GeoForschungsZentrum Potsdam
in der Helmholtz-Gemeinschaft

Yearbook
Magnetic Results 2000

Adolf Schmidt
Geomagnetic Observatory
Niemegk

Geomagnetic Observatory
Wingst

Potsdam 2005

Imprint

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Printed by:
Koebcke GmbH
Neuendorfer Str. 39a
D-14480 Potsdam

Note

The yearbooks of Geomagnetic Adolf Schmidt Observatory Niemegk (NGK) of GeoForschungs-Zentrum Potsdam and of Erdmagnetisches Observatorium Wingst (Wingst Geomagnetic Observatory, WNG) are published jointly from 2000 on.

WNG was founded in 1938 and operated by the German maritime authorities - now Bundesamt für Seeschifffahrt und Hydrographie (BSH) - until 1999. As BSH decided to terminate the operation of the observatory, the continuation of measurements could be achieved by a joint sponsorship proposed by GeoForschungsZentrum Potsdam (GFZ). BSH remains responsible for the property and its maintenance, while GFZ took over the actual operation and scientific responsibility.

The first part of this bulletin is the NGK yearbook (pp. 2-49), the second part is the WNG yearbook (pp. 50-73).

Hans Joachim Linthe
Günter Schulz

GeoForschungsZentrum Potsdam

Yearbook

Geomagnetic Results Niemegk

Adolf Schmidt Geomagnetic Observatory

Niemegk

2000

Hans-Joachim Linthe

Potsdam 2005

Contents

RESULTS OF THE OBSERVATIONS AT THE ADOLF-SCHMIDT-OBSERVATORIUM FÜR GEOMAGNETISMUS AT NIEMEGK IN THE YEAR 2000

H.-J. Linthe

1. Summary/Introduction

This part of the bulletin reports the observations carried out during the year 2000 at the Niemegk Geomagnetic Adolf Schmidt Observatory.

Instrumentation, Observation and Data

During 2000 the recordings and measurements at the Niemegk observatory have been continued without interruption. Absolute measurements were taken at least once per week using the DI-flux theodolite and an Overhauser effect proton magnetometer. The four classical variometers remained in operation. The three component flux-gate variometers FGE, GEOMAG and MAGSON and the total field variometer GSM recorded continuously throughout the year. There were no modifications to the sensor locations or the recording equipment in 2000.

The Niemegk observatory has continued to participate in the INTERMAGNET project. The recordings of the GEOMAG variometer were sent hourly by METEOSAT as Reported Data. The Definitive Data (minute and hourly mean values) have been submitted for the INTERMAGNET CD-ROM and sent to the World Data Centres.

The Kp calculation was continued as in 1999. Twice a month, immediately after receiving the K numbers of the 13 Kp observatories, the Kp and derived indices are calculated and distributed by e-mail. The tables and diagrams are produced monthly and sent to the users. The whole Kp data series are also available online at:

http://www.gfz-potsdam.de/pb2/pb23/GeoMag/niemegk/kp_index/index.html.

The repeat station measurement campaign started in 1999 was continued and finished. As a result the magnetic map of Germany for the period 2000.5 was determined.

Meetings and Visitors

On September 20, 2000, a meeting took place at Niemegk observatory with scientists involved in the observatories Fürstenfeldbruck, Göttingen, Niemegk and Wingst. M. Beblo, V. Haak, R. Holme, M. Korte, H.-J. Linthe, E. Pulz, G. Schulz, H. Soffel and P. Spitta attended this meeting.

R. Holme, M. Korte, H.-J. Linthe and E. Pulz participated in the IXth IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition and Processing, held in June at Hurbanovo observatory, Slovakia.

A students group of the Institute for Geophysics and Meteorology of the Technical University of Braunschweig visited the observatory at May 26, 2000, in the frame of their lectures. The training “Absolute determination of the geomagnetic field vector” was carried out by the following student groups:

- a group from the Geophysical Institute of the Freie Universität Berlin on June 21, 2000.
- two groups of the Geoscience Institute of Potsdam University on November 20 and 24, 2000.

At February 15, 2000, a special physics class from Liberius Gymnasium at Dessau visited the observatory. Several interested groups took guided tours through the observatory.

On October 24, 2000, three people from AMilGeo (Amt für millitärisches Geowesen) at Euskirchen came to the observatory for calibration of their declinometers.

Constructional Changes

The renovation of the main building continued. The electrical system, painting and floors of first floor and basement were finished.

A new magnetogram archive was established in the heating house (house No. 8) by using new shelfs in the former coal storage room.

Data Availability
In addition to this yearbook NGK information is available online. The observatory's homepage is
http://www.gfz-potsdam.de/pb2/pb23/Niemegk/dt/index.html

The preliminary variations and K indices in graphical form can be found at
http://www.gfz-potsdam.de/pb2/pb23/GeoMag/niemegk/Magnetogram/niemegk_dhz.html
http://www.gfz-potsdam.de/pb2/pb23/GeoMag/niemegk/Magnetogram/niemegk_k.html

A digital archive of minute mean data can be accessed at
http://www.gfz-potsdam.de/pb2/pb23/GeoMag/niemegk/DB/index.html

Rapid access information is published in the Monthly Reports, also available at:
http://www.gfz-potsdam.de/pb2/pb23/GeoMag/niemegk/monrep

Both publications, this report and the monthly report, can be requested from the GFZ; see the address in the imprint. The web home page of the Niemegk observatory can be found at:
http://www.gfz-potsdam.de/pb2/pb23/Niemegk/en/index.html

Acknowledgements
The following persons participated in the production of this yearbook: I. Goldschmidt for absolute measurements and tables, M. Fredow for absolute measurements and plots, J. Schulz for tables and typing of the manuscript and J. Haseloff for diagrams.

Content of the CD
As in the 1999 issue the complete results of the observatory are given in digital form on a CD-ROM. Wingst observatory data are included. The structure and the data formats of the CD-ROM are organised in the same manner as for INTERMAGNET [3]. The CD contains this report as "yearb00.pdf" and the following directories:

- INTERMAGNET
- Niemegk
- Wingst

The substructure of the directories is as follows:

INTERMAGNET

```
├── gmag.cfg                         Configuration file for imag23.exe
├── imag23.exe                       Browsing program
├── instimag.exe                     Installation program
├── readme.txt                       ASCII file containing contents information
├── mag1995 ... mag2000
│   ├── crty_inf
│   │   ├── ctrylist.idx             Country list file for imag23.exe
│   │   └── intro.pcx                Welcome graphic file for imag22.exe
│   ├── SSS                          Data subdirectories NGK, WNG
│   │   ├── SSSYYjan.bin             January minute mean values binary file
│   │   ├── SSSYYfeb.bin             February minute mean values binary file
│   │   │   ...
│   │   ├── SSSYYdec.bin             December minute mean values binary file
│   │   ├── SSSYY.blv                ASCII base line file
│   │   ├── SSSYYk.dka               ASCII K number file
│   │   ├── readme.SSS               ASCII information file
│   │   └── yearmean.SSS             ASCII annual mean values file
│   └── obsy_inf
│       └── YYobsdat.dbf             Configuration file for imag22.exe
├── plotutil
│   ├── hpgl                         HP-GL plotting programs :
│   │   ├── imagblv.exe              Base lines
│   │   ├── imagdayl.exe             Daily mean values
│   │   ├── imaghour.exe             Hourly mean values
│   │   ├── imagknum.exe             K numbers
│   │   └── imagn.exe                Daily magnetograms
│   └── ps                           PostScript plotting programs:
│       ├── gs601w32.exe                 Ghostscript
│       ├── gsv34w32.exe             Ghostview
│       ├── imagplot.exe             Plotting program for Windows
│       ├── readme.txt               Information about PS plotting
│       └── salflibc.dll             Windows system file
└── xtras
    ├── prnstruc.exe                 Display of the binary file format
    └── structur.dat                 Data file for prnstruc.exe
```

with: YY = Year (95-99, 00); SSS = NGK, WNG

Niemegk

```
└──── data00                    2000 data files in IAGA2002 format
      ├──── ngk2000MMdhor.hor   Hourly mean values
      ├──── ngk2000dday.day     daily mean values
      ├──── ngk2000dmon.mon     monthly mean values
      └──── ngk2000dyea.yea     annual mean values
```

with: MM = month (00…12)

Wingst

```
├──── tree.txt                  File structure of directory Wingst
├──── yearb00
│     ├──── instr.txt           Instruments used since 1938
│     └──── wng6dec.pdf         Reprint of Schulz, 2001
└──── data00                    2000 data files
      ├──── wlh+wng.yr          Updated epoch values WLH and WNG
      ├──── wng.mon             Updated monthly mean values WNG
      ├──── wng.day             Updated daily mean values WNG
      ├──── wng.k               Updated WNG K numbers
      └──── iaga00              2000 data files in IAGA2002 format
            ├──── YR.WNG        Epoch values WNG
            ├──── 2000MT.WNG    Monthly mean values
            ├──── 2000DY.WNG    Daily mean values
            ├──── 2000mmHR.WNG  Hourly mean values
            └──── 2000mmMN.WNG  Minute mean values
```

with: MM = month (00…12)

2. Variation Recording

In 2000 the following recording equipments were in operation (Table 1):

- 3 three component flux-gate variometers with digital recording (FGE, GEOMAG, MAGSON)
- 1 scalar Overhauser effect proton magnetometer with digital recording (GSM)
- 1 three component induction coil magnetometer with analogue and digital recording (ICM)
- 4 classical variometer systems with photographic recording (CS, CW, CE, CR)
- 2 telluric recording lines (1000m) with analogue recording (TR)

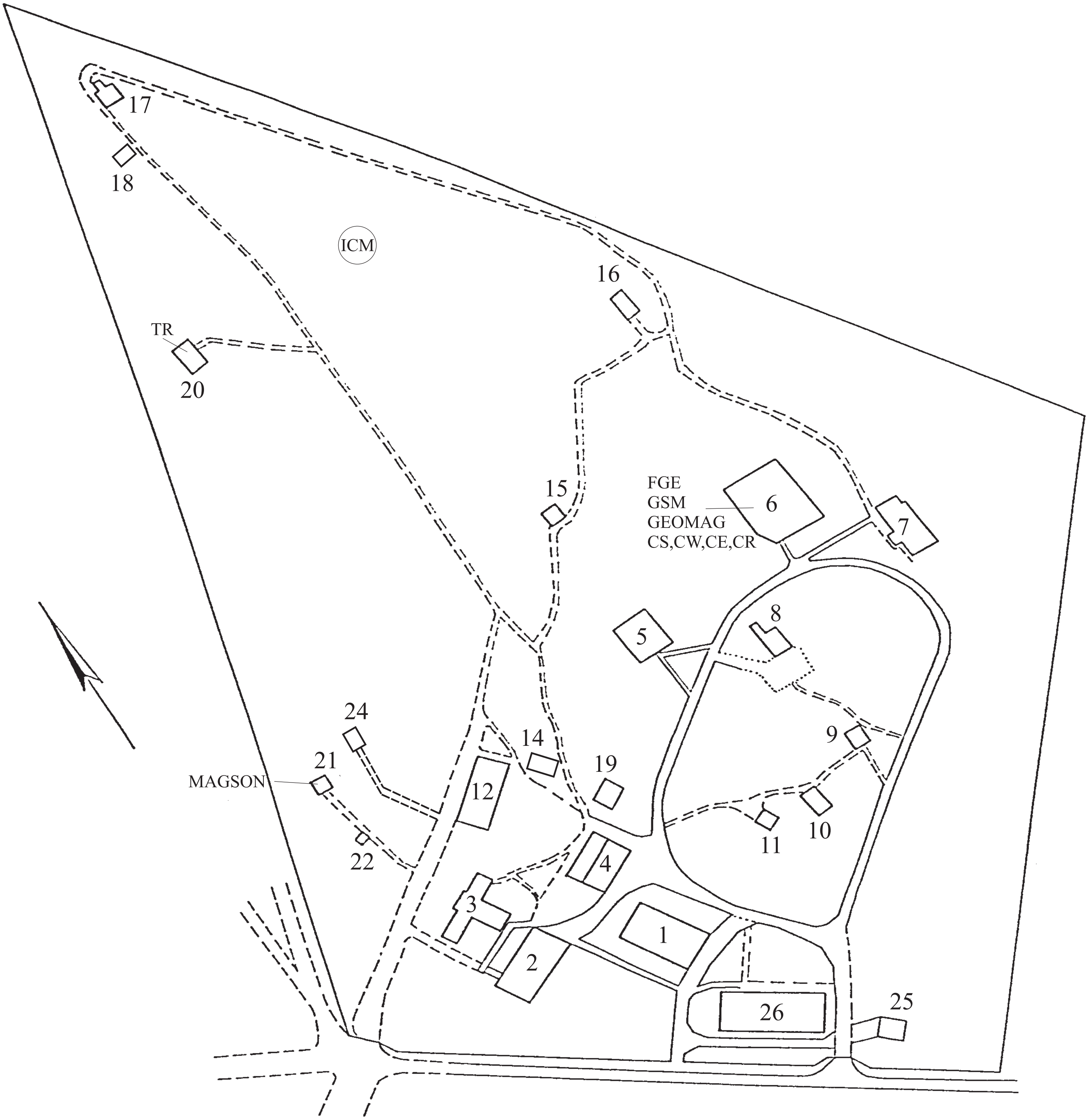
Name	**Elements**	**Recording**	**Sampling rate**	**Resolution**
FGE	H, D, Z	digital	2 Hz	0.1 nT
GEOMAG	X, Y, Z, F	digital	5 s /1 min	0.1 nT
MAGSON	X, Y, Z	digital	1 s	0.1 nT
GSM	F	digital	5 s	0.01 nT
ICM	X, Y, Z	analogue; digital	360 mm/h; 1 s	0.01 nT
CS	X, Y, Z	analogue	20 mm/h	2 nT/mm
CW	H, D, Z	analogue	20 mm/h	2 nT/mm
CE	H, D, F	analogue	20 mm/h	2 nT/mm
CR	H, D, Z	analogue	20 mm/h	10 nT/mm
TR	N-S, E-W	analogue	20 mm/h	0.2 mV/km/mm

<u>Table 1:</u> Parameters of the variometer systems

Fig. 1 shows a sketch of the premises of the observatory, including the locations of the recording systems. Fig. 2 shows the ground plan of the variation house (building No. 6) showing the locations of the variometers. Fig. 3 shows the block diagram of the recording systems and the data paths. Table 2 contains the conversion factors of the single geomagnetic elements for the year 2000 according to [1] p.5 fig. 5;2.

In the horizontal plane					**In the plane of the magnetic meridian**				
	ΔX/nT	ΔY/nT	ΔH/nT	ΔD/’		ΔH/nT	ΔZ/nT	ΔF/nT	ΔI/’
ΔX/nT	- - -	- 41.3359 -0.02419	0.9997 - 1.0003	-0.13212 -225.880 -	ΔH/nT	- - -	- 0.4164 -2.4014	0.3844 - 2.6013	-13.1187 -15.3936 -
ΔY/nT	- 0.02419 -41.3359	- - -	0.02418 - 41.3480	5.4613 5.4645 -	ΔZ/nT	- 2.4014 -0.4164	- - -	0.9232 - 1.0832	5.4629 36.9664 -
ΔH/nT	- 1.0003 0.9997	41.3480 - 0.02418	- - -	-225.814 0.13216 -	ΔF/nT	- 2.6013 0.3844	1.0832 - 0.9232	- - -	-5.9176 34.1258 -
ΔD/’	- -7.5689 -0.00443	0.1831 - 0.1830	-0.00443 7.5667 -	- - -	ΔI/’	- -0.07623 -0.06496	0.1831 - 0.02705	-0.1690 0.02930 -	- - -
Δ D/nT = 5.4629 · Δ D/’					Δ I/nT = 14.2107 · Δ I/’				

<u>Table 2:</u> Conversation factors for the geomagnetic elements in 2000



1. Main building
2. Electric laboratory
3. Measurement and computer centre
4. Storehouse
5. Magnetic laboratory
6. Variation house
7. Absolute house
8. Heating house
9. Small hut
10. Adjusting hut
11. Thermal adjusting hut
12. Garage
14. Equipments shed
15. Proton magnetometer hut
16. Control hut
17. Coil hut No. 1
18. Control hut
19. Storage hut
20. Telluric hut
21. Coil hut No. 2
22. Small control hut
24. Coil hut No. 3
25. Power unit house
26. Workshop building

Fig. 1: Sketch of the premises of the observatory

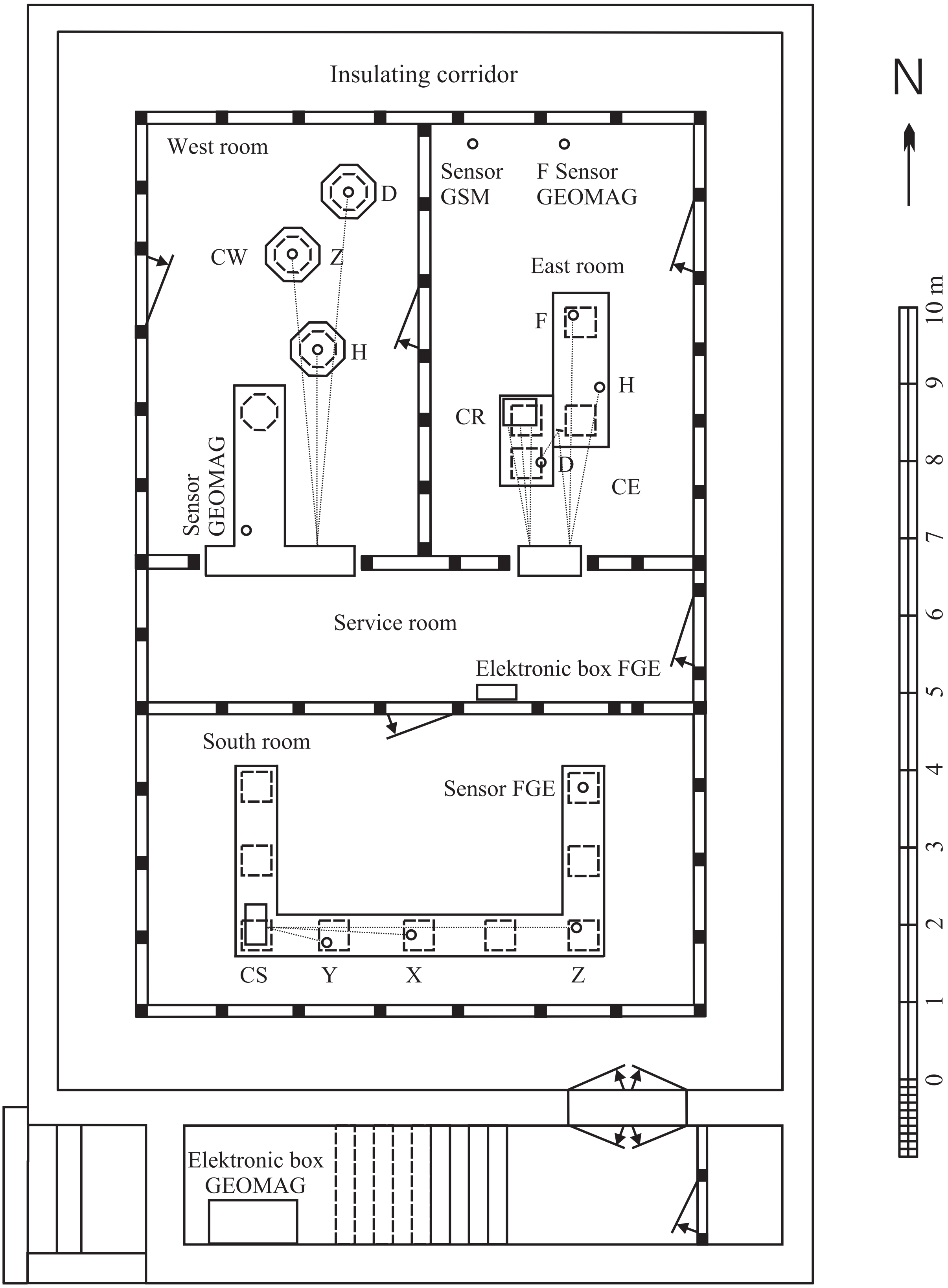


Fig. 2: Ground plan of the Variation House with the locations of the variometers

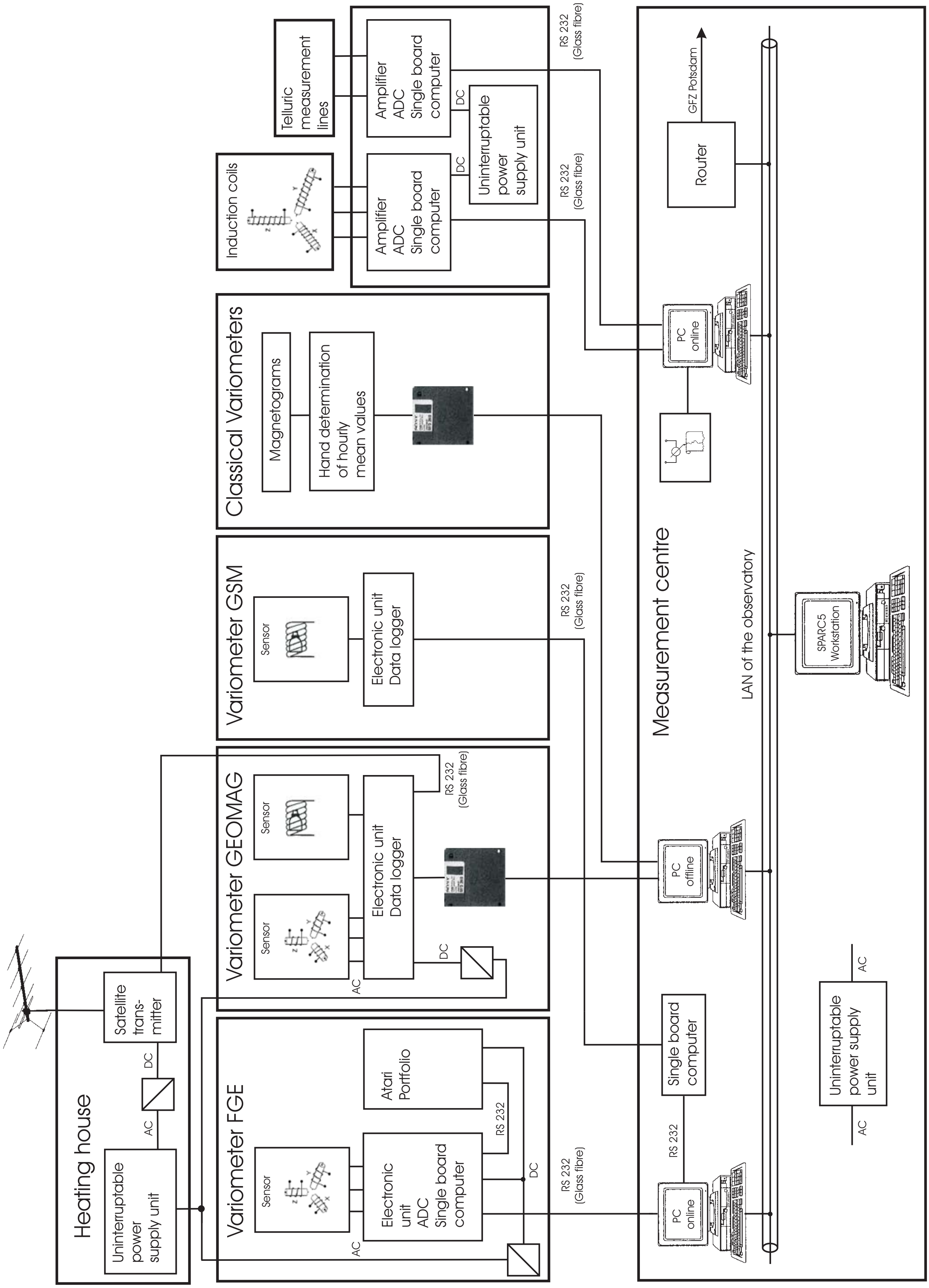


Fig. 3: Block diagram of the recording systems and data paths

2.1 Three component flux-gate variometers

2.1.1 FGE

The FGE variometer is the main vector magnetometer. It is a three component linear core flux-gate magnetometer with Cardan's suspension, manufactured by the Danish Meteorological Institute at Copenhagen [2]. The three magnetic elements H, D and Z and the room temperature are recorded.
The scale factor of the instrument is 250 nT/V, the measurement range is $\pm$2500 nT for the magnetic elements. The temperature channel has a scale factor of 1000 K/V with a measurement range of $\pm$2.5 V.
The analogue to digital conversion is carried out by a 20 bit ADC (type CS5506, Crystal) with a sampling rate of 2 Hz by means of a single board computer Z80miniEMUF. The resolution, given by the manufacturer as 0.2 nT is completely satisfied by the 20 bit ADC. The time signal for the data logger is given by a DCF77 radio clock.
The variometer was in operation at the same position and in the same manner as in 1999. The 2 Hz momentary values, obtained by means of the single board computer and the ADC, are transmitted serially (RS232) by glass fibre cable to a PC at the measurement and computer centre (building No. 3). In the same way, minute mean values are transferred to the pocket PC Atari Portfolio. Fig. 5 shows the base lines of this variometer.

2.1.2 GEOMAG

This instrument includes a three component ring core flux-gate magnetometer and an Overhauser effect proton magnetometer. The French manufacturer GEOMAG calls it an "automatic geomagnetic observatory". It consists of the 2 sensors, the electronic unit (analogue electronic, data logger and power supply unit) and a telemetry.
The instrument was operating throughout 2000 under the same conditions as in 1999. Minute mean values with a resolution of 0.1 nT are recorded according to the INTERMAGNET standard [3]. The data files are written on a 3.5" diskette. The mean values are transmitted by a special telemetry (located at the heating house, building No. 8) via METEOSAT to the INTERMAGNET GINs at Paris and Edinburgh.

2.1.3 MAGSON

This three component ring core flux-gate magnetometer (manufacturer: MAGSON GmbH, Berlin) was further operating in the coil hut (building No. 21, sensor) and control hut (building No. 22, electronic unit) as a preliminary place. It recorded continuously during the complete year, except for a few interruptions. The components X, Y and Z were recorded. The data logger triggers the measurement values with a sampling rate of 1 Hz and generates 1 minute mean values of a resolution of 0.1 nT which are recorded in the RAM. The storage capacity is sufficient for 15 days. The recorded data can be read by a laptop via the serial interface. Up to now the recorded time series have only been used for occasional comparison. In 2000 the base lines were not determined.

2.2 Overhauser Effect Proton Magnetometer GSM

The geomagnetic total intensity was recorded using the GSM Overhauser effect proton magnetometer (manufactured by GEM Systems, Canada), as in 1999. Every 5 seconds, a measurement value of resolution 0.01 nT is generated and transmitted by glass fibre cable to the same PC which records the 2 Hz momentary values of the FGE variometer. Table 3 contains the differences between the momentary values of the GSM 19 and the observatory F momentary values, calculated for the times of the absolute measurements.

2.3 Induction Coil Magnetometer ICM

These three induction coils with highly permeable cores record the temporal gradients of the geomagnetic variations for the North, East and vertical components. For thermal stability, the sensors are buried east of the telluric hut (building No. 20). The electronic amplifiers are located in building No. 20, while a paper recorder and a PC are in the measurement and computer centre (building No. 3).
The analogue recording was carried out continuously during the whole year by means of the Laumann paper recorder in the measurement and computer centre (building No. 3). The signal is transmitted via glass fibre cable. No changes have to be reported for the whole system in 2000.
The digital recording of the temporal gradients of the geomagnetic variations was carried out as in 1999. The signal of the amplifier output, to which the Laumann paper recorder is connected, is digitised by means of a 20 bit ADC (Type CS5506, Crystal). The ADC is controlled by a single board computer (Z80miniEMUF). The measurement values are triggered with a sampling rate of 1 Hz. They are transferred serially (RS232) by glass fibre cable to a PC at the measurement and computer centre (building No. 3). The time signal for the data logger is given by a DCF77 radio clock.
The measurement values are stored in binary format (2 bytes per value of the 3 components), where 1 digit corresponds to 0.1 mV. The induction coils transfer function is dependent on the signal period. In cases of modifications of the equipment the transfer function is re-determined by calibration. For this purpose calibration signals are applied to the calibration coils of the sensors. The calibration procedure yields the transfer functions of the complete apparatus. From the transfer functions, correction functions can be calculated for the 3 components, which must be taken into account if the recording material is used.
Data analysis revealed that the previously published transfer functions are not completely correct. A re-calibration by means of a spectrum analyser using sinusoidal signals has been carried out and Fig. 4 shows the new correction functions, which are also applicable to the data from previous years. The ordinate axis scale is 0.1 mV. The sinusoidal calibration signal confirmed that in the period range of 5 to 100 seconds no phase shift (0 phase characteristic) is present.
The digital recording was in operation all the year with very few interruptions.

2.4 Classical magnetic variometers with photographic recording

The observatory operates 4 classical variometers with photographic recording in the variation house (building No. 6). The single systems are named according to their location rooms: CS: South system, CW: West system, CE: East system. The storm variometer CR and the East system are located in the East room. Table 1 lists the parameters of the instruments. The variometers are temperature compensated. The rooms are continuously heated by a thermostat-controlled electrical heating system supported in cold seasons by warm water central heating. The daily temperature changes are less than 0.1°C. The location of all classical variometers is unchanged since 1982. Hourly mean values of the elements X, Y and Z are obtained from the classical recordings. They are only used for comparison purposes nowadays.

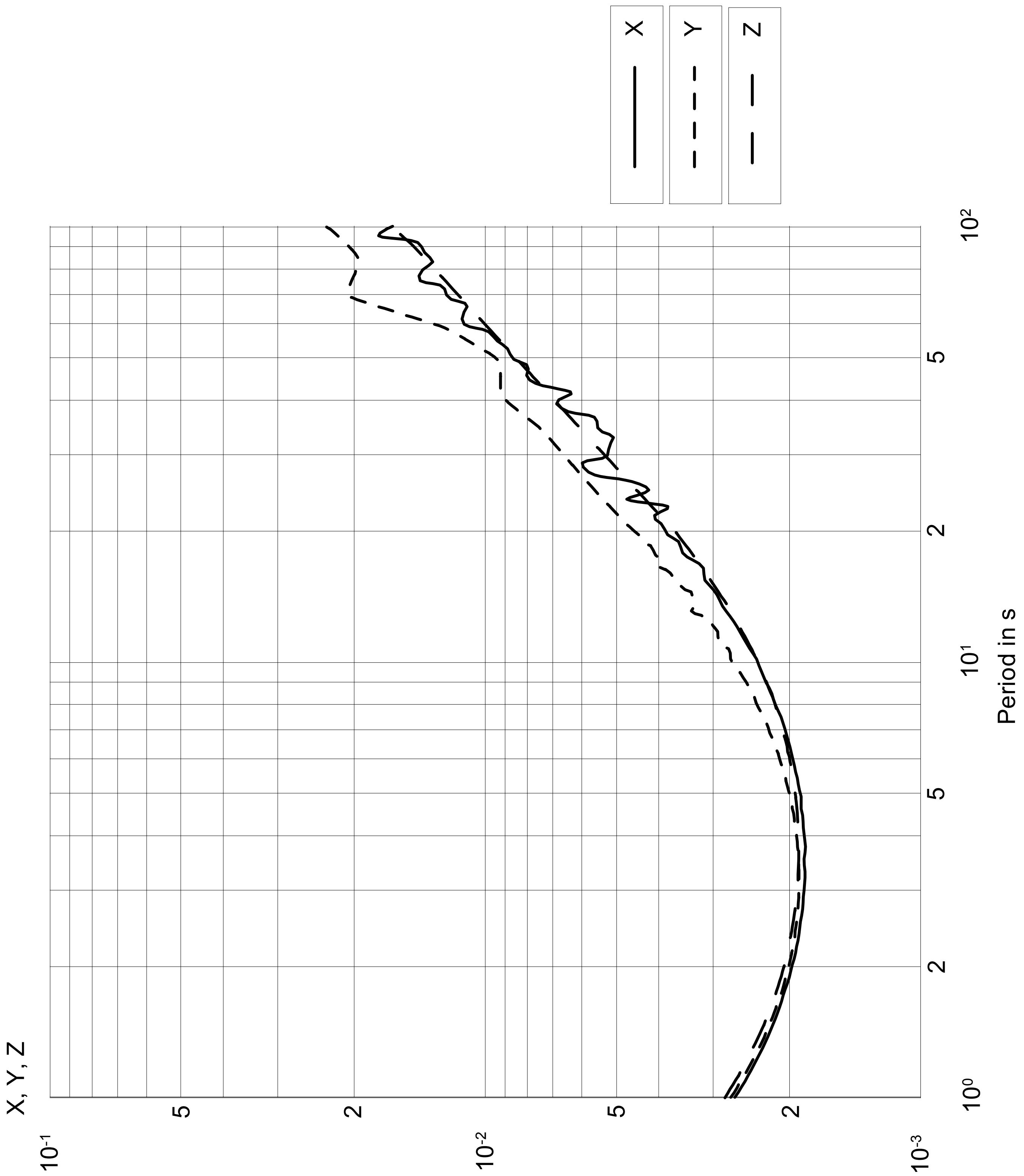


Fig. 4: Transfer functions (amplitudes) of the induction coil variometers

3. Absolute Measurements

Throughout the year, the absolute measurements were carried out as follows: One absolute measurement is taken using the THEO 010B DI-flux theodolite on pillar No. 8 once per week. The corresponding total field measurement is taken using a GSM19 Overhauser effect proton magnetometer located 40 cm above pillar No.14. Therefore, the THEO 010B needs not to be taken away from the pillar for the F measurements. The F measurement values, obtained at pillar No. 14, are corrected by means of the corresponding offset to the level of pillar No. 8. One total field measurement per month is carried out on pillar No. 8 40 cm over the pillar (approximately the altitude of the DI-flux sensor) to check this offset.
Total field measurements are taken once per month on pillars No. 2 and 5 to record the long term drift of the pillar differences. DI-flux measurements are carried out normally once per month by means of a second instrument on pillars No. 2 and 5. The measurements on pillars No. 2 and 5 have comparing and accompanying character. The base lines are determined from the measurements taken on the pillars No. 8 (D, I, F) and No. 14 (F). The measurement values obtained on pillar No. 8 represent the observatory standard.
I. Goldschmidt was in general responsible for the measurements on pillar No. 8, while M. Fredow was responsible for these done on the other pillars. I. Goldschmidt calculated the base values of the variometers from the absolute measurements. The adopted base lines are obtained from the measurements on pillar No. 8. Additional base lines were calculated from the measurements on the pillars No. 2 and 5 to obtain pillar differences between the single pillars. The results are presented in table 3 (annual averages).

Pillar	Δ H/nT	ΔD/’	ΔZ/nT	ΔI/’	ΔF/nT
2	+0.1	-0.2	+2.2	+0.05	+1.4
5	+0.1	-0.05	- 0.6	-0.02	-0.5
14					-1.3

Table 3: Pillar differences of H, D, Z, I and F obtained on pillars No. 2 and 5 to those on pillar No. 8

$\Delta H = H_{Pn} - H_{P8}$, n = 2,5; equivalent for D, Z, I and F.
The following results of the absolute measurements were reduced with the recordings of the FGE variometer by means of a PC program, which calculates the base values of the elements H, D and Z. This program calculates in addition ΔF, the difference of the total intensity, calculated from the momentary H and Z values for the times of the absolute measurements, and the synchronous recording value of the GSM variometer.

Date	$\Delta F = F_{GSM} - F_{P8}$
2000-01-21	+1.3
2000-02-15	+1.3
2000-03-20	+1.2
2000-04-13	+1.1
2000-05-18	+1.3
2000-06-27	+1.3
2000-08-09	+1.2
2000-09-22	+1.1
2000-10-17	+1.3
2000-11-21	+1.3
2000-12-21	+1.3

Table 4: Differences of the total intensity between the GSM recordings in the variation house and the observatory level (absolute house, pillar No. 8, 40 cm over the pillar)

Table 7 contains the results of the absolute DI-flux measurements combined with the absolute GSM 19 measurements. The adopted base lines of the FGE variometer are shown in Fig. 5. The deviations of the absolute measurement values from the adopted base lines can also be found in table 7. The total intensity measurements carried out once per month on pillar No. 8 were compared with synchronous recording values of the GSM variometer. Table 4 shows the results.
The results of the absolute measurements were also reduced with the variations of the classical West system (CW, complete reduction) and of the classical East system (CE, short reduction) using a PC program. From the results adopted base lines were obtained, which were used for comparisons with the reduction results of the digital FGE variometer recordings and for cross-check. They are not published any more.

3.1 Declination

The declination measurements are carried out, as described, by means of the THEO 010B DI-flux theodolite in the absolute house on pillars No. 8, No. 5 and No. 2. The azimuth marks are the Niemegk church tower and water tower and a collimator at pillar No. 6 (low distance azimuth mark for times of no visibility to the far azimuth marks). Bearings of all azimuth marks can be taken from pillar No. 8, while bearings to the church tower and the water tower can be taken from pillar No. 2, and only the water tower is visible from pillar No. 5. Table 5 contains the azimuth values used [4].

Pillar	Church tower	Water tower	Collimator
8	65°00’11”	91°10’44”	1°49’04”
2	65°06’44”	91°19’54”	
5		91°01’48”	

Table 5: Azimuth values of the azimuth marks

The annual mean differences of the azimuth mark bearings can be found in table 6.

Azimuth mark difference	Pillar 8	Pillar 2
Water tower-church tower	26°10.62’ ±0.15’	26°13.21’ ±0.12’
Water tower – collimator	89°21.73’ ±0.23’	
Church tower - collimator	63°11.10’ ±0.17’	

Table 6: Annual mean differences of the azimuth mark bearings

Table 7 contains the measurement results for the FGE variometer and the deviations from the adopted base lines. Fig. 5 shows the FGE adopted base lines.

3.2 Inclination

Directly following every declination measurement the inclination is measured by means of the same instrument using the magnetic meridian determined from the declination measurement. The inclination measurement results are used together with the total intensity values for the determination of the base values of the horizontal and vertical intensity.

3.3 Horizontal Intensity

The horizontal intensity base values are calculated by means of a PC program from the inclination and total intensity absolute measurements. Table 7 contains the measurement results for the FGE variometer and the deviations from the adopted base lines. Fig. 5 shows the FGE adopted base lines.

3.4 Vertical Intensity

The vertical intensity base values are calculated by means of a PC program from the inclination and total intensity absolute measurements. Table 7 contains the measurement results for the FGE variometer and the deviations from the adopted base lines. Fig. 5 shows the FGE adopted base lines.

3.5 Total Intensity

The total intensity measurements are done as described by means of the GSM19 Overhauser effect proton magnetometer always following the DI-flux measurements. The GSM19 uses the gyromagnetic ratio:

$$\gamma_p = 0.267515255 \cdot 10^9 \, s^{-1} \, T^{-1} \qquad [5]$$

for the conversation of the frequency values into the magnetic total intensity values. The total intensity measurement results are used together with the inclination values for the determination of the base values of the horizontal and vertical intensity.

4. Base Values

The base values of the FGE variometer (the observatory main variometer) were determined by means of useful adoptions from the absolute measurement results (table 7). For every day an adopted base value exists of every recorded element (H, D, Z). The deviations ΔH, ΔD and ΔZ of the absolute measurements from the adopted base values are shown in table 7. A program from the INTERMAGNET CD-ROM was used to plot the adopted base lines. Fig. 5 shows the adopted base values as lines of small squares and the results of the absolute measurements as larger squares. The H, D and Z base values were transferred into X, Y and Z values.
The base values of the photographic recording variometers were determined as described in the previous yearbooks for comparison and mutual check with the base values of the digital recording FGE variometer. They are no longer published.

Month	Day	UT	Horizontal intensity		Declination		Vertikal intensity		F
			H/nT	ΔH/nT	D	ΔD/′	Z/nT	ΔZ/nT	ΔF/nT
Jan.	04	09:21	18735.3	-0.1	0°38.16’	0.15	44929.1	0.1	-1.4
Jan.	11	09:29	18734.2	-0.9	0°37.97’	0.03	44929.2	0.2	-1.0
Jan.	19	07:51	18734.6	-0.3	0°37.86’	0.01	44928.7	-0.3	-0.9
Jan.	26	09:07	18734.3	-0.4	0°37.75’	-0.03	44928.8	-0.2	-0.8
Feb.	03	09:18	18733.8	-0.7	0°37.63’	-0.18	44929.2	0.2	-0.6
Feb.	09	12:26	18733.8	-0.5	0°37.99’	0.08	44929.3	0.3	-0.9
Feb.	16	09:15	18734.7	0.5	0°38.04’	0.01	44928.8	-0.2	-1.2
Feb.	22	12:12	18734.9	0.8	0°38.18’	0.13	44929.2	0.2	-1.1
Feb.	29	09:28	18733.9	-0.2	0°38.05’	0.00	44928.4	-0.6	-1.2
Mar.	09	07:10	18733.7	-0.3	0°38.02’	-0.03	44929.0	0.0	-1.0
Mar.	15	12:09	18734.4	0.4	0°38.04’	-0.01	44929.5	0.5	
Mar.	16	09:18	18734.7	0.7	0°37.98’	-0.07	44929.8	0.8	-0.7
Mar.	22	09:21	18734.6	0.6	0°38.00’	-0.05	44928.2	-0.8	-1.2
Mar.	29	11:27	18733.7	-0.3	0°38.08’	0.03	44929.0	-0.0	-1.1
Apr.	05	11:36	18733.6	-0.4	0°38.26’	0.06	44929.1	0.1	-1.2
Apr.	12	11:30	18734.8	0.8	0°38.20’	0.00	44928.8	-0.2	-1.3
Apr.	18	11:29	18734.0	-0.0	0°38.13’	-0.06	44929.2	0.2	-1.0
Apr.	26	11:03	18733.4	-0.6	0°38.23’	0.05	44929.4	0.2	-1.0
May	03	11:27	18733.5	-0.5	0°38.03’	-0.14	44929.6	0.2	-1.1
May	10	06:05	18734.1	0.1	0°37.75’	-0.40	44929.3	-0.0	-0.9
May	17	06:05	18734.5	0.5	0°38.18’	0.05	44928.8	-0.4	-1.0
May	25	07:48	18733.9	-0.1	0°38.36’	0.24	44929.1	0.0	-1.1
May	29	11:23	18733.6	-0.4	0°38.05’	-0.06	44929.4	0.4	3.3
June	07	11:31	18734.2	0.2	0°38.07’	-0.01	44929.1	0.1	-1.5
June	14	12:46	18735.1	1.1	0°37.99’	-0.07	44928.9	-0.1	-0.7
June	20	06:01	18733.7	-0.3	0°37.75’	-0.29	44929.2	0.3	-1.0

Table 7: Absolute measurement results by means of the THEO 010B DI-flux theodolite and the GSM 19 Overhauser effect proton magnetometer, reduced with the FGE variometer recordings

Month	Day	UT	Horizontal intensity		Declination		Vertikal intensity		F
			H/nT	ΔH/nT	D	ΔD/′	Z/nT	ΔZ/nT	ΔF/nT
July	04	05:47	18734.3	0.3	0°37.69’	-0.33	44927.4	-0.1	-0.7
July	19	08:06	18734.2	0.2	0°38.04’	-0.05	44926.9	-0.6	-1.3
July	26	11:34	18734.4	0.4	0°38.15’	0.03	44928.4	0.9	-1.0
Aug.	02	11:20	18734.5	0.5	0°38.20’	0.05	44928.2	0.7	-0.9
Aug.	10	11:24	18734.1	0.1	0°38.15’	0.00	44927.9	0.3	-1.4
Aug.	16	11:16	18734.2	0.3	0°38.29’	0.14	44929.3	1.6	-0.7
Aug.	23	11:36	18734.5	0.5	0°38.18’	0.06	44927.7	-0.2	-0.6
Aug.	30	11:15	18733.9	-0.1	0°37.98’	-0.09	44928.0	-0.0	-0.8
Sep.	06	11:32	18733.6	-0.4	0°38.01’	-0.06	44928.5	0.5	-0.7
Sep.	14	11:31	18733.5	-0.5	0°38.07’	-0.02	44928.1	0.1	-1.0
Sep.	21	11:23	18734.5	0.5	0°38.20’	0.08	44928.2	0.2	-1.0
Sep.	27	11:11	18734.0	0.0	0°38.14’	0.00	44928.1	0.1	-1.0
Oct.	04	11:14	18735.1	1.0	0°38.32’	0.16	44928.6	0.6	-1.2
Oct.	12	11:18	18734.6	0.4	0°38.20’	0.02	44928.5	0.3	-0.7
Oct.	18	11:14	18734.4	0.1	0°38.18’	-0.02	44928.3	0.1	-1.0
Oct.	25	11:27	18734.1	-0.2	0°38.32’	0.10	44928.6	0.2	-1.1
Nov.	03	07:04	18734.9	0.4	0°38.06’	-0.18	44928.0	-0.5	-1.0
Nov.	09	12:20	18734.3	-0.2	0°38.13’	-0.11	44928.7	0.0	-1.0
Nov.	14	12:11	18734.2	-0.3	0°38.10’	-0.14	44928.4	-0.4	-1.1
Nov.	22	12:20	18735.1	0.6	0°38.26’	0.01	44928.3	-0.5	-1.0
Nov.	30	09:16	18734.6	0.1	0°38.29’	0.04	44929.3	0.3	-1.0
Dec.	06	12:28	18734.9	0.3	0°38.02’	-0.15	44929.5	0.5	-0.8
Dec.	14	12:15	18734.4	-0.3	0°37.91’	-0.09	44927.7	-1.3	-0.8
Dec.	20	12:21	18735.1	0.3	0°38.17’	0.13	44929.4	0.4	-1.1
Dec.	28	09:22	18735.0	0.1	0°38.14’	0.09	44927.1	-1.9	-0.6

Table 7: Absolute measurement results by means of the THEO 010B DI-flux theodolite and the GSM 19 Overhauser effect proton magnetometer, reduced with the FGE variometer recordings (continued)

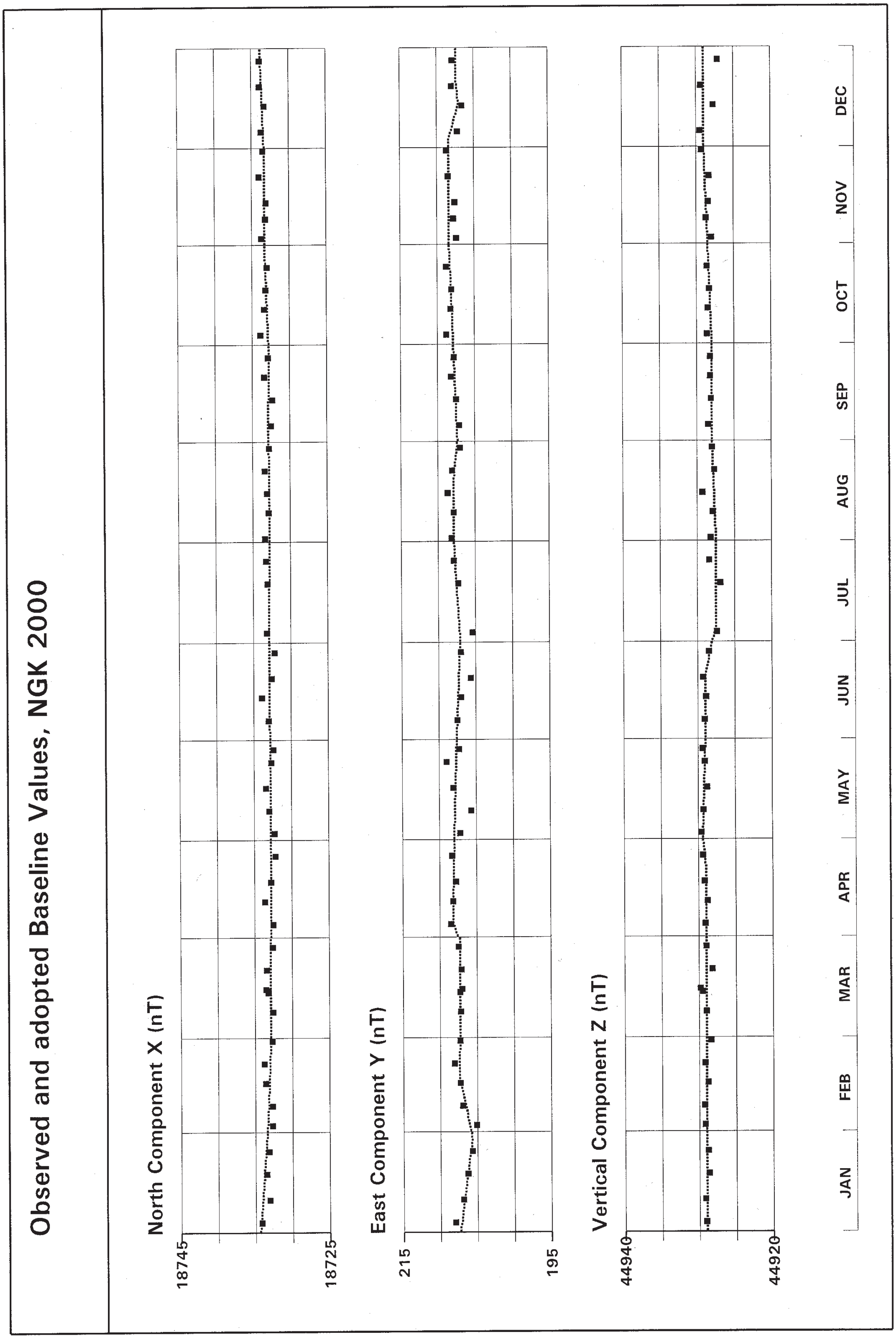


Fig. 5: FGE variometer base lines

5. Telluric Recordings

5.1 Measurement Lines

Four telluric lines in the geographic main directions exist at the observatory: one 1000 m line and one 100 m line in North-South (N-S) and East-West (E-W) direction, respectively. The electrodes of the two 100 m lines are located completely within the properties of the observatory, while the Northern electrode of the 1000 m N-S line and the Western electrode of the 1000 m E-W line are outside. Because of the A9 motorway widening in 1995 the Western electrode of the 1000 m E-W line had to be moved 50 m eastward. This is taken into account by the scale value. The electrodes are connected to the recording equipment located in the telluric hut (building No. 20) by cables. Further information can be found in [6].

5.2 Electrodes

Polarisation free electrodes are in use at all measurement lines [6].

5.3 Recording equipment

Only the 1000 m lines N-S_{1000} and E-W_{950} were continuously recording throughout the year. The electrodes are connected by resistor circuits [7] to 2 light spot galvanometers, which record the potential variations of both measurement lines on the same photographic paper (same recording materials as the classical variometers) with a velocity of 20 mm/h. The electrical equipment and the recording unit are located in the telluric hut (building No. 20).

5.4 Zero Adjustment of the Measurement Circuit

The adjustment was checked frequently. 10 Ω of the compensation resistor correspond to a basic voltage of 1 mV.

5.5 Scale Values

The scale values are determined once per month. A voltage of 1 mV is applied to the measurement lines by modifying of the compensation resistor [7] by 10 Ω. The auxiliary current is adjusted using a standard cell.

Scale values 2000	**Niemegk (mV/km/mm)**	
Date	**N-S_{1000}**	**E-W_{950}**
1 January - 31 January	0.46	0.21
1 February - 31 July	0.45	0.21
1 August - 30.September	0.44	0.20
1 October - 31 December	0.45	0.21

Table 8: Scale values of the telluric measurement lines

The telluric current direction is in the case of an increasing recording signal:

- N-S line: from South to North
- E-W line: from West to East

6. Remarks to the Tables and Plots

As already mentioned in the preface, the tables and plots were obtained from the digital recordings of the FGE variometer and the absolute measurements by means of the THEO 010B DI-flux theodolite and the GSM19 Overhauser effect proton magnetometer. From the 2 Hz momentary values at first minute mean values are calculated. The minute mean value is centred to the second No. 30. That means, the momentary values corresponding to the seconds No. 0, 0.5, 1.0, 1.5, …, 59.5 are averaged to a minute mean value. These “variometer minute mean values” are in files (1 file per day) with temporary character. The absolute minute mean values are calculated from these by means of the formulas given in [2] and are written into corresponding files (1 file per day). These absolute minute mean value files become final, when the final base values are determined. The hourly mean values are calculated from the “variometer minute mean values” by means of the formulas given in [2] and are written into corresponding files (1 file per year). The hourly mean value files become final, when the final base values are determined.
The absolute minute mean values and the hourly mean values are sent to the world data centres and to INTERMAGNET after the necessary format conversations. The hourly mean values are the base of the following tables and plots after conversation from H, D, Z values into X, Y, Z ones.
The acquisition and the preparation of the recording material and the production of the tables and plots was done by programs, written by H.-J. Linthe and S. Wendt.
As in the previous years the hourly mean values obtained from the photographic recording classical variometers were compared with those from the FGE digital recordings. The deviations never exceeded ± 1nT.
Table 9 contains the activity in terms of the inter-diurnal variability u of the North component [10]:

2000	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
u	1.22	1.07	0.86	2.03	1.56	1.15	2.06	1.39	1.47	2.07	1.73	0.86	1.46

Table 9: Inter-diurnal variability u of the North component in 2000

The reduction factor for Niemegk with the geomagnetic coordinates Φ = 51°53′, Λ = 97°41′and Ψ= -17°01′ (referring to the International Geomagnetic Reference field Model ‘IGRF 2000’) has the value 0.01689 [11].

Note the following remarks on the tables and plots:

- X points toward North, Y points toward East and Z points downward. Corresponding to that Eastern declinations and Northern inclinations are positive. Since 1986 the declination in Niemegk is eastward, therefore positive.
- All times correspond to Universal Time (UTC). The hourly mean values correspond to the hours $0^h – 1^h$, $1^h – 2^h$, …, $23^h – 24^h$.
- The minimum value of a table line is marked with “n”, while the maximum is marked with “x”. The quietest days are marked with “*” in the tables and with “Q” in the plots. The most disturbed days are marked with “+” in the tables and with “D” in the plots. The quietest and most disturbed days are determined in the frame of the Kp service of the IAGA at Niemegk.

The order of tables and plots is as follows:

1. Table with the geographic and geomagnetic coordinates of the observatory, the monthly and annual mean values of all magnetic elements and the deviations of the monthly means from the annual mean values.

2. Hourly mean value plots of X, Y and Z for every month.

3. Table with the daily mean values of the declination, horizontal intensity, inclination and total intensity.

4. Daily mean value plots of the North component, East component and vertical intensity.

5. Tables containing the following activity numbers:
   - The Schmidt character figures (C) in scales of 0, 1, 2
   - The Fanselau character figures (F) in scales of 0, 0.5, 1.0, 1.5, 2.0
   - The mean planetary daily activity A_P, calculated in the frame of the ISGI (International Service of Geomagnetic Indices, Kp Index Service) at Niemegk [9]
   - The mean local daily activity A_K, calculated from the K and given in terms of 2nT
   - The tree-hourly activity numbers K determined at Niemegk [8], where the lower limit of K=9 corresponds to 500 nT.
   - The daily sum $\sum$K of the 8 K numbers

The a_K are determined from the K corresponding to table 10, with $A_K = \sum a_K / 8$.

K	0	1	2	3	4	5	6	7	8	9
a_K	0	3	7	15	27	48	80	140	240	400

Table 10: Derivation of the a_K from the single K

6. Tables giving a summary about the frequency of the single K corresponding to the day time and month.

7. This bulletin contains the plot "Deviation of the continuously calculated daily mean values from the normal value" of 1999 and the table "Monthly values of the normal value 1999". The monthly values of the normal value are displayed by a line in the plots. The numerical values are written next to the right margin of the plots and contained in table 11.

Month	X/nT	Y/nT	Z/nT
January	18774.1	403.5	45044.4
February	18774.1	406.3	45047.2
March	18774.2	409.1	45050.1
April	18774.2	411.9	45053.1
May	18774.2	414.8	45056.0
June	18774.3	417.7	45059.0
July	18774.3	420.5	45062.0
August	18774.3	423.5	45065.0
September	18774.4	426.3	45067.9
October	18774.4	429.2	45070.9
November	18774.5	432.1	45073.8
December	18774.5	434.9	45076.8

Table 11: Monthly values of the normal value 1999

8. The final table contains the annual mean values of the complete observatory series Potsdam-Seddin-Niemegk adjusted to the level of Niemegk in a table and as a plot.

7. References

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[11] T. Iyemori, M. Takeda, T. Kamei:
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8. Tables and Plots of the Results of the Observations in 2000 at Niemegk

Astronomic co-ordinates: φ = 52°4.3’ , λ = 12°40.5’ E. of Grw.
= 0h50m42s E. of Grw.

Geomagnetic co-ordinates: Φ = 51°53’ , Λ = 97°41’ Ψ = -17°01’,
referring to the International Geomagnetic Reference Field Model 'IGRF 2000' [11]

Altitude above sea level: 78 m

Monthly and Annual Mean Values

Niemegk 2000

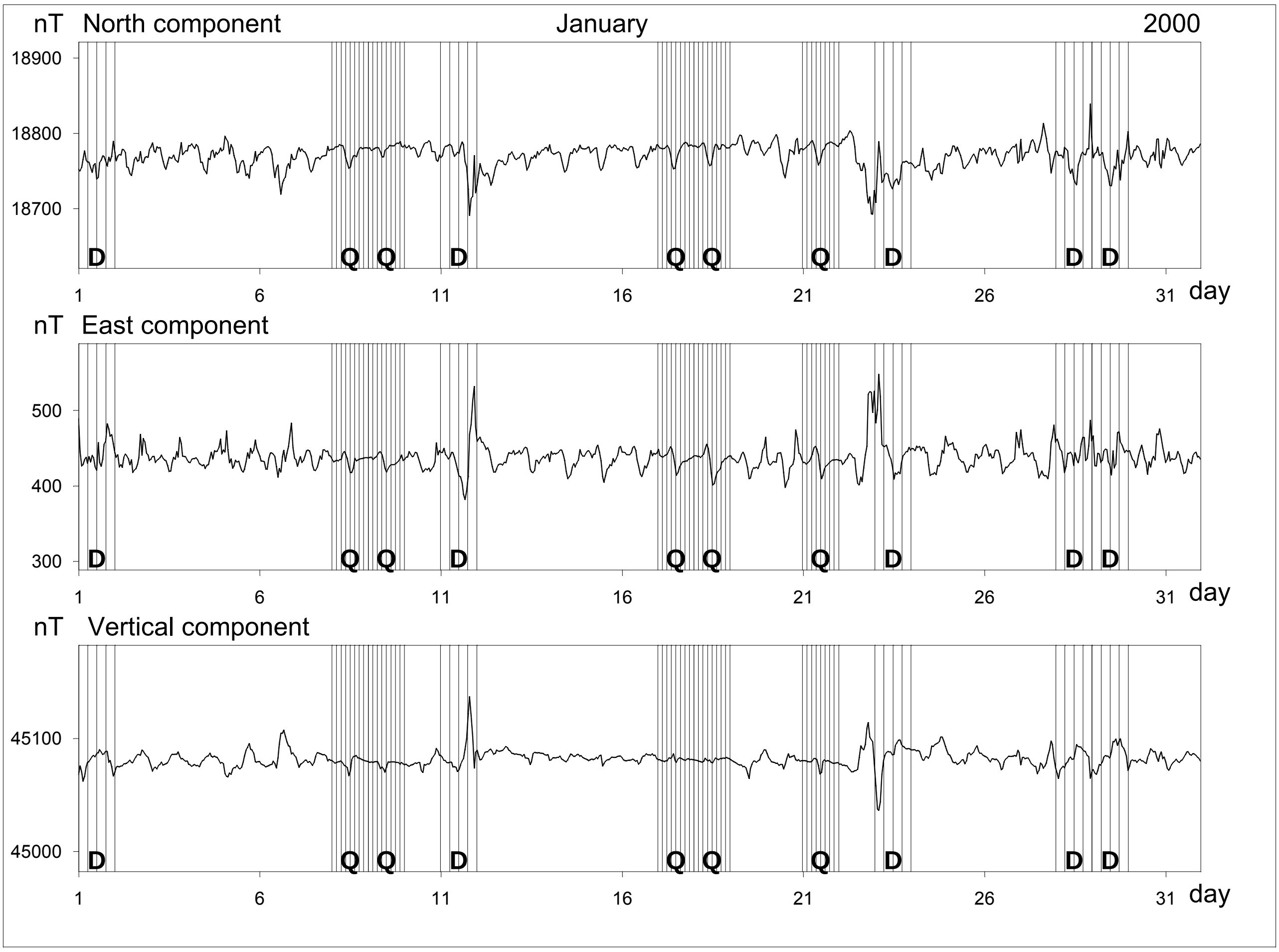
	D	I	H	F	X	Y	Z
Jan.	1° 20.31'	67° 23.35'	18776.0 nT	48836.0 nT	18770.9 nT	438.6 nT	45082.3 nT
Feb.	1 20.49	67 23.39	18776.6	48839.1	18771.5	439.6	45085.4
Mar.	1 20.62	67 22.70	18785.8	48839.5	18780.6	440.5	45082.1
Apr.	1 22.23	67 23.42	18777.2	48841.5	18771.8	449.1	45087.8
May	1 22.16	67 22.60	18789.5	48845.5	18784.1	449.0	45087.0
June	1 22.42	67 22.61	18791.9	48852.3	18786.5	450.5	45093.4
July	1 23.50	67 23.37	18782.9	48854.7	18777.4	456.2	45099.7
Aug.	1 23.96	67 23.79	18778.8	48858.3	18773.2	458.6	45105.3
Sep.	1 24.86	67 24.15	18774.7	48860.0	18769.0	463.4	45108.9
Oct.	1 25.66	67 24.76	18768.8	48865.5	18763.0	467.6	45117.3
Nov.	1 26.02	67 24.60	18772.4	48869.3	18766.5	469.7	45119.9
Dec	1 25.56	67 23.66	18785.4	48871.1	18779.6	467.5	45116.4
Year	1° 23.15'	67° 23.53'	18780.0 nT	48852.7 nT	18774.5 nT	454.2 nT	45098.8 nT

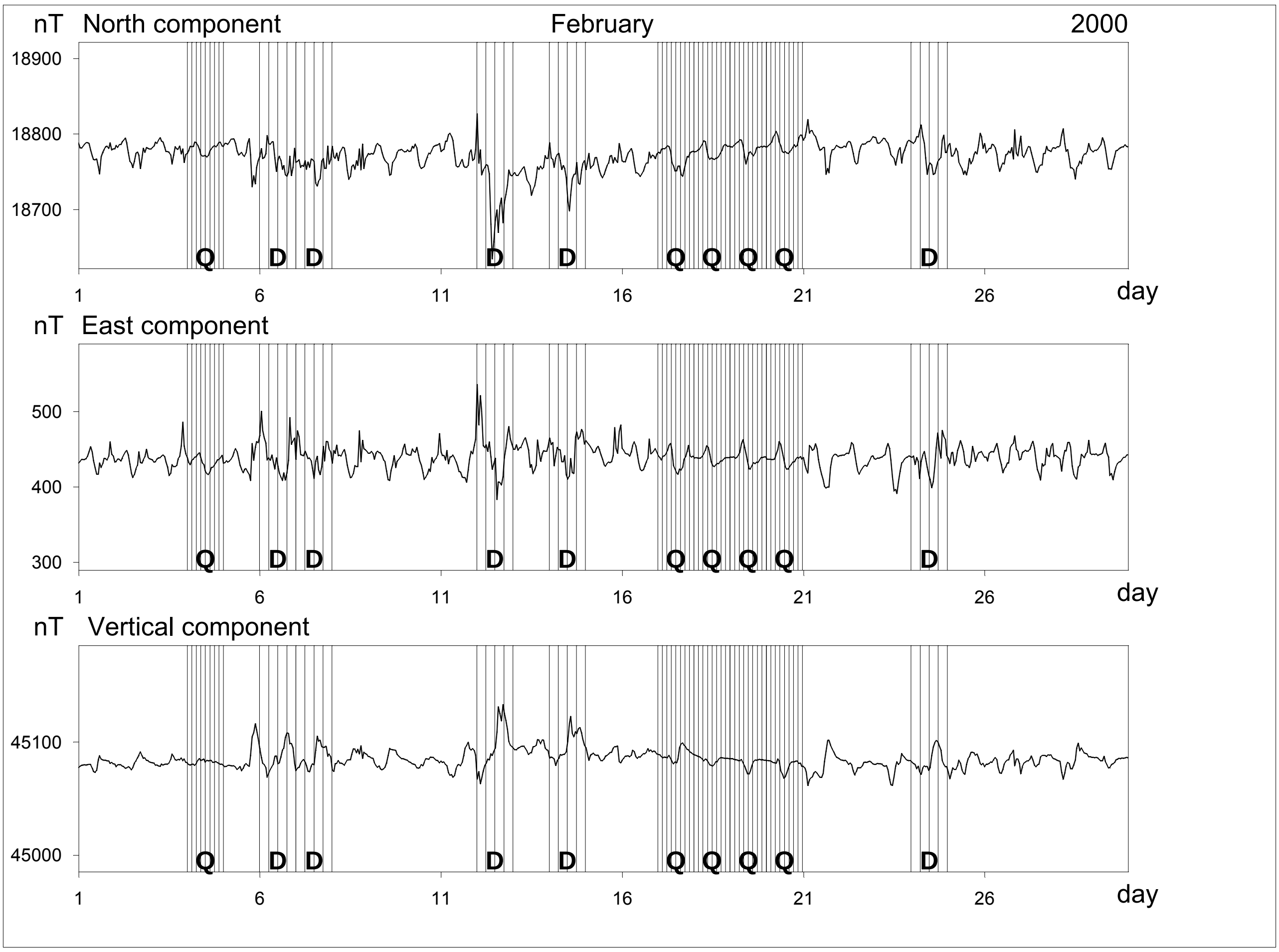
Deviation of the Monthly Means from the Annual Means

Niemegk 2000

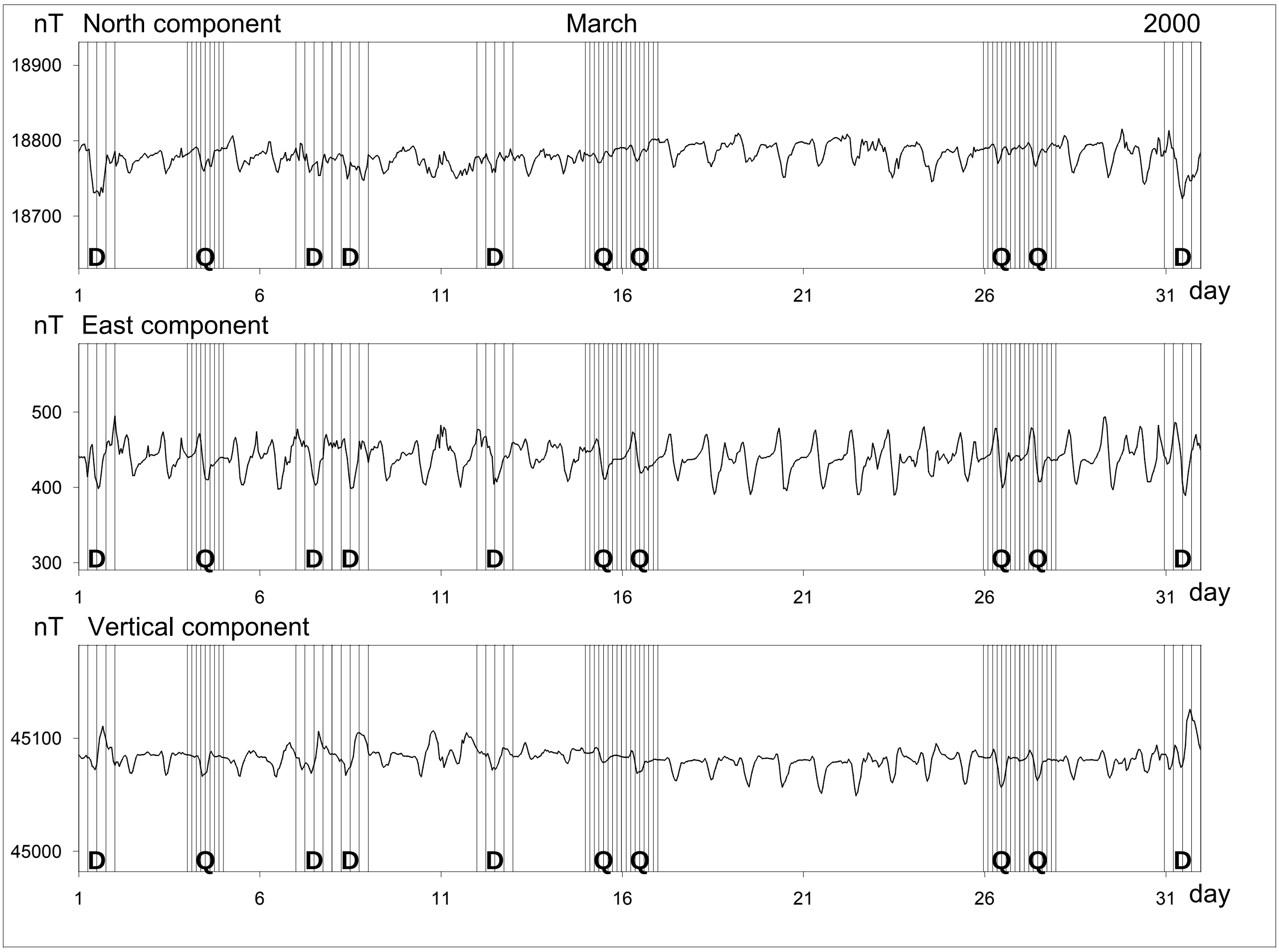
	D	I	H	F	X	Y	Z
Jan.	-2.84 '	-0.18 '	-4.0 nT	-16.7 nT	-3.6 nT	-15.6 nT	-16.5 nT
Feb.	-2.66	-0.14	-3.4	-13.6	-3.0	-14.6	-13.4
Mar.	-2.53	-0.83	5.8	-13.2	6.1	-13.7	-16.7
Apr.	-0.92	-0.11	-2.8	-11.2	-2.7	-5.1	-11.0
May	-0.99	-0.93	9.5	-7.2	9.6	-5.2	-11.8
June	-0.73	-0.92	11.9	-0.4	12.0	-3.7	-5.4
July	0.35	-0.16	2.9	2.0	2.9	2.0	0.9
Aug	0.81	0.26	-1.2	5.6	-1.3	4.4	6.5
Sep.	1.71	0.62	-5.3	7.3	-5.5	9.2	10.1
Oct.	2.51	1.23	-11.2	12.8	-11.5	13.4	18.5
Nov.	2.87	1.07	-7.6	16.6	-8.0	15.5	21.1
Dec.	2.41	0.13	5.4	18.4	5.1	13.3	17.6

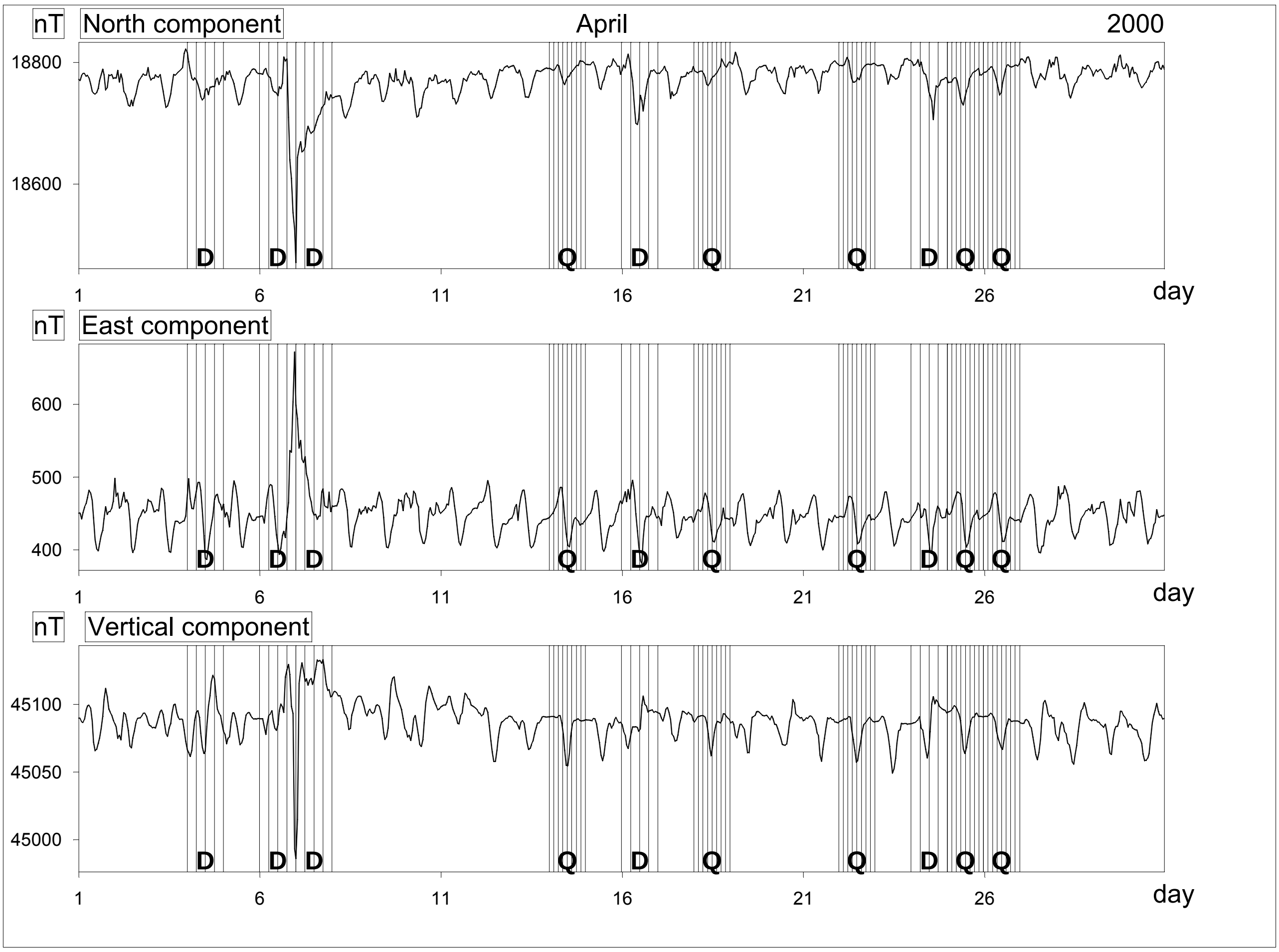
Hourly Mean Values Plot 2000



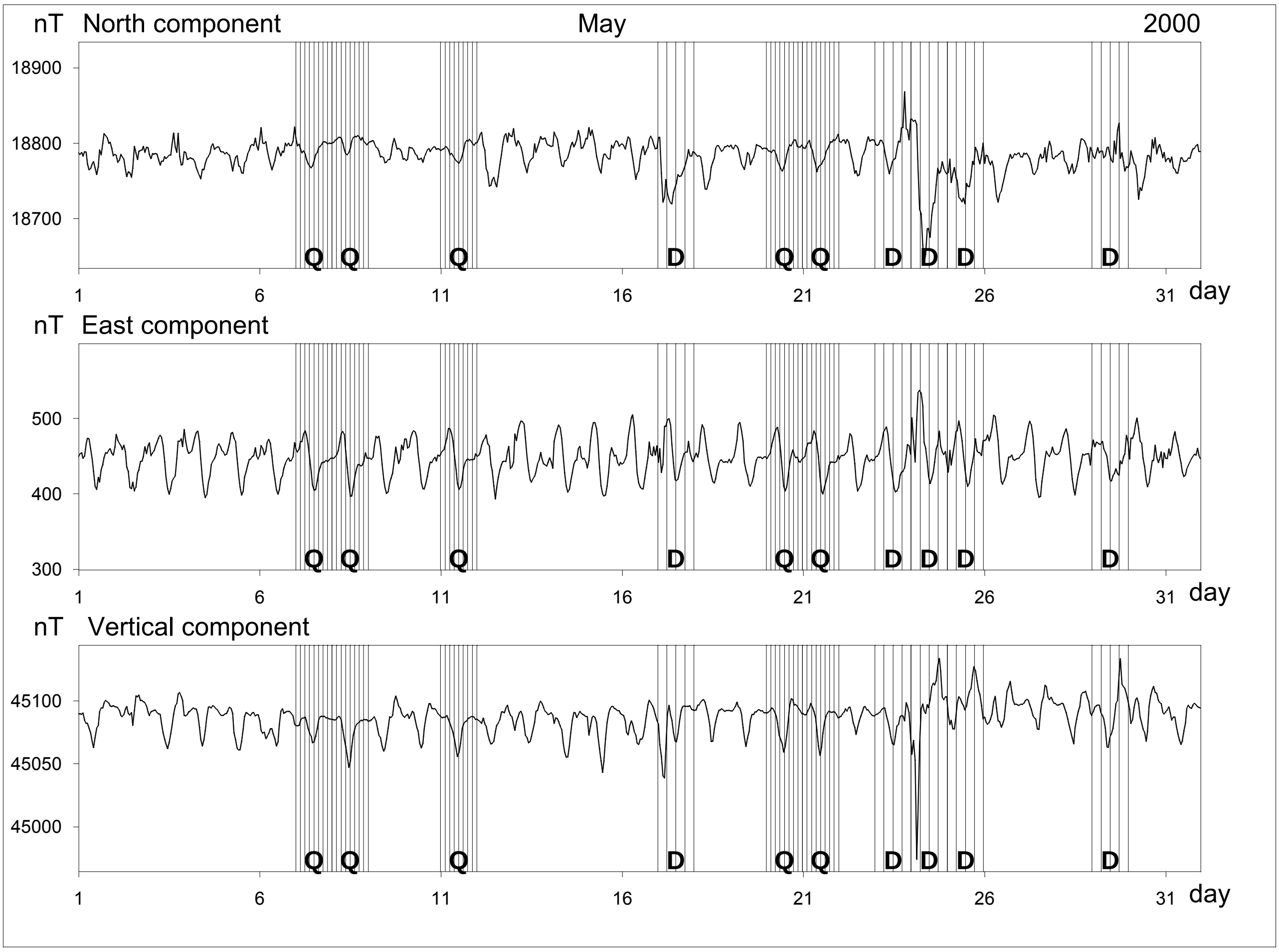


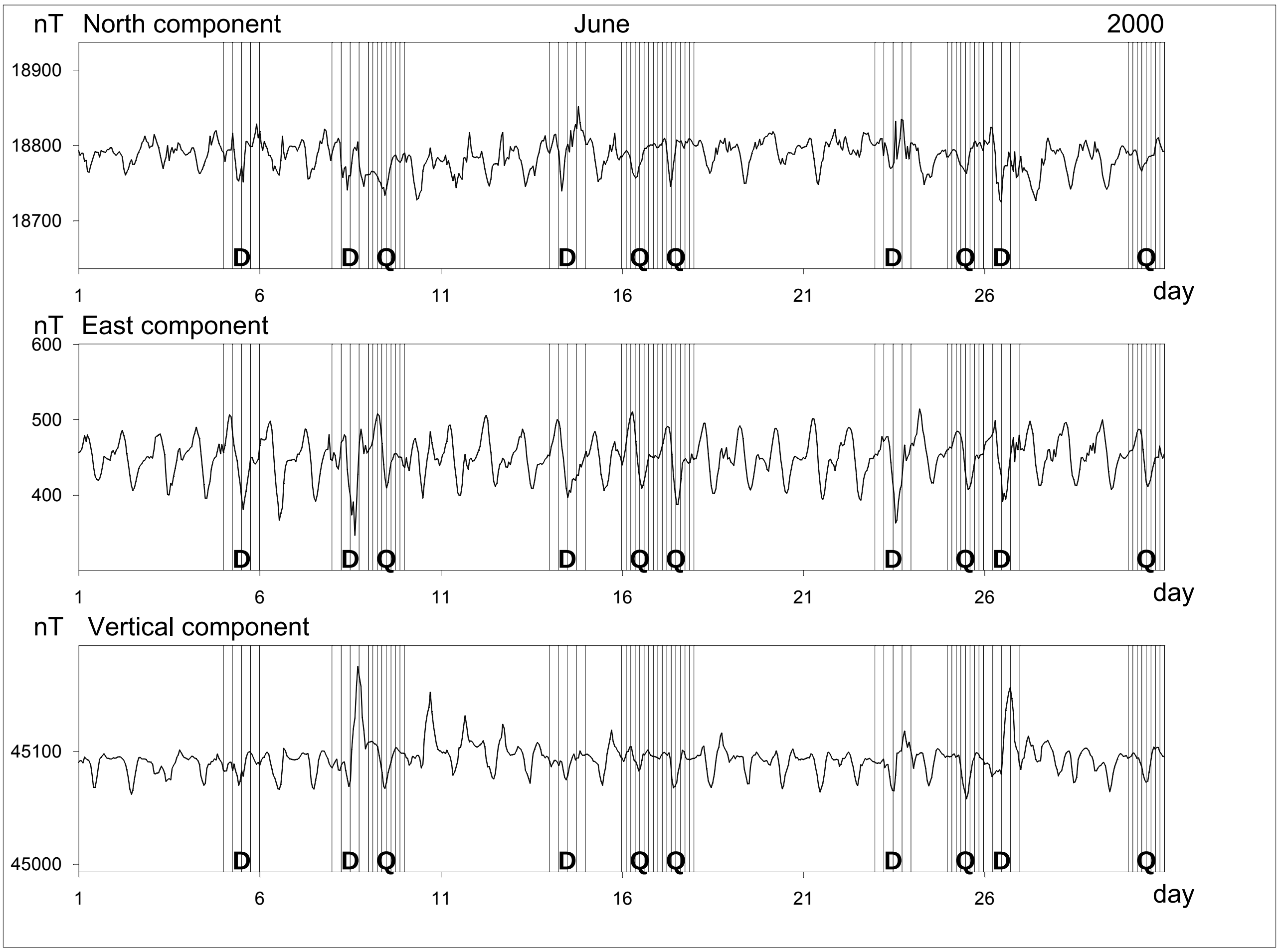
Q = Quiet day D = Disturbed day





Q = Quiet day D = Disturbed day





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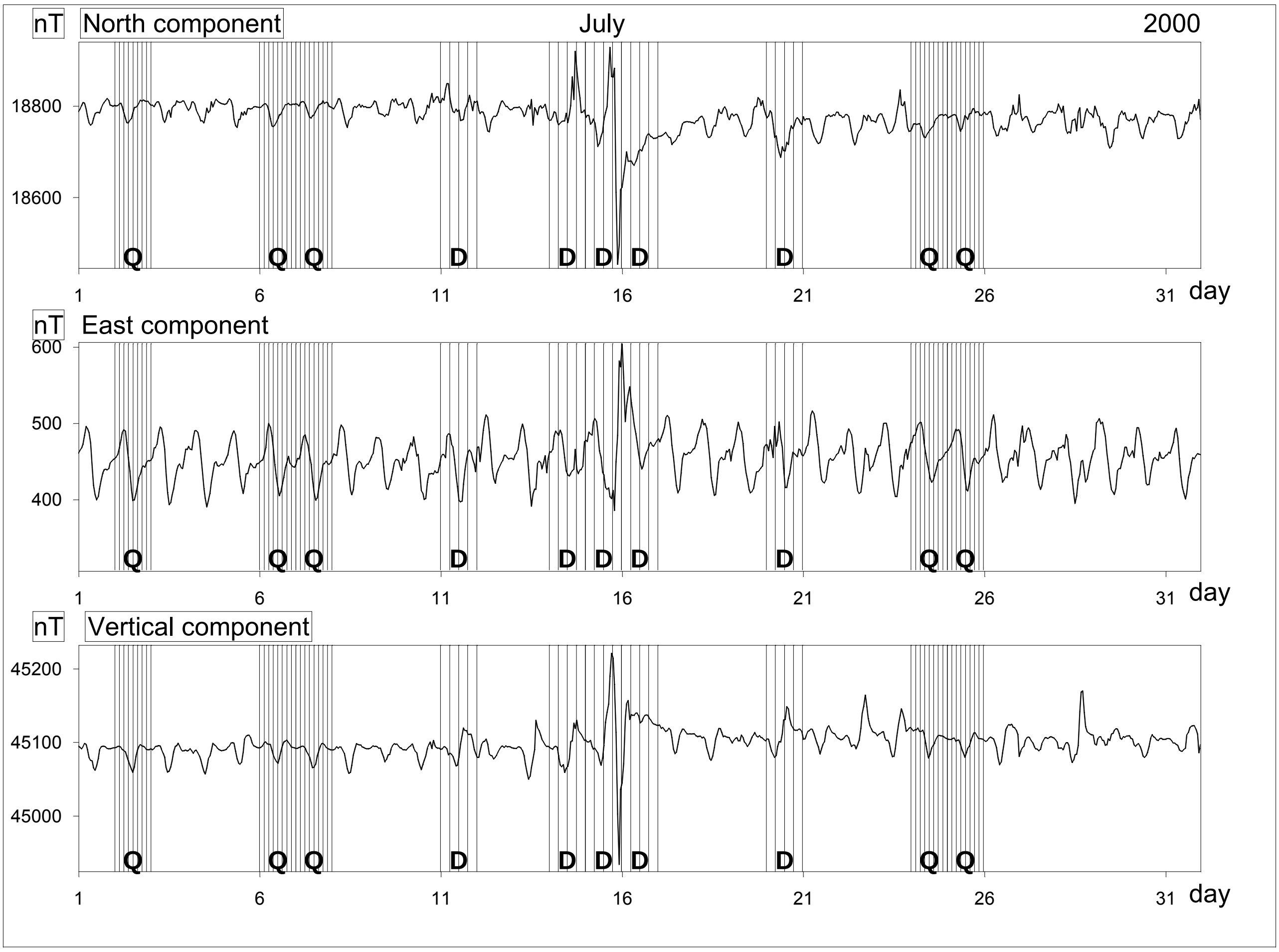
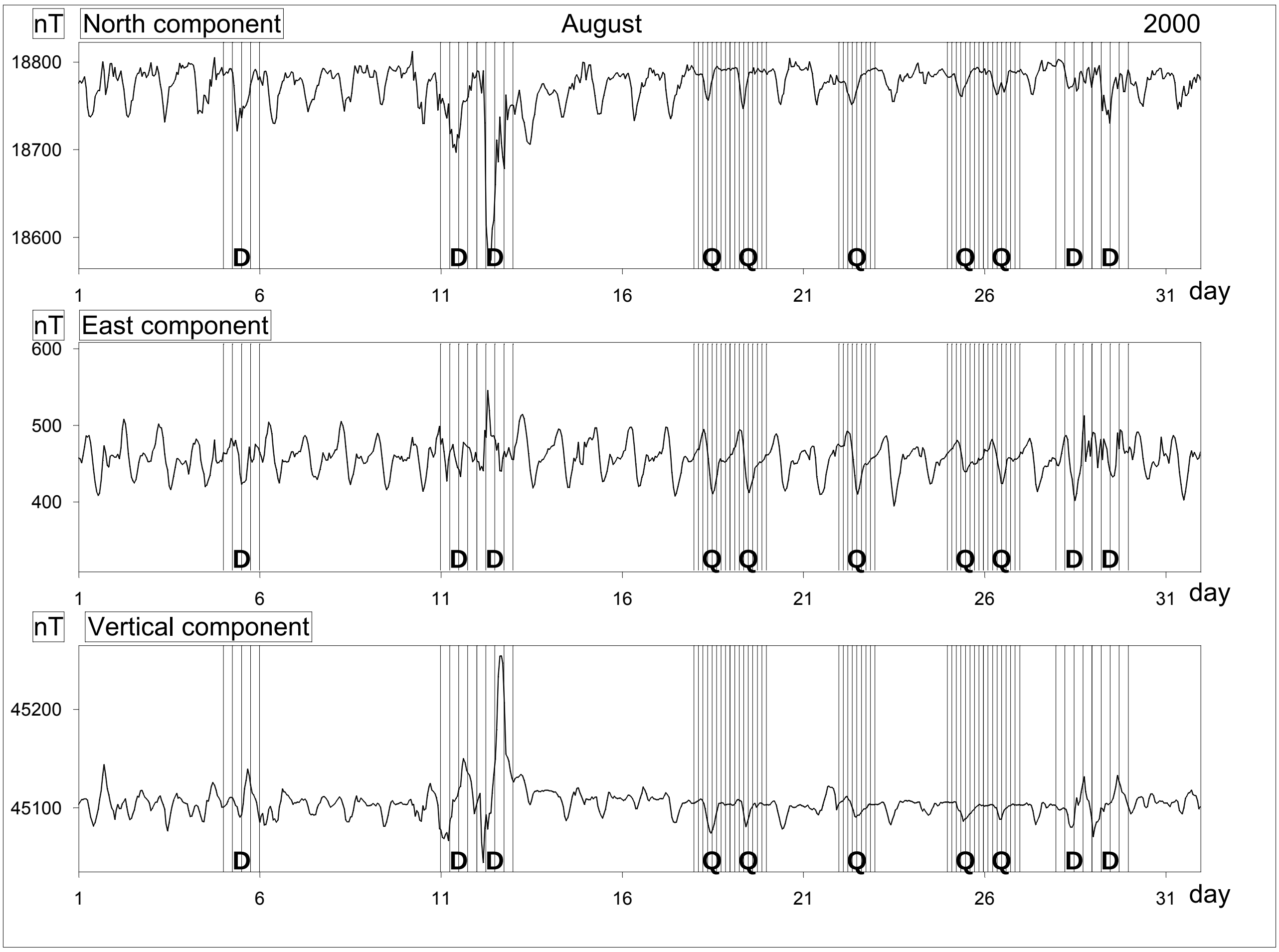
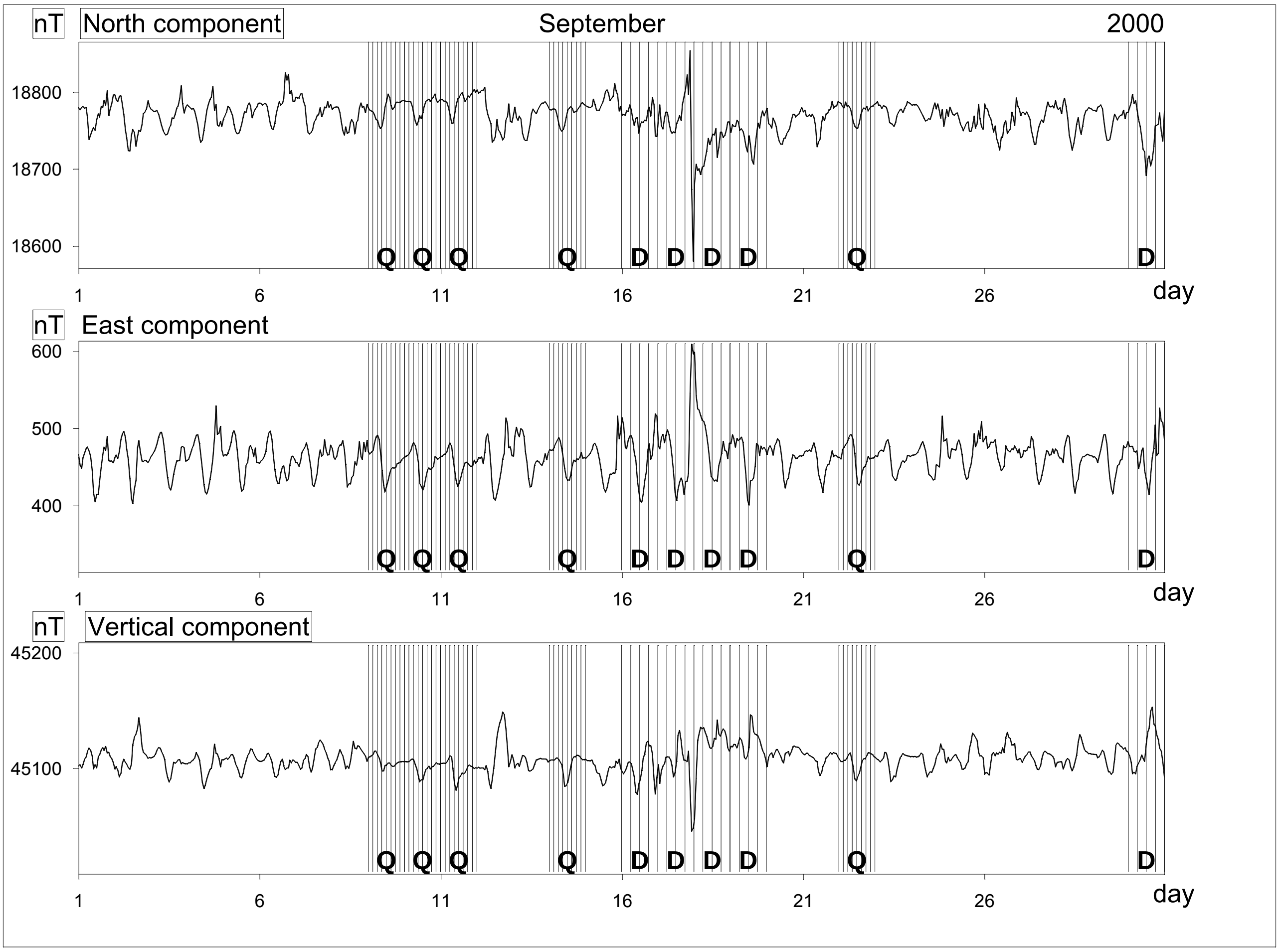
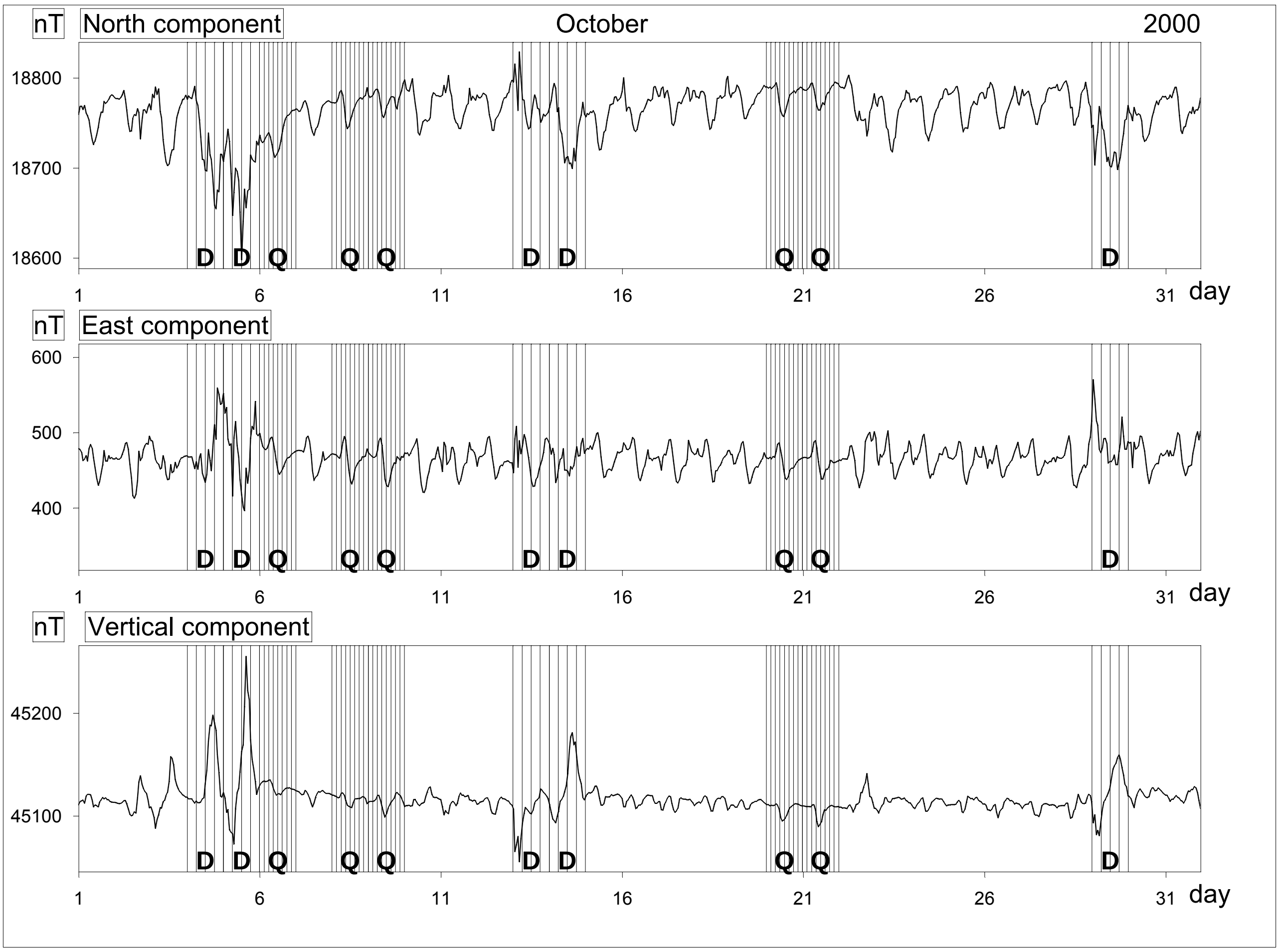


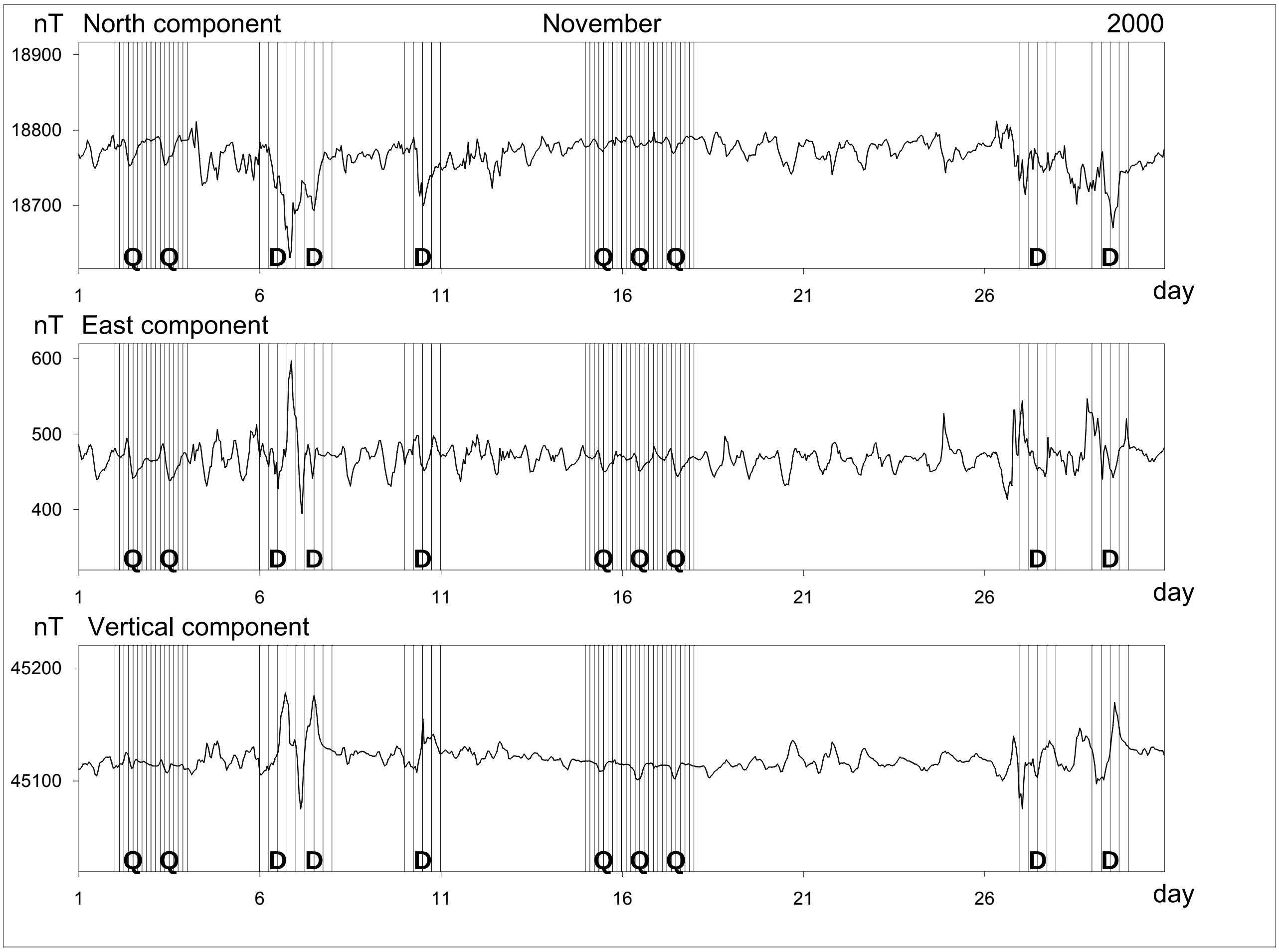


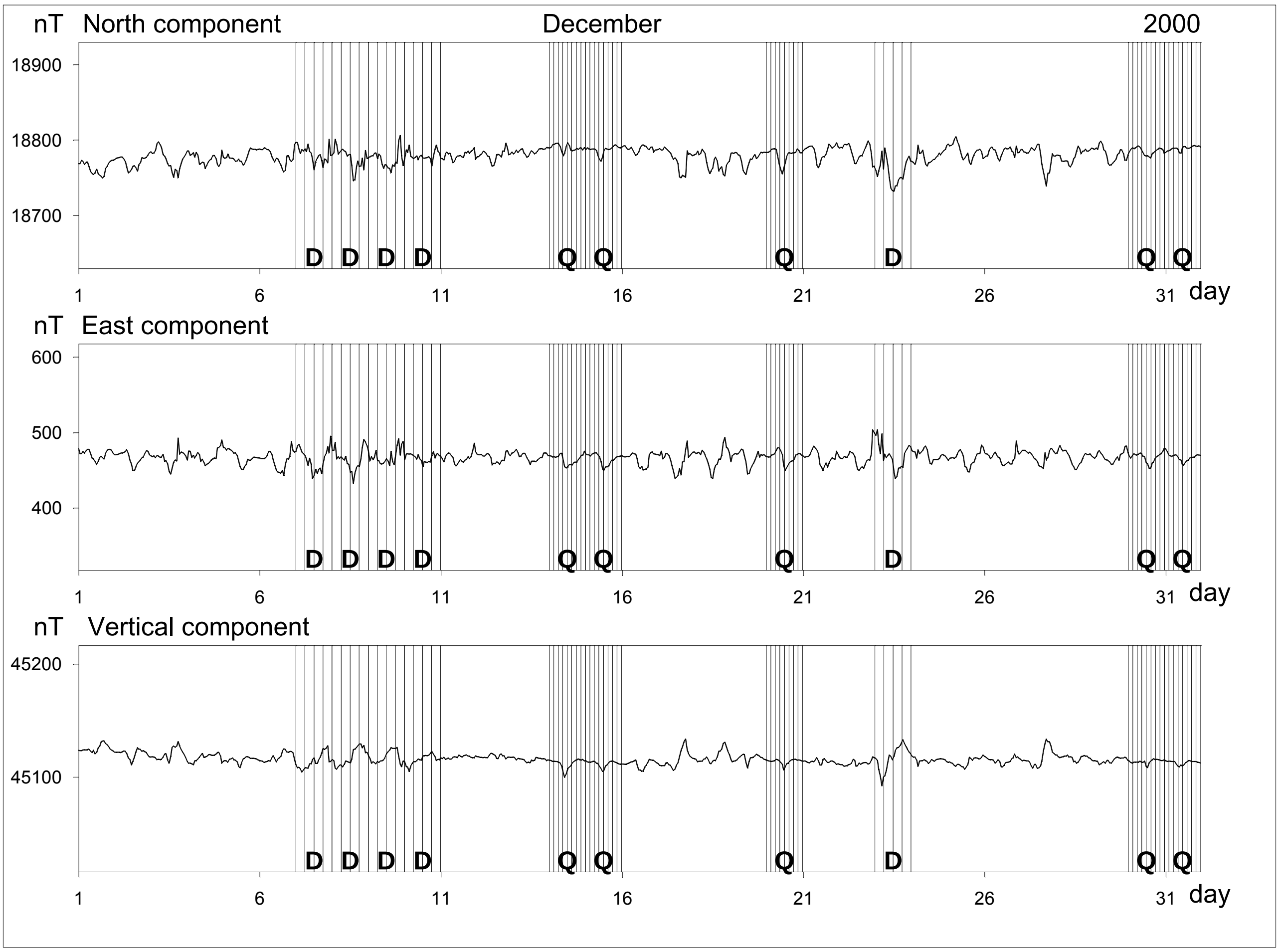
Q = Quiet day D = Disturbed day





Q = Quiet day D = Disturbed day





Q = Quiet day D = Disturbed day

Daily Mean Values of the Declination

Niemegk — Daily Intervals Calculated in Terms of UTC — 2000

D= 1° 10.0' + Tabular Value

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	11.7	10.0	10.2	11.8	11.7	12.6	12.1	13.2	13.2 n	15.0	15.3	16.4 x
2	10.2	9.7	11.6	12.9	11.4	11.9	11.9	14.2	14.3	15.1	15.3	15.7
3	10.1	10.1	11.0	11.3	12.4	12.1	12.1	14.0	14.8	14.5 n	14.7 n	15.4
4	10.0	9.3	10.2	13.5	11.9	12.5	12.1	13.1	15.6	17.7	16.3	15.9
5	10.4	9.8	10.2	11.8	11.7	11.7	12.4	14.2	14.9	18.0	16.7	15.6
6	10.4	11.3	10.1	15.9	11.0 n	11.5	12.5	14.6	13.7	16.7	19.5 x	14.9 n
7	10.1	10.9	11.7 x	20.0 x	11.6	12.0	11.7	13.9	14.4	15.8	15.7	15.2
8	9.5	10.5	11.1	13.0	11.0 n	10.7 n	13.0	14.5	14.6	15.3	15.5	15.3
9	9.5	10.0	10.4	12.3	11.2	14.0	12.4	13.6	13.7	14.8	15.6	15.9
10	9.5	10.1	10.6	13.0	12.2	12.0	11.0 n	14.3	13.4	14.7	17.4	15.5
11	10.6	9.6	11.4	12.3	12.1	11.8	12.1	14.7	13.4	15.0	16.3	15.5
12	10.7	12.8 x	11.4	11.8	11.4	13.2	14.5	16.5 x	14.1	15.1	16.6	15.6
13	10.3	11.9	11.6	11.1	12.8	12.2	12.4	15.6	15.2	15.7	16.2	15.8
14	9.7	11.8	10.9	11.4	11.9	11.6	13.9	14.7	14.8	15.2	15.7	15.0
15	9.9	12.3	10.4	11.1	11.6	12.5	15.3	14.7	13.8	16.1	15.3	15.1
16	10.1	11.2	10.3	12.5	12.5	13.5	20.4 x	14.2	15.7	15.9	15.3	15.2
17	9.9	10.3	10.3	11.8	13.2	11.8	15.4	13.2	16.4	15.1	14.9	14.9 n
18	9.2 n	10.3	9.9	11.5	11.9	12.5	14.7	13.4	18.6 x	15.4	15.3	15.7
19	9.3	10.4	9.1 n	10.9	11.9	12.0	12.8	13.3	15.3	14.5 n	14.9	15.4
20	9.3	10.2	9.7	11.7	12.3	11.6	14.6	13.3	14.8	14.6	14.7 n	15.6
21	9.3	9.0 n	9.8	11.1	11.5	12.0	14.9	12.7 n	14.1	14.7	15.9	15.5
22	12.2	10.1	9.9	11.3	11.2	12.1	13.1	13.6	14.8	15.9	15.2	15.5
23	12.6 x	9.1	9.9	11.0	11.7	10.9	13.8	12.9	14.4	16.0	15.3	16.1
24	10.6	10.2	10.9	11.3	15.7 x	14.2 x	14.8	13.2	15.2	15.7	15.9	16.1
25	10.3	10.9	10.7	12.0	13.1	12.9	13.9	14.0	16.3	15.1	15.9	15.4
26	10.5	11.1	10.6	11.6	13.6	13.2	14.1	13.7	16.5	15.0	15.0	15.5
27	10.2	10.9	10.5	10.6 n	12.5	13.4	14.3	13.0	15.0	15.1	17.3	16.0
28	11.7	10.4	10.2	13.1	12.1	13.6	11.7	13.6	14.4	15.0	17.7	15.7
29	11.2	10.1	11.6	11.4	12.2	13.3	14.3	15.4	14.5	19.5 x	18.2	15.8
30	11.1		11.4	11.9	13.1	12.9	13.7	14.3	16.1	15.9	17.0	15.6
31	9.6		11.3		12.4		12.7	13.0		17.0		15.6
Mean	10.3	10.5	10.6	12.2	12.2	12.4	13.5	14.0	14.9	15.6	16.0	15.6

Daily Mean Values of the Inclination

Niemegk Daily Intervals Calculated in Terms of UTC 2000

I= 67° 20.0' + Tabular Value

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	3.9	2.9	3.9	3.6	2.5	2.5	2.0	4.0	3.9	4.9	4.1	4.9
2	3.6	2.9	3.0	3.9	3.0	2.4	1.7	3.6	4.5	4.6	3.9	4.3
3	3.2	2.7	2.9	3.4	2.5	2.0	1.6	3.4	4.0	5.5	3.6	4.1
4	3.1	2.7	2.7	3.7	2.9	2.2	1.8	3.5	3.9	7.5	4.8	3.9
5	3.5	3.1	2.6	3.5	2.6	2.2	2.2	4.2	4.0	10.0 x	4.8	3.7
6	4.1	3.6	2.8	5.6	1.8	2.3	2.3	3.8	3.0	6.6	7.5 x	3.8
7	3.4	4.3	3.2	9.4 x	2.0	2.2	1.6	3.7	3.8	4.9	7.4	3.5
8	3.0	3.7	3.7	5.2	1.2 n	3.5	2.0	3.4	4.3	4.2	4.8	3.9
9	2.5	3.4	3.1	4.0	2.1	4.0 x	1.7	3.1	3.5	3.8	4.5	4.0
10	2.7	3.1	3.3	4.4	2.3	4.0 x	1.7	3.7	3.1	4.2	5.9	3.6
11	3.9	3.2	3.9	4.2	1.9	3.6	1.4 n	5.7	2.6 n	4.1	5.3	3.7
12	4.6	6.6 x	3.0	3.1	2.5	3.2	2.5	9.4 x	4.3	4.1	5.0	3.6
13	3.4	5.2	3.1	3.0	1.9	2.9	2.1	5.8	4.0	3.8	4.2	3.3
14	3.3	5.0	3.1	2.3	1.7	1.5 n	1.9	4.2	3.7	6.4	3.7	2.9 n
15	3.0	4.1	2.7	2.2	1.8	2.6	5.2	3.8	2.6 n	5.2	3.4	3.1
16	3.1	4.0	2.0	3.8	2.0	2.7	9.0 x	3.8	4.0	4.3	3.1 n	2.9 n
17	2.8	3.7	2.0	3.3	4.0	1.9	5.8	3.6	4.4	3.8	3.2	3.8
18	2.8	3.0	2.1	2.5	3.0	2.2	4.0	2.9	7.1 x	3.9	3.3	4.2
19	2.4 n	2.7	1.9	2.6	2.4	2.4	3.5	3.0	5.8	3.7	3.8	3.9
20	2.9	2.2 n	2.3	2.9	2.3	1.9	5.8	2.8	5.0	3.3	4.4	3.5
21	2.6	2.3	1.7 n	2.4	2.1	2.0	4.6	3.4	4.2	3.1 n	4.3	3.2
22	3.9	2.5	1.7 n	2.1 n	2.2	1.6	4.7	3.4	3.6	4.1	4.1	3.2
23	4.8 x	2.5	2.6	2.1 n	1.5	1.8	3.9	3.3	3.6	4.8	3.8	5.0 x
24	4.4	3.0	2.9	3.4	5.5 x	3.0	4.6	2.8	3.7	4.4	3.5	3.7
25	3.4	3.3	2.6	3.7	4.5	2.3	3.4	3.1	4.6	4.1	4.3	3.2
26	3.2	3.1	2.1	2.6	3.9	3.4	3.9	3.1	4.8	4.0	3.3	3.3
27	2.6	3.3	2.1	2.2	3.0	3.9	3.8	2.7 n	4.3	3.7	5.3	3.8
28	3.4	3.3	2.2	2.9	2.8	2.8	3.7	3.0	4.4	3.7	6.3	3.7
29	3.9	3.0	2.1	2.3	2.6	2.9	4.5	3.9	4.4	7.1	7.3	3.5
30	3.3		2.8	2.6	3.3	2.5	3.9	3.6	5.5	5.2	5.3	3.2
31	3.0		4.1 x		2.9		3.8	3.8		4.5		2.9 n
Mean	3.3	3.4	2.7	3.4	2.6	2.6	3.4	3.8	4.2	4.8	4.6	3.7

Daily Mean Values of the Horizontal Intensity

Niemegk — Daily Intervals Calculated in Terms of UTC — 2000

H= 18700 nT + Tabular Value

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	67	83	70 n	76	92	93	99	77	79	66	78	70
2	72	83	80	69	86	93	103	81	70	71	82	77
3	77	86	83	77	92	99	104	84	76	59	85	81
4	78	86	86	72	86	97	101	82	76	35	70	82
5	72	81	87	75	89	96	98	75	76	-2 n	69	85
6	66	74	85	46	99	95	97	76	91	45	33 n	84
7	75	64	80	-4 n	96	97	105	80	81	68	35	88
8	81	72	73	55	108 x	83	99	84	74	77	71	83
9	87	77	81	71	97	71 n	105	88	84	83	76	81
10	84	80	79	63	93	76	104	79	88	77	55	86
11	69	79	70 n	70	97	81	111 x	51	94 x	78	65	86
12	60	32 n	81	82	89	86	93	8 n	74	78	68	87
13	76	54	81	82	99	88	99	54	75	78	79	91
14	78	58	82	93	101	108 x	104	74	79	49	85	96 x
15	81	67	87	94	99	92	57	80	94 x	63	88	93
16	79	69	96	71	96	92	8 n	81	74	75	91 x	95
17	83	73	95	79	65	101	51	80	69	82	90	82
18	85	83	94	90	85	98	75	90	35 n	81	90	77
19	90 x	86	96	89	93	95	84	89	55	84	83	82
20	82	92 x	90	85	94	101	51	91	64	88	76	86
21	86	91	98 x	91	96	99	68	85	75	90 x	76	92
22	68	89	98 x	95 x	96	106	69	83	82	79	79	91
23	54 n	87	87	95 x	105	103	80	84	82	68	83	65 n
24	63	82	83	78	47 n	86	68	93 x	81	72	88	84
25	76	77	87	74	65	94	84	88	70	77	77	92
26	79	81	93	89	73	84	77	87	67	78	90	90
27	86	78	93	95 x	87	76	77	93 x	73	82	61	84
28	75	78	92	83	89	89	81	90	71	83	49	86
29	68	82	94	93	93	85	68	78	73	35	34	88
30	77		85	88	82	93	74	83	57	64	65	92
31	81		70 n		86		78	79		73		95
Mean	76	77	86	77	90	92	83	79	75	69	72	86

Daily Mean Values of the Total Intensity

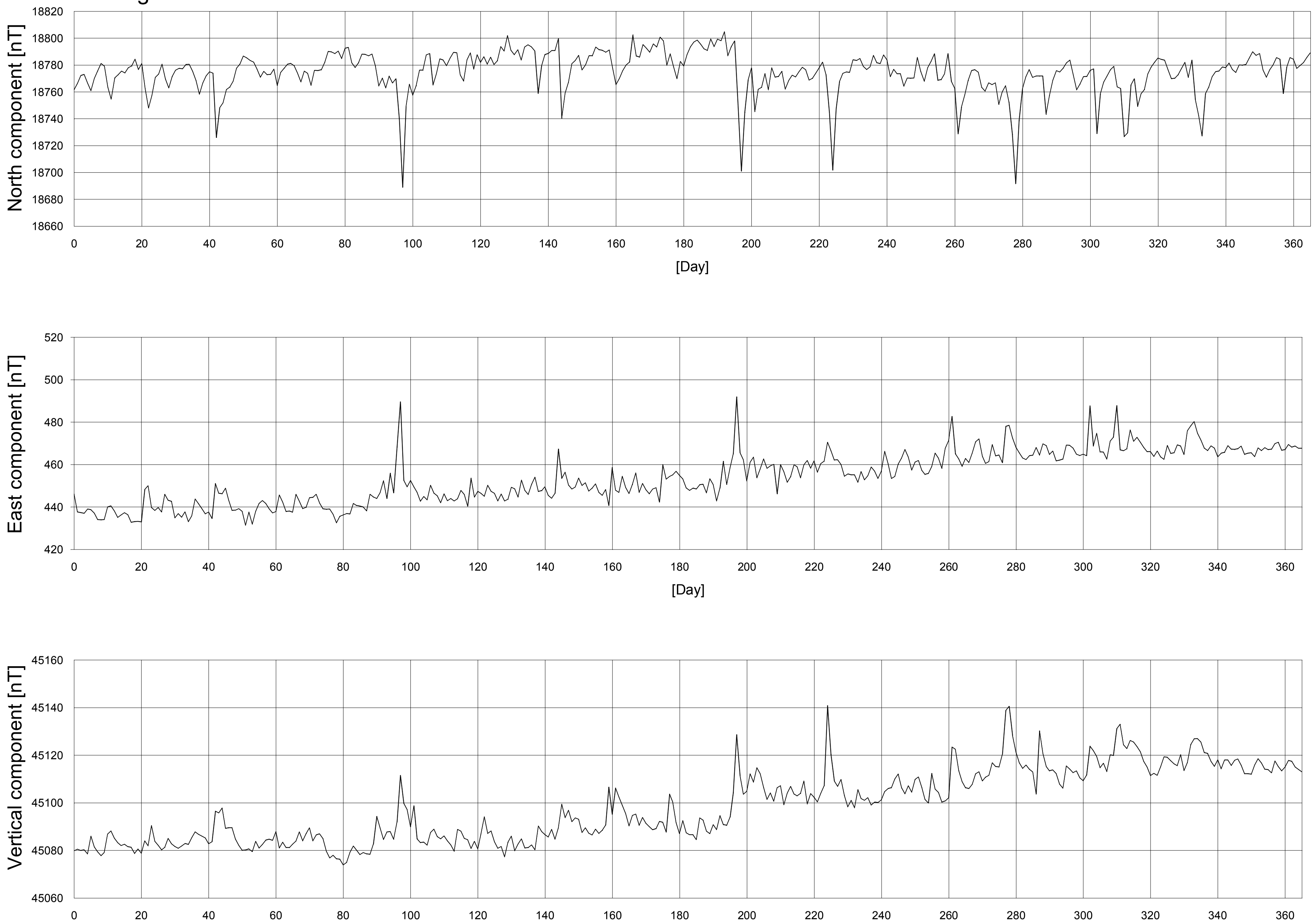
Niemegk Daily Intervals Calculated in Terms of UTC 2000

F= 48800 nT + Tabular Value

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	30	38	39	43	47	49	50	59	63	63	67	74 x
2	33	38	36 n	35	51	47	50	58	61	64	70	72
3	35	40	40	42	47	49	51	58	58	65	68	73
4	35	40	39	40	45	50	48 n	59	56	72 x	69	71
5	31	41	39	38	42	49	55	61	59	60	68	70
6	36	40	40	34	44	49	54	52	63	67	65	72
7	35	35	39	32 n	43	52	53	58	64	69	67	70
8	35	38	40	44	43	61 x	50	58	62	69	73	72
9	36	39	40	48	45	46	55	57	61	68	73	71
10	36	38	42	38	46	58	53	57	59	68	69	71
11	38	39	41	49 x	42	57	61	49 n	59	66	72	73
12	35	32 n	40	41	42	55	50	64 x	63	65	71	74 x
13	39 x	40	42	39	47	53	53	63	57	57 n	74 x	73
14	38	43 x	43	44	44	56	58	60	58	70	72	71
15	38	39	43	43	44	54	49	60	60	67	71	70
16	38	40	41	39	44	54	53	64 x	52 n	66	69	71
17	38	42	38	44	30 n	53	53	57	52 n	67	69	70
18	38	41	39	45	47	55	55	56	59	67	68	70
19	38	40	38	44	48	52	60	58	65 x	67	69	71
20	37	40	36 n	43	47	53	54	56	60	64	70	69
21	37	40	37	43	47	51	57	61	60	63	70	71
22	35	40	38	43	50	54	63	57	61	68	70	70
23	27 n	38	37	41	49	56	65 x	57	61	62	70	64 n
24	39 x	40	39	43	31	49	55	61	62	63	72	70
25	38	35	39	41	48	48	57	56	61	65	72	71
26	37	38	39	44	46	59	57	57	61	63	70	72
27	38	39	40	45	54 x	53	54	59	60	63	62	72
28	35	39	39	37	50	50	60	59	60	66	65	72
29	36	40	39	44	53	44 n	56	58	62	59	61 n	71
30	37		40	39	48	52	51	61	61	68	73	71
31	38		45 x		45		57	60		70		72
Mean	30	38	39	43	47	49	50	59	63	63	67	74

Daily Mean Values Plot of the Components X, Y, Z

Niemegk 2000



Niemegk **A c t i v i t y   I n d i c e s**

January 2000

Day	C	F	Ap	AK	SK	K	
1	1	0.5	30	26	30	5333	4354
2	1	0.5	16	16	25	3333	3433
3	0	0.5	12	12	20	3222	3242
4	0	0.5	13	12	21	2222	3334
5	1	0.5	19	18	26	4333	2344
6	1	0.5	19	25	29	3323	5544
7	0	0.5	10	10	18	3312	2232
8	0	0.0	5	3	7	2011	1200
9	0	0.0	3	3	6	1101	0003
10	0	0.5	6	6	11	1200	0224
11	1	0.5	24	25	26	3212	3465
12	0	0.5	10	10	18	4322	1231
13	0	0.5	9	8	16	2213	2312
14	0	0.5	8	7	14	3211	1231
15	0	0.5	6	6	14	2212	2122
16	0	0.5	6	6	12	1111	1232
17	0	0.0	3	2	5	2011	0010
18	0	0.0	3	2	6	0001	1211
19	0	0.5	5	6	12	1110	1233
20	0	0.5	10	13	19	3122	2252
21	0	0.0	2	1	3	1001	1000
22	1	0.5	22	26	27	2223	3465
23	1	0.5	29	20	24	5523	3312
24	0	0.5	13	12	20	1233	2234
25	0	0.5	7	6	14	1221	1232
26	0	0.5	8	8	15	2212	1124
27	1	0.5	17	19	24	4212	3354
28	1	0.5	32	27	31	4433	4445
29	1	1.0	30	28	31	4333	4554
30	1	0.5	15	17	25	3332	3344
31	0	0.5	10	9	18	3222	2322
Mean:	0.4	0.4	13.0	12.5	18.3		
Max:	1	1.0	32	28	31		
Min:	0	0.0	2	1	3		

February 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	8	10	18	2221	3233
2	0	0.5	8	9	17	2112	2333
3	0	0.5	10	12	18	1111	3344
4	0	0.5	5	5	12	2221	1112
5	0	0.5	12	12	15	1001	1354
6	1	1.0	34	28	31	4434	3355
7	1	1.0	31	33	33	5333	5554
8	1	0.5	15	17	24	3323	2353
9	0	0.5	11	11	19	1322	3422
10	0	0.5	10	10	19	3222	2224
11	1	0.5	17	19	25	3422	2345
12	1	1.0	60	40	36	6545	5443
13	0	0.5	14	14	22	3123	3433
14	1	1.0	33	38	35	3434	5655
15	1	0.5	17	18	24	4322	2254
16	0	0.5	7	8	16	2211	2332
17	0	0.5	6	7	14	1113	2231
18	0	0.0	1	2	4	0011	1010
19	0	0.5	3	3	8	0012	2111
20	0	0.5	5	5	9	0111	1014
21	1	0.5	21	18	25	4423	3432
22	0	0.5	6	6	14	2211	3212
23	0	0.5	11	11	19	2123	4322
24	1	1.0	30	29	32	3434	4455
25	1	0.5	20	20	27	3433	3434
26	1	0.5	16	19	25	3223	2454
27	0	0.5	13	14	23	4223	3333
28	0	0.5	16	13	22	3333	3223
29	0	0.5	7	6	12	1123	2111
Mean:	0.4	0.6	15.4	15.1	20.6		
Max:	1	1.0	60	40	36		
Min:	0	0.0	1	2	4		

March 2000

Day	C	F	Ap	AK	SK	K	
1	1	0.5	21	20	26	2343	3335
2	0	0.5	11	13	19	5322	2113
3	0	0.5	5	6	13	1012	2232
4	0	0.0	3	3	7	0011	2201
5	0	0.5	6	7	14	0212	2223
6	0	0.5	12	12	20	2223	2324
7	1	0.5	16	18	26	3433	3334
8	0	0.5	14	15	23	2223	3443
9	0	0.5	4	6	12	3101	2122
10	0	0.5	9	8	15	1112	2224
11	0	0.5	13	12	21	4322	3223
12	1	0.5	19	16	24	2334	3333
13	0	0.5	4	7	12	3210	0033
14	0	0.5	6	8	15	2112	1233
15	0	0.0	2	2	5	1001	1110
16	0	0.0	2	2	5	0001	1111
17	0	0.5	4	5	11	2222	2100
18	0	0.5	6	6	12	0012	2232
19	0	0.5	7	8	17	2322	2222
20	0	0.5	6	5	9	1013	3100
21	0	0.5	4	3	7	0021	1210
22	0	0.5	12	11	20	2222	3333
23	0	0.5	14	12	20	3323	3321
24	0	0.5	11	10	19	2223	3322
25	0	0.5	8	8	15	2222	1330
26	0	0.5	3	5	10	0012	1312
27	0	0.5	4	4	9	1121	1111
28	0	0.0	4	3	7	1112	0110
29	0	0.5	10	9	14	1111	1144
30	0	0.5	12	15	21	3221	2353
31	1	0.5	23	18	26	3433	3334
Mean:	0.4	8.9	8.9	15.3	0.4		
Max:	0.5	23	20	26	0.5		
Min:	0.0	2	2	5	0.0		

April 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	13	14	22	3222	2344
2	0	0.5	15	14	21	4332	2124
3	0	0.5	9	10	18	3222	2214
4	1	0.5	22	17	24	4321	3344
5	0	0.5	11	9	16	3421	1122
6	2	1.5	82	85	34	1422	3679
7	1	1.5	74	57	37	8553	4444
8	0	0.5	10	8	16	2222	2123
9	0	0.5	14	14	22	2222	3443
10	1	0.5	19	16	25	3333	3334
11	0	0.5	9	8	16	1232	2231
12	0	0.5	7	6	14	2221	1222
13	0	0.5	6	4	9	2311	1100
14	0	0.0	2	2	6	0011	0121
15	0	0.5	6	7	14	1112	1233
16	1	0.5	22	18	26	4333	4333
17	0	0.5	12	8	17	3232	1222
18	0	0.5	6	5	11	2210	1032
19	0	0.5	12	12	20	3412	3322
20	0	0.5	13	12	21	3322	3332
21	0	0.5	10	10	18	3113	3322
22	0	0.5	5	6	13	1222	2121
23	0	0.5	6	6	14	1113	2222
24	1	0.5	21	19	25	1343	5333
25	0	0.5	5	6	12	2013	2130
26	0	0.0	2	2	4	0011	0011
27	0	0.5	13	13	21	3123	2334
28	1	0.5	14	15	22	5322	2233
29	0	0.5	12	14	22	2223	3334
30	0	0.5	12	12	19	3411	2242
Mean:	0.3	0.5	15.5	14.3	18.6		
Max:	2	1.5	82	85	37		
Min:	0	0.0	2	2	4		

Niemegk **A c t i v i t y I n d i c e s**

May 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	15	12	21	1323	3333
2	1	0.5	21	18	26	3324	4433
3	1	0.5	17	17	22	2221	2454
4	0	0.5	6	8	17	2222	2232
5	0	0.5	10	10	19	2232	2224
6	0	0.5	11	12	20	3313	3223
7	0	0.5	5	6	13	3221	1121
8	0	0.5	4	5	11	1011	2222
9	0	0.5	8	8	16	1212	1333
10	0	0.5	6	6	14	3211	1222
11	0	0.5	4	4	9	1111	1112
12	0	0.5	15	12	20	2222	3234
13	0	0.5	14	15	23	4223	4332
14	0	0.5	9	10	18	4212	2232
15	0	0.5	12	14	22	4323	3322
16	1	0.5	16	17	25	3433	3234
17	1	0.5	28	24	25	6523	2133
18	0	0.5	7	8	15	3322	2111
19	0	0.5	7	9	17	2323	3211
20	0	0.5	4	5	11	1111	1132
21	0	0.5	5	8	16	2222	1223
22	0	0.5	8	7	16	2222	2222
23	1	0.5	29	23	25	2222	3365
24	1	1.5	93	58	41	7655	5454
25	1	0.5	28	22	29	4433	3444
26	1	0.5	15	16	23	3333	2441
27	0	0.5	8	8	17	2212	3322
28	0	0.5	9	10	19	1223	2333
29	1	0.5	24	23	27	2223	4554
30	1	0.5	22	22	29	4343	4434
31	0	0.5	10	11	20	3332	2223
Mean:	0.3	0.5	15.2	13.8	20.2		
Max:	1	1.5	93	58	41		
Min:	0	0.5	4	4	9		

June 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	8	9	17	3321	2213
2	0	0.5	6	6	15	2222	1222
3	0	0.5	11	14	22	3234	3232
4	0	0.5	12	13	18	1220	1444
5	1	0.5	24	22	28	4332	4444
6	1	0.5	15	17	23	3323	4521
7	0	0.5	11	14	22	2223	3334
8	1	1.0	64	47	38	3445	6655
9	0	0.5	5	6	12	1113	2112
10	1	0.5	21	16	25	3333	4333
11	1	0.5	25	20	26	2333	4542
12	1	0.5	15	16	24	2332	4433
13	0	0.5	10	10	18	1222	4223
14	1	1.0	29	34	33	4243	5555
15	1	0.5	23	23	28	5333	4442
16	0	0.5	5	6	13	3122	1112
17	0	0.5	6	8	16	2122	3222
18	0	0.5	10	11	17	1012	2344
19	0	0.5	6	9	17	3312	1322
20	0	0.5	6	8	17	2223	3221
21	0	0.5	6	7	14	1111	2323
22	0	0.5	11	13	21	4223	3331
23	1	0.5	27	24	27	2421	5454
24	0	0.5	15	14	20	4442	2112
25	0	0.5	6	6	13	2111	2123
26	1	1.0	40	29	32	3345	4454
27	1	0.5	18	17	25	4332	4333
28	0	0.5	10	11	20	3222	2333
29	0	0.5	8	6	14	3221	2211
30	0	0.5	4	4	9	0001	1232
Mean:	0.4	0.6	15.2	14.7	20.8		
Max:	1	1.0	64	47	38		
Min:	0	0.5	4	4	9		

July 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	7	7	15	2121	2232
2	0	0.5	4	6	13	1211	2222
3	0	0.5	8	8	17	2212	3223
4	0	0.5	8	11	19	2212	4332
5	0	0.5	9	11	19	2223	4321
6	0	0.5	5	6	14	1211	3222
7	0	0.5	5	5	12	2211	1122
8	0	0.5	6	8	16	1213	3321
9	0	0.5	6	8	16	1222	2223
10	1	0.5	20	22	27	2243	4453
11	1	1.0	34	36	34	3434	6545
12	0	0.5	9	11	19	4313	2222
13	1	1.0	42	34	30	1325	6634
14	1	1.0	51	46	35	3334	4765
15	2	2.0	164	158	47	3344	7998
16	1	1.0	50	42	33	7545	5322
17	0	0.5	8	11	19	3333	3211
18	0	0.5	12	15	23	2322	4334
19	0	0.5	14	15	20	2211	2534
20	1	0.5	36	24	29	4544	3333
21	0	0.5	7	10	18	3322	3212
22	0	0.5	12	14	22	2323	2442
23	1	0.5	23	22	26	2313	4553
24	0	0.5	5	4	10	2211	1012
25	0	0.5	5	8	16	1212	3322
26	1	0.5	19	19	25	2233	3345
27	0	0.5	7	8	15	4211	1222
28	1	0.5	32	25	29	3334	5533
29	1	0.5	27	24	29	4335	4433
30	0	0.5	8	8	17	2312	2232
31	1	0.5	21	19	23	1222	3355
Mean:	0.4	0.6	21.4	20.8	22.2		
Max:	2	2.0	164	158	47		
Min:	0	0.5	4	4	10		

August 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	12	12	20	2212	2443
2	0	0.5	10	11	20	3322	2332
3	0	0.5	9	11	20	3223	2332
4	1	0.5	17	18	26	4333	3343
5	1	0.5	25	18	26	2344	3433
6	1	0.5	16	18	25	4423	3324
7	0	0.5	7	8	16	1123	3222
8	0	0.5	6	8	16	2221	3222
9	0	0.5	5	6	13	2211	1222
10	1	0.5	25	22	27	1344	4335
11	1	1.0	47	31	32	5443	4255
12	1	1.5	123	65	43	4666	6663
13	1	0.5	19	18	24	4532	3223
14	0	0.5	12	12	18	1111	3344
15	0	0.5	8	8	16	3312	1222
16	0	0.5	7	8	16	3122	2222
17	0	0.5	6	6	14	1212	2222
18	0	0.5	3	4	10	2211	1111
19	0	0.5	4	6	12	1111	2312
20	0	0.5	4	5	11	0102	1322
21	0	0.5	10	12	20	2322	2234
22	0	0.0	2	2	6	1210	1001
23	0	0.5	7	9	15	1012	2432
24	0	0.5	8	9	18	2332	2222
25	0	0.5	3	3	8	0111	1121
26	0	0.5	5	6	14	2222	2211
27	0	0.5	7	8	16	2112	3232
28	1	1.0	27	31	29	2223	4664
29	1	1.0	35	29	32	5443	3544
30	0	0.5	12	14	23	3323	3324
31	0	0.5	14	14	23	3223	3334
Mean:	0.3	0.6	16.0	13.9	19.6		
Max:	1	1.5	123	65	43		
Min:	0	0.0	2	2	6		

Niemegk **Activity Indices**

September 2000

Day	C	F	Ap	AK	SK	K	
1	1	0.5	16	16	24	3233	3343
2	1	0.5	23	21	28	4334	4433
3	0	0.5	7	7	14	1111	2233
4	1	0.5	18	20	23	2122	3364
5	0	0.5	7	9	17	2121	2333
6	0	0.5	12	15	18	1110	2544
7	0	0.5	15	14	22	3223	2343
8	0	0.5	17	14	23	3223	3343
9	0	0.5	5	7	14	2222	3210
10	0	0.5	4	5	11	0012	1232
11	0	0.5	4	5	11	0011	2322
12	1	0.5	21	19	26	2324	4344
13	0	0.5	10	11	19	4321	2223
14	0	0.5	4	4	11	1111	1222
15	0	0.5	12	12	17	0212	2235
16	1	0.5	29	22	27	4223	3445
17	1	1.5	56	49	32	4323	3458
18	1	1.5	70	58	40	7546	5643
19	1	0.5	30	22	28	3334	5433
20	0	0.5	12	12	20	4313	3222
21	0	0.5	9	8	17	2222	2232
22	0	0.5	6	6	14	2222	2121
23	0	0.5	7	6	14	2222	2211
24	0	0.5	12	12	17	0112	2353
25	1	0.5	19	18	25	3223	3444
26	1	0.5	24	18	26	4333	4333
27	0	0.5	11	10	19	3232	2223
28	0	0.5	12	10	18	2313	3321
29	0	0.5	7	8	17	2212	3232
30	1	1.0	51	34	34	3344	5555
Mean:	0.4	0.6	17.7	15.7	20.9		
Max:	1	1.5	70	58	40		
Min:	0	0.5	4	4	11		

October 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	13	10	19	3332	2321
2	0	0.5	10	11	17	0112	3433
3	1	0.5	30	17	24	4343	3412
4	1	1.0	63	36	33	2334	5565
5	1	1.5	116	72	45	5565	6675
6	0	0.5	4	4	8	3110	1011
7	0	0.5	4	5	10	0111	2230
8	0	0.5	2	3	7	0011	1013
9	0	0.5	4	6	12	1112	1123
10	0	0.5	8	10	19	3222	2323
11	0	0.5	15	14	21	4422	2142
12	0	0.5	6	7	14	3112	2113
13	1	1.0	36	32	30	6632	4432
14	1	1.0	45	32	34	4444	4545
15	0	0.5	8	7	16	2222	2222
16	0	0.5	10	12	20	4222	2323
17	0	0.5	11	11	20	3322	2233
18	0	0.5	9	12	20	3222	3224
19	0	0.5	9	8	16	3222	3112
20	0	0.0	3	3	7	1111	0111
21	0	0.0	3	3	7	0011	2111
22	1	0.5	16	17	22	1123	3543
23	0	0.5	15	14	23	4333	2233
24	0	0.5	9	8	16	3122	2123
25	0	0.5	6	6	14	1122	2123
26	0	0.5	8	8	17	3222	2123
27	0	0.5	4	5	12	2112	1212
28	1	0.5	20	17	22	2024	3335
29	1	0.5	34	25	29	5533	2443
30	1	0.5	15	15	22	5333	2222
31	0	0.5	13	14	22	3222	2434
Mean:	0.3	0.5	17.7	14.3	19.3		
Max:	1	1.5	116	72	45		
Min:	0	0.0	2	3	7		

November 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	7	8	15	3221	1123
2	0	0.5	4	4	9	3111	1011
3	0	0.5	3	5	9	0001	1133
4	1	0.5	26	26	30	3433	3545
5	0	0.5	14	14	22	3221	3344
6	1	1.5	55	48	36	3334	5576
7	1	0.5	46	27	30	5544	3342
8	0	0.5	18	15	23	2344	3232
9	0	0.5	13	11	19	2221	2334
10	1	0.5	42	25	29	3355	4333
11	1	0.5	16	21	25	2312	4553
12	1	0.5	20	16	24	3333	3423
13	0	0.5	9	10	19	2213	3233
14	0	0.5	5	6	12	2211	1023
15	0	0.5	4	4	9	1111	1031
16	0	0.5	3	3	7	1010	1013
17	0	0.0	3	2	6	1011	1110
18	0	0.5	5	7	12	0001	2243
19	0	0.5	6	8	16	2222	1223
20	0	0.5	8	8	17	2122	2332
21	0	0.5	9	10	19	3222	2233
22	0	0.5	8	8	16	3113	2222
23	0	0.5	6	6	12	3211	2210
24	0	0.5	11	13	19	0223	1344
25	0	0.5	6	7	13	3211	0132
26	1	0.5	28	26	27	2133	3465
27	1	1.0	45	29	32	5444	4353
28	1	0.5	31	24	29	2443	4453
29	1	1.0	56	33	32	6553	4324
30	0	0.5	6	6	14	2212	1213
Mean:	0.3	0.6	17.1	14.3	19.4		
Max:	1	1.5	56	48	36		
Min:	0	0.0	3	2	6		

December 2000

Day	C	F	Ap	AK	SK	K	
1	0	0.5	6	5	12	2211	2211
2	0	0.5	3	4	9	0011	2212
3	0	0.5	10	11	19	1222	3342
4	0	0.5	9	8	17	3222	2123
5	0	0.5	5	4	11	1212	2111
6	0	0.5	7	8	15	0112	2333
7	1	0.5	15	16	24	3333	3234
8	1	0.5	18	20	27	3333	4434
9	1	0.5	18	18	25	3332	2444
10	0	0.5	11	11	20	3322	2233
11	0	0.5	8	8	16	2222	2123
12	0	0.5	5	7	15	1212	2232
13	0	0.5	5	6	12	3211	1022
14	0	0.5	3	4	11	1112	2112
15	0	0.0	2	2	5	1001	1110
16	0	0.5	3	3	8	0001	1222
17	0	0.5	9	10	17	2211	3341
18	0	0.5	9	8	17	2212	2332
19	0	0.5	5	5	11	2112	1220
20	0	0.5	3	3	8	0012	1121
21	0	0.5	4	4	10	1002	2212
22	0	0.5	6	7	12	0111	1224
23	1	0.5	21	17	23	4532	2232
24	0	0.5	6	6	14	2321	1122
25	0	0.5	6	8	15	2111	3313
26	0	0.5	6	6	13	2111	1133
27	0	0.5	8	10	17	2111	3432
28	0	0.5	6	6	13	2111	3221
29	0	0.5	6	5	11	1311	0122
30	0	0.5	3	4	10	2111	2102
31	0	0.0	2	2	5	2002	1000
Mean:	0.1	0.5	7.4	7.6	14.3		
Max:	1	0.5	21	20	27		
Min:	0	0.0	2	2	5		

K Index Frequencies in the Eight Three Hourly Intervals

2000

UT	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
				January										**July**				
K=0	1	4	4	2	3	3	3	3	23	-	-	-	-	-	1	-	-	1
1	7	4	11	8	9	2	4	3	48	7	1	13	7	3	1	3	3	38
2	7	13	9	11	7	12	4	9	72	13	15	8	8	7	10	11	13	85
3	9	8	7	10	8	8	9	3	62	6	12	6	8	9	9	9	7	66
4	5	1	-	-	3	4	5	10	28	4	1	4	5	7	3	3	3	30
5	2	1	-	-	1	2	4	3	13	-	2	-	3	2	4	3	4	18
6	-	-	-	-	-	-	2	-	2	-	-	-	-	2	1	1	-	4
7	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	3
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
				February										**August**				
K=0	3	3	1	-	-	2	-	1	10	2	1	1	1	-	1	1	-	7
1	5	7	8	8	4	3	6	3	44	7	7	11	6	6	2	3	4	46
2	6	7	13	6	10	6	4	6	58	10	10	11	12	10	12	12	13	90
3	9	5	6	11	10	9	8	7	65	6	8	3	9	11	10	8	5	60
4	4	6	1	3	2	7	3	8	34	4	3	4	2	3	3	4	7	30
5	1	1	-	1	3	1	8	4	19	2	1	-	-	-	1	1	2	7
6	1	-	-	-	-	1	-	-	2	-	1	1	1	1	2	2	-	8
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				March										**September**				
K=0	6	8	3	1	2	1	3	6	30	4	2	-	1	-	-	-	1	8
1	7	6	11	8	8	9	7	4	60	3	6	10	5	2	1	2	3	32
2	10	9	13	13	11	9	8	6	79	9	12	13	10	12	11	7	6	80
3	6	6	3	8	10	11	10	9	63	7	9	5	9	10	10	9	12	71
4	1	2	1	1	-	1	2	5	13	6	-	2	4	3	5	8	4	32
5	1	-	-	-	-	-	1	1	3	-	1	-	-	3	2	3	3	12
6	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	3
7	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				April										**October**				
K=0	2	3	-	1	2	2	1	2	13	4	3	-	1	1	2	-	1	12
1	6	4	10	7	6	7	2	4	46	4	10	9	4	4	9	8	4	52
2	7	10	13	13	11	8	10	9	81	4	7	13	17	16	7	10	7	81
3	10	8	5	9	8	10	11	6	67	10	6	6	5	6	4	7	13	57
4	3	4	1	-	2	2	5	8	25	5	2	2	3	2	5	4	2	25
5	1	1	1	-	1	-	-	-	4	3	2	-	1	1	3	-	4	14
6	-	-	-	-	-	1	-	-	1	1	1	1	-	1	1	1	-	6
7	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	1
8	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
				May										**November**				
K=0	-	1	-	-	-	-	-	-	1	3	4	2	1	1	4	-	2	17
1	6	2	8	6	6	5	3	4	40	3	5	11	11	10	4	5	2	51
2	10	15	16	11	11	12	10	10	95	10	11	7	5	6	8	6	5	58
3	8	9	5	12	9	7	12	8	70	11	5	4	8	7	8	9	14	66
4	5	2	1	1	4	6	2	8	29	-	3	4	4	5	3	5	4	28
5	-	1	1	1	1	1	3	1	9	2	2	2	1	1	3	3	2	16
6	1	1	-	-	-	-	1	-	3	1	-	-	-	-	-	1	1	3
7	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				June										**December**				
K=0	1	2	1	1	-	-	-	-	5	5	6	4	-	1	2	2	3	23
1	5	5	5	6	5	4	5	4	39	7	9	18	14	9	10	7	5	79
2	8	10	13	11	8	8	8	10	76	12	9	5	15	14	11	10	13	89
3	10	10	7	9	5	8	8	8	65	6	6	4	2	6	5	9	6	44
4	5	3	4	1	9	6	5	6	39	1	-	-	-	1	3	3	4	12
5	1	-	-	2	2	3	4	2	14	-	1	-	-	-	-	-	-	1
6	-	-	-	-	1	1	-	-	2	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

K Index Frequencies

Niemegk — Annual Sums — 2000

K	UT	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	Σ
0		31	37	16	9	10	18	10	19	150
1		67	66	125	90	72	57	55	43	575
2		106	128	134	132	123	114	100	107	944
3		98	92	61	100	99	99	109	98	756
4		43	27	24	24	41	48	49	69	325
5		13	13	4	9	15	20	30	26	130
6		4	3	2	2	5	8	9	1	34
7		3	-	-	-	1	1	3	-	8
8		1	-	-	-	-	-	-	2	3
9		-	-	-	-	-	1	1	1	3

K Index Monthly Means

Niemegk — 2000

Month	UT	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	Mean
January		2.5	2.0	1.6	1.9	2.1	2.5	2.9	2.7	2.3
February		2.4	2.2	1.9	2.4	2.7	2.8	3.1	3.0	2.6
March		1.7	1.6	1.6	2.0	1.9	2.1	2.1	2.2	1.9
April		2.5	2.3	2.0	2.0	2.2	2.2	2.7	2.7	2.3
May		2.7	2.5	2.1	2.4	2.5	2.5	2.8	2.7	2.5
June		2.5	2.2	2.3	2.3	2.9	3.0	2.8	2.7	2.6
July		2.4	2.6	2.0	2.6	3.3	3.3	3.0	2.9	2.8
August		2.3	2.4	2.1	2.3	2.5	2.7	2.7	2.7	2.5
September		2.4	2.1	2.0	2.5	2.8	3.0	3.2	3.0	2.6
October		2.7	2.1	2.2	2.3	2.4	2.5	2.5	2.7	2.4
November		2.4	2.1	2.1	2.2	2.3	2.4	3.1	2.9	2.4
December		1.7	1.6	1.3	1.6	1.9	1.9	2.1	2.1	1.8
Mean		2.4	2.2	1.9	2.2	2.4	2.6	2.8	2.7	2.4

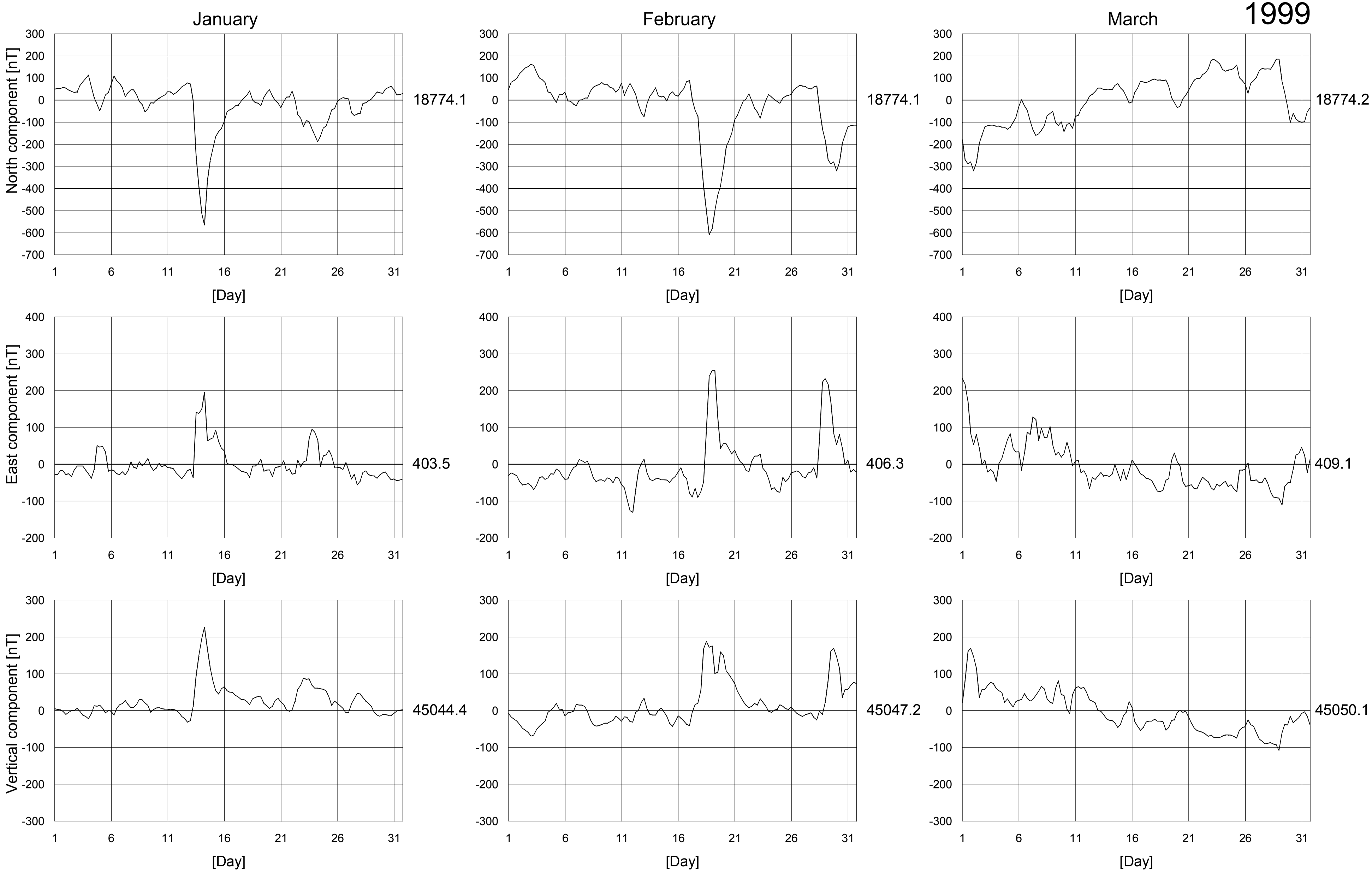
K Index Frequencies

Niemegk — Monthly Sums — 2000

K	Month	Jan.	Feb.	Mar.	Apr.	Mai	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	∑
0		23	10	30	13	1	5	1	7	8	12	17	23	150
1		48	44	60	46	40	39	38	46	32	52	51	79	575
2		72	58	79	81	95	76	85	90	80	81	58	89	944
3		62	65	63	67	70	65	66	60	71	57	66	44	756
4		28	34	13	25	29	39	30	30	32	25	28	12	325
5		13	19	3	4	9	14	18	7	12	14	16	1	130
6		2	2	-	1	3	2	4	8	3	6	3	-	34
7		-	-	-	1	1	-	3	-	1	1	1	-	8
8		-	-	-	1	-	-	1	-	1	-	-	-	3
9		-	-	-	1	-	-	2	-	-	-	-	-	3

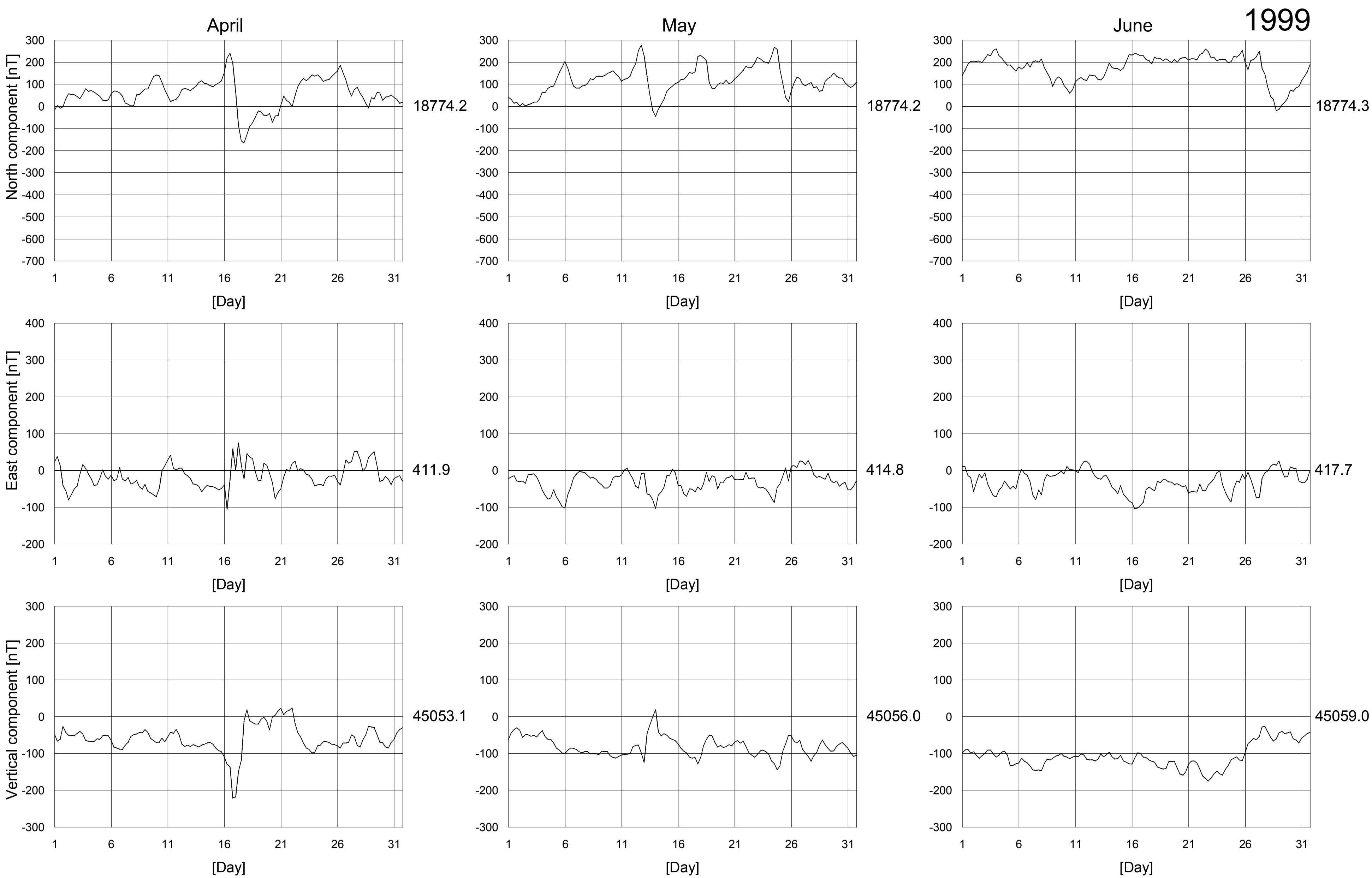
Deviations of the Magnetic Components from Normal Value

1999



The values at the right margin apply to the middle of the month

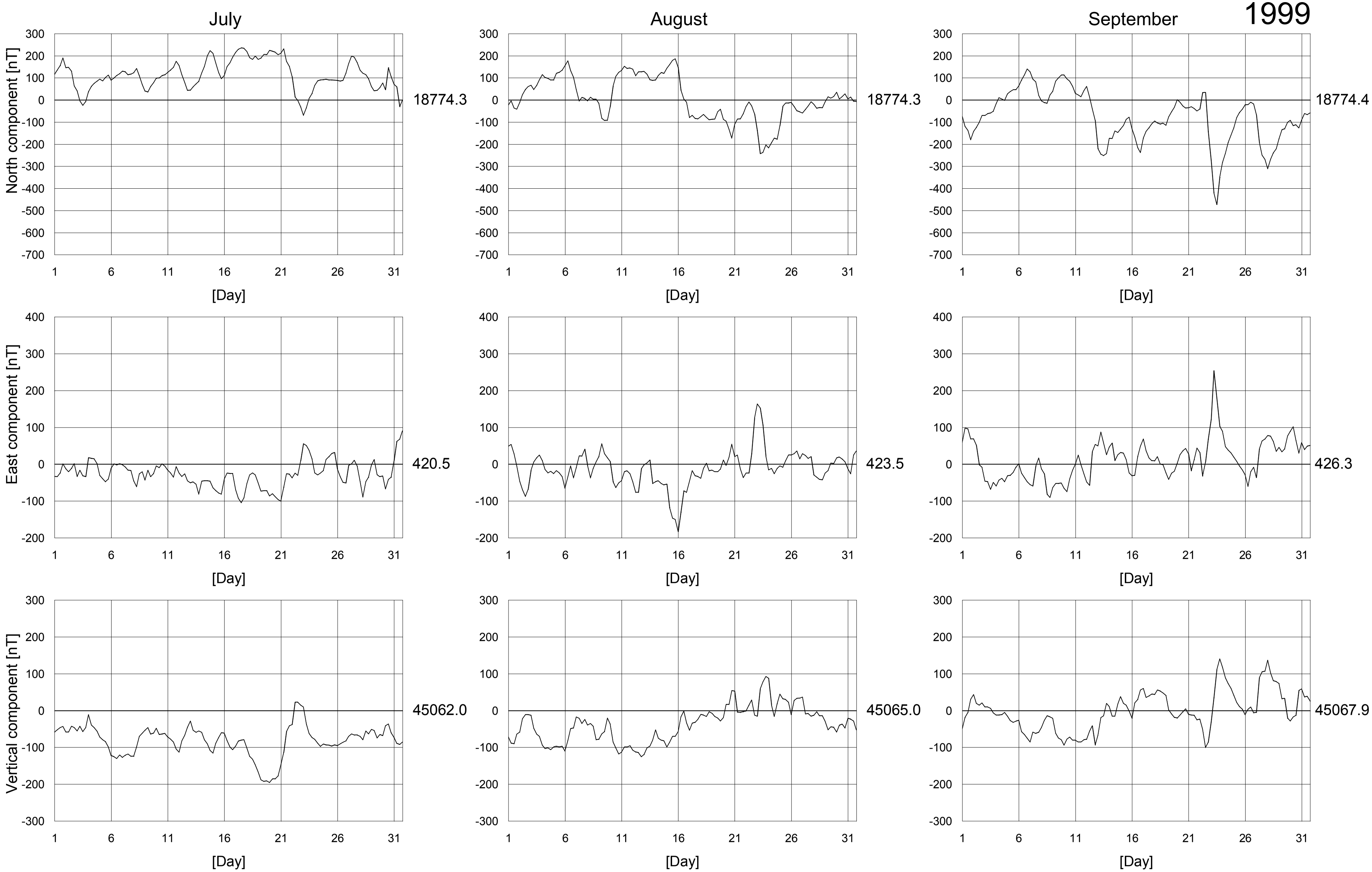
Deviations of the Magnetic Components from Normal Value



The values at the right margin apply to the middle of the month

Deviations of the Magnetic Components from Normal Value

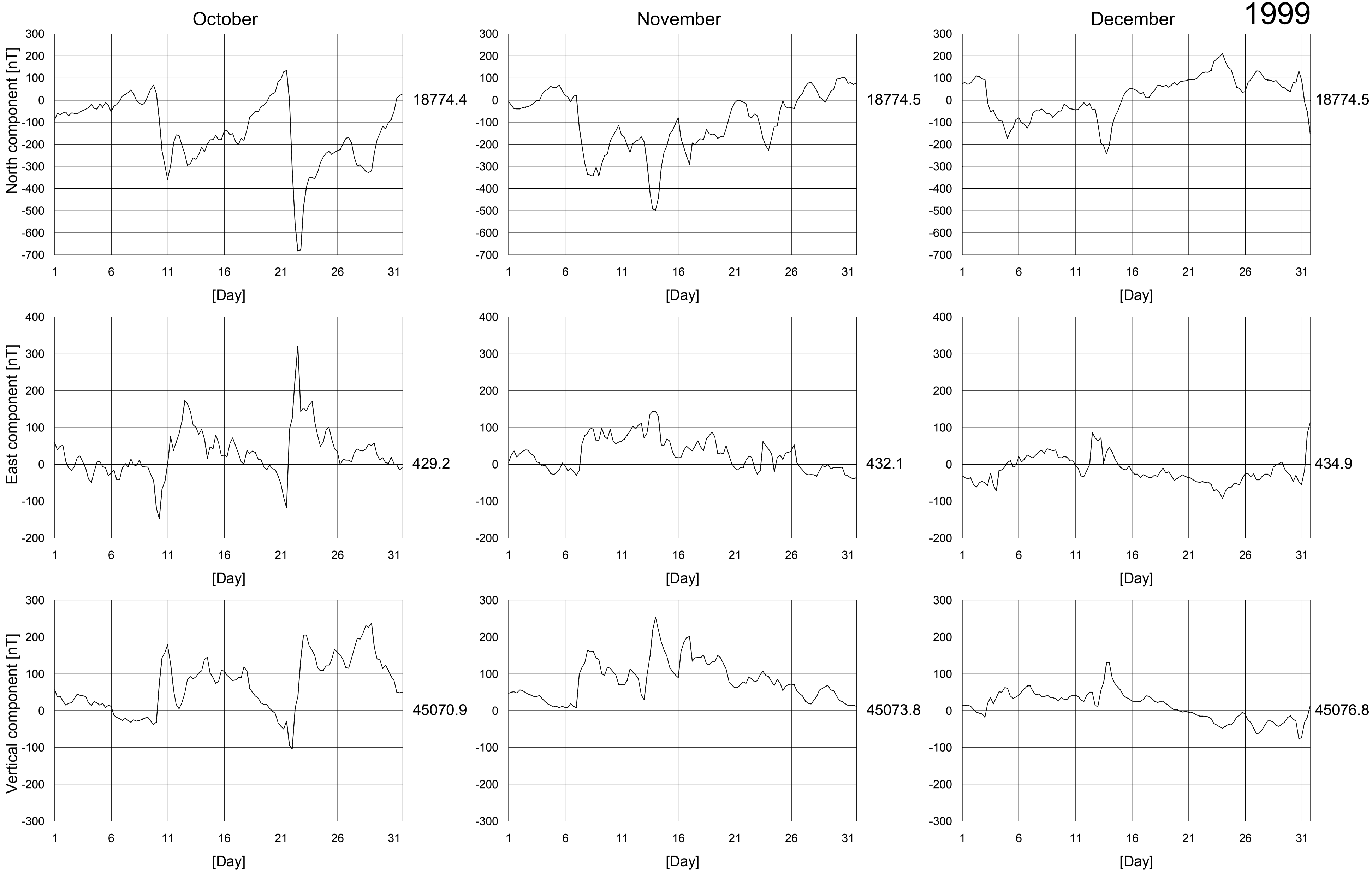
1999



The values at the right margin apply to the middle of the month

Deviations of the Magnetic Components from Normal Value

1999



The values at the right margin apply to the middle of the month

Annual Mean Values of the Observatories
Potsdam (1890-1907), Seddin (1908-1931) and Niemegk (from 1932), referenced to Niemegk

Year	D	H	I	F	X	Y	Z
1890	-10° 57.3’	18731 nT	66° 29.0’	46942 nT	18390 nT	-3559 nT	43044 nT
1891	-10 50.8	18749	66 25.3	46873	18414	-3528	42959
1892	-10 44.8	18759	66 25.8	46914	18430	-3498	43000
1893	-10 39.9	18790	66 25.0	46966	18466	-3477	43044
1894	-10 34.0	18809	66 23.3	46959	18490	-3449	43028
1895	-10 28.5	18834	66 21.1	46954	18520	-3424	43011
1896	-10 22.9	18861	66 19.8	46976	18552	-3399	43024
1897	-10 18.3	18888	66 17.7	46982	18583	-3379	43018
1898	-10 13.6	18908	66 16.6	46999	18608	-3357	43028
1899	-10 09.3	18932	66 14.6	46993	18635	-3338	43011
1900	-10 04.9	18958	66 13.0	47008	18665	-3319	43016
1901	-10 00.7	18975	66 11.5	47006	18686	-3299	43006
1902	-9 56.6	18987	66 09.6	46977	18702	-3279	42969
1903	-9 52.4	18990	66 08.8	46959	18709	-3256	42948
1904	-9 48.0	18994	66 08.4	46957	18717	-3233	42943
1905	-9 43.1	18993	66 08.0	46942	18720	-3206	42928
1906	-9 38.2	18993	66 07.2	46916	18725	-3179	42900
1907	-9 32.6	18980	66 07.7	46900	18717	-3147	42888
1908	-9 26.6	18966	66 08.0	46875	18709	-3112	42867
1909	-9 19.3	18952	66 08.4	46855	18702	-3070	42850
1910	-9 11.6	18942	66 08.4	46828	18699	-3027	42826
1911	-9 03.1	18929	66 08.8	46808	18694	-2978	42809
1912	-8 54.6	18916	66 09.2	46788	18688	-2930	42794
1913	-8 45.2	18898	66 10.1	46772	18678	-2876	42784
1914	-8 35.4	18874	66 11.6	46758	18662	-2819	42780
1915	-8 25.9	18841	66 13.8	46743	18637	-2763	42778
1916	-8 16.3	18812	66 15.8	46737	18617	-2706	42783
1917	-8 07.1	18787	66 17.8	46734	18599	-2653	42791
1918	-7 58.1	18763	66 19.4	46724	18582	-2601	42792
1919	-7 48.6	18739	66 21.1	46715	18565	-2546	42792
1920	-7 38.5	18721	66 22.3	46708	18554	-2489	42792
1921	-7 27.8	18704	66 23.4	46700	18546	-2430	42791
1922	-7 16.7	18690	66 24.6	46701	18539	-2368	42798
1923	-7 05.9	18679	66 25.3	46697	18536	-2308	42799
1924	-6 54.1	18665	66 26.7	46706	18530	-2243	42815
1925	-6 42.0	18646	66 28.5	46714	18518	-2175	42831
1926	-6 29.6	18615	66 31.4	46729	18496	-2105	42861
1927	-6 18.2	18602	66 32.9	46742	18490	-2042	42880
1928	-6 06.9	18580	66 34.6	46740	18475	-1980	42888
1929	-5 56.4	18556	66 37.3	46766	18456	-1920	42927
1930	-5 45.9	18532	66 40.1	46791	18438	-1861	42965
1931	-5 36.2	18526	66 41.5	46820	18437	-1809	42999
1932	-5 25.7	18511	66 43.5	46848	18428	-1751	43035
1933	-5 16.1	18499	66 45.7	46884	18421	-1698	43080
1934	-5 05.2	18491	66 46.9	46905	18418	-1639	43106

Annual Mean Values Potsdam – Seddin – Niemegk (continued)

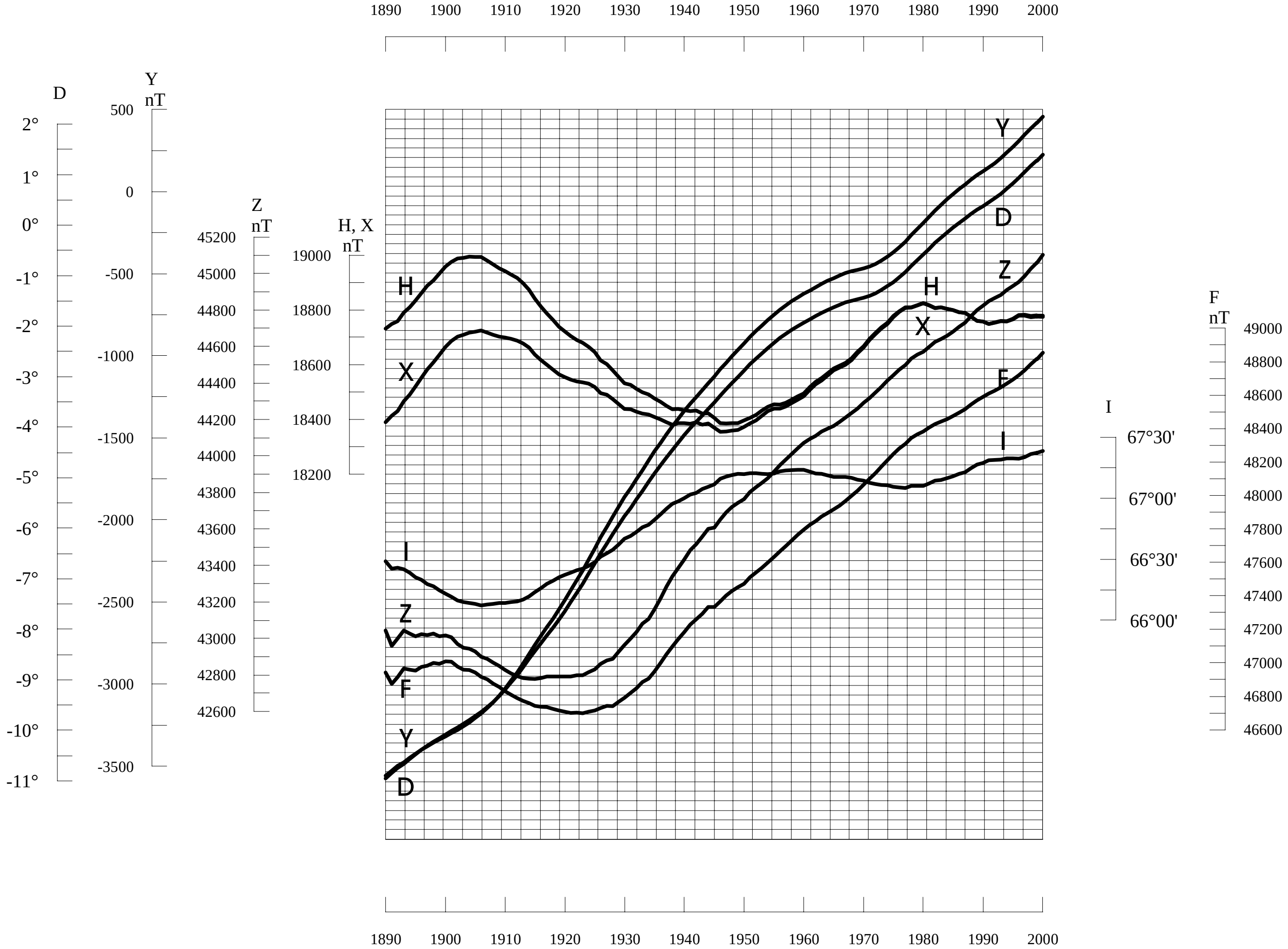
Year	D	H	I	F	X	Y	Z
1935	-4° 54.9’	18477 nT	66° 49.4’	46948 nT	18409 nT	-1583 nT	43159 nT
1936	-4 45.3	18464	66 52.1	46999	18400	-1531	43220
1937	-4 35.8	18449	66 54.8	47051	18390	-1478	43284
1938	-4 27.1	18437	66 57.3	47098	18381	-1431	43339
1939	-4 18.3	18438	66 58.5	47141	18386	-1384	43386
1940	-4 09.6	18434	67 00.1	47182	18386	-1337	43431
1941	-4 01.4	18430	67 01.9	47228	18384	-1293	43484
1942	-3 53.8	18433	67 02.6	47259	18390	-1252	43516
1943	-3 46.0	18421	67 04.6	47293	18381	-1210	43558
1944	-3 38.4	18422	67 05.7	47333	18385	-1169	43601
1945	-3 30.7	18405	67 07.0	47333	18370	-1127	43608
1946	-3 22.5	18386	67 09.6	47366	18354	-1082	43652
1947	-3 15.1	18385	67 10.7	47401	18356	-1043	43690
1948	-3 07.6	18387	67 11.5	47430	18359	-1003	43721
1949	-3 00.4	18386	67 12.1	47451	18361	-965	43744
1950	-2 53.1	18396	67 12.0	47472	18373	-926	43763
1951	-2 45.3	18406	67 12.4	47511	18385	-885	43801
1952	-2 38.4	18417	67 12.5	47541	18397	-848	43829
1953	-2 32.2	18433	67 12.1	47568	18414	-816	43852
1954	-2 25.9	18446	67 11.9	47599	18430	-782	43879
1955	-2 20.0	18455	67 12.3	47633	18439	-751	43913
1956	-2 14.1	18454	67 13.4	47666	18439	-720	43949
1957	-2 09.1	18461	67 13.8	47697	18448	-693	43980
1958	-2 04.6	18472	67 13.9	47730	18460	-669	44011
1959	-2 00.2	18484	67 14.0	47764	18472	-646	44042
1960	-1 55.9	18495	67 14.1	47796	18485	-623	44072
1961	-1 52.0	18518	67 13.2	47824	18508	-603	44094
1962	-1 48.2	18537	67 12.3	47847	18528	-583	44110
1963	-1 44.1	18551	67 12.1	47874	18542	-562	44134
1964	-1 40.8	18568	67 11.4	47895	18560	-544	44150
1965	-1 37.8	18586	67 10.6	47916	18579	-529	44164
1966	-1 34.7	18596	67 10.6	47939	18589	-512	44186
1967	-1 31.8	18606	67 10.6	47966	18599	-497	44211
1968	-1 29.8	18623	67 10.2	47997	18617	-486	44236
1969	-1 28.2	18647	67 09.3	48028	18641	-478	44260
1970	-1 26.3	18668	67 08.7	48064	18662	-468	44291
1971	-1 24.1	18695	67 07.7	48099	18690	-457	44317
1972	-1 21.2	18716	67 07.1	48134	18711	-442	44347
1973	-1 17.2	18736	67 06.6	48171	18732	-421	44378
1974	-1 12.5	18753	67 06.5	48211	18749	-396	44414
1975	-1 07.9	18777	67 05.7	48246	18773	-371	44442
1976	-1 02.1	18795	67 05.4	48280	18792	-340	44472
1977	-0 56.0	18810	67 05.1	48309	18807	-306	44497
1978	-0 48.5	18810	67 06.1	48343	18808	-266	44534
1979	-0 41.6	18817	67 06.2	48366	18816	-228	44556
1980	-0 35.0	18825	67 06.2	48382	18824	-192	44570

Annual Mean Values Potsdam – Seddin – Niemegk (continued)

Year	D	H	I	F	X	Y	Z
1981	-0° 28.1’	18817 nT	67° 07.4’	48406 nT	18816 nT	-154 nT	44598 nT
1982	-0 21.2	18807	67 08.8	48426	18806	-116	44625
1983	-0 15.0	18809	67 09.1	48440	18809	-82	44639
1984	-0 08.8	18804	67 10.0	48456	18804	-48	44659
1985	-0 03.1	18799	67 10.8	48474	18799	-17	44680
1986	0 02.6	18791	67 12.1	48495	18791	14	44707
1987	0 07.7	18789	67 12.9	48516	18789	42	44730
1988	0 13.0	18775	67 14.8	48543	18775	71	44765
1989	0 18.2	18760	67 16.7	48569	18760	99	44800
1990	0 22.4	18758	67 17.5	48589	18757	122	44822
1991	0 27.2	18748	67 18.8	48610	18748	148	44848
1992	0 31.6	18754	67 18.9	48627	18753	172	44865
1993	0 37.1	18760	67 19.0	48645	18759	203	44882
1994	0 43.4	18759	67 19.7	48669	18757	237	44909
1995	0 49.6	18768	67 19.8	48693	18766	271	44931
1996	0 56.1	18781	67 19.5	48719	18779	307	44953
1997	1 03.2	18782	67 20.4	48749	18779	346	44986
1998	1 10.5	18777	67 21.8	48784	18773	385	45026
1999	1 16.6	18780	67 22.4	48816	18775	419	45059
2000	1 23.1	18780	67 23.5	48853	18775	454	45099

Niemegk Observatory

Secular Variation of the Geomagnetic Elements

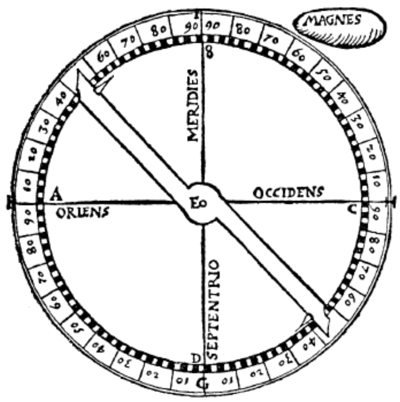


GeoForschungsZentrum Potsdam

Geomagnetic Results Wingst

2000

Yearbook No. 46



Potsdam 2005

Geomagnetic Results Wingst 2000 – Yearbook No 46

Günter Schulz

Contents

Wingst Observatory: The Absolute House on the left and the Variometer House in the background

FGE double system at Wingst Observatory. One of the suspended triples is provided with a coil system constructed after Beblo at al. (1999)

Cover: Compass after Pierre de Maricourt, 1269 (SCHÜCK,1911)

1 Introduction

This report (yearbook No 46) contains the results of Erdmagnetisches Observatorium Wingst (WNG) for 2000. Earlier reports were published by Bundesamt für Seeschiffahrt und Hydrographie[1]).

The enclosed CDrom contains recorded minute values as well as derived (hourly, daily, monthly) mean values and indices. It also provides recalculated epoch values from 1939.5 on and those of Marineobservatorium Wilhelmshaven (WLH) before then. Revised sets of monthly and daily mean values (since 1943) and K values (since 1944) are also included.

In the year under review, Wingst Observatory additionally published on a monthly basis:

a) Reports on geomagnetic indices and special geomagnetic events
b) Reports on preliminary daily and monthly means

Geomagnetic data have been provided on a regular basis to the following institutions:

a) International Space Environment Service (ISES): Geomagnetic indices and geomagnetic events (daily)

b) International Service of Geomagnetic Indices (ISGI): Geomagnetic indices and special geomagnetic events (monthly and annually)

c) World Data Centers for Geomagnetism: Microfiches of pulsation magnetograms, geomagnetic indices and one-minute values (annually)

d) INTERMAGNET (Global near-real-time magnetic observatory network): One-minute values (reported data via METEOSAT and Email, hourly; adjusted data via Email, on weekdays); Geomagnetic indices and one-minute values (CDrom, annually)

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[1] The last one of these reports (SCHULZ, 2004) contains a complete digital set of all data that have been published since the establishment of Wingst Observatory in 1938.

Indices and information about special events were made available through a telephone service on weekdays.

The preliminary variations and indices can be found on the Internet on a real time basis (10 min updates) in graphical form:

http://www.gfz-potsdam.de/pb2/pb23/Wingst/E/index.html

Definitive (compressed) data from 1939 onwards (minute values since 1981) can be found at:

ftp://ftp.bsh.de/outgoing/wng

The following list shows some additional selected links providing Wingst data:

Intermagnet (variations):
http://www.intermagnet.bgs.ac.uk/cgi-bin/imagform

RWC Brussels (indices):
http://sidc.oma.be/products/wng/index.php3

WDC Kyoto (pulsations):
http://swdcft49.kugi.kyoto-u.ac.jp/film/index.html

WDC Copenhagen (variations):
http://web.dmi.dk/fsweb/projects/wdcc1/obs.html

Address:

Erdmagnetisches Observatorium
Am Olymp 13
D-21789 Wingst

Phone: +49 4778 81210
Fax: +49 4778 812150

Collaborators: W.D. Grube and A. Glodek.

2 General Remarks

Wingst Geomagnetic Observatory was established in 1938 as a successor to Marineobservatorium Wilhelmshaven (WLH). Since then, the station has been operated without interruption. The observatory's development is described by VOPPEL, 1988, and SCHULZ, 2001 (see also appendix 4). The development of the modern recording devices is given by SCHULZ, 1998. For the instrumentation since 1938, see also instr.txt on the Cdrom.

The observatory is located in the Lower Elbe area on top of a terminal moraine of the Saale glacial period (elevation 50 m). Its co-ordinates are:

	Latitude	Longitude
Geographic	53° 44.6'N	09° 04.4'E
Geomagnetic	54.2°	95.3°

Geomagnetic co-ordinates refer to DGRF (Definitive Geomagnetic Reference Field) 1980.

The following abbreviations are used throughout this report:

X North component
Y East component
Z Vertical component (downward positive)
H Horizontal intensity
D Declination (eastward positive)
I Inclination (downward positive)
F Total intensity
U North-west component
V North-east component

Times are related to UTC (Co-ordinated Universal Time).

2.1 Recording systems

The results of this edition were derived from the following recording systems:

a) Digital system for variations:

Suspended fluxgate magnetometer (FM) of type FGE(DMI) (*U*, V, Z): One-minute and hourly means as well as indices of activity
Proton precession magnetometer (PPM) of type V75(VARIAN) (F): One minute spot values for quality check only

b) Photographic system for variations of type SCHULZE/LA COUR (*D*, *H* and *Z*; 20 mm h^{-1}): Geomagnetic events (ssc, sfe, bay) and substitute hourly means

c) Photographic system for pulsations of type KIM762(KARMANN) (amplitude and phase characteristics see yearbook, 1984): Geomagnetic events (pc, pi)

2.2 Levels, standards and constants

The results of this edition refer to the International Magnetic Standard (IMS). The results of the yearbooks up to and including 1980 referred to the Observatory Standard (OBS), which was represented by the classic type base line instruments bound to their original locations and surroundings.

H, *Z*, and *F* are referred to the proton vector magnetometer (PVM) of type ASKANIA/V4931(VARIAN) on pier NW (section 3.2), *D* to the fluxgate theodolite (DI-flux) of type 010B(ZEISS)/MAG01H(BARTINGTON) on pier NE (section 3.1) of the absolute house. Both instruments are assumed to represent IMS.

The following equations apply to *D* (see yearbook No 37, 1991), *H* and *Z* (see yearbook No 38, 1992):

$D_{OBS} = D_{IMS}$
$H_{OBS} = H_{IMS} + 6.7$ nT
$Z_{OBS} = Z_{IMS} + 11.1$ nT.

The differences for the derived elements depend on the components, i.e. for 2000:

$F_{OBS} = F_{IMS} + 12.8$ nT
$I_{OBS} = I_{IMS} - 0.15'$
$X_{OBS} = X_{IMS} + 6.7$ nT
$Y_{OBS} = Y_{IMS}$

The following physical standards are available at Wingst. They guarantee the quality of data:

SCHWILLE (frequency, DCF77, 10^{-8})
PATEK PHILIPPE and HOPF (UTC, DCF77)
CROPICO VS10 (Voltage, $5 \cdot 10^{-6}$)
GUILDLINE 100 Ohm (resistance, $5 \cdot 10^{-6}$)
Helmholtz coil of high precision (magnetic field strength, 10^{-4})

For the determination of the magnetic induction, the IAGA-recommended gyromagnetic constant (RASMUSSEN, 1991) was used:

$2\pi\tau^{-1} = 23.487203$ nT s

The azimuth marks were last checked by the German Geodetic Survey in 1995. Their values, related to the NE pier (R: 3504926.873, H: 5956702.028), and their deviations in the year under review are:

Azimuth mark	Azimuth	Deviation against
N	11°38.36’	N
NE	13° 23.19’	(-0.14 ±0.04)’
W	308° 42.94’	(-0.01 ±0.03’)

2.3 Special measurements

In the year under review, comparative measurements were carried out at Wingst and at the observatories Fürstenfeldbruck (FUR), Hurbanovo (HRB) and Wien-Kobenzl (WIK). The station differences are as follows:

at	WNG minus	D	I	F
FUR	FUR	-0.19’	-0.05’	0.0 nT
HRB	HRB	+0.01’	-0.06’	+0.1 nT
WIK	WIK	-0.25’	+0.07’	+1.5 nT
WNG	NGK	-0.07’	-0.12’	-1.0 nT

3 Absolute measurements

The absolute measurements were reduced according to the variations of the digital system (section 4).

3.1 Declination and Inclination

Absolute measurements of *D* were made with the *DI*-flux on an approximately monthly basis. Also the determination of *I* was included in the measurement routine. Each measurement is based on a set of four positions. *I* was corrected by the pier difference of -0.2’ in the sense of NW minus NE. The differences $E=I$-arctg(Z/H) are shown in Table 1.

Additionally, relative measurements of *D* were carried out with the PVM according to the addition field method (Serson) on a weekly basis. The mean difference in the sense of PVM minus DI-flux of all pairs of measurements carried out on the same day was used as an instrument constant. Its value e is as follows:

e = -23.88’ (11 measurements).

3.2 Horizontal intensity, vertical component and total intensity

Absolute measurements of *H* and *Z* were carried out with the PVM according to the compensation field method (Nelson) after each relative determination of *D.*

The magnetic induction vector is over-determined due to the measurement of three elements within the meridian plane. The difference $c=F-(H^2+Z^2)^{1/2}$ represents the measurements' inherent accuracy. The annual mean of the error c amounted to:

+0.5 nT ± 0.4 nT value (52 measurements).

C is shown in Table 1.

As a rule, the PPM of type V75 was used. This instrument shows a long-term drift of some 0.1 nT depending on the components (SCHULZ AND CARSTENS, 1979).). Therefore, comparative measurements using the PPM of type V4931, which represents IMS (see section 2.2), were carried out on a monthly basis. All base line values as well as the recorded minute spot values of *F* (section 4) are referred to this instrument.

4 Digital recording system

Minute mean values of the orthogonal components *U*, *V*, and *Z* as well as spot values of *F* were acquired by the primary digital system (V75 and FGE (No 125), section 2.1). The PPM is not only part of the recording system but also serves as an indicator of the PVM (section 3).

Owing to over-determination, outliers, jumps and short-term base line instabilities between the dates of absolute measurements of all three components could be detected (section 4.1) and, under certain conditions, automatically eliminated. The following equation applies to Wingst:

$dF = 0.26\, dU + 0.26\, dV + 0.93\, dZ.$

Additionally, a forth fluxgate was operated, which had been aligned in such a way that its W orientation satisfies the following equation:

$dW = 0.578(dU + dV + dZ).$

In this way, jumps and outliers of the secondary system could be monitored independently.

A second suspended FM of type FGE (No 126), an FM of type EDA FM100B and a PPM of type PPM105(EDA) were operated as stand-by devices in case of failure of the primary system.

4.1 Base line values

Table 1 shows the base line values of the FGE125 referred to IMS. Fig 1 shows the results in graphical form. Absolute measurements of *D* and I (DI-flux) are marked by circles, those of *H* and *Z* (PVM) as well as relative measurements of D by dots. *I* (derived from H and Z) is also displayed (dots).

To obtain base line values, the dependence of the measured elements *D*, *H, I* and *F* on the recorded components *U*, *V*, and *Z* within the range of variations was developed up to terms of second order (appendix 3). Minute mean values of the magnetometer and the baseline instruments were processed, which had been synchronized within ±5 s.

For 2000, the base line values of the primary components refer to the following equivalent voltages *E* of the fluxgate compensation fields:

Component	*E* in mV (nominal)
U	12861
V	12613
Z	45463

4.2 Scale values, temperature coefficients and cross talk

Scale values and cross talk were traced back to the respective parameters of the old FM100C(EDA) system by employing stochastic methods, making use of strong variations during a substorm on April 7, 1995 (SCHULZ, 1998). The following values apply to the primary components (FGE125):

	Scale Values in nT/mV 1.000+	Cross Talk against FM100C in 10^{-3}	
U	$+10^{-3}$(1.4 ±0.6)	V: +0.2±1.0	Z: +0.9±0.6
V	-10^{-3}(1.5 ±0.8)	U: -0.7±0.6	Z: -0.5±0.4
Z	$+10^{-3}$(0.8 ±0.6)	U: -0.6±0.4	V: -1.2±0.8

Considering the respective values of the FM100C (see yearbook No 41, 1995), the absolute misalignments and errors of the scale values of the FGE125 fluxgates probably do not exceed the order of magnitude of 10^{-3}.

Temperature coefficients were neglected because the FGE double system had been installed in the old variometer room (SCHULZ 2001) with almost perfect temperature control (contact thermometers, ±0.03°C).

5 Data processing

The base line values (Tables 1) were smoothed by Bathspline approximation in steps of 0.01‘ for *D* or 0.1 nT for *H* and *Z*, respectively (SCHOTT, 1992).

Hourly mean values were formed using 60 minute mean values of U, V, and Z (taken at minutes 00 to 59 UTC and centred at second 30) as well as 60 F spot values (taken at second 05).

The international quiet (*Q*) and disturbed (*D*) days were taken from the Niemegk listings of ISGI. *A* denotes normal days. In the case of averaging, *A* means that all days of the month or the year, respectively, have been included.

The data were processed by a computer double system of type HP9000 330/360. Each workstation is connected to a data acquisition unit of type HP3852 and to the Internet. All necessary calculations including those for the yearbook were carried out by the workstation of type HP9000 360.

6 Indices

The indices presented in this edition (File wng00.k and Table 4) indicate the local disturbances of the geomagnetic field resulting from particle radiation. Their meaning in detail:

K: geomagnetic three-hourly index, quasi-logarithmic measure of the maximum disturbance in steps of 0 to 9; lower limit for *K* = 9: 500 nT

sum: Sum of the eight three-hourly indices of a day

Ak: Mean value of the equivalent amplitudes derived from the eight three-hourly indices. The mean value of the daily disturbance of the geomagnetic field is 2 *Ak,* given in nT

Ck: daily character figure derived from *Ak* and scaled from 0.0 to 2.5.

C: estimated daily character figure; scale: 0, 1, 2

The indices were derived using the IAGA-recommended FMI-routine (Häkkinen, 1992).

7 Files on the CDrom

Wingst	*Wingst subdirectory, containing as follows*
tree_00.txt:	File structure
yearb00\\:	
yearb00\instr.txt:	Instruments used since 1938
yearb00\wng6dec.pdf:	Reprint of SCHULZ, 2001
data00\wlh+wng.yr:	Updated epoch values WLH and WNG (*D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)
data00\wng.mon:	Updated monthly mean values WNG (since 1943; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)
data00\wng.day:	Updated daily mean values WNG (since 1944; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)
data00\wng.k:	Updated activity figures *K*, *Ak*, *Ck*, and *C* as well as monthly and annual mean values of *Ak*, *Ck,* and *C* (since 1944)
data00\iaga00\\:	*Directory containing the following data in the IAGA2000 format See also: http://www.ngdc.noaa.gov/IAGA/vdat/iagaformat.html*
data00\iaga00\YR.WNG:	Epoch values WNG 1939 -1979: *D* and *I* in 0.1´; *X, Y, Z, H* and *F* in nT; from 1980 onward: 0.01' or 0.1 nT, respectively
data00\iaga00\2000MT.WNG:	Monthly means (*D* and *I* in 0.01'; *X, Y, Z, H* and *F* in 0.1 nT)
data00\iaga00\2000DY.WNG:	Daily means (*D* and *I* in 0.01'; *X, Y, Z, H* and *F* in 0.1 nT)
data00\iaga00\2000mmHR.WNG:	Hourly means (*F, X, Y,* and *Z* in 0.1 nT) of the month mm
data00\iaga00\2000mmMN.WNG:	Minute means (*F, X, Y* and *Z* in 0.1 nT) of the month mm

8 References

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Appendix 1 and 2: Figures and Tables

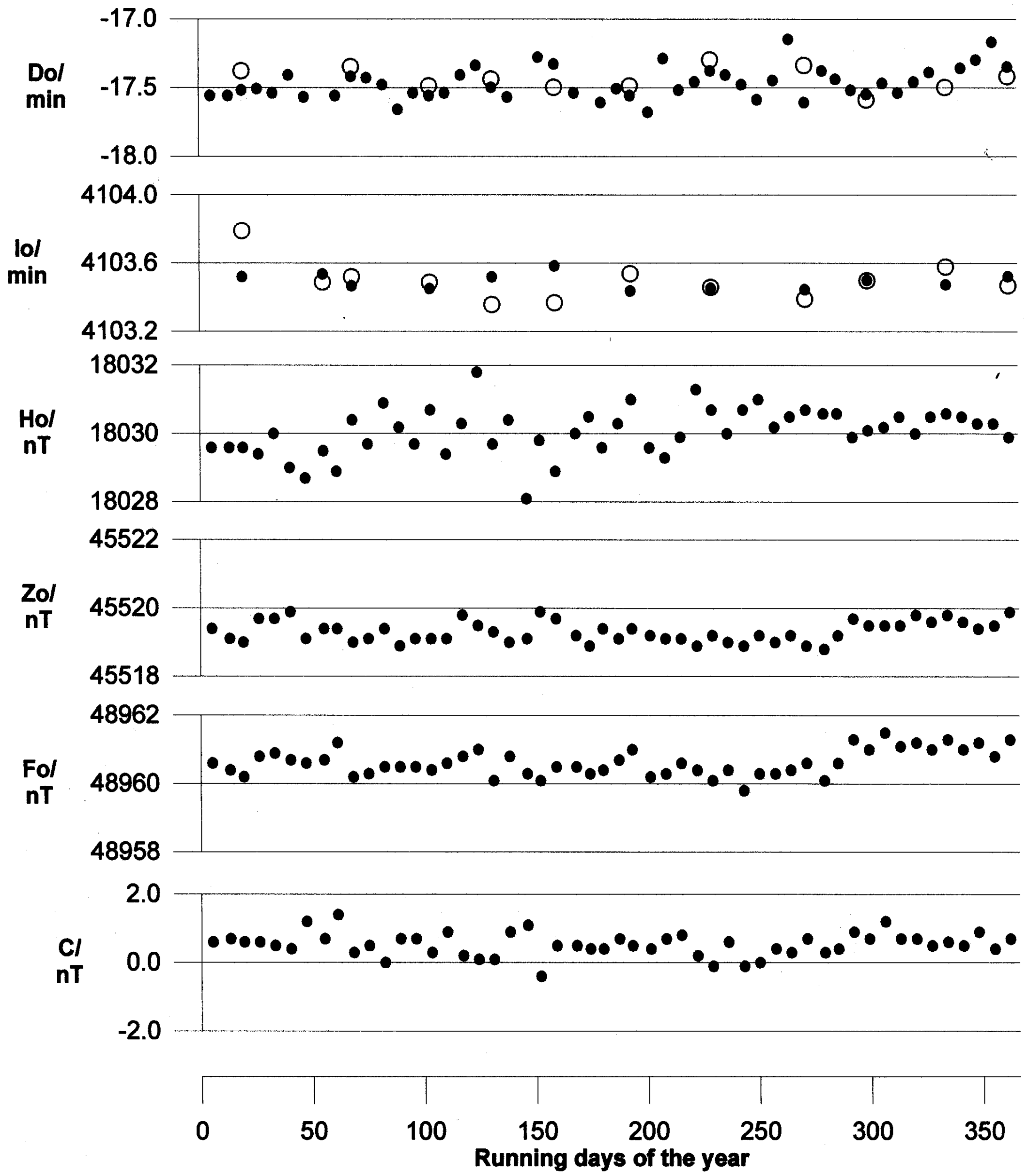

Fig. 1

Wingst 2000 Base line values of the fluxgate system FGE125, IMS

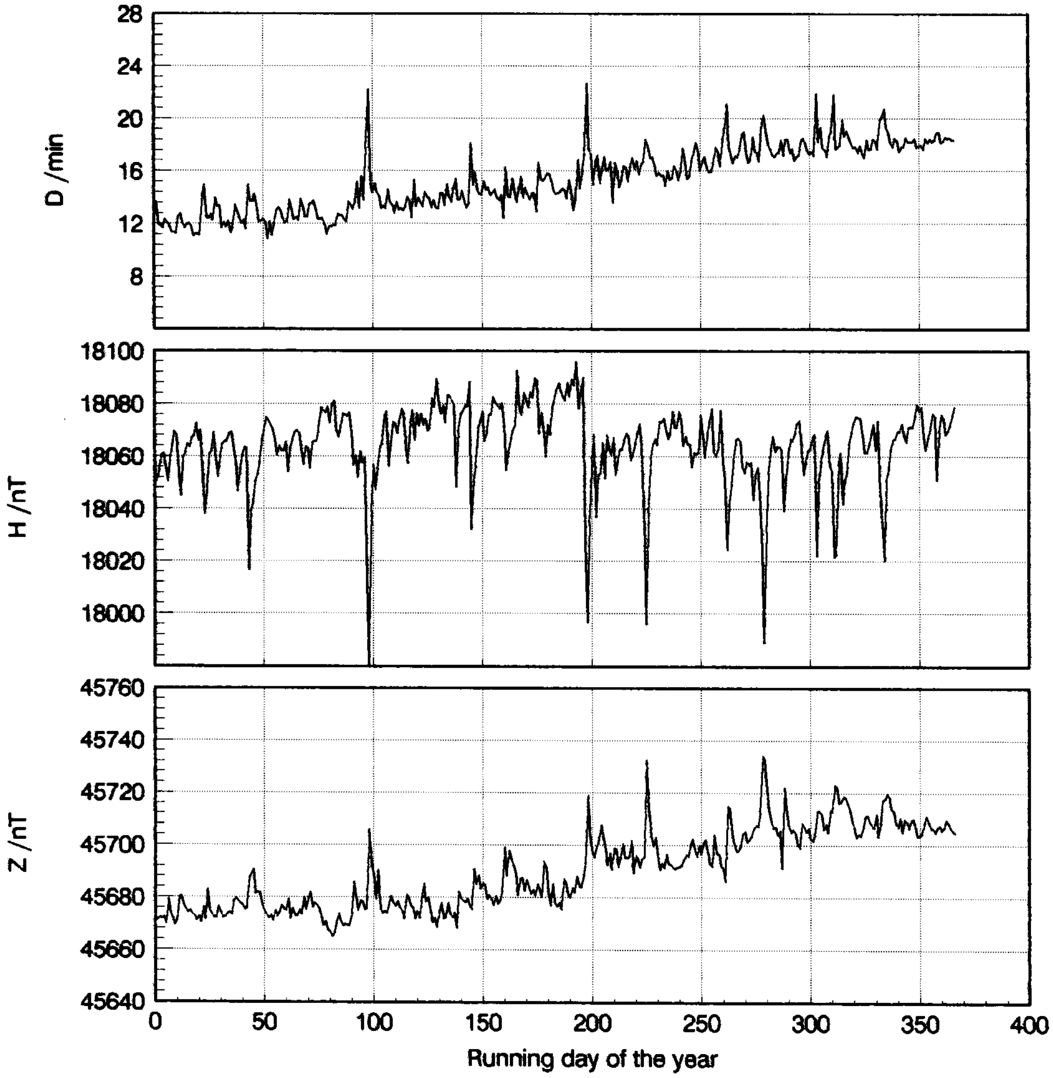

Fig. 2

Wingst 2000 Daily mean values D, H and Z

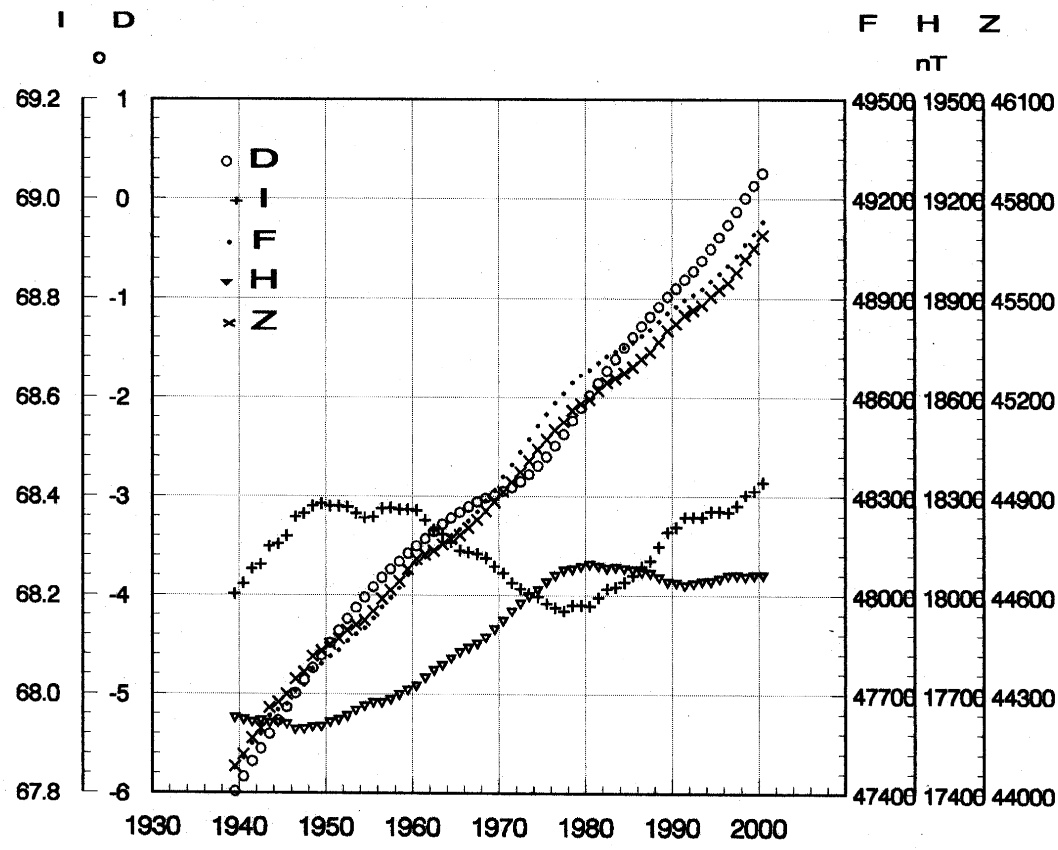

Fig. 3

Wingst Epoch values I, D, F, H and Z

```
wingst\
        tree_00.txt

        yearb00\
                instr.txt
                wng6dec.pdf


        data00\
                wlh+wng.yr
                wng.mon
                wng.day
                wng.k

                iaga00\
                        YR.WNG
                        2000MT.WNG
                        2000DY.WNG
                        200001MN.WNG
                        .
                        200012MN.WNG
                        200001HR.WNG
                        .
                        200012HR.WNG
```

Fig. 4

Structure of the file set on CDrom

Wingst 2000

Base-line measurements, system FGE125, IMS

Month	day	Do(abs)	Do(rel)	Io	Fo nT	Ho nT	Zo nT	C	E
Jan.	5		-0°17.56'		48960.6	18029.6	45519.4	+0.6	
	13		-0 17.56		48960.4	18029.6	45519.1	+0.7	
	19	-0°17.38'	-0 17.52	+68°23.79'	48960.2	18029.6	45519.0	+0.6	+0.27'
	26		-0 17.51		48960.8	18029.4	45519.7	+0.6	
Feb.	2		-0 17.54		48960.9	18030.0	45519.7	+0.5	
	9		-0 17.41		48960.7	18029.0	45519.9	+0.5	
	16		-0 17.57		48960.6	18028.7	45519.1	+1.2	
	24		+* 39.99	+68 23.49	48960.7	18029.5	45519.4	+0.7	-0.05
March	1		-0 17.56		48961.2	18028.9	45519.4	+1.5	
	8	-0 17.35	-0 17.42	+68 23.52	48960.2	18030.4	45519.0	+0.3	+0.05
	15		-0 17.43		48960.3	18029.7	45519.1	+0.5	
	22		-0 17.48		48960.5	18030.9	45519.4	+0.0	
	29		-0 17.66		48960.5	18030.2	45518.9	+0.7	
April	5		-0 17.54		48960.5	18029.7	45519.1	+0.7	
	12	-0 17.49	-0 17.56	+68 23.49	48960.4	18030.7	45519.1	+0.3	+0.04
	19		-0 17.54		48960.6	18029.4	45519.1	+0.9	
	26		-0 17.41		48960.8	18030.3	45519.8	+0.2	
May	3		-0 17.34		48961.0	18031.8	45519.5	+0.1	
	10	-0 17.44	-0 17.50	+68 23.36	48960.1	18029.7	45519.3	+0.2	-0.16
	17		-0 17.57		48960.8	18030.4	45519.0	+0.9	
	25				48960.3	18028.1	45519.1	+1.1	
	31		-0 17.28		48960.1	18029.8	45519.9	-0.4	
June	7	-0 17.50	-0 17.33	+68 23.37	48960.5	18028.9	45519.7	+0.5	-0.21
	16		-0 17.54		48960.5	18030.0	45519.2	+0.5	
	22				48960.3	18030.5	45518.9	+0.4	
	28		-0 17.61		48960.4	18029.6	45519.4	+0.4	
July	5		-0 17.51		48960.7	18030.3	45519.1	+0.7	
	11	-0 17.49	-0 17.56	+68 23.54	48961.0	18031.0	45519.4	+0.5	+0.10
	19		-0 17.68		48960.2	18029.6	45519.2	+0.4	
	26		-0 17.29		48960.3	18029.3	45519.1	+0.7	
Aug.	2		-0 17.52		48960.6	18029.9	45519.1	+0.8	
	9		-0 17.46		48960.4	18031.3	45518.9	+0.2	
	16	-0 17.30	-0 17.38	+68 23.46	48960.1	18030.7	45519.2	-0.1	+0.01
	23		-0 17.41		48960.4	18030.0	45519.0	+0.6	
	30		-0 17.48		48959.8	18030.7	45518.9	-0.1	
Sep.	6		-0 17.59		48960.3	18031.0	45519.2	+0.0	
	13		-0 17.45		48960.3	18030.2	45519.0	+0.4	
	20		-0 17.15		48960.4	18030.5	45519.2	+0.2	
	27	-0 17.34	-0 17.61	+68 23.39	48960.6	18030.7	45518.9	+0.7	-0.06
Oct.	5		-0 17.38		48960.1	18030.6	45518.8	+0.3	
	11		-0 17.44		48960.6	18030.6	45519.2	+0.4	
	18		-0 17.52		48961.3	18029.9	45519.7	+0.9	
	25	-0 17.59	-0 17.55	+68 23.50	48961.0	18030.1	45519.5	+0.7	+0.00
Nov.	1		-0 17.47		48961.5	18030.2	45519.5	+1.2	
	8		-0 17.54		48961.1	18030.5	45519.5	+0.7	
	15		-0 17.46		48961.2	18030.0	45519.8	+0.7	
	22		-0 17.39		48961.0	18030.5	45519.6	+0.5	
	29	-0 17.50	-0 17.03	+68 23.58	48961.3	18030.6	45519.8	+0.6	+0.10
Dec.	6		-0 17.36		48961.0	18030.5	45519.6	+0.5	
	13		-0 17.30		48961.2	18030.3	45519.4	+0.9	
	20		-0 17.17		48960.8	18030.3	45519.5	+0.4	
	27	-0 17.42	-0 17.35	+68 23.47	48961.3	18029.9	45519.9	+0.7	-0.05

Table 1 Wingst 2000 base line values of the fluxgate system FGE125

Wingst (WNG)
Geographic Coordinates: 53.743° N 9.073° E

2000

Monthly mean values, IMS

D: disturbed, Q: quiet, A: all days

Month		D	F nT	H nT	I	X nT	Y nT	Z nT
Jan	A	12.3'	49115	18060	68°25.6'	18060	64	45674
Feb	A	12.5	49118	18060	68 25.6	18060	66	45677
Mar	A	12.7	49118	18069	68 24.9	18069	67	45673
Apr	A	14.3	49120	18061	68 25.6	18061	75	45679
May	A	14.3	49123	18073	68 24.8	18073	75	45678
Jun	A	14.6	49131	18076	68 24.8	18076	77	45685
Jul	A	15.7	49134	18067	68 25.5	18067	82	45692
Aug	A	16.2	49138	18064	68 25.9	18064	85	45697
Sep	A	17.4	49139	18060	68 26.2	18060	91	45700
Oct	A	18.0	49146	18055	68 26.8	18055	94	45709
Nov	A	18.4	49149	18058	68 26.6	18058	97	45712
Dec	A	18.3	49150	18070	68 25.8	18070	96	45708
Mean	A	15.4	49132	18064	68 25.7	18064	81	45690
Jan	Q	11.4	49116	18068	68 25.0	18068	60	45672
Feb	Q	12.0	49119	18068	68 25.1	18068	63	45676
Mar	Q	12.4	49118	18074	68 24.6	18074	65	45672
Apr	Q	13.5	49122	18071	68 24.9	18071	71	45677
May	Q	13.9	49123	18081	68 24.2	18081	73	45674
Jun	Q	15.3	49130	18074	68 24.9	18074	80	45685
Jul	Q	15.2	49133	18075	68 24.9	18075	80	45687
Aug	Q	16.0	49136	18071	68 25.3	18071	84	45692
Sep	Q	16.5	49138	18070	68 25.4	18070	87	45695
Oct	Q	17.6	49147	18062	68 26.3	18062	93	45708
Nov	Q	17.5	49149	18072	68 25.6	18072	92	45705
Dec	Q	18.2	49149	18077	68 25.3	18077	96	45705
Mean	Q	15.0	49132	18072	68 25.1	18072	79	45687
Jan	D	13.7	49112	18050	68 26.2	18050	72	45675
Feb	D	13.4	49117	18046	68 26.7	18046	70	45682
Mar	D	13.2	49119	18059	68 25.7	18059	70	45679
Apr	D	16.7	49115	18036	68 27.3	18036	88	45684
May	D	15.2	49120	18059	68 25.7	18059	80	45679
Jun	D	13.7	49135	18081	68 24.5	18081	72	45687
Jul	D	17.3	49133	18049	68 26.9	18049	91	45698
Aug	D	17.1	49137	18046	68 27.2	18046	89	45704
Sep	D	19.0	49135	18044	68 27.3	18044	100	45703
Oct	D	19.5	49144	18027	68 28.8	18027	102	45719
Nov	D	20.0	49145	18031	68 28.6	18031	105	45718
Dec	D	18.3	49148	18065	68 26.0	18065	96	45708
Mean	D	16.4	49130	18049	68 26.7	18049	86	45695

Table 2 Monthly and annual mean values 2000
Wingst (WNG)

Geographic Coordinates: 53.743°N 9.073°E

Annual mean values (IMS)

Epoch	D	F nT	H nT	I	X nT	Y nT	Z nT
1939.5	-5°59.1'	47476	17630	68°12.1'	17534	-1838	44081
1940.5	-5 50.2	47506	17624	68 13.4	17533	-1792	44116
1941.5	-5 40.8	47550	17617	68 15.2	17530	-1744	44166
1942.5	-5 33.1	47579	17622	68 15.7	17540	-1705	44196
1943.5	-5 24.2	47634	17614	68 18.0	17535	-1659	44259
1944.5	-5 16.2	47652	17616	68 18.3	17541	-1618	44276
1945.5	-5 8.2	47671	17611	68 19.2	17540	-1577	44299
1946.5	-4 59.6	47708	17595	68 21.5	17528	-1532	44346
1947.5	-4 51.7	47726	17596	68 22.0	17532	-1491	44365
1948.5	-4 44.4	47775	17602	68 22.9	17541	-1454	44415
1949.5	-4 36.6	47791	17604	68 23.2	17547	-1415	44431
1950.5	-4 29.1	47814	17617	68 22.9	17562	-1378	44451
1951.5	-4 21.5	47832	17624	68 22.8	17573	-1339	44468
1952.5	-4 14.5	47861	17636	68 22.7	17587	-1304	44494
1953.5	-4 7.6	47882	17653	68 22.0	17607	-1270	44510
1954.5	-4 1.3	47899	17666	68 21.5	17623	-1239	44523
1955.5	-3 55.1	47930	17676	68 21.6	17634	-1208	44552
1956.5	-3 49.3	47964	17676	68 22.6	17636	-1178	44589
1957.5	-3 44.2	47993	17686	68 22.6	17648	-1152	44616
1958.5	-3 39.5	48023	17700	68 22.4	17663	-1129	44643
1959.5	-3 34.6	48062	17714	68 22.4	17679	-1105	44679
1960.5	-3 30.1	48095	17727	68 22.4	17693	-1082	44710
1961.5	-3 25.7	48117	17751	68 21.1	17719	-1061	44723
1962.5	-3 21.3	48136	17773	68 20.0	17742	-1040	44735
1963.5	-3 16.9	48160	17789	68 19.4	17760	-1018	44755
1964.5	-3 13.1	48183	17810	68 18.4	17782	-1000	44771
1965.5	-3 9.6	48201	17829	68 17.5	17802	-983	44783
1966.5	-3 6.3	48226	17842	68 17.3	17815	-966	44805
1967.5	-3 3.4	48254	17855	68 17.1	17829	-952	44830
1968.5	-3 1.0	48286	17874	68 16.5	17849	-941	44857
1969.5	-2 59.2	48320	17899	68 15.5	17874	-932	44883
1970.5	-2 56.9	48359	17924	68 14.7	17900	-922	44915
1971.5	-2 54.5	48397	17953	68 13.6	17930	-911	44944
1972.5	-2 51.0	48434	17977	68 12.9	17954	-894	44975
1973.5	-2 46.6	48473	17999	68 12.2	17978	-872	45008
1974.5	-2 41.4	48513	18018	68 11.9	17998	-846	45043
1975.5	-2 36.0	48549	18043	68 11.0	18024	-818	45073
1976.5	-2 29.3	48583	18062	68 10.5	18045	-784	45101
1977.5	-2 22.4	48612	18078	68 10.1	18062	-748	45126
1978.5	-2 14.1	48646	18081	68 10.9	18066	-705	45161
1979.5	-2 6.3	48668	18089	68 10.9	18076	-664	45181
1980.5	-1 59.0	48682	18096	68 10.7	18085	-626	45194
1981.5	-1 51.4	48704	18091	68 11.7	18082	-586	45220
1982.5	-1 43.9	48724	18084	68 12.8	18076	-546	45244
1983.5	-1 36.9	48738	18087	68 13.0	18080	-510	45257
1984.5	-1 29.9	48752	18083	68 13.7	18077	-473	45274
1985.5	-1 23.5	48768	18080	68 14.4	18075	-439	45292
1986.5	-1 17.0	48787	18071	68 15.5	18067	-404	45316
1987.5	-1 11.1	48804	18069	68 16.2	18065	-374	45336
1988.5	-1 5.0	48829	18056	68 17.9	18053	-341	45368
1989.5	-59.0	48856	18042	68 19.7	18039	-309	45402
1990.5	-53.9	48875	18041	68 20.3	18038	-283	45423
1991.5	-48.5	48895	18032	68 21.5	18031	-255	45448
1992.5	-43.4	48911	18038	68 21.5	18037	-228	45463
1993.5	-37.1	48928	18044	68 21.6	18043	-195	45479
1994.5	-30.0	48952	18045	68 22.2	18044	-158	45505
1995.5	-23.0	48975	18053	68 22.2	18053	-121	45526
1996.5	-15.6	48998	18062	68 22.1	18062	-82	45547
1997.5	-7.6	49028	18063	68 22.9	18063	-40	45579
1998.5	0.5	49062	18059	68 24.2	18059	3	45618
1999.5	8.0	49094	18063	68 24.7	18063	42	45651
2000.5	15.4	49132	18064	68 25.7	18064	81	45690

Table 3 Wingst Epoch values from 1939 to 2000

Wingst (WNG)
Geographic Coordinates: 53.743°N 9.073°E

2000

Absolute and relative Frequencies of the Three-hourly Index K

K UTC	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
0	24	24	7	7	2	12	10	14
1	59	63	103	76	61	59	51	38
2	100	117	135	123	128	105	95	104
3	100	107	81	116	102	93	106	95
4	53	34	28	33	49	58	48	78
5	19	16	9	7	14	25	42	27
6	7	5	2	4	9	10	8	7
7	3	0	1	0	1	3	4	0
8	0	0	0	0	0	0	1	0
9	1	0	0	0	0	1	1	3

Absolute Number of Days during the Year for a given K

K	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
0	13	8	19	7	1	1	0	7	7	7	10	20	100
1	41	38	62	38	19	30	27	34	25	55	56	85	510
2	81	63	78	81	100	71	76	77	77	68	56	79	907
3	62	57	70	71	71	74	79	74	67	67	60	48	800
4	33	40	16	33	37	41	34	33	40	28	34	12	381
5	14	23	3	6	16	16	20	17	14	9	17	4	159
6	4	3	0	0	3	7	5	5	8	11	6	0	52
7	0	0	0	1	1	0	4	1	1	3	1	0	12
8	0	0	0	1	0	0	0	0	0	0	0	0	1
9	0	0	0	2	0	0	3	0	1	0	0	0	6

Absolute Number of Three-hour-intervals for a given K

Table 4 Statistics of indices 2000

Appendix 3: On the calculation of base-line values using definitive variations

1. Co-ordinate systems

At Wingst Observatory, the elements *D*, *I*, *F*, *Z*, Nelson's H and Serson's *D* are measured using a DI-flux and a PVM (VOPPEL, 1972; SCHULZ, 1981), respectively. On the other hand, variations of the geomagnetic components are recorded by fluxgates aligned towards the co-ordinates *U*, *V* and *Z*, which differ from the geographic co-ordinates *X*, *Y* and *Z*. This system, which is also Cartesian, is derived from the geographic system by 45° counter-clockwise rotation on the horizontal plane (from N to NE). Advantage: due to the small declination at Wingst, both horizontal components *U* and *V* are equally included in the difference between the recorded and calculated *F*.

X (N) and *Y* (E) can be calculated from the recorded components *U* (NW) and *V* (NE) as follows:

(1) $X = a(U+V)$ and $Y = a(V-U)$, with a = sqrt(2)/2

They are analytically connected with the polar co-ordinates D and H:

(2) D = atan(Y/X) and H = sqrt(X^2+Y^2)

Generally, the following applies to the base-line values B_0:

(3) $B_0 = B-b$, with

B = *X*, *Y*, *Z*, *H*, *D*, *I* or *F*	for the elements, and
b = *x*, *y*, *z*, *h*, *d*, *i* or *f*	for the corresponding variations.

Relation (1) applies also to the variations:

$x = a(u+v)$ and $y = a(v-u)$.

2. Determination of definitive variations:

There are two major advantages to having definitive variations available:

Base-line measurements of different elements can be carried out consecutively – and, if appropriate, independently at the same location. In the latter case, the determination of differences between two locations is not necessary.

The readings can be reduced individually according to the variations of the element measured. Freed from external parts, the quality of the readings can be easily checked and outliers detected by assessing their scattering at a given coil/sensor position.

a) D, I, F and Nelson's H:

The elements *D*, *I*, *F*, *Z* and *H* are measured using a DI-flux and a PVM (compensation field method), respectively. The corresponding variations *d*, *i*, *f* and *h* have to be calculated from these elements and from the variations *x*, *y* and *z*. In order to obtain definitive values, this can be done by developing relation (2) according to Taylor's rule within the range of variations up to terms of second order. The results of the latest base-line measurements can be inserted for the coefficients according to (3).The following applies to the elements on the horizontal plane (*d* and *i in radians*):

(4a)

$$h = 1/H[Xx+Yy+0.5(1-X^2/H^2)x^2+0.5(1-Y^2/H^2)y^2-(XY/H^2)xy)]$$

$$d = 1/H^2\ [Xy-Yx-XY/H^2(x^2-y^2)-((Y^2-X^2)/H^2)xy]$$

Correspondingly, the following applies to the magnetic meridian:

(4b)

$$f = 1/F[Hh+Zz+0.5(1-H^2/F^2)h^2+0.5(1-Z^2/F^2)z^2-(HZ/F^2)hz)]$$

$$i = 1/F^2[Hz-Zh-HZ/F^2(h^2-z^2)-((Z^2-H^2)/F^2)hz]$$

Even for strong variations (storm), higher terms do not have to be added. They seldom exceed the relative order of magnitude of 10^{-3}.

B-b

are the readings of the elements referred to the respective coil/sensor position, freed from external parts.

b) Serson's D:

The readings S of Serson's *D (PVM, addition field method*) can be developed in the same manner. They are given by

(5)

$$S^2{}_1 = Z^2+H^2+A^2-2HA\sin(d) \text{ and}$$

$$S^2{}_2 = Z^2+H^2+A^2+2HA\sin(d).$$

The horizontal bias field A is either directed eastward (index 1) or westward (index 2), respectively. Applying Taylor's rule, the following expressions can be used to reduce the readings (5)

$$s_1 = 1/S\{Zz+Hh-HAd-0.5/S^2[(S^2-Z^2)z^2+(S^2-H^2)h^2-H^2A^2d^2]+HZhz-HAZzd-H^2Ahd\}$$

and

$$s_2 = 1/S\{Zz+Hh+HAd-0.5/S^2[(S^2-Z^2)z^2+(S^2-H^2)h^2-H^2A^2d^2]+HZhz+HAZzd+H^2Ahd\},$$

respectively.

Half the difference α in the sense 1 minus 2 is the small correction which has to be applied to the fixed nominal position on the horizontal circle to get the base-line of Serson's *D* referred to the respective coil position:

$$\alpha = S/(2HA)[S_{01}-S_{02}]$$

c) A more simple routine for D, I, F and H:

Going back to the elements *D*, *I*, *F* and *H*, the following simplification provides an faster method from the programmer's point of view. It corresponds to the quadratic solutions (4), but only linear terms are taken into account. Index 1 denotes the terms developed at the positions of the base-line values B_0 most recently calculated, index 2 those at the measured elements :

$$d_1 = 1/H_0^2(X_0y-Y_0x) \qquad d_2 = 1/H^2(-Xy+Yx)$$

$$i_1 = 1/F_0^2(H_0z-Z_0h) \qquad i_2 = 1/F^2(-Hz+Zh)$$

$$f_1 = 1/F_0(H_0h+Z_0z) \qquad f_2 = 1/F(-Hh-Zz)$$

$$h_1 = 1/H_0(X_0x+Y_0y) \qquad h_2 = 1/H(-Xx-Yy)$$

In this way, half the differences in the sense 1 minus 2

$$b = 1/2(b_1-b_2)$$

are sufficiently accurate and can also be considered definitive.

References:

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