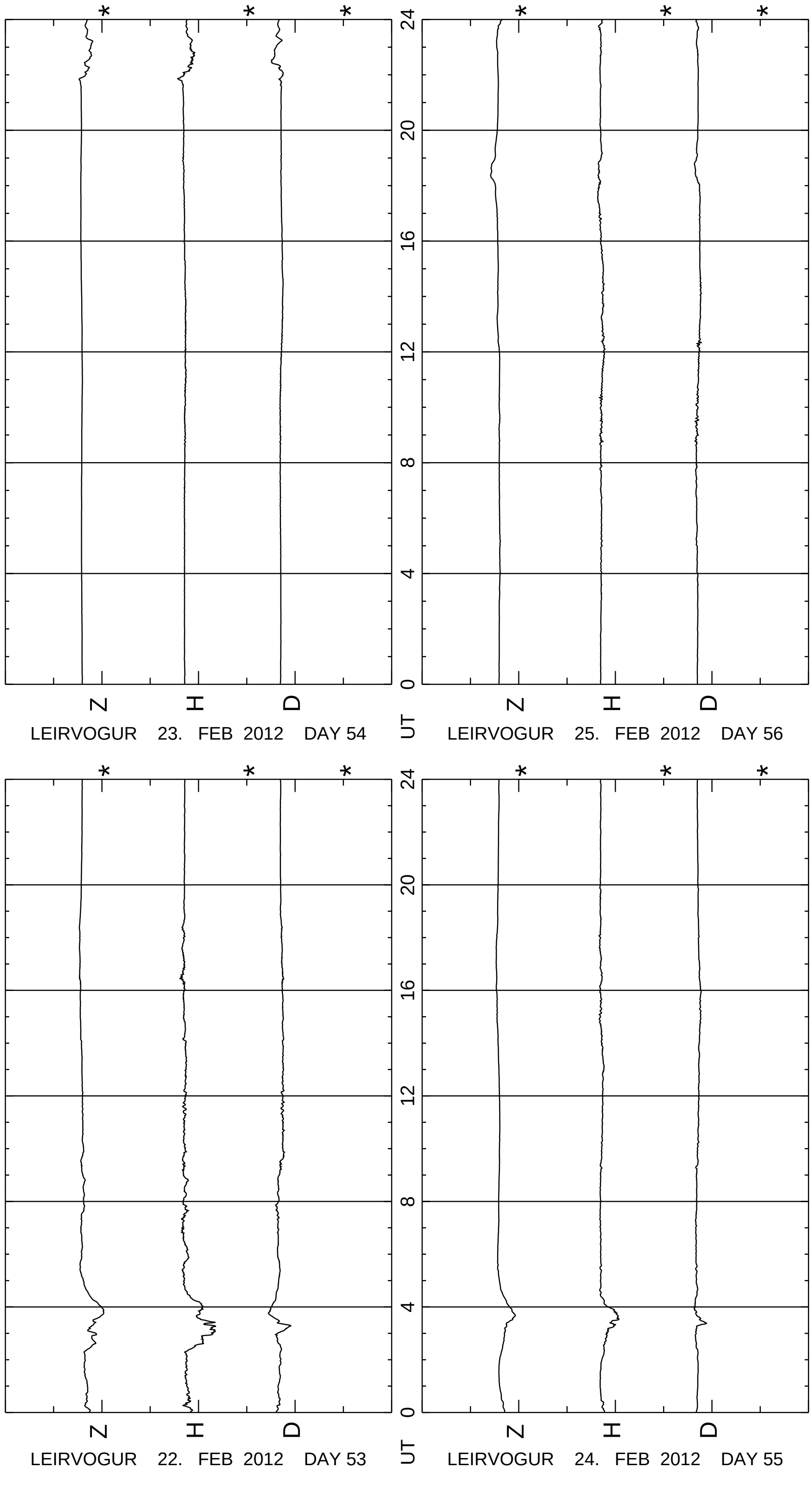
LEIRVOGUR 23. FEB 2012 DAY 54
LEIRVOGUR 25. FEB 2012 DAY 56
LEIRVOGUR 22. FEB 2012 DAY 53
LEIRVOGUR 24. FEB 2012 DAY 55
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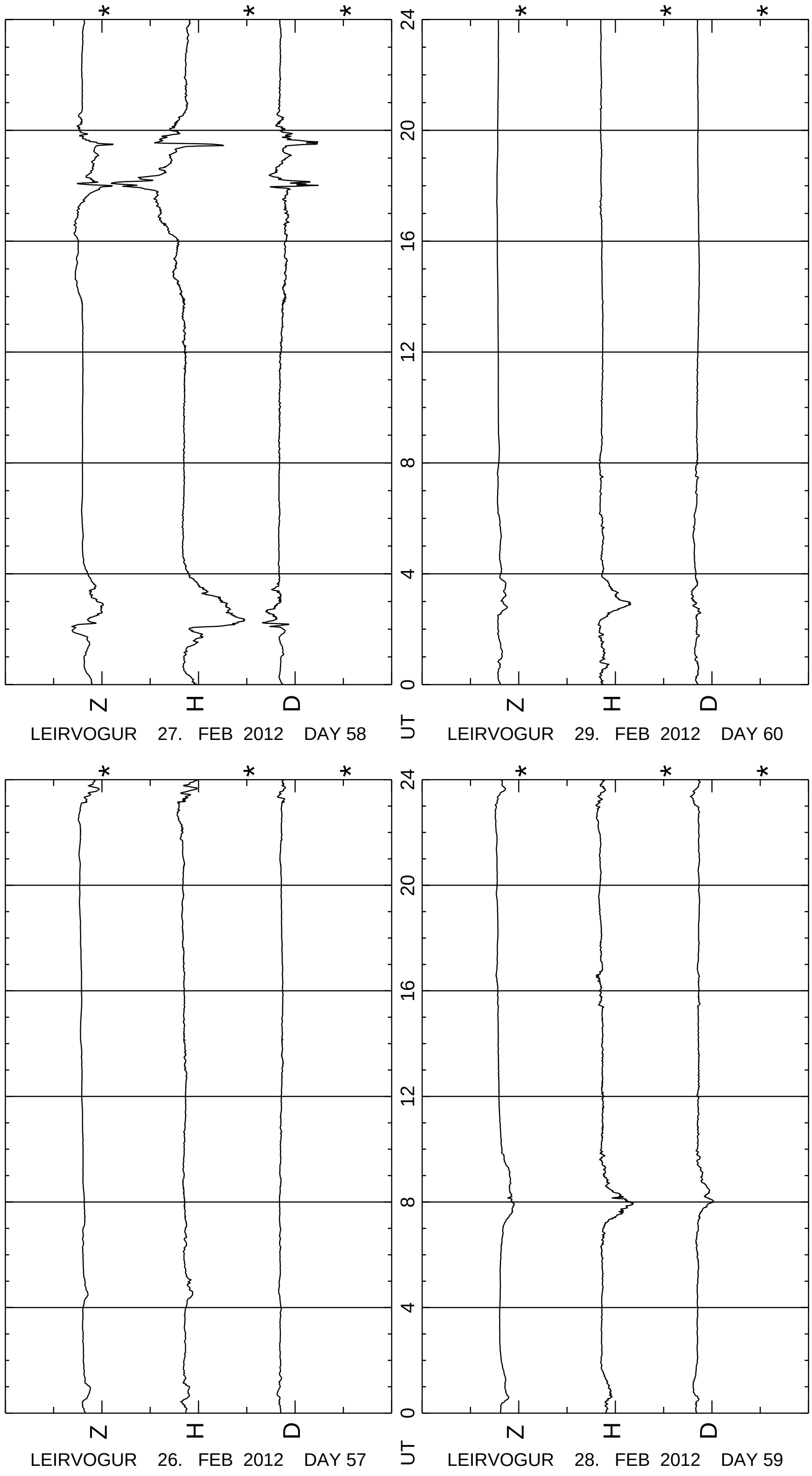
LEIRVOGUR 27. FEB 2012 DAY 58
LEIRVOGUR 29. FEB 2012 DAY 60
LEIRVOGUR 26. FEB 2012 DAY 57
LEIRVOGUR 28. FEB 2012 DAY 59
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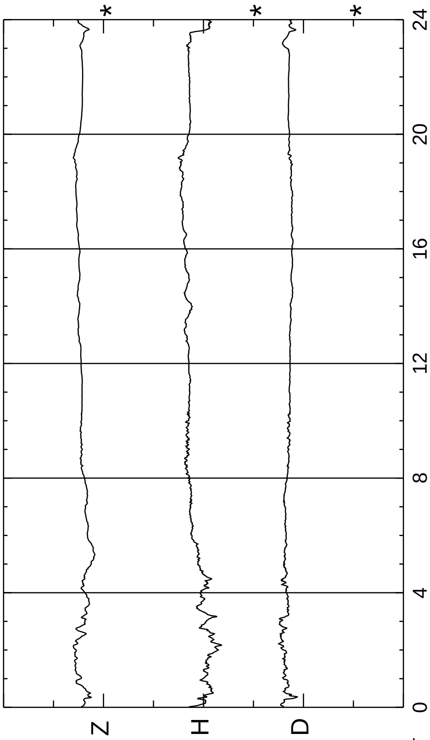
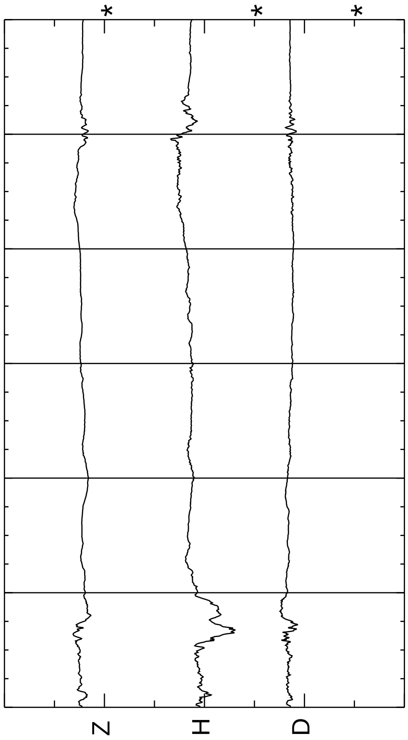
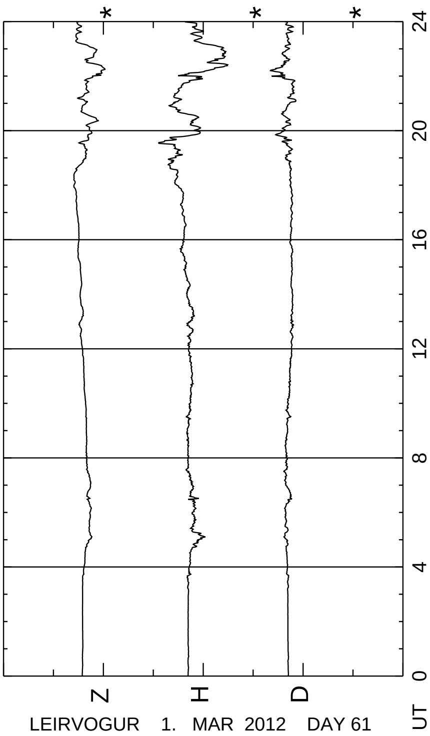


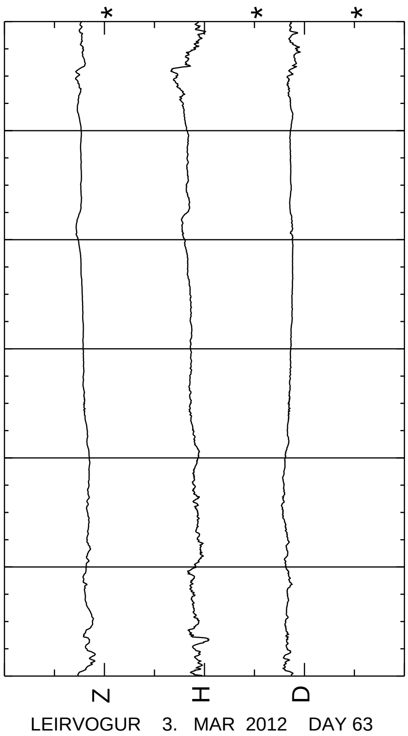
LEIRVOGUR 2. MAR 2012 DAY 62



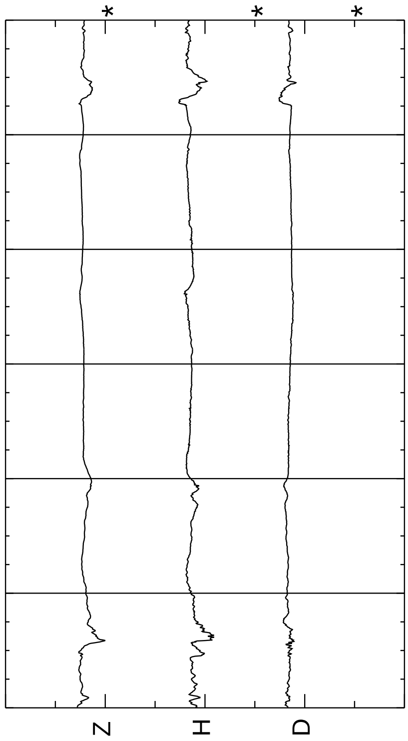
LEIRVOGUR 4. MAR 2012 DAY 64



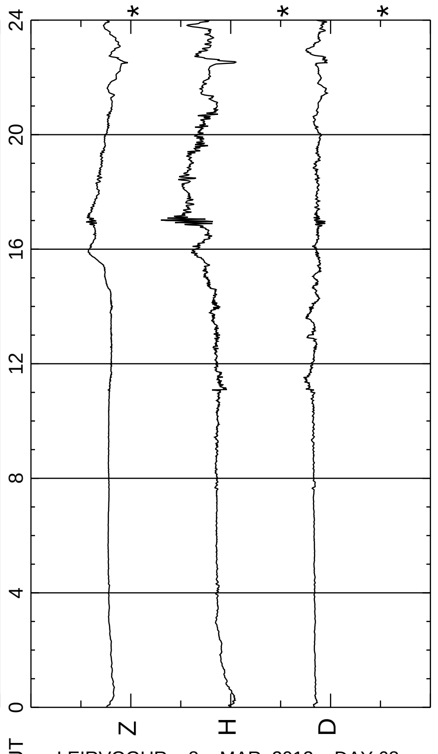
LEIRVOGUR 1. MAR 2012 DAY 61



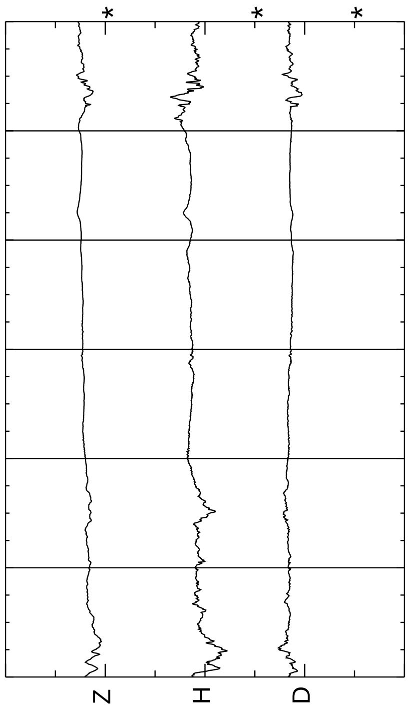
LEIRVOGUR 3. MAR 2012 DAY 63



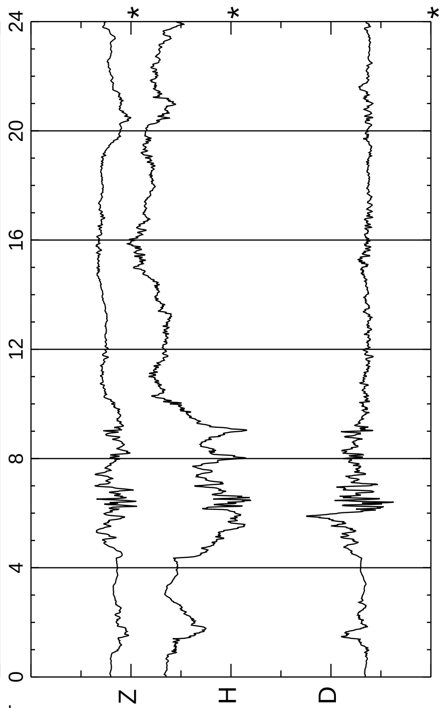
LEIRVOGUR 6. MAR 2012 DAY 66



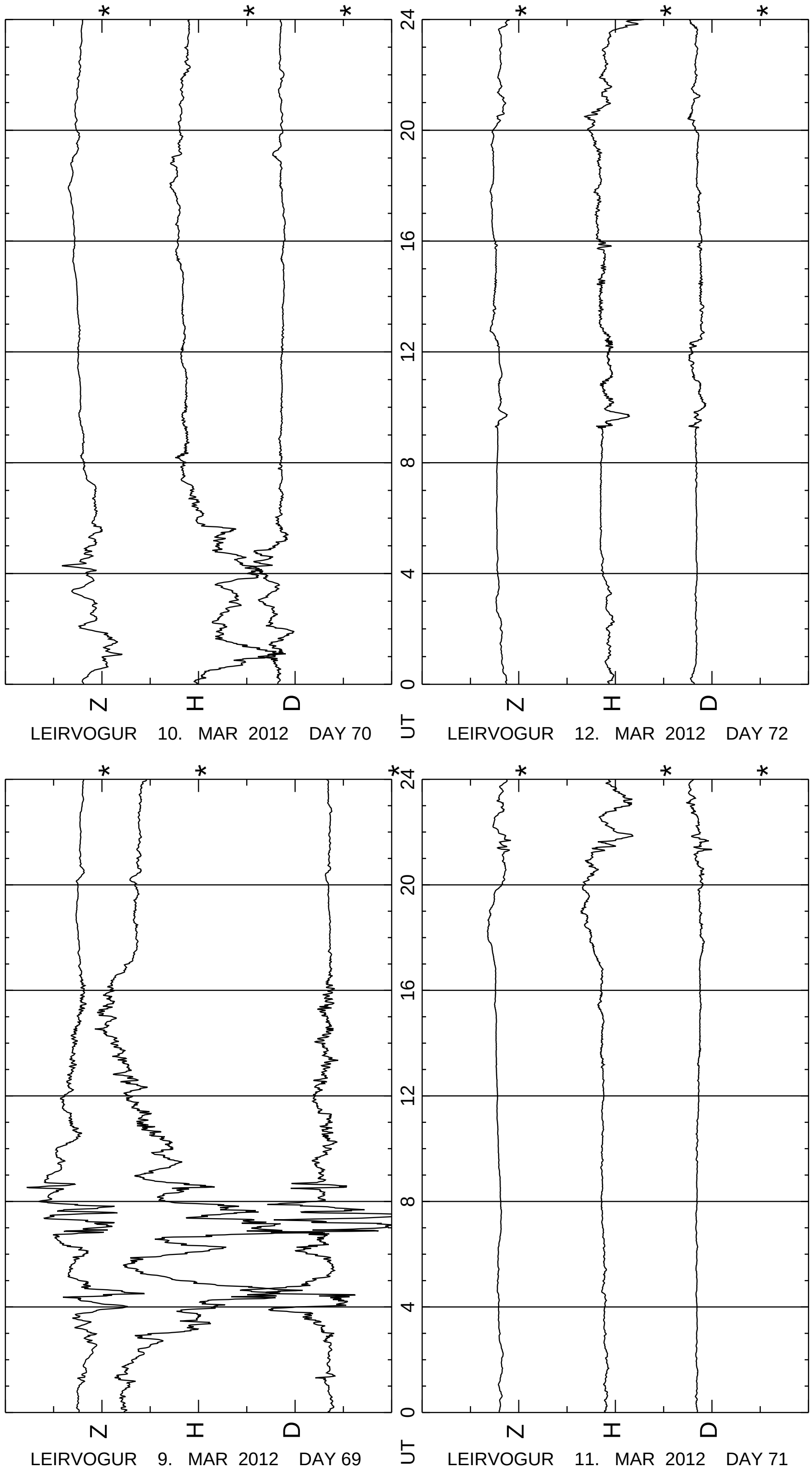
LEIRVOGUR 8. MAR 2012 DAY 68



LEIRVOGUR 5. MAR 2012 DAY 65



LEIRVOGUR 7. MAR 2012 DAY 67


LEIRVOGUR 10. MAR 2012 DAY 70
LEIRVOGUR 12. MAR 2012 DAY 72
LEIRVOGUR 9. MAR 2012 DAY 69
LEIRVOGUR 11. MAR 2012 DAY 71
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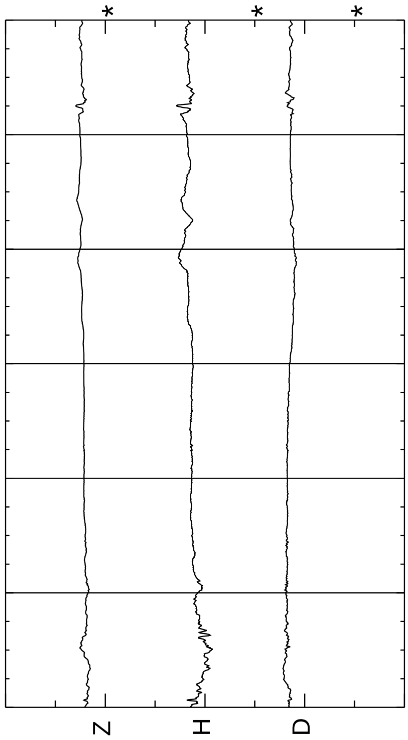
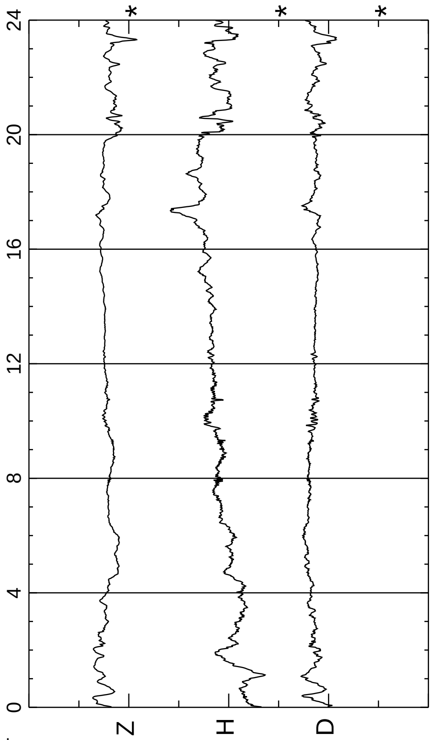
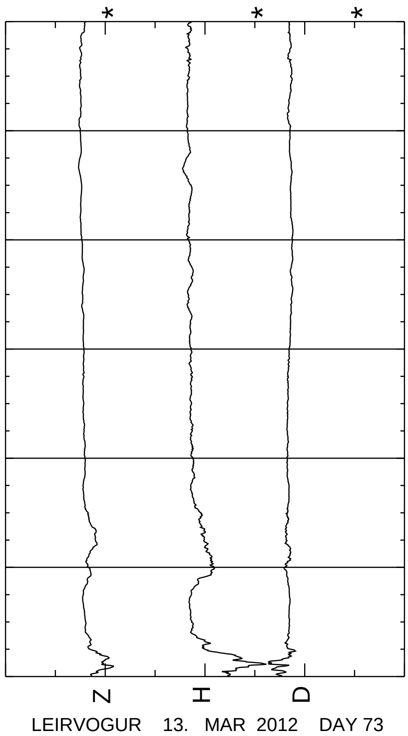


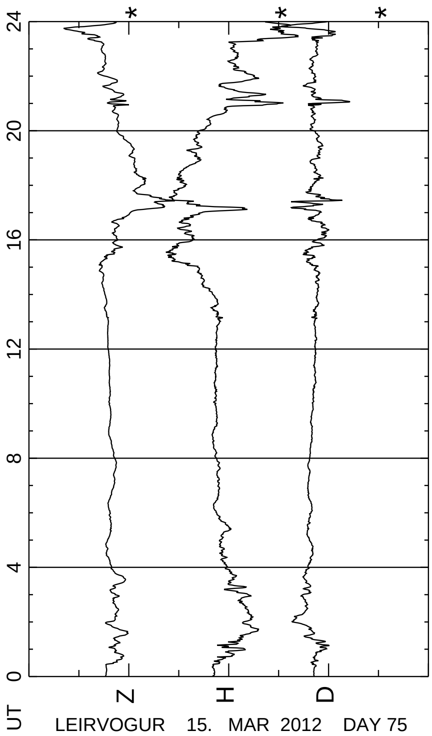
LEIRVOGUR 14. MAR 2012 DAY 74



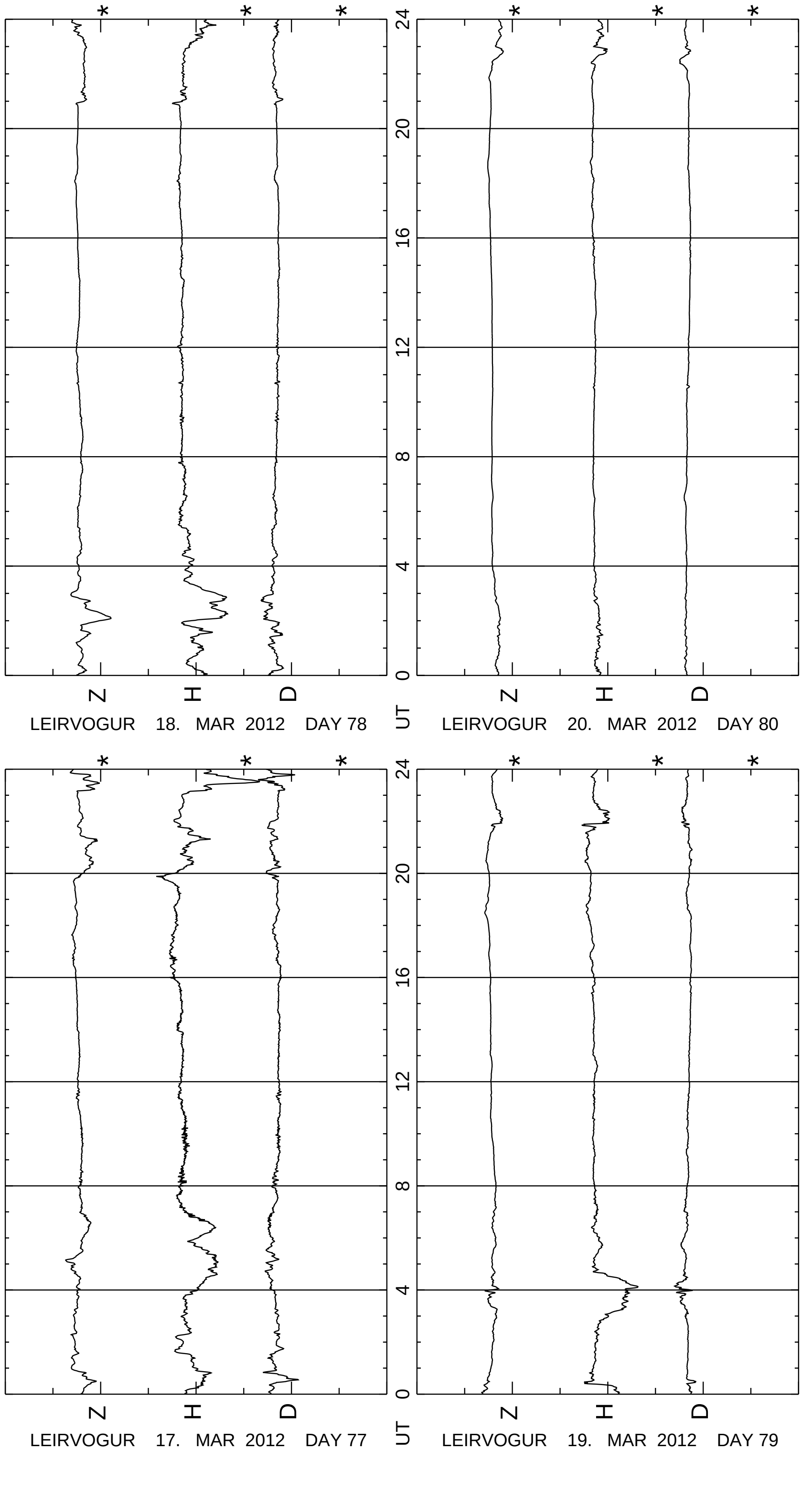
LEIRVOGUR 16. MAR 2012 DAY 76



LEIRVOGUR 13. MAR 2012 DAY 73



LEIRVOGUR 15. MAR 2012 DAY 75


LEIRVOGUR 18. MAR 2012 DAY 78
LEIRVOGUR 20. MAR 2012 DAY 80
LEIRVOGUR 17. MAR 2012 DAY 77
LEIRVOGUR 19. MAR 2012 DAY 79
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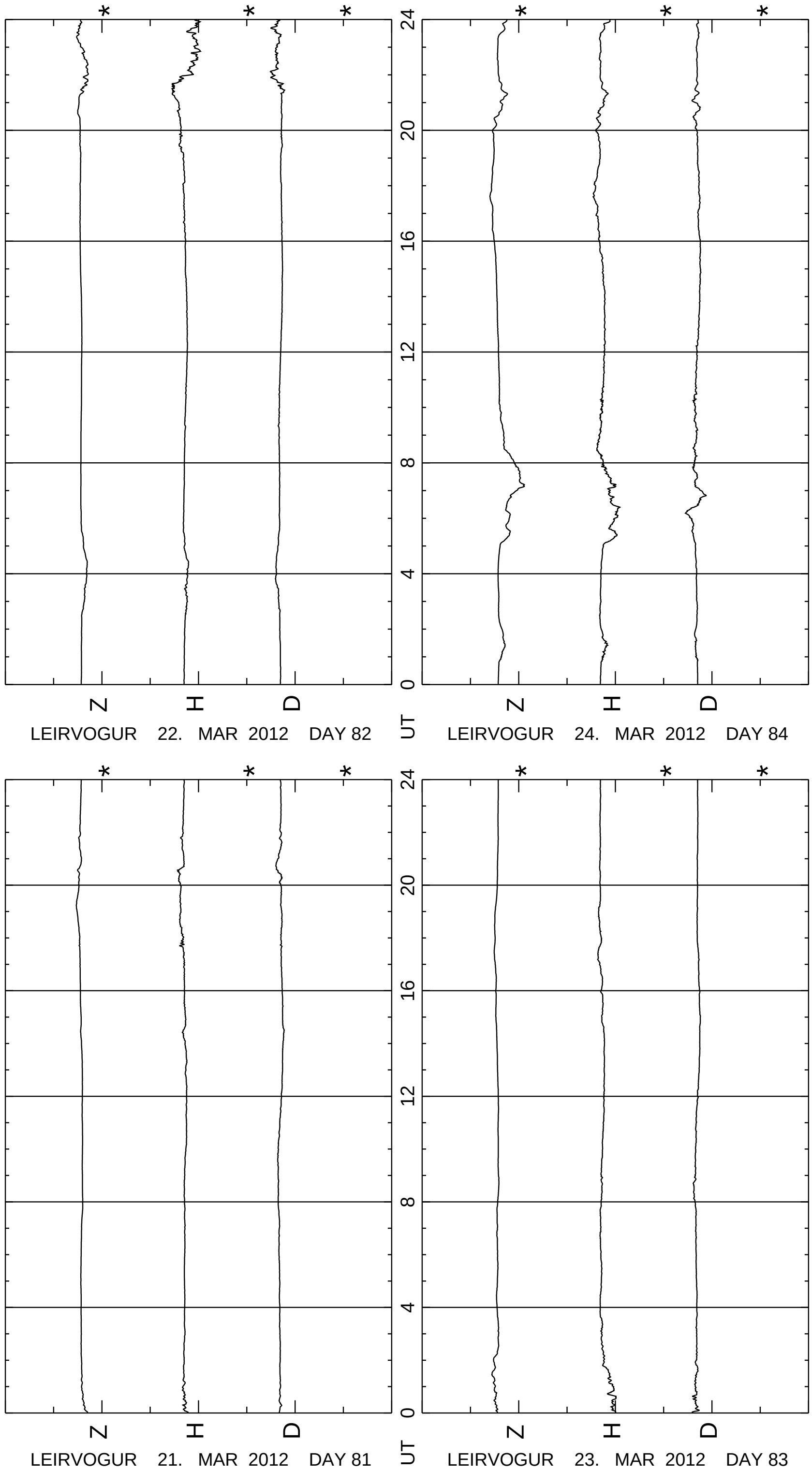
Z H D
LEIRVOGUR 22. MAR 2012 DAY 82
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Z H D
LEIRVOGUR 24. MAR 2012 DAY 84
Z H D
LEIRVOGUR 21. MAR 2012 DAY 81
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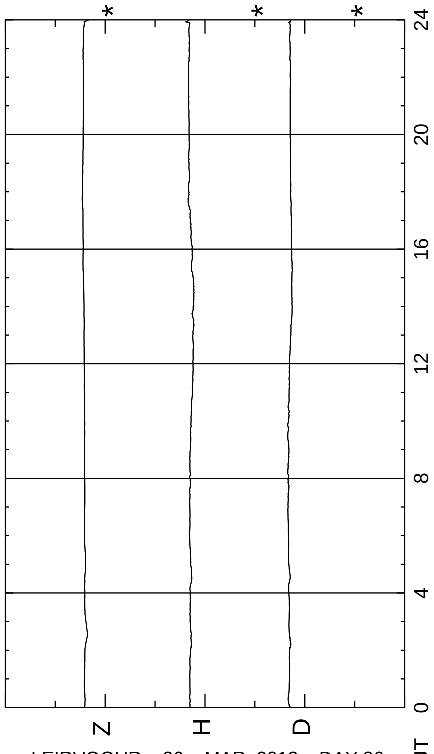
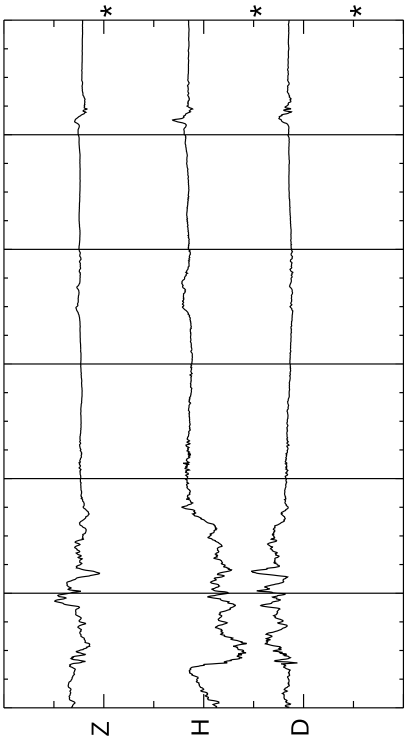
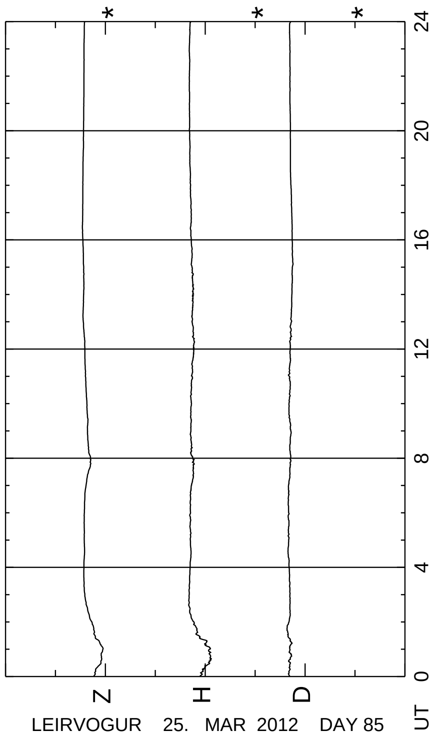
Z H D
LEIRVOGUR 23. MAR 2012 DAY 83
0 4 8 12 16 20 24



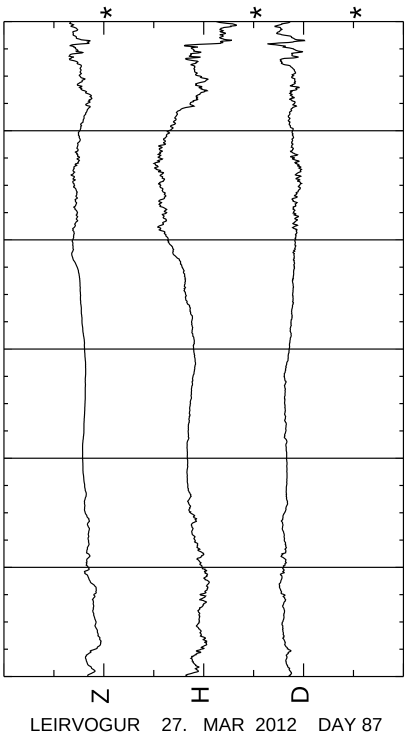
LEIRVOGUR 26. MAR 2012 DAY 86



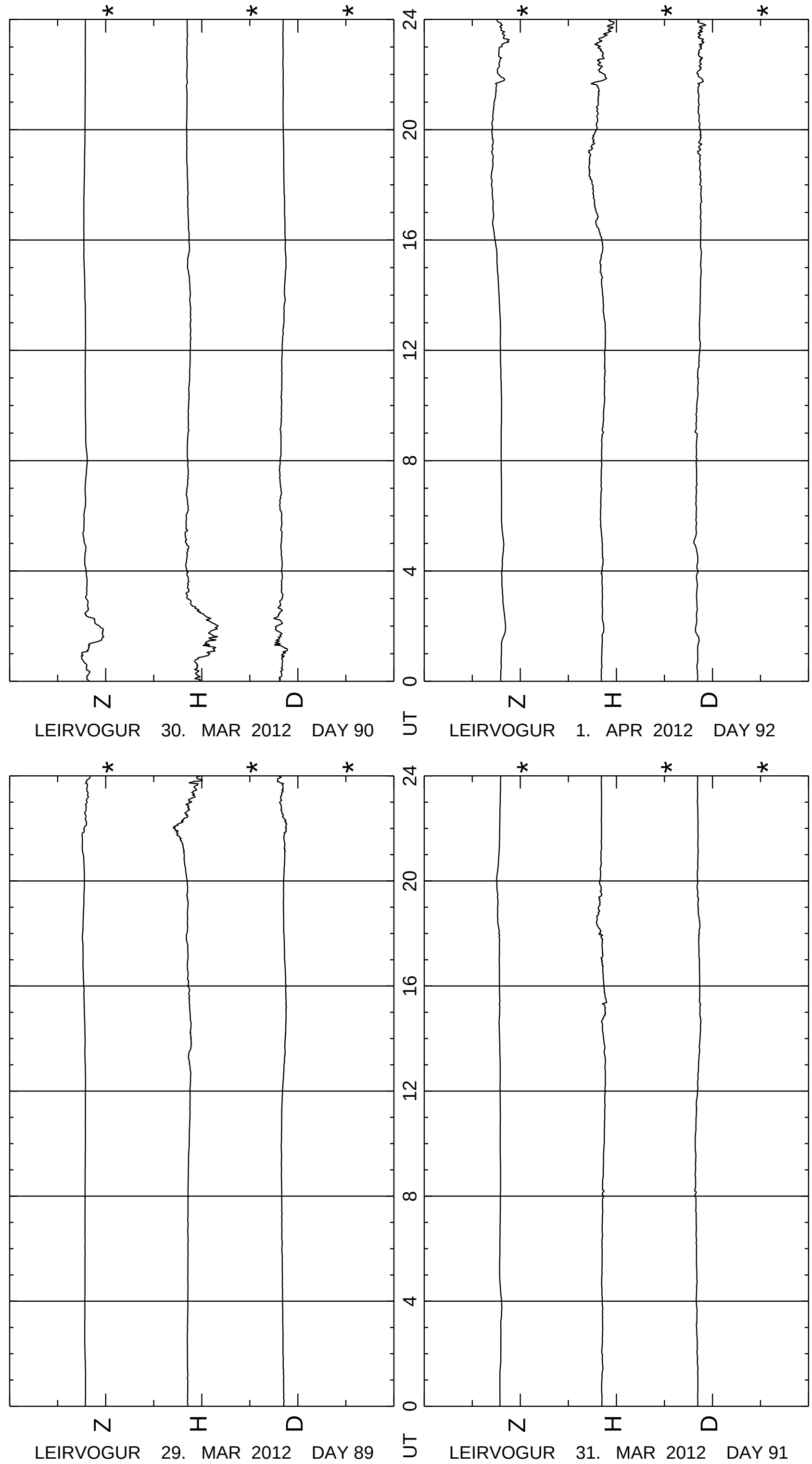
LEIRVOGUR 28. MAR 2012 DAY 88



LEIRVOGUR 25. MAR 2012 DAY 85



LEIRVOGUR 27. MAR 2012 DAY 87


LEIRVOGUR 30. MAR 2012 DAY 90
LEIRVOGUR 1. APR 2012 DAY 92
LEIRVOGUR 29. MAR 2012 DAY 89
LEIRVOGUR 31. MAR 2012 DAY 91
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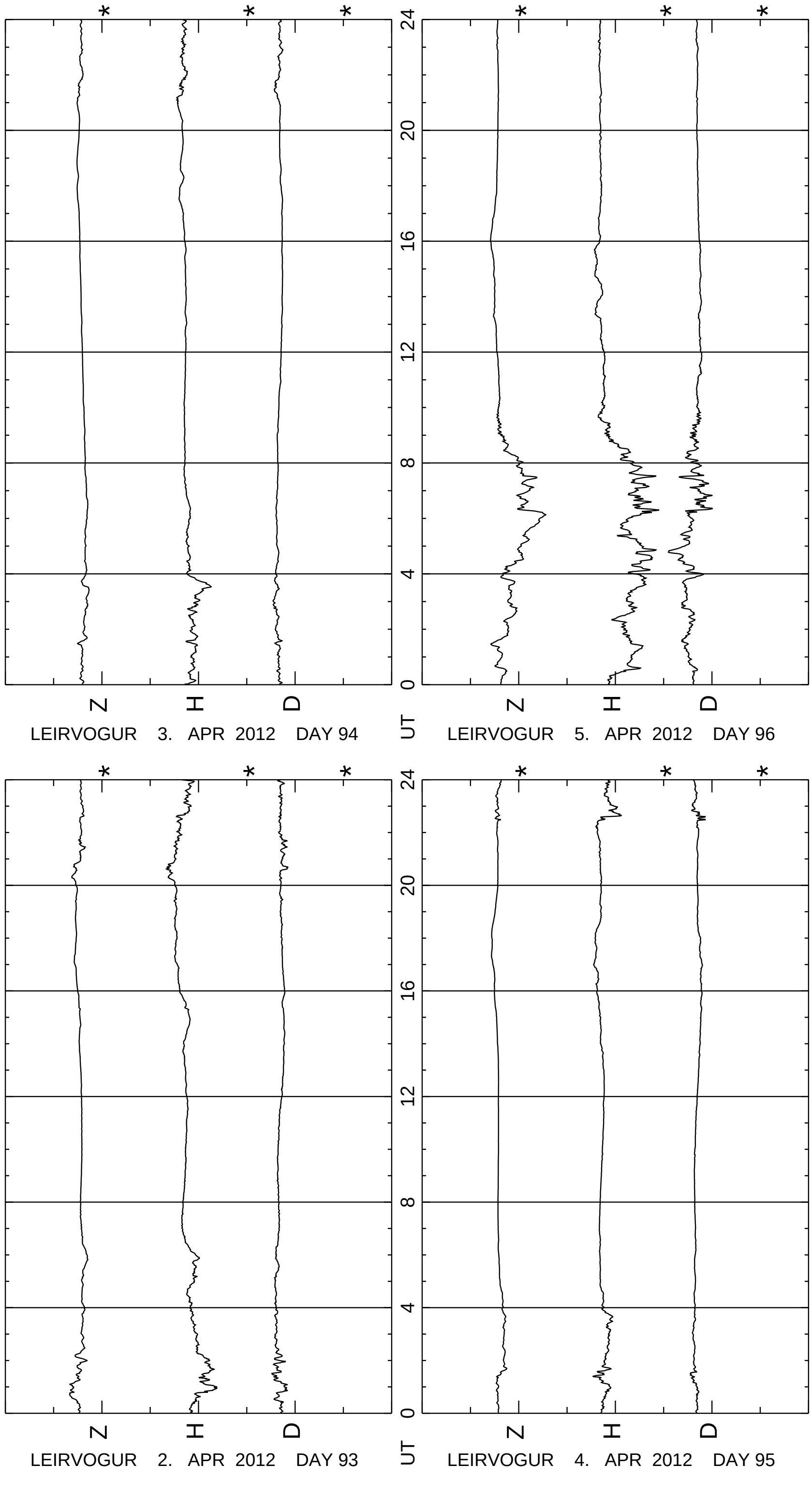

Z H D
LEIRVOGUR 3. APR 2012 DAY 94
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LEIRVOGUR 5. APR 2012 DAY 96
Z H D
LEIRVOGUR 2. APR 2012 DAY 93
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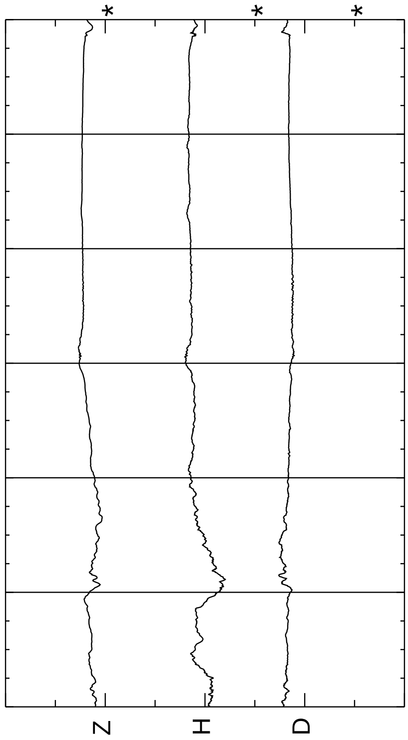
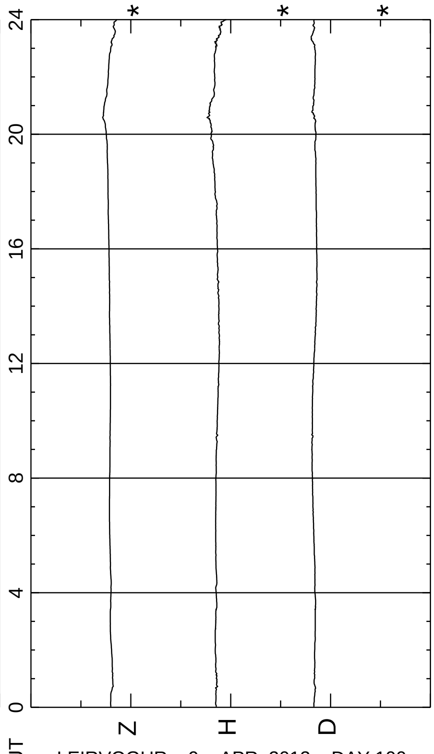
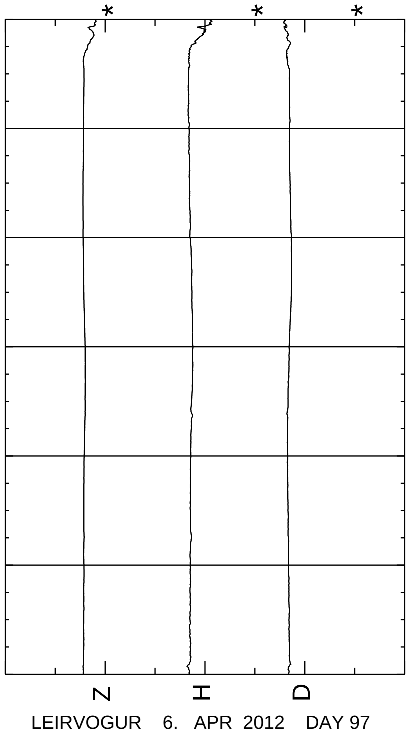
LEIRVOGUR 4. APR 2012 DAY 95
0 4 8 12 16 20 24



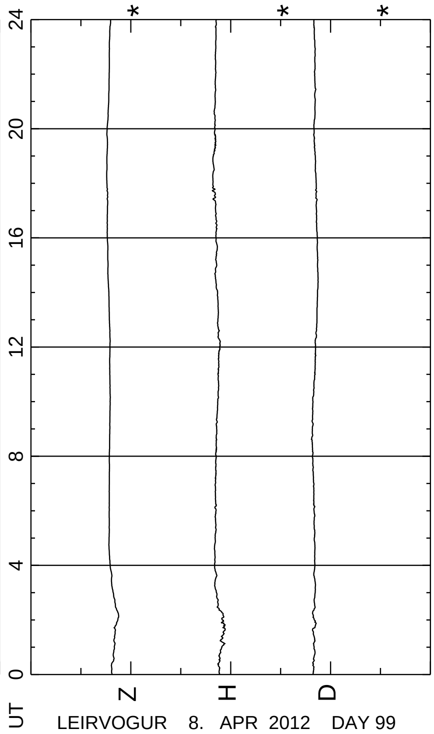
LEIRVOGUR 7. APR 2012 DAY 98



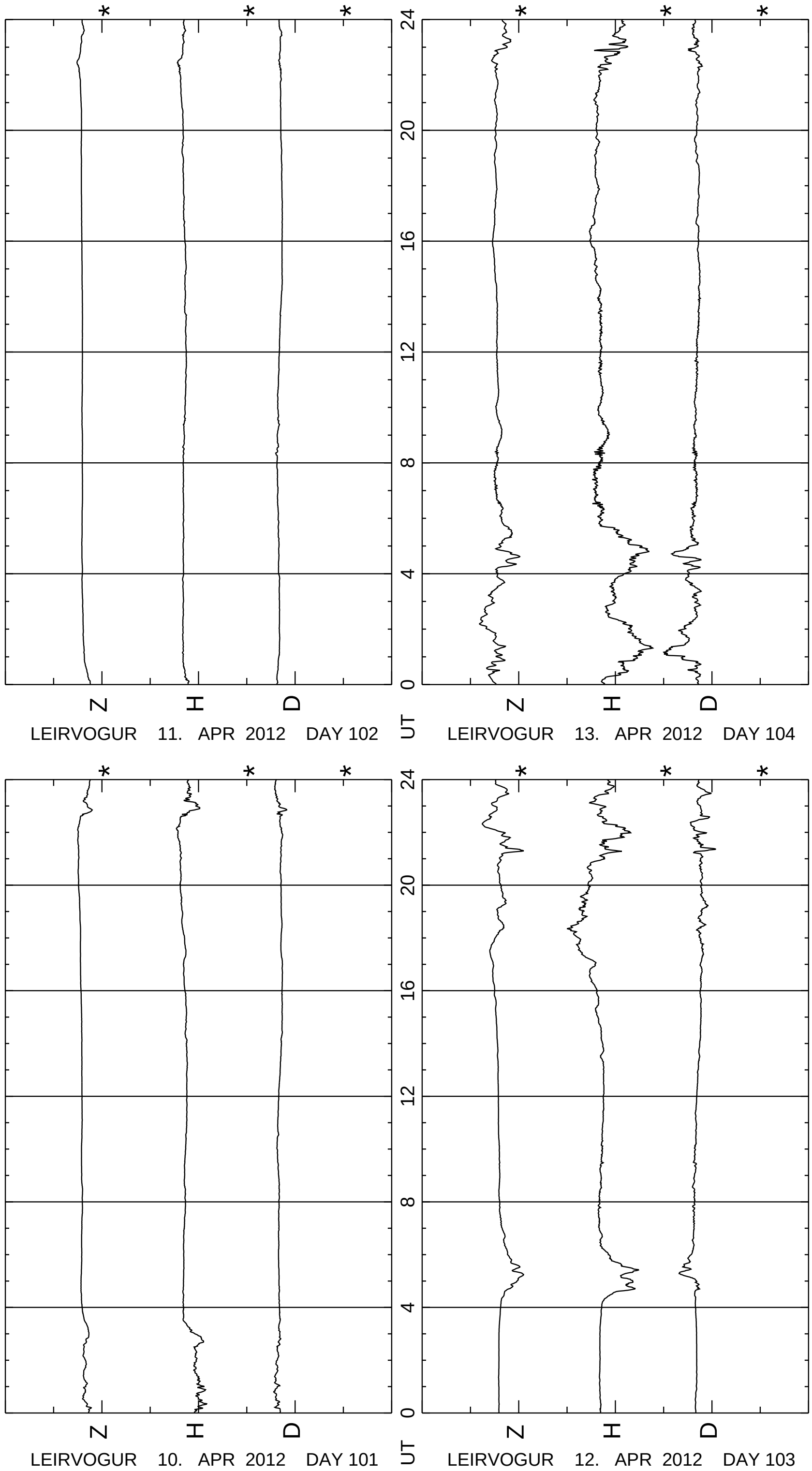
LEIRVOGUR 9. APR 2012 DAY 100



LEIRVOGUR 6. APR 2012 DAY 97



LEIRVOGUR 8. APR 2012 DAY 99


LEIRVOGUR 11. APR 2012 DAY 102
LEIRVOGUR 13. APR 2012 DAY 104
LEIRVOGUR 10. APR 2012 DAY 101
LEIRVOGUR 12. APR 2012 DAY 103
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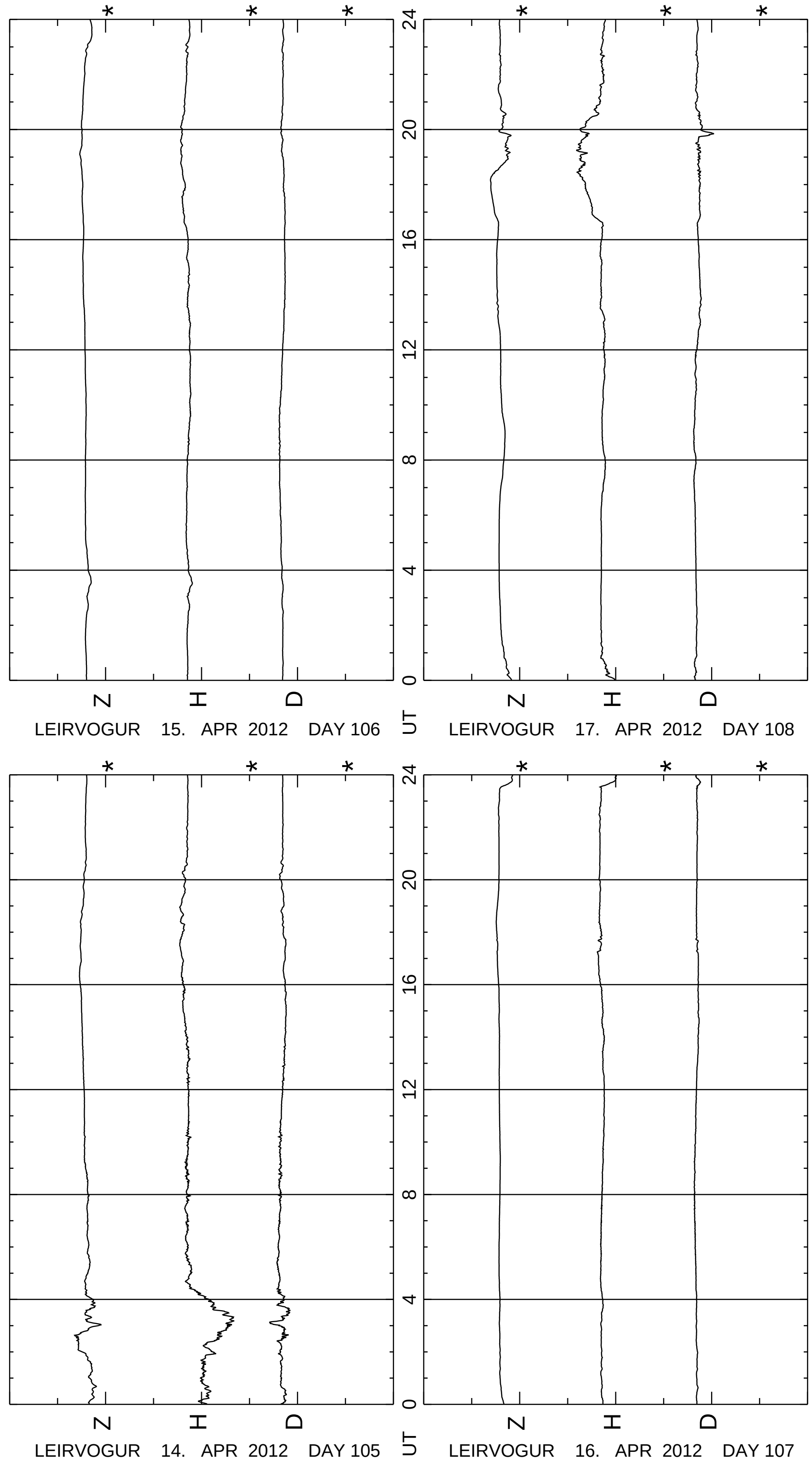
LEIRVOGUR 15. APR 2012 DAY 106
LEIRVOGUR 17. APR 2012 DAY 108
LEIRVOGUR 14. APR 2012 DAY 105
LEIRVOGUR 16. APR 2012 DAY 107
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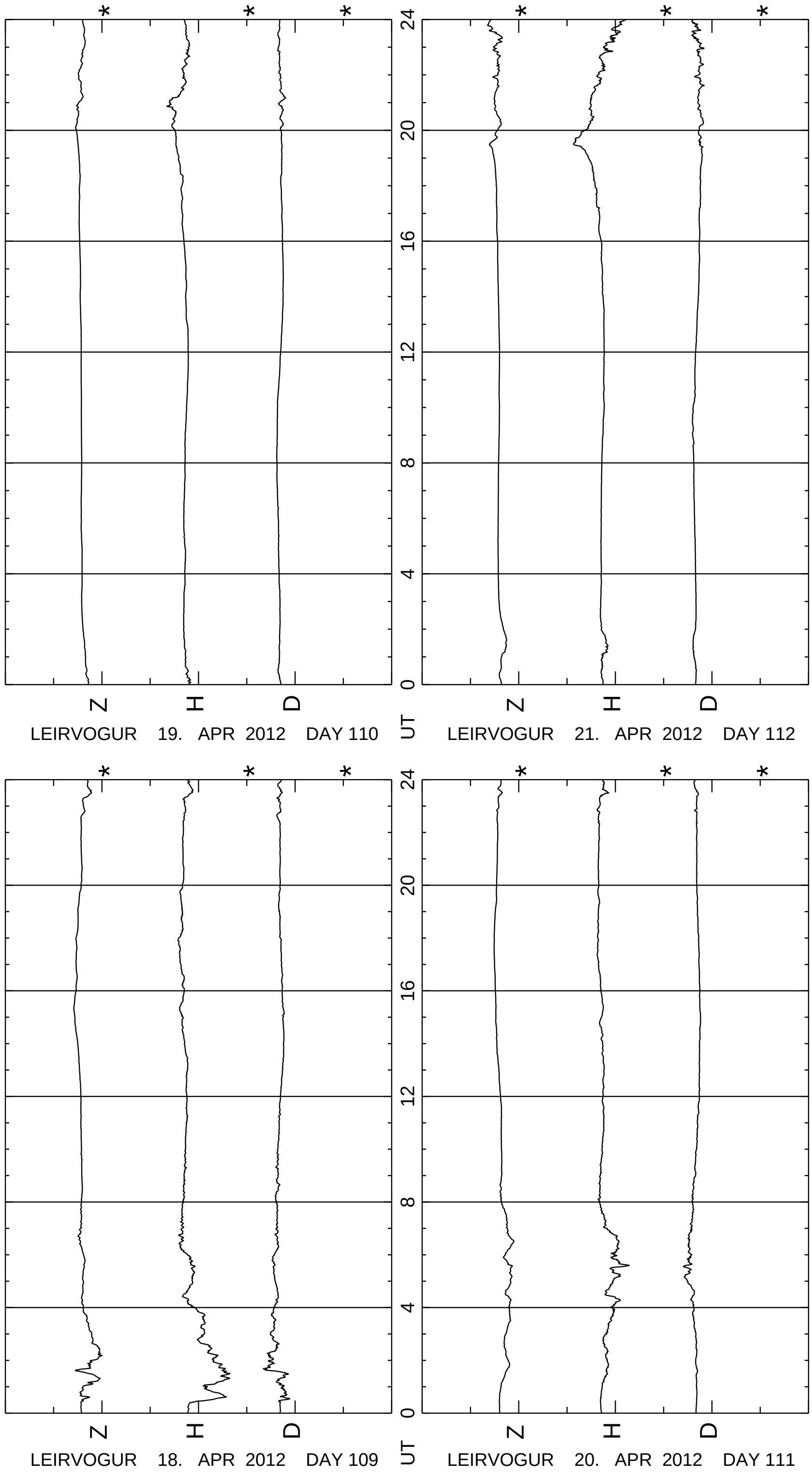
Z H D
LEIRVOGUR 19. APR 2012 DAY 110
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LEIRVOGUR 21. APR 2012 DAY 112
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LEIRVOGUR 18. APR 2012 DAY 109
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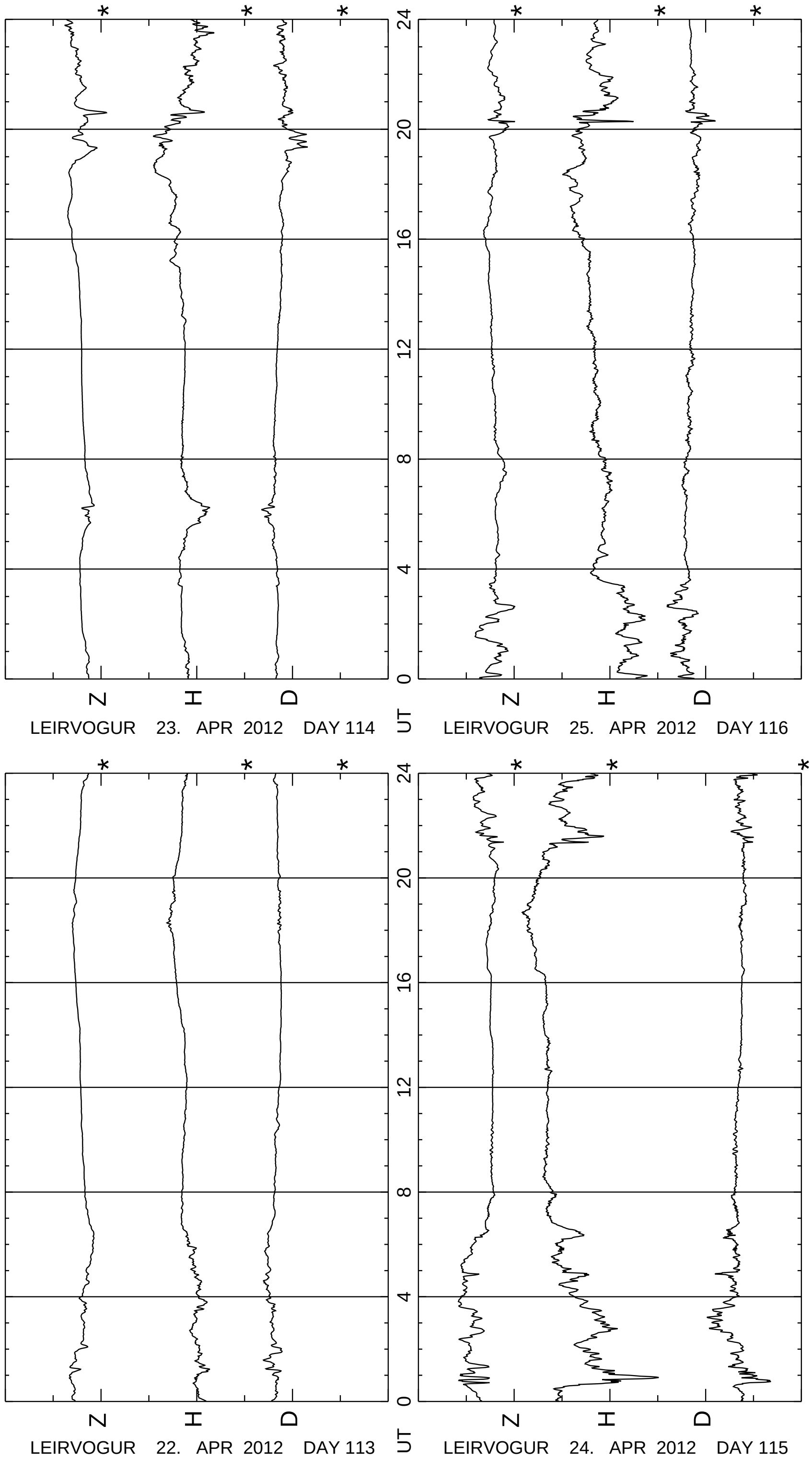
LEIRVOGUR 20. APR 2012 DAY 111
0 4 8 12 16 20 24


LEIRVOGUR 23. APR 2012 DAY 114
LEIRVOGUR 25. APR 2012 DAY 116
LEIRVOGUR 22. APR 2012 DAY 113
LEIRVOGUR 24. APR 2012 DAY 115
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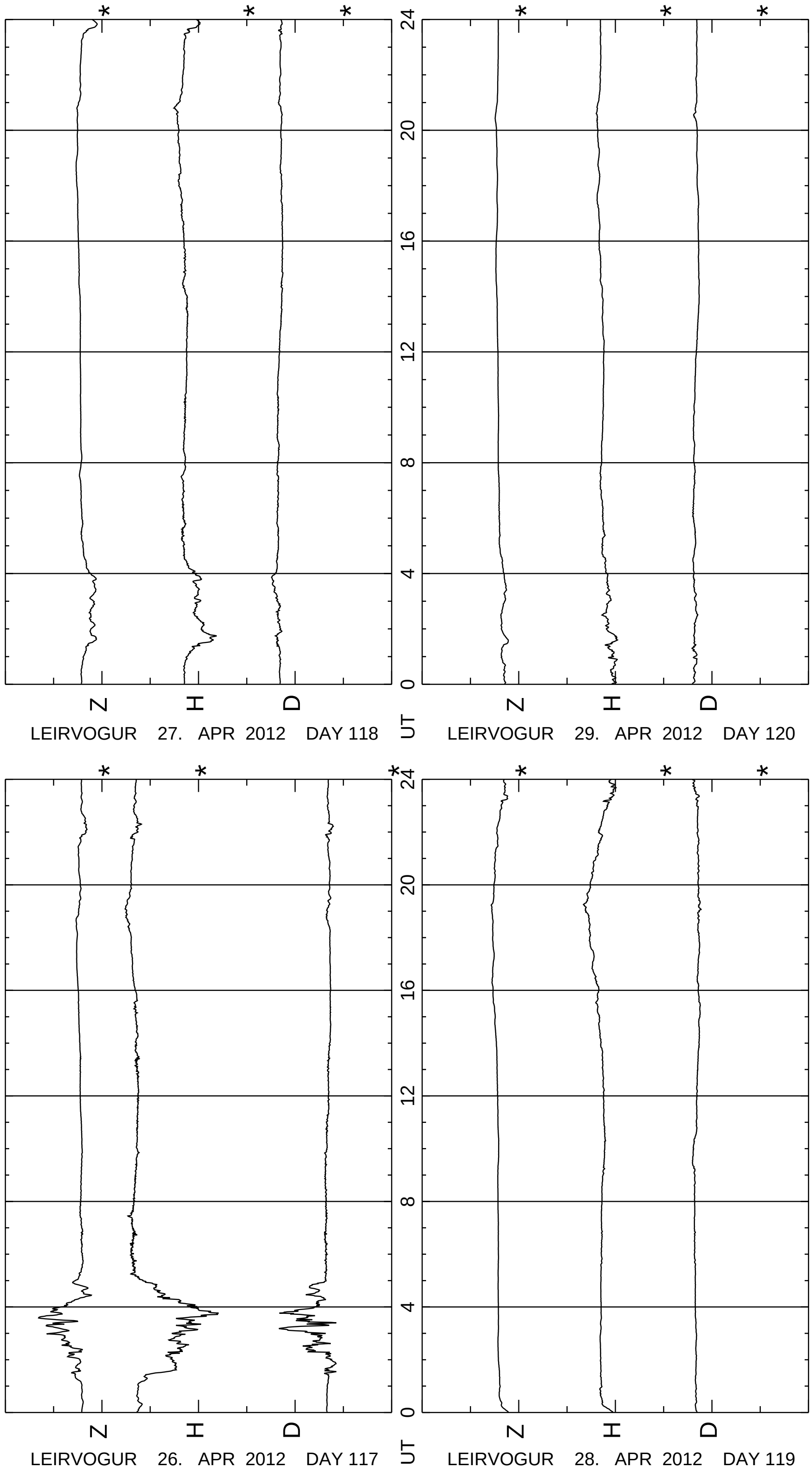

LEIRVOGUR 27. APR 2012 DAY 118
LEIRVOGUR 29. APR 2012 DAY 120
LEIRVOGUR 26. APR 2012 DAY 117
LEIRVOGUR 28. APR 2012 DAY 119
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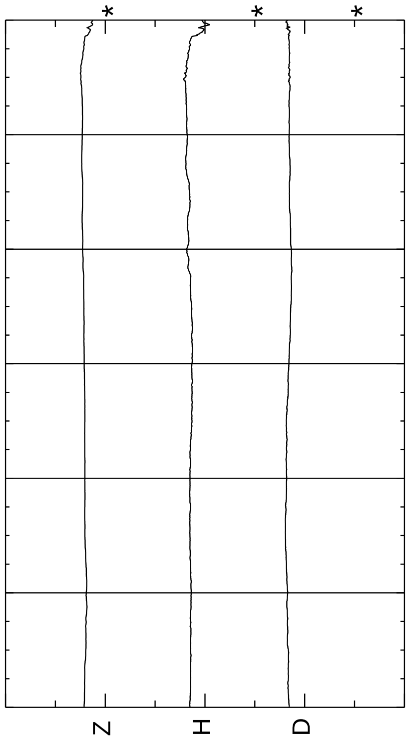
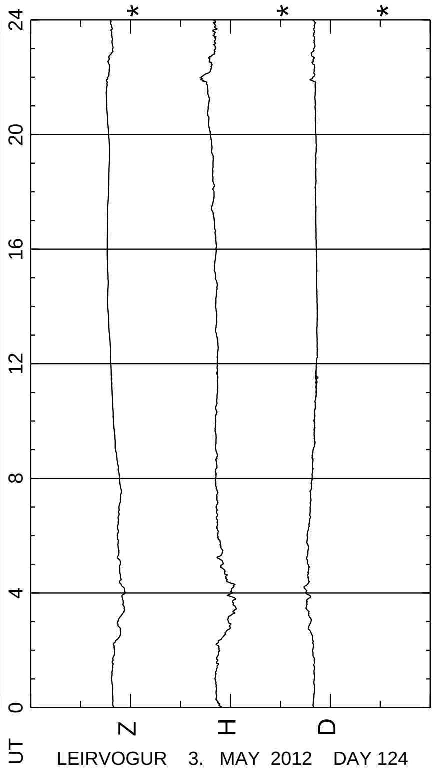
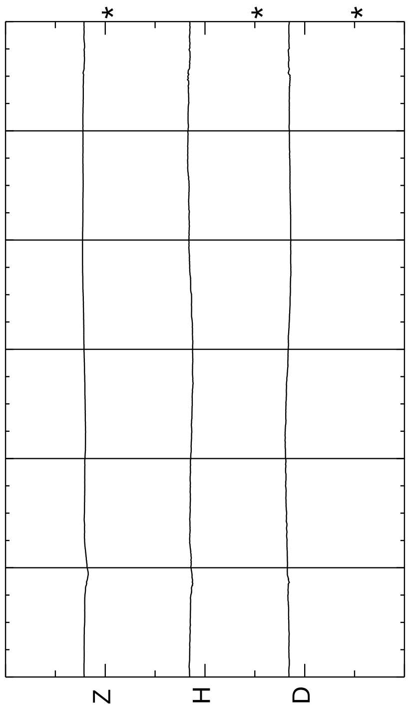


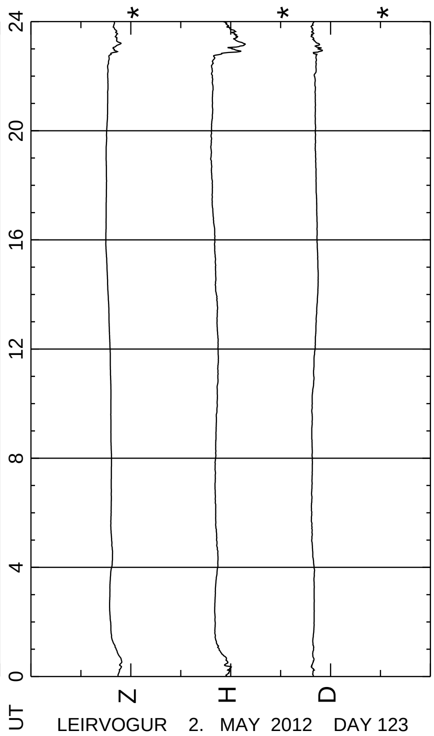
LEIRVOGUR 1. MAY 2012 DAY 122



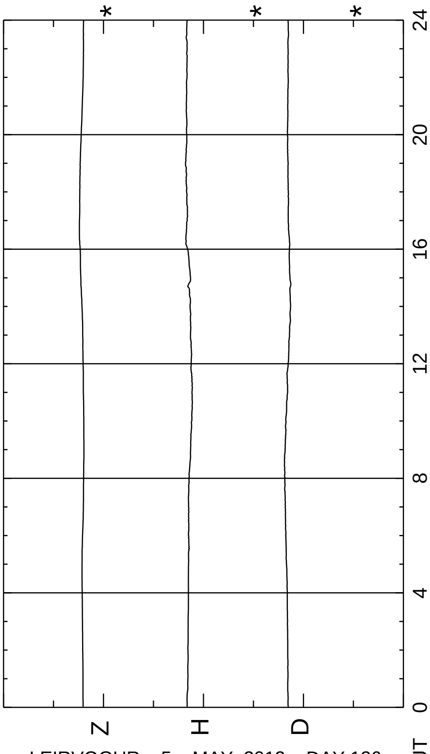
LEIRVOGUR 3. MAY 2012 DAY 124



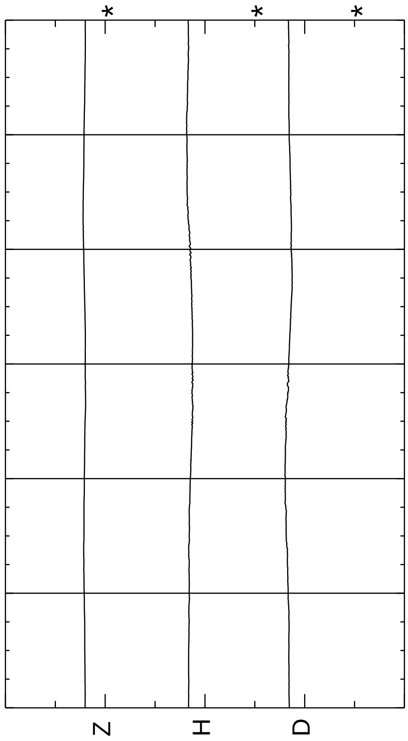
LEIRVOGUR 30. APR 2012 DAY 121



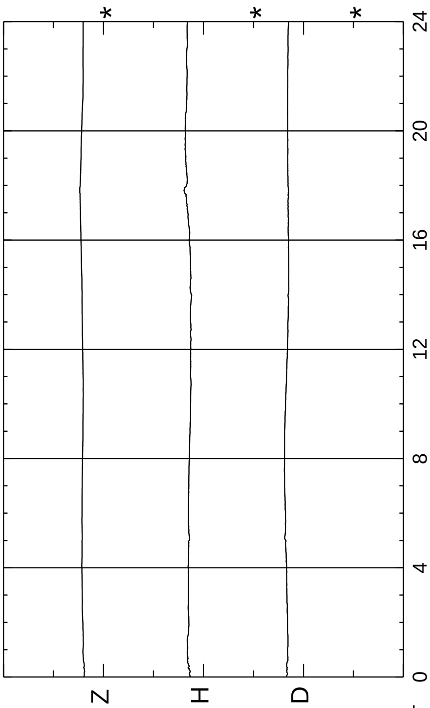
LEIRVOGUR 2. MAY 2012 DAY 123



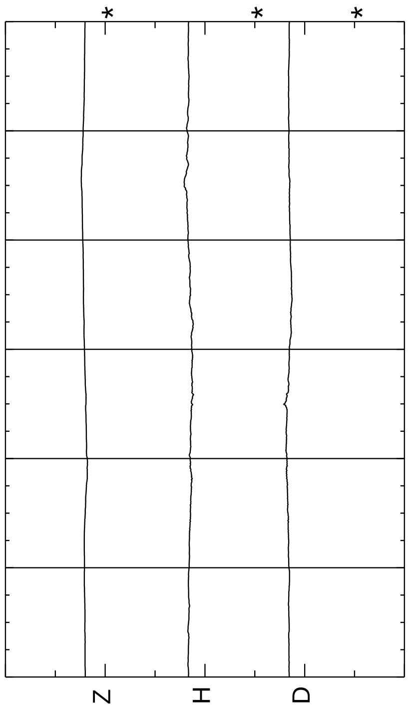
LEIRVOGUR 5. MAY 2012 DAY 126



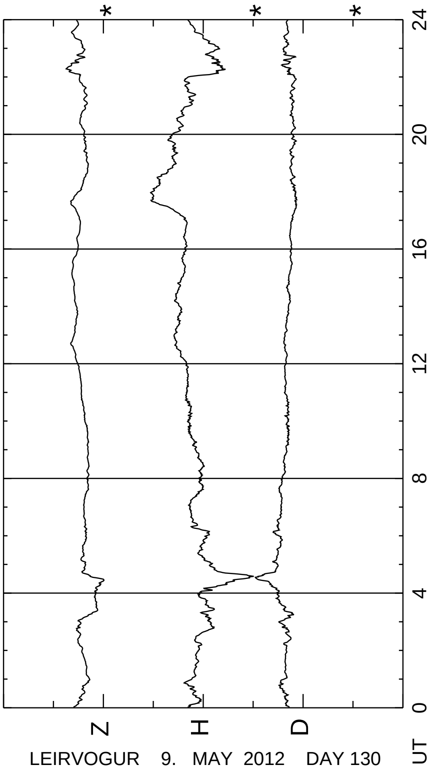
LEIRVOGUR 7. MAY 2012 DAY 128



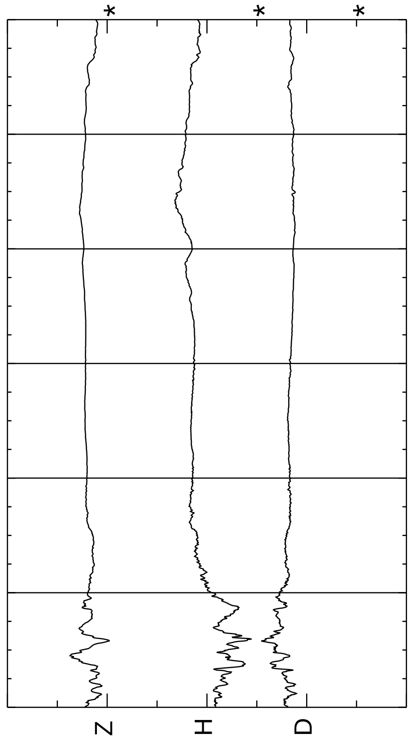
LEIRVOGUR 4. MAY 2012 DAY 125



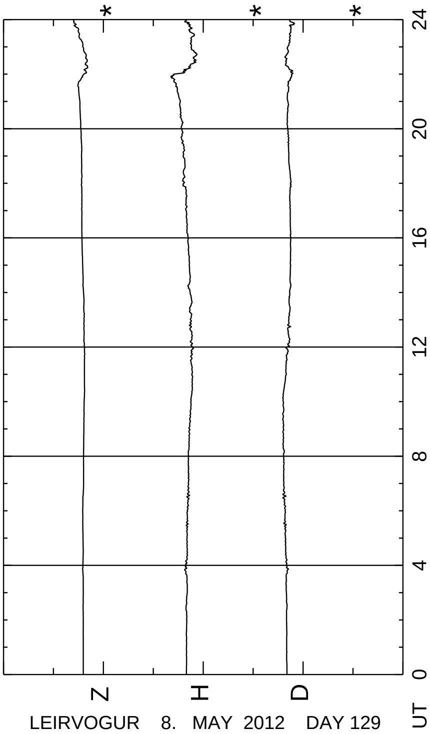
LEIRVOGUR 6. MAY 2012 DAY 127



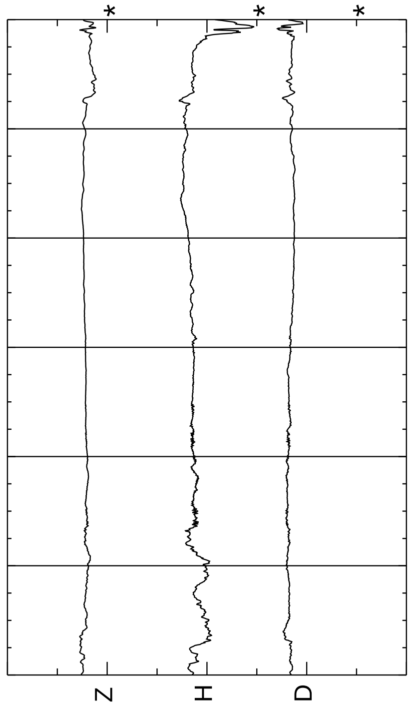
LEIRVOGUR 9. MAY 2012 DAY 130



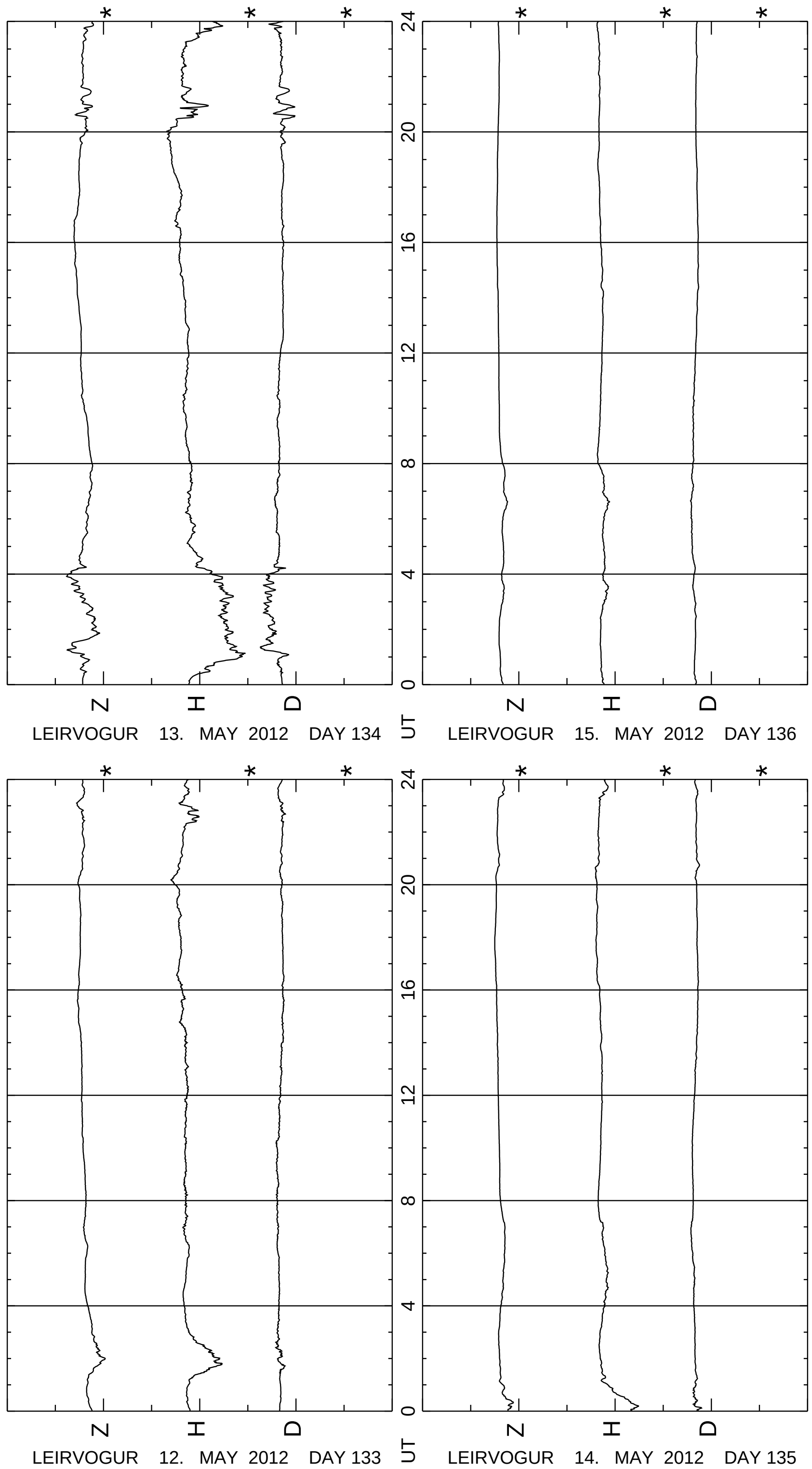
LEIRVOGUR 11. MAY 2012 DAY 132



LEIRVOGUR 8. MAY 2012 DAY 129



LEIRVOGUR 10. MAY 2012 DAY 131


LEIRVOGUR 13. MAY 2012 DAY 134
LEIRVOGUR 15. MAY 2012 DAY 136
LEIRVOGUR 12. MAY 2012 DAY 133
LEIRVOGUR 14. MAY 2012 DAY 135
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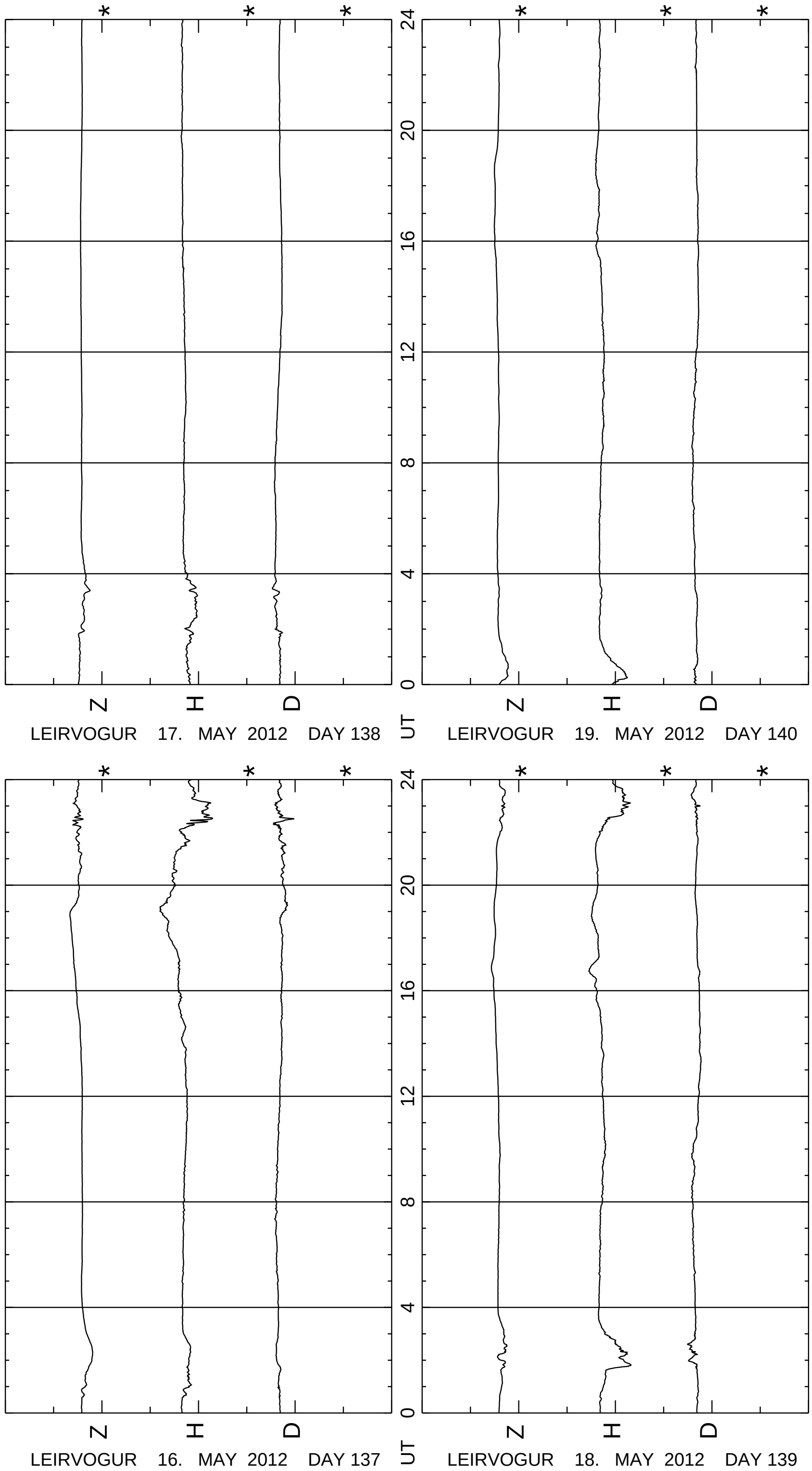
LEIRVOGUR 17. MAY 2012 DAY 138
LEIRVOGUR 19. MAY 2012 DAY 140
LEIRVOGUR 16. MAY 2012 DAY 137
LEIRVOGUR 18. MAY 2012 DAY 139
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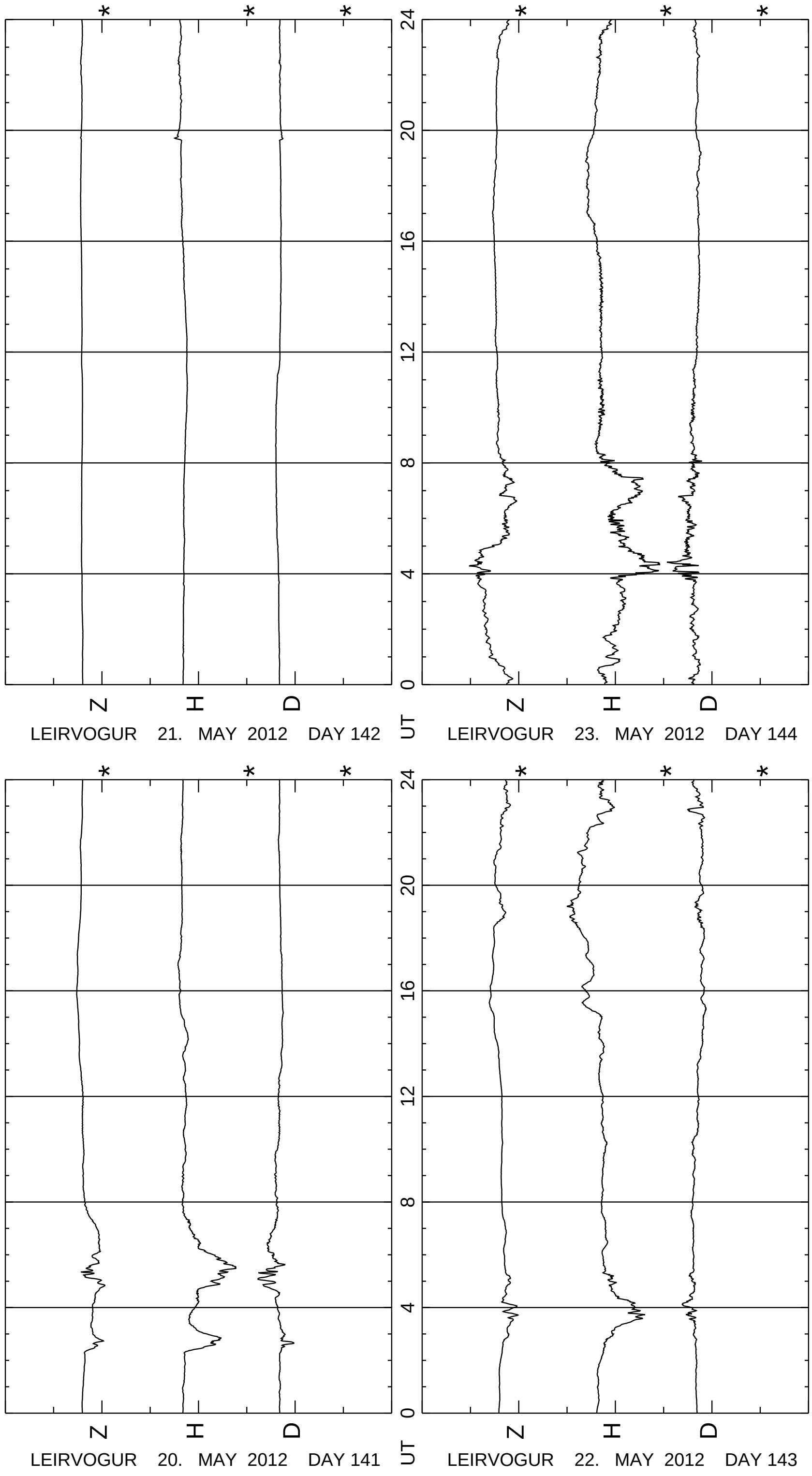
LEIRVOGUR 21. MAY 2012 DAY 142
LEIRVOGUR 23. MAY 2012 DAY 144
LEIRVOGUR 20. MAY 2012 DAY 141
LEIRVOGUR 22. MAY 2012 DAY 143
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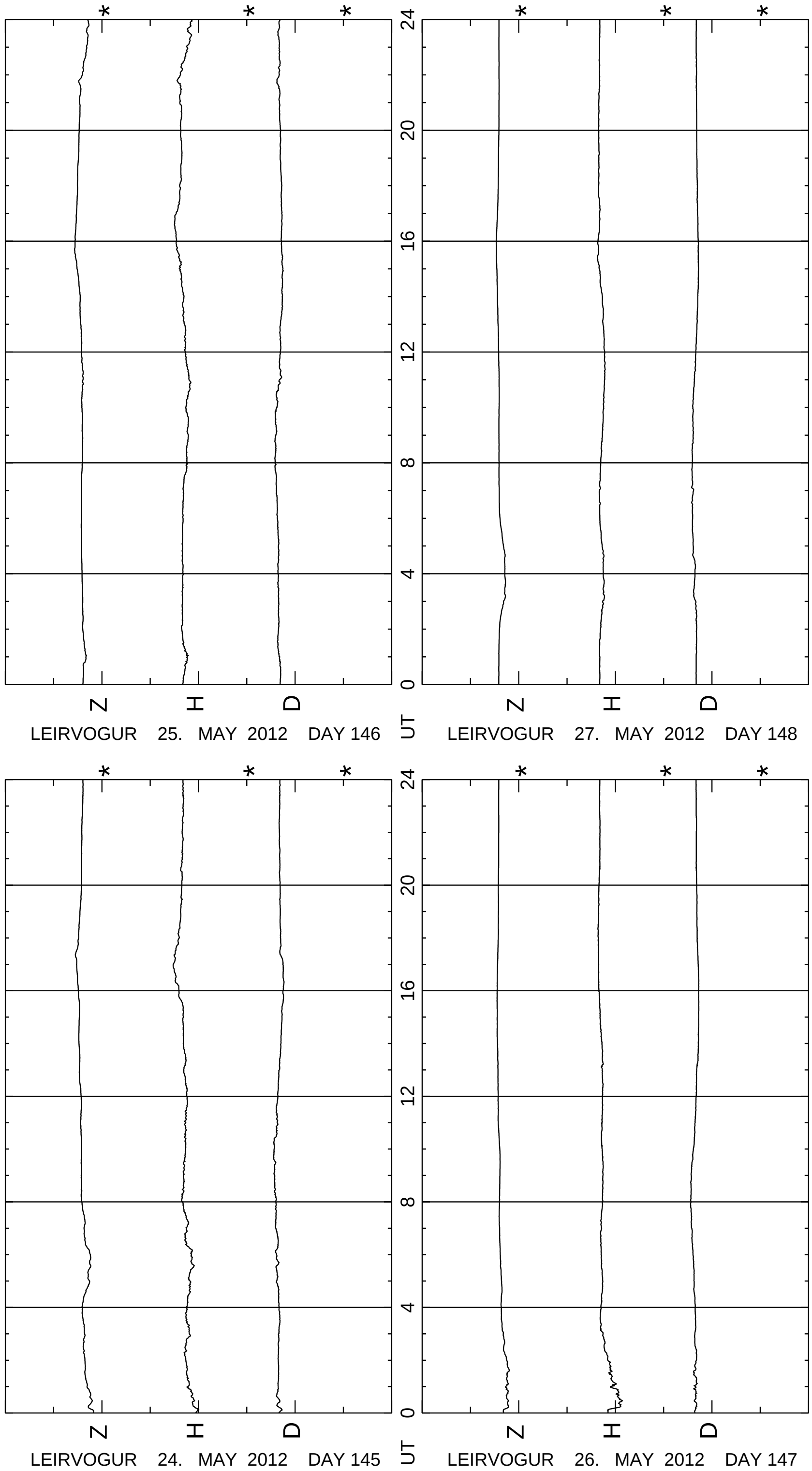
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LEIRVOGUR 25. MAY 2012 DAY 146
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LEIRVOGUR 27. MAY 2012 DAY 148
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LEIRVOGUR 24. MAY 2012 DAY 145
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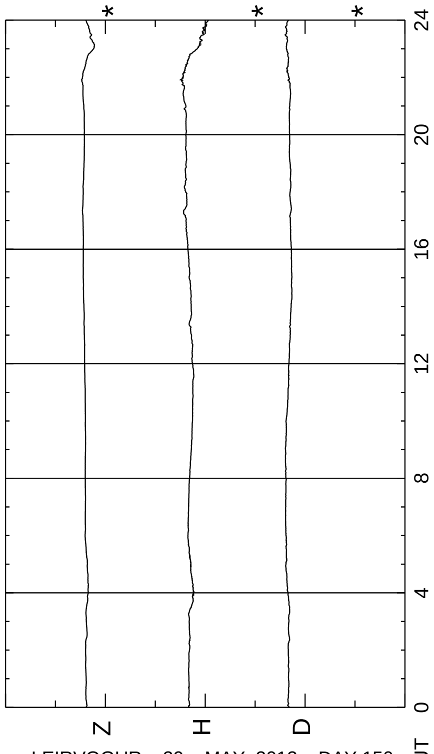
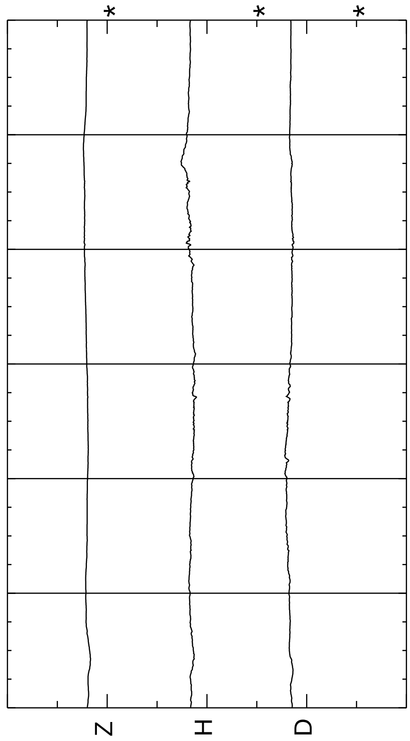
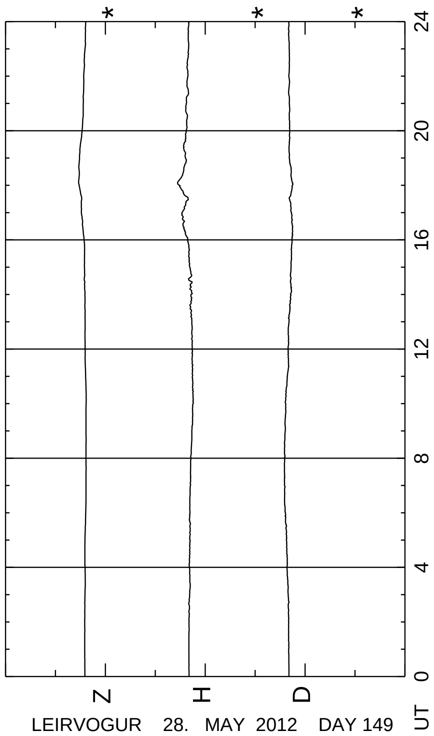
LEIRVOGUR 26. MAY 2012 DAY 147



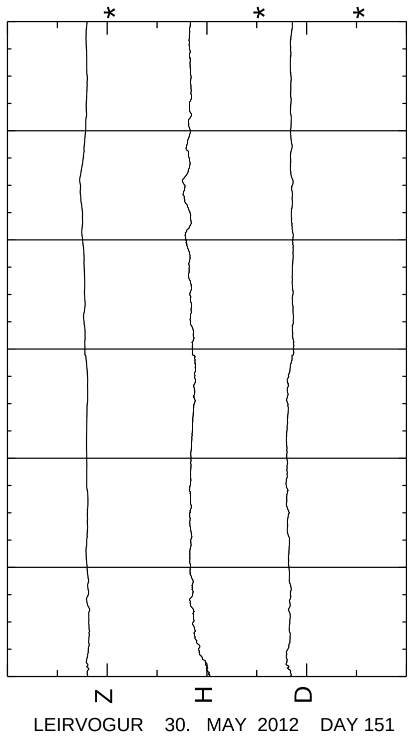
LEIRVOGUR 29. MAY 2012 DAY 150



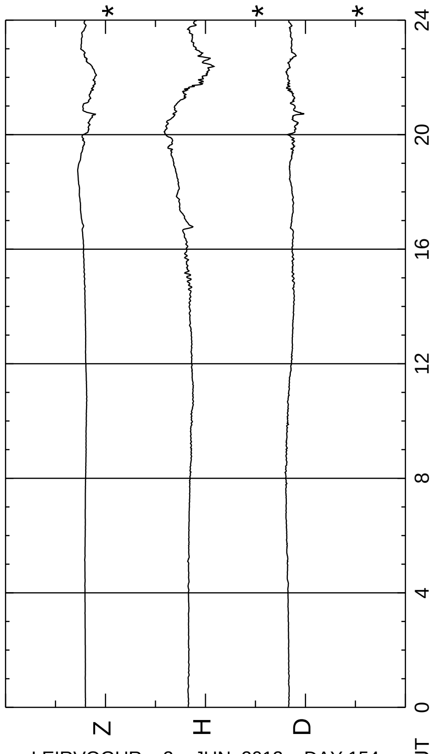
LEIRVOGUR 31. MAY 2012 DAY 152



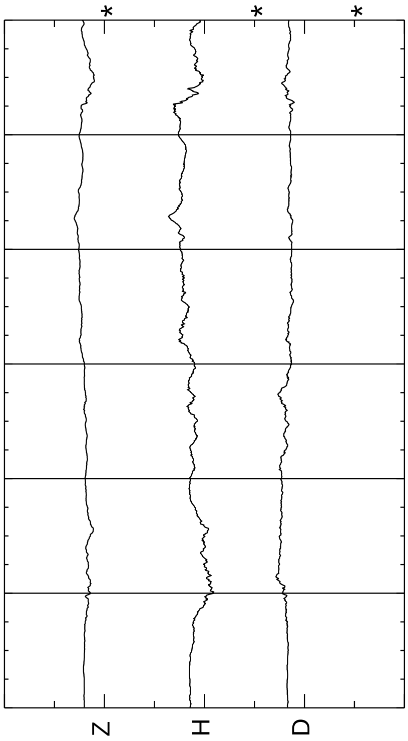
LEIRVOGUR 28. MAY 2012 DAY 149



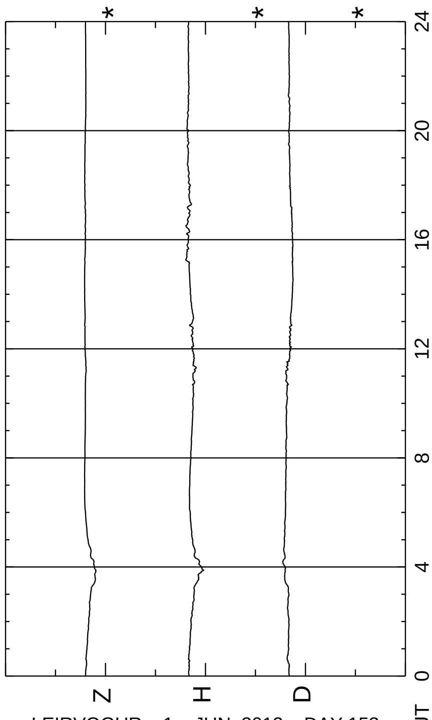
LEIRVOGUR 30. MAY 2012 DAY 151



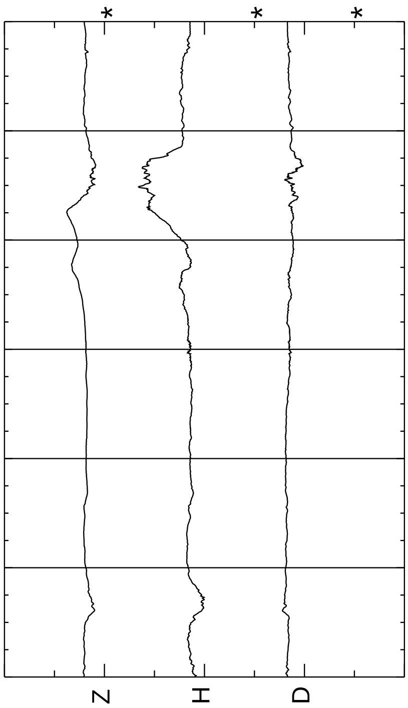
LEIRVOGUR 2. JUN 2012 DAY 154



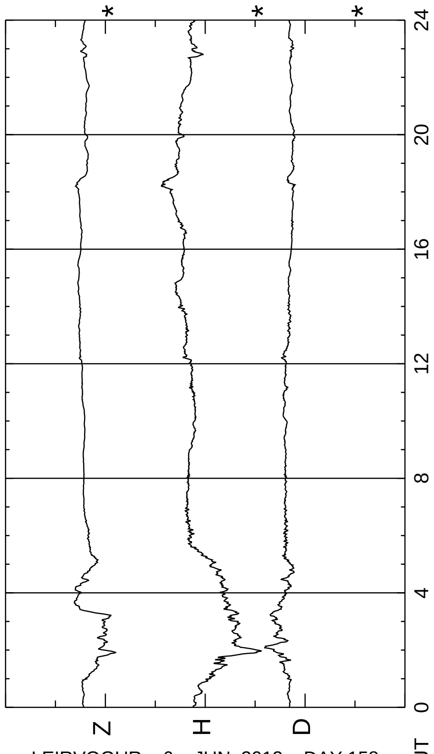
LEIRVOGUR 4. JUN 2012 DAY 156



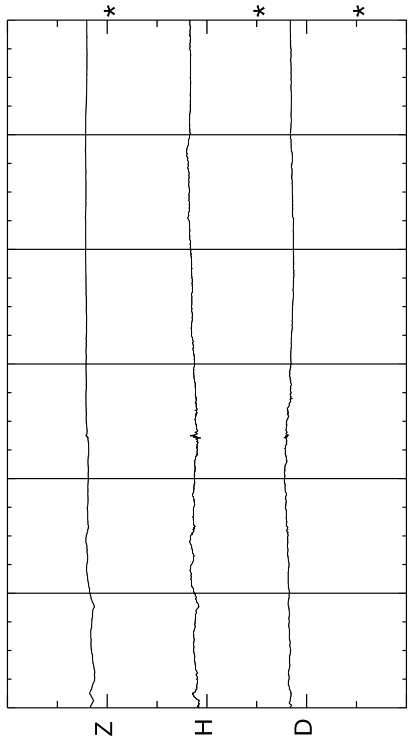
LEIRVOGUR 1. JUN 2012 DAY 153



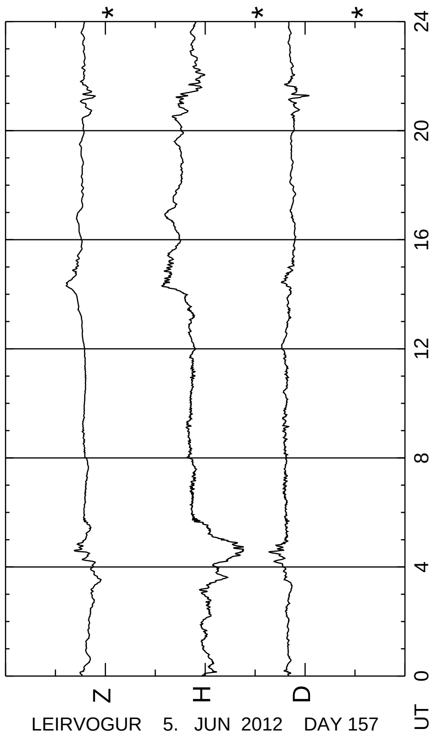
LEIRVOGUR 3. JUN 2012 DAY 155



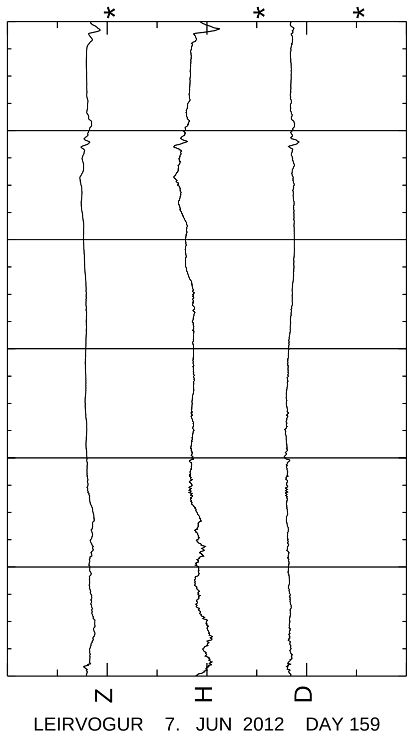
LEIRVOGUR 6. JUN 2012 DAY 158



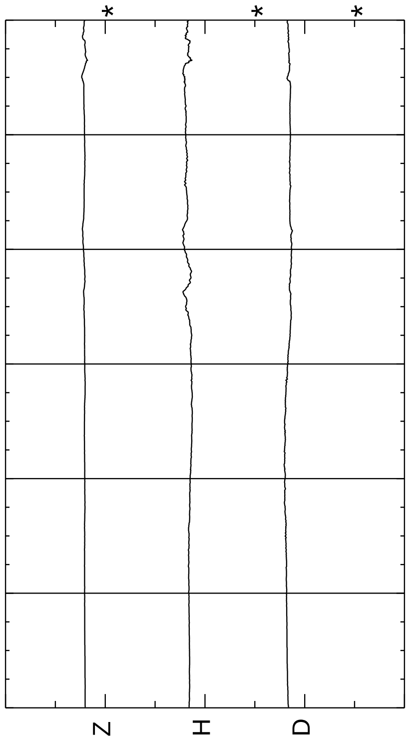
LEIRVOGUR 8. JUN 2012 DAY 160



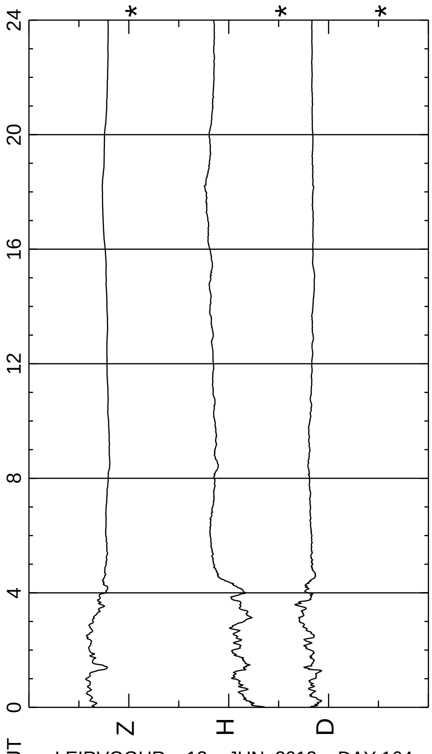
LEIRVOGUR 5. JUN 2012 DAY 157



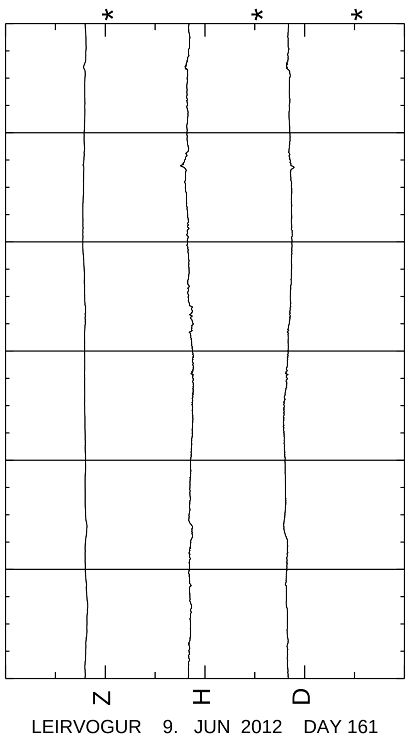
LEIRVOGUR 7. JUN 2012 DAY 159



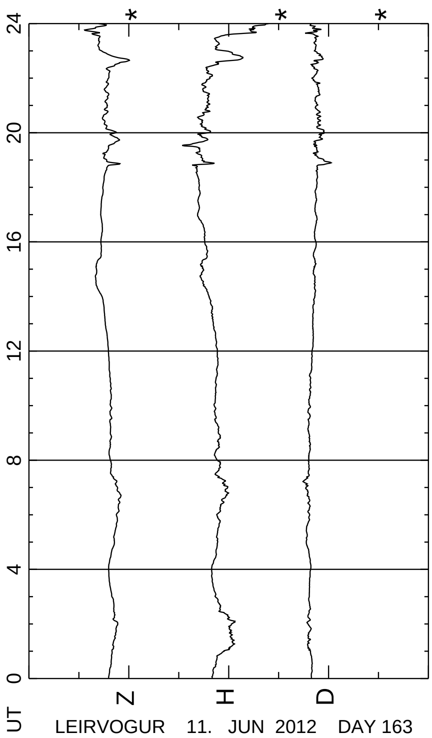
LEIRVOGUR 10. JUN 2012 DAY 162



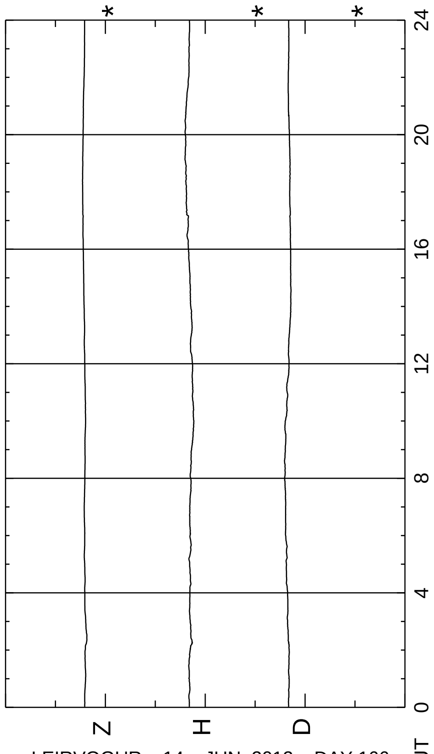
LEIRVOGUR 12. JUN 2012 DAY 164



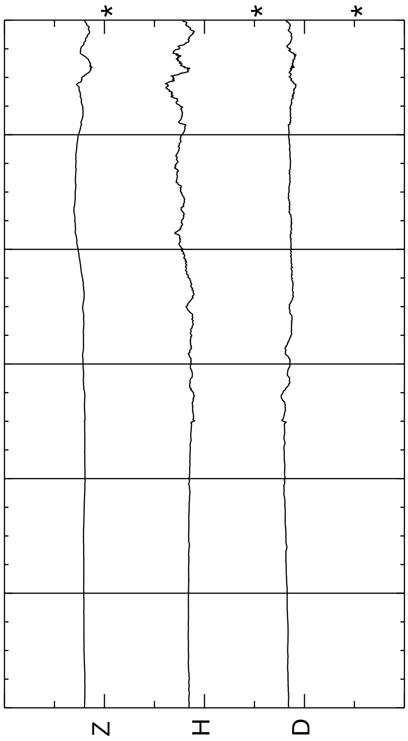
LEIRVOGUR 9. JUN 2012 DAY 161



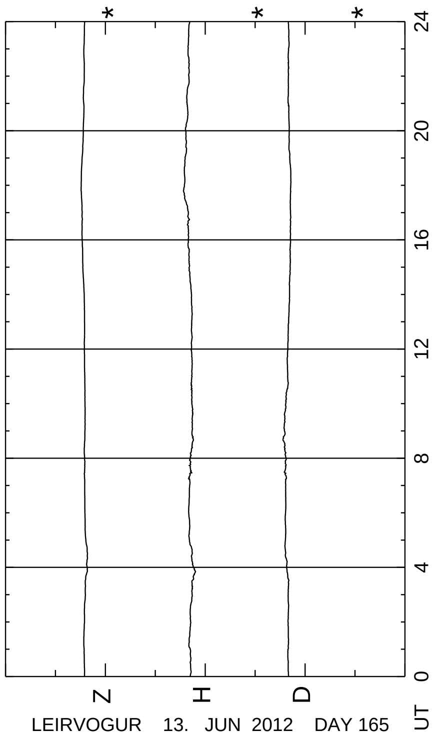
LEIRVOGUR 11. JUN 2012 DAY 163



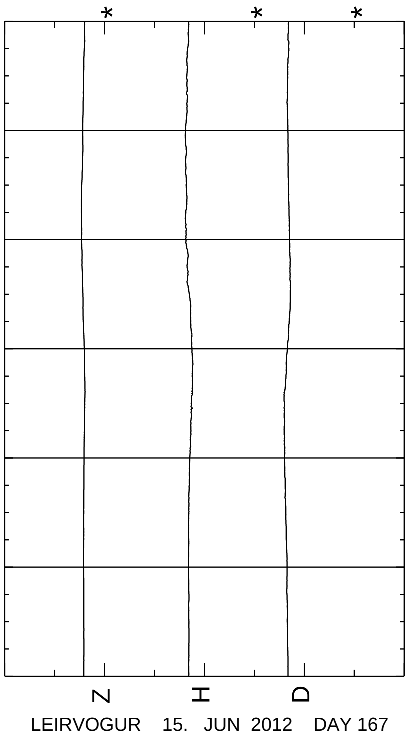
LEIRVOGUR 14. JUN 2012 DAY 166



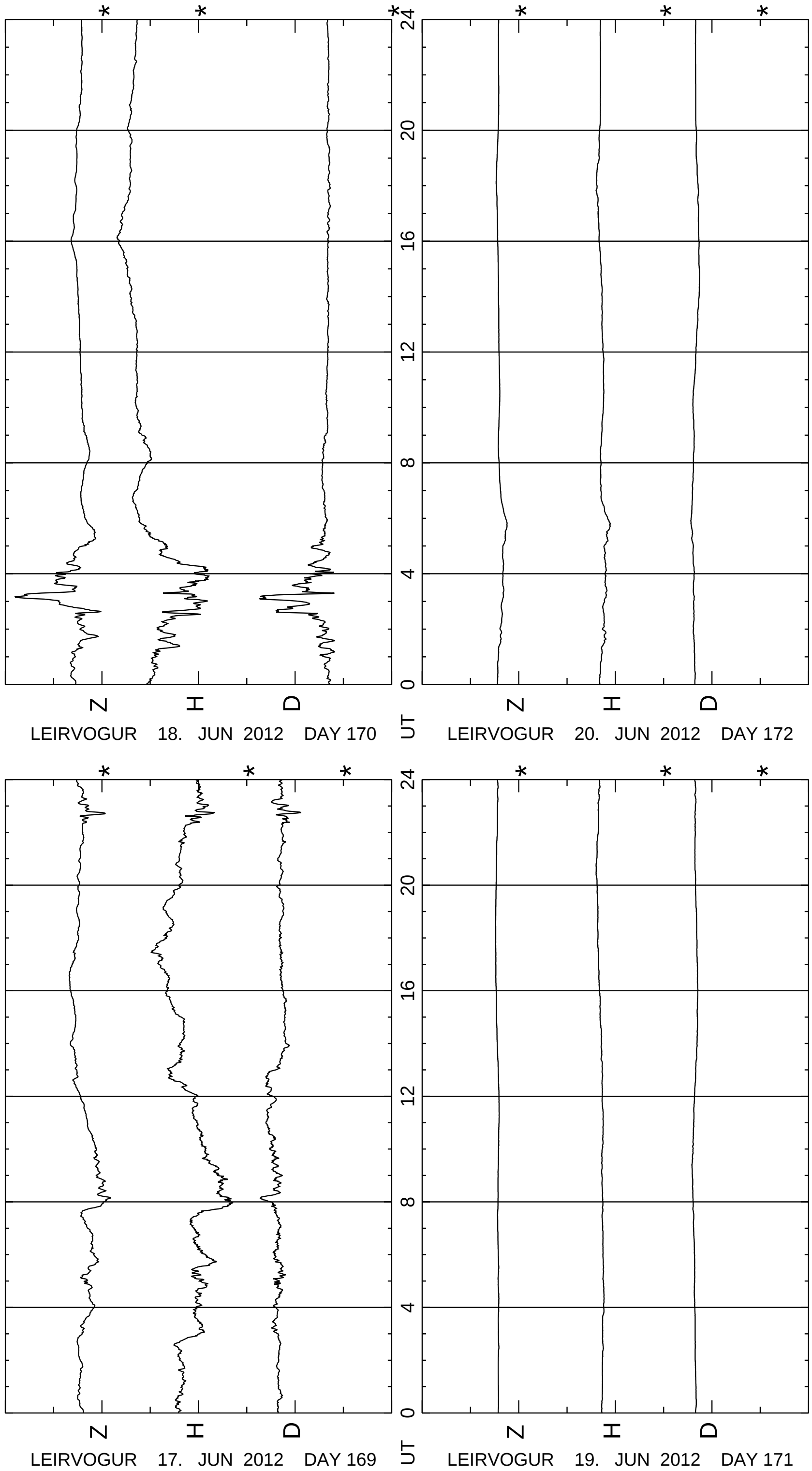
LEIRVOGUR 16. JUN 2012 DAY 168



LEIRVOGUR 13. JUN 2012 DAY 165



LEIRVOGUR 15. JUN 2012 DAY 167



LEIRVOGUR 18. JUN 2012 DAY 170
LEIRVOGUR 20. JUN 2012 DAY 172
LEIRVOGUR 17. JUN 2012 DAY 169
LEIRVOGUR 19. JUN 2012 DAY 171
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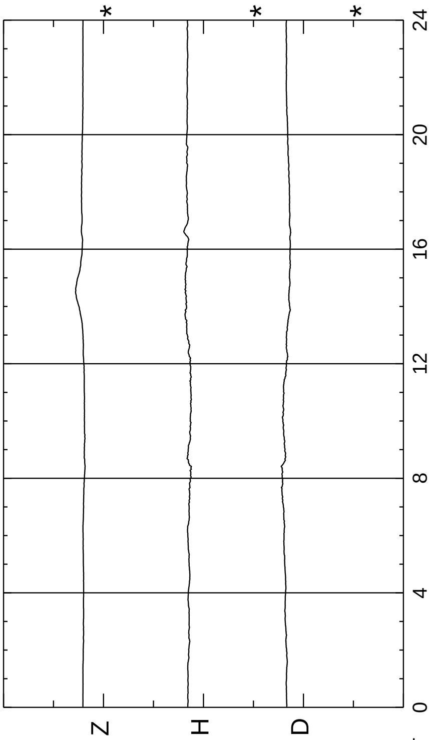
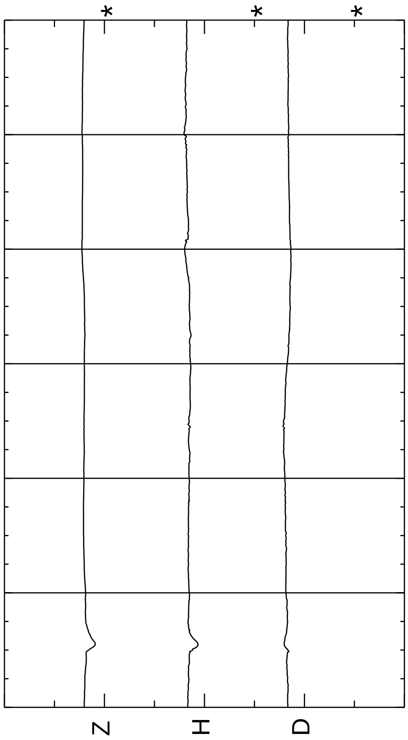
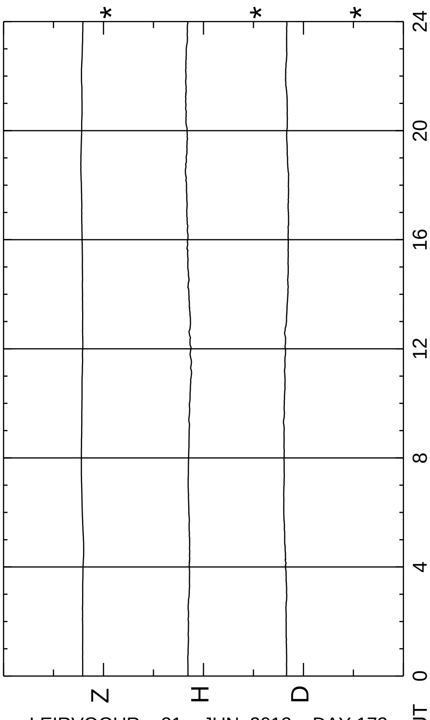


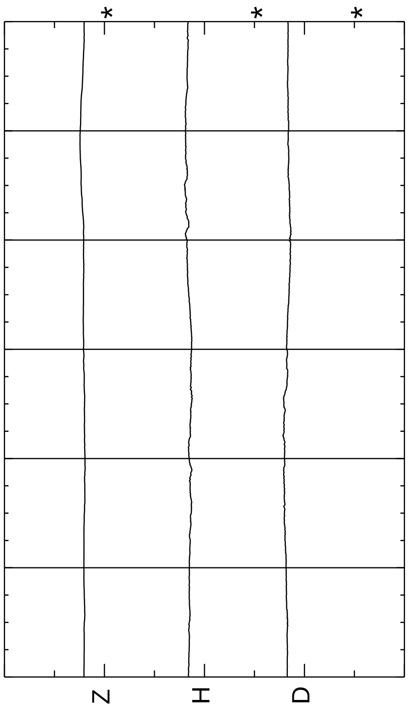
LEIRVOGUR 22. JUN 2012 DAY 174



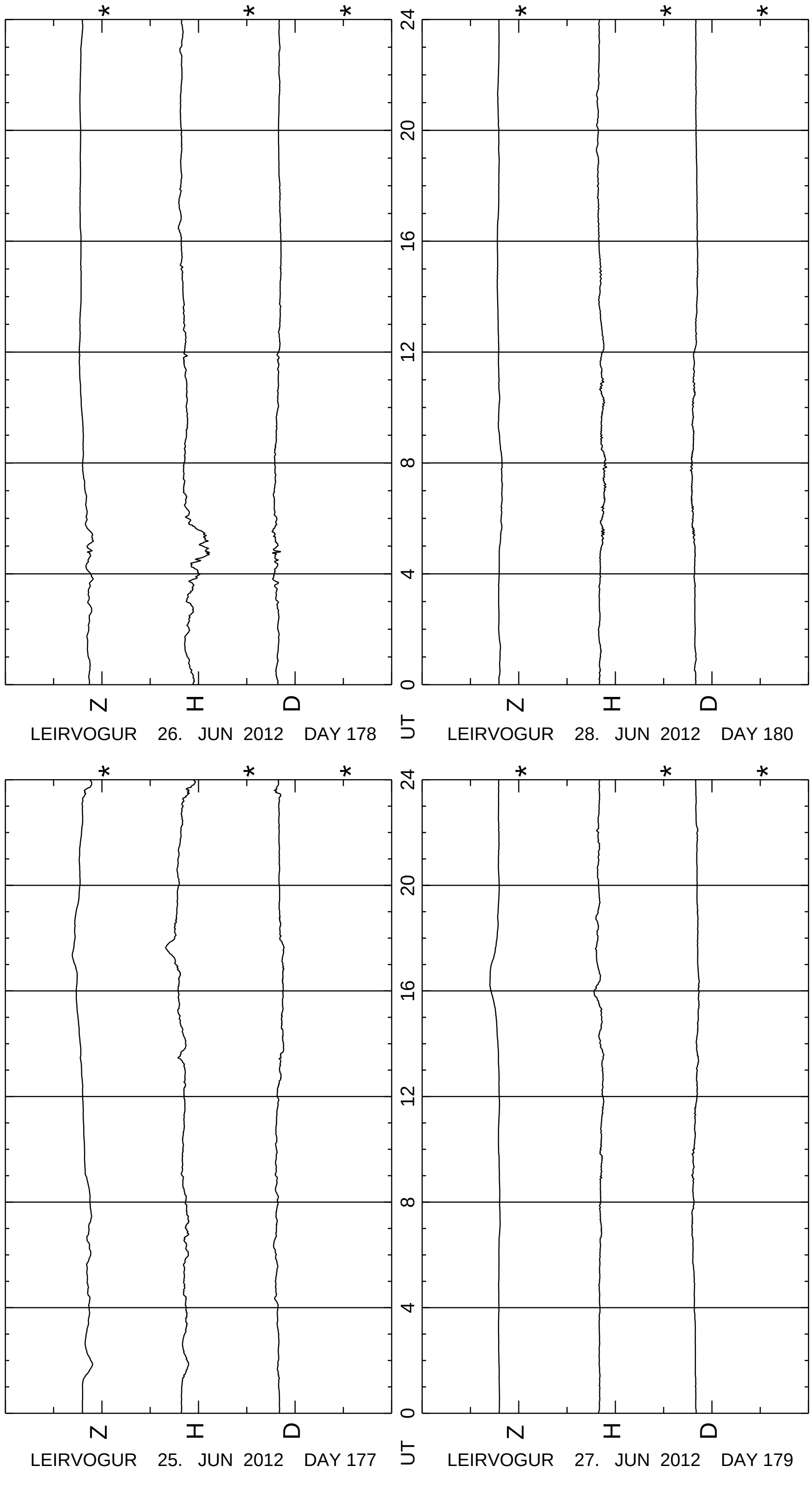
LEIRVOGUR 24. JUN 2012 DAY 176



LEIRVOGUR 21. JUN 2012 DAY 173



LEIRVOGUR 23. JUN 2012 DAY 175


LEIRVOGUR 26. JUN 2012 DAY 178
LEIRVOGUR 28. JUN 2012 DAY 180
LEIRVOGUR 25. JUN 2012 DAY 177
LEIRVOGUR 27. JUN 2012 DAY 179
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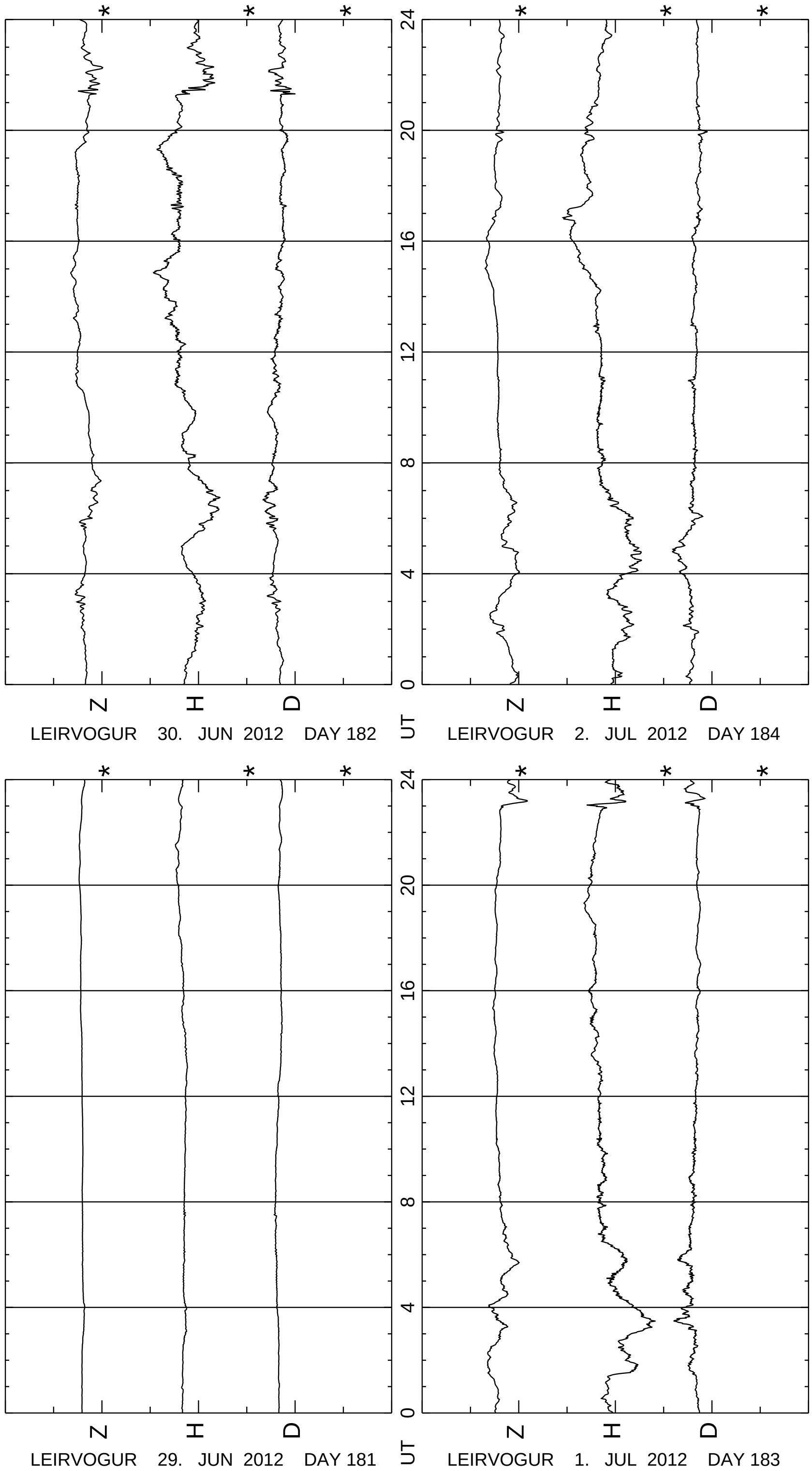
LEIRVOGUR 30. JUN 2012 DAY 182
LEIRVOGUR 2. JUL 2012 DAY 184
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LEIRVOGUR 1. JUL 2012 DAY 183
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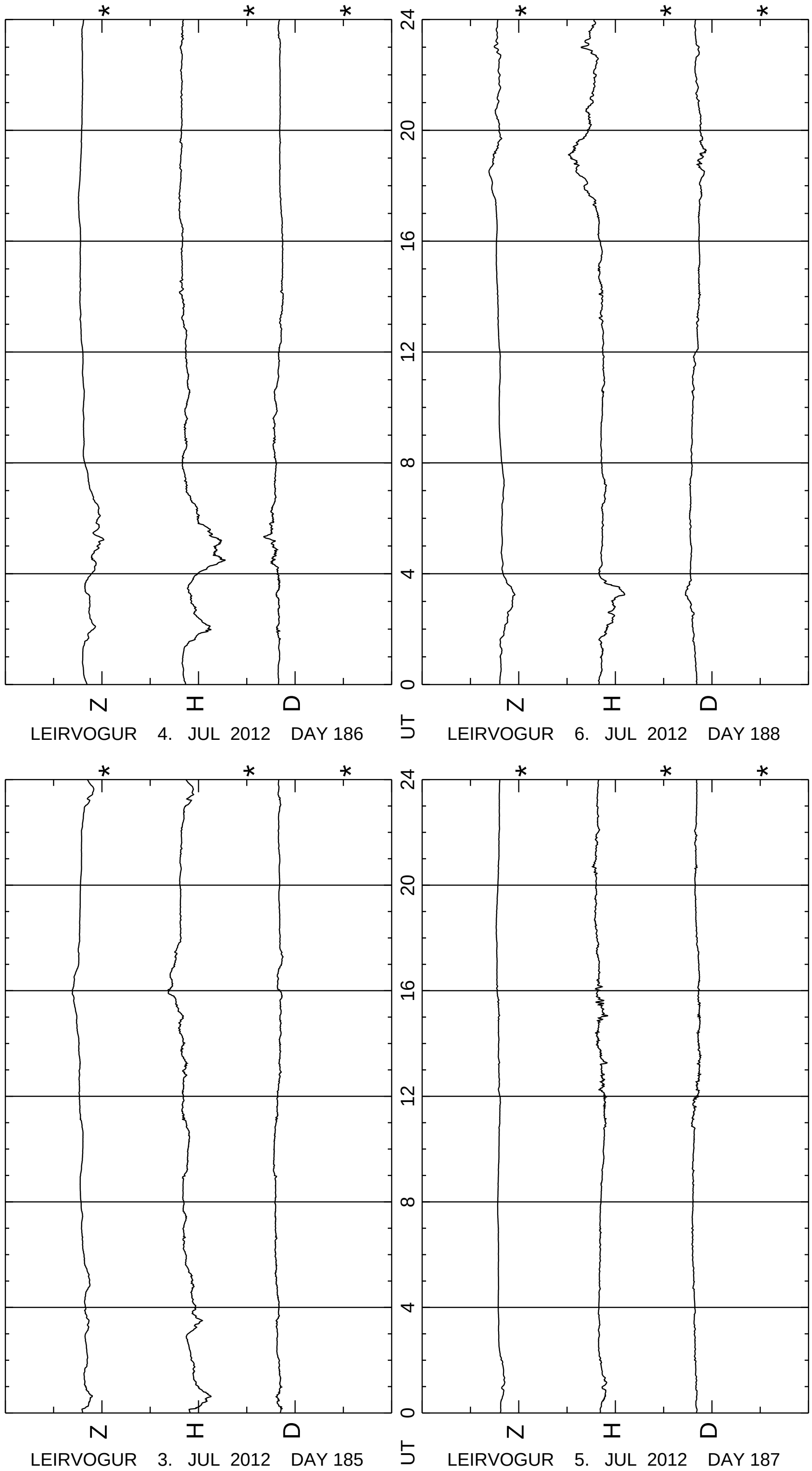
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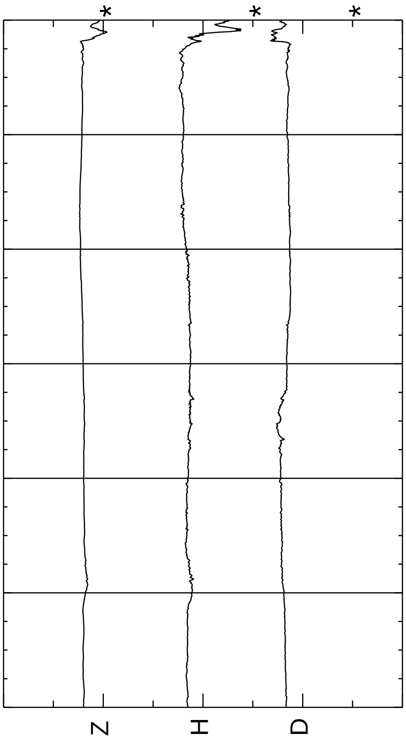
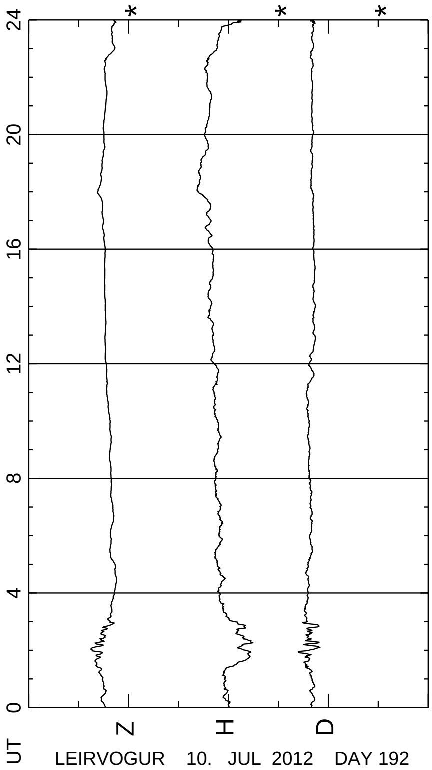
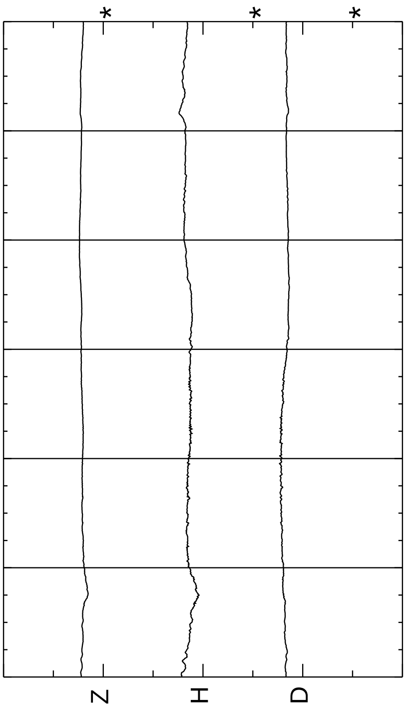
LEIRVOGUR 4. JUL 2012 DAY 186
LEIRVOGUR 6. JUL 2012 DAY 188
LEIRVOGUR 3. JUL 2012 DAY 185
LEIRVOGUR 5. JUL 2012 DAY 187



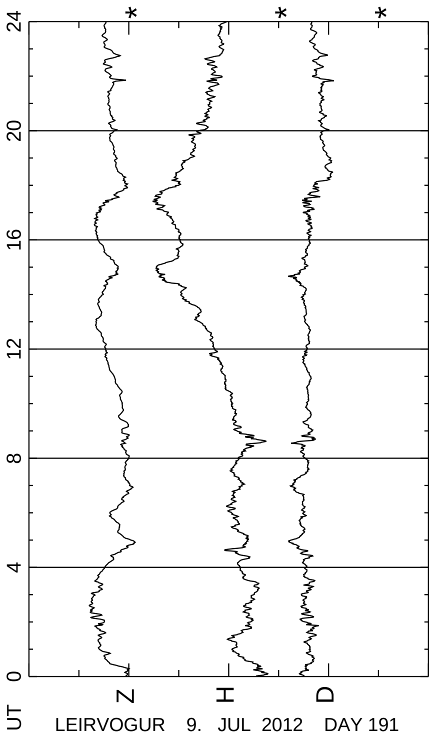
LEIRVOGUR 8. JUL 2012 DAY 190



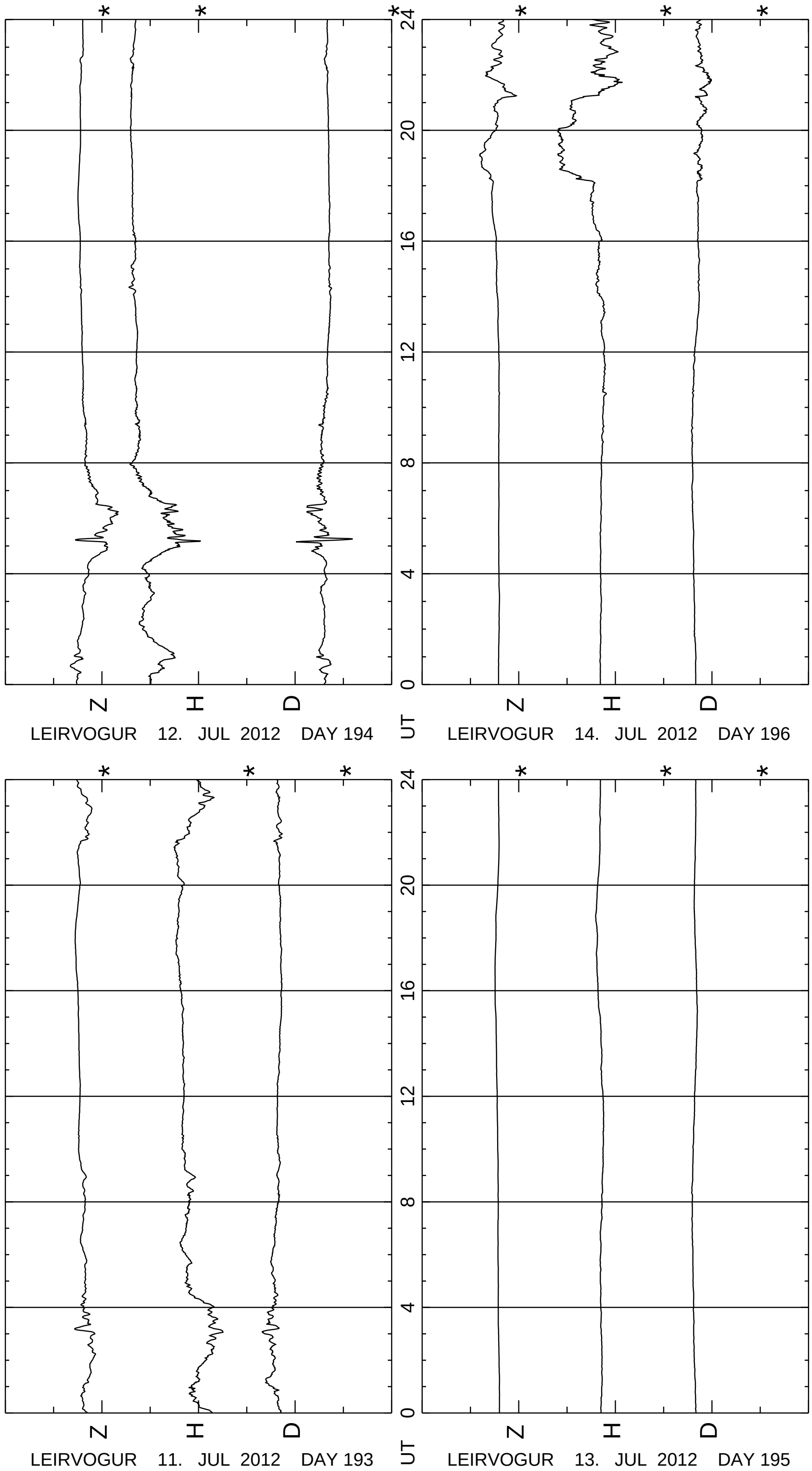
LEIRVOGUR 10. JUL 2012 DAY 192



LEIRVOGUR 7. JUL 2012 DAY 189



LEIRVOGUR 9. JUL 2012 DAY 191


LEIRVOGUR 12. JUL 2012 DAY 194
LEIRVOGUR 14. JUL 2012 DAY 196
LEIRVOGUR 11. JUL 2012 DAY 193
LEIRVOGUR 13. JUL 2012 DAY 195
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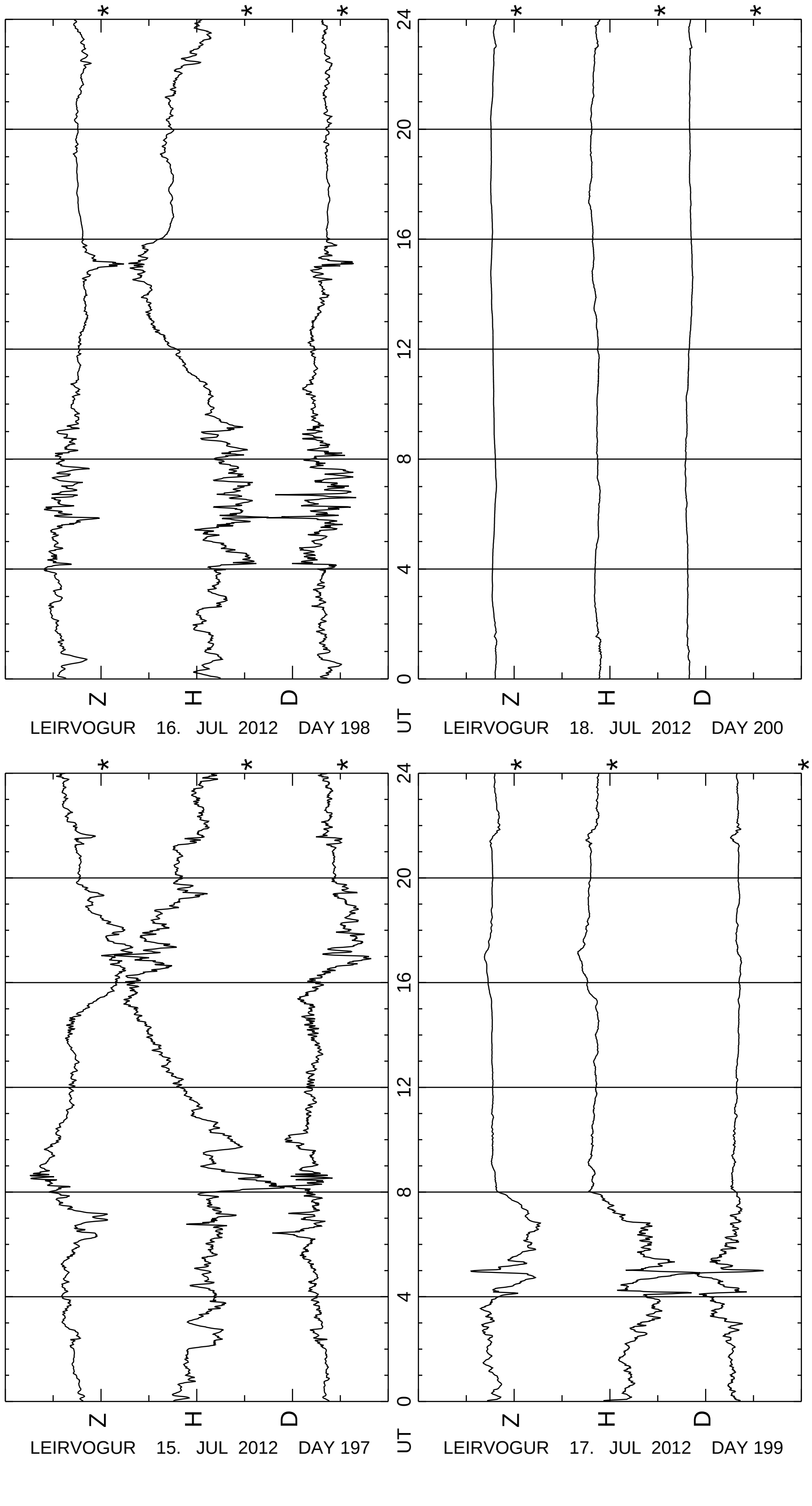

LEIRVOGUR 16. JUL 2012 DAY 198
LEIRVOGUR 18. JUL 2012 DAY 200
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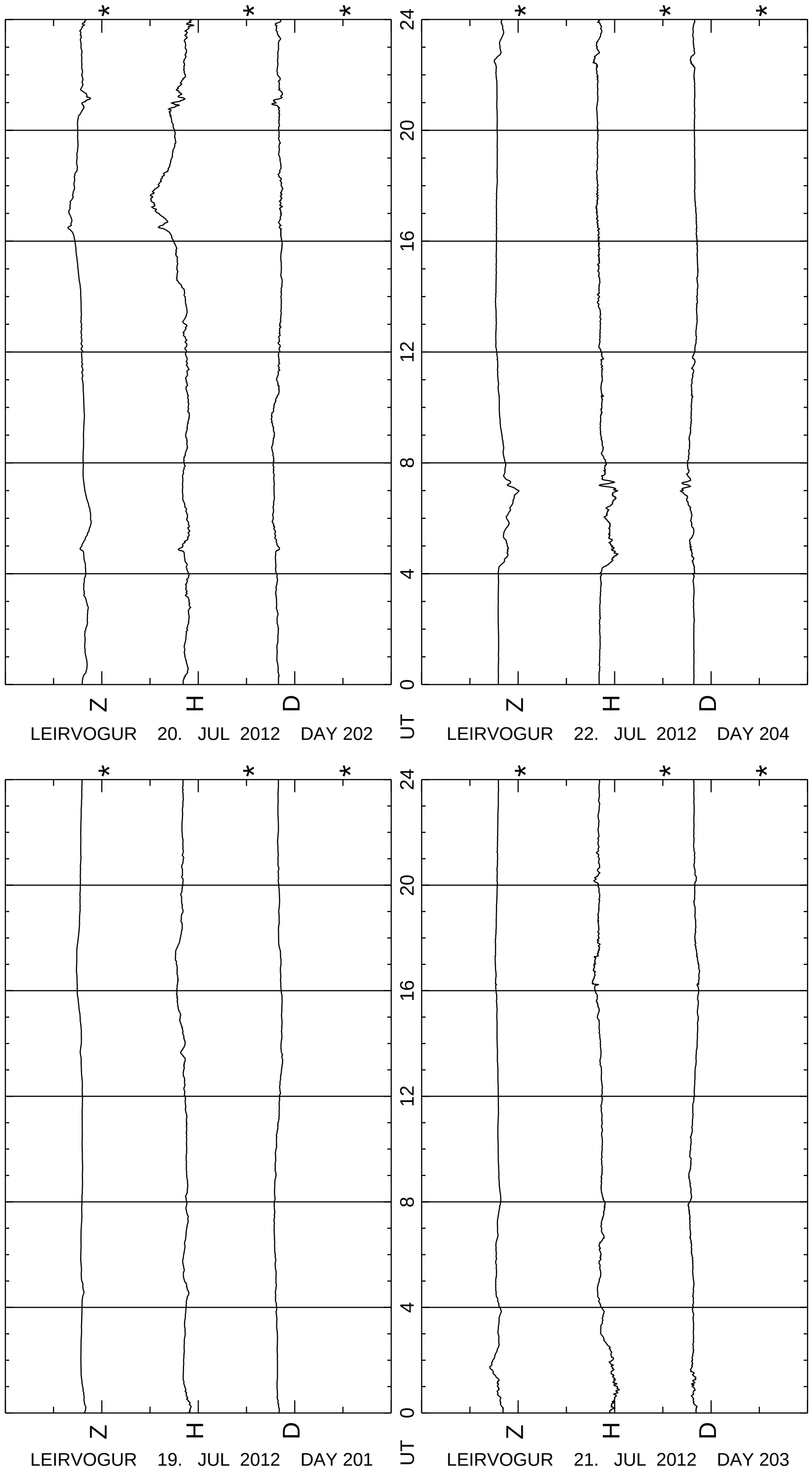
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LEIRVOGUR 22. JUL 2012 DAY 204
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LEIRVOGUR 19. JUL 2012 DAY 201
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LEIRVOGUR 21. JUL 2012 DAY 203
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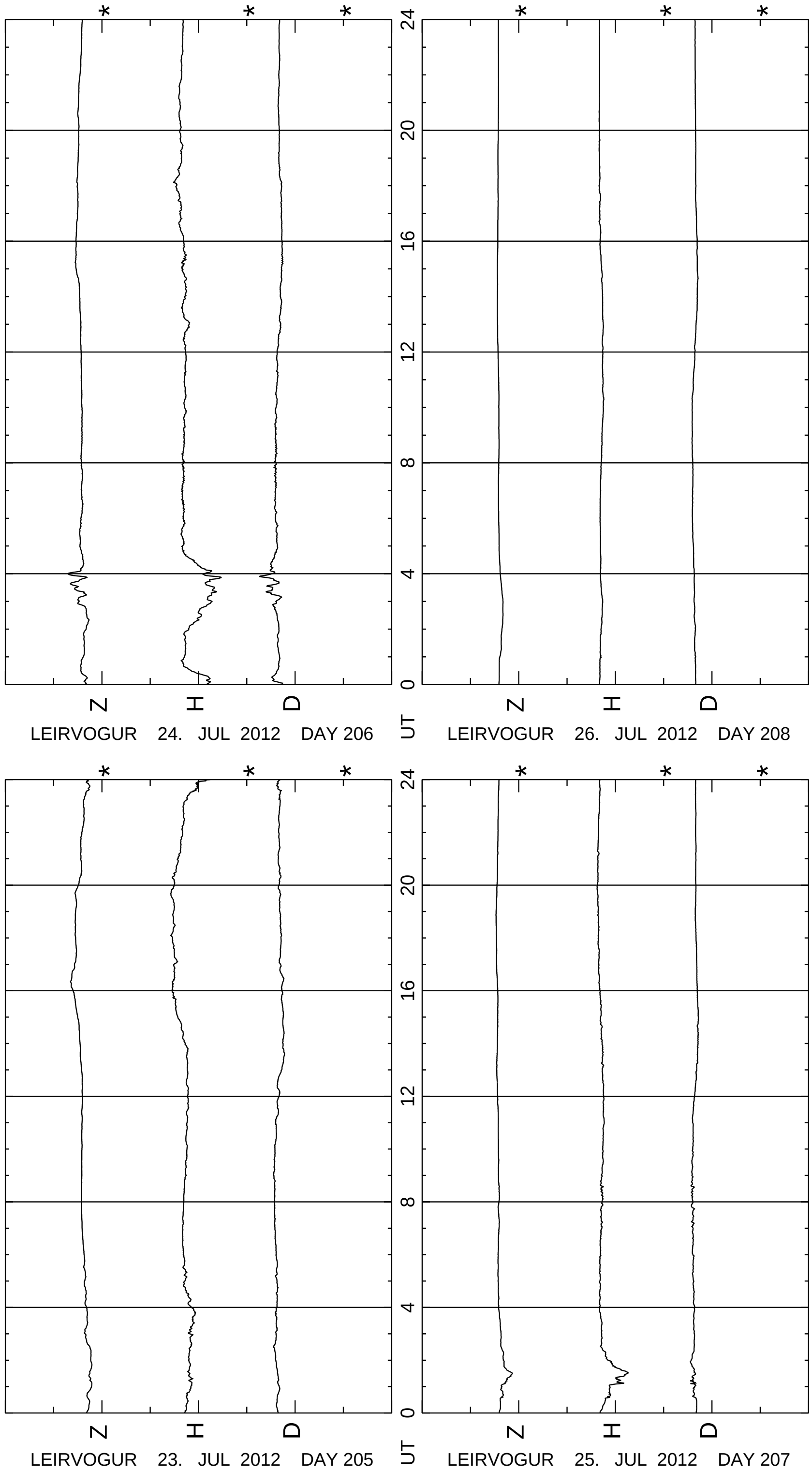

LEIRVOGUR 24. JUL 2012 DAY 206
LEIRVOGUR 26. JUL 2012 DAY 208
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LEIRVOGUR 25. JUL 2012 DAY 207
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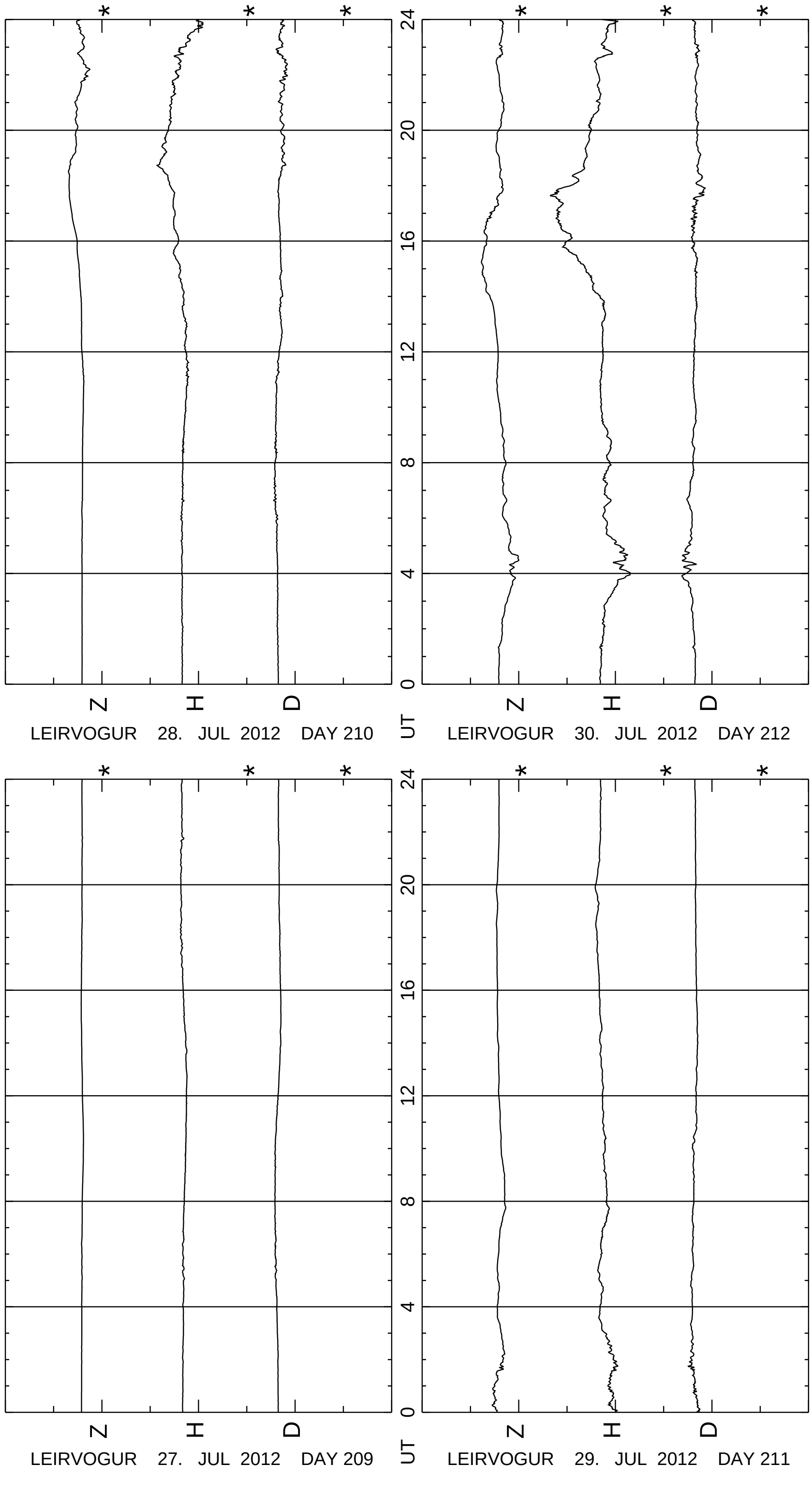
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LEIRVOGUR 30. JUL 2012 DAY 212
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LEIRVOGUR 29. JUL 2012 DAY 211
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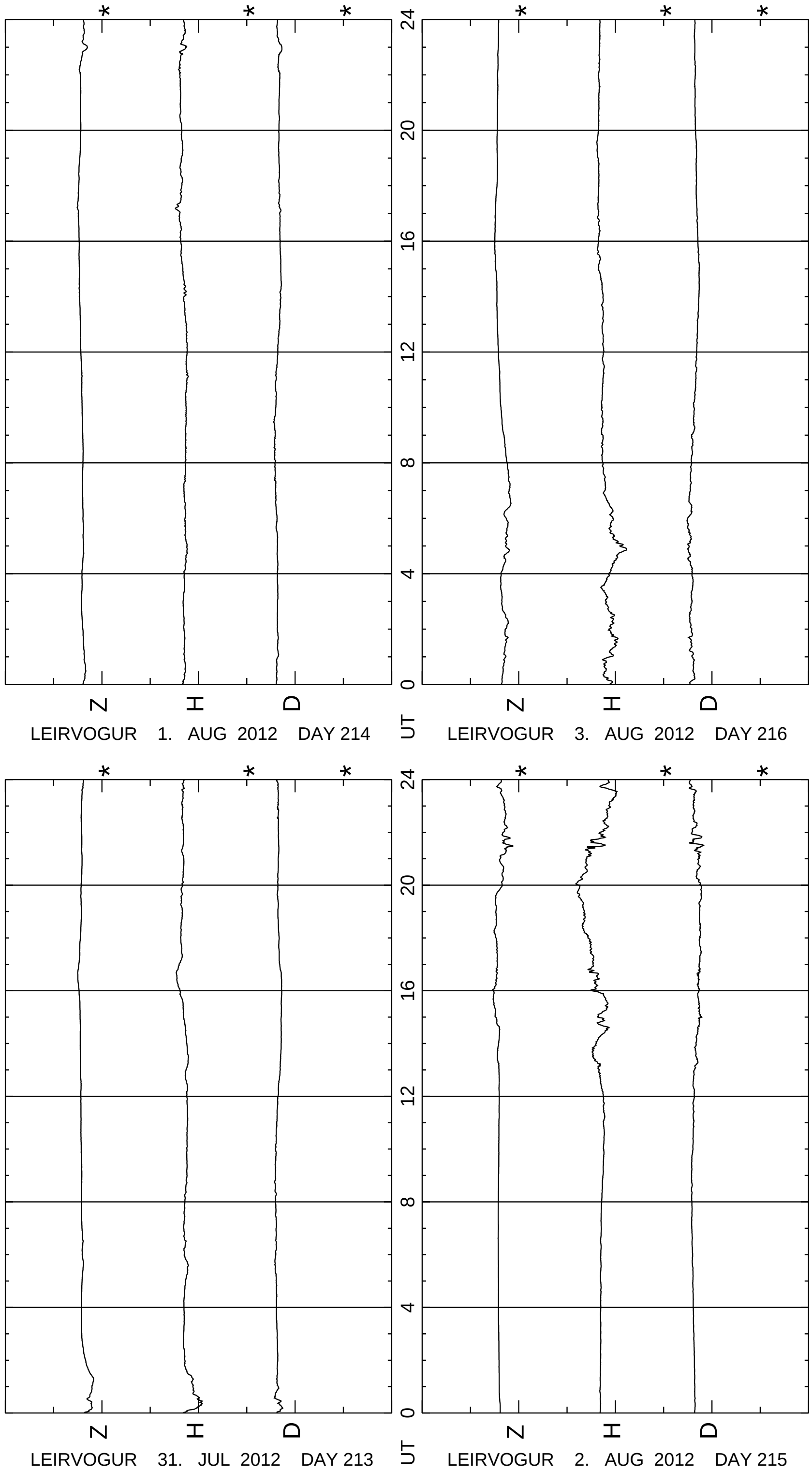
LEIRVOGUR 1. AUG 2012 DAY 214
LEIRVOGUR 3. AUG 2012 DAY 216
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LEIRVOGUR 2. AUG 2012 DAY 215
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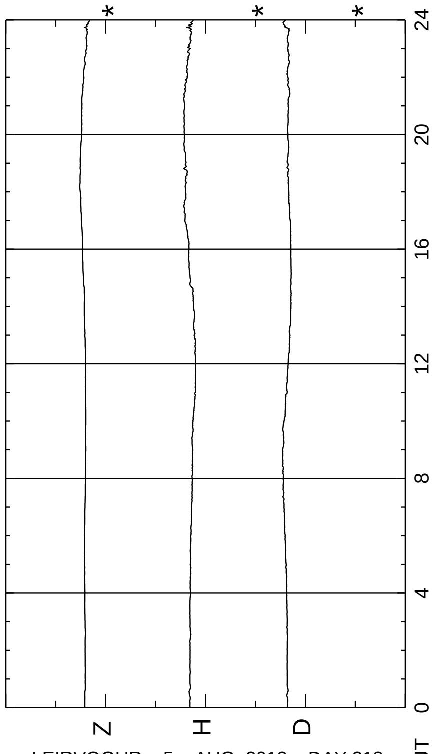

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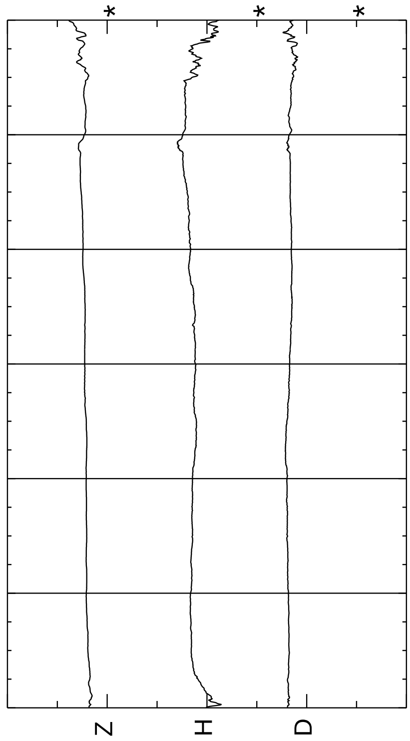
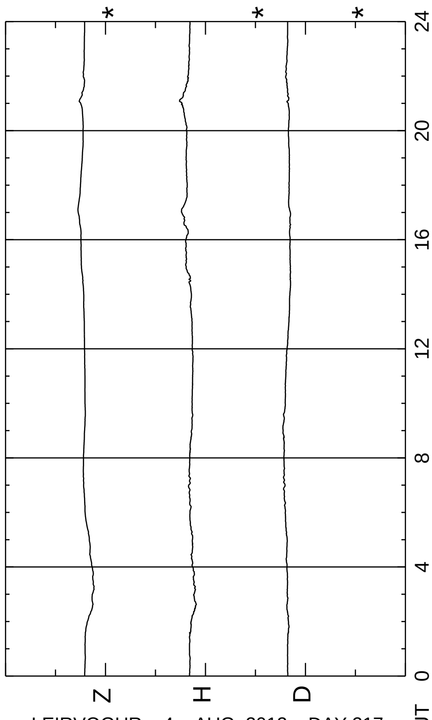
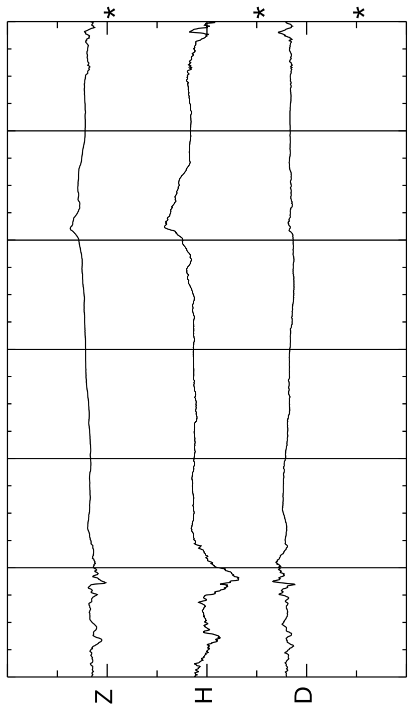


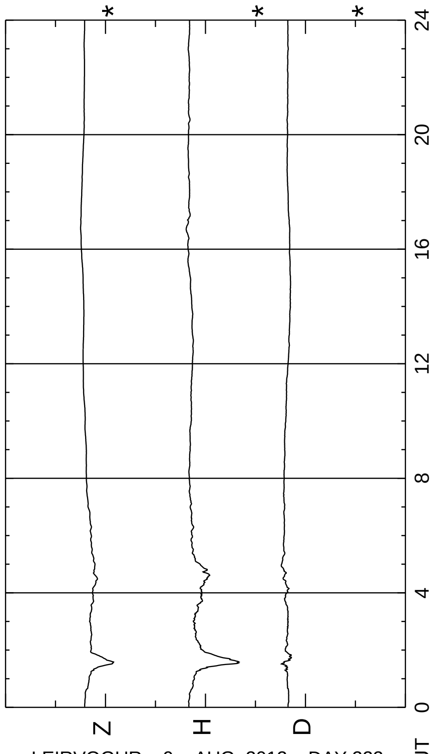
LEIRVOGUR 7. AUG 2012 DAY 220



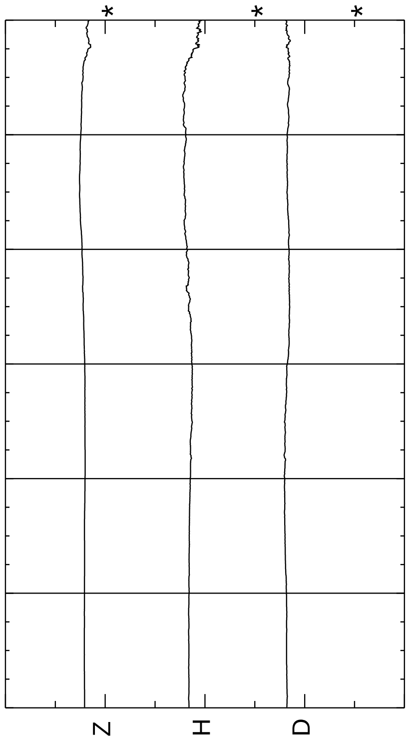
LEIRVOGUR 4. AUG 2012 DAY 217



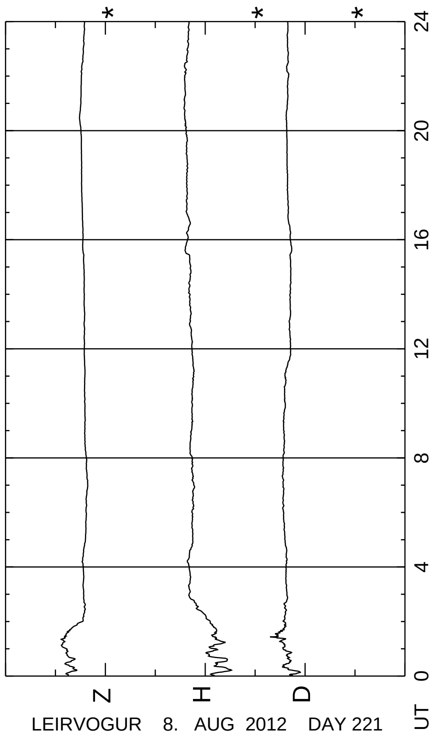
LEIRVOGUR 6. AUG 2012 DAY 219



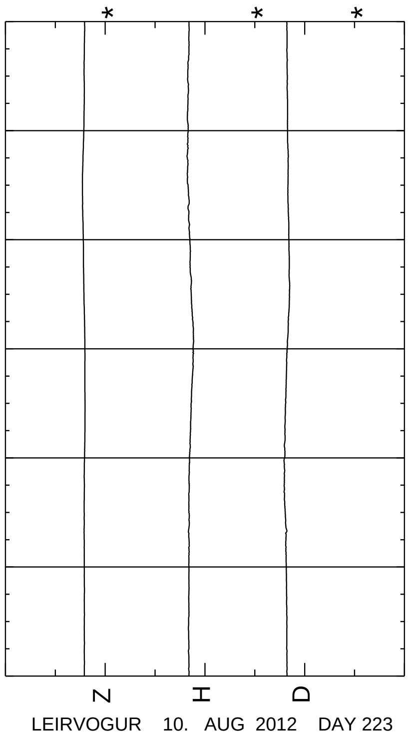
LEIRVOGUR 9. AUG 2012 DAY 222



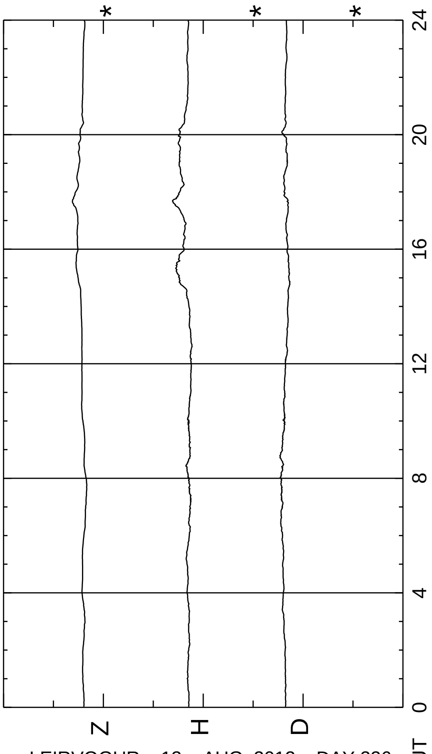
LEIRVOGUR 11. AUG 2012 DAY 224



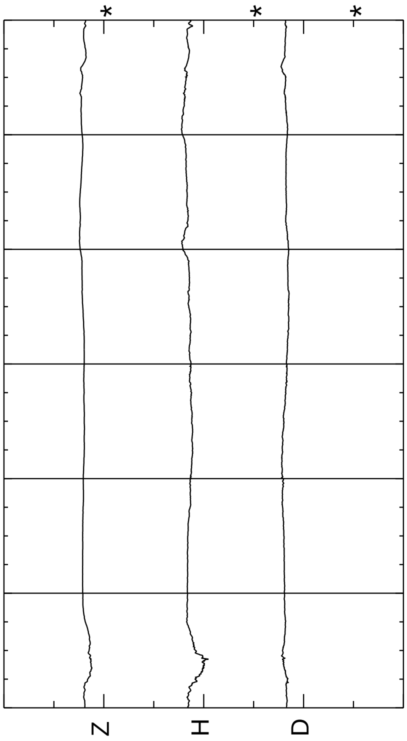
LEIRVOGUR 8. AUG 2012 DAY 221



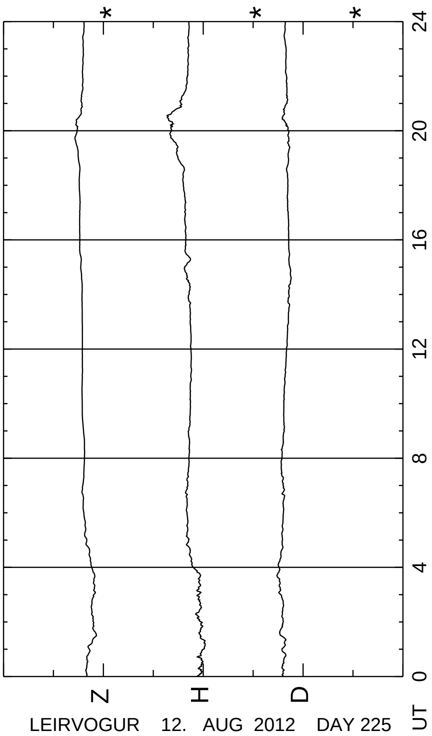
LEIRVOGUR 10. AUG 2012 DAY 223



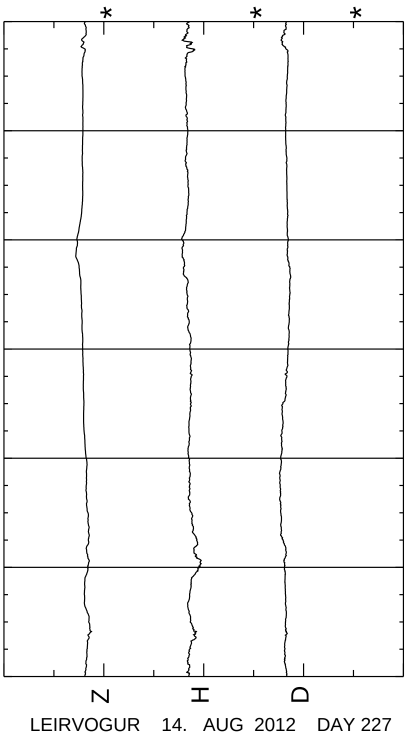
LEIRVOGUR 13. AUG 2012 DAY 226



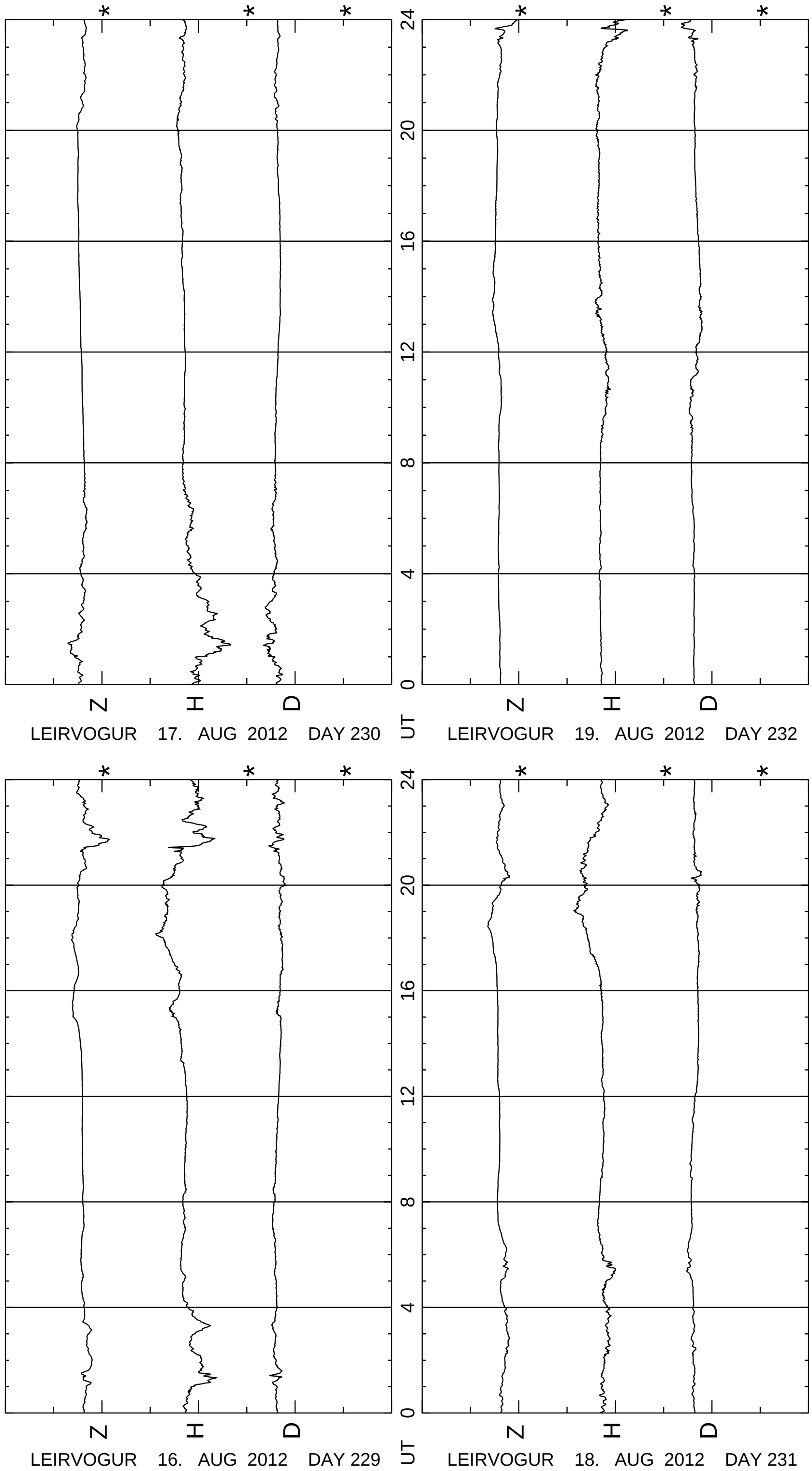
LEIRVOGUR 15. AUG 2012 DAY 228



LEIRVOGUR 12. AUG 2012 DAY 225



LEIRVOGUR 14. AUG 2012 DAY 227


LEIRVOGUR 17. AUG 2012 DAY 230
LEIRVOGUR 19. AUG 2012 DAY 232
LEIRVOGUR 16. AUG 2012 DAY 229
LEIRVOGUR 18. AUG 2012 DAY 231
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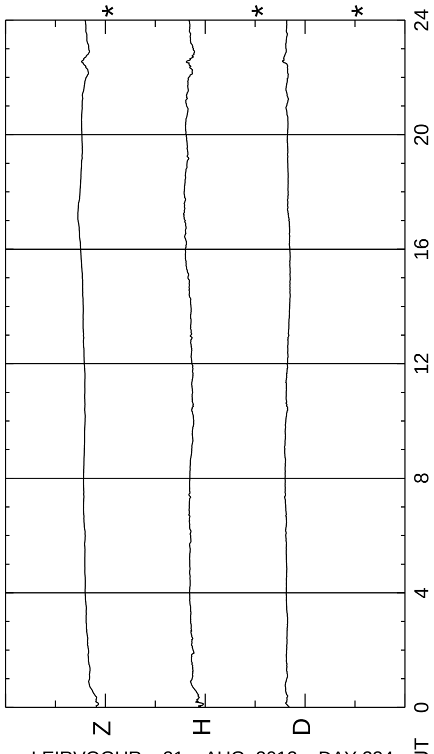
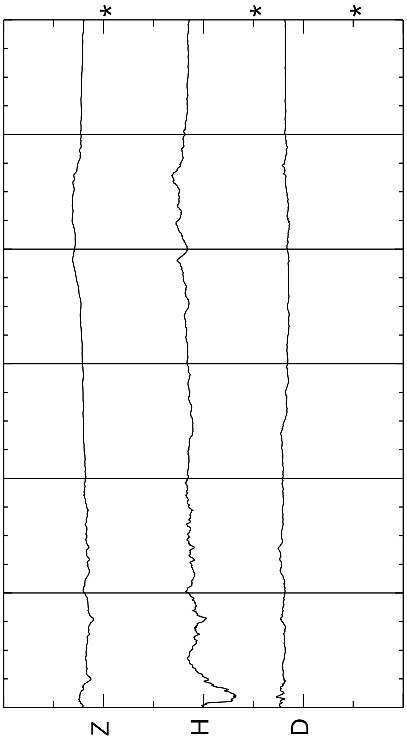
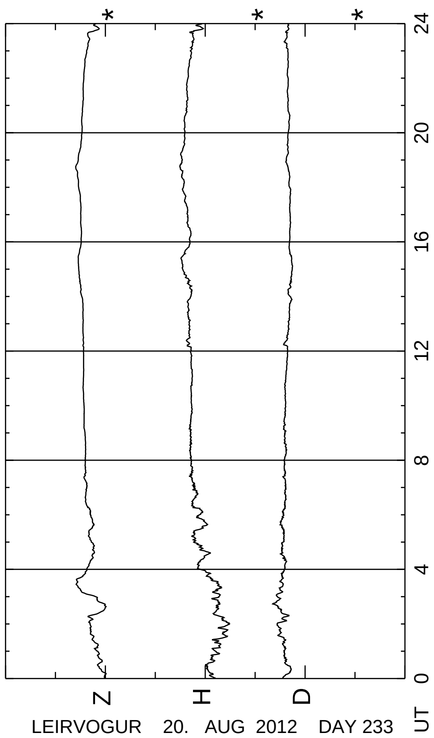


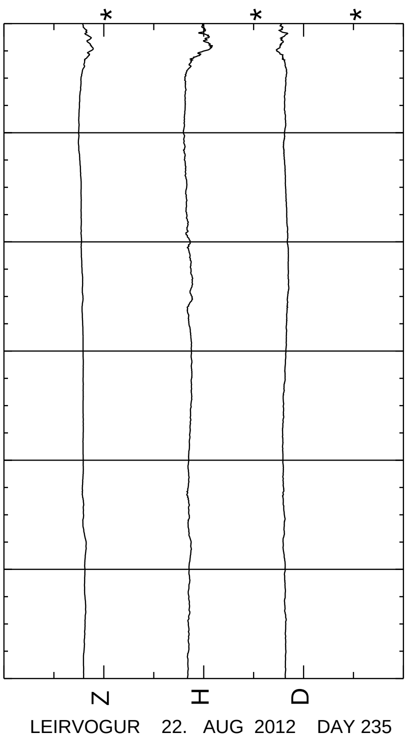
LEIRVOGUR 21. AUG 2012 DAY 234



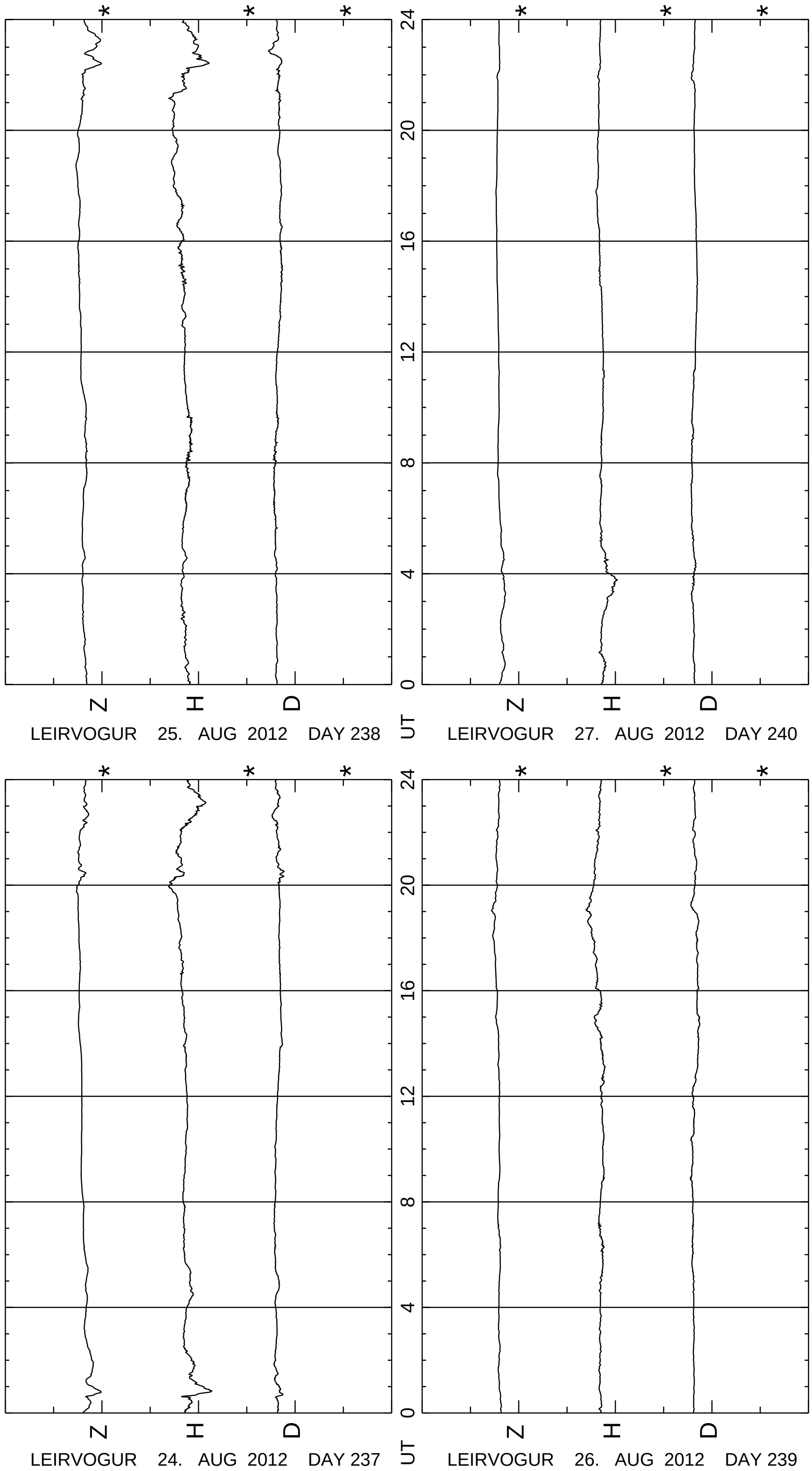
LEIRVOGUR 23. AUG 2012 DAY 236



LEIRVOGUR 20. AUG 2012 DAY 233



LEIRVOGUR 22. AUG 2012 DAY 235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LEIRVOGUR 27. AUG 2012 DAY 240
LEIRVOGUR 24. AUG 2012 DAY 237
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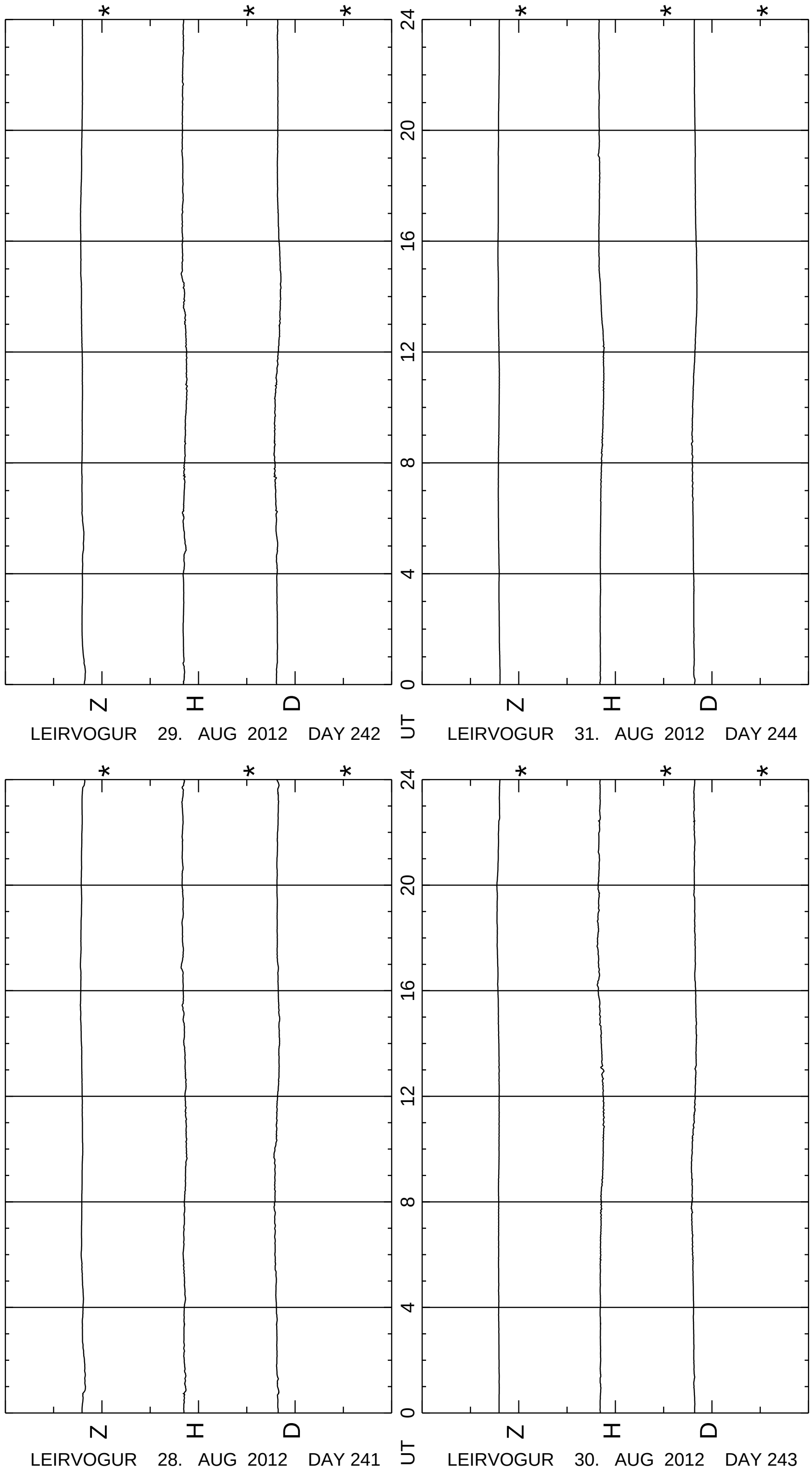
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LEIRVOGUR 30. AUG 2012 DAY 243
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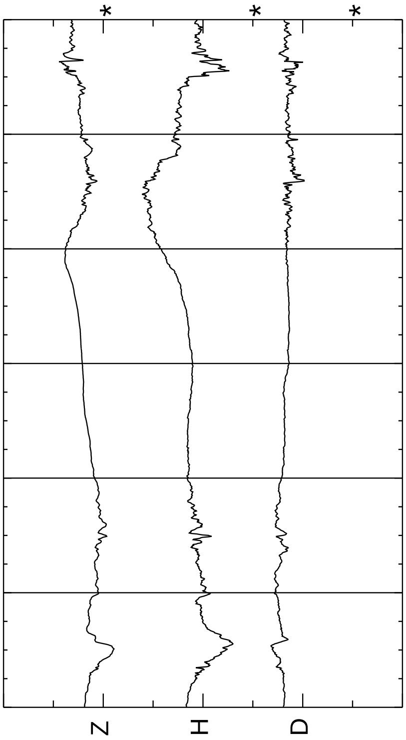
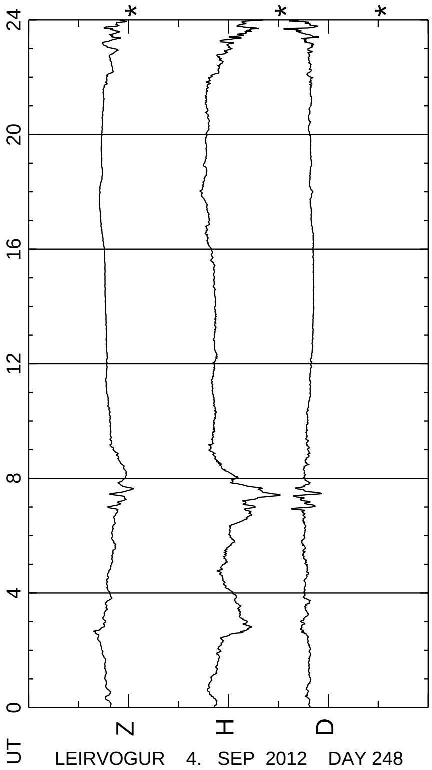
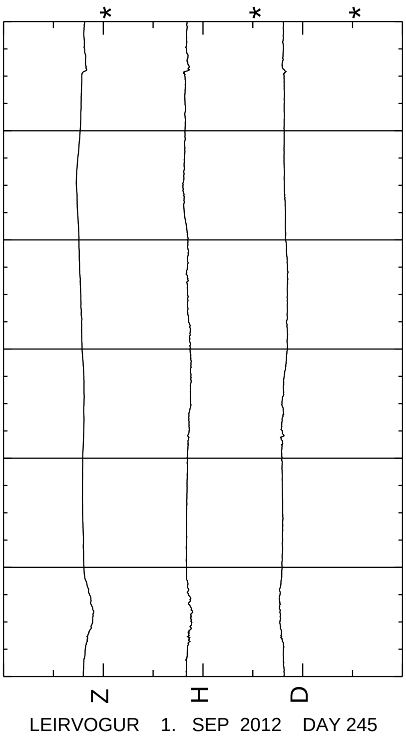


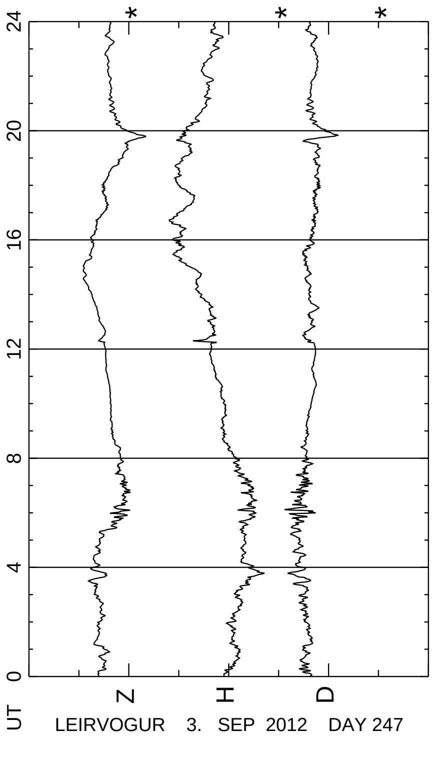
LEIRVOGUR 2. SEP 2012 DAY 246



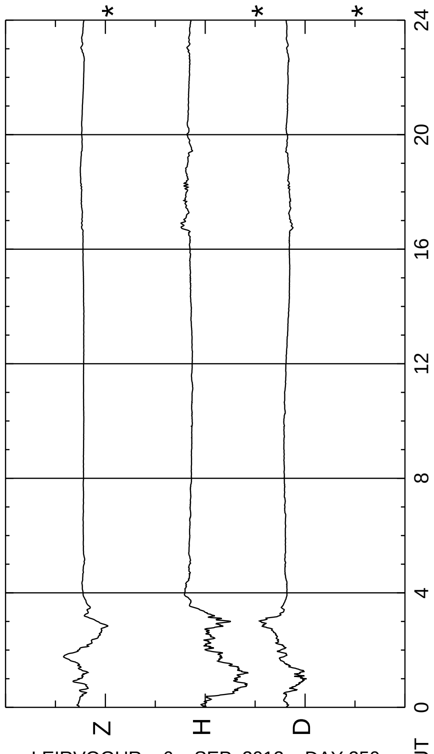
LEIRVOGUR 4. SEP 2012 DAY 248



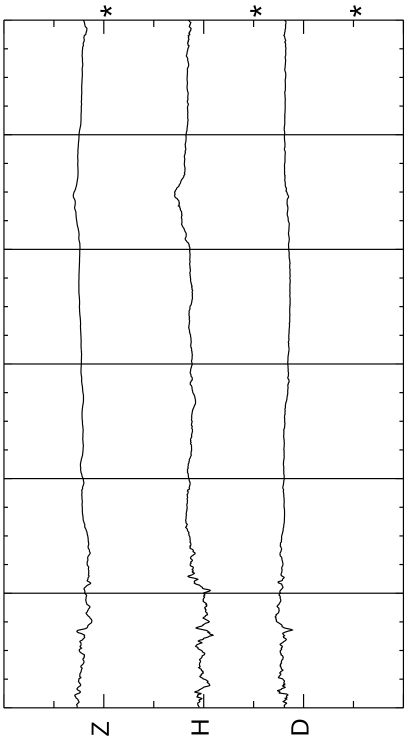
LEIRVOGUR 1. SEP 2012 DAY 245



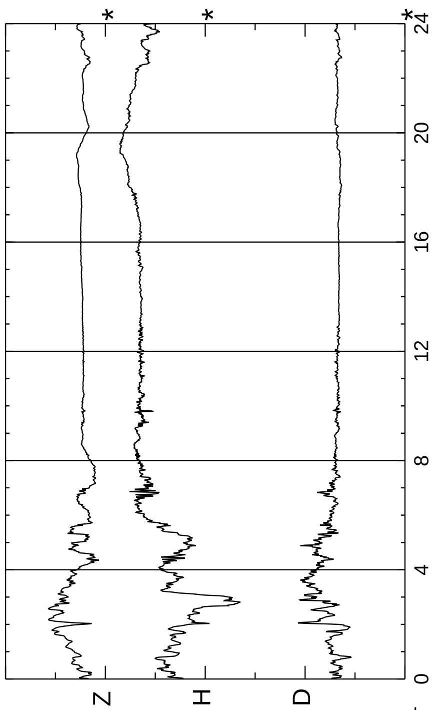
LEIRVOGUR 3. SEP 2012 DAY 247



LEIRVOGUR 6. SEP 2012 DAY 250



LEIRVOGUR 8. SEP 2012 DAY 252



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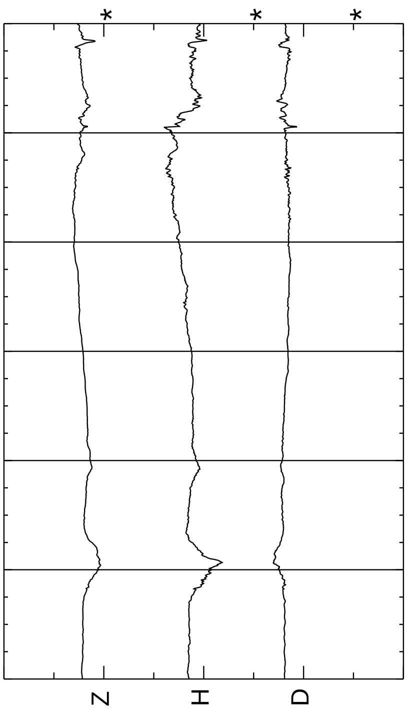
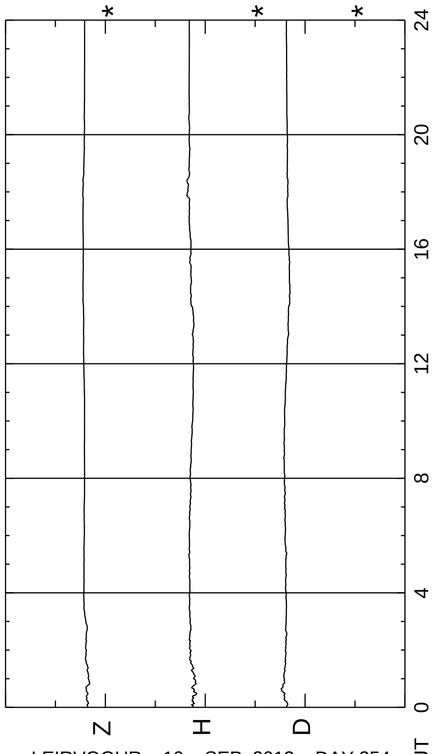
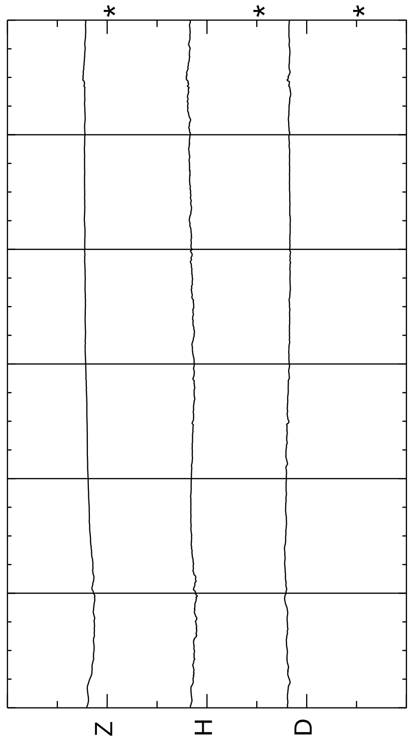


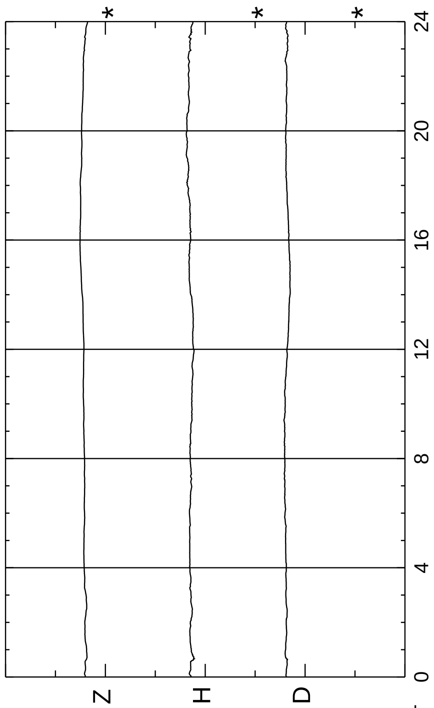
LEIRVOGUR 7. SEP 2012 DAY 251



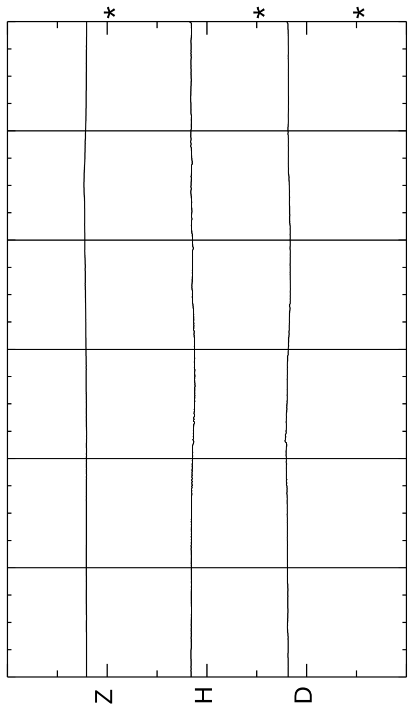
LEIRVOGUR 10. SEP 2012 DAY 254



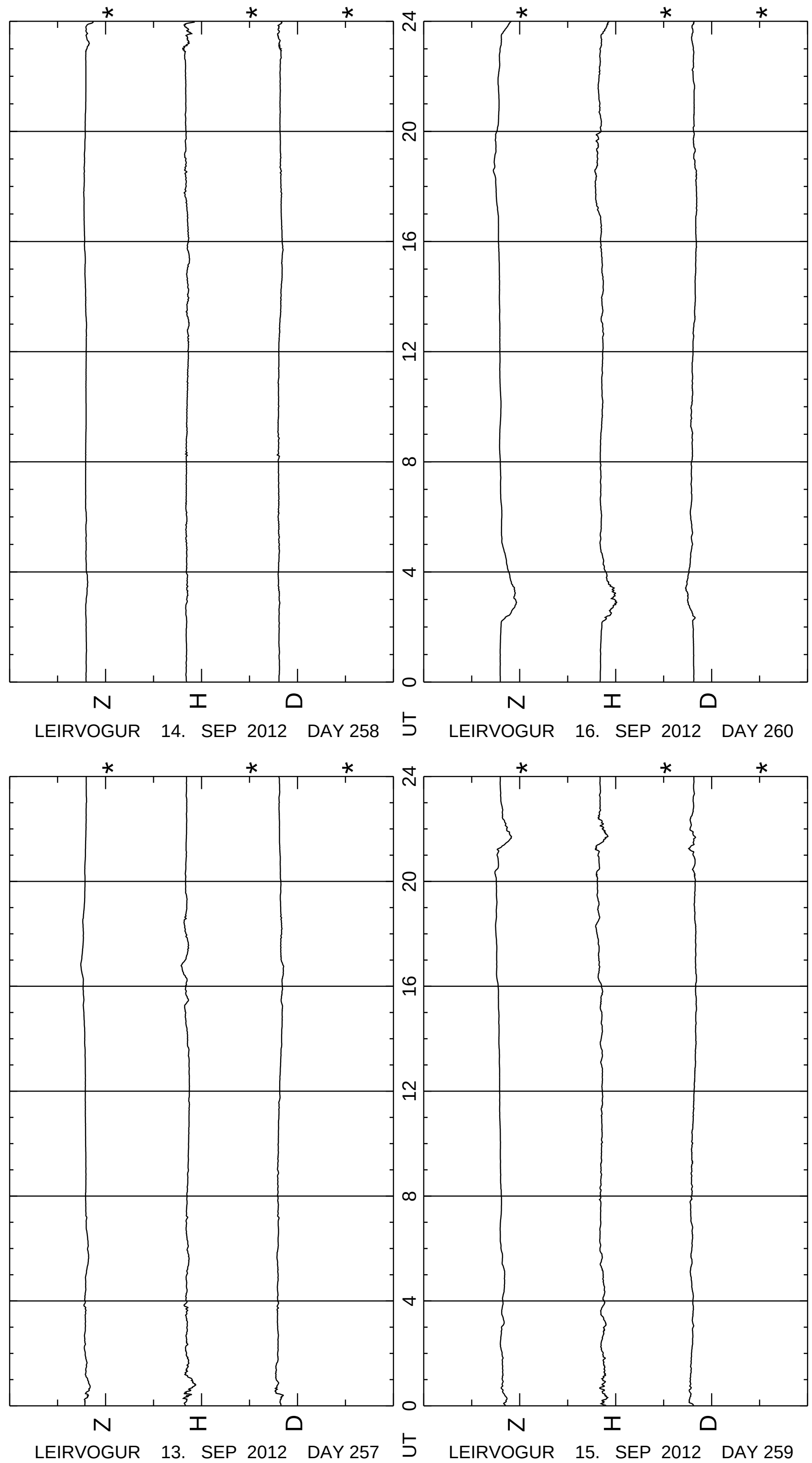
LEIRVOGUR 12. SEP 2012 DAY 256



LEIRVOGUR 9. SEP 2012 DAY 253



LEIRVOGUR 11. SEP 2012 DAY 255


Z H D
LEIRVOGUR 14. SEP 2012 DAY 258
UT
Z H D
LEIRVOGUR 16. SEP 2012 DAY 260
Z H D
LEIRVOGUR 13. SEP 2012 DAY 257
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Z H D
LEIRVOGUR 15. SEP 2012 DAY 259
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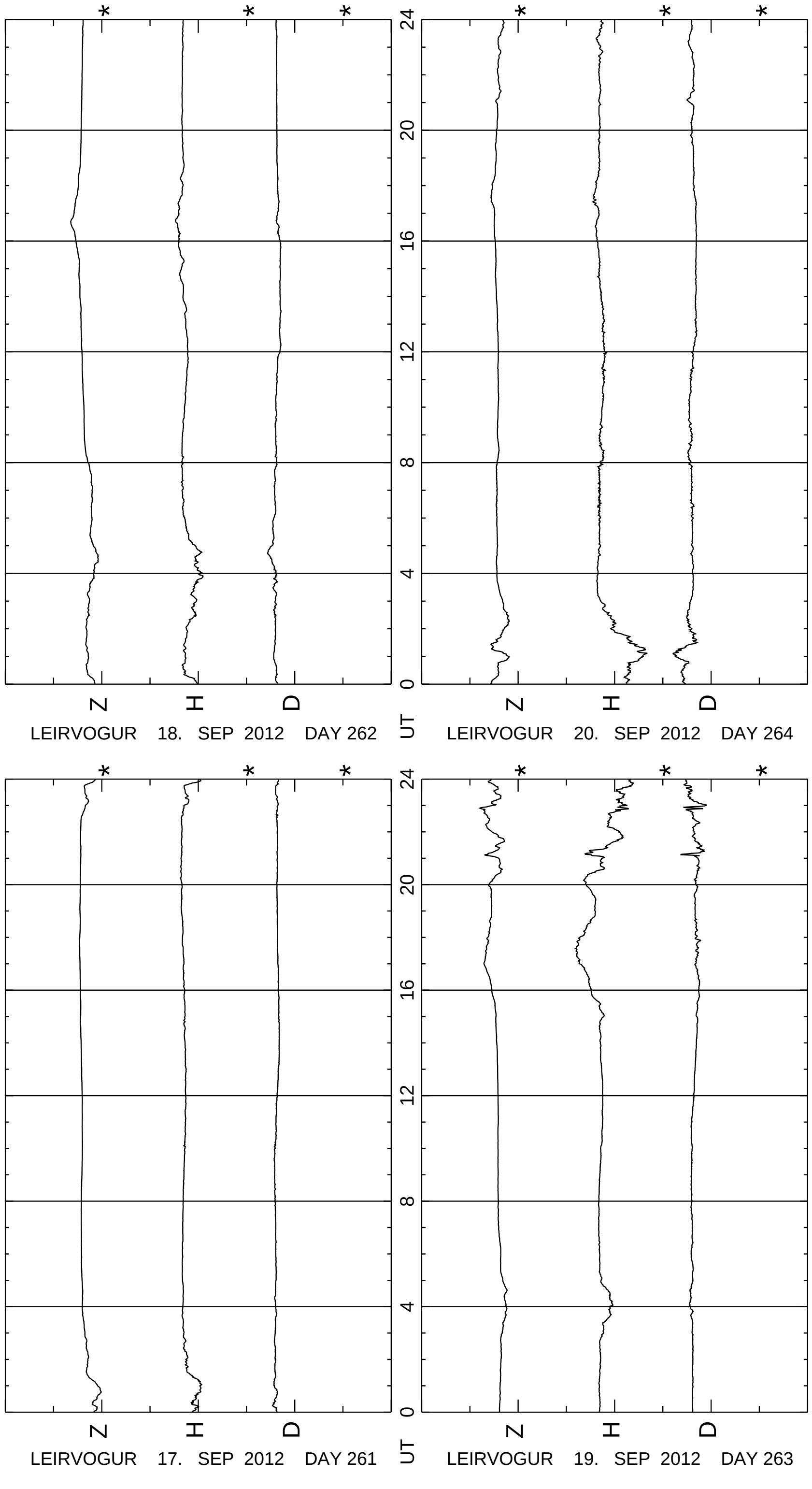
Z H D
LEIRVOGUR 18. SEP 2012 DAY 262
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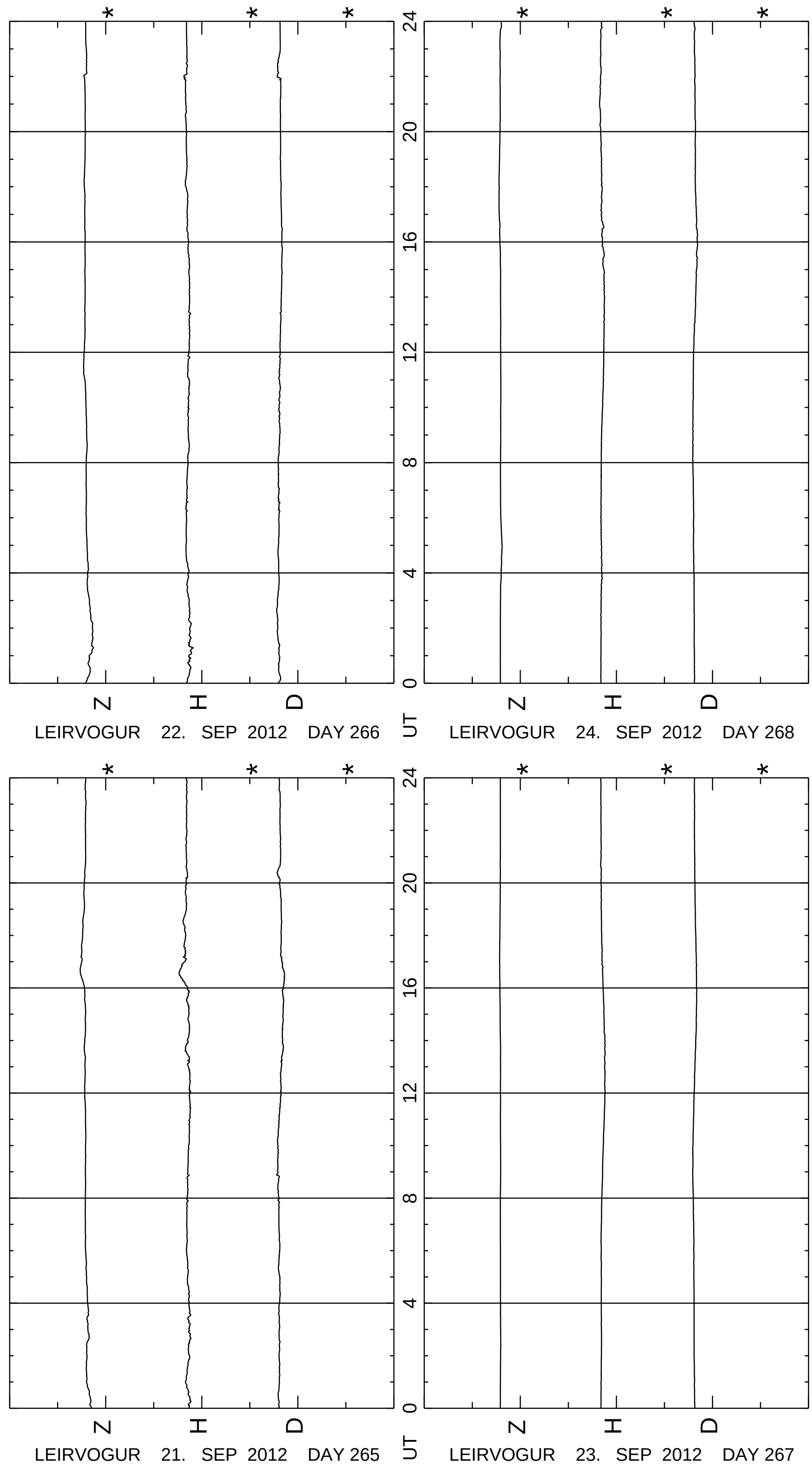
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 20. SEP 2012 DAY 264
Z H D
LEIRVOGUR 17. SEP 2012 DAY 261
Z H D
LEIRVOGUR 19. SEP 2012 DAY 263



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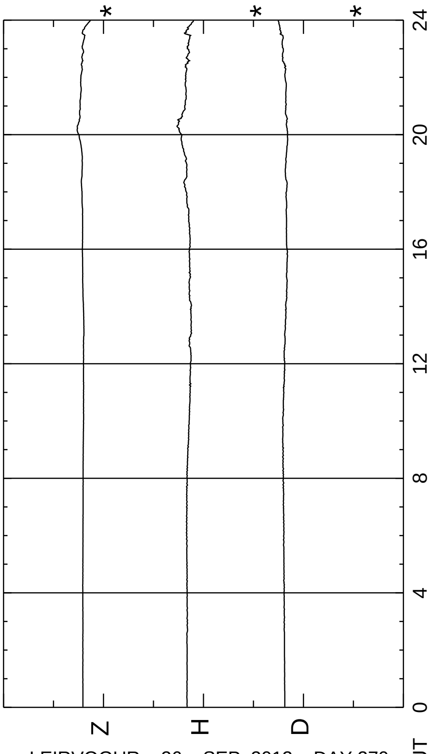
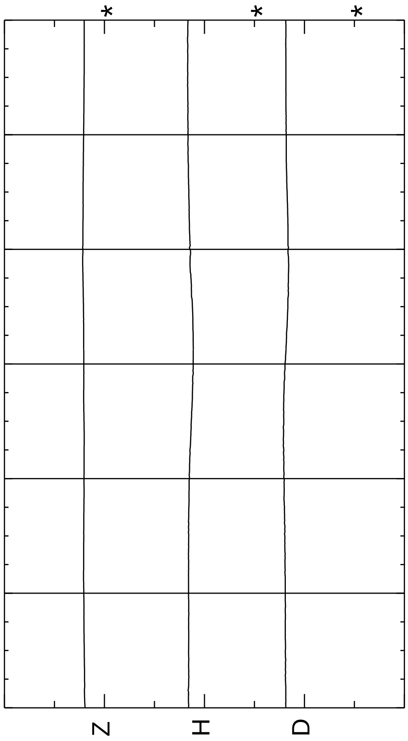
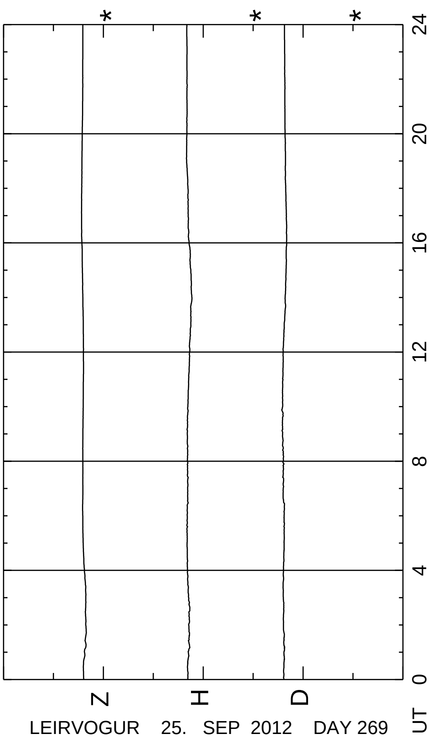
LEIRVOGUR 22. SEP 2012 DAY 266
LEIRVOGUR 24. SEP 2012 DAY 268
LEIRVOGUR 21. SEP 2012 DAY 265
LEIRVOGUR 23. SEP 2012 DAY 267



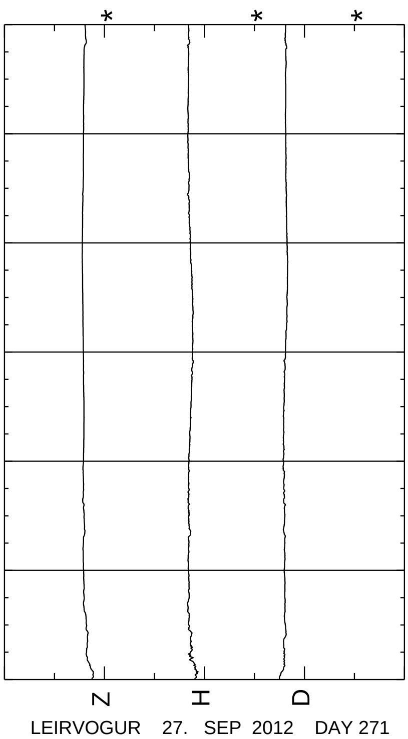
LEIRVOGUR 26. SEP 2012 DAY 270



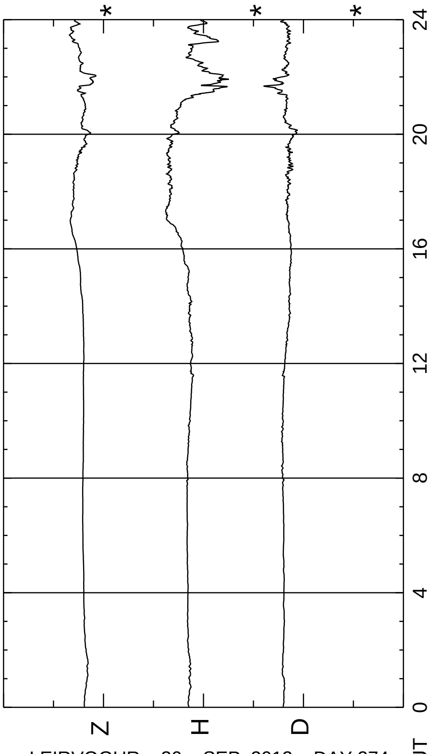
LEIRVOGUR 28. SEP 2012 DAY 272



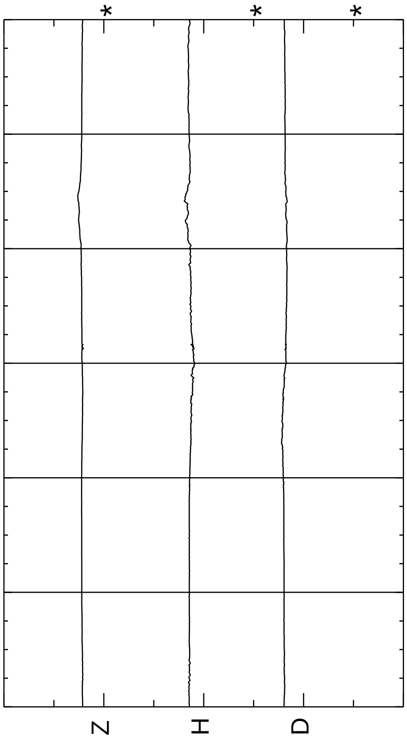
LEIRVOGUR 25. SEP 2012 DAY 269



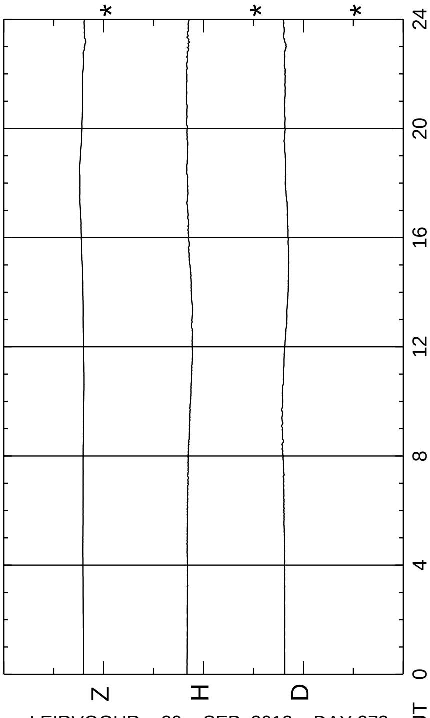
LEIRVOGUR 27. SEP 2012 DAY 271



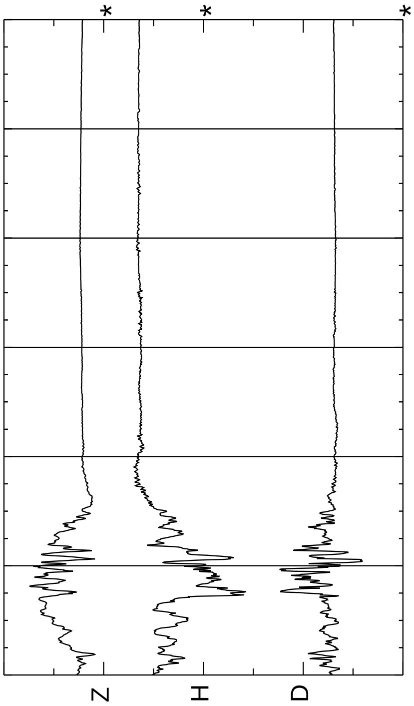
LEIRVOGUR 30. SEP 2012 DAY 274



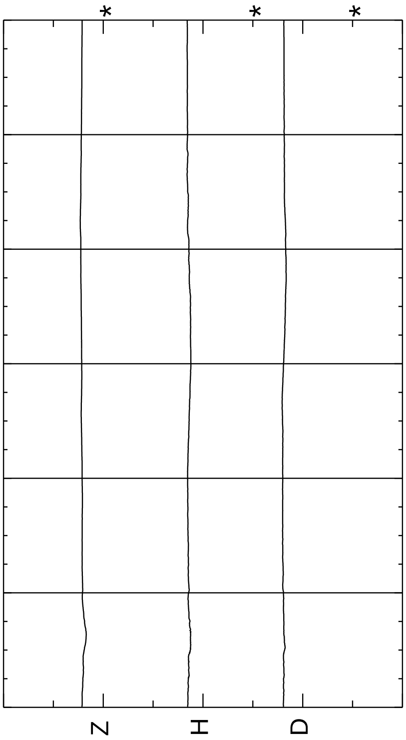
LEIRVOGUR 2. OCT 2012 DAY 276



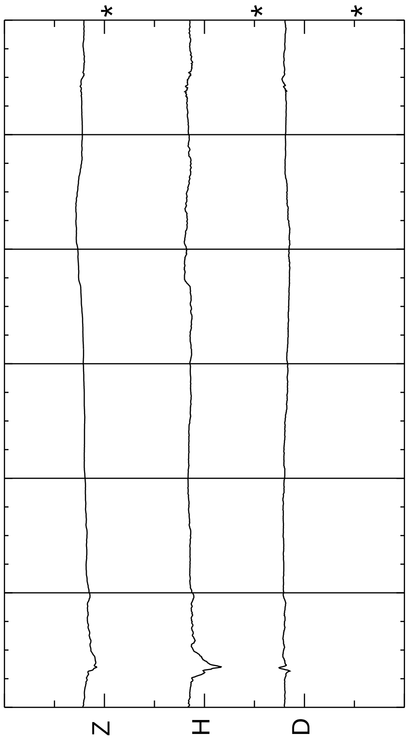
LEIRVOGUR 29. SEP 2012 DAY 273



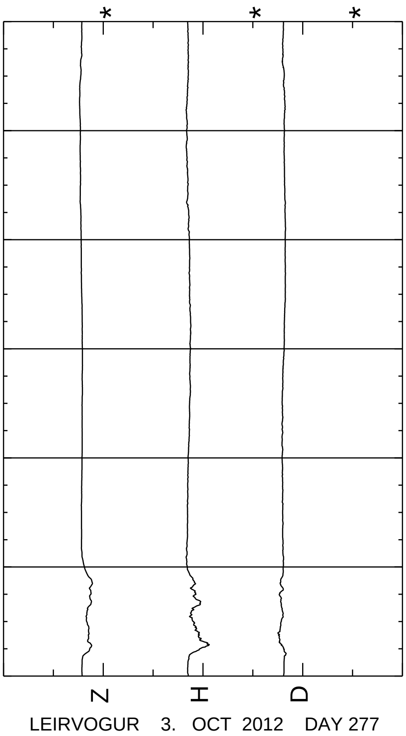
LEIRVOGUR 1. OCT 2012 DAY 275



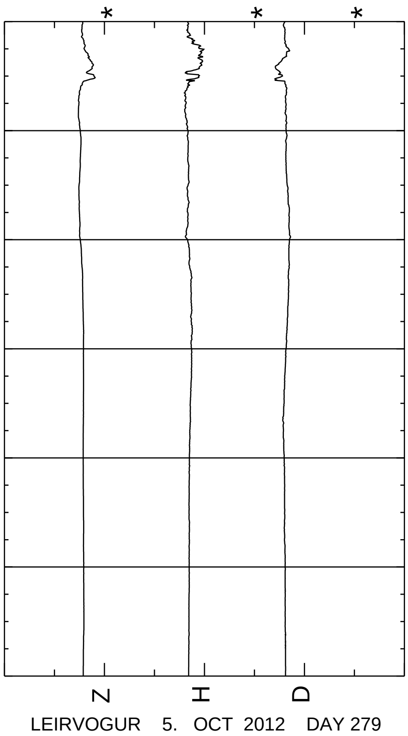
LEIRVOGUR 4. OCT 2012 DAY 278



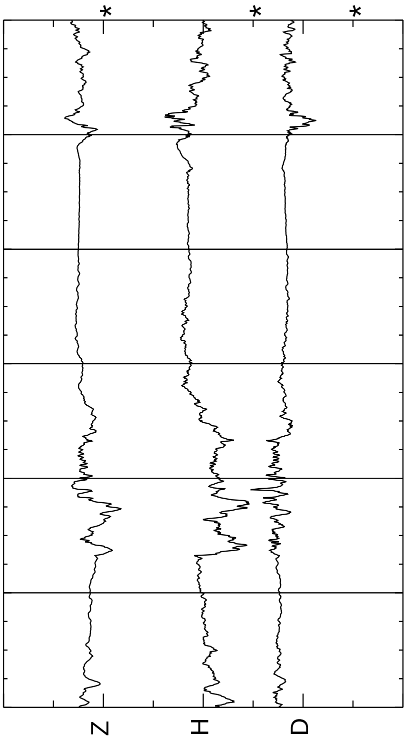
LEIRVOGUR 6. OCT 2012 DAY 280



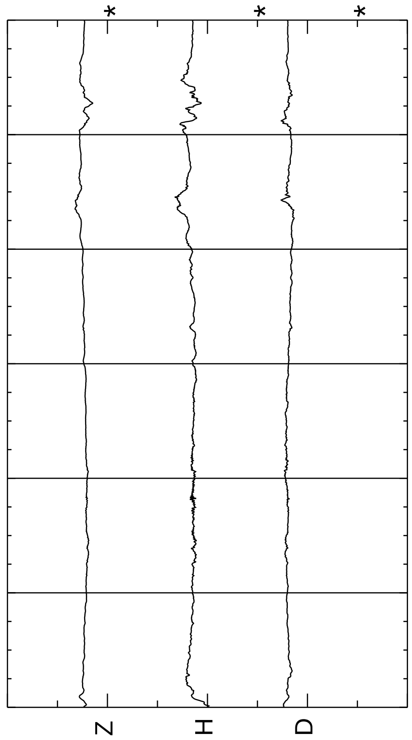
LEIRVOGUR 3. OCT 2012 DAY 277



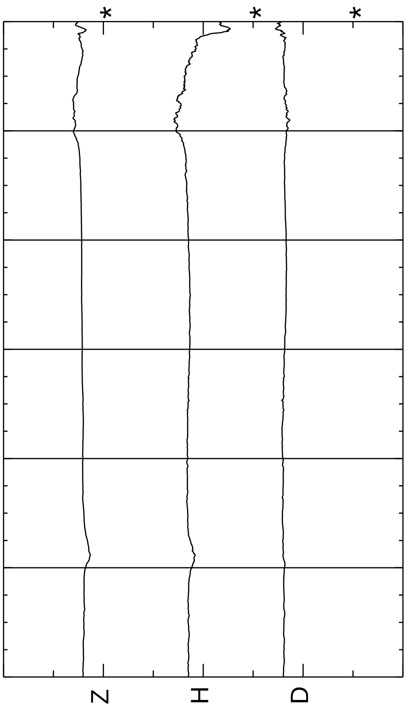
LEIRVOGUR 5. OCT 2012 DAY 279



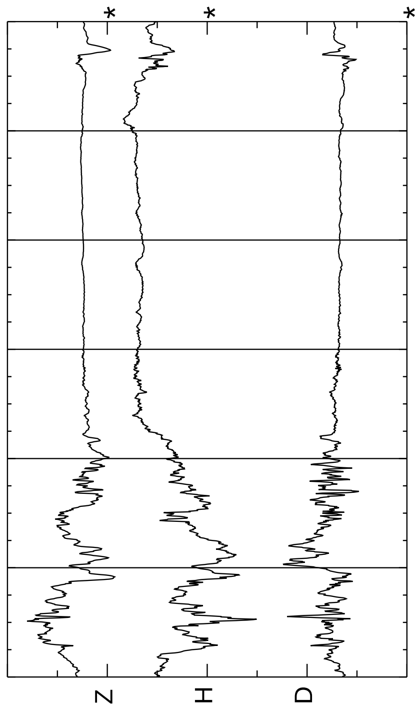
LEIRVOGUR 8. OCT 2012 DAY 282



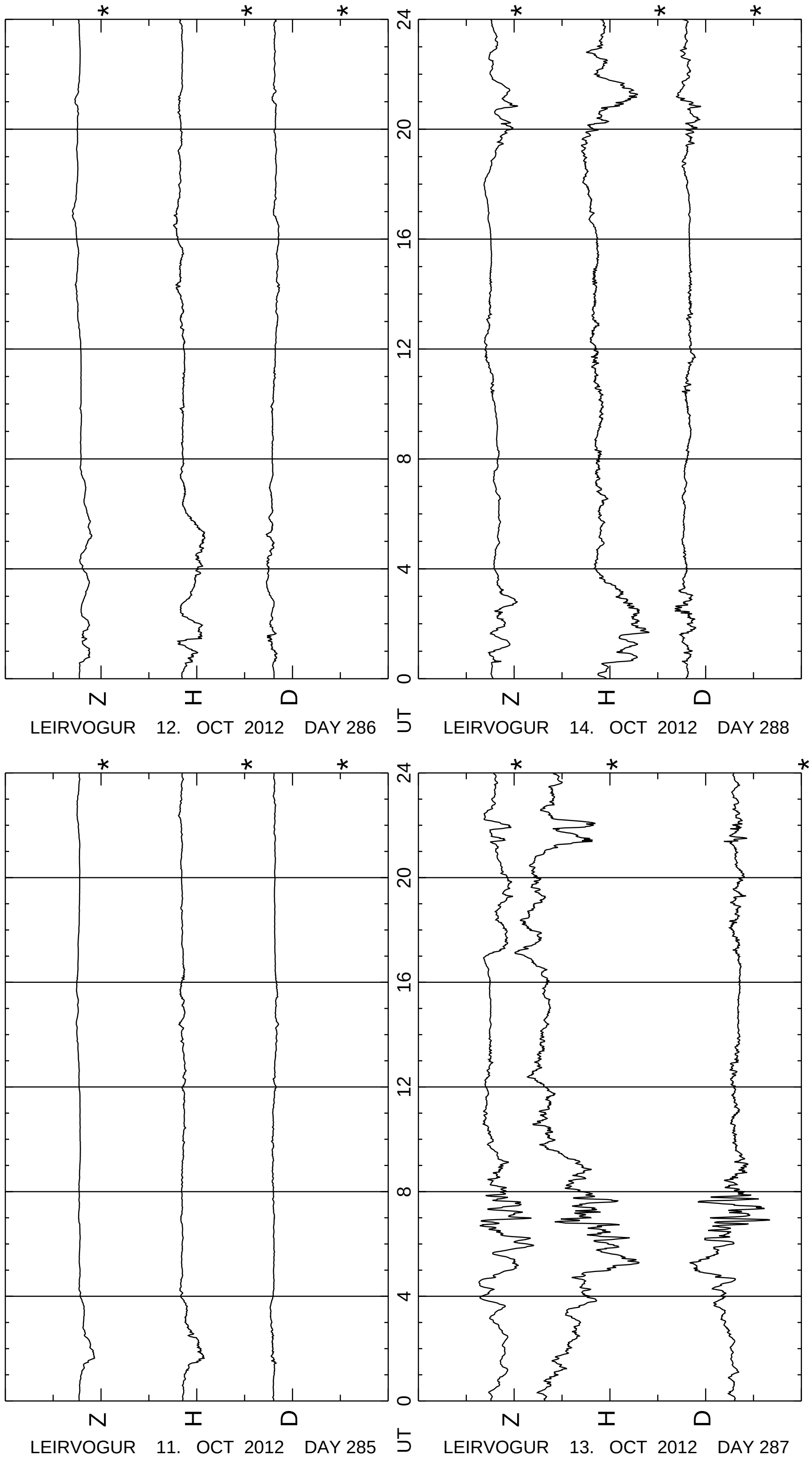
LEIRVOGUR 10. OCT 2012 DAY 284



LEIRVOGUR 7. OCT 2012 DAY 281



LEIRVOGUR 9. OCT 2012 DAY 283


LEIRVOGUR 12. OCT 2012 DAY 286
LEIRVOGUR 14. OCT 2012 DAY 288
LEIRVOGUR 11. OCT 2012 DAY 285
LEIRVOGUR 13. OCT 2012 DAY 287
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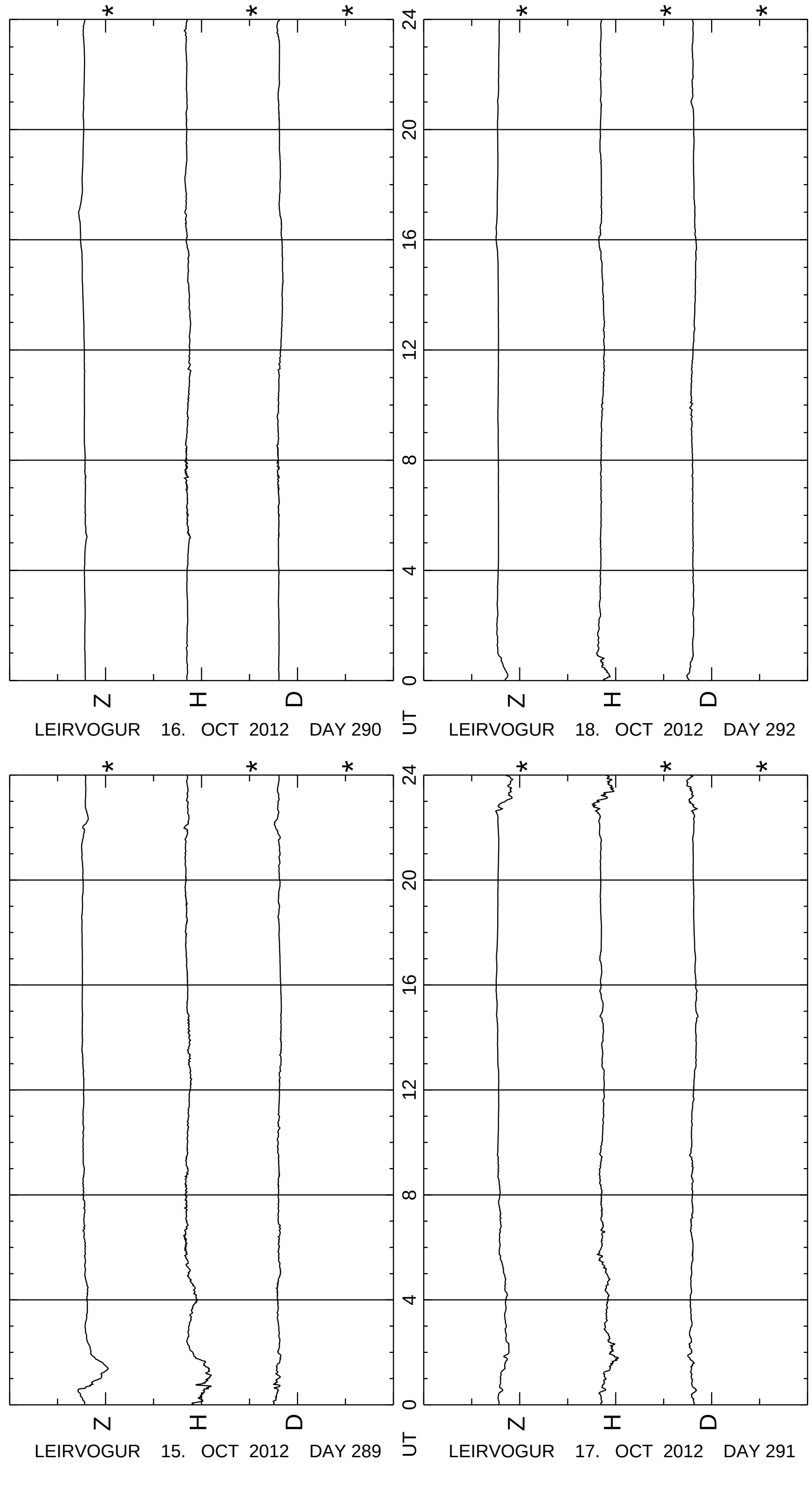
LEIRVOGUR 16. OCT 2012 DAY 290
LEIRVOGUR 18. OCT 2012 DAY 292
LEIRVOGUR 15. OCT 2012 DAY 289
LEIRVOGUR 17. OCT 2012 DAY 291
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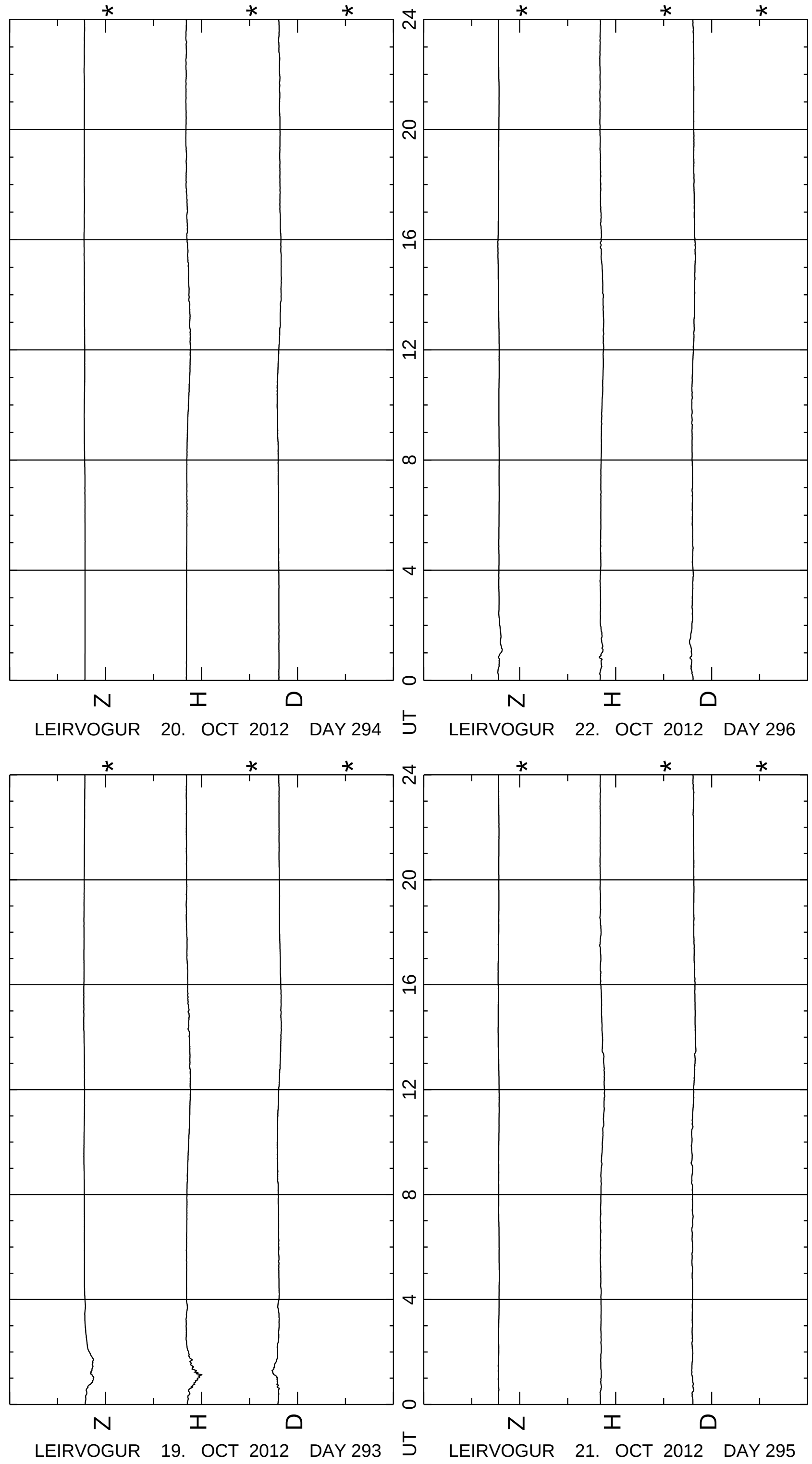
Z H D
LEIRVOGUR 20. OCT 2012 DAY 294
Z H D
LEIRVOGUR 22. OCT 2012 DAY 296
Z H D
LEIRVOGUR 19. OCT 2012 DAY 293
Z H D
LEIRVOGUR 21. OCT 2012 DAY 295
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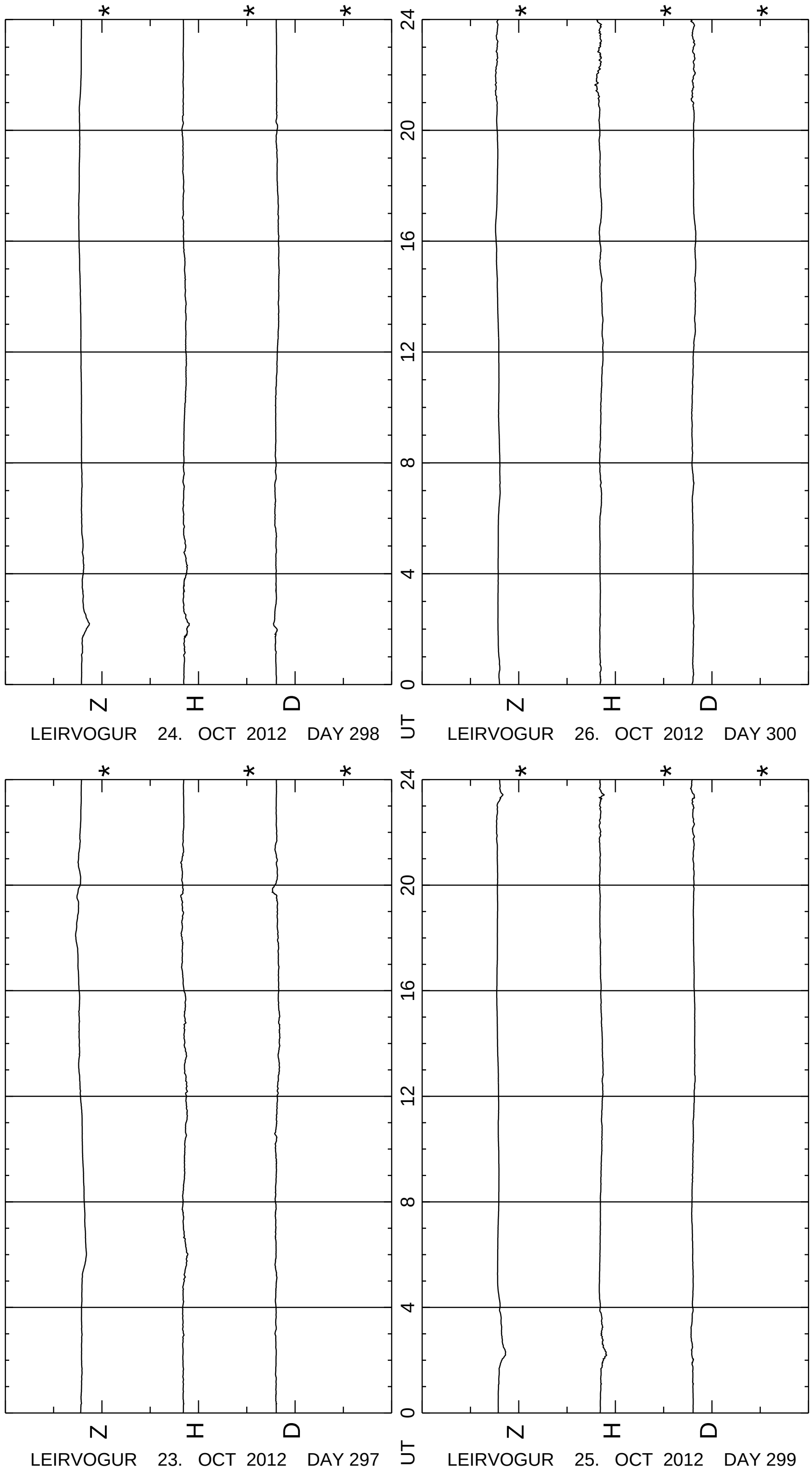

LEIRVOGUR 24. OCT 2012 DAY 298
LEIRVOGUR 26. OCT 2012 DAY 300
LEIRVOGUR 23. OCT 2012 DAY 297
LEIRVOGUR 25. OCT 2012 DAY 299
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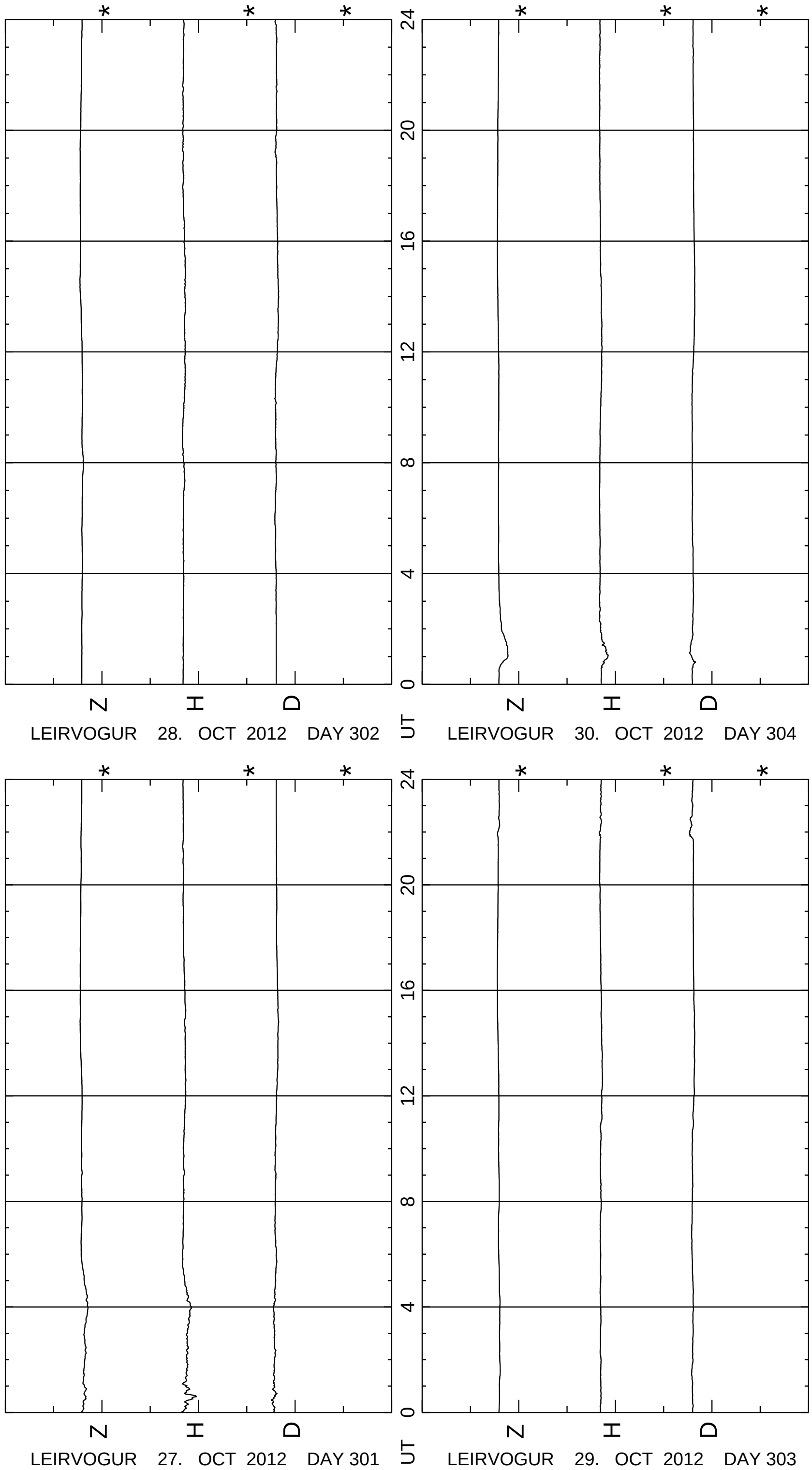
LEIRVOGUR 28. OCT 2012 DAY 302
LEIRVOGUR 30. OCT 2012 DAY 304
LEIRVOGUR 27. OCT 2012 DAY 301
LEIRVOGUR 29. OCT 2012 DAY 303
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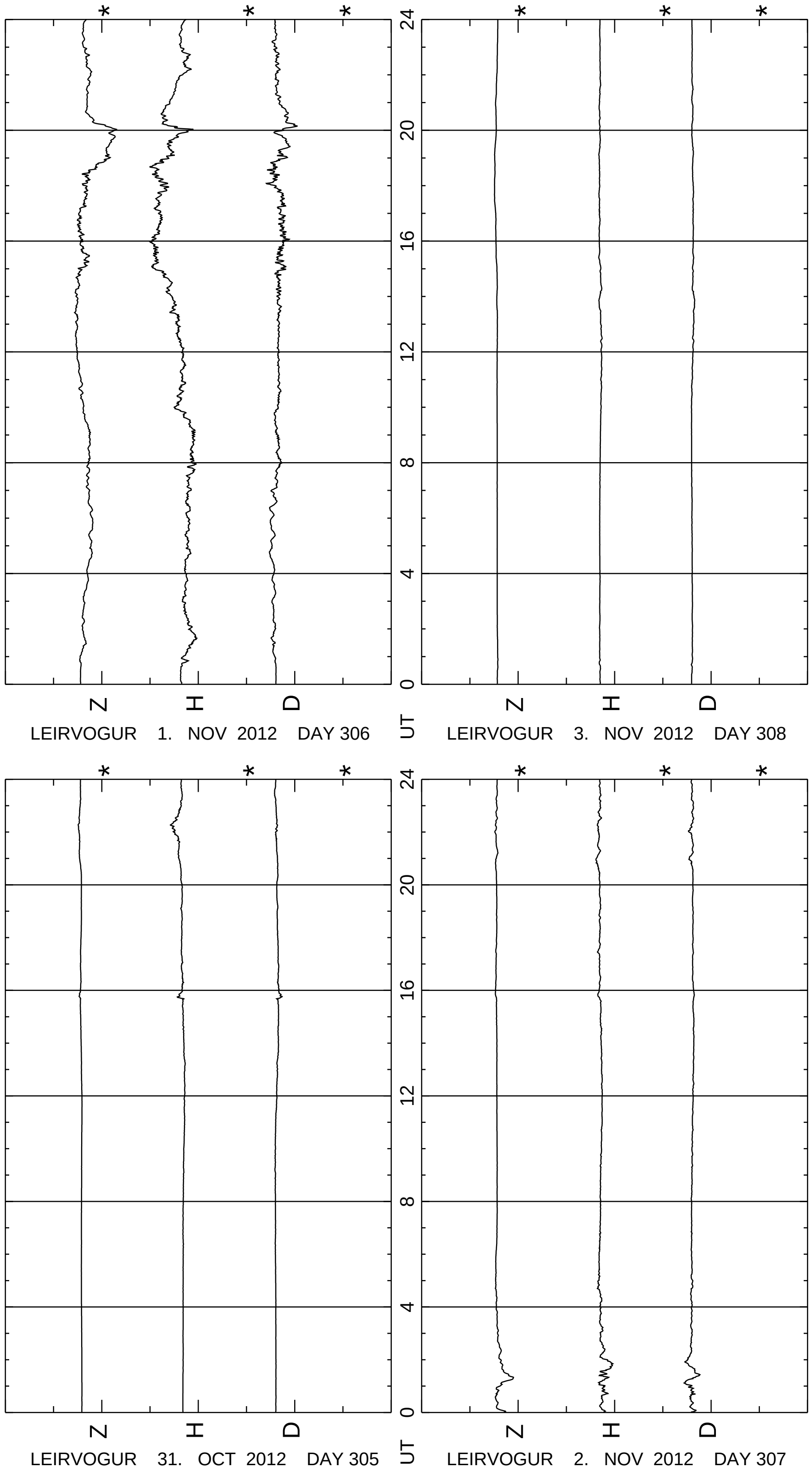
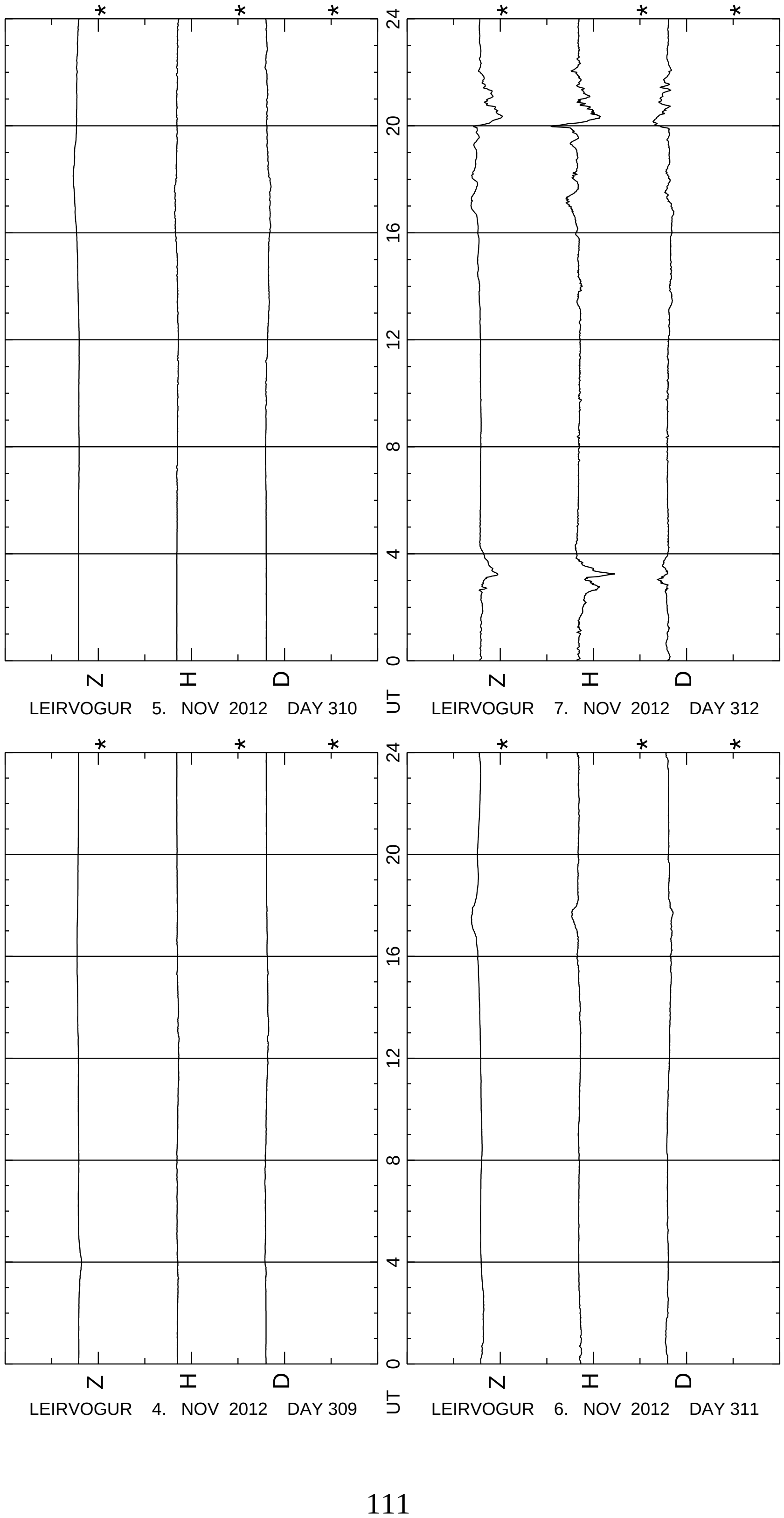

Z H D
LEIRVOGUR 1. NOV 2012 DAY 306
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 3. NOV 2012 DAY 308
Z H D
LEIRVOGUR 31. OCT 2012 DAY 305
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 2. NOV 2012 DAY 307


LEIRVOGUR 5. NOV 2012 DAY 310
LEIRVOGUR 7. NOV 2012 DAY 312
LEIRVOGUR 4. NOV 2012 DAY 309
LEIRVOGUR 6. NOV 2012 DAY 311
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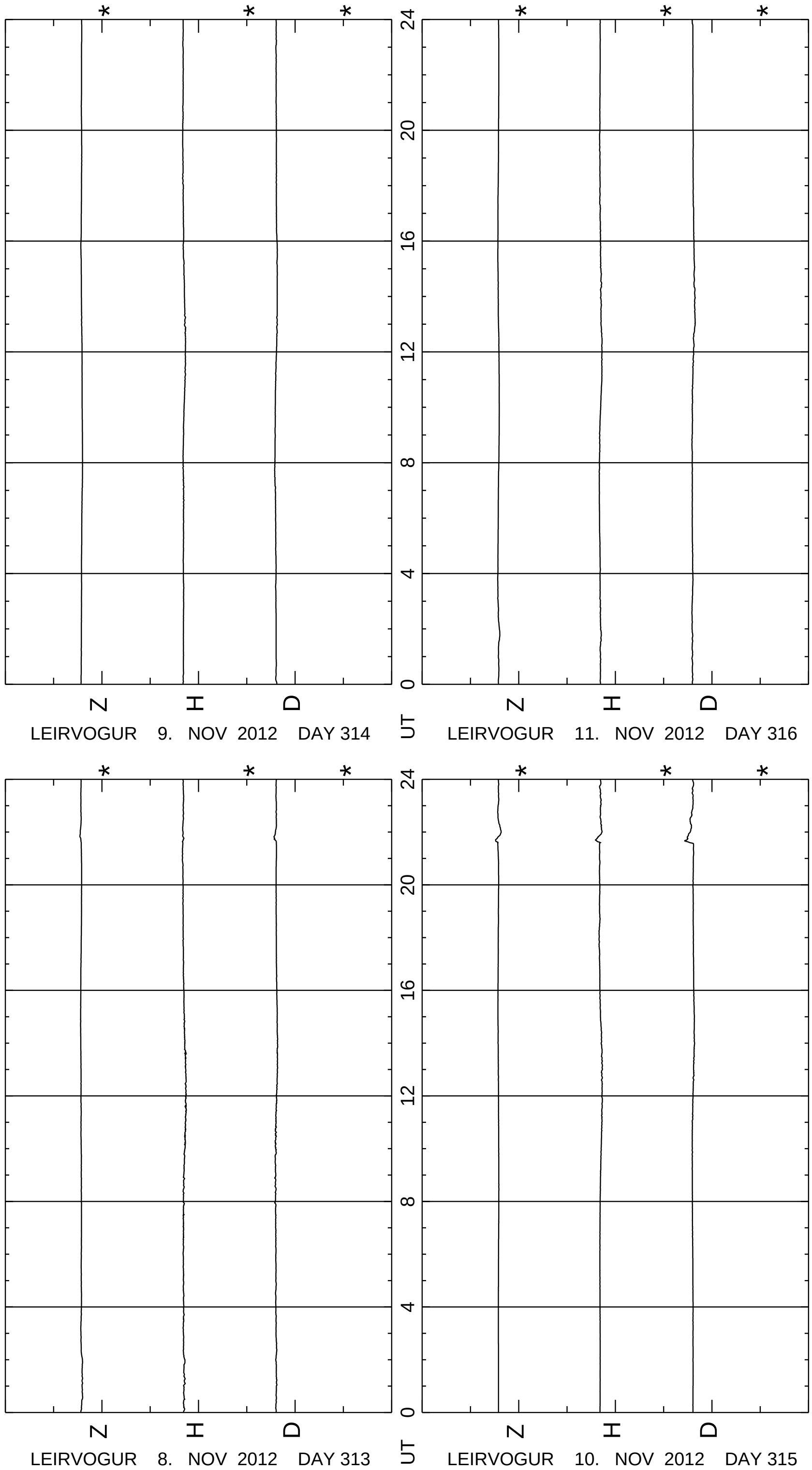
Z H D
LEIRVOGUR 9. NOV 2012 DAY 314
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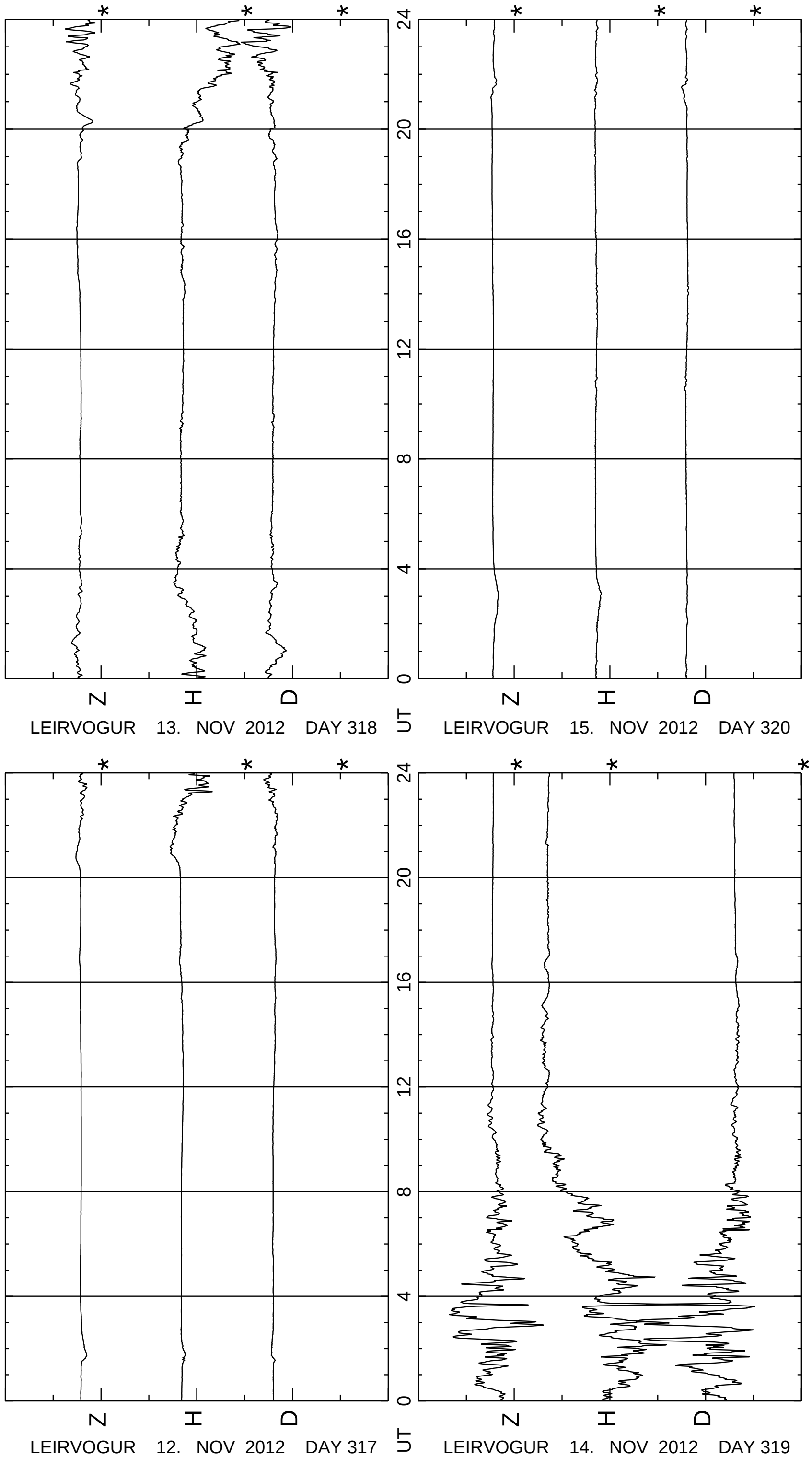
Z H D
LEIRVOGUR 11. NOV 2012 DAY 316
Z H D
LEIRVOGUR 8. NOV 2012 DAY 313
UT
Z H D
LEIRVOGUR 10. NOV 2012 DAY 315


LEIRVOGUR 13. NOV 2012 DAY 318
LEIRVOGUR 15. NOV 2012 DAY 320
LEIRVOGUR 12. NOV 2012 DAY 317
LEIRVOGUR 14. NOV 2012 DAY 319
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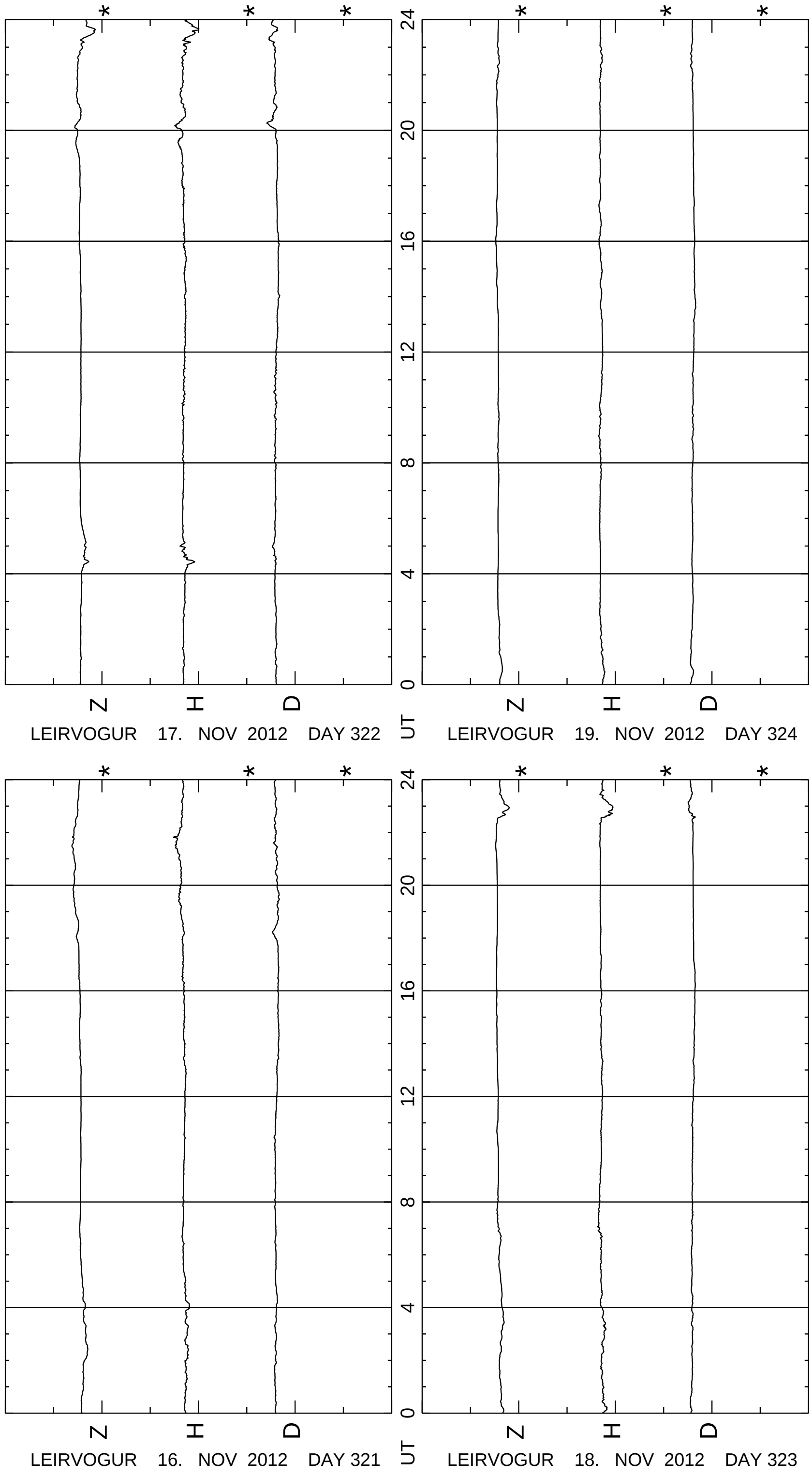

LEIRVOGUR 17. NOV 2012 DAY 322
LEIRVOGUR 19. NOV 2012 DAY 324
LEIRVOGUR 16. NOV 2012 DAY 321
LEIRVOGUR 18. NOV 2012 DAY 323
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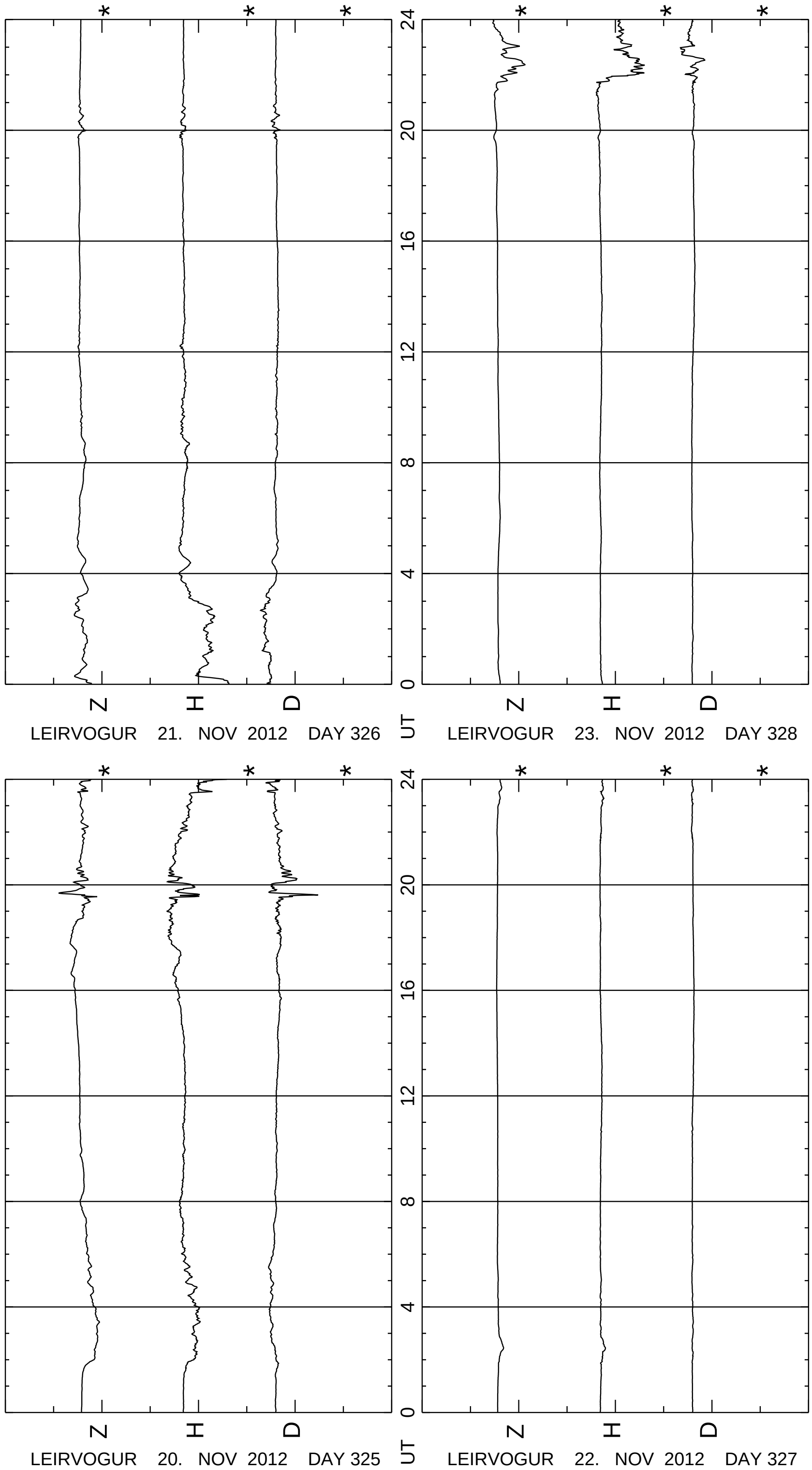
LEIRVOGUR 21. NOV 2012 DAY 326
LEIRVOGUR 23. NOV 2012 DAY 328
LEIRVOGUR 20. NOV 2012 DAY 325
LEIRVOGUR 22. NOV 2012 DAY 327
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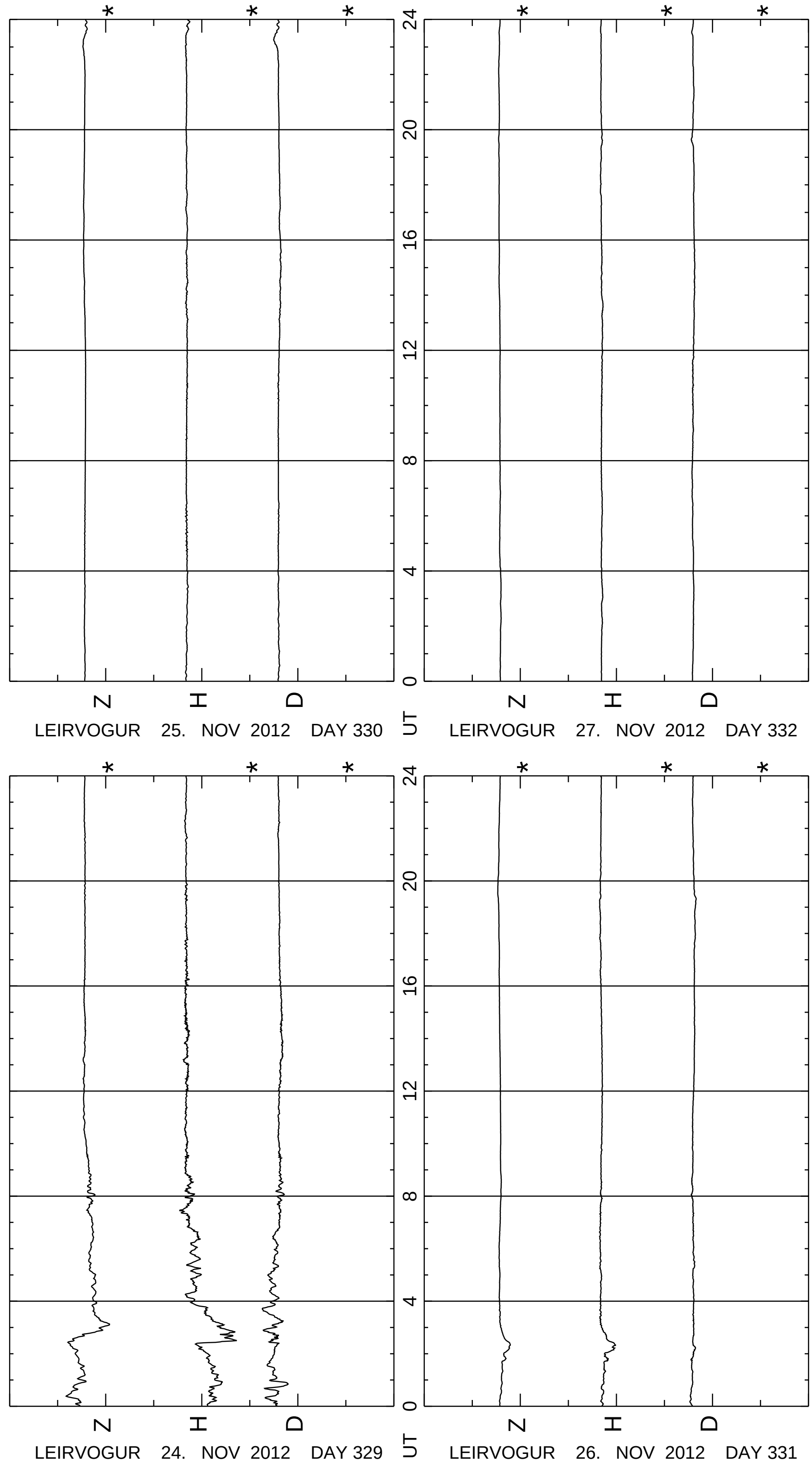
LEIRVOGUR 25. NOV 2012 DAY 330
LEIRVOGUR 27. NOV 2012 DAY 332
LEIRVOGUR 24. NOV 2012 DAY 329
LEIRVOGUR 26. NOV 2012 DAY 331
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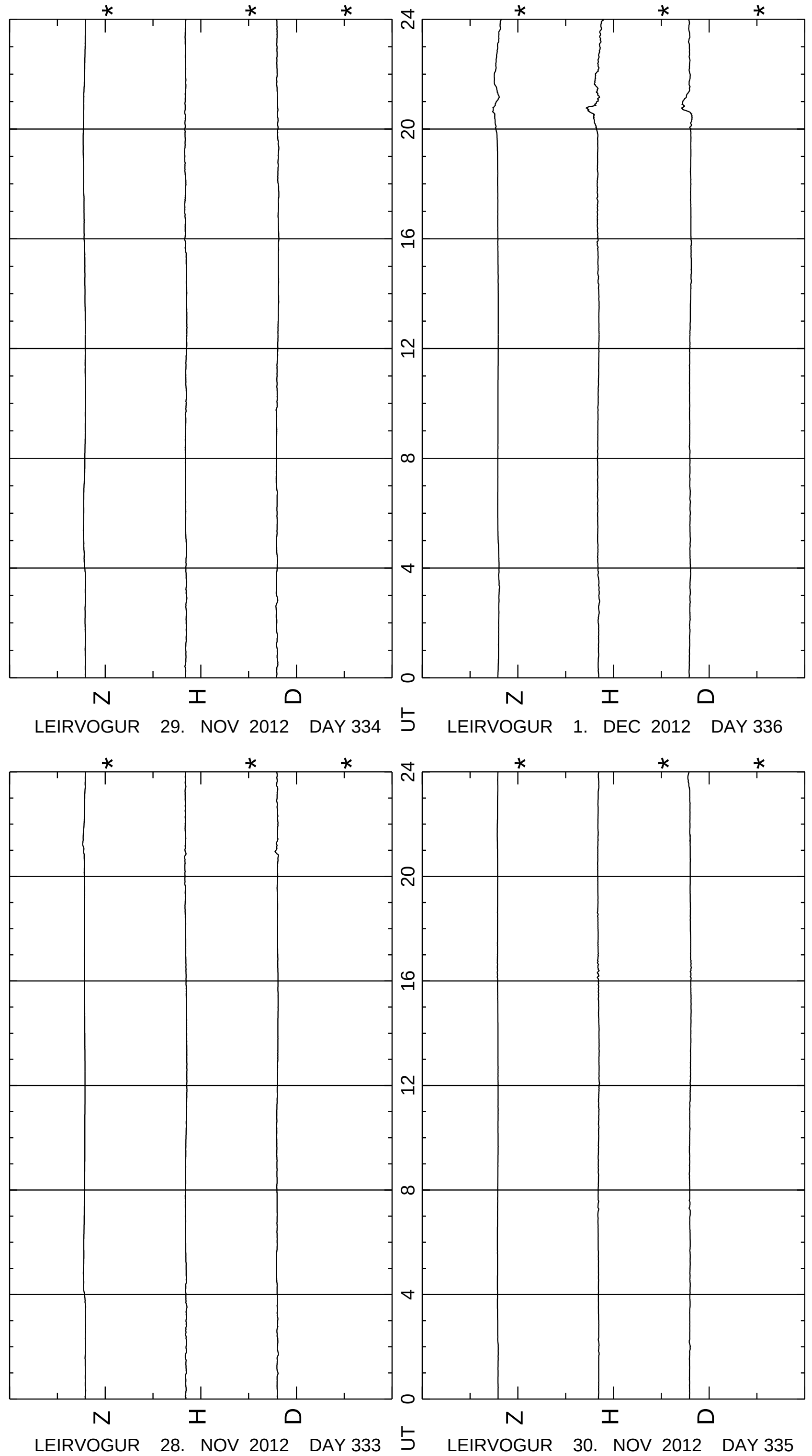
LEIRVOGUR 29. NOV 2012 DAY 334
LEIRVOGUR 1. DEC 2012 DAY 336
LEIRVOGUR 28. NOV 2012 DAY 333
LEIRVOGUR 30. NOV 2012 DAY 335
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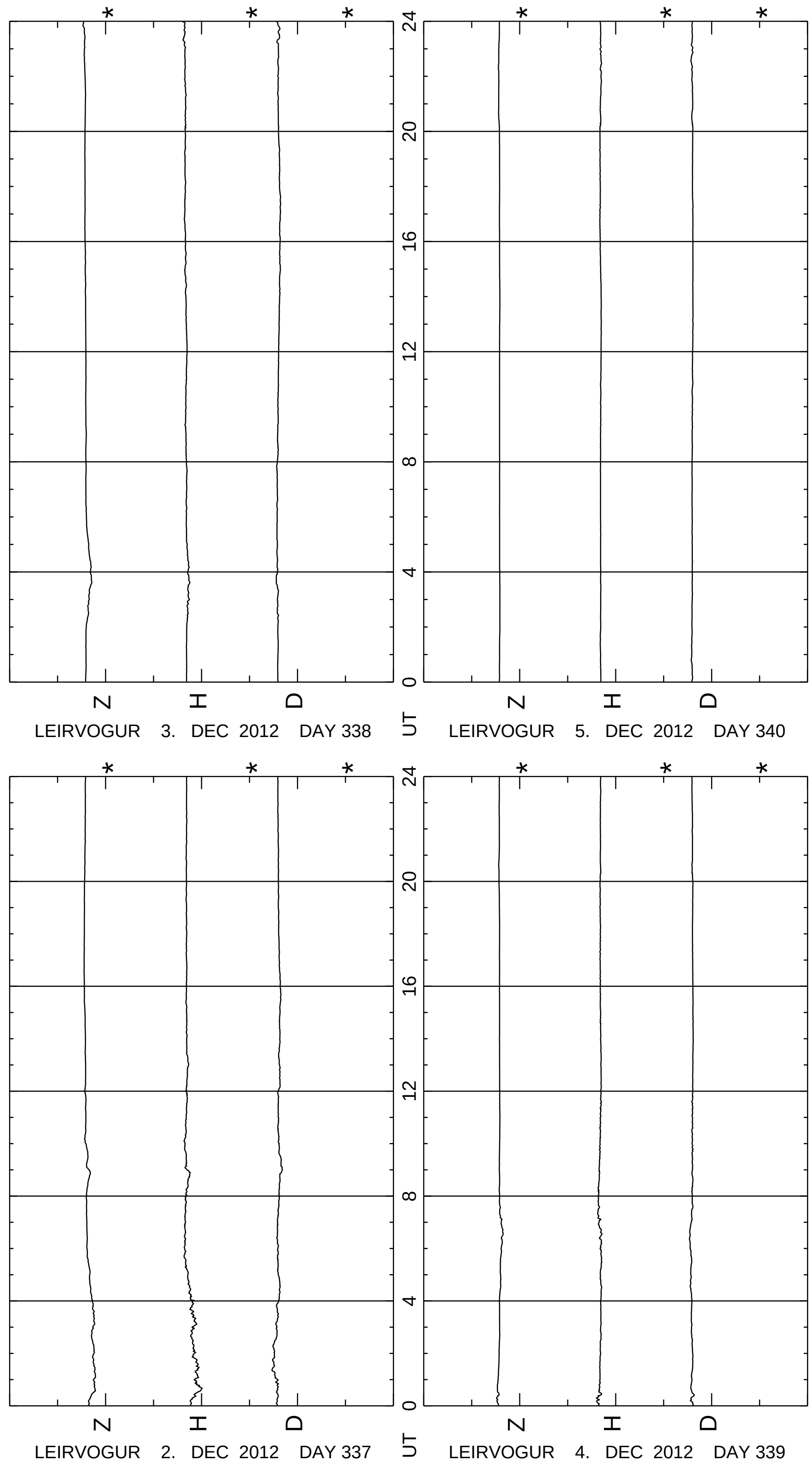
LEIRVOGUR 3. DEC 2012 DAY 338
LEIRVOGUR 5. DEC 2012 DAY 340
LEIRVOGUR 2. DEC 2012 DAY 337
LEIRVOGUR 4. DEC 2012 DAY 339
Z H D
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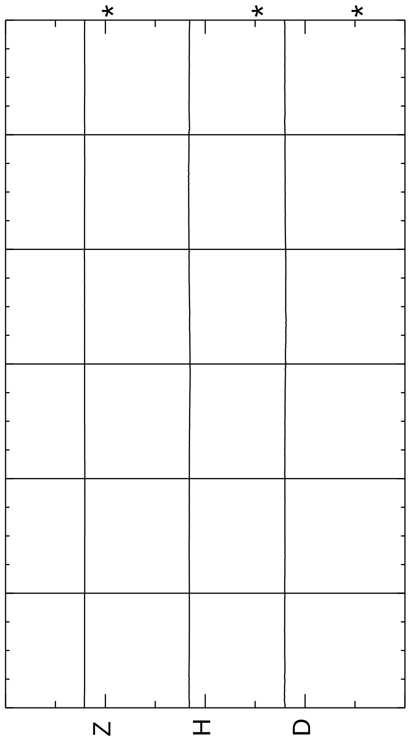
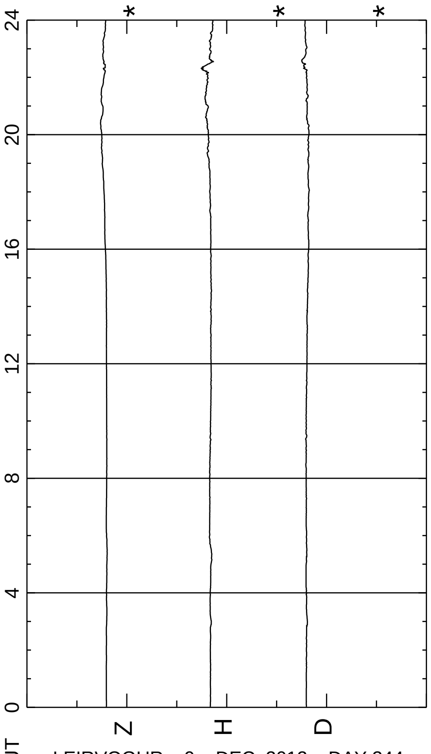
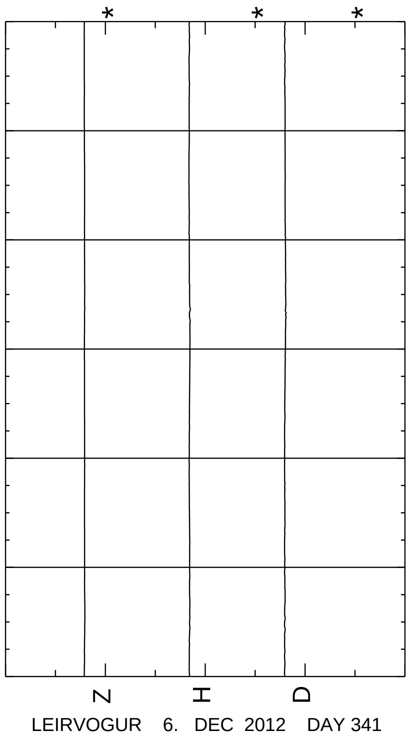
0 4 8 12 16 20 24



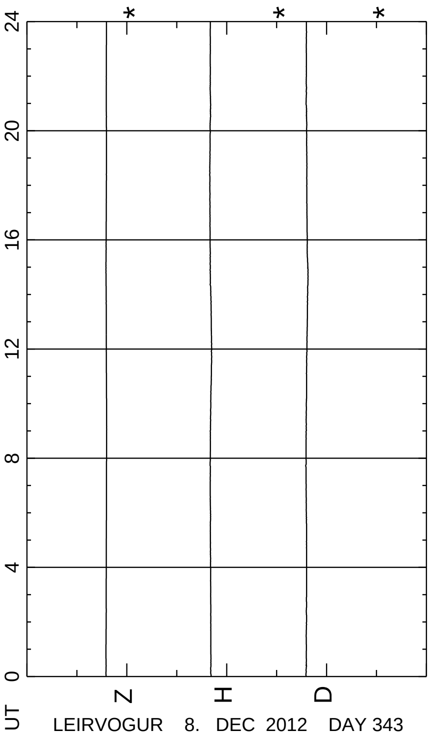
LEIRVOGUR 7. DEC 2012 DAY 342



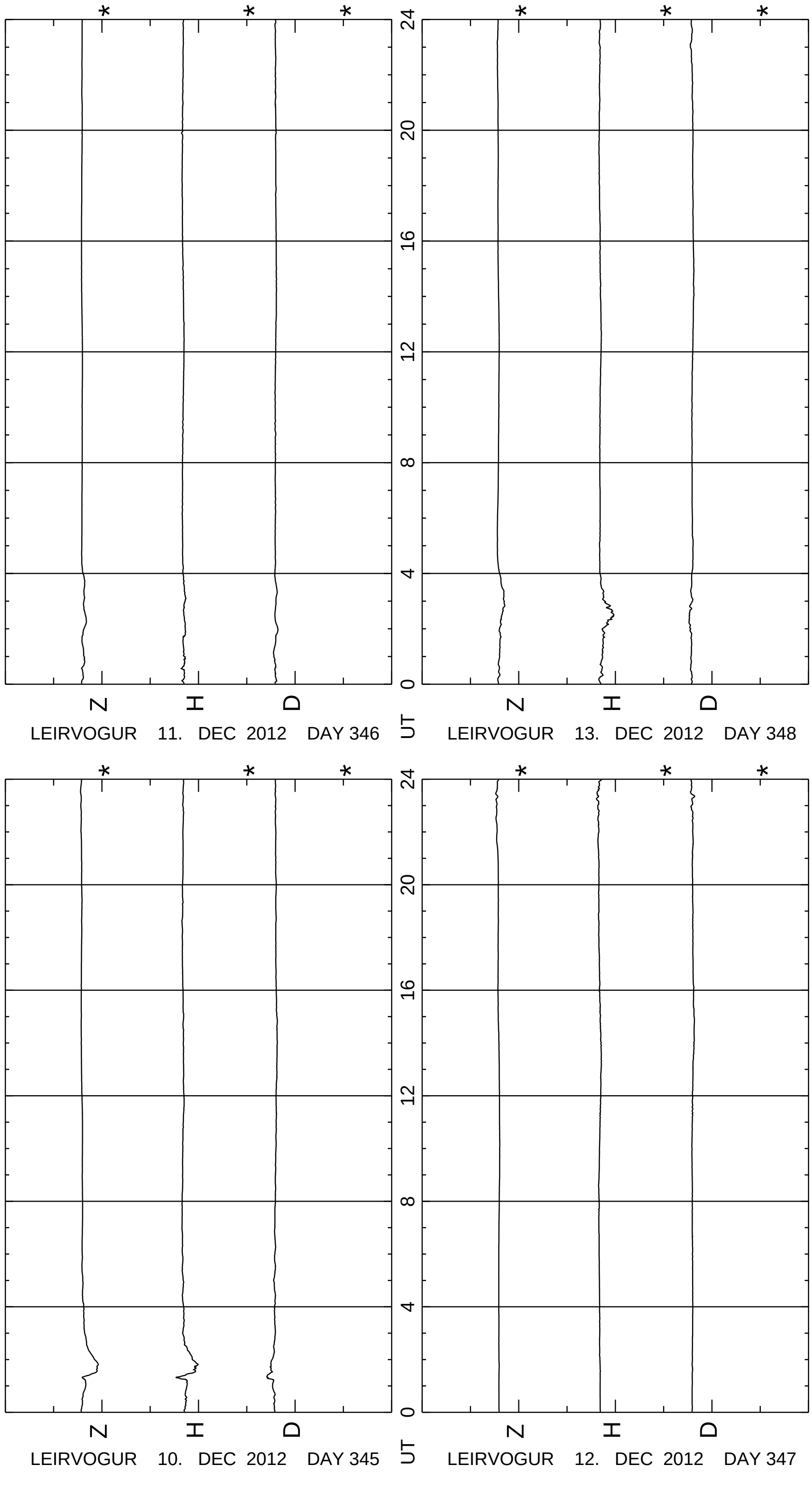
LEIRVOGUR 9. DEC 2012 DAY 344



LEIRVOGUR 6. DEC 2012 DAY 341



LEIRVOGUR 8. DEC 2012 DAY 343


LEIRVOGUR 11. DEC 2012 DAY 346
LEIRVOGUR 13. DEC 2012 DAY 348
LEIRVOGUR 10. DEC 2012 DAY 345
LEIRVOGUR 12. DEC 2012 DAY 347
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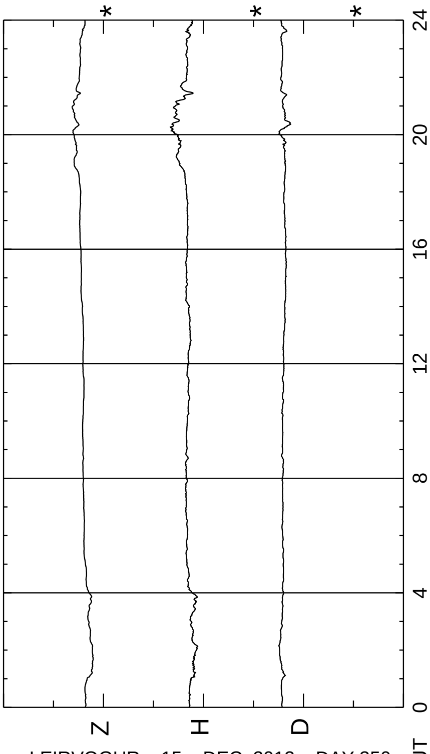
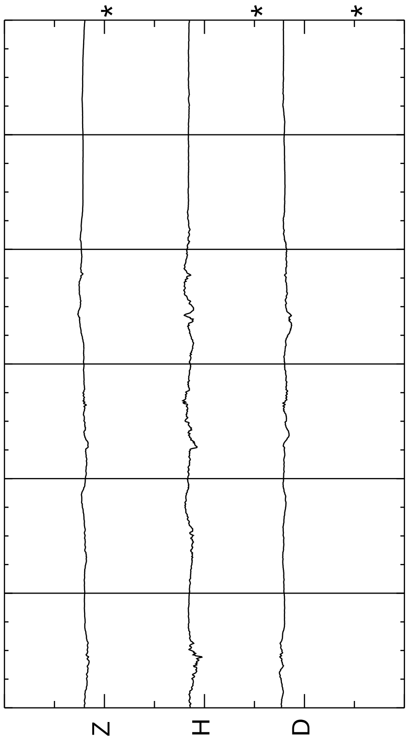
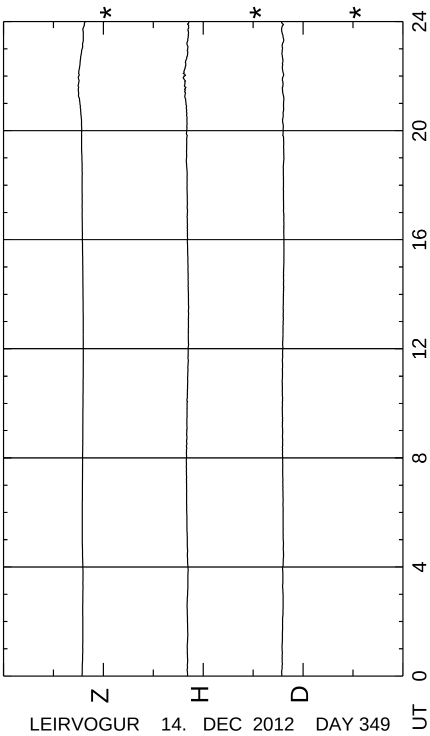


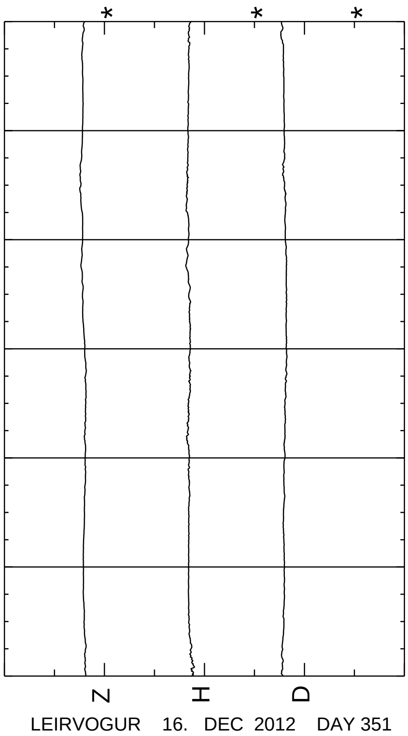
LEIRVOGUR 15. DEC 2012 DAY 350



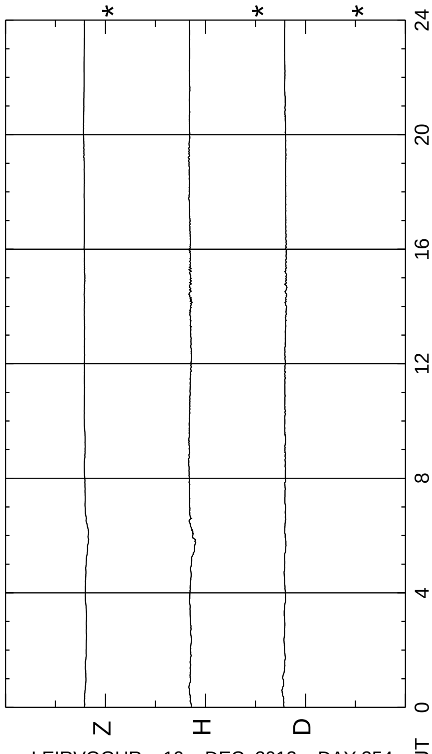
LEIRVOGUR 17. DEC 2012 DAY 352



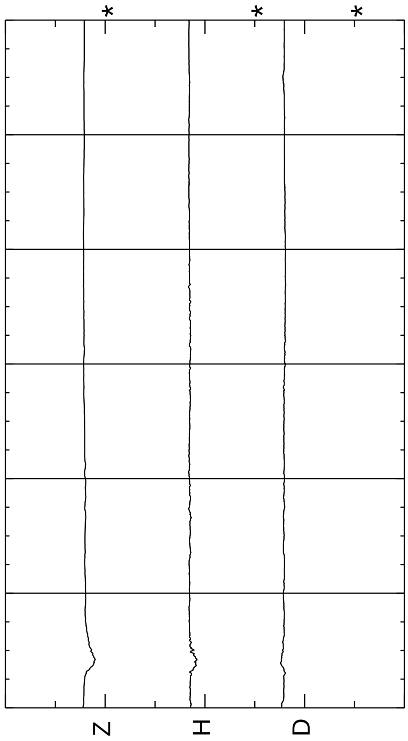
LEIRVOGUR 14. DEC 2012 DAY 349



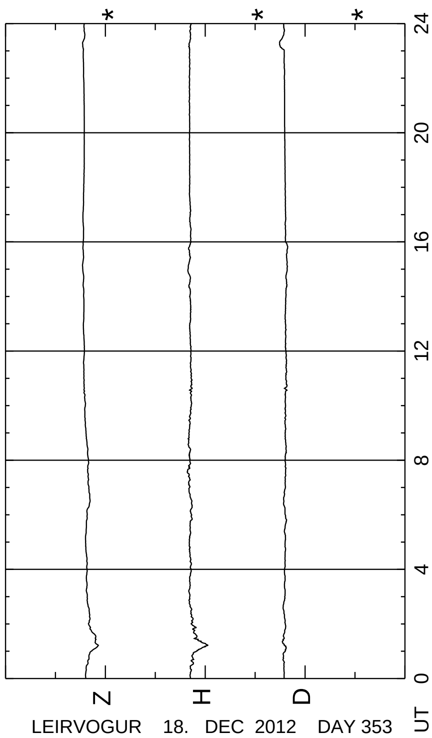
LEIRVOGUR 16. DEC 2012 DAY 351



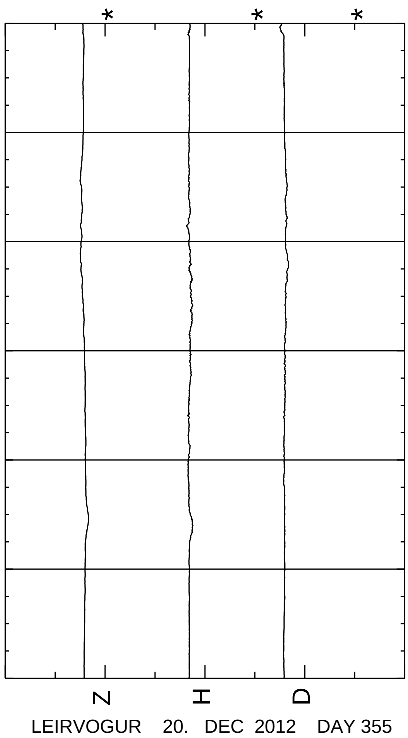
LEIRVOGUR 19. DEC 2012 DAY 354



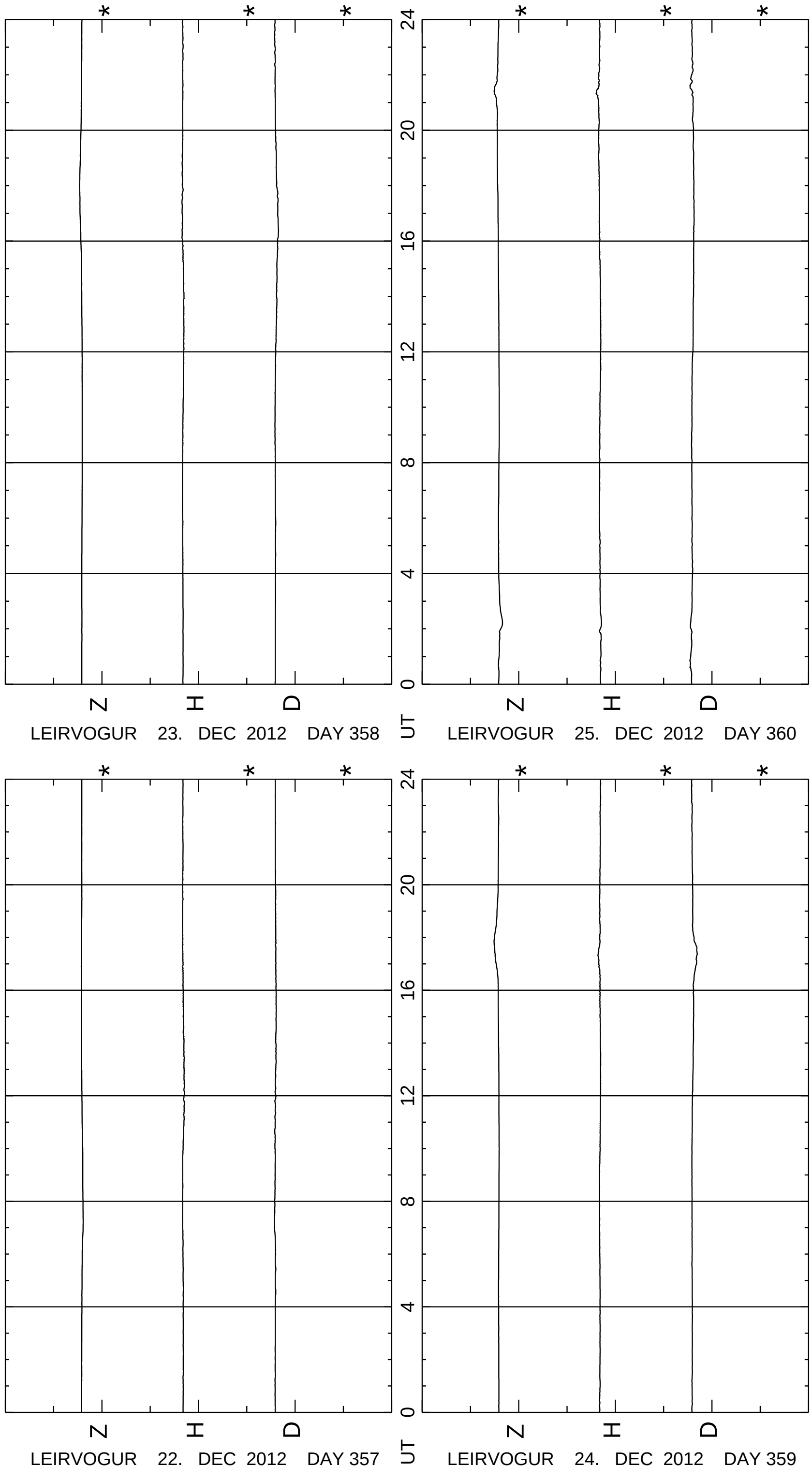
LEIRVOGUR 21. DEC 2012 DAY 356



LEIRVOGUR 18. DEC 2012 DAY 353



LEIRVOGUR 20. DEC 2012 DAY 355


LEIRVOGUR 23. DEC 2012 DAY 358
LEIRVOGUR 25. DEC 2012 DAY 360
LEIRVOGUR 22. DEC 2012 DAY 357
LEIRVOGUR 24. DEC 2012 DAY 359
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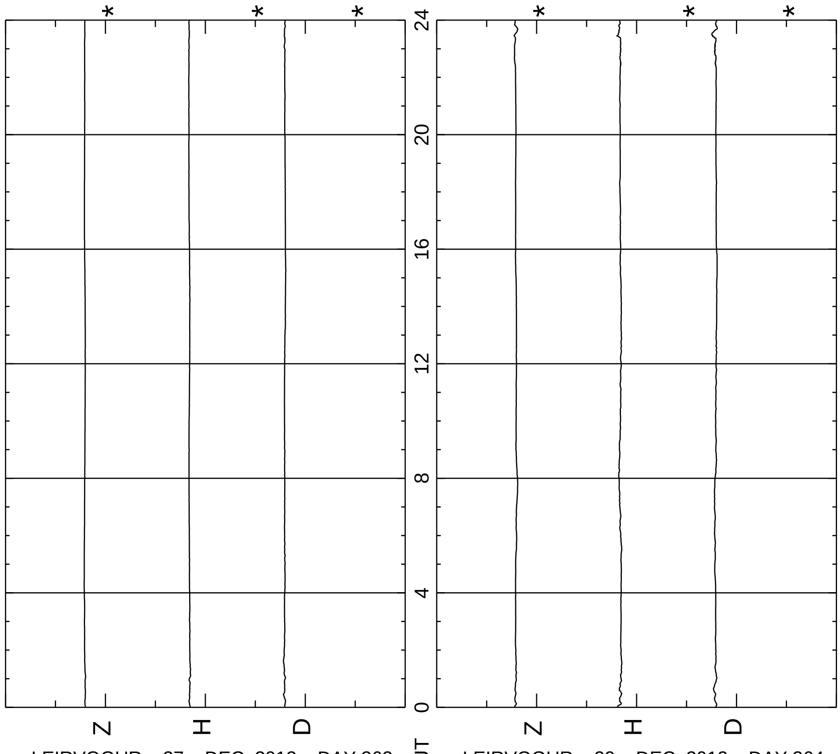
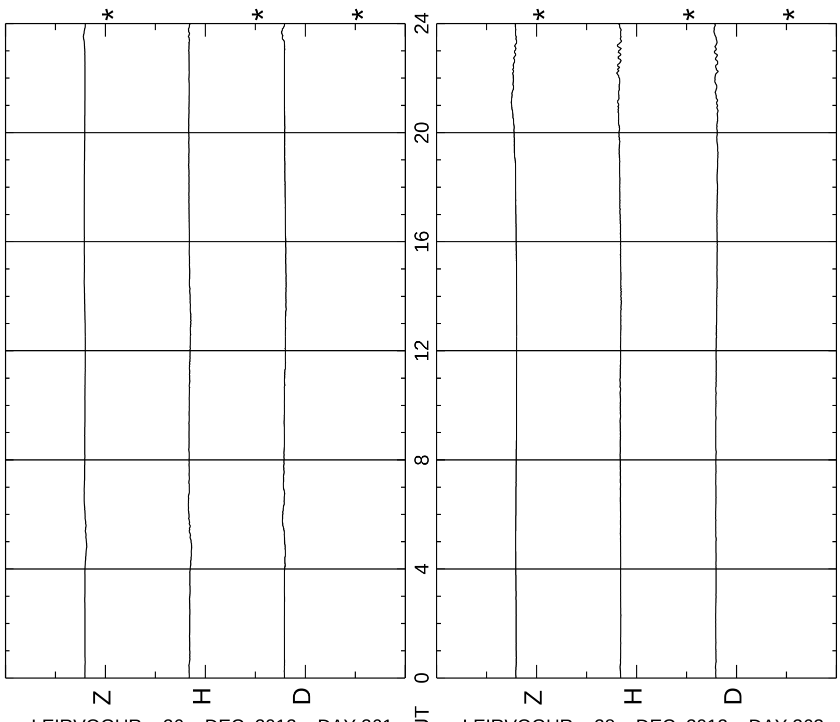
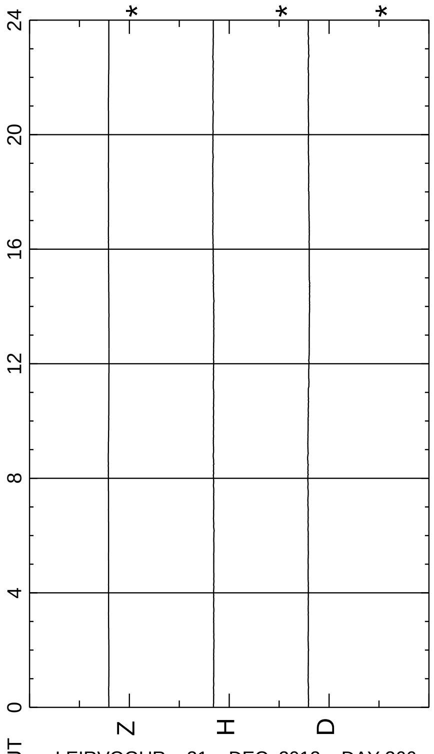


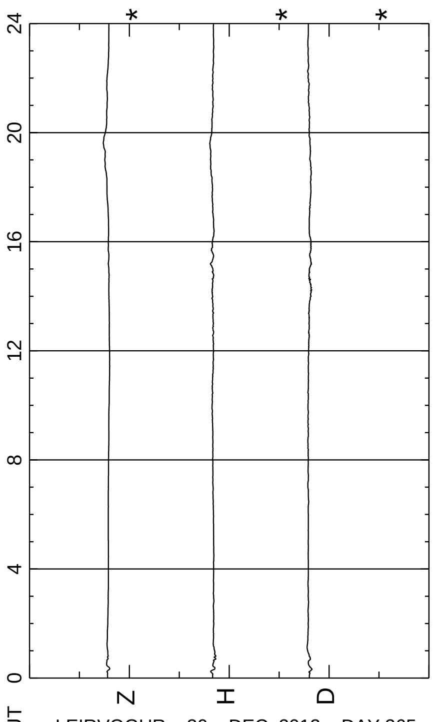
LEIRVOGUR 27. DEC 2012 DAY 362 LEIRVOGUR 29. DEC 2012 DAY 364



LEIRVOGUR 26. DEC 2012 DAY 361 LEIRVOGUR 28. DEC 2012 DAY 363



LEIRVOGUR 31. DEC 2012 DAY 366



LEIRVOGUR 30. DEC 2012 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)

	Z	H	D		F	X	Y	I	
1983	49994	12407	339	38.3	51511	11632	-4317	76	3.8
	-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

ANNUAL MEANS AT LEIRVOGUR
(Continued)

	Z	H	D	F	X	Y	I
2008	50185	12590	345 52.1	51740	12209	-3074	75 55.0
	3	22	17.6	8	37	57	-1.4
2009	50188	12612	346 9.7	51748	12246	-3017	75 53.6
	7	9	18.8	9	25	65	-0.4
2010	50195	12621	346 28.5	51757	12271	-2952	75 53.2
	7	11	18.8	10	27	65	-0.6
2011	50202	12632	346 47.3	51767	12298	-2887	75 52.6
	7	8	19.3	9	23	67	-0.4
2012	50209	12640	347 6.6	51776	12321	-2820	75 52.2