OHIO RIVER BASIN PRECIPITATION FREQUENCY STUDY

Update of *Technical Paper 40*

First Progress Report
for the period from
March 1 through September 30, 1997

Lesley Tarleton Julian, Bingzhang Lin, Julie M. Daniel, Tania Davila,
Edwin H. Chin, Susan M. Gillette, and Michael Yekta

Office of Hydrology
National Weather Service
Silver Spring, Maryland
October 2 1997

TABLE OF CONTENTS

OVERVIEW 1

DATA 4

MAPPING AND ANALYSIS 5
- Mapping Process 5
- Various Durations 6
  - All-season 6
    - Standard durations and return frequencies 6
    - Intermediate durations 6
    - Long return frequencies 6
    - N-minute values 6
    - Five-six events per year 6
  - Seasonal 6

SUMMARY 6

REFERENCES 7

OHIO RIVER PRECIPITATION FREQUENCY STUDY
Update of *Technical Paper 40*

First Progress Report
for the period from
April 1 through September 30, 1997

OVERVIEW

The Hydrometeorological Design Studies Center has begun a precipitation frequency study to update Technical Paper 40 (Hershfield 1961) for the Ohio River Basin and surrounding area. It will cover all of 13 states and parts of 9 others for continuity, and to ensure coverage in all of the Ohio, Susquehanna, and Delaware River basins. Figure 1 shows the map of the study area. States are listed in Table 1. In the initial part of a study, the major effort is to gather data and use various quality-control measures and editing to prepare the data for analysis. Efforts also include development of computer software to format the datasets. In this report the data collection and processing is the primary topic. Also some discussion is included about the statistics to be used and the mapping process. Most of the procedures used have been developed in the update of NOAA Atlas 2 (Miller et al 1973) for the Semiarid southwestern United States. The Semiarid report will be published as Volume 1 of NOAA Atlas 14, Precipitation-frequency Atlas of the United States, 1998.

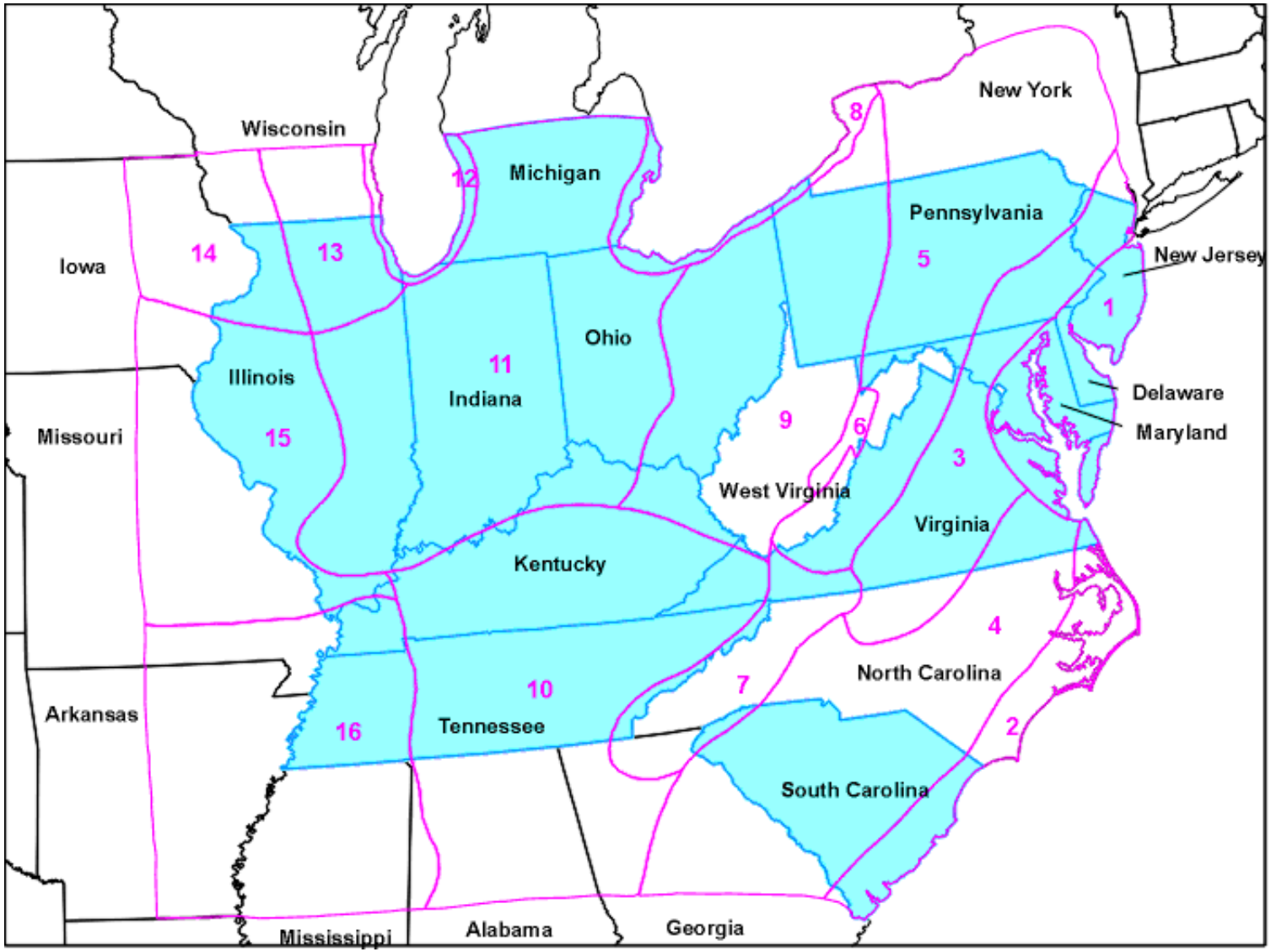

Figure 1. Ohio River Basin study area.

Table 1.

Number of NCDC daily stations in the Ohio River Precipitation Frequency Study area before any quality control.

Alabama	35
Arkansas	123
Delaware	4
Georgia	118
Illinois	167
Indiana	154
Iowa	54
Kentucky	117
Maryland	42
Michigan	49
Mississippi	48
Missouri	81
New Jersey	55
New York	182
North Carolina	125
Ohio	209
Pennsylvania	296
South Carolina	46
Tennessee	105
Virginia	108
West Virginia	81
Wisconsin	89

Core states in Bold
Borders states not in Bold

DATA

The initial digital data have been acquired from the National Climatic Data Center (NCDC) for over 5000 daily and about 2500 hourly stations. However, the record length ranges from 1 month! to 100 years. Most of the digital data begin in 1948 and may go through 1996, therefore, many stations have nearly 50 years of record. The number of NCDC daily stations by state are shown in Table 1. We also have hard copy of the monthly maximums for many earlier years, and these are being hand-entered to extend the record lengths. Also, 15-minute and n-minute data will be acquired.

For analysis with the L-moment statistics, at least 20 years of data are needed. Thus, with the addition of the hand-entered data, many stations that were too short may now become usable. Also some nearby stations with short records and similar climate regimes may be merged to make longer records. All stations in the final daily dataset will have at least 20 years of record. Other quality-control measures include checking for outliers, missing, and accumulated data. The L-moment statistical procedures also include a discordancy check. When the quality control measure are completed, it is expected that there will be about 2500 daily stations in the study area. Using the various datasets, the following durations and return frequencies will be prepared:

Durations:

5, 10, 15, and 30 minutes;
1 (60 minutes), 2, 3, 6, 12, 24 (1 day), and 48 (2 days) hours;
4, 7, 10, 20, 30, 45, and 60 days.

Return frequencies:

2, 5, 10, 25, 50, 100, (200, 500, and 1000) years.

Short duration return frequencies (less than 24 hours) will be estimated up to 100 years; for durations of 24 hours to 60 days, estimates up to 1000 years will be provided.

MAPPING AND ANALYSIS

Mapping Process

The mapping and analysis process will be a combined hand-analysis and computer mapping technique that creates an *Index Map*, determines its relation to other durations and/or return frequencies, and uses the computer to do the arithmetic to generate other maps of interest. The 2-year, 24-hour map (*Index Map*) will be hand-analyzed from quality-controlled data, and return-frequency values computed using L-moment statistical software over near-homogeneous climatic regions. The *Index Map* is then multiplied by the appropriate regional growth factors (RGFs) for the 24-hour return frequency of interest. Since the RGFs are defined relative to the mean value, the RGFs for return frequencies other than 2-year, 24-hour must be divided by the 2-year, 24-hour RFGs; and then this ratio is used as the multiplier to define the intensity for a particular return frequency. Furthermore, it is important to note that 1- and 2-day values are converted to 24 and 48 hours, and 1-hour and 2-hour values are converted to 60 and 120 minutes. The conversion factors are dependent on return frequency. Conversion factors will be determined specifically for the study area. To produce maps of less than 24-hour duration, the *Index Map* is spatially multiplied by ratios of hourly values to 24-hour values. The process is illustrated in the flow chart in Diagram 1 (Tarleton et al 1995).

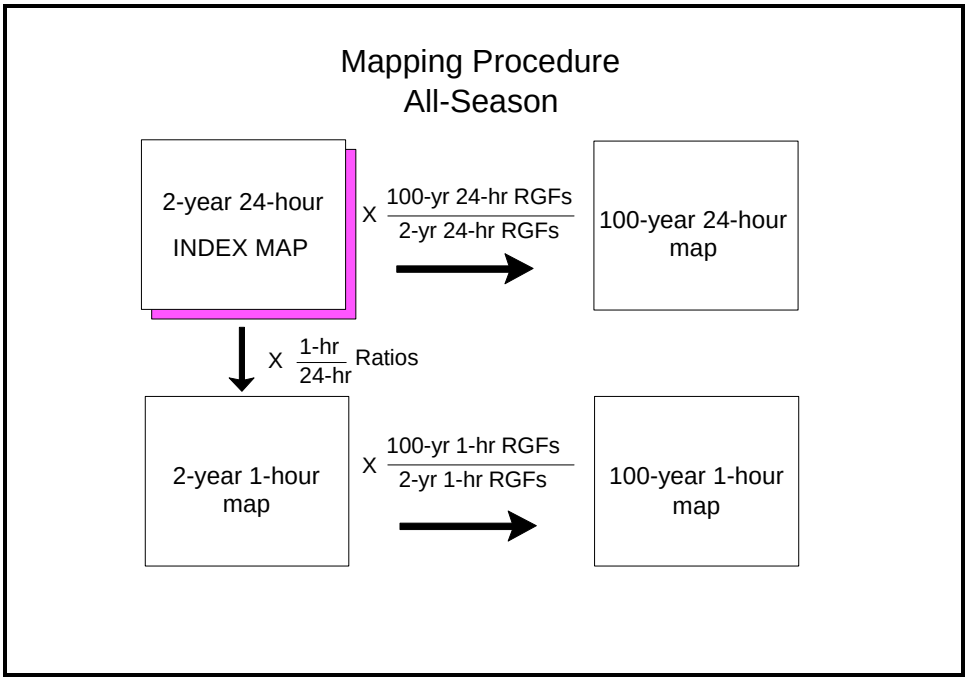

Diagram 1. *Flow chart of all-season mapping procedure.*

Various Durations

All-season

Standard durations and return frequencies. The plan is to prepare all-season isopluvial maps for a range of the most used values: 1-hour, 6-hour, and 24-hour for the standard return frequencies from 2 to 100 years. For longer durations, 10-day and 60-day maps will also be prepared for standard return periods up to 100 years.

Intermediate durations. Intermediate durations will be represented by ratio maps to the *Index map* (2-year 24-hour). Ratio maps of 2- and 3-hour to the 6-hour, and 12- to the 24-hour maps will be given. For durations of more than 1 day, ratio maps of 2-, 4-, 7-, 10- 20-, 30-, 45-, and 60-day map will be presented.

Long return frequencies. For 200-, 500-, and 1000-year return frequencies, tables of regional growth factors (RGFs), to be used with 2-year or 100-year isopluvial maps, will be included.

N-minute values. For durations less than 60 minutes, ratios to 60 minutes will be determined from the n-minute data in the study area.

Five-six events per year. Users have requested information about more frequent events. Information on precipitation intensities which are equaled or exceeded 5 or 6 times a year will also be provided.

Seasonal

Seasons for extreme precipitation will be determined. It is expected that two or three seasons (warm, cool, and possibly tropical storm) will represent the different seasonal regimes of extreme rainfall.

SUMMARY

Dataset preparation is well underway. L-moment statistics will be used for quality control and for computation of frequency values. Map analysis will be done using Geographic Information Systems (GIS) on workstations and Personal Computers (PCs).

REFERENCES

Hershfield, D. M., 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years, *Technical Paper No. 40*, U. S. Weather Bureau, Washington, DC.

Julian, L.T. et al, [1998]: Rainfall frequency atlas of the United States, *NOAA Atlas 14,* Semiarid southwestern United States, In Progess.

Miller, J.F., R,H. Frederick, and R.J. Tracey, 1973: Precipitation-frequency atlas of the western United States, *NOAA Atlas 2*, National Weather Service, Silver Spring, Md.

Tarleton, L.F., J.M. Olson, E.H. Chin, S.M. Gillette, J.L. Vogel, and M. Yekta, 1995: Semiarid precipitation frequency study, *Fourteenth Quarterly Report*, 19 pp.