TECHNICAL MEMORANDUM

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Diagnostic postprocessing package

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PREFACE

The package is designed for evaluation and plotting the diagnostic data calculated by the grid-point and spectral model forecast. Diagnostic data consist of zonally averaged temperature-, wind- and humidity tendencies calculated on sigma-levels due to individual physical parameterization subroutines. These tendencies are integrated over the forecast period. Furthermore, it is possible to obtain diagnostics for the adiabatic part of the grid point model. A list of all diagnostics calculated in the forecast model is shown in Appendix 2.

The task of the package is to read, unpack, and process the diagnostic data, i.e. scale, integrate over levels and/or latitudes, print and plot the data according to the options given (see Section 1.5). Appendix 4 gives an example of the printed and plotted output produced with the package.

Section 1 of the documentation describes the input, i.e. the diagnostic file itself and the namelist input containing the options for the package.

Section 2 is a user's guide on how to run the package containing a description of interactive procedures to set up the plotting as well as other housekeeping jobs.

Section 3 contains the mathematical background of this diagnostic package.

1. INPUT FOR DIAGNOSTIC POST PROCESSING PACKAGE

1.1 Operational diagnostic files

Operationally the diagnostic files are produced with the output package. They are called FDISyymmddhhh,ID=OUhhh, where yy is the year, mm the month, dd the day of the initial data the forecast has started with, hhh is the hour of the forecast time. Every forecast day a diagnostic file is produced, i.e. hhh = Ø24, Ø48,..., 24Ø and catalogued on CRAY disc. After the forecast has finished a dispose-job is launched by the supervisor disposing the files to CYBER private disc pack SN=DSETØ1, VSN=PAO34Q.

Every month or twice a month depending on the number and size of the files they have to be archived on a 6250 bpi-tape to clear the disc. This is done by a procedure described in Sect. 2.4.2. A list of available files (archived or still on disc) can be obtained by a special option in the procedure, too (see Sect.2.4.4).

The diagnostic file can be attached either internally (if LINTAT=.TRUE., see Section 1.5) or externally (LABEL, ATTACH).

1.2 Research model diagnostic file

Running the grid-point- or spectral-research-model with the output package the diagnostic files have the same format as the operational files. In the grid-point-model-version they are produced every write-up-time, i.e. normally every half a day and disposed to CYBER private disc pack DSETØ1, VSN=PAo34Q as all other files produced with the output package. The name is PPDcnnThhhh, ID=EWP3, where cnn is the experiment number and hhhh the forecast time in hours, i.e. normally hhhh=ØØØØ,ØØ12,...Ø24Ø. They are automatically archived at the end of a forecast and can be retrieved by procedure FIND described in "Archiving system of the global grid point model run by research department" by U. Pilz, File R2326, No.78.

In an earlier version of postprocessing forecast data designed by K. Arpe the diagnostic file is part of the so called "global file" which is archived in a similar way. The structure of the file is slightly different but can be processed giving a special parameter in procedure PLODIP (see Sect. 2.4.1).

1.3 Contents and structure of operational diagnostic file

The diagnostic data are extracted from a model σ-file in which one vector field (length NLEV*NLP2, NLEV: no. of levels, NLP2: no. of longitudes +2) is reserved for zonal means.

Each level of this vector field is divided into several "diagnostic fields" (see Fig. 1).

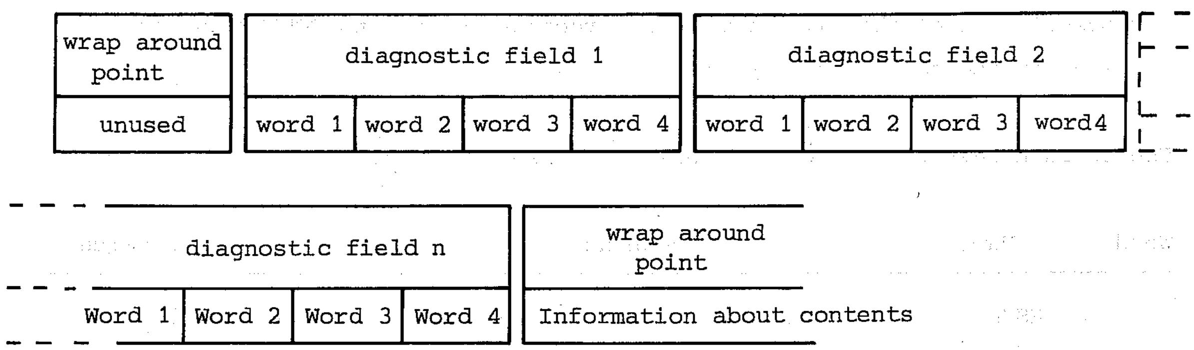


Fig. 1 Structure of one level of diagnostic vector field (length NLP2)

The maximum number of diagnostic fields is n=NLON/4 and is therefore determined by the resolution of the model. Each diagnostic field is composed of 4 words, containing sum over land/sea, top/bottom of clouds over land/sea, square sums over land/sea, individual maximum/minimum. All quantities are sums, etc. of the change of one meteorological parameter (T,u,v,q) due to one specific subroutine. The contents of each diagnostic field depends on the calculation done in the model and is described in the code number stored in a wrap around point. See Appendix 1 and documentation of the global grid point model for all possible quantities stored in the diagnostic fields.

The last wrap around point of the first 7 levels of the diagnostic vector field in the model is used, that is

level 1	code number describing contents of first two words in diagnostic fields
level 2	code number describing contents of last two words in diagnostic field
level 3,4	text describing contents of first (level 3) and last (level 4) two words of diagnostic field
level 5,6	count how often diagnostic subroutine is called (level 5 for first, level 6 for last two words of diagnostic field)

level 7 number of land points at every latitude

Level 1 to 6 are used only at row i (i = code-no/100, see Appendix 2) whereas level 7 is set at every latitude.

From these data and model common blocks the diagnostic file is constructed. It consists of three header records which are in CYBER format and not packed followed by scaled and packed data records. See Technical Memorandum No. 2 for description of the first two header records COMHKP and COMSDO and for the scaling and packing method used.

The third header record, COMDIA, has the following format:

Word	Name	Meaning	Initial value
1	MSZDIA	length of header record	415
2	MPRDIA	length of preliminary array	294
3	MNXDIA	(length of first data record)	(MPRELO+NLEV*NREC)
4	NDIFDS	number of groups of diagnostics following on output file	data dependent
5	NDIMAX	maximum possible number of groups of diagnostics	48
6→293	MDIACD(6,48)	codes for diagnostics groups	data
294→414	MLAND(121)	number of land-points for every latitude	dependent
415	MRCDIA	record number	3

There can be a maximum of NDIMAX groups of diagnostics (where in practice NDIMAX = NLON/4). Each group has 6 codes associated with it, held in MDIACD(6,48). If, for the Jth group, both MDIACD(1,J) = 0 and MDIACD(2,J) = 0, then all the diagnostics for that group are zero. In this case, no data records for this group are written to the post-processing file.

If at least one of MDIACD(1,J) and MDIACD(2,J) is non-zero, then the Jth group of diagnostics is written to the post-processing file as 4 data records. Each group contains 4 elements, which are held at NLEV levels and NOREC rows. There is a record for each element, and these are ordered first by level, then by row (i.e. all the levels for the first (northernmost) row, ordered from top to bottom, followed by all the levels for the next row to the south, etc). Each data record, preceded by a preliminary array of length 16 words, is scaled, packed and converted to Cyber format.

The preliminary array has the following format:

Word	Name	Meaning	Initial value
1	MSIZDO	total (unpacked) data record length	MPRELO + NLEV*NOREC
2	MPRELO	length of preliminary array	16
3	MNXDO	length of next data record	NLEV*NOREC
4	MX1DO	maximum subscript of first dimension	NLEV
5	MX2DO	maximum subscript of second dimension	NOREC
6	MTYDO	data type	4
7	MFDO	group number	
8	MLEVO	element number within group	
9	MZM1	minimum value of data field, see Tech.Mem. 2 for packing method	data dependent
10	MZM2		
11	MZM3		
12	MINO	scaling factor for packing routines	
13	MSH001	not used for diagnostics fields	
14	MSH002		
15	MSH003		
16	MRECDO	record number	

The diagnostics are post-processed by including field code 23 (and any level code, since diagnostics can only be output at all levels) in the post processing input section for fields which are to be output uninterpolated on the model grid.

1.4 Orography file

This type of input file is used only if the diagnostic file does not contain information of orography, i.e. in old model versions. Normally, this file is not necessary as level 7 of wrap around point carries this information (see Sect. 1.3).

The orography file contains the number of land and sea points and their reciprocal for each latitude. The file is internally attached on unit 2 according to the number of latitudes in the model.

For the grid-point model there are only two files available, for 24 and 48 latitudes, called N48ORO, N24ORO and ID=PAU, respectively, catalogued on CYBER public disc.

The file is read by the following READ-statement:

```
READ(2,910) NLAND,NSEA,RLAND,RSEA
910 FORMAT (4(40I3/)34I3/(5E25.15))
```

, where NLAND and NSEA are integer arrays of length 97 and contain the number of land- and sea-points for each latitude respectively. The real arrays RLAND and RSEA contain the corresponding reciprocal.

For the spectral model the following files are available:

latitudes	filename	id
32	T15ORO	NAUC3
64	T40ORO	NAUC3
72	R28ORO	NAUC3
96	T63ORO	NAUC3
116	P63ORO	NAUC3

These data are read unformatted: READ(2)NLAND, NSEA, RLAND, RSEA, where NLAND, NSEA, RLAND, RSEA are arrays of dimension. MAXROW, where MAXROW is the number of latitudes in the model.

1.5 Namelist input file containing options for processing the data

1.5.1 Survey of possible options

First of all choose the forecast days (from...to) you want to process of a particular forecast or a forecast period (ICOENS≠0). The default is processing day 0 to day 10 of one single forecast. Then choose the kind of processing: plots/no plots, calculation and plotting of variances yes/no, level integrated plots yes/no (NTYPE). Further additional computations can be done or omitted: calculation of minimum and maximum, division into 10 classes, integration over levels and/or latitudes. (MIMAF). These computations are done for all diagnostic fields you mention in ISUB. Appendix 2 gives a summary of all diagnostic fields for which diagnostic is calculated in the model.

Up to eight different combinations of diagnostic fields are allowed for latitude/level cross sections (ISPAD), for instance combine DT RADHEAT, DT KUO COND, DT KUO EVAP, as well as a combination of the first and last part of a diagnostic field (ICOMAC) used for dissipation stored in the first and second part of a diagnostic field (see Appendix 1). As print options either the print of raw data (IPRTES) or the scaled values in integer format can be chosen (IPRICO).

As plot option you can specify the plot size (ISUB,ISPAD,ICOMAC), for latitude/level cross sections the contour interval (CINTAG, CINTAE, CINTCG, CINTCE), and the scale for level integrated (SCAMIN,SCAMAX) and latitude integrated plots (SCEMIN,SCEMAX).

See next Section for detailed description of all available parameters.

1.5.2 Description of namelist parameters

<u>IDATE</u> type : integer, dimension : 1, default : Ø

meaning : date of initial data where forecast started

format : yymmdd, i.e. 8ØØ815 for 15 August 1980

remark : used only if diagnostic file is attached internally (LINTAT=.T.) and ICOENS=0, i.e. for operational diagnostic file only.

<u>ICOENS</u> type : integer, dimension : 1, default : Ø

meaning : code number for ensemble means over several forecasts, i.e. March 1980 includes all forecasts started with initial data of March 1980 even if forecast period extends into April 1980.

format : dfdfmfmfyfyfdtdtmtmtytyt, where

dfdf,mfmf,yfyf day, month, and year of starting day of first forecast in ensemble

dtdt, mtmt, ytyt day, month, and year of starting day of last forecast in ensemble example : ICOENS= Ø1Ø38Ø31Ø38Ø calculates average of diagnostic data over all forecasts with initial data in the period from 1 to 31 March 1980. Warning messages will be issued if a file is missing in that period and if preceeding common blocks differ.

remark : used only for operational forecasts with LINTAT=.TRUE.

<u>LINTAT</u> type : logical, dimension : 1, default : TRUE

meaning : attaching diagnostic file internally or externally.

TRUE : attach diagnostic file internally with CALL ATTACH according to IDATE or ICOENS supplied. Only files of the form FDISyymmddhhh,ID=OUhhh (see chapter 1.1) are attached on DSETØ1.

FALSE : diagnostic file has to be attached via control cards (ATTACH, LABEL, etc) File containing DAYFR-data is expected on unit 2, DAYTO-data on unit 1.

<u>DAYFR, DAYTO</u> type : real, dimension 1, default : DAYFR=Ø.
DAYTO=1Ø.

meaning : diagnostic data integrated from day DAYFR to DAYTO of forecast period.

remarks : 1) real variables containing decimal point, i.e. day 5, 6 hours = 5.25

2) DAYFR-file is read on unit 2,
DAYTO-file is read on unit 1.

<u>NTYPE</u> type : integer, dimension : 1, default : 4

meaning : type of processing data

NTYPE = 0 : no processing of day I
1 : calculation only, no plots
2 : latitude/level plots only
3 : level integrated latitude plots only
4 : latitude/level and level integrated plots
} without variances

5 : calculation only, no plot
6 : latitude level plots only
7 : level integrated latitude plots only
8 : latitude/level and level integrated plots
} with variances

2. FORMAL STRUCTURE AND USER'S GUIDE TO RUN THE PACKAGE

The diagnostic package is written in FORTRAN IV for CDC CYBER 175. The update-source code is catalogued on CYBER public disc under PPDINn,ID=PAU, where n is the upgrade level (at present n=5).

2.1 Structure of source code

The source code consists of three main parts (see Fig. 2), i.e. running the package is done in three steps:

Step 1: dimension preprocessor: creation of common blocks depending on latitudes, levels, MAXDIA (physics only or additional adiabatic diagnostics), and kind of model (spectral or grid-point). This step is skipped when object library is used. Running procedure PLODIP (see Sect. 2.4.1) the object library called PLOBLLmmmSPsdd if requested and not available will be created and catalogued interactively, where LL : number of levels in model, mmm : number of latitudes in model, s : kind of model (s=0 for gridpoint model, s=1 for spectral model), dd=19 for physics diagnostic only, dd = 48 for physics and adiabatic diagnostics.

Step 2: reading of diagnostic data (DAYFR on unit 2, DAYTO on unit 1), unpacking and writing data in reorganized form to unit 3 and/or 4.

Step 3: scaling of data, integration over levels and latitudes, plotting of results.

The main programs consist only of a call to the main subroutines (see Fig. 2).

Main program MAIN1:

```
      PROGRAM MAIN1    (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     1                  TAPE1=0,TAPE2=0,TAPE3,TAPE4)
      CALL PREJAN       for diagnostic produced with output package
or:   CALL PREKLA       for diagnostic produced with old research post-
                        processing package
      STOP
      END
```

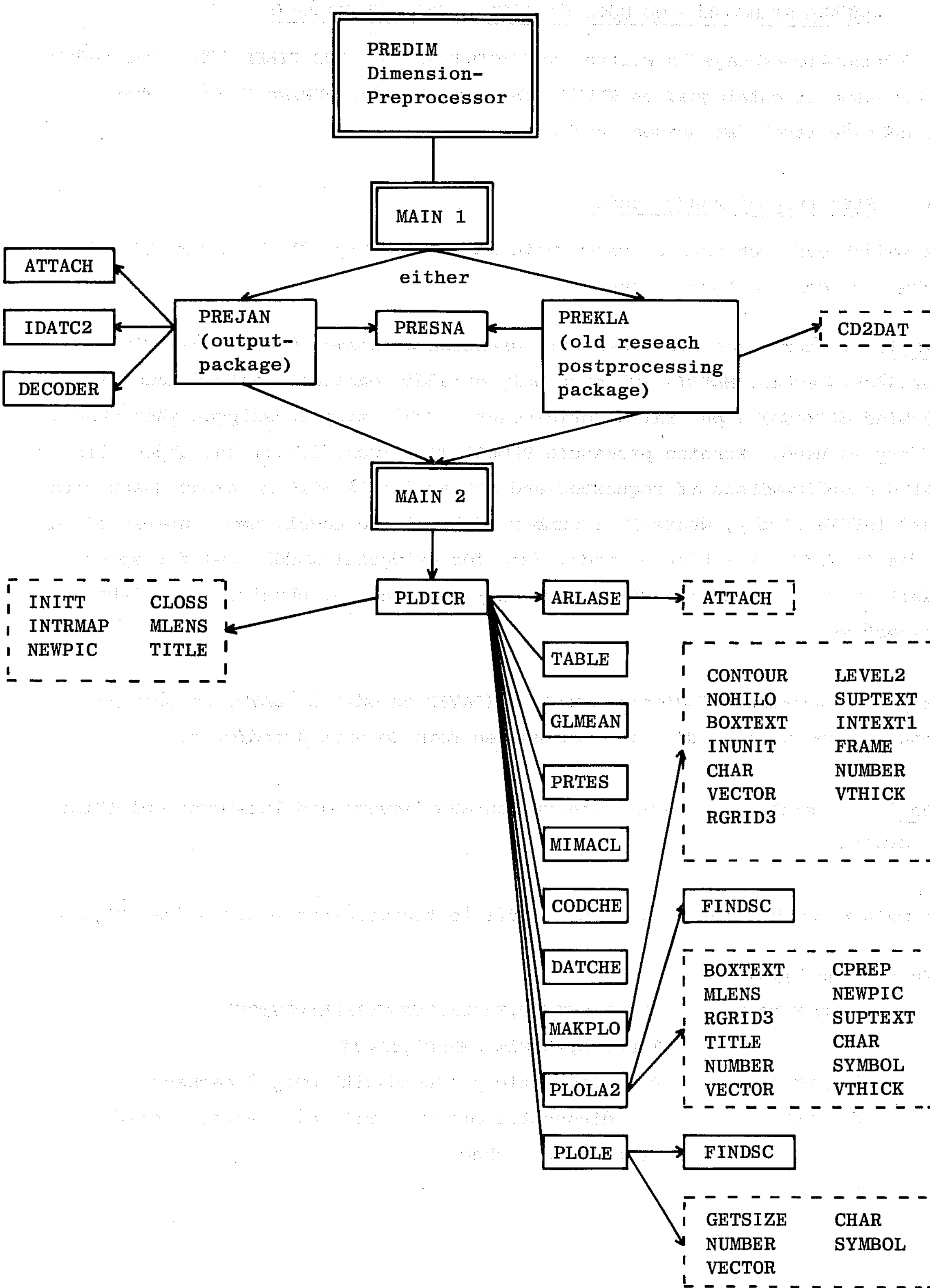


Fig. 2 Structure of source library. Main programs are in double frames; subroutines of the package in frames and externals in dashed frames.

Main program MAIN2:

```
      PROGRAM MAIN2     (OUTPUT,TAPE6=OUTPUT,TAPE2=1000B,
     1                  TAPE3,TAPE4,TAPE98=0,TAPE99)
      CALL PLDICR
      STOP
      END
```

Short descriptions and flow diagrams of every subroutine of the package can be found in Appendix 3 of this documentation.

2.2 External libraries used by the package

The first part of the package if processing operational diagnostic data (see Section 1.1) is using ECMWF system library ECLIB for internal attaching of the diagnostic file. The object code of the model library ECMODEL called N16CYBEROBJ, ID=EWP3 is used by both, processing operational or research files for calculating the century date from the actual date or vice versa.

The ECMWF-contouring library is used by the second part of the package for plotting the data, that is CONTLIB, VARLIB and CERNLIB. Internal attaching of the orography file (see Section 1.4) requires ECLIB again.

To summarize the following libraries have to be attached:

N16CYBEROBJ,ID=EWP3		ECLIB	CONTLIB
VARLIB	and	CERNLIB	

2.3 Typical memory- and time-requirement

The memory requirement depends on the resolution of the model. To reduce field length segmented loader directives are available for the second part of the program. The directives are kept as an update deck called SEGDIA. This deck is part of a segmented loader source library catalogued under SEGDIR,ID=PAU.

The first part (main program MAIN1, see Fig. 2) uses 50 K octal words, the second part (main program MAIN2) for physics diagnostics only and for a N48/15 level model 164 K, including adiabatic diagnostics 215 K octal words. These numbers are taken from LWA+1 of the load in the load map. Specifying the CM-parameter on the jobcard adding of about 30 K to the field length given for the second part is necessary.

Using segmented loader LWA+1 address is reduced by 14 K whereas "CM max. used" determining CM-parameter on jobcard is reduced by 27 K.

A normal run processing operationally produced diagnostic data with all default options and physical diagnostics only takes about 150 sec CP- and 150 sec IO-time on CDC CYBER-175.

One month ensemble mean processing all available data (including diabatic) takes about 860 sec CP-time and 2130 IO-time with all default options.

2.4 Interactive procedure package

A procedure package is available to set up all jobs concerning the diagnostic package. It is designed in an interactive self-explainable question-answer mode.

The main tasks and the different jobs set up and launched in CYBER input queue are briefly described below. Within each task the required parameters are interactively asked.

The procedure package is catalogued under PLODIP,ID=PAU using FORTRAN-code gathered in the file PROCFTN,ID=PAU.
It is started by typing:
FETCH,PLODIP,PAU
PLODIP,userid,useraccount
It will answer with:

```
Please type N for special parameters
            R run with research diagnostic
            O run with operational diagnostic
            S default run with spectral model diagnostic
            M default run for monthly mean of operational diagnostic
            L for making object library only
           AR for archiving operational diagnostic files
           AU diagnostic file archive
           LD for loading diagnostic files from tape to disk
           RE for reading archive catalog
```

2.4.1 Running the diagnostic post processing package

By typing either N, R, O, or S the procedure starts asking for all information which is needed to run the package.

If a run with object-library is wanted. If this is stored under ID=PAU no objectlibrary of a particular resolution is catalogued a objectlibrary will be created interactively and catalogued.

A job (JCL and several input streams) will be created which can directly be launched into the CYBER input queue or in case of option N be left as a local file called "JOB".

2.4.2 Archiving procedure for operational diagnostic files

Depending on number and size of the operational diagnostic files (which are disposed to disc SN=DSETØ1,VSN=PA034Q, see Section 1.1) an archive job has to be launched by typing "AR" to clear the disc. This job will archive all files of a certain period (to be typed in) to a dumptape and a back-up-tape (destructive dump). This period must be chosen such that all requested files will fit on one single tape. In the same job a file called DIARCHIVECATALOG,ID=PAU containing a directory of all archived operational files is updated, used as input for the load-procedure described below.

2.4.3 Load-procedure of operational diagnostic files

By typing "LD" a job loading operational diagnostic files back from tape to disc DSETØ1,PA034Q is launched. A second job containing JCL for purging these files is prepared and catalogued under PURGEDIAG, IS=userid and has to be launched after diagnostic postprocessing job (see Section 2.4.1) has completed successfully.

Attention: Load job itself or not purging loaded files can lead to disc overflow resulting in loss of operational diagnostic files.

2.4.4 Audit and reading archive-catalogue

A special audit option (initiated by typing 'AU') is available listing all operational diagnostic files date-ordered. Archived files are flagged and listed, too.

The archive directory (see Section 2.4.2) can be read as well by typing 'RE'.

As in all other procedure options a batch job is launched into CYBER input queue which can be printed after completion.

ISUB type: integer, dimension: MAXDIA, where MAXDIA =
19 (physics diagnostics only) or
48 (physics and adiabatic diagn.)

default: for MAXDIA=19 ISUB(1,...,6)=1,
ISUB(9,10,11,16)=1, all other elements=0
for MAXDIA=48 as for MAXDIA=19, but additional
ISUB(7,8,13,14,15,17,18,30)=9,
ISUB(25,27,28,29,31,34,35,38,41)=1,
all other elements=0

meaning: 1. index: diagnostic field to be processed (see Appendix 2)
2. value: plot size and kind of plotting

ISUB(I)=0 : no processing of diagnostic field I

ISUB(I)=1 : processing of field I, plot size:
2x7 cm if more than 4 pictures requested for one diagnostic field,
8x16 cm if less than 5 pictures requested

ISUB(I)=2 : 8x16 cm for more than 4 pictures
16x32 cm for less than 5 pictures

ISUB(I)=3 : as ISUB(I)=1, but only mean over land and sea plotted in level integrated plots

ISUB(I)=4 : as ISUB(I)=2, but with restriction as in ISUB(I)=3

ISUB(I)=9 : no plot but processing of that diagnostic field which is needed if combination with other fields is required.

ISPAD type: integer, dimension: (n,MAXDIA), where n=4 for
MAXDIA=19 and n=8 for MAXDIA=48.
MAXDIA described under ISUB.

default for MAXDIA=19 : ISPAD(1; 2,3)=1
ISPAD(2; 5,6)=1
ISPAD(3; 1,2,4,4,5,6)=1
ISPAD(4; 9,10,16)=1
all other elements=0

default for MAXDIA=48 : as for MAXDIA=19, but additional:
ISPAD(5; 7,18,30)=1
ISPAD(6; 8,17,34)=1
ISPAD(7; 1,2,3,4,5,6,13,38)=1
all other elements=0.

meaning: 1. combination, i.e. adding up of several diagnostic field
2. plot size and kind of plotting

1st index : combination number 1,...,n (see remark 1)

2nd index : number of diagnostic field to be added up (see Appendix 2)

value : ISPAD(J,I) = 0 no adding

ISPAD(J,I) = 1 combination J, adding up all diagnostic fields I with ISPAD(J,I)≠ 0 and plot combination, plot size described under ISUB.

ISPAD(J,I) = 2,3,4,9 : same meaning as described under ISUB.

remarks : 1. Up to 4 different combinations are allowed for MAXDIA=19, up to 8 different combinations are allowed for MAXDIA=48.

2. One diagnostic field I can be added up in several combinations.

3. Within one combination no restriction of number of diagnostic fields to be combined, but warning message is issued if more than 6 fields are combined as label above plots will be incomplete.

4. diagnostic field I has to be processed first by specifying ISUB(I)≠0.

5. Only contents of first part of diagnostic field is added up.

6. If one value of ISPAD(J,I=1,...,n)=2, large plot size is assumed.

7. Combination allowed only if units of diagnostic field are the same. Otherwise warning message is issued and following combinations are suppressed.

8. See remark 3 of LV-description.

<u>ICOMAC</u> type: integer, dimension: MAXDIA (as described under ISUB

default: ICOMAC(11)=1, all other elements=0.

meaning: combination of the two parts of one diagnostic field (see Appendix 1 and 2)

index: number of diagnostic field of which the two parts should be added up.

value: ICOMAC(I)=0: no adding

ICOMAC(I)=I: add up two parts of diagnostic field I and plot the sum (plot size see under ISUB)

ICOMAC(I)=2,3,4,9: same meaning ad described under ISUB

ICOMAC(I)=2,3,4,9: same meaning as described under ISUB

remark: combination of the two parts of any diagnostic field is allowed only if the two parts contain the same contents, i.e. sums or dissipation, etc. (see Appendix 1).

IPRTES   type: integer, dimension: MAXROW (no. of latitudes)
default: all elements=0

meaning: test print of raw data

index: latitude number

value: IPRTES(NROW)=

Ø :	no print							
1 :	print	1st	word	of	diagnostic	field	(all	levels)
2 :	"	2nd	"	"	"	"	"	"
3 :	"	3rd	"	"	"	"	"	"
4 :	"	4th	"	"	"	"	"	"
5 :	"	1st & 2nd			"	"	"	"
6 :	"	3rd & 4th			"	"	"	"
7 :	"	all words			"	"	"	"
8 :	as 7 but do not process data further.							

remarks: if only 1 element of IPRTES (NROW)=8, no further processing of data is done.

SP2DT   type: real, dimension: 1, default: Ø

meaning: special value for $2\Delta t$

remarks: 1) If SP2DT≠Ø this value is assumed to be $2\Delta t$ otherwise $2\Delta t$ is used from the value read in COMHKP.

2) For spectral model 2 t is assumed to be 1 for diagnostic fields with code nos. 10,40,41,70,71,81 independently of SP2DT or TWODT.

IPRICO   type: integer, dimension: 1, default: Ø

meaning: print code for processed data, i.e. data already scaled and ready to plot.
format: iijj, ii : code, jj: first jj rows

The data are stored in the following form:

k = 1. mean over land

k = 2. mean over sea

k = 3. mean over land and sea

k = 4. variance over land

k = 5. variance over sea

k = 6. variance over land and sea

where k is the array number.

If you want a print of the first jj latitudes of array k plus the n cyclic following arrays, the code no. has to be calculated by the following formula:

IPRICO = (n * 6 + k) * 1ØØ + jj

Example: print the first 20 latitudes of variance over sea, variance over land and sea, and mean over land : jj = 2Ø, k = 5, n = 2 = IPRICO = (2 * 6 + 5) 1ØØ + 20 = 172Ø

no print: jj = Ø, IPRICO = 0

all latitudes: jj = 99, all fields, all latitudes: IPRICO = 3199

MIMAF type: integer, dimension: 1, default: 4

meaning: code for following calculations to be done:

1) calculate minimum and maximum of a diagnostic field
2) divide values into 10 classes
3) integrate over levels
4) integrate over levels and latitudes to get global mean
5) do calculations 1) to 4) for means (and variances)

value: MIMAF =

0 calculation of global means only
1 calculate minimum and maximum and global mean
2 as 1 but division into 10 classes too
3 integrate over levels and calculate global mean
4 as 3 but calculate minimum and maximum too
5 as 4 but division into 10 classes too.

1-5: for means only
6-10: for means and variances, i.e. 8 has the same effect as 3 but calculation done for means and variances
11-20: same as 1-10 but no calculation of global means
21: no further calculation at all.

remarks: 1) If MIMAF=0,1,2,6,7,11,12,16,17 or 21 no plotting of level integrated values possible as not available. It conflicts with IDAYP(I)=3,4,7 or 8. A warning messsage is issued.

2) If minimum and maximum is not calculated, plot label contains: MAXIMUM=NOT AVAIL. and MINIMUM=NOT AVAIL.

LV type: logical, dimension: 23 for MAXDIA=19,
56 for MAXDIA=48
(MAXDIA described under ISUB)

default: for MAXDIA=19: LV(8,17)=.true., all other elements=.false.
for MAXDIA=48: LV(8,17,22,27,30)=.true., all other elements=.false.

meaning: position of diagnostic variable in staggered grid

index: number of diagnostic field (see Appendix 2)

value: LV(I)=.true. : diagnostic variable I on v-point in st. grid
LV(I)=.false.: diagnostic variable I on u-point in st. grid

remarks:

1. indices 20,21,22,23 with MAXDIA=19 or indices 49,...,56 with MAXDIA=48 are used for combined fields as follows: 20 (or 49) for combination no.1 according to ISPAD(1,I), or general: 19+J (48+J for MAXDIA=48) for combination number J according to ISPAD(J,I), where J is 1,...,4 for MAXDIA=19 and J=1,...,8 for MAXDIA=48 (see description for ISPAD)
   example: adding up diagnostic field 8 and 17 (both v-points) with ISPAD(1,8)=1 and ISPAD(1,17)=1, set LV(20) (or LV(49) for MAXDIA=48)=.true.
2. LV is used only for calculation of global means, i.e. only if MIMAF<10.
3. If combination of fields is requested which are at different locations in staggered grid, error message is issued and further combinations are suppressed.

CINTAG, CINTCG, CINTAE, CINTCE

type: real, dimension: 23 if MAXDIA=19,
56 if MAXDIA=48
(MAXDIA described under ISUB)

default: see Appendix 2

meaning: contour intervals for plotting latitude/level cross sections

CINTAG	for mean over land, sea, land and sea if	GFDL-physics	is used
CINTAE	" " " " " " " " "	ECMWF "	" "
CINTCG	" variance " " " " " "	GFDL "	" "
CINTCE	" " " " " " " "	ECMWF "	" "

index: diagnostic field number (see Appendix 2)

value: contour interval

remarks:

1. If the value is = 0 the most convenient interval is chosen by system and plot label contains: INTERVAL=SYST VALUE.

2. If too many contour lines are to be drawn, a warning message is issued, the interval is multiplied by 10, and a second try is made to plot. If it succeeds this time plot label contains INTERVAL=ZINT*, where ZINT is the new interval and "*" indicates the second try to plot. If it fails again the message "TOO MANY CONTOUR LINES" is printed within the plot without any contours.

3. Indices 20,21,22,23 (if MAXDIA=19) or 49,...56 (if MAXDIA=48) are used for combined fields ISPAD (see remark 1 under LV-description).

4. For the latitude/level cross sections of the adiabatic diagnostics the contour intervals for land and for sea only are by the factor 10 bigger than the ensemble of land and sea.

<u>SCAMIN, SCAMAX, SCEMIN, SCEMAX</u>

type: real, dimension: 23 for MAXDIA=19,
56 for MAXDIA=48
(MAXDIA described under ISUB)

default: see Appendix 2

meaning: plot scale for integrals over latitudes and levels, respectively

index: diagnostic field number (see Appendix 2)

value:

SCAMIN: left scale boundary for plotting integrals over latitude
SCAMAX: right " " " " " " "
SCEMIN: lower " " " " " " "
SCEMAX: upper " " " " " " "

remarks:

1. If SCAMIN=SCAMAX or SCEMIN=SCEMAX, the most convenient scale is calculated.

2. Indices 20,21,22,23 (if MAXDIA=19) of 49,...,56 (if MAXIDA=48) are used for combined fields (see remark 1 under LV-description)

3. The zero-line is additionally drawn slightly thicker if range contains zero.

4. Values out of range are plotted as "*" at the corresponding edge.

LLSPLI: type: logical, dimension: 1, default: FALSE

meaning: 1) Contour lines in latitude/level cross sections are smoothed by parametric cubic functions if TRUE.

2) Spline interpolation between the points in level integrated plots if TRUE, linear interpolation if FALSE.

3. MATHEMATICAL BACKGROUND

Four subroutines are involved in mathematical calculation:

PLDICR : calculation of longitudinal time-means and variances,

GLMEAN : integration of these means over latitudes and levels,

MIMACL : integration of these means over levels,

ARLASE : calculation of area of land and sea.

3.1 Longitude and time integration (calculated in forecast model itself and in PLDICR)

Considering a meteorological parameter f $(\lambda,t,\sigma,\theta)$ such as temperature, wind or humidity a longitudinal integral over λ is defined as

$$\bar{f}^{\lambda}(t,\sigma,\theta) = \frac{1}{2\pi}\int_{0}^{2\pi} f(\lambda,t,\sigma,\theta)d\lambda \qquad (1)$$

which results in the following numerical expression as NLON*$\Delta\lambda$ = 2 π (NLON is the number of longitude points at each latitude and $\Delta\lambda$ the constant grid mesh distance in longitudinal direction)

$$\bar{f}(t,\sigma,\theta) = \frac{1}{NLON}\sum_{i=1}^{NLON} f(\lambda_i,t,\sigma,\theta)\Delta\lambda_i \qquad (2)$$

where $\Delta\lambda$ cancels.

In the model the sum (i.e. zonal mean) is calculated separately for land and sea points.

If NLAND(θ) is the number of longitudinal land points at a particular latitude θ and NSEA(θ) the number of sea points at θ

$$\bar{f}^{\lambda land}(t,\sigma,\theta) = \frac{1}{NLAND} \sum_{i=1}^{NLAND} f(\lambda_{i,land},t,\sigma,\theta) \qquad (3)$$

and

$$\bar{f}^{\lambda sea}(t,\sigma,\theta) = \frac{1}{NSEA} \sum_{i=1}^{NSEA} f(\lambda_i,sea,t,\sigma,\theta) \qquad (4)$$

Equation 2, the zonal mean over land and sea, can be written as a combination of the two sums in (3) and (4):

$$\bar{f}^{\lambda}(t,\sigma,\theta) = \frac{1}{NLON} \left[\bar{f}^{\lambda land}(t,\sigma,\theta)*NLAND + \bar{f}^{\lambda sea}(t,\sigma,\theta)*NSEA\right] \qquad (5)$$

The time integration over t of these zonal means is defined as

$$\bar{\bar{f}}^{\lambda t}(\sigma,\theta) = \frac{1}{T_2-T_1} \int_{T_1}^{T_2} \bar{f}^{\lambda}(t,\sigma,\theta)\, dt \qquad (6)$$

which results in

$$\bar{\bar{f}}^{\lambda t}(\sigma,\theta) = \frac{1}{NCALL*2\Delta t} \sum_{i=1}^{NCALL} \bar{f}(t_j,\sigma,\theta)*2\Delta t; \qquad (7)$$

where NCALL is the number of calls to MEAN-subroutines in the forecast model within the time interval T_2-T_1, i.e. the number of adding up zonal means as time goes on.

Δt; the model-timestep is constant and cancels.

The diagnostic data produced with operational output package or research post-processing package are of the following form (the right hand side is summed up in the forecast model itself):

$$\sum_{j=1}^{NCALL} \sum_{i=1}^{NLAND(\theta)} f(\lambda_{iland},t_j,\sigma,\theta) = NCALL*NLAND(\theta)*\bar{\bar{f}}^{\lambda t\, land}(\sigma,\theta) \qquad (8)$$

and

$$\sum^{NCALL} \sum^{NSEA(\theta)} f(\lambda_{isea}, t_j, \sigma, \theta) = NCALL*NSEA(\theta)*\bar{\bar{f}}^{\lambda}{}^{t}_{sea}(\sigma,\theta) \quad (9)$$

for land- and sea-points respectively.

The units of $\bar{\bar{f}}^{\lambda t}(\sigma,\theta)$ are K, $msec^{-1}$, $g\ kg^{-1}$ for temperature, wind and humidity, respectively per model time step $2\Delta t$.

In subroutine PLDICR of the diagnostic package the read diagnostic data (left hand side of (8) and (9)) are divided by NCALL*NLAND (or NSEA(θ)) and multiplied by 86400/2Δt to obtain the required means in units per day.

3.2. Integration over levels

(calculated in MIMACL)

With the time integrated zonal means $\bar{\bar{f}}^{t}{}^{\lambda land}(\sigma,\theta)$ and $\bar{\bar{f}}^{t}{}^{\lambda sea}(\sigma,\theta)$ simply called $m_{land}(\sigma,\theta)$ and $m_{sea}(\sigma,\theta)$, respectively, the integration over σ-levels is a straightforward multiple by $\Delta\sigma_i$:

$$\bar{m}^{\sigma}_{land/sea}(\theta) = \int_1^0 m_{land/sea}(\sigma,\theta)\, d\sigma \quad (10)$$

or in finite difference form

$$\bar{m}^{\sigma}_{land/sea}(\theta) = \sum^{NLEV} m_{land/sea}(\sigma_i,\theta)\Delta\sigma_i \quad (11)$$

where NLEV is the number of levels in the model and

$$\Delta\sigma_i = \sigma_{i+\frac{1}{2}} - \sigma_{i-\frac{1}{2}} \quad (12)$$

and σ_i and $\sigma_{i\pm\frac{1}{2}}$ are the main and intermediate σ-levels in the forecast model, respectively.

3.3 Global average (integrated over longitudes and latitudes in GLMEAN AND ARLASE)

The global average of the time integrated function $\bar{\bar{f}}^t(\lambda,\sigma,\theta)$ is defined as

$$g(\sigma)= \bar{\bar{f}}^{t\,\bar{\bar{\lambda}}\,\bar{\theta}}(\sigma) = \frac{1}{\int_{-\pi/2}^{\pi/2}\int_{0}^{2\pi} a^2\cos\theta d\lambda d\theta} \int_{-\pi/2}^{\pi/2}\int_{0}^{2\pi} \bar{\bar{f}}^t(\lambda,\sigma,\theta)a^2\cos\theta d\lambda d\theta \qquad (13)$$

where a^2 the square of the earth radius cancels.

Now we have to distinguish four cases: land and sea whether the diagnostic variable is calculated at a u-point (u,T,q) or a v-point (v) in the model's staggered grid.

Considering the u-land points only equation (13) reads in finite difference form:

$$g(\sigma) = \frac{\sum_{i=1}^{MAXROW}\sum_{j=1}^{NLAND} \bar{\bar{f}}^t(\theta_i,\lambda_{jland},\sigma)\Delta\lambda_{jland}\cos_u(\theta_i)\Delta\theta_i}{\sum_{i=1}^{MAXROW}\sum_{j=1}^{NLAND} \Delta\lambda_{jland}\cos_u(\theta_i)\Delta\theta_i} \qquad (14)$$

where MAXROW is the number of latitudes in the forecast model. The index u indicates that the cosin is calculated at a u-latitude point. The denominator can be considered as an area of land without certain factors.

Since

$$\sum_{j=1}^{NLAND} \Delta\lambda_{jland} = NLAND(\theta)*\ \Delta\lambda \qquad (15)$$

equation (14) can be written with (3) and cancelling $\Delta\lambda$ and $\Delta\theta$:

$$g(\sigma) = \frac{\sum_{i=1}^{MAXROW} NLAND(\theta_i)\bar{\bar{f}}^{t\,\bar{\bar{\lambda}}land}(\theta_i,\sigma)\ \cos_u(\theta_i)}{\sum_{i=1}^{MAXROW} NLAND(\theta_i)\cos_u\ (\theta_i)} \qquad (16)$$

The sums are reduced as the following quantities are zero:

$$NLAND(1) = 0 \qquad \cos_u(1) = 0$$
$$NSEA(MAXROW) = 0 \qquad \cos_u(MAXROW) = 0 \qquad (17)$$

Therefore the four cases of the denominator read as:

"area of land at v-point" $= ARVL = \sum_{IROW=2}^{MAXROW} \cos_v(IROW) * NLAND(IROW)$ (18)

"area of sea at v-point" $= ARVS = \frac{1}{2} \cos_v(2) * NSEA(1) + \sum_{IROW=2}^{MAXROW-1} \cos_v(IROW) * NSEA(IROW)$ (19)

"area of land at u-point" $= ARUL = \frac{1}{2} \cos_v(MAXROW) * NLAND(MAXROW) + \sum_{IROW=2}^{MAXROW-1} \cos_u(IROW) * NLAND(IROW)$ (20)

"area of sea at u-point" $= ARUS = \frac{1}{2} \cos_v(2) * NSEA(1(+ \sum_{IROW=2}^{MAXROW-1} \cos_u(IROW) * NSEA(IROW)$ (21)

The area calculation is done in subroutine ARLASE called only once in the package. In the N48 grid point model the numerical values are:

ARUL = 3783.0 ARUS = 7952.4

ARVL = 3777.1 ARVS = 7959.2

and the combination of both:

global area at v-point = ARVLS = ARVL + ARVS
global area at u-point = ARULS = ARUL + ARUS (22)

ARULS = 11736.26988, ARVLS = 11736.26999

The analytical value of the global area ($4 a^2$) (land and sea) is with a = 6.371E6 m : 5.10064E14 m^2 compared with the numerical result of 5.10156E14 m^2 at u- or v-point).

Similar to equations (18) to (21) the numerator has to be split in four cases. With $f^{\lambda t}(\sigma,\theta) = m(\sigma,\theta)$ as in Section 3.2 equation (16) can be written as

$$g_{v,land}(\sigma) = \frac{1}{ARVL}\{ \sum_{i=2}^{MAXROW} m_{land}(\sigma,\theta_{v,i}) * \cos_v(\theta_i) * NLAND(\theta_i)\} \quad (23)$$

$$g_{u,land}(\sigma) = \frac{1}{ARUL}\{\tfrac{1}{2}\, m_{land}(\ ,MAXROW)*\cos_v(MAXROW)*NLAND(MAXROW) + \sum_{i=2}^{MAXROW-1} m_{land}(\sigma,\theta_{u,i})*\cos_u(\theta_i)*NLAND(\theta_i)\} \tag{24}$$

$$g_{v,sea}(\sigma) = \frac{1}{ARVS}\ \{\tfrac{1}{2}\, m_{sea}(\sigma,1)*\cos_v(2)*\ NSEA(1) + \sum_{i=2}^{MAXROW-1} m_{sea}(\sigma,\theta_{v,i})*\cos_v(\theta_i)*NSEA(\theta_i)\} \tag{25}$$

$$g_{u,sea}(\sigma) = \frac{1}{ARUS}\ *\ \{\tfrac{1}{2}\, m_{sea}(\sigma,1)*\cos_v(2)*\ NSEA(1) + \sum_{i=2}^{MAXROW-1} m_{sea}(\sigma,\theta_{u,i})*\cos_u(\theta_i)*NSEA(\theta_i)\ \} \tag{26}$$

The indices u and v indicate that the diagnostic variable or the cosine is taken at a u- or v-point, respectively. The global mean over land and sea, i.e. over the total area, can be calculated either with equation (27) or (30):

$$g_u(\ ) = \frac{NLON}{ARULS}\ \{\ \tfrac{1}{2}\left[\ \cos_v(2)*\ m(\sigma,1)+\cos_v(MAXROW)*\ m(\sigma,MAXROW)\right] + \sum_{i=2}^{MAXROW-1} m(\sigma,\theta_{ui})*\cos_u(\theta_i) \tag{27}$$

where $NLON=NLAND(\theta_i) + NSEA(\theta_i)$ (28)

for $i = 1$, MAXROW is the number of longitudes and

$$m(\sigma,\theta_i) = m_{land}(\sigma,\theta_i) + m_{sea}(\sigma,\theta_i) \tag{29}$$

The alternative calculation can be made with the already calculated $g(\theta)$:

$$g_u(\sigma) = \frac{ARUL\ *\ g_{u,land}(\sigma)\ +\ ARUS\ *\ g_{u,sea}(\sigma)}{ARULS} \tag{30}$$

For a v-point equation (27) and (30) read as:

$$g_v(\sigma) = \frac{NLON}{ARVLS} \{\tfrac{1}{2}[m(\sigma,1)* \cos_v(2) + \sum_{i=2}^{MAXROW-1} m(\sigma,\theta_{v,i})\cos_v(\theta_i)\} \tag{31}$$

$$g_v(\sigma) = \frac{ARVL * g_{v,land}(\sigma) + ARVS * g_{v,sea}(\sigma)}{ARVLS} \tag{32}$$

The results of equations (27) and (30) at a u-point and equations (31) and (32) normally agree within 4 to 6 figures. However, if the quantities are small and change sign very often the accuracy is far less.

To calculate the overall global mean $g(\sigma)$ has to be integrated over all σ-levels, which can be done as described in equation (11).

$$GM_{land/sea} = \sum_{\ell=1}^{NLEV} g_{land/sea}(\sigma)\Delta\sigma_\ell \tag{33}$$

GM finally is a pure number derived from integration over longitudes, latitudes, time and levels.

3.4 Square quantities

The variance σ^2 is defined as

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^{N} (f_i - \mu)^2 \tag{34}$$

where

$$\mu = \frac{1}{N} \sum_{i=1}^{N} f_i \tag{35}$$

is the mean of f.

From (33) follows

$$\sigma^2 = \frac{1}{N} [\sum_{i=1}^{N} f_i^2 - 2 \sum_{i=1}^{N} f_i \frac{1}{N} \sum_{i=1}^{N} f_i + N \frac{1}{N^2} (\sum_{i=1}^{N} f_i)^2] =$$

$$f_i^2 - \frac{1}{N^2}(\sum_{i=1}^{N} f_i)^2 \tag{36}$$

We are interested in variances at each level and latitude showing the deviation from time and longitudinal means. Therefore

$$\sigma^2 = \sigma^2(\theta,\sigma) \quad ; \quad f_i = f_i(\lambda,t,\sigma,\theta)$$

$$N = NCALL * NLAND(\theta) \quad \text{or} \quad N = NCALL * NSEA(\theta) \tag{37}$$

where NCALL is the number of time addings and NLAND(θ) or NSEA(θ) the number of land and sea points, respectively. The dimension of σ^2 is (Parameter change in $2\Delta t)^2$, where "parameter" stands for T,u,v or q. To achieve units per day σ^2 has to be multiplied by a scaling factor δ^2 where

$$\delta^2 = \left(\frac{86400}{2\Delta t}\right)^2 \tag{38}$$

With equations (35), (36) and (37) the variance can be written as

$$\sigma^2_{land}(\theta,\sigma) = S^2 \quad \frac{1}{NCALL * NLAND(\theta)} \sum_{i=1}^{NLAND} \sum_{j=1}^{NCALL} f^2(\lambda_{iland}, t_j, \sigma, \theta)$$

$$- \frac{1}{NCALL^2 * NLAND^2(\theta)} \left[\sum_{i=1}^{NLAND} \sum_{j=1}^{NCALL} f(\lambda_{iland}, t_j, \sigma, \theta) \right]^2 \tag{39}$$

Substituting index "land" by "sea" and "NLAND" by "NSEA" in equation (38) the variance over sea is defined. The double sums of f and f^2 are calculated in the forecast model and written out to the diagnostic file. The variance over land <u>and</u> sea is defined in the next equation:

$$\sigma^2(\theta,\sigma) = \delta^2 \frac{1}{NCALL*NLON} \left[\sum_{i=1}^{NLAND} \sum_{j=1}^{NCALL} f^2(\lambda_{iland}, t_j, \sigma, \theta) + \right.$$

$$\sum_{i=1}^{NSEA} \sum_{j=1}^{NCALL} f^2(\lambda_{isea}, t_j, \sigma, \theta) -$$

$$\frac{1}{NCALL^2 * NLON^2} \left[\sum_{i=1}^{NLAND} \sum_{j=1}^{NCALL} f(\lambda_{iland}, t_j, \sigma, \phi) + \right.$$

$$\left. \sum_{i=1}^{NSEA} \sum_{j=1}^{NCALL} f\ (\lambda_{isea}, t_j, \sigma, \theta) \right]^2 \tag{40}$$

3.5 Accuracy depending on frequency of diagnostic calculation

Several sensitivity tests were carried out adding up physics tendencies every model timestep, every 3, 6, 12, and 24 timesteps in a N48/15 level grid point model forecast (i.e. every 1/4, 3/4, 1 1/2, 3 and every 6 hours.

The five different sets of data obtained were compared after a 10 day forecast period.

In the case of temperature change due to radiation (which is newly calculated only every 12 hours and therefore should be independent on diagnostic frequency $<$ 12 hours) the differences showed the inaccuracy due to the packing procedure (4 words in one).

Apart from these numerical inaccuracies it turned out that the diagnosis of physical processes with high time fluctuations is very frequency dependent. These processes are for instance the change of temperature and humidity due to vertical diffusion in PBL.

Physical parameterizations like KUO-convection of horizontal diffusion are more stable in time and therefore a 10 day diagnostic mean shows little difference if it is calculated by adding up tendencies every 15 minutes or every 3 hours taking into account the unavoidable difference due to the packing method. Because of numerical reasons differences are big when extreme values or only few values (i.e. few land or sea-points) are added up.

In general these tests are useful to determine how often a physical parameterization subroutine has to be called in a forecast to minimize the computation time without changing the results drastically. The following hierarchy of physical processes can be assumed:

not very time dependent	temperature change due to radiation
↓	dissipation of horizontal diffusion
↓	KUO convection
↓	PBL dissipation and vertical diffusion
↓	humidity adjustment (QNEGAT)
↓	large scale condensation
highly time dependent	temperature and humidity change due to vertical diffusion (VDIFF)

APPENDIX 1

CONTENTS OF DIAGNOSTIC FIELDS

k	Word 1	Word 2	Word 3	Word 4
0	sum over land (MEAN) sum of positive/ negative quantities over land (MEAN)	sum over sea (MEAN) sum of positive /negative quantities over sea (MEANPN)	square sums over land (MEAN) square sums of positive/negative quantities over land (MEANPN)	square sums over sea (MEAN) square sums of positive/negative quantities over sea (MEANPN)
1	dissipation over land (MEAN)	dissipation over sea (MEAN)	-	-
2	-	-	dissipation over land	dissipation over sea (MEAN)
3	-	-	sum over land (MEAN)	sum over sea (MEAN)
4	sum over land (MEAN)	sum over sea (MEAN)	maximum over longitudes & time (MEAN)	minimum over longitudes and time (MEAN)
5	sum over land (MEAN) sum of positive quantities over land (MEANPN)	sum over sea (MEAN) sum of positive quantities over sea (MEANPN)	sum of negative quantities over land (MEANPN)	sum of negative quantities over sea (MEANPN)
6	top of clouds over land (MEANLEV)	top of clouds over sea (MEANLEV)	bottom of clouds over land (MEANLEV)	bottom of clouds over sea (MEANLEV)

Contents of diagnostic fields depending on code number k.

MEAN-subroutine involved in brackets.

APPENDIX 2

SUMMARY OF DIAGNOSTICS CALCULATED IN THE GLOBAL GRID POINT AND SPECTRAL MODEL

(S indicates used in Spectral model only)
(G indicates used in Gridpoint model only)

No.	Code No.	Subroutine diagnosed	Text (field processed)	Mean sub-routine involved	Contour interval*	Scale for integrated plots**
1	100	DTRAD	DT RADIA	MEAN	.5/5.	-1.5/0.
					(.5/1.)	-1.5/1.5
2	200	COND	DT CDC	MEANPN	.5/10.	0./1.
					(.5/50.)	0./1.2
3	(300)	(COND)	DT CDE	MEANPN	.5/5.	-1./0.
					(.5/10.)	-0.8/0.
	400	PB2GFD,HFLUX GFPBMQ,DADADJ	DT PB DA	MEAN	.5/500.	-0.2/0.8
4	410	VDIFF	DT VDIFF	MEAN	.5/100.	0.5/3.5
	420 G	DADADJ	DT DADAD	MEAN	.5/500.	
	(if NLKUO AND NOT NLPHEC)					
	430 S		DT PB			
5	500	MADADJ	DT MADAD	MEAN	.5/100.	0./3.
	510	KUO	DT KUOC	MEANPN	.5/10.	0./1.5
6	(610)	(KUO)	(DT KUO E)	(MEANPN)	.5/1.	-0.25/0.
	620 S		DT DADAD		.5/100.	-0.6/0.
7	700	GFPBMQ	DU GFPBM	MEAN	5./500	-2.5/2.5
	710	VDIFF	DU VDIFF	MEAN	5./500.	-2./2.
8	800	GFPBMQ	DV GFPBM	MEAN	5./750.	-2.5/2.5
	810	VDIFF	DV VDIFF	MEAN	5./750.	-8./2.
9	900	GFPBMQ	DQ GFPBM	MEAN	2.E-3/5.E-5	0./1.E-3
	910	VDIFF	DQ VDIFF	MEAN	2.E-4/5.E-4	-.25E-3/1.75 E-3
10	1000	MADADJ	DQ MADAD	MEAN	2.E-3/5.E-3	-1.E-3/0.
	1010	KUO	DQ KUO	MEAN	2.E-4/5.E-4	-1.E-3/.2 E-3
11	1101	GFPBMQ	DI GFPB	MEAN	50./5.	-100./0.
	1111	VDIFF	DI VDIF	MEAN	50./5.	-300./0.
	1122	D2ZD4	DI D2ZD4	MEAN	50./5.	
	1132	DEL4	DIS DEL4	MEAN	50./5	
	1142	HDIFF	DI HDIFF	MEAN	50./5.	

* 1st part/2nd part of diagnostic field (in brackets: GFDL physics if different)

** plot scale for integrals over latitudes and levels, respectively.
SCAMIN/SCAMAX

APPENDIX 2 (Continued)

No.	Code No.	Subroutine diagnosed	Text (field processed)	Mean sub-routine involved	Contour interval*	Scale for integrated plots**
12	1206/1216	MADADJ	MADA	MEANLEV	.2/15.	0./50.
	1226/1236	KUO	KUO	MEANLEV	.2/15.	0./30.
13	1300	D2ZD4	DT D2ZD4	MEAN	.5/1.	-5./.5
	1310	DEL4	DT DEL4	MEAN	.5/1.	
	1320	HDIFF	DT HDIFF	MEAN	.5/1.	-.05/.05
14	1400	QNEGAT	DQ QNEGA	MEAN	5.E-5/1.E-6	.5E-7/1.5E-7
						-.2E-4/.1E-4
15	1500	D2ZD4	DQ D2ZD4	MEAN	1.E-4/1.E-6	-.2E-3/.3E-3
	1510	DEL4	DQ DEL4	MEAN	1.E-4/1.E-6	-.4E-4/.2E-4
	1520	HDIFF	DQ HDIFF	MEAN	1.E-4/1.E-6	
16	1600	COND	DQ COND	MEAN	2.E-4/1.E-6	-2.5E-4/0.
						-2E-4/2.E-4
17	1700	D2ZD4	DV D2ZD4	MEAN	1./10	-.2/.2
	1710	DEL4	DV DEL4	MEAN	1./10	
	1720	HDIFF	DV HDIFF	MEAN	1./10	-.03/.07
18	1800	D2ZD4	DU D2ZD4	MEAN	1./20.	-.4/.4
	1810	DEL4	DU DEL4	MEAN	1./20.	
	1820	HDIFF	DU HDIFF	MEAN	1./20	-.6E-2/.6E-2
19	1906/1916	DADADJ	DADA	MEANLEV	.5/10.	

* 1st part/2nd part of diagnostic field (in brackets: GFDL physics if different)

** plot scale for integrals over latitudes and levels, respectively. SCAMIN/SCAMAX

APPENDIX 2 (Continued)

No.	Code No.	Subroutine diagnosed	Text (field processed)	Mean sub-routine involved	Contour interval*
20	2005 G	DYN	VALUE T	DYMEAN	5./-
21	2105 G	DYN	VALUE U	DYMEAN	2./-
22	2205 G	DYN	VALUE V	DYMEAN	2./-
23	2305 G	DYN	VALUE Q	DYMEAN	.001/-
24	2405 G	DYN	DU AVORV	DYMEAN	.2./-
25	2505 G	DYN	DU RVORV	DYMEAN	2./-
26	2605 G	DYN	DU RVORV	DYMEAN	1./-
27	2705 G	DYN	DU COR*V	DYMEAN	2./-
28	2805 G	DYN	DU VORPS	DYMEAN	2./-
29	2905 G	DYN	DU VEADV	DYMEAN	.5/-
30	3005 G	DYN	DU TENDC	DYMEAN	1.,/-
31	3105 G	DYN	OU TENDC	DYMEAN	.5/-
32	3205 G	DYN	DU OPSE	DYMEAN	2./-
33	3305 G	DYN	DV VEADV	DYMEAN	.5/-
34	3405 G	DYN	DV TENDC	DYMEAN	1.,/-
35	3505 G	DYN	DT HOADV	DYMEAN	.5/-
36	3605 G	DYN	DT VEADV	DYMEAN	1./-
37	3705 G	DYN	DT ECONV	DYMEAN	1./-
38	3805 G	DYN	DT TENDC	DYMEAN	.5/-
39	3905 G	DYN	DQ HOADV	DYMEAN	.001/-
40	4000 G	DYN	DQ VEADV	DYMEAN	.0001/-
41	4100 G	DYN	DQ TENDC	DYMEAN	.0001/-

*1st part/2nd part of diagnostic field (in brackets: GFDL physics if different)

APPENDIX 3

Short Description and Flow Diagrams of all programs and subroutines of the package

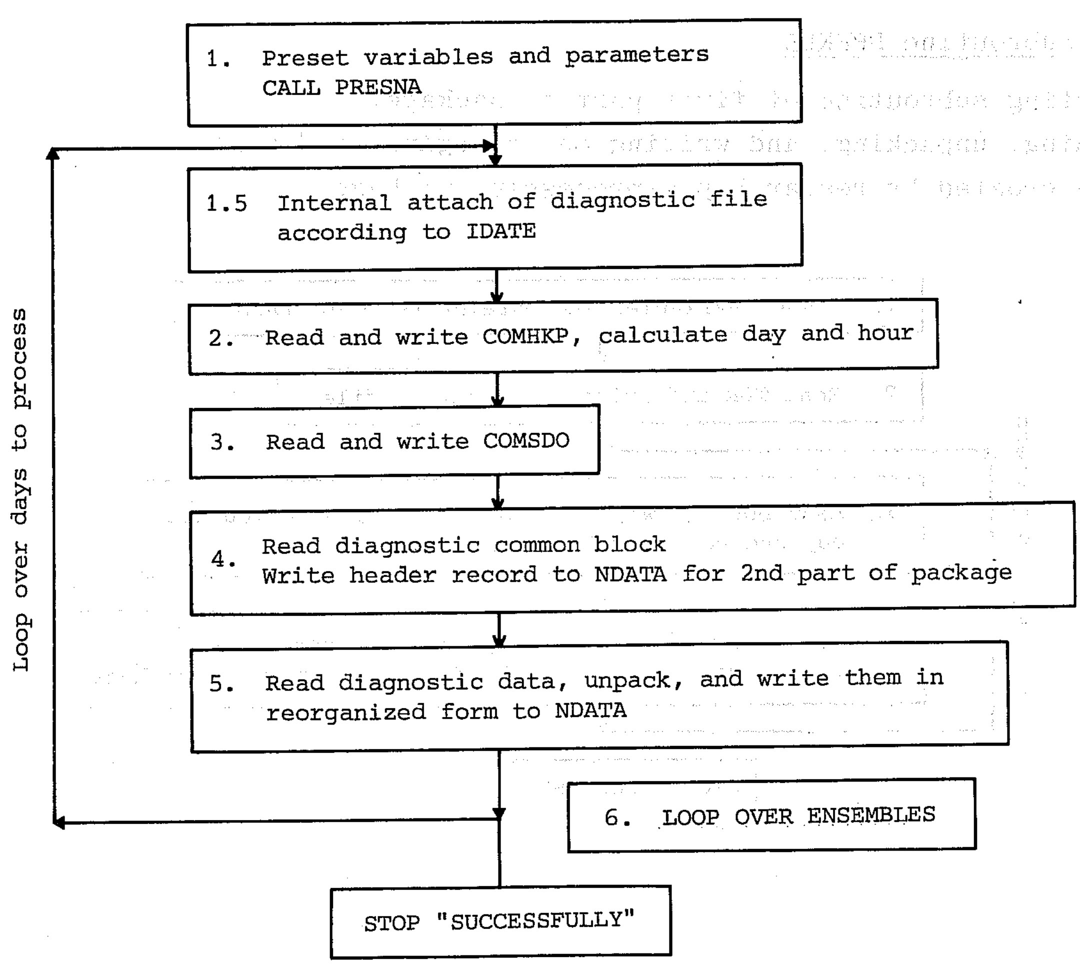
1. Main program MAIN 1

Starting first part of the package, calling PREJAN if diagnostic data is produced by operational output package, calling PREKLA if they are produced by research model output package.

2. Subroutine PREJAN

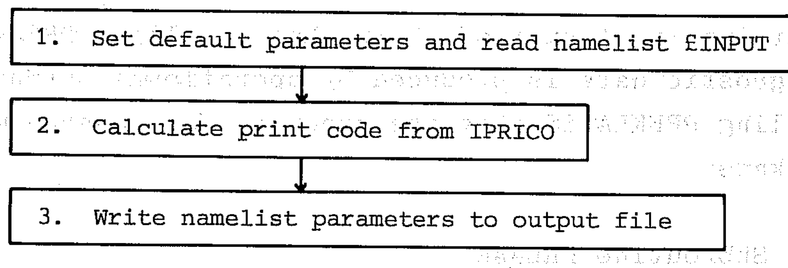
Starting subroutine of first part of package.

Reading, unpacking, writing out reorganized diagnostic data created by operational output package.



3. Subroutine PRESNA

Set default namelist parameters,
overwrite part of them by reading in namelist £INPUT,
and write all parameters to output file.

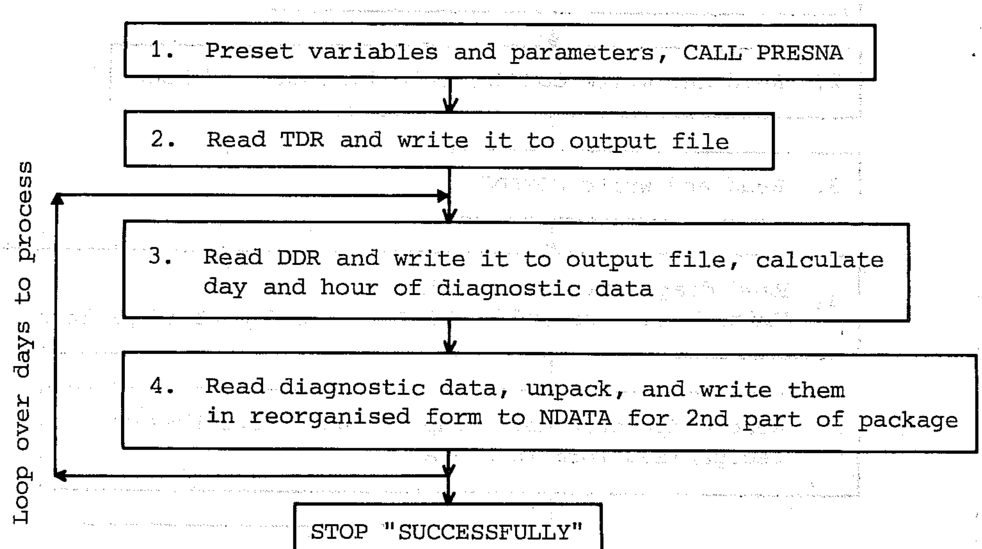


4. Subroutine DECODER

Decode real number from 3 15-bit-integers
(similar to DECODER in ECMODEL)

5. Subroutine PREKLA

Starting subroutine of first part of package.
Reading, unpacking, and writing out reorganized diagnostic data created by research postprocessing package

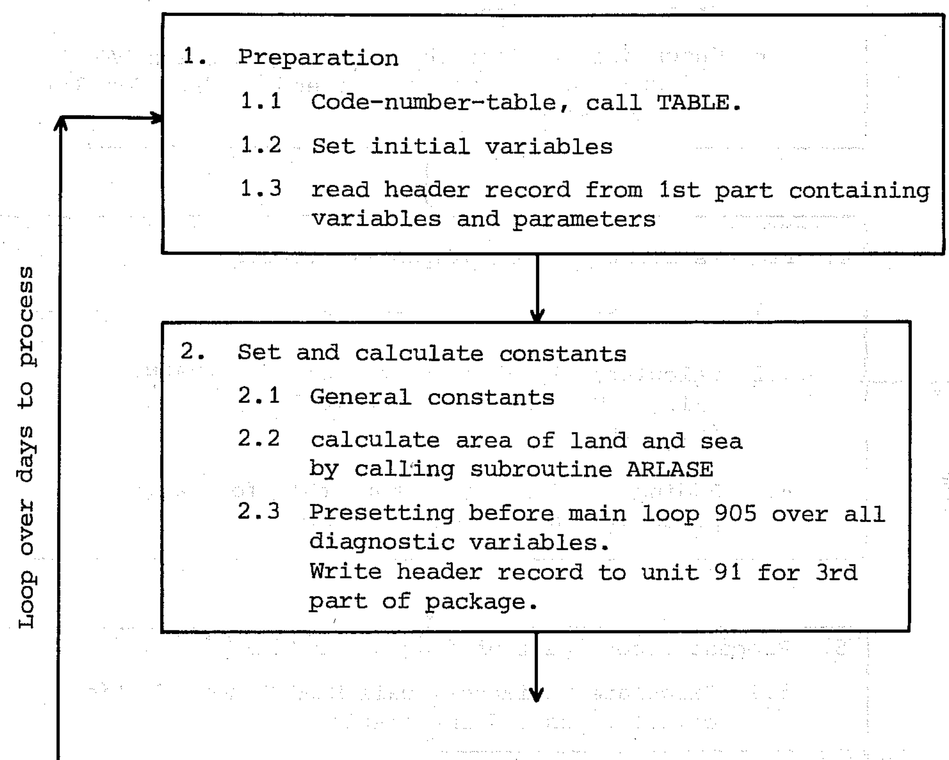


6. Main program MAIN2

Main program starting second part of package, calling PLDICR.

7. Subroutine PLDICR

Starting subroutine of second part of package.
Reading, checking and scaling diagnostic data written in reorganised form by first part.
Calculation of means and variances and plotting latitude/ level-cross-sections.



Loop over all days to process

to 1.3

Loop over all diagnostic fields

3. Loop 905 starting over all diagnostic fields

   3.1 Presetting inside loop

   3.2 Read diagnostic data written by 1st part of package

   3.25 Subtract data of previous day if diagnostic wanted from day i to j with i ≠ 0.

   3.3 Decode code-numbers

   3.4 Test print of raw data

   3.5 Check code-numbers by calling subroutine CODCHE write header line to output file

   3.6 Check data if less than limit by calling DATCHE and write header record proceeding data for 3rd part of package.

4. Process first part of diagnostic fields

   4.1 Calculate means over land, sea, and land and sea

from 7.2

   4.2 Calculate global means by calling GLMEAN, calling MIMACL (several calculations and integrations

   4.3 Adding up fields and store them for later processing according to ISPAD

5. Process second part of diagnostic fields

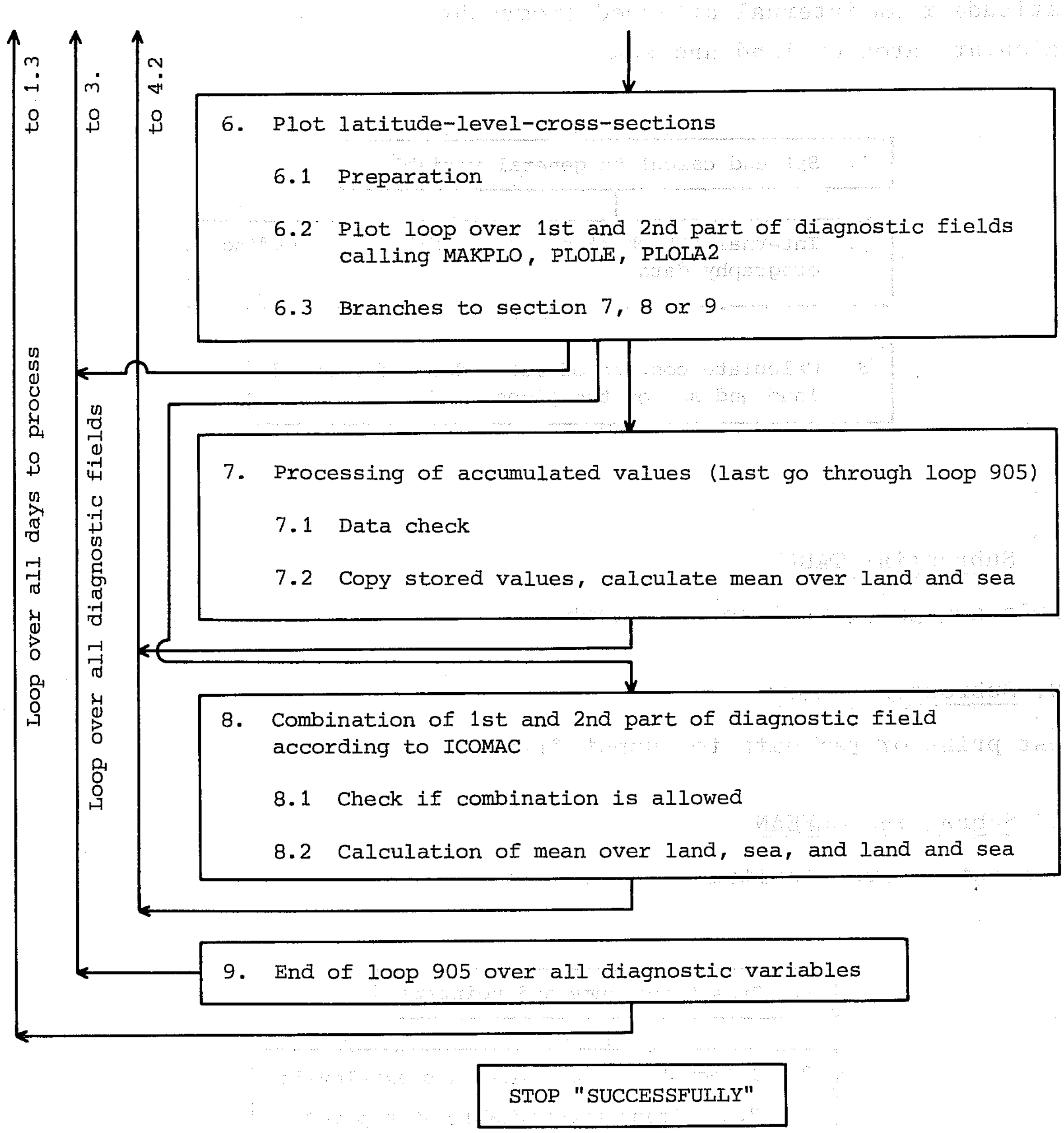
   5.1 Calculate variances, call MIMACL for additional calculations and integrations

   5.2 Top and bottom of clouds and dissipation

   5.3 Minimum and maximum in 2nd part of diagnostic field

   5.4 Call MIMACL for additional calculations and integrations

to 6.1



6. Plot latitude-level-cross-sections
6.1 Preparation
6.2 Plot loop over 1st and 2nd part of diagnostic fields calling MAKPLO, PLOLE, PLOLA2
6.3 Branches to section 7, 8 or 9
7. Processing of accumulated values (last go through loop 905)
7.1 Data check
7.2 Copy stored values, calculate mean over land and sea
8. Combination of 1st and 2nd part of diagnostic field according to ICOMAC
8.1 Check if combination is allowed
8.2 Calculation of mean over land, sea, and land and sea
9. End of loop 905 over all diagnostic variables
STOP "SUCCESSFULLY"
to 1.3
to 3.
to 4.2
Loop over all days to process
Loop over all diagnostic fields

8. Subroutine ARLASE

Reading number of land and sea points for each latitude from internal attached orography file and calculate area of land and sea.

1. Set and calculate general variables
2. Internal attach of orography file, and reading orography data
3. Calculate cosines of latitudes and area of land and sea on the globe

9. Subroutine TABLE

Table assigning text to code-numbers.

10. Subroutine PRTES

Test print of raw data to output file.

11. Subroutine GLMEAN

Integration over latitudes and levels

1. Presetting sums and pointers
2. Integration over latitudes and levels
   - 2.1 Diagnostic variable at u-point
   - 2.2 Diagnostic variable at v-point
   - 2.3 Calculation of global means
3. Write integrated values to output file

12. Subroutine MIMACL

Additional calculations for one diagnostic word, i.e. latitude-level-matrix.
Calculation of minimum and maximum.
Division into 10 classes, integration over levels and writing integrals to unit 91 for 3rd part of package (several branches inside routine depending on MIMAF)

1. General pointers and constants, writing to output file

↓

2. Integration over levels, writing integrals to unit 91 for 3rd part of package

↓

3. Calculation of minimum and maximum

↓

4. Division into 10 classes

↓

5. Determination of factor and multiply for integer print to output file

↓

6. Format-statements

13. Subroutine CODCHE

Check code-numbers if in permitted range and calculate scaling factors

1. First part of diagnostic field
   1.1 Check code numbers
   1.2 Calculate scaling factor

2. Second part of diagnostic field
   2.1 Check code numbers
   2.2 Calculate scaling factor

14. Subroutine DATCHE

Check data if greater than certain limit.

Set data to 0 if less than limit, caused by unpacking procedure.

1. Check data of first part of diagnostic field

2. Check data of second part of diagnostic field

3. Set data to zero if less than limit

15. Subroutine MAKPLO

Plot label and contours of latitude-level-cross-sections.

1. Pointers and constants

2. Plot label and contours

3. Formats for warning messages

16. Subroutine PLOLE

Plot contours of global mean along levels

1. Draw box and grid

2. Draw label and numbers

3. Scale array and plot it

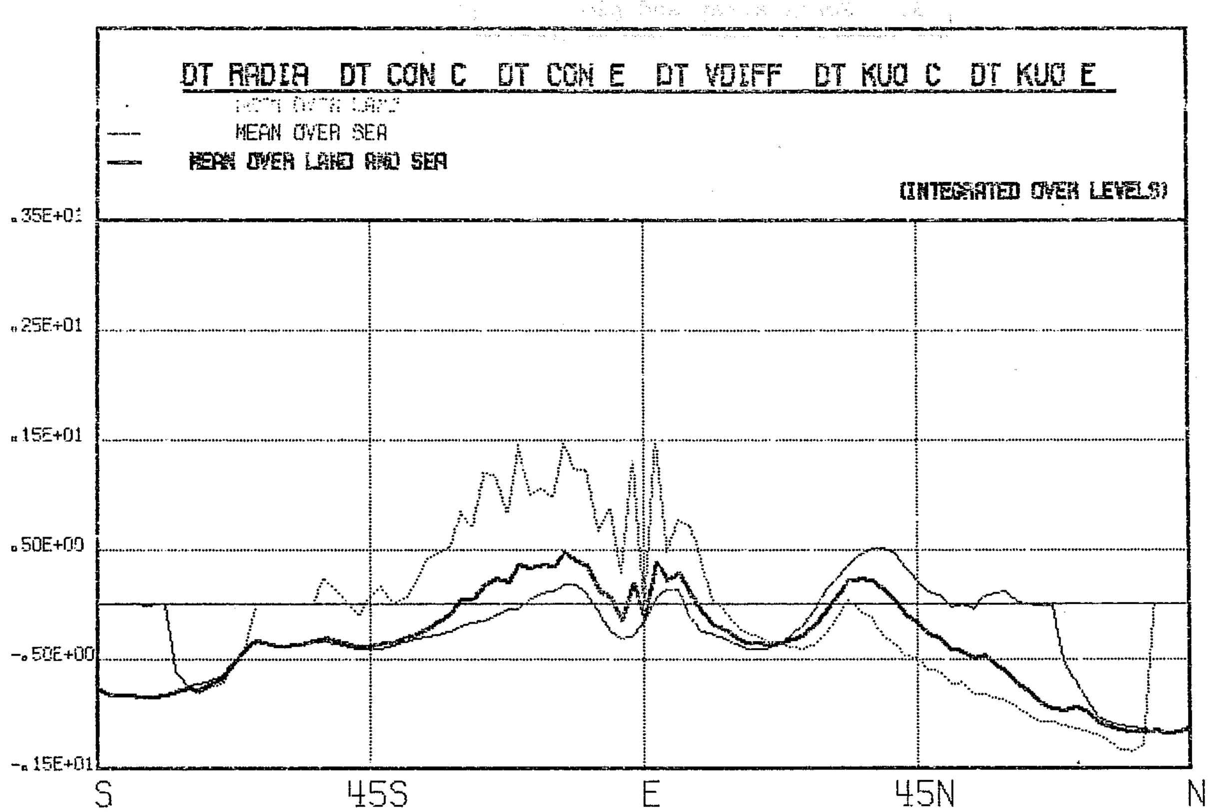
17. Subroutine PLOLE 2

Plot contours of vertical mean along latitudes

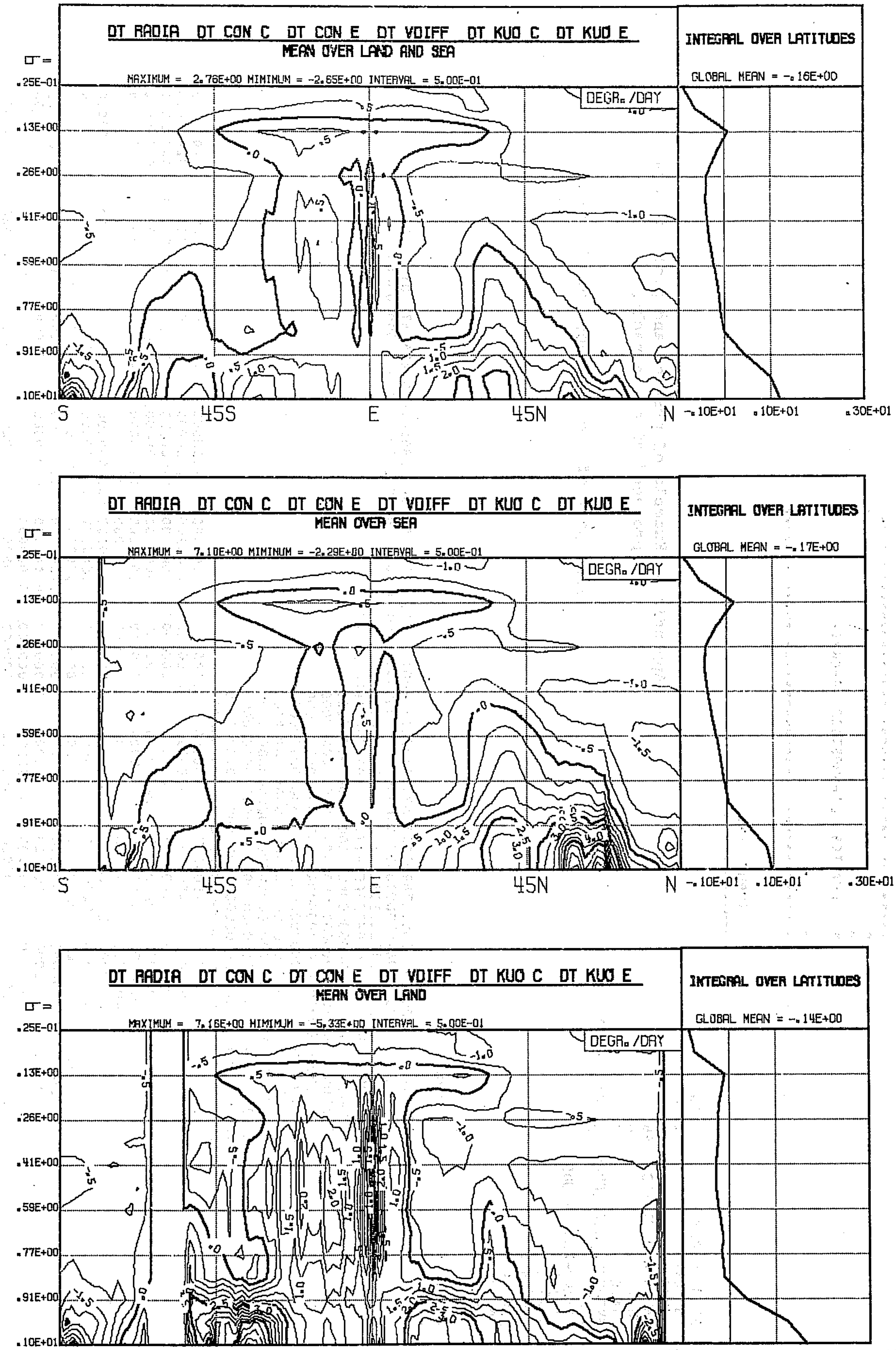
1. Contour package plots: box and labels

2. Subtext and numbers

3. Scale array and plot it



Plot of vertically intergrated diagnostics



Plot of height-latitude cross-sections of diagnostics for mean over land, sea and over land and sea

```
*******************************************
*                                         *
*   PHYSICS  DIAGNOSTICS  PACKAGE         *
*                                         *
*******************************************
```

1. INPUT DATA

Appendix 4 Example of printed and plotted output produced with the package

First part of the print-out of the package

```
FROM FC.DAY            0.00
TO FC.DAY             10.00
NTYPE                  4
MAX.DIAGN.FIELDS      48
NOUT      =            0
IDATE     =            0
ENSEMBLE MEAN FROM   1/ 2/81 TO 28/ 2/81
LINTAT    =            T
ATTACH-FAILE-CODE     -1
JPRIN1    =            0
JPRIN2    =            0
JPRIN3    =            0
JPRIN4    =            0
JPRIN5    =            0
JPRIN6    =            0
NIMAF     =            4
SPRDT     =               0.000
LLSPLT    =            F
                      12345678901234567890123456789012345678901234567890123456789012345678901234567890
IPRTES    =           00000000000000000000000000000000000000000000000000000000000000000000000000000000
ISUB      =           111111111111111111111111111111111111111110000000
LV        =           FFFFFFFTFFFFFFFTFFFFFFFFFFFFFFTTTFFFFFFFFFFFFFFFFFFFTFF
ISPAD     =           011000000000000000000000000000000000000000000000
                      000011000000000000000000000000000000000000000000
                      111110000000000000000000000000000000000000000000
                      000000001100000100000000000000000000000000000000
                      000000010000000001000000000000010000000000000000
                      000000010000000010000000000000000100000000000000
                      111110000001000000000000000000000010000000000000
                      000000001100011100000000000000000000010000000000
ICOMAC    =           000000000100000000000000000000000000000000000000
CIMTAG    =            .500000    .500000    .500000    .500000    .500000    .500000   5.000000   5.000000    .002000    .002000
                     50.000000   2.000000    .500000    .000050    .000100    .000200   1.000000   1.000000    .500000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000    .500000    .500000
                       .500000    .000500   0.000000   0.000000   0.000000   0.000000
CIMTCG    =           1.000000  50.000000  10.000000 500.000000 100.000000 100.000000 500.000000 750.000000    .000050    .005000
                      5.000000   5.000000   1.000000    .000001    .000001    .000001  10.000000  20.000000  10.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
                      0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
CIMTAF    =            .500000    .500000    .500000    .500000    .500000    .500000   5.000000   5.000000    .000200    .000200
                     50.000000   2.000000    .500000    .000050    .000100    .000200   1.000000   1.000000    .500000   1.000000
```

```
SCAMIN =       -1.500000    0.000000   -1.000000    -.200000    0.000000    -.250000   -2.500000   -2.500000    0.000000    -.001000
             -100.000000    0.000000    -.500000    -.000000    -.000200    -.000250    -.200000    -.400000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000    0.000000    0.000000
               -1.500000    -.001000  999.000000  999.000000  999.000000  999.000000
SCAMAX =        0.000000    1.000000    0.000000     .800000    3.000000    0.000000    2.500000    2.500000     .001000    0.000000
                0.000000   50.000000     .500000     .000000     .000300    0.000000     .200000     .400000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000    1.000000    2.500000
                3.500000     .000500  999.000000  999.000000  999.000000  999.000000
SCFMIN =       -1.500000    0.000000    -.800000    -.500000    0.000000    -.600000   -2.000000   -6.000000    -.000250    -.001000
             -300.000000    0.000000    -.050000    -.000020    -.000040    -.000200    -.030000    -.006000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000    -.500000   -1.000000
               -1.000000    -.000500  999.000000  999.000000  999.000000  999.000000
SCFMAX =        1.500000    1.200000    0.000000    3.500000    1.500000    0.000000    2.000000    2.000000     .001750     .000200
                0.000000   30.000000     .050000     .000010     .000020     .000200     .070000     .300000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000
              999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000  999.000000     .500000    1.000000
                3.000000     .001000  999.000000  999.000000  999.000000  999.000000

FILE CALLED FDI3610201240                              ID=OU240,SN=DSET12,MR=1.
                 ATTACHED ON UNIT NO. 1

                                      2. PRINT COMHKP
                                      ---------------

     925       24       34      1471        4   810202    34402       13       97      900   810211       48   810201       48
 9.0000000000000E+01 0.                       -9.0000000000000E+01-1.8750000000000E+00 1.8750000000000E+00
     194       88       25       725        0
OPERATIONAL GRID POINT MODEL - THIRD EDITION  - INTRODUCED 15/01/80                 J6 DYNAMICS - SEMI-IMPL.
                                       EC PHYSICS
EC RADIATION
                                       THIS RUN IS BASED ON DATA FOR 12 HRS  1/ 2/1981
     31        2
 0.                    2.5062963000000E-02 5.0488888900000E-02 7.6600000000000E-02 1.0367407410000E-01
 1.3194444440000E-01 1.6160000000000E-01 1.9278518520000E-01 2.2560000000000E-01 2.6010000000000E-01
 2.9629629630000E-01 3.3413555560000E-01 3.7360000000000E-01 4.1450740740000E-01 4.5671111110000E-01
 5.0000000000000E-01 5.4411851850000E-01 5.8876666670000E-01 6.3360000000000E-01 6.7822962960000E-01
 7.2222222220000E-01 7.6510000000000E-01 8.0634074070000E-01 8.4537777760000E-01 8.8160000000000E-01
 9.1435185190000E-01 9.4293333330000E-01 9.6660000000000E-01 9.8456296300000E-01 9.9598888890000E-01
 1.0000000000000E+00
FORECAST DAY  10.00 FOUND IN DIAGNOSTIC DATA. FORECAST FROM  1/ 2/81.

                                      3. PRINT COMSDO
                                      ---------------

     34        34        425
      T         T          T          F          T          T          T          T          F          T
      F         T          F          F          F          F          F          F          T          F
     43 1.000E+03 5.000E-02 1.000E+00 1.000E+00 3.000E+02 2.592E+06 7.500E-07 1.500E-01 5.000E-02
      2
```

First part of the print-out of the package

```
                              4. PRINT CODE-NO. .GT. 0
                              ------------------------
PRELIMINARY VALUES      415      415     -1471        40        48

NO.  1 ICOD1 =  100 TEXT 1 = DT RADIA IDIP1 =  20 ICOD2 =  100 TEXT 2 = DT RADIA IDIP2 =  20
NO.  2 ICOD1 =  200 TEXT 1 = DT CON C IDIP1 =  80 ICOD2 =  200 TEXT 2 = DT CON C IDIP2 =  80
NO.  3 ICOD1 =  300 TEXT 1 = DT CON E IDIP1 =  80 ICOD2 =  300 TEXT 2 = DT CON E IDIP2 =  80
NO.  4 ICOD1 =  410 TEXT 1 = DT VDIFF IDIP1 = 160 ICOD2 =  410 TEXT 2 = DT VDIFF IDIP2 = 160
NO.  5 ICOD1 =  510 TEXT 1 = DT KUO C IDIP1 =  40 ICOD2 =  510 TEXT 2 = DT KUO C IDIP2 =  40
NO.  6 ICOD1 =  610 TEXT 1 = DT KUO E IDIP1 =  40 ICOD2 =  610 TEXT 2 = DT KUO E IDIP2 =  40
NO.  7 ICOD1 =  710 TEXT 1 = DU VDIFF IDIP1 =  40 ICOD2 =  710 TEXT 2 = DU VDIFF IDIP2 =  40
NO.  8 ICOD1 =  810 TEXT 1 = DV VDIFF IDIP1 =  40 ICOD2 =  810 TEXT 2 = DV VDIFF IDIP2 =  40
NO.  9 ICOD1 =  910 TEXT 1 = DQ VDIFF IDIP1 = 160 ICOD2 =  910 TEXT 2 = DQ VDIFF IDIP2 = 160
NO. 10 ICOD1 = 1010 TEXT 1 = DQ KUO   IDIP1 =  40 ICOD2 = 1010 TEXT 2 = DQ KUO   IDIP2 =  40
NO. 11 ICOD1 = 1111 TEXT 1 = DIS VDIF IDIP1 =  40 ICOD2 = 1132 TEXT 2 = DIS DEL4 IDIP2 =  40
NO. 12 ICOD1 = 1226 TEXT 1 = TJP KUO  IDIP1 =  40 ICOD2 = 1226 TEXT 2 = BGT KUO  IDIP2 =  40
NO. 13 ICOD1 = 1310 TEXT 1 = DT DEL4  IDIP1 =  40 ICOD2 = 1310 TEXT 2 = DT DEL4  IDIP2 =  40
NO. 14 ICOD1 = 1400 TEXT 1 = DQ QNEGA IDIP1 =  80 ICOD2 = 1400 TEXT 2 = DQ QNEGA IDIP2 =  80
NO. 15 ICOD1 = 1510 TEXT 1 = DQ DEL4  IDIP1 =  40 ICOD2 = 1510 TEXT 2 = DQ DEL4  IDIP2 =  40
NO. 16 ICOD1 = 1600 TEXT 1 = DQ COND  IDIP1 =  80 ICOD2 = 1600 TEXT 2 = DQ COND  IDIP2 =  80
NO. 17 ICOD1 = 1710 TEXT 1 = DV DEL4  IDIP1 =  40 ICOD2 = 1710 TEXT 2 = DV DEL4  IDIP2 =  40
NO. 18 ICOD1 = 1810 TEXT 1 = DU DEL4  IDIP1 =  40 ICOD2 = 1810 TEXT 2 = DU DEL4  IDIP2 =  40
NO. 20 ICOD1 = 2005 TEXT 1 = VALUE T  IDIP1 =  80 ICOD2 = 2005 TEXT 2 = VALUE T  IDIP2 =  80
NO. 21 ICOD1 = 2105 TEXT 1 = VALUE U  IDIP1 =  80 ICOD2 = 2105 TEXT 2 = VALUE U  IDIP2 =  80
NO. 22 ICOD1 = 2205 TEXT 1 = VALUE V  IDIP1 =  80 ICOD2 = 2205 TEXT 2 = VALUE V  IDIP2 =  80
NO. 23 ICOD1 = 2305 TEXT 1 = VALUE Q  IDIP1 =  80 ICOD2 = 2305 TEXT 2 = VALUE Q  IDIP2 =  80
NO. 24 ICOD1 = 2405 TEXT 1 = DU AVORV IDIP1 =  80 ICOD2 = 2405 TEXT 2 = DU AVORV IDIP2 =  80
NO. 25 ICOD1 = 2505 TEXT 1 = DU RVORV IDIP1 =  80 ICOD2 = 2505 TEXT 2 = DU RVORV IDIP2 =  80
NO. 26 ICOD1 = 2605 TEXT 1 = DU RVORV IDIP1 =  80 ICOD2 = 2605 TEXT 2 = DU RVORV IDIP2 =  80
NO. 27 ICOD1 = 2705 TEXT 1 = DU COR*V IDIP1 =  80 ICOD2 = 2705 TEXT 2 = DU COR*V IDIP2 =  80
NO. 28 ICOD1 = 2805 TEXT 1 = DU VORPS IDIP1 =  80 ICOD2 = 2805 TEXT 2 = DU VORPS IDIP2 =  80
NO. 29 ICOD1 = 2905 TEXT 1 = DU VEADV IDIP1 =  80 ICOD2 = 2905 TEXT 2 = DU VEADV IDIP2 =  80
NO. 30 ICOD1 = 3005 TEXT 1 = DU TENDC IDIP1 =  80 ICOD2 = 3005 TEXT 2 = DU TENDC IDIP2 =  80
NO. 31 ICOD1 = 3105 TEXT 1 = DU TENDC IDIP1 =  30 ICOD2 = 3105 TEXT 2 = DU TENDC IDIP2 =  80
NO. 32 ICOD1 = 3205 TEXT 1 = DV VOPSE IDIP1 =  80 ICOD2 = 3205 TEXT 2 = DV VOPSE IDIP2 =  80
NO. 33 ICOD1 = 3305 TEXT 1 = DV VEADV IDIP1 =  80 ICOD2 = 3305 TEXT 2 = DV VEADV IDIP2 =  80
NO. 34 ICOD1 = 3405 TEXT 1 = DV TENDC IDIP1 =  80 ICOD2 = 3405 TEXT 2 = DV TENDC IDIP2 =  80
NO. 35 ICOD1 = 3505 TEXT 1 = DT HOADV IDIP1 =  80 ICOD2 = 3505 TEXT 2 = DT HOADV IDIP2 =  80
NO. 36 ICOD1 = 3605 TEXT 1 = DT VEADV IDIP1 =  80 ICOD2 = 3605 TEXT 2 = DT VEADV IDIP2 =  80
NO. 37 ICOD1 = 3705 TEXT 1 = DT ECONV IDIP1 =  80 ICOD2 = 3705 TEXT 2 = DT ECONV IDIP2 =  80
NO. 38 ICOD1 = 3805 TEXT 1 = DT TENDC IDIP1 =  80 ICOD2 = 3805 TEXT 2 = DT TENDC IDIP2 =  80
NO. 39 ICOD1 = 3905 TEXT 1 = DQ HOADV IDIP1 =  80 ICOD2 = 3905 TEXT 2 = DQ HOADV IDIP2 =  80
NO. 40 ICOD1 = 4005 TEXT 1 = DQ VEADV IDIP1 =  60 ICOD2 = 4005 TEXT 2 = DQ VEADV IDIP2 =  80
NO. 41 ICOD1 = 4105 TEXT 1 = DQ TENDC IDIP1 =  80 ICOD2 = 4105 TEXT 2 = DQ TENDC IDIP2 =  80
```

First part of the print-out of the package

```
NO.: 1  DT RADIA   DT RADIA   DT RADIA   DT RADIA   DT RADIA   DT RADIA   ENS.MEAN OVER 28 FC. 01/02/81-28/02/81 FC DAY  0.00- 10.00 O
                                                                                                                            PERATIONAL
DIAGNOSTIC CALLED    20 TIMES (2ND PART   20 TIMES). AVERAGE OVER  28 CASES.
SCALING FACTOR RMULT1 =  .2400E+01  RMULT2 (2ND PART) =  .1152E+03  V-POINT ? F CODE-NOS.   100   100

  DT RADIA

GLOBAL MEANS INTEGRATED OVER SIGMA AND LATITUDES.
      LAND               SEA               LAND AND SEA     LAND AND SEA(OTHER INTEGRATION METHOD)
   -8.0088729067E-01   -7.5520786509E-01   -7.9830750118E-01   -7.9830750118E-01


 DT RADIA         MEAN OVER LAND

GLOBAL MEANS INTEGRATED OVER LATITUDES (LEVEL DEPENDENT)
-8.47784E-01 -5.07602E-01 -1.68098E-01 -3.75650E-01 -6.97645E-01 -9.35617E-01 -1.16341E+00 -1.35428E+00 -1.38649E+00 -1.20761E+00
-9.91717E-01 -8.68186E-01 -7.27722E-01 -4.37318E-01 -3.82714E-01

MINIMUM=   -2.0291983913E+00 MAXIMUM=    4.8624615463E-01

 DT RADIA         MEAN OVER SEA

GLOBAL MEANS INTEGRATED OVER LATITUDES (LEVEL DEPENDENT)
-8.98693E-01 -3.82230E-01  1.28409E-01 -2.47876E-01 -7.29644E-01 -9.53789E-01 -1.08823E+00 -1.16202E+00 -1.10741E+00 -8.98544E-01
-7.51444E-01 -8.30342E-01 -6.23788E-01 -3.85778E-01 -4.50609E-01

MINIMUM=   -2.2519127317E+00 MAXIMUM=    5.6330538359E-01

 DT RADIA      MEAN OVER LAND AND SEA

GLOBAL MEANS INTEGRATED OVER LATITUDES (LEVEL DEPENDENT)
-8.82279E-01 -4.22685E-01  3.28123E-02 -2.89071E-01 -7.19327E-01 -9.47930E-01 -1.11247E+00 -1.22400E+00 -1.19739E+00 -9.98189E-01
-8.28911E-01 -8.22215E-01 -6.60685E-01 -4.02395E-01 -4.28719E-01

GLOBAL MEANS INTEGRATED OVER LATITUDES (LEVEL DEPENDENT)  (OTHER INTEGRATION METHOD)
-8.82279E-01 -4.22685E-01  3.28123E-02 -2.89071E-01 -7.19327E-01 -9.47930E-01 -1.11247E+00 -1.22400E+00 -1.19739E+00 -9.98189E-01
-8.28911E-01 -8.22215E-01 -6.60685E-01 -4.02395E-01 -4.28719E-01

MINIMUM=   -2.2519127317E+00 MAXIMUM=    5.2813651797E-01
```

Second part of the print-out of the package