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BNL-27801

INFORMAL REPORT

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MASTER

USER'S GUIDE TO THE HEFFTER INTERACTIVE-TERMINAL TRANSPORT MODEL
(ARL-HITTM)

Carmen M. Benkovitz and Jerome L. Heffter

APRIL 1980

DEPARTMENT OF ENERGY AND ENVIRONMENT

BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

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USER'S GUIDE TO THE
HEFFTER INTERACTIVE-TERMINAL TRANSPORT MODEL
(ARL-HITTM)

Carmen M. Benkovitz and Jerome L. Heffter¹

¹Air Resource Laboratories
National and Oceanic and Atmospheric Administration
Silver Spring, MD 20910

April 1980

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ATMOSPHERIC SCIENCES DIVISION
DEPARTMENT OF ENERGY AND ENVIRONMENT
BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

Under Contract No. DE-AC02-76CH00016 with the
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USER AID

Questions on running HITTM should be addressed to:

Carmen Benkovitz
Associated Universities, Inc.
Brookhaven National Laboratory
Building 51
Upton, NY 11973

FTS: 666-4135
Commercial: (516) 345-4135

Questions on model structure and suggested changes should be addressed to:

Nick Heffter
NOAA - Air Resources Laboratories
8060 13th Street
Silver Spring, MD 20910

FTS: 427-7609
Commercial: (301) 427-7609

INTRODUCTION

The transport section of the Air Resources Laboratories (ARL) Atmospheric Transport and Dispersion Model (ATAD, Heffter, 1980) has been revised and simplified for use on interactive computer terminals. The resulting model, called the Heffter Interactive-Terminal Transport Model (ARL-HITTM) calculates four trajectories per day from one origin, forward or backward in time, using observed rawinsonde and pibal data for North America as input to the model. Trajectories, of three days duration, are based on observed winds averaged in a transport layer above terrain either chosen by the user or determined by the model.

Standard and optional output includes:

1. Complete list of input parameters of completed run (standard).
2. Plots of observed vertical temperature and wind profiles (optional).
3. A table of model calculated transport layer depths along each trajectory (standard).
4. A table of vertical wind shears along each trajectory (standard).
5. A table of latitude and longitudes of trajectory positions at 6-hour intervals (standard).
6. Plots of trajectories on a latitude-longitude grid (optional).

METEOROLOGICAL DATA

The rawinsonde data needed by the model as input is kept on a library of magnetic tapes. To be accessible to the model running interactively, the portion of these data needed for trajectory calculations must be extracted from the tapes and copied to the on-line disks. The first user/computer interaction determines what data sets are needed on-line and will make these available for use.

Data is partitioned into two data sets per month. Part 1 contains the data needed to calculate trajectories starting the first to the fifteenth of the month, Part 2 contains the data needed to calculate trajectories starting the fifteenth to the end of the month. At the start of execution, a list of all data sets available on-line is generated. If no sets are currently available on-line, a message will so state. The user is then asked whether any additional data sets will be needed on-line. The starting date for the desired trajectory calculations determines the data set needed. If not currently available on-line, the data sets needed are specified by entering the month (number 1-12 corresponding to January-December), last two digits of year and the part of the month (1 or 2, corresponding to first or second half). The entries are separated by commas. As an example, trajectory calculations are desired starting on April 1, 1977 for 2 days. The required data set is specified as 4,77,1. If the starting date is April 16, 1977, the specification would be 4,77,2. See Examples section of this writeup for further examples.

The requested information generates batch jobs to bring data sets needed on-line. These batch jobs are completely independent of the model running interactively and may have to wait one to several hours for execution. If no

data sets are currently available, on-line the model terminates execution with the message "STOP HTPROC RFT, AU REVOIR." If any data sets are available on-line, model execution will commence. If on-line data sets are not of interest, execution of the model can be terminated by entering ST. (See examples 1 and 2A for further detail.)

MODEL INPUT

User defined data is divided into six data blocks for input to model. The model is initialized with a set of default parameters for all data blocks except two: 1) the trajectory origin and 2) the start date and number of trajectory days to be run. Model execution starts by interrogation of the user for the values of these parameters. Sample dialog is as follows:[†]

```
PLEASE ENTER TRAJECTORY ORIGIN AS
ORIGIN ID(III-LETTERS) LAT(LL.LL) LON(LL.LL) IN WHOLE DEGREES AND HUNDREDTHS
IF 3 LETTER CODE FOR MAP3S PRECIP CHEM NETWORK USED
LATITUDE AND LONGITUDE FIELDS MUST BE LEFT BLANK.
ENTER ??? FOR LIST OF MAP3S STATION IDS.
III,LL.LL,LLL.LL
>TST,40.00,85.00
```

Invoking the ??? option as the origin ID will produce a list of the MAP3S precipitation chemistry network station ID's as follows:

```
MAP3S PRECIPITATION CHEMISTRY STATION IDS;
WHI
ITH
PEN
VIR
ILL
BNL
LEW
OXF
```

Latitude/longitude values for these stations are built into the program.

```
ENTER THE TRAJECTORY START DATE AND NUMBER OF DAYS TO BE RUN AS
MM,DD,YY,NN
>4,1,77,1
```

A data block printout is then generated to display the current set of parameter values.

```
BLOCK
NO.
1      ORIGIN ***** TST(40.00 85.00)
2      START DATE    1 APR 77 FOR    1 DAYS
3      BACK IN TIME  FOR 3 DAYS
```

[†] User input follows prompt character >.

```

4     TRANSPORT LAYER CALCULATED INTERNALLY
5     BOUNDARIES FOR MET STATION INPUT:
      TOP AND BOTTOM LATITUDES ***** 48.    35.
      LEFT AND RIGHT LONGITUDES *****90.    65.
6     NO TEMPERATURE PROFILES PRINTED
PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

```

A number of "commands" are available so that the user can change the current values of the data, print some or all of the data and instruct the program to start computations or stop. Instructions on valid commands for input and their effect can be obtained by entering ?? as follows:

```

> ??
COMMAND HAS THE FORM ABN IN COLS 1,2,3
AB IS A TWO LETTER CODE, N IS AN INTEGER FROM 0 TO 6
ABN
===
??          THIS LISTING
GO          ALL INPUT OK, COMPUTATION TO BE DONE
PRN         PRINT VALUES IN BLOCK N. N=0 TO PRINT ALL BLOCKS.
CHN         CHANGE VALUES IN BLOCK N
ST          STOP ALL CALCULATIONS DONE
PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

```

The user can change the default value of parameters in any data block as desired using the CHn (where n is the block number) command. Each CH command will prompt the user as to the format for changing the values within the data block addressed.

Data block 3 includes the trajectory direction (forward or backwards in time) and the duration of the trajectory calculations. Default value for trajectory direction is backward. Trajectory duration is fixed by the model at 3 days and cannot be changed by the user.

Data block 4 - Model averages winds through a transport layer whose depth is determined by internal model calculations (default) or can be specified by the user.

Data block 5 - Meteorological data within the map area bounded by the rectangle specified here are extracted from the rawinsonde and pibal data sets for use in model calculations. A smaller than necessary area may limit

calculations terminating trajectories prematurely. A larger than necessary area may include unneeded data and waste computation time. Individual requirements and experience will dictate reasonable values to be chosen. Defaults were chosen for the MAP3S precipitation chemistry network area and are 35°N to 48°N, 65°W to 90°W.

Data block 6 - Vertical temperature and wind profiles can be printed during the computation for the trajectory starting on the date and time specified by user. The profiles are those used for computation at a time period X hours after start time (also specified by user). Default - no profiles to be printed.

Current values of any and all parameters can be displayed at any time by using the PRn command. Examples of selected data input, prompts and responses follows:[†]

Example A:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

> CH3

ENTER 1 FOR A FORWARD TRAJECTORY , 2 FOR BACK

>1

Example B:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

> CH5

MAP BOUNDARIES

TOP LAT,BOTTOM LAT,LEFT LON,RIGHT LON

IN REAL DEGREES

> 50., 35., 90., 65.

Example C:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

> CH6

TO PRINT VERTICAL TEMPERATURE AND WIND PROFILES FOR ONE TRAJECTORY ENTER:

TRAJECTORY DATE (DAY OF MONTH)

TRAJECTORY START HOUR

TIME AFTER START OF TRAJECTORY IN HOURS

ENTER 0,0,0 FOR NO PROFILES

> 1,12,2

[†] User inputs follow prompt character >.

Example D:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> PR6

BLOCK

NO.

6 VERTICAL TEMPERATURE PROFILE

PRINTED FOR TRAJECTORY DAY 1 , START HOUR 12 , HOURS AFTER START 2

Example E:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> PR5

BLOCK

NO.

5 BOUNDARIES FOR MET STATION INPUT:

TOP AND BOTTOM LATITUDES ***** 50. 35.

LEFT AND RIGHT LONGITUDES ***** 90. 65.

Example F:

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> PRO

BLOCK

NO.

1 ORIGIN ***** TST(40.00 85.00)

2 START DATE 1 APR 77 FOR 1 DAYS

3 FORW IN TIME FOR 3 DAYS

4 TRANSPORT LAYER CALCULATED INTERNALLY

5 BOUNDARIES FOR MET STATION INPUT:

TOP AND BOTTOM LATITUDES ***** 50. 35.

LEFT AND RIGHT LONGITUDES ***** 90. 65.

6 VERTICAL TEMPERATURE PROFILE

PRINTED FOR TRAJECTORY DAY 1 , START HOUR 12 , HOURS AFTER START 2

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> GO

When the user is satisfied with all parameter values, model execution is initiated by the command GO.

MODEL OUTPUT

Standard and optional output data are listed according to computer printed headings. A description is included for each heading.

INPUT METEOROLOGY

TIME PERIOD TYPE

Standard output includes tabular values of the input meteorological data time period and type (read directly from the meteorological tapes) as a check that proper data are being used in the calculations. (Backward in time runs will list the time periods in reverse chronological order.)

SID= TLH= TLD

Optional profiles of vertical temperatures are printed for the previously indicated trajectory and time period. Profiles are identified by the block-station number (SID) of the contributing radiosonde station. In addition, the computed transport layer height (TLH) in meters above mean sea level (MSL) and the transport layer depth (TLD) in meters (above terrain) are given.

CODE HT XW YW

A wind profile is included with each optional temperature profile. The height (HT) of the X-wind component (XW) and Y-wind component (YW) are given here. A wind hodograph, using tabular coded height values, is also plotted for viewing convenience. The station location is indicated by an asterisk and North is vertical toward the top of the printout.

TRANSPORT LAYER DEPTH
(HUNDREDS OF METERS ABOVE TERRAIN)

An optional table of transport layer depth is given when the layer is determined by the model. The printed values are averages along each trajectory for successive 3-hour intervals. The coded number 99 indicates the trajectory computation terminated due to a lack of sufficient meteorological data. No table is printed when the user designates transport layer values.

VERTICAL WIND SHEAR
(PER SECOND * 100)

Standard output includes the maximum vertical shear in the transport layer for successive 3-hour intervals. The coded number 99 indicates trajectory termination.

LATITUDE AND LONGITUDE POSITIONS (DEGREES * 100)

Standard output includes tabular values along each trajectory given at 6-hour intervals. The coded number 9990 indicates trajectory termination.

TRAJECTORY MAPS

Optional trajectory maps may be printed on a latitude/longitude grid within an area specified by the user. After the trajectory positions table is printed the user is given the option of generating such maps after determining the map boundaries as follows:

DO YOU WANT TO PRINT TRAJECTORY MAPS?(Y OR N)
>Y

ENTER MAP BOUNDARIES
TOP LATITUDE, BOTTOM LATITUDE, LEFT LONGITUDE
>50,35,90

50.00 35.00 90.00
OK?(Y OR N)
>Y

A map of four individual trajectories per day (00,06,12 and 18Z), identified by day, is printed in mercator projection. Trajectory codes precede the printed maps. The right longitude boundary is determined by:

$\text{right longitude} = \text{left longitude} - (\text{top latitude} - \text{bottom latitude}).$

Therefore, user should refer to trajectory positions table and judiciously set his limits for optimum presentation of the data. If the OK? is answered with N, model will rerequest map boundaries until a Y answer is obtained.

After the trajectory maps are printed the user is given the option of regenerating the maps using different values for the map boundaries as follows:

DO YOU WANT TO REDO TRAJECTORY MAPS? (Y OR N)

>Y

ENTER MAP BOUNDARIES

TOP LATITUDE, BOTTOM LATITUDE, LEFT LONGITUDE

>45,35,87

45.00 35.00 87.00

OK? (Y OR N)

>Y

DATA BLOCK PRINTOUT

At the conclusion of the calculations a complete data block printout is generated and the model is ready to accept new data for subsequent execution.

Sample output:

INPUT METEOROLOGY
TIME PERIOD TYPE
FROM 1977 APR 1- 0Z WIND
FROM 1977 APR 1- 0Z TEMP
TO 1977 APR 5- 0Z WIND
TO 1977 APR 5- 0Z TEMP

MAXIMUM NUMBER OF STATIONS 24

TRANSPORT LAYER DEPTH
(HUNDREDS OF METERS ABOVE TERRAIN)

	DURATION (HOURS)																								
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	
START																									
DATE-TIME																									
APR 77																									
1- 0Z	2	4	5	5	7	9	9	10	9	6	6	5	5	5	6	6	13	13	16	10	11	11	11	11	
1- 6Z	2	4	7	8	8	8	7	6	5	5	5	5	99	99	99	99	99	99	99	99	99	99	99	99	
1-12Z	7	8	9	9	8	6	5	5	5	5	7	7	8	12	13	9	10	11	11	14	14	9	9	5	
1-18Z	8	10	9	8	6	5	5	6	6	7	16	15	18	11	13	13	13	13	13	10	9	6	5	6	

VERTICAL WIND SHEAR
(PER SECOND * 100)

	DURATION (HOURS)																								
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	
START																									
DATE-TIME																									
APR 77																									
1- 0Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	1	2	
1- 6Z	0	0	0	0	0	0	0	0	0	0	0	0	99	99	99	99	99	99	99	99	99	99	99	99	
1- 12Z	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	
1-18Z	0	0	0	0	0	0	0	0	0	0	2	2	2	1	0	0	1	1	1	0	1	0	0	0	

LATITUDE AND LONGITUDE OF TRAJECTORY POSITIONS (DEGREES*100)

		DURATION (HOURS)											
		6		12		18		24		30		36	
		42		48		54		60		66		72	
		LAT	LON	LAT	LON	LAT	LON	LAT	LON	LAT	LON	LAT	LON
START													
DATE-TIME													
APR 77													
1- 0Z	4008	9370	4046	8367	4111	8423	4229	8496	4372	8591	4476	8770	
	4475	8938	4327	8933	4238	8669	4132	8435	4041	8379	4069	8465	
1- 6Z	4040	8506	4116	8568	4256	8646	4401	8753	4498	8937	4493	9105	
	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	
1-27Z	4076	8567	4214	8642	4367	8742	4466	8924	4463	9077	4333	8997	
	4196	8788	4996	8675	4923	8732	4061	8863	4146	8996	4243	9074	
1-18Z	4128	8589	4294	8653	4404	8810	4405	8960	4268	8904	4226	8558	
	4129	8240	4025	8056	3990	8044	4021	8143	4114	8280	4234	8459	

DO YOU WANT TO PRINT TRAJECTORY MAPS?(Y OR N)

>N

BLOCK

NO.

```

1  ORIGIN ***** TST(40.00      85.00)
2  START DATE      1 APR 77 FOR      1 DAYS
3  FORW IN TIME FOR 3 DAYS
4  TRANSPORT LAYER CALCULATED INTERNALLY
5  BOUNDARIES FOR MET STATION INPUT:
   TOP AND BOTTOM LATITUDES ***** 50.      35.
   LEFT AND RIGHT LONGITUDES ***** 90.      65.
6  NO TEMPERATURE PROFILES PRINTED
PLEASE ENTER A COMMAND: ?? FOR INSTRUCTIONS
    
```

Refer to Examples section of this writeup for complete output from several model runs.

INSTRUCTIONS FOR USING THE BNL INTERACTIVE SYSTEM

The user must have opened a computer account and have valid INTERCOM name and password. Details are available in "A Guide to the Use of Brookhaven National Laboratory's Central Scientific Computing Facility (CSCF)" which is available from:

Mr. Kurt Fuchel
Applied Mathematic Department
Brookhaven National Laboratory
Upton, New York 11973

To establish interactive contact with the CSCF user terminals must have the following hardware specifications:

Modem: Bell 103A or compatible non-Bell unit (communication designated CDC mode 3).

Half-duplex (NON-ECHO) asynchronous transmission.

MARK or ODD parity.

100 or 300 baud.

Pertinent telephone numbers are as follows:

Commercial (516) 345-XXXX

FTS 666-XXXX

where XXXX:

2635 24 ports, 300 baud

2680 3 ports, 300 baud (express[†])

7894 2 ports, 110 baud

2683 3 ports, 1200 baud

On initial dial-up the user will be greeted by a message as follows:

[†](express) = automatic disconnect after 10 mins of connect time (not usable for HITM calculations)

BROOKHAVEN INTERCOM 4.5
DATE 03/06/80
TIME 14.57.07.

PLEASE LOGIN

User enters:

LOGIN, (user name), (password), (account number) CR[†]

INTERCOM answers with pertinent login information plus news of the day. The following commands are then used to initiate HITTM execution:

```
ETL, 500      CR
ATTACH, PR, HEFFTERPROC, ID=CMB      CR
BEGIN, HTPROC, PR      CR
(model execution)
```

Default CPU time limit on LOGIN is 10 secs. Since this limit is inadequate for any trajectory calculations, the command ETL, 500 raises the limit to 500 CPU secs, the maximum allowed per LOGIN session. Permanent file HEFFTERPROC, ID=CMB is made available to user under the name PR via the ATTACH command. This file contains the computer procedure needed for model execution. The BEGIN command instructs INTERCOM to accept commands from a procedure name HTPROC on the file PR until all commands have been executed. Several extraneous teletype messages are generated by the commands needed to set up HITTM execution; these messages have been clearly marked (ignore) in the examples section of this writeup.

INTERCOM session is terminated by entering:

LOGOUT CR

CR = carriage return

COSTS

On receiving the LOGOUT command INTERCOM prints out the resources used during the interactive session. The following figures resulted from running example 2B) in the Examples section of this writeup:

COMMAND-LOGOUT

```
CPA      73.169 SEC.      73.169 ADJ
SYS TIME                295.975
CONNECT TIME    0 HRS.   22 MIN.
03/11/80  LOGGED OUT AT 16.11.13.
```

<

Cost of the session, in Computer Charge Units (CCU) is calculated by multiplying the system time by 0.006 and adding a charge of 4 CCU's/hour for connect time. Thus the above session cost approximately 3.24 CCU's. CCU to dollar figure is given in the Guide to the CSCF.

As a general guide the following cost figures were obtained from additional runs of HITTM:

1. One day starting April 1, 1977 no temperature profiles printed - 2.1 CCU's.
2. Five days of trajectories, starting July 19, 1978, no temperature profiles printed - 3.5 CCU's.

REFERENCES

- Heffter, Jerome, L., "Air Resources Laboratories Atmospheric Transport and Dispersion Model (ARL-ATAD)," NOAA Technical Memorandum ERL ARL-81 (Feb. 1980). Air Resources Laboratories, 8060 13th St., Silver Spring, Md. 20910.
- "A Guide to the Use of Brookhaven National Laboratory's Central Scientific Computing Facility by Other Members of the Scientific Community," Brookhaven National Laboratory (December 1979).
- "INTERCOM Reference Manual, Models 72, 73, 74, Version 4, 6000 Version 4," Control Data Corporation publication #60307100.

EXAMPLES

1. NO DATA SETS AVAILABLE.

COMMAND- ATTACH,PR,HEFFTERPROC,ID=CMB

PF CYCLE NO. = 003

COMMAND- ETL,500

COMMAND- BEGIN,HTPROC,PR

EXIT

←(ignore)

```
*****
*          AIR RESOURCES LABORATORIES          *
* HEFFTER INTERACTIVE TERMINAL TRANSPORT MODEL *
*          (ARI-HTTTM)                         *
*          ADAPTED TO RUN ON BNL CDC 6600      *
*****
```

MET DATA IS PARTITIONED INTO TWO DATA SETS PER MONTH
 PART 1 CONTAINS DATA FROM THE FIRST TO THE FIFTEENTH OF THE MONTH
 PART 2 CONTAINS DATA FROM THE FIFTEENTH TO THE END OF THE MONTH
 STARTING DATE FOR TRAJECTORY DETERMINES DATA SET NEEDED
 THERE ARE NO DATA SETS THAT ARE IMMEDIATELY AVAILABLE
 ANY DATA SET MUST BE RETRIEVED FROM TAPE
 ENTER THE DATA SETS YOU WISH TO RETRIEVE FROM TAPE
 ENTER ONE DATA SET PER LINE AS MM,YY,PART
 TERMINATE THE LIST BY ENTERING 0,0,0
 IF NO ADDITIONAL DATA SETS ARE REQUIRED,
 ENTER 0,0,0 AS THE FIRST ENTRY.

>

PF CYCLE NO. = 004

1,78,2

←(ignore)

> 1,78,1

> 0,0,0

THE DATA SET FOR JAN 78 PART 1
 DOES NOT EXIST IN OUR DATA BANK.
 JOBS REQUESTING YOUR FILES FROM TAPE HAVE
 BEEN ENTERED INTO THE COMPUTER
 THESE FILES SHOULD BE READY IN ABOUT ONE HOUR
 STOP HTPROC RFT, AU REVOIR
 .092 CP SECONDS EXECUTION TIME

←(job to load
 Jan 1978 part 2)

COMMAND-

2.DATA SETS AVAILABLE.

A) DATA SET NOT DESIRED FOR THIS RUN.

COMMAND-ATTACH,PR,HEFFTERPROC,ID=CMB

PF CYCLE NO. = 003

COMMAND- ETL,500

COMMAND- BEGIN,HTPROC,PR

EXIT

PF CYCLE NO. = 005

←(ignore)

←(ignore)

```
*****
*           AIR RESOURCES LABORATORIES           *
* HEFFTER INTERACTIVE TERMINAL TRANSPORT MODEL *
*           (ARL-HITTM)                           *
*           ADAPTED TO RUN ON BNL CDC 6600         *
*****
```

MET DATA IS PARTITIONED INTO TWO DATA SETS PER MONTH
PART 1 CONTAINS DATA FROM THE FIRST TO THE FIFTEENTH OF THE MONTH
PART 2 CONTAINS DATA FROM THE FIFTEENTH TO THE END OF THE MONTH
STARTING DATE FOR TRAJECTORY DETERMINES DATA SET NEEDED
THE FOLLOWING DATA SETS ARE IMMEDIATELY AVAILABLE:

APR, 1977 PART 1

ENTER THE DATA SETS YOU WISH TO RETRIEVE FROM TAPE

ENTER ONE DATA SET PER LINE AS MM,YY,PART

TERMINATE THE LIST BY ENTERING 0,0,0

IF NO ADDITIONAL DATA SETS ARE REQUIRED,

ENTER 0,0,0 AS THE FIRST ENTRY.

> 1,78,2

> 0,0,0

JOBS REQUESTING YOUR FILES FROM TAPE HAVE

BEEN ENTERED INTO THE COMPUTER

THESE FILES SHOULD BE READY IN ABOUT ONE HOUR

PLEASE ENTER TRAJECTORY ORIGIN AS

ORIGIN ID(III-LETTERS) LAT(LL.LL) LON(LLL.LL) IN WHOLE DEGREES AND HUNDREDTHS

IF 3 LETTER CODE FOR MAP3S PRECIP CHEM NETWORK USED

LATITUDE AND LONGITUDE FIELDS MUST BE LEFT BLANK.

ENTER ??? FOR LIST OF MAP3S STATION IDS.

III,LL.LL,LLL.LL

>ST

←(data set on line not
of interest to user)

STOP AS PER YOUR COMMAND

.115 CP SECONDS EXECUTION TIME

COMMAND-

B) DESIRED DATA SET IS AVAILABLE.

COMMAND-ATTACH,PR,HEFFTERPROC,ID=CMB

PF CYCLE NO. = 003
COMMAND- ETL,500

COMMAND- BEGIN,HTPROC,PR

EXIT
PF CYCLE NO. = 005

← (ignore)
← (ignore)

```
*****  
*           AIR RESOURCES LABORATORIES           *  
* HEFFTER INTERACTIVE TERMINAL TRANSPORT MODEL *  
*           (ARL-HITTM)                           *  
*           ADAPTED TO RUN ON BNL CDC 6600         *  
*****
```

MET DATA IS PARTITIONED INTO TWO DATA SETS PER MONTH
PART 1 CONTAINS DATA FROM THE FIRST TO THE FIFTEENTH OF THE MONTH
PART 2 CONTAINS DATA FROM THE FIFTEENTH TO THE END OF THE MONTH
STARTING DATE FOR TRAJECTORY DETERMINES DATA SET NEEDED
THE FOLLOWING DATA SETS ARE IMMEDIATELY AVAILABLE:

JAN, 1978 PART 2

APR, 1977 PART 1

ENTER THE DATA SETS YOU WISH TO RETRIEVE FROM TAPE

ENTER ONE DATA SET PER LINE AS MM,YY,PART

TERMINATE THE LIST BY ENTERING 0,0,0

IF NO ADDITIONAL DATA SETS ARE REQUIRED,

ENTER 0,0,0 AS THE FIRST ENTRY.

> 0,0,0

PLEASE ENTER TRAJECTORY ORIGIN AS

ORIGIN ID(III-LETTERS) LAT(LL.LL) LON(LLL.LL) IN WHOLE DEGREES AND HUNDREDTHS

IF 3 LETTER CODE FOR MAP3S PRECIP CHEM NETWORK USED

LATITUDE AND LONGITUDE FIELDS MUST BE LEFT BLANK.

ENTER ??? FOR LIST OF MAP3S STATION IDS.

III,LL.LL,LLL.LL

>???

MAP3S PRECIPITATION CHEMISTRY STATION IDS;

WHI

ITH

PEN

VIR

ILL

BNL

LEW

OXF

PLEASE ENTER TRAJECTORY ORIGIN AS

ORIGIN ID(III-LETTERS) LAT(LL.LL) LON(LLL.LL) IN WHOLE DEGREES AND HUNDREDTHS

IF 3 LETTER CODE FOR MAP3S PRECIP CHEM NETWORK USED

LATITUDE AND LONGITUDE FIELDS MUST BE LEFT BLANK.

ENTER ??? FOR LIST OF MAP3S STATION IDS.

III,LL.LL,LLL.LL

>PNE

-----STATION ID= PNE NOT IN MAP3S LIST.

PLEASE ENTER TRAJECTORY ORIGIN AS

ORIGIN ID(III-LETTERS) LAT(LL.LL) LON(LLL.LL) IN WHOLE DEGREES AND HUNDREDTHS

IF 3 LETTER CODE FOR MAP3S PRECIP CHEM NETWORK USED
LATITUDE AND LONGITUDE FIELDS MUST BE LEFT BLANK.
ENTER ??? FOR LIST OF MAP3S STATION IDS.
III,LL,LL,LLL,LL
>PEN

ENTER THE TRAJECTORY START DATE AND NUMBER OF DAYS TO BE RUN AS
MM,DD,YY,NN
>4,1,77,1

BLOCK
NO.

1 ORIGIN ***** PEN(40.78 77.95)
2 START DATE 1 APR 77 FOR 1 DAYS
3 BACK IN TIME FOR 3 DAYS
4 TRANSPORT LAYER CALCULATED INTERNALLY
5 BOUNDARIES FOR MET STATION INPUT:
TOP AND BOTTOM LATITUDES ***** 48. 35.
LEFT AND RIGHT LONGITUDES ***** 90. 65.
6 NO TEMPERATURE PROFILES PRINTED
PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> ??

COMMAND HAS THE FORM ABN IN COLS 1,2,3
AB IS A TWO LETTER CODE, N IS AN INTEGER FROM 0 TO 6
ABN

===
?? THIS LISTING
GO ALL INPUT OK, COMPUTATION TO BE DONE
PRN PRINT VALUES IN BLOCK N, N=0 TO PRINT ALL BLOCKS.
CHN CHANGE VALUES IN BLOCK N
ST STOP ALL CALCULATIONS DONE
PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> CH6

TO PRINT VERTICAL TEMPERATURE AND WIND PROFILES FOR ONE TRAJECTORY ENTER:
TRAJECTORY DATE (DAY OF MONTH)
TRAJECTORY START HOUR
TIME AFTER START OF TRAJECTORY IN HOURS
ENTER 0,0,0 FOR NO PROFILES
> 1,12,2

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS
> GO

INPUT METEOROLOGY
TIME PERIOD TYPE
FROM 1977 APR 1-18Z WIND
FROM 1977 APR 1-18Z TEMP

SID=72518 TLH(MSL)= 806 TLD(ABOVE TERRAIN)= 493

HT (METERS)

HT CODED	HT M	XW M/S	YW M/S
R	5640	34.9	12.7
Q	4877	23.6	13.7
P	4267	26.3	15.2
N	3658	22.8	15.9
M	3024	14.9	5.4
L	2743	12.6	2.2
K	2438	11.3	1.0
J	2134	12.8	.0
I	1829	16.4	.0
H	1524	18.0	.0
G	1443	19.5	.0
F	1219	20.0	1.8
E	914	13.1	6.1
D	610	4.3	7.5
C	305	-.0	7.7
B	93	-.3	2.0
A	86	-.3	2.0

N
P
Q

D

E
M

L F
K J I HG

*

SID=72520 TLH(MSL)=2053 TLD(ABOVE TERRAIN)=1755

HT (METERS)

4900
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0

275 280 285 290 295 300 305 310 315
POTENTIAL TEMP (DEG K)

HT CODED	HT M	XW M/S	YW M/S
Q	5670	55.7	14.9
P	5182	54.8	14.7
N	4877	52.3	14.0
M	4267	41.1	7.2
L	3658	31.3	8.4
K	3033	27.5	10.0
J	2743	26.6	9.7
I	2438	27.3	7.3
H	2134	27.8	7.5
G	1829	26.9	7.2
F	1524	27.3	7.3
E	1440	26.6	9.7
D	1219	27.6	12.8
C	914	22.4	15.7
B	610	13.8	13.8
A	359	5.3	7.5

C

B

D

JK

A

IH

*

TO 1977 MAR 29- 0Z WIND

TO 1977 MAR 29- 0Z TEMP

MAXIMUM NUMBER OF STATIONS 24

TRANSPORT LAYER DEPTH
(HUNDREDS OF METERS ABOVE TERRAIN)

DURATION (HOURS)

3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72

END

DATE-TIME

APR 77

1- 0Z 15 20 21 25 20 23 22 29 30 99 99 99 99 99 99 99 99 99 99 99 99 99 99

1- 6Z 14 16 17 23 26 23 16 21 21 28 30 21 99 99 99 99 99 99 99 99 99 99 99 99

1-12Z 13 14 14 18 22 27 25 16 13 20 20 25 99 99 99 99 99 99 99 99 99 99 99 99

1-18Z 99

VERTICAL WIND SHEAR
(PER SECOND * 100)

DURATION (HOURS)

3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72

END

DATE-TIME

APR 77

1- 0Z 1 1 1 1 1 1 1 1 1 1 99 99 99 99 99 99 99 99 99 99 99 99

1- 6Z 1 1 1 1 1 1 1 1 1 2 2 1 99 99 99 99 99 99 99 99 99 99 99

1-12Z 1 1 1 1 1 1 1 0 0 1 1 1 99 99 99 99 99 99 99 99 99 99 99

1-18Z 99

LATITUDE AND LONGITUDE OF TRAJECTORY POSITIONS (DEGREES*100)

DURATION (HOURS)

6		12		18		24		30		72	
42		48		54		60		66			
LAT	LON	LAT	LON	LAT	LON	LAT	LON	LAT	LON	LAT	LON

END

DATE-TIME

APR 77

1- 0Z	4118	8131	4179	8503	4238	8847	4196	9278	9990	9990	9990	9990
	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990
1- 6Z	4155	7999	4205	8291	4307	8593	4402	8798	4375	9097	4280	9430
	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990
1-12Z	4187	7925	4252	8141	4315	8439	4435	8659	4537	8826	4531	9099
	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990
1-18Z	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990
	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990	9990

DO YOU WANT TO PRINT TRAJECTORY MAPS?(Y OR N)

>Y

ENTER MAP BOUNDARIES

TOP LATITUDE, BOTTOM LATITUDE, LEFT LONGITUDE

> 46,37,87

46.00 37.00 87.00

OK?(Y OR N)

>N

ENTER MAP BOUNDARIES

TOP LATITUDE, BOTTOM LATITUDE, LEFT LONGITUDE

> 46,36,87

46.00 36.00 87.00

OK?(Y OR N)

>Y

INDIVIDUAL TRAJECTORY CODE

A = TRAJECTORY ENDING 00Z AT *

B = TRAJECTORY ENDING 06Z AT *

C = TRAJECTORY ENDING 12Z AT *

D = TRAJECTORY ENDING 18Z AT *

X = TWO OR MORE TRAJECTORIES

1 = 6 HOURS DURATION

2 = 12 HOURS DURATION

3 = 18 HOURS DURATION

4 = 24 HOURS DURATION

5 = 30 HOURS DURATION

6 = 36 HOURS DURATION

7 = 42 HOURS DURATION

8 = 48 HOURS DURATION

9 = 54 HOURS DURATION

0 = 60 HOURS DURATION

1 = 66 HOURS DURATION

2 = 72 HOURS DURATION

INDIVIDUAL TRAJECTORIES FOR 1 APR 77

87.00	85.60	84.20	82.80	81.40	80.00	78.60	77.21
46.00+	+	+	+	+	+	+	+

45.51+

45.02+C

44.52+ C
4

44.02+

43.52+

43.01+

42.49+ .

41.98+

41.45+

40.93+

AX*

40.40+

39.86+

39.32+

38.78+

38.23+

37.68+

37.12+

36.56+

36.00+

DO YOU WANT TO REDO THE TRAJECTORY MAPS?(Y OR N)
>N

BLOCK
NO.

1 ORIGIN ***** PEN(40.78 77.95)

2 START DATE 1 APR 77 FOR 1 DAYS

3 BACK IN TIME FOR 3 DAYS

4 TRANSPORT LAYER CALCULATED INTERNALLY

5 BOUNDARIES FOR MET STATION INPUT:

TOP AND BOTTOM LATITUDES ***** 48. 35.

LEFT AND RIGHT LONGITUDES ***** 90. 65.

6 VERTICAL TEMPERATURE PROFILE

PRINTED FOR TRAJECTORY DAY 1 , START HOUR 12 , HOURS AFTER START 2

PLEASE ENTER A COMMAND; ?? FOR INSTRUCTIONS

> ST

STOP AS PER YOUR COMMAND