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THE BUNKER CLIMATE ATLAS  
OF THE  
NORTH ATLANTIC OCEAN

- technical description of the data tapes -

by  
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## INTRODUCTION

This is a short guide to a climatological surface data set of the North Atlantic Ocean. A large part of this data set has been published in two volumes of "The BUNKER Climate Atlas of the North Atlantic Ocean" (ISEMER & HASSE, 1985, 1987). The purpose of this report is to describe the access to different magnetic tapes containing the climatological data set, and the retrieval of certain data. Copies of the tapes can be requested for scientific research from the Institut für Meereskunde in Kiel.

The basic version of the North Atlantic Ocean data set was evaluated by the late Andrew F. BUNKER of Woods Hole Oceanographic Institution, who left his results on computer outprints. BUNKER analysed observations from the ships of the Voluntary Observing Fleet to calculate the various components of the heat budget at the air-sea interface. The original BUNKER data set is defined on irregularly shaped areas, called "Gerrymanders". The data coverage includes the North Atlantic Ocean south of 80°N except the Baltic and Mediterranean Seas. For information about details see BUNKER (1975, 1976) and GOLDSMITH & BUNKER (1979).

Within the research project "Warmwassersphäre des Atlantiks" ("Sonderforschungsbereich 133") at the Institut für Meereskunde, Kiel, (IFMK), the climatological data were brought back on magnetic tape and were interpolated onto a regularly shaped 1° grid. Interpolation onto the 1° grid was limited to regions south of 65°N. The 1° grid data form the base for the above-mentioned climate atlas of the North Atlantic Ocean. Volume 1 of this atlas contains monthly fields of observed meteorological quantities. Monthly fields of derived parameters such as air-sea heat fluxes and wind stress are mapped in the second volume. In addition to BUNKER's methods recent observational and experimental evidence from the open ocean has been used to recalculate a revised version of air-sea heat fluxes and wind stress (ISEMER, 1987, ISEMER & HASSE, 1987). The main part of the second volume of the climate atlas presents maps of the revised fluxes. Also, a collection of charts showing BUNKER's results is given for comparison. Note, that in the appendant data tables the revised fluxes are labeled "revised" while BUNKER's results are labeled "BUNKER".

The data are now available on tape both in the original and in the interpolated and revised versions. Hence, the climatological data set is available in different forms on the VAX computers of the IFMK and on the PDP-10 computer of Kiel University computer centre.

Two different tapes were prepared at the IFMK:

1. a PDP-11 "Files 11" tape, created on a VAX-750 computer. The archive number of this tape at IFMK computer centre is MTH430, its description can be found in section 1.1 of this report. Users working at the VAX computers of the IFMK should use this tape. A copy of this tape is offered as exchange tape to users working especially on a VAX or PDP-11 computer at other institutes. The ANSI tape label of this tape copy will be "NAODAT".

2. a tape coded in EBCDIC on a VAX-750 computer. A copy of this tape is offered as exchange tape to users working on others than VAX or PDP-11 computers. The contents and structure of the data on this tape are identical to those on the PDP "Files 11" tape. The archive number of this tape at the IFMK computer centre is MTH431. Technical specifications of this tape are given in section 1.2 of this report.

The access to the tapes at Kiel University computer centre is described in chapter 2. These tapes have exclusively been prepared for PDP-10 users of this computer centre.

# 1 THE CLIMATE DATA SET AT THE INSTITUT FÜR MEERESKUNDE KIEL

## 1.1 DESCRIPTION OF TAPE MTH430

### 1.1.1 TECHNICAL DETAILS

PDP "Files 11" tape  
1600 bpi  
9 tracks  
ANSI-ASCII  
ANSI tape label : MTH430

First part: 50 files (filenumber 1 to 50), each file consists of 23 blocks,  
each file contains 6048 integer numbers (format I7).

Second part: one file with 19 blocks (filenumber 51), containing 8388 integer numbers (format I4).

55 files (filenumber 52 to 106), each file consists of 210 blocks,  
each file contains 50352 integer numbers (format I8).

The data are organized in logical records (lines) separated by a "Carriage Return-Line Feed" (CRLF). The files on the tape are named ISEMER.001, ISEMER.002, ... up to ISEMER.106. The ANSI tape label of the copy of this tape sent to other institutes upon request will be "NAODAT".

### 1.1.2 ORIGINAL VERSION OF THE BUNKER DATA

The first part of this tape contains the original BUNKER data - long-term monthly averages of both observed and derived parameters - defined on 502 sometimes irregularly shaped Gerrymanders over the North Atlantic Ocean from the equator to 80°N. The data have been copied from outprints which are available at Woods Hole Oceanographic Institution (WHOI). On the tape they are organized in a different way than on the original computer outprints. The organisation hierarchy on the tape is as follows:

- 1: parameter,
- 2: calendar month,
- 3: Marsden Square,
- 4: Gerrymander.

Each file contains all monthly values of one single parameter for all Gerrymanders. Within each file the data are grouped according to calendar month. Every group of data consists of (1) the number of the month (January = 1, February = 2, etc), (2) the parameter identification number according to BUNKER (see table 1 in appendix 1) and (3) 502 parameter values. Thus each file consists of 6048 numbers. They are written in integer format I7. Physical units are given in

table 1. "- 9999" is inserted, if no data are available. Within each monthly group the data are arranged due to the Marsden Square (10°-Square) division from south to north and from east to west. The sequence of Gerrymanders within each Marsden Square was taken from BUNKER. This report contains an appendant map which shows the Gerry-mander configuration over the North Atlantic Ocean and the corresponding sequence number of each Gerry-mander in the monthly data group.

A number of CRLFs divide each file into logical records. They have been inserted (a) behind the parameter identification number, (b) behind every tenth parameter value and (c) at the end of each calendar month group. A FORTRAN READ format for a whole file could be :  
12(2I7/,50(10I7/),2I7).

Note, that the sign of the air-sea heatflux and its components has been chosen positive if the ocean gains energy, and negative if it loses energy at the surface.

Appendix 2 gives an outprint of the beginning of file 1 on the tape.

### 1.1.3 INTERPOLATED CLIMATE DATA

The second part of the tape consists of an information file and 55 parameter files containing the interpolated climate surface data. Long-term monthly means as well as standard deviations of selected parameters are given, defined on a regular 1° grid over the North Atlantic Ocean from the equator to 65°N (see table 2 in appendix 3). Net long-wave radiation, parameterised according to the ELSASSER(1942) radiation chart (see BUNKER & GOLDSMITH, 1979), was calculated by using additional information from WHOI-data files, and has been added to the data set (filenumber 81). Corrections of the air-sea heat flux components by the presence of sea-ice (see BUNKER & GOLDSMITH, 1979) have been applied to the 1° grid data using ice coverage data from WHOI-data files ( the original data on the first part of this tape have not been corrected ! ). Again, the sign of the air-sea heatflux and its components is positive (negative) if the ocean gains (loses) energy at the surface.

### 1.1.4 COORDINATE SYSTEM

The interpolated data are defined on the latitude ( $\phi$ ) - longitude ( $\lambda$ ) grid. To facilitate computation, the ( $\phi, \lambda$ ) - system is transformed into a ( $\phi, \epsilon$ ) - system with  $\epsilon = 0$  at  $\lambda = 100^\circ\text{W}$ .  $\epsilon$  is positiv to the east, so all coordinates in the North Atlantic Ocean are positiv (for example  $\epsilon = 51$  means  $\lambda = 49^\circ\text{W}$ ,  $\epsilon = 100$  means  $\lambda = 0^\circ$ ). The data are defined in the centre of each  $\phi, \epsilon$  - field, that means that the exact definition point for  $\phi, \epsilon$  is  $\phi-0.5, \epsilon-0.5$ .

The information file (filenumber 51 on both tapes MTH430 and MTH431) contains each pair of coordinates  $\phi, \epsilon$  for all 1° grid data available, in the same sequence as the data are organised in every monthly group

of the parameter files. The coordinates are written in integer format I4. Ten numbers form a logical record and are separated by a CRLF. A FORTRAN READ-format for the whole information file could be :  
838(10I4/),8I4.

### 1.1.5 ORGANISATION OF THE INTERPOLATED DATA

The organisation hierarchy on the tape is as follows:

- 1: parameter
- 2: calendar month
- 3: latitude, from south to north
- 4: longitude, from west to east

Each file contains all monthly values of one single parameter for all  $\phi, \epsilon$  coordinates over the North Atlantic Ocean. Within each file the data are grouped according to the calendar month. Every group of data consists of (1) the number of the month, (2) the parameter identification number according to table 2 (see appendix 3) and (3) 4194 parameter values. Thus each file consists of 50352 numbers. They are written in integer format I8. Parameters, filenames and physical units are given in table 2. A number of CRLFs divides each file into logical records. They have been inserted (a) behind the parameter identification number, (b) behind every tenth parameter value, and (c) at the end of each calendar month group. A FORTRAN READ-format for a whole file could be: 12(2I8/,419(10I8/),4I8).

Within each monthly group the data are arranged from south to north and from west to east. First, all  $1^\circ$  grid data for  $\phi = 1^\circ\text{N}$  are written from west to east for each  $1^\circ$  field, which is covered with water by more than 50%. Then the data for  $\phi = 2^\circ\text{N}$  follow, etc. As mentioned in section 1.4, the sequence of coordinates within each monthly group of all climate data files is given in the information file.

A possible access to the interpolated data within a computer program could be as follows:

1. Declare a real array DAT for one monthly North Atlantic Ocean field with dimensions at least [110,65] and set all elements equal -9999. (for land grid points or points without data).
2. Read the number of the month and the field number from the data file.
3. Read one pair of coordinates  $\phi, \epsilon$  from the information file and one data value from the data file and attach the data value to DAT[ $\epsilon, \phi$ ].

Step 3 must be repeated 4194 times to read the whole January field. To get the February field, close the information file and start again with step 1. Appendix 4 gives an outprint of the beginning of file 52 on the tape.

1.1.6 FINAL REMARKS

A program TRNBK.FOR is available on the VAX computer of the IFMK to convert the 1° grid data into the MK4 data format. This program needs files from the tape MTH430 as input data. The program was written by Johannes Diemer of the oceanographic department of the IFMK.

Originally, the 1° grid data were created on the PDP-10 computer of Kiel University. The source tapes, containing the same data as MTH430, are archived at Kiel University computer centre under 330149 and 330010.

As mentioned above, a copy of this tape may be requested as exchange tape for scientific research. All specifications described are valid for the exchange tape, too. Note, that the ANSI tape label will be "NOADAT".



## 1.2 DESCRIPTION OF TAPE MTH431

### 1.2.1 TECHNICAL DETAILS

1600 bpi  
9 tracks  
Industry compatible  
EBCDIC, parity: ODD  
Label: none  
Record length: 80 characters  
Blocking factor: 50

First part: 50 files (filenumber 1 to 50), each file consists of  
13 blocks,  
each file contains 6048 integer numbers (format I7).

Second part: one file with 17 blocks (filenumber 51), containing  
8388 integer numbers (format I4).

55 files (filenumber 52 to 106), each file consists of  
102 blocks,  
each file contains 50352 integer numbers (format I8).

The data are organized in logical records (lines of 80 characters each). They are not separated by a "Carriage Return-Line Feed" (CRLF). Free columns within logical records are filled with blanks to get always a record length of 80 characters. Files on the tape are separated by one EOF mark. Two subsequent EOFs define the end of tape.

### 1.2.2 FINAL REMARKS

The data organisation and the contents of this tape are identical to those of tape MTH430. Refer to sections 1.1.2, 1.1.3, 1.1.4 and 1.1.5 for details.

As mentioned above, a copy of this tape may be requested as exchange tape for scientific research. All specifications described are valid for the exchange tape, too.

## 2 THE CLIMATE DATA SET AT KIEL UNIVERSITY COMPUTER CENTRE

Again, the climate data set is available in two versions, but on different tapes:

1. the original version of the BUNKER data,
2. the interpolated 1° grid data. The results of BUNKER are contained as well as the revised air-sea heat fluxes and wind stress. The interpolation program stores all monthly and the annual fields of one parameter into one binary coded file. The structure of these files is shortly described in section 2.2. A program BINPLO.ALG is additionally offered to convert the binary coded data into PDP-10 ASCII-files. This program creates one ASCII-file for each monthly field in the so-called PLVEIS format (see HLP:PLVEIS.DOC). These files may be used as input data for plots or further numerical calculations. A detailed description of BINPLO.ALG is given in section 2.3.

### 2.1 ORIGINAL VERSION OF THE BUNKER DATA

The original BUNKER data set is stored in the first 50 files on tape 330147. The organisation of these data and the contents of the files on the tape are identical to those on tape MTH430 at IFMK. The user is advised to refer to section 1.1.2, table 1 and the appendant North Atlantic Ocean map for further details.

#### Technical details:

Tape number: 330147, with a copy on 330149  
1600 bpi  
9 tracks  
PDP-10 ASCII  
50 files, filename 1 to 50  
Length of file: 69 blocks

### 2.2 INTERPOLATED CLIMATE DATA

The interpolated 1° grid data are stored in 55 files on tape 330146 (filename 2 to 56). The first file on this tape contains an ALGOL program and additional data files to allow an access to the climate data. The climate data are stored in binary mode. When copying the binary data file into the user's disk space in order to further process the data with BINPLO.ALG the file name and the first character of the extension may be chosen by the user. The last two characters of the extension must always be "BI" (e.g. TLUFT.2BI).

Technical details:

Tape number: 330146 , with a copy on 330056

1600 bpi

9 tracks

File 1: PDP-10 ASCII,

length: 102 blocks

see section 2.3

File 2 to 56: Binary mode ,

length: 429 blocks

see section 2.4

2.3 ACCESS TO THE 1° GRID DATA

The first file on tape 330146 was created with the PDP-10 service program LIBMAN (see HLP:LIBMAN.HLP). The user should first copy this file into his disk space. By doing so the extension should be LIB (e.g. BINPLO.LIB). This file contains a subdirectory:

DIRECTORY OF DSKU:BINPLO.LIB:

BINPLO.ALG	11
KOORDI.NAT	56
PARAME.TER	5
BINPLO.INP	1
BINPLO.EXE	24

TOTAL OF 97 BLOCKS IN 5 FILES

BINPLO.EXE is the executable program to convert the binary coded climate data into PDP-10 ASCII-files. For that purpose the user has to copy all files (except the source file BINPLO.ALG) from the subdirectory into his disk space. Use one of your disks in your search list. It is important to retain the given filenames (except you like to change the source program). The files KOORDI.NAT and PARAME.TER should not be modified! On the contrary, the file BINPLO.INP is the program control file, it contains informations for the individual program run and has to be changed (or created) by the user before execution of the program. The control file must contain the following informations:

- Line 1: input device (disk name, where the binary coded data file is stored)
- Line 2: output device (disk name, where the ASCII files are to be created)
- Line 3:  $m_a$  (first month),  $m_e$  (last month),  
p (parameter identification)
- Line 4:  $\epsilon_a$  (first coordinate in east direction)  
 $\epsilon_e$  (last coordinate in east direction)  
 $\phi_a$  (first coordinate in north direction)  
 $\phi_e$  (last coordinate in north direction)
- Line 5: filename and first character of the extension.

Example of file BINPLO.ALG:

```
DSKT
DSKU
1,13,4
1,110,1,70
TLUFT.2
```

Comments:

Line 3: One program run allows the conversion of all monthly fields (including the annual field) of one parameter or a sequence of months defined by  $m_a$  and  $m_e$ . The filenames and the first character of the extensions of the output files are identical to those of the input file. The last two characters of the output file extensions contain the number of the respective calendar month (January = 01, February = 02, ..., year = 13). Hence, a run of BINPLO with the example file BINPLO.INP given above creates DSKU:TLUFT.201, TLUFT.202, ..., TLUFT.213. An input file DSKT:TLUFT.2RI is required containing the North Atlantic Ocean air temperature data.

The parameter identification numbers of all parameters available are listed in table 3 in appendix 5 as well as the physical units of the parameters in the ASCII outputfile. These units are identical to those in the real array DAT in the procedure REABIN (see appendix 6). The divisor in the second line of the ASCII file's header (see HLP:PLVEIS.DOC) is always set to 1. If the value of the parameter identification number in BINPLO.INP is not identical to that stored in the binary data file a message returns to the user and the program execution is stopped.

Line 4: Maximum dimensions for one North Atlantic Ocean field are

1,110,1,70.

In this case all data available are read into the ASCII file. The file length then is 169 blocks. Gridpoints without data are filled with -9999.0. The FORTRAN READ format for one ASCII line is (3I6, 10F12.3).  $\phi_a$  and  $\phi_b$  should always be  $(n \cdot 10) + 1$  and  $(m \cdot 10)$ , respectively, <sup>a</sup>for  $n=0,1,2,3,4,5,6$  and  $m=1,2,3,4,5,6,7$  and  $n < m$ .

The source program BINPLO.ALG is given in appendix 6. The procedure REABIN may be linked to other ALGOL or SIMULA programs. Users preferring FORTRAN should use BINPLO.ALG first and read the ASCII files. Users, who insist on reading the binary data by means of a FORTRAN program must use the so-called binary "image" mode.

#### 2.4 STRUCTURE AND PHYSICAL UNITS OF THE 1° GRID DATA

The structure and sequence of the 1° grid data in the binary files are identical to those of the 1° data ASCII files on tape MTH430. Of course, CRLFs are omitted. Refer to sections 1.1.3, 1.1.4 and 1.1.5 for details. There is one general exception: Unlike the ASCII files on tape MTH430, the binary coded files additionally contain the annual mean field, which is stored as an additional monthly group behind the December field. Filenumbers on tape 330146, the parameter names and parameter identifications are listed in table 3. Also documented are the physical units of the parameters in the ASCII files after conversion with BINPLO.ALG.

### 3 ACKNOWLEDGEMENTS

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APPENDIX 1

Table 1: List of parameterfiles which are given in the first part of the tapes MTH430 and MTH431. The sequence number of the respective file on the tapes and the parameter identification number according to BUNKER's outprints are listed as well as the units.  
stdev = standard deviation.

File- number	Identifi- cation number	Parameter name	Unit
1	3	number of observations	
2	4	air temperature TAIR	°C · 10
3	5	stdev. of TAIR	°C · 10
4	6	minimum of TAIR	°C
5	7	maximum of TAIR	°C
6	8	dewpoint temperature TDEWP	°C · 10
7	9	stdev. of TDEWP	°C · 10
8	10	minimum of TDEWP	°C
9	11	maximum of TDEWP	°C
10	12	sea surface temperature SST	°C · 10
11	13	stdev. of SST	°C · 10
12	14	minimum of SST	°C
13	15	maximum of SST	°C
14	16	TAIR minus SST	°C · 10
15	17	stdev. of TAIR minus SST	°C · 100
16	18	minimum of TAIR - SST	°C
17	19	maximum of TAIR - SST	°C
18	20	total cloud cover	oktas · 10
19	21	low cloud cover	oktas · 10
20	22	mixing ratio	g/kg · 10
21	23	mixing ratio at SST	g/kg · 10
22	24	sea level air pressure PRESS	hPa
23	25	stdev. of PRESS	hPa · 10
24	26	minimum of PRESS	hPa
25	27	scalar wind speed W	m/s
26	28	stdev. of W	m/s
27	29	maximum of W	m/s
28	30	east-west component of wind speed U	cm/s
29	31	stdev. of U	cm/s
30	32	north-south component of wind speed V	cm/s
31	33	stdev. of V	cm/s
32	34	wind direction	degrees from north
33	35	precipitation frequency	per cent
34	36	sea ice coverage	per cent
35	37	net shortwave radiation (BUDYKO/BERLIAND)	W/m <sup>2</sup> · 10
36	38	net longwave radiation (BUDYKO/EFIMOVA)	W/m <sup>2</sup> · 10
37	39	net radiation (BUDYKO)	W/m <sup>2</sup> · 10
38	40	latent heatflux (BUDYKO)	W/m <sup>2</sup> · 10
39	41	sensible heatflux (BUDYKO)	W/m <sup>2</sup> · 10
40	42	net air-sea heatflux (BUDYKO)	W/m <sup>2</sup> · 10
41	43	latent heatflux (BUNKER)	W/m <sup>2</sup> · 10
42	44	sensible heatflux (BUNKER)	W/m <sup>2</sup> · 10
43	45	net air-sea heatflux (BUNKER)	W/m <sup>2</sup> · 10
44	46	east component of wind stress (BUNKER)	Pa · 100

45	47	north component of wind stress (BUNKER)	$\text{Pa} \cdot 100$
46	48	mean Dalton number	$10^5$
47	49	transport ratio	$10^2$
48	50	air density	$\text{kg/m}^3 \cdot 10^2$
49	51	integrated net air-sea heatflux (BUDYKO)	$\text{W} \cdot 10^{-10}$
50	52	integrated net air-sea heatflux (BUNKER)	$\text{W} \cdot 10^{-10}$





APPENDIX 3

Table 2: List of parameterfiles which are given in the second part of the tapes MTH430 and MTH431. The sequence number of the respective file on the tape and the parameter identification number, which refers to BUNKER's outprints (exceptions are in brackets) are listed as well as the units. "Charts" indicates volume number and chart number of the climate atlas (ISEMER & HASSE, 1985,1987).  
stdev = standard deviation.

File- number	Identifi- cation number	Parameter name	Charts	Unit
51	/	information about coordinates		/
52	4	air temperature TAIR	I/25-30	°C · 100
53	5	stdev. of TAIR		°C · 100
54	8	dewpoint temperature TDEWP		°C · 100
55	9	stdev. of TDEWP		°C · 100
56	12	sea surface temperature SST	I/6-19	°C · 100
57	13	stdev. of SST	I/20-24	°C · 100
58	16	TAIR minus SST	I/31-44	°C · 100
59	17	stdev. of TAIR minus SST	I/45-49	°C · 10 <sup>3</sup>
60	20	total cloud cover	I/81-94	oktas · 100
61	21	low cloud cover	I/95-100	oktas · 100
62	22	mixing ratio	I/50-63	g/kg · 100
63	(53)	stdev. of mixing ratio	I/64-68	g/kg · 100
64	23	mixing ratio at SST		g/kg · 100
65	(54)	mixing ratio minus mixing ratio at SST	I/75-80	g/kg · 100
66	(55)	relative humidity	I/69-74	per cent · 100
67	24	sea level air pressure PRESS	I/115-128	hPa · 10
68	25	stdev. of PRESS	I/129-133	hPa · 100
69	27	scalar wind speed W	I/134-147	m/s · 10
70	28	stdev. of W		m/s · 10
71	30	east component of wind speed U		cm/s · 10
72	31	stdev. of U	I/167-171	cm/s · 10
73	32	north component of wind speed V		cm/s · 10
74	33	stdev. of V	I/172-176	cm/s · 10
75	(57)	directional steadiness of the wind	I/162-166	per cent · 10
76	(58)	divergence of the wind	I/177-181	s <sub>-1</sub> · 10 <sup>8</sup>
77	35	precipitation frequency	I/101-114	per cent · 10
78	50	air density		kg/m <sup>3</sup> · 10 <sup>3</sup>
79	37	net shortwave radiation (BUDYKO/BERLIAND)	II/1-6	W/m <sup>2</sup> · 100
80	38	net longwave radiation (BUDYKO/EFIMOVA)	II/7-12	W/m <sup>2</sup> · 100
81	(1)	net longwave radiation (ELSASSER)		W/m <sup>2</sup> · 100
82	39	net radiation (BUDYKO)		W/m <sup>2</sup> · 100
83	40	latent heatflux (BUDYKO)		W/m <sup>2</sup> · 100
84	41	sensible heatflux (BUDYKO)		W/m <sup>2</sup> · 100
85	42	net air-sea heatflux (BUDYKO)		W/m <sup>2</sup> · 100

86	43	latent heatflux (BUNKER)	II/13-18	$W/m^2 \cdot 100$
87	44	sensible heatflux (BUNKER)	II/19-24	$W/m^2 \cdot 100$
88	45	net air-sea heatflux (BUNKER)	II/25-30	$W/m^2 \cdot 100$
89	46	east component of wind stress (BUNKER)	II/31-36	$Pa \cdot 10^3$
90	47	north component of wind stress (BUNKER)	II/31-36	$Pa \cdot 10^3$
91	(59)	scalar wind speed (revised)	II/37-42	$m/s \cdot 10$
92	(60)	net shortwave radiation (REED)		$W/m^2 \cdot 100$
93	(61)	net shortwave radiation (revised)	II/43-56	$W/m^2 \cdot 100$
94	(62)	net longwave radiation (revised)	II/57-70	$W/m^2 \cdot 100$
95	(63)	net radiation (revised)	II/71-76	$W/m^2 \cdot 100$
96	(64)	latent heat flux (revised)	II/77-90	$W/m^2 \cdot 100$
97	(65)	evaporation (revised)	II/91-96	$mm/month$
98	(66)	sensible heat flux (revised)	II/97-110	$W/m^2 \cdot 100$
99	(67)	net air-sea heat flux (revised)	II/117-130	$W/m^2 \cdot 100$
100	(68)	oceanic heat loss by net longwave radiation, latent and sensible heat fluxes (revised)	II/111-116	$W/m^2 \cdot 100$
101	(69)	east component of wind stress (revised)	II/159-186	$Pa \cdot 10^3$
102	(70)	north component of wind stress (revised)	II/159-186	$Pa \cdot 10^3$
103	(71)	curl of wind stress (revised)	II/132-158	$N/m^3 \cdot 10^9$
104	(72)	east component of Ekman volume transport (revised)	II/187-200	$m^3/s \cdot 10^{-3}$
105	(73)	north component of Ekman volume transport (revised)	II/187-200	$m^3/s \cdot 10^{-3}$
106	(74)	vertical Ekman velocity (revised)	II/201-206	$m/s \cdot 10^8$

APPENDIX 4

Outprint of the beginning of file 52 on MTH430.

1	4								
2740	2734	2729	2724	2721	2720	2719	2718	2717	2716
2714	2711	2707	2703	2699	2695	2688	2677	2663	2649
2639	2636	2638	2645	2655	2667	2676	2681	2679	2667
2650	2636	2629	2628	2632	2641	2653	2661	2663	2662
2661	2663	2670	2677	2681	2684	2690	2699	2711	2725
2739	2749	2755	2759	2762	2765	2769	2774	2780	2717
2713	2709	2706	2704	2702	2701	2700	2699	2697	2696
2694	2691	2688	2684	2680	2675	2668	2658	2649	2641
2638	2640	2645	2655	2665	2674	2679	2679	2671	2660
2651	2648	2650	2656	2667	2678	2688	2692	2692	2691
2693	2698	2703	2708	2713	2720	2727	2735	2742	2748
2752	2756	2759	2763	2766	2770	2775	2780	2688	2694
2694	2692	2689	2687	2686	2685	2684	2682	2682	2681
2680	2677	2674	2671	2668	2664	2660	2655	2649	2643
2640	2641	2646	2654	2663	2672	2677	2679	2676	2671
2667	2669	2674	2682	2692	2703	2711	2716	2718	2720
2722	2725	2727	2730	2735	2741	2746	2750	2752	2753
2754	2757	2760	2764	2768	2772	2776	2780	2681	2681
2679	2677	2675	2674	2674	2673	2672	2671	2671	2670
2669	2667	2665	2662	2659	2656	2653	2651	2647	2643
2640	2641	2644	2651	2659	2667	2673	2678	2680	2682
2685	2691	2699	2707	2716	2724	2730	2734	2735	2739
2747	2748	2741	2738	2741	2745	2749	2752	2753	2753
2755	2757	2761	2766	2771	2775	2779	2780	2675	2673
2671	2668	2665	2664	2664	2665	2665	2665	2664	2663
2662	2661	2660	2657	2655	2652	2649	2646	2644	2641
2638	2636	2636	2639	2644	2650	2657	2665	2673	2681
2689	2699	2709	2720	2729	2736	2739	2742	2744	2742
2734	2729	2731	2734	2737	2740	2743	2746	2750	2754
2758	2762	2767	2668	2669	2668	2666	2663	2659	2656
2654	2654	2656	2657	2656	2655	2655	2654	2653	2651
2649	2646	2642	2639	2635	2632	2628	2626	2624	2624
2626	2629	2634	2641	2650	2660	2673	2687	2702	2716
2729	2740	2746	2746	2744	2743	2748	2753	2759	2764
2769	2662	2664	2664	2665	2664	2663	2662	2658	2654
2649	2646	2644	2643	2643	2643	2642	2641	2640	2640
2639	2636	2633	2629	2625	2620	2614	2610	2606	2603
2602	2601	2602	2603	2608	2615	2625	2636	2650	2667
2684	2702	2718	2731	2739	2741	2737	2732	2658	2663
2664	2664	2662	2660	2657	2654	2649	2644	2639	2635
2632	2630	2628	2626	2623	2620	2619	2618	2617	2613
2609	2604	2598	2591	2585	2578	2574	2572	2571	2569
2567	2567	2570	2576	2585	2596	2610	2625	2643	2662
2681	2699	2715	2726	2654	2660	2663	2664	2662	2658
2654	2650	2645	2639	2634	2629	2624	2620	2616	2612
2608	2603	2599	2595	2593	2590	2585	2580	2573	2566
2558	2550	2543	2538	2536	2533	2529	2526	2523	2524
2528	2535	2545	2555	2566	2580	2598	2620	2647	2676
2708	2654	2659	2661	2660	2656	2652	2646	2641	2635
2630	2625	2620	2614	2609	2603	2597	2591	2585	2578
2573	2568	2563	2557	2550	2542	2533	2524	2515	2506

APPENDIX 5

Table 3: List of parameterfiles which are given on tape 330146. The sequence number of the respective file on the tape and the parameter identification number, which refers to BUNKER's outprints (exceptions are in brackets) are listed as well as the physical units in the ASCII files after conversion with BINPLO.ALG. "Charts" indicates volume number and chart number of the climate atlas.  
stdev = standard deviation.

File-number	Identifi-cation number	Parameter name	Charts	Unit
1	/	subdirectory file		/
2	4	air temperature TAIR	I/25-30	°C
3	5	stdev. of TAIR		°C
4	8	dewpoint temperature TDEWP		°C
5	9	stdev. of TDEWP		°C
6	12	sea surface temperature SST	I/6-19	°C
7	13	stdev. of SST	I/20-24	°C
8	16	TAIR minus SST	I/31-44	°C
9	17	stdev. of TAIR minus SST	I/45-49	°C
10	20	total cloud cover	I/81-94	oktas
11	21	low cloud cover	I/95-100	oktas
12	22	mixing ratio	I/50-63	g/kg
13	(53)	stdev. of mixing ratio	I/64-68	g/kg
14	23	mixing ratio at SST		g/kg
15	(54)	mixing ratio minus mixing ratio at SST	I/75-80	g/kg
16	(55)	relative humidity	I/69-74	per cent
17	24	sea level air pressure PRESS	I/115-128	hPa
18	25	stdev. of PRESS	I/129-133	hPa
19	27	scalar wind speed W	I/134-147	m/s
20	28	stdev. of W		m/s
21	30	east component of wind speed U		cm/s
22	31	stdev. of U	I/167-171	cm/s
23	32	north component of wind speed V		cm/s
24	33	stdev. of V	I/172-176	cm/s
25	(57)	directional steadiness of the wind	I/162-166	per cent
26	(58)	divergence of the wind	I/177-181	$s^{-1} \cdot 10^6$
27	35	precipitation frequency	I/101-114	per cent
28	50	air density		kg/m <sup>3</sup>
29	37	net shortwave radiation (BUDYKO/BERLIAND)	II/1-6	W/m <sup>2</sup>
30	38	net longwave radiation (BUDYKO/EFIMOVA)	II/7-12	W/m <sup>2</sup>
31	(1)	net longwave radiation (ELSASSER)		W/m <sup>2</sup>
32	39	net radiation (BUDYKO)		W/m <sup>2</sup>
33	40	latent heatflux (BUDYKO)		W/m <sup>2</sup>
34	41	sensible heatflux (BUDYKO)		W/m <sup>2</sup>
35	42	net air-sea heatflux (BUDYKO)		W/m <sup>2</sup>

36	43	latent heatflux (BUNKER)	II/13-18	$W/m^2$
37	44	sensible heatflux (BUNKER)	II/19-24	$W/m^2$
38	45	net air-sea heatflux (BUNKER)	II/25-30	$W/m^2$
39	46	east component of wind stress (BUNKER)	II/31-36	$Pa \cdot 10^2$
40	47	north component of wind stress (BUNKER)	II/31-36	$Pa \cdot 10^2$
41	(59)	scalar wind speed (revised)	II/37-42	m/s
42	(60)	net shortwave radiation (REED)		$W/m^2$
43	(61)	net shortwave radiation (revised)	II/43-56	$W/m^2$
44	(62)	net longwave radiation (revised)	II/57-70	$W/m^2$
45	(63)	net radiation (revised)	II/71-76	$W/m^2$
46	(64)	latent heat flux (revised)	II/77-90	$W/m^2$
47	(65)	evaporation (revised)	II/91-94,96 II/95	cm/month dm/year
48	(66)	sensible heat flux (revised)	II/97-110	$W/m^2$
49	(67)	net air-sea heat flux (revised)	II/117-130	$W/m^2$
50	(68)	oceanic heat loss by net longwave radiation, latent and sensible heat fluxes (revised)	II/111-116	$W/m^2$
51	(69)	east component of wind stress (revised)	II/159-186	$Pa \cdot 10^2$
52	(70)	north component of wind stress (revised)	II/159-186	$Pa \cdot 10^2$
53	(71)	curl of wind stress (revised)	II/132-158	$N/m^3 \cdot 10^7$
54	(72)	east component of Ekman volume transport (revised)	II/187-200	$m^3/s \cdot 10^5$
55	(73)	north component of Ekman volume transport (revised)	II/187-200	$m^3/s \cdot 10^5$
56	(74)	vertical Ekman velocity (revised)	II/201-206	$m/s \cdot 10^6$

APPENDIX 6

Source code of BINPLO.ALG written in ALGOL-60.

COMMENT

PROGRAMM B I N P L O . A L G

VERSION MAERZ 1987

HANS-JOERG ISEMER

NORD-ATLANTIK-KLIMADATEN WERDEN AUS EINEM BINAERFILE  
IN DAS ARRAY "FELD" GELESEN.  
DAS ARRAY "FELD" ENTHAELT JEWEILS EIN MONATSFELD.  
DIESES MONATSFELD WIRD IN EIN ASCII FILE  
GESCHRIEBEN, DER ENTSPRECHEND DEN FORMATANFORDERUNGEN  
FUER ZEICHENPROGRAMME AUFGEBAUT IST (Z.B. PLVEIS ETC).  
INFORMATIONEN ZUM PROGRAMMABLAUF WERDEN DEM FILE BINPLO.INP  
ENTNOMMEN.

DAS PROGRAMM BENOETIGT

1. EINEN INFORMATIONSDATEI "DSK:BINPLO.INP",
2. EINEN KOORDINATENDATEI "DSK:KOORDI.NAT",
3. EINEN PARAMETERDATEI "DSK:PARAME.TER",
4. EINEN BINAEREN DATENDATEI, DER AUF DER IM  
INFORMATIONSDATEI ANGEGEBENEN PLATTE STEHT.

BEGIN

BOOLEAN PMRF;  
REAL ARRAY FELD[1:120,1:70];  
INTEGER M,MA,ME,P,P1,I,J,UEBNUM,PFILE,XA,XE,YA,YE;  
REAL DIVIS;  
STRING NAME,MIT,DATDSK,BINDSK,NAM,UEB,UEBS;  
STRING ARRAY ENDUNG[1:74],MONAT[1:13],UEBER[1:74];

PROCEDURE SET2(XARR,A1,B1,A2,B2,WERT);

COMMENT=====

DIE PROZEDUR "SET2" ORDNET JEDEM ELEMENT DES  
ZWEIDIMENSIONALEN ARRAYS "FELD[A1:B1,A2:B2]"  
DEN DURCH DIE VARIABLE "WERT" DEFINIERTEN WERT ZU

;

REAL ARRAY XARR;INTEGER B1,B2,A1,A2;REAL WERT;

BEGIN

INTEGER I,J;

FOR I:= A1 UNTIL B1 DO

BEGIN

FOR J:= A2 UNTIL B2 DO

XARR[I,J]:=WERT;

END--I--;

END--"WERT"--SETZEN EINES ZWEIDIMENSIONALEN REAL ARRAYS--;

```
PROCEDURE PLOFI(XA,XE,YA,YE,P,M,UEBERSCHRIFT,FELD);
COMMENT=====
DIE PROZEDUR "PLOFI" ERZEUGT EINEN ASCII-FILE, DER EIN
MONATSFELD EINES PARAMETERS, DAS IM ARRAY "FELD" UEBERGEHEN
WIRD, IM PLVEIS-FORMAT ENTHAELT.
XA,XE,YA,YE SIND DIE ANFANGS- UND ENDKOORDINATEN DES GE-
WUENSCHTEN FELDAUSSCHNITTS. XA, YA SOLLTEN JEWEILS (N*10.)+1 SEIN.
XE,YE MUESSEN (N*10.) SEIN.
P UND M SIND DIE PARAMETER- BZW MONATSKENNUNG.
"UEBERSCHRIFT" ENTHAELT EINEN STRING, DER IN DEN HEADER DES
ASCII-FILES GESCHRIEBEN WIRD (SIEHE PLVEIS.DOC).
;
REAL ARRAY FELD;
INTEGER XA,XE,YA,YE,P,M;
STRING UEBERSCHRIFT;
BEGIN
INTEGER I;
REAL ARRAY PARAM[YA:YE];
INTEGER Q1,Q2,TYP,ZMAX,MA,ME,NA,NE,X,Y,ZZ;
REAL Q3,ZEIT,DIVISOR,POSWERT,NN;

MA:=1;
ME:=XE-XA+1;
NA:=1;
NE:=YE-YA+1;
Q1:=1;
Q2:=999;
Q3:=-7777.0;
TYP:=100+M;
ZEIT:=0.;

DIVISOR:=1.;
PF1:
WRITE(UEBERSCHRIFT);
NEWLINE;
PRINT(TYP,4,0);
PRINT(ZEIT,4,2);
PRINT(DIVISOR,4,2);PRINT(DIVISOR,4,2);NEWLINE;

NN:=NE;
ZMAX:=(NN/10.);

FOR X:= XA STEP 1 UNTIL XE DO
BEGIN
FOR Y:= YA STEP 1 UNTIL YE DO
BEGIN
PARAM[Y]:=FELD[X,Y];
END---Y---;

```



```
FOR ZZ:= 1 STEP 1 UNTIL ZMAX DO
BEGIN
PRINT(X-XA+1,5,0);PRINT(((ZZ-1)*10)+1,5,0);PRINT(ZZ*10,5,0);
FOR Y:= ((ZZ-1)*10)+YA STEP 1 UNTIL ((ZZ*10)+YA-1) DO
PRINT(PARAM[Y],7,3);
NEWLINE;
END---ZZ---;
END---X----;
COMMENT
DAS BILD LIEGT NUN MIT WEST-OST ACHSE
IN PLOTPAPIERRICHTUNG. X UND Y ENTSPRECHEN DEN KOORDINATEN
IN ZEICHENPROGRAMMEN WIE Z.B. PLVEIS.
;
PRINT(X,5,0);PRINT(Q1,5,0);PRINT(Q1,5,0);
PRINT(Q3,7,3);
NEWLINE;
PRINT(Q2,5,0);
FOR I:= 1,2 DO PRINT(ZEIT,5,2);NEWLINE;
END---PROZEDUR PLOFI---;

PROCEDURE REABIN(NAME,M,P,PFILE,FELD,BINDSK,DIVIS,PR);
!=====;
BOOLEAN PR;
STRING NAME,BINDSK;
INTEGER M,PFILE,P;
REAL DIVIS;
REAL ARRAY FELD;
COMMENT
DIE PROZEDUR "REABIN" LIEST JEWEILS EIN MONATSFELD FUER DEN
NORDATLANTIK AUS BINAEREN DATENFILES
IN DAS ARRAY FELD;

BEGIN
INTEGER ANZDAT,I,MI,PI,DI,PHI,LAM,WERT;
INPUT(1,BINDSK,11);
INPUT(2,"DSK");
OPENFILE(2,"KOORDI.NAT");
COMMENT DER FILE KOORDI.NAT ENTHAELT DIE
KOORDINATEN SAEMTLICHER 1 GRAD GITTERPUNKTE
IM NORDATLANTIK;

OPENFILE(1,NAME);
ANZDAT:=4194;
COMMENT ANZAHL SAEMTLICHER 1 GRAD GITTERPUNKTE
IM NORDATLANTIK;
```

```
SET2(FELD,1,110,1,70,-9999.);
SELECTINPUT(1);
IF M=1 THEN GO TO LB1;
FOR I:=1 UNTIL ((M-1)*(ANZDAT+3)) DO
BEGIN
SKIPSYMBOL;
END;
LB1:
INSYMBOL(MI);
INSYMBOL(PI);
INSYMBOL(DI);
COMMENT EINLESEN DER MONATS-, PARAMETERKENNUNG UND
DES DIVISIONSFAKTORS (IST IMMER = 100.)
;
PFILE:=PI;
IF MI#M OR PI#P THEN PR:=TRUE;
IF PR THEN GOTO MUNGLEICH;

FOR I:= 1 UNTIL ANZDAT DO
BEGIN
SELECTINPUT(2);
READ(PHI);
READ(LAM);
SELECTINPUT(1);
INSYMBOL(WERT);
FELD[LAM,PHI]:=WERT;
FELD[LAM,PHI]:=FELD[LAM,PHI]/(DI*DIVIS);
COMMENT EINLESEN EINES KOORDINATENPAARES UND DES ZU-
GEOERIGEN DATENWERTES UND ZUORDNUNG IN DAS ARRAY
"FELD". "DIVIS" IST EIN PARAMETERABHAENGIGER DIVISOR,
DER DIE PARAMETEREINHEIT ERZEUGT (SIEHE IFM BERICHT 160A)
;

END---I---;

MUNGLEICH:
FOR I:= 1,2 DO RELEASE(I);
IF PR THEN
BEGIN
SELECTOUTPUT(0);
WRITE("ACHTUNG ! PARAMETER UNGLEICH: ");
NEWLINE;
WRITE("MONATSWERT IN BINPLO.INP: ");
PRINT(M,5,0);NEWLINE;
WRITE("MONATSWERT IM DATENFILE: ");
PRINT(MI,5,0);NEWLINE;
WRITE("PARAMETERWERT IN BINPLO.INP: ");
PRINT(P,5,0);NEWLINE;
WRITE("PARAMETERWERT IM DATENFILE: ");
PRINT(PI,5,0);
NEWLINE;
END;

END---REABIN-----;

PROCEDURE FB(PWERT,DWERT,P,DIVIS);
!=====;
INTEGER PWERT,P;
REAL DWERT,DIVIS;
BEGIN
IF P=PWERT THEN DIVIS:=DWERT;
END;
```

COMMENT BEGINN DES HAUPTPROGRAMMS

=====;

PMRF:=FALSE;

COMMENT

DIE BOOLSCHES VARIABLE PMRF IST NUR "TRUE", WENN PARAMETER-  
ODER MONATSKENNUNG IM DATENFILE NICHT MIT DEN GEWUENSCHTEN  
ANGABEN IM FILE "BINPLO.INP" UEBEREINSTIMMEN. DANN ERFOLGT  
PROGRAMMABBRUCH.

;

OUTPUT(0, "TTY");

INPUT(3, "DSK");

OPENFILE(3, "PARAME.TER");

SELECTINPUT(3);

FOR I:= 1 UNTIL 13 DO

READ(MONAT[I]);

FOR I:= 1 UNTIL 74 DO

READ(ENDUNG[I]);

FOR I:= 1 UNTIL 74 DO

READ(UEBER[I]);

CLOSEFILE(3);

COMMENT

MONATSNAMEN UND PARAMETERNAMEN WERDEN EINGELESSEN;

OPENFILE(3, "BINPLO.INP");

SELECTINPUT(3);

INLINE(BINDSK);

INLINE(DATDSK);

READ(MA);

READ(ME);

READ(P);

READ(XA); READ(XE); READ(YA); READ(YE);

INLINE(NAM);

CLOSEFILE(3);

COMMENT

INFORMATIONEN ZUM PROGRAMMABLAUF WERDEN  
EINGELESSEN;

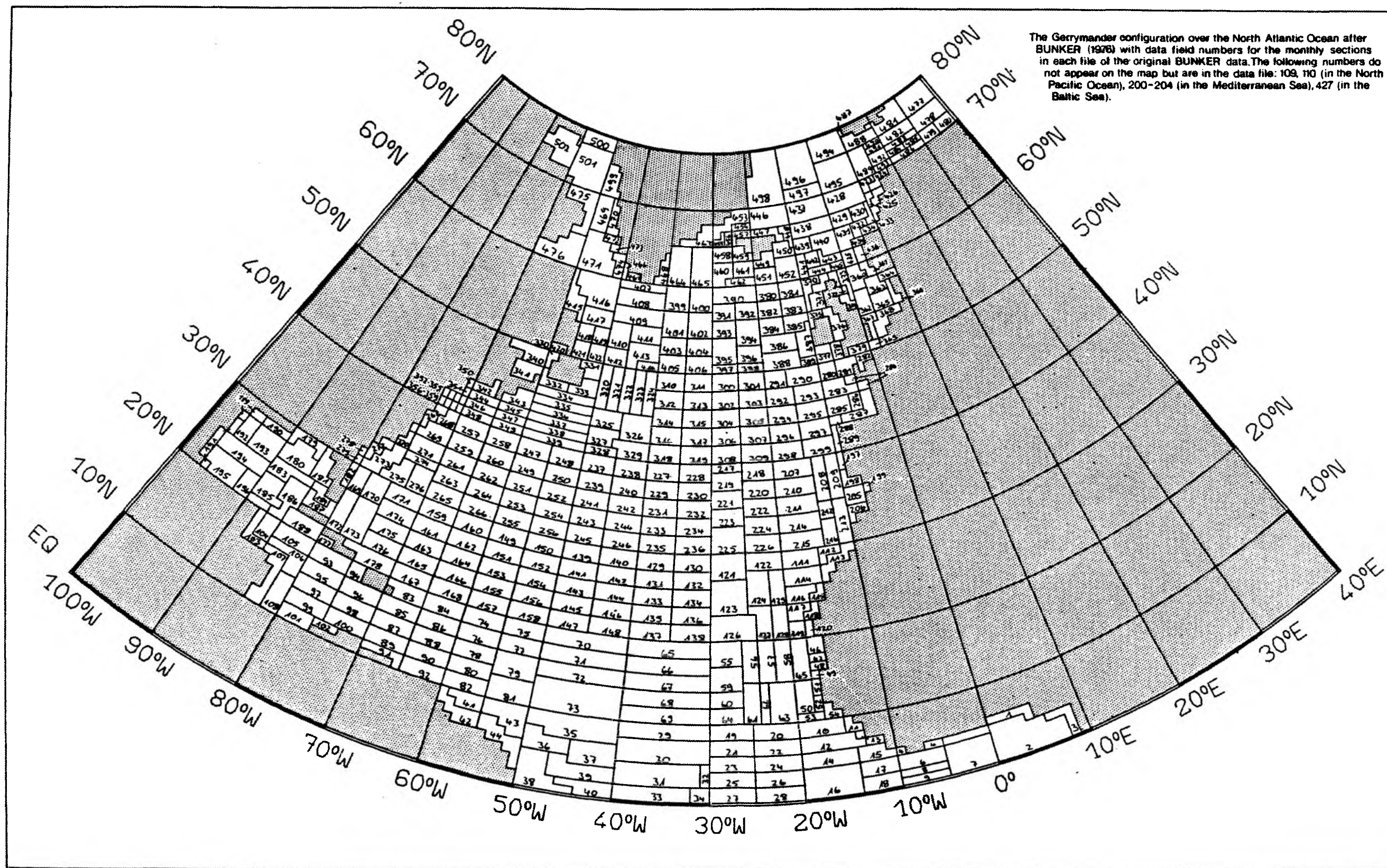
```
DIVIS:=10.;
FOR P1:= 24,25,27,28,30,32,35,46,47,53,55,57,58,74 DO
FB(P1,1.,P,DIVIS);
FOR P1:= 59,69,70 DO
FB(P1,100.,P,DIVIS);
FB(71,1000.,P,DIVIS);
COMMENT
FESTLEGUNG EINES PARAMETERABHAENGIGEN
DIVISORS;

FOR M:=MA UNTIL ME DO
BEGIN
NAME:=CONCAT(NAM,"BI");
REABIN(NAME,M,P,PFILE,FELD,BINDSK,DIVIS,PMRF);

IF PMRF THEN
BEGIN
SELECTOUTPUT(0);
NEWLINE;
WRITE("PROGRAMMABBRUCH");NEWLINE;
GOTO SCHLUSS;
END;

OUTPUT(9,DATDSK);
NAME:=CONCAT(NAM,ENDUNG[M]);
OPENFILE(9,NAME);
SELECTOUTPUT(9);
UEBS:=CONCAT(UEBER[P]," ",MONAT[M]);
PLOFI(XA,XE,YA,YE,P,M,UEBS,FELD);
RELEASE(9);
SELECTOUTPUT(0);
WRITE("FERTIG: ");
WRITE(MONAT[M]);
NEWLINE;
END---M---;

SCHLUSS:
END;
```



The Gerrymander configuration over the North Atlantic Ocean after BUNKER (1976) with data field numbers for the monthly sections in each file of the original BUNKER data. The following numbers do not appear on the map but are in the data file: 109, 110 (in the North Pacific Ocean), 200-204 (in the Mediterranean Sea), 427 (in the Baltic Sea).