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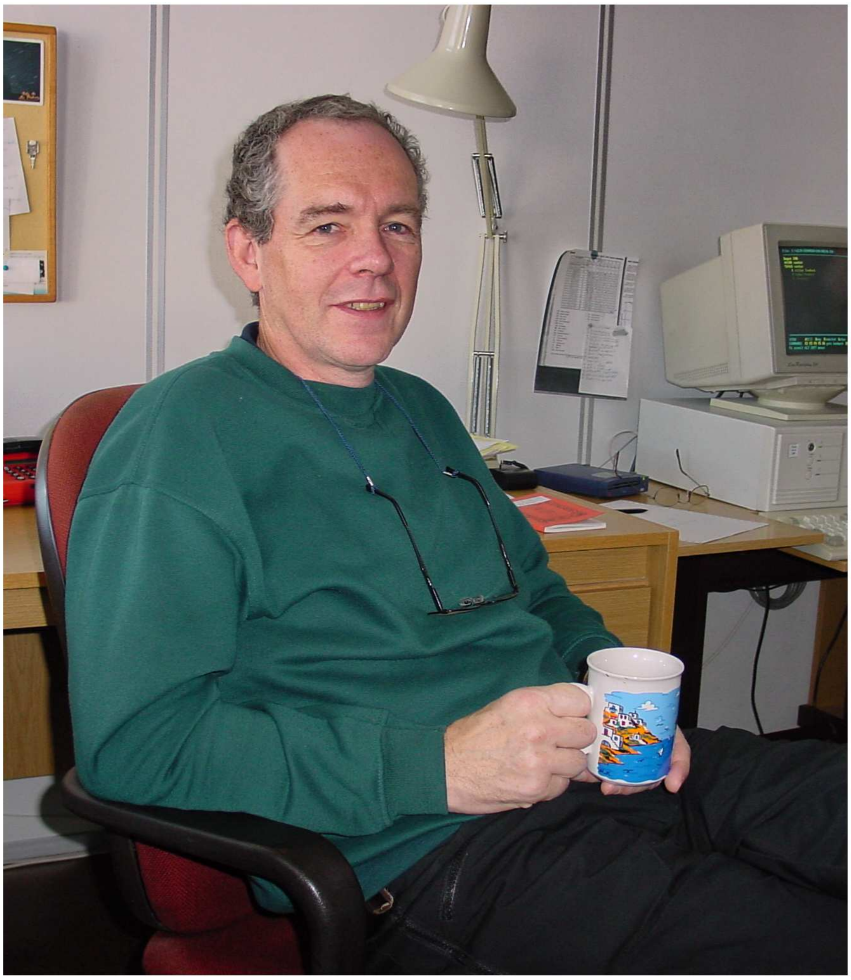
LEIRVOGUR

MAGNETIC RESULTS

2008

REYKJAVíK 2009



Marteinn Sverrisson (1947-2008) was an electrical engineer and came to the Science Institute in 1973. He built instruments for most research fields at the Institute, sometimes designing them from scratch, a practice that was common until special-purpose instruments became commercially available. He first worked for the Observatory in 1979 and took part in implementing the real-time data acquisition. During the past decade he helped to upgrade some of the Observatory electronics. As the Institute systems manager, he developed many of the routines used to monitor the Observatory dataloggers. He also programmed and automated the routines that produce the graphs on the Observatory website.

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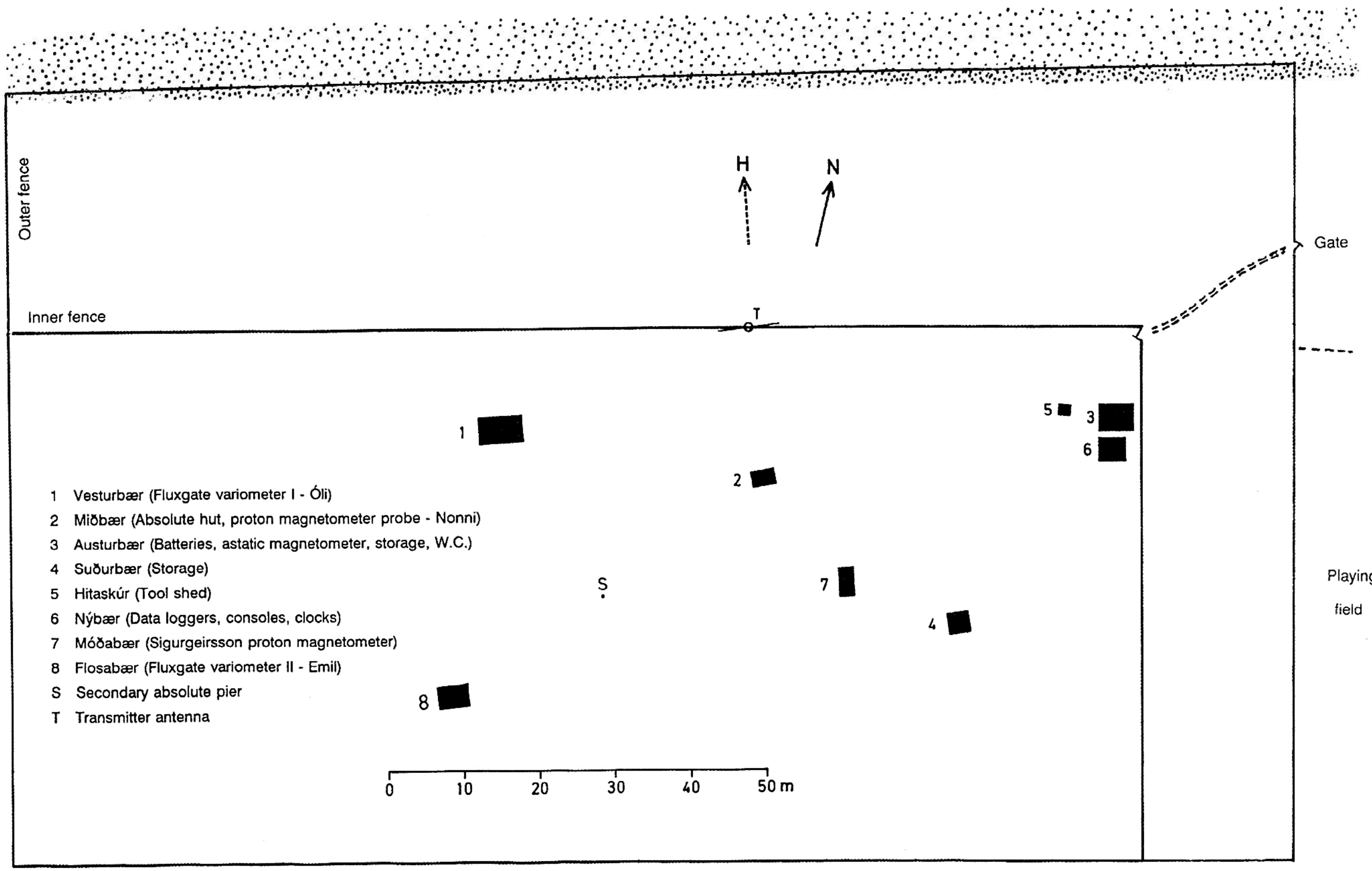
Outer fence
Inner fence
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Playing field
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S
0 10 20 30 40 50 m
1 Vesturbær (Fluxgate variometer I - Óli)
2 Miðbær (Absolute hut, proton magnetometer probe - Nonni)
3 Austurbær (Batteries, astatic magnetometer, storage, W.C.)
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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 2008. 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

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

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 2008 was approximately 5.5 earth-radii, the corresponding corrected geomagnetic latitude being $64.°8$. The geomagnetic conjugate point at 100 km altitude was at $69.°1$ S, $30.°0$ E geographic, about 380 km from the Japanese Antarctic station Syowa.

PERSONNEL

In 2008, the Upper Atmosphere Section had a staff of two: Gunnlaugur Björnsson, director and Pálmi Ingólfsson, research assistant. Former director, Þorsteinn Sæmundsson, continued to serve in an advisory capacity and made absolute measurements on occasions when Gunnlaugur was away.

Marteinn Sverrisson of the Physics Division continued to maintain and update the Linux operating system used for handling the 10-second data at Leirvogur. He passed away on October 21 after a long fight with cancer. Runólfur Valdimarsson, a retired technician of the Science Institute, overhauled the pump of the proton magnetometer Móði.

Helgi Freyr Rúnarsson, a physics student at the University of Iceland, was hired during the summer to port some of the data handling programs from Comal to Python.

Ingi Þ. Bjarnason from the Institute of Earth Sciences visited the observatory on November 12.

Selma Bjarnadóttir at the nearby farm Leirvogstunga contributed to the security of the observatory by watching out for uninvited visitors.

DEVELOPMENTS

The staff made 72 trips to the observatory in 2008, equal to the lowest ever number of trips in 1999. All systems were stable in 2008. 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 only slight snow that did not cause any problems. The lowest temperature was $-14°$C in February, and the highest was $+25°$C in August.

Construction work on a number of houses continued around the nearby farm Leirvogstunga whose owners have converted some of their land to a housing project with about 400 houses and apartments. About a third of the houses have now either been completed or are at various stages of completion. Due to the economic crisis that befell the country in October, it seems that the remaining construction work will be put on hold. The situation is closely monitored, but so far no major problems have been caused by the new neighbours.

The electrical supply was interrupted twice near the end of March. On March 28, the cause was related to work at the construction site next to the observatory. Due to the short duration of the outage, no data was lost. On March 31, a major failure in the power distribution network of the township of Mosfellsbær was the cause of the second outage. A portable power generator was borrowed from glaciologists of the Science Institute and used as backup. However, by the time it was installed the data-loggers were already out and about an hour of data was lost.

In May an uninterrutible power supply (UPS) was purchased and installed for System II and its datalogger. It should operate for at least 5 hours should power be lost for an extended period.

On May 29 at 15:46 a 6.1 magnitude earthquake occurred in south Iceland, about 40 km away from the Observatory. The quake was clearly recorded by the fluxgates as discussed in more detail below. Although severe damage was caused near the epicentre, none occurred at Leirvogur, but one of the instruments turned by a few arcminutes on its pier.

On the weekend of May 31 - June 1, a series of football matches was held on the sports field, attended by rather large crowds of people. A watch was kept to ensure that cars were not parked too close to the observatory and to ward off inquisitive spectators. Matches like these have become an annual event.

In September a technician from the phone company came to inspect wirings and connectors to try to locate the source of frequent ADSL connection problems. He replaced a couple of connectors and simplified the wiring. No problems have been observed with the connection since.

Digital fluxgate systems I and II

The new System II with the new datalogger ran perfectly during the year. The old datalogger was operated in parallel while the data handling routines for the new logger were being written and tested.

As described earlier, a major failure occurred on March 31 in the power distribution network that feeds the observatory. It took the power company several hours to fix the problem. A portable power generator was brought in, but 55 minutes of data were lost.

On May 28, 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 26.

The thermostat in Vesturbær which houses System I (Óli) was adjusted from winter level ($13°$C) to summer level ($20°$C) on June 4. Readjustment took place on December 3.

Móði

The proton magnetometer Móði worked without problems for the entire year. A sub-surface plastic pipe connecting Móðabær and Nýbær was installed in late May and a new power cable connected to the Móðabær electronics in June.

In September new purpose-built electronics were installed to feed the signal from Móði directly to the USB-port of the system II datalogger. The output from this counter will be compared to the old system for several months.

Geó II

The conventional proton magnetometer Geó (G856-AX) was used in the absolute measurements. All connections with the new signal cable were checked and modified to ensure proper contact. The setup has worked very well since.

Backup computer

The PC-computer "Muninn", which has been used at the Science Institute for receiving and storing 10-second data from Leirvogur, worked without problems throughout the year.

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. The clocks are also compared with time signals from Rugby on 60 kHz. 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.

The old crystal clock, which served as the main observatory clock from 1963 to 1988 was kept running. It is believed to be the oldest Icelandic-built electronic device still working.

ADSL connection

The ADSL-connection worked without major problems most of the year. Frequent connection losses occurred until a technician from the phone company simplified old wirings as mentioned above. Backup data are transferred to the Science Institute from System I every 10 minutes. A laptop computer reads and stores System II data every second and transfers each day's data to the Institute. The connection was lost for a few days in May due to nearby construction work, when the phone line was accidentally cut. No data loss occurred, but delivery to the Institute was interrupted until the connection was restored.

Software development

Work was begun on porting the various data handling routines from *Comal* to *Python*. A procedure was also set up to simplify the regular analysis and correction of the raw measurements to provide absolute data. This is a time-consuming work that must be carefully checked and is expected to be completed in 2009. Both systems are then expected to be on line with one second time resolution and semi-automatic data handling.

General maintenance and modifications

Trees and hedges were pruned and fertiliser applied in the spring. Because of the warm weather, tree growth was more vigourious than ususal. During the summer and autumn, the grass around the observatory was cut from time to time with a lawnmower and a brush cutter. Talks were initiated with municipal officials on repairing the fence around the observatory.

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. The 10-second values are also transmitted by UHF radio to the Science Institute in Reykjavík and stored there on a PC computer.

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 loggers and BBC computers. This will be continued while the data handling routines are being upgraded. This system serves as a backup for Óli. All the 1-minute data from this instrument are fully processed. Data delivery is automatic to the Institute every morning at 03:15.

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

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

5. A Sigurgeirsson proton magnetometer ("Móði") producing an uninterrupted record of the total force F. The precession cycles are counted and 1-minute averages recorded using the data loggers serving the fluxgate variometers Óli and Emil. Hourly means are also printed out. 10-second averages are recorded on a PC computer at Leirvogur and transmitted by radio to a backup computer and a display in Reykjavík.

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

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

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

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

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

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

TIME CONTROL

The older digital fluxgate loggers are controlled by a quartz crystal clock which is adjusted using a signal from the Global Positioning System (GPS). The aim has been to keep the timing correct to within one second. This limit was never exceeded in 2008. 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 2008 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 2008, the correction varied between -3.4 nT and -4.1 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 22. Individual measurements are indicated by squares. The solid lines which shift in steps are the adopted base-line values Z_0, H_0 and D_0, the definition of which will be given below.

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

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

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

The formulae giving the field in the absolute hut are then

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

where Z_0, H_0, and D_0 are the base-line values. The adopted base-line values for 2008 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 19	-0.5
Jan 20	– Mar 2	-1.0
Mar 3	– Mar 8	-0.5
Mar 9	– May 23	-1.0
May 24	– Jun 4 (15:25)	-1.5
Jun 4	– Jun 4 (17:55)	-1.0
Jun 4	– Jun 4 (20:25)	-0.5
Jun 4	– Jul 11	0.0
Jul 12	– Aug 2	0.5
Aug 3	– Oct 3	0.0
Oct 4	– Dec 3 (14:00)	0.5
Dec 3	– Dec 3 (15:40)	0.0
Dec 3	– Dec 3 (17:20)	-0.5
Dec 3	– Dec 31	-1.0

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 4	-5.5
Jan 5	– Mar 15	-6.0
Mar 16	– Mar 21	-5.5
Mar 22	– Apr 30	-6.0
May 1	– May 9	-5.5
May 10	– May 23	-6.0
May 24	– Jun 4 (14:10)	-5.5
Jun 4	– Jun 4 (15:25)	-5.0
Jun 4	– Jun 4 (16:40)	-4.5
Jun 4	– Jun 4 (17:55)	-4.0
Jun 4	– Jun 4 (19:10)	-3.5
Jun 4	– Jun 4 (20:25)	-3.0
Jun 4	– Sep 26	-2.5
Sep 27	– Oct 19	-2.0
Oct 20	– Dec 3 (14:00)	-2.5
Dec 3	– Dec 3 (15:40)	-3.5
Dec 3	– Dec 3 (17:20)	-4.0
Dec 3	– Dec 3 (19:00)	-5.0
Dec 3	– Dec 31	-5.5

Declination (D_0):

Jan 1	– Jan 4	$345° 08'.9$
Jan 5	– Jan 19	$345° 08'.8$
Jan 20	– Feb 15	$345° 08'.9$
Feb 16	– May 2	$345° 08'.8$
May 3	– Jun 4 (15:25)	$345° 08'.9$
Jun 4	– Jun 4 (17:55)	$345° 08'.8$
Jun 4	– Jun 4 (20:25)	$345° 08'.7$
Jun 4	– Jun 14	$345° 08'.6$
Jun 15	– Jun 28	$345° 08'.5$
Jun 29	– Jul 11	$345° 08'.6$
Jul 12	– Jul 26	$345° 08'.7$
Jul 27	– Sep 12	$345° 08'.6$
Sep 13	– Oct 12	$345° 08'.5$
Oct 13	– Oct 25	$345° 08'.4$
Oct 26	– Nov 8	$345° 08'.5$
Nov 9	– Dec 3 (14:00)	$345° 08'.4$
Dec 3	– Dec 3 (15:40)	$345° 08'.5$
Dec 3	– Dec 3 (17:20)	$345° 08'.6$
Dec 3	– Dec 3 (19:00)	$345° 08'.7$
Dec 3	– Dec 3 (20:40)	$345° 08'.8$
Dec 3	– Dec 31	$345° 08'.9$

The changes in base lines on June 4 and December 3 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 23. 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 2008 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 12	-1.0
Jan 13	– Mar 2	-0.5
Mar 3	– Mar 15	0.0
Mar 16	– May 24	-0.5
May 25	– May 29 (15:50)	-1.0
May 29	– Aug 16	-1.5
Aug 17	– Aug 31	-2.0
Sep 1	– Nov 26 (14:00)	-1.5
Nov 26	– Nov 26 (18:00)	-1.0
Nov 26	– Nov 26 (21:40)	-0.5
Nov 26	– Dec 13	-0.0
Dec 14	– Dec 31	-0.5

Horizontal intensity (H_0):

		nT
Jan 1	– Jan 4	-5.5
Jan 5	– Mar 2	-6.0
Mar 2	– Mar 8	-5.5
Mar 9	– Mar 21	-6.0
Mar 22	– Mar 31	-6.5
Apr 1	– May 28 (16:40)	-6.0
May 28	– May 28 (20:00)	-6.5
May 28	– May 28 (21:40)	-7.0
May 28	– May 28 (23:20)	-7.5

		nT
May 29	– Jul 26	-8.0
Jul 27	– Aug 31	-8.5
Sep 1	– Oct 4	-8.0
Oct 5	– Oct 21	-7.5
Oct 22	– Oct 31	-8.0
Nov 1	– Nov 26 (14:00)	-7.5
Nov 26	– Nov 26 (18:00)	-7.0
Nov 26	– Nov 26 (21:40)	-6.5
Nov 26	– Dec 31	-6.0

Declination (D_0):

Jan 1	– Jan 4	$345° \; 8'.9$
Jan 5	– Jan 12	$345° \; 8'.8$
Jan 13	– Feb 2	$345° \; 9'.0$
Feb 3	– Mar 2	$345° \; 9'.1$
Mar 3	– Mar 31	$345° \; 9'.0$
Apr 1	– May 29 (15:50)	$345° \; 9'.1$
May 29	– Jun 28	$345° \; 5'.7$
Jun 29	– Sep 12	$345° \; 5'.8$
Sep 13	– Sep 30	$345° \; 5'.7$
Oct 1	– Oct 11	$345° \; 5'.8$
Oct 12	– Oct 31	$345° \; 5'.9$
Nov 1	– Nov 22	$345° \; 5'.8$
Nov 23	– Dec 31	$345° \; 5'.9$

The steps in the base lines on May 28 and November 26 were caused by adjustments of the thermostat in the variometer house. The change in Z_0 and D_0 on May 29 is due to the earthquake that is discussed further on page 19. 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, $02^s - 09^s$, $12^s - 19^s$, $22^s - 29^s$, $32^s - 39^s$, $42^s - 49^s$and $52^s - 59^s$ past each minute mark, giving a total of 48 measurements per minute. An exception occurs during the first minute of each quarter-hour, when measurements from 02^{s} to 07^{s} past the minute are left out, resulting in 42 measurements per minute. During the first minute of each day, measurements at $12^{\mathrm{s}} - 17^{\mathrm{s}}$ are left out as well.

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

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

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

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

The adopted values of δF in 2008 were as follows:

		δF (nT)
Jan 1	– Jan 4	-4.0
Jan 5	– Jan 27	-3.9
Jan 28	– Feb 8	-3.7
Feb 9	– Feb 15	-4.0
Feb 16	– Mar 2	-3.8
Mar 3	– Mar 21	-3.7
Mar 22	– Mar 29	-4.0
Mar 30	– Apr 30	-3.9
May 1	– May 17	-3.7
May 18	– Jun 14	-3.9
Jun 15	– Jul 11	-3.6

		nT
Jul 12	– Aug 2	-3.5
Aug 3	– Aug 9	-3.7
Aug 10	– Sep 5	-3.5
Sep 6	– Sep 19	-3.7
Sep 20	– Oct 19	-3.6
Oct 20	– Dec 5	-3.7
Dec 6	– Dec 31	-3.6

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

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

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

was evaluated for this purpose. The mean value of M over the year was -0.10 nT. Most of the values (99.96%) were in the range -1 to $+1$ nT, 0.04% reached ± 2 nT, and there were 3 cases of higher values.

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 2008, there were 59 gaps in the 1-minute values for Z, H and D or 0.01% of the total time. Of these, 55 were caused by the loss of power on March 31 and 4 were due to the earthquake on May 29. Gaps or errors in the 1-minute data from the proton magnetometer Móði were 438 or 0.08% of the total time. Most of this was due to the power failure on March 29.

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 p. 18). In 2008, 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 2008 was the lowest ever recorded at Leirvogur and there were no highly disturbed days. The most significant disturbances occurred on the following dates:

Date	*K-sum*	*C9*	*L9*
Feb 28 - Mar 1	(37,41,35)	(5,6,5)	(5,6,6)
Mar 9	(43)	(6)	(6)
Mar 26-28	(32,43,41)	(6,6,6)	(5,7,6)
Apr 23-24	(42,38)	(6,4)	(6,5)
Sep 4	(40)	(6)	(6)

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

K never reached the extreme value 9 in 2008, and the value 8 only four times. The quietest time of the year was on November 5 when the field kept steady to the nearest nanotesla in all elements for 323 consecutive 10-second readings (54 minutes).

THE EARTHQUAKE OF MAY 29

At 15:45:59 on May 29, a 6.1 magnitude earthquake occurred near Hveragerði in South-West Iceland. The epicentre was about 40 km south-east of Leirvogur and it took the seismic waves 6 seconds to reach the observatory. In the figures on pages 24 and 25, we show the raw data from our reserve instrument, Emil, that records at one second intervals.

On page 24 we show the entire day in Z, H and D shifted so the y-axis has the range from 0 to 1000. As can be seen, just before 16:00 a sharp spike appears in all three components with the largest amplitude in the D-component. On page 25 we show a 4 minute expanded view starting one minute before the earthquake. It is clear that the instrument was oscillating for at least 3 minutes after the onset of the earthquake. As a consequence, 4 minutes were deleted from the fully processed 1-minute data as mentioned on page 18.

It is also clear from the D-panel on page 25 that the instrument turned on its pier. This is seen from the fact that the value at the right hand side of the figure (near 15:49) is somewhat higher than that near the left hand side (at 15.45). It is also quite obvious from the sharp step in the baseline value of D_0, as seen on page 23.

The quake was, of course, also picked up by the primary instrument, but as this only records at 10 second intervals, the output was not as detailed. That instrument apparently did not move at all on its pier.

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, also 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 2008, 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 September 1 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 results were as follows:

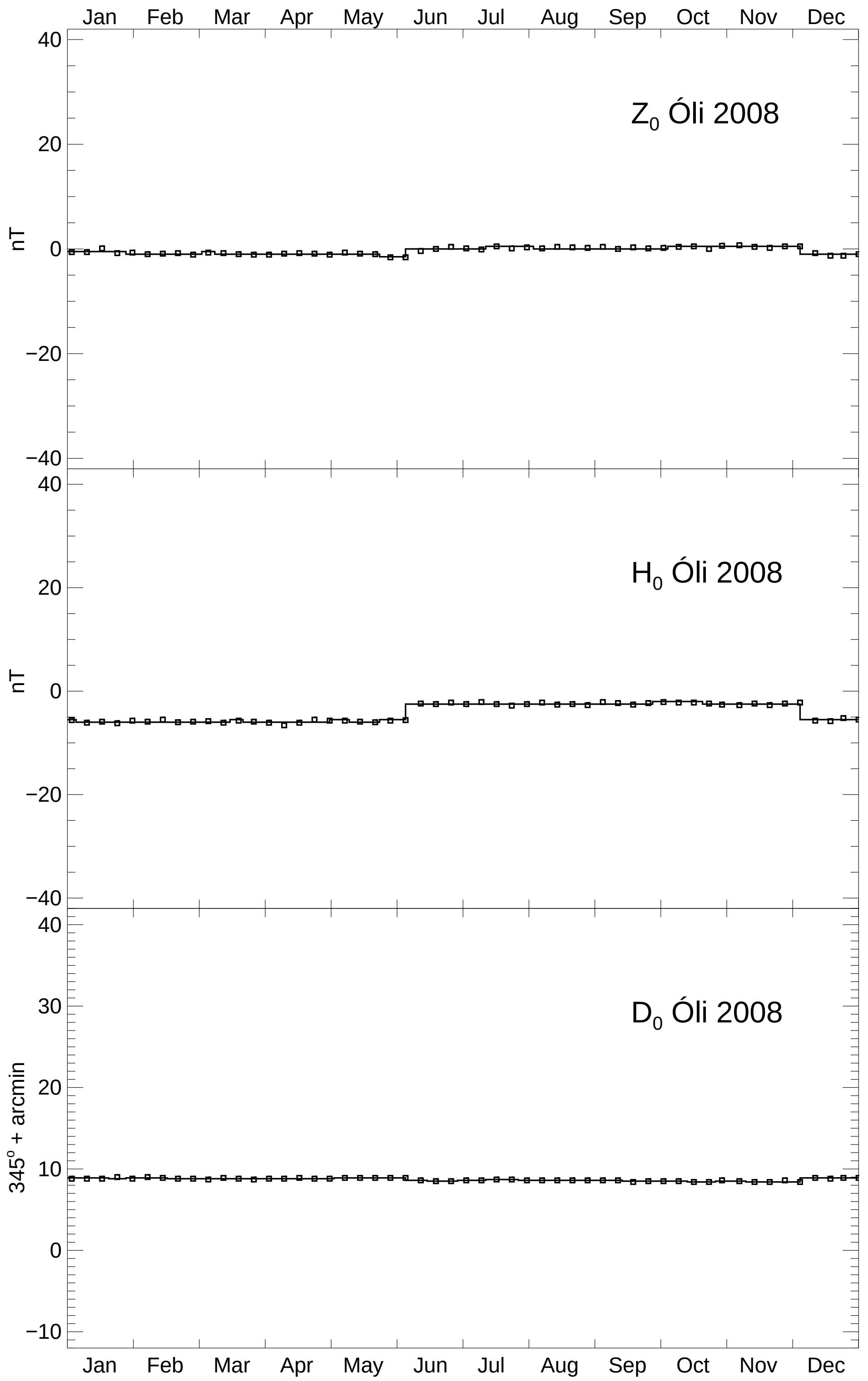
Guðnastaðir minus Leirvogur

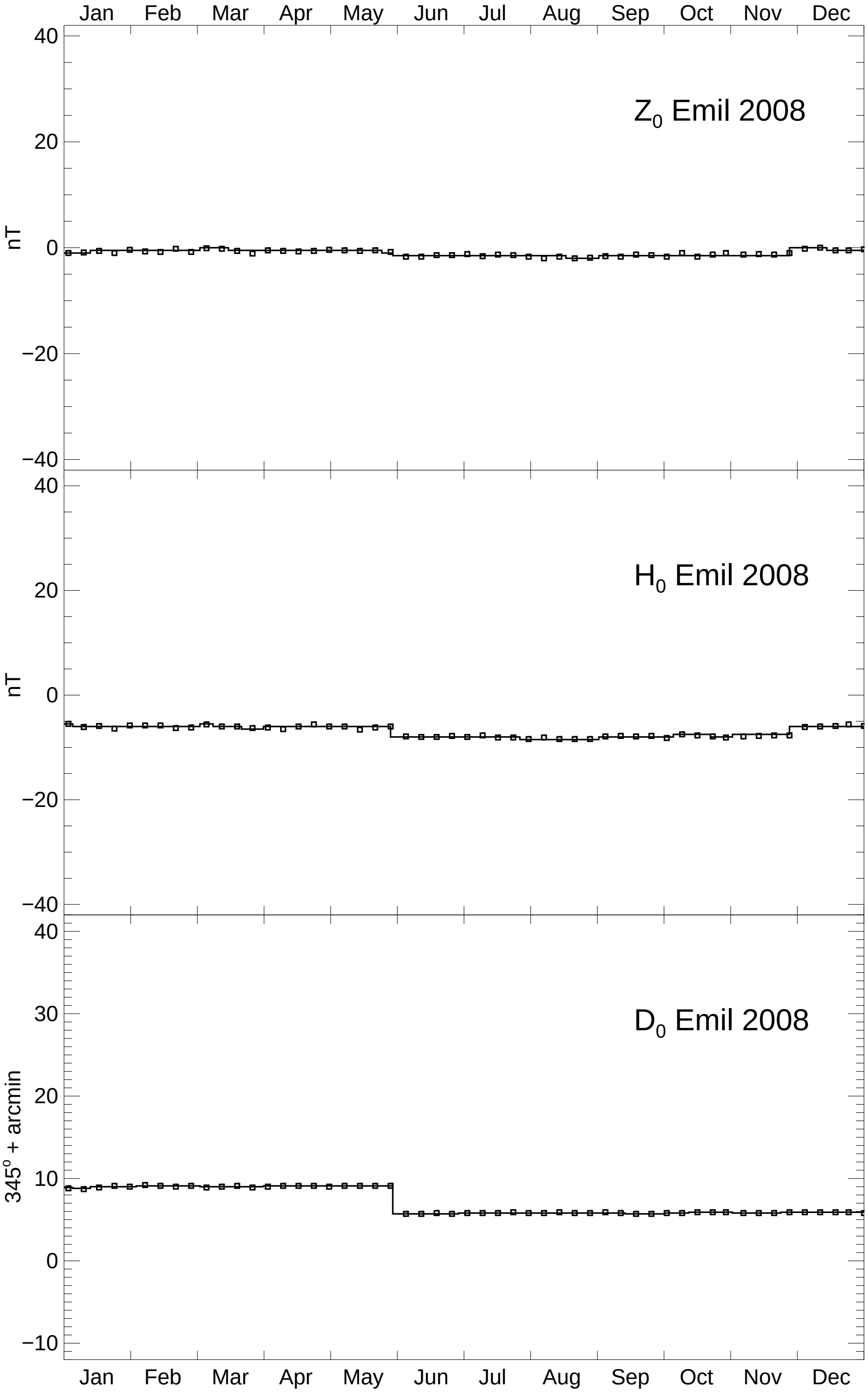
	dF	dZ	dH	dD
2008	+662	+490	+751	$-49.'3$
2006	+664	+491	+754	$-47.'1$

The units of F, Z and H are nanoteslas. As can be seen from the graph on page 26, the results are in conformity with a previously established trend.

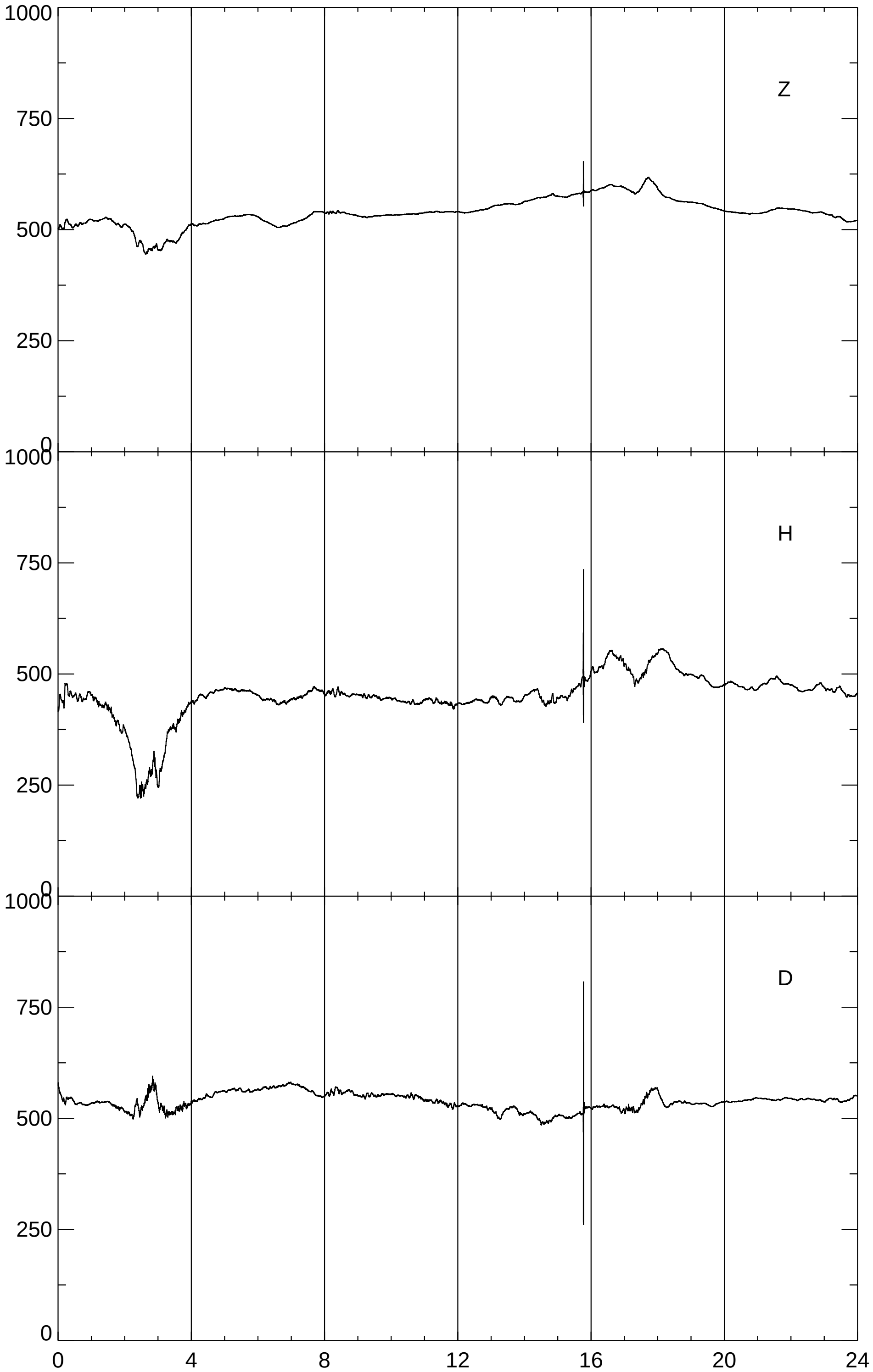
October 2009

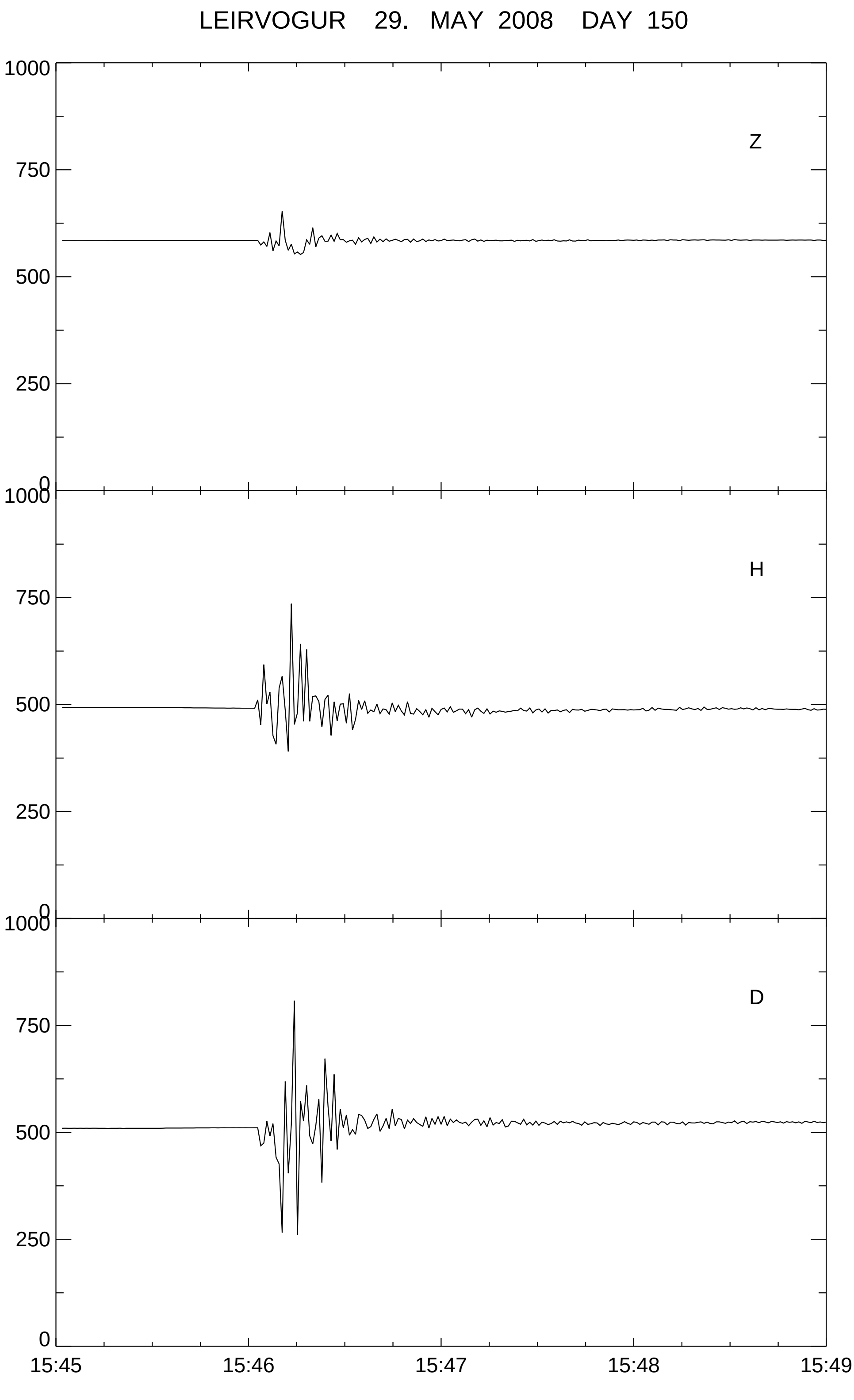
Gunnlaugur Björnsson

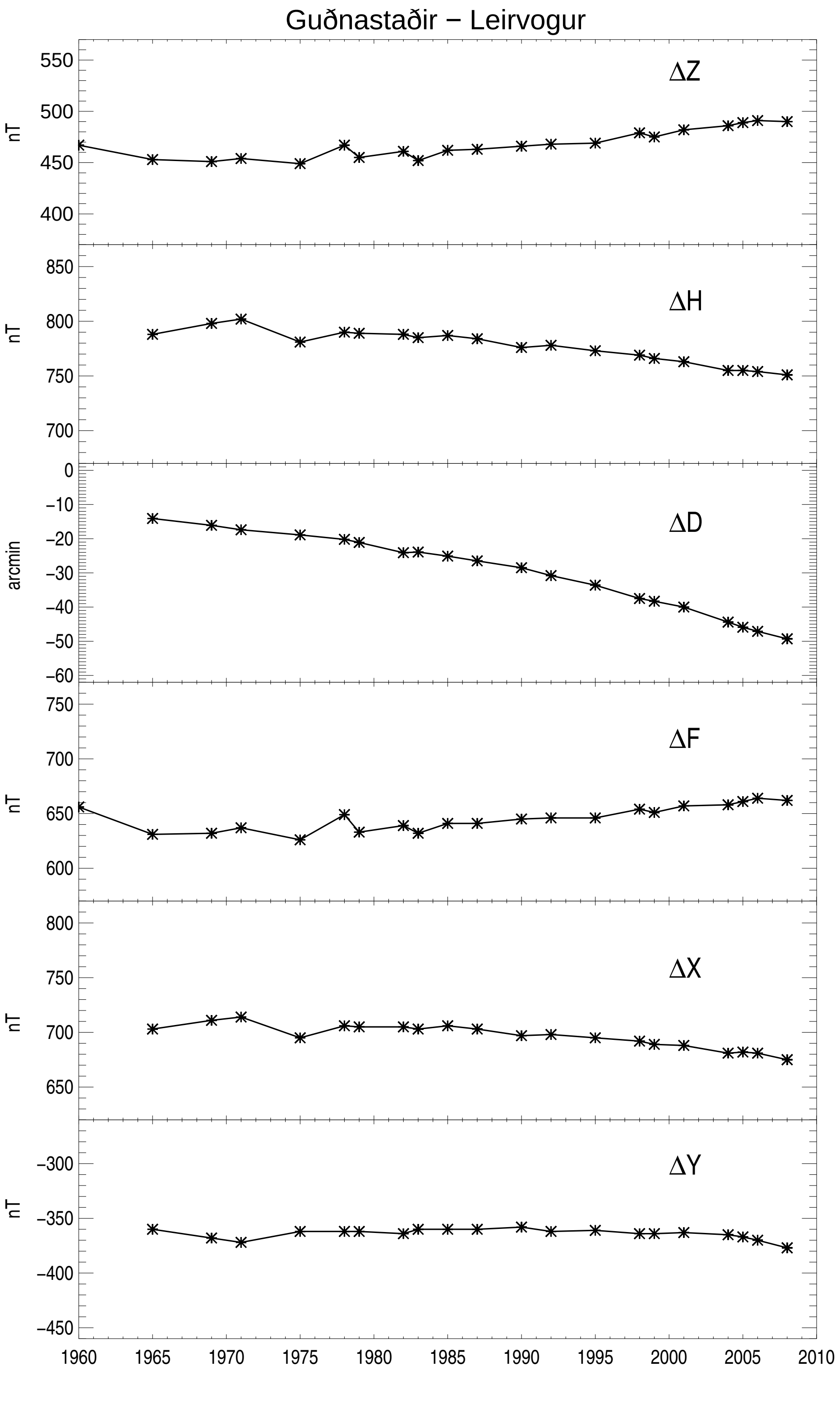

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Z_0 Óli 2008
nT
H_0 Óli 2008
nT
D_0 Óli 2008
345° + arcmin
40
20
0
−20
−40
30
10
−10


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Z_0 Emil 2008
nT
40
20
0
−20
−40
H_0 Emil 2008
nT
40
20
0
−20
−40
D_0 Emil 2008
345° + arcmin
40
30
20
10
0
−10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

LEIRVOGUR 29. MAY 2008 DAY 150




LEIRVOGUR 29. MAY 2008 DAY 150
Z
H
D
1000
750
500
250
0
15:45
15:46
15:47
15:48
15:49


Guðnastaðir − Leirvogur
ΔZ
ΔH
ΔD
ΔF
ΔX
ΔY
nT
arcmin
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

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 $345°$ corresponds to $15°$ 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 128-129.

Diurnal variations

The tables on pages 29-30 show the mean diurnal inequalities of the magnetic elements Z, H, D and F at Leirvogur in 2008. 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 31. The daily K-sums are shown on page 32 in runs of 27 days. The table on page 33 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 34.

LEIRVOGUR 2008
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 345 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	183	183	182	584	591	580	440	437	438	737	738	735
FEB	184	187	172	586	592	585	455	451	466	739	743	727
MAR	183	187	177	575	589	535	470	468	477	735	742	719
APR	183	190	171	582	589	560	483	480	493	736	745	720
MAY	183	187	178	592	599	585	501	498	508	739	745	732
JUN	183	185	181	592	600	585	515	511	512	739	743	735
JUL	183	183	178	596	601	585	528	522	533	740	741	732
AUG	185	188	186	594	599	583	544	542	550	741	745	739
SEP	187	189	190	591	598	567	559	555	571	743	746	740
OCT	187	192	182	594	600	590	570	570	573	743	749	737
NOV	189	191	184	596	603	576	585	582	594	745	749	736
DEC	190	190	183	602	604	590	598	595	603	748	748	738
MEAN	185	188	180	590	597	577	521	518	527	740	745	733

LEIRVOGUR 2008

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	-22	-26	-27	-24	-17	-12	-10	-7	-4	-1	1	3	7	10	15	20	24	25	23	20	14	5	-2	-13	3.	18.	52
ZW	-15	-20	-25	-24	-16	-10	-8	-6	-2	0	1	2	5	7	10	13	16	16	16	16	16	7	4	-4	3.	99.	41
ZE	-28	-25	-25	-24	-16	-14	-15	-11	-6	-3	1	4	9	14	20	24	27	28	26	23	13	4	-8	-21	1.	18.	56
ZS	-25	-34	-33	-23	-19	-13	-7	-4	-2	-2	0	2	5	9	16	21	27	30	26	22	14	4	-2	-14	2.	18.	64
ZQ	-10	-12	-10	-6	-4	-2	-1	-2	-2	-2	-3	-2	-1	1	5	8	9	10	9	7	6	4	2	-2	2.	18.	22
ZQW	-5	-9	-8	-4	-3	0	0	0	-1	-2	-2	-2	-1	0	2	4	4	4	4	4	5	6	3	2	2.	22.	16
ZQE	-11	-12	-10	-5	-5	-4	-3	-6	-4	-3	-3	-2	0	3	7	10	12	13	12	8	6	3	0	-5	2.	18.	25
ZQS	-13	-16	-11	-7	-5	-2	1	1	-1	-2	-3	-2	-1	1	5	9	12	12	10	8	5	3	1	-3	2.	17.	28
ZD	-18	-26	-35	-40	-32	-38	-32	-23	-11	-2	4	11	19	26	31	39	46	45	36	31	18	-6	-14	-27	4.	17.	86
ZDW	-17	-27	-55	-56	-33	-30	-18	-15	-3	4	8	14	20	19	22	30	37	36	34	30	28	-2	-1	-21	4.	17.	94
ZDE	-25	-20	-4	-28	-19	-39	-52	-34	-20	-4	3	13	25	38	41	48	48	39	29	28	9	-5	-28	-43	7.	16.	99
ZDS	-13	-32	-46	-34	-45	-45	-28	-21	-12	-6	1	4	12	21	30	40	53	61	47	34	18	-12	-13	-17	3.	18.	107
H	-33	-40	-40	-32	-21	-10	0	5	5	1	-4	-7	-6	0	8	17	26	33	35	34	28	16	-1	-18	2.	19.	76
HW	-27	-29	-34	-26	-13	-3	2	7	9	7	3	-2	-1	0	4	10	15	18	18	21	19	14	-1	-14	3.	20.	55
HE	-41	-44	-47	-38	-25	-15	-2	7	7	3	-2	-5	-4	3	12	23	33	40	44	39	28	13	-6	-24	3.	19.	91
HS	-30	-49	-38	-31	-24	-11	1	1	-2	-8	-12	-15	-12	-3	7	17	31	42	45	44	37	23	5	-15	2.	19.	94
HQ	-2	-3	-2	-2	-2	0	2	1	-2	-6	-11	-14	-15	-12	-6	0	5	10	13	13	12	10	7	4	13.	20.	28
HQW	-4	-5	-3	-2	-2	0	2	2	2	1	-2	-5	-5	-5	-4	0	2	4	4	5	5	5	3	2	13.	99.	11
HQE	-2	-4	-1	-2	-3	0	4	3	3	-2	-9	-15	-18	-16	-9	-1	5	10	14	13	12	11	8	2	13.	19.	32
HQS	1	-1	-1	-1	0	1	1	-4	-10	-15	-21	-23	-23	-16	-7	0	9	16	19	20	18	16	12	8	12.	20.	44
HD	-66	-86	-108	-100	-77	-52	-11	9	15	15	10	7	13	26	37	55	77	90	85	80	56	20	-26	-66	3.	18.	199
HDW	-66	-77	-106	-87	-38	-19	3	15	21	18	13	5	14	14	19	34	49	53	49	60	50	31	-5	-50	3.	20.	166
HDE	-98	-97	-128	-115	-92	-78	-32	11	19	23	15	17	25	48	60	86	106	116	111	93	47	11	-52	-93	3.	18.	244
HDS	-35	-85	-91	-99	-102	-60	-5	2	5	3	3	-2	1	17	30	46	75	102	95	85	72	18	-21	-57	5.	18.	204

LEIRVOGUR 2008

MEAN DIURNAL INEQUALITIES

UT 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MIN	MAX	RANGE
D	19	24	25	27	32	35	38	32	28	20	10	-7	-27	-45	-55	-55	-47	-34	-24	-16	-5	1	9	15	99.	7.	93
DW	27	25	22	10	11	16	16	8	2	-2	-4	-10	-22	-32	-38	-40	-31	-21	-13	-3	13	15	25	26	16.	1.	67
DE	20	27	30	41	42	38	39	27	22	16	4	-15	-35	-54	-61	-56	-47	-30	-22	-14	-5	3	11	20	15.	5.	103
DS	10	21	23	31	43	51	59	62	59	47	30	4	-25	-50	-67	-70	-63	-51	-37	-29	-24	-16	-7	-1	16.	8.	132
DQ	12	10	9	10	16	22	28	32	34	31	21	2	-20	-36	-45	-44	-33	-24	-15	-10	-7	-1	0	6	15.	9.	79
DQW	16	12	8	2	4	6	10	12	10	10	7	-2	-15	-24	-27	-25	-16	-11	-6	-2	-1	9	10	13	15.	1.	44
DQE	15	13	13	15	20	23	21	25	31	31	24	4	-21	-39	-49	-46	-33	-22	-13	-10	-6	-2	-2	9	15.	10.	80
DQS	4	5	7	15	25	38	53	60	62	51	32	3	-24	-44	-57	-60	-51	-40	-28	-17	-13	-10	-8	-5	16.	9.	122
DD	29	45	54	67	75	73	64	41	19	0	-11	-25	-46	-65	-74	-77	-65	-48	-33	-28	-22	-4	10	20	16.	5.	152
DDW	44	50	57	30	41	45	23	7	-12	-28	-24	-25	-39	-49	-57	-69	-51	-31	-19	-3	7	19	44	41	16.	3.	126
DDE	33	57	65	104	95	80	90	41	11	-12	-29	-41	-63	-83	-83	-76	-66	-47	-33	-29	-22	-9	2	18	15.	4.	187
DDS	11	29	42	66	87	93	79	74	59	40	21	-8	-35	-62	-81	-85	-79	-66	-47	-50	-52	-21	-15	0	16.	6.	179
F	-30	-35	-36	-30	-22	-14	-10	-5	-3	-1	0	1	5	10	16	23	30	32	31	28	21	9	-2	-17	3.	18.	68
FW	-21	-26	-32	-30	-18	-11	-7	-4	0	1	2	2	4	7	10	15	20	20	20	20	20	10	4	-7	3.	99.	53
FE	-37	-35	-35	-32	-22	-17	-15	-9	-5	-2	0	3	8	15	22	29	35	37	36	32	20	7	-9	-27	1.	18.	74
FS	-32	-45	-41	-30	-24	-15	-7	-4	-3	-4	-3	-2	2	8	17	25	34	40	36	32	23	10	0	-17	2.	18.	85
FQ	-10	-13	-10	-6	-4	-2	0	-1	-2	-4	-5	-6	-5	-2	3	7	11	12	11	10	8	7	3	-1	2.	18.	24
FQW	-6	-10	-9	-4	-3	0	1	0	0	-1	-2	-3	-3	-1	1	4	5	5	5	5	6	7	4	2	2.	22.	17
FQE	-11	-12	-10	-6	-6	-4	-2	-5	-4	-3	-5	-6	-5	-1	4	10	13	15	15	11	9	6	2	-5	2.	18.	28
FQS	-13	-15	-11	-7	-4	-1	1	0	-3	-7	-8	-8	-7	-3	3	9	14	15	14	13	10	7	4	-1	2.	18.	30
FD	-34	-46	-60	-63	-50	-50	-34	-20	-7	1	6	12	21	31	39	51	63	66	56	49	32	-1	-20	-42	4.	18.	129
FDW	-33	-45	-80	-76	-42	-35	-16	-11	2	8	11	15	23	22	25	37	48	48	44	44	39	5	-3	-33	3.	18.	128
FDE	-48	-43	-34	-56	-41	-56	-58	-31	-15	1	7	16	29	48	54	67	72	66	55	50	20	-3	-40	-64	24.	17.	135
FDS	-21	-52	-66	-57	-68	-59	-29	-20	-10	-6	1	4	11	24	36	50	70	84	69	54	35	-7	-17	-30	5.	18.	153

LEIRVOGUR MAGNETIC OBSERVATORY 2008
K-INDICES FOR THREE HOUR INTERVALS IN U.T.
LOWER LIMIT FOR K-9 = 1500 NANOTESLAS IN H

DAYS	K-INDICES						
1- 7	22010001	00001100	01000001	00011001	14333356	45333446	64433215
8- 14	33232334	53321212	30011112	31111110	00111433	53312453	64343456
15- 21	63423224	54323335	72124236	55322342	22334423	24211124	11121123
22- 28	11001200	00101132	21102121	54421144	52212113	21011122	12011113
29- 35	34111000	11110000	00011236	54422556	76333346	44343245	53222234
36- 42	32011120	00011145	54001213	41011234	20012122	14333544	75343334
43- 49	45334334	54323332	33223254	33334332	54122230	02222112	00234347
50- 56	73533343	24222201	21122221	11211201	11112133	30011113	22110100
57- 63	02111122	33012264	65332666	65533658	76433345	33333333	43222212
64- 70	31211102	33133323	11111214	31111122	00023451	78744436	65323447
71- 77	42624323	55532353	55233222	44433556	64243222	53112213	41011321
78- 84	65212210	01312335	23123323	53111235	40011114	66322212	11122210
85- 91	00022213	31434575	76533577	66634466	34223355	54322324	21011222
92- 98	34211210	00011101	20011200	00122546	11233547	66634335	55332536
99-105	32234334	55433234	54323334	41022211	45333224	12223322	21011110
106-112	00012325	43323455	73222221	32222222	42211225	41112331	22111210
113-119	00122324	56543577	76643336	54323235	54332565	44322332	21224443
120-126	54312232	11121441	11212226	74322002	64223333	32222334	55413564
127-133	74322222	42121325	41122222	21111110	11221221	21211222	00101111
134-140	33111210	11122110	01111211	12112221	01112110	01122211	41223443
141-147	44223335	66323423	54223545	43123345	51323313	35222212	12222222
148-154	10112213	55323434	55222332	61123663	13333433	34222433	22123222
155-161	13021222	41112211	01021311	02232333	31333335	62123323	33021212
162-168	20121211	02211101	01121212	01111211	01022447	66533326	43333446
169-175	66323434	65322211	32122442	55622235	31122113	21122211	22112000
176-182	11112225	56312344	76333332	73223322	12222333	45222346	42112221
183-189	32122111	21121110	01122210	01122210	11223334	22112220	22121112
190-196	10111212	01112111	10122214	21222123	36534333	44333545	43333325
197-203	63222223	34112234	54112210	22121211	01122211	21112121	31223222
204-210	21223437	57434456	63323222	03211111	11123231	00121226	33322212
211-217	01112222	24212121	00222211	02112222	00012221	11122323	20112321
218-224	11111200	01122223	21112222	01121211	13222547	56523423	53223223
225-231	43222313	53212112	55122220	41012100	01222214	53123312	55334344
232-238	65323432	54121210	00122211	12121212	21121212	10121102	00121100
239-245	00122201	32122110	11122211	11122210	10122100	00113222	10111110
246-252	11122211	12232334	88534444	44212225	62223333	64122351	15223343
253-259	22211115	20121211	00111112	20111110	00010111	00122245	45334344
260-266	25532324	43010100	33232212	01112223	43001100	00011114	53000201
267-273	20111101	10111100	10012233	41011100	00011232	00012100	01111100
274-280	00012324	11223333	34236335	54334327	66223313	23122202	24111201
281-287	10012201	30011101	00012100	00011104	32345654	75423335	45222223
288-294	10122202	43322215	42111111	00011100	00011000	11022355	30011102
295-301	33011102	00011355	32211100	01011000	00011101	13112202	10111000
302-308	11222232	44522445	52233344	23211323	20011011	00012112	00001000
309-315	20010000	00001000	00010100	00222226	66333323	74322234	33011000
316-322	01011000	10011103	30001000	00010100	22011114	66222134	22200010
323-329	01000000	00000000	01000002	10000001	00000000	21100000	00000001
330-336	64322243	55212135	33121132	22111014	01111002	20000000	00000000
337-343	00000000	10000102	35223112	32332425	66433433	33222212	11001131
344-350	00000000	00001021	11111112	20011011	21000000	20000000	12000002
351-357	00011134	33100211	10000022	10011112	10001100	01100001	00000222
358-364	33222255	33121222	11001111	21000012	10000001	20011000	10000001
365-366	00000001	55322232					

LEIRVOGUR MAGNETIC OBSERVATORY 2008

K-SUMS IN 27-DAY RUNS

DAYS	K-SUMS																										
1- 27	6	2	2	3	28	32	28	23	19	9	9	13	26	35	26	28	27	26	23	17	12	5	8	10	25	17	10
28- 54	10	10	4	13	33	35	29	23	10	12	16	16	10	27	32	29	25	24	24	19	12	23	31	15	13	9	13
55- 81	10	7	10	21	37	41	35	24	18	11	21	12	12	15	43	34	26	31	24	34	25	18	13	19	18	19	21
82-108	12	24	10	10	32	43	41	27	25	11	14	4	6	20	26	36	32	24	29	27	13	26	17	7	13	29	21
109-135	17	19	16	10	14	42	38	27	33	23	22	22	15	17	20	26	21	33	24	20	16	8	12	13	5	12	9
136-162	8	12	7	10	23	26	29	30	25	21	19	15	11	29	24	28	23	23	16	13	13	9	18	24	22	14	10
163-189	8	10	8	20	34	30	31	22	20	30	14	12	8	15	28	30	24	18	28	15	13	9	9	9	19	12	12
190-216	9	8	13	15	30	31	26	22	20	16	12	10	11	17	24	38	23	10	14	14	18	11	15	10	12	8	15
217-243	12	7	13	13	9	26	30	22	20	17	19	9	14	20	31	28	16	9	12	12	8	5	8	12	11	10	7
244-270	11	6	11	20	40	22	24	24	23	15	10	7	7	4	16	30	26	9	18	12	9	8	11	7	5	12	8
271-297	9	4	5	12	18	29	31	26	14	12	7	7	4	7	32	32	22	10	22	12	3	2	19	8	11	15	10
298-324	3	4	12	4	15	30	26	17	6	7	1	3	1	2	16	29	27	8	3	7	4	2	12	26	7	1	0
325-351	3	2	0	4	1	26	24	16	12	6	2	0	0	4	19	24	32	17	8	0	4	9	6	3	2	5	10
352-366	11	5	7	3	3	6	24	16	6	6	2	4	2	1	24												

LEIRVOGUR MAGNETIC OBSERVATORY 2008

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	46	69	42	43	26	13	8	1	0	0	0	2.0	13
FEB	23	43	51	53	29	18	10	4	1	0	0	2.6	20
MAR	14	47	55	58	27	23	15	8	1	0	0	2.9	23
APR	20	41	62	49	30	23	10	5	0	0	0	2.7	20
MAY	13	67	78	44	21	15	8	2	0	0	0	2.3	15
JUN	15	57	77	50	17	9	12	3	0	0	0	2.4	16
JUL	17	79	87	36	15	7	5	2	0	0	0	2.0	11
AUG	33	78	87	25	10	12	2	1	0	0	0	1.8	10
SEP	53	78	47	28	20	10	2	0	2	0	0	1.7	11
OCT	55	65	52	38	17	15	4	2	0	0	0	1.9	12
NOV	121	50	34	18	7	3	6	1	0	0	0	1.1	7
DEC	114	60	41	21	4	6	2	0	0	0	0	1.1	5
YEAR	524	734	713	463	223	154	84	29	4	0	0	2.0	13
%	17.9	25.1	24.4	15.8	7.6	5.3	2.9	1.0	0.1	0.0			

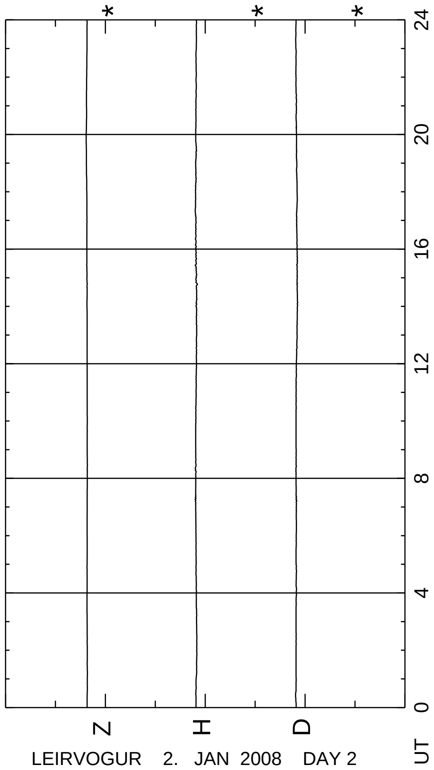
	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\bar{K}$	$\overline{Ak}$
1958	76	267	459	591	510	488	328	87	12	2	100	3.6	33
1959	46	260	360	567	562	547	388	138	33	8	11	3.9	39
1960	75	275	399	539	468	492	304	165	32	4	175	3.7	38
1961	224	477	475	518	482	351	222	87	19	1	64	3.1	27
1962	17	346	592	569	444	412	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

EXPLANATION OF DAILY GRAPHS

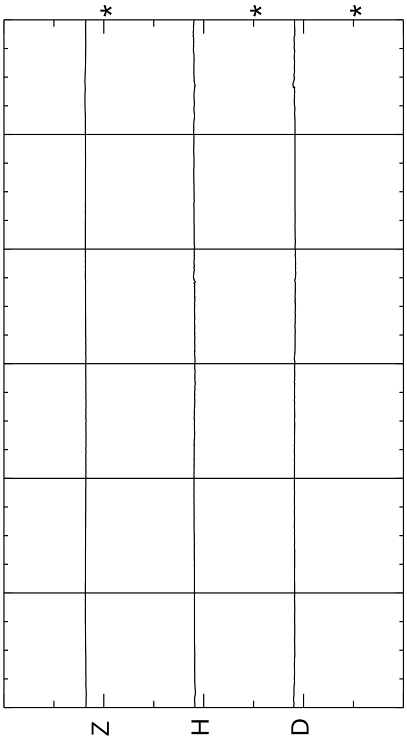
The graphs on pages 36–127 show the 1-minute means of the magnetic elements Z, H, and D at Leirvogur in 2008. Vertical divisions are spaced at intervals of 500 nT in Z and H and $2.^{\circ}31$ in D. The last figure is equivalent to 500 nT in the direction of magnetic east for average values of H at Leirvogur.

Levels marked with asterisk (*) are as follows:
Z: 50000 nT
H: 12000 nT
D: 343° E

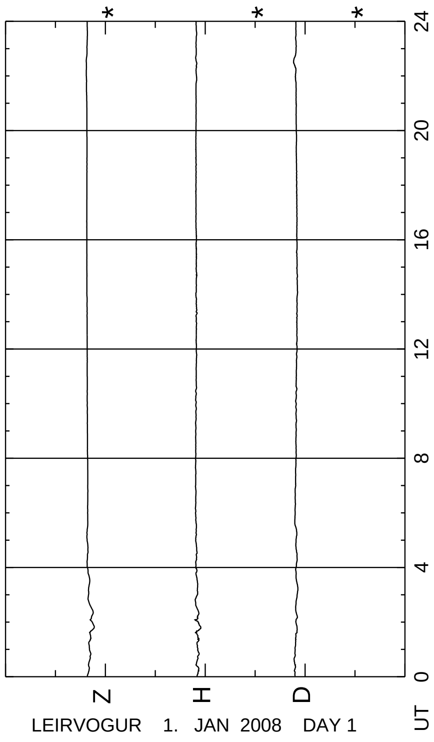
In several cases the H and D components had to be shifted upwards or downwards by one interval (500 nT) to disentangle the lines or prevent them from disappearing off scale.



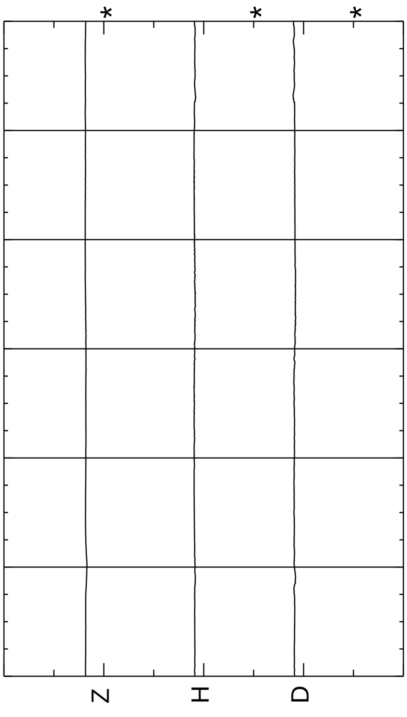
LEIRVOGUR 2. JAN 2008 DAY 2



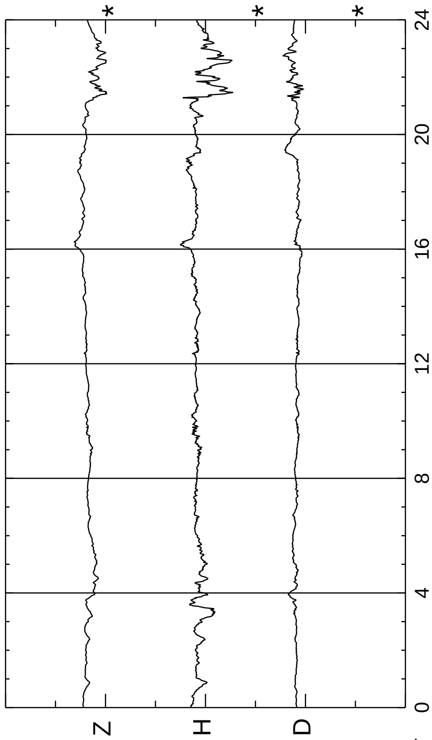
LEIRVOGUR 4. JAN 2008 DAY 4



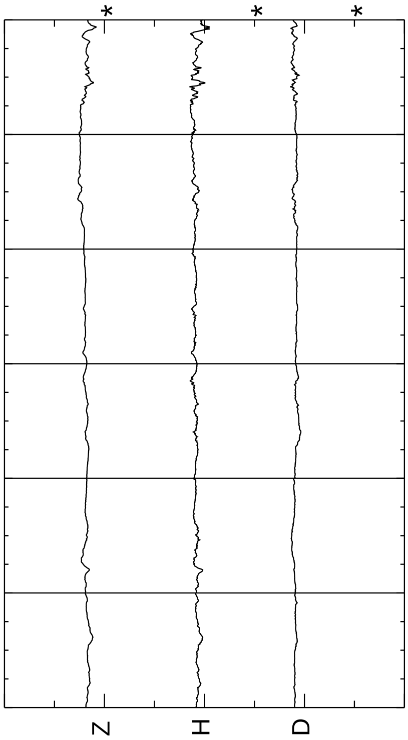
LEIRVOGUR 1. JAN 2008 DAY 1



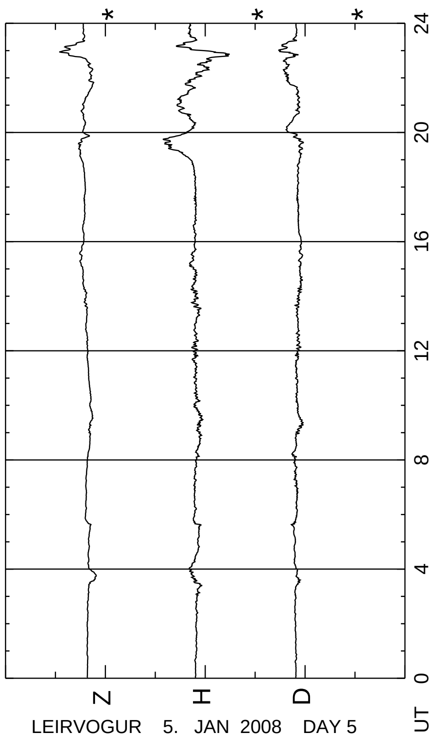
LEIRVOGUR 3. JAN 2008 DAY 3



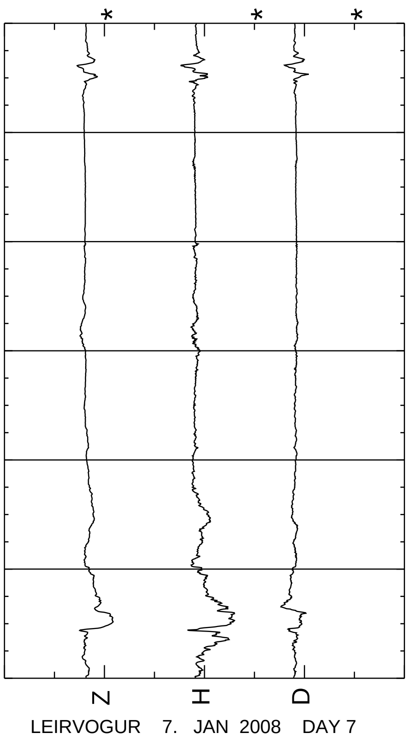
LEIRVOGUR 6. JAN 2008 DAY 6



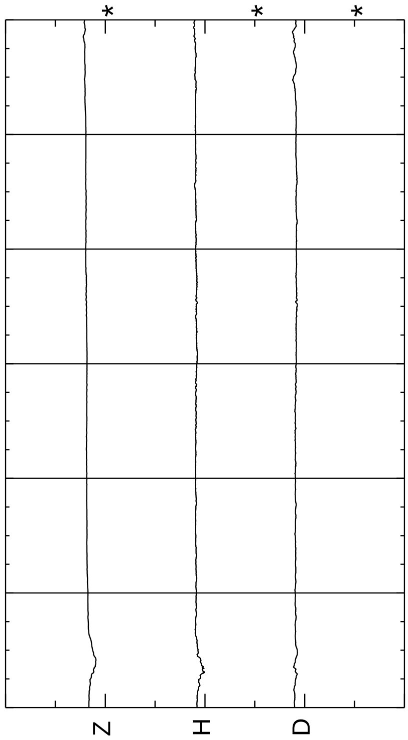
LEIRVOGUR 8. JAN 2008 DAY 8



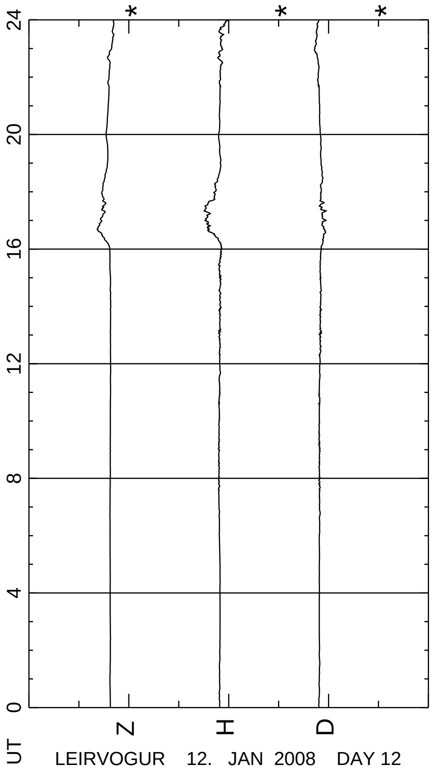
LEIRVOGUR 5. JAN 2008 DAY 5



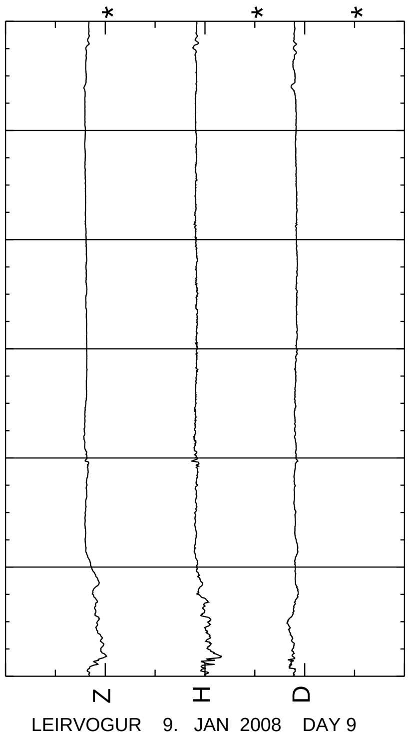
LEIRVOGUR 7. JAN 2008 DAY 7



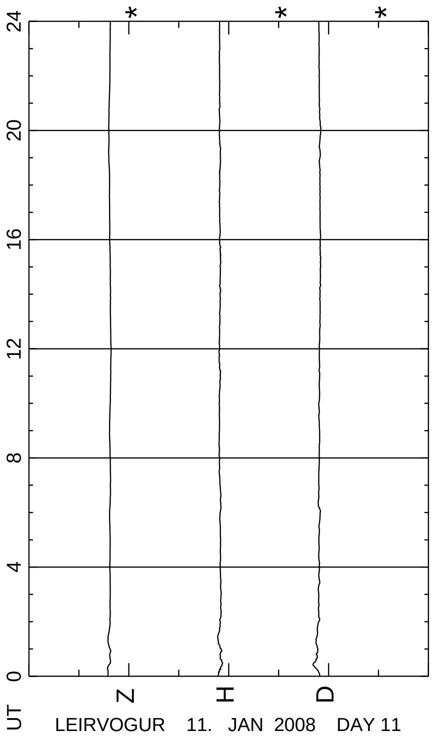
LEIRVOGUR 10. JAN 2008 DAY 10



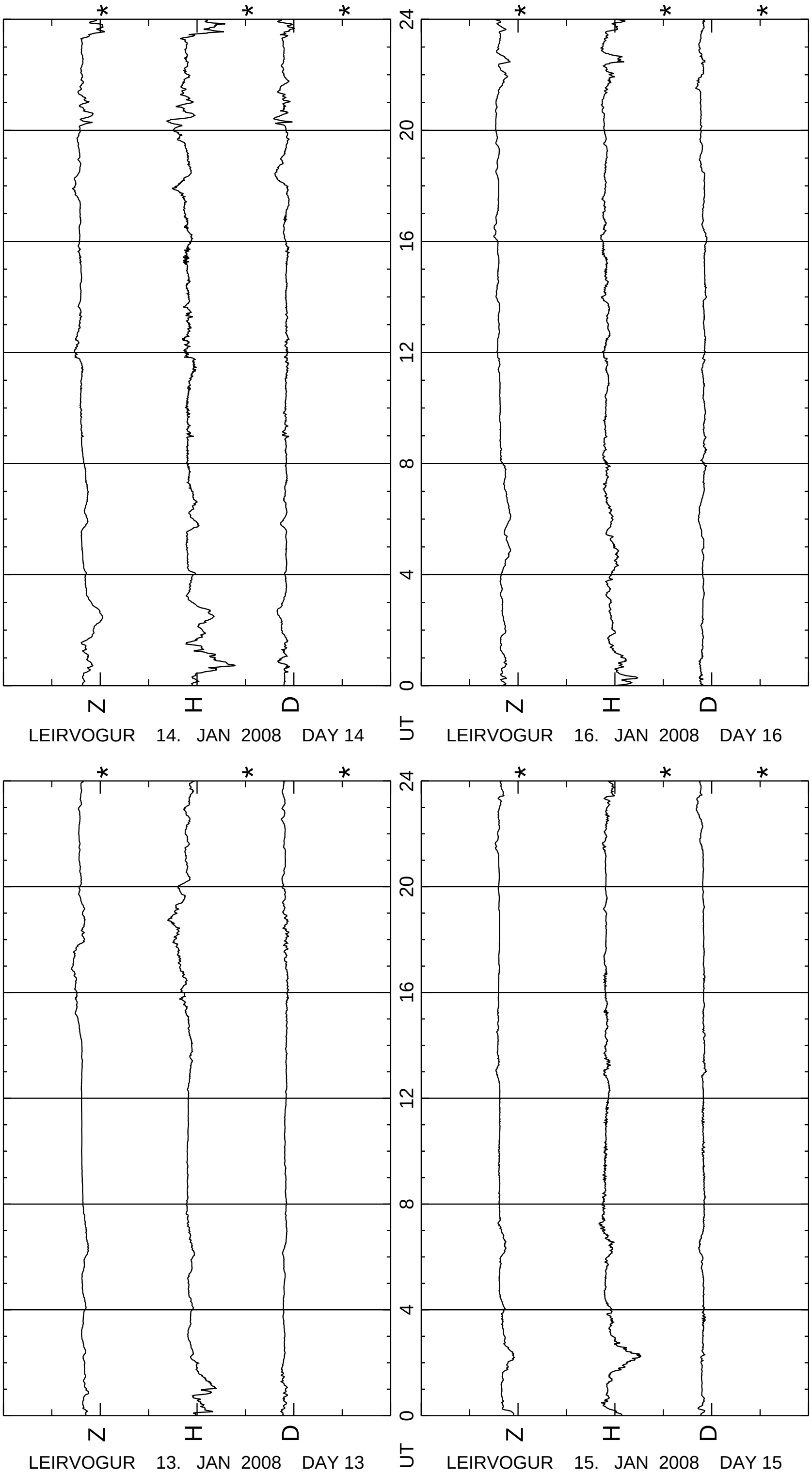
LEIRVOGUR 12. JAN 2008 DAY 12

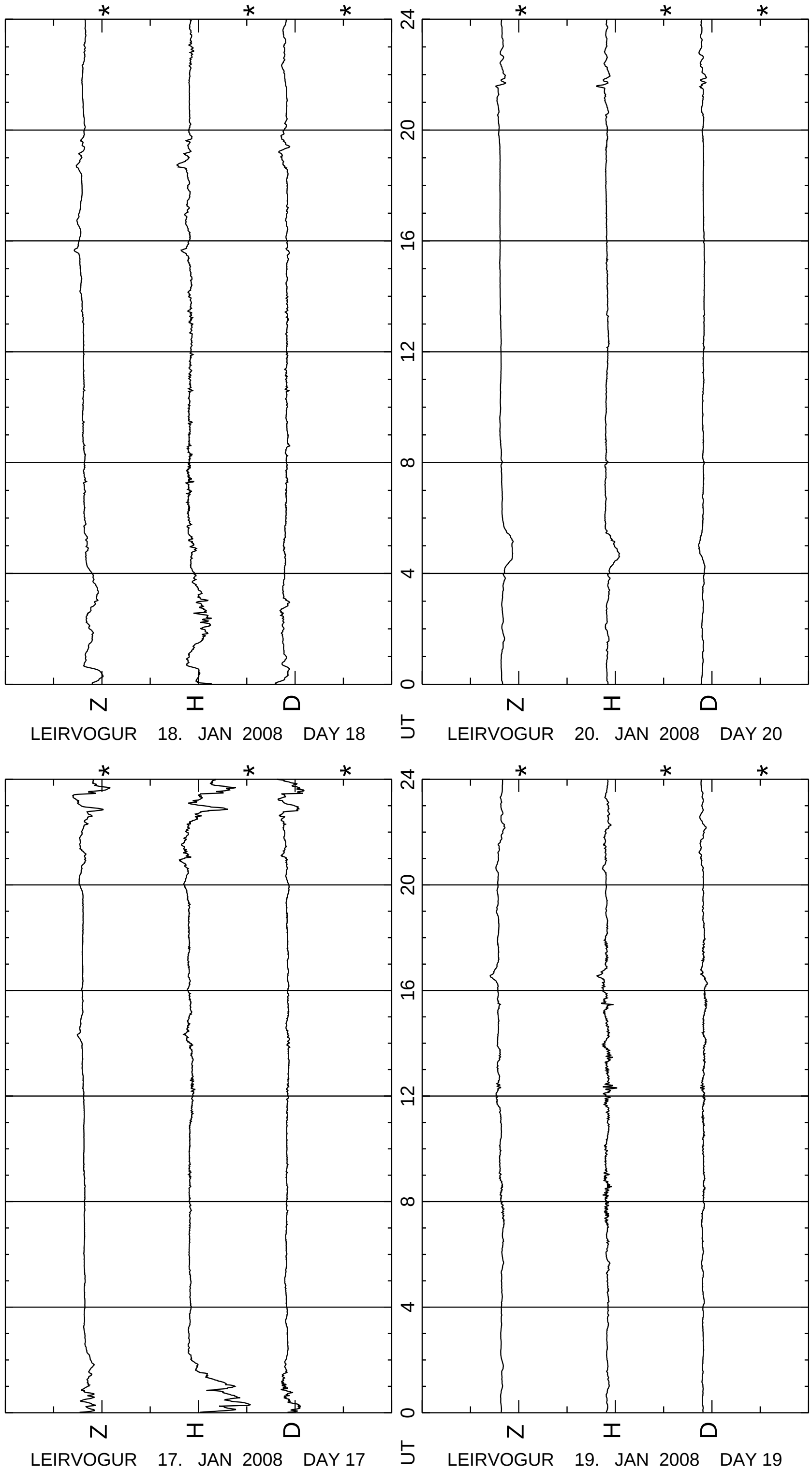


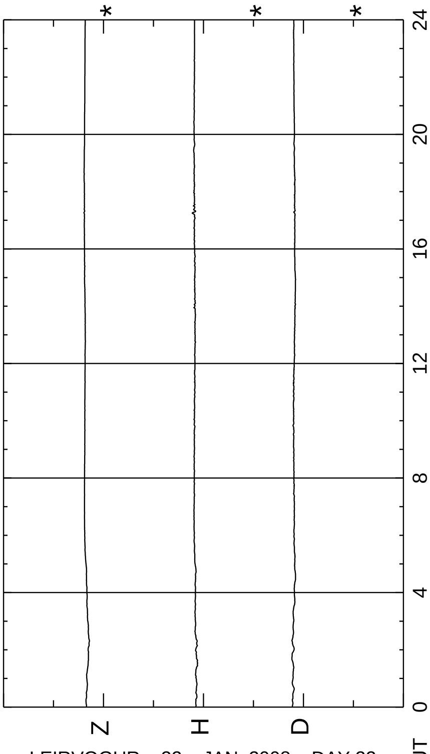
LEIRVOGUR 9. JAN 2008 DAY 9



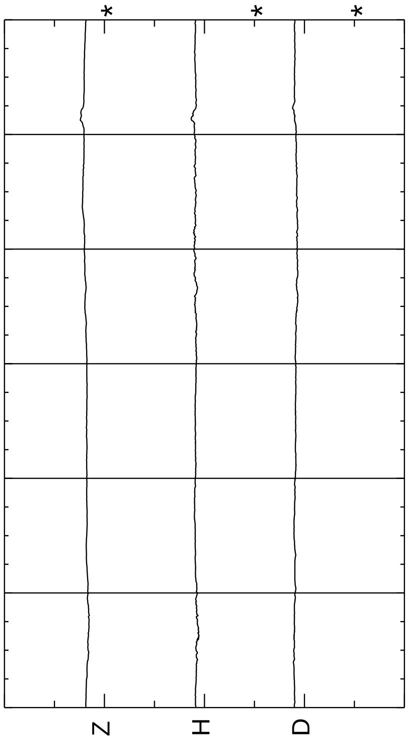
LEIRVOGUR 11. JAN 2008 DAY 11


Z H D
LEIRVOGUR 14. JAN 2008 DAY 14
UT
Z H D
LEIRVOGUR 16. JAN 2008 DAY 16
Z H D
LEIRVOGUR 13. JAN 2008 DAY 13
UT
Z H D
LEIRVOGUR 15. JAN 2008 DAY 15
0
4
8
12
16
20
24

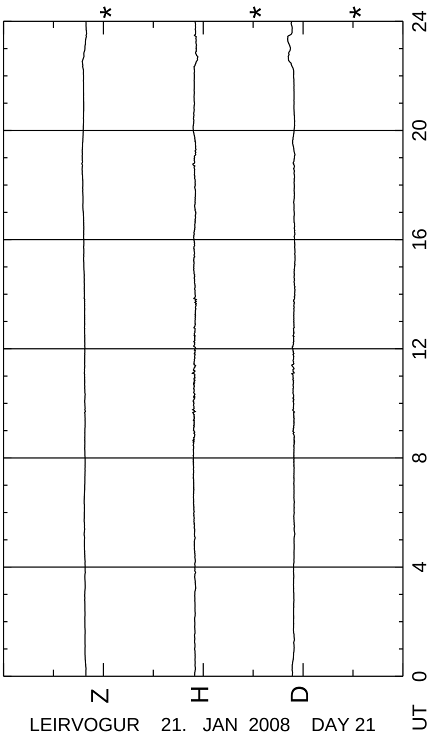

LEIRVOGUR 18. JAN 2008 DAY 18
LEIRVOGUR 20. JAN 2008 DAY 20
LEIRVOGUR 17. JAN 2008 DAY 17
LEIRVOGUR 19. JAN 2008 DAY 19
Z H D
UT
0 4 8 12 16 20 24



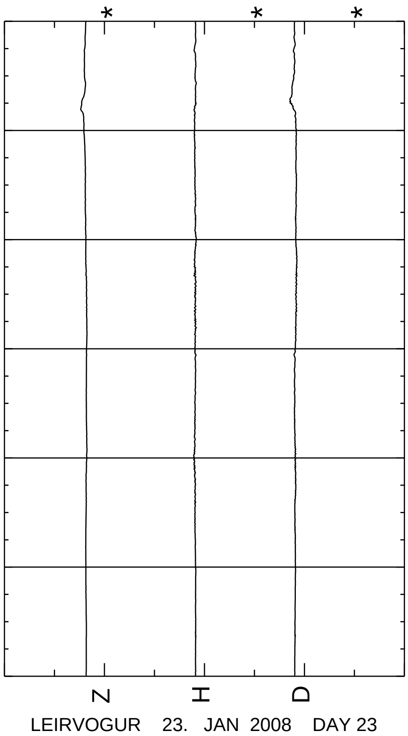
LEIRVOGUR 22. JAN 2008 DAY 22



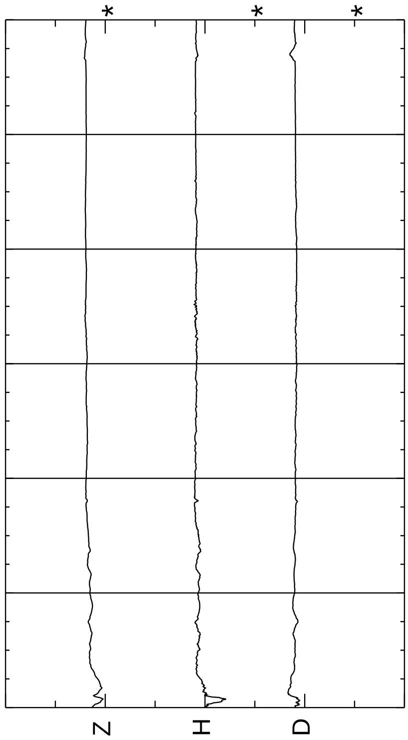
LEIRVOGUR 24. JAN 2008 DAY 24



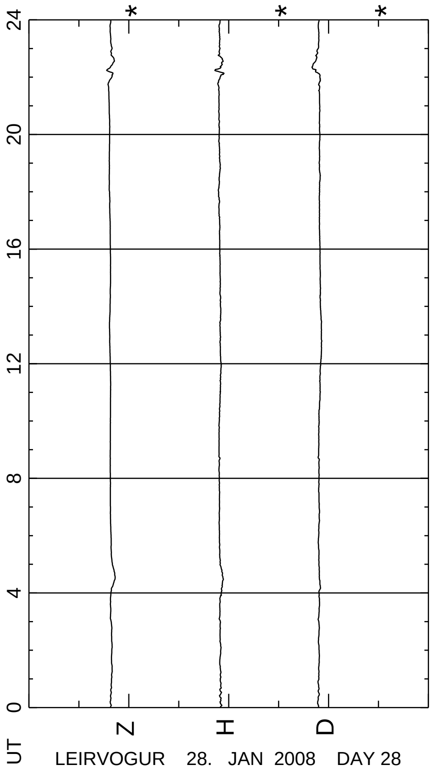
LEIRVOGUR 21. JAN 2008 DAY 21



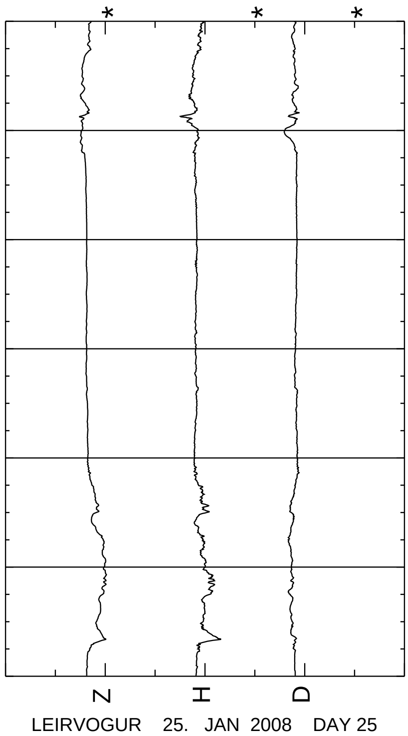
LEIRVOGUR 23. JAN 2008 DAY 23



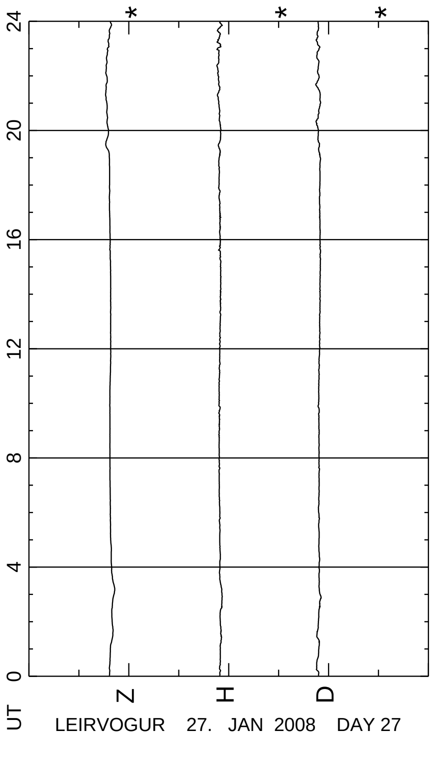
LEIRVOGUR 26. JAN 2008 DAY 26



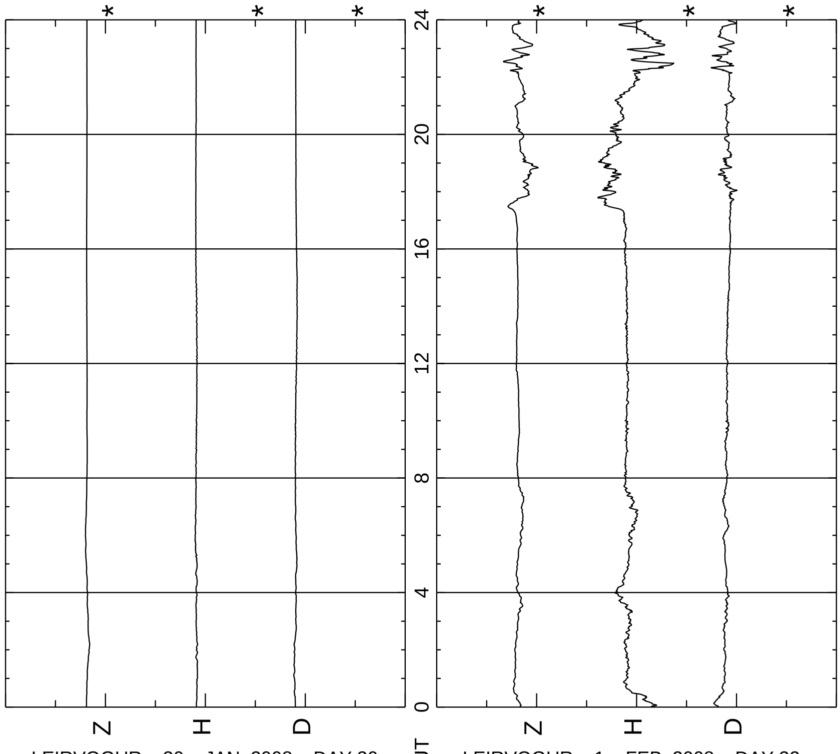
LEIRVOGUR 28. JAN 2008 DAY 28



LEIRVOGUR 25. JAN 2008 DAY 25

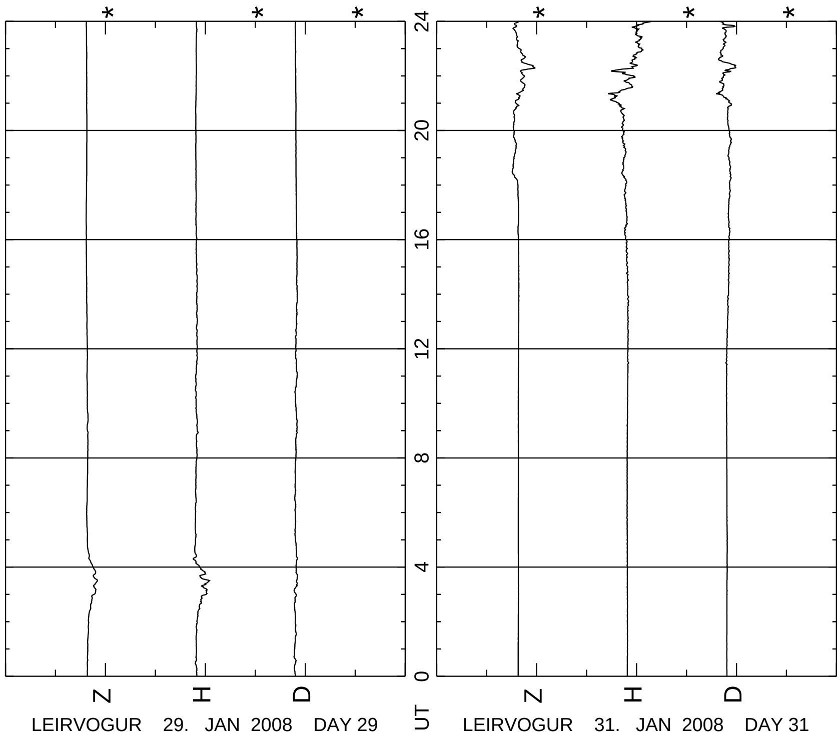


LEIRVOGUR 27. JAN 2008 DAY 27



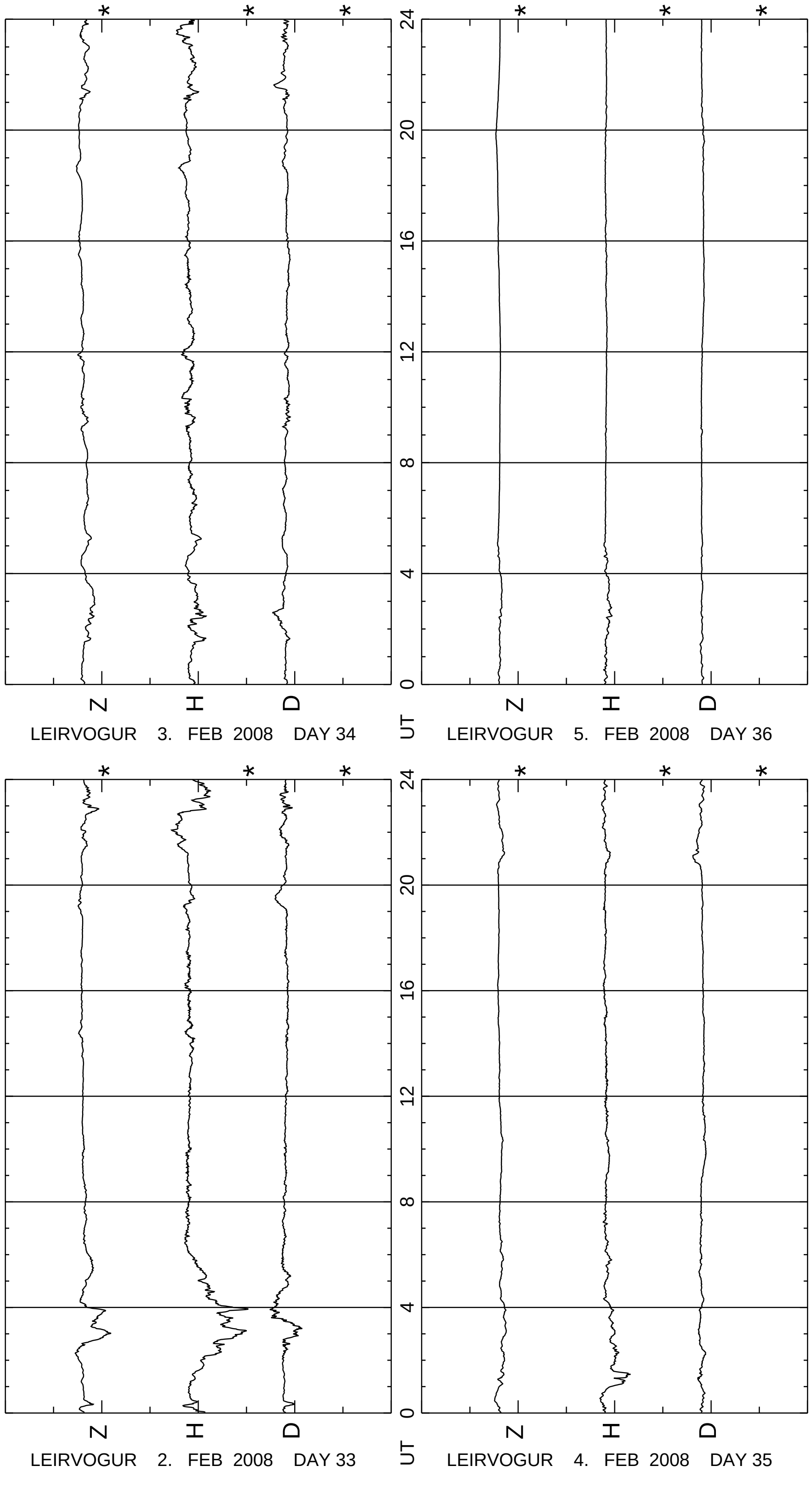
LEIRVOGUR 30. JAN 2008 DAY 30

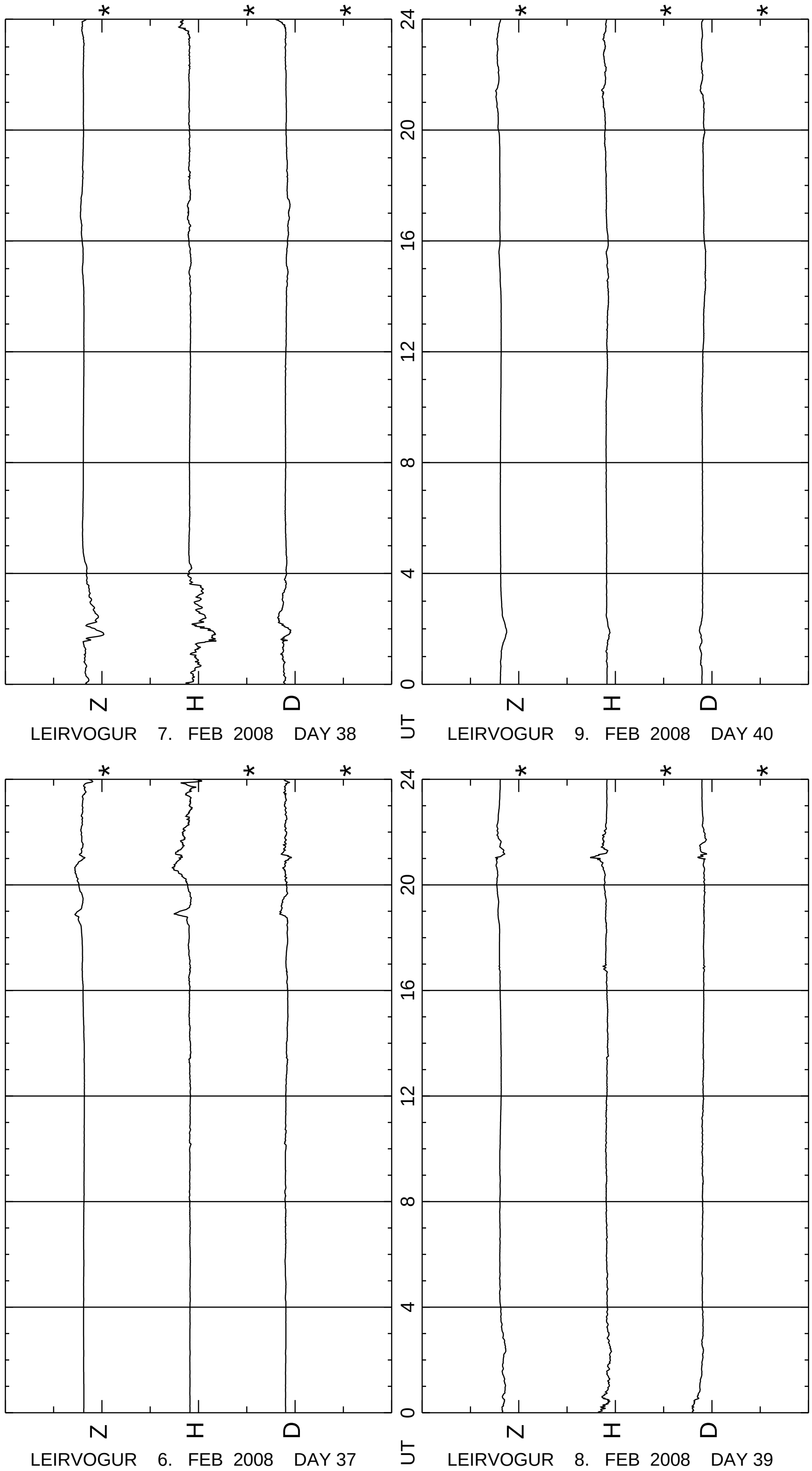
LEIRVOGUR 1. FEB 2008 DAY 32

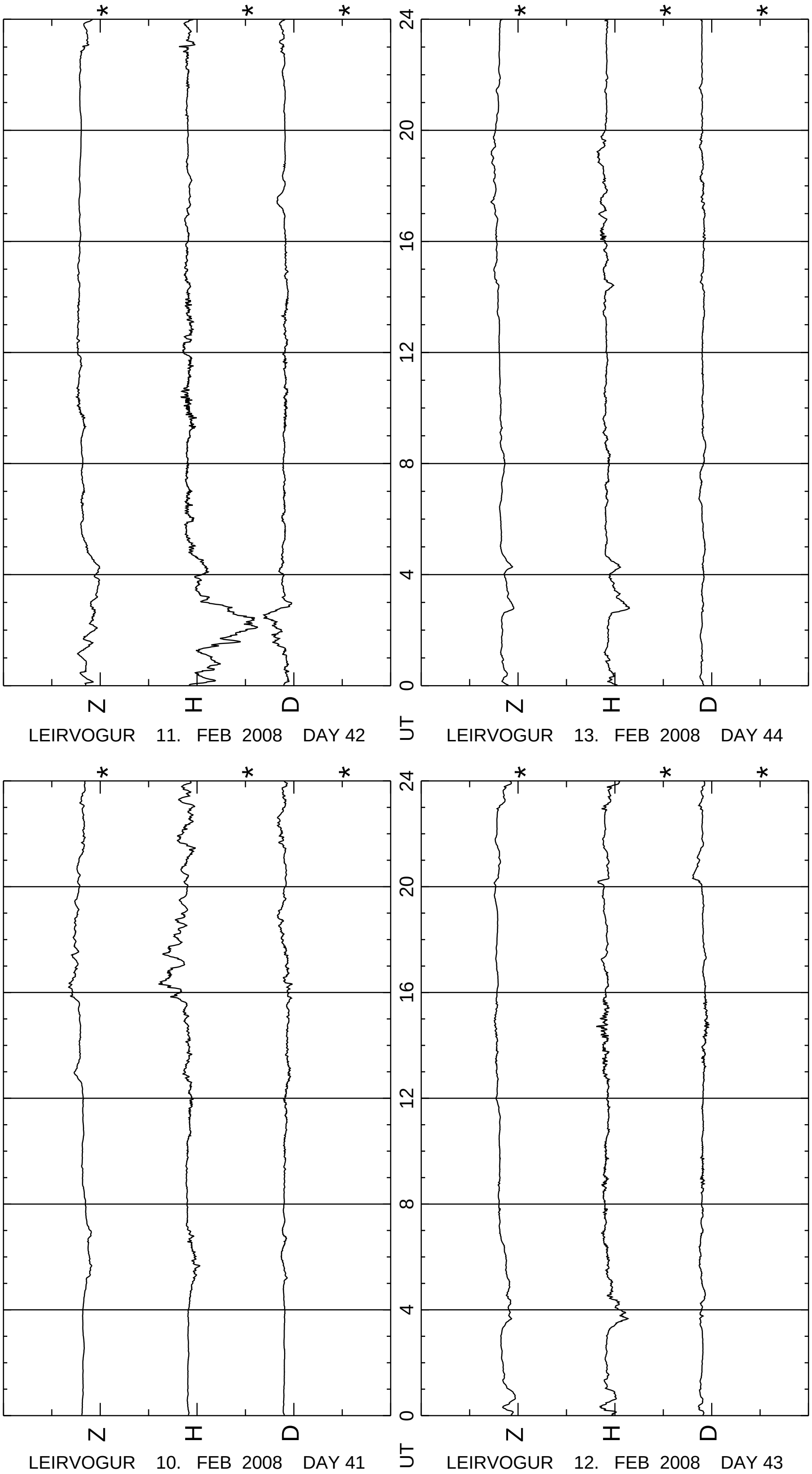


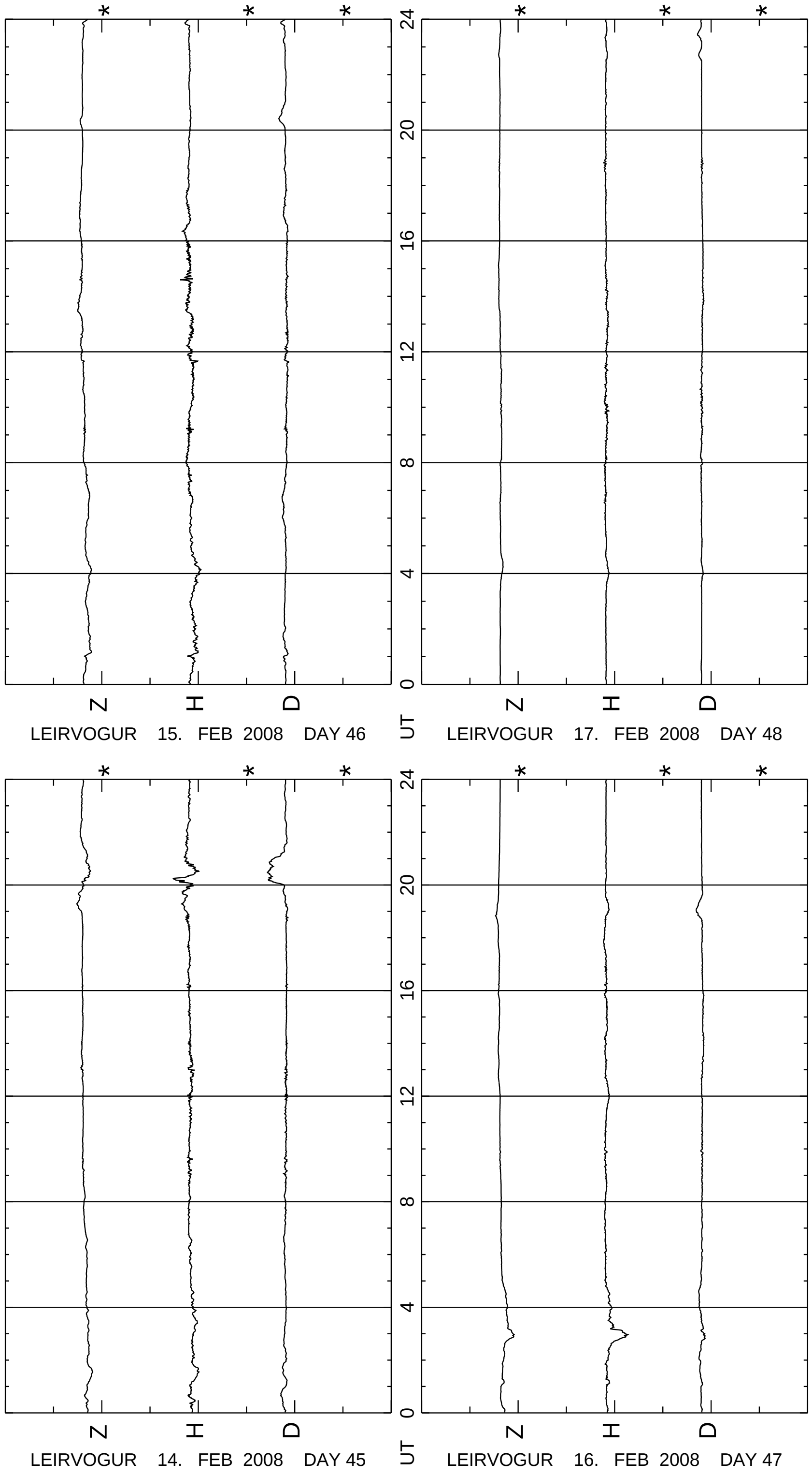
LEIRVOGUR 29. JAN 2008 DAY 29

LEIRVOGUR 31. JAN 2008 DAY 31


LEIRVOGUR 3. FEB 2008 DAY 34
LEIRVOGUR 5. FEB 2008 DAY 36
LEIRVOGUR 2. FEB 2008 DAY 33
LEIRVOGUR 4. FEB 2008 DAY 35
Z
H
D
UT
0
4
8
12
16
20
24


LEIRVOGUR 7. FEB 2008 DAY 38
LEIRVOGUR 9. FEB 2008 DAY 40
LEIRVOGUR 6. FEB 2008 DAY 37
LEIRVOGUR 8. FEB 2008 DAY 39
Z
H
D
UT
0
4
8
12
16
20
24


Z H D
LEIRVOGUR 11. FEB 2008 DAY 42
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 13. FEB 2008 DAY 44
Z H D
LEIRVOGUR 10. FEB 2008 DAY 41
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 12. FEB 2008 DAY 43


LEIRVOGUR 15. FEB 2008 DAY 46
LEIRVOGUR 17. FEB 2008 DAY 48
LEIRVOGUR 14. FEB 2008 DAY 45
LEIRVOGUR 16. FEB 2008 DAY 47
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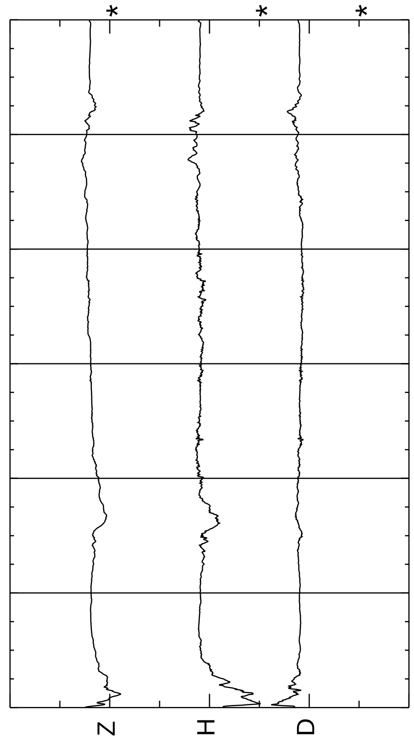
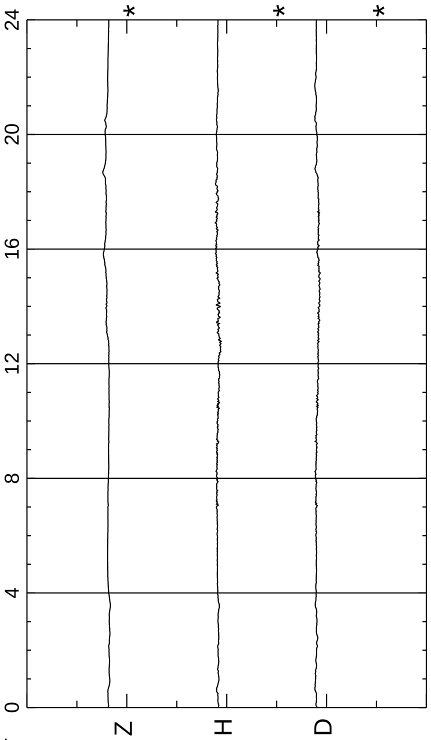
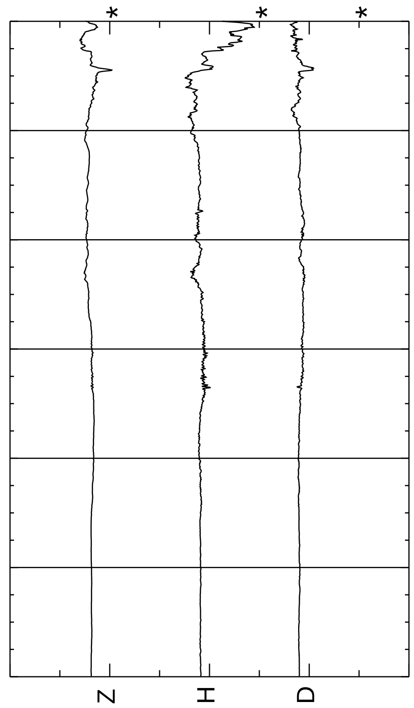
8
12
16
20
24



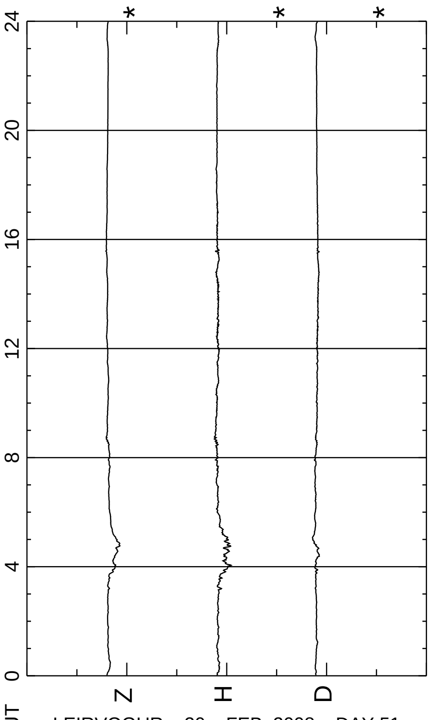
LEIRVOGUR 19. FEB 2008 DAY 50



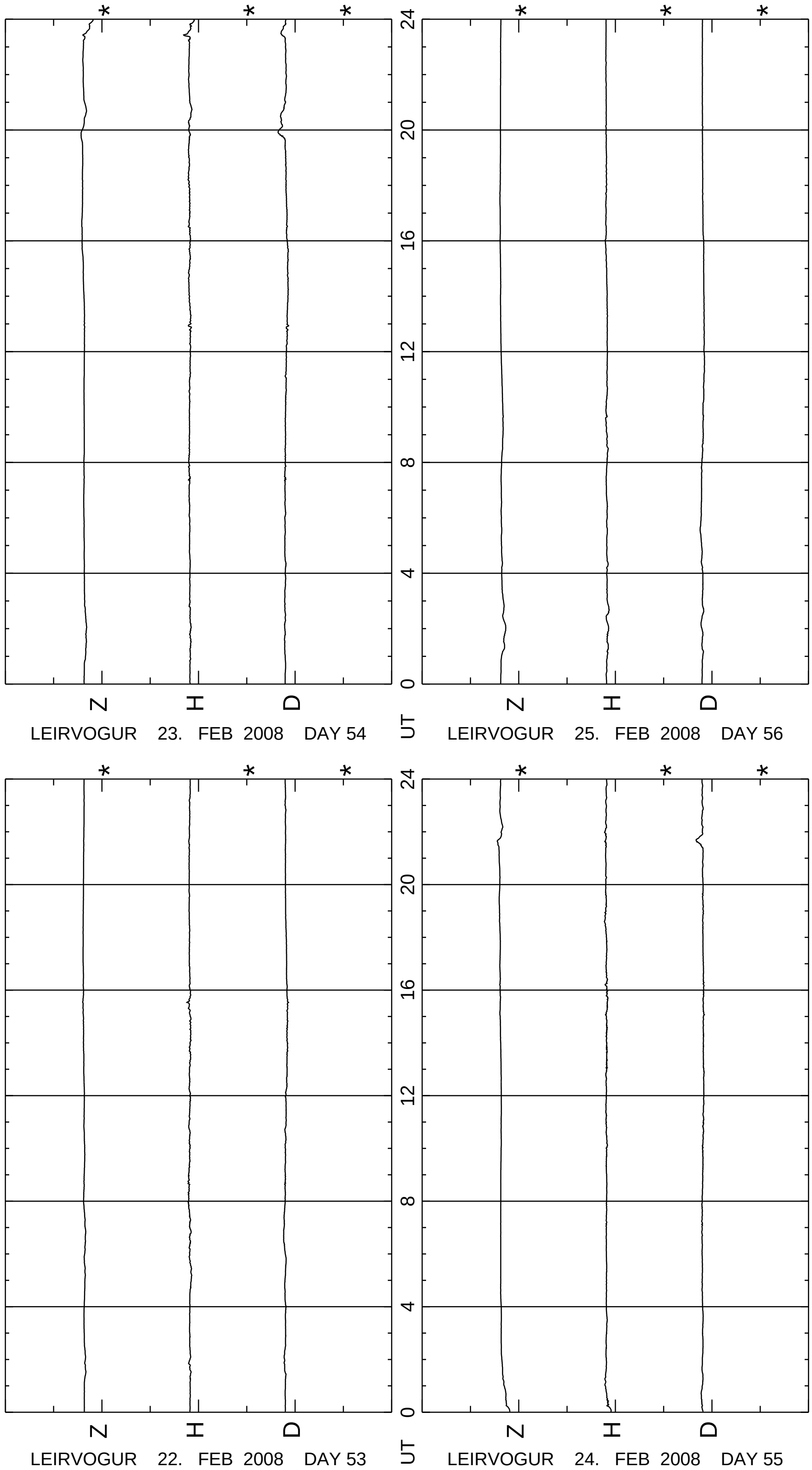
LEIRVOGUR 21. FEB 2008 DAY 52



LEIRVOGUR 18. FEB 2008 DAY 49



LEIRVOGUR 20. FEB 2008 DAY 51

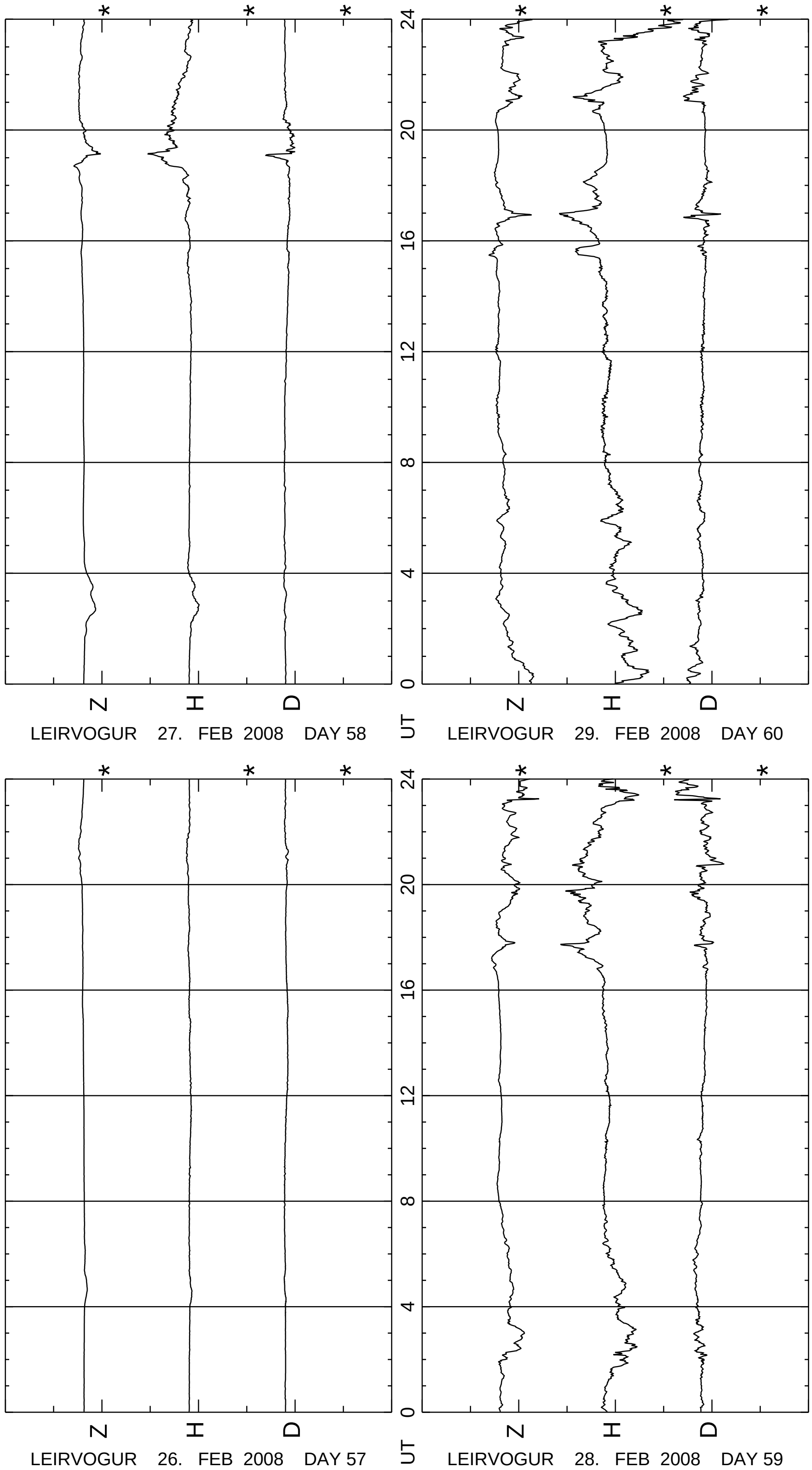


LEIRVOGUR 23. FEB 2008 DAY 54

LEIRVOGUR 25. FEB 2008 DAY 56

LEIRVOGUR 22. FEB 2008 DAY 53

LEIRVOGUR 24. FEB 2008 DAY 55


Z H D
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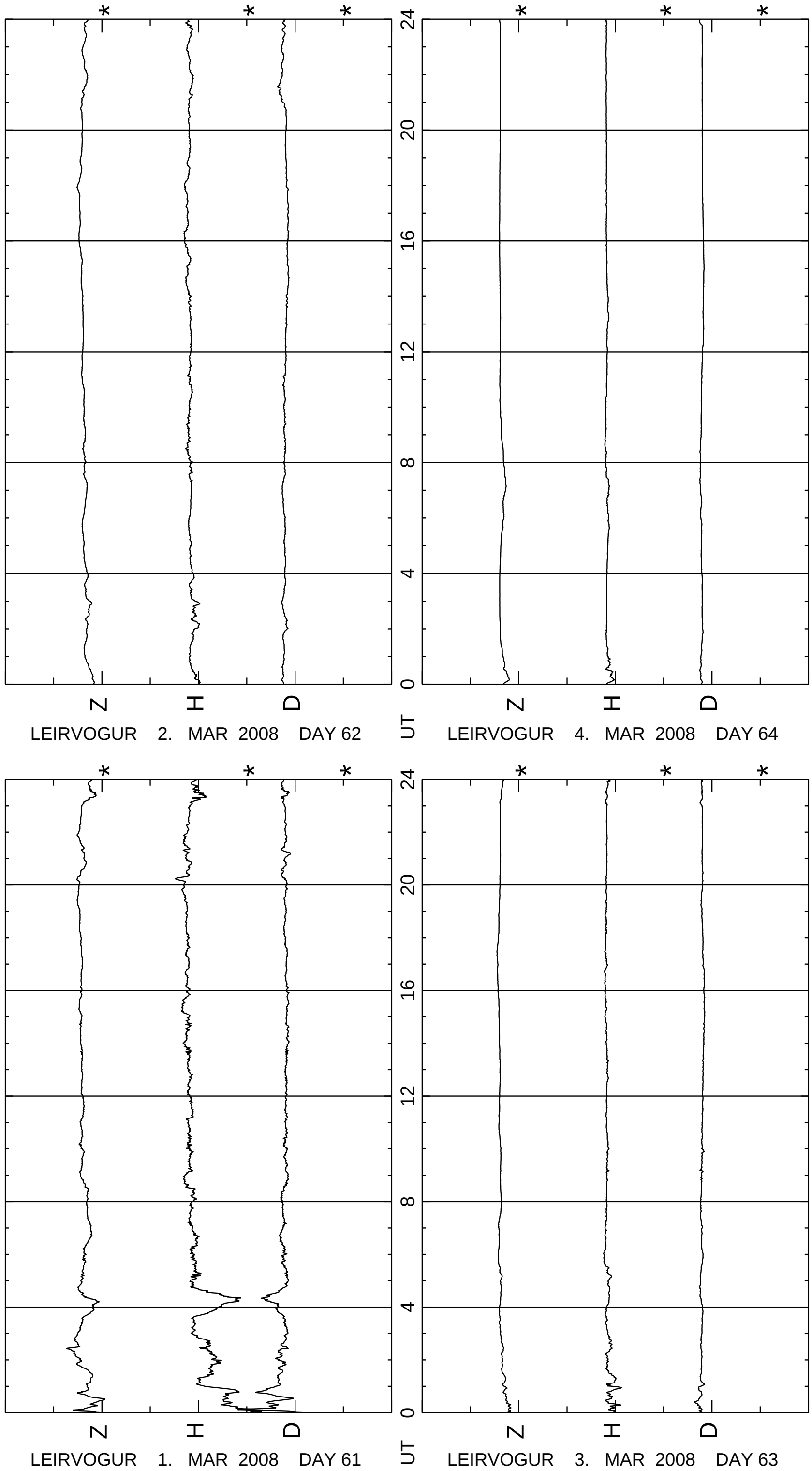
LEIRVOGUR 27. FEB 2008 DAY 58
LEIRVOGUR 29. FEB 2008 DAY 60
LEIRVOGUR 26. FEB 2008 DAY 57
LEIRVOGUR 28. FEB 2008 DAY 59
0 4 8 12 16 20 24


LEIRVOGUR 2. MAR 2008 DAY 62
LEIRVOGUR 4. MAR 2008 DAY 64
LEIRVOGUR 1. MAR 2008 DAY 61
LEIRVOGUR 3. MAR 2008 DAY 63
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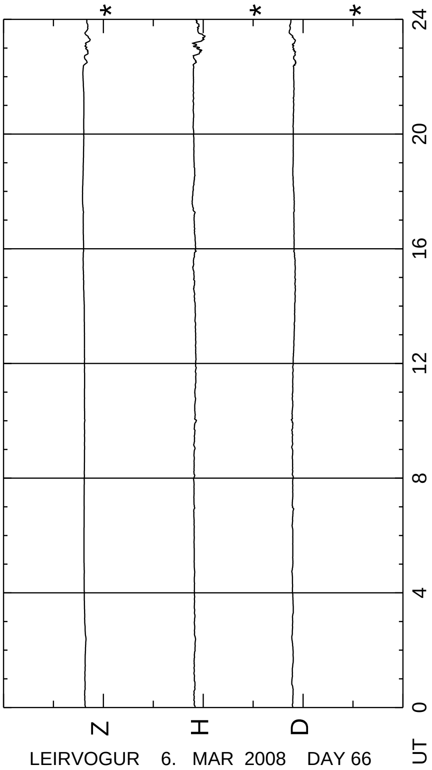
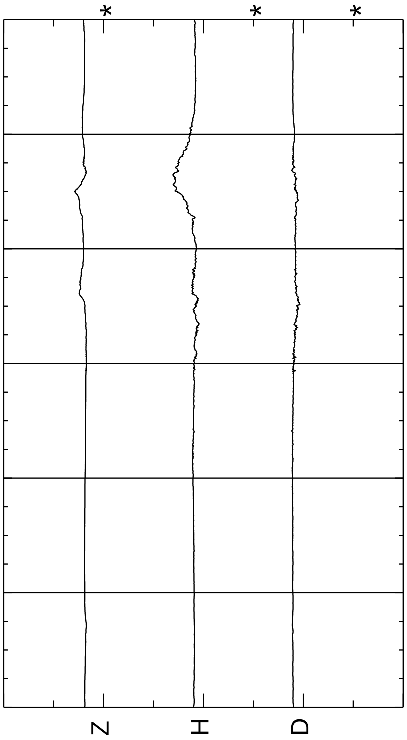
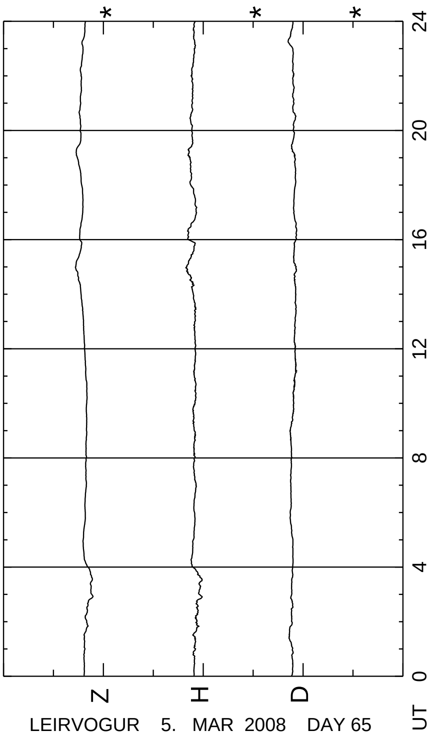


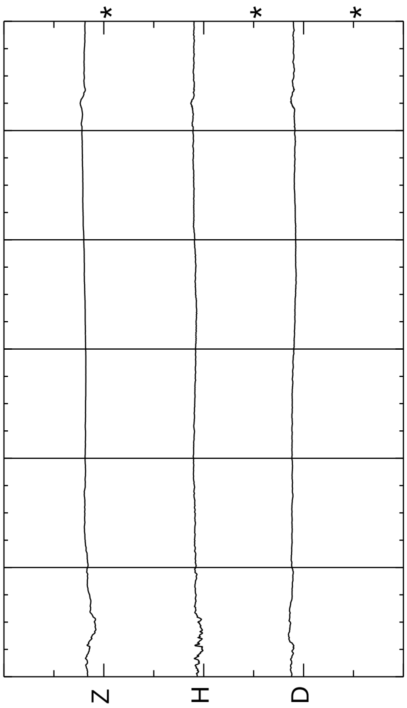
LEIRVOGUR   6.   MAR 2008   DAY 66



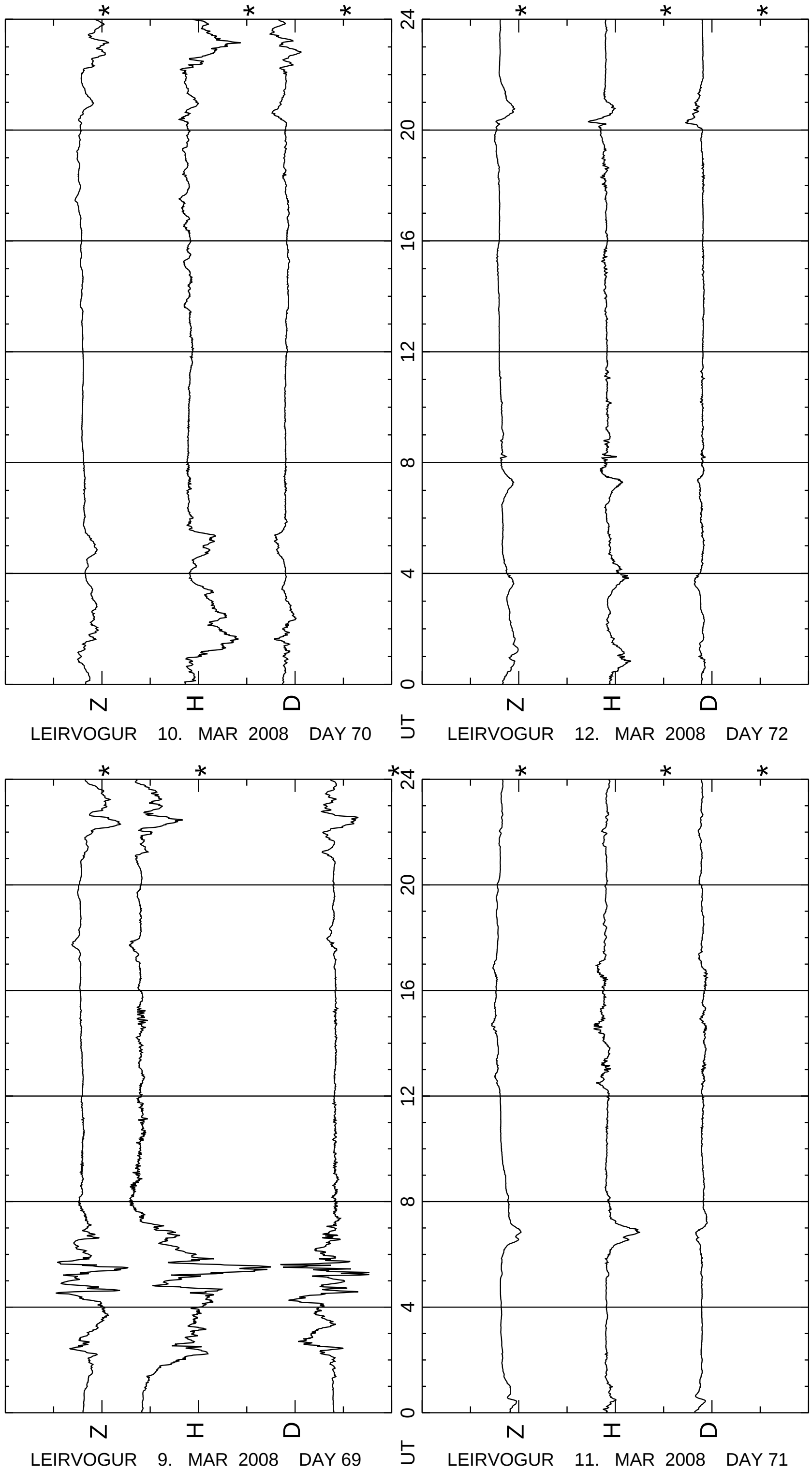
LEIRVOGUR   8.   MAR 2008   DAY 68



LEIRVOGUR   5.   MAR 2008   DAY 65



LEIRVOGUR   7.   MAR 2008   DAY 67


LEIRVOGUR 10. MAR 2008 DAY 70
LEIRVOGUR 12. MAR 2008 DAY 72
LEIRVOGUR 9. MAR 2008 DAY 69
LEIRVOGUR 11. MAR 2008 DAY 71
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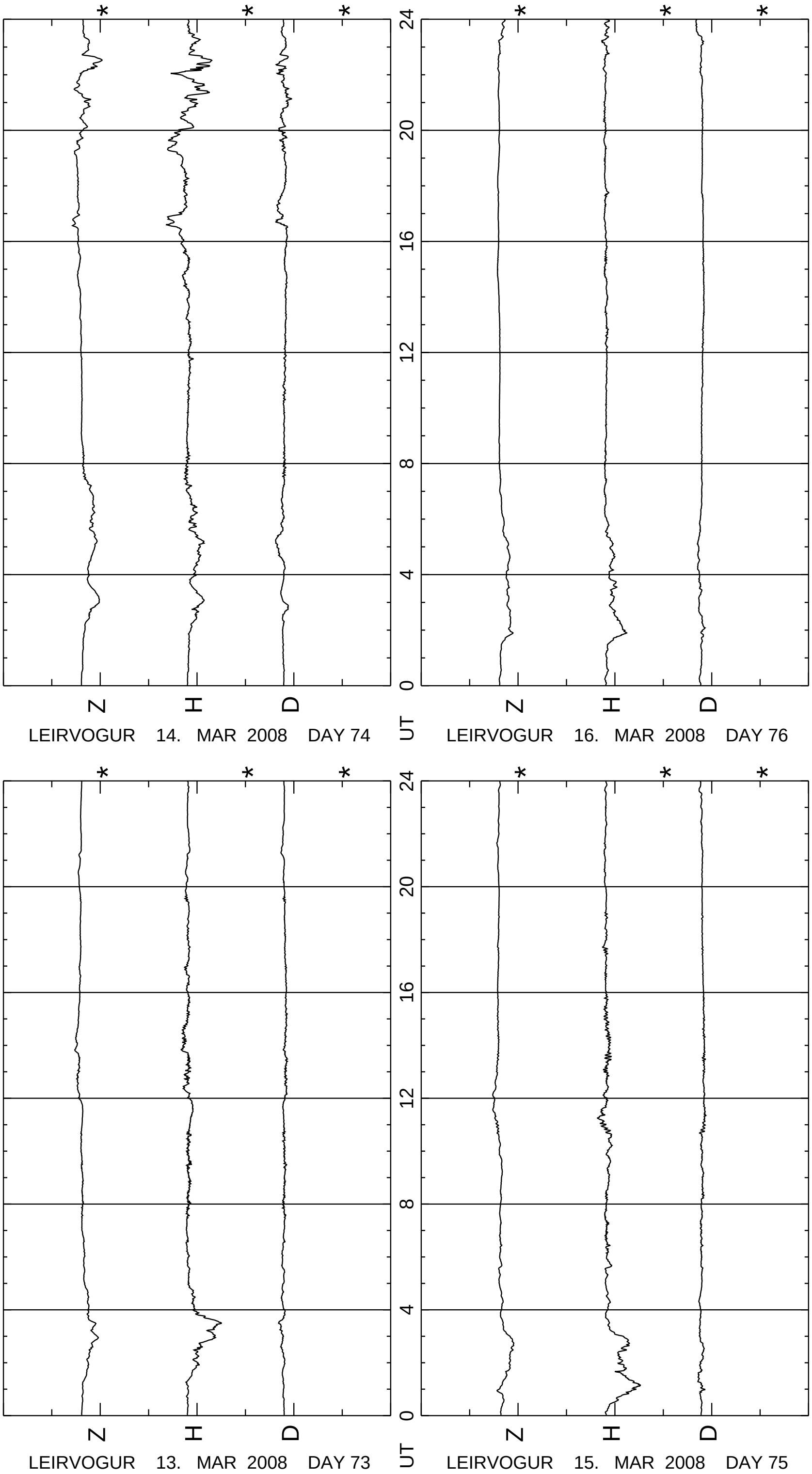
LEIRVOGUR 14. MAR 2008 DAY 74
LEIRVOGUR 16. MAR 2008 DAY 76
LEIRVOGUR 13. MAR 2008 DAY 73
LEIRVOGUR 15. MAR 2008 DAY 75
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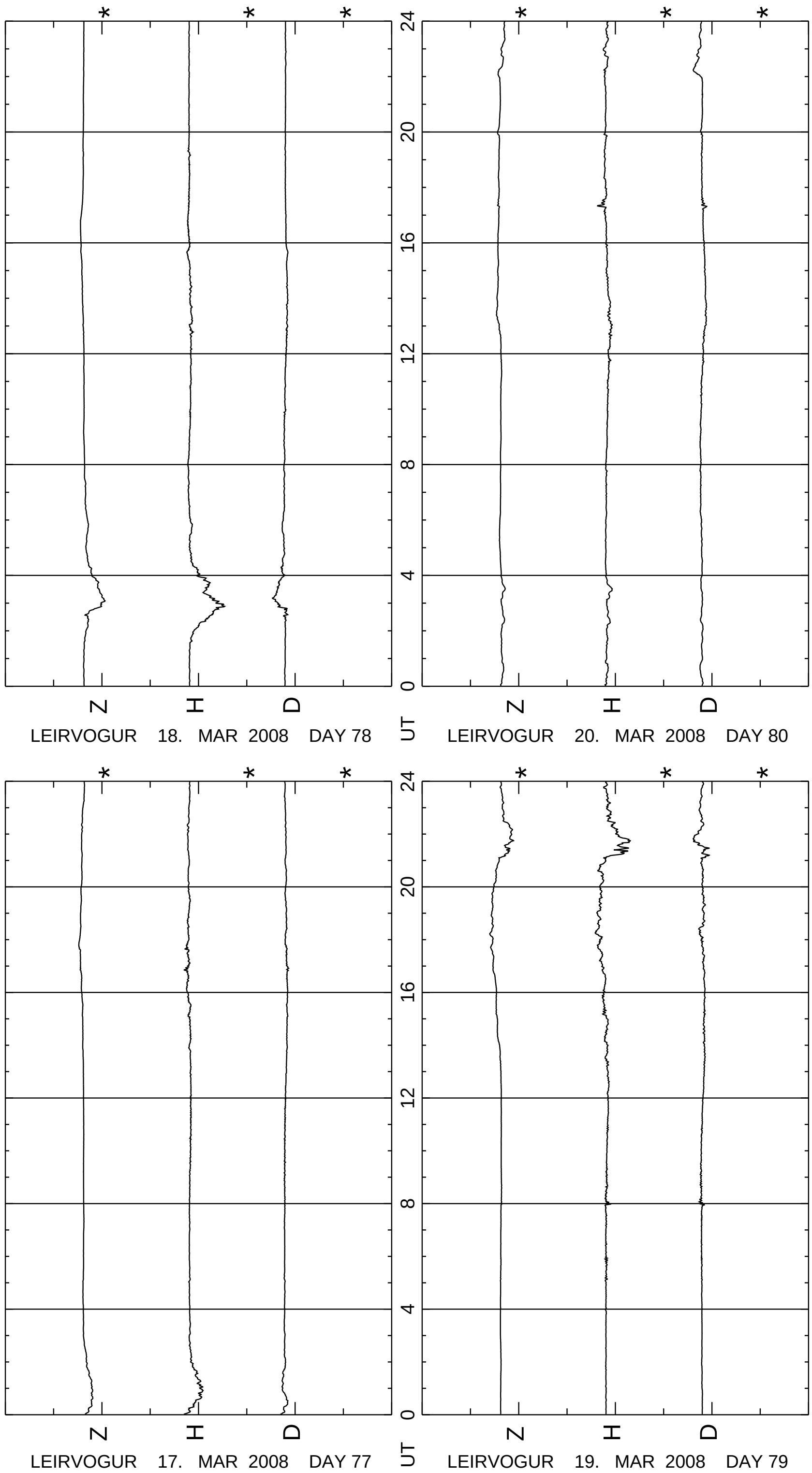

LEIRVOGUR 18. MAR 2008 DAY 78
LEIRVOGUR 20. MAR 2008 DAY 80
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LEIRVOGUR 19. MAR 2008 DAY 79
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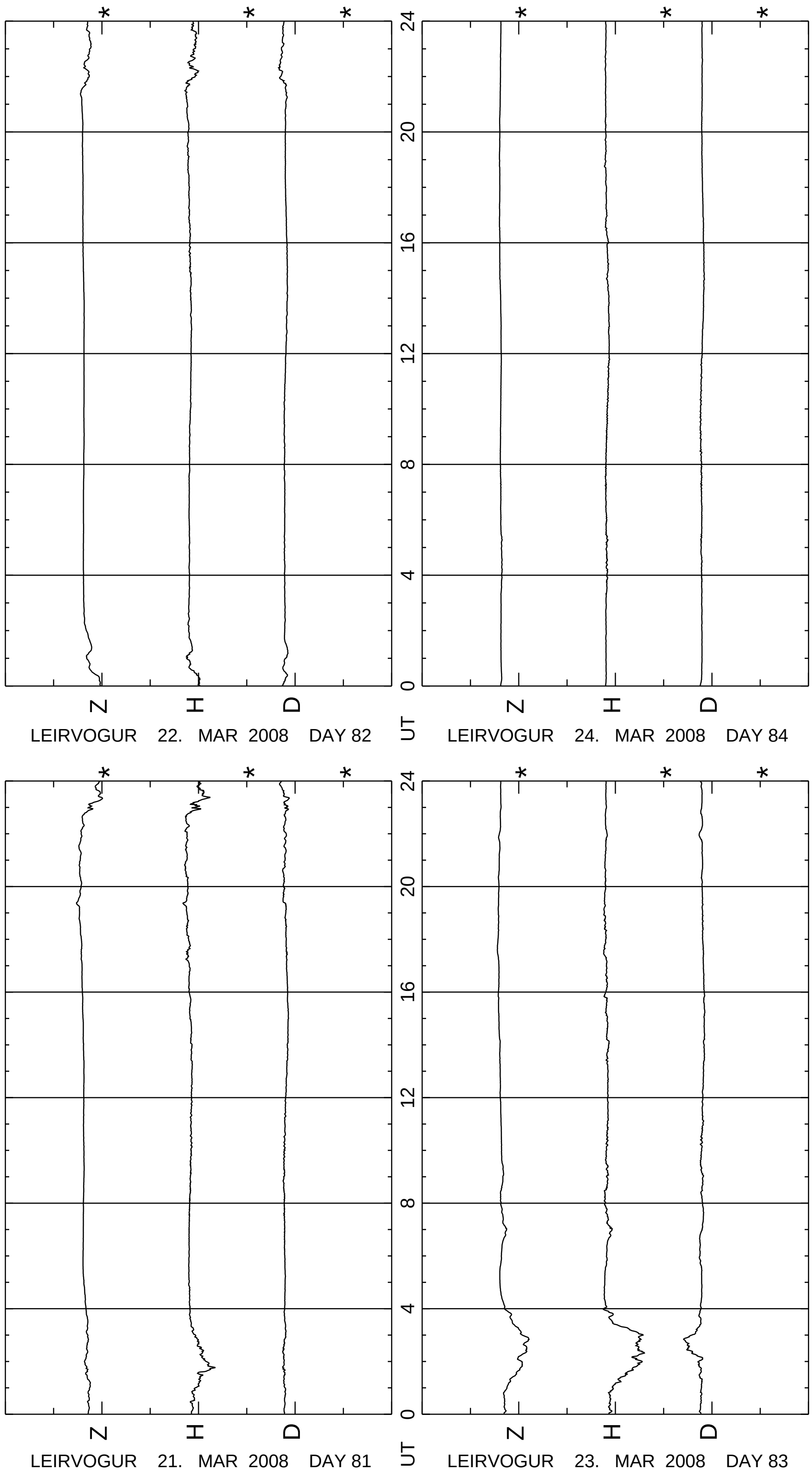
LEIRVOGUR 22. MAR 2008 DAY 82
LEIRVOGUR 24. MAR 2008 DAY 84
LEIRVOGUR 21. MAR 2008 DAY 81
LEIRVOGUR 23. MAR 2008 DAY 83
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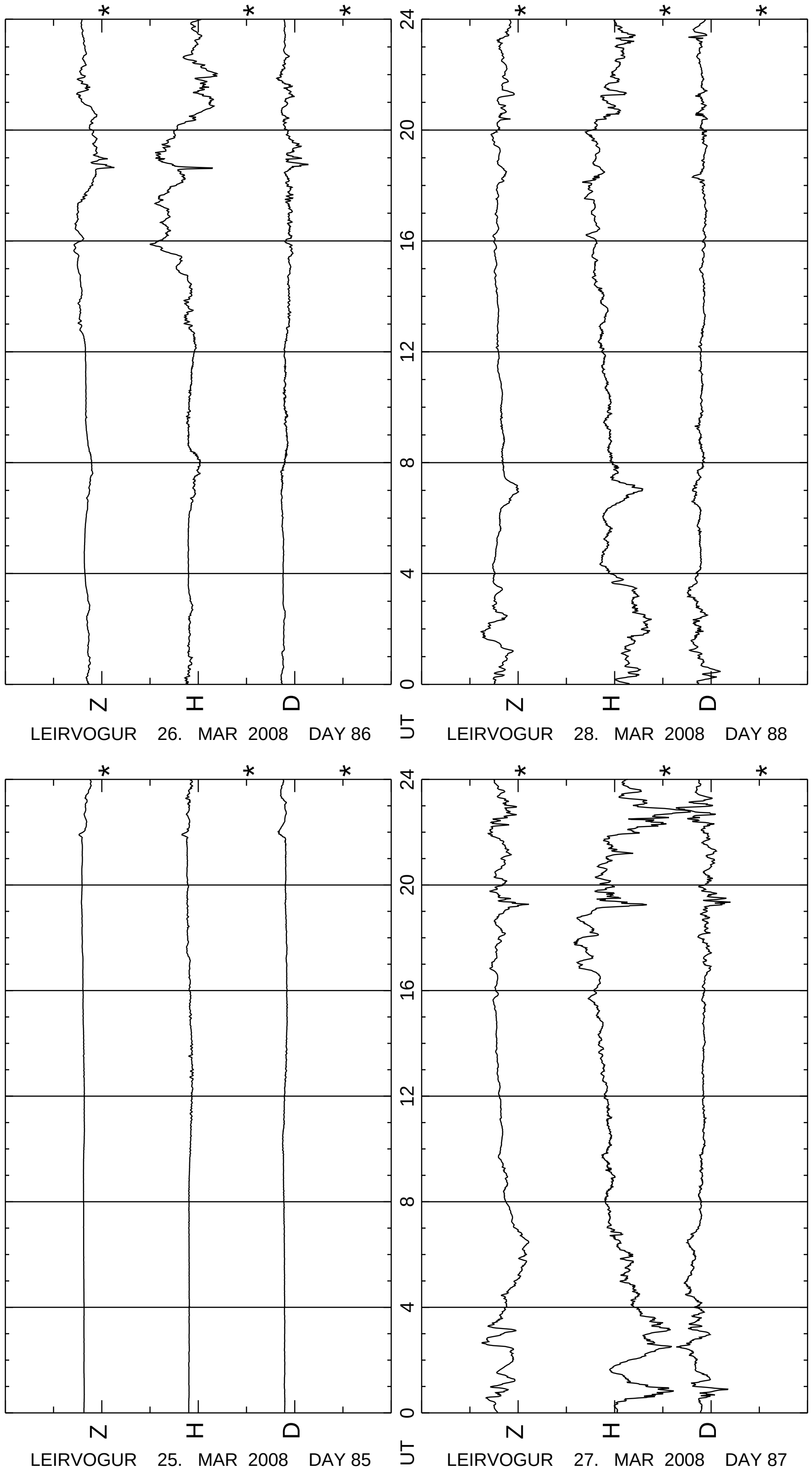
LEIRVOGUR 26. MAR 2008 DAY 86
LEIRVOGUR 28. MAR 2008 DAY 88
LEIRVOGUR 25. MAR 2008 DAY 85
LEIRVOGUR 27. MAR 2008 DAY 87
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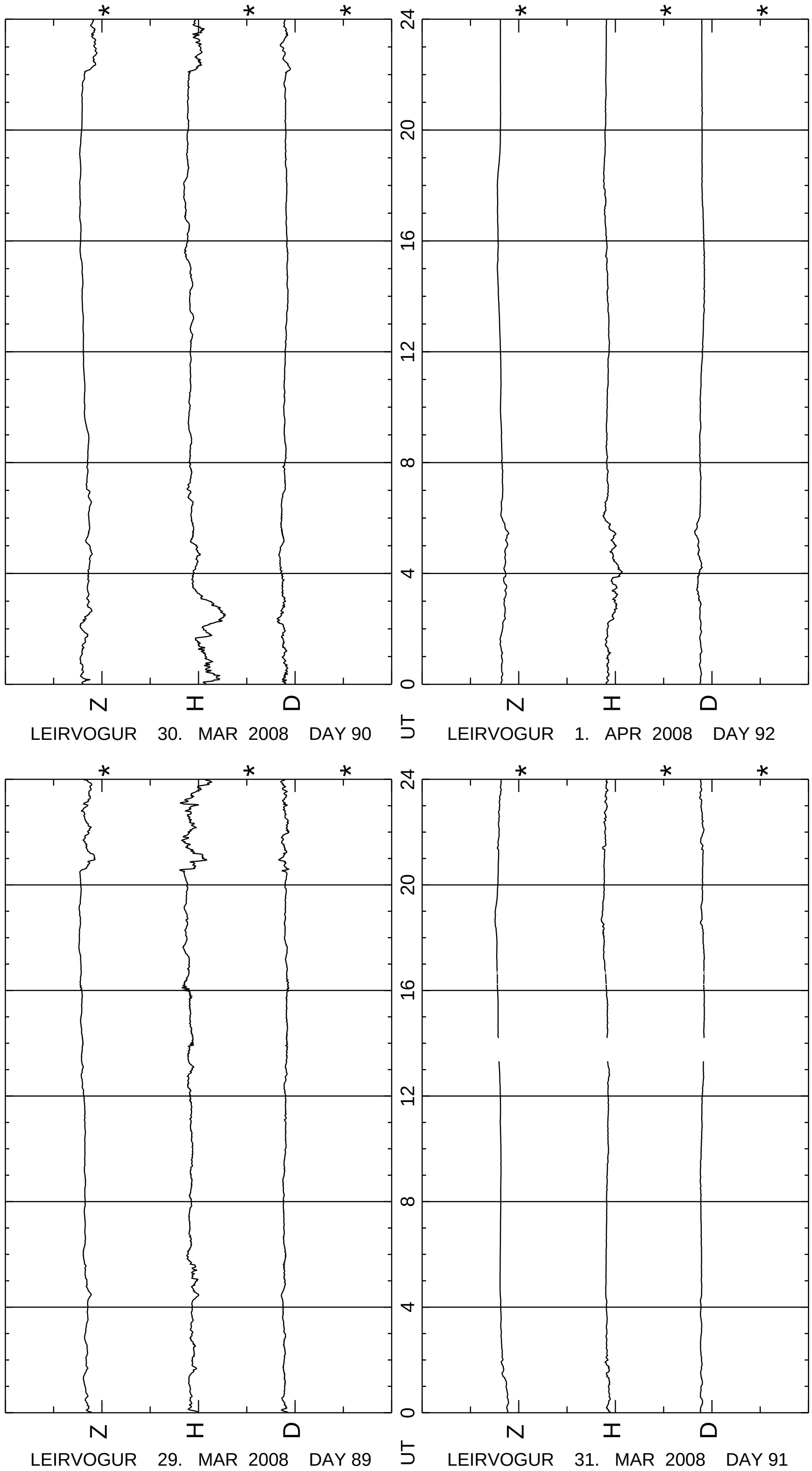
LEIRVOGUR 30. MAR 2008 DAY 90
LEIRVOGUR 1. APR 2008 DAY 92
LEIRVOGUR 29. MAR 2008 DAY 89
LEIRVOGUR 31. MAR 2008 DAY 91
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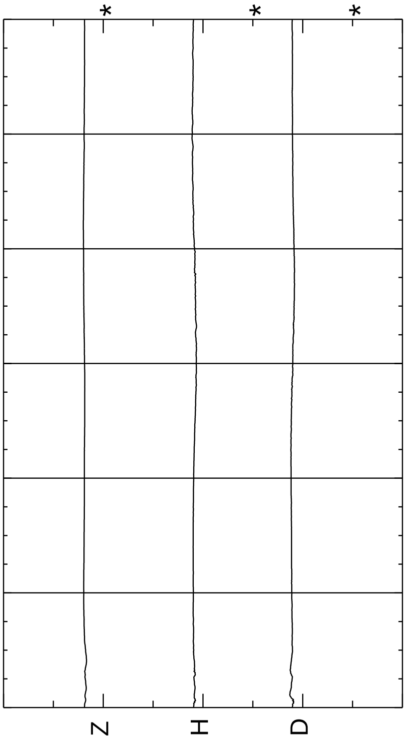
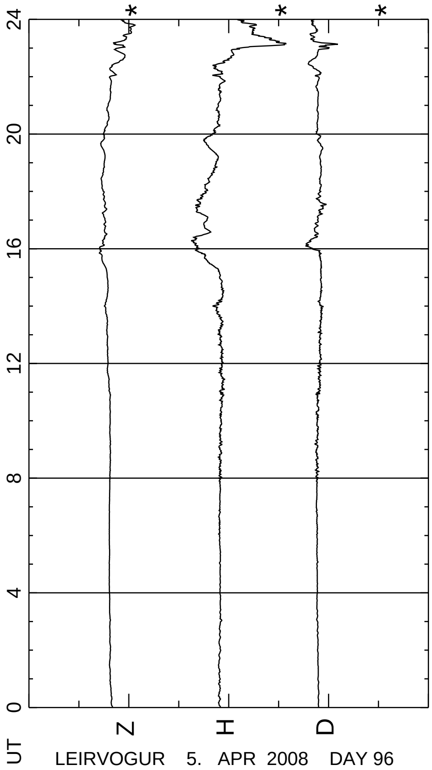
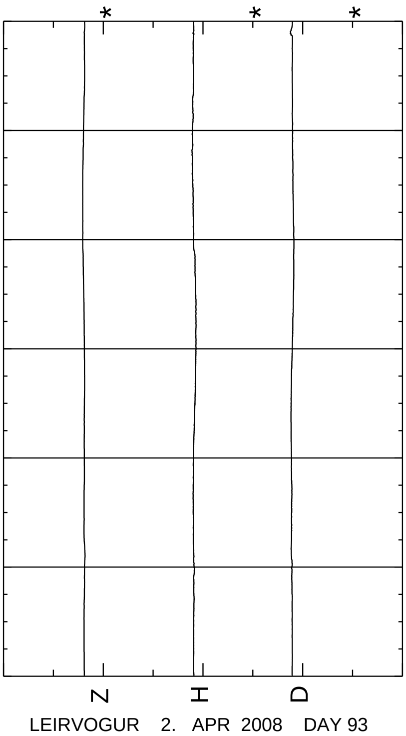


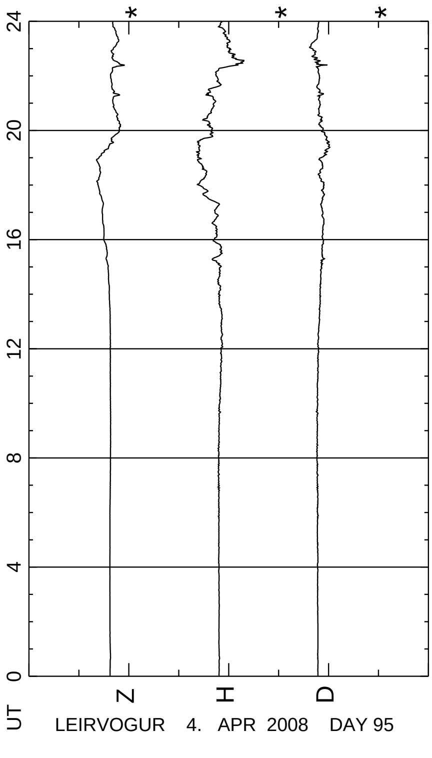
LEIRVOGUR 3. APR 2008 DAY 94



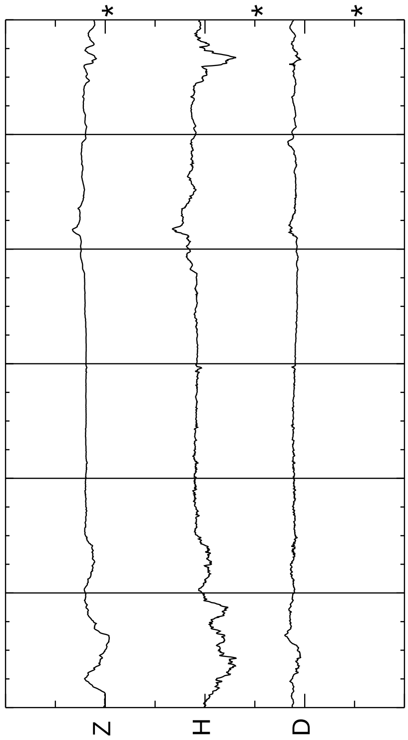
LEIRVOGUR 5. APR 2008 DAY 96



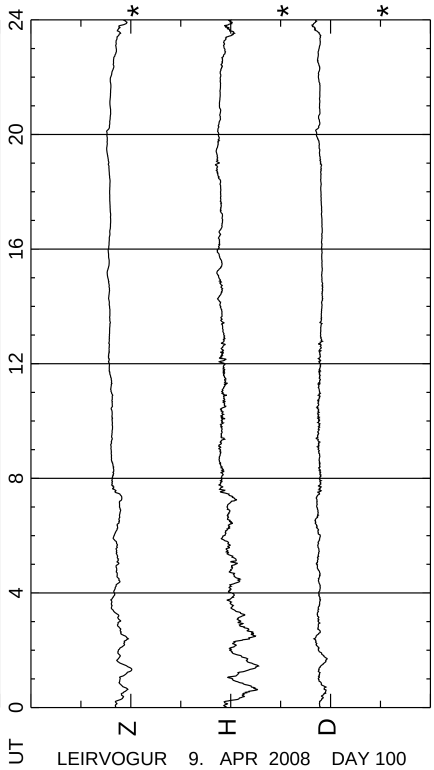
LEIRVOGUR 2. APR 2008 DAY 93



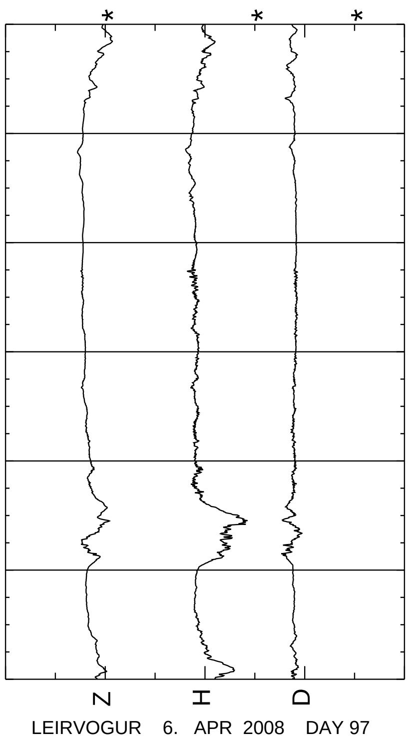
LEIRVOGUR 4. APR 2008 DAY 95



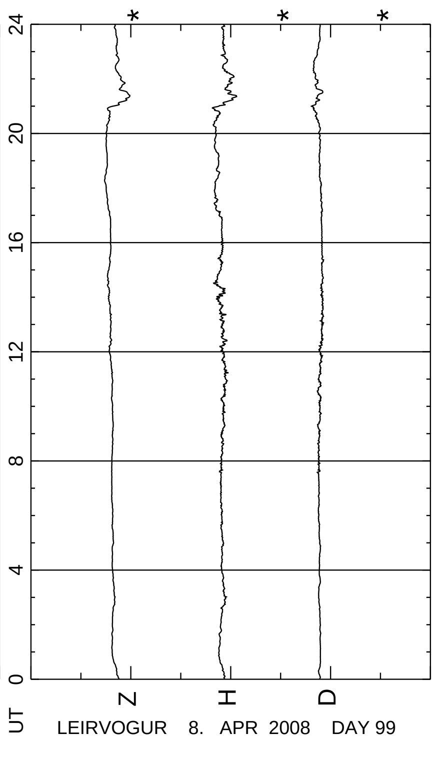
LEIRVOGUR 7. APR 2008 DAY 98



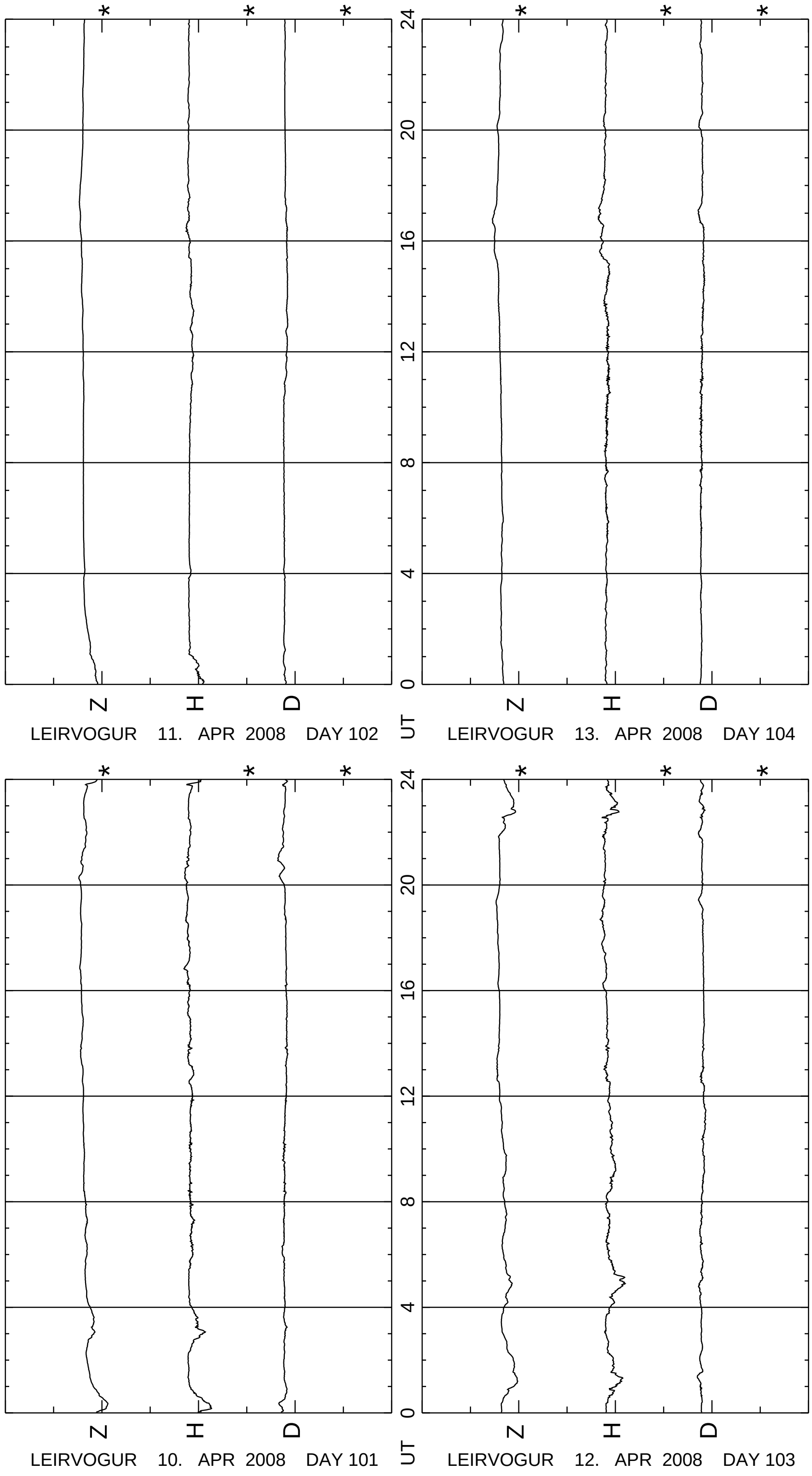
LEIRVOGUR 9. APR 2008 DAY 100



LEIRVOGUR 6. APR 2008 DAY 97



LEIRVOGUR 8. APR 2008 DAY 99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LEIRVOGUR 11. APR 2008 DAY 102
LEIRVOGUR 13. APR 2008 DAY 104
LEIRVOGUR 10. APR 2008 DAY 101
LEIRVOGUR 12. APR 2008 DAY 103
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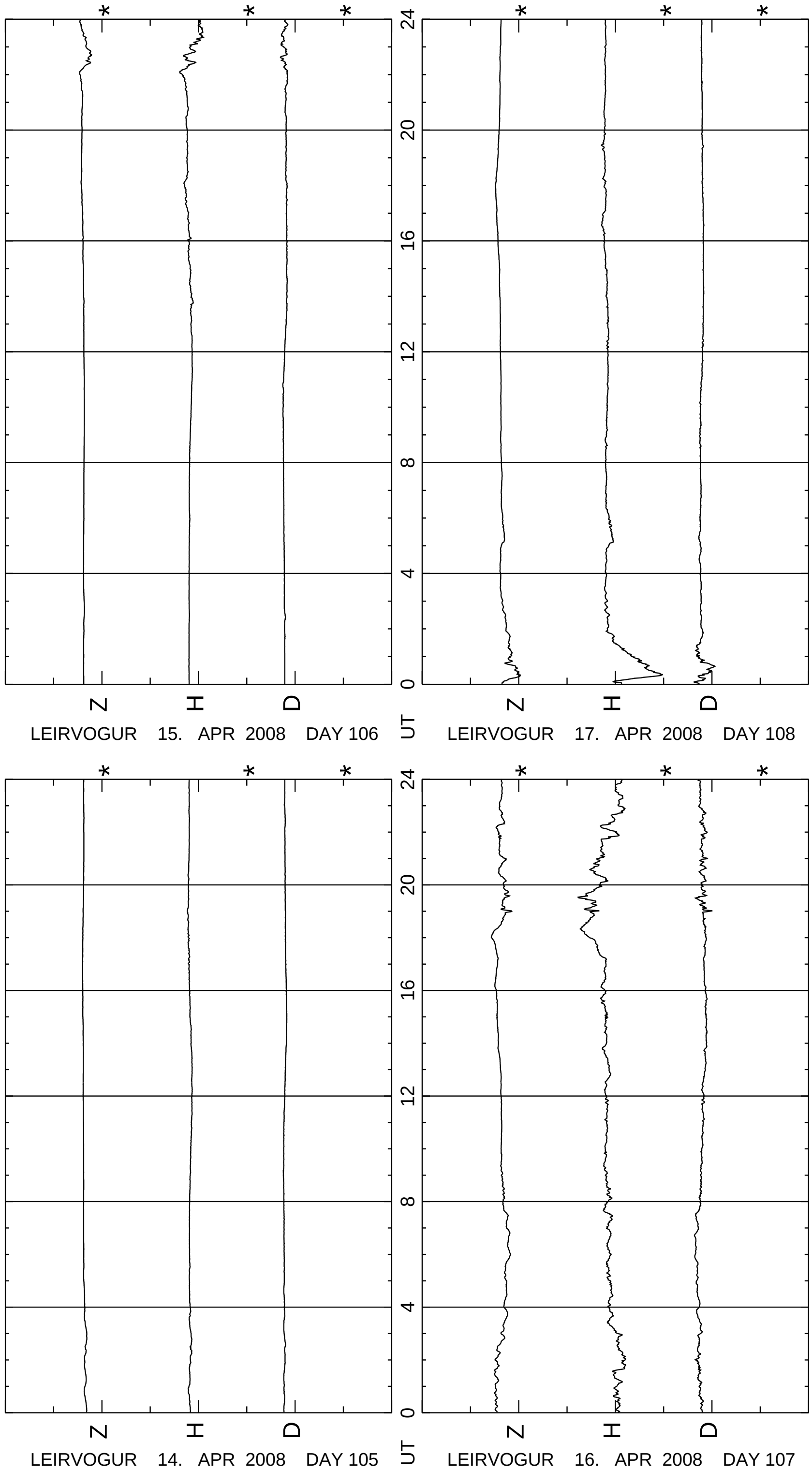
LEIRVOGUR 15. APR 2008 DAY 106
LEIRVOGUR 17. APR 2008 DAY 108
LEIRVOGUR 14. APR 2008 DAY 105
LEIRVOGUR 16. APR 2008 DAY 107
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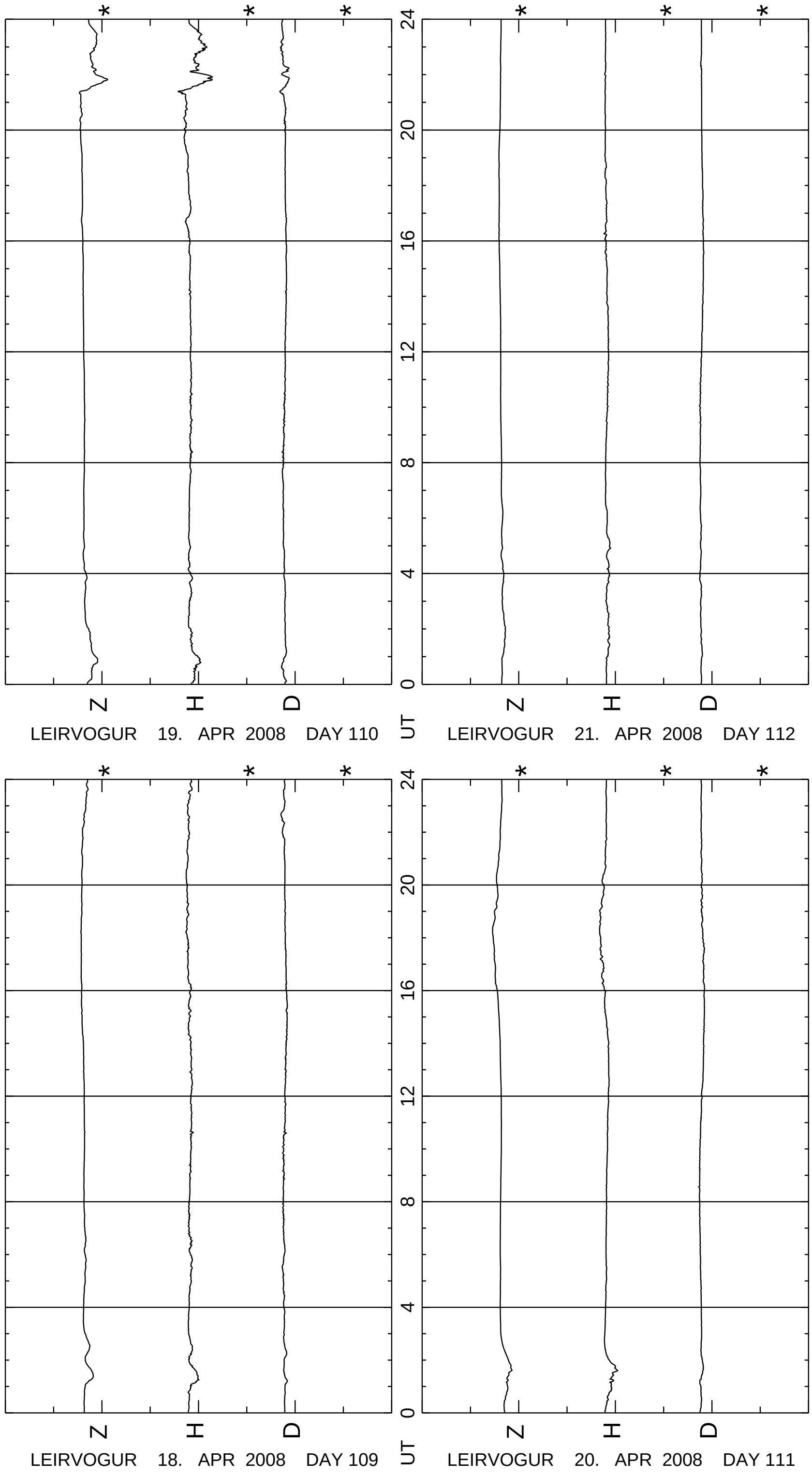
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LEIRVOGUR 19. APR 2008 DAY 110
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LEIRVOGUR 21. APR 2008 DAY 112
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LEIRVOGUR 18. APR 2008 DAY 109
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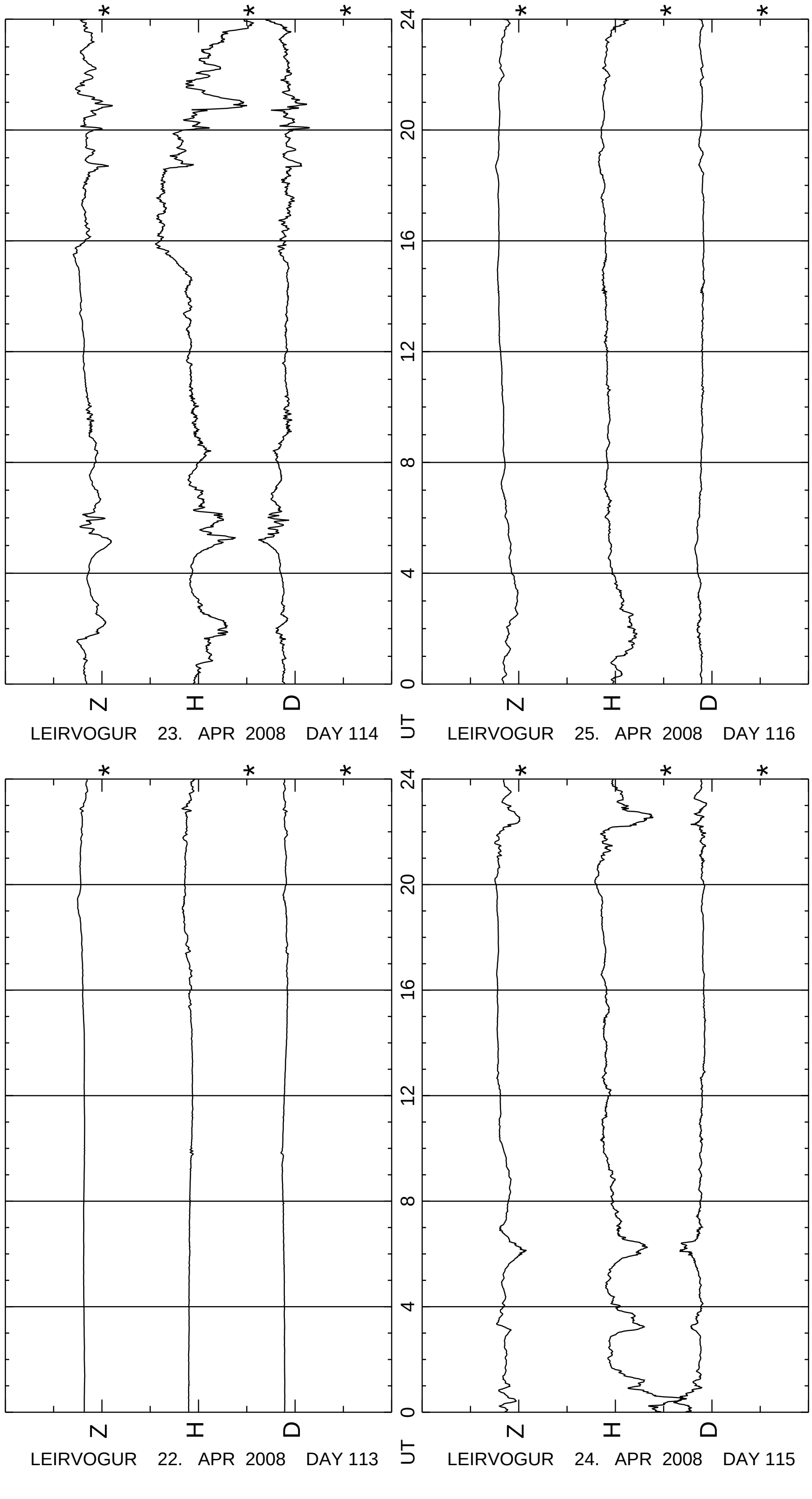
Z H D
LEIRVOGUR 20. APR 2008 DAY 111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LEIRVOGUR 23. APR 2008 DAY 114
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LEIRVOGUR 25. APR 2008 DAY 116
LEIRVOGUR 22. APR 2008 DAY 113
LEIRVOGUR 24. APR 2008 DAY 115
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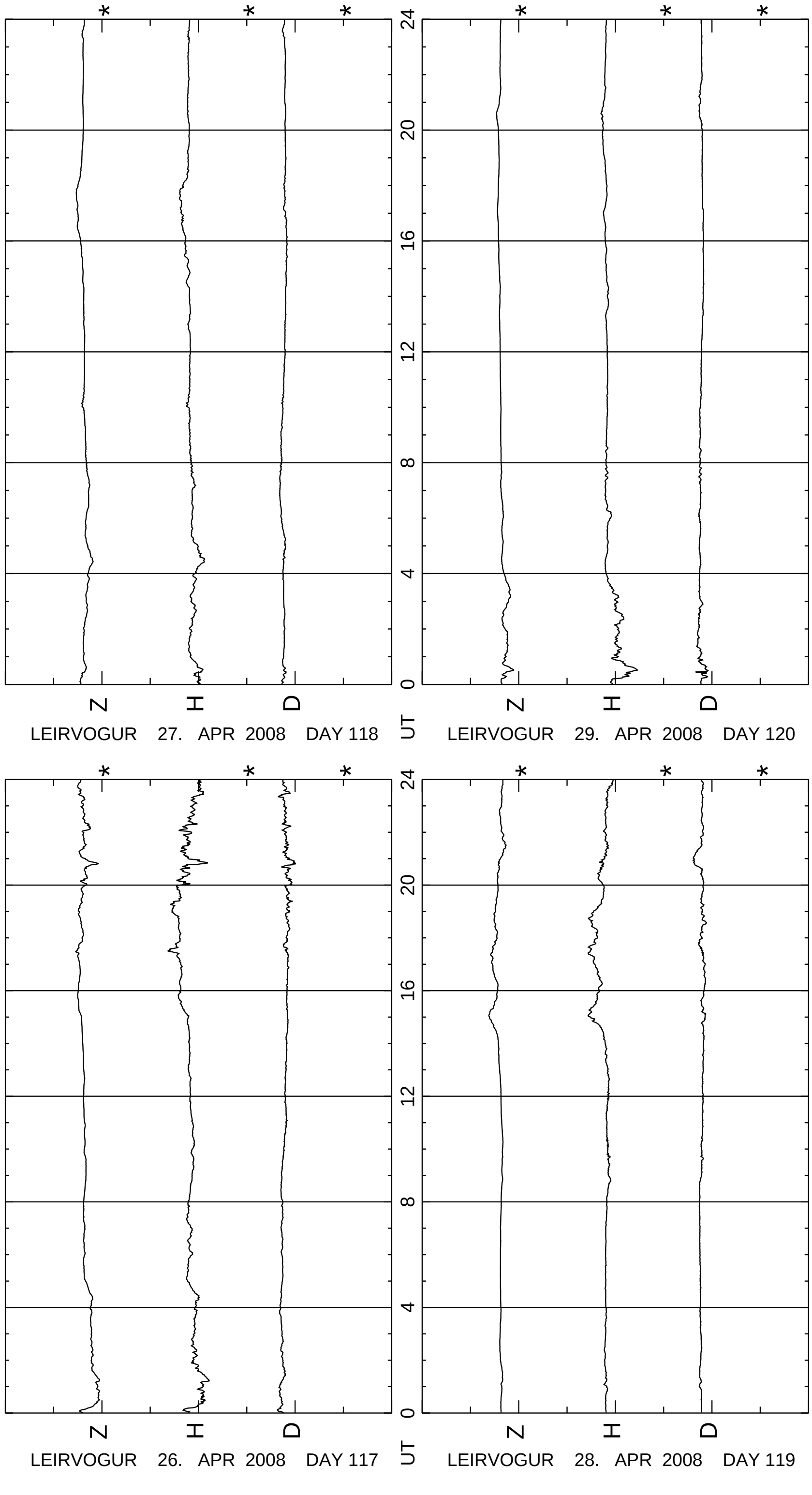
LEIRVOGUR 27. APR 2008 DAY 118
LEIRVOGUR 29. APR 2008 DAY 120
LEIRVOGUR 26. APR 2008 DAY 117
LEIRVOGUR 28. APR 2008 DAY 119
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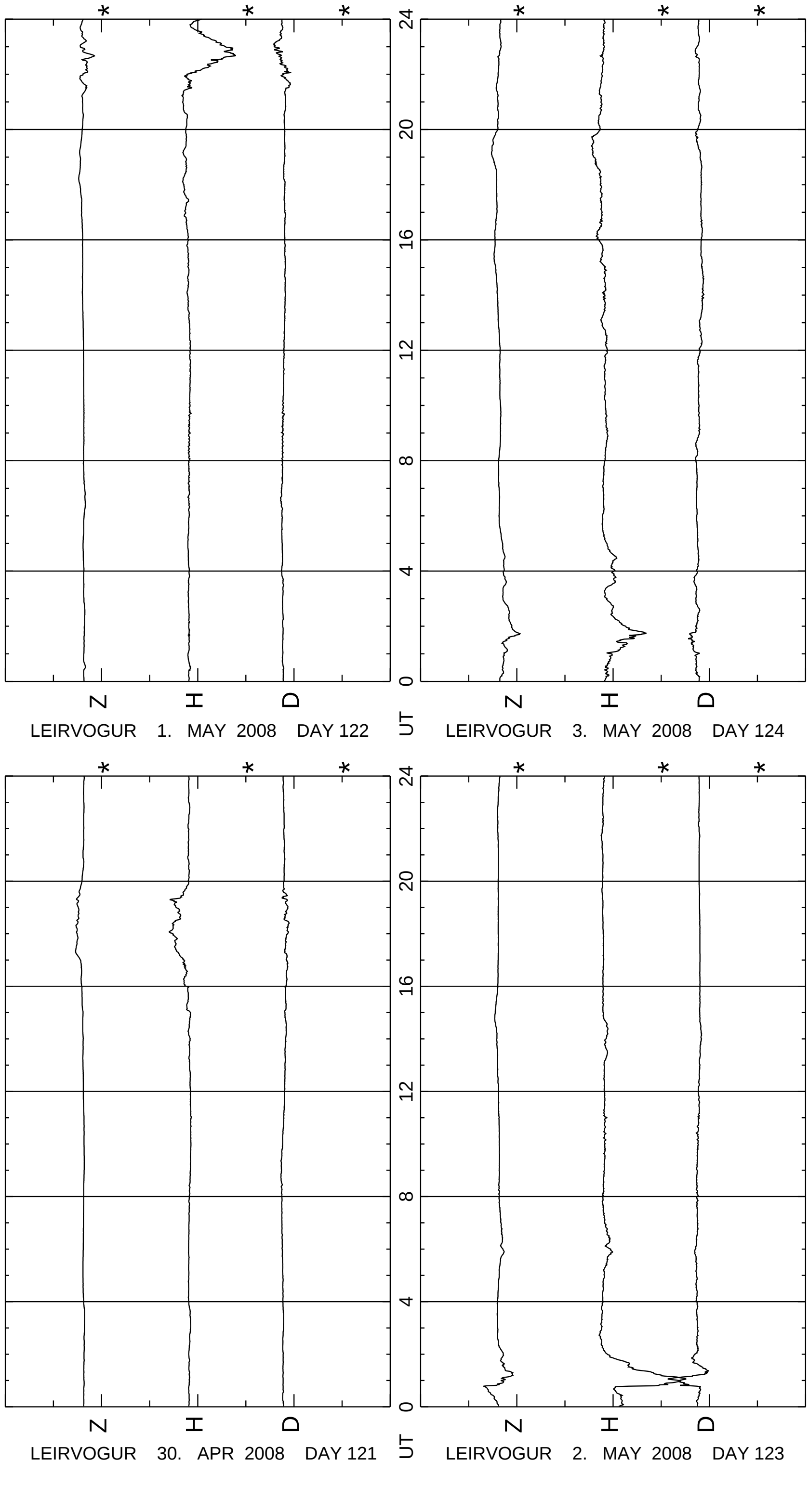
LEIRVOGUR 1. MAY 2008 DAY 122
LEIRVOGUR 3. MAY 2008 DAY 124
LEIRVOGUR 30. APR 2008 DAY 121
LEIRVOGUR 2. MAY 2008 DAY 123
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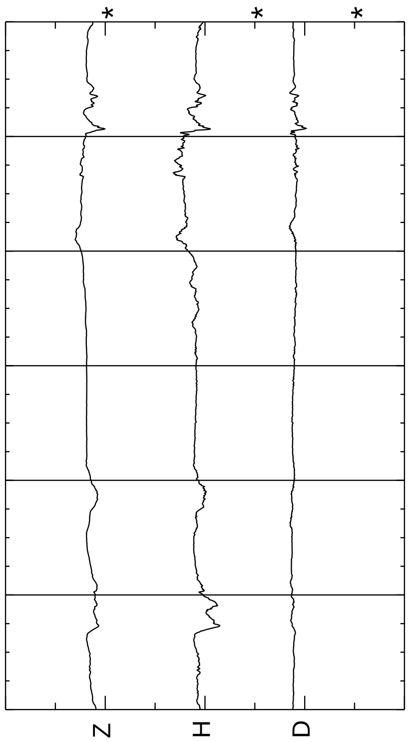
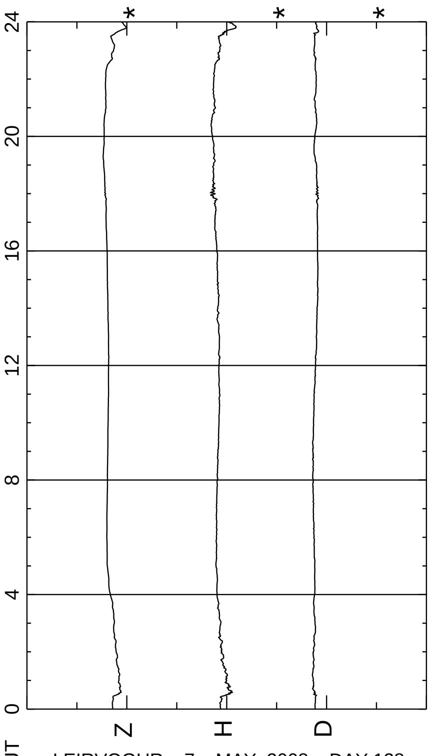
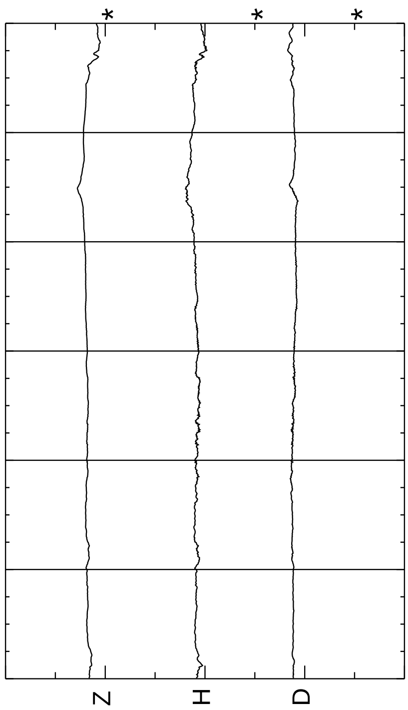


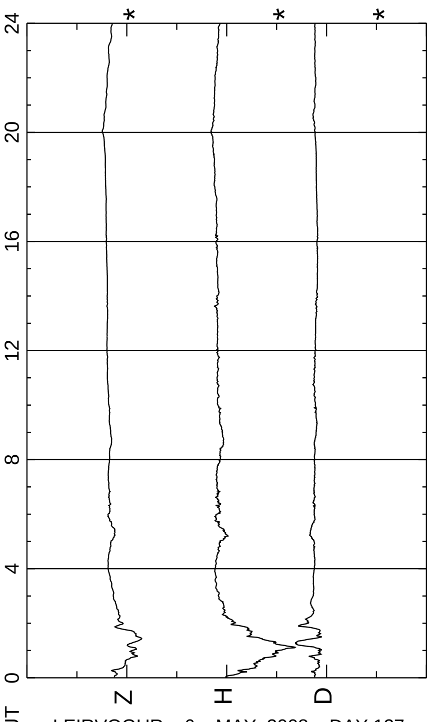
LEIRVOGUR 5. MAY 2008 DAY 126



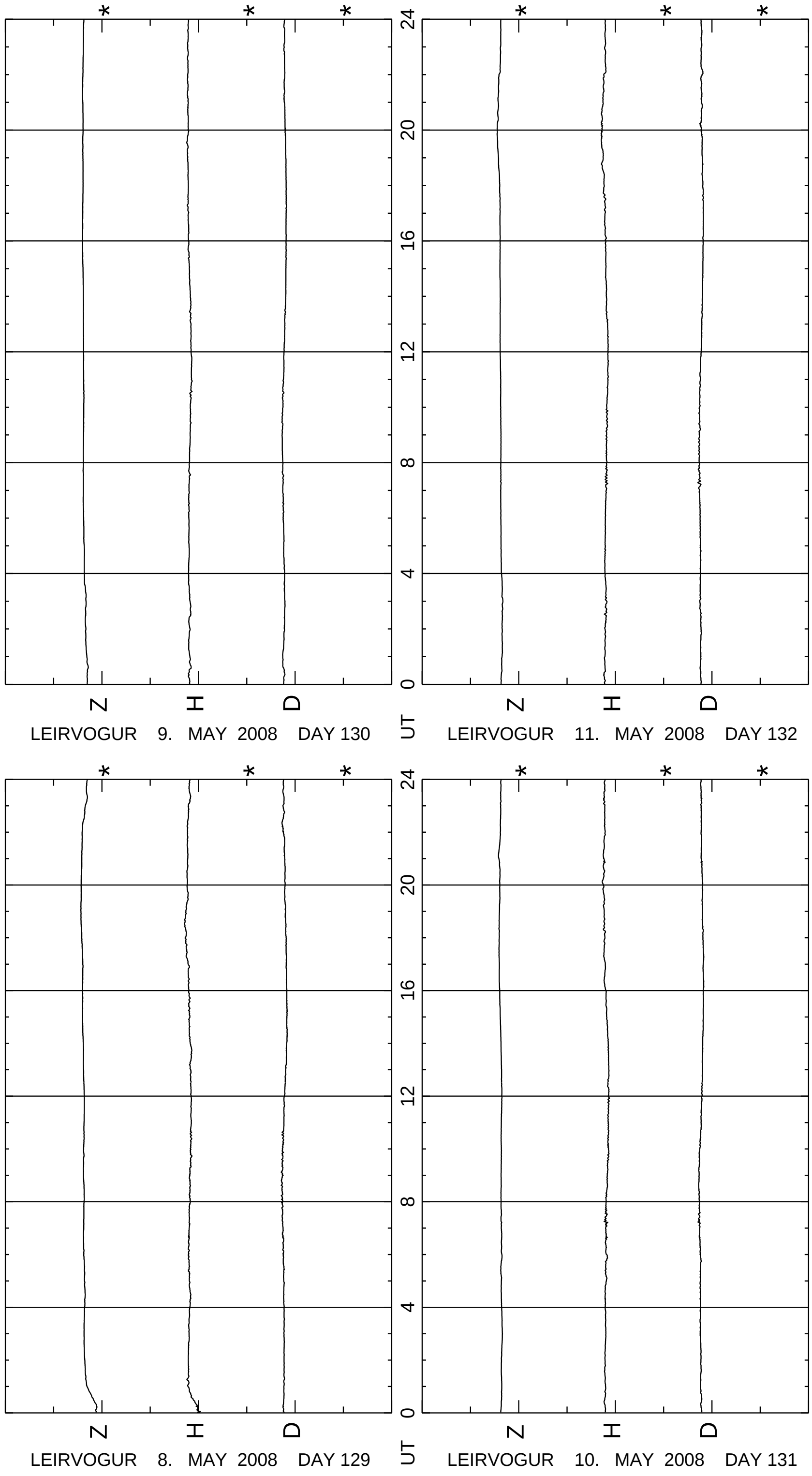
LEIRVOGUR 7. MAY 2008 DAY 128



LEIRVOGUR 4. MAY 2008 DAY 125



LEIRVOGUR 6. MAY 2008 DAY 127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LEIRVOGUR 9. MAY 2008 DAY 130
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LEIRVOGUR 11. MAY 2008 DAY 132
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LEIRVOGUR 8. MAY 2008 DAY 129
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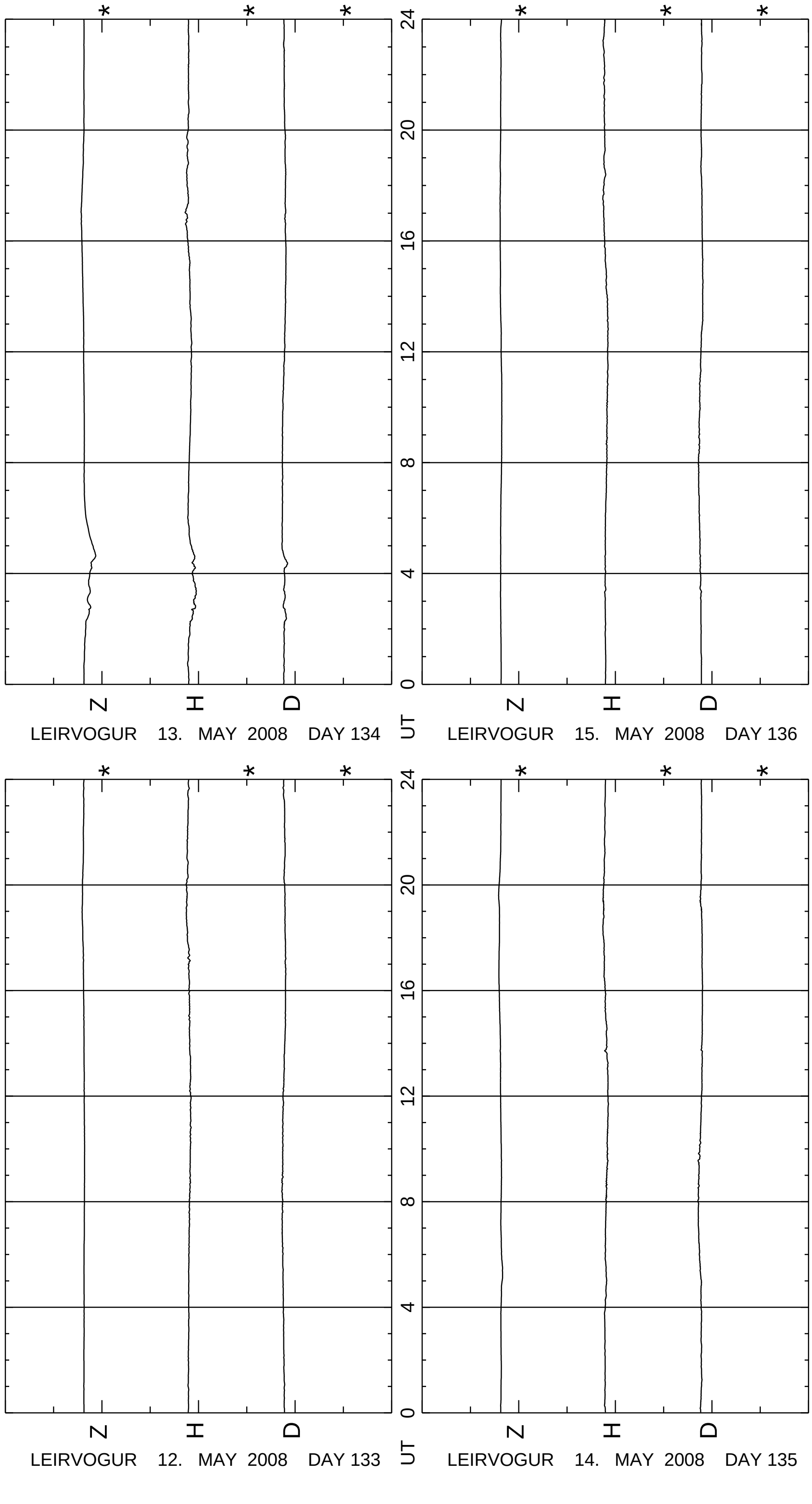
LEIRVOGUR 13. MAY 2008 DAY 134
LEIRVOGUR 15. MAY 2008 DAY 136
LEIRVOGUR 12. MAY 2008 DAY 133
LEIRVOGUR 14. MAY 2008 DAY 135
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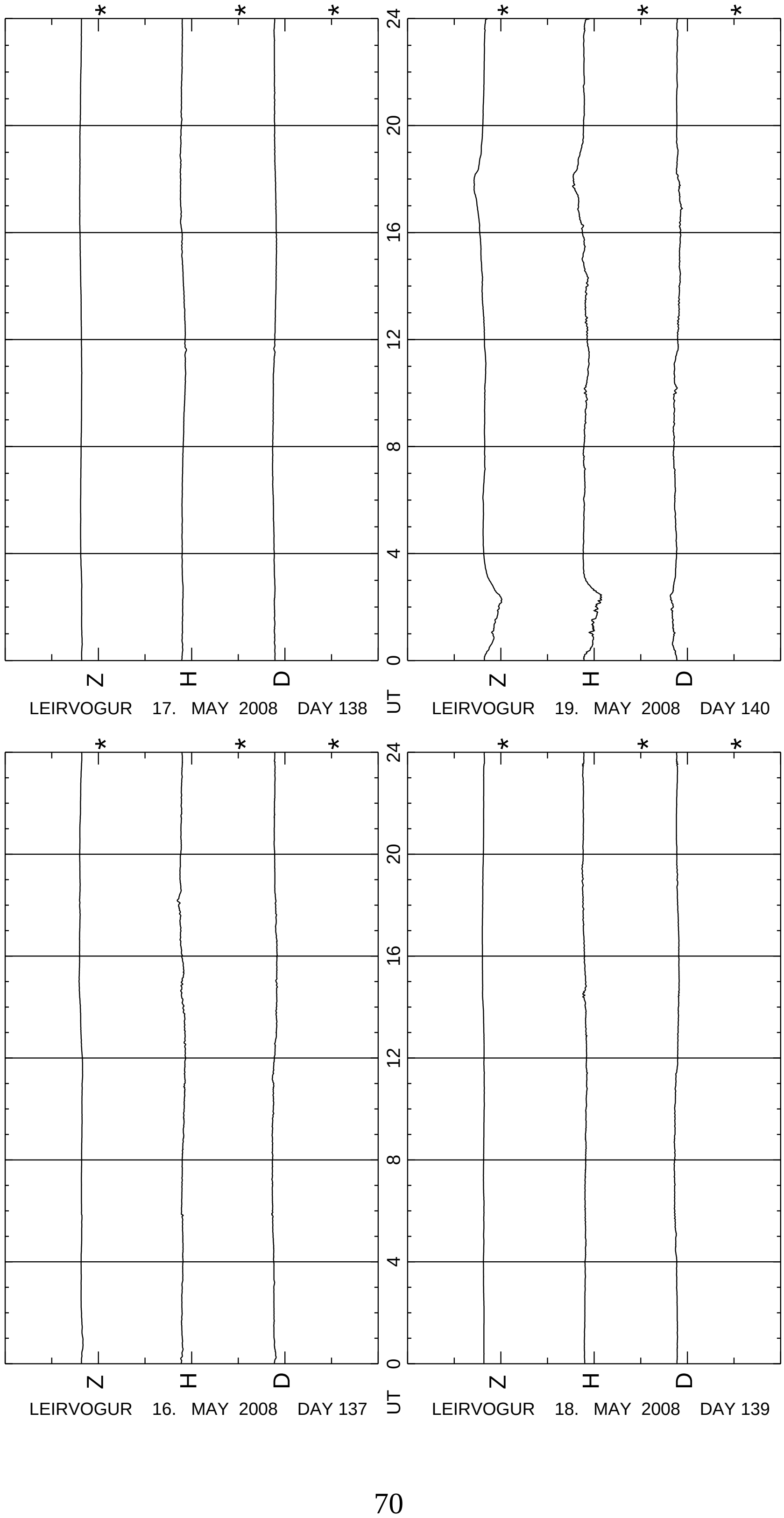
LEIRVOGUR 17. MAY 2008 DAY 138
LEIRVOGUR 19. MAY 2008 DAY 140
LEIRVOGUR 16. MAY 2008 DAY 137
LEIRVOGUR 18. MAY 2008 DAY 139
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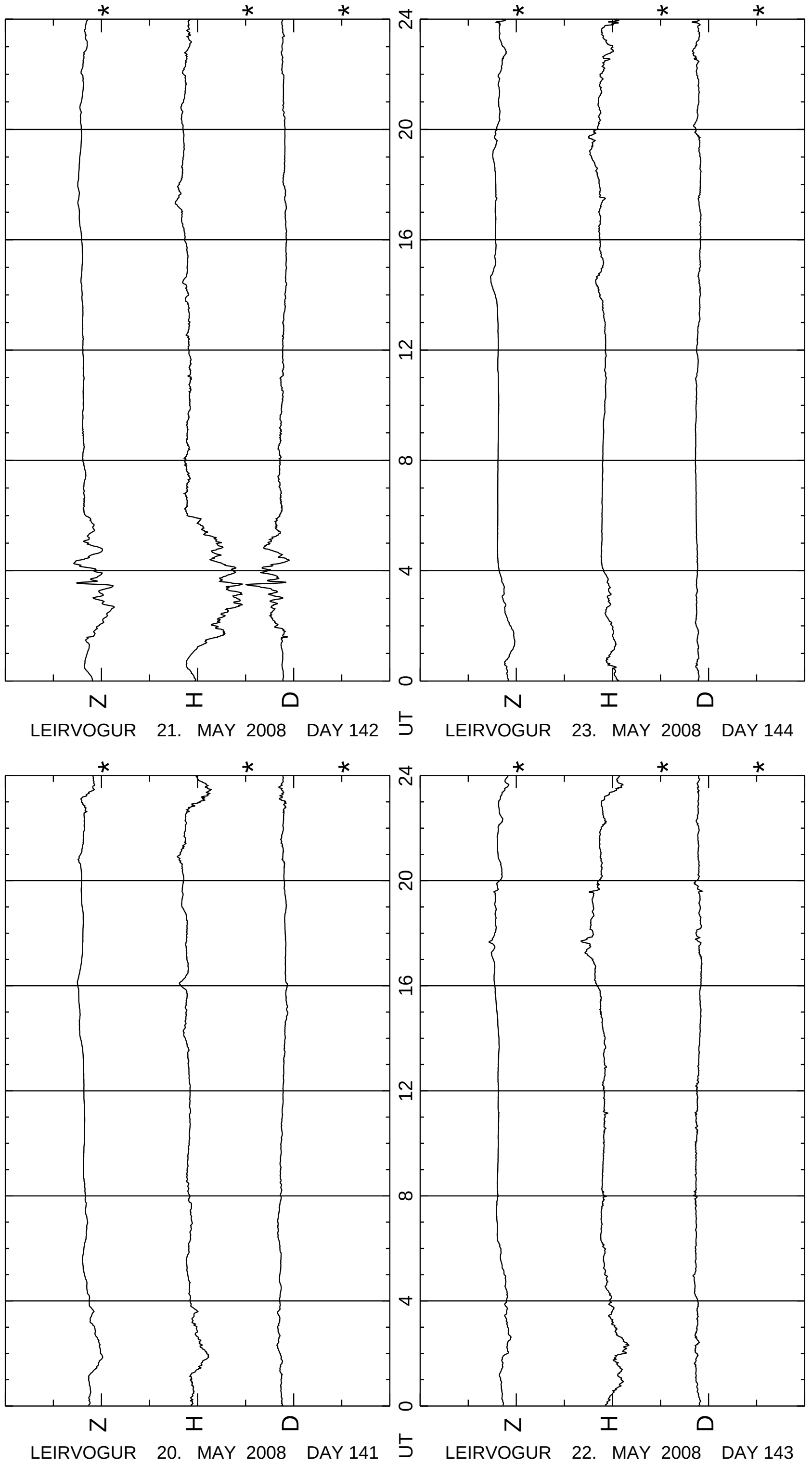
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LEIRVOGUR 21. MAY 2008 DAY 142
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LEIRVOGUR 23. MAY 2008 DAY 144
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LEIRVOGUR 20. MAY 2008 DAY 141
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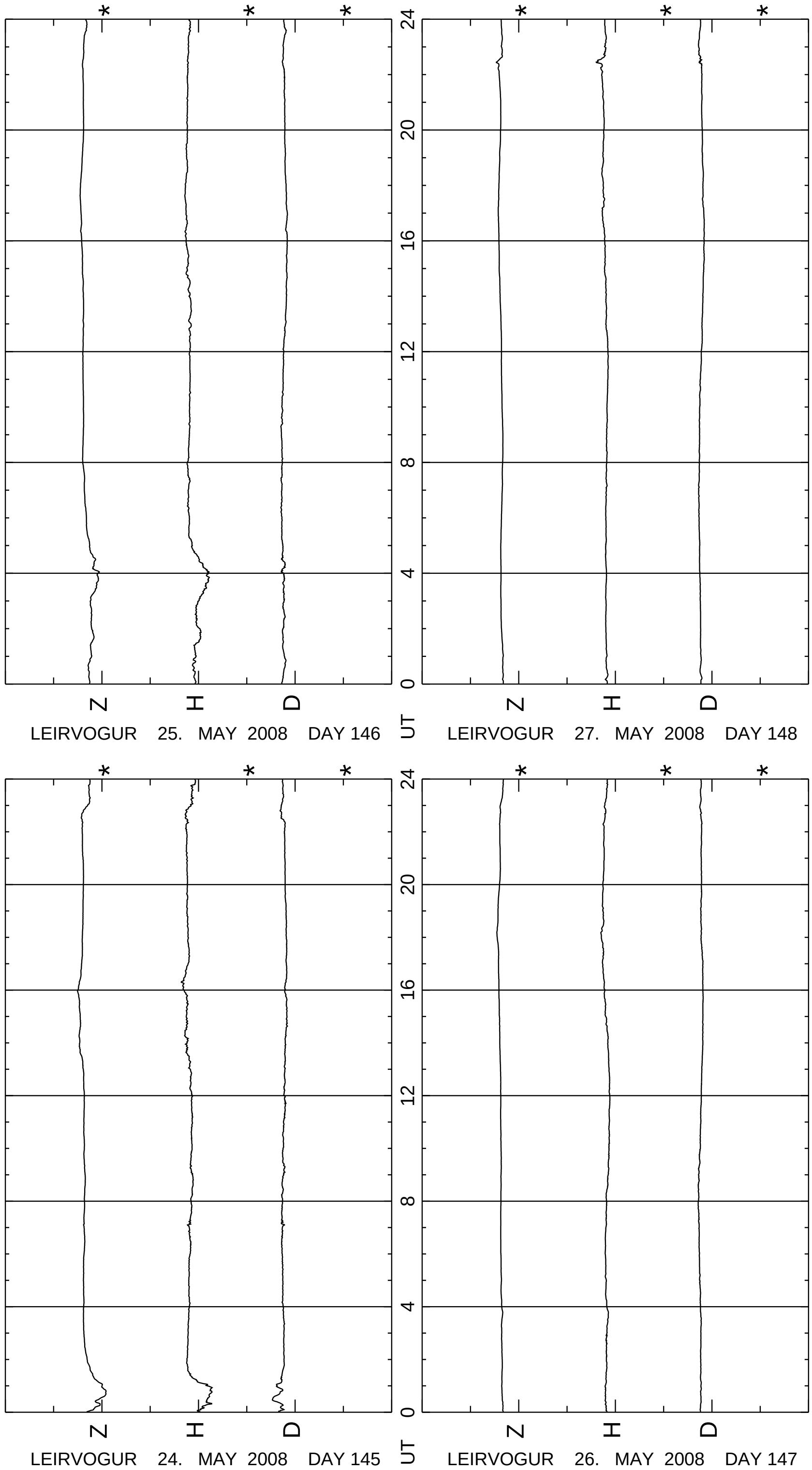
LEIRVOGUR 22. MAY 2008 DAY 143
UT


LEIRVOGUR 25. MAY 2008 DAY 146
LEIRVOGUR 27. MAY 2008 DAY 148
LEIRVOGUR 24. MAY 2008 DAY 145
LEIRVOGUR 26. MAY 2008 DAY 147
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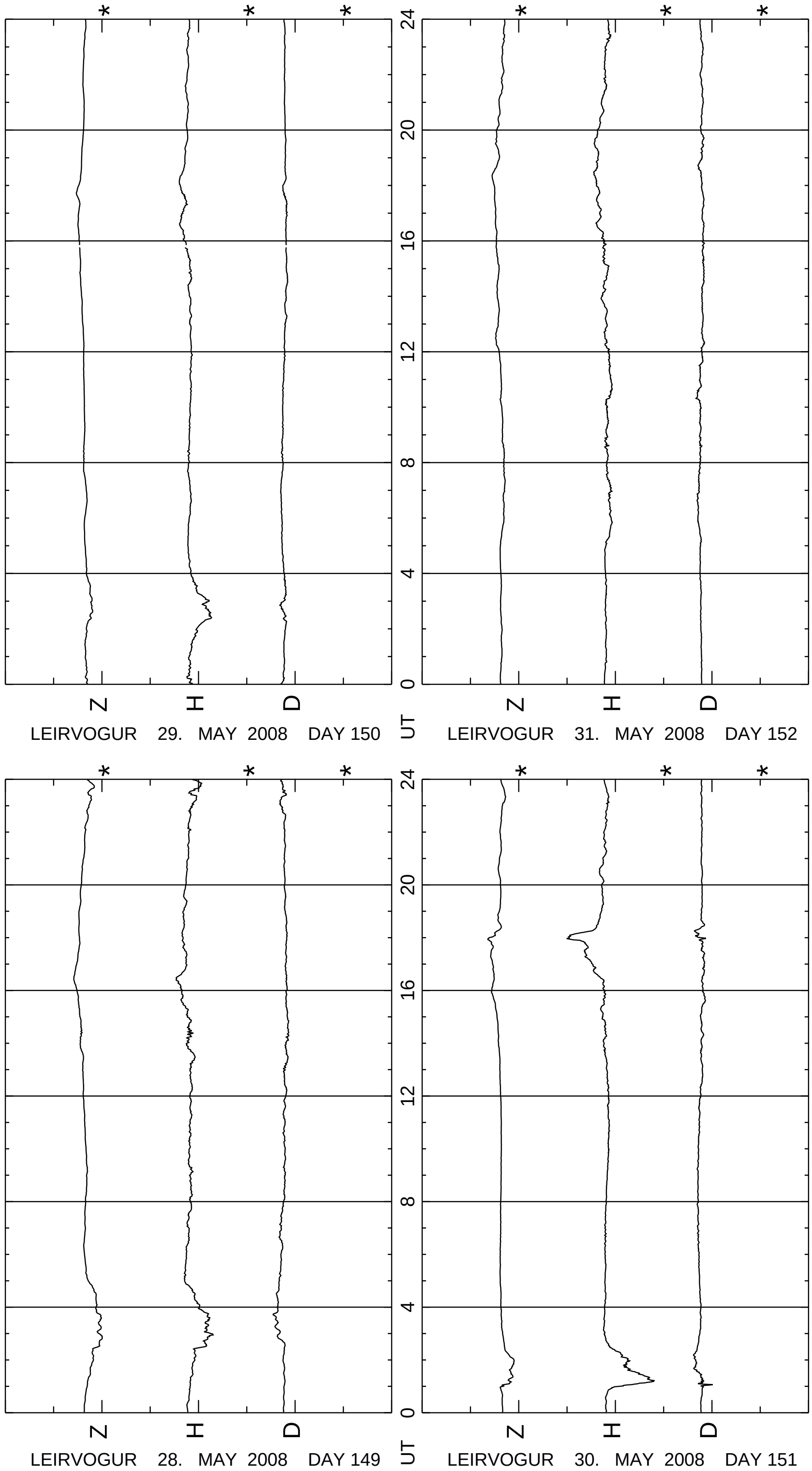
LEIRVOGUR 29. MAY 2008 DAY 150
LEIRVOGUR 31. MAY 2008 DAY 152
LEIRVOGUR 28. MAY 2008 DAY 149
LEIRVOGUR 30. MAY 2008 DAY 151
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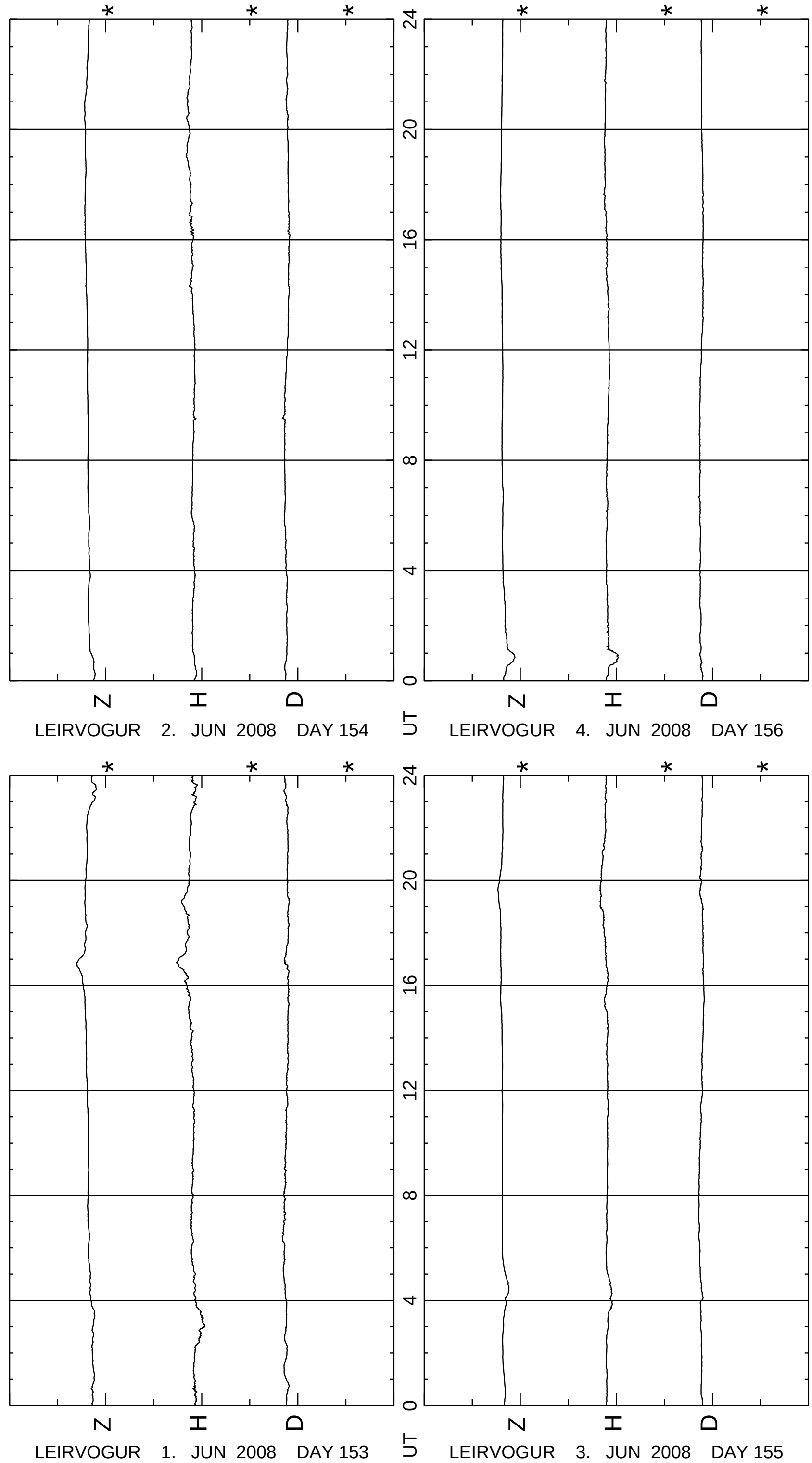
LEIRVOGUR 2. JUN 2008 DAY 154
LEIRVOGUR 4. JUN 2008 DAY 156
LEIRVOGUR 1. JUN 2008 DAY 153
LEIRVOGUR 3. JUN 2008 DAY 155
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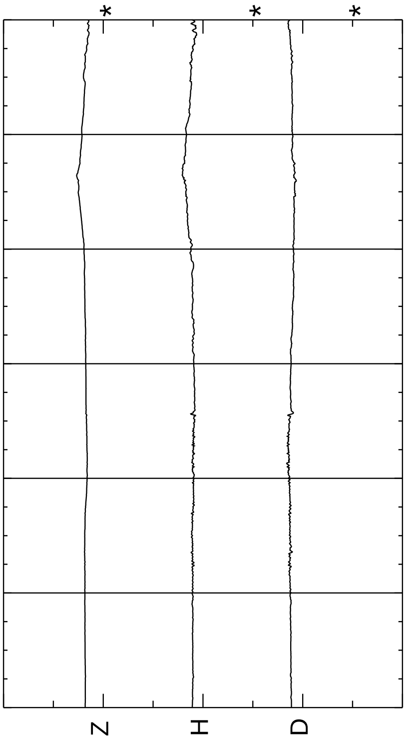
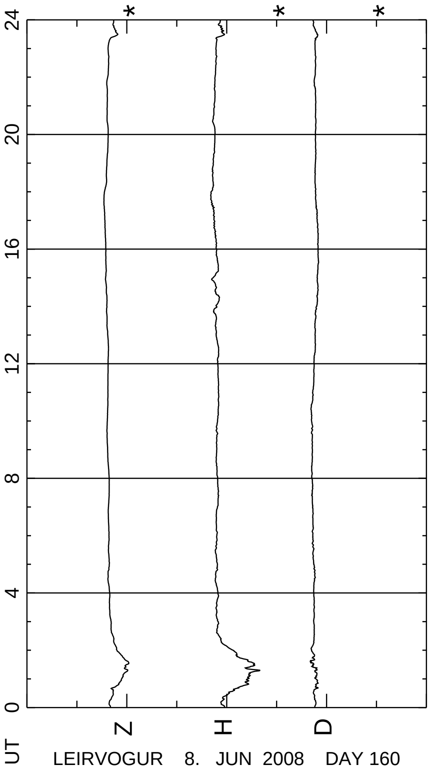
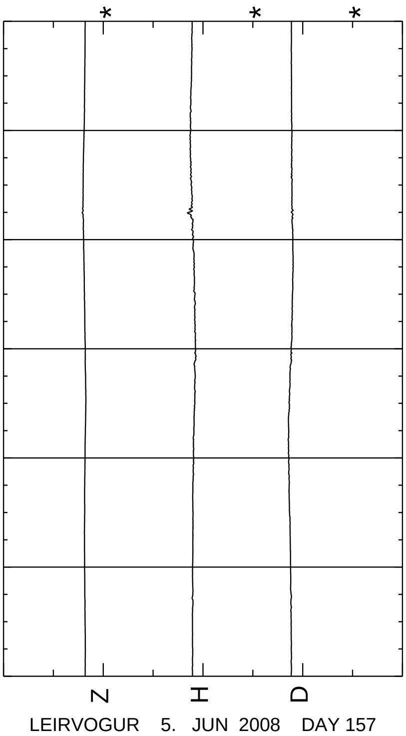


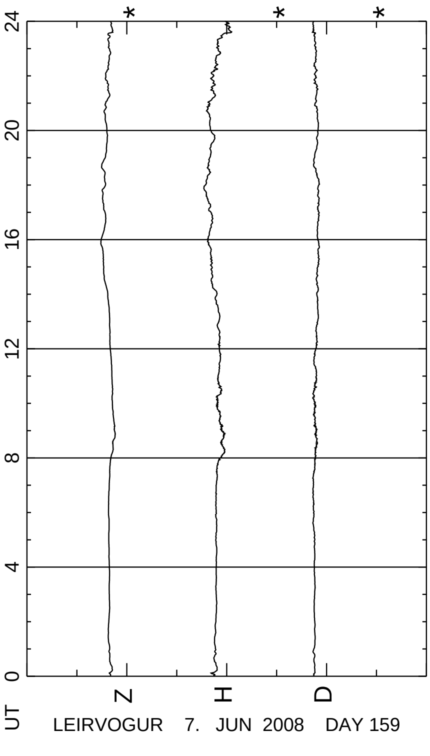
LEIRVOGUR 6. JUN 2008 DAY 158



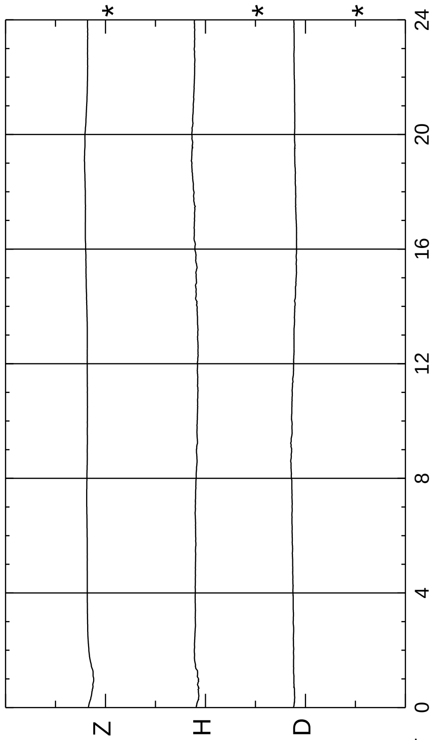
LEIRVOGUR 8. JUN 2008 DAY 160



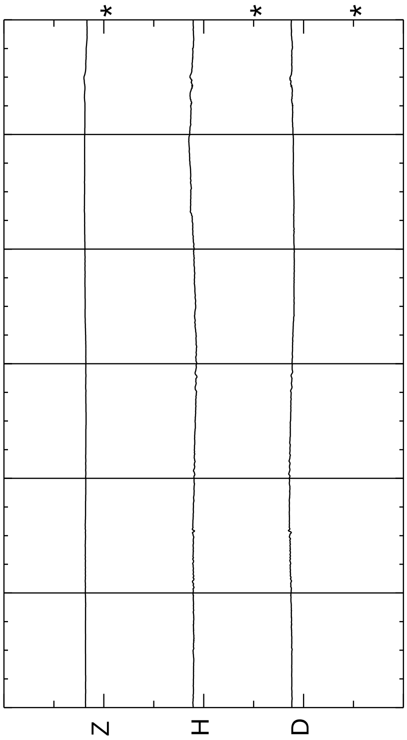
LEIRVOGUR 5. JUN 2008 DAY 157



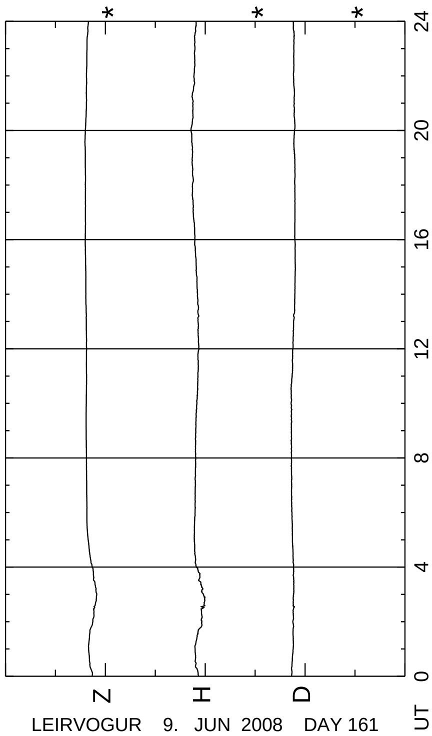
LEIRVOGUR 7. JUN 2008 DAY 159



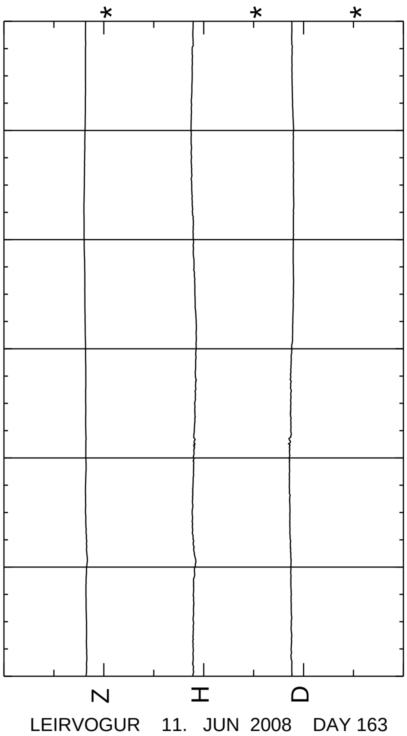
LEIRVOGUR 10. JUN 2008 DAY 162



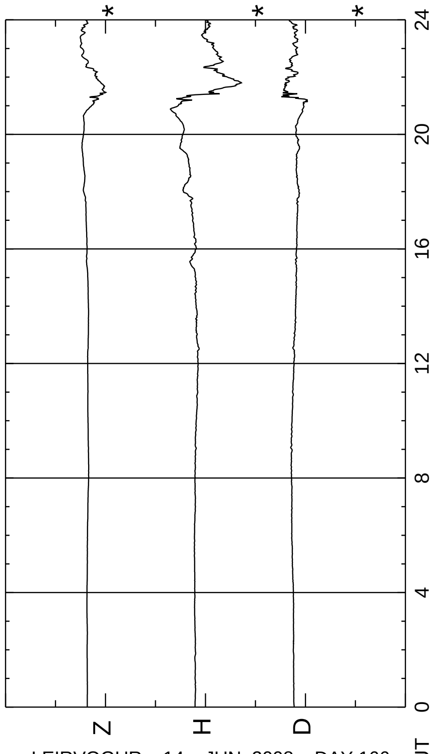
LEIRVOGUR 12. JUN 2008 DAY 164



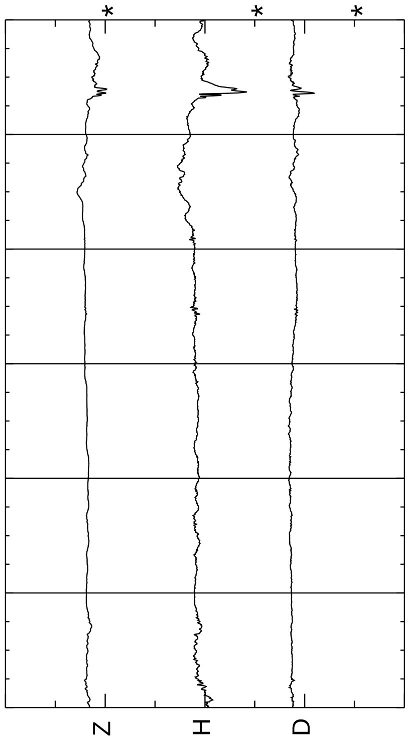
LEIRVOGUR 9. JUN 2008 DAY 161



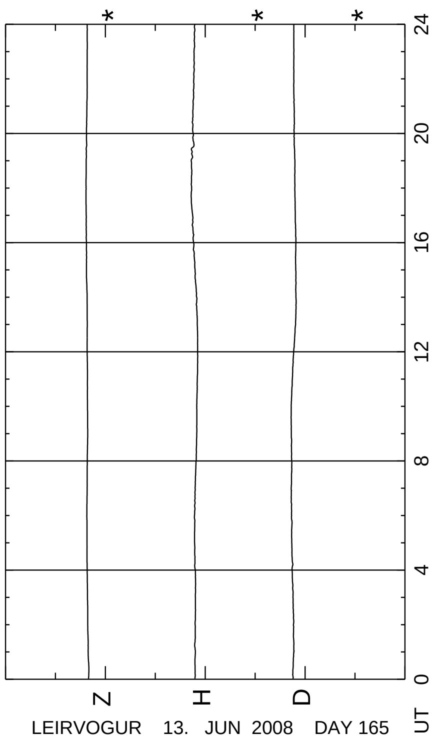
LEIRVOGUR 11. JUN 2008 DAY 163



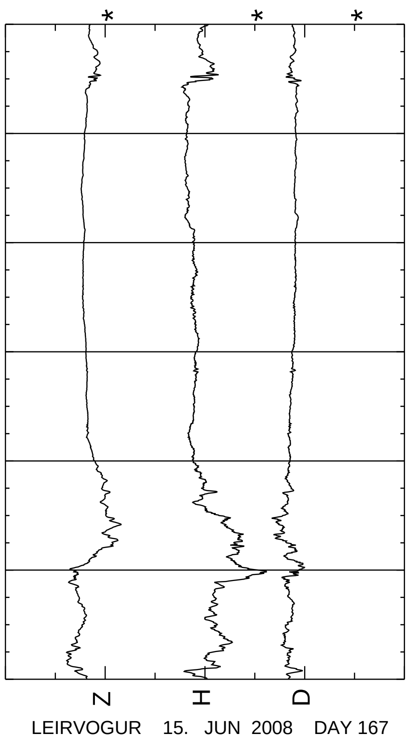
LEIRVOGUR 14. JUN 2008 DAY 166



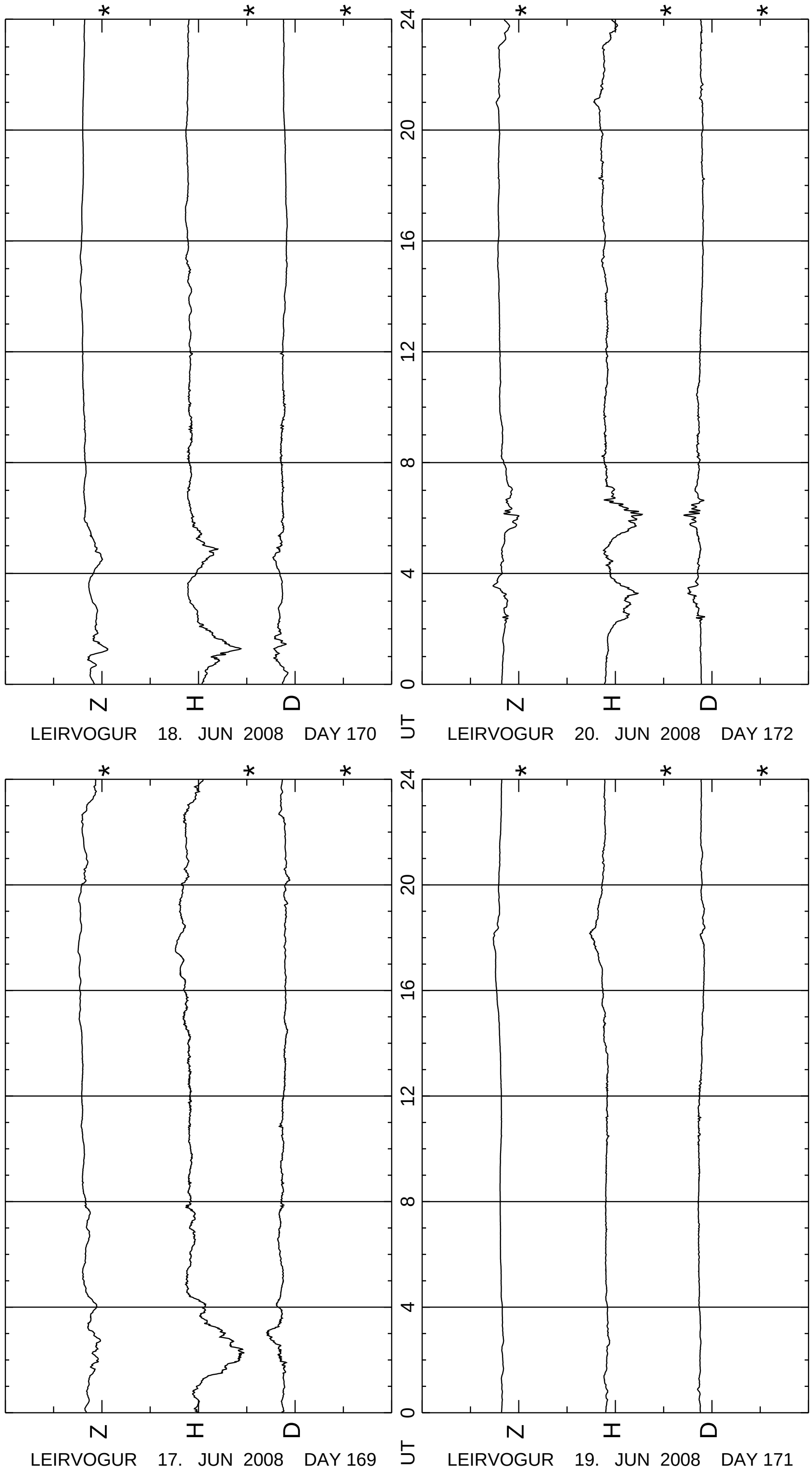
LEIRVOGUR 16. JUN 2008 DAY 168



LEIRVOGUR 13. JUN 2008 DAY 165



LEIRVOGUR 15. JUN 2008 DAY 167


LEIRVOGUR 18. JUN 2008 DAY 170
LEIRVOGUR 20. JUN 2008 DAY 172
LEIRVOGUR 17. JUN 2008 DAY 169
LEIRVOGUR 19. JUN 2008 DAY 171
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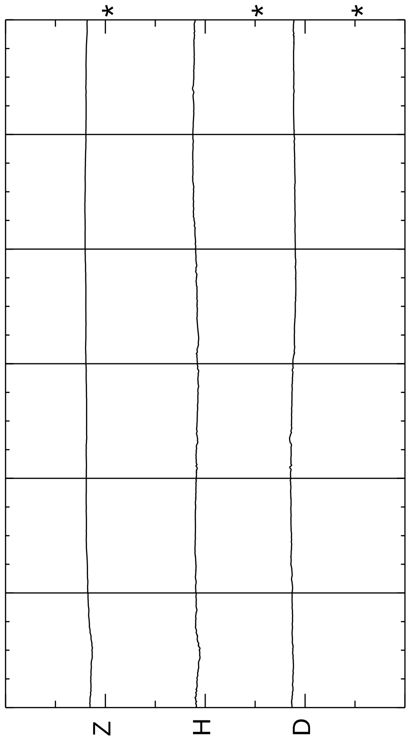
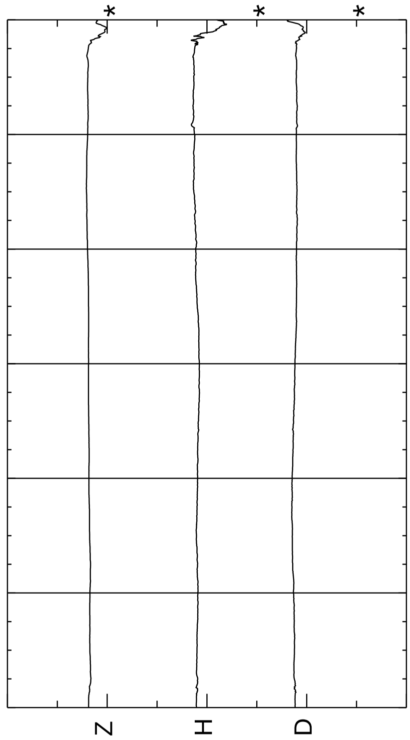
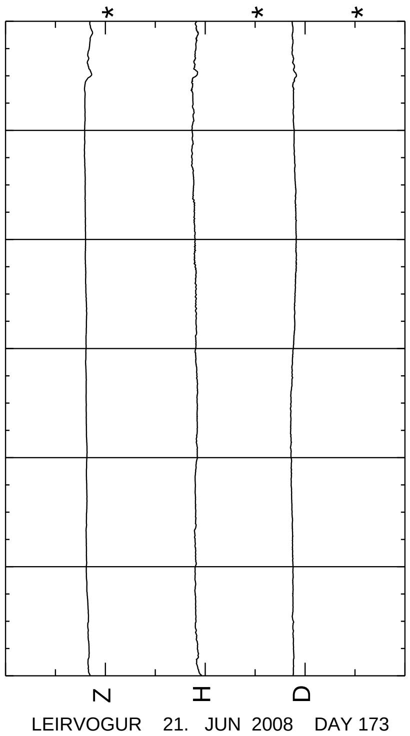


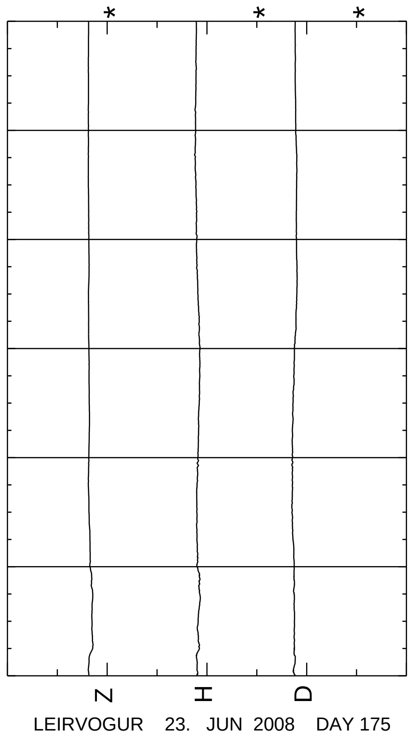
LEIRVOGUR 22. JUN 2008 DAY 174



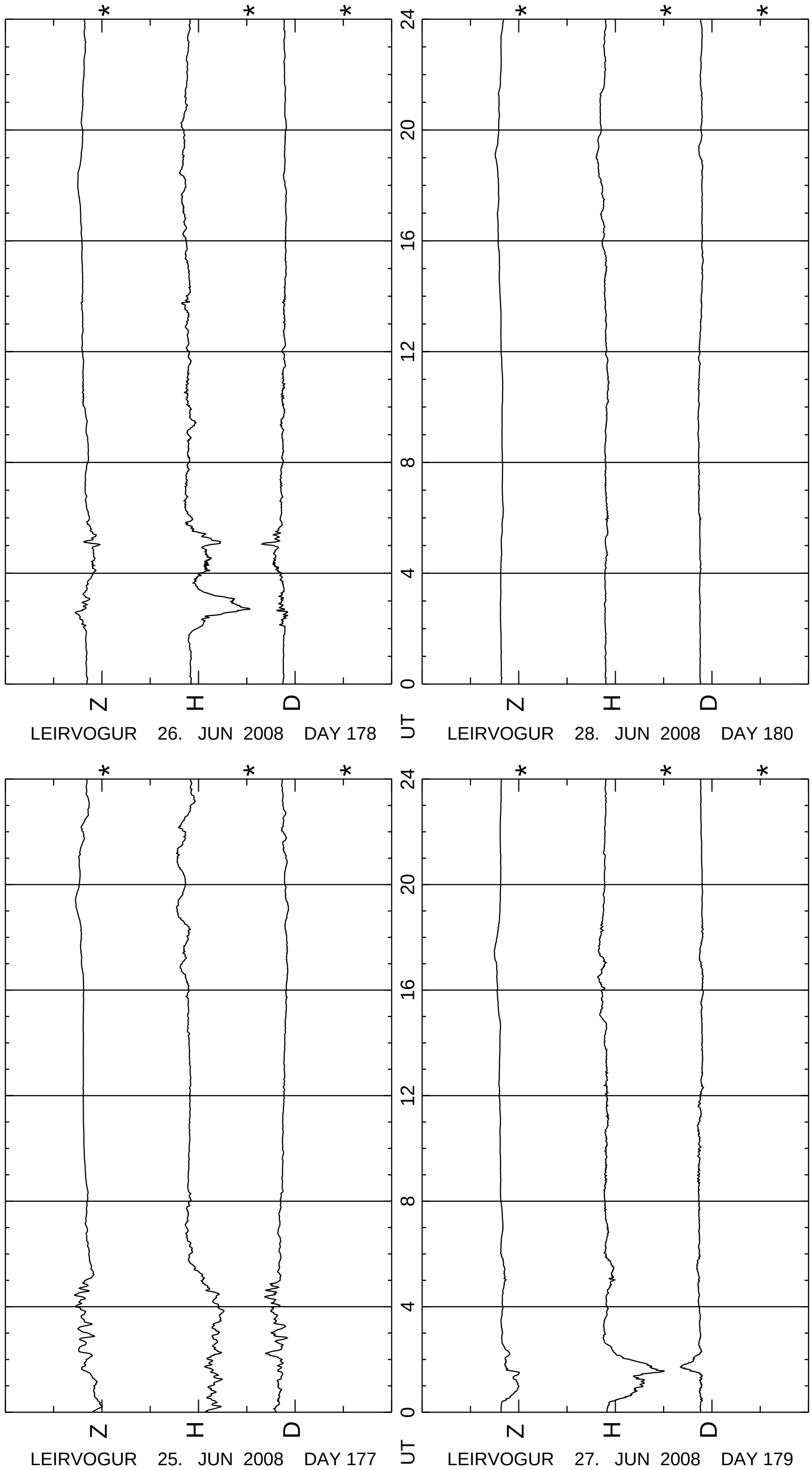
LEIRVOGUR 24. JUN 2008 DAY 176



LEIRVOGUR 21. JUN 2008 DAY 173



LEIRVOGUR 23. JUN 2008 DAY 175


LEIRVOGUR 26. JUN 2008 DAY 178
LEIRVOGUR 28. JUN 2008 DAY 180
LEIRVOGUR 25. JUN 2008 DAY 177
LEIRVOGUR 27. JUN 2008 DAY 179
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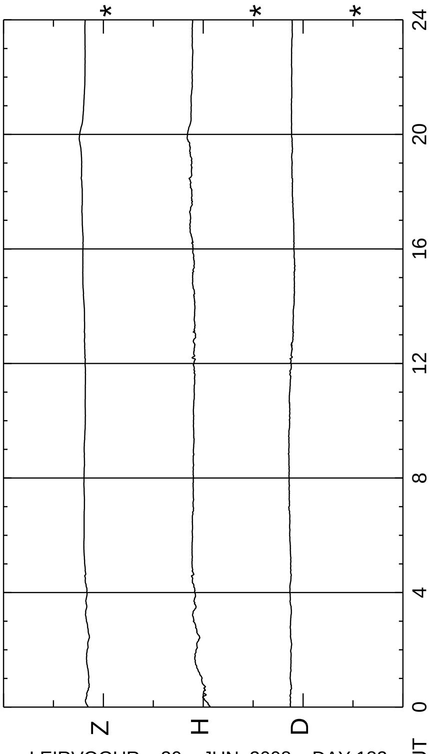
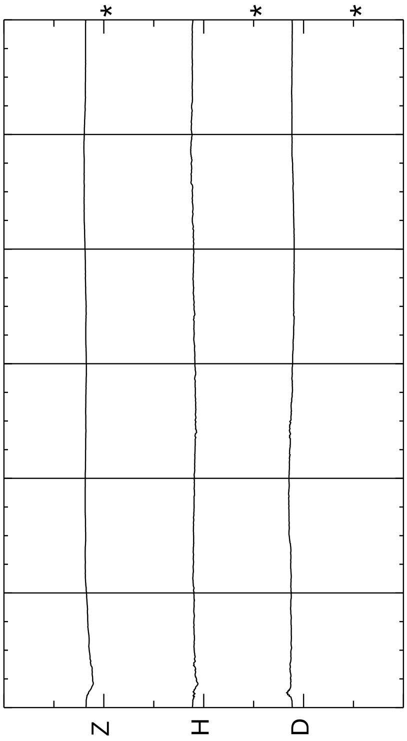
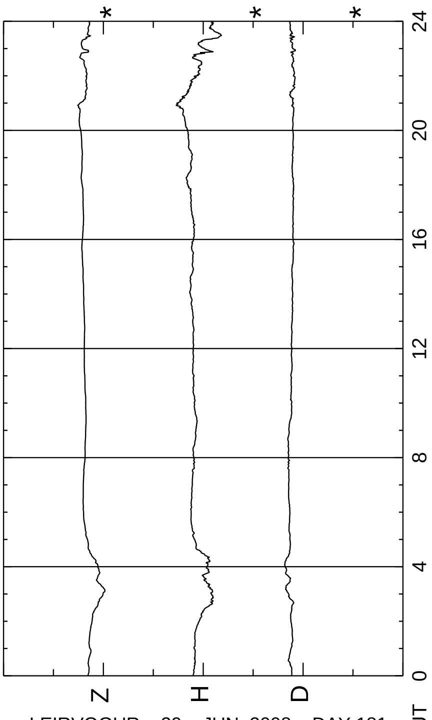


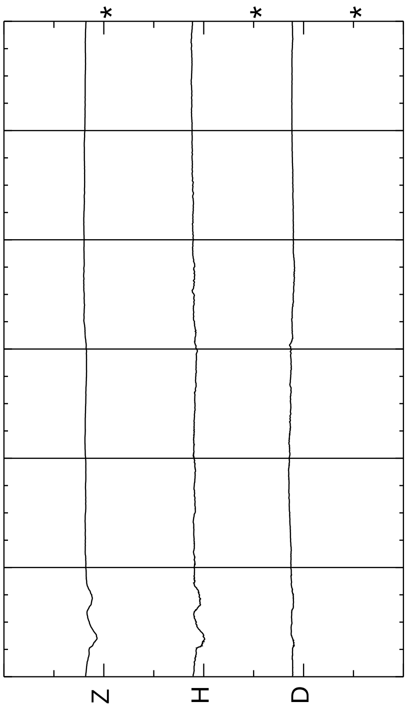
LEIRVOGUR 30. JUN 2008 DAY 182



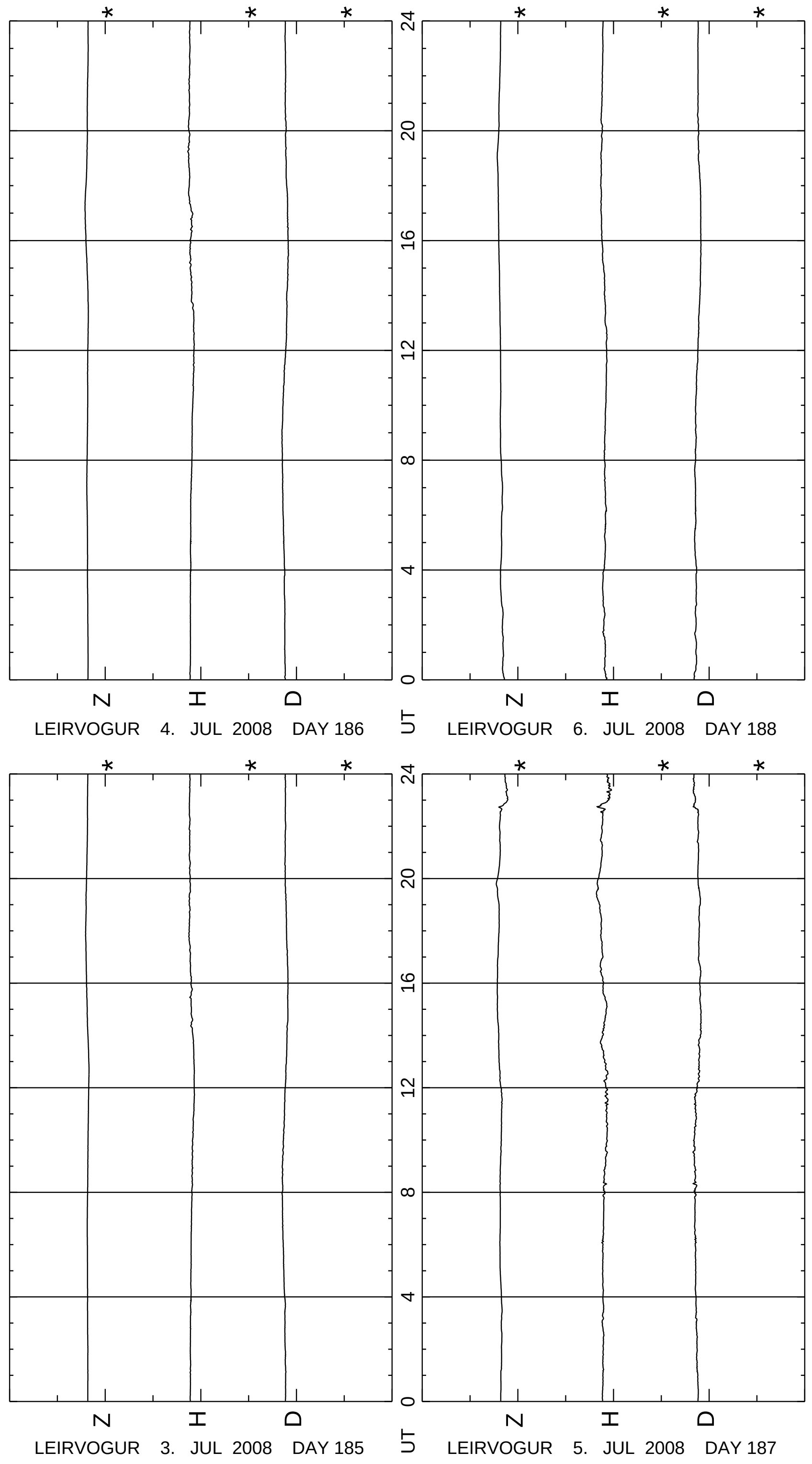
LEIRVOGUR 2. JUL 2008 DAY 184



LEIRVOGUR 29. JUN 2008 DAY 181



LEIRVOGUR 1. JUL 2008 DAY 183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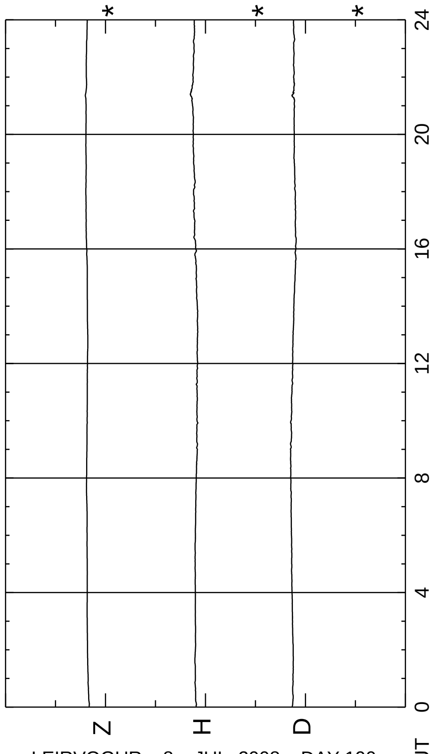
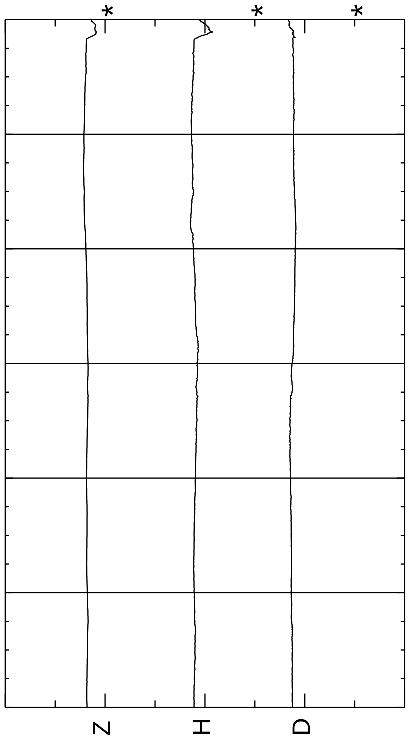
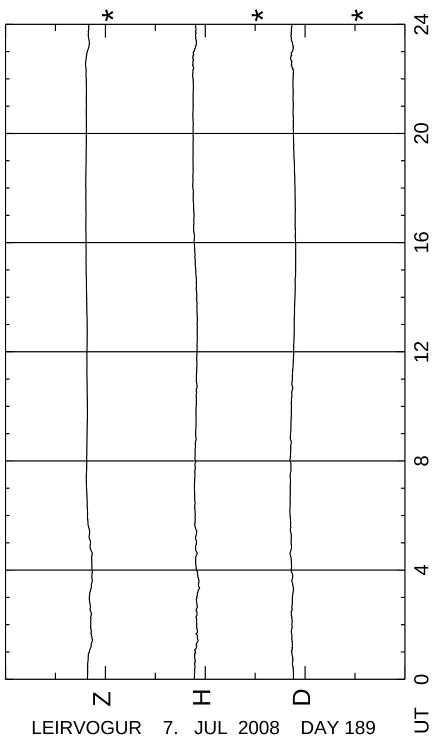


LEIRVOGUR 8. JUL 2008 DAY 190



LEIRVOGUR 10. JUL 2008 DAY 192



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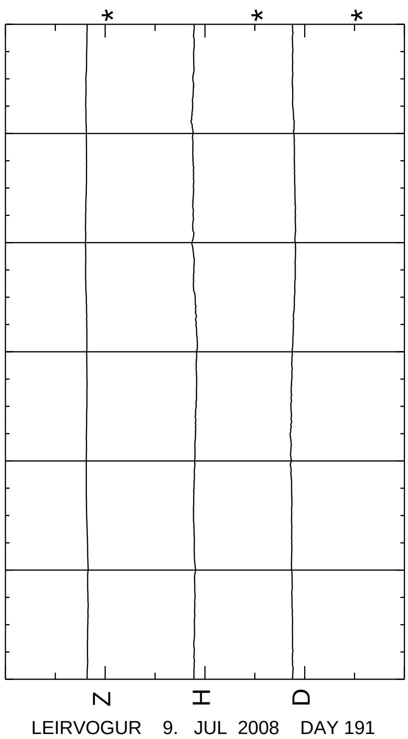

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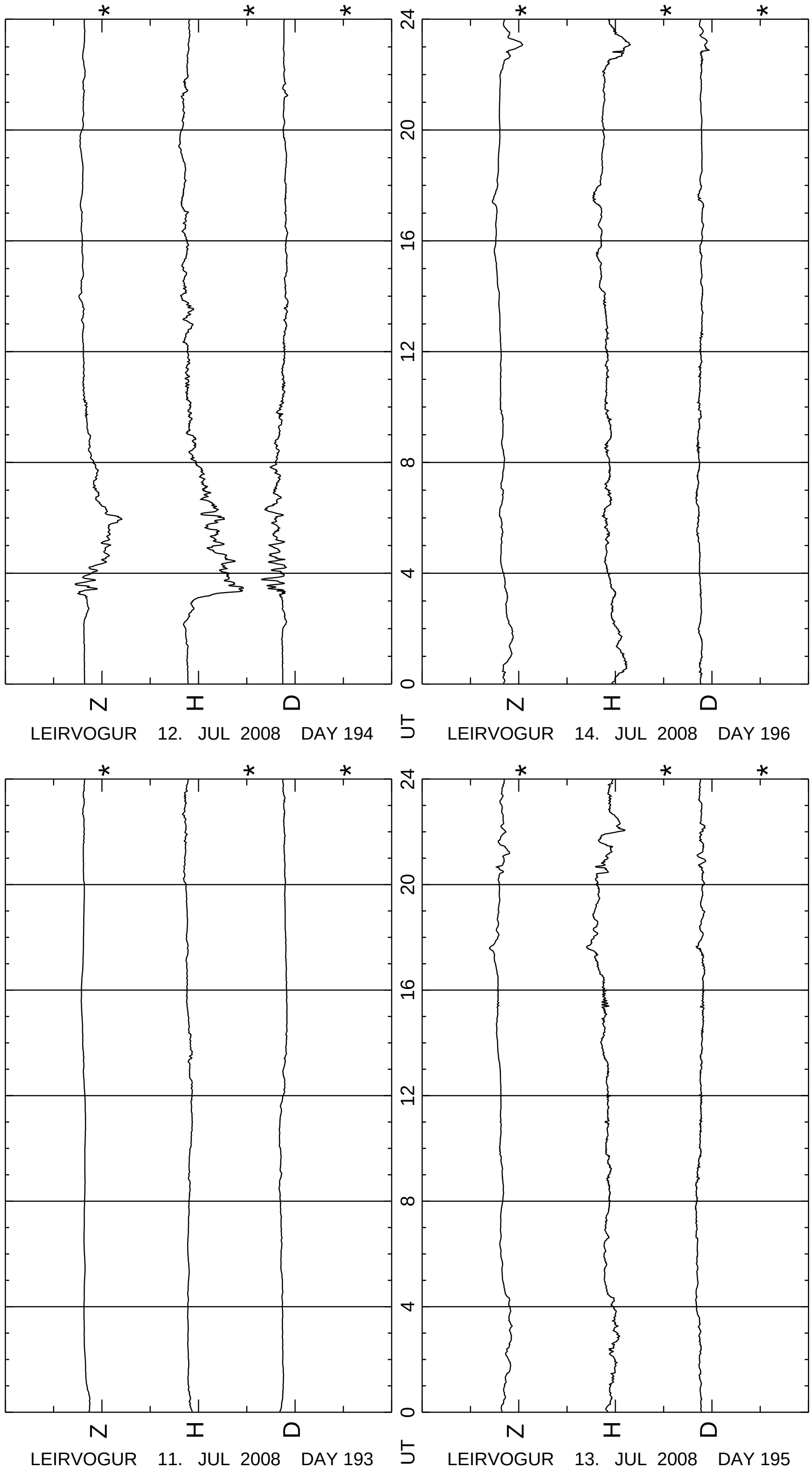
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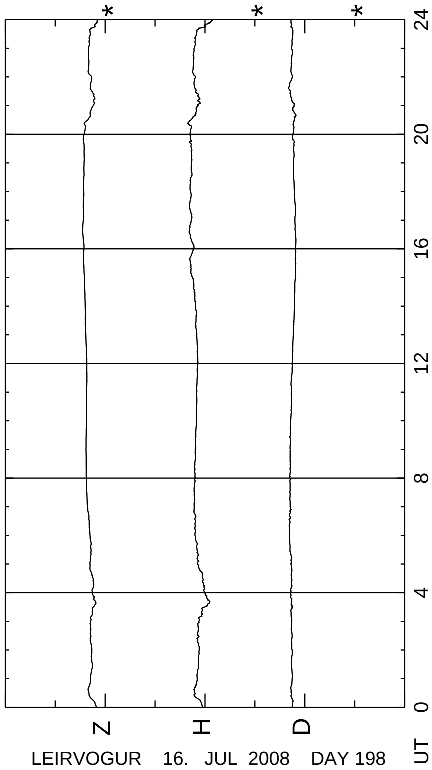
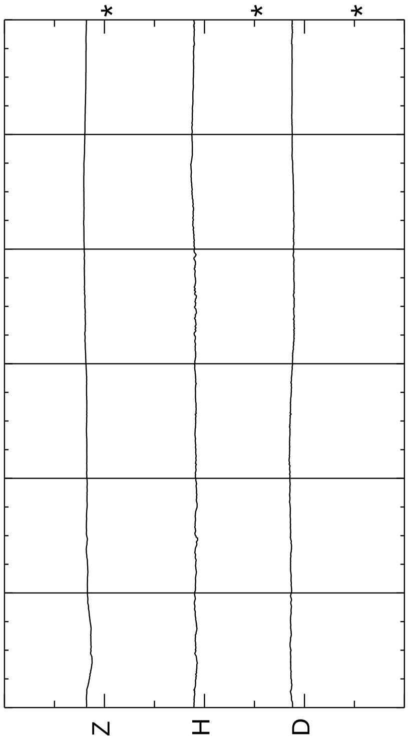


LEIRVOGUR 16. JUL 2008 DAY 198



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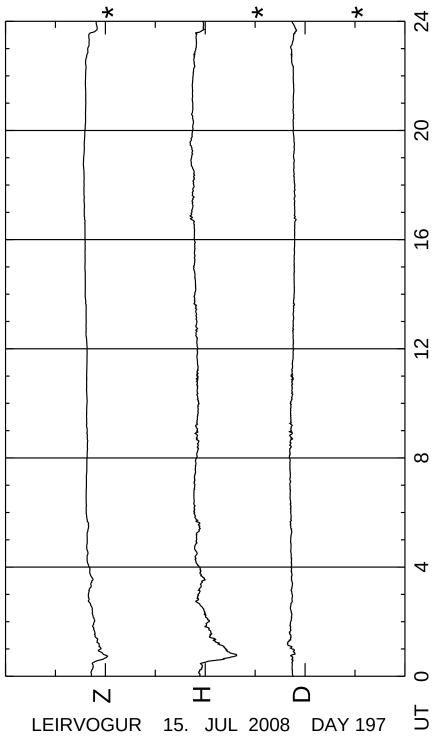

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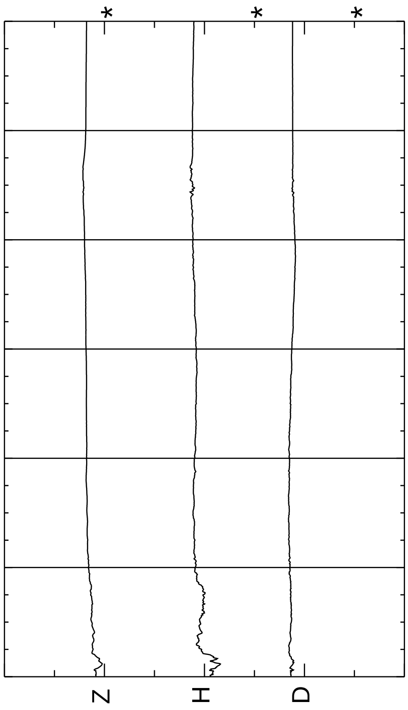

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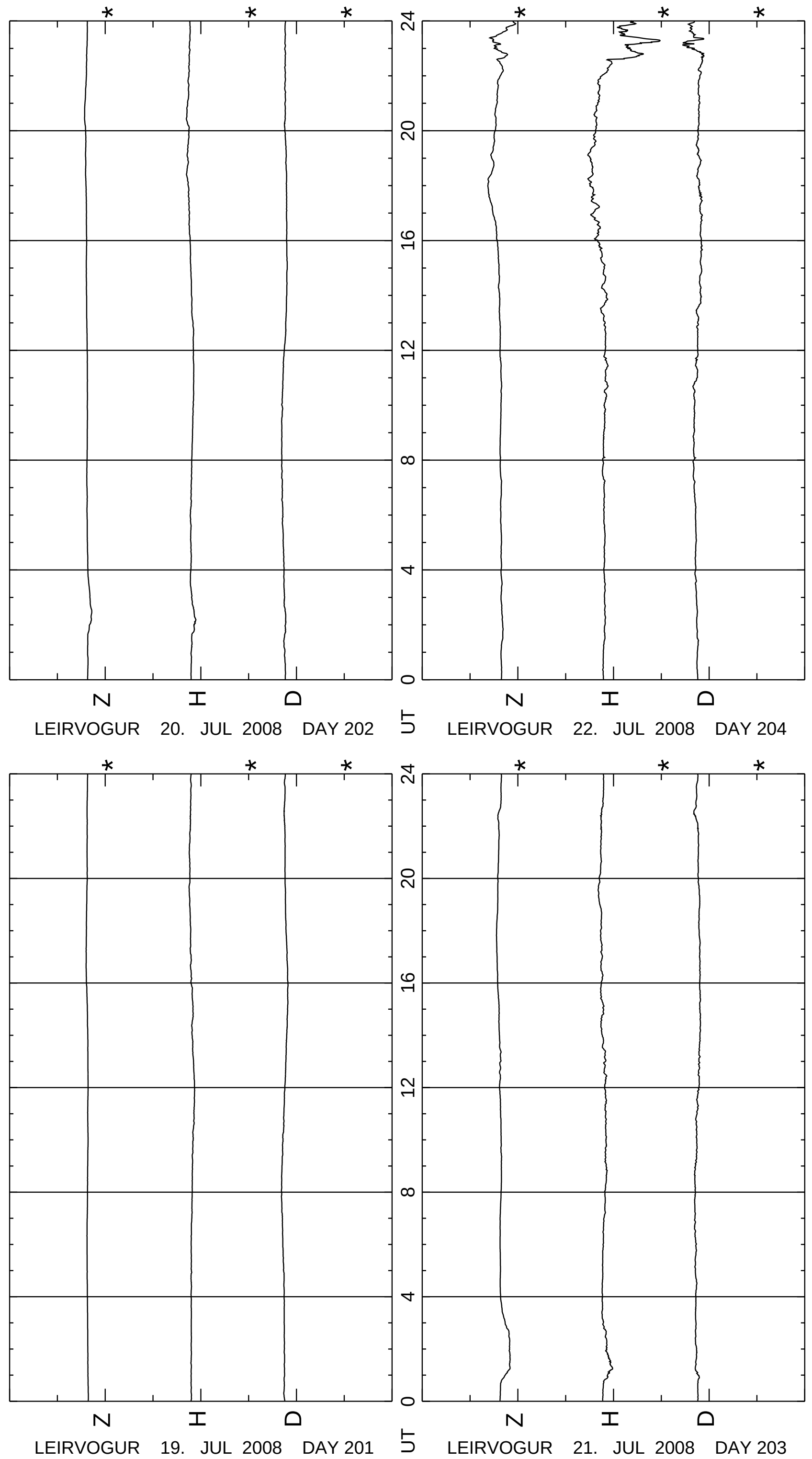
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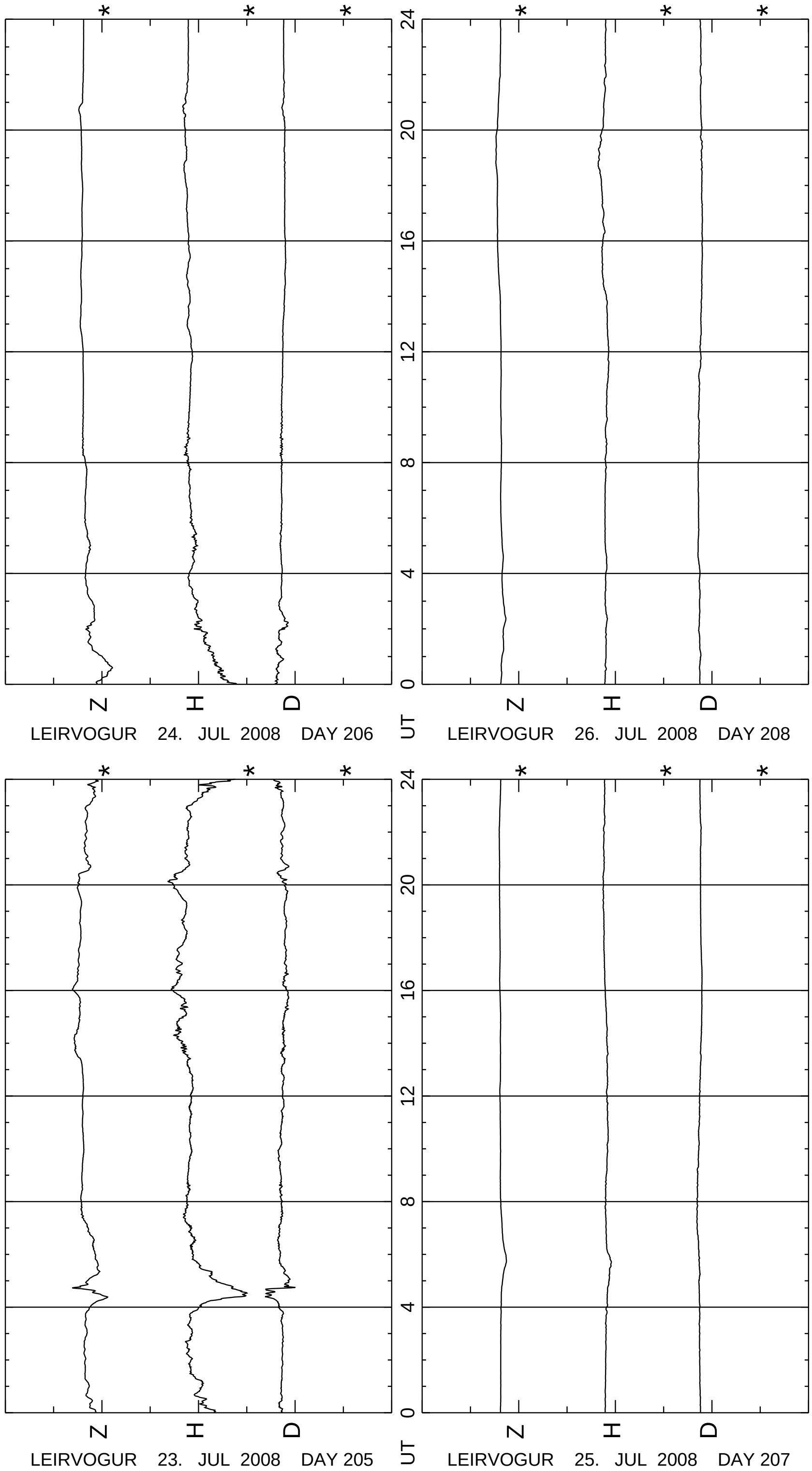
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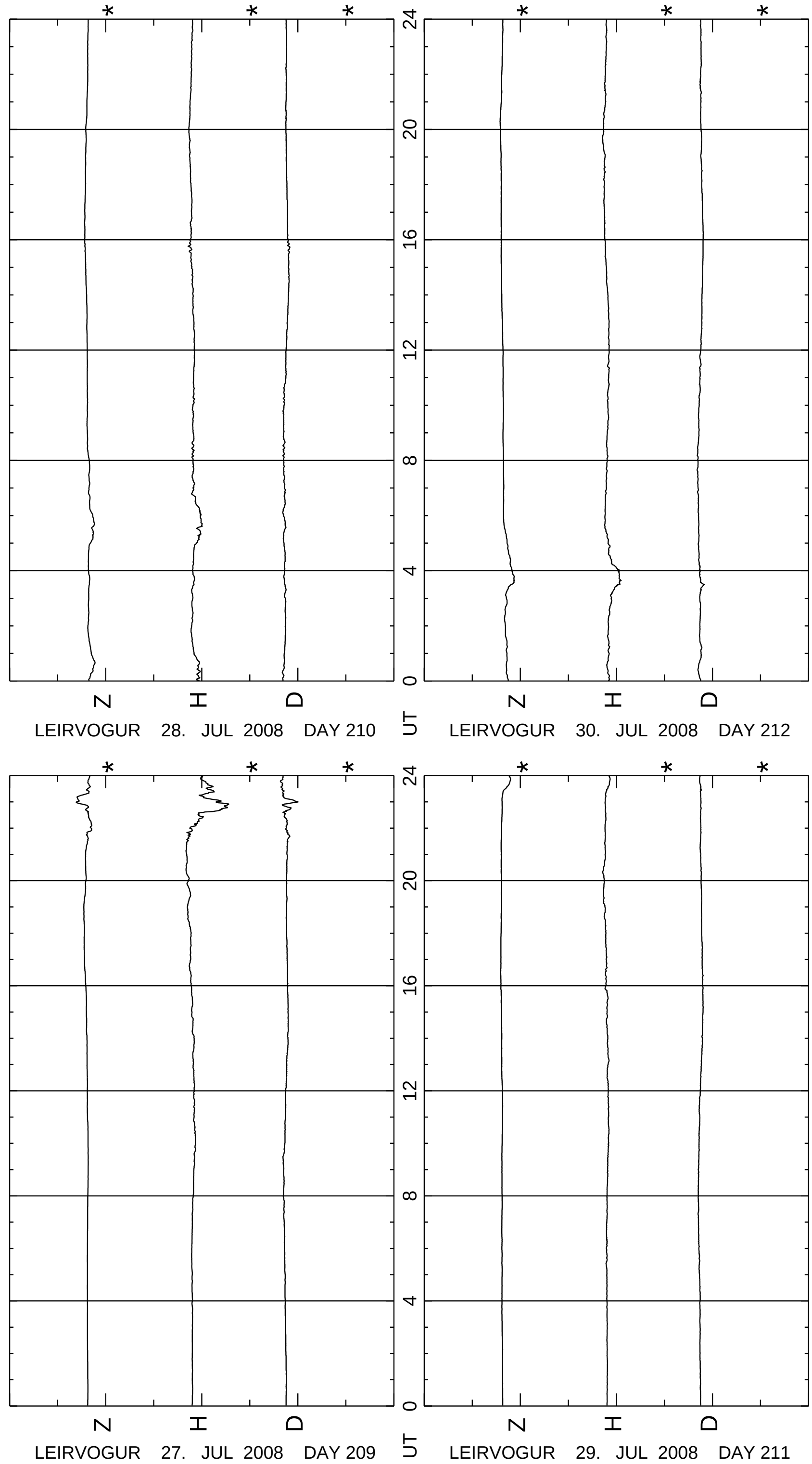
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LEIRVOGUR 30. JUL 2008 DAY 212
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LEIRVOGUR 29. JUL 2008 DAY 211
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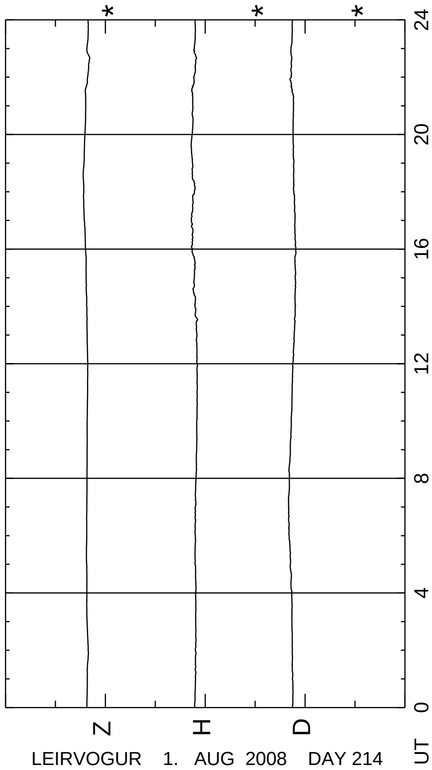
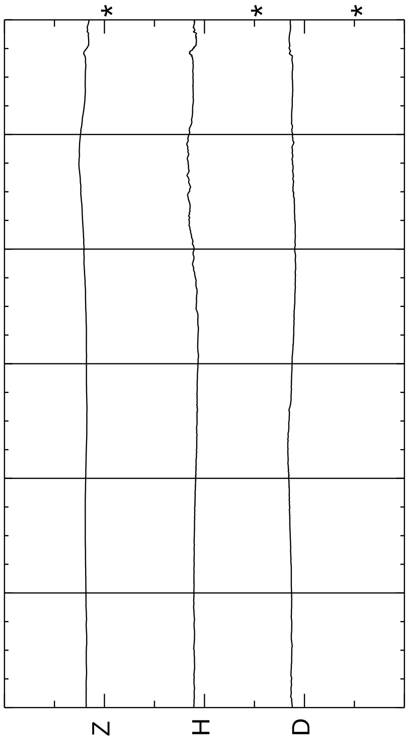
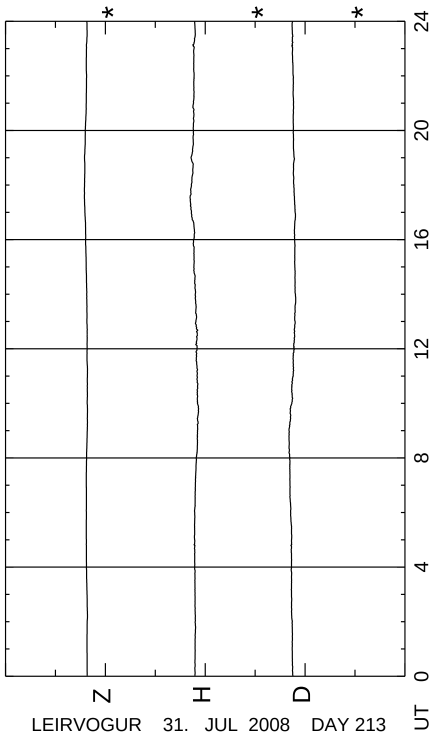


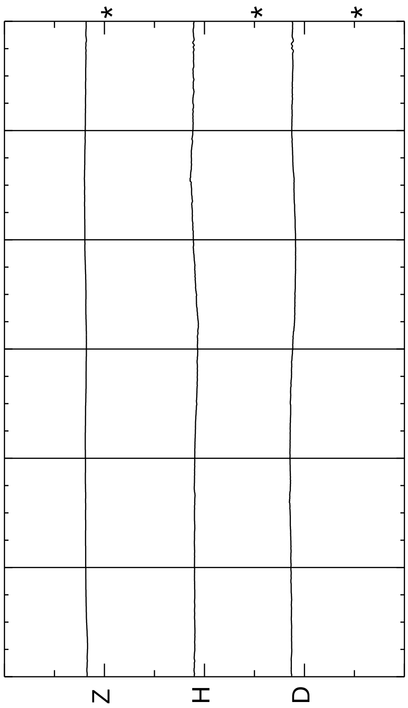
LEIRVOGUR 1. AUG 2008 DAY 214



LEIRVOGUR 3. AUG 2008 DAY 216



LEIRVOGUR 31. JUL 2008 DAY 213



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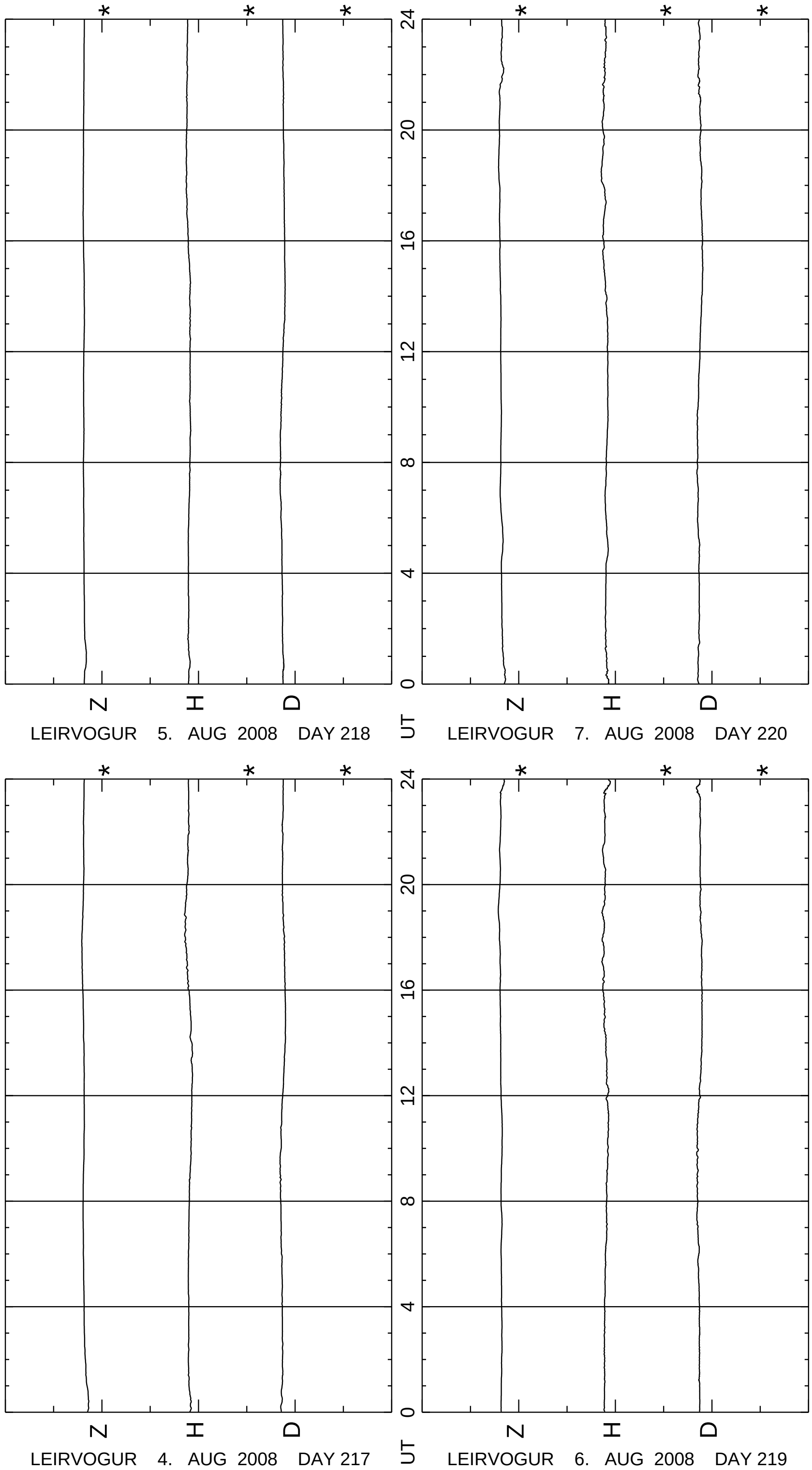
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LEIRVOGUR 7. AUG 2008 DAY 220
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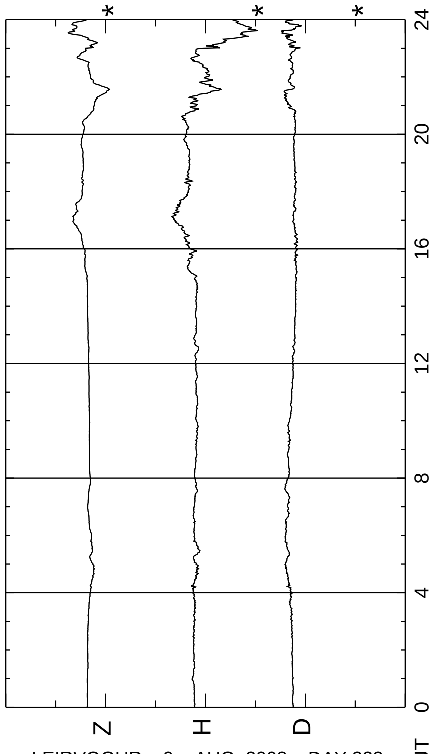

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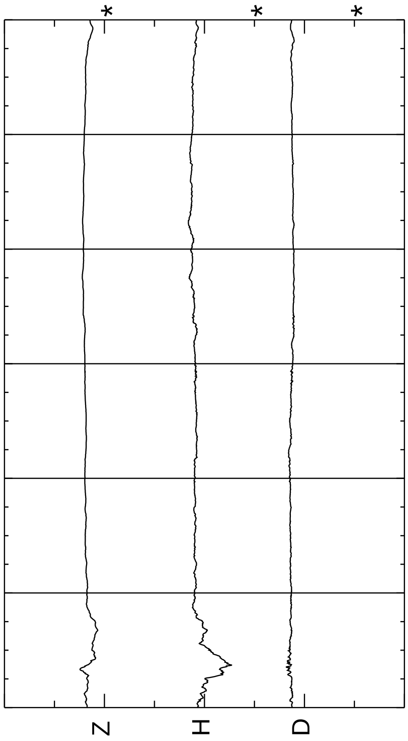

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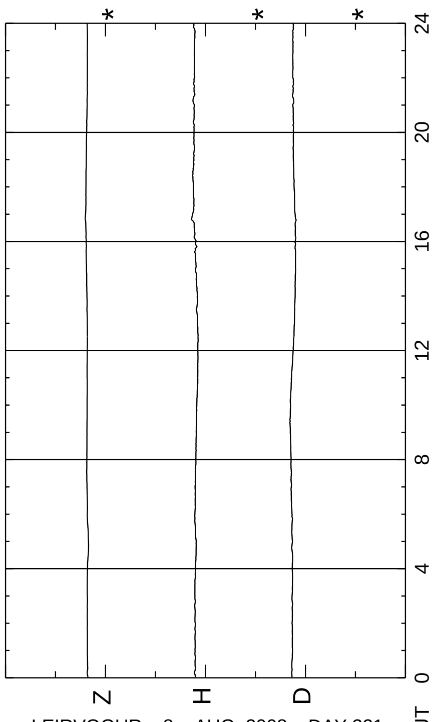
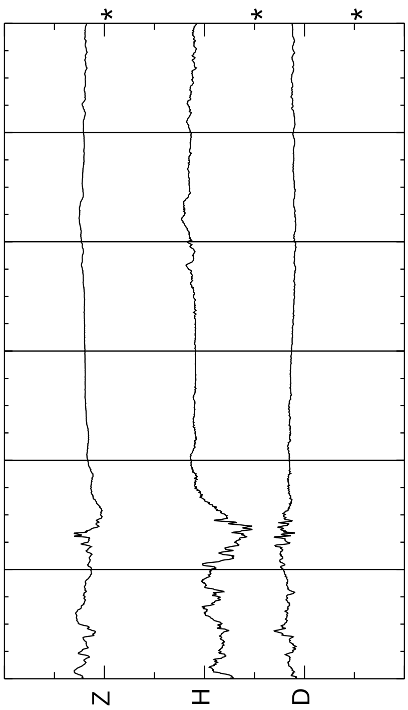


LEIRVOGUR 8. AUG 2008 DAY 221



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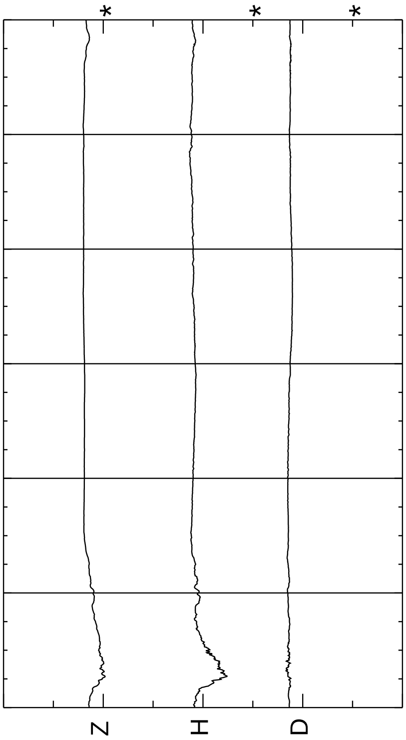
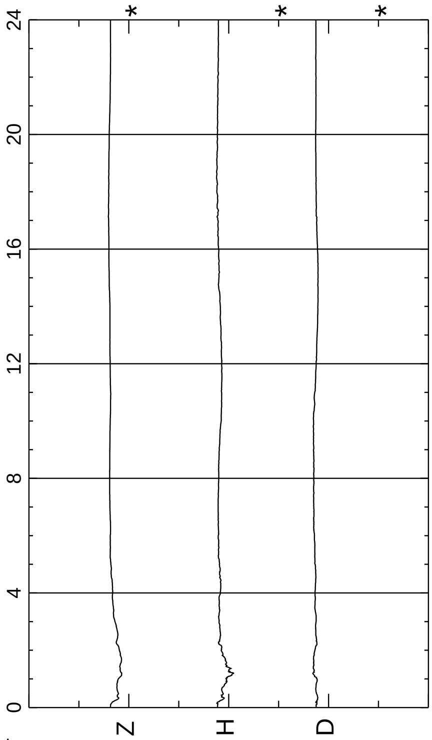
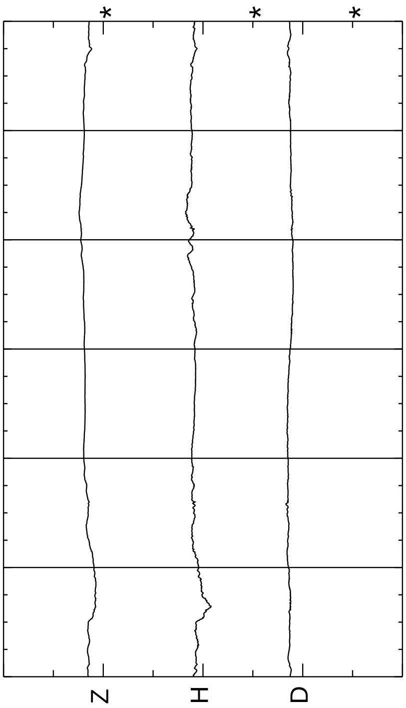
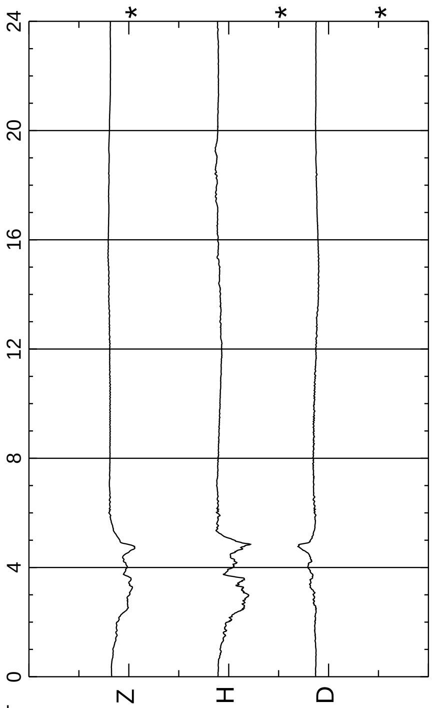




LEIRVOGUR 13. AUG 2008 DAY 226

LEIRVOGUR 15. AUG 2008 DAY 228





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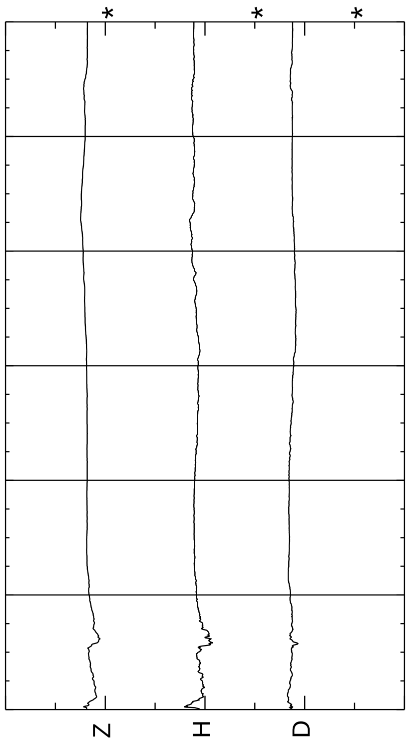
LEIRVOGUR 14. AUG 2008 DAY 227



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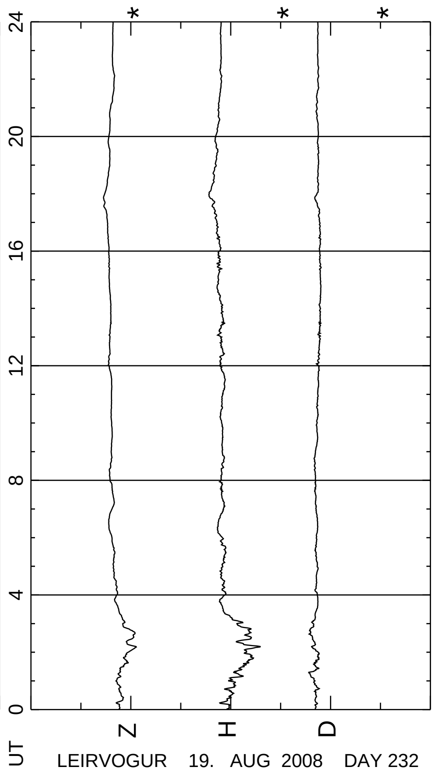

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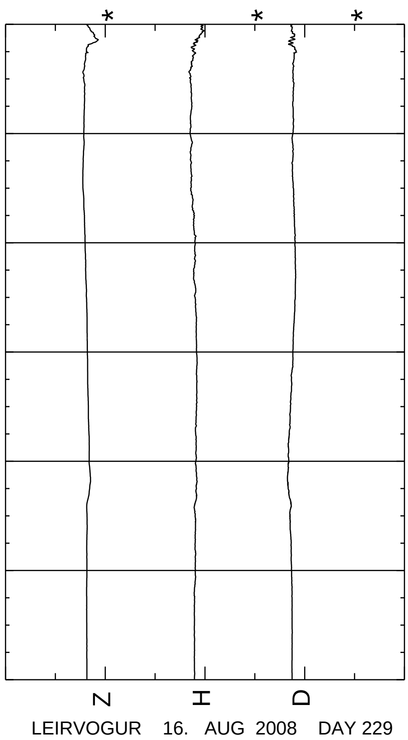

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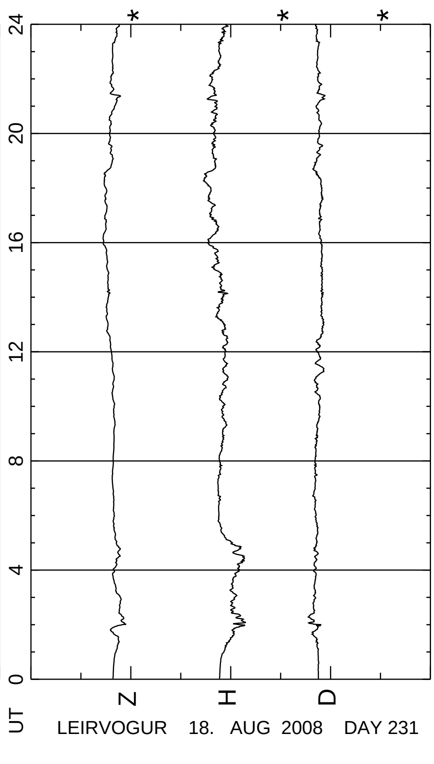

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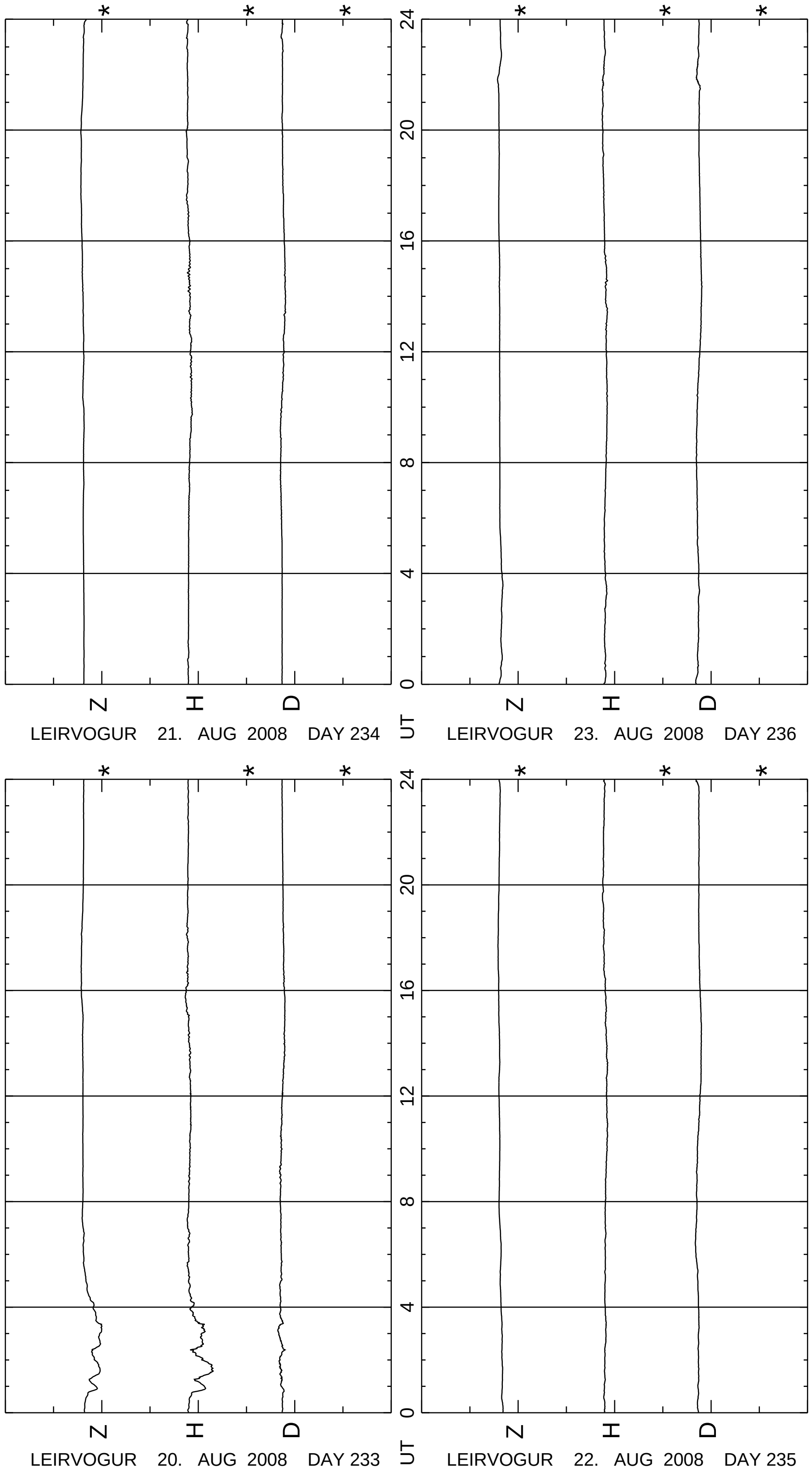
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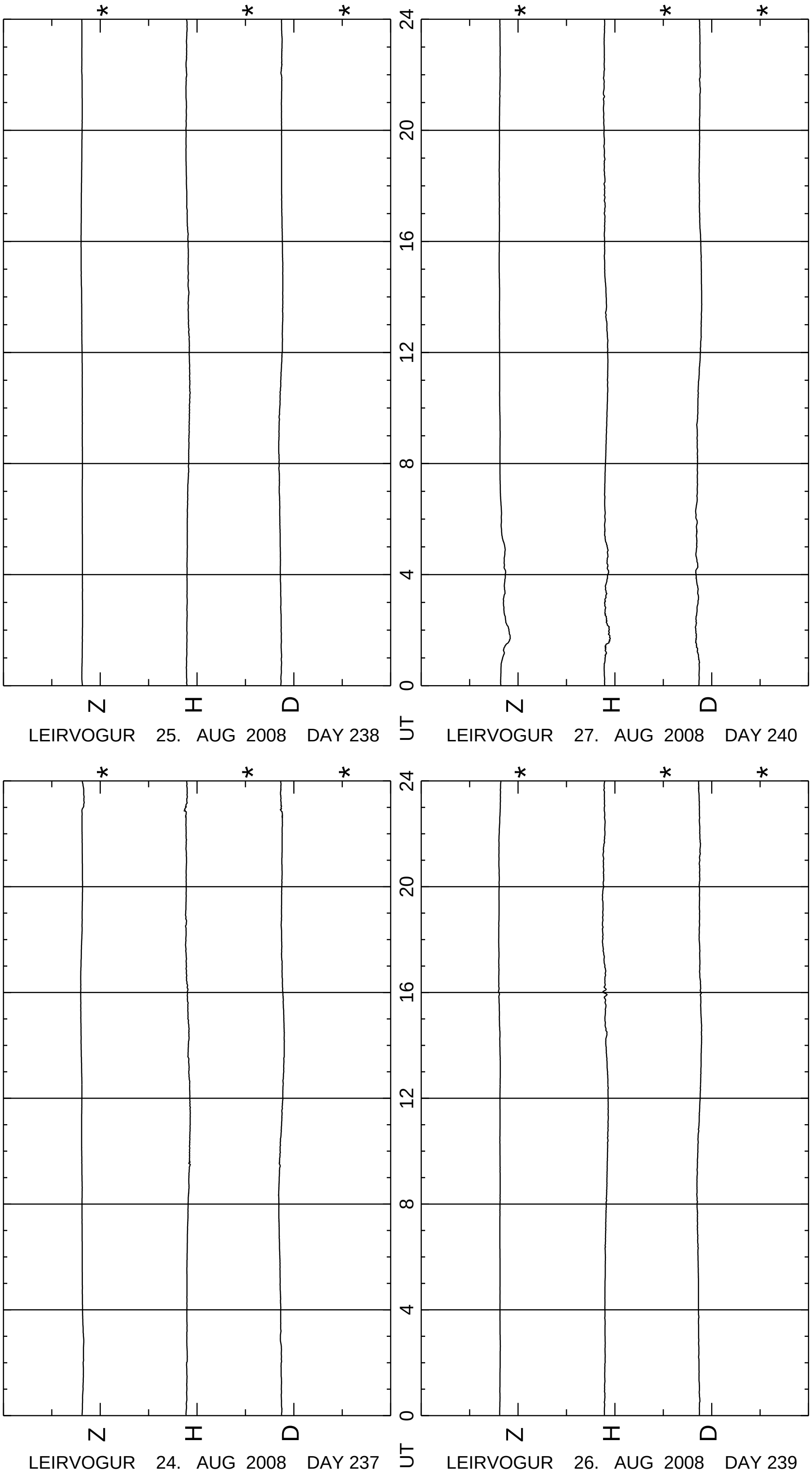
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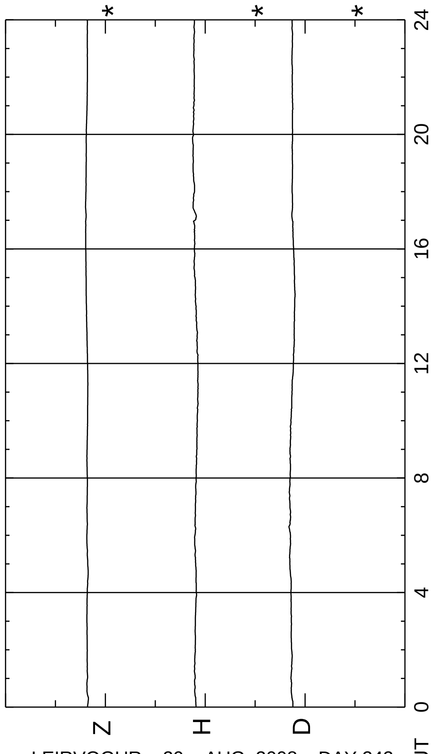

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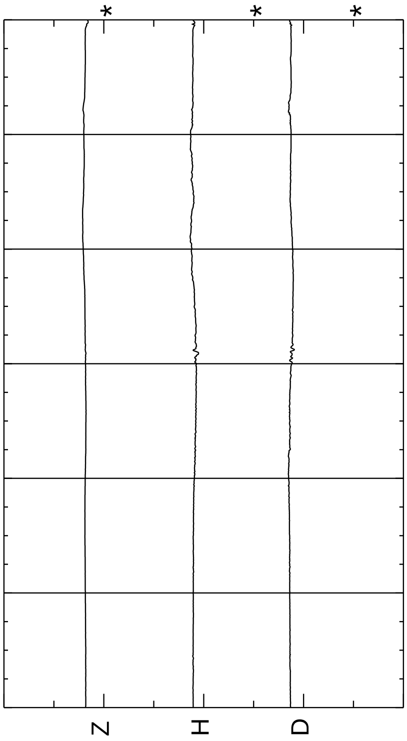

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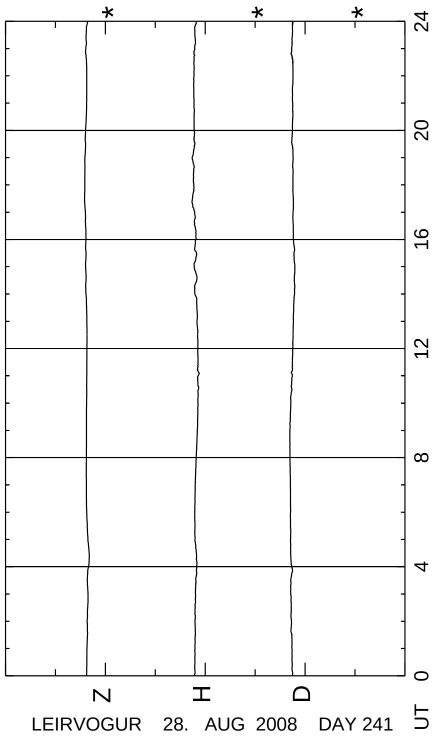
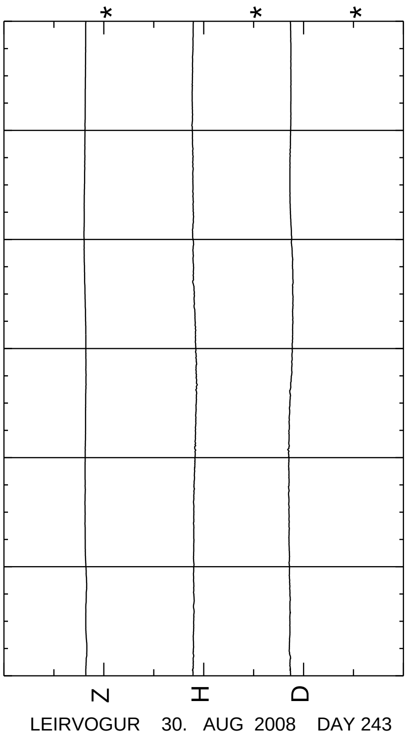


LEIRVOGUR 28. AUG 2008 DAY 241



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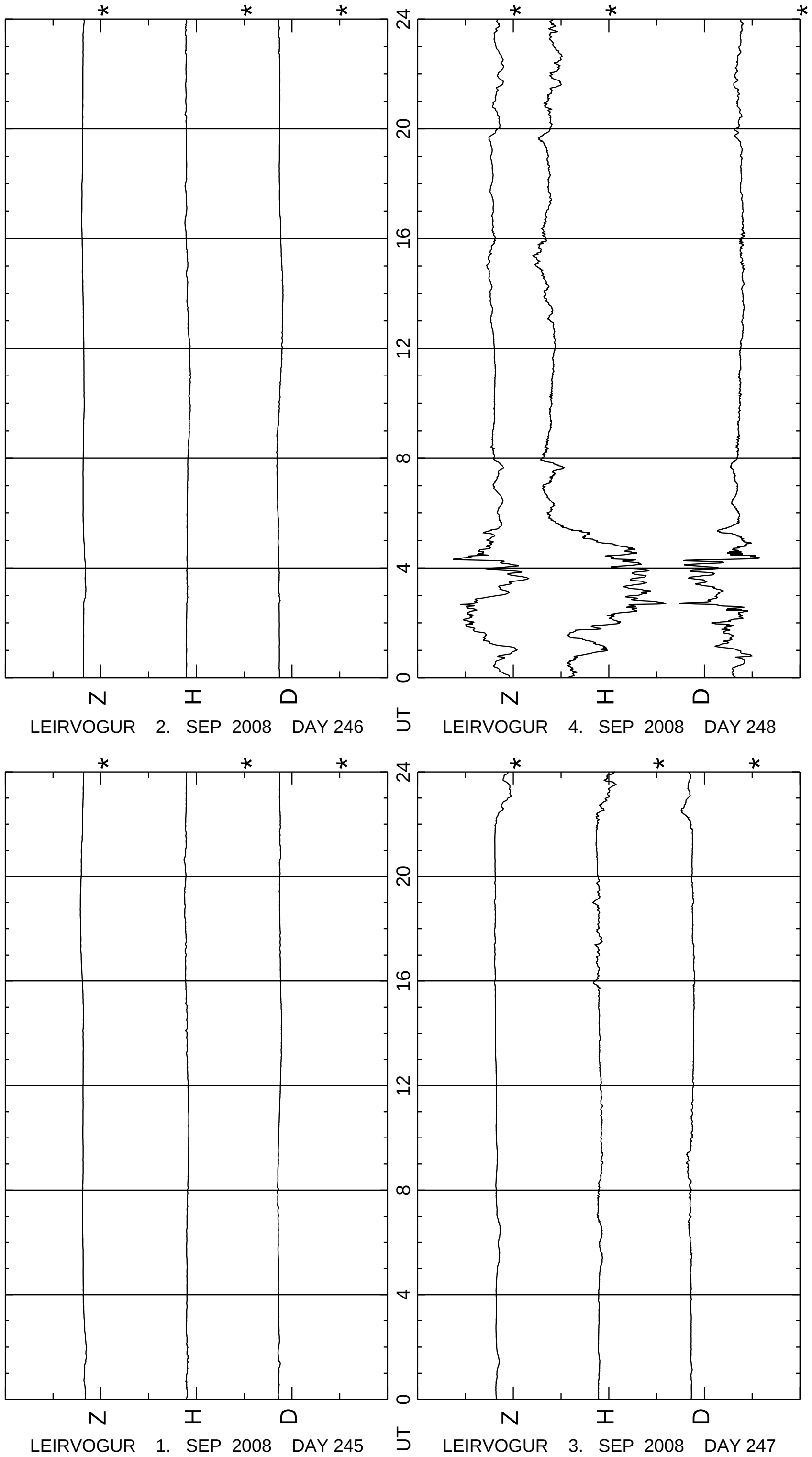
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LEIRVOGUR 4. SEP 2008 DAY 248
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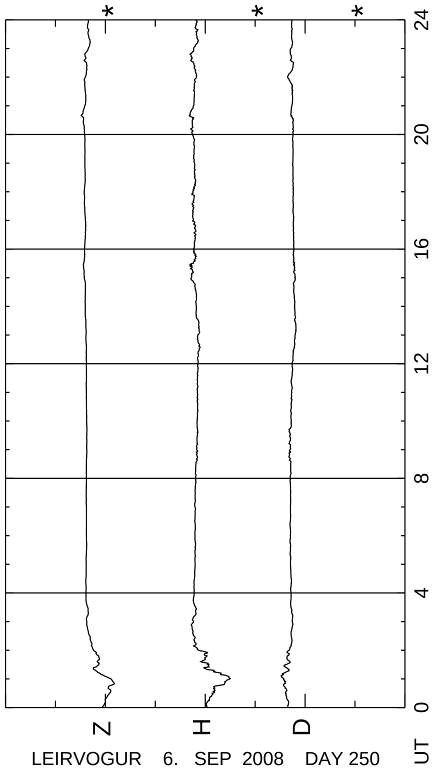

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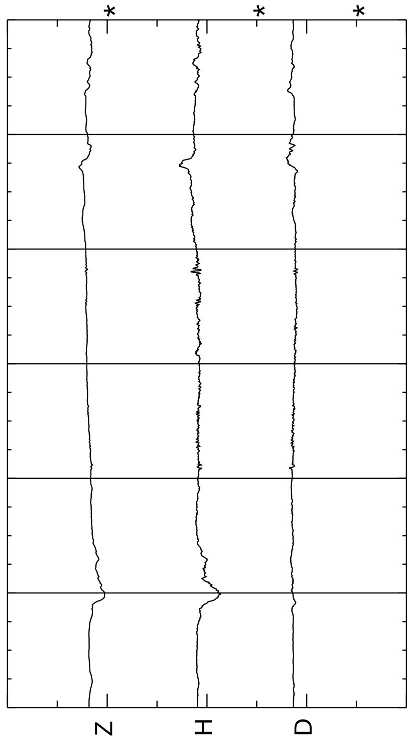
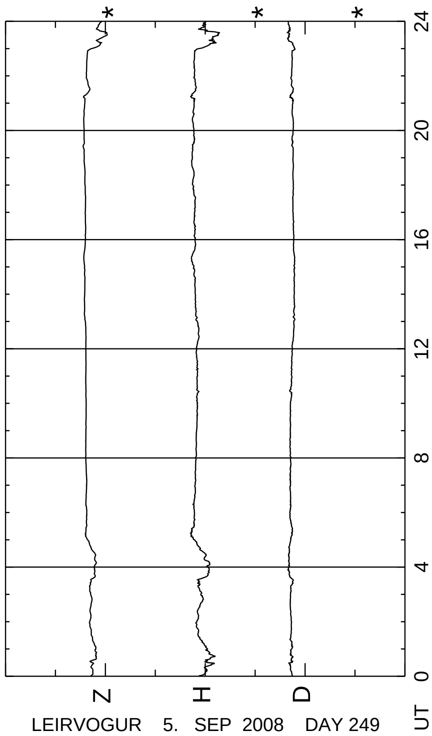


LEIRVOGUR 8. SEP 2008 DAY 252



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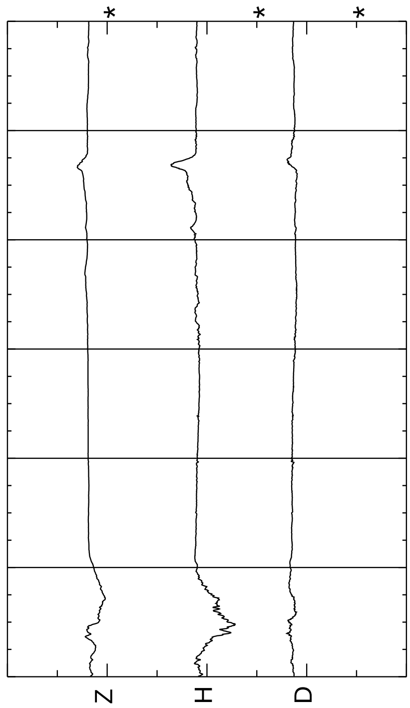
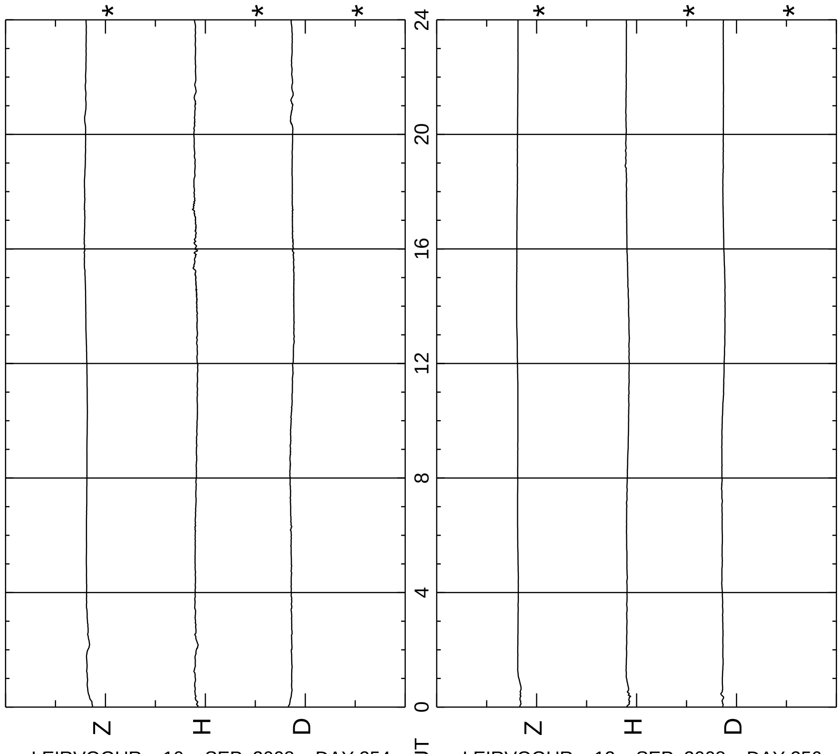


LEIRVOGUR 7. SEP 2008 DAY 251



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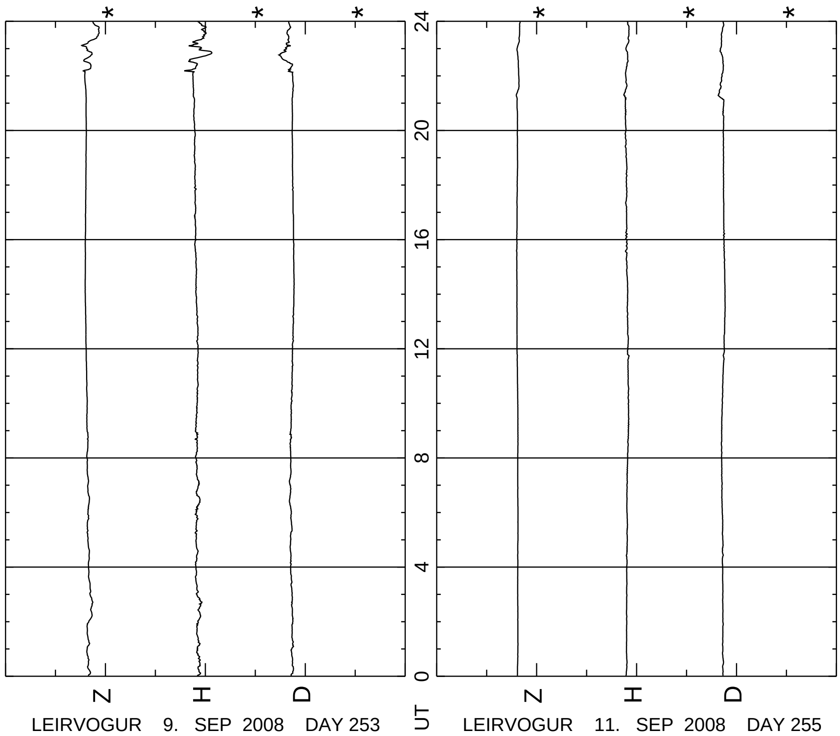

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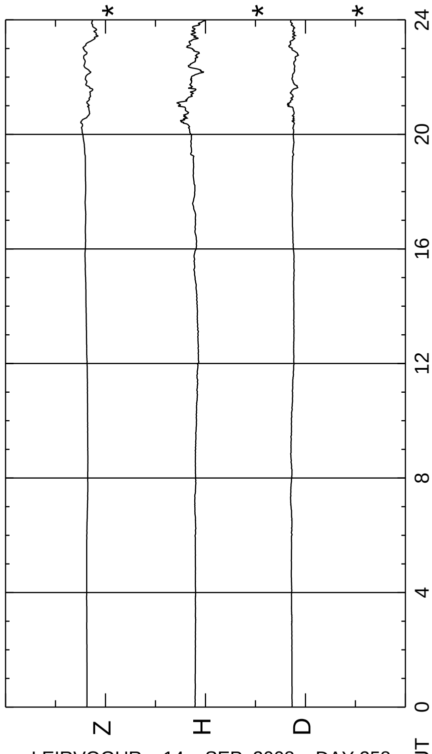
LEIRVOGUR 11. SEP 2008 DAY 255



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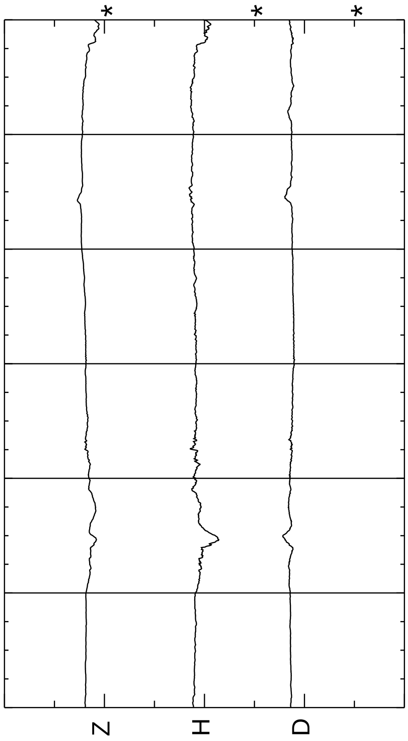

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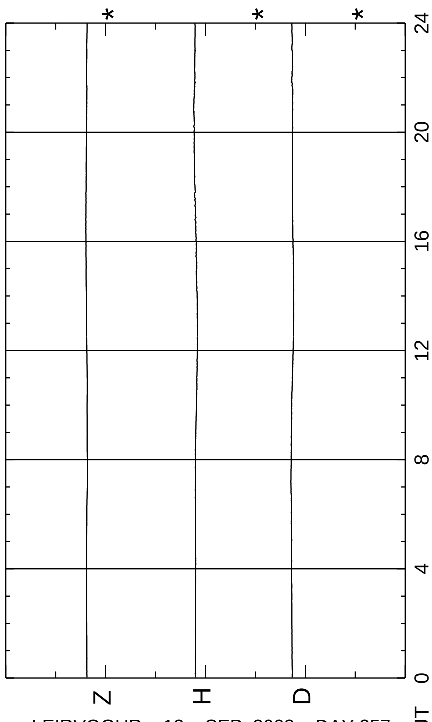

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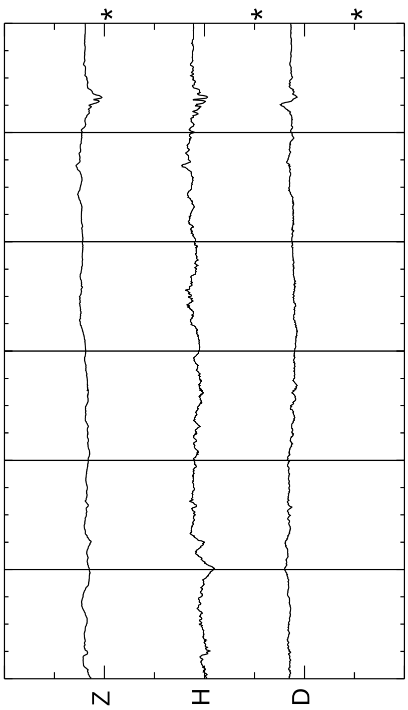

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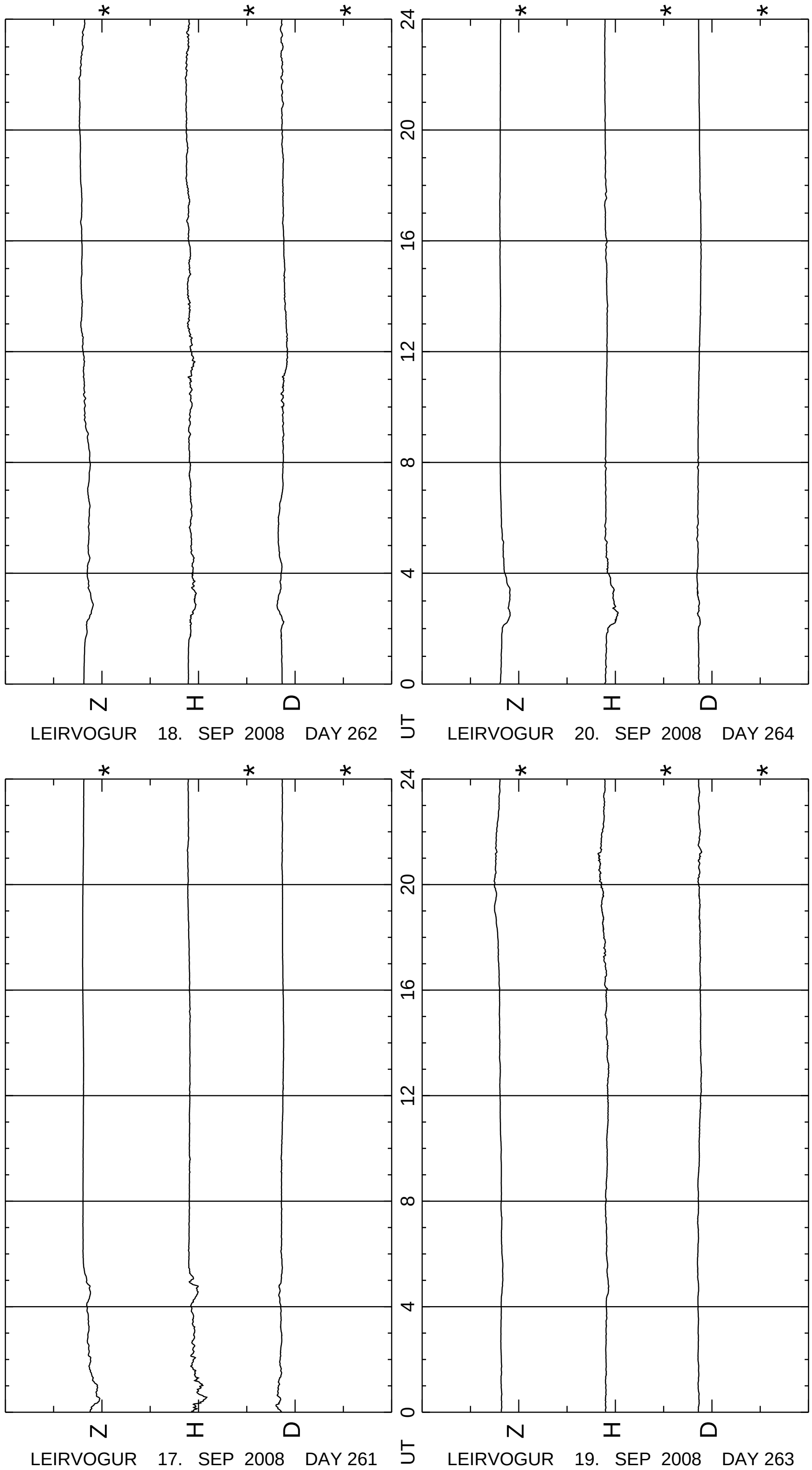

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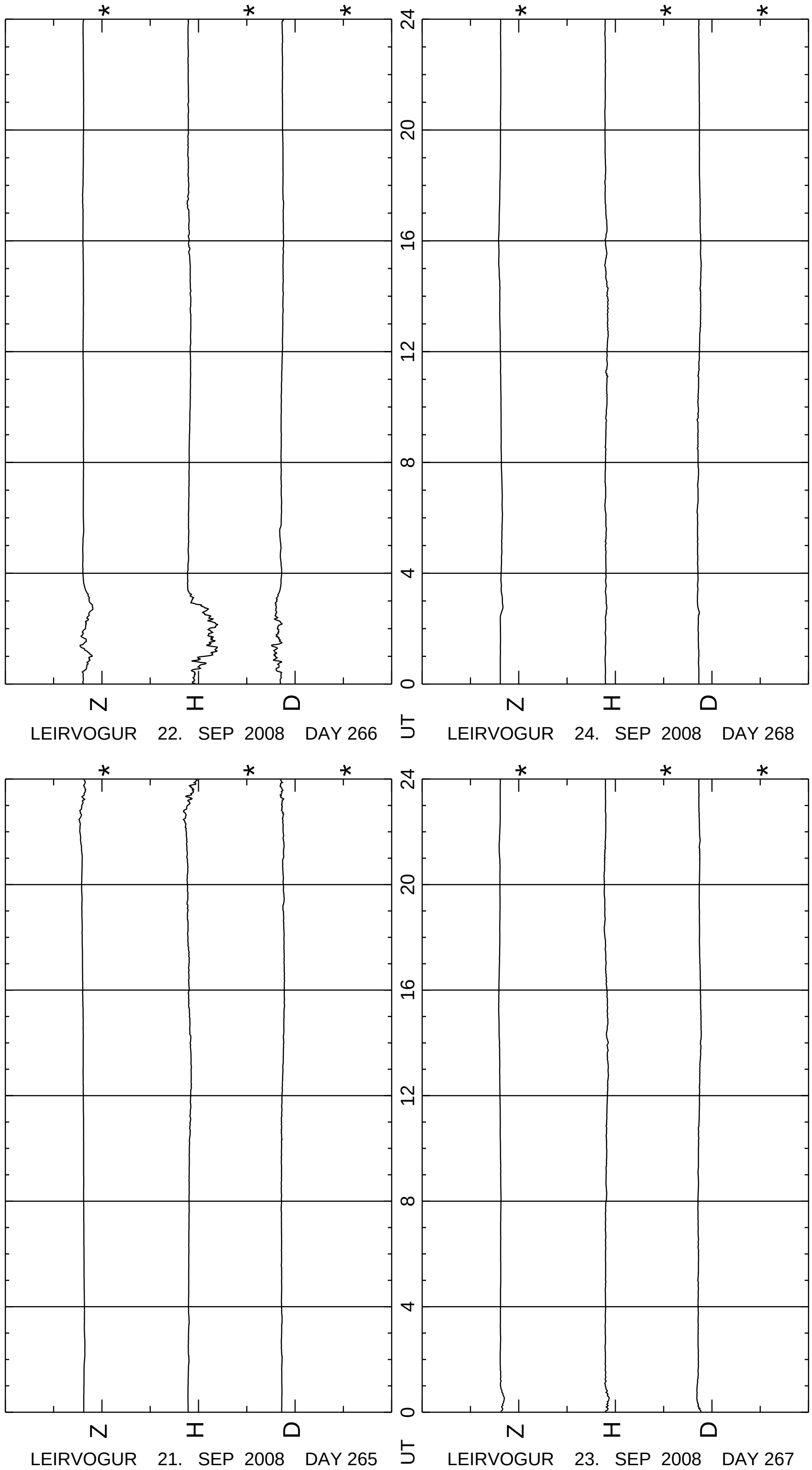
LEIRVOGUR 20. SEP 2008 DAY 264

LEIRVOGUR 17. SEP 2008 DAY 261

LEIRVOGUR 19. SEP 2008 DAY 263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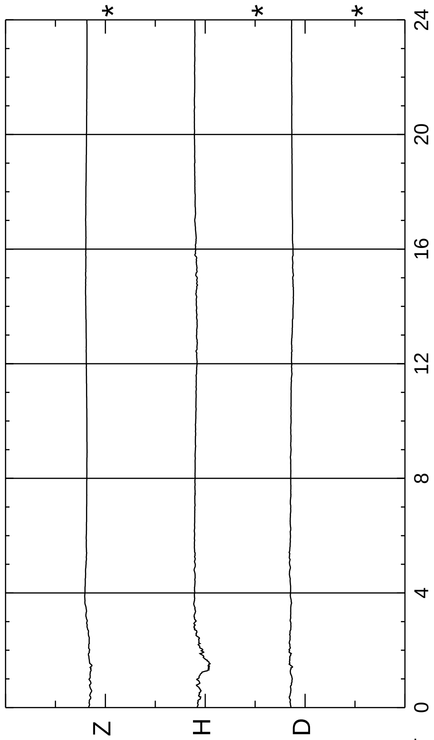

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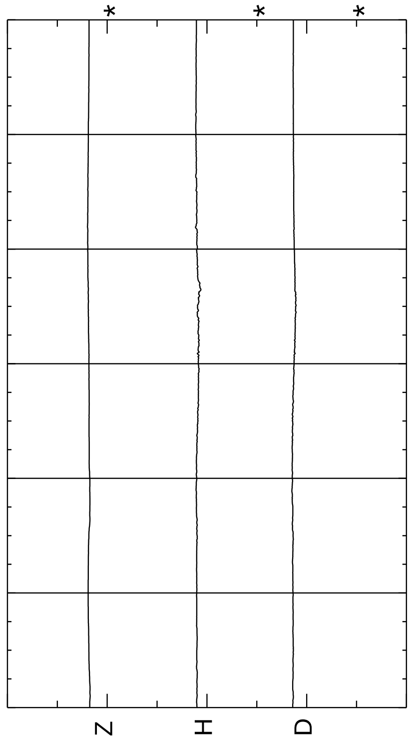

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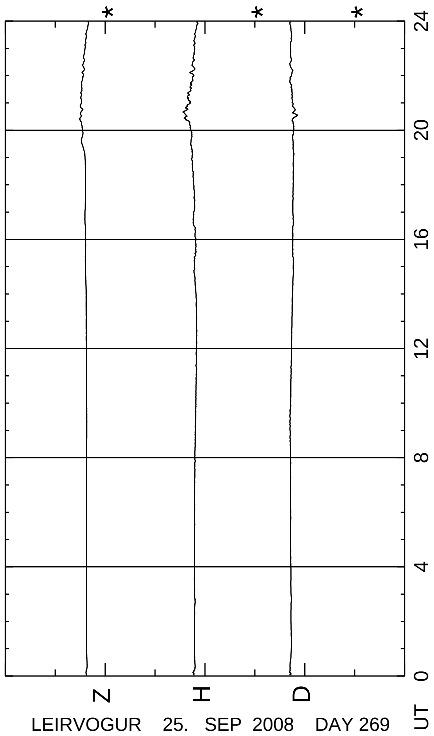

LEIRVOGUR 25. SEP 2008 DAY 269

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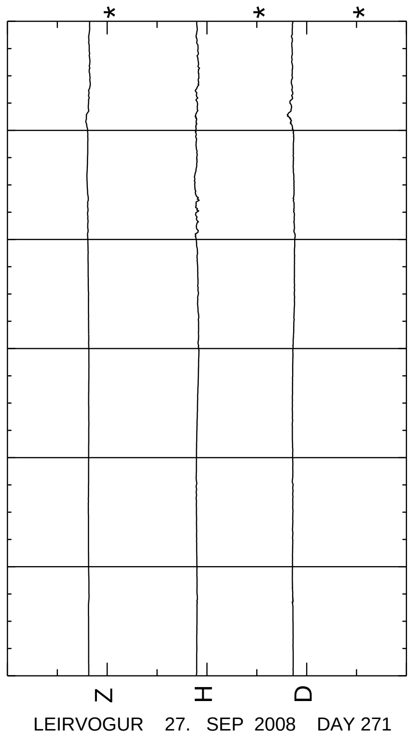

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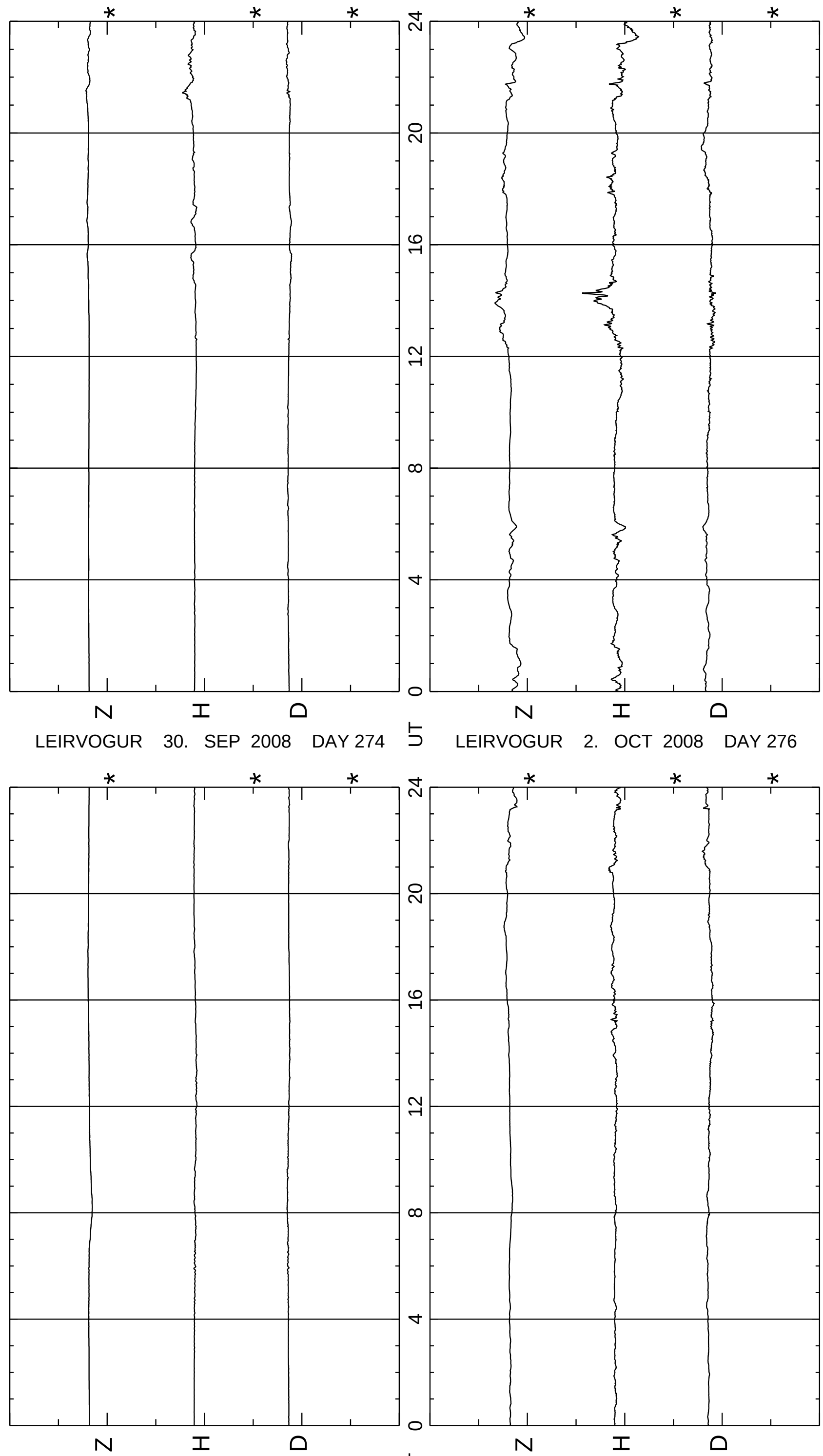

LEIRVOGUR 30. SEP 2008 DAY 274

LEIRVOGUR 2. OCT 2008 DAY 276

LEIRVOGUR 29. SEP 2008 DAY 273

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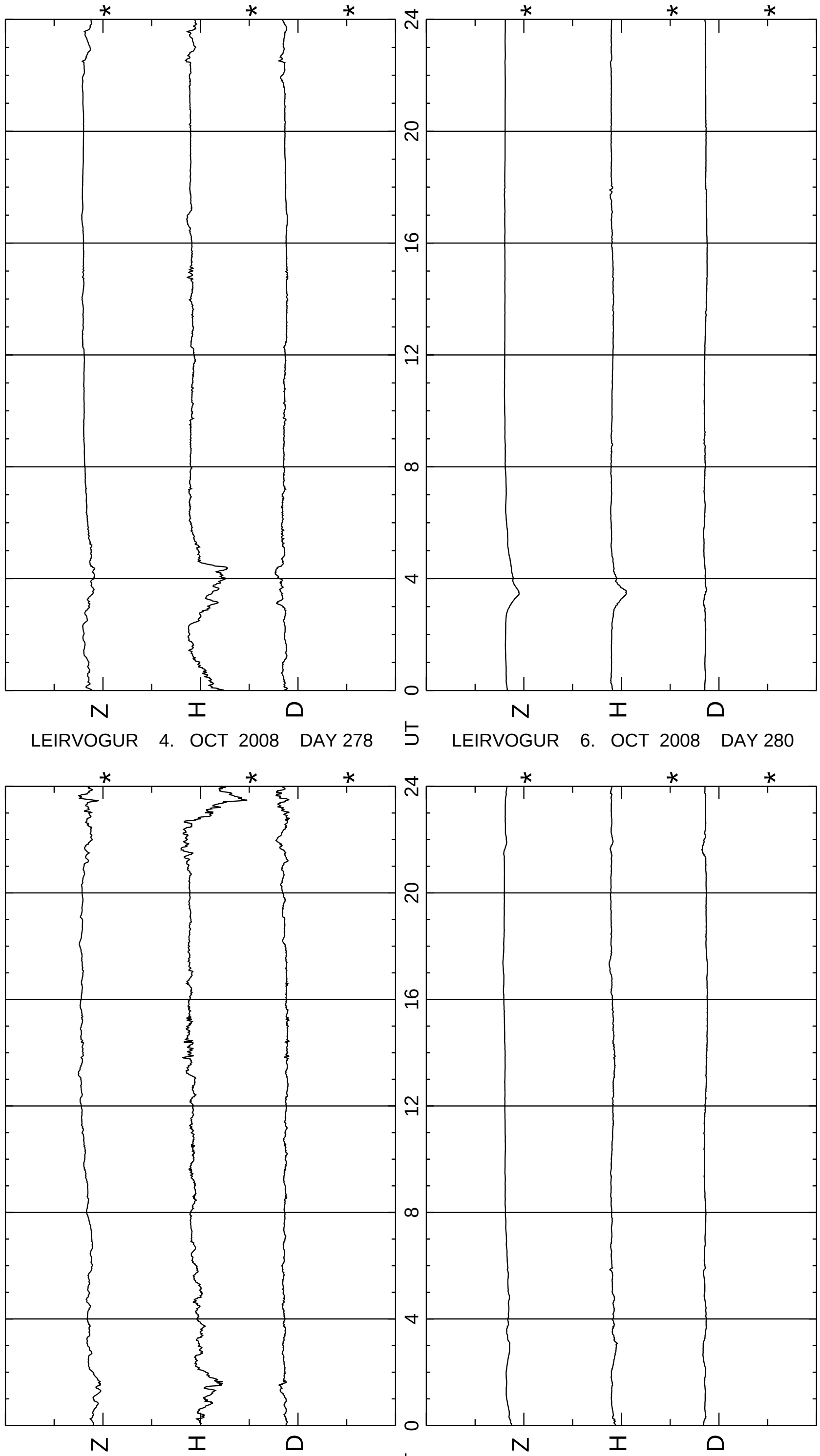
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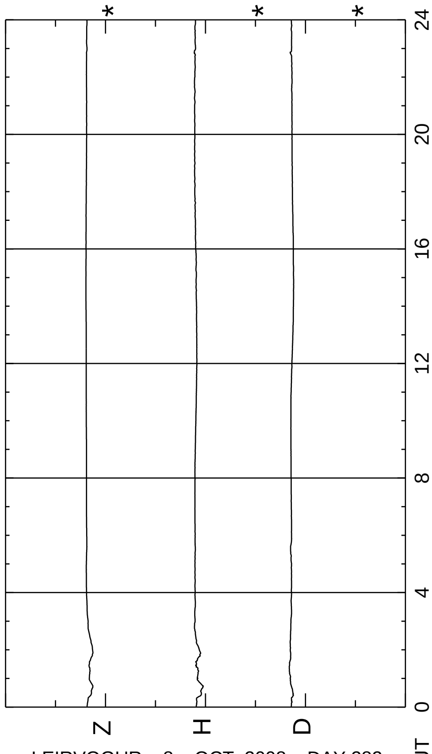
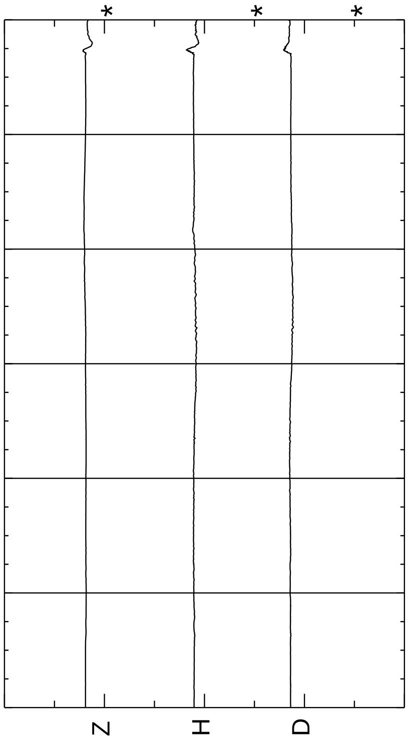


LEIRVOGUR 8. OCT 2008 DAY 282



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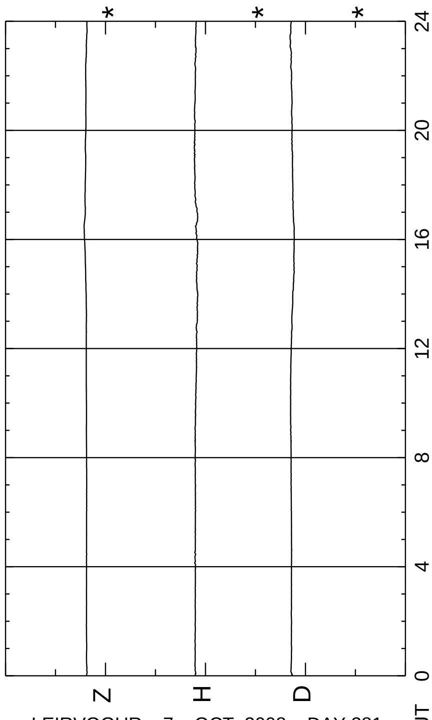
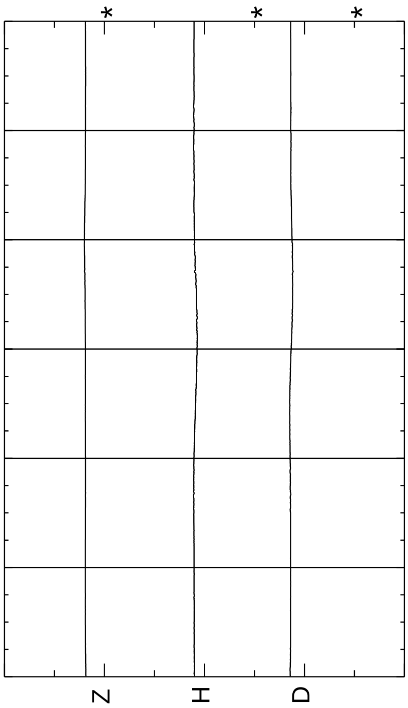
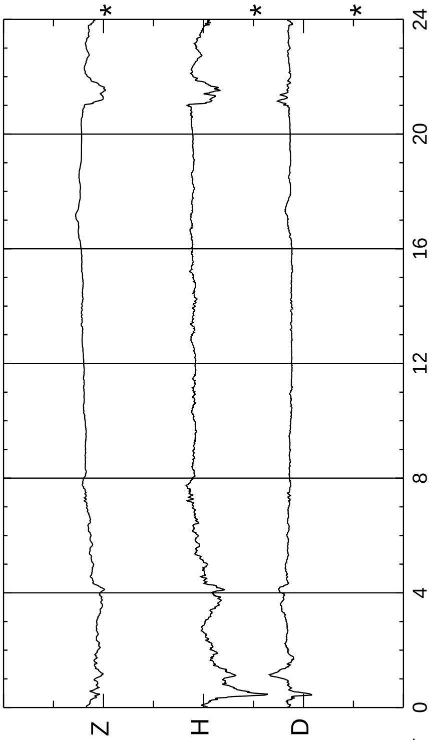


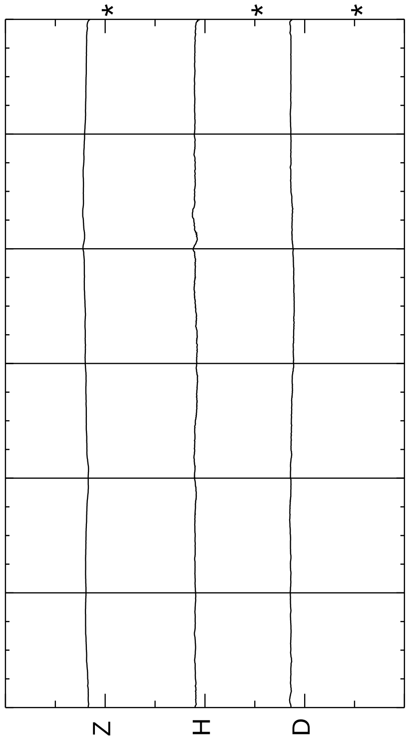
LEIRVOGUR 7. OCT 2008 DAY 281



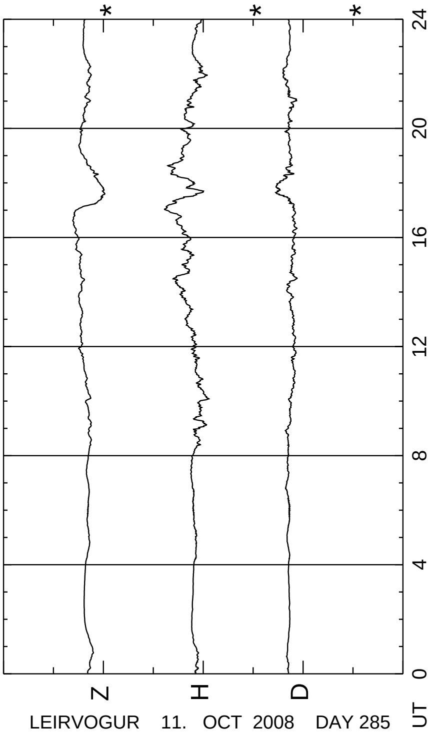
LEIRVOGUR 9. OCT 2008 DAY 283



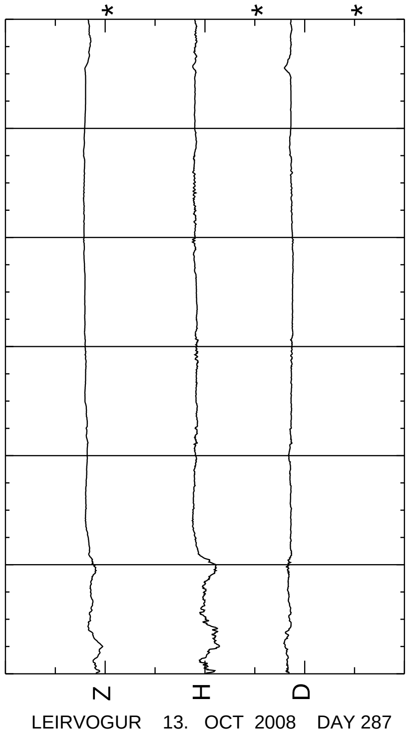
LEIRVOGUR 12. OCT 2008 DAY 286



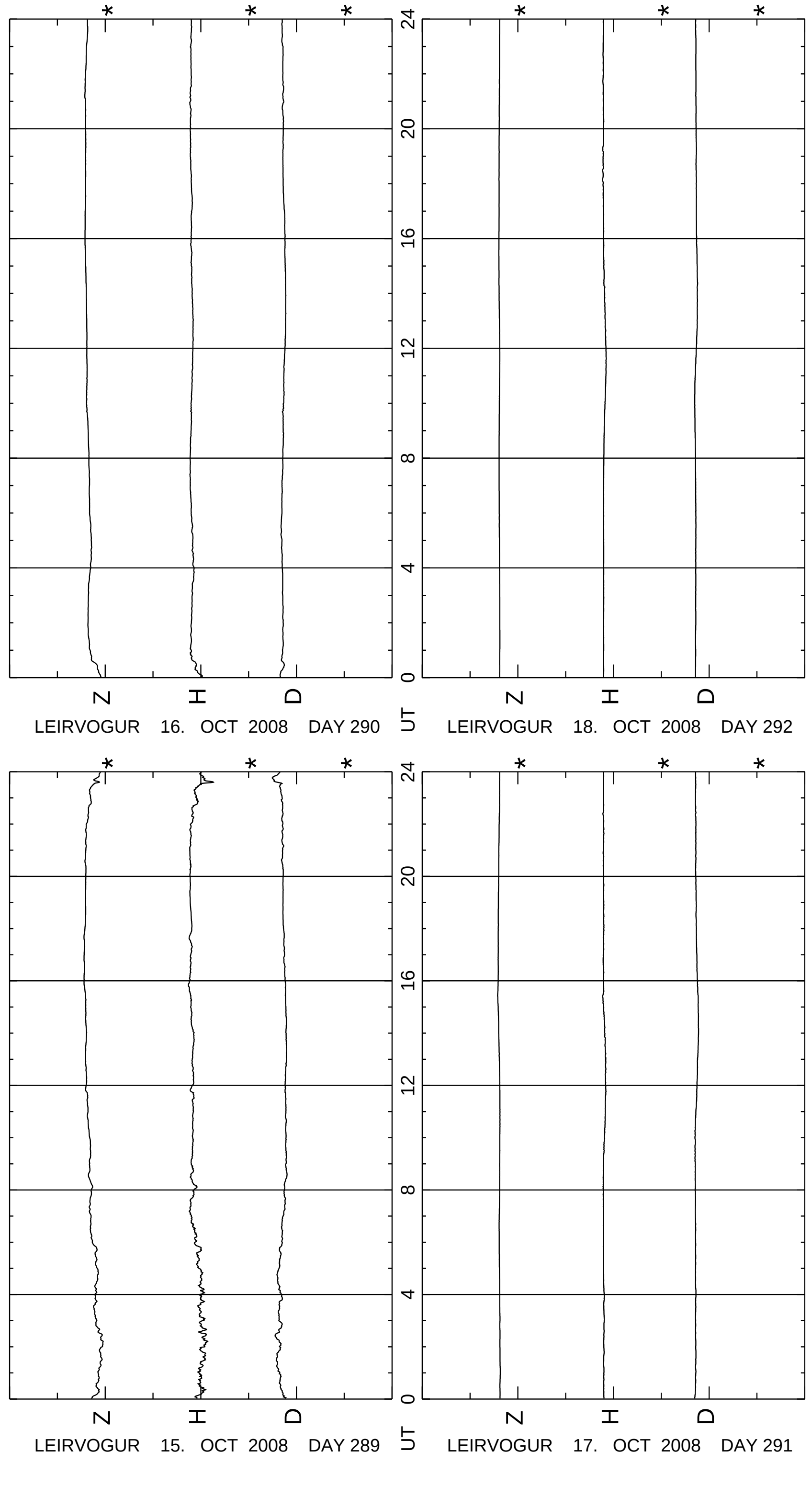
LEIRVOGUR 14. OCT 2008 DAY 288



LEIRVOGUR 11. OCT 2008 DAY 285



LEIRVOGUR 13. OCT 2008 DAY 287


LEIRVOGUR 16. OCT 2008 DAY 290
LEIRVOGUR 18. OCT 2008 DAY 292
LEIRVOGUR 15. OCT 2008 DAY 289
LEIRVOGUR 17. OCT 2008 DAY 291
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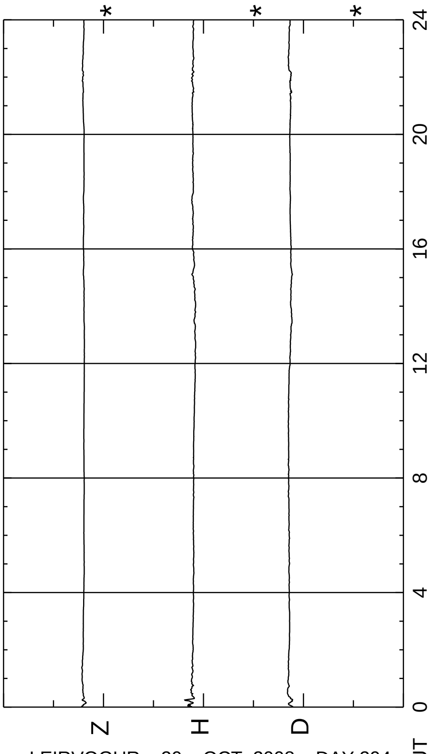
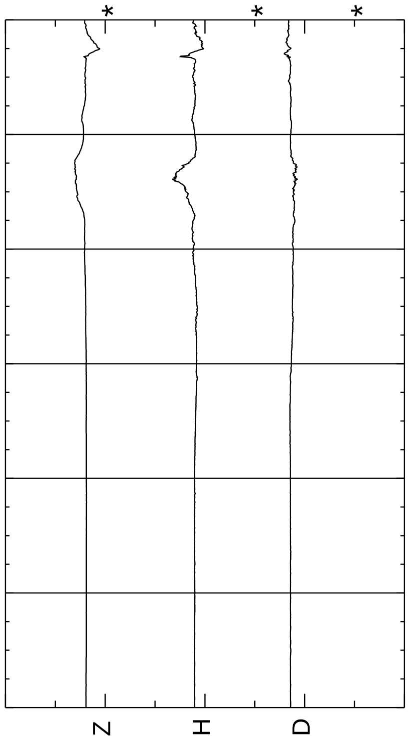
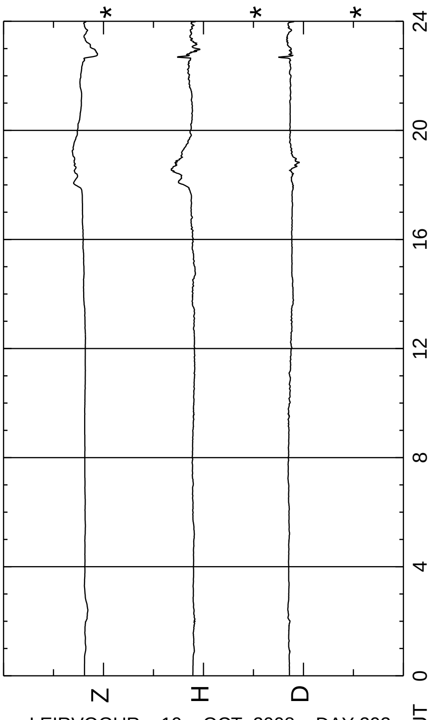


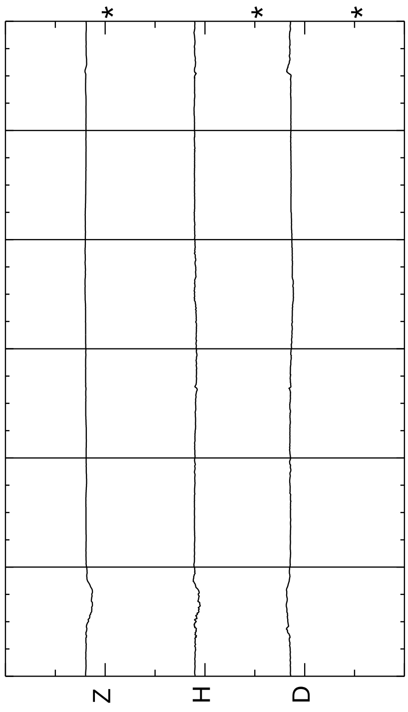
LEIRVOGUR 20. OCT 2008 DAY 294



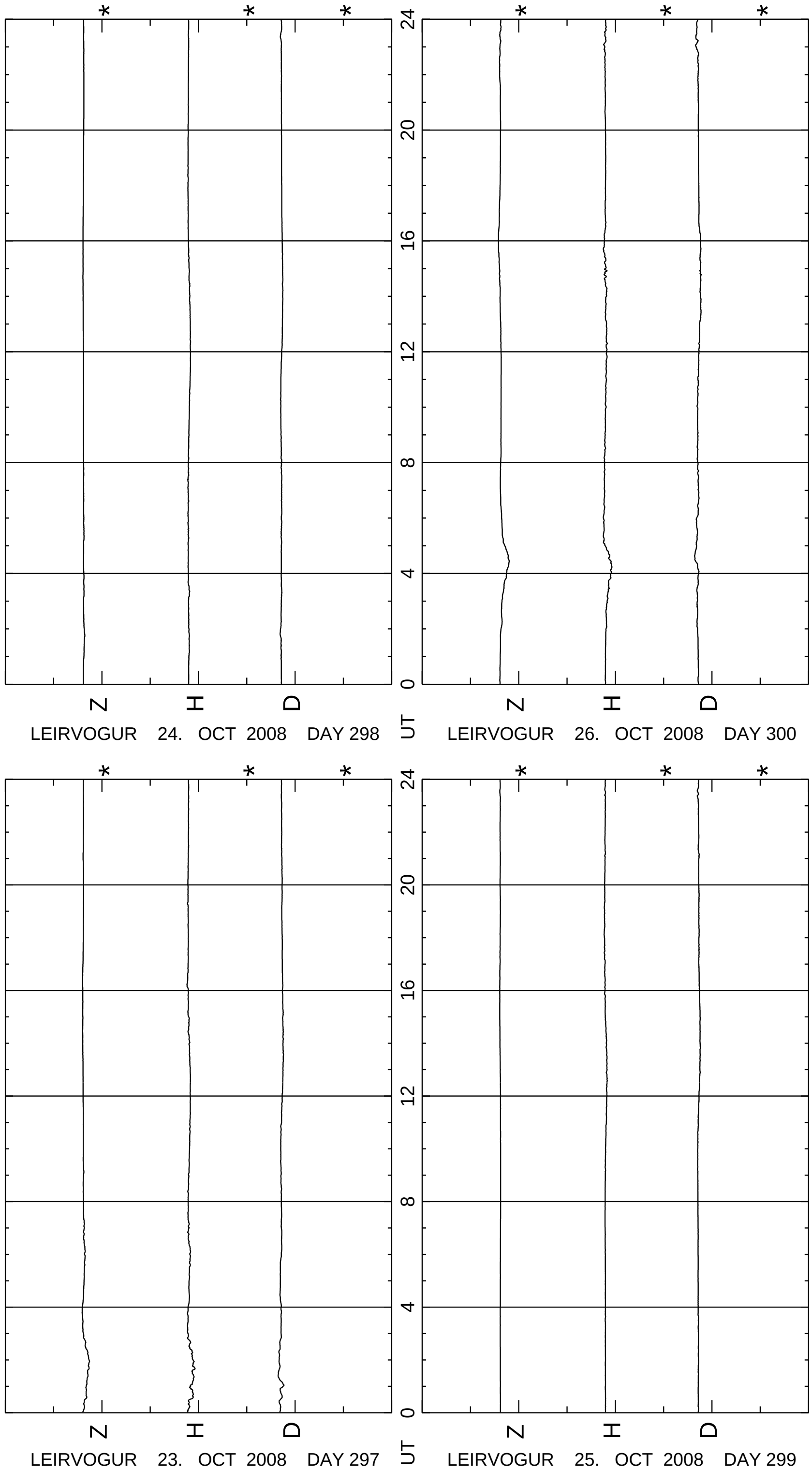
LEIRVOGUR 22. OCT 2008 DAY 296

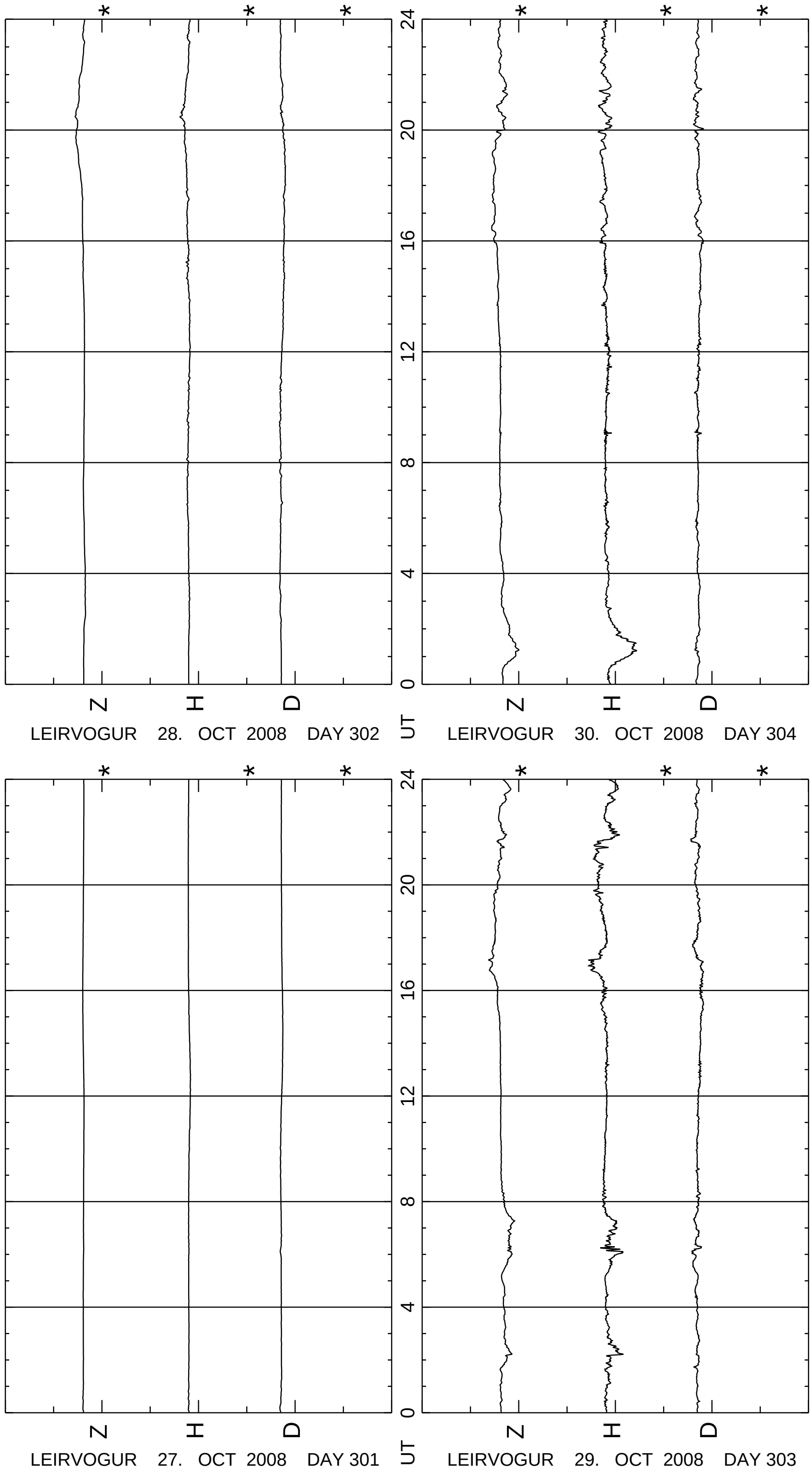


LEIRVOGUR 19. OCT 2008 DAY 293



LEIRVOGUR 21. OCT 2008 DAY 295


Z H D
LEIRVOGUR 24. OCT 2008 DAY 298
Z H D
LEIRVOGUR 26. OCT 2008 DAY 300
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 23. OCT 2008 DAY 297
Z H D
LEIRVOGUR 25. OCT 2008 DAY 299


LEIRVOGUR 28. OCT 2008 DAY 302
LEIRVOGUR 30. OCT 2008 DAY 304
LEIRVOGUR 27. OCT 2008 DAY 301
LEIRVOGUR 29. OCT 2008 DAY 303
Z
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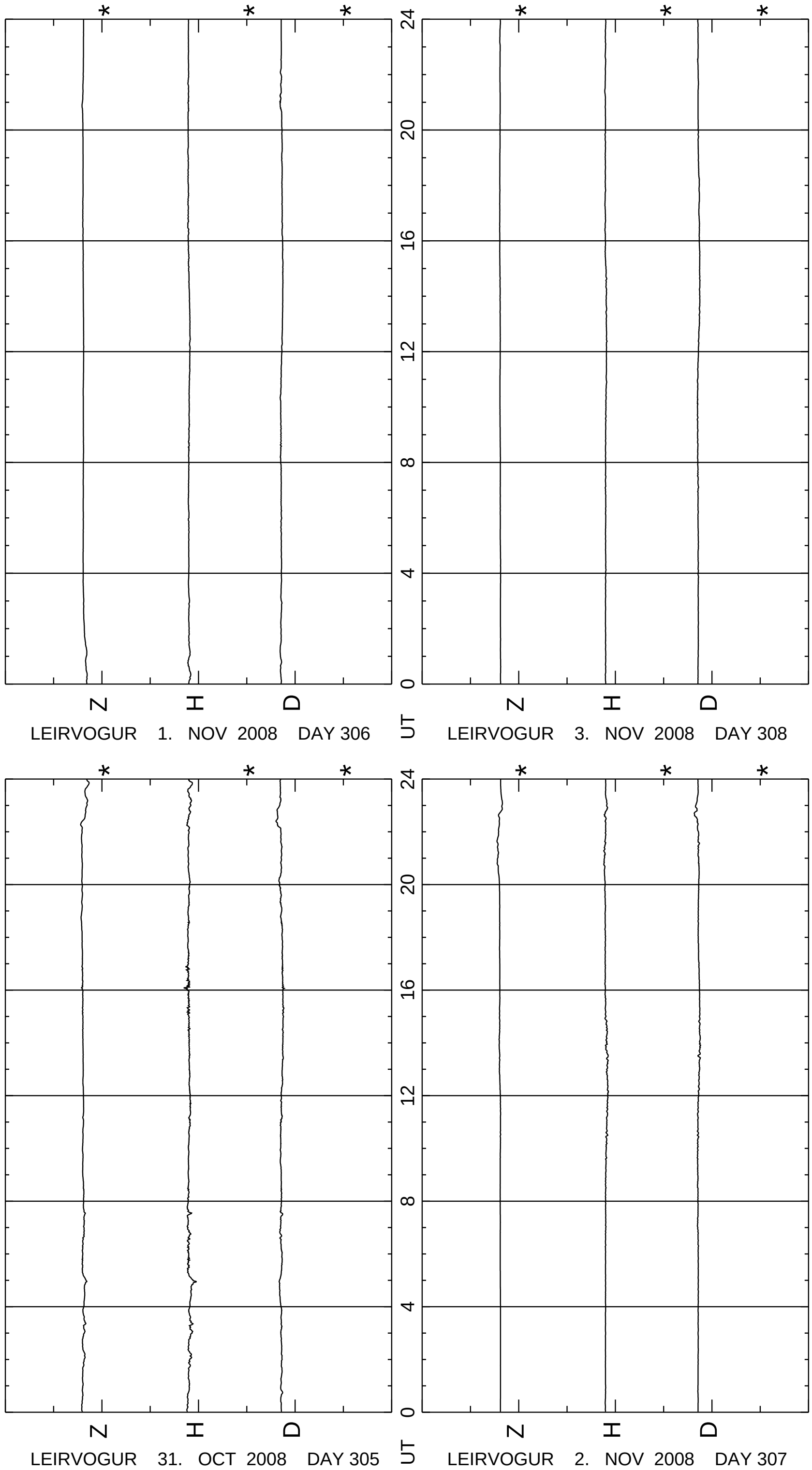
LEIRVOGUR 1. NOV 2008 DAY 306
LEIRVOGUR 3. NOV 2008 DAY 308
LEIRVOGUR 31. OCT 2008 DAY 305
LEIRVOGUR 2. NOV 2008 DAY 307
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Z
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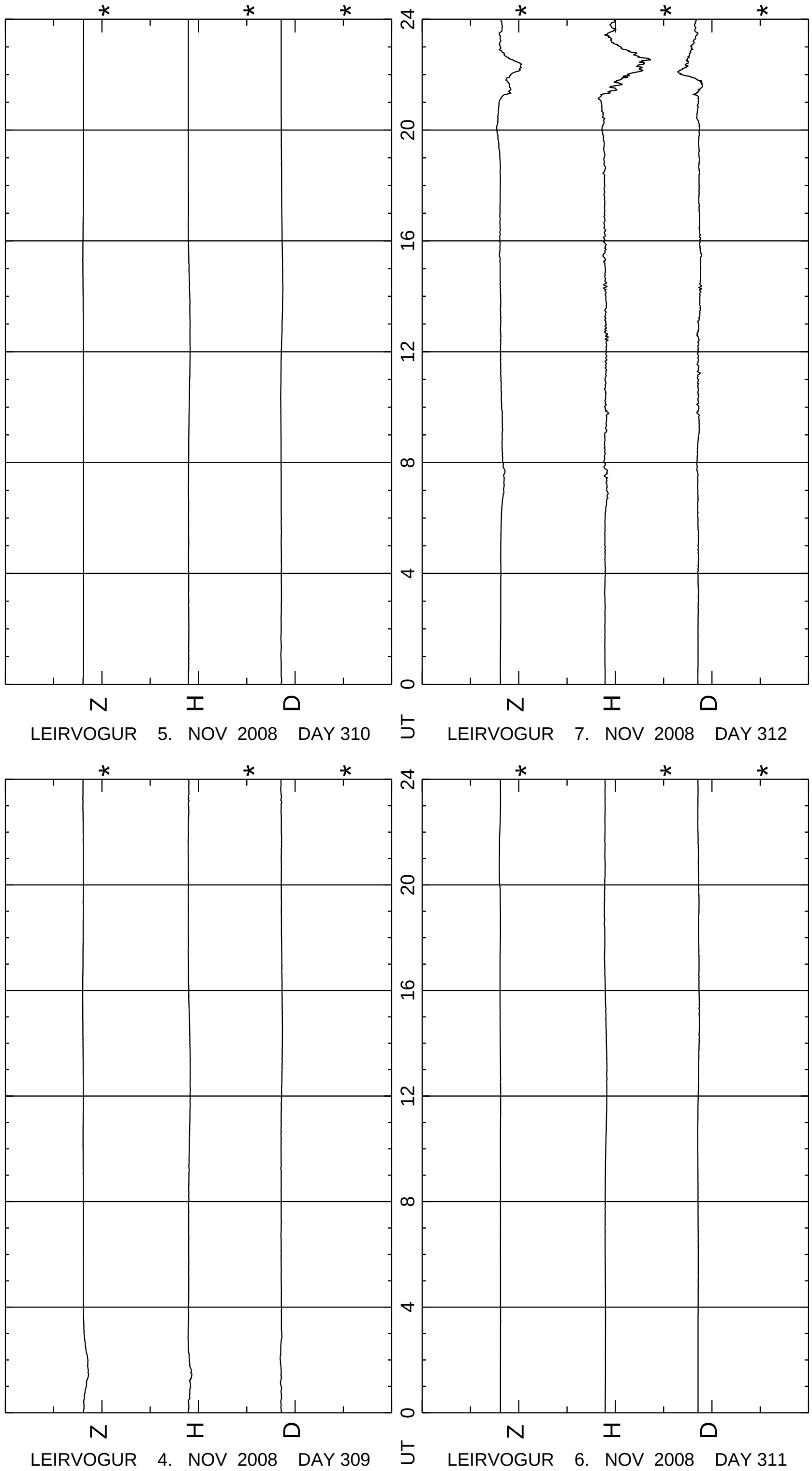
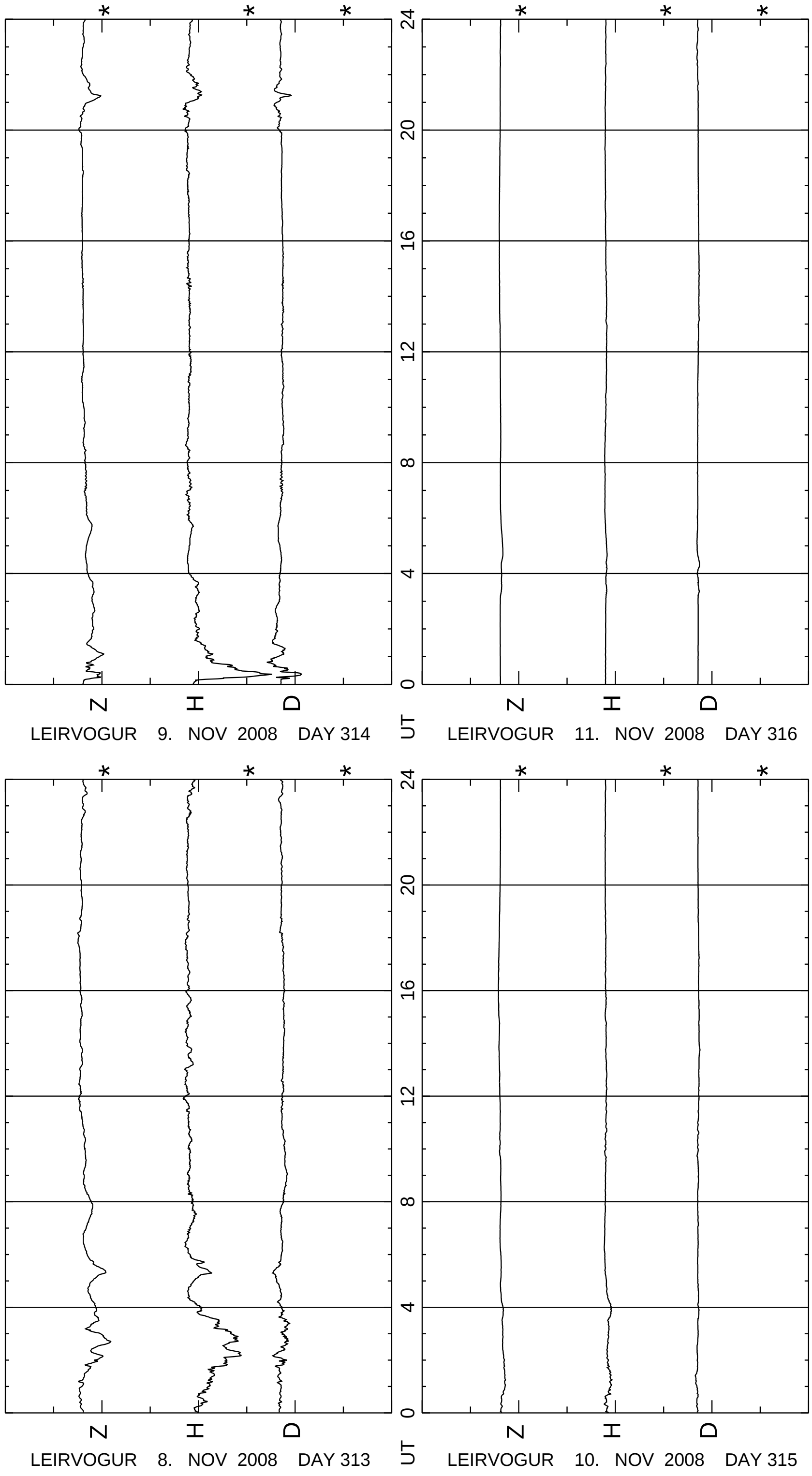
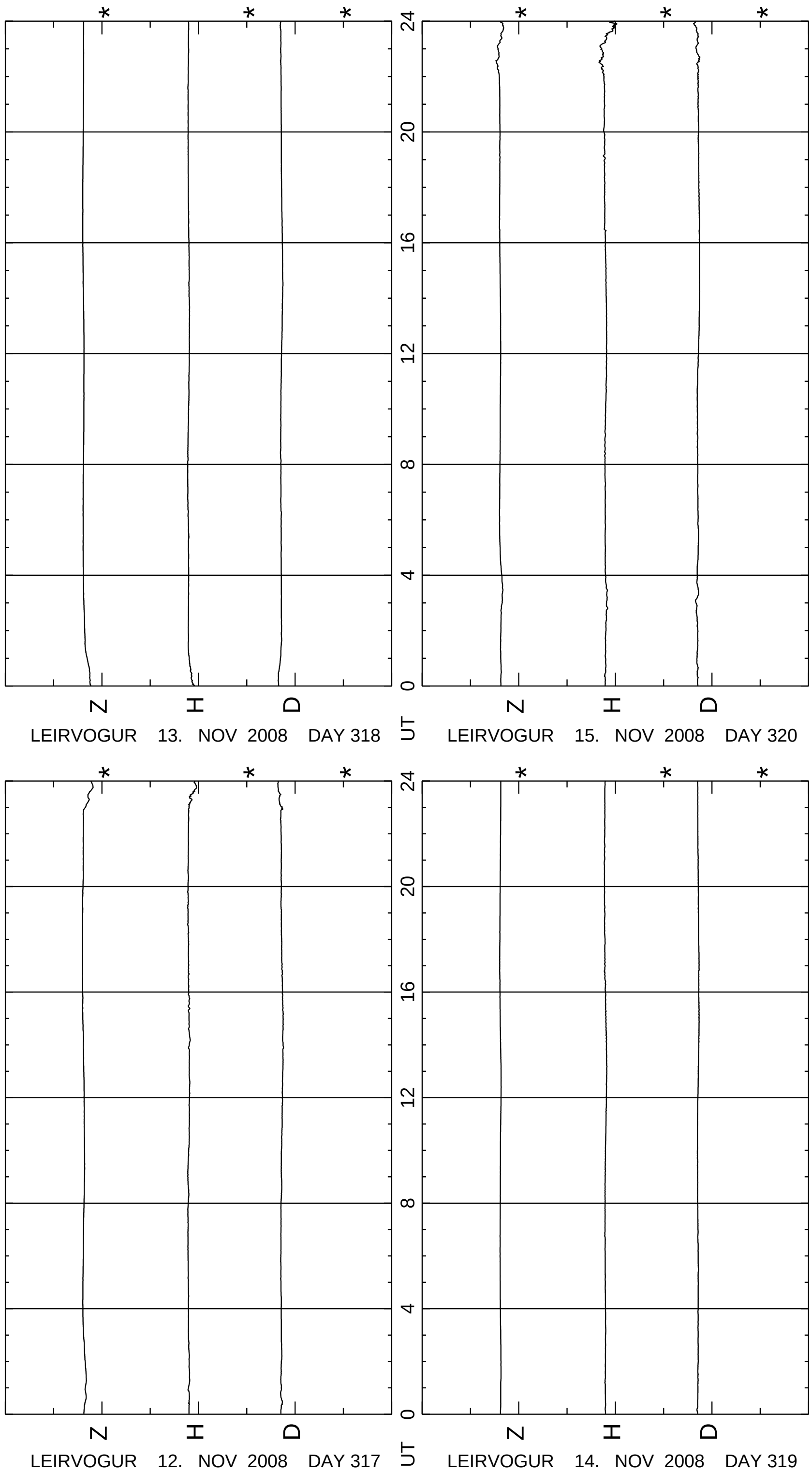

LEIRVOGUR 5. NOV 2008 DAY 310
LEIRVOGUR 7. NOV 2008 DAY 312
LEIRVOGUR 4. NOV 2008 DAY 309
LEIRVOGUR 6. NOV 2008 DAY 311
Z H D
UT
0 4 8 12 16 20 24


Z H D
LEIRVOGUR 9. NOV 2008 DAY 314
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 11. NOV 2008 DAY 316
Z H D
LEIRVOGUR 8. NOV 2008 DAY 313
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 10. NOV 2008 DAY 315


LEIRVOGUR 13. NOV 2008 DAY 318
LEIRVOGUR 15. NOV 2008 DAY 320
LEIRVOGUR 12. NOV 2008 DAY 317
LEIRVOGUR 14. NOV 2008 DAY 319
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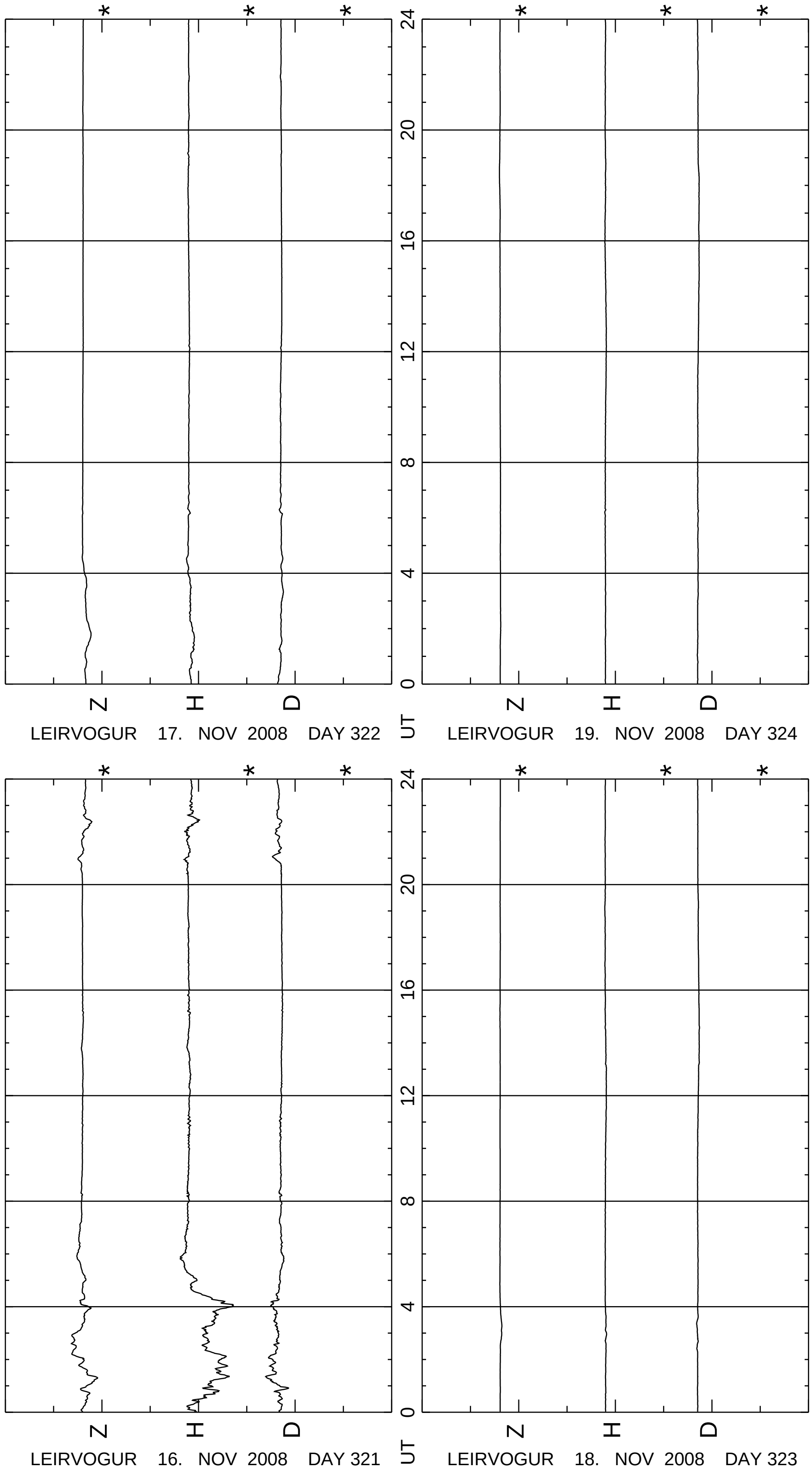
LEIRVOGUR 17. NOV 2008 DAY 322
LEIRVOGUR 19. NOV 2008 DAY 324
LEIRVOGUR 16. NOV 2008 DAY 321
LEIRVOGUR 18. NOV 2008 DAY 323
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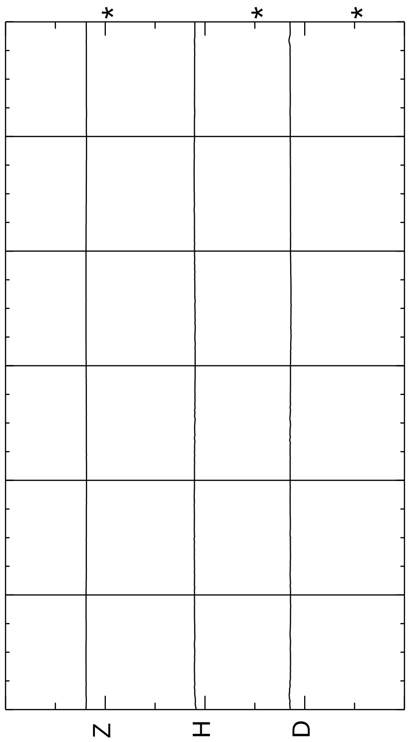
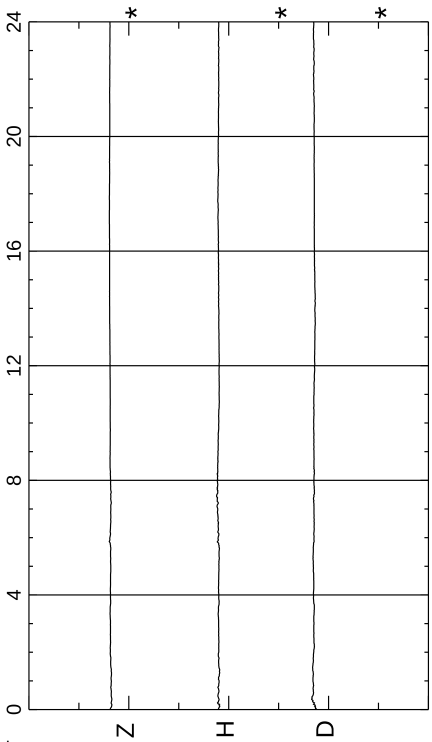
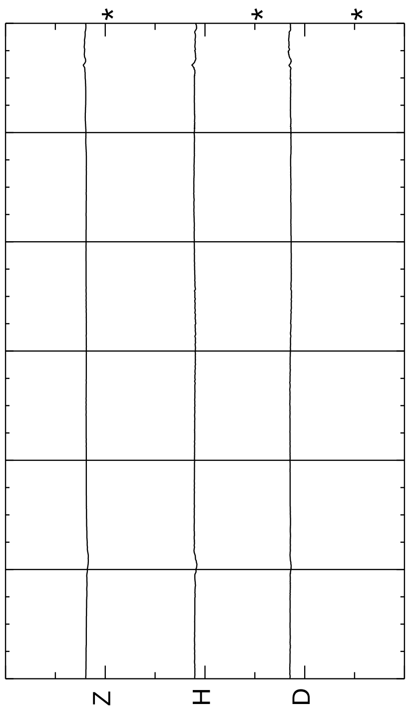


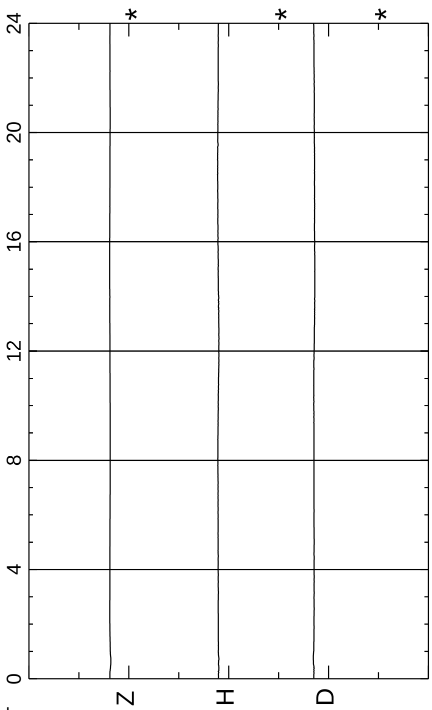
LEIRVOGUR 21. NOV 2008 DAY 326



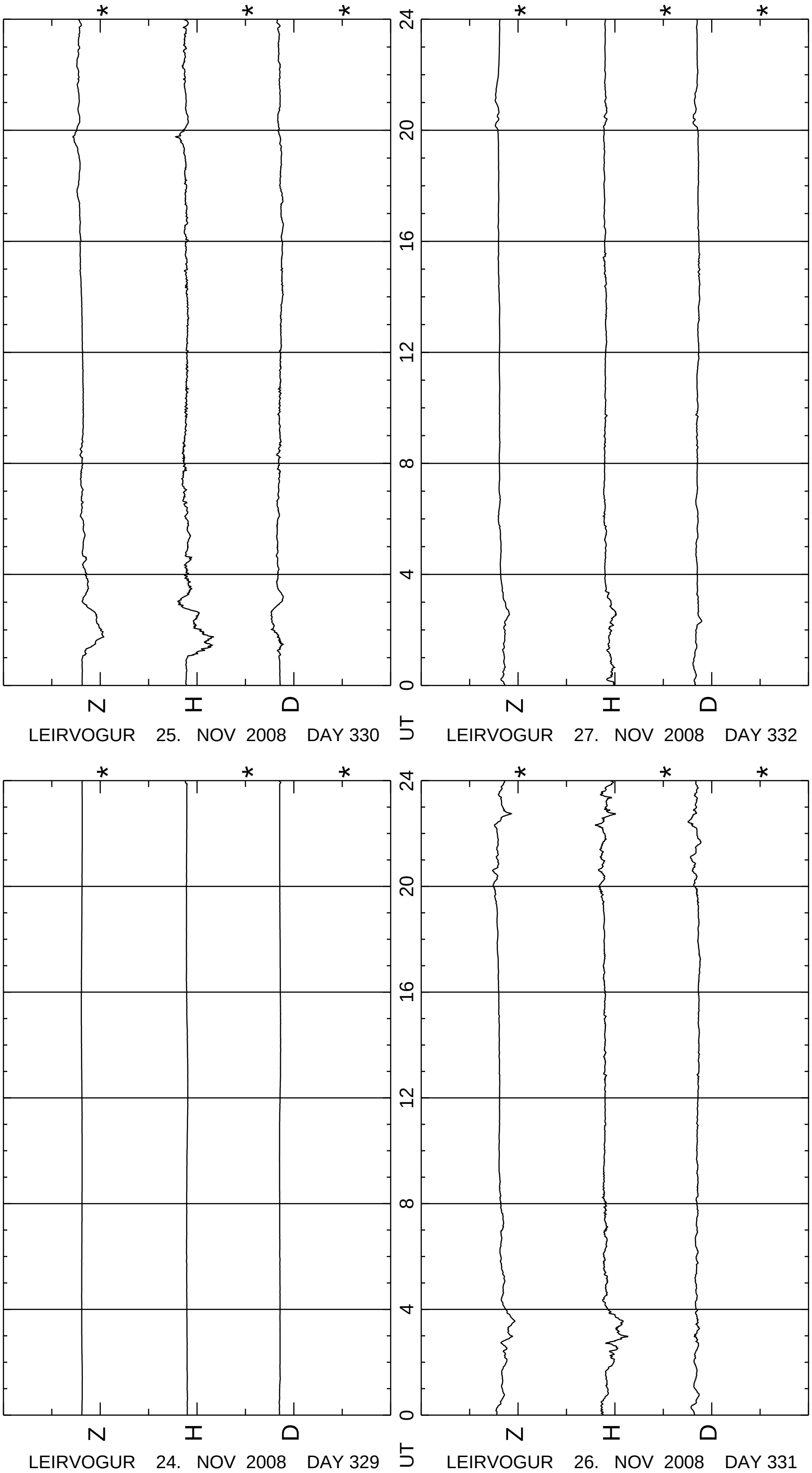
LEIRVOGUR 23. NOV 2008 DAY 328



LEIRVOGUR 20. NOV 2008 DAY 325



LEIRVOGUR 22. NOV 2008 DAY 327


LEIRVOGUR 25. NOV 2008 DAY 330
LEIRVOGUR 27. NOV 2008 DAY 332
LEIRVOGUR 24. NOV 2008 DAY 329
LEIRVOGUR 26. NOV 2008 DAY 331
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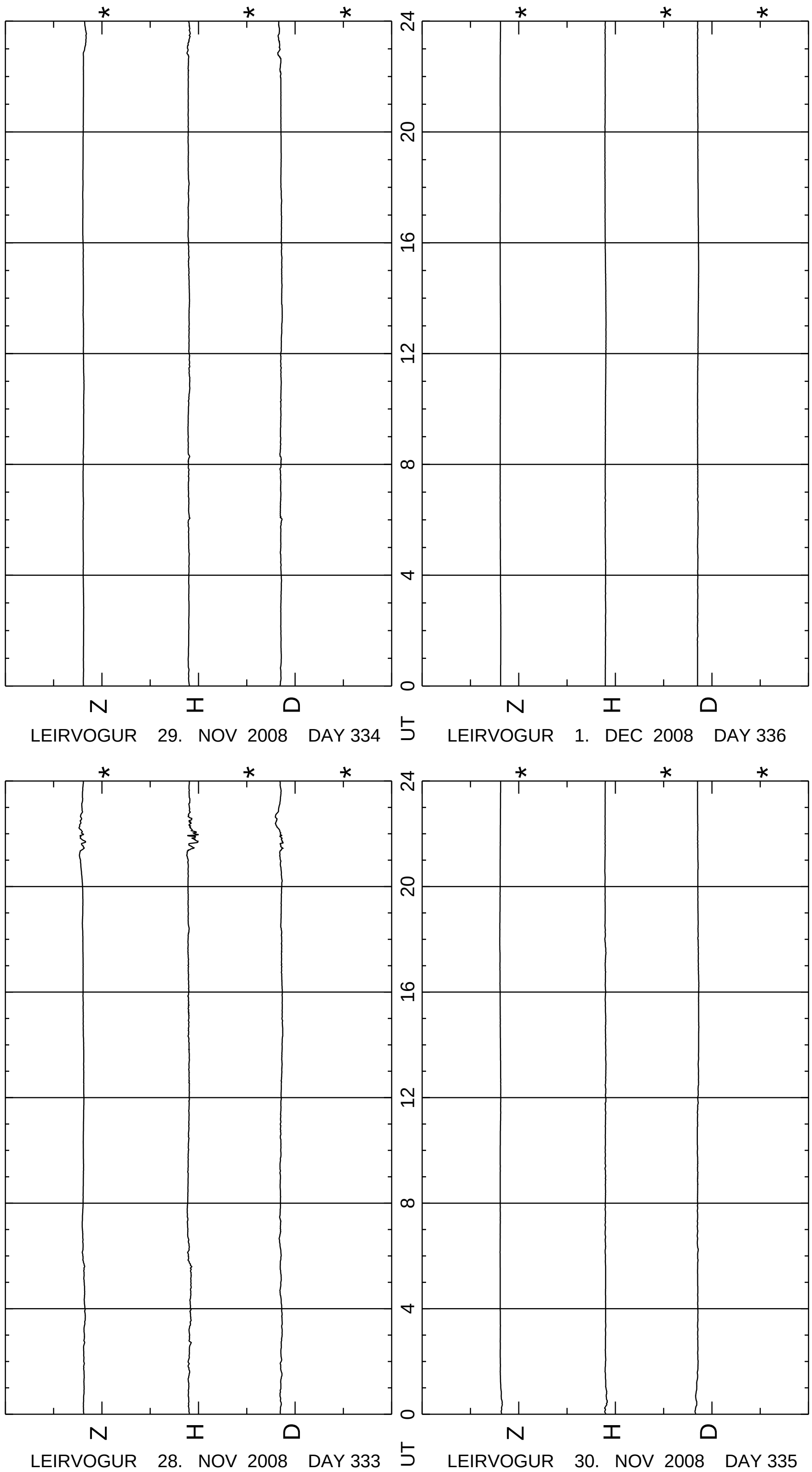
LEIRVOGUR 29. NOV 2008 DAY 334
LEIRVOGUR 1. DEC 2008 DAY 336
LEIRVOGUR 28. NOV 2008 DAY 333
LEIRVOGUR 30. NOV 2008 DAY 335
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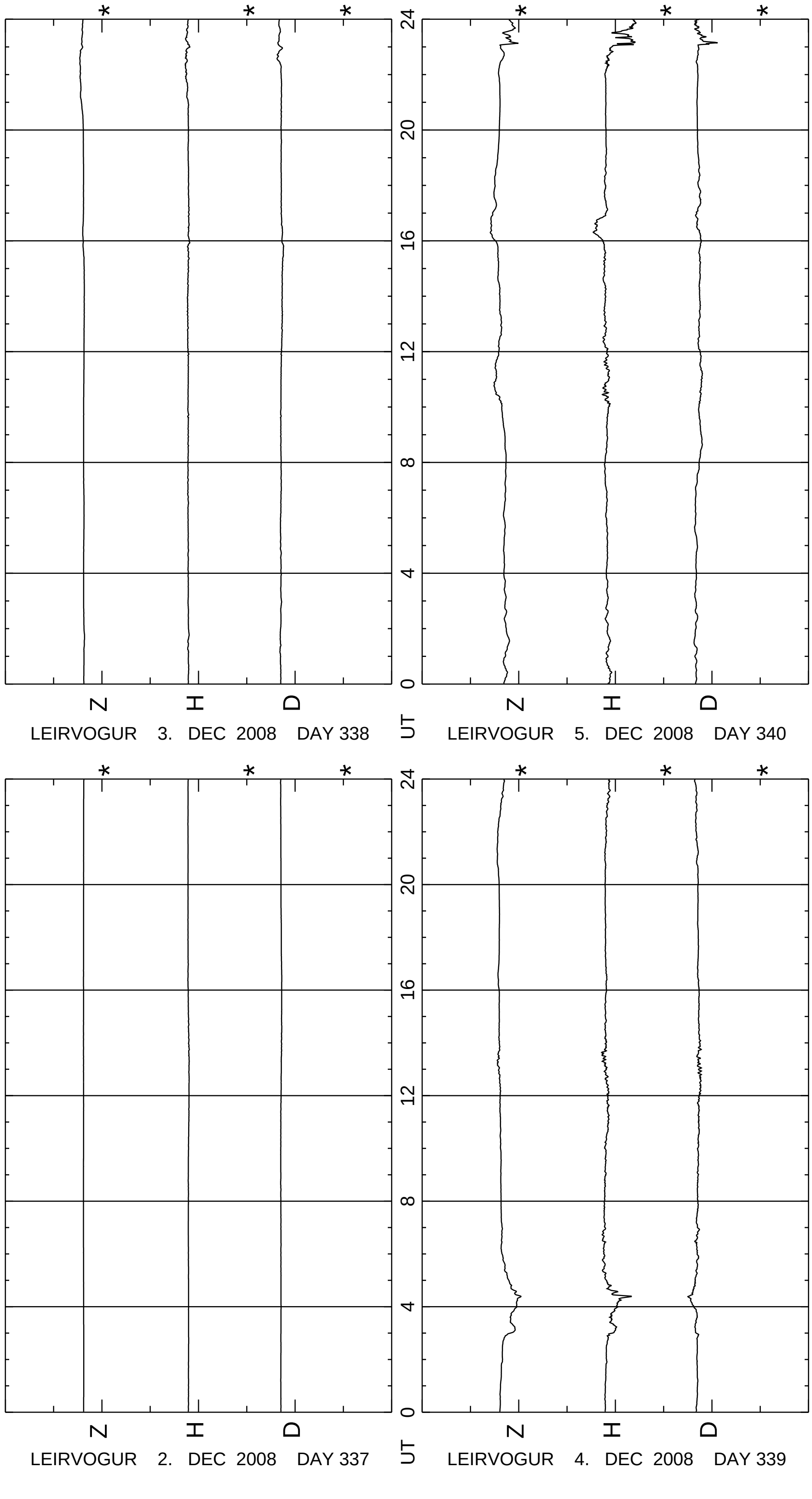
LEIRVOGUR 3. DEC 2008 DAY 338
LEIRVOGUR 5. DEC 2008 DAY 340
LEIRVOGUR 2. DEC 2008 DAY 337
LEIRVOGUR 4. DEC 2008 DAY 339
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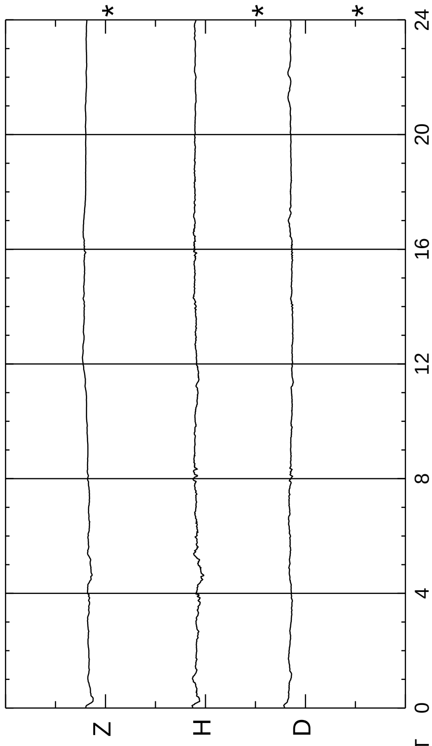
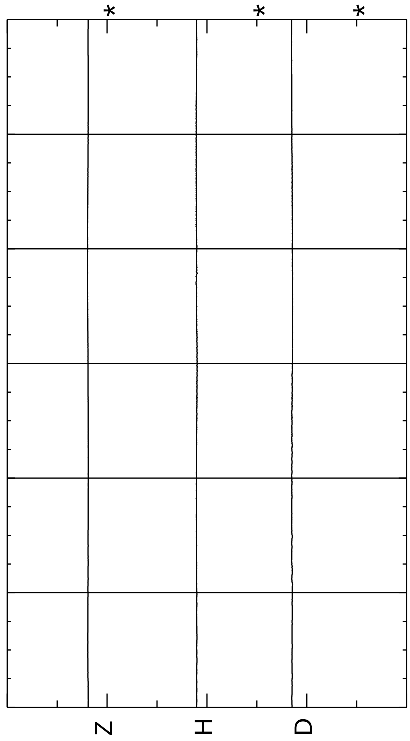
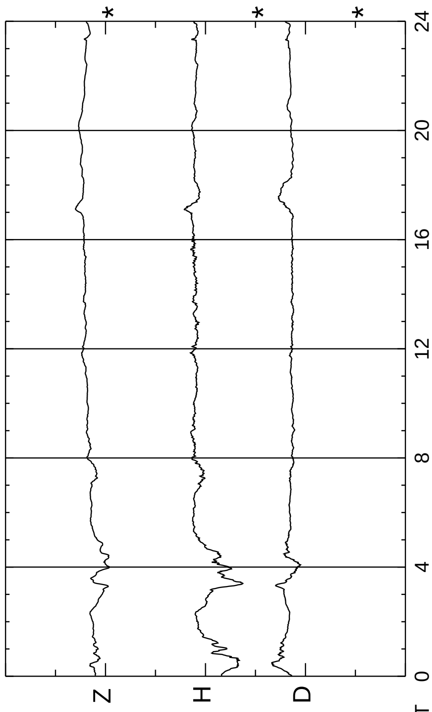


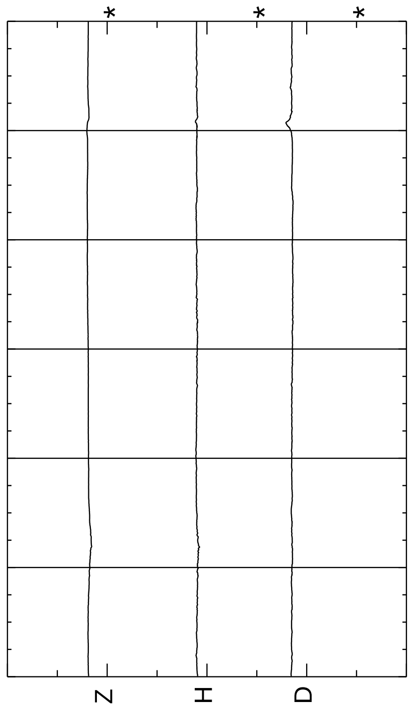
LEIRVOGUR 7. DEC 2008 DAY 342



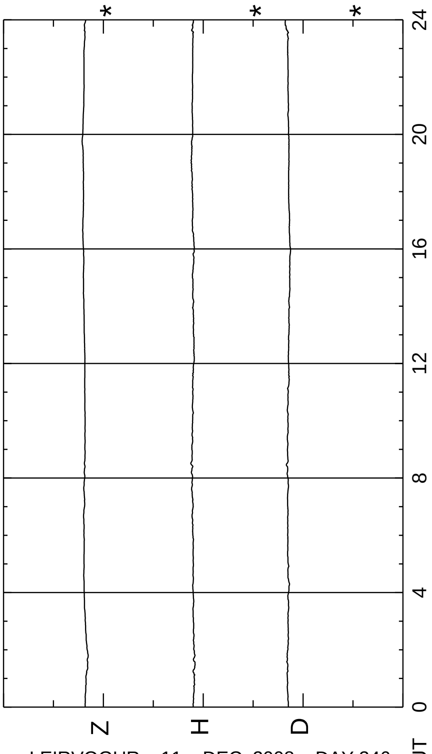
LEIRVOGUR 9. DEC 2008 DAY 344



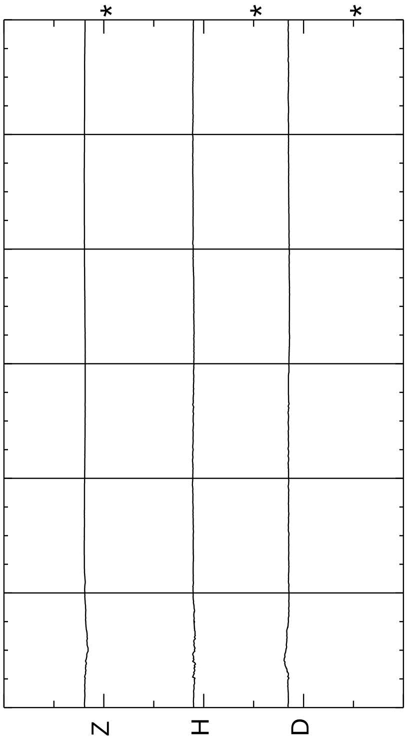
LEIRVOGUR 6. DEC 2008 DAY 341



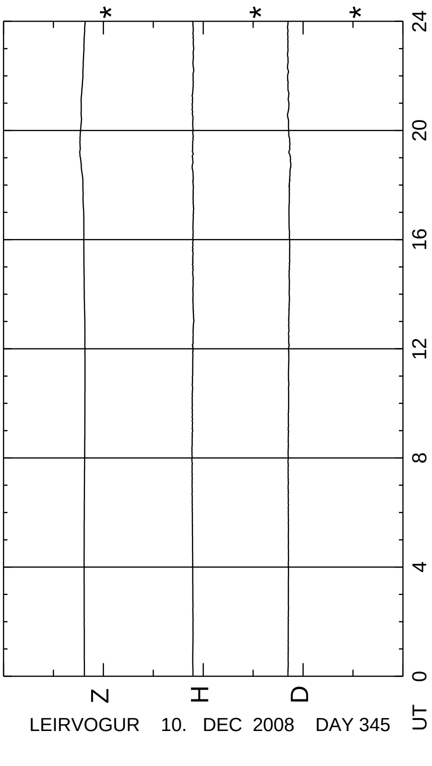
LEIRVOGUR 8. DEC 2008 DAY 343



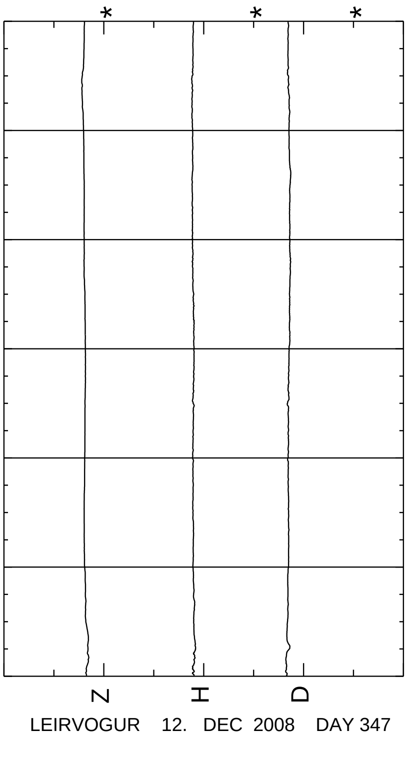
LEIRVOGUR 11. DEC 2008 DAY 346



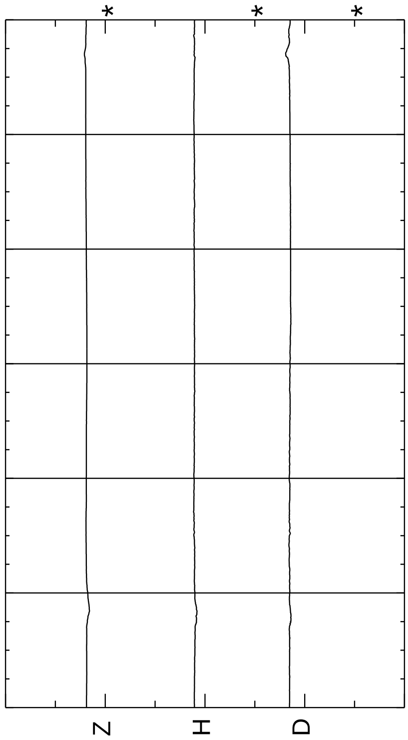
LEIRVOGUR 13. DEC 2008 DAY 348



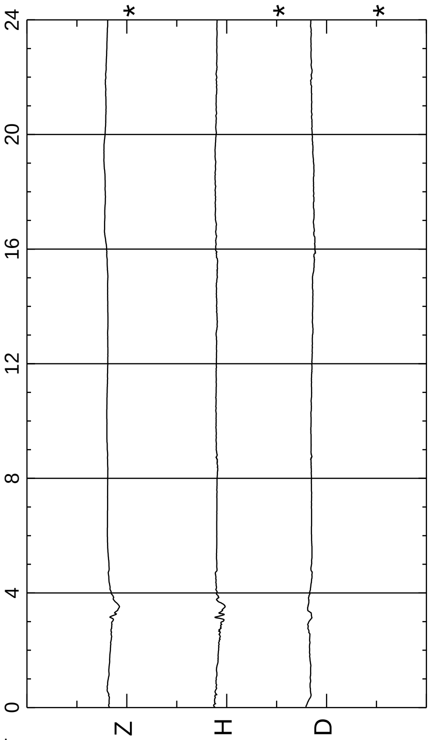
LEIRVOGUR 10. DEC 2008 DAY 345



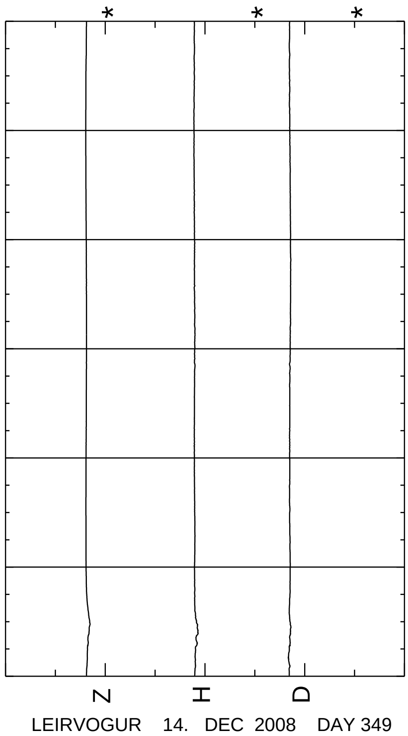
LEIRVOGUR 12. DEC 2008 DAY 347



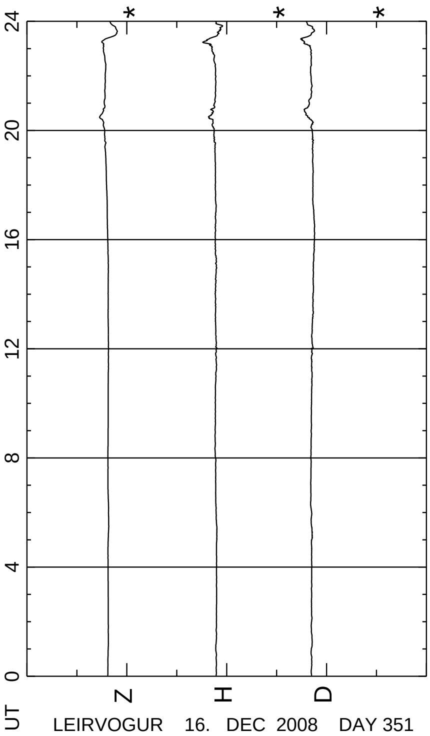
LEIRVOGUR 15. DEC 2008 DAY 350



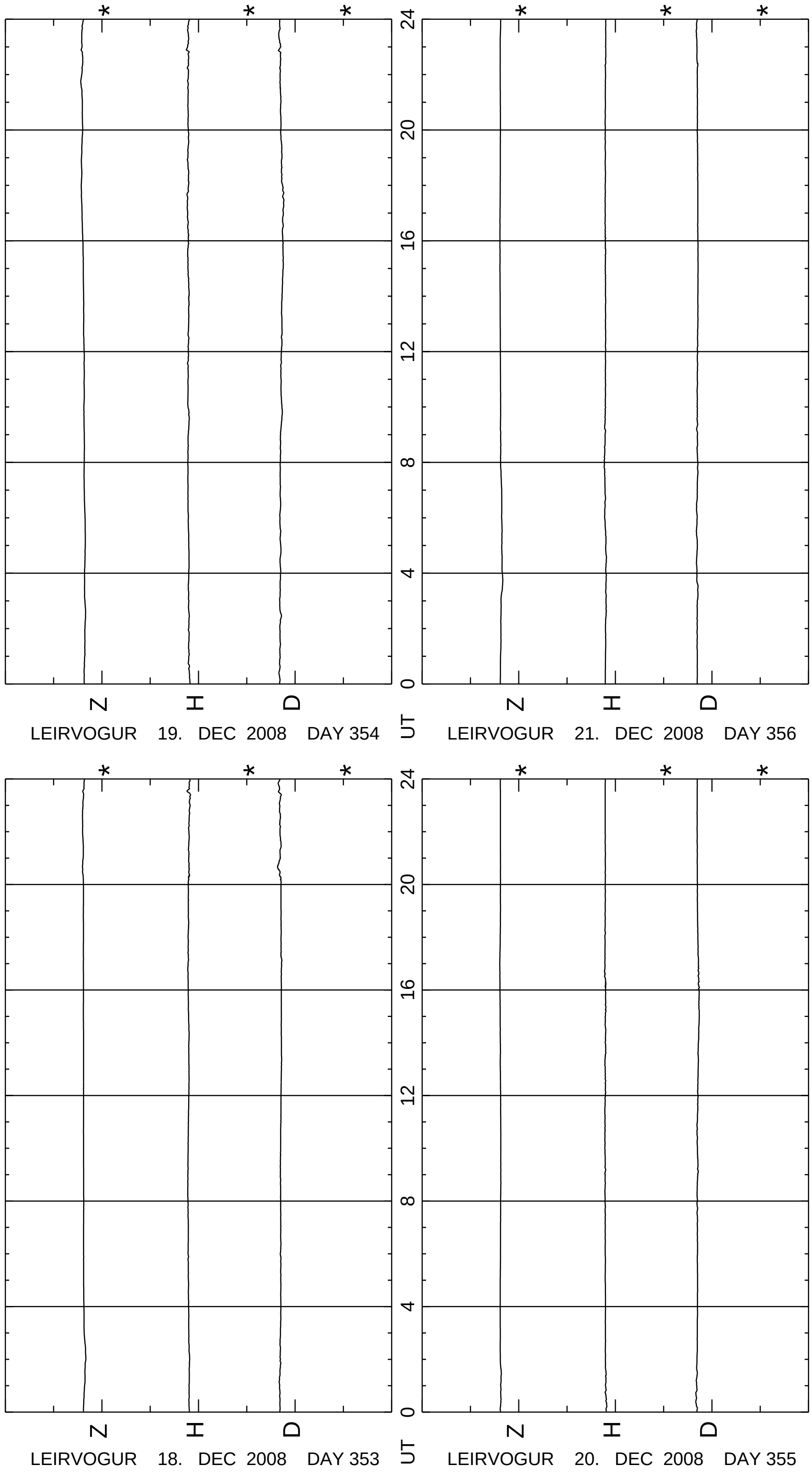
LEIRVOGUR 17. DEC 2008 DAY 352



LEIRVOGUR 14. DEC 2008 DAY 349



LEIRVOGUR 16. DEC 2008 DAY 351


LEIRVOGUR 19. DEC 2008 DAY 354
LEIRVOGUR 21. DEC 2008 DAY 356
LEIRVOGUR 18. DEC 2008 DAY 353
LEIRVOGUR 20. DEC 2008 DAY 355
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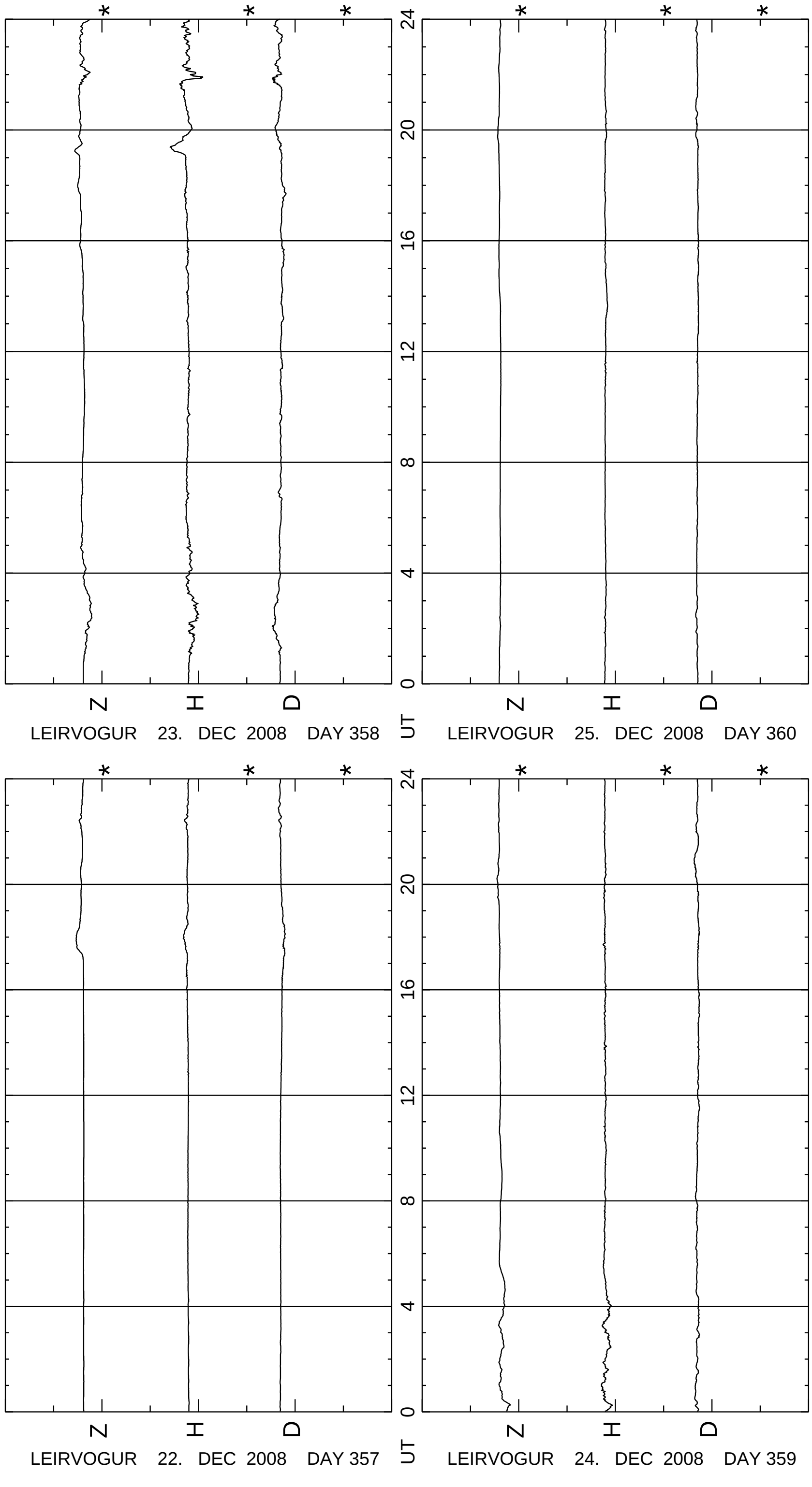
LEIRVOGUR 23. DEC 2008 DAY 358
LEIRVOGUR 25. DEC 2008 DAY 360
LEIRVOGUR 22. DEC 2008 DAY 357
LEIRVOGUR 24. DEC 2008 DAY 359
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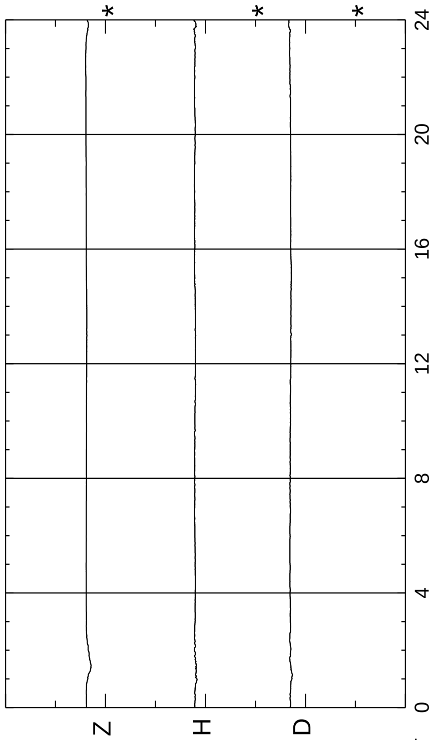
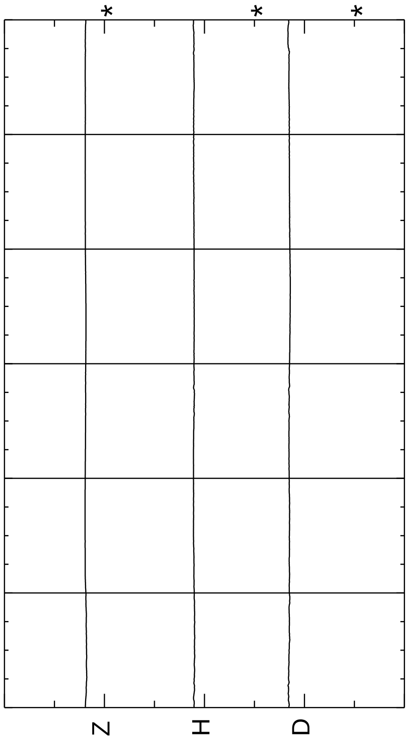
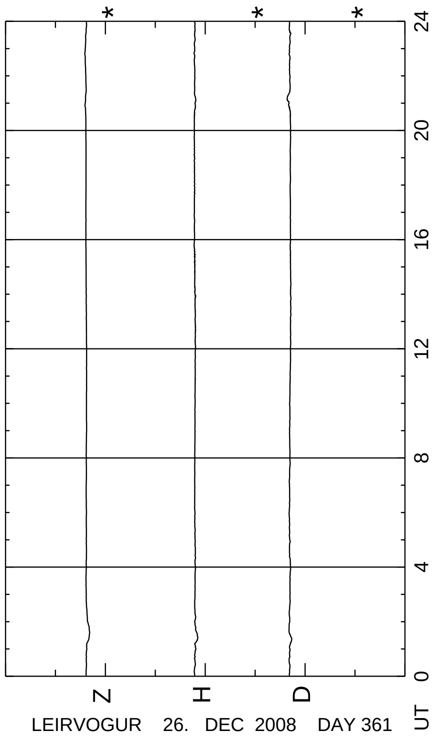


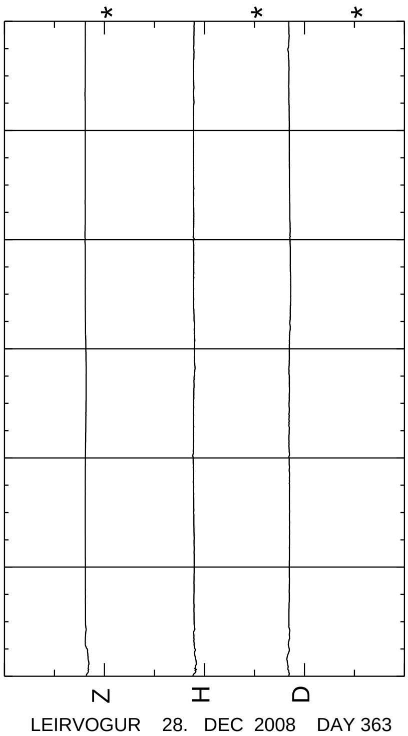
LEIRVOGUR 27. DEC 2008 DAY 362



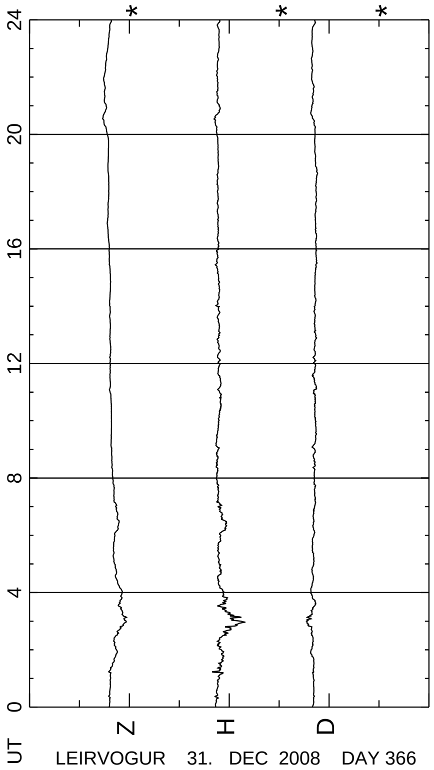
LEIRVOGUR 29. DEC 2008 DAY 364



LEIRVOGUR 26. DEC 2008 DAY 361



LEIRVOGUR 28. DEC 2008 DAY 363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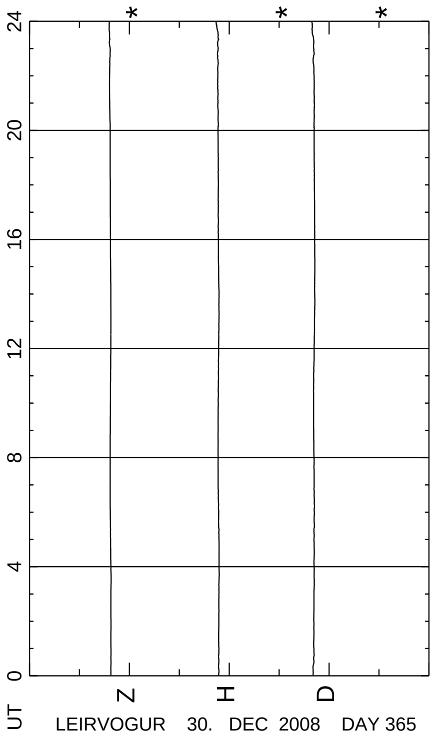
LEIRVOGUR 31. DEC 2008 DAY 366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LEIRVOGUR 30. DEC 2008 DAY 365

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

ANNUAL MEANS AT LEIRVOGUR
(Continued)

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