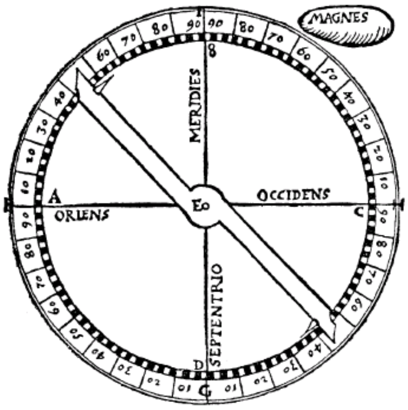
GeoForschungsZentrum Potsdam

Geomagnetic Results Wingst

2003

Yearbook No. 49



Potsdam 2004

Wingst Observatory: the Variation House and the NE azimuth mark in the background

Wingst Observatory: Absolute House

PVMs of type Askania/Varian (in the background on the right-hand side) and Zeiss/Magson (on the left-hand side); DI-flux of type Zeiss/Bartington in the foreground

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

Geomagnetic Results Wingst 2003 – Yearbook No 49

Günter Schulz

Contents

1 Introduction

This report (yearbook No 49) contains the results of Erdmagnetisches Observatorium Wingst (WNG) for 2003.

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[1]).

Using the visualisation software year.exe, the one-minute, hourly and daily values of the year under review can be displayed as graphs in the same manner as in the years before. High resolution magnetograms for each day are stored as post script files on the CDrom.

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: 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)

[1]Reports up to 1999 were published by Bundesamt für Seeschiffahrt und Hydrographie The last one (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.

Phone: +49 4778 812152

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/GeoMag/Other/BothObs_e.html

or (update every hour):

http://www.bsh.de/en/Marine%20data/Observations/Geomagnetism/obs.jsp

and in numerical form (update every 10 minutes, pass word required):

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

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.intermagne.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 for data requests, data exchange and information:

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Am Olymp 13
D-21789 Wingst

Phone: +49 4778 812110
Fax: +49 4778 812150
E-mail: guenter.schulz@bsh.de

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

2 General Remarks

Wingst Geomagnetic Observatory was established in 1938 as a successor to Wilhelmshaven. Since then, the station has been operated without interruption. The observatory's development is described by VOPPEL, 1988, and SCHULZ, 2001 (see also yearbook No 46, appendix 3). 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 and software 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 PPM105(EDA) (*F*): One minute spot values for quality check only

b) Visualisation software varplot.exe (BEBLO AND FELLER, 2002) for variations (*D, H, Z, F* and $c=F-(H^2+Z^2)^{1/2}$): Geomagnetic events (ssc, sfe, bay)

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 2003:

$F_{OBS} = F_{IMS} + 12.8$ 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	3811°.36’	N
NE	13° 23.19’	(-0.23 ±0.09)’
W	308° 42.94’	(-0.04 ±0.03’)

While the differences between the N and W azimuth mark proved to be small and stable, the NE azimuth mark showed an increasing eastward drift during the last few months of the year under review. Therefore, the bearings of the NE azimuth mark were no longer taken into account. This means that *D* may have been reported with an error of some +0.05’ towards east in the preceding years.

2.3 Special measurements

In the year under review, no comparative measurements were carried out.

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 $E = I - \mathrm{arctg}(Z/H)$ 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 = -23.93’ (13 measurements).

3.2 Horizontal intensity, vertical component and total intensity

Absolute measurements of *H* were carried out with the PVM according to the addition field method (Serson) and *Z* 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:

+0.6 nT ± 0.2 nT value (54 measurements).

C is shown in Table 1.

At the beginning of the year under review, the PPM of type V75 (VARIAN) was replaced by the PPM of type PPM105 (EDA). See also appendix 3.

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 (PPM105 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 GSM19(GEM) 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 (see yearbook No 46, 2000, appendix 3). Minute mean values of the magnetometer and the baseline instruments were processed, which had been synchronized within ±5 s.

For 2003, 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	$+10^{-3}(1.4 \pm 0.6)$	*V*: +0.2±1.0	*Z*: +0.9±0.6
V	$-10^{-3}(1.5 \pm 0.8)$	*U*: -0.7±0.6	*Z*: -0.5±0.4
Z	$+10^{-3}(0.8 \pm 0.6)$	*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).

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.

5 Indices

The indices presented in this edition (File wng03.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* 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).

6 Files on the CDrom

\wingst *Wingst root directory, containing the following subdirectories and files*

tree_03.txt: File structure

info.txt: Information on the operating system

yearb03\: *Directory containing this report (yearbook No 49), tables 5 and 6, magnetograms and a reprint*

yearb03\yearb03.pdf: This report

yearb03\tabs5_03\: Directory containing tables wngYYmmm.e of hourly and daily mean values for the month mmm of the element e data (*D* in 0.1', *H* and *Z* in nT).

yearb03\tab6_03.txt: Table of indices

yearb03\mags03\dhz2003mmdd.ps: Magnetograms (post script) of the day dd in the month mm

yearb03\instr.txt: Instruments used since 1938

progs\: *Directory containing software*

progs\year.exe: Visualisation programme for hourly and daily mean values as well as one-minute values located in data03

progs\readme.txt: Notes concerning operation of the programme year.exe and the meaning of the parameters in year.ini

progs\setup.bat: Installs the programme year under the local directory c:\year and starts the visualisation software

data03\: *Directory containing the following data*

data03\wlh+wng.yr: Updated epoch values WLH and WNG (*D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)

data03\wng.mon: Updated monthly mean values WNG (since 1943; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)

data03\wng.day: Updated daily mean values WNG (since 1944; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT) data03\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)

yearb.exe input files:

data03\hour03\wng03mmm.wdc: Hourly mean values of the month mmm in the format WDC (ICSU, 1989); yearb.exe input files

data03\min03mm\wng03mmm.0nn: One-minute values of the days nn for the month mm or mmm, respectively, in the format WDC (ICSU, 1989); yearb.exe input files

data03\iaga03\: Directory containing the following data in the IAGA2000 format (IYEMORI et al., 2002). See also: http://www.ngdc.noaa.gov/IAGA/wg2

data03\iaga03\YR.WNG: Epoch values WNG starting 1939 (from 1981 on: *D* and *I* in 0.01´; *X, Y, Z, H* and *F* in 0.1 nT; before then: 0.1’ or 1 nT, respectively)

data03\iaga03\2003MT.WNG: Monthly means (*D* and *I* in 0.01’; *X, Y, Z, H* and *F* in 0.1 nT)

data03\iaga03\2003DY.WNG: Daily means (*D* and *I* in 0.01’; *X, Y, Z, H* and *F* in 0.1 nT)

data03\iaga03\2003mmHR.WNG: Hourly means (*F, X, Y* and *Z* in 0.1 nT) of the month mm

data03\iaga03\2003mmMN.WNG: Minute means (*F, X, Y* and *Z* in 0.1 nT) of the month mm

7 References

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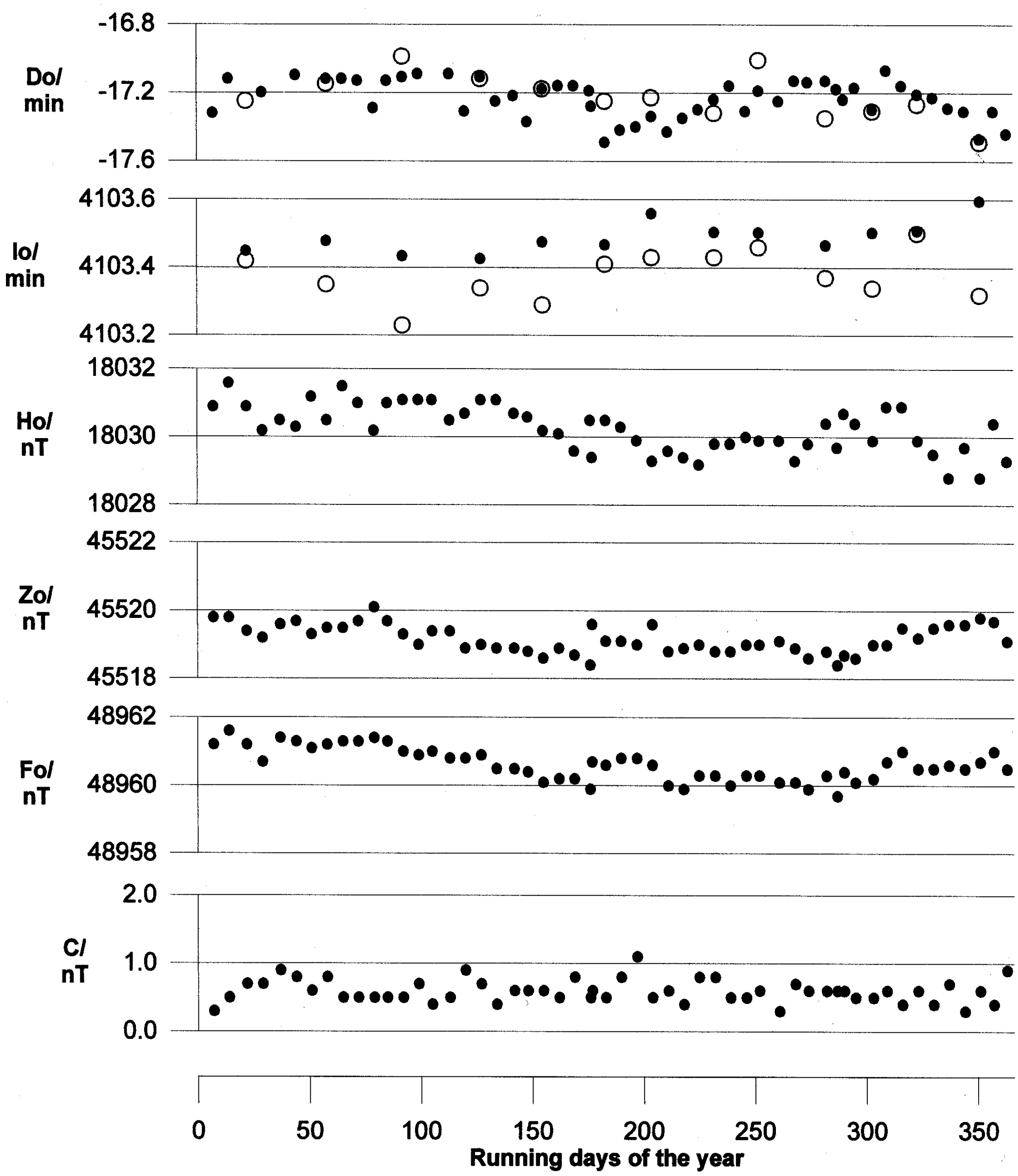

Fig. 1

Wingst 2003 Base line values of the fluxgate system FGE125, IMS

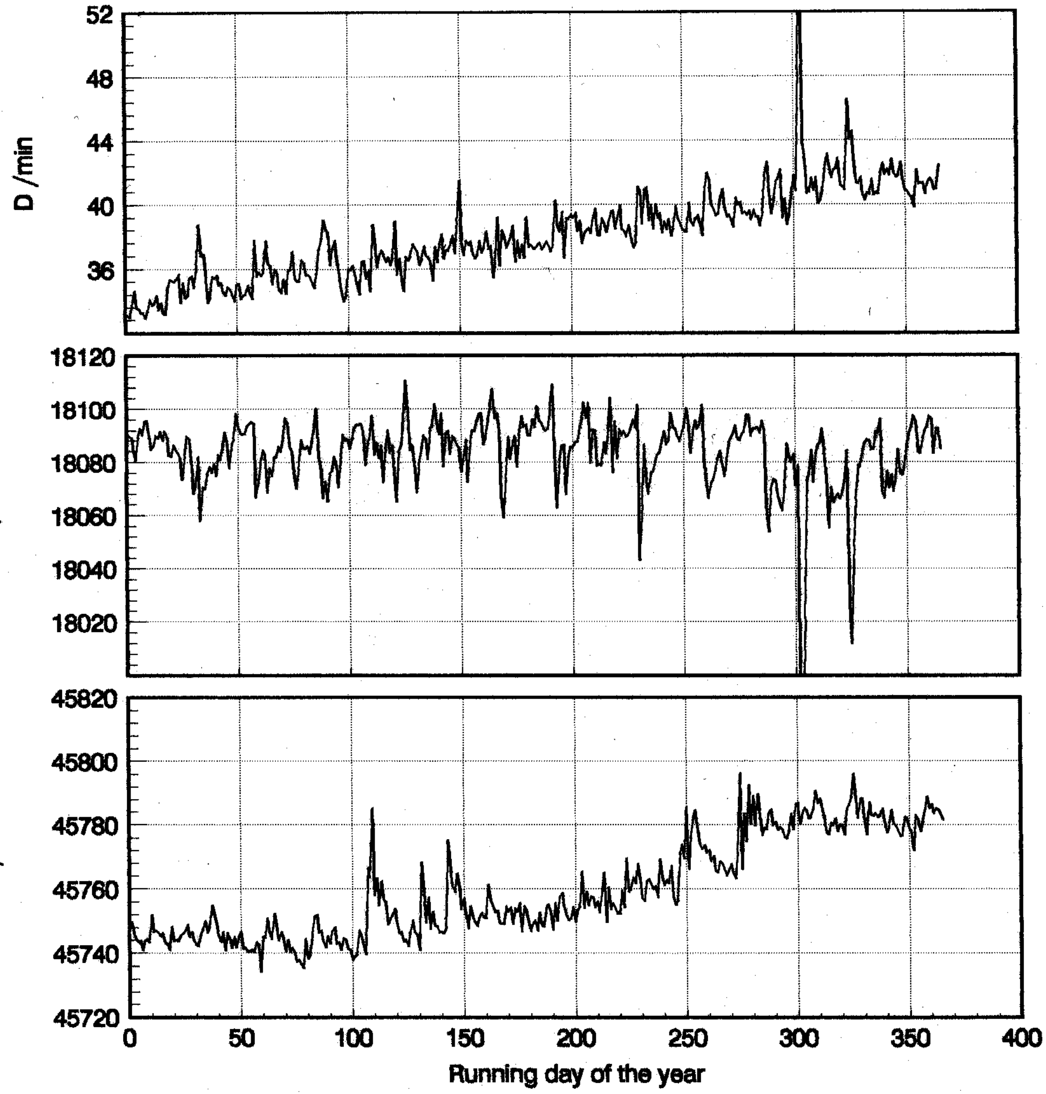

Fig. 2

Wingst 2003 Daily mean values D, H and Z

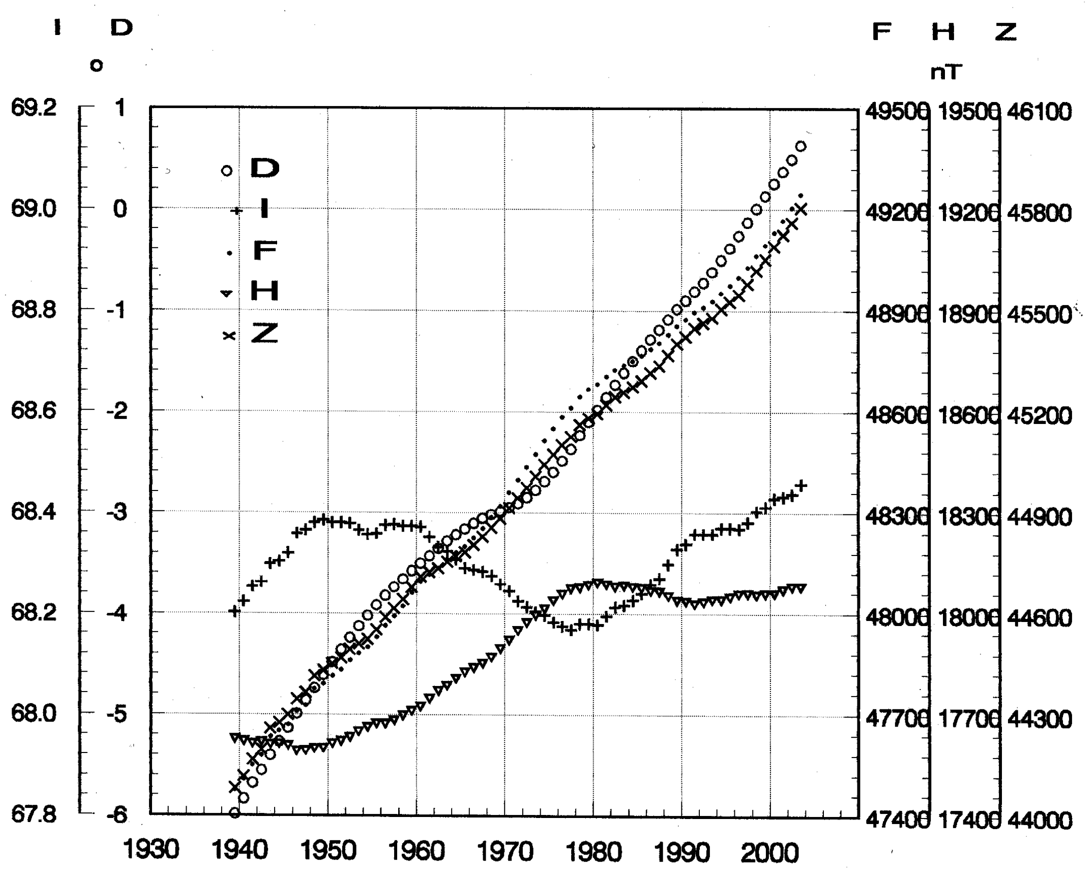

Fig. 3

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

```
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        info.txt
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                yearb03.pdf
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                        wng03jan.h
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                        .
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                cga.bgi
                egavga.bgi
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                vesa16.bgi
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                min0312\
                        wng03dec.001
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                        200312MT.WNG
                        200301HR.WNG
                        .
                        200312HR.WNG
```

Fig. 4

Structure of the file set on CDrom

Wingst 2003

Base-line measurements, system FGE125, IMS

Month	day	Do(abs)	Do(rel)	Io	Fo nT	Ho nT	Zo nT	C	E
Jan.	7		-0°17.32'		48961.2	18030.9	45519.8	+0.3	
	14		-0 17.12		48961.6	18031.6	45519.8	+0.5	
	22	-0°17.25'	-0 17.05	+68°23.42'	48961.2	18030.9	45519.4	+0.7	-0.03'
	29		-0 17.20		48960.7	18030.2	45519.2	+0.7	
Feb.	6		-0 16.96		48961.4	18030.5	45519.6	+0.9	
	13		-0 17.10		48961.3	18030.3	45519.7	+0.8	
	20		-0 17.04		48961.1	18031.2	45519.3	+0.6	
	27	-0 17.15	-0 17.12	+68 23.35	48961.2	18030.5	45519.5	+0.8	-0.12
March	6		-0 17.12		48961.3	18031.5	45519.5	+0.5	
	13		-0 17.13		48961.3	18031.0	45519.7	+0.5	
	20		-0 17.29		48961.4	18030.2	45520.1	+0.5	
	26		-0 17.13		48961.3	18031.0	45519.7	+0.5	
April	2	-0 16.99	-0 17.11	+68 23.23	48961.0	18031.1	45519.3	+0.5	-0.20
	9		-0 17.09		48960.9	18031.1	45519.0	+0.7	
	15		-0 17.06		48961.0	18031.1	45519.4	+0.4	
	23		-0 17.09		48960.8	18030.5	45519.4	+0.5	
	30		-0 17.31		48960.8	18030.7	45518.9	+0.9	
May	7	-0 17.12	-0 17.11	+68 23.34	48960.9	18031.1	45519.0	+0.7	-0.08
	14		-0 17.25		48960.5	18031.1	45518.9	+0.4	
	22		-0 17.22		48960.5	18030.7	45518.9	+0.6	
	28		-0 17.37		48960.4	18030.6	45518.8	+0.6	
June	4	-0 17.18	-0 17.18	+68 23.29	48960.1	18030.2	45518.6	+0.6	-0.18
	11		-0 17.16		48960.2	18030.1	45518.9	+0.5	
	18		-0 17.16		48960.2	18029.6	45518.7	+0.8	
	25		-0 17.19		48959.9	18030.5	45518.4	+0.5	
	26		-0 17.28		48960.7	18029.4	45519.6	+0.6	
July	2	-0 17.25	-0 17.49	+68 23.41	48960.6	18030.5	45519.1	+0.5	-0.05
	9		-0 17.42		48960.8	18030.3	45519.1	+0.8	
	16		-0 17.40		48960.8	18029.9	45519.0	+1.1	
	23	-0 17.23	-0 17.34	+68 23.43	48960.6	18029.3	45519.6	+0.5	-0.12
	30		-0 17.43		48960.0	18029.6	45518.8	+0.6	
Aug.	6		-0 17.35		48959.9	18029.4	45518.9	+0.4	
	13		-0 17.30		48960.3	18029.2	45519.0	+0.8	
	20	-0 17.32	-0 17.24	+68 23.43	48960.3	18029.8	45518.8	+0.8	-0.07
	27		-0 17.16		48960.0	18029.8	45518.8	+0.5	
Sep.	3		-0 17.31		48960.3	18030.0	45519.0	+0.5	
	9	-0 17.01	-0 17.19	+68 23.46	48960.3	18029.9	45519.0	+0.6	-0.04
	18		-0 17.25		48960.1	18029.9	45519.1	+0.3	
	25		-0 17.13		48960.1	18029.3	45518.9	+0.7	
Oct.	1		-0 17.14		48959.9	18029.8	45518.6	+0.6	
	9	-0 17.35	-0 17.13	+68 23.37	48960.3	18030.4	45518.8	+0.6	-0.09
	14		-0 17.18		48959.7	18029.7	45518.4	+0.6	
	17		-0 17.24		48960.4	18030.7	45518.7	+0.6	
	22		-0 17.17		48960.1	18030.4	45518.6	+0.5	
	30	-0 17.31	-0 17.30	+68 23.34	48960.2	18029.9	45519.0	+0.5	-0.16
Nov.	5		-0 17.07		48960.7	18030.9	45519.0	+0.6	
	12		-0 17.16		48961.0	18030.9	45519.5	+0.4	
	19	-0 17.27	-0 17.21	+68 23.50	48960.5	18029.9	45519.2	+0.6	-0.01
	26		-0 17.23		48960.5	18029.5	45519.5	+0.4	
Dec.	3		-0 17.29		48960.6	18028.8	45519.6	+0.7	
	10		-0 17.31		48960.5	18029.7	45519.6	+0.3	
	17	-0 17.49	-0 17.47	+68 23.32	48960.7	18028.8	45519.8	+0.6	-0.27
	23		-0 17.31		48961.0	18030.4	45519.7	+0.4	
	29		-0 17.44		48960.5	18029.3	45519.1	+0.9	

Table 1 Wingst 2003 base line values of the fluxgate system FGE125

Wingst (WNG)
Geographic Coordinates: 53.743³ N 9.073³ E

2003

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	34.2'	49226	18086	68°26.7'	18085	180	45783
Feb	A	35.2	49229	18083	68 27.0	18082	185	45788
Mar	A	36.0	49231	18082	68 27.1	18081	189	45790
Apr	A	36.2	49234	18085	68 26.9	18084	191	45792
May	A	37.1	49237	18087	68 26.9	18086	195	45794
Jun	A	37.4	49246	18089	68 27.0	18088	197	45803
Jul	A	38.3	49247	18090	68 27.0	18089	201	45805
Aug	A	39.0	49250	18085	68 27.4	18083	205	45810
Sep	A	39.4	49252	18087	68 27.3	18086	207	45811
Oct	A	41.2	49252	18072	68 28.4	18071	216	45816
Nov	A	41.8	49268	18073	68 28.8	18071	220	45833
Dec	A	41.4	49267	18085	68 27.9	18084	218	45827
Mean	A	38.1	49245	18084	68 27.4	18083	200	45804
Jan	Q	33.4	49227	18092	68 26.2	18091	176	45781
Feb	Q	34.7	49229	18091	68 26.3	18090	183	45784
Mar	Q	35.4	49233	18092	68 26.4	18091	186	45789
Apr	Q	35.6	49236	18090	68 26.6	18089	187	45792
May	Q	36.1	49237	18094	68 26.4	18093	190	45792
Jun	Q	37.4	49247	18096	68 26.5	18095	197	45802
Jul	Q	38.0	49248	18096	68 26.5	18095	200	45802
Aug	Q	38.4	49253	18092	68 26.9	18091	202	45810
Sep	Q	39.0	49253	18092	68 26.9	18091	205	45810
Oct	Q	39.4	49254	18091	68 27.0	18090	208	45811
Nov	Q	40.6	49267	18088	68 27.7	18087	213	45827
Dec	Q	40.7	49267	18094	68 27.2	18093	214	45825
Mean	Q	37.4	49246	18092	68 26.7	18091	197	45802
Jan	D	35.1	49225	18078	68 27.2	18077	184	45785
Feb	D	37.0	49228	18069	68 28.0	18068	195	45792
Mar	D	37.7	49231	18069	68 28.1	18068	198	45795
Apr	D	37.0	49231	18078	68 27.4	18077	194	45792
May	D	38.5	49236	18080	68 27.4	18078	203	45797
Jun	D	37.6	49239	18077	68 27.7	18076	198	45801
Jul	D	38.3	49245	18077	68 27.8	18076	201	45806
Aug	D	40.0	49251	18068	68 28.7	18067	210	45817
Sep	D	40.6	49251	18075	68 28.2	18073	213	45814
Oct	D	47.0	49233	18014	68 32.3	18012	246	45819
Nov	D	43.3	49273	18056	68 30.1	18055	227	45845
Dec	D	42.1	49266	18072	68 28.8	18070	221	45832
Mean	D	39.5	49242	18068	68 28.5	18066	208	45808

Table 2 Monthly and annual mean values 2003

Wingst (WNG) annual mean values (IMS)

Geographic Coordinates: 53.743°N 9.073°E

Epoch	D	F nT	H nT	I	X nT	Y nT	Z nT
1939.5	-5³59.1'	47476	17630	68³12.1'	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
2001.5	22.5	49167	18075	68 25.9	18074	118	45724
2002.5	29.8	49204	18084	68 26.2	18083	157	45761
2003.5	38.1	49245	18084	68 27.4	18083	200	45804

Table 3   Wingst Epoch values from 1939 to 2003

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

2003

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 2003

Appendix 3: Changes of instrumentation and their implications for the measuring routine

1. Base-line instruments

At the beginning of the year under review, the PPM of type V75 was replaced by that of type PPM105, which resulted in two changes affecting the measuring routine.

H: Nelson's method had to be replaced by Serson's method due to a limitation of the measurement range at low fields;

F, H and Z: comparative measurements with the PPM of type V3931 (period measuring, IMS) were no longer carried out.

At the end of the year under review, measurements with the old PVM of type ASKANIA/V4931(VARIAN) were discontinued. At the same time, test measurements with the new PVM of type ZEISS/MAGSON (SCHULZ, 2002), which is located on the central pier, were resumed. The electronics of the PVM had been replaced by a new one with an improved signal/noise ratio.

From 2004, the primary *I* standard will be replaced by the DI-flux located on pier NE in order to eliminate the base-line system's overestimation. This means that *H* and *Z* will no longer be considered to be separate standards; instead, they will be derived from *F* and *I* in future.

Recent differences *E* of the inclination in the sense of PVM(NW,IMS) minus DI-flux(NE) are given in Table 1 (page 19). Owing to the fact that *C* (also shown in Table 1) systematically deviates from zero, the transfer of the standard can only be achieved by a compromise. An acceptable solution avoiding unrealistic jumps of the FGE125's *H* and *Z* base-line is given in the case of zero *E*.

Contrary to *I*, the *F standard* continues to be related to pier NW. The following differences in the sense of V4931 minus PPM are based on special measurements or long-term recordings:

V4931 minus	V75	-0.9 nT
	PPM105	-0.4
	GSM19	-0.7

To preserve the magnetic standards of *F* and *I*, the following relations are applied:

in 2003
F(IMS) = *F*(PPM105,NW) -0.4 nT
H(IMS) = *H*(PVM,NW)
Z(IMS) = *Z*(PVM,NW)

from 2004
F(IMS) = *F*(GSM19,NW) –0.7 nT
I(IMS) = *I*(DI-flux, NE)

2. Variometers

On October 14, the FGE125 electronics was replaced by a low-noise version, which additionally contains an integrated data logger of type Niemegk.

The scale values of the new assembly were determined galvanically by means of the Helmholtz coil triple designed by BEBLO at al. (1999). The scale values of *Z* had to be corrected by a factor of 0.9987 (PULZ, 2003) because the fluxgate had shifted in the direction of the coil axis. Before determining the scale values, the coil constants had been checked magnetically using the Helmholtz coil of high precision (see section 2.2). The constants show small significant deviations from the calculated values:

		U	*V*	*Z*
constants	calculated	14.7729	14.7729	22.6088 nT/mA
	measured	14.7683 $\pm 4 \cdot 10^{-4}$	14.7442 $\pm 7 \cdot 10^{-4}$	22.5963 nT/mA $\pm 4 \cdot 10^{-4}$
scale values		1.0003 $\pm 10^{-3}$	0.9988 $\pm 10^{-3}$	0.9986 nT/mV $\pm 10^{-3}$

References

BEBLO, M., FELLER,.M. and W. BAUER, 1999: A single 3-axial coil system for calibration of the DMI fluxgate magnetometer FGE with suspended sensors. Münchner Geophys. Mitteil., MGM 8

PULZ, E, 2003: personal communication