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HYDROMETEOROLOGICAL DATA BASE FOR THE UNITED STATES

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1. INTRODUCTION

The National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA), of the U.S. Department of Commerce, has the responsibility for the river and flood warning service in the United States. The Hydrologic Research Laboratory (HRL), Office of Hydrology (O/H), NWS, NOAA, has developed and is now assisting in the implementation of a new National Weather Service River Forecast System (NWSRFS) (Monro and Anderson 1974). The NWSRFS is a system of hydrologic models together with a data management subsystem (Curtis and Smith 1976).

Several years of hydrometeorological data are generally required for calibrating hydrologic models (Peck 1976). Model calibration of the NWSRFS is being done in the field by the NWS River Forecast Centers (RFC's). River forecasts are operationally issued for approximately 2,500 locations in the United States. To adapt the NWSRFS models to all these basins requires an extensive data base. Most climatic and hydrologic data have been available either in published books or on cards or tape with a format not best suited for use in handling or processing by computers.

2. CLIMATOLOGICAL RECORDS

The National Climatic Center (NCC) of the Environmental Data Service (EDS), NOAA, is the depository of most climatological records in the United States. Arrangements were made to have many of these records processed and placed in formats designed for use in implementing the NWSRFS nationwide. These tapes have been designated as Office of Hydrology (O/H) format tapes. Copies of all tapes are retained by NCC for use in providing copies to other users.

Three climatological data sets have been prepared in the O/H format. These are:

Hourly precipitation data
Daily climatological data
Synoptic meteorological data

2.1 General Information

All records available for each data set at NCC have been transferred to the O/H format. The period of record for each data set begins in January 1948. The tapes are periodically brought up to date. All non-integer characters have been eliminated. All tapes have been tested to 1600 BPI and are available in two options:

1. Written in 9-channel EBCDIC at a density of 800 or 1600 BPI, or

2. Written in 7-channel BCD even parity at a density of 556 or 800 BPI.

2.2 Hourly Precipitation Data Tapes

Approximately 3,000 hourly precipitation station records are included on the hourly data tapes. These include records from instruments using analog recorders (Universal gages) and those recording on digital paper tapes (Fischer-Porter gages). The hourly O/H format data tapes were created from NCC's master tape file-Card Deck 488 images. The quality of the data is considered to be very high.

All hourly records for a station are listed in chronological order. Each record on the tape consists of 2,400 characters representing 1 month of data. This permits approximately 650 station years of data per tape (at 800 BPI). All NCC-archived hourly data for each state are in the O/H format tape set. The number of tapes for each state varies with the number of stations and their period of record (see table 4).

The O/H format for the hourly precipitation data tapes is shown in table 1.

2.3 Daily Climatological Data Tapes

There are over 10,000 stations reporting daily climatological data. These include stations known as cooperative stations, river stations, evaporation stations, Weather Service Offices (first- and second-order stations), and Federal Aviation Administration (FAA) stations.

Daily climatological O/H format tapes were created from NCC's master tape file-Card Deck 486 images.

Table 1.--O/H format of hourly precipitation data tapes

Character string (per tape record)	
1-2	State index number
3-6	Climatological station number (NCC)
7-8	Year
9-10	Month
11-2242	Hourly precipitation values (744 values)
2243-2366	Total daily precipitation (31 values)
2367-2400	Blanks

Daily observation data from October 1963 on are considered of high quality. Prior to 1963, some errors were introduced, since data for this period were originally stored on FOSDIC (similar to microfilm). Dust particles on the FOSDIC introduced some errors during conversion to magnetic tape.

A tape record consists of 960 characters representing a month of data. This permits approximately 1,300 station years of data per tape (at 800 BPI). All NCC-archived daily climatological data for each state are in the O/H format tape set. Table 4 indicates the number of tapes required for each state.

The O/H format for the daily climatological data tapes is shown in table 2.

Table 2.--O/H format of daily observations data tapes

Character string (per tape record)	
1-2	State index number
3-6	Climatological station number
7-8	Year
9-10	Month
11-134	Precipitation (31 values)
135-227	Maximum temperature (31 values)
228-320	Minimum temperature (31 values)
321-382	Maximum water temperature - pan (31 values)
383-413	Estimated precipitation (31 values)
414-475	Snowfall (31 values)
476-568	Snow depth on ground (31 values)
569-661	Water equivalent of snow on ground (31 values)
662-785	Wind movement (31 values)
786-878	Evaporation - pan (31 values)
879-940	Minimum water temperature - pan (31 values)
941-960	Field of 1's

2.4 Synoptic Meteorological Data Tapes

Most of the meteorological data contained on the synoptic meteorological data tapes come from the hourly observations taken at first-order NWS stations. Records from other weather observing stations (such as second-order NWS stations, FAA stations, and some military weather observing stations) are processed and computerized by NCC. Hourly records from these stations were obtained from the NCC files-WBAN Hourly Surface Observation Card Deck 144. Once a day measurements from these stations are taken from NCC files-WBAN Summary of Day Deck 345.

Daily total radiation and total sunshine records from the national network of radiation stations have been included on the O/H format synoptic meteorological tapes. These were obtained from the NCC files-Solar Radiation Summary of Day Card Deck 480.

Each record on the tapes contains one-half of the data for 1 month (3,360 characters). There are approximately 225 station years of data per tape and 36 tapes are sufficient for the entire United States for the period 1948 through 1976. These data are in one set for the entire country and not separated by state.

The O/H format for the synoptic meteorological data tapes is shown in table 3.

Table 3.--O/H format of synoptic meteorological data tapes

Character string (per tape record)	
1-6	Station number
7-12	Date (year, month)
13-14	Time of first standard 3-hourly observation (LST 24-hour clock)
15-15	(1) First record of month
16-759	Ceiling height (3-hourly)
760-1503	Visibility (3-hourly)
1504-2247	Wind speed (3-hourly)
2248-2743	Wind direction (3-hourly)
2744-2991	Total sky cover (3-hourly)
2992-3239	Thunderstorm (3-hourly)
3240-3360	Blanks
1-6	Station number
7-12	Date (year, month)
13-14	LST
15-15	(2) Second record of month
16-759	Dry bulb temperature (3-hourly)
760-1503	Dew point temperature (3-hourly)
1504-1751	Precipitation type (3-hourly)
1752-2247	Station pressure (6-hourly)
2248-2340	Maximum temperature (daily)
2341-2443	Minimum temperature (daily)
2444-2557	Precipitation amount (daily)
2558-2650	Snowfall amount (daily)
2651-2743	Snow depth (daily)
2744-2867	Water equivalent (daily)
2868-2898	Maximum wind speed type (daily)
2899-2991	Maximum wind speed (daily)
2992-3053	Maximum wind direction (daily)
3054-3146	Total sunshine (daily)
3147-3270	Total radiation (daily) (hemispheric solar)
3271-3360	Blanks

3. OTHER HYDROMETEOROLOGICAL DATA

In addition to the hydrometeorological data on the O/H format tapes, other records are needed to complete the data base required for hydrologic modeling. The U.S. Geological Survey (USGS), Department of the Interior, has provided a set of tapes (12) listing all daily streamflow records for the United States. These are for the entire length of record for all stations. The Soil Conservation Service (SCS), Department of Agriculture, has provided complete records of all snow survey data for the Western United States.

All O/H format tapes, the streamflow records (USGS), and snow survey records (SCS) are now stored at the NOAA Central Computer Site, Suitland, Maryland. Each RFC of the NWS has direct access to the three 360/195 IBM computers through remote terminals and thus to all sets of tapes. The NWSRFS contains procedures for flexible and efficient data storage and retrieval as well as data processing programs.

The data base at the central computer location is updated to include the latest data at least once every 3 years.

4. OTHER USES

Although the O/H format tapes were designed specifically for use in implementing NWSRFS and for calibration of hydrologic models, use for other purposes was kept in mind. For this reason, most data available on the NCC files were placed on the O/H format tapes. The tapes provide the most complete, readily accessible file of hydrometeorological data for the United States.

5. AVAILABILITY OF O/H FORMAT TAPES

The NCC retains master copies of all data tapes processed in the O/H format (including those by users other than the O/H). Copies of any previously processed tapes may be purchased at a cost of reproducing the tapes. NCC can also provide a printed inventory for each tape. These are listings by stations indicating the length of record and periods of missing data for all data on the tape.

Table 4 is a listing by states of the number of tapes required to obtain all data for the period 1948-1973 for the hourly precipitation and daily climatological records. As previously indicated, 36 tapes comprise the set of synoptic meteorological data for the period 1948-1976.

At the present time, the cost for obtaining a single copy of any of the master tapes is $60. The printed inventories may be ordered at a cost of $25 each. A reduction in unit charge is possible if a large number of tapes is ordered. The cost of producing data tapes not previously prepared in the O/H format would be considerably greater.

At the present time, O/H format master tapes are available for the period 1948-1976 (to 1975 for hourly data). The entire set with inventories may be obtained for the following costs.

O/H Format data tapes	No. of tapes*	Cost of tapes	Cost of inventories
Hourly precipitation	177	$ 5,500	$3,500
Daily climatological	243	7,500	4,500
Synoptic meteorological	36	1,640	**
Total for all data sets:	456	$14,640	$8,000

*9-channel 800 BPI
**Included with tapes.

Table 4.--Number of tapes required for complete hourly (1948-73) and daily climatological data (1948-73) for entire United States

State	Hourly data	Daily climatological data
Alabama	2	6
Alaska	1	4
Arizona	2	6
Arkansas	3	4
California	12	14
Colorado	4	7
Connecticut	1	2
Delaware	1	1
Florida	4	5
Georgia	4	5
Hawaii	Not available	Not available
Idaho	3	3
Illinois	5	4
Indiana	3	3
Iowa	5	4
Kansas	3	6
Kentucky	3	4
Louisiana	2	4
Maine	1	2
Maryland	1	2
Massachusetts	1	2
Michigan	3	4
Minnesota	3	4
Mississippi	3	4
Missouri	5	5
Montana	5	7
Nebraska	3	6
Nevada	3	3
New Hampshire	1	2
New Jersey	2	2
New Mexico	5	6
New York	4	7
North Carolina	4	5
North Dakota	2	4
Ohio	4	5
Oklahoma	3	5
Oregon	6	5
Pennsylvania	6	6
Rhode Island	1	1
South Carolina	2	3
South Dakota	2	4
Tennessee	3	5
Texas	9	14
Utah	2	4
Vermont	1	2
Virginia	3	4
Washington	5	5
West Virginia	2	3
Wisconsin	4	4
Wyoming	3	4

6. REFERENCES

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