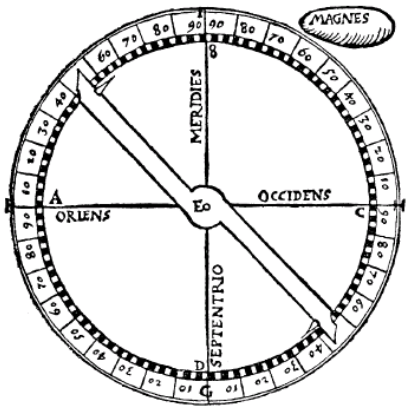
GeoForschungsZentrum Potsdam

Geomagnetic Results Wingst

2002

Yearbook No. 48



Potsdam 2004

Map showing the location of Wingst Observatory

The Wingst is one of a number of hills of glacial origin formed by a terminal moraine in the North German Lowland

In the north-east: the Oste, a tributary of the river Elbe

In the south: Lake Balksee, which formed at the same time as the large high-moor bogs in the area when land was deposited by the North Sea's tidal currents several millennia ago

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

Geomagnetic Results Wingst 2002 – Yearbook No 48

Günter Schulz

Contents

1 Introduction

This report (yearbook No 48) contains the results of Erdmagnetisches Observatorium Wingst (WNG) for 2002.[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.

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:

Erdmagnetisches Observatorium
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, 2000, 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 V75(VARIAN) (*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 2002:

$F_{OBS} = F_{IMS} + 12.8$ 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’	(-0.16 ±0.02)’
W	308° 42.94’	(-0.08 ±0.04’)

2.3 Special measurements

In the year under review, one comparative measurement was carried out at Wingst using Niemegk (NGK) instruments. The station difference is as follows:

at	WNG minus	D	I	F
WNG	NGK	+0.12’	-0.04’	+2.7 nT

A PPM of type G856 (GEOMETRICS) was installed near to the pulsation hut. The device was connected to the data acquisition system via telemetry. Together with the V75 at the absolute house and the FGE125 *F* recording at the variation house, it forms a triple which makes it possible to detect external sources of disturbances by monitoring their mutual *F* differences.

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 $E=I-\text{arctg}(Z/H)$ 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 = -23.99’ (12 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:

+0.1 nT ± 0.5 nT value (54 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 (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 2002, 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 wng02.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).

7 Files on the CDrom

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

tree_02.txt: File structure

info.txt: Information on the operating system

yearb02\: *Directory containing this report (yearbook No 48), tables 5 and 6, magnetograms and a reprint*

yearb02\yearb02.pdf: This report

yearb02\tabs5_02\: 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).

yearb02\tab6_02.txt: Table of indices

yearb02\mags02\dhz2002mmdd.ps: Magnetograms (post script) of the day dd in the month mm

yearb02\instr.txt: Instruments used since 1938

yearb02\abs_meas.pdf: Reprint of SCHULZ, 2002

progs\: *Directory containing software*

progs\year.exe: Visualisation programme for hourly and daily mean values as well as one-minute values located in data02

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

data02\: *Directory containing the following data*

data02\wlh+wng.yr: Updated epoch values WLH and WNG (*D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)

data02\wng.mon: Updated monthly mean values WNG (since 1943; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)

data02\wng.day: Updated daily mean values WNG (since 1944; *D* and *I* in 0.1'; *F*, *H*, *X*, *Y*, and *Z* in nT)

data02\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:

data02\hour02\wng02mmm.wdc: Hourly mean values of the month mmm in the format WDC (ICSU, 1989); yearb.exe input files

data02\min02mm\wng02mmm.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

*data02\iaga02\: Directory containing the following data in the IAGA2000 format (*IYEMORI *et al., 2002). See also: http://www.ngdc.noaa.gov/IAGA/wg2*

data02\iaga02\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)

data02\iaga02\2002MT.WNG: Monthly means (*D* and *I* in 0.01'; *X, Y, Z, H* and *F* in 0.1 nT)

data02\iaga02\2002DY.WNG: Daily means (*D* and *I* in 0.01'; *X, Y, Z, H* and *F* in 0.1 nT)

data02\iaga02\2002mmHR.WNG: Hourly means (*F, X, Y* and *Z* in 0.1 nT) of the month mm

data02\iaga02\2002mmMN.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

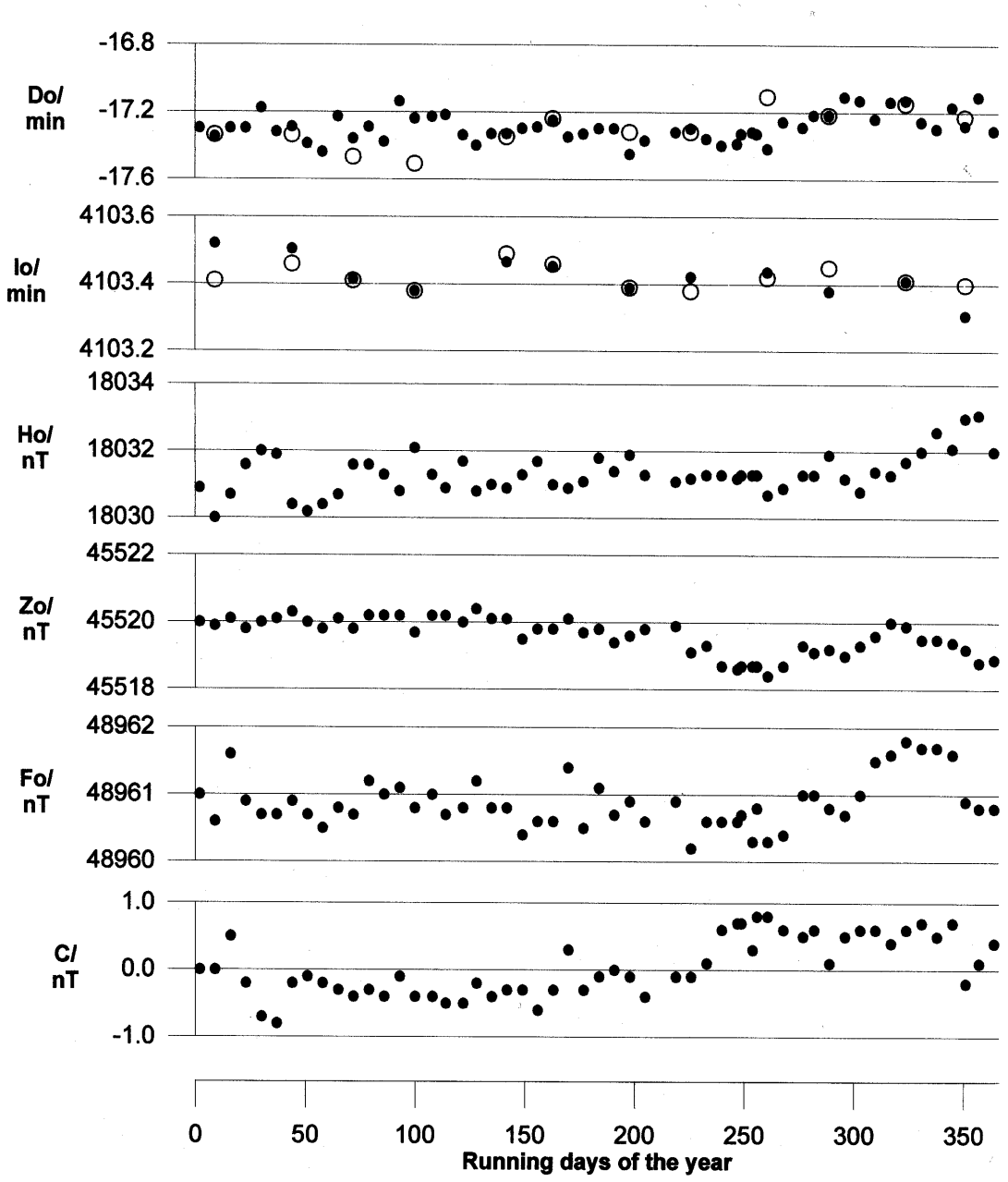

Fig. 1

Wingst 2002 Base line values of the fluxgate system FGE125, IMS

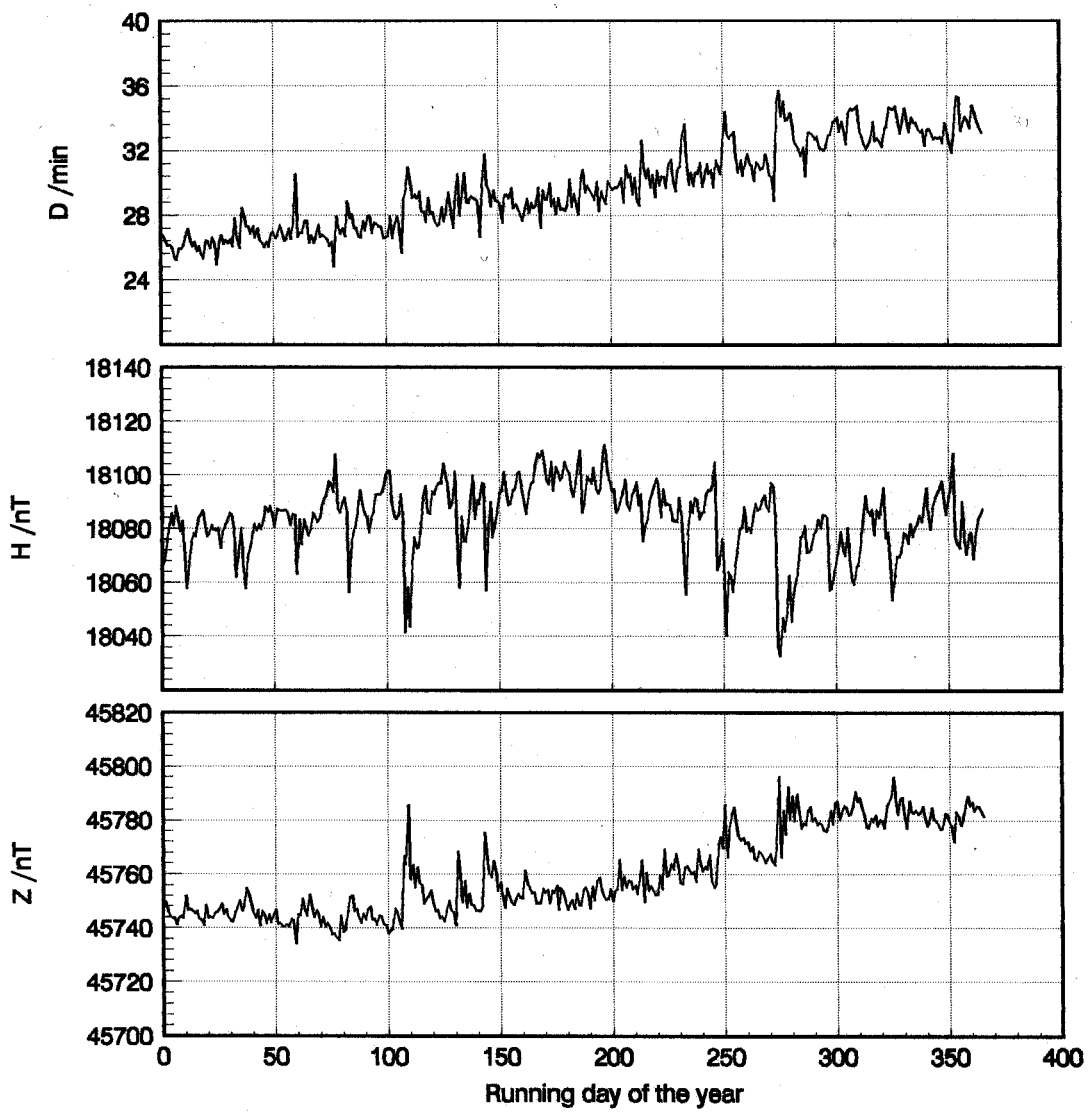

Fig. 2

Wingst 2002 Daily mean values D, H and Z

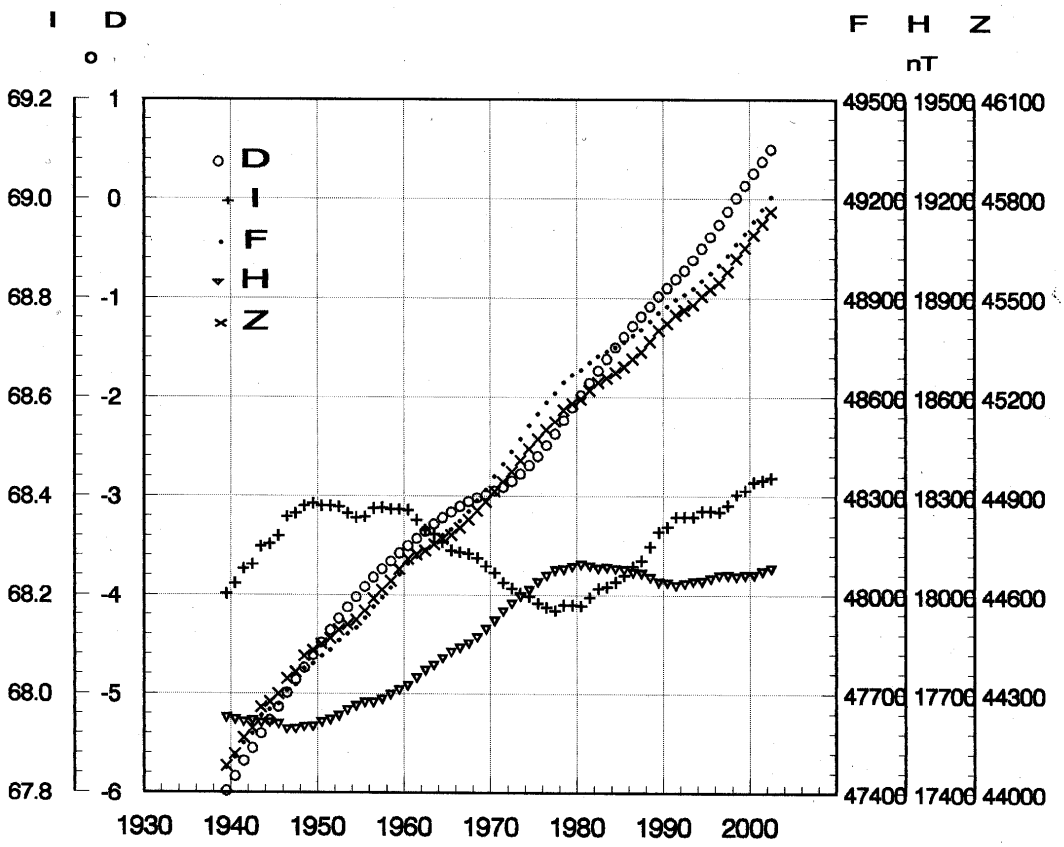

Fig. 3

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

```
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        info.txt
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                yearb02.pdf
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                        wng02jan.h
                        wng02jan.z
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                        wng02dec.h
                        wng02dec.z
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                .
                mags02\dhz20021231.ps
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                abs_meas.pdf
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                readme.txt
                year.exe
                year.ini
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                cga.bgi
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                herc.bgi
                vesa16.bgi
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                wng.mon
                wng.day
                wng.k
                hour02\
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                        wng02dec.wdc
                min0201\
                        wng02jan.001
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                        .
                        200212HR.WNG
```

Fig. 4

Structure of the file set on CDrom

Wingst 2002

Base-line measurements, system FGE125, IMS

Month	day	Do(abs)	Do(rel)	Io	Fo nT	Ho nT	Zo nT	C	E
Jan.	2		-0°17.30'		48961.0	18030.9	45520.0	+0.0	
	9	-0°17.34'	-0 17.35	+68°23.41'	48960.6	18030.0	45519.9	+0.0	-0.11'
	16		-0 17.30		48961.6	18030.7	45520.1	+0.5	
	23		-0 17.30		48960.9	18031.6	45519.8	-0.2	
	30		-0 17.18		48960.7	18032.0	45520.0	-0.7	
Feb.	6		-0 17.32		48960.7	18031.9	45520.1	-0.8	
	13	-0 17.34	-0 17.29	+68 23.46	48960.9	18030.4	45520.3	-0.2	-0.04
	20		-0 17.39		48960.7	18030.2	45520.0	-0.1	
	27		-0 17.44		48960.5	18030.4	45519.8	-0.2	
March	6		-0 17.23		48960.8	18030.7	45520.1	-0.3	
	13	-0 17.47	-0 17.36	+68 23.41	48960.7	18031.6	45519.8	-0.4	+0.00
	20		-0 17.29		48961.2	18031.6	45520.2	-0.3	
	27		-0 17.38		48961.0	18031.3	45520.2	-0.4	
April	3		-0 17.14		48961.1	18030.8	45520.2	-0.1	
	10	-0 17.51	-0 17.24	+68 23.38	48960.8	18032.1	45519.7	-0.4	+0.00
	18		-0 17.23		48961.0	18031.3	45520.2	-0.4	
	24		-0 17.22		48960.7	18030.9	45520.2	-0.5	
May	2		-0 17.34		48960.8	18031.7	45520.0	-0.5	
	8		-0 17.40		48961.2	18030.8	45520.4	-0.2	
	15		-0 17.33		48960.8	18031.0	45520.1	-0.4	
	22	-0 17.35	-0 17.33	+68 23.49	48960.8	18030.9	45520.1	-0.3	+0.03
	29		-0 17.30		48960.4	18031.3	45519.5	-0.3	
June	5		-0 17.29		48960.6	18031.7	45519.8	-0.6	
	12	-0 17.24	-0 17.25	+68 23.46	48960.6	18031.0	45519.8	-0.3	+0.01
	19		-0 17.35		48961.4	18030.9	45520.1	+0.3	
	26		-0 17.33		48960.5	18031.1	45519.7	-0.3	
July	3		-0 17.30		48961.1	18031.8	45519.8	-0.1	
	10		-0 17.30		48960.7	18031.4	45519.4	+0.0	
	17	-0 17.32	-0 17.45	+68 23.39	48960.9	18031.9	45519.6	-0.1	+0.00
	24		-0 17.37		48960.6	18031.3	45519.8	-0.4	
Aug.	7		-0 17.32		48960.9	18031.1	45519.9	-0.1	
	14	-0 17.32	-0 17.30	+68 23.38	48960.2	18031.2	45519.1	-0.1	-0.04
	21		-0 17.36		48960.6	18031.3	45519.3	+0.1	
	28		-0 17.40		48960.6	18031.3	45518.7	+0.6	
Sep.	4		-0 17.39		48960.6	18031.2	45518.6	+0.7	
	6		-0 17.33		48960.7	18031.3	45518.7	+0.7	
	11		-0 17.32		48960.3	18031.3	45518.7	+0.3	
	13		-0 17.33		48960.8	18031.3	45518.7	+0.8	
	18	-0 17.11	-0 17.42	+68 23.42	48960.3	18030.7	45518.4	+0.8	-0.01
	25		-0 17.26		48960.4	18030.9	45518.7	+0.6	
Oct.	4		-0 17.29		48961.0	18031.3	45519.3	+0.5	
	9		-0 17.22		48961.0	18031.3	45519.1	+0.6	
	16	-0 17.22	-0 17.22	+68 23.45	48960.8	18031.9	45519.2	+0.1	+0.08
	23		-0 17.11		48960.7	18031.2	45519.0	+0.5	
	30		-0 17.13		48961.0	18030.8	45519.3	+0.6	
Nov.	6		-0 17.24		48961.5	18031.4	45519.6	+0.6	
	13		-0 17.14		48961.6	18031.3	45520.0	+0.4	
	20	-0 17.15	-0 17.13	+68 23.41	48961.8	18031.7	45519.9	+0.6	+0.00
	27		-0 17.26		48961.7	18032.0	45519.5	+0.7	
Dec.	4		-0 17.30		48961.7	18032.6	45519.5	+0.5	
	11		-0 17.17		48961.6	18032.1	45519.4	+0.7	
	17	-0 17.23	-0 17.28	+68 23.40	48960.9	18033.0	45519.2	-0.2	+0.10
	23		-0 17.11		48960.8	18033.1	45518.8	+0.1	
	30		-0 17.31		48960.8	18032.0	45518.9	+0.4	

Table 1 Wingst 2002 base line values of the fluxgate system FGE125

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

2002

Monthly mean values, IMS

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

Month		D	F	H	I	X	Y	Z
			nT	nT		nT	nT	nT
Jan	A	26.1'	49188	18079	68°26.1'	18078	137	45745
Feb	A	26.9	49188	18080	68 26.1	18079	141	45745
Mar	A	27.1	49189	18085	68 25.7	18084	142	45744
Apr	A	28.0	49194	18083	68 26.0	18082	147	45750
May	A	28.8	49198	18088	68 25.7	18087	152	45752
Jun	A	28.7	49202	18099	68 25.0	18098	151	45752
Jul	A	29.6	49202	18096	68 25.3	18095	156	45754
Aug	A	30.6	49205	18087	68 26.0	18086	161	45760
Sep	A	31.3	49211	18080	68 26.7	18079	165	45770
Oct	A	33.1	49218	18067	68 27.9	18066	174	45782
Nov	A	33.5	49223	18076	68 27.3	18075	176	45784
Dec	A	33.4	49224	18085	68 26.7	18084	176	45782
Mean	A	29.8	49204	18084	68 26.2	18083	157	45761
Jan	Q	25.9	49188	18084	68 25.8	18084	136	45743
Feb	Q	26.4	49189	18083	68 25.9	18083	139	45745
Mar	Q	26.7	49189	18090	68 25.3	18090	140	45742
Apr	Q	27.8	49193	18092	68 25.4	18091	147	45746
May	Q	29.4	49199	18085	68 25.9	18085	155	45753
Jun	Q	28.3	49201	18101	68 24.8	18100	149	45751
Jul	Q	28.8	49201	18099	68 24.9	18098	152	45751
Aug	Q	30.3	49203	18091	68 25.6	18090	160	45756
Sep	Q	31.9	49211	18063	68 28.0	18062	168	45776
Oct	Q	32.0	49219	18081	68 26.8	18080	168	45777
Nov	Q	32.5	49223	18087	68 26.5	18086	171	45780
Dec	Q	32.6	49224	18098	68 25.7	18097	171	45776
Mean	Q	29.4	49204	18088	68 25.9	18087	155	45759
Jan	D	26.3	49188	18070	68 26.7	18070	139	45748
Feb	D	27.8	49186	18068	68 26.9	18067	146	45747
Mar	D	27.7	49187	18080	68 26.1	18079	146	45744
Apr	D	28.9	49202	18060	68 28.0	18059	152	45767
May	D	28.8	49206	18086	68 26.1	18086	152	45761
Jun	D	28.6	49201	18095	68 25.3	18094	151	45753
Jul	D	29.6	49202	18091	68 25.6	18090	156	45755
Aug	D	31.7	49200	18076	68 26.7	18075	167	45760
Sep	D	30.8	49211	18090	68 25.9	18089	162	45766
Oct	D	34.6	49209	18043	68 29.4	18042	181	45782
Nov	D	34.5	49222	18063	68 28.3	18062	181	45788
Dec	D	34.2	49222	18073	68 27.5	18072	180	45785
Mean	D	30.4	49204	18075	68 26.9	18074	160	45764

Table 2 Monthly and annual mean values 2002

Wingst (WNG) annual mean values (IMS)

Geographic Coordinates: 53.743°N 9.073°E

Epoch	D	F	H	I	X	Y	Z
		nT	nT		nT	nT	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
2001.5	22.5	49167	18075	68 25.9	18074	118	45724
2002.5	29.8	49204	18084	68 26.2	18083	157	45761

Table 3 Wingst Epoch values from 1939 to 2002

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

2002

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	18	17	8	3	5	5	8	14
1	52	71	98	62	52	69	51	54
2	110	128	135	145	136	104	107	91
3	108	99	83	120	106	97	101	115
4	54	28	35	25	51	56	62	53
5	16	19	6	9	12	25	20	28
6	6	3	0	0	2	4	13	8
7	0	0	0	1	1	4	3	2
8	1	0	0	0	0	1	0	0
9	0	0	0	0	0	0	0	0

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	22	9	19	6	1	4	1	0	11	0	0	5	78
1	62	45	66	51	55	44	32	29	51	8	20	46	509
2	96	82	72	70	98	97	81	89	89	54	54	74	956
3	45	64	59	65	56	80	86	75	55	90	86	68	829
4	19	18	24	27	26	13	39	36	18	51	53	40	364
5	4	5	8	12	7	2	9	18	11	29	18	12	135
6	0	1	0	7	2	0	0	1	3	13	6	3	36
7	0	0	0	2	3	0	0	0	1	2	3	0	11
8	0	0	0	0	0	0	0	0	1	1	0	0	2
9	0	0	0	0	0	0	0	0	0	0	0	0	0

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

Table 4 Statistics of indices 2002