Data Sets for Meteorological Research

Roy L. Jenne

ATMOSPHERIC TECHNOLOGY DIVISION
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
BOULDER, COLORADO
NCAR TECHNICAL NOTES

The Technical Note series provides an outlet for a variety of NCAR manuscripts that contribute in specialized ways to the body of scientific knowledge but which are not suitable for journal, monograph, or book publication. Reports in this series are issued by the NCAR Scientific Divisions; copies may be obtained on request from the Publications Office of NCAR. Designation symbols for the series include:

EDD - Engineering, Design, or Development Reports
Equipment descriptions, test results, instrumentation, and operating and maintenance manuals.

IA - Instructional Aids
Instruction manuals, bibliographies, film supplements, and other research or instructional aids.

PPR - Program Progress Reports
Field program reports, interim and working reports, survey reports, and plans for experiments.

PROC - Proceedings
Documentation of symposia, colloquia, conferences, workshops, and lectures. (Distribution may be limited to attendees.)

STR - Scientific and Technical Reports
Data compilations, theoretical and numerical investigations, and experimental results.

The National Center for Atmospheric Research is operated by the University Corporation for Atmospheric Research and is sponsored by the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
Primary emphasis is given to describing the data sets that are available for meteorological research. Some of the main sets for physical oceanography are also included. Conventional instrumental data and satellite data are discussed; the proxy data such as tree rings and pollen receive only limited attention. We have attempted to refer to the major sets of data held within the United States. Many of the data sets give global coverage. Most of the data sets listed are stored in such a way that they can be read by computers.
ACKNOWLEDGEMENTS

I would especially like to acknowledge the many people in different organizations who have shared their knowledge about the various data sets. The time taken by several of these organizations to help prepare the information about their data and to proofread the completed chapters is appreciated very much.

J. Fletcher (Office of Polar Programs-NSF, then NOAA Environmental Research Labs) and Uwe Radok (NSF) encouraged the expansion of the scope of this work and its early completion to help with some of the aspects of establishing national climate programs. Close contact has also been maintained with W. Sprigg of the NOAA office that is responsible for helping to draft the U.S. Climate Program Plan.

In December 1974, working group II (organized under the Office of Climate Dynamics, NSF, and with NOAA input) met at NCAR to consider the assembly of conventional data. I am very indebted to the other members of this group for portions of the information in this Technical Note. Members were:


James Churgin - NODC (National Oceanographic Data Center, Washington, D.C.)

Richard Davis - NCC (National Climatic Center, Asheville, N.C.)

Tadepalli Murty - Ocean and Aquatic Affairs, Dept. of the Environment, Ottawa.

Richard Wert - NORPAX, Northern Pacific Ocean Experiment, Scripps Institution of Oceanography, California.

James Zuver - FNWC, Navy Fleet Numerical Weather Central, Monterey, California.

Roy Jenne - NCAR, Chairman.

W. Buchan and Ralph Russell (ETAC operating location in Asheville) have been extremely helpful in assembling and proofreading the material for the ETAC chapter. James Churgin played a similar role for the NODC chapter. Richard Davis and Vincent Hagarty of NCC spent a lot of time checking information and answering questions. Robert Quayle and Frank Quinlan of NCC also fielded many
questions. Tad Murty shared his wealth of knowledge about the availability of oceanographic products. Richard Wert provided information about data preparation being done at NORPAX, and J. Zuver helped in the preparation of the FNWC chapter.

I also wish to acknowledge the efforts of several other people in both helping us to obtain data and answering questions: Arthur Bedient, James McDonell, and Robert Gelhard of NMC; Thomas Gray and Charles Bristol of National Environmental Satellite Service (NESS); Thomas Flattery of National Meteorological Center (NMC) and USAF; James Vette and Leland Dubach of the National Space Science Data Center (NSSDC).

I also wish to acknowledge the administrative-level support that the various organizations have given: Thomas Austin and Arnold Hull of the NOAA Environmental Data Service; William Haggard, NCC; Robert Ochinero, NODC; Col. Robert Gottuso, ETAC; Capt. Conley Ward, FNWC; Francis Bretherton and G. Stuart Patterson, NCAR.

The typing of the manuscript by Ruby Fulk, Sara Ladd, Colleen Velie, Nancy Wright, Billie Wheat, Dianne Bernier, and Mary Buck is appreciated very much.

The preparation of the information about the NCAR data sets has been aided by Dennis Joseph, Paul Mulder, and Wilbur Spangler.

Other review and proofreading efforts have been very helpful: by Bram Oort, J. M. Wallace, Jay Winston, Thomas Vonder Haar, and Hugh O’Neil.

Finally I wish to acknowledge the patience of Harold Crutcher, of NCC, who has been waiting for the completion of a project to clean up the monthly mean rawinsonde data. The project has been further delayed by the preparation of this text.
TABLE OF CONTENTS

FOREWORD
ACKNOWLEDGEMENTS
TABLE SHOWING LOCATION OF INFORMATION
INTRODUCTION

CHAPTER 1. GENERAL INFORMATION ABOUT DATA SETS AT NCAR
1. DAILY GRID DATA
2. AVERAGE GRIDS
3. SYNOPTICALLY FILED UPPER AIR OBSERVED DATA
4. TIME SERIES OF UPPER AIR OBSERVED DATA
5. SYNOPTICALLY FILED SURFACE OBSERVED DATA
6. MONTHLY MEAN SURFACE DATA
7. MONTHLY MEAN RAWINSONDE DATA
8. SATELLITE BRIGHTNESS DATA
9. GEOGRAPHIC DATA
10. DATA HANDLING METHODS

CHAPTER 2. SELECTED DAILY GRIDS AT NCAR (PRESSURE, HEIGHT, TEMPERATURE)
1. SEA LEVEL PRESSURE GRIDS 1899-CURRENT
2. SEA LEVEL PRESSURE AND SURFACE TEMPERATURE FROM AFGWC
3. SEA LEVEL PRESSURE AND SURFACE AIR TEMPERATURE FROM MNC B-3
4. SEA LEVEL PRESSURE AND 700 MB HEIGHT AND TEMPERATURE
5. 300 MB DATA FROM UNIVERSITY OF WISCONSIN
6. 433L ESSPO PROJECT GRID DATA
7. IGY NORTHERN HEMISPHERE STRATOSPHERIC DATA
8. HEIGHT AND TEMPERATURE ANALYSES FROM AFGWC
9. ANALYSES FROM NMC
10. WESTERN HEMISPHERE ANALYSES OF THE HIGH STRATOSPHERE
11. SOUTHERN HEMISPHERE DAILY GRID DATA
12. IGY SURFACE AND 500 MB DAILY TROPICAL GRID

CHAPTER 3. NMC ANALYSIS DATA FROM THE NATIONAL METEOROLOGICAL CENTER
1. INTRODUCTION
2. MAIN STACK OF N. HEM. HEIGHT AND TEMP GRIDS THRU DEC 72
3. VERTICAL MOTION DATA
4. ANALYZED WINDS FROM NMC B-3
5. TROPICAL GRID DATA FROM NMC
6. SELECTED N. HEM. GRIDS FROM NMC
7. THE SELECTION OF NMC GRID DATA STARTING IN JAN 1973
8. NMC FORECASTS AVAILABLE AT NCAR (WRITTEN SEP 1973)
9. GLOBAL ANALYSES FROM NMC

CHAPTER 4. CLOUD, HUMIDITY, RAIN, MOISTURE, AND WATER DATA
1. DEW POINT AND NEPH DATA FROM AFGWC
2. LAYER HUMIDITY FROM NMC B-3 TAPES (AT NCAR)
3. U.S. NAVY MOISTURE ANALYSES
4. TROPICAL NEPHANALYSIS DATA
5. CLOUD COVER BASED ON SATELLITE BRIGHTNESS DATA
6. AVERAGE CLOUDS BASED ON SURFACE OBSERVATIONS
7. DAILY STREAMFLOW DATA
8. PRECIPITATION DATA FROM RADAR
9. SOIL MOISTURE AND DROUGHT DATA
CHAPTER 5. MISCELLANEOUS DATA SETS
1. GULF OF MEXICO OCEANOGRAPHIC AND ATMOSPHERIC DATA
2. OZONE DATA
3. EOLE FRENCH BALLOON DATA
4. LINE ISLANDS EXPERIMENT
5. AIRCRAFT DATA FOR GATE
6. S.W. ASIA MESOSCALE UPPER AIR DATA
7. WATER VAPOR SPECTRUM LINES
8. STATION LIBRARY INFORMATION
9. DATA FROM NATIONAL HAIL RESEARCH EXPERIMENT
10. DATA AT THE NATIONAL SEVERE STORMS LABORATORY
11. DATA AT THE ILLINOIS STATE WATER SURVEY

CHAPTER 6. ETAC, ENVIRONMENTAL DATA SETS AT USAF/ETAC
1. INTRODUCTION
2. SURFACE DATA - SYNOPTIC CODE AND AIRWAYS
3. UPPER AIR DATA
4. SATELLITE SOUNDINGS
5. TDF 19-SURFACE SYNOPTIC DATA
6. ANALYSES FROM AFGWC
7. OTHER DATA SETS AT ETAC

CHAPTER 7. NCC DATA AT THE NATIONAL CLIMATOLOGICAL CENTER
1. INTRODUCTION
2. LISTINGS OF DATA HOLDINGS
3. RAWINSONDE DATA
4. WINDS ALOFT DATA
5. ROCKETSONDE DATA AT NCC (JAN 1975)
6. SURFACE SYNOPTIC OBSERVATIONS
7. AIRWAYS DATA
8. DAILY SURFACE DATA FOR UNITED STATES
9. OTHER DAILY SURFACE OBSERVATIONS
10. RAINFALL DATA
11. MISC. SETS OF SURFACE DATA
12. SOLAR RADIATION
13. DATA FROM BOMEX EXPERIMENT
14. CYCLONE POSITIONS
15. TOWER DATA - CEDAR HILL, TEXAS
16. DATA SETS STORED ELSEWHERE THAT ARE RELATED TO NCC DATA
17. OZONE SOUNDINGS FROM BALLOON ASCENTS
18. COASTAL OBSERVING STATIONS
19. ATMOSPHERIC TURBIDITY DATA
20. DATA FROM GATE EXPERIMENT

CHAPTER 8. UPPER AIR OBSERVED DATA
SECTION A. UPPER AIR OBSERVED DATA IN SYNOPTIC ORDER
1. FROM NMC
2. FROM AFGWC
3. AT FMC
4. NORTHERN HEMISPHERE FROM UNIVERSITY OF MISSOURI, MIT, NCC
5. AIRCRAFT DATA
6. PRINTED UPPER AIR DATA ON MICROFILM
SECTION B. UPPER AIR OBSERVED DATA IN TIME SERIES ORDER
CHAPTER 9. SURFACE SYNOPTIC OBSERVED DATA
1. INTRODUCTION
2. FILED IN SYNOPTIC SEQUENCE
3. FILED IN TIME SERIES ORDER

CHAPTER 10. CLIMATOLOGICAL YR-MO SURFACE AND UA DATA, TREE RINGS
1. MONTHLY MEAN RAWINSONDE DATA
2. MONTHLY MEAN REPORTS FROM SURFACE STATIONS
3. ATLAS OF MFAN SURFACE TEMPERATURE AND PRESSURE BY MONTHS 1881-1960
4. TREE RING DATA FOR WESTERN AMERICA
5. N. AMERICAN CLIMATE DATA TO 10,000 YEARS
6. DATA BANK OF EARLY CLIMATOLOGICAL SOURCES

CHAPTER 11. GLOBAL CLIMATOLOGICAL GRID DATA
1. GLOBAL CLIMATOLOGY TO 100 MB
2. CLIMATOLOGICAL GRID DATA PREPARED BY RAND
3. STRATOSPHERIC CLIMATOLOGY

CHAPTER 12. STRATOSPHERIC DATA
1. INTRODUCTION
2. IGY NORTHERN HEMISPHERE STRATOSPHERIC DATA
3. HEIGHT AND TEMPERATURE ANALYSES FROM AFGWC (AIR FORCE)
4. DAILY HEIGHT AND TEMPERATURE ANALYSES FROM NMC
5. DAILY HEIGHT AND TEMPERATURE ANALYSES PREPARED IN GERMANY.
6. WEEKLY CONSTANT PRESSURE GRIDS AT 5, 2, AND .4 MB
7. STRATOSPHERIC ANALYSES FROM GERMANY
8. STRATOSPHERIC CLIMATOLOGY
9. RAWINSONDE DATA
10. MONTHLY THICKNESS DATA FROM SATELLITES AT NCAR
11. ROCKETSonde DATA AT NCC

CHAPTER 13. SATELLITE DATA
1. INTRODUCTION
2. SATELLITE BRIGHTNESS DATA FROM NESS
3. ARCHIVE OF NESS SCANNER IR AND VISIBLE DATA
4. LRIR DATA
5. OTHER SATELLITE IR DATA
6. MOISTURE DATA FROM NESS
7. CLOUD DRIFT WINDS AND MOVIE LOOPS
8. SOLAR PROTON MONITOR DATA
9. GENERAL INFORMATION ABOUT SATELLITE SIRS AND VTPR DATA
10. VTPR SATELLITE IR SOUNDING DATA FROM NESS
11. DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP) (WAS DAPP)
12. SEA SURFACE TEMPERATURE DATA FROM NESS
13. SCR SOUNDING DATA FROM NIMBUS-4 SATELLITE
14. NIMBUS-5 DATA
15. OZONE SOUNDING DATA FROM SATELLITE
16. ICE AND SNOW AND ESMR MICROWAVE DATA
17. SATELLITE DATA FOR THE GATE EXPERIMENT
18. SEASAT SATELLITE
19. ERTS DATA
CHAPTER 14. FNWC. METEOROLOGICAL AND OCEANOGRAPHIC DATA AT FLEET NUMERICAL WEATHER CENTRAL

SECTION A. DAILY ANALYZED DATA
1. INTRODUCTION
2. COVERAGE OF SURFACE DATA
3. SEA LEVEL PRESSURE
4. SURFACE AIR TEMPERATURE
5. UPPER AIR DATA IN ANALYZED GRIDS--ALL TWICE DAILY COVERAGE
6. MOISTURE AND CLOUD GRIDS
7. DERIVED SURFACE WIND
8. HEAT FLUX
9. TEMPERATURE AT DEPTH (DAILY GRIDS)
10. WAVES
11. SURFACE CURRENTS
12. TROPICAL GRIDS
13. GLOBAL SEA LEVEL PRESSURE ANALYSES AND WATER TEMPERATURE
14. SOUTHERN HEMISPHERE ANALYSES

SECTION B. OBSERVED DATA
15. SYNOPSIS SURFACE OBSERVATIONS
16. SYNOPTIC UPPER-AIR OBSERVATIONS
17. RECENT SURFACE AND UPPER AIR SYNOPTICALLY FILED DATA
18. SPECIAL MARINE OBSERVATIONS
19. EXPOSABLE BATHYTERMOPHORAP SOUNINGS

SECTION C. AVERAGE OCEAN TEMPERATURE AT DEPTH
20. AVERAGE OCEAN TEMPERATURES AT DEPTH PREPARED AT FNWC
21. NORTHERN HEMISPHERE OCEAN TEMPERATURE ANALYSES

SECTION D. AVERAGE ANALYSIS DATA
22. LONG TERM (NORMAL) MONTHLY GRID STATISTICS PRODUCED AT FNWC
23. MONTHLY AND HALF MONTHLY GRID MEANS FOR EACH YEAR AT FNWC

CHAPTER 15. NODE. DATA AT THE NATIONAL OCEANOGRAPHIC DATA CENTER
1. INTRODUCTION
2. OCEANOGRAPHIC STATION DATA FILE
3. MHT
4. XBT
5. OCEAN WEATHER STATION DATA
6. SURFACE TEMPERATURE AND SALINITY
7. SURFACE AND SEABED CURRENTS
8. DATA FROM CURRENT METERS AND FROM SELECTED DRIFTERS

CHAPTER 16. SEA SURFACE WATER TEMPERATURE GRID DATA
1. NAVY SEA SURFACE TEMPERATURE GRIDS
2. NMC SEA SURFACE TEMPERATURES
3. BUREAU OF COMMERCIAL FISHERIES SST GRID DATA
4. LONG-TERM MEAN SEA SURFACE WATER TEMPERATURE
5. SEA SURFACE TEMPERATURES
6. HALF MONTHLY PACIFIC OCEAN GRIDS PREPARED BY NORPAX
7. SATELLITE DATA
CHAPTER 17. WORLD SURFACE SHIP DATA
1. INTRODUCTION
2. PROJECTS THAT AID IN THE DEVELOPMENT OF THIS DATA SET
3. RECOMMENDATIONS CONCERNING THE DATA FLOW AND CHECKING
4. ASPECTS OF DATA MANAGEMENT
5. STATUS OF THE DATA SETS BASED ON SHIP LOGS
6. SYNOPTIC FILE OF SHIP OBSERVATIONS
7. AN EVALUATION OF THE GLOBAL TELECOMMUNICATIONS SYSTEM (GTS) AS A MARINE CLIMATIC DATA SOURCE

CHAPTER 18. GEOGRAPHICAL DATA
1. ELEVATION DATA FROM USAF, 1 DEG, 30 MIN, 5 MIN
2. AVE ONE DEGREE ELEVATION, DEPTH, AND ICE DATA FROM SCRIPPS
3. TEN MINUTE ELEVATION DATA FOR THE WORLD
4. ICE AGE SURFACE ELEV AND SEA SURFACE TEMPERATURE
5. ELEVATION DATA—HIGH RESOLUTION
6. CONTINENTAL SHELF DEPTH AND MAP DATA

CHAPTER 19. DATA FOR ASSESSMENT STUDIES
SECTION A. CROP DATA
1. CROP YIELDS BY STATES
2. US COUNTY AND CROP DISTRICT DATA
3. USDA CROP DISTRICT DATA
4. CROP STATISTICS FOR THE WORLD
5. CROP DATA FROM FAO IN ROME
6. LACIE (LARGE AREA CROP INVENTORY PROGRAM)
SECTION B. AIR QUALITY DATA
7. AIR QUALITY DATA
8. DATA FROM LOS ANGELES REACTIVE POLLUTANT PROGRAM
SECTION C. CENSUS AND ECONOMIC DATA
9. DATA AT LAWRENCE BERKELEY LABORATORY

CHAPTER 20. SELECTED INFORMATION ABOUT DATA SETS HERE AND IN OTHER COUNTRIES
1. FEDERAL DATA CENTERS IN THE US
2. WMO CATALOG OF DATA FOR RESEARCH
3. ENDEX SYSTEM FOR DATA SET INFORMATION
4. WORLD SURVEY OF OCEANOGRAPHIC PRODUCTS AND METHODS
5. DATA SETS IN CANADA
6. INFORMATION ABOUT DATA HOLDINGS IN OTHER COUNTRIES

CHAPTER 21. SELECTED ASPECTS OF DATA SET PREPARATION
1. INTRODUCTION
2. CONSIDERATIONS NECESSARY IN PLANNING EACH SET OF DATA
3. DATA VOLUME

APPENDIX 1. ENVIRONMENTAL DATA SETS AT USAFETAC
APPENDIX 2. A LISTING OF DATA SETS AT THE NATIONAL CLIMATIC CENTER
APPENDIX 3. NEWS CLIPPINGS ABOUT DATA
APPENDIX 4. SOURCES OF INFORMATION AND DATA

ADDRESSES
REFERENCES
INDEX
Table Showing Location of Information in this Text

For selected data types, this table shows where information about the data may be found in the text. An * means data are there but are not specifically described in this text. The number 2.11 is Chapter 2, Section 11. The NMC data are covered in the NCAR column. Also, see the Index at the end of the text.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>NCAR</th>
<th>PNWC</th>
<th>ETAC</th>
<th>NCC</th>
<th>NODC</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level pressure grids</td>
<td>2.</td>
<td>14.3</td>
<td>6.6</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern hemisphere analyses</td>
<td>2., 3., 4.1, 4.2</td>
<td>14.</td>
<td>6.6</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical analyses</td>
<td>2.12, 3.5</td>
<td>14.12</td>
<td>6.6</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern hemisphere analyses</td>
<td>2.11, 3.9</td>
<td>14.13, 2.12</td>
<td>14.14</td>
<td>6.6</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Stratosphere grids</td>
<td>2.7, 3, 2.10, 12</td>
<td>14.5</td>
<td>6.6</td>
<td>2.7, 2.10</td>
<td>12., 13</td>
<td></td>
</tr>
<tr>
<td>Ocean analyses</td>
<td></td>
<td>14.</td>
<td></td>
<td>20.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climatology grids</td>
<td>11.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.3, 16.6</td>
</tr>
<tr>
<td>Average grids</td>
<td>1.2, 11.3</td>
<td>14.D</td>
<td>6.6</td>
<td>10.3, 16.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface synoptic</td>
<td>1.5, 9.</td>
<td>14.15</td>
<td>6.2</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface synoptic time series</td>
<td>9.</td>
<td></td>
<td>6.2, 6.5</td>
<td>6.2, 7.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airways</td>
<td></td>
<td>6.2</td>
<td></td>
<td>6.2, 7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainfall</td>
<td>10.</td>
<td>6.2</td>
<td>6.2</td>
<td>7.8, 7.6</td>
<td>7.10, 10.</td>
<td></td>
</tr>
<tr>
<td>Drought</td>
<td></td>
<td></td>
<td>6.7</td>
<td>7.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper air synoptic file</td>
<td>1.3, 8.A</td>
<td>6.3</td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper air time series</td>
<td>1.4, 8.B</td>
<td>6.3</td>
<td>7.3, 7.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocketsonde</td>
<td></td>
<td></td>
<td></td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.</td>
</tr>
<tr>
<td>Solar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.12, 13.</td>
</tr>
<tr>
<td>Satellite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.</td>
</tr>
<tr>
<td>Ocean currents</td>
<td>14.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.</td>
</tr>
<tr>
<td>Geographical</td>
<td>18.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.</td>
</tr>
</tbody>
</table>
INTRODUCTION

This document is intended to provide information about various data sets for meteorological and oceanographic research. We provide a few details about the data, but generally avoid voluminous information such as station lists, and detailed methods. Although several years ago this was conceived as a relatively brief write-up describing the data sets archived at NCAR, it has been expanded to cover many of the data sets held in other centers. Given this general information about various data sets, people can more quickly approach a specific data bank to satisfy their needs.

NCAR has an extensive set of grid point data. Our set of upper-air synoptically filed observed data is also fairly complete. Other types of data are usually in more complete sets at NOAA's National Climatic Center (NCC) in Asheville, N.C., which is the basic national archive for meteorological data. Since NCAR has data from sources other than NCC, and because we have often re-formulated the data in a way that may be convenient for other groups, NCAR also makes its data available (at cost) as a service to members of the research community. The data can be accessed by approved projects run on the NCAR computers, or they can be sent on tape. Because we have only a very small staff, requests for hard copy output or for changes of format usually cannot be met. We anticipate that most requests for data will continue to be directed to the data centers of NOAA's Environmental Data Service and to NASA.

Those who wish to run their own research programs on the NCAR computer may write to the Director of the NCAR Computing Facility, requesting the necessary application forms.

In planning for data sets, NCAR attempts to emphasize multiple-use data sets, continuity in time, and sufficient information to monitor some of the changes in the global atmosphere.

We are preparing a data base for studies of climatic change and long-range prediction. We routinely archive synoptic-scale data, and will archive an augmented set of data during the GARP experiments.

We believe that it is most cost-effective for the data banks to spend a good deal of time in cleaning the various errors out of the data and in making certain that the formats are as stated. If this is done once at the centers, it means that each user will not need to cope with all of these problems. Thus many of the
data sets that NCAR receives are processed to reduce the error content, and are put into formats that often reduce the data volume and the time necessary to unpack the data. Such cleanup work is always in progress at other data banks also. However, with hundreds of millions of observations, it is clear that the amount of manual intervention involved in the cleanup process must be limited. Thus there will always be some problems in the various data sets; however they are usually reduced to the point that the data can be easily used. Feedback about problems also helps; thus a listing or cards saying that station A for January 1949 reported a mean temperature of 22° but it should have been 27° are helpful. However, since there are a number of rather extreme rare events, one must be very cautious in changing data (and normally changes should be flagged). Program checks for extreme values (sometimes poorly known) have caused problems, such as the deletion of jet stream winds.

We also note that various instrumental errors may be included in the data. Finally, even if the instruments are perfect, there is the question of whether a sample is representative of only a small area (such as the top of a black roof, a heat island in a city, or the edge of a thunderstorm) or of a much wider area. In the case of the analysis data, there are questions about how much observed data were available for the analyses, how much smoothing was done, and whether the procedures that were used tried to build in vertical consistency between levels. We have included a few statements in the text about the content, reliability, and methods used in preparing the sets. The basic point that we wish to make about the observations and analyses is that although they are not perfect, if they are used wisely they can help us find answers to a number of problems.

In organizing the material, we have compromised between a complete listing of what each organization is doing, and a grouping of information according to type of data. The text leans somewhat toward a listing by organization but a number of chapters discuss given types of data. The Table of Contents, the table showing the location of information (p. XII), and the index also help to track individual types of data.

Chapter 1 gives an overview of the data sets at NCAR; Chapters 2 and 3 give details about grid-point data at NCAR. Chapter 4 about cloud and moisture data and Chapter 5 about other data sets include information about some sets of data not available at NCAR. Chapter 6 discusses ETAC (Air Force Environmental Technical Applications Center) and Chapter 7 covers NCC (National Climatic Center);
these centers have huge archives of meteorological data. Chapters 8-13 discuss atmospheric data according to data type: upper air observed data, surface synoptic, year-month mean data, climatological grid data, stratospheric data, and satellite data.

In Chapter 14 we include more about the ocean data by considering both the atmospheric and the ocean data at FNWC (Fleet Numerical Weather Central). We then consider NODC (National Oceanographic Data Center). Chapters 16 and 17 discuss sea surface water temperature grid data and world surface ship data. In Chapters 18 and 19 we consider geographical data and data for assessment studies such as crop data. Chapter 20 discusses a few of the other sources of information and includes information about a directory of federally supported information analysis centers and about a world survey of oceanographic products. Finally, in Chapter 21 we consider aspects of data set preparation that make it easier for us to share data sets.

In order to make the current information widely available, we have arbitrarily limited the scope of this writeup. The list of addresses, references, Appendix 4, and comments in the text will indicate the best places to get other questions answered.

Some comment on the relationship between the world data centers and the national data centers may also be helpful. For example, World Data Center-A for oceanography is located with NODC. However, it does not list all of NODC's data holdings as belonging in its files. The reason is that all data that are part of a WDC are supposed to be equally accessible at the sister WDCs overseas, and it is not practical to exchange all data.
Chapter 1: General Information about Data Sets at NCAR

In this chapter we will discuss the data at NCAR in a general way. Other chapters will provide more specific information about data sets located at NCAR and elsewhere.

1. Daily Grid Data

We have northern hemisphere sea level pressure daily grid data starting in 1899. Ten missing months in 1945 may soon be obtained from Scripps. Height and temperature grids at 700 mb start in 1947, heights at 500 mb start in 1946, 300 mb heights start in 1950, and 100 mb heights start in July 1957. Other stratospheric grids are available from July 1957 through June 1959, and then start again in 1962 or 1964, depending on the source. The earlier grids often have a resolution of only about 5° latitude by 10° longitude, whereas the later grids usually have a spacing of about 400 km. Figure 1-1 shows the availability of height and temperature grids.

Dew point analyses are available for 850, 700, 500, and 400 mb, and neph analyses for low, middle, high, and total clouds start 1 September 1963. Only total clouds are available until April 1964, when the layered clouds were added. Cloud analyses in this form stop in November 1969. We also have grids of 1000-500 mb average relative humidity starting in March 1968.

We have wind analyses 850-100 mb for 1963 to date except that lower level grids are missing during selected periods. We also have tropical analyses of winds for 700-200 mb starting in 1968 and of temperature starting in 1970 (48°S - 48°N). There are analyses of southern hemisphere sea level pressure and 500 mb height for 18 months during the IGY.

Sea surface temperature grids are available for the northern hemisphere starting in November 1961.

2. Average Grids

Long-term mean monthly climatological data are available on one magnetic tape for each hemisphere, surface to 100 mb. Included are heights, temperature, dew point, and geostrophic winds. Another tape has a climatology of the northern hemisphere stratosphere from 100 to 10 mb. We also have global sea surface water temperature data.
Chapter 1

The German stratospheric analyses for each month start in about 1957 or 1964, depending on level and type. Monthly grids of surface water temperature in the North Pacific cover the period January 1949 through December 1962.

3. Synoptically Filed Upper Air Observed Data

We have upper air data in synoptic sequence starting in May 1958. The first five years were from MIT, and the later data from NMC (and sometimes from the USAF). The coverage on the NMC tapes became global (as received operationally) in June 1966. The data coverage for typical times in 1968 and 1974 is shown in Figure 1-2.

The NMC tapes include aircraft wind reports, wind data from the cirrus blowing off from cumulonimbus clouds ("blowoff winds"), wind data from the drift of clouds seen on ATS film loops, and "bogus" data put in by analysts to help the objective analysis programs. Figure 1-3 shows the coverage of these data on a given day in 1970. Figure 13-1 shows wind data coverage in 1974.

4. Time Series of Upper Air Observed Data

NCAR also has data from about 1,600,000 rawinsonde ascents in time-series sort (on 48 tapes). We are attempting to obtain all available mandatory level rawinsonde data for the stations south of about 30°N. We have also just obtained the U.S. and Canadian data starting with 1961. The primary source of data has been NCC with additional data from England, Australia, New Zealand, Argentina, Singapore, and Mauritius. We hope to soon obtain data from Brazil. We are also corresponding with several other countries to try to make this set more complete.

5. Synoptically Filed Surface Observed Data

NCAR has observed surface data (synoptically filed) for 19 February 1967, through 25 April 1967, and for December 1967. We are obtaining more of these data. Three other organizations have more complete sets (see Chapter 9).

6. Monthly Mean Surface Data

We now have about 337,000 monthly reports from surface stations. In the period from 1731 to 1860, the number of stations increased from 1 to 84; by 1900, there
General Information

were 438 stations. In the 1961-1970 decade, there were 1722 stations, of which 541 were in the southern hemisphere.

7. Monthly Mean Rawinsonde Data

We are cooperating with NCC to make available a set of about 75,000 mean monthly rawinsonde reports (CLIMAT reports - global coverage). The southern hemisphere climatology project made extensive use of these data. Error detection and correction work on the northern hemisphere reports is not yet complete.

8. Satellite Brightness Data

Daily global brightness data, averaged by 5° latitude-longitude squares are available for 1 January 1967 through 31 August 1972. One average brightness value is given for each grid point. These satellites view the earth at about 1500 local time each day. To produce this data set, the Satellite Service summarized the mesoscale brightness data, which are given for squares that are about 50 km on a side (one-eighth of NMC grid). For each square there is a count of how many of the 64 sub-squares have brightnesses in categories one through five.

9. Geographic Data

We have two sets of global 1° elevation data; one of these also has water depth and ice thickness. Elevation data for each 5 min are also available for North America and Europe. A set with points each 208 ft is available for the United States from the Army Map Service. A set of 5° global mean elevation data is included on the climatology tape for the southern hemisphere.

10. Data Handling Methods

Our input data are received in a number of different formats on cards and on tape. Much of the data would be easier to use if the formats were changed. For example, some of the card formats have overpunches on the data, and some binary packed data require the bits to be reordered in order to be meaningful. The various levels for individual rawinsonde balloon ascents often are not together in a data set. We have taken time to restructure many of these formats so that the information is easy and quick to use. For example, one set of 602,000 rawinsonde reports on 56 tapes was repacked into a variable length binary format.
Chapter 1

The volume dropped by a factor of 3.9 and the time to unpack all of the data on the Control Data 6600 dropped from 464 to 34 min.

Often we choose a format that uses packed positive numbers in order to save storage volume and machine time. Most of the data are kept under checksum protection.

In order to use the binary packed data easily on another computer, that computer must have a binary capability (nearly all computers now have this). Also, one standard general purpose routine (GBYTES) must be written for the machine in question. Such a routine has now been written for 360 systems and for the Univac 1108. We have prepared a technical note (Jenne and Joseph, 1974) which discusses some of the techniques for the processing, storage, and exchange of data. It describes some of the considerations involved in choosing formats and presents some time and volume comparisons for different options. It also describes some of the methods that can be used to process data that have been received in any of a variety of formats.
Fig. 1-1. Northern hemisphere analyses of sea level pressures, heights, and temperatures. The daily sea level pressure analyses start in 1899. The southern limit for most grids is about 15 or 20°N. The resolution of the more recent grids is about 400 km and the grids are usually two per day. Hashed lines show time periods when analyses are not available for every day of every month. Some levels, such as 250, 150, and 70 mb, are available but are not listed in the figure.
Chapter 1

NMC DATA FOR YR/MO/DY/HR 68 7 15 0
ALL LEVELS OF DATA
CODE X=RAOB, O=WIND OR RAWIN, V=ACFT

Fig. 1-2a. Data coverage of conventional observed upper air data from the NMC for a typical time in 1968 (0000 GMT on 15 July). Separate wind-with-height soundings received from stations that have thermal RAOB data are counted as RAWIN reports; if thermal data are lacking, they are counted as WIND reports. ACFT denotes aircraft report. Nearly all RAOB reports also report winds at mandatory levels. A zero plotted on top of an X looks like a rectangle. A spot check in 1969 showed that data above 100 mb were generally not received from the southern hemisphere, North Africa, China, or the Middle East.

GATE ARCHIVE DATA FOR YR/MO/DY/HR 74 9 2 12
ALL LEVELS OF DATA
CODE X=RAOB, O=WINDS ONLY, V=ACFT

Fig. 1-2b. Data coverage of upper air data from NMC for a time period during the GATE experiment. The count of aircraft reports are for a 6-h period. The real-time receipt of data from the GATE ships was not as good as this in July 1974.
Fig. 1-3. Data coverage of reconnaissance data, of winds derived from satellites, and of bogus data on the synoptic tapes from the NMC for a day in June 1970.
Chapter 2: Selected Daily Grids at NCAR
(Pressure, Height, Temperature)

Analyses discussed here are for the northern hemisphere unless otherwise stated and usually do not extend to the equator. The NMC octagonal grid goes to about 15°N. See Figure 2-1.

1. Daily Sea Level Pressure Grids 1899–Current
   a. Sea Level Pressure Grids from Historical Maps
      These grids cover January 1899 through June 1939. The data are on a diamond 5° latitude 10° longitude grid 20–80°N, with no data at 75°N. G. Briar's laboratory in Environmental Data Service did a lot of work cleaning these grids. Data are missing where the historical maps could not be analyzed. Eastern Russia (40–80°N, 35–150°E) is missing for 1916–1920, for three months in 1921, for one month in 1922 and in 1931, and for six months in 1938 and in 1939. (On three tapes.)
   b. Sea Level Pressure Data from MIT
      These data cover July 1939 through November 1944. They are for each 5° latitude and even 10° longitudes for 15–80°N. This grid is always complete. Data for 85°N are also available for ten days. (On one tape.)
   c. Sea Level Pressure Data from the Navy
      Sea level pressure grids for November 1945 through March 1955 (daily at 15Z) and April 1960 through June 1962 (12002) were digitized with a curve follower at NCC under Navy contract. The Navy then used the points along the contours, and used the high and low centers in their objective analysis program which is also used on current data. The operational analyses from the Navy are available starting in July 1963. See Chapter 14 for more information.
   d. Daily Sea Level Pressure Grids 1899–1972
      These grids are daily data on a uniform 5° latitude-longitude grid taken from a, b, c above and from the (ESSPO) data as prepared by NCAR, which is described later in this chapter. We have received monthly mean 1945 data from NORPAX. The missing 5° latitude-longitude points from a and b are interpolated, except that large missing areas are left as missing.
Chapter 2

2. **Sea Level Pressure and Surface Temperature Data from Air Force Global Weather Central (AFGWC)**

   100 mb height (H) 15 May 1963 - 2 Jan 1965 (00 and 12Z)
   Surface temperature (T) 15 May 1963 - 2 Jan 1965 (00 and 12Z)

   The 1000 mb height (in tens of feet) was calculated from the sea level pressure using the formula:

   \[ Z_{1000} = T_{sfc} \left[ 9.58 \times \text{Alog}(P_{\text{sea lvl}}) - 66.18 \right] \]

3. **Sea Level Pressure and Surface Air Temperature from NMC B-3**

   Pressure 18 May 1965 - current (00 and 12Z)
   Surface (T) 4 Oct 1965 - current (00 and 12Z)

4. **Sea Level Pressure and 700 mb Height and Temperature from Extended Forecast Laboratory**

   Sea level pressure Jan 1947 - Aug 1967 (00 and 12Z)
   700 mb H,T Jan 1947 - Jun 1967 (00 and 12Z)

   Many missing in the early months. On a diamond grid (5° latitude and 10° longitude) from 15°N to the pole. In earlier years the grid coverage was less.

5. **300 mb Data from University of Wisconsin**

   300 mb H 1 Jan 1950 - 31 Dec 1957 (15Z)

   Values read to nearest 100 ft from USAF and WBAN charts. Ten days are completely missing. Data in parts of eastern hemisphere are missing for three months. See the atlas by Lahey et al. 1960. Diamond grid 15°N to the pole (each 5° latitude, 10° longitude, with fewer points near the pole). Grids are on one tape with a 5° grid and 15-bit pack at NCAR. Original height data were read to the nearest 100 ft. The University of Wisconsin provided the original 170,000 cards.

6. **433L ESSPO Project Grid Data**

   Data for every other point (one-fourth of the points) in the NMC grid were manually read from many charts for April 1955 through March 1960 (all twice daily). The data have been cleaned up and are now in the standard NMC grid format.
The grids for SLP, 700 mb H,T, 500 H,T are complete for every month.

The grids for 300 and 200 mb height and temperature are available each third month for:

200 mb Apr 1956 – Jul 1958
250 mb Oct 1958 – Jul 1959

These cards were received on tapes from United Aircraft and much time was spent at NCAR to clean up the set. The data are now on the NMC grid with values interpolated for the missing grid points. The few points outside the NMC grid are carried at the end of the records. The grid point values were read to the precision of whole degrees, whole millibars and tens of feet.

The Weather Bureau, Air Force, Navy, and FAA were involved in this project. 1959: Reference Manual for Climatic Data Computer Tapes, 433 L, ESSPO (joint), 424 Trapelo Road, Waltham, Massachusetts 02154 (NCAR has a copy).

7. **IGY Northern Hemisphere Stratospheric Data**

Daily 100 and 50 mb 12Z height and temperature grids for the period July 1957 through June 1959; 30 mb height and temperature grids are for only three days per month for the same period. The card data were taped at NCC, paid for by NCAR and by Deland of New York University. The cards were processed into standard NMC grid format at NCAR.

8. **Height and Temperature Analyses from AFGWC**

All are twice-daily analyses on the NMC grid. This set is continuing but has not been updated at NCAR since early 1965.

850 H,T - start Jan 1962
700 H,T - start Jan 1962
500 H - start Jan 1960 (note 1)
500 T - start Jan 1962
400 H,T - start Jan 1962
Chapter 2

300 H - start Apr 1959 (note 2)
300 T - start Jan 1962
200 H,T - start Jan 1962
100 H - start Apr 1959 (note 2)
100 T - start Jan 1962
50 H,T - start Jan 1962
30 H,T - start Jan 1962
10 H,T - start May 1963

Note 1: These were NMC grids with one-fourth of the points sent to AFGWC by teletype (until January 1962).

Note 2: Based on hand analyses made at AFGWC with one-fourth of the points manually read and the rest interpolated (until January 1962).

9. Analyses from NMC

See Chapter 3 for NMC grids, most of which start in 1963.

10. Western Hemisphere Analyses of the High Stratosphere

Once-weekly analyses of the 5, 2, and 0.4 mb heights for January, April, July, and October for 1964, 1965, and 1966. (The area is 10°N to the pole and 0°W, 5°W, ..., 220°W, but only 40°W - 190°W at 0.4 mb.) See Chapter 12 for more information about similar data. On tape at NCAR and NCC.

11. Southern Hemisphere Daily Grid Data

IGY grids for sea level pressure and 500 mb height for the period July 1957 through December 1958, for the area 15°S to the South Pole are available. The grids have data at each 5° of latitude and longitude. The original data were generally read each 10° longitude on a diamond latitude-longitude grid, with no sea level pressure data over Antarctica. The card data were from South Africa or repunched from NOTOS. On tape at NCAR.

We also have grids for sea level pressure for 1951-1957, but these have not yet been cleaned up.
12. **IGY Surface and 500 mb Daily Tropical Grid**

Daily sea level pressure and 500 mb heights for the period 1 July 1957 through 31 December 1958. (Pressure read to whole millibars, height read in dekameters.) Data for 25°S through 25°N, each 5° of latitude and longitude.
Chapter 2

Fig. 2-1. NMC $47 \times 51$ grid. There are 1977 data points in the octagon. The pole point is $I,J = 24,26$. 
Chapter 3: NMC. Analysis Data from the National Meteorological Center

Nearly all of these data sets are available at NCAR.

1. Introduction

The NMC has had a policy of purging much of their older data. Thus, the files of NMC data at NCAR and at NCC are more extensive than those at NMC.

Until January 1973, the grid analysis data and the observed upper air data were combined on one set of "B-3" tapes. Data for 4 March 1962 to 31 December 1972 were on 1845 tapes.

NCAR has processed these tapes to separate the analyses from the observed upper air data and to block the observed data more tightly. Much of the forecast data was thrown away. We have made separate data sets of analyses of heights and temperatures, winds, and forecasts. The analyses on the B-3 tapes are those done with a data cutoff of 3 h 20 min after data time. However, the primary archive of NMC height and temperature analyses at NCAR are the final analyses which were received on separate tapes. These were usually based on a data cutoff of about 10h after data time. NCAR is now (February 1975) using the operational (B-3) tapes to fill in the gaps in the final analysis tapes. All final and operational grids have been put into a common format. Wind analyses are only made during the operational run.

Starting in December 1974 NMC has been preparing selected zonal mean energy statistics from their global analyses.

2. Main Stack of NMC Northern Hemisphere Height and Temperature Grids through December 1972

These analyses are generally from the NMC final analyses tapes. Thus, they include data up to about 10 h after data time for the time periods (usually at least once a day) when NMC makes a final analysis after the earlier operational run which has a data cutoff at 3 h 20 min. Data are available as follows.
Chapter 3

The levels (in millibars) are:

a. 1000 H: Five months in 1962, continuous twice a day from December 1962. Sometimes only available in the form of a 1000-500 thickness and the 500 mb chart.

b. 850, 500 H: 00Z starts October 1958. Continuous twice a day from December 1962.

c. 700, 200 H: Five months in 1962 (Jan, Apr, Jul, Oct, Dec), continuous twice a day from December 1962.

d. 300 H: Starts March 1961 at 00Z, continuous twice a day from December 1962.

e. 850, 700, 500, 300, 200 T: Five months in 1962, continuous twice a day from December 1962, but April 1963 missing.

f. 400 H, T: Continuous twice a day starting May 1964.

g. 250 H, T: Continuous twice a day starting October 1965.

h. 150, 100 H: All of 1963, five months in 1964, continuous twice a day starting in May 1965.

i. 150, 100 T: Same as 150 H except January and April 1963 are also missing.

j. 70 H, T: 12Z analyses start 14 April 1969; twice a day starts 18 September 1970.

k. 50, 30, 10 H, T: 12Z analyses start May 1964. Twice a day starts 18 September 1970; once a day again, starting January 1973.

3. Vertical Motion (W) Data:

a. 500 mb W: October 1958 through 18 January 1962 for 00Z. In March 1962 there is an 11-day period of 650 mb vertical velocity (i.e., not 500).


d. The 650 and 350 mb W-grids continue after 1964 in another sequence of tapes.

4. Analyzed Winds from NMC B-3

These octagonal grid wind analyses are based on a geostrophic first guess and modified with observed wind data.Analyses made twice-daily.

a. Old pack format starts 4 March 1962 for the levels 850, 700, 500, 300 and 200 mb.

b. 100 mb starts 17 March 1963.

Analyses from NMC

d. Winds below 300 mb were dropped after 00Z, 1 Jun 1964.
e. 500, 400, 250, 150 mb added 20 Apr 1965.
f. 850, 700 mb included again 11 Aug 1966 to make a complete 850-100 mb set.

5. Tropical Grid Data from NMC

NCAR has NMC tropical grid analyses of winds starting 28 January 1968 for 1200Z. These are for the 700, 500, 300, 250, and 200 mb levels. Wind analyses at 00Z start 3 March 1968. Temperature grids start 22 January 1970.

The data in these analyses include all tropical rawinsondes, wind soundings, and aircraft data received at NMC. They also include an average of about 125 winds deduced from cloud drift as shown in satellite pictures. The satellite SIRS temperature data are now (as of February 1972) used only in the area north of about 15°N.``

6. Selected Northern Hemisphere Grids from NMC

a. Sea level pressure and surface air temperature from NMC B-3
   Pressure: 18 May 1965 - current (00 and 12Z)
   Surface Temperature: 4 Oct 1965 - current (00 and 12Z)

b. Sea level pressure and 700 mb height and temperature from the Extended Forecast Laboratory.
   Sea Level Pressure: Jan 1947 - Aug 1967 (00 and 12Z)
   700 mb H, T: Jan 1947 - Jun 1967 (00 and 12Z)

   Many missing in the early months. On a diamond grid (5° latitude and 10° longitude) from 15°N to the pole. In earlier years the grid coverage was less.

c. Layer Humidity from NMC B-3 Tapes
   These are 1000-500 mb average relative humidity (3 March 1968 - 31 December 1972, 00 and 12Z, type 44). Starting in January 1973, there are three layers of relative humidity.

d. A discussion of NMC global grid data is contained in another section.

7. The Selection of NMC Grid Data Starting in January 1973

The Table shows the selection of NMC grid point data saved on the main archive tapes starting on 1 January 1973. Most of these grids were also saved
Chapter 3

prior to 1973. Some NMC grid data such as global analyses are discussed elsewhere. In the table below, the NCAR function code shows the type of data, and the grid type is:

1 = 1977 point NMC octagon (northern hemisphere)
3 = 73 x 23 point tropical grid
5 = data for 143 U.S. cities (maximum and minimum temperatures)
6 = data for 286 U.S. cities (precipitation) (deleted on 10 August 1973)

If Fcst is 0, it is an analysis grid; otherwise it is a forecast valid the designated number of hours later. The level is in millibars, except that 1013 = sea level and 1001 = surface.

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fcst)</th>
<th>Grid Type</th>
<th>Levels (mb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Pressure (sea level)</td>
<td>0</td>
<td>1</td>
<td>1013</td>
</tr>
<tr>
<td>1</td>
<td>Heights</td>
<td>0</td>
<td>1</td>
<td>1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, (70, 50, 30, 10 = 12Z only)</td>
</tr>
<tr>
<td>10</td>
<td>Temperature</td>
<td>0</td>
<td>1</td>
<td>1001, 850, etc. as for heights</td>
</tr>
</tbody>
</table>

Northern hemisphere winds (42 grid analyses/day)

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fcst)</th>
<th>Grid Type</th>
<th>Levels (mb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Vertical Velocity</td>
<td>0</td>
<td>1</td>
<td>850, 500, 200</td>
</tr>
<tr>
<td>30</td>
<td>U winds</td>
<td>0</td>
<td>1</td>
<td>850, 700, 500, 400, 300, 250, 200, 150, 100</td>
</tr>
<tr>
<td>31</td>
<td>V winds</td>
<td>0</td>
<td>1</td>
<td>same as for U winds</td>
</tr>
</tbody>
</table>

Northern hemisphere miscellaneous analyses and observations (20 grids/day)

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fcst)</th>
<th>Grid Type</th>
<th>Levels (mb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>Relative humidity</td>
<td>0</td>
<td>1</td>
<td>layers (1002-900), (666-1000), (333-666)</td>
</tr>
<tr>
<td>93</td>
<td>Snow depth</td>
<td>0</td>
<td>1</td>
<td>1001</td>
</tr>
<tr>
<td>47</td>
<td>Sea surface T</td>
<td>0</td>
<td>1</td>
<td>1001</td>
</tr>
<tr>
<td>28</td>
<td>Pressure tropopause</td>
<td>0</td>
<td>1</td>
<td>0-mb code-tropopause pressure</td>
</tr>
</tbody>
</table>
### Analyses from NMC

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fct)</th>
<th>Grid Type</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>T tropopause</td>
<td>0</td>
<td>1</td>
<td>0-mb code-tropopause temperature</td>
</tr>
<tr>
<td>20</td>
<td>Station T maximum</td>
<td>0</td>
<td>5</td>
<td>1001 station T maximum</td>
</tr>
<tr>
<td>21</td>
<td>Station T minimum</td>
<td>0</td>
<td>5</td>
<td>1001 station T minimum</td>
</tr>
<tr>
<td>90</td>
<td>Station total precipitation</td>
<td>0</td>
<td>6</td>
<td>1001 station precipitation</td>
</tr>
</tbody>
</table>

**Tropical analyses (36 grids/day)**

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fct)</th>
<th>Grid Type</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Temperature</td>
<td>0</td>
<td>3</td>
<td>850, 700, 500, 300, 250, 200</td>
</tr>
<tr>
<td>30</td>
<td>U wind</td>
<td>0</td>
<td>3</td>
<td>same</td>
</tr>
<tr>
<td>31</td>
<td>V wind</td>
<td>0</td>
<td>3</td>
<td>same</td>
</tr>
</tbody>
</table>

**Northern hemisphere forecasts (49 grids/day)**

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameter</th>
<th>Forecast (Fct)</th>
<th>Grid Type</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heights</td>
<td>12</td>
<td>1</td>
<td>850, 500, 300</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>24</td>
<td>1</td>
<td>1000, 500</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>36</td>
<td>1</td>
<td>1000, 850, 700, 500, 300</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>48</td>
<td>1</td>
<td>1000, 500</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>72</td>
<td>1</td>
<td>1000, 500 (no 1000 at 12Z)</td>
</tr>
<tr>
<td>10</td>
<td>Temperature</td>
<td>12</td>
<td>1</td>
<td>850, 500, 300</td>
</tr>
<tr>
<td>5</td>
<td>Vertical velocity</td>
<td>36</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>30</td>
<td>U wind</td>
<td>12</td>
<td>1</td>
<td>850, 500, 300</td>
</tr>
<tr>
<td>31</td>
<td>V wind</td>
<td>12</td>
<td>1</td>
<td>same</td>
</tr>
<tr>
<td>90</td>
<td>Total precipitation</td>
<td>36</td>
<td>1</td>
<td>1001</td>
</tr>
</tbody>
</table>

8. **NMC Forecasts Available at NCAR (written September 1973)**

a. Some forecasts for 24 and 36 h for 00Z for December 1968, January 1969, and May 1969. A more complete set of forecasts is available for December 1967, 00 and 12Z.

b. Starting August 1970:
   - 24 h 500 mb H
   - 36 h 1000, 850, 700, 500, 300 mb H
Chapter 3

c. Starting 15 July 1971:
   12 h fcst.: 500 mb H, T; 850, 300 mb H
   24 h fcst.: 1000, 500 mb H
   36 h fcst.: 1000, 850, 700, 500, 300 mb H
   650, 350 mb vertical motion
   Precipitation forecast

d. Starting 1 January 1973:
   12 h fcst.: U, V, H, T, at 850, 500, 300 mb
   24 h fcst.: 1000, 500 mb H
   36 h fcst.: 1000, 850, 700, 500, 300 mb H
   500 vertical motion
   Precipitation forecast
   48 h fcst.: 1000, 500 mb H
   72 h fcst.: 100, 500 mb H at 00Z
      only 500 mb H at 12Z

9. **Global Analyses from NMC**

   a. Introduction


   T. Flattery at NMC started running these test global analyses twice a day in January 1972. We believe that they should be useful global analyses starting 22 November 1972. The analyses are described by zonal mean values, zonal harmonics in the east-west direction, Hough functions in the north-south (program is called Huf-Puf), and other orthogonal functions for the vertical. At first there were about 16 waves for each horizontal direction and five vertical functions. During the archival period there have been 24 waves in each horizontal direction and seven vertical functions (smallest horizontal wave has a wavelength of 15° latitude or longitude). Surprisingly, this resolution has been observed to describe pressure troughs and jet stream core winds as well as or
better than the analyses on the NMC mesh with a spacing (at the standard latitude $60^\circ N$) of 381 km.

b. Height and wind analyses

Data were input at 12 levels: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, and 50 mb.

The number of 12-bit coefficients output is as follows for each of the quantities: phase of heights, phase of winds (U and V handled together), amplitude of heights, and amplitude of winds:

(7 in vertical) x (25 N-S) x (24 E-W)

The zonal mean values are given separately.

Descriptors for the vertical functions are also given. Since March 1973 a best choice of vertical functions is made each day from the global raob data. The choice of functions changes little from day to day.

Initially the first guess was persistence. In areas far from observed data, the methods that are used hold the persistence values rather rigidly (even from summer to winter). On 14 September 1972, the northern hemisphere forecasts were used as a guess north of $18^\circ N$, still persistence elsewhere.

The guess became the output from Stackpole's $5^\circ$ latitude-longitude, 8-level primitive equation model in October 1972. It worked correctly starting 15 November 1972.

When this analysis program became the operational package (starting in September 1974), the guess was Stackpole's $2.5^\circ$ latitude-longitude, 8-level primitive equation model.

We have noted that average analyzed 150 mb winds at Gan Island in the Indian Ocean for July 1973 show light westerly winds where the station showed the normal easterly winds. This is probably due to some combination of: lack of observed data, a poor guess from the coarse resolution forecast, something relating to the VTPR data, or the relative weighting of winds vs heights in the tropics. The analysed wind data were about $250^\circ/15 \text{ m s}^{-1}$. The Gan observed monthly mean data was $079^\circ/22 \text{ m s}^{-1}$.

NMC received data for 19 days during the month.
Chapter 3

The observed surface data were first used on about 30 April 1972. VTPR satellite sounding data were available starting 22 November 1972. These data were observed to improve the analyses considerably in the southern hemisphere (even the zonal means changed). On each analysis iteration, the heights for the VTPR soundings are recalculated, based on the analyzed pressure-height near the surface. Thus, surface data and rawinsonde data act to improve the reference level information for the use of the infrared soundings.

The analysis program uses ±6 h of VTPR data for the large scales and only ±3 h for the smaller scales.

Counts of the number of VTPR soundings for two random 12-h periods in May 1973 were 117 and 256 in the northern hemisphere, 159 and 222 in the southern hemisphere.

On 14 May 1973, forecasts from these analyses were first used to serve as a guess temperature structure for the operational workup of the VTPR soundings. This procedure was dropped after about three months because a program bug apparently jacked the guess up by the height of the mountains in the conversion from pressure sigma surfaces to heights and back. This made pulses over Antarctica, and over mountainous areas, which were carried along by the guess and may have caused good data to be thrown out. They went back to the old guess for VTPR which was a blend of the northern hemisphere forecasts, tropical forecast, and a simple southern hemisphere analysis.

T. Flattery noted (May 1973) that his 50 mb analyses were rougher than the operational analyses because he was not using as much smoothing.

c. Temperature and moisture analyses

Thickness temperatures are calculated from the height analyses. These thicknesses are used to calculate temperatures at the mandatory levels. The temperatures, in turn, are the guess for a reanalysis of the temperature for surface through 500 mb using temperature data. The surface temperature is entered at its elevation in such a way that it can be interpolated from the two surrounding mandatory levels. This analyzed temperature starts on about August 1973. There is now (January 1975) some
d. NCAR 2.5° Grid of global analyses

Because of its complexity and because machine time necessary to use the Huf-Puf analyses in wave form is very high, NCAR is preparing an archive of these data in 2.5° latitude-longitude grid point form.

For each analysis time there are 12 levels of height, temperature, U, V grids (1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50 mb), six levels of humidity (1000, 850, 700, 500, 400, 300 mb), and surface temperature and tropopause pressure. This is 56 global analyses per time or 224 hemispheric grids per day, each with 1032 x 60 bits.

Volume = 1.39 x 10^7 bits per day.

The 50 mb temperature grids are said to have problems because they are derived from thickness temperatures and thus represent an extrapolation.
Chapter 4: Cloud, Humidity, Rain, Moisture, and Water Data

In this chapter, we will discuss only a portion of the available data. The chapters on ETAC and NCC cover various sets of surface synoptic, daily summary, and hourly rainfall data. Chapter 10 discusses the average monthly surface station rainfall data. The satellite chapter indicates the brightness data that are available. Note that the Nimbus-5 data include cloud pressure and amount. Estimates of total clear column water vapor amount may be derived from the satellite VTPR data.

1. **Dew Point and Nephanalysis Data from AFGWC**

   Daily analyses are available at NCAR on the NMC octagonal grid for the following levels:

   **Dew Point:** 850, 700, 500, 400 mb

   **Nephanalyses:** 1013 (total clouds), 850 mb (low), 600 mb (middle), 400 mb (high). The period is 1 September 1963 - 20 November 1969, twice daily. Only total clouds are available until 15 April 1964, when the layered clouds were added.

2. **Layer Humidity from NMC B-3 Tapes (at NCAR)**

   These are 1000-500 mb average relative humidity (3 March 1968 through December 1972, 00 and 12Z, type 44). Starting in January 1973, there are three layers of relative humidity.

3. **U.S. Navy Moisture Analyses**

   The U.S. Navy has surface, 850, 700, and 500 mb moisture grids available from about 1965. See Chapter 14.

4. **Tropical Nephanalysis Data**

   Period February 1965 through January 1971 (at NCAR) and continuing. J. Sadler of the University of Hawaii has prepared daily cloud cover grids for the equatorial strip, 27.5°S to 30°N, with data each 2.5° of latitude and longitude. These data are based on the nephanalysis charts from the Satellite Service which are, in turn, based on brightness data from satellites.
Chapter 4

Maps of total average monthly cloudiness (30°N - 30°S) are given in Atkinson and Sadler (1970).

5. **Cloud Cover Based on Satellite Brightness Data**

Global cloud cover based on four years of satellite mesoscale (~40 x 40 km) brightness data are also available. Observation time is about 1400 - 1600 local. Has mean cloud cover, occurrence frequency of (a) 0, 1, 2 octas, (b) 3, 4, 5 octas, and (c) 6, 7, 8 octas. Tapes are available at NCC, Asheville. See Miller and Feddes (1971). Other brightness data are discussed in the satellite chapter.

6. **Average Clouds Based on Surface Observations**

In a NASA study, the globe was divided into 29 climatic regions and monthly statistics of cloudiness were prepared for each region, based on surface observations. Data for five cloud amounts (including clear and overcast), eight times a day, and each month are given on 1740 punched cards. Included are data on cloud changes with space and time. The climatic regions are located by 140 cards. See Sherr et al. (1968).

7. **Daily Stream-flow Data**

The U.S. Geological Survey has prepared 12 tapes (1600 BPI) with the daily stream-flow data for the United States. The set has 310,000 station-years of data. For the most part, the file contains those records that have hydrologic significance (excluding ditches, drains, etc.), and the file increases by about 14,000 station years per year. A related microfiche copy of a report is available from the U.S. Geological Survey, Reston, Virginia.

8. **Precipitation Data from Radar**

a. Automatically digitized data

In October 1974, six U.S. radar sites had digitizers giving echo intensity in 2° by 1 n mi increments out to about 120 n mi. There is a scan each 12 min. Intensity in 256 levels. Thus, (180) (100 n mi) (8 bits each) or about 150,000 bits each 12 min. This can be data-compressed by a factor of four. Root-mean-square error on total rain
Cloud and Moisture Data

is about 13% using a 12 min scan, because of echo movement and intensity changes. These data have not been archived yet.

There will be a digitizer at each of the 60 U.S. radar sites.

b. Manually digitized radar data

Archive started 1 July 1973, for an area of southeastern United States, bounded approximately by Texas, Oklahoma, Tennessee, and Florida (these states included). For each area 40 mi on a side, a digit is encoded in each box, each hour. Codes 0-9 are for none, weak, very strong, and include some information about echo coverage within the 40 mi box. Plans are to go to a 20 mi box size. Information from D. Smith of the National Weather Service. A report has been written.

The NWS Techniques Development Laboratory (TDL) has a similar data set including all data from the Rockies eastward, starting 1 November 1973. "Additive data" includes information about lines of echoes and changes of intensity. Data for November 1973 to November 1974 are on one packed 1600 BPI tape. For the 1974 summer season, TDL is now making another file of information about all severe storm reports (obtained from the severe storms lab). Information from D. Foster, TDL (NOAA Techniques Development Laboratory).

9. Soil Moisture and Drought Data

ETAC calculates soil moisture data. See Chapter 6, ETAC. Drought index (1931 on) from the Palmer index is at NCC.
Chapter 5: Miscellaneous Data Sets

1. **Gulf of Mexico Oceanographic and Atmospheric Data**

   Period of data: October 1968 through November 1971.

   The data-gathering stations were installed on six offshore oil platforms located about in an east-west line about 90 km south of the Louisiana-Mississippi coastline.

   The recorded data are wind speed, wind direction, barometric pressure, time, and two wave staffs. Several hurricanes went over the network. (Available from NCC.)

2. **Ozone Data**

   NCAR has data prepared by J. London, University of Colorado, that contain all the daily global total ozone data that he could locate and clean up. There were about 20 stations in 1957 and 80 stations in 1972. Data prior to 1957 are spotty. Oxford records go back to 1950 and Arosa records to 1932.

   London has also provided gridded average total ozone data for each month from May 1957 through December 1970. The grid is global and 10° latitude by 10° longitude.

3. **EOLE French Balloon Data**

   Data period 21 August 1971 to 23 December 1972 (satellite orbits 0065-7075).

   Gives the position of drifting balloons over the southern hemisphere. Six tapes have all of the data and one tape has the data for 27 August 1971 - 5 July 1972 without correction matrices. Data at NCAR. The French prepared a movie showing balloon drift; NCAR has a print.

4. **Line Islands Experiment**

   Surface and upper air data obtained in the Line Islands during the period February-April 1967 are discussed in NCAR TN-35, *A Catalog of Meteorological Data Obtained During the Line Islands Experiment*. (Zipser and Taylor, 1968). These data are also archived at NCAR.
Chapter 5

5. **Aircraft Data for GATE**

   NCAR is processing the aircraft data from the GATE experiment (June to September 1974). The packed, calibrated, primary data base at NCAR from seven aircraft will be about $3 \times 10^{10}$ bits, including gust probe data. A set of these data will be archived in one-minute averages on about $2 \times 10^8$ bits at NCAR. Most of the data will also be available for distribution in higher volume character formats. A copy will be available from NCC.

6. **Southeast Asia Mesoscale Upper Air Data**

   This data set includes rawinsonde data for about 20 stations, often four times a day starting in about April 1967. The soundings usually went up to about 300 mb. This data set was being processed by the Army. Its current status is unknown.

7. **Water Vapor Spectrum Lines**

   AFCRL has a data tape giving data for 110,000 lines of the water vapor spectrum.

8. **Station Library Information**

   NCAR has a tape prepared by USAF ETAC showing the location and elevation of WMO surface and upper air reporting stations. Elevations of raob stations are checked by downward hydrostatic checks. When WMO data are corrected, this fact is indicated. The tape has all WMO stations regardless of receipt. New tapes are made each month, but NCAR does not usually obtain the updates.

9. **Data from National Hail Research Experiment (NHRE)**

   There are now data from the NHRE experiment for the years 1972, 1973, and 1974. The operational periods were:

   1972: 1 May - 29 Jul (22 hail days)
   1973: 1 May - 9 Aug (6 hail days)
   1974: 13 May - 9 Aug (29 hail days)

   The NHRE definition of a hail day is somewhat arbitrary.

   **Rawinsondes**

   There were four, five, and two raob stations for the three summers. Each
generally took three or more soundings during every day of the operational period.

**Surface Observations**

There were hourly and special surface observations at the upper air stations for the hours 0800 to 1800 local time.

**Mesoscale Network OBS**

In a 70 by 70 km region in northern Colorado, there were about 30 stations (running 24 h per day) with strip charts showing pressure, temperature, humidity, wind and rain. These sites also had hail pads. Most of the rainfall charts have been digitized, as have some of the other charts.

**Precipitation Network**

In addition to the 30 mesoscale stations, there were about 90 stations with recording rain gauges and hail pads and 200 stations with regular rain gauges or hail pads or both.

**Radar Data**

There were up to seven radars in operation. The scan data were recorded digitally, and the magnetic tapes processed to produce simulated radar scope pictures on microfilm. In 1974 there were 40 days with microfilm output. In addition, a limited number of direct photographs of the radar scopes are available.

**Aircraft Data**

These data include digital data from penetrations of clouds and from flights around the clouds.

For further information contact NCAR.

10. **Data at the National Severe Storms Laboratory (NSSL)**

NSSL concentrates on obtaining mesoscale data (surface, upper air, and radar) during the period of about 15 April to 15 June. Radar data are obtained for the whole year. The upper air mesoscale rawinsonde data network has included as many as ten raob stations in an area 100 by 100 n mi. The surface mesoscale network in the same area often had about 64 stations.
Chapter 5

11. **Data at the Illinois State Water Survey (ISWS)**

    Hourly rainfall data for an east central Illinois station network from 1956-1967 (49 stations in summer, 25 in winter), are on cards. They have Saint Louis Experiment rainfall data starting June 1971 to last five years, for June, July, and August. ISWS has the upper air sounding data from the Saint Louis Experiment. They have surface 1009 cards (daily rain, maximum and minimum temperatures, etc.) for about 50 stations in Illinois, about 1901-1971. Data are also at NCC.
Chapter 6: ETAC. Environmental Data Sets
at USAF Environmental Technical Application Center

1. Introduction

This gives some information (as of January 1975) about the data sets held by the Air Force Environmental Technical Applications Center (ETAC), headquartered in Washington, D.C. ETAC will move to Scott AFB, Illinois in July 1975. The text sometimes refers to Offutt AFB, Nebraska, which is the location of the Air Force Global Weather Central (AFGWC). Appendix 1 gives an area breakdown and report counts of many of the major sets of data. Most of these data sets are saved at Asheville, North Carolina, where they can be easily accessed by ETAC or by NCC. A subunit of ETAC is located at Asheville. Some of these same data are also described in Chapter 7 (NCC). Some of the analysis data are described in Chapter 2. Major W. Buchan and Ralph Russell of ETAC have been a tremendous help in providing most of this information and helping to resolve the various questions that have arisen.

In this writeup, some data sets are referred to by Pnnn numbers, even though ETAC has since dropped this numbering scheme.

2. Surface Data -- Synoptic Code and Airways

Appendix 1 discusses the availability of surface synoptic data and airways code data in TDF 13 or TDF 14 formats. Between 1940 and about 1965 the data were usually punched onto cards from hard copies and finally were incorporated into TDF 13 and 14 which are arranged in station sequence. From about 1965 to 1970 the data were generally received on magnetic tape, decoded and manually edited. From 1971 on the data have been taken as decoded and checked by AFGWC, with additional quality control done only as required for specific projects.

a. Surface synfile (synoptically ordered file)

This is an ETAC decode of data from Carswell (data from communications circuits) with some data still from other sources. For example, some overseas circuits were recorded before they could be communicated to the United States. This data set is called COLFAC data. The file started 1 June 1964 (2, 3, 5, 6 August 1964 are missing). Then almost no data are missing up to June 1973.
Chapter 6

<table>
<thead>
<tr>
<th>Years</th>
<th>Usual No. of Days/Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964/65</td>
<td>7</td>
</tr>
<tr>
<td>1966</td>
<td>6</td>
</tr>
<tr>
<td>1967/68</td>
<td>5</td>
</tr>
<tr>
<td>1969</td>
<td>4</td>
</tr>
<tr>
<td>1970</td>
<td>3</td>
</tr>
</tbody>
</table>

Only identical duplicates have been eliminated. Airways and synoptic reports are included (but not combined, as Offutt does). Surface ship observations are also in this set. There are consistency checks against wild data but no checks for consistency with time (662 tapes up to 15 January 1972).

Captain Fenix (ETAC) thinks the quality is very good from 1966 on but is less sure about 1965. In January 1972 there were about 9300 active stations in the world. These are stations which normally report at least once per day. Many stations give three-hourly data, some six-hourly, and only once or twice per day.

The number of active stations was higher than in the tapes from Offutt or NMC.

b. Surface synfile from AFGWC

These surface data are the decoded data from Offutt. Thus duplicates have been eliminated and airways and synoptics combined. A copy of these tapes are saved at NCC, called the surface Datsav. Loose binary pack. Average length, 1200 bits each; $8.4 \times 10^6$ bits per day; 70,000 observations per day (but synoptics and airways at the same times combined to one).

c. Archive at NCC of these surface synoptic files

NCC has the COLFAC decode tapes from January 1967 through May 1973. Starting in June 1973 they have the tapes decoded from AFGWC. They pull off eight synoptic and ship observations per day to use in other files.
d. Sfc stafie (surface station file)

Data are in order by station, then date. One month for a number of
stations on a tape. The ships are at the front of the tape (block 00)
until November 1971, then at the end of the tape. Starting January 1965
from COLFAC data (a above). This station-ordered file has all of the
data in the associated synoptically ordered set plus some hand inserted
data from decode or library rejects at the end of the month. Has 546
tapes up to December 1971.

e. Sfc stafie from the surface synfile decoded by AFGWC

Starts January 1971. One month of data for a number of stations on a
tape. Ships at end of the number sequence each month. Was about
13 tapes per month, now 18. Synoptic and airways reports combined. About
8.4 x 10^7 bits per day.

f. ARPA surface data

This is an improved set of global surface synoptic and airways data
starting January 1965. From January 1965 to June 1971 this set has data
from TDF 13 synoptics and TDF 14 airways as well as the COLFAC data in
d above. From July 1971 through May 1973 it has data from COLFAC and
AFGWC decodes (d + e above). Starting June 1973 it is solely the AFGWC
decode. The AFGWC decode saves wind gust data, the COLFAC decode did not.
This ARPA set contains synoptics, hourlies, specials. Rainfall is
included if reported. Synoptics and airways at the same hour are
combined.

This is a station-ordered file by years: One year of first station,
one year of second, etc. Permanent ships have block 99 and a station
number. The roving ships are in a separate file. The Navy FNWC ship
file is probably somewhat better than this one. An exact synoptic file
version of this set is not being prepared, but a above is very similar
and b above should be the same in recent months.

The volume increases from about 65,000 observations per day in 1965 to
about 80,000 observations per day now (February 1975). Average 1200 bits
each, 8.4 x 10^7 bits per day.
Chapter 6

ETAC plans to concentrate on saving the most recent ten years of data.

3. Upper Air Data

As in the case of the surface data, ETAC has decoded earlier data that were saved by the communications system in order to get a better decode. In recent years the AFGWC decode has become the only source.


Only identical duplicates eliminated. Not hydrostatically checked yet. Data are fairly continuous from 2 November 1964.

<table>
<thead>
<tr>
<th>Years</th>
<th>Usual No. of Days/Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965/66</td>
<td>7</td>
</tr>
<tr>
<td>1967</td>
<td>10</td>
</tr>
<tr>
<td>1968/69</td>
<td>8</td>
</tr>
<tr>
<td>1970/71</td>
<td>6</td>
</tr>
</tbody>
</table>

In January 1972 ETAC received data from 1600 active upper air stations. Raob and pibal stations that reported any data were counted. This is more than AFGWC or NMC were obtaining then. This set includes permanent ships, moving ships, and aircraft reports, but not dropsondes (375 tapes to 31 December 1971).

b. Upper air synoptic data from Offutt (called Hydro tapes).

Starts 27 April 1966. From 1966 to 1968 there are usually about 6 days per tape. Data to 1 November 1969. The raobs had a radiation correction applied until about August 1968; the corrections were applied only to the higher mandatory levels and not to the corresponding significant levels. After this date there is some gap in the data set, and then it is in packed binary rather than in BCD, and it does not have the radiation corrections applied. NCAR has some of these data.

c. Later upper air synoptic file from AFGWC.

These upper air Datsav tapes from Offutt started in 1970. ETAC says the coverage and quality of the COLFAC is normally better where they overlap in time, but by the time the COLFAC decode stopped, the AFGWC decode was nearly as good. Has land raobs and pibals, and ship and
aircraft data. Usually three tapes per month, about 4700 observations of all types per day.

d. Archive at NCC of these upper air synoptic files.

NCC has the COLFAC decode tapes from January 1967 through December 1972. The data before 1968 are in a different format and, like the later COLFAC data, have not been hydrostatically checked; the data set, however, has been used with success. Starting January 1973 the tapes were decoded at AFGWC. These are all in the NCC tape set 9601. In addition NCC makes a selection-merge of data from the AFGWC and NMC tapes to produce a file of raobs in TD 5600 format (started in July 1971).

e. P240 Upper air station file, from P210 COLFAC.

Only one month for a number of stations on a tape. Has land raobs and pibals, and ship and aircraft data. Starts January 1968. At end of each month a few stations that fall decode or library checks are inserted in this set that are not in the synoptic set. Has 191 tapes January 1968 to December 1971, and continues.

f. P370 Upper air stafile from AFGWC.

September 1970 on. Much of the first of this data set has been thrown away because the set from COLFAC data (P240) is better. ETAC does not really use this until January 1973. They noticed a slight drop in quality when they shifted to the AFGWC data in January 1973, and then a gradual improvement. Data are hydrostatically checked at GWC. One month of data for many stations on a tape.

g. ARPA Upper air data.

This will start with January 1968. It is the COLFAC set P240 through 1972, then the AFGWC set P370. It is all in the AFGWC Datsav format (loose binary, variable length blocked). The data from COLFAC will also be hydrostatically checked. The other raob TDF sets will not be used in the preparation of this. Work on this set is starting at ETAC OL-A in Asheville. They have received 300 tapes of data for January 1968 to December 1972, and will receive about 72 more through December 1974. They hope to have the set of data through 1974 finished by September 1975.
Chapter 6

It will then be in Datsav format on about 322 tapes. It will be in station order within years: first station for a year, next station, etc. Includes land raobs and pibals, and ship and aircraft data.

4. **Satellite Soundings**

Temperature retrievals from the IR radiances from the military satellites are being saved as received from AFGWC. The radiances are not saved yet. See Chapter 13 for more information.

5. **TDF 13 Surface Synoptic Data**

See Appendix 1 for a global breakdown. Each observation is variable length with 65 standard characters and an estimated average of 15 more characters. Thus total volume (excluding block fill characters) is: \(107,231,000\) observations \((80\) characters each) = \(8.58 \times 10^9\) characters.

6. **Analyses from AFGWC**

a. Northern hemisphere analyses

Analyses from AFGWC at Offutt (on the NMC northern hemisphere octagonal grid). A more detailed listing of the available height, temperature, cloud, and moisture analyses is given in Chapter 2.

- Multilevel heights
  1 Jan 1962 - 20 Aug 1970, continuing

- Multilevel temperatures
  1 Jan 1962 - 20 Aug 1970, continuing

- Multilevel nephanalyses
  1 Sep 1963 - 20 Nov 1969

b. Tropical analyses

Tropical analyses from Offutt starting August 1970. Winds and temperatures for \(40^\circ\)S - \(40^\circ\)N. Levels: surface and 850, 700, 500, 400, 300, 250, 200, 150, 100, 50 mb; this now (February 1975) goes to 10 mb. The analysis guess was 6 h persistence, but this was blended with the northern hemisphere forecast from 20 to \(40^\circ\)N, and with a southern hemisphere forecast when available from September 1971. The result was then blended with \(30^\circ\) climatology to produce the guess that was used. Each level was analyzed independently with no additional methods to
Data at USAF/ETAC

provide more vertical consistency. Two tapes per month. (1 August 1970 to 15 January 1972 uses 32 tapes.)

c. Southern hemisphere analyses

These analyses are for 15 levels from 1000 to 10 mb and start in January 1972.

d. Upper-air analysis data base

The later years of the AFCWC analysis data are restructured in the following ways for this data base, so that they can be more easily used with the 3-D nephanalysis: This data base is maintained in two parts, northern hemisphere and southern hemisphere. Each of the hemispheric disks is divided into 64 boxes, as in the 3-D nephanalysis data base. Within each box there are 64 grid points in an arrangement of eight rows and eight columns. The data elements for each point are pressure and temperature of the surface level; D value, temperature, and wind components for 15 levels above surface; dew point temperature of the surface, 850, 700, 500, and 400 mb levels.

Data are maintained for the 00Z and 12Z hours. The sequence of the file is YR-MO-DA-HR-BOX-POINT-ELEMENT. Each hemisphere-year-month is a separate subfile within the data base.

The period of record for the northern hemisphere begins with January 1971; for the southern hemisphere it begins with January 1972.

e. Monthly averages of analysis data

Year-month averages of the analysis data will start with January 1971 for the northern hemisphere and January 1972 for the southern hemisphere. These will give means and standard deviations of height, temperature, U, and V for the levels 1000 through 10 mb. Moisture will be included through 400 mb.

f. Three-dimensional nephanalysis data base

1) The 3-D nephanalysis data base is formulated into two parts, the northern hemisphere (3DNEPHNHA) and the southern hemisphere (3DNEPHSHA). Each of the hemispheric disks is divided into 64 boxes. Within each box there are 4096 grid points in an arrangement of 64
Chapter 6

rows and 64 columns. Figure 6 (1a and 1b) shows the arrangement graphically.

Twenty-two parameters are reported at each grid point. The first seven are cloud types (3), weather, maximum tops, minimum bases, and total coverage. The remaining 15 are percent cloud amounts for 15 layers of variable thicknesses. The first layer goes from the surface to 150 ft above the ground. The top of successive layers are 300, 600, 1000, and 2000 ft AGL, and 3500, 5000, 6500, 10,000, 14,000, 18,000, 22,000, 26,000, 35,000, and 55,000 ft MSL. The horizontal resolution is one-eighth NMC mesh or about 45 km at 60°N. The analysis procedure uses satellite, aircraft, and conventional data. See Coburn (1970) for a description of the procedure.

3DNEPHNHA is reported every three hours at 00, 03, 06, 09, 12, 15, 18, 21Z. The general period of record began in August 1970. Initially 32 boxes were reported; additional boxes were added in 1971 and 1972. Sixty boxes are reported currently (boxes 1, 8, 57 and 64 are not reportable since they are off the disk). Figure 6–1 shows the beginning period of record for each box in the northern hemisphere. The data base is kept in BOX–TIME sequence.

3DNEPHSHA period of record begins in May 1974. These data are not currently processed into box-time files but are maintained in synoptic sequence.

Volume: There are

5.905 × 10⁵ bits per box analysis
1.726 × 10⁷ bits per box year

2) Low, middle, high cloud file

This is a condensed version of the 3-D nephanalysis and has about one-fourth the volume.

3) Histogram file

This file keeps histograms of cloud frequency from 3-D nephanalysis by month, level, and time of day. There are 6.5 × 10⁵ bits per hemisphere.
Data at USAF/ETAC

g. AFGWC Boundary-layer model (BLM) grids

BLM analyses began in August 1970 at AFGWC for the U.S. window, 00Z and 12Z. The European and Asian windows were added later (see table below). Mesh size is one-half NMC (100 n mi). The levels are: surface, 50, 150, 300, 600, 900, 1200 and 1600 m. Parameters are: U, V, W wind components, temperature, specific humidity, specific moisture (vapor plus liquid), relative humidity, and D-values. Only levels 1, 2, 5, and 6 were available until April 1973. When the data are prepared at AFGWC hourly forecast values are also available, but these are dropped from the data tapes before transmission to ETAC. See Hadeen (1970) for a description of the boundary layer model.

<table>
<thead>
<tr>
<th>Area</th>
<th>Start Date</th>
<th># Points</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Window</td>
<td>Aug 1970</td>
<td>29 X 27</td>
<td>45N 137W, 62N 53W,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17N 107W, 23N 70W</td>
</tr>
<tr>
<td>European Window</td>
<td>18 Jul 1974</td>
<td>29 X 35</td>
<td>73N 55W, 45N 91E</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>32N 06W, 22N 48E</td>
</tr>
<tr>
<td>Asian Window</td>
<td>18 Jul 1974</td>
<td>29 X 35</td>
<td>44N 111E, 72N 110W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21N 153E, 32N 155W</td>
</tr>
</tbody>
</table>

7. Other Data Sets at ETAC

a. Astrogophysical data

ETAC has been accumulating AFGWC-processed solar/geophysical data since January 1972. The original set contained 23 parameters; five more were added in July 1974. The parameters include sunspot counts, flare data, ionosonde data, and maximum and minimum observable radio frequency for the ionospheric layers (120 magnetic tapes have been accumulated through December 1974).

b. Long-term precipitation means from charts


c. Soil moisture

Calculated from precipitation, etc., in P200. Only available for selected areas. One tape for a month. Saved for only a few months.
Chapter 6

d. Airfield summary data

ETAC has published worldwide airfield climatological summary data in 23 volumes, covering all of the world's runways over 3000 ft in length (about 4500). In some cases a "closest station" had to be used rather than one right at the airport. Monthly mean snowfall is included. Wind rose data are not given, but the frequencies of days with winds over 17 kt and over 27 kt are given. These data are also on about 60 magnetic tapes at ETAC Washington.
Boxes
11, 12, 13, 14, 18, 19, 20, 21
22, 23, 26, 27, 28, 29, 30, 31
34, 35, 36, 37, 38, 39, 42, 43
44, 45, 46, 47, 51, 52, 53, 54
03, 04, 05, 17, 25, 33
50, 59, 60, 61, 62
24, 32, 40, 48
02, 06, 07, 09, 10, 15, 16, 41
49, 55, 56, 58, 63

Beginning P.O.R. Reporting
1 Jan 1971 00Z (32 boxes)
21 Mar 1972 12Z (38 boxes)
20 Apr 1972 12Z (43 boxes)
16 May 1972 15Z (47 boxes)
15 Feb 1973 09Z (60 boxes)

NOTE: Boxes 01, 08, 57, 64, do not contain data as they are off the Equator.

Geographic Location
02, 09, 10, 17, 18, 19, Western Pacific
03, 04, 05, 11, 12, 13, South East Asia
06, 07, 14, 15, 16, 24, Indian Ocean
25, 26, 27, 33, 34, 35, Central Pacific
20, 21, 28, 29, 36, 37, Polar Region
22, 23, 30, 31, 38, 39, Europe/Africa
41, 42, 49, 50, 58, 59, Eastern Pacific
43, 44, 45, 51, 52, 53, United States
46, 47, 54, 60, 61, 62, Atlantic/South America
32, 40, 48, 50, 55, 63, South Atlantic

Fig. 6-1a. 3DNEPHNA Projection Map of Numbered Boxes.

Fig. 6-1b. 3DNEPHSHA Projection Map of Numbered Boxes.

Fig. 6-1. Locations of 3DNEPH grid boxes. The period of record for the northern hemisphere is shown. Southern hemisphere data start in May 1974.
Chapter 7: NCC Data at the National Climatological Center

1. Introduction

NCC, in Asheville, N.C., is the main data archive in the United States for meteorological data. It is under the Environmental Data Service (EDS) of NOAA. In this writeup, we will only consider some of their main data sets. Analyzed and observed data from NMC flow into NCC. Data from the Air Force AFGWC go to ETAC in Washington, D.C., and, finally, most of it goes to the ETAC unit in Asheville. Some of the Navy FNWC data also goes to NCC. There is a Navy unit at Asheville. When data are punched by civilian or military sections at NCC, they become part of a common data pool. Data on tape or cards from various foreign or United States sources also become a part of the pool, although there is bound to be somewhat less knowledge of data sets that were not locally created.

Much of the satellite data also now goes to NCC in Asheville, but the plans are for it to be stored at NESS.

A number of the sets of NCC data will be treated outside of this section of the text. Also some of the sets listed may be superseded by the same data in better condition in a reformatted set.

For the U.S. first-order stations, there were many station moves from city locations to airports during the period 1935-1939. Then between about 1955 and 1965 many of the instruments were moved from shelters on airport roofs to remote reading locations above the grass in the middle of the airport. Only about five of some 300 first-order stations were not moved in the period from 1935 to 1970.

Information about published climatic data can be found in Selective Guide to Published Climatic Data Sources (NCC, 1969). The LCD (Local Climatic Data) NCC publications provide information about the station histories.

2. Listings of Data Holdings

Appendix 1 gives a broad view of the data holdings within some of the sets of observed surface and upper air data. The information for this appendix was prepared by ETAC in December 1974. Appendix 2 gives a data listing prepared by NCC and NCAR in 1975.

3. Rawinsonde Data

The U.S. sondes used during the approximate period 1963 to 1972 could give
mixing ratios (in moist air and sunny skies) of 12 g/kg rather than the correct 20 g/kg. The humidity element absorbed too much direct sunlight and gave a relative humidity appropriate to this elevated temperature and not to the cooler actual temperature reported by the temperature element. The archived raob data do not include any stratospheric radiation corrections made after data receipt. See McInturff and Finger (1968) for suggested corrections as a function of instrument type, pressure level, and solar elevation angle.

Canadian data are not now (January 1975) available at NCC past September 1971.

a. Rawinsonde mandatory and significant level data (TDF 5600)

Since 1971 the U.S. rawinsonde data have been saved in this format, which includes significant levels. Some of the new data are converted to the older formats and vice versa (2000 characters per raob).

b. Raob mandatory level cards (Deck 645) January 1961 - June 1971

The Deck 645 raob mandatory level cards were punched for Canadian stations, for U.S. stations, and for selected other stations with bilateral agreements. The mandatory levels are for each 50 mb in the lower troposphere. There are about 33 levels in the normal sounding. These data are thus more extensive and better checked than the data transmitted by teletype. The wind direction is given to the nearest degree. Data are on 59 7-channel, 556 BPI tapes at NCC. Received on 32 9-channel, 1600 BPI tapes at NCAR. Volume: 9.4 X 10^8 characters.

c. Rawinsonde data -- mandatory levels (TDF-54) January 1928 - December 1971

ETAC has put many of the available U.S. and foreign mandatory level data onto tape in TDF 54 format. This has 800 characters per raob and provides for up to 40 levels. Data at constant pressure levels, except in early periods when they are at constant heights. The U.S. data mostly start in 1946; Canadian data start in about 1955. The earlier U.S. constant height raobs generally started about July 1939. The constant pressure data include Deck 541 (1946-1948), Deck 542 (1949-1952), Deck 544 (1952-1955), Deck 545 (1956-1960), and parts of Deck 645 (1961-1971). These data are in a common set of units.
Data at NCC

Area: Worldwide, including ocean weather stations
Volume: 5,155,000 observations from 1412 stations, 800 characters per raob, on 535 reels of 9-track tape

d. Northern hemisphere rawinsonde (January 1949 – June 1971 on)
   Area: Northern hemisphere
   Rawinsonde observations going as high as 10 mb, 600 stations, on magnetic tape

e. Rawinsonde data – Northern hemisphere Scherhag set (March 1954 – December 1962)
   Data from 31 northern hemisphere stations, once a day
   The data are on magnetic tape

f. Dropsondes, Ptarmigan-Arctic (Deck 610) June 1951 – November 1959
   Volume: 24,000 observations on two reels of Fosdic film
   (Also, there are other decks of dropsonde and reconnaissance observations.)

g. Monthly means of rawinsonde data (about 1950 on)
   NCC and NCAR have tapes of these data which are being cleaned up. These data can be found in the NCC publication, Monthly Climatic Data of the World.

h. Raob signal levels (Deck 606) January 1945 – May 1963
   Area: Worldwide land and ships, mostly U.S. Nearly all of these are for only the seasonal months January, April, July, and October. After 1952, this set will be mostly redundant with the data in Deck 505.
   Volume: 5,000,000 significant levels (about 397,000 observations) on 431 reels of Fosdic film.

i. Radiosonde significant levels (Deck 505) July 1952 on
   Area: United States, Canada, Mexico, Caribbean Sea, Antarctica, South America, North Atlantic Ocean, Pacific Islands. Canadian data are mostly from 1957 on.
   Volume: 20,000,000 significant levels (about 1,450,000 observations) on 125 reels of 9-track tape.
Chapter 7

4. Winds Aloft Data

The mandatory level rawinsonde observations will include wind data for many stations that are not in these sets.

a. WBAN winds aloft (TDF-53) January 1918-December 1964
   Global coverage
   Volume: 5,119,000 observations on 500 reels of 9-track tape

b. Foreign winds aloft (TDF 52) January 1922-December 1966
   Global coverage, not including North America
   Volume: 3,853,000 observations on 150 reels of 9-track tape

c. Winds aloft WBAN January 1945-August 1965
   From 1400 worldwide stations
   From rawinsonde and pilot balloons (Weather Service, Air Force, Navy, and Canadian stations.)
   The data are on Fosdic film

d. Upper air winds (Deck 508) March 1951-February 1959
   For 950 to 10 mb, United States, Canada, Puerto Rico, Canal Zone
   Volume: 275,000 observations on 25 reels Fosdic film

e. Upper air winds, Eurasian (Deck 500) January 1951-February 1958
   Area: Asia, Europe, Greenland, North Africa
   Volume: 115,000 observations on ten reels Fosdic film

f. Winds aloft, Canadian (Deck 685) July 1955-July 1971
   Area: 70 stations in Canada
   These data are on magnetic tape. They are also included in TDF-53 through 1964.

5. Rocketsonde Data at NCC (January 1975)

NCC has all of the U.S. data and a portion of the foreign data on about 24 tapes. The data for U.S. stations for 1961 through 1968 are on 12 tapes in an earlier format. The main effort started in 1969; this tape format includes data
for U.S. and foreign stations. The U.S., South American, and Spanish stations are on one tape each four months. (In January 1975, data are available through 1972; 1973 should be ready in two months.)

There are three delayed data tapes. One is from Russian land stations with some data back to 1961. Another similar tape contains Russian ship data, and another has some of the Australian and Japanese data. NCC is attempting to obtain more of these data.

The January 1970 and 1972 issues of the High Altitude Meteorological Data Publications from NCC have inventories of the data. The January 1973 issue will contain another inventory and will be published about July 1975.

6. **Surface Synoptic Observations**

Most of the smaller sets are not listed here. See Appendix 1 for coverage of land synoptic observations.

   a. Surface synoptic observations (TDF-13) January 1901 on Area: worldwide land (not including the United States) Volume: 64,000,000 observations on 1300 reels of 9-track tape

   b. Surface synoptic observations, Norwegian January 1951-December 1956 Volume: 280,000 observations on two reels of 9-track tape Surface synoptic observations, Greenland Volume: 107,000 observations on two reels of 9-track tape

   c. Surface marine synoptic observations (TDF-11) January 1854 on See Chapter 17 for a more complete discussion. Area: worldwide ocean (grouped by 10° latitude-longitude squares) Volume: 43,000,000 observations on 375 reels 9-track tape

7. **Airways Data**

   a. General

   NCC has hourly observations from about 300 to 400 U.S. first-order stations on tape for the period January 1949-December 1964. A number of
Chapter 7

stations go back to 1930. Starting in January 1965, only eight observations per day have been punched.

Worldwide U.S. military stations were still punched each hour through December 1970 and are on tape. The punching of the military data stopped when the receipt of the teletype data was considered good enough.

The tapes from ETAC-AFGWC have about 30,000 hourly airways and special reports per day. These are for all stations received on the teletype circuits, not just the first-order stations.

In 1977, NCC will get hourly information plus specials directly from about 1000 stations. They will be a primary node in the communications system.

b. Airways surface observations (TDF-14) January 1940 on
Area: worldwide land, mostly United States, 1800 stations. The U.S. stations came from Deck 1440 and generally start in July 1948.
Volume: 166,000,000 observations on 2800 reels of 7-track, 556 BPI tape through 1973.

c. Hourly surface observations (Deck TD-9753,928) January 1965-December 1970
Area: North Atlantic and North Pacific Oceans
Volume: 315,000 observations on two reels of 9-track tape

8. **Daily Surface Data for United States**

a. Daily data from U.S. Cooperative Stations and First-Order Stations (at NCC)

Daily data for about 12,000 stations are punched and checked at NCC (Deck 486, punched from Form 612-3, formerly 1009, and First-Order Summary of the Day from MF 1 10B). The data include at least daily precipitation and most stations report maximum and minimum temperatures. Evaporation data are included from 500 stations. The State Climatologists assisted NCC with data checking until their positions were eliminated in 1973. Data for the current year are on four tapes per month: three for the United States, Caribbean, Alaska, and Hawaii; and one for delayed data.
Once a year, between March and June, the previous year's file is combined onto 20 reels. The data through about 1970 are organized on tapes by long station time series within each state.

Through cooperative agreements with universities and state agencies, some records as early as 1879 are included. Approximately 600 stations have 30 or more consecutive years of data. These long-term records are usually from suburban areas. Some states have no data prior to 1948. The general beginning date for this file is 1948. Data prior to October 1963 were placed on Fosdick film for retention, but by July 1975 all of these will be placed on tape. The volume of observations in CD 486 on tape is 110,000,000 card images (80 characters each) on 700 reels of 9-track tape and covers the United States, Caribbean, Alaska, Hawaii, Pacific Islands, and a very small number of Canadian stations.

b. Summaries and climate division data

The world records data (year-month mean surface) are on tape at NCC and NCAR; they are discussed in the NCAR section.

c. Surface observations -- monthly means of 1009 (Deck TD 9924, 932)

January 1891 on

Area: United States, Caribbean, Pacific Islands

Volume: 4,000,000 observations on 30 reels of 9-track tape

d. Surface observations -- monthly summaries and daily data (TD 9716)

1 January 1960 on

Area: United States, Pacific Islands, Puerto Rico

Data for first-order stations, including some monthly summaries by hours. From airways Deck 1440 (hourly or three-hourly data). Summary of winds by speed categories, etc. Published in LCD (Local Climatological Data) summaries.

Volume: 4,000,000 observations (80 characters each) on 22 reels of 9-track tape.

e. Station climatology

A tape containing station climatologies is also available. A new two-volume publication of the station climatologies may be purchased from NCC.
Chapter 7

f. Climatic division data -- monthly summaries (Deck 475) January 1931 on

For the 400 climate divisions in the United States, this deck gives year-month means of temperature and precipitation.

Volume: one tape

g. Daily and weekly data for climatic divisions (about 1965 on)

Includes daily maximum and minimum temperatures, by U.S. climatic divisions. Heating and cooling degree days were calculated from this.

9. Other Daily Surface Observations

a. Summary of day observations (TDF-34) January 1885 on

Area: worldwide land (mostly United States)

Volume: 20,000,000 observations on 900 reels of 9-track tape

b. Summary of day observations (U.S.) (Deck 331) January 1934-December 1944

Volume: 90,000 observations on eight reels of Fosdick film

c. Summary of day observations (TDF 30)

NCC is gradually putting many summary-of-day observations into this format. Now all summaries for first-order stations (Deck 345) and some of Deck 486 have been converted. TDF 34 will also be converted.

d. Summary of day, Canadian Arctic (Deck 335) January 1955-December 1967

Area: Canadian Arctic

Volume: 24,000 observations on one reel of tape

e. Surface daily winds, ocean station vessels (Deck 328) January 1948-December 1972

Area: North Atlantic, North Pacific

Volume: 25,000 observations on one reel of 9-track tape

10. Rainfall Data

In addition to the sets below, rainfall data are also given in the airways data, the surface synoptic data, the radar data, the daily summary data, and the monthly mean data.
Rainfall data taken from the surface synoptic reports are often somewhat questionable. They are subjected to a variety of coding practices which might not be taken into account. If the rain group is not reported, one cannot be certain that there was no rain. In a recent survey of the teletype data, the rainfall data for Russia and China appeared good; over parts of southeast Asia they were poor (and could be either too high or too low). The rain data can even be poor in the TDF-13 deck of surface synoptic observations.

a. Hourly precipitation data (Deck 488) July 1948 on
   Area: North America, United States, Honduras, Mexico, Swan Island, Nicaragua, Puerto Rico, Virgin Islands, Bahama Islands.
   Volume: 14,000,000 observations on 150 reels of 9-track tape

b. Seven-day U.S. rainfall (Deck 487) January 1906–December 1935
   Area: United States
   Volume: 342,000 observations on 29 reels of Fosdick film

c. Australian monthly and annual precipitation (Deck 990) January 1900–December 1964
   Volume: 7000 observations on one reel of Fosdick film

11. Miscellaneous Sets of Surface Data

a. Drought analyses.
   NCC has Palmer index data from about 1931 and nearly up to date. There are also some crop moisture index data.

b. Freeze data, United States (TD 9712, 948) January 1931 on
   Volume: 80,000 observations on one reel of 9-track tape

c. Soil temperatures (Deck 860) January 1967 on
   Area: United States, Puerto Rico
   Volume: 200,000 observations on one reel of tape
Chapter 7

12. Solar Radiation

a. Solar radiation, hourly and daily (Deck 470) September 1923–June 1952
   Area: United States, Canada, Pacific Islands, Iceland
   Volume: 370,000 observations on 31 reels of Fosdic film

b. Solar radiation sum of day (Deck 480) July 1952 on
   From about 160 stations in the United States, Canada, Caribbean, and
   Pacific Islands. Canadian data stopped December 1959. Corrective
   measures are being taken on the set. Values may vary from a few percent
   high to 20 to 30% low.
   Volume: 650,000 observations on four reels of 9-track tape

c. Solar radiation hourly (Deck 280) July 1952 on
   Area: United States
   Volume: 2,500,000 observations on 20 reels of 9-track tape. Work is
   proposed to clean up this set more fully and to calibrate at least some
   of the stations in it.

13. Data from Bomex Experiment

   Period of experiment: May through July 1969

   a. Bomex marine observations
      Ship and land synoptic observations eight times daily; Caribbean,
      2,000,000 observations

   b. Bomex rawinsonde observations
      Rawinsonde ship observations, 8 to 15 daily; Caribbean, 2500 soundings

   c. Bomex aircraft reconnaissance flights
      Area: tropical Atlantic and Caribbean
      Volume: data from 79 aircraft flights on magnetic tape

   d. Bomex boom data
      In Caribbean: Data each 30 sec on air and water temperatures, wind,
      humidity, and precipitation.
Volume: 2,000,000 observations on magnetic tape

14. **Cyclone Positions**

   a. **Tropical cyclone positions**

   This NCC set has about 70,000 12-hourly positions up through about 1971 (12,000 in the North Atlantic, 20,000 in the North Pacific, and 10,000 in the Indian Ocean). Some of the data include the central pressure and maximum winds. Some six-hourly positions are given. Data from a number of sources are included. For example, data are included from Chin's (1972) *Tropical Cyclone Climatology for the China Seas and Western Pacific from 1884 to 1970*. After about 1947, data from reconnaissance aircraft were often used to position the storms. Since about 1960, satellite pictures have been available. Chin's book includes central pressure and peak winds (NCAR has a copy).

   b. **Extratropical cyclone positions (1899 present)**

   For the period 1899-1939, there are once-a-day low pressure centers with central pressure. For June 1965 to the present, there are six-hourly positions, with central pressure only given at 12h. On tape.

15. **Tower Data - Cedar Hill, Texas (December 1960-December 1962)**

   Wind and temperature data at 12 levels, 30-1420 ft, near Dallas. Observations each 40, 280, or 580 s.

   Volume: 256,000 observations on five reels of 9-track tape.

16. **Data Sets Stored Elsewhere that are Related to NCC Data**

   a. In the section on NCAR data holdings, a number of sets are discussed which originated partly or totally at NCC.

   b. **Maximum and minimum temperatures, daily precipitation data**

   Data at the Extended Range Forecast Laboratory (NMC), based on information from R. Gelhard, September 1971.

   The Extended Forecast Laboratory has tapes based on daily card data for 108 stations in the 48 contiguous states. The period of record is
Chapter 7

1947-1965; the data were from NCC. Their tapes contain cleaned-up data (and no missing values) of maximum and minimum temperatures and total daily precipitation. The Techniques Development Laboratory added about 32 U.S. and Canadian stations, and Gelhard thinks that these were also cleaned up.

The Extended Forecast Laboratory put the original cards (Gelhard thinks WBAN-3 cards) on tape and edited them; the original records were used to fill in the many missing values and to correct many errors.

c. Station data

A number of states have tapes that have much of the past station data. A program should be started to identify such data unless they merely duplicate NCC holdings without additional cleanup, etc.

d. The Bonneville Power Administration, in cooperation with several other federal and state organizations maintains extensive sets of surface data on magnetic tape for several western states and for British Columbia.

17. Ozone Soundings from Balloon Ascents (January 1963 through May 1969)

The first eight months of data are in one format on 11 tapes for 11 stations; not much data on each tape. The rest of the period is on two tapes. Bedford has data for 68 months with 451 observations. The next best station is Goose Bay with 53 months and 178 observations. The data have been summarized by Hering and Borden (1967).
Data at NCC

18. Coastal Observing Stations

There is no combined set of coastal station observations. Some Weather Service stations such as Miami Beach record water temperatures on WBAN-10 forms, but they are not punched because there is no room for the data in the card format. Until recently there has been little standardization in Coast Guard station practices. The WMO synoptic code includes a code group for water temperature data, so if the code is used and if NMC or AFGWC decode the data, then the water data should be available with the rest of the synoptic data at NCC. Such sets of global synoptic code data start in 1965.

19. Atmospheric Turbidity Data

Starting in 1971 (and punched through October 1973 as of March 1975), NCC has taped data for about 60 global stations measuring turbidity. Most of these stations are in the United States. The data are published in the annual publications by NCC, Atmospheric Turbidity and Precipitation Chemistry Data for the World.

The earlier data are being prepared by the Environmental Protection Agency at Research Triangle Park and will then be sent to NCC. See Flowers et al. (1969) for information about turbidity over the United States.

20. Data from GATE Experiment

The data from the June-September 1974 GARP Atlantic Tropical Experiment are being archived at World Data Center-A at NCC. A GATE data catalog has been prepared by NCC with the assistance of CEDDA. The data include ship surface and rawinsonde data, ship radar data (digital and picture), satellite data (digital and picture), boundary-layer data, aircraft data, radiation data, and oceanographic data. The synoptic-scale and global data will also be available. These data are being prepared by the GATE National Processing Centers and Subprogram Centers and will be sent to NCC when the data processing is completed.

A number of WMO publications about GATE are available. People ordering from all countries except the United States should write to the WMO in Geneva, Switzerland. Orders from the United States should be sent to WMO Publications Center, UNIPUB Inc., P. O. Box 433, New York 10016.
Chapter 8: Upper Air Observed Data

Section A: Upper Air Observed Data in Synoptic Order

NCAR has upper air data in synoptic sequence starting in May 1958. The first five years were from MIT. Since about 1962, the synoptically filed data are from real time teletype data decoded by the numerical weather centrals. These data include significant-level information. In fact, more significant-level data have been transmitted over teletype than were post-punched for U.S. stations at NCC until procedures changed in 1971. The data coverage on the NMC tapes became global (as received operationally) in June 1966.

1. From NMC


NCAR has tapes containing the upper air data received synoptically at the weather centrals. Figure 1-2 shows NMC data coverage on typical days in 1968 and 1974. This plot was computer-made by scanning one of the time periods on a tape from NMC. (The coverage became global in June 1966.) Data from 4 March 1962 to 31 December 1972 are on 377 tapes. For earlier years up to 44 sounding times (22 days) are stored on each tape; in 1972, about 15 sounding times are stored per tape. Previous to 1 November 1969, only the 00Z and 12Z soundings were archived; since 1 November 1969, 06Z and 18Z records have also been kept for a few months, the former in the 00Z file and the latter in the 12Z file. To obtain these data from 4 March 1962 to 31 December 1972, NCAR read 1,845 B-3 tapes from NMC. The tapes have the upper air data received within about 10 h of 00 or 12Z. Prior to 1973, the aircraft data were deleted on the tapes for NCC, but NCAR retained these data. Starting on 1 January 1973, there is a format change to a character code. NCAR receives the data on four tapes per month and is normally within about six weeks of being up to date.

The NMC tapes include aircraft wind reports, wind data from the cirrus blowing off from cumulonimbus clouds ("blowoff winds"), wind data from the drift of clouds seen on ATS film loops, atmospheric temperature soundings calculated from satellite infrared soundings, and "bogus" data put in by analyses to help the objective analysis programs. See the satellite data chapter for more details.

For the GATE period (June-September 1974), tapes are available that contain the six-hourly data.
Chapter 8

2. From AFGWC


NCAR has 1,620 sounding times (00, 12Z) of these data through 28 August 1969. These are now on 101 tapes, usually 18 sounding times (9 days) per tape. See the section on data sets at ETAC for more information about these data. Time periods covered with only minor skips are:

<table>
<thead>
<tr>
<th>Day Mo. Yr. thru</th>
<th>Day Mo. Yr.</th>
<th>Days Missing</th>
<th>Day Mo. Yr. thru</th>
<th>Day Mo. Yr.</th>
<th>Days Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 7 66</td>
<td>29 7 66</td>
<td>6 6 67</td>
<td>5 7 68</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>14 10 66</td>
<td>21 10 66</td>
<td>75</td>
<td>12 7 68</td>
<td>15 1 69</td>
<td>6</td>
</tr>
<tr>
<td>10 11 66</td>
<td>16 11 66</td>
<td>18</td>
<td>20 1 69</td>
<td>6 5 69</td>
<td>4</td>
</tr>
<tr>
<td>9 1 67</td>
<td>17 1 67</td>
<td>54</td>
<td>9 5 69</td>
<td>1 6 69</td>
<td>2</td>
</tr>
<tr>
<td>22 1 67</td>
<td>2 2 67</td>
<td>5</td>
<td>6 6 69</td>
<td>14 6 69</td>
<td>4</td>
</tr>
<tr>
<td>4 3 67</td>
<td>12 3 67</td>
<td>60</td>
<td>20 6 69</td>
<td>1 8 69</td>
<td>5</td>
</tr>
<tr>
<td>10 4 67</td>
<td>17 4 67</td>
<td>27</td>
<td>24 8 69</td>
<td>28 8 69</td>
<td>23</td>
</tr>
<tr>
<td>3 5 67</td>
<td>18 5 67</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

"Missing" gives the approximate number of days of data missing in the gap from the previous date. Each sounding time usually has about 620 rawinsondes (of these about 330 give wind by height as well as wind by pressure). There are 280 wind soundings with no raob, and 450 to 700 aircraft reports. The original set of data at ETAC is more complete (see chapter six).

3. At FNWC

The section on data at FNWC describes the upper air data that are available on their tapes. NCAR now only has a small amount of these data.

4. Northern Hemisphere from University of Missouri, MIT, NCC


Rawinsonde data for this five-year period were obtained from Prof. Ernest Kung of the University of Missouri (00Z and 12Z data are in the set). The data originated on 60 tapes at Prof. Starr's General Circulation Laboratory at MIT. Kung did some additional cleanup work on the data. Most of the original data were
Upper Air Observations

from NCC, Asheville, and have been further processed under NSF grants.

The data are mandatory levels with information each 50 mb in the lower levels when available. The volume was 39 9-channel, 1600 BPI tapes, but has been reformatted without loss of data to 20 tapes of 00Z data and five tapes of 12Z data, all recorded at 7 channel, 800 BPI.

5. Aircraft Data

J. Sadler, at the University of Hawaii, has gathered and punched several years of aircraft wind data for tropical areas, including data for a number of aircraft routes not received by NMC. T. N. Krishnamurti, at Florida State University, has gathered aircraft data for the GATE period and for other selected periods, such as June-August 1972.

6. Printed Upper Air Data on Microfilm

A selection of the data is available in printed form from NCC in the Northern Hemisphere Data Tabulations. These tabulations were printed through December 1963. Since that time, they have been produced on one reel of microfilm per month. The table below compares the data available on tape from the Weather Centrals with the amount of printed data.

<table>
<thead>
<tr>
<th>From Numerical Weather Centrals</th>
<th>N. Hem. Data Tabs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00 plus</td>
</tr>
<tr>
<td>Rawinsonde</td>
<td>750</td>
</tr>
<tr>
<td>Winds aloft</td>
<td>650</td>
</tr>
<tr>
<td>Aircraft</td>
<td>800</td>
</tr>
<tr>
<td>SIRS or VTPR</td>
<td>80</td>
</tr>
<tr>
<td>Surface synoptic</td>
<td>40,000</td>
</tr>
</tbody>
</table>
Chapter 8

Section B: Upper Air Station Daily Time-Series

Observed Data

NCAR is still in the process of obtaining all available mandatory level rawinsonde data for stations south of about 30°N. There are now about 1.6 million soundings in this set (on about 48 tapes). The primary data source has been NCC, with additional data from England, Australia, New Zealand, Argentina, Singapore, and Mauritius. Data will soon be sent from Brazil. NCAR has just received (January 1975) tapes from NCC with U.S. and Canadian stations (mandatory levels -- usually 35 levels per sounding) starting in 1961. A microfilm inventory may be borrowed from NCAR.

See the ETAC and NCC chapters (6 and 7) for discussions of the most complete sets of time-series data.
Chapter 9: Surface Synoptic Observed Data

1. **Introduction**

   These surface observations are usually taken once each 3 or 6 h globally. The code form for a surface synoptic report from land station is:

   \[
   \begin{array}{cccc}
   \text{SYNOP} & \text{(1)} & \text{(2)} & \text{(3)} & \text{(4)} & \text{(5)} \\
   & \text{IIIii} & \text{Nddff} & \text{VVww} & \text{PPTT} & \text{hLhC} \\
   & \text{(6)} & \text{(7)} & \text{(8)} & \text{(9)} & \text{(10)} \\
   & T_dT_djaj_p & (6P_oP_oP_o) & (7RRjj) & (8N_sCh_s) & (9S_sS_sS_s) \\
   & pppp & pppp & pppp & pppp & pppp \\
   \end{array}
   \]

   1) Block and station number
   2) Total cloud, wind direction and speed
   3) Visibility, present weather, past weather
   4) Sea level pressure in tenths of millibars, temperature
   5) Cloud types
   6) Dew point, pressure tendency
   7) 6-group: Station pressure in tenths of millibars
   8) 7-group: Rainfall
   9) 8-group: Cloud layer
   10) 9-group: Special phenomena such as snow depth, state of sea, etc.

2. **Filed in Synoptic Sequence**

   a. NMC has been saving these data since January 1973. They use a smaller library in the data decode to restrict the data to less than half of what is possible.

   b. At FNWC the Navy has also been saving the data and uses the most compact format. This set does not include rain. See Chapter 14 for a breakdown of number of reports by time of day. In 1974 the average volume was:

   \[
   \begin{align*}
   \text{Surface ships} & \quad 3857 \text{ reports/day} = 0.9 \times 10^6 \text{ bits/day} \\
   \text{Land stations} & \quad 28,297 \text{ reports/day} = 5.1 \times 10^6 \text{ bits/day}
   \end{align*}
   \]
Chapter 9

c. Chapter 6 describes the surface synoptic data sets that have been decoded at either ETAC or AFGWC. These are the only sets that contain data from airways hourly reports (specials are included) as well as the synoptic code data. In 1974 they contain about 50,000 synoptic reports per day and 30,000 separate airways reports that have not been combined with a synoptic.

d. NCAR has these data for 19 February 1967 through 25 April 1967, for December 1967, and for the summer 1974 GATE period. We are now obtaining a more comprehensive data set.

3. Filed in Time-Series Order

a. See Chapters 6 and 7 on ETAC and NCC. Note the table for TDF-13 in Appendix 1 and the listing for surface synoptic data in Appendix 2.

b. NCAR has only a trivial amount of these data.
Chapter 10: Climatological Year-Month Surface
and Upper Air Data; Tree Rings

We will discuss the surface and upper air data that are available in averages by single months or longer. Some tree ring data are also discussed. The availability of monthly mean grid point data is discussed elsewhere.

1. Monthly Mean Rawinsonde Data

We are cooperating with NCC to make a set of about 75,000 global mean monthly rawinsonde reports available (CLIMAT reports). The southern hemisphere climatology project made extensive use of these data. Error detection and correction work on the northern hemisphere reports is not yet completed.

NCAR has made monthly summaries of about 2,000,000 daily rawinsonde soundings. The output includes momentum transports, etc. Calculations have not been made on U.S. raobs yet.

GFDL obtained about nine years of rawinsonde data from NCAR that had been picked up by NMC from communications circuits. A. Oort at GFDL is having these put into time-series sort and screened for errors; calculations of year-month means, variances, and co-variances are being made.

2. Monthly Mean Reports from Surface Stations

NCAR has about 887,000 monthly mean reports from surface stations with global coverage. In the period from 1731 to 1860 the number of stations increased from 1 to 84. From 1870 to 1900 the number increased from 138 to 438. In the decade 1961-1970 there were 1722 stations; of these, 541 were in the southern hemisphere. In the total period there were about 487,000 reports of average monthly sea level pressure, 458,000 reports of station pressure, 821,000 reports of temperature, and 887,000 reports of rainfall. (See Table 10-1 for a general inventory.) These data include the World Weather Records data (mostly from NCC, but six months punched at NCAR), and Clayton's (Smithsonian) Weather Records. The latter were punched at NCC under contract with John Wolback of Harvard College Observatory. Volume: two binary tapes, or four in BCD format.

Another data set contains monthly rainfall data from 200 Pacific Island stations. Many of the periods of records are longer than 30 years. Ronald
Chapter 10

Taylor of the University of Hawaii has provided NCAR with this data set. Data listings are given in Taylor (1973).

The University of Wisconsin is punching data from some of the U.S. forts. These should give some long records.

3. **Atlas of Mean Surface Temperature and Pressure by Months 1881-1960**

J. Fletcher (NOAA-ERL), Boulder, Colorado, has a copy of a Russian atlas showing monthly surface temperature and pressure for the northern hemisphere, January 1881 - December 1960. During 1975, Russia may be able to provide the United States with grid point data for these charts.

4. **Tree Ring Data for Western America**

Tree ring data were collected for about 150 sites in western America. The investigators tried to sample at least ten trees to define each site. The data from the best site in each area were used to define 49 stations (Fig. 10-1). The starting years of the oldest six stations are 800, 1107, 1194, 1263, 1270, 1298 A.D. For the other stations the starting times were:

- years 1304 to 1368: 8 stations
- 1415 to 1485: 13 stations
- 1508 to 1592: 19 stations
- 1612 to 1631: 3 stations

The period of record usually ends in 1964.

The data are published in Stokes et al. (1973).

5. **North American Climate Data to 10,000 Years**

R. Bryson at the University of Wisconsin will soon have 10,000 years of decadal mean data for eight stations over the eastern half of the United States.
and Canada. From the pollen data, they hope to provide objective estimates of snowfall to ± 20%, rain within 10%, growing season ± 5 days, and mean temperature ± 0.5°C.

6. **Data Bank of Early Climatological Sources**

The Center for Climatic Research at the University of Wisconsin has established a catalog of references containing information of past weather conditions. Some sources are original, whereas others are summaries or analyses of original data. The data bank was begun to help extend climatological records back in time and to provide quantitative, although perhaps discontinuous, information of past environments. These data may provide sufficient environmental information to enable a better understanding of temporal and areal relationships between given events and the environment.

Resources are organized by location (latitude and longitude, country, and in some cases smaller scale political divisions). References are punched on computer cards and may be queried by location or time (years before 1950), or both, thereby yielding a list of the appropriate references, including parameters contained in the source, the frequency of observations, and the length of the record.
Chapter 10

Table 10-1

Monthly surface climatological station data. Number of available monthly averages of sea level pressure, station pressure, temperature, and precipitation for a global network of surface stations. Data are included through 1973. The explanation of the symbols follows:

<table>
<thead>
<tr>
<th>DECADE</th>
<th>RECS</th>
<th>S</th>
<th>SSLP</th>
<th>MSLP</th>
<th>SP</th>
<th>MP</th>
<th>ST</th>
<th>MT</th>
<th>SR</th>
<th>MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-1980</td>
<td>4334</td>
<td>1644</td>
<td>1399</td>
<td>41399</td>
<td>1436</td>
<td>42014</td>
<td>1540</td>
<td>46089</td>
<td>1515</td>
<td>45044</td>
</tr>
<tr>
<td>1961-1970</td>
<td>14136</td>
<td>1722</td>
<td>1554</td>
<td>134791</td>
<td>133</td>
<td>2706</td>
<td>1716</td>
<td>151374</td>
<td>1692</td>
<td>147623</td>
</tr>
<tr>
<td>1951-1960</td>
<td>17946</td>
<td>1657</td>
<td>1308</td>
<td>144950</td>
<td>1137</td>
<td>1294-61</td>
<td>1737</td>
<td>208290</td>
<td>1817</td>
<td>206636</td>
</tr>
<tr>
<td>1941-1950</td>
<td>8003</td>
<td>499</td>
<td>592</td>
<td>58211</td>
<td>575</td>
<td>59412</td>
<td>856</td>
<td>83319</td>
<td>873</td>
<td>32584</td>
</tr>
<tr>
<td>1931-1940</td>
<td>6849</td>
<td>729</td>
<td>309</td>
<td>31159</td>
<td>428</td>
<td>46056</td>
<td>638</td>
<td>69593</td>
<td>722</td>
<td>30159</td>
</tr>
<tr>
<td>1921-1930</td>
<td>6152</td>
<td>547</td>
<td>222</td>
<td>25377</td>
<td>375</td>
<td>42349</td>
<td>535</td>
<td>60150</td>
<td>633</td>
<td>72105</td>
</tr>
<tr>
<td>1911-1920</td>
<td>5584</td>
<td>554</td>
<td>134</td>
<td>15351</td>
<td>341</td>
<td>38489</td>
<td>476</td>
<td>53507</td>
<td>550</td>
<td>62292</td>
</tr>
<tr>
<td>1901-1910</td>
<td>4953</td>
<td>537</td>
<td>120</td>
<td>12709</td>
<td>322</td>
<td>35393</td>
<td>436</td>
<td>46897</td>
<td>591</td>
<td>54708</td>
</tr>
<tr>
<td>1891-1900</td>
<td>3946</td>
<td>438</td>
<td>45</td>
<td>9076</td>
<td>263</td>
<td>294-43</td>
<td>347</td>
<td>36995</td>
<td>406</td>
<td>43137</td>
</tr>
<tr>
<td>1881-1890</td>
<td>3043</td>
<td>342</td>
<td>58</td>
<td>5830</td>
<td>205</td>
<td>20740</td>
<td>274</td>
<td>29136</td>
<td>313</td>
<td>33241</td>
</tr>
<tr>
<td>1871-1880</td>
<td>1949</td>
<td>245</td>
<td>40</td>
<td>3620</td>
<td>122</td>
<td>10195</td>
<td>173</td>
<td>15180</td>
<td>225</td>
<td>21429</td>
</tr>
<tr>
<td>1861-1870</td>
<td>1853</td>
<td>134</td>
<td>17</td>
<td>1713</td>
<td>36</td>
<td>3290</td>
<td>75</td>
<td>7031</td>
<td>123</td>
<td>11030</td>
</tr>
<tr>
<td>1851-1860</td>
<td>719</td>
<td>94</td>
<td>10</td>
<td>594</td>
<td>20</td>
<td>1663</td>
<td>45</td>
<td>4550</td>
<td>71</td>
<td>6972</td>
</tr>
<tr>
<td>1841-1850</td>
<td>456</td>
<td>35</td>
<td>6</td>
<td>549</td>
<td>7</td>
<td>766</td>
<td>29</td>
<td>3055</td>
<td>43</td>
<td>3495</td>
</tr>
<tr>
<td>1831-1840</td>
<td>296</td>
<td>36</td>
<td>2</td>
<td>240</td>
<td>5</td>
<td>500</td>
<td>22</td>
<td>2308</td>
<td>25</td>
<td>2821</td>
</tr>
<tr>
<td>1821-1830</td>
<td>231</td>
<td>25</td>
<td>2</td>
<td>243</td>
<td>5</td>
<td>500</td>
<td>17</td>
<td>1496</td>
<td>15</td>
<td>1295</td>
</tr>
<tr>
<td>1811-1820</td>
<td>158</td>
<td>21</td>
<td>2</td>
<td>240</td>
<td>5</td>
<td>440</td>
<td>14</td>
<td>1344</td>
<td>9</td>
<td>764</td>
</tr>
<tr>
<td>1801-1810</td>
<td>125</td>
<td>13</td>
<td>2</td>
<td>240</td>
<td>5</td>
<td>646</td>
<td>10</td>
<td>1290</td>
<td>5</td>
<td>503</td>
</tr>
<tr>
<td>1791-1800</td>
<td>113</td>
<td>12</td>
<td>2</td>
<td>240</td>
<td>2</td>
<td>240</td>
<td>10</td>
<td>1108</td>
<td>3</td>
<td>360</td>
</tr>
<tr>
<td>1781-1790</td>
<td>115</td>
<td>12</td>
<td>2</td>
<td>240</td>
<td>2</td>
<td>240</td>
<td>9</td>
<td>1080</td>
<td>4</td>
<td>372</td>
</tr>
<tr>
<td>1771-1780</td>
<td>57</td>
<td>7</td>
<td>2</td>
<td>240</td>
<td>2</td>
<td>240</td>
<td>5</td>
<td>564</td>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>1761-1770</td>
<td>34</td>
<td>5</td>
<td>2</td>
<td>132</td>
<td>2</td>
<td>156</td>
<td>4</td>
<td>264</td>
<td>2</td>
<td>142</td>
</tr>
<tr>
<td>1751-1760</td>
<td>16</td>
<td>2</td>
<td>1</td>
<td>72</td>
<td>1</td>
<td>72</td>
<td>1</td>
<td>72</td>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>1741-1750</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>1731-1740</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL DATA COVERAGE 80234 2554 2073 487491 1976 457799 2473 921002 2516 896809
Chapter 11: Global Climatological Grid Data

1. Global Climatology to 100 mb

NCAR has one tape of climatological data for each hemisphere. The tapes have long-term mean data for each 5° latitude-longitude point, and for each month. Data are sea level pressure, surface air temperature, and height and temperature for 850, 700, 500, 300, 200, and 100 mb. Dew points are given for surface, 850, 700, and 500 mb. Calculated geostrophic winds are included for each level. The tapes also include some other data. The northern hemisphere data are based on Crutcher and Meserve (1970), and the southern hemisphere on Taljaard et al. (1969). The southern hemisphere tapes, available microfilm, and motion pictures are discussed in Jenne et al. (1974).

2. Climatological Data Prepared by RAND

Tapes are available from RAND having seasonal data for the surface, 850 mb, and 400 mb. Data on sea level pressure, geopotential height, temperature, moisture, and geostrophic winds were interpolated from the tapes above (southern hemisphere and northern hemisphere Climatology projects) to a grid 4° latitude by 5° longitude. Data on sea surface water temperature, cloudiness, precipitation, evaporation, albedo (surface and planetary), solar radiation absorbed, long-wave radiation, radiation balance, sensible heat flux, heat balance, and observed winds were included from other sources. Various charts are shown in the report by Schutz and Gates (1971), one of four reports and three supplements in which these seasonal data are documented.

3. Stratospheric Climatology

A climatology based on the German data has been prepared. Figure 12-1 shows the data input to this climatology. Two atlas volumes (LaBitzke, 1972; and van Loon et al., 1972) are available.

A tape with the climatology is available, as described in an NCAR Technical Note (Jenne et al., in preparation). This note also describes the contents of a set of data maps, cross sections, and graphs on about 5,000 frames of microfilm. The contents of a motion picture based on these data are also described. Some of the data available on magnetic tape and in the displays are:
Chapter 11

a. Long-term means of heights at 100, 50, 30, 10 mb (17 to 14 years) and of temperature for five years (and for 15 years at 100 mb).

b. Cold and warm winter temperature and heights.

c. Geostrophic winds calculated from the height grids in a and b.

d. Standard deviation of the year-month height, temperature, U, and V winds.
Chapter 12: Stratospheric Data

1. Introduction

We will describe NCAR's stratospheric grid point data from NMC, the Free University of Berlin, and the USAF. A climatology of the lower stratosphere has been prepared based on the German data (see section 8 below).

2. IGY Northern Hemisphere Stratospheric Data

See Chapter 2 section 7.

3. Height and Temperature Analyses from AFGWC (Air Force)

All are twice daily analyses on the NMC octagonal grid. This set is continuing but has not been updated at NCAR since early 1965:

- 100 mb H - start Apr 1959
- 100 mb T - start Jan 1962
- 50 mb H,T - start Jan 1962
- 30 mb H,T - start Jan 1962
- 10 mb H,T - start May 1963

4. Daily Height and Temperature Analyses from NMC

Octagonal grid.

- 100 mb H,T - start Feb 1963
- 70 mb H,T - start Apr 1969
- 50, 30, 10 mb H,T - start Jun 1964

5. Daily Height and Temperature Analyses Prepared in Germany

Since May 1973, the Free University of Berlin has been punching the daily height and temperature analyses at 50 and 30 mb and putting them on tape. NCAR has a selection of earlier daily grids from Germany.

6. Weekly Constant Pressure Grids at 5, 2, and 0.4 mb

The grid point values were from the National Climatic Center (NCC) based on selected NMC weekly maps for the western northern hemisphere for January, April, July, and October 1964, 1965, and 1966. The maps were based largely on rocket
Chapter 12

data. The area covered is 10°N to the pole and 0°W, 5°W --, 220°W, but only 40°W -- 190°W at 0.4 mb. The selective digitizing was paid for by Marshall Space Flight Center. The weekly maps were drawn at NMC during the period January 1964 December 1968.

Hemispheric analyses at 5, 2, 0.4 mb

Starting in January 1972, hemispheric analyses at these levels have been prepared by the upper air section at NMC (contact: F. Finger). The analyses are prepared as follows:

The VTPR channel-two radiance correlates very well with 100-5 mb thickness. This is added to the operational 100 mb height analyses, which gives an estimated 5 mb height. These heights are then adjusted to the heights and winds from rockets (and a few raobs) at 5 mb. From SCR (channel B34), which is mailed from Oxford, England, they obtain a guess temperature at 5 mb which is then adjusted to observed data.

In a similar way, 2 mb analyses are obtained from a correlation of VTPR channel one with 100-2 mb thickness, and a SCR channel B12 correlation with 2 mb temperature. These guesses are then adjusted to the observed data.

For 0.4 mb, the correlation of SCR channel B12 with 10-0.4 mb thickness is used. This thickness is added to the operational 10 mb height, which does not now involve the use of satellite data. This guess is adjusted to the 0.4 mb rocket data. A temperature analysis is produced without direct assistance from satellite data.

If satellite data are not available, the heights from 10 mb are built up by first analyzing the 5 mb temperature, making a thickness from the 10 and 5 mb temperatures, adding it to the 10 mb height, etc.

The maps for January 1972 - June 1973 will be published in about April 1975.

Karen Labitzke (Free University, Berlin) is using satellite data from W. Smith, NESS, to help in making 5 and 2 mb analyses for 1969, 1970, and 1971.

Tape data

MIT (R. Newell) has digitized the 5 and 2 mb data for January - December 1972, for 20°N to the pole, each 10° latitude and longitude. NCAR will have a
copy of the data, including both height and temperature.

AFCRL (Alan Cole, January 1975) has plans to digitize all of these maps to aid in the preparation of the U.S. standard reference atmosphere.

7. **Stratospheric Analyses from Germany**

These grid data were tabulated in Germany from hand-analyzed maps; the card punching was divided between Germany and NCAR. Latitude-longitude points at intervals of 10° were punched for 10°N to the pole. Figure 12-1 shows the earlier mean grids and the year-month analyses that were available for the preparation of the longer term climatology described below. A tape of the year-month data is available as described in Jenne et al. (in preparation). Additional year-month data were received in 1974 (see Figure 12-1). Some of the German daily analyses have been punched in Germany or Japan and sent to NCAR, but they have not been processed yet.

8. **Stratospheric Climatology**

NCAR and Germany have prepared a climatology of northern hemisphere 100, 50, 30, and 10 mb heights and temperatures, based on German analyses. Many year-month analyses are also available in this set. A motion picture based on this climatology is available from NCAR. See Chapter 11 for more information about these data.

9. **Rawinsonde Data**

NCC, ETAC, and NCAR have a large sample of the world's daily rawinsonde data in both station and synoptic order on tapes.

10. **Global Monthly Thickness Data**

NCAR has tapes of global monthly thickness data for 100-50, 50-30, and 30-10 mb for May 1969 through April 1970. These data are based on retrievals made at NESS from SIRS-A monthly mean radiance data. Various data and retrieval problems are inherent in this set. Comparisons have been made with German thickness data where possible.
Chapter 12

11. Rocketsonde data at NCC

See the information under NCC data holdings (Chapter 7).
Fig. 12-1. Shows the year-month grids and the earlier long-term mean grids that were available for use in this climatological study. The indicated data are year-month grids except where noted. Dashed lines show year-month grids that were more recently acquired. The first 18 months of data in the 50 mb height mean were from Muench (from Jenne et al., in preparation).
Chapter 13: Satellite Data

1. Introduction

In this section we will briefly describe a number of the U.S. satellites that have contributed data sets that are important in the study of meteorological and oceanographic problems. The principal locations of the data are the National Space Science Data Center (NSSDC), Goddard Space Flight Center; the National Environmental Satellite Service (NESS), Suitland, Md.; and the National Climatic Center (NCC), Asheville, N.C. Assume that NCAR does not have the data unless otherwise stated.

Stoldt and Havanac (1973) of ETAC have compiled data on the meteorological satellite and instrument programs of the United States, U.S.S.R., United Kingdom, and France. The compendium includes references to the various data catalogs and to scientific papers.

NSSDC hopes to update this compendium in 1977. In early 1975, they will publish a four-volume catalog of satellite experiments. One of the volumes will cover experiments in meteorology and oceanography.

Figure 13-4 shows the data periods for various satellites.

Table 13-1, taken from the compendium, shows where some of the data may be obtained. NSSDC maintains catalog listings that give information about the data availability from the various experiments on each satellite. They also keep track of data sets and publications associated with approximately 7000 rocket launches. Table 13-2 includes information about the satellites and the experiments from the compendium and from NESS. In the cases of disagreements in the dates given, the latest termination dates are used.

Hoppe and Ruiz (1974) at NESS have published a catalog of operational satellite products.

In April 1974, NESS and EDS (Environmental Data Service) prepared a Satellite Data Archival Plan which covers the data produced by NESS. This plan discusses the archival of pictures, microfilm, movie film loops, and magnetic tapes. A Satellite Data Services Branch (of NCC under the EDS) has been located with NESS in Washington. Requests for satellite data may be directed to them. The archival location of the satellite data will gradually be moved from Asheville to Washington. NESS has published a monthly magazine (Environmental
Chapter 13

Satellite Imagery] with global coverage of daily visible and IR pictures.


The book on *Climatology from Satellites* (Barrett, 1974) contains more information about data from satellites, and shows many charts based on information from satellites.

2. **Satellite Brightness Data from NESS (Vidicon tubes)** (Written October 1973)

   **Data Period:** 1 January 1967 thru 31 August 1972

   a. NCAR has 5° latitude-longitude daily global brightness data on one tape in packed binary format, data set DS 670. The orbit numbers are listed in the format.

   These data were prepared at NESS from the mesoscale brightness data tapes noted below. These mesoscale tapes have a gray scale with only five levels.

   The data are derived from vidicon tubes, which tend to drift in calibration. Some of these problems have been taken care of (adjustments made to make key points uniform); but, for example, the data have to be used with caution in looking for long-period changes in global brightness.

   b. Copies of the mesoscale brightness data tapes having a grid of 512 × 512 points per hemisphere (a resolution 8 × 8 that of the NMC grid) are kept at NCC. There is one grid per day which is valid at about 1400 local time (sun-synchronous satellites). The original tapes had 16 levels in the gray scale, but these tapes have a gray scale with only five levels.

   At each grid point there are 48 bits, giving frequency counts of the number of the associated 64 points within the original 4096 × 4096 grid that have each of the five brightness levels.

   Volume for each hemispheric grid is $1.26 \times 10^7$ bits. Volume per day is $2.52 \times 10^7$ bits.

   Tape volume at NCC is about one tape per three days for the period 1 January 1967 through 31 October 1972. NCAR has a limited number of these tapes.
c. D. B. Miller processed the mesoscale tapes for 1 January 1967 through 31 December 1970. He related the brightness levels to cloudiness in order to prepare tapes of cloud frequency data for each month of the four-year period. Adjustments were not made for changes in satellite calibrations that were noted after the vidicon data were originally saved. The tapes are at NCC; an associated cloud atlas is available (Miller and Feddes, 1971).

3. **Archive of NESS Scanner IR and Visible Data** (Written November 1974)

   a. This describes NESS procedures for archiving scanner IR and visible data from NOAA-2 since 1 January 1973. (It was received starting in November 1972, but was not archived until January 1973.) The high resolution grid is $2048 \times 2048$ per hemisphere (32 times the NMC grid resolution). There are eight bits per visible or IR sample. During the daytime pass there are both visible and IR data, but only the IR at night. There are three tapes per day: one for northern hemisphere visible and IR data, one for southern hemisphere visible and IR, and one for the global nighttime IR. These three tapes are now being combined onto one 1600 BPI 9-track tape per day.

   b. Mesoscale version of the above: For a $512 \times 512$ grid for each hemisphere there are 48 bits of data saved each day for each grid point. The 48 bits are broken into six bytes (eight bits each) with the following data:

   1) Average minimum visual data; this is the average of the four smallest (darkest) values from the $4 \times 4$ cluster.

   2) Average visual data.

   3) Average maximum daytime IR; average of four largest (warmest) values.

   4) Average daytime IR.

   5) Average maximum nighttime IR.

   6) Average nighttime IR.

   \[
   \text{Volume per day} = 2 \ \text{hemispheres} \times (1.26 \times 10^7 \ \text{bits/hemisphere}) \\
   = 2.52 \times 10^7 \ \text{bits/day}
   \]

   c. Larger scale averaged data. Starting with June 1973, NESS is averaging the data onto a $125 \times 125$ grid for each hemisphere (the pole is the center point, data average is centered about each point) of the average
Chapter 13

visible, the day IR, and the night IR. From these NESS is also calculating the albedo, the absorbed solar radiation, and the total outgoing long-wave radiation (about $10^6$ bits per day). Thus, there will be a gap in the larger scale averaged data from September 1972 through May 1973. T. Gray says that there was some trouble with the digital data for January - May 1973, even though the analog data were all right.

4. **LRIR Data** (low resolution infrared)

Recently these have been FPR data (flat-plate radiometer).

a. These are from a flat-plate radiometer.

The approximate dates of LRIR data availability are as follows:

- **ESSA-5**: 9 May 1967 - 30 Sep 1967
- **ESSA-7**: 3 Sep 1968 - 22 Jun 1969
- **ESSA-9**: 1 May 1969 - 15 Apr 1970

The tapes (about 30) are at NCC and at NESS (see S. Brown).

b. Tapes of the FPR data are at NESS (see Phillips and Rubin, 1972):

- **NOAA-1**: 4 Feb 1971 - 27 May 1971

**Volume:** $1320 \times 24 \times 24 \text{ bits/day} = 7.6 \times 10^5 \text{ bits/day}

5. **Other Satellite IR Data**

a. Tapes with $5^\circ$ latitude-longitude average IR data are available for the TIROS 7 period of about June 1963 - June 1964; the sampling was poorer for the following year. Window channel.

b. **ITOS** - about June 1970 to April 1971

The daily global IR is available on 2048 x 2048 grids for each hemisphere. About two days per tape per hemisphere; thus, about one tape per day. Daily values for day and night.

The data are very noisy and badly calibrated. Gray thinks it would take more time to summarize than it is worth. The tapes show erroneous warm and cold strips of water in the Gulf Stream, etc.
c. NOAA-1 19 April 1971 to 10 July 1971.

The 5° IR data are at NESS and NCAR.

d. Note from Table 2 that MRIR (medium resolution infrared) instruments were on Tiros 2, 3, 4, 5, etc.

e. Some of the IR data have been gridded and processed into average heat budget data for the periods shown below. Total IR, albedo from top of atmosphere, and net radiation assuming a solar constant are included. T. Vonder Haar at Colorado State University (CSU) has these data on tape and he and J. Ellis have just published an atlas (Vonder Haar and Ellis, 1974).

<table>
<thead>
<tr>
<th>Period</th>
<th>Satellite</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul 1964 - Nov 1965</td>
<td>Experimental</td>
<td>Vonder Haar (C.S.U.) monthly average</td>
</tr>
<tr>
<td>15 May – 15 Jul 1966</td>
<td>Nimbus 2</td>
<td>Raschke and Bandeen (GSFC) 15-day average</td>
</tr>
<tr>
<td>Dec 1966 - Jan 1967</td>
<td>ESSA-3</td>
<td>McDonald (NESS)</td>
</tr>
<tr>
<td>1968 – Apr 1969</td>
<td>ESSA-5</td>
<td>NOAA/NESS Not final</td>
</tr>
<tr>
<td>May 1969 – Jan 1970</td>
<td>Nimbus-3</td>
<td>Vonder Haar and Ellis Ten 15-day periods</td>
</tr>
</tbody>
</table>

6. **Moisture Data from NESS**

   Since about July 1973, NESS has been preparing data on total precipitable water (from VTPR), but has not archived it. (We would like to see it saved.)

   Since about July 1972 NESS has been preparing estimates of relative humidity for two layers over the Pacific Ocean, Western Atlantic, and Gulf of Mexico. The layers are surface to 700 mb and 700 to 500 mb. The estimates are made from cloud pictures. The data are not archived. Surface bogus reports are saved, and contain estimates of present weather and cloud amount.

7. **Cloud Drift Winds and Movie Loops**

   The winds derived by NESS from satellite cloud pictures are included on the upper air data tapes from NMC. Some of the winds have been estimated by looking at single pictures showing the cirrus plumes blowing off of the tops of cumulonimbus clouds.
Chapter 13

More reliable winds have been derived from clouds at various levels with the advent of the geostationary satellites in the ATS and SMS-GOES series. These take a "picture" about each 20 to 30 min. A number of these pictures for 3 or 4 h are put together into a motion picture film loop in which great care has been taken to position each frame properly by using physical landmarks. A person watches these clouds move forward and then drop back, on a digitizing table as the film loop is shown. From this, he obtains end-point locations, and then winds can be calculated. The cloud heights (and thus wind levels) have been estimated from cloud types, and the associated climatological knowledge of the operators. Starting in July or August 1974, SMS infrared data have been available to provide 24-hour cloud viewing and to help the operator estimate the cloud height. Starting in May 1972, the picture-pair method has been used in deriving the low-level winds. Correlation methods are used to obtain the winds; the operator compares this with film loop data and usually rejects about 7% of the picture-pair calculations. Efforts are now being made to implement computer vector derivation for various levels using various temperature intervals in infrared.

Movie loops: Starting with June 1969, the movie loops are available at NES. The data locations and dates are as follows:

Satellite from which the data are obtained:

- ATS-1 (Jun 1969 - Sep 1972), over the Pacific Ocean at 151°W
- ATS-3 (Jun 1970 - on), at 45°W to 95°W
- SMS-1 GOES (May 1974 - on) is at about 75°W since late Nov 1974
  (was at 40°W during GATE, June - Sep 1974)

Cloud wind data: Starting in June 1969, the movie loop winds have been on the NMC upper air data tapes. NESS tries to produce one wind for each 5° latitude-longitude square, and for each cloud layer when possible. Some cirrus blowoff winds were also on the tapes until October 1974. Starting in August 1974, NESS is also making a separate archive of these cloud wind data.

The NSSDC compendium on meteorological satellites (Stoldt and Havanac, 1973) lists various motion pictures that have been produced, some from the movie loop pictures, and some from one-per-day maps.
8. Solar Proton Monitor Data

These data were processed at NESS and archived at the Space Environmental Laboratory, NOAA, Boulder, Colorado 80302.

Periods:

ITOS-1 8 Mar 1970 - 14 Mar 1970

NOAA-1 5 Feb 1971 - 27 May 1971

Volume \(= \left[ \frac{25000 \text{ bits}}{1.32 \text{ min}} \right] \times \left[ \frac{60 \text{ min}}{h} \right] \times \left[ \frac{12 \text{ viewing h}}{\text{ day}} \right] \)

\(= \frac{1.36 \times 10^6 \text{ bits/day}}{}\)

See Phillips and Rubin (1972).

9. General Information about Satellite SIRS and VTPR Data

In the SIRS (from Nimbus) and VTPR infrared sounding data, there are eight channels which receive infrared radiation from different pressure bands in the atmosphere (surface to about 10 mb; other experiments include higher data). The amount of radiation emitted varies with the temperature and, thus, an approximate temperature vs pressure sounding through the atmosphere can be constructed from the temperatures in the eight layers. The pressure weighting functions of the eight channels overlap each other somewhat, so that the eight pieces of information are not entirely independent. It is clear that one cannot expect a sounding with high resolution information in the vertical. Problems can also arise from undetected clouds or dust. Data from rawinsondes are used to "calibrate" the channel radiances.

The NMC Upper Air Branch has noted that the VTPR Q channel radiance correlates well with the 100 to 2 mb thickness and that the next channel correlates well with the 100 to 5 mb thickness (correlation coefficients over 0.95, standard deviation is about 250 to 300 m). For the 100 to 10 mb analyses, they stopped using the VTPR retrieved temperatures in December 1970 because of problems.

There are differences of up to 2% in VTPR radiances between the ascending orbits and the descending orbits. For example, this discrepancy is equivalent to a 100 m thickness difference 100 to 2 mb, or 1°C in the mean temperature. Some of
Chapter 13

describes a probable real diurnal variation, but most of the error is likely
due to unremoved calibration changes with spacecraft temperatures.

The NMC Upper Air Branch has compared all raobs with all retrieved VTPR
soundings within 1° of latitude. Figure 13-2 shows the result of this comparison
for a given month. This problem is also discussed in Finger et al. (1973).

10. VTPR Satellite IR Sounding DATA from NESS (as of November 1974)

a. Started about October 1972

b. Archive I: Each VTPR spot (binary format)
   II: Clear column radiance (binary)
   III: Retrieved soundings (BCD format)

   These three archives are all together on the tapes sent by NESS to NCC.
   Tape volume is about ten tapes each three weeks. Practical limit of
   information in the vertical is up to 10 to 20 mb.

c. The retrieved soundings are also in the NMC archived data (available
   at NCAR). The NMC tapes had about 400 to 550 soundings (average 525)
   each 12 h in December 1972. These include data during every hour in the
day. On about one-fourth of the sounding times the VTPR data are missing
   on the NMC tapes.

   The average counts in August 1974 were still about 1000 per day
   (400 in northern hemisphere, 600 in southern hemisphere).

   Figure 13-3 shows the coverage of these data.

11. Defense Meteorological Satellite Program (DMSP, formerly DAPP)

   Starting 25 February 1973 (but July 1973 missing), picture transparencies of
   the 2 n mi resolution IR data have been saved at the University of Wisconsin. They
   also have IR pictures of the 1/3 n mi data for northern hemisphere land masses.

   The nighttime pictures that show city lights, the aurora, etc., are archived
   in the NOAA EDS center in Boulder, Colorado.

   The IR sounder data contain six CO₂ channels with peak response at about
   30, 70, 150, 400, 600, and 1000 mb. There is a channel for surface temperature
   and one for total water vapor content. These sounders are calibrated for each
scan line. There is about a 2°C change in calibration during an orbit. The NOAA satellites have only been calibrated once per orbit. In about July 1975, the Air Force hopes to add a 7-channel moisture profiler and a measurement for total ozone (O₃). They are also planning for microwave systems. The clear column radiance data have not been saved, but the retrieved soundings are saved on the AFGWC archive tapes. (Information from Major Wilkes and Captain St. Onge, January 1975.)

12. **Sea Surface Temperature Data from NESS**

Starting 1 December 1972 NESS (John Leese) has been sending one tape per month to NCC with these data.

To obtain the sea level temperature data, the clear sky radiance data must be corrected for the amount of water vapor in the column. The corrections are usually about:

- 1 to 3°C  high latitudes
- 3 to 6°C  mid-latitudes (30°-50° N or S)
- 1 to 12°C  tropics

NESS does not trust the data too much until September 1973. In March 1973 and July 1973 there were calibration problems. Until 31 May 1973, there was only a latitudinal moisture correction. Then they used a latitude-longitude climatological correction until September 1973. Sometimes they still use a climate correction when they are fighting other calibration problems such as changes between NOAA-2 and NOAA-3 satellites. Now they usually derive the total column moisture from the VTPR data, and use this to make the temperature correction.

Each day they receive about 1100 ship observations from Navy/Monterey (100 from southern hemisphere). R. Brower, NESS, then prepares ship vs satellite statistics for 14 ocean regions. Comparisons:

a. Average ship observations vs average satellite observations is within ± 0.5°C
b. The RMS of differences between ship and satellite observations within a distance of 1° latitude is 1.5°C
c. The RMS of differences between ship observations and Navy analyses based mostly on ship observations is 1.4°C
Chapter 13

In places there can be an incorrect 3° change in temperature continuity as one crosses the equator. The reason is that although the VTPR retrieval process is the same for both hemispheres, the objective analyses now only work with data from their own hemisphere. Thus sometimes the northern hemisphere analysis may have to go a long distance for data because of clouds, but the southern hemisphere analysis near the same point may have data that are close.

Tapes: Starting 1 June 1974, a 256 X 256 once-daily grid of SST for each hemisphere is being saved.

Starting September 1973, a 64 X 64 grid of monthly mean SST (including count of observations near each point) is also being saved.

Starting 1 December 1972, one tape per month is sent to NCC. (We believe that it would help to know what corrections for water vapor have been applied to the radiance temperature data.)

13. SCR Sounding Data from Nimbus-4 Satellite

(Information from Jack Chiu, Control Data Corporation, February 1974; A. Belmont, January 1975)

Data Period: April 1970 through April 1971

A. Belmont's group at Control Data obtained tapes of the SCR radiance soundings from Nimbus-4. Along the orbital tracks which went from 80°N to 80°S, they averaged the radiance data for each 5° of latitude (fewer degrees at high latitudes) and for each of the six SCR channels which have peak responses at about the 1, 10, 50, 100, 200, and 1,000 mb levels. The averages were made in a straightforward way, without checks for clouds or odd values. The six average radiances were then used to obtain five inverted temperatures at 1, 10, 50, 200, and 1000 mb. About 5 or 6% of the soundings were rejected in the retrieval process but the radiances are still saved on the output tapes. These data rejections probably were due to bad radiances or to cloud radiances getting into the averages. Some cloud effects are no doubt still in the data. On 17 March 1971 the two lowest channels went bad most of the time, so there are very few retrieved soundings after that (but the radiances are saved). The channels started working again two or three months later. One output tape (not ready yet) has all of the averaged radiances. Between April and December 1970, there are
about 50 missing days, and other whole orbits are missing. The other tape has 168,722 retrieved soundings for the year. The number of possible soundings for the year would be about (380 days) (13 orbits per day) (70 per orbit) = 345,000.

In the output format, time and location are packed into one 60-bit word, the temperatures are one word each, and the six average radiances are packed into two words. There are 40 such logical records per physical record. The archive tapes for the first year should be ready in about March 1975. Control Data is now (January 1975) hoping to obtain funds to process the second year of data; they have the tapes from NASA. The group in Oxford has published portions of the second year of data.

14. **Nimbus-5 Data**

(Information from W. Smith and H. Woolf, NESS, 20 September 1973)


Outputs are:

a. Global surface temperature analyses
b. Global stratospheric radiance analyses (including the SCR data)
c. Global multilayer temperature analyses
d. Vertical soundings:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Resolution (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T (P)</td>
<td>400, 150</td>
</tr>
<tr>
<td>q (P)</td>
<td>400</td>
</tr>
<tr>
<td>W precipitable H₂O</td>
<td>400</td>
</tr>
<tr>
<td>T surface (from 3.7 and 11 μm windows)</td>
<td>400, 150</td>
</tr>
<tr>
<td>P_c, N Cloud pressure and amount</td>
<td>400</td>
</tr>
<tr>
<td>F_T Total outgoing IR flux</td>
<td>400</td>
</tr>
</tbody>
</table>

The tapes have about 1100 soundings (called ITPR soundings) per day. The retrieval of the temperature soundings uses neither raob data nor first-guess analyses from NMC. The microwave data help in defining clear column radiances, and even improve the retrievals in clear regions. These data are not used in NMC analyses and do not get into the NMC data tapes. However, during special DST (Data Systems Test) periods, they are put onto the NMC DST archive tapes, and