NOAA Technical Memorandum NWS HYDRO-34

ANNOTATED BIBLIOGRAPHY OF NOAA PUBLICATIONS OF HYDROMETEOROLOGICAL INTEREST

Silver Spring, Md.
April 1977

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / National Weather Service

NOAA TECHNICAL MEMORANDA

National Weather Service, Office of Hydrology Series

The Office of Hydrology (HYDRO) of the National Weather Service (NWS) develops procedures for making river and water supply forecasts, analyzes hydrometeorological data for planning and design criteria for other agencies, and conducts pertinent research and development.

NOAA Technical Memoranda in the NWS HYDRO series facilitate prompt distribution of scientific and technical material by staff members, cooperators, and contractors. Information presented in this series may be preliminary in nature and may be published formally elsewhere at a later date. Publication 1 is in the former series, Weather Bureau Technical Notes (TN); publications 2 to 11 are in the former series, ESSA Technical Memoranda, Weather Bureau Technical Memoranda (WBTM). Beginning with 12, publications are now part of the series, NOAA Technical Memoranda, NWS.

Publications listed below are available from the National Technical Information Service, U.S. Department of Commerce, Sills Bldg., 5285 Port Royal Road, Springfield, Va. 22151. Price: $3.00 paper copy; $1.45 microfiche. Order by accession number shown in parentheses at end of each entry.

Weather Bureau Technical Notes

TN 44 HYDRO 1 Infrared Radiation from Air to Underlying Surface. Vance A. Myers, May 1966. (PB-170-664)

ESSA Technical Memoranda

WBTM HYDRO 2 Annotated Bibliography of ESSA Publications of Hydrological Interest. J. L. H. Paulhus, February 1967. (Superseded by WBTM HYDRO 8)

WBTM HYDRO 3 The Role of Persistence, Instability, and Moisture in the Intense Rainstorms in Eastern Colorado, June 14-17, 1965. F. K. Schwarz, February 1967. (PB-174-609)

WBTM HYDRO 4 Elements of River Forecasting. Marshall M. Richards and Joseph A. Strahl, October 1967. (Superseded by WBTM HYDRO 9)

WBTM HYDRO 5 Meteorological Estimation of Extreme Precipitation for Spillway Design Floods. Vance A. Myers, October 1967. (PB-177-687)

WBTM HYDRO 6 Annotated Bibliography of ESSA Publications of Hydrometeorological Interest. J. L. H. Paulhus, November 1967. (Superseded by WBTM HYDRO 8)

WBTM HYDRO 7 Meteorology of Major Storms in Western Colorado and Eastern Utah. Robert L. Weaver, January 1968. (PB-177-491)

WBTM HYDRO 8 Annotated Bibliography of ESSA Publications of Hydrometeorological Interest. J. L. H. Paulhus, August 1968. (PB-179-855)

WBTM HYDRO 9 Elements of River Forecasting (Revised). Marshall M. Richards and Joseph A. Strahl, March 1969. (PB-185-969)

WBTM HYDRO 10 Flood Warning Benefit Evaluation - Susquehanna River Basin (Urban Residences). Harold J. Day, March 1970. (PB-190-984)

WBTM HYDRO 11 Joint Probability Method of Tide Frequency Analysis Applied to Atlantic City and Long Beach Island, N.J. Vance A. Myers, April 1970. (PB-192-745)

NOAA Technical Memoranda

NWS HYDRO 12 Direct Search Optimization in Mathematical Modeling and a Watershed Model Application. John C. Monro, April 1971. (COM-71-00616)

NWS HYDRO 13 Time Distribution of Precipitation in 4- to 10-Day Storms--Ohio River Basin. John F. Miller and Ralph H. Frederick, May 1972. (COM-72-11139)

NWS HYDRO 14 National Weather Service River Forecast System Forecast Procedures, December, 1972. COM-73-10517)

(Continued on inside back cover)

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UNITED STATES
DEPARTMENT OF COMMERCE
Juanita M. Kreps, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

National Weather
Service
George P. Cressman, Director

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John F. Miller

Water Management Information Division, Office of Hydrology
National Weather Service, National Oceanic and
Atmospheric Administration, U.S. Dept. of Commerce

INTRODUCTION

General bibliographies of Government publications are issued periodically, but they cover publications in a wide variety of fields of interest. The selection of publications providing information in some particular field is often difficult. This bibliography is intended to fill a particular purpose of providing the engineer or hydrologist with a summary of that information published by NOAA. Many requests from engineers and others for hydrometeorological information indicate that many are not aware that much of the information required is already available in published form.

This bibliography is not intended to be a comprehensive listing of everything that has been published by NOAA scientists in the field of hydrometeorology. The primary medium for the publication of NOAA research results is through recognized scientific journals, e.g., Journal of Geophysical Research, Water Resources Research, Journal of Applied Meteorology, etc. Contract research reports prepared by the various universities or private research organizations and submitted to NOAA in fulfillment of contracts are considered as reports of the individual organizations and are not listed.

The material listed in this publication was selected by the author to list relevant publications prepared by NOAA during approximately the past 20 years. As may be recognized, a good many of these publications are out of print. Certainly a portion of the research results in some of these reports have been invalidated by later investigations. They are listed because they may provide the only source for some useful information or because they provide valuable background information on various topics. These publications are on the shelves of many libraries. Local National Weather Service Offices maintain files of many of these publications for reference purposes. Additionally, the Environmental Data Service and the National Weather Service, Office of Hydrology, also maintain reference copies of most of these publications that may be examined.

There is no clear-cut line between publications that are strictly of meteorological interest and those that are of hydrometeorological interest. These decisions were made by the author and reflect the general interest of the meteorologists within the Office of Hydrology, National Weather Service.

Department of Commerce policy limits free distribution of publications. The following are entitled to receive free copies of available publications upon request (generally one copy of a given publication): (1) Federal, State, and local government agencies; (2) cooperative observers who furnish observational data to NOAA; (3) organizations publishing environmental data for industry-wide use; (4) foreign governments and other organizations under exchange agreements approved by the NOAA Libraries Division; (5) authorized depository libraries; (6) public information media; (7) individuals connected with state colleges or experiment stations having a cooperative agreement with NOAA providing for distribution of publications. These designated official copies may be obtained from the Environmental Data Service or from the Environmental Research Laboratory.

Priced NOAA publications for individuals other than those mentioned in the preceding paragraph should be purchased from either the Government Printing Office or the National Technical Information Service. As costs are increasing, only some prices are given for publications available from the Government Printing Office. Prices for publications of the National Technical Information Service are obtainable from them or their latest catalogs. Reference numbers for ordering publications from the National Technical Information Service are given with the appropriate citations.

Prices for subscriptions to NOAA periodicals vary as costs change. The current price for a subscription may be obtained by inquiry to the Environmental Data Service (EDS) or to the National Climatic Center (NCC). Other prices quoted for publications from the NCC are for current publication stocks. If these are exhausted, charges will be based on the cost of reproducing the file copy on request or for the reprinting of the publication, whichever is appropriate.

Omission of the "Availability" portion under a citation in the text indicates that current non-purchasable publications are available through the Environmental Data Service. Publication stocks are maintained by the Environmental Data Service, the Environmental Research Laboratory, and the Government Printing Office for only a limited period, generally no longer than 3 years. If older publications are not available through the National Technical Information Service, copies occasionally may be maintained by the office preparing the report or requests may be sent to the Environmental Data Service for appropriate referral.

Key to Availability

GPO Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

NTIS National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, Va. 22151.

EDS Libraries and Information Division (D825), Environmental Science Information Center, Environmental Data Service, WSC-4, Washington Science Center, Executive Boulevard, Rockville, MD 20852.

ERL Publications Services Division (R57), Environmental Research Laboratories, NOAA, U.S. Department of Commerce, Boulder, CO 80302.

NCC National Climatic Center, U.S. Department of Commerce, Federal Bldg., Asheville, N.C. 28801.

H Historical information and background purposes.

Abstracts of NOAA scientific and technical publications, including NOAA contractor and grantee reports and publications by NOAA authors appearing in journals, conference proceedings, and books, are listed in "NOAA Publications Announcements," issued about twice monthly at no charge. Publications are arranged in about 22 subject fields.

1. CLIMATOLOGICAL DATA AND OBSERVATIONS

1.1. "Selective Guide to Climatic Data Sources," Key to Meteorological Records Documentation No. 4.11, 1969.

The types of climatic data available in published and unpublished forms are described. Examples of formats of published data are shown, their historical backgrounds are discussed, and how these may be obtained is explained. Also, references to sources where data were published during different time periods are given.

Availability: NCC.

1.2. "Climatological Data."

This publication is issued monthly and annually for each State or combination of States, the Pacific area, and Puerto Rico and the Virgin Islands.

The monthly issue presents a table of monthly averages, departures from normal, extremes, etc., of precipitation and temperature and tables of daily precipitation, temperature, snowfall, and snow on ground, evaporation, and wind and soil temperature. Monthly and seasonal snowfall and heating degree

day data are published in the July issue only. A station index map and table are also presented.

The annual issue contains monthly and annual average values and departures from normal of most data given in the monthly issue.

Availability: NCC.

1.3. "Climatological Data, National Summary."

This publication is issued monthly and annually on a national basis.

The monthly issue gives general summaries of weather, river, and flood conditions and presents the following data alphabetically by State and station name for selected stations: monthly averages, departures from normal, extremes, etc., of pressure, temperature, relative humidity, precipitation, wind, and sky cover; storms by type, number, deaths, and damage; flood stage data; and daily and monthly average solar radiation data. Summaries of other meteorological data are also presented.

The annual issue gives general summaries of weather, tornadoes, tropical storms, etc., and river and flood conditions, related charts and tables, and presents annual average data for selected stations alphabetically by State and station. Also, data on maximum precipitation for durations from 5 to 180 minutes are included.

Availability: NCC.

1.4. "Local Climatological Data."

This publication is issued monthly and annually for each of about 300 cities where National Weather Service first-order stations are located.

The monthly issue, "Local Climatological Data," presents detailed climatological and meteorological data for the particular station.

The annual issue, "Local Climatological Data Annual Summary with Comparative Data," presents monthly and annual averages, plus normals, means, and extremes of record, etc., of climatological and meteorological data and a station location table showing changes in the location and exposure of instruments and related information.

Availability: NCC.

1.5. "Hourly Precipitation Data."

This publication is issued monthly and annually for each State or combination of States.

The monthly issue presents alphabetically by station hourly and daily precipitation amounts for stations equipped with recording gages. A station location map is also included.

The annual issue, "Hourly Precipitation Data, Annual Summary," gives a station index table showing monthly and annual total precipitation amounts for stations equipped with automatic recording gages and a station location map.

Availability: NCC.

1.6. "Climatic Summary of the United States by State, Supplement for 1951-60," Climatography of the U.S. Series No. 86, 1963-64.

This publication was printed for each State or combination of States, Puerto Rico and the Virgin Islands, and the West Indies.

The following monthly and annual data are presented for each State alphabetically by station: monthly totals of precipitation and snowfall and mean temperature for each month for the period 1951-1960; means for 10-year period and for the total record for total precipitation, total snowfall, mean temperature, and maximum and minimum temperature; means for the 10-year period only are given for the number of days with precipitation $\geq$ .10 and $\geq$ 0.50, days with temperatures $\geq$ 90°F or $\leq$ 32°F and mean evaporation; maximum and minimum temperatures of record are given for the 10-year period and for the total record. A station index and history table, showing changes in the locations and exposures of instruments and related information, is also included.

Issues of 106 specified climatological sections of the United States, including Puerto Rico and the Virgin Islands, were first published in the "Climatic Summary of the United States by Sections," for the period covering from the time stations began to 1930. Another supplement, "Climatic Summary of the United States by States, Supplement for 1931-52," Climatography of the U.S. Series No. 11, has also be published.

Availability: NCC.

1.7. "World Weather Records."

This publication is issued by geographic regions for 10-year periods. Data are listed by country or area name, station name, WMO number, latitude and longitude, and elevation. Monthly and annual mean values of station pressure, sea-level pressure, and temperature and monthly and annual total precipitation are given in sequential order.

The most current issue for 1951-60 is printed in six volumes: Vol. I, North America; Vol. II, Europe; Vol. III, South and Central America, West Indies, Caribbean area, and Bermuda; Vol. IV, Asia; Vol. V, Africa; and Vol. VI, Australia, New Zealand, Antarctica, oceanic islands, and ocean Weather ships.

Availability: NCC.

1.8. "Climates of the States," Climatography of the U.S. Series No. 60, 1959 and some revised editions.

This publication was printed for each State, Puerto Rico, and the Virgin Islands based on the 20-yr period 1931-52. Issues for some States have been revised to include the recent data.

The following are presented: a climatological summary of each State; tables of freeze data, monthly and annual mean temperature and precipitation by climatological division, and long-record monthly and annual normals, means, and extremes of precipitation, temperature, relative humidity, wind, and sunshine; and charts of mean maximum and minimum temperatures for January and July and mean annual precipitation.

Availability: NCC.

1.9. "Climatic Atlas of the United States," published in 1968, reprinted in 1974.

Maps showing the national distributions of monthly, annual, and/or seasonal mean, normal, and/or extreme values of temperature, precipitation, wind, barometric pressure, relative humidity, dew point, are presented. Originally separate sheets were made available as soon as printed. The entire set--a total of 40 large sheets containing 271 climatic maps and 15 tables--was bound into this atlas.

Availability: NCC.

1.10. "Decennial Census of the U.S. Climate, Monthly Normals of Temperature, Precipitation, and Heating Degree Days," Climatography of the U.S. Series No. 81, 1973.

This publication was printed for each State or combination of States based on the period 1941-70. Values of normal monthly and annual mean temperature and precipitation for National Weather Serivce first-order stations and for a large number of substations are given. Monthly and annual heating and cooling degree day normals are given for a representative number of stations in each State.

Availability: NCC.

1.11. "Monthly Averages of Temperature and Precipitation for State Climatic Division 1941-70," Climatography of the United States No. 85, 1973.

Monthly and annual divisional averages of temperatures and precipitation for the period 1941-70 for each State are presented. Each value is the simple arithmetic average of the data for all stations in the division that furnished both temperature and precipitation records.

1.12. "Summary of Hourly Observations," Climatography of the U.S. Series No. 82, 1963.

This publication was printed for each station where 24 hourly observations were recorded daily for the period 1951-60. The contents are: a narrative description of the location and topography of each station; tables of temperature and wind speed-relative humidity occurrences, frequency of hourly occurrences of precipitation amounts, and percentage frequencies of wind direction and speed, ceiling-visibility, sky cover, wind and relative humidity, and a station location table showing changes in the location and exposure of instruments and related information.

Availability: NCC.

1.13. "Storage Gage Precipitation Data for Western United States."

This publication is issued annually and includes all stations in the West having storage gages requiring reading and maintenance only at monthly or seasonal intervals. Monthly and/or seasonal precipitation totals and a station index table and map are given.

Availability: NCC.

1.14. "Storm Data."

This publication is issued monthly and contains information for all States. It lists chronologically by State occurrences of storms and unusual weather phenomena, together with data on the paths of individual storms, deaths, injuries and property damage, and gives a brief description of associated details.

Availability: NCC.

1.15. "Substation Observations," NWS Observations Handbook No. 2, 1972 edition.

This publication serves as a guide to cooperative observers who take and record observations of temperature, precipitation, evaporation, soil temperature, or atmospheric phenomena for the National Weather Service. Instructions pertain to the exposure and operation maintenance of instruments and equipment.

Availability: GPO, NCC.

1.16. "BOMEX Permanent Archive Description of Data," NOAA Technical Report EDS 12, May 1975, 327 pp.

This report described the data available from the BOMEX Permanent Archive, a depository for data collected during the Barbados Oceanographic and Meteorological Experiment (BOMEX) in 1969. Procedures used in data processing are described, and an inventory of the archived data is given.

Availability: NTIS (COM 72-50289).

1.17. "Eastern Lake Ontario Precipitation Network," NOAA Technical Memorandum ERL-GLERL 5, November 1975, 59 pp.

A six-gage precipitation network was operated for a 5-year period in the eastern portion of Lake Ontario basin. Descriptions of the instrumentation, site locations, and data reduction procedures and a complete listing of the data are provided.

Availability: NTIS (PB 253 134/1GA)

1.18. "Hourly Cumulative Totals of Rainfall Black Hills Flash Flood," June 9-10, 1972," NOAA Technical Memorandum NWS CR-59, 17 pp.

A brief description of the data gathered and the 6 hourly isohyetal maps produced.

1.19. "IFYGL RAWINSONDE SYSTEM: Description of Archived Data," NOAA Technical Report EDS-14, May 1976, 53 pp.

The report describes the rawinsonde data collected during the International Field Year for the Great Lakes conducted in 1972-1973 for the study of Lake Ontario and its basin. Procedures used in data processing are described and an inventory of the archived data is given.

Availability: NTIS (PB 258-057).

2. CLIMATOLOGICAL STUDIES

2.1. "Bibliography of Climate," NOAA Technical Memorandum EDS BC subseries, published irregularly.

Annotated bibliographies on climates of various regions of the world are presented in this series. Entries on precipitation, humidity, and other studies of hydrometeorological interest are included.

2.2. "Bibliography of Climatic Maps," NOAA Technical Memorandum EDS BM subseries, published irregularly.

Annotated bibliographies of climatic maps for various regions of the world are presented in this series. Entries pertinent to hydrometeorological studies for the various regions are included.

2.3. "Climates of the World," January 1969, 113 pp.

The principal features of climates of all continents are discussed briefly. Worldwide temperatures and precipitation are illustrated by maps. Monthly and annual temperatures are presented in tabular form for approximately 800 stations throughout the world.

2.4. "Climates of the United States," 1973, 113 pp.

The climates of the United States and their causes and events of interest are described and illustrated by maps and diagrams, some adapted from

item 1.9. This publication is not as lengthy or as detailed as item 1.8.

Availability: GPO, NCC.

2.5. "Historical and Climatological Study of Grinnel Glacier, Montana," ESSA Technical Memorandum WBTM WR 24, July 1967, 26 pp.

A study of the precipitation and temperature history of Grinnell Glacier, Mont., is presented.

Availability: NTIS (PB-178-071).

2.6. "Climate Along a Pipeline from the Arctic to the Gulf of Alaska," ESSA Technical Memorandum WBTM AR-2, Dec. 1968.

A brief climatic summary of a north-south route across Alaska is presented.

2.7. "Climate of the North Slope of Alaska," NOAA Technical Memorandum NWS AR-4, Feb. 1971.

Available climatological data for the Alaskan North Slope are presented.

2.8. "Frequency and Intensity of Freezing Rain/Drizzle in Ohio," NOAA Technical Memorandum NWS ER-51, Feb. 1973, 6 pp.

Using the Poisson probability distribution, a mean recurrence table of annual number of days with freezing rain or drizzle for several return periods was devised for eight Ohio locations.

Availability: NTIS (COM-73-10570).

2.9. "Radar Precipitation Study ESSA Interoceanic Canal Project, Final Report," ESSA Technical Memorandum ERL-ARL-23, July 1970, 115 pp.

A precipitation climatology was developed from weather radar and rain gage data obtained in eastern Panama and northwestern Columbia. Summaries of monthly rainfall frequency maps for several times of day and statistics on areal coverage of precipitation and vertical extent of clouds with precipitation size droplets are included.

Availability: NTIS (PB-194-416).

2.10 "Sacramento Weather Radar Climatology," ESSA Technical Memorandum WRTM-52, July 1970.

Average monthly and seasonal hourly radar echo frequencies are presented.

Availability: NTIS (PB-193-347).

2.11. "Study on Duration of Measurable Precipitation at Birmingham, Ala.," ESSA Technical Memorandum SRTM 27, Sept. 1966.

A climatological study on duration of measurable precipitation at Birmingham, Ala., is presented.

2.12. "Study on Duration of Measurable Precipitation at Lubbock, Texas," ESSA Technical Memorandum SRTM-34, Apr. 1967.

A climatological study on the duration of measurable precipitation at Lubbock, Tex., is presented.

2.13. "Persistence of Precipitation at 108 Cities in the Conterminous United States," ESSA Technical Memorandum WBTM TDL-31, May 1970, 84 pp.

Values of persistence of precipitation for each of the four seasons are derived for 108 cities in the conterminous United States for a selected combination of time intervals. These values show significant differences between stations and seasons.

2.14. "BOMEX Synoptic Weather Atlas," February 1975, 258 pp.

The atlas presents synoptic charts as an aid to users of the BOMEX data. Included in the atlas are mercator projection charts for sea level, the top of the Ekman layer, and 700-, 500-, and 200-mb levels. The base charts were the operational charts prepared at the National Hurricane Center in Miami, Florida. The BOMEX shipboard data were added and the charts re-analyzed at the National Climatic Center in Asheville, North Carolina.

Availability: NTIS (COM 75-11041/1GA).

2.15. "Summer Radar Echo Distribution Around Limon, Colorado," NOAA Technical Memorandum NWS CR-57, November 1974, 21 pp.

Radar echoes for the area within 125 n.mi. of Limon, Colorado for the summer (June-August) months of 1971-72 are examined for diurnal characteristics and relation to the terrain. There is little daylight frequency till about 1100 MDT. From then till 1730 MDT it increases everywhere but at the greatest rate over the mountains, then over east-west ridges extending into the plains. By 2130 the decreased frequency over the mountains is low enough for the maximum to be well over 100 n.mi. east of the Continental Divide. Then there is decay everywhere to near zero by 0530 MDT.

Availability: NTIS (COM 75-10076).

NOTE:

1. See "Hurricanes," items 9.3 through 9.7 and 9.11.
2. See "Precipitable Water," item 10.5.
3. See "Precipitation, depth-area-duration analysis," item 12.2.
4. See "Precipitation, distribution," item 13.8.
5. See "Precipitation, excessive and maximum observed," items 14.7 and 14.11.
6. See "Precipitation, forecasting," items 15.1 through 15.6.
7. See "Precipitation, hurricane," items 16.1 and 16.3.
8. See "Precipitation, mean and normal," item 17.1.
9. See "Precipitation probability," items 19.19 and 19.26.
10. See "Relative humidity," item 23.4.
11. See "Storms," items 28.3, 28.4 and 28.9.
12. See "Storm surges," item 29.19.

3. CLOUDS, LIQUID WATER CONTENT IN STORMS

3.1. "Measurements by Aircraft of Condensed Water in Great Plains Thunderstorms," ESSA Technical Memorandum IERTM NSSL-19, 1966.

The results obtained in flights on five thunderstorm days in Oklahoma are presented. The maximum value reported was 43.7 g/m^3. A diagram, relating liquid water content to rainfall rate, indicates that 33 g/m^3 corresponds to 50 in. per hr. Actual rain gage measurements of up to 24-27 in. per hr for durations of a few minutes are reported.

Availability: NTIS (PB-173-048).

3.2. "The Distribution of Liquid Water in Hurricanes," National Hurricane Research Project Report No. 62, 1963.

Data on liquid water content of clouds, as measured by airplane flights through four hurricanes, are presented. The maximum value obtained was 9.5 g/m^3.

Availability: NTIS (PB-168-411).

3.3. "Water Load in Convective Storms and Its Influence on Storm Kinetics," ESSA Technical Memorandum ERLTM-APCL 6, Mar. 1969, 55 pp.

The growth rate and accumulation of precipitation water mass in convective cloud updrafts is examined.

NOTE:
1. See "Storms", item 28.8.

4. DEW POINTS, MAXIMUM PERSISTING

NOTE:
1. See "Climatological Data and Observations," items 1.1 and 1.9.
2. See "Relative Humidity," item 23.1.

5. DROUGHT

5.1. "Drought Bibliography," NOAA Technical Memorandum EDS 20, June 1971.

Bibliographic citations of literature on agricultural, hydrologic, and meteorological drought are given. Abstracts are given where available.

Availability: NTIS (COM-71-00937).

5.2. "Meteorological Drought," Weather Bureau Research Paper No. 45, 1965.

An index of drought severity (Palmer drought index), which permits time and regional comparisons is developed.

5.3. "Meteorological Drought in West Virginia," ESSA Technical Memorandum EDS 11, Sept. 1969.

Palmer drought index values and precipitation data for the years 1931-67 are tabulated for regional climatic divisions of West Virginia.

Availability: NTIS (PB-187-474).

6. EVAPORATION

6.1. "Evaporation Maps of the United States," Weather Bureau Technical Paper No. 37, 1959.

The geographic distributions of average annual Class A pan evaporation, lake evaporation, and Class A pan coefficient are shown based on data for the period 1946-55 at 146 stations. Also, the geographic distributions of average May-October evaporation and standard deviation of annual Class A pan evaporation are shown.

6.2. "Evaporation from Pans and Lakes," Weather Bureau Research Paper No. 38, 1955.

Techniques for estimating reservoir evaporation from pan evaporation and other meteorological data are described.

6.3. "Objective Forecasting of Pan Evaporation-Two Contributions," NOAA Technical Memorandum NWS SR-85, March 1976, 17 pp.

The first approach, an Aid to Agricultural Evaporation Forecasting, offers a linear equation which estimates 24-hr pan evaporation as a function of means of temperature, relative humidity, and 20-ft winds. Since these three variables are routinely forecast, application of this evaporation equation is fairly straightforward. The second approach, An Objective Method of Forecasting Total Open-Pan Evaporation for a 48-Hour Period on the Texas South Plains Using Some Parameters from the FOUS 68 Message, introduces an equation thought to produce meaningful forecasts of 48-hr open pan evaporation observed at the Texas A&M Research and Extension Center at Lubbock, Texas.

Availability: NTIS (PB 253 525/0GS).

NOTE:

See "Climatological Data and Observations," items 1.1 through 1.3, 1.6, 1.8, 1.9, and 1.15.

7. FLOODS

7.1. "Rainfall and Floods of April, May and June 1957 in the South-Central States," Weather Bureau Technical Paper No. 33, 1958.

Storms and floods are described and tabulations of hourly and daily rainfall amounts for stations in the storm area, Texas to Missouri, are given.

7.2. "Hurricane Rains and Floods of August 1955, Carolinas to New England," Weather Bureau Technical Paper No. 26, 1956.

Storm and floods are described and tabulations of hourly and daily rainfall amounts for the Eastern States from South Carolina to Maine are presented.

7.3. "The Meteorological and Hydrological Aspects of the May 1968 New Jersey Floods," Weather Bureau Technical Memorandum ER-32, Feb. 1969, revised July 1970, 35 pp.

Major flooding occurred in northern and east-central New Jersey May 29-31, 1968. Crest stages resulting from the flooding were generally the highest in this area since 1936 and in selected river basins since 1903.

Availability: NTIS (PB-194-222).

7.4. "Kansas-Missouri Floods of June-July 1951," Weather Bureau Technical Paper No. 17, 1952.

The storms and floods are described and tabulations of hourly and daily rainfall amounts and river stages are presented.

Availability: X.

7.5. "Floods of April 1952--Upper Mississippi, Missouri, Red River of the North," Weather Bureau Technical Paper No. 23, 1954.

The causes and development of the floods are described and daily meteorological and river stage data are presented.

7.6. "Snowmelt Floods of March-April 1960," Weather Bureau Technical Paper No. 45, 1962.

The causes and development of the floods are described and precipitation and river gage data are presented.

7.7. "The March-May 1965 Floods in the Upper Mississippi, Missouri, and Red River of the North Basins," ESSA Technical Report WB-4, 1967.

The meteorological events leading to the record-breaking floods are described. Statistics on flood and crest stages, areas and periods of flooding, warnings issued, and flood damages are presented.

7.8. "The March-April 1969 Snowmelt Floods in the Red River of the North, Upper Mississippi, and Missouri Basins," NOAA Technical Report NWS-13, Apr. 1971, 92 pp.

The record and near-record floods in the North Central States in the spring of 1969 are described.

Availability: NTIS (COM-71-50269).

7.9. "The Flood of April 1974 in Southern Mississippi and Southeastern Louisiana," NOAA Technical Memorandum NWS HYDRO 24, August 1975, 45 pp.

The flood of April 1974 over the Pascagoula and Pearl River Basins in southern Mississippi ranks among the most severe in terms of crest stages and maximum flood discharges reached. This report discusses the meteorological situation that caused the heavy rains that produced the flooding. Bucket survey data and some peak discharges are given.

Availability: NTIS (COM 75-11387/AS).

Joint NOAA/USGS Flood Reports

Reports on major recent floods are being prepared as a cooperative effort of NOAA and the Geological Survey. These reports will be published in the Geological Survey Professional Paper Series.

7.10. "The Black Hills-Rapid City Flood of June 9-10, 1972: A Description of the Storm and Flood," Geological Survey Professional Paper No. 877. 1975, 47 pp.

A description of the meteorological situation that produced the extreme flood event is given. An analysis of the precipitation data is presented. Hydrologic data on peak stages and discharge are given for the creeks along the eastern slopes of the Black Hills.

Availability: GPO.

7.11. "Hurricane Agnes: Rainfall and Floods June - July 1972," Geological Survey Professional Paper No. 924, 1975, 403 pp, 1 plate.

The life history of Hurricane Agnes, including the tropical depression and tropical storm stages, is traced. Associated rainfalls are analyzed and compared with climatological recurrence values. These are followed by a description of the streamflows of each affected basin. A summary of peak stages and discharges and comparison data for previous floods at 989 stations are presented. Deaths and flood damages are compiled.

Availability: GPO.

7.12. "Southeastern United States Flood, March 14-18, 1973," Geological Survey Professional Paper No. 998, 1976, 283 pp.

A description of the meteorologic and hydrologic events during the floods of March 1973 in the Tennessee, Yazoo, and Tombigbee River Basins is presented.

Availability: GPO.

7.13. "The Mississippi River Basin Flood of Spring 1973," Geological Survey Professional Paper No. 937, 1975, 137 pp., 9 plates.

A description of the meteorologic and hydrologic events that resulted in the record-breaking floods on the Mississippi River in the spring of 1973 is presented.

Availability: GPO.

NOTE:
1. See "Climatological Data and Observations," items 1.3 and 1.18.
2. See "Precipitation, Maximum and Observed," item 14.9.
3. See "River and Flood Forecasting," items 24.5 and 24.22.

8. HYDROLOGIC CYCLE

8.1. "The Hydrologic Cycle," 1974, 8 pp.

The marine, atmospheric, and land phases of the cycle and the National Weather Service hydrologic services are described.

Availability: GPO; EDS, official copies.

9. HURRICANES

9.1. "Hurricane--The Greatest Storm on Earth," 36 pp.

The incidence and general causes of hurricanes, their structure, dynamics, and destructive effects, NOAA's work on warnings, Hurricane Hunters, hurricane modification, and individual and community safety rules are described.

Availability: GPO; EDS, official copies.

9.2. "Tropical Cyclones of the North Atlantic," Weather Bureau Technical Paper No. 55, 1965.

Tracks and frequencies of tropical storms and hurricanes for the period 1871-1963 are presented. Tracks are shown on maps for each year and by months and by other calendar periods.

9.3. "Climatology of Atlantic Tropical Storms and Hurricanes," ESSA Technical Report WB-6, May 1968, 18 pp.

Sections on hurricane formation, frequency, motion, and structure are presented.

9.4. "Climatology of Atlantic Tropical Cyclones by Two and One-half Degree Latitude-Longitude Boxes," Weather Bureau Technical Memorandum SR-44, Feb. 1969, 3 pp., 44 maps.

Climatological and statistical analyses of Atlantic tropical storms and hurricanes by 2 1/2° latitude-longitude boxes are presented.

9.5. "Digitized Atlantic Tropical Cyclone Tracks," NOAA Technical Memorandum NWS SR-55, July 1971, 147 pp.

The source regions and eventual disposition of all tropical cyclones passing through unit 2 1/2° latitude-longitude boxes during the 84-yr period of record 1886-1969 are shown. Also, the mean vector speed and direction and the mean scalar speeds of cyclones as they pass through each unit box are presented.

Availability: NTIS (COM-71-00984).

9.6. "Atlantic Hurricane Frequencies Along the U.S. Coastline," NOAA Technical Memorandum NWS SR-58, June 1971, 14 pp.

The total number of incidents and the frequency of hurricanes and tropical storms for 50-mi segments of the Gulf of Mexico and Atlantic coastlines are presented.

Availability: NTIS (COM-71-00796).

9.7. "Some Climatological Characteristics of Hurricanes and Tropical Storms, Gulf and East Coasts of the United States," NOAA Technical Report NWS 15, May 1975, 87 pp.

A climatology of hurricane factors important to storm surges is presented for the Gulf of Mexico and Atlantic coasts of the United States. Factors presented are: frequency of entering, exiting, and alongshore hurricanes; ratio of tropical storms to hurricanes; central pressures of hurricanes and tropical storms; radius of maximum winds and speed of forward motion for hurricanes; and direction of motion for entering hurricanes.

Availability: NTIS (COM 75-11088).

9.8. "Meteorological Considerations Pertinent to Standard Project Hurricane, Atlantic and Gulf Coasts of the United States," National Hurricane Research Project Report No. 33, Nov. 1959.*

A description of the meteorological factors pertinent to the most severe hurricane reasonably characteristic of a region.

Availability: NTIS (PB-166-855).

9.9. "Memorable Hurricanes of the United States Since 1873," Weather Bureau Technical Memorandum SR-56, 1969, revised May 1971.

Whether or not a hurricane is notable and should be remembered depends upon many things. The selections in this publication are limited to those that have made landfall in the United States or have been near misses. Also, most of them were major, extreme, or great hurricanes.

Availability: NTIS (COM-71-00610).

* This study is currently being revised and updated. The revisions of the investigations will be published in the Hydrometeorological Report series late in 1977.

9.10. "Florida Hurricanes," ESSA Technical Memorandum WBTM SR-38, Nov. 1967.

Descriptive and historical information on hurricanes, particularly as they affect Florida, is provided. The life cycle of hurricanes, their location, tracking, and specific hurricane characteristics are described.

Availability: NTIS (PB-182-220).

9.11. "Preliminary Climatic Data Report Hurricane Agnes June 14-23, 1972," NOAA Technical Memorandum EDS NCC-1, Aug. 1972.

A brief storm history and climatological data on the pressure, winds, tides, rainfall, and runoff associated with Agnes are provided in this preliminary report.

Availability: NTIS (COM-72-11225), NCC, EDS.

9.12. "Hurricane Agnes, June 14-23, 1972," Preliminary Reports on Hurricanes and Tropical Storms, Sept. 1972, 190 pp.

Weather Service advisories and bulletins on Hurricane Agnes are listed. A brief storm history is given.

9.13. "Reconstruction of the Surface Pressure and Wind Fields of Hurricane Helene," National Hurricane Research Project Report No. 59, Nov. 1962, 44 pp.

Study reconstructs the pressure and wind fields associated with this severe hurricane during the time it threatened the coastal region of Southeastern United States.

9.14. "An Analysis of Hurricane Betsy," Weather Bureau Technical Memorandum SR-41, Jan. 1969, 9 pp.

Hourly weather observations from several reporting stations were used to produce analyses of ceiling heights, visibility, precipitation intensity, and surface wind gusts associated with Hurricane Betsy of 1965.

Availability: NTIS (PB-182-383).

9.15. "Hurricane Camille, August 14-22, 1969 (Preliminary Report)," Sept. 1969, 58 pp.

The advisories, bulletins, and statements issued by the Weather Bureau on this hurricane are listed. A brief storm history is given.

9.16. "On the Maximum Intensity of Hurricanes," National Hurricane Research Project Report No. 14, Dec. 1957.

An attempt to determine the minimum pressure that can occur within a hurricane is described. This minimum pressure is related to the temperature of the sea surface over which the hurricane moves.

Availability: NTIS (PB-166-839).

9.17. "The Three-Dimensional Wind Structure Around a Tropical Cyclone," National Hurricane Research Project Report No. 15, Jan. 1958.

Wind data from a number of hurricanes are combined to obtain a composite of the hurricane circulation.

Availability: NTIS (PB-168-369).

9.18. "Surface Winds Near the Center of Hurricanes (and Other Cyclones)," National Hurricane Research Project Report No. 39, Sept. 1960.

Observed wind and pressure data from 14 hurricanes in the Gulf of Mexico and along the Atlantic coast of the United States are presented. Data from three tropical storms off the middle Atlantic coast are also included.

Availability: NTIS (PB-166-842).

9.19. "Some Properties of Hurricane Wind Fields as Deduced from Trajectories," National Hurricane Research Project Report No. 49, Nov. 1961.

Surface wind fields for hurricanes are simulated by a trajectory technique. The technique applies to moving, as well as stationary, storms.

Availability: NTIS (PB-168-398).

9.20. "On the Evolution of the Wind Field During the Life Cycle of Tropical Cyclones," National Hurricane Research Project Report No. 65, Nov. 1963.

The structure of the wind field of tropical cyclones and its changes with time during the intensification and dissipation stages are studied by means of radial wind profiles recorded by research aircraft.

Availability: NTIS (PB-168-414).

9.21. "On the Filling of Tropical Cyclones Over Land," National Hurricane Research Project Report No. 66, Dec. 1963.

The processes that resulted in the dissipation of a tropical cyclone over-land were investigated. The investigation was based upon the study of the eddy fluxes of latent and sensible heat and the dissipation of kinetic energy at the Earth's surface. A comparison was made of the rates of energy exchange at the surface after the character of the lower boundary had changed from water to land.

Availability: NTIS (PB-168-415).

9.22. "A Study of Hurricane Rainbands," National Hurricane Research Project Report No. 69, Mar. 1964.

The structure and variability of the spiral rainbands of hurricanes are described using data from more than 75 rainbands selected from tropical cyclones that occurred between 1957 and 1962.

Availability: NTIS (PB-168-417).

9.23. "A Simple Model of the Hurricane Inflow Layer," Technical Note 18-National Hurricane Research Laboratory-75, Nov. 1965.

A simple numerical model of the hurricane inflow layer is constructed. A pressure profile representative of an actual hurricane is specified.

Availability: NTIS (PB-169-210).

9.24. "Changes of the Maximum Winds in Atlantic Tropical Cyclones as Deduced from Central Pressure Changes," NOAA Technical Memorandum ERL WMPO-6, Aug. 1973.

Changes of maximum winds for Atlantic tropical storms have been studied. Mean values and standard deviations of these changes were computed and are presented by 5° squares of latitude and longitude. These data have also been stratified by direction of storm movement.

Availability: NTIS (COM-73-11952/1AS); ERL, official copies.

9.25. "A Statistical Study of Tropical Cyclone Positioning Errors With Economic Applications," NOAA Technical Memorandum NWS SR-82, March 1975, 21 pp., 7 fig., 6 tab.

Hurricane landfall forecasts are based heavily on the latest available motion vector and position of a storm. This study uses a Monte Carlo simulation of hurricane positioning errors to determine a statistical relationship between positioning errors and landfall errors. For a typical 18-hr landfall forecast, it is shown 22% of landfall position error results from initial data uncertainties. A 10-n.mi. increase in initial position error can result in a 20% increase in the warning zone but a 10-n.mi. decrease in initial error can result in only a 11% decrease in the warning zone. A typical 300-n.mi. Gulf of Mexico coastal hurricane warning zone will have protection costs to $25.1 million. An increase in positioning error will thus increase costs by about $5 million, while a corresponding decrease will reduce costs by about $2.75 million.

Availability: NTIS (COM 75-11362/AS).

9.26. "Atlantic Tropical and Subtropical Cyclone Classification for 1975," NOAA Technical Memorandum NESS 75, March 1976, 14 pp.

Estimates of the locations and maximum sustained winds of all named tropical and subtropical cyclones in the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico were made. The estimates were compared with the National Hurricane Center's "best tracks" data to establish the measure of accuracy achieved. The average difference between satellite locations and best track locations was approximately 17 n.mi. The accuracy in estimating the maximum sustained wind speed showed an absolute average difference of 6 knots, an algebraic average difference of minus 2 knots, and a standard deviation of 6 knots. These data are not completely independent because the best track data is partly determined from satellite data.

Availability: NTIS (PB 253-968/AS).

9.27. "Atlantic Tropical Cyclone Classifications for 1974," NOAA Technical Memorandum NESS 68, April 1975, 12 pp.

Estimates of the locations and maximum sustained winds of all named tropical cyclones in the North Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico during 1974 were made using the technique proposed by Dvorak.

This technique was applied to pictures from SMS-1 and ATS-3 geostationary satellites. These estimates were compared with other data to establish the measure of accuracy achieved. The results are presented together with comments on expected future performance.

Availability: NTIS (COM 75-10676/AS).

9.28. "Digitized Eastern Pacific Tropical Cyclone Tracks," NOAA Technical Memorandum NWS WR-101, September 1975, 189 pp.

A series of 184 charts is presented consisting of two maps showing the source and eventual disposition of tropical cyclones passing through 2-1/2 degree latitude-longitude boxes during the 14 year period, 1961-74, and a bar graph showing the daily distribution of the storms which passed through the boxes, the number of storms and, when they total 5 or more, the speed.

Availability: NTIS (COM 75-11479/AS).

NOTE:

1. See "Clouds, Liquid Water Content in Storms," item 3.2.
2. See "Floods," item 7.2.
3. See "Precipitation, Hurricane," items 16.1 and 16.2.
4. See "Storm Surges," items 29.1 through 29.4, 29.8, 29.9, 29.10, 29.20 and 29.22.
5. See "Weather Modification," items 33.5 and 33.11.

10. PRECIPITABLE WATER

10.1 "Mean Precipitable Water in the United States," Weather Bureau Technical Paper No. 10, 1949.

Tabulations and maps showing average monthly and annual distributions of atmospheric moisture in the layers from the surface to 8 km and from 2 to 8 km over the 48 States are presented based on the period of record ending in 1943.

Availability: H.

10.2. "Tables of Precipitable Water and Other Factors for a Saturated Pseudo-Adiabatic Atmosphere," Weather Bureau Technical Paper No. 14, 1951.

Tables showing variations of atmospheric moisture, pressure and temperature with height are presented.

10.3. "Calculation of Precipitable Water," Weather Bureau Technical Memorandum TDL-33, June 1970, 61 pp.

Two methods of calculating precipitable water are given in terms of data obtainable from a radiosonde or rawinsonde observation. Method I is based on the premise that aqueous vapor pressure (or dew point) and temperature are reported for altitudes with reference to mean sea level. Method II is predicted on the basis that the values are reported for respective specified barometric pressure levels.

Availability: NTIS (PB-193-600).

10.4 "Water-Vapor and Mass Divergence Computations Based on BOMEX Aircraft and Dropsonde Data: A Comparison," NOAA Technical Memorandum EDS BOMAP-13, December 1974, 24 pp.

Water vapor and mass divergences were computed from aircraft and radiosonde data. The contribution to the water-vapor flux divergence by horizontal subgrid-scale eddies was found to be unimportant during undisturbed weather conditions. Correlation coefficients and rms differences between measurements of the same horizontal wind derivatives by different systems are discussed. Results indicate that divergence computations based on data from a single four-aircraft mission are compatible in accuracy to those based on rawinsonde data averaged over four release times and 50 mb.

Availability: NTIS (COM-75-10268).

10.5 "Parameterized Moisture and Heat Flux Through Top of Bomex Volume," NOAA Technical Memorandum EDS-BOMAP 15, May 1975, 48 pp.

A prime objective of the Barbados Oceanographic and Meteorological Experiment (BOMEX) was to determine the budgets of moisture, enthalpy, and mass in a fixed atmospheric volume over a tropical ocean. The fluxes through the top of the volume were not measured directly. A parameterization scheme is developed to estimate the top of-the-volume moisture flux as a ratio to rainfall produced. The enthalpy flux is also treated briefly.

Availability: NTIS (COM 75-10905/8GA).

10.6. "Precipitable Water Over the United States, Volume I. Monthly Means," NOAA Technical Report NWS 20, November 1976, 173 pp.

Mean monthly values of precipitable water are presented in tabular and graphical form for all radiosonde stations in the conterminous United States for the period 1946-72 and for Alaska 1950-69. Precipitable water is given by layers from the surface to 400 mb from twice-daily observations.

NOTE:

1. See "Relative Humidity," items 23.2 and 23.3.
2. See "Satellite Meteorology," item 26.5.

11. PRECIPITATION, COMPUTED

11.1. "A Comparison of Kinematically Computed Precipitation with Observed Convective Rainfall," ESSA Technical Memorandum IERTM NSSL-25, 1965.

Observed wind and moisture patterns in an extensive squall-line development are used to compute precipitation from a continuity equation for moist air. Horizontal flux of water vapor accounts for about 80 percent of observed rainfall; and when the local change in water vapor content is included in the moisture-balance equation, the computed budget accounts for 95 percent of the actual rainfall production.

Availability: NTIS (PB-168-445).

11.2. "Three Dimensional Wind Flow and Resulting Precipitation in a Northern California Storm," Weather Bureau Research Paper No. 44, 1963.

A reconstruction of the temperature, wind, pressure, and moisture distributions in a major storm is presented.

12. PRECIPITATION, DEPTH-AREA-DURATION ANALYSIS

12.1. "Manual for Depth-Area-Duration Analysis of Storm Precipitation," Weather Bureau Cooperative Studies Technical Paper No. 1, 1946.

The standard procedures used by various Federal agencies for making these analyses are described.

Availability: As a World Meteorological Organization publication with the same title (WMO No. 237. TP 129). Order from: UNIPUB, Inc., P.O. Box 433, New York, New York 10016.

12.2. "Precipitation Analysis for BOMEX Period III," NOAA Technical Report EDS 13, September 1975, 40 pp.

Radar, satellite, and rain-gage data are used quantitatively and qualitatively to describe the precipitation morphology for 10 days (June 21-30, 1969) of period III of the Barbados Oceanographic and Meteorological Experiment (BOMEX). Typical satellite and radar photographs are presented to illustrate cloud patterns and precipitation echoes for both undisturbed and disturbed weather. Procedures for calibrating and optimizing the use of the quantitative radar data are discussed. Satellite cloud data are used to extrapolate the rainfall estimates to areas not covered by radar.

Availability: NTIS (PB 246 870/AS).

12.3. "Greatest Known Areal Storm Rainfall Depths for the Contiguous United States," NOAA Technical Memorandum NWS HYDRO 33, (in press).

Greatest known areal storm rainfall depths for the contiguous United States are presented for winter, spring, summer, and fall. Depths are for 100, 200, 1,000, 5,000 and 10,000 mi^2 (259, 518, 2590, 12950, 25900 km^2) for 6, 12, 24, and 48 hours. Rainfall values are on maps and tables.

13. PRECIPITATION, DISTRIBUTION: TIME AND SPACE

13.1. "A Preliminary Examination of Areal Characteristics of Precipitation in New Mexico," Weather Bureau Technical Memorandum SR-40, Nov. 1968, 14 pp.

Statistics on the areal coverage of precipitation by State climatic divisions are presented.

Availability: NTIS (PB-182-222).

13.2. "Areal Coverage of Precipitation in Northwestern Utah," ESSA Technical Memorandum WBTM WR-56, Sept. 1970.

The percentage of area to be covered by precipitation if it occurs is discussed.

Availability: NTIS (PB-194-389).

13.3. "A Study of the Areal Distribution of Radar Detected Precipitation at Charleston, S.C.," ESSA Technical Memorandum WBTM ER-31, Oct. 1968, 3 pp., 36 figures.

A series of charts showing the areal distribution of radar detected precipitation within 125 nautical miles (n.mi.) of the Weather Bureau Airport Station at Charleston, S.C., is presented.

Availability: NTIS (PB-180-480).

13.4. "Areal Shower Distribution--Mountain Versus Valley Coverage," ESSA Technical Memorandum CR-3, June 1966.

A study of summer showers over the Colorado mountains is presented.

13.5. "A Study of the Effect of Sea Surface Temperature on the Areal Distribution of Radar Detected Precipitation Over the South Carolina Coastal Waters," ESSA Technical Memorandum WBTM ER-23, June 1967, 9 pp.

Using data for the period July 1-30, 1963, the precipitation frequency maximum was found over the warmer waters of the Gulf Stream in contrast to the cooler waters near shore.

Availability: NTIS (PB-180-612).

13.6. "Time Distribution of Precipitation in 4- to 10-Day Storms--Ohio River Basin," NOAA Technical Memorandum NWS HYDRO 13, May 1973.

This report suggests a characteristic time distribution for precipitation frequency values for the 4- through 10-day durations over the subject basin. The suggested distribution was developed from over a 1,400-storm sample for each duration and based on data for 1937-66.

Availability: NTIS (COM-72-11139).

13.7. "Time Distribution of Precipitation in 4- to 10-Day Storms--Arkansas-Canadian River Basins," NOAA Technical Memorandum NWS HYDRO-15, June 1973.

Same description as above item but based on data for 1941-70.

Availability: NTIS (COM-73-11169).

13.8. "Lake Ontario Basin: Overland Precipitation 1972-73," NOAA Technical Memorandum ERL-GLERL-1, March 1975, 18 pp.

Daily precipitation values were derived for the United States portion of the Lake Ontario land basin for 1972 and 1973. Isohyetal maps are provided for 1972 and 1973.

Availability: NTIS (COM 75-10589/0GA).

13.9. "Radar and Satellite Precipitation Analysis of a 5-Day BOMEX Data Sample," NOAA Technical Memorandum EDS BOMAP-18, November 1976, 46 pp.

Radar and satellite data are used qualitatively and quantitatively to describe the precipitation morphology for a five-day period of the Barbados Oceanographic and Meteorological Experiment (BOMEX) conducted in 1969. The period was characterized by undisturbed weather conditions but was immediately preceded and followed by moderate and mild disturbances respectively. Typical satellite and radar photographs are presented to illustrate cloud patterns and precipitation echoes. Minimums of cloud echo amounts are generally observed around mid-day, maximums in the early morning hours. Average echo and cloud amounts for the period were found to decrease with increasing latitude.

Availability: NTIS (PB 249 589/3GA).

NOTE:

1. See "Climatological Data and Observations," item 1.18.
2. See "Precipitation, Hurricane," items 16.3 and 16.4.
3. See "Precipitation, Distribution," item 15.16.
4. See "Satellite Meteorology," item 26.3.

14. PRECIPITATION, EXCESSIVE AND MAXIMUM OBSERVED

14.1. "Excessive Precipitation Techniques," Key to Meteorological Records Documentation No. 3.081, 1958.

The various criteria used for defining excessive precipitation and the different ways the data were measured and published are discussed. Names of the various periodicals in which these data were published are listed.

14.2. "Maximum Recorded United States Point Rainfall for 5 Minutes to 24 Hours at 207 First-Order Stations," Weather Bureau Technical Paper No. 2, revised 1963.

Data are presented in tables and on maps.

Availability: H.

14.3. "Maximum Station Precipitation for 1, 2, 3, 6, 12, and 24 Hours," Weather Bureau Technical Paper No. 15, published in parts for individual states.

Tables of maximum amounts for the period 1940-50 for about 2,000 recording-gage stations in 27 States are presented.

Availability: H.

14.4. "Maximum 24-Hour Precipitation in the United States," Weather Bureau Technical Paper No. 16, 1952.

Tables of maximum 24-hr amounts for the period of record ending 1949 for 7,355 stations in the 48 states are presented.

Availability: H.

14.5. "Heavy Rains in Colorado--June 16 and 17, 1965," ESSA Technical Memorandum WBTM CR-4, July 1966.

The meteorological factors associated with this storm are discussed briefly.

14.6. "Weather Extremes," NOAA Technical Memorandum NWS WR-28, Apr. 1968, revised Nov. 1971, 21 pp.

Fifteen categories covering the elements of temperature, precipitation, snowfall, atmospheric pressure, and wind are listed for 14 western cities, 13 Western States.

Availability: NTIS (COM-71-01126).

14.7. "Heavy Fall and Winter Rains in the Carolina Mountains," NOAA Technical Memorandum ER 57, October 1974, 6 pp.

There were eight days in the period October 1, 1972 to March 31, 1973 in which more than two inches of rain occurred at any North Carolina or South Carolina mountain station. These patterns were examined to see if any common weather patterns could be identified.

Availability: NTIS (COM 74-11761/AS).

14.8. "Study on a Significant Precipitation Episode in the Western United States," NOAA Technical Memorandum NWS WR-98, April 1975, 45 pp.

The synoptic study for the period 22 September to 3 October 1974 involves a case analysis of an unforeseen major precipitation episode associated with the merger of an inactive upper tropospheric perturbation that moved

eastward out of the subtropics and an inactive extratropical low moving southeastward. The amalgamation of the two systems caused a major surface storm within 24 hours.

Availability: NTIS (COM 75-10719/3GA).

14.9. "Severe Rainstorm at Enid, Oklahoma, October 10, 1973," L. P. Merritt, E. K. Wilk, and Weible, NOAA Technical Memorandum ERL NSSL-73, November 1974.

Meteorological analysis at synoptic and sub-synoptic scale are presented of an extreme convective rainstorm over Enid, Oklahoma. The analyses indicate (1) that evolution of events was governed by conditions and events at synoptic scale, (2) concentrated convective rainfall occurred in conjunction with and enhanced a major extratropical system and (3) the most outstanding feature was the formation of a stationary and well-defined region of sustained convective activity.

Availability: NTIS (COM 75-10583/AS).

14.10. "Moisture Source for Three Extreme Local Rainfalls in the Southern Intermountain Region," NOAA Technical Memorandum NWS HYDRO-26, November 1975, 57 pp.

Three cases of extreme local rain in summer season in the intermountain region were studied to determine the moisture source. Synoptic data were used to analyze surface and upper-level moisture changes in time and space. The study showed a tongue of high moisture at low levels approached the vicinity or encompassed the storm area prior to the onset of the rain. The moisture could be traced back to the Gulf of California. A general conclusion is that greater emphasis should be given to tropical Pacific moisture in evaluating extreme summer precipitation values for the intermountain region.

Availability: NTIS (PB 248 433).

14.11. "Greatest Known Areal Storm Rainfall for the Contiguous United States," NOAA Technical Memorandum NWS HYDRO 33 (in press).

The greatest known areal storm rainfall depths for the contiguous United States are presented for the winter, spring, summer, and fall seasons. The 5 greatest depths are given for 100, 200, 1,000, 5,000 and 10,000 sq mi for 6, 12, 24, and 48 hours within each of the forty 5-degree latitude-longitude squares.

14.12. "A Record Arkansas Rainfall - The El Dorado Deluge," NOAA Technical Memorandum NWS SR-86, August 1976, 16 pp.

The report discusses the meteorological situation that accompanied a rainfall of over 18 inches in less than 12 hours on the night of June 7-8, 1974.

NOTE:

1. See "Climatological Data and Observations," items 1.1 through 1.6, 1.8, and 1.15.
2. See "Climatological Studies," item 2.4.

15. PRECIPITATION FORECASTING

15.1. "Charts Giving Station Precipitation in the Plateau States from 700-Mb Lows During Winter," ESSA Technical Memorandum WBTM TDL-12, Oct. 1967, 54 pp.

Lows are classified into three intensity categories according to the departure from normal of the central height. For each category, the average precipitation amount, extent, and frequency of occurrence over a grid system are presented.

Availability: NTIS (PB-176-742).

15.2. "Charts Giving Station Precipitation in the Plateau States from 850- and 500-Millibar Lows During Winter," ESSA Technical Memorandum WBTM TDL-25, Sept. 1969, 9 pp., 2 apps.

Probabilities of precipitation from 850- and 500-mb Lows are derived for selected stations in the intermountain West during winter.

Availability: NTIS (PB-187-476).

15.3. "A Synoptic Climatology of Winter Precipitation from 700-Mb Lows for the Intermountain Areas of the West," Weather Bureau Technical Note 45 TDL-4, May 1966.

The location and intensity of Low systems during the winter in relation to the frequency and amount of precipitation at each of 34 stations in the plateau region are given.

Availability: NTIS (PB-170-635).

15.4. "Synoptic Climatological Studies of Precipitation in the Plateau States from 850-, 700-, and 500-Millibar Lows During Spring," NOAA Technical Memorandum NWS TDL-48, Aug. 1972, 130 pp.

The synoptic climatology of precipitation over the plateau states or intermountain region of the western part of the United States during spring is derived using 12-hr precipitation amounts (expressed as a percent of the 7-day normal) for 13 yr at 157 stations.

Availability: NTIS (COM-73-10069).

15.5. "Synoptic Climatological Studies of Precipitation in the Plateau States from 850-Millibar Lows During Fall," NOAA Technical Memorandum NWS TDL-49, Aug. 1972.

The synoptic climatology of precipitation, from upper level Lows at 850 mb over the intermountain region of Western United States during September,

October, and November is discussed. The average precipitation amount, distribution, and frequency of occurrence are derived and related to the level, intensity, and location of the upper Low.

Availability: NTIS (COM-74-10464).

15.6. "Precipitation Probabilities in the Western Region Associated with Winter 500-Mb Map Types," ESSA Technical Memorandum WBTM WR 45-1, Dec. 1969, 91 pp.

Twelve-hr precipitation climatologies as specified by 500-mb flow patterns were generated. Development of types, proper usage, limitations, and other general information is discussed. Types along with their climatologies and a listing of type dates are also included.

This is part 1 (as indicated by the -1 in the series title) of a set covering the four seasons. Parts 2, 3, and 4 have identical titles-except spring, summer, or fall, respectively.

Availability: NTIS (PB-188-248, PB-189-434, PB-189-414, and PB-189-435).

15.7. "Forecasting Precipitation at Bakersfield, California, Using Pressure Gradient Vectors," NOAA Technical Memorandum NWS WR-78, July 1972.

An objective method for forecasting probability of precipitation at Bakersfield, Calif., is described.

Availability: NTIS (COM-72-11146).

15.8. "Objective Forecast of Precipitation Over the Western Region of the United States," NOAA Technical Memorandum NWS WR-89, Sept. 1973, 47 pp.

The climatology of 500-mb winter flow types is presented as follows: frequency of occurrence of seven characteristic 500-mb height configurations and associated patterns of vorticity, vertical velocity, higher and lower pressure levels, dew-point depressions, frequency of precipitation, etc.

Availability: NTIS (COM-73-11946/3GA).

15.9. "A Paradox Principle in the Prediction of Precipitation Type," NOAA Technical Memorandum NWS WR-72, Feb. 1972.

A method utilizing 500-mb temperature, in addition to 1000-mb thickness, in forecasting precipitation type is described.

Availability: NTIS (COM-72-10432).

15.10. "Forecasting Type of Precipitation," NOAA Technical Memorandum NWS ER-45, Jan. 1972.

An objective technique for forecasting precipitation type in Eastern United States out to 48 hr is described.

Availability: NTIS (COM-72-10316).

15.11. "Forecasting Precipitation Type at Greer, South Carolina," NOAA Technical Memorandum NWS ER-44, Dec. 1971.

An objective technique for forecasting precipitation type at Greer, S.C., is described.

Availability: NTIS (COM-72-10332).

15.12. "Predicting Precipitation Types," ESSA Technical Memorandum WBTM WR-49, Mar. 1970.

A method of predicting precipitation types over the Sierra Nevadas is described.

Availability: NTIS (PB-190-962).

15.13. "Predicting the Conditional Probability of Frozen Precipitation," NOAA Technical Memorandum NWS TDL-51, Mar. 1974, 38 pp.

A system producing objective forecasts of conditional probability of frozen precipitation for the conterminous United States is described.

Availability: NTIS (COM-74-10909/1GA).

15.14. "On Quantitative Precipitation Forecasting," National Hurricane Research Project Report No. 38, Aug. 1960.

A method of quantitative precipitation forecasting is discussed.

Availability: NTIS (PB-180-085).

15.15. "An Objective Aid to Forecasting Summertime Showers Over the Lower Rio Grande Valley of South Texas," NOAA Technical Memorandum NWS SR-79, Jan. 1975, 14 pp.

Local forecast study directed primarily to the short-range forecasting of areal coverage of summertime air-mass showers over the Lower Rio Grande Valley. The best predictors were the mean relative humidity in the 850- to 700-mb and the 650- to 500-mb layers of the latest atmospheric sounding at Brownsville.

Availability: NTIS (COM 75-10307/AS).

15.16. "Dynamics of Cold Season Precipitation in the Southwestern United States," NOAA Technical Memorandum NWS SR-78, November 1974, 12 pp.

The percentage frequency and spatial distribution of cold season precipitation in New Mexico during the 1972-73 fall, winter, and spring season are related to the intensity and path of 500-mb vorticity maxima for 12-hour periods.

Availability: NTIS (COM 75-10085/AS).

NOTE:
1. See "Climatological Studies," items 2.8 and 2.11 through 2.13.
2. See "Precipitation Distribution, Time and Space," items 13.3 through 13.5.

3. See "Precipitation Probability," items 19.16 through 19.18.
4. See "Snow," items 27.5 and 27.6.
5. See "Storms, General," items 28.15 and 28.16.

16. PRECIPITATION, HURRICANE

16.1. "Climatological Regime of Rainfall Associated With Hurricanes After Landfall," ESSA Technical Memorandum WBTM ER-29, June 1968, 25 pp.

A climatology of hurricane rainfall for the Northeastern United States is described. Three items are presented: 1) climatology of areal average and maximum point rainfall depths for 24 hr after a hurricane's landfall, 2) characteristic rainfall patterns for the duration of hurricanes as they neared, then passed over a land mass, and 3) unusual hurricane rainfall events of record.

Availability: NTIS (PB-179-341).

16.2. "Rainfall Associated With Hurricanes," National Hurricane Research Project Report No. 3, 1956.

Meteorological summaries, isohyetal maps, and maximum depth-area-duration data for over 200 tropical storms are presented.

Availability: NTIS (PB-168-360).

16.3. "Effects of Tropical Cyclone Rainfall on the Distribution of Precipitation Over the Eastern and Southern United States," ESSA Professional Paper No. 1, June 1967, 67 pp.

The effects of tropical storm rainfall on the distribution of mean precipitation over the Eastern and Southern United States are described.

16.4. "Frequency and Areal Distribution of Tropical Storm Rainfall in the United States Coastal Region on the Gulf of Mexico," ESSA Technical Report WB-7, July 1968, 33 pp.

Rainfall within 150 mi of the storm track and 100 mi inside the coastline during the period 24 hr before landfall to 24 hr after are discussed.

NOTE:
1. See "Floods," Weather Bureau Technical Paper No. 26, item 7.2.
2. See "Hurricanes," items 9.41 and 9.22.

17. PRECIPITATION, MEAN AND NORMAL

17.1. "Normal Monthly Number of Days with Precipitation of 0.5, 1.0, 2.0, and 4.0 Inches or More in the Contiguous United States," Weather Bureau Technical Paper No. 57, 1966.

Four series of 12 maps of the United States, each 1:10,000,000, present data based on the 30-yr period 1931-60.

17.2. "Washington Metropolitan Area Precipitation and Temperature Patterns," ESSA Technical Memorandum WBTM ER-28.

Maps showing mean annual and seasonal precipitation, mean annual snowfall, and mean seasonal temperatures for the 20-yr period 1946-65 are presented. Also, total precipitation in wettest and driest months and temperature in coldest and warmest months are shown.

Availability: NTIS (PB-179-340).

17.3. "Quantiles of Monthly Precipitation for Selected Stations in the Contiguous United States," ESSA Technical Report EDS-6, Aug. 1968.

The gamma and mixed gamma distributions were fitted to 30-yr monthly precipitation series for 122 first-order weather stations. Quantiles for selected probabilities from 0.02 to 0.98 are presented.

Availability: NTIS (PB-180-057).

17.4. "Monthly Precipitation--Amount Probabilities for Selected Stations in Virginia," ESSA Technical Memorandum WBTM ER-30, June 1968.

A statistical analysis of 30-yr monthly precipitation data at six well dispersed stations is presented.

Availability: NTIS (PB 179-342).

17.5A. "Normal Annual and Seasonal May-September and October-April Precipitation Maps."

These maps are available for the States of Arizona, Colorado, New Mexico, and Utah. They were prepared by the NWS River Forecast Center, Salt Lake City, Utah, and are based on the 1931-60 period. They may be obtained from the following organizations:

Arizona

The University of Arizona
Room 102, West Stadium Bldg.
Tucson, AZ 85717

Price: $1.00 per set

Colorado

Colorado Water Conservation Board
215 State Services Bldg.
1525 Sherman Street
Denver, CO 80203

Price: $1.00 per set

New Mexico

State Engineer Office
State Capitol Bldg.
Santa Fe, NM 87501

Price: $1.00 per set

Utah

Utah State Engineer Office
State Capitol Bldg.
Salt Lake City, UT 84114

Price: $0.75 per map

17.5B. "Normal Annual Precipitation Map."

These maps are available for the States of Idaho, Oregon, and Washington. They were prepared by the NWS River Forecast Center, Portland, Oregon and are based on the 1930-57 period. They may be obtained from the following organizations:

NWS River Forecast Center
320 Custom House
Portland, OR 97209

Western Regional Technical Service Center
USDA, Soil Conservation Service
Rm. 209, 511 NW Broadway
Portland, OR 97209

NOTE:
1. See "Climatological Data," items 1.1 through 1.4, 1.6, and 1.8 through 1.11.
2. See "Precipitation, Hurricane," item 16.3.
3. See "Precipitation Probability," items 19.1, 19.2, and 19.22.
4. See "Snow," item 27.3.

18. PRECIPITATION MEASUREMENTS (EQUIPMENT)

Gages

18.1. "History of Weather Bureau Precipitation Measurements," Key to Meteorological Records Documentation No. 3.082, 1963.

The various gages that have been used and how measurements are made are described.

18.2. "Final Report--Test and Evaluation of the Fischer and Porter Precipitation Gage," ESSA Technical Memorandum WBTM T&EL-7, Oct. 1968, 22 pp.

The 2-yr test on this gage is discussed.

Availability: NTIS (PB-180-290).

18.3. "A Rainfall Rate Sensor," ESSA Technical Memorandum ERLTM NSSL-42, Nov. 1968, 10 pp.

An instrument designed to measure rainfall rate is described. Rain passes from a collector into a reservoir formed between two concentric electrodes while it empties from the reservoir through a small nozzle at its base.

Availability: NTIS (PB-183-979).

18.4. "A Selective Precipitation Indicator," ESSA Technical Memorandum WBTM EDL-4, July 1968, 10 pp. and figures.

An electronic instrument, designed to sense or detect the presence of dew, frost, drizzle, rain, or snow, to differentiate between these forms, and to render a report concerning their incidence, duration, and type is described.

Availability: NTIS (PB-179-344).

Radar-Rain Gage Comparisons

18.5. "Comparison of Gage and Radar Methods of Convective Precipitation Measurement," NOAA Technical Memorandum ERL OD-18, Mar. 1973, 74 pp.

Raingage and radar methods of estimating convective rainfall over an area in Florida are discussed and compared in the context of the Experimental Meteorology Laboratory's multiple cloud seeding experiment.

Availability: NTIS (COM-73-10727).

18.6. "A Rain Gage Evaluation of the Miami Reflectivity Rainfall Rate Relation," ESSA Technical Memorandum ERLTM AOML-3, Sept. 1969, 16 pp.

Fifty comparisons were made between shower rainfall recorded by rain gages and observed with radar to evaluate the reflectivity-rainfall rate relation to provide a foundation for other radar studies in the Miami area.

18.7. "A Case Study of Radar Determined Rainfall as Compared to Rain Gage Measurement," NOAA Technical Memorandum NWS ER-42, July 1971, 7 pp.

WSR-57 radar-estimated rainfall amounts during a 36-hr storm period are obtained by using Wilson's Rainfall Rate-Echo Intensity, RR-EI, chart. These estimates are compared with rainfall data from three tipping buckets.

Availability: NTIS (COM-71-00897).

Radar

18.8. "A Preliminary Report on Correlation of ARTCC Radar Echoes and Precipitation," NOAA Technical Memorandum NWS WR-66, June 1971.

The ability of ARTCC radars to detect precipitation of minor or great intensity is described.

Availability: NTIS (COM-71-00829).

18.9. "Precipitation Detection Probabilities by Salt Lake ARTC Radars," ESSA Technical Memorandum WBTM WR-31, July 1968, 12 pp.

ARTC radar locations in the intermountain region are shown and areas of "good" and "poor" precipitation detection capabilities are delineated.

Availability: NTIS (PB-179-084).

18.10. "Precipitation Detection Probabilities by Los Angeles ARTC Radars," NOAA Technical Memorandum NWS WR-67, July 1971.

Same description as above item, 18.9.

Availability: NTIS (COM-71-00925).

18.11. "Range of Radar Detection Associated with Precipitation Echoes of Given Heights by the WSR-57 at Missoula, Montana," NOAA Technical Memorandum NWS WR-85, Apr. 1973.

The range of radar detection associated with precipitation echoes of given heights is discussed.

Availability: NTIS (COM-73-11030).

18.12. "Meteorological Radar Signal Intensity Estimation," NOAA Technical Memorandum ERL NSSL-64, Sept. 1973, 95 pp.

The digital integrator processing techniques used to reduce the variance of precipitation echo power estimates are described. The statistical properties of precipitation echoes are reviewed and related to measurements of atmospheric and WSR-57 weather radar parameters.

Availability: NTIS (COM-73-11923/2GA); ERL, official copies.

18.13. "A Grid Method for Estimating Precipitation Amounts by Using the WSR-57 Radar," ESSA Technical Memorandum WRTM-19, Dec. 1966.

A method for estimating precipitation amounts based on radar reflectivity, from echoes that are predominantly from snow, has been developed for operational use in the mountainous area around Missoula, Mont., and is discussed.

18.14. "Radar Rainfall Pattern Optimizing Technique," NOAA Technical Memorandum ERL NSSL-67, Mar. 1974, 25 pp.

Estimates of precipitation are improved when quantitative radar data are combined with rain gage observations. Gage observations are used to calibrate radar data as well as to estimate precipitation in areas without radar data. Radar data added to gage observations increased the explained variance at test gages beyond that given by gage data alone from 66 to 72 percent and 50 to 59 percent for the same calibrating gages. Large storm-to-storm variations in average radar calibration and large spatial correction variations within storms were attributed to propogation effects.

Availability: NTIS (COM-74-10906/7GA); ERL, official copies.

18.15. "Manually Digitized Radar Grids: A Comparison of Resolution Capabilities for a Heavy Rainstorm Situation," NOAA Technical Memorandum NWS SR-80, Feb. 1975, 11 pp.

The present grid size used in the Manually Digitized Radar Program (MDR) was quartered to provide a greater definition of the area covered by heavy rain. A storm centered near Bakersfield, Tex., on September 19, 1974 was used to illustrate the value of the system.

Availability: NTIS (COM 75-10436/AS).

18.16. "A Comparison of Manually Digitized Radar Data and Observed Cool Season Precipitation Over the Southern Appalachians," NOAA Technical Memorandum NWS SR-84, January 1976, 10 pp.

A limited evaluation over the southern Appalachians and adjacent plains for the period mid-November 1973 through mid-February 1974.

Availability: NTIS (PB 253-144/0GA).

NOTE:
1. See "Climatological Studies," items 2.9 and 2.10.
2. See "Precipitation Distribution, Time and Space," items 13.3 and 13.5.
3. See "Radar," items 21.1 through 21.3.
4. See "Satellite Meteorology," items 26.3 and 26.6.

19. PRECIPITATION, PROBABILITY (FREQUENCY)

19.1. "Precipitation Probability for Eastern Asia," NOAA Atlas 1, July 1971, 71 pp.

Precipitation amounts for each month are presented for 10 probability levels between 0.10 and 0.99 (five levels as maps and five as tables).

Availability: NTIS (COM-72-50446).

19.2. "Characteristics and Probabilities of Precipitation in China," NOAA Technical Report EDS-8, Sept. 1969.

The availability of China's climatological data is discussed. Spatial distribution of monthly precipitation probabilities of selected amounts is given.

Availability: NTIS (PB-188-420).

19.3. "Rainfall Intensities for Local Drainage Design in the United States," Technical Paper No. 24, Aug. 1953, revised Feb. 1955.

This was the initial generalized study of precipitation frequency data. Values for durations from 5 to 240 minutes are presented.

Availability: H.

19.4. "Rainfall Intensities for Local Drainage Design in Western United States," Technical Paper No. 28, Nov. 1956.

This is an expansion of item 19.3, above, to provide values for durations to 24 hr.

Availability: H.

19.5. "Rainfall Intensity-Duration-Frequency Curves for Selected Stations in the United States, Alaska, Hawaiian Islands, and Puerto Rico," Technical Paper No. 25, 1955.

Curves for 203 stations show 5-min to 24-hr intensities for return periods of 2, 5, 10, 25, 50, and 100 yr.

Availability: H.

19.6. "Rainfall Intensity-Frequency Regime," Technical Paper No. 29, Part I, The Ohio Valley, 1957; Part 2, Southeastern United States, 1958; Part 3, The Middle Atlantic Region, 1958; Part 4, Northeastern United States, 1959.

A continuation of the generalized precipitation frequency studies for the United States that was started with Technical Paper Nos. 24 and 28, items 19.3 and 19.4, respectively. These papers were the first major study for short durations since the investigations by David L. Yarnell in August 1935.

Availability: H.

19.7. "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, 1961 (reprinted 1963). Information for 11 Western States superseded by NOAA Atlas 2, item 19.8. Information for durations of 1 hour and less for the Central and Eastern States has been superseded by NOAA Technical Memorandum NWS HYDRO-35, item 19.28.

Forty-nine maps showing 30-min,1-, 2-, 3-, 6-, 12-, and 24-hr point precipitation for return periods of 1, 2, 5, 10, 25, 50, and 100 yr and interpolation diagrams for obtaining values for intermediate durations and return periods are presented. Ratios for obtaining 5-, 10-, and 15-min precipitation from 30-min values are also presented. Area reduction curves for reducing point values for areas up to 400 mi^2 are included.

19.8. "Precipitation Frequency Atlas of Western United States," NOAA Atlas 2, 1973.

Generalized maps are presented for the 6- and 24-hr point precipitation for return periods of 2, 5, 10, 25, 50, and 100 yr. Equations and interpolation diagrams are provided for determining values for other durations less than 24 hr and for intermediate return periods. Area reduction curves for adjusting point values for areas up to 400 mi^2 are included. This Atlas is published in a separate volume for each of the 11 Western States.

Availability: GPO: Vol. I, Montana, $8.35; Vol. II, Wyoming, $8.45; Vol. III, Colorado, $10.10; Vol. IV, New Mexico, $8.45; Vol. V, Idaho, $8.45; Vol. VI, Utah, $10.10; Vol. VII, Nevada, $8.45; Vol. VIII, Arizona, $8.35; Vol. IX, Washington, $8.45; Vol. X, Oregon, $8.45; and Vol. XI, California, $10.30. EDS, official copies.

19.9. "Generalized Estimates of Probable Maximum Precipitation and Rainfall-Frequency Data for Puerto Rico and Virgin Islands," Technical Paper No. 42, 1961.

The same type data described in item 19.7 are presented.

19.10. "Rainfall Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years," Technical Paper No. 43, 1962.

The same type data described in item 19.7 are presented.

19.11. "Probable Maximum Precipitation and Rainfall-Frequency Data for Alaska," Technical Paper No. 47, 1963.

The same type data described in item 19.7 are presented.

19.12. "Two- to Ten-Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States," Technical Paper No. 49, 1964.

Twenty-four maps showing 2-, 4-, 7-, and 10-day point precipitation values for return periods of 2, 5, 10, 25, 50, and 100 yr and interpolation diagrams for obtaining values for intermediate durations and return periods are presented. Area reduction curves for reducing point values for areas up to 400 mi^2 are also included.

19.13. "Two- to Ten-Day Rainfall for Return Periods of 2 to 100 Years in the Hawaiian Islands," Technical Paper No. 51, 1965.

The same type data described in item 19.12 are presented.

19.14. "Two- to Ten-Day Precipitation for Return Periods of 2 to 100 Years in Alaska," Technical Paper No. 52, 1965.

The same type data described in item 19.12 are presented.

19.15. "Two- to Ten-Day Rainfall for Return Periods of 2 to 100 Years in Puerto Rico and Virgin Islands," Technical Paper No. 53, 1963.

The same type data described in item 19.12 are presented.

19.16. "Climatological Probabilities of Precipitation for the Conterminous United States," ESSA Technical Report WB-5, Dec. 1967, 60 pp.

Probabilities of 6-, 12-, and 24-hr precipitation (0.01 in. or more) for 108 stations, showing diurnal and seasonal trends, are given.

19.17. "Conditional Probabilities of Precipitation Amounts in the Conterminous United States," ESSA Technical Memorandum WBTM TDL-18, Mar. 1969, 89 pp.

Conditional probabilities of precipitation are derived from a 15-yr period of record for 108 selected stations within the 48 conterminous States. The required condition is that precipitation occurs within given periods.

Availability: NTIS (PB-183-144).

19.18. "Climatic Frequency of Precipitation at Central Region Stations," ESSA Technical Memorandum WBTM CR-8, Nov. 1966.

The frequency of measurable precipitation (0.01 in. or more) for locations and time periods for which local forecasts are issued is discussed. The station data were subjected to a space-and-time smoothing to reduce sampling error and to get a homogeneous set of values.

19.19. "Climatological Precipitation Probabilities," ESSA Technical Memorandum WRTM-2, Dec. 1965.

Tables showing monthly climatological probabilities of 0.01 in. or more precipitation for 48 stations in Western United States are presented.

19.20. "Conditional Probabilities for Sequences of Wet Days at Phoenix, Arizona," NOAA Technical Memorandum NWS WR-86, June 1973.

The probability of "k" additional days with precipitation, given that "i" consecutive days with thunderstorms have just occurred at Phoenix is presented.

Availability: NTIS (COM-73-11264); EDS, official copies.

19.21. "Average Weekly Rainfall and Probabilities during the Planting-Growing-Harvesting Period in South Carolina," NOAA Technical Memorandum NWS CR-14, Mar. 1973, 48 pp.

Weekly average values of precipitation were computed for 31 weeks, from April 24 through November 26, for 17 locations. Weekly precipitation probabilities were computed and are tabulated.

19.22. "Climatology of Rainfall Probabilities for Oahu, Hawaii," NOAA Technical Memorandum NWS PR-10, Apr. 1972, 48 pp.

This study is designed to provide the statistical probability of rainfall by months for the island of Oahu, Ha.

Availability: NTIS (COM-73-10242); EDS, official copies.

19.23. "An Application of the Gamma Distribution Function to Indian Rainfall," ESSA Technical Report EDS-5, Aug. 1968, 47 pp.

This report investigates (1) whether the monthly monsoon rainfall at Indian stations can be characterized by the incomplete gamma distribution function, (2) the length of period required to permit stabilization of the estimates of the distribution parameters, and (3) the correlation of month-to-month rainfall during the monsoon season.

Availability: NTIS (PB-180-056).

19.24. "A Note on a Gamma Distribution Computer Program and Graph Paper," NOAA Technical Report EDS-11, Apr. 1973, 92 pp.

The gamma distribution function may be used as a model for many sets of data. A FORTRAN IV computer program is presented that provides the analytic solution to a set of data. It gives the probabilities of exceeding or not exceeding arbitrary amounts and indicates the amounts exceeded or not exceeded for arbitrary probabilities. A specialized graph paper is also constructed.

Availability: NTIS (COM-73-11401); EDS, official copies.

19.25. "Frequency and Intensity of Freezing Rain/Drizzle in Ohio," NOAA Technical Memorandum NWS ER-51, February 1973, 6 pp.

A mean recurrence table of annual number of days with freezing rain/drizzle for return periods of 2, 5, 10, 25, 50, and 100 years was devised for eight Ohio locations from output generated from a Poisson probability distribution.

Availability: NTIS (COM 73-10570).

19.26. "Probability of Sequences of Wet and Dry Days in Tennessee," NOAA Technical Memorandum EDS-22, December 1974, 84 pp.

Probabilities of sequences of wet and dry days can be used in evaluating probable gains or losses related to many activities. Both initial and transitional probabilities can be calculated from past, long-term weather observations. Initial probabilities indicate the likelihood that any day of the week will be dry, without reference to rainfall or previous days. Transition probabilities predict the probability of a day being dry if the previous day was also dry or if the previous day was wet. Tables of these probabilities are presented for 67 locations in Tennessee.

Availability: NTIS (COM 75-10650/0GA).

19.27. "Map Type Precipitation Probabilities for the Western Region," NOAA Technical Memorandum NWS WR-96, February 1975, 138 pp.

A method of obtaining probabilities of precipitation (PoP) using 500-mb flow typing. An independent test is presented which shows that for flow significantly different from climatological, the PoP forecasts represent a significant improvement over climatology.

Availability: NTIS (COM 75-10428/AS).

19.28, "5 to 60 Minutes Precipitation Frequency for Eastern and Central U.S.," NOAA Technical Memorandum NWS HYDRO 35 (in press).

Precipitation-frequency values for the central and eastern United States for return periods from 2- to 100 years for durations of 5 minutes to 1 hour are provided in a series of maps and graphs. This material supersedes the similiar material published in Weather Bureau Technical Paper No. 40.

NOTE:
1. See "Climatological Data," item 1.12.
2. See "Climatological Studies," item 2.8.
3. See "Precipitation Distribution, Time and Space," items 13.6 and 13.7.
4. See "Precipitation, Forecasting," item 15.16.
5. See "Precipitation, Hurricane," item 16.4.
6. See "Precipitation, Mean and Normal," items 17.3 and 17.4.
7. See "River and Flood Forecasting," item 24.17.

20. PRECIPITATION, PROBABLE MAXIMUM (PMP)

20.1. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, 1956. This study is currently being revised and updated. The new study provides data for durations to 72 hours and areas to 20,000 mi^2. It will be available as Hydrometeorological Report No. 51, later in 1977.

Maps showing the 24-hr 200 mi^2 PMP and curves for adjusting those values for durations of 6, 12, and 48 hr and for areas from 10 to 1,000 mi^2 are presented.

20.2. "Generalized Estimates of Probable Maximum Precipitation for the United States West of the 105th Meridian for Areas to 400 Square Miles and Durations to 24 Hours," Technical Paper No. 38, 1960.

Major storms are discussed and maps showing 1-, 6-, and 24-hr PMP for 10 mi^2 are presented. An interpolation diagram and area-reduction curves are provided for estimating values for intermediate durations and areas up to 400 mi^2. Superseded for all but the region east of the Continental Divide by later studies. See items 20.3 and 20.4 and by studies currently in preparation for publication.

20.3. "Interim Report--Probable Maximum Precipitation in California, Hydrometeorological Report No. 36, 1961, revisions of 1969.

Estimates of PMP for storm durations up to 72 hr for basin areas up to several thousand sq mi throughout the Pacific drainage of California are provided by months through the primary precipitation season of October to April.

Availability: NTIS (COM 75-11325/AS).

20.4. "Probable Maximum Precipitation, Northwest States," Hydrometeorological Report No. 43, 1966.

Generalized estimates of PMP are presented for areas up to 5,000 mi^2 and durations to 72 hr. Also, critical sequences of wind, temperature, and dew point for optimum snowmelt conditions are presented.

20.5. "Probable Maximum Precipitation and Rainfall-Frequency Data for Alaska for Areas to 400 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years," Weather Bureau Technical Paper No. 47, 1963.

Maps showing 1-, 6-, and 24-hr probable maximum point precipitation are presented, and an interpolation diagram and area-reduction curves for obtaining values for intermediate durations for areas up to 400 mi^2 are provided.

20.6. "Probable Maximum Precipitation in the Hawaiian Islands," Hydrometeorological Report No. 39, 1963.

Point values of 24-hr PMP on maps and a depth-area-duration relation for reducing those values for durations down to 30 min and for areas up to 200 mi^2 are presented.

20.7. "Generalized Estimates of Probable Maximum Precipitation and Rainfall Frequency Data for Puerto Rico and Virgin Islands," Weather Bureau Technical Paper No. 42, 1961.

The same data described in item 20.5 are presented.

20.8. "Probable Maximum Precipitation and TVA Precipitation for Tennessee River Basins Up to 3,000 Square Miles in Area and Durations to 72 Hours," Hydrometeorological Report No. 45, May 1969.

Generalized estimates of PMP and TVA precipitation are presented for durations from 1 to 72 hr for basin sizes from a few to 3,000 mi^2.

Antecedent rainfall criteria are provided also for use as indices to soil moisture conditions and existing streamflows at the beginning of the critical rainfalls.

20.9. "Probable Maximum Precipitation and Snowmelt Criteria for Red River of the North Above Pembina, and Souris River Above Minot, North Dakota," Hydrometeorological Report No. 48, May 1973, 69 pp.

Generalized estimates of PMP are provided for durations from 6 to 72 hr and areas from 10 to 40,000 mi^2 centered on the Souris and Red River of the North drainages. Suggested areal and time distributions are provided. Critical snowpack accumulations and snowmelt criteria are given.

Availability: GPO, 90 cents; EDS, official copies.

20.10. "Meteorological Conditions for the Probable Maximum Flood on the Yukon River above Rampart, Alaska," Hydrometeorological Report No. 42, 1966.

Estimates of PMP and critical values of temperature, wind, and snow cover for optimum snowmelt conditions are presented.

20.11. "Probable Maximum Precipitation Over the Susquehanna River Basin Above Harrisburg, Pa.," Hydrometeorological Report No. 40, 1965.

Estimates for durations from 6 to 72 hr and for areas from 10 mi^2 to total basin area (24,100 mi^2) are presented.

20.12. "Probable Maximum and TVA Precipitation Over the Tennessee River Basin Above Chattanooga," Hydrometeorological Report No. 41, 1965.

Estimates for durations from 6 to 72 hr for the total basin (21,400 mi^2) and one subarea (7,980 mi^2) are presented. Variation of PMP during March through September is also given.

20.13. "Probable Maximum Precipitation on the Upper South Platte River, Colorado, and Upper Mississippi River, Minnesota," Hydrometeorological Report No. 44, 1968.

Several critical isohyetal patterns for determining the probable maximum flood on the Upper South Platte River above Chatfield, Colo., and on eight subbasins of the Minnesota River are presented. Critical sequences of 6-hr rainfall increments are included.

20.14. "Meteorological Criteria for Extreme Floods for Four Basins in the Tennessee and Cumberland River Watersheds," Hydrometeorological Report No. 47, May 1973, 59 pp.

PMP and TVA precipitation estimates for 16,170- and 26,780 mi^2 basins in the Tennessee River drainage and 2,734- and 11,674 mi^2 basins in the Cumberland River watershed for durations to 72 hr are presented. Suggested areal and time distributions of precipitation are provided.

Availability: GPO, 90 cents; EDS, official copies.

20.15. "Probable Maximum Precipitation, Mekong River Basin," Hydrometeorological Report No. 46, May 1970, 152 pp.

Generalized estimates of PMP for 5,000-to 25,000-km^2 drainages for durations up to 3 days covering the Lower Mekong River Basin are determined.

20.16. "Meteorological Estimation of Extreme Precipitation for Spillway Design Floods," ESSA Technical Memorandum WBTM HYDRO 5, Oct. 1967, 29 pp.

The reasons for the meteorological approach to design in the United States are reviewed, the procedures for estimating PMP are summarized, and trends are examined.

Availability: NTIS (PB-177-687).

20.17. "Probable Maximum Precipitation, Colorado River and Great Basin Drainages," Hydrometeorological Report No. 49, (in preparation).

Provides procedures to compute estimates of PMP for any watershed up to 5,000 mi^2 and for durations to 72 hours. General storm and thunderstorm criteria are provided.

NOTE:
See "Storms," items 28.11 through 28.13.

21. RADAR, HYDROLOGIC APPLICATIONS

21.1. "Video Integrator and Processor," ESSA Technical Memorandum WBTM EDL-8, Feb. 1969, 17 pp., 2 apps.

The design and operation of a new weather radar intensity contouring device is described.

Availability: NTIS (PB-183-510).

21.2. "The National Weather Service Manually Digitized Radar Program and Some Applications," NOAA Technical Memorandum NWS SR-75, Apr. 1974, 26 pp.

Descriptions of the manually digitized radar program, its application to flash flood forecasting, and the tracking of radar patterns are given.

Availability: NTIS (COM-74-11149/3GA); EDS, official copies.

21.3. "The Use of Radar in Flash Flood Forecasting," ESSA Southern Region Technical Memorandum 23, 1966.

The results of correlation studies between a dense network of rain gages in Oklahoma (175 recording gages in 1,100 mi^2) and the WSR-57 radar at Norman, Okla., are presented. It is shown that radar can assess areal rainfall in shower type precipitation significantly better than the present rain gage network density.

21.4. "Digital Radar Data and It's Application in Flash Flood Forecasting," NOAA Technical Memorandum NWS ER-59, March 1975, 12 pp.

The paper describes Digitized Radar Experiments (D/RADEX) designed to

assist in the development, testing and evaluation of techniques for automatic processing and presentation of weather radar data in real-time for operational applications. A minicomputer and its related processing and interface equipment are used to take over control of the radar video returns for approximately 20 seconds for archiving and printout displays. A case study is presented that illustrates how it can be used in determining areas of flash flooding. The printout is used and illustrated.

Availability: NTIS (COM 75-10582/5GA).

NOTE:
1. See "Climatological Studies," items 2.9, 2.10, and 2.15.
2. See "Precipitation, Distribution," item 13.9.
3. See "Precipitation Measurements," items 18.5 through 18.16.
4. See "River and Flood Forecasting," item 24.16.
5. See "Storms," items 28.5 and 28.6.
6. See "Storm Surges," item 29.16.

22. RADIATION, SOLAR AND SKY

22.1. "Weekly Mean Values of Daily Total Solar and Sky Radiation," Weather Bureau Technical Paper No. 11, 1949 (Supplement No. 1, 1955).

Seasonal variation curves of radiation for 30 stations in the United States are presented. The supplement presents data for five additional stations.

22.2. "Sunshine and Cloudiness at Selected Stations in the United States, Alaska, Hawaii and Puerto Rico," Weather Bureau Technical Paper No. 12, 1951.

Average monthly values based on period of record ending 1948 are presented in tabular form for about 80 stations in the United States.

22.3. "Infrared Radiation from Air to Underlying Surface," Technical Note 44 Hydro-1, May 1966, 35 pp.

A computer method for calculating the flux of infrared radiation from the atmosphere, with or without clouds, to the Earth's surface is described.

Availability: NTIS (PB-170-664).

NOTE:
See "Climatological Data and Observations," items 1.3, 1.4, 1.8, 1.9, and 1.12.

23. RELATIVE HUMIDITY

23.1. "Method for Obtaining Wet-Bulb Temperature by Modifying the Psychrometric Formula," NOAA Technical Memorandum EDS BOMAP-11, June 1974.

A method of obtaining wet-bulb temperature from air temperature, relative humidity, and pressure is described. The algorithm provides values consistent within $\pm$ 0.01°C with the input data.

Availability: EDS.

23.2. "Estimating Mean Relative Humidity from the Surface to 500 Millibars by Use of Satellite Pictures," ESSA Technical Memorandum NESC TM-23, Mar. 1970.

A method for estimating atmospheric relative humidity by using satellite cloud photographs is described.

Availability: NTIS (PB-191-741).

23.3. "A Surge of Maritime Tropical Air-Gulf of California to the Southwestern United States," NOAA Technical Memorandum NWS WR-88, July 1973, 40 pp.

A synoptic study for the period 13 to 16 July 1972. The study uses surface radar and radiosonde observations as well as satellite pictures. The depth of moisture with this surge of tropical air was of the order 8,000 to 12,000 ft. A unique feature of this type of surge is its resemblance to a giant sea-breeze effect. This effect is emphasized by the lack of upper-air support as shown in the mean vector winds from 10,000 to 20,000 feet.

23.4 "Correction of BOMEX Radiosonde Humidity Errors," NOAA Technical Memorandum EDS BOMAP-16, May 1975, 16 pp.

During the Barbados Oceanographic and Meteorological Experiment (BOMEX) in 1969, rawinsonde soundings indicated a large diurnal variation in relative humidity. Comparison with other measurement systems showed that values were as much as 25% too low at mid-day. The primary source of error was found to be deficient design of the duct that housed the hygristor. Procedures were developed to correct the error.

Availability: NTIS (COM 75-10992/9GA).

NOTE:
1. See "Climatological Data and Observations," items 1.3, 1.4, 1.8, 1.9, and 1.12.
2. See "Precipitable Water," item 10.4.
3. See "Precipitation, Maximum and Observed," item 14.10.
4. See "Satellite Meteorology," items 26.5 and 26.7.

24. RIVER AND FLOOD FORECASTING

24.1. "Floods and Flood Warnings," 6 pp.

The Weather Service's flood forecasting and warning services and community and individual actions recommended during flood emergencies are described.

Availability: GPO (C55.2:F65); EDS.

24.2. "Flash Flood, The Treacherous Torrent," poster.

Flash flood safety rules and flood watch and warning terms used by the National Weather Service are described.

Availability: GPO (C55.2:F61); EDS.

24.3. "Elements of River Forecasting," ESSA Technical Memorandum WBTM HYDRO 9, Mar. 1969, 57 pp.

Elementary explanations of how to forecast volume of surface runoff, distribution of volume at a point, and changes in hydrograph as water moves downstream are given. (Supersedes ESSA Technical Memorandum WBTM HYDRO-4.)

Availability: NTIS (PB-185-969).

24.4. "Predicting the Runoff from Storm Rainfall," Weather Bureau Research Paper No. 34, 1951.

The technique for developing graphical rainfall-runoff relations is described.

24.5. "Flood Warning Benefit Evaluation--Susquehanna River Basin (Urban Residences)," ESSA Technical Memorandum WBTM HYDRO-10, Mar. 1970, 42 pp.

The effectiveness of a flood warning service, coupled with either temporary flood-proofing or evacuation of residential structures, in reducing flood damage is discussed.

Availability: NTIS (PB-190-984).

24.6. "Direct Search Optimization in Mathematical Modeling and a Watershed Model Application," NOAA Technical Memorandum NWS HYDRO-12, Apr. 1971, 52 pp.

Application of Pattern Search, a direct search optimization technique, to mathematical modeling is described.

Availability: NTIS (COM-71-00616).

24.7. "National Weather Service River Forecast System Forecast Procedures," NOAA Technical Memorandum NWS HYDRO-14, Dec. 1972.

The necessary steps for developing a river forecast system based on conceptual hydrologic modeling are described. The techniques and programs required from the initial processing of basin data to the preparation of forecasts are provided. The programs are written for a large-capacity digital computer and are generalized for use on any river system.

Availability: NTIS (COM-73-10517); EDS, official copies.

24.7A. "National Weather Service River Forecast System, Forecast Procedures-Programs and Test Data," Dec. 1972.

A file containing computer programs for the efficient implementation of a conceptual hydrologic model for river forecasting is provided. Test data are also included. There are eight programs written in the FORTRAN IV language and nine sets of test data. Five programs are used for data processing and data manipulation. Model calibration, historical hydrograph simulation, and operational river flow forecasting programs are included. There are 17 files comprised of 12360 card images (records). The computer programs are written for CDC 6600 computers.

Dec. 72, 1 reel mag tape, specify tape recording mode desired: 7 track, 556 BPI, even parity, BCD; or 9 track, 800 BPI, odd parity, EBCDIC.

Availability: NTIS (COM 73-10298).

24.8. "A Dynamic Model of Stage-Discharge Relations Affected by Changing Discharge," NOAA Technical Memorandum NWS HYDRO-16, Nov. 1973, 38 pp., apps. A and B, 13 pp.

A mathematical model is developed to simulate the dynamic relationship between stage and discharge when the energy slope is variable due to changing discharge. Either stage or discharge may be computed if the other is specified.

Availability: NTIS (COM-74-10818); EDS, official copies.

24.9. "Numerical Properties of Implicit Four-Point Finite Difference Equations of Unsteady Flow," NOAA Technical Memorandum NWS HYDRO-18, Mar. 1974, 38 pp.

Linearized model equations of the quasi-linear differential equations of unsteady quadually varied flow are utilized to investigate the effect of the discretization of the continuous partial derivatives with implicit four-point finite-difference quotients. The investigation is generalized to include various four-point implicit-difference schemes.

24.10. "National Weather Service River Forecast System--Snow Accumulation and Ablation Model," NOAA Technical Memorandum NWS HYDRO-17, Nov. 1973, 223 pp.

A conceptual model of the snow accumulation and ablation process and the associated computer subroutines and programs that enable the model to be used in conjunction with the National Weather Service River Forecast System are described.

Availability: NTIS (COM-74-10728/5GA); EDS, official copies.

24.10A. "National Weather Service River Forecast System, Snow Accumulation and Ablation Model - Programs and Test Data," Oct. 1973.

The magnetic tape contains computer programs and test data for the National Weather Service River Forecast System, Snow Accumulation and Ablation model. The complete source deck of the two programs used for model calibration (the verification and optimization programs) are included. In addition, the tape contains snow subroutines for the operational river forecasting program and three programs to compute mean areal air temperature. The test data are for the Passumpsic River at Passumpsic, Vermont. Precipitation, potential evapotranspiration, air temperature, and streamflow data are included. The programs are written in FORTRAN IV language and extended for use on CDC 6600/SCOPE 3.3 computer system. There are 12 files comprised of 11342 card images (records) on the magnetic tape.

Specify tape recording mode desired: 7 track, 556 BPI, even parity, BCD- or 9 track, 800 BPI, odd parity EBCDIC. Includes documentation, COM 74-10728.

Availability: NTIS (COM-74-10930, set: 2 tapes); (COM-74-10931/5GA).

24.11. "Application of the SSARR Model to a Basin Without Discharge Record," ESSA Technical Memorandum WBTM WR-55, Aug. 1970, 14 pp.

The SSARR (Streamflow Synthesis and Reservoir Regulation) model was designed to be a general, flexible model with special provisions for use in daily river forecasting operations. It has been tested on many basins with adequate data, thus demonstrating its ability to reliably synthesize watershed response to both rainfall and snowmelt.

Availability: NTIS (PB-194-394).

24.12. The Effects of Dams, Reservoirs and Levees on River Forecasting," ESSA Technical Memorandum ER-16, Sept. 1966.

The effect of manmade controls on river flow and river forecasting is discussed. The river system portrayed is hypothetical.

24.13. "Forecasting the Spring 1969 Midwest Snowmelt Floods," NOAA Technical Memorandum NWS CR-40, Feb. 1971, 21 pp.

The winter of 1968-69 in the upper Midwest experienced a long period of heavy snow of high water content over a large area, with widespread disastrous spring floods in its wake. The use of hydrologic data by the National Weather Service to estimate flood potential up to 2 1/2 months before the onset of flooding and for day-to-day short-term flood forecasting is described.

Availability: NTIS (COM-71-00489).

24.14. "Flash Flood Forecasting and Warning Program in the Western Region," NOAA Technical Memorandum NWS WR-82, Dec. 1972.

A description of the conditions that cause flash floods in Western United States, the requirements for an effective warning program, and procedures useful in developing flash flood watches are described.

Availability: NTIS (COM-73-10251); EDS, official copies.

24.15. "Guidelines for Flash Flood and Small Tributary Flood Protection," NOAA Technical Memorandum NWS CR-58, October 1975, 13 pp.

This report provides guidelines for the threat and extent of flash floods and other small tributary floods. Basically these involve knowledge of when, how much and how fast rain came down and over how much of a particular river basin and some method of converting this to flood potential.

Availability: NTIS (PB 247 569/7GA).

24.16. "Use of Radar Information in Determining Flash Flood Potential," NOAA Technical Memorandum NWS ER-60, December 1975, 10 pp., 3 tab.

A method is described of using manually digitized radar data with estimates of 3-hour precipitation amounts required for flash flooding for monitoring flash flood potential.

Availability: NTIS (PB 250 071/AS).

24.17. "A Study of Flash-Flood Occurrences at a Site Versus Over a Forecast Zone," NOAA Technical Memorandum NWS WR-100, August 1975, 16 pp.

Some relations are described between probability of point rainfall amounts and probability of the same amount falling some place within an area; i.e., point vs. areal probability. Analogously, the relationship between flash-flood occurrences at sites and the probability somewhere within a forecast zone are developed. The paper considers rainfall of short duration from convective activity. Some of the conclusions drawn from the study are that the 100-yr 1/2-hr amount of point rainfall probably may occur once every several years somewhere on a 60-mi^2 basin. Flash floods seem to exhibit similar relationship over larger areas.

Availability: NTIS (COM 75-11404/AS).

24.18. "A Study of Flash Flood Susceptibility - A Basin in Southern Arizona," NOAA Technical Memorandum NWS WR-99, August 1975, 9 p, 2 fig.

Two commonly used methods of hydrologic analyses are parameteric reconstruction and development of frequency distributions. Both techniques can be used to develop estimates of potential of damaging flash floods. However, under conditions of limited data, many areas may not have experienced enough flash floods to be recognized as flash flood prone. A method was used to estimate potential peak flows on Sabino Canyon, Arizona, and probability of occurrence of specified magnitudes was analyzed. These estimates indicate a strong possibility of damaging flash floods occurring in areas where none have occurred in several decades.

Availability: NTIS (COM 75-11360).

24.19. "The use of a Multizone Hydrologic Model with Distributed Rainfall and Distributed Parameters in the National Weather Service River Forecast System," NOAA Technical Memorandum NWS HYDRO-25, August 1975, 15 p, 4 fig., 3 tables.

Tests were conducted on a basin with less than optimum rain gage network to evaluate the possibility of improving streamflow simulation through the use of zonal precipitation input and zonally varied parameters. Preliminary results for the 959-mi^2 4-zone watershed indicate that improved hydrograph reconstitution is obtained for rises caused by convective rains. The approach is model independent and should be valid for any conceptual hydrologic model employing a unit hydrograph to define temporal distribution.

Availability: NTIS (COM 75-11361/AS).

24.20. "Application of the National Weather Service Flash Flood Program in the Western Region," NOAA Technical Memorandum NWS WR-103, January 1976, 29 pp.

The NWS uses four methods to communicate warning information regarding potential flash floods to the public: 1) flash flood watches and warnings, 2) a flash flood alarm system, 3) self-help procedures and 4) informational materials. Each is described. A combination of at least two may be desirable. A technique using an intensity rain gage network would fill a void left by present methods.

Availability: NTIS (PB 253-053).

24.21. "A Point Energy and Mass Balance Model of a Snow Cover," NOAA Technical Report NWS 19, February 1976, 150 pp.

A point energy and mass balance model is developed for snow cover. The model is based on the snow cover energy balance equation and the equation for energy transfer within a snow cover. The snow cover is divided into layers and equations are written for each layer. The model is tested on 6-years of extensive, high-quality data obtained as part of a cooperative snow research project between NOAA and the Agricultural Research Service near Danville, Vt.

Availability: NTIS (PB 254-653/AS).

24.22. "Flood Damage Reduction Potential of River Forecast Services in the Connecticut River Basin," NOAA Technical Memorandum NWS HYDRO-28, February 1976, 52 pp.

Flood plain management has been a subject of special concern in the United States for the past two decades. A river forecasting program is an integral part of a total flood management program. The flood warning system associated with such a forecast system can be one of the most cost effective alternatives. This study examines flood damage reduction in four communities in the Connecticut River Basin. A basin-wide extrapolation from these four communities found that approximately $1,500,000 of reducible damages can be expected on commercial and residential elements of the flood plains.

Availability: NTIS (PB 256-758/AS).

24.23. "Catchment Modeling and Initial Parameter Estimation for the National Weather Service River Forecast System," NOAA Technical Memorandum NWS HYDRO-31, June 1976, 64 pp.

This report presents two papers. The first describes a revision in the soil moisture accounting for the catchment model of the National Weather Service River Forecast System (NWSRFS). The component from the Sacramento model has replaced that of the modified Stanford Model as used in the original system. The second paper describes techniques used to develop initial parameter estimates for the 16 model parameters. These estimates are developed directly from the hydrometeorological data base of a catchment.

NOTE:
1. See "Radar, Hydrologic Applications," items 21.2 and 21.3.
2. See "Snow", item 27.9.
3. See "Storm Surges," item 29.16.
4. See "Streamflow Frequency Analysis," items 30.1 and 30.2.
5. See "Water Management," items 31.1 and 31.2.

25. RIVER STAGES

25.1. "River Forecasts Provided by the National Weather Service," published annually.

This publication is issued annually. River forecast points and miscellaneous information about the location, together with the highest stage

observed during the period of record and highest for the year are given.

Prior to 1972, daily river gage data, highest stages of record, and descriptions of gage locations, were published in "Daily River Stages."

Availability: NCC, inquire as to price. Issues for years prior to 1950 are out of print.

NOTE:
See "Climatological Data and Observations," items 1.1 and 1.3.

26. SATELLITE METEOROLOGY

26.1. "Study of the Use of Aerial and Satellite Photogrammetry for Surveys in Hydrology," ESSA Technical Memorandum NESCTM-14, Mar. 1970, 22 pp.

Possible applications of photogrammetry in problems of hydrology are explored.

Availability: NTIS (PB-191-735).

26.2. "Applications of Environmental Satellite Data to Oceanography and Hydrology," ESSA Technical Memorandum NESCTM-19, Jan. 1970, 12 pp.

Three applications of satellites are discussed: (1) large-scale mapping of sea-surface temperatures, (2) relation between sunglint patterns and the ocean wave spectrum and low-level wind stress, and (3) mapping of major snow and ice boundaries.

Availability: NTIS (PB-190-652).

26.3. "Rainfall Estimation From Geosynchronous Satellite Imagery During Daylight Hours," NOAA Technical Report ERL 356, WMPO-7, Sept. 1973.

A method to estimate rainfall from visible geosynchronous satellite imagery during daylight hours has been derived and tested. Based on the findings that areas of active convection and rainfall in the tropics are brighter on the satellite visible photographs than inactive regions, ATS-3 images were calibrated with gage-adjusted 10-cm radar data over south Florida. The resulting empirical relationships require a time sequence of cloud area, measured from the satellite images at a specified threshold brightness, to calculate the rain volume over a given time.

Availability: NTIS (PB 254 652).

26.4. "Snow Depth and Snow Extent Using VHRR Data From the NOAA-2 Satellite," NOAA Technical Memorandum NESS 63, February 1975, 10 pp.

The NOAA-2 environmental satellite provides daily coverage of the Earth in the visible (0.6-0.7 mm) and thermal (10.5-12.5 mm) spectral bands. The ground resolution of the Very High Resolution Radiometer (VHRR) is 1 km at nadir. A densitometer examination of a visible-band image from February 11, 1973, which shows heavy snow cover in considerable detail over areas extending from Alabama to North Carolina indicates that, in general, there is direct correlation between increasing brightness and increasing snow

depths. Digitized reflectance data from the study area were compared with prestorm bare-ground digitized reflectance data of February 6, 1973, to determine the relation of digitized reflectance data of February 6, 1973, to determine the relation of snow reflectivity to snow depths. A parabolic regression of greatest satellite brightness versus greatest snow depth for 211 data pairs produced a correlation coefficient of 0.84.

Availability: NTIS (COM 75-10482/AS).

26.5. "NIMBUS-5 Sounder Data Processing System: Part I. Measurement Characteristics and Data Reduction Procedures," NOAA Technical Memorandum NESS 57, June 1974, 99 pp.

Part I of this report describes the data processing system developed to obtain various meteorological variables from infrared and microwave radiometeric data obtained from the Nimbus-5 spacecraft. The parameters deduced from the radiance data include: a) surface temperature, b) vertical temperature profile, c) precipitable water content, d) total outgoing longwave radiation flux, and e) vertical cloud distributions. Determinations are made with horizontal resolutions of 500 km and 150 km.

Availability: NTIS (COM-74-11436/AS).

26.6. "A Comparison of Infrared Imagery and Video Pictures in the Estimation of Daily Rainfall From Satellite Data," NOAA Technical Memorandum NESS 62, January 1975, 14 pp.

An empirical method of estimating 24-hr rainfalls in the tropics and subtropics using both satellite video pictures and infrared imagery was tested to determine whether comparable results could be obtained. This method was tested for Alabama, Georgia, and South Carolina for the months of July, August, and September 1973. The infrared data set provided approximately the same degree of accuracy as the video data set; and the mean of the two estimates provided additional accuracy; 7-day-running totals of these mean estimates coincided closely with 7-day-running totals of observed rainfalls.

Availability: NTIS (COM 75-10435/AS).

26.7. "NIMBUS-5 Sounder Data Processing System, Part II. Results," NOAA Technical Memorandum NESS 71, July 1975, 102 pp.

Discusses the various meteorological results obtained from the application of NIMBUS-5 sounding data processing system during 1973-74. Data are on (a) vertical temperature and water vapor profiles, (b) cloud height, fractional coverage, and liquid water content, (c) surface temperature, and (d) total outgoing long-wave radiation flux.

Availability: NTIS (COM 75-11334/AS).

26.8. "Satellite Derived Sea-Surface Temperatures from NOAA Spacecraft," NOAA Technical Memorandum NESS 78, June 1976.

A brief description of the past, present, and future of the sea-surface temperature (SST) operation is followed by indepth discussions of the back

ground for measurement of sea surface temperatures. The data processing system, its' performance and SST products and display.

Availability: NTIS (PB 258-026/AS).

26.9. "A Satellite Classification Technique for Subtropical Cyclones," Paul H. Hebert, Kenneth O. Poteal, NOAA Technical Memorandum NWS SR-83, 1975.

The Dvorak technique for estimating the intensity of tropical cyclones from satellite pictures is frequently inapplicable for subtropical cyclones. A new technique which gives not only the intensity but also the type (tropical, subtropical) cyclone has been derived, using guidelines similar to the Dvorak scheme, so that the two systems intermesh when cyclones change type.

Availability: NTIS (COM 75-11220/AS).

26.10. "The Use of Radiosonde in Deriving Temperature Soundings From the Nimbus and NOAA Satellite Data," NOAA Technical Memorandum NESS-76, April 1976, 21 pp.

The radiosonde has played an important role in improving the accuracy of the temperature profiles in both operational and developmental work at the National Environmental Satellite Service. Methods used to tune the minimum information solution of the data from the Vertical Temperature Profiles Radiometer on NOAA 2, 3, and 4 satellites are reviewed. It is demonstrated that some technique for incorporating radiosonde information is necessary if satellite-derived temperatures are to approach parity with radiosonde temperatures.

Availability: NTIS (PB 256-755/AS).

26.11. "On the Estimation of Areal Windspeed Distribution in Tropical Cyclones with The Use of Satellite Data," NOAA Technical Report NESS 74, August 1976, 41 pp.

This paper attempts to determine whether the areal windspeed distributions in Tropical Cyclones can be estimated by two satellite data parameters (1) the low-level convective cloud band crossing angle relative to tangents to concentric circles centered on the eye, and (2) the infrared temperatures from the 10.5- to 12.5-mm channel. Radial distance from the storm center was found to explain 63% of the variance in windspeed. When this was removed by screening regression, the two satellite parameter could explain only an additional 2% to 3% of the variance.

Availability: NTIS (PB 248-437/AS).

NOTE:

1. See "Precipitation, Distribution," item 13.9.
2. See "Precipitation Measurements," items 18.15 and 18.16.
3. See "Snow," items 27.7 and 27.8.

27. SNOW

27.1. "Snow Cover Surveys by Eastern Snow Conference," published annually.

This report presents monthly data on snow depths and water equivalents for the season December through April. The data are for some 700 stations in New England, New York, and Pennsylvania.

Availability: Regional Hydrologist, National Weather Service Eastern Region, 585 Stewart Ave., Garden City, N.Y. 11530.

27.2. "Frequency of Maximum Water Equivalent of March Snow Cover in North Central United States," Weather Bureau Technical Paper No. 50, 1964.

The relationship between maximum snow depths and their water equivalents is described. Two sets of six maps showing water equivalent for the first and second halves of March for return periods of 2, 5, 10, 25, 50, and 100 yr are provided.

27.3. "Snowfall, Snowfall Frequencies, and Snow Cover Data for New England," ESSA Technical Memorandum EDS-12, Dec. 1969, 15 pp.

Seasonal total snowfall averages and extremes, frequencies of various snowfall intensities from 1 to 8 in. in a day, and snow cover data are presented in a series of eight maps and two tables.

Availability: NTIS (PB-194-221).

27.4. "Climatic Data Report, Southeastern Snow Storm, February 8-11, 1973," NOAA Technical Memorandum EDS NCC-2, May 1973.

A brief storm history and some pertinent climatological data are provided in this preliminary report.

Availability: NCC and EDS, official copies.

27.5. "A Synoptic Climatology of Blizzards on the North-Central Plains of the United States," NOAA Technical Memorandum NWS CR-39, Feb. 1971.

The type weather situation that will produce blizzard conditions over the North-Central Plains is described.

Availability: NTIS (COM-71-00369).

27.6. "A Synoptic Climatology for Snowstorms in Northwestern Nevada," NOAA Technical Memorandum NWS WR-73, Feb. 1972.

A climatological aid for forecasting snow in northwestern Nevada.

Availability: NTIS (COM-72-10338).

27.7. "Experimental Large-Scale Snow and Ice Mapping with Composite Minimum Brightness Charts," ESSA Technical Memorandum NESCTM-12, Sept. 1969.

A composite minimum brightness chart is a computer product derived from digitized and rectified satellite video data. Displays a means of suppressing transient cloudiness and enhancing major snow and ice features in

satellite imagery. Examples are presented and limitations are discussed.

Availability: NTIS (PB-186-362).

27.8. "Monthly Winter Snowline Variation in the Northern Hemisphere From Satellite Records 1966-75," NOAA Technical Memorandum NESS 74, November 1975, 21 pp.

Maps and graphs are used to depict snow cover over the Northern Hemisphere for the months of December through March for the period 1966-75.

Availability: NTIS (PB 248 437).

27.9. "Water Available for Runoff for 4 to 15 Days Duration in the Snake River Basin in Idaho," NOAA Technical Memorandum NWS HYDRO 29, June 1976, 39 pp.

Through adaptation of the National Weather Service River Forecast System Snow Accumulation and Ablation Model, this study estimates the frequency of water available for runoff from snowmelt and precipitation over the agricultural areas of Idaho's Snake River Basin.

Availability: NTIS (PB 258-427/AS).

NOTE:
1. See "Climatological Data and Observations," items 1.2, 1.5, and 1.9.
2. See "Precipitation Forecasting," item 15.16.
3. See "River and Flood Forecasting," items 24.10 and 24.21.
4. See "Satellite Meteorology," item 26.4.
5. See "Storms," item 28.14.

28. STORMS, GENERAL

28.1. "Lightning," 6 pp.

The phenomenon of lightning and safety rules are discussed.

Availability: GPO (C55.102:L62); EDS, official copies.

28.2. "Thunderstorms," 6 pp.

The causes, life cycle, destructive offspring, and incidence of thunderstorms, including thunderstorm safety rules, are discussed.

Availability: GPO (C55.2:T42); EDS, official copies.

28.3. "Mean Number of Thunderstorm Days in the United States," Weather Bureau Technical Paper No. 19, 1952.

Tabluations and maps show mean monthly and seasonal number of days with thunderstorms for 266 stations in the United States.

28.4. "Thunderstorms and Hail Days Probabilities in Nevada," NOAA Technical Memorandum NWS WR-74, Apr. 1972.

At five sites in Nevada, probabilities for selected number of thunderstorm days in a month and in a year and probabilities for a selected number of

hail days in a year were determined.

Availability: NTIS (COM-72-10554); EDS.

28.5. "A Study of Radar Echo Distribution in Arizona During July and August," NOAA Technical Memorandum NWS WR-77, July 1972, 25 pp.

Hourly composite radar charts for the summer months of July and August of 1970 and 1971 are provided for the greater part of Arizona. These charts clearly illustrate the pronounced diurnal regime of thunderstorm activity.

Availability: NTIS (COM-72-11136); EDS.

28.6. "Structure and Movement of the Severe Thunderstorms of April 3, 1964, as Revealed from Radar and Surface Mesonetwork Data Analysis," ESSA Technical Memorandum ERL TM NSSL-41, Oct. 1968, 47 pp.

Detailed analyses of radar echoes, NSSL Beta-network data and upper air soundings recorded on April 3, 1964, are made to investigate possible mechanisms of the movement of severe thunderstorms.

Availability: NTIS (PB-183-310).

28.7. "The Role of Persistence, Instability, and Moisture in the Intense Rainstorms in Eastern Colorado, June 14-17, 1965," ESSA Technical Memorandum WBTM HYDRO-3, 1967, 21 pp.

The meteorological characteristics of the rain-favoring inflow of air into the storm, which caused widespread flooding and the greatest flood of record in Denver, are evaluated.

Availability: NTIS (PB-174-609).

28.8. "Papers on Oklahoma Thunderstorms, April 29-30, 1970," NOAA Technical Memorandum ERL NSSL-69, 1974, 233 pp.

A collection of papers analyzing an eight-hour series of events that ranged from small hailstorms to gigantic, tornado-spawning maelstroms. The data are among the most detailed storm observations acquired to that time.

Availability: NTIS (COM 74-11474/AS).

28.9. "Meteorology of Major Storms in Western Colorado and Eastern Utah," ESSA Technical Memorandum WBTM HYDRO-7, 1968, 80 pp.

Forty-two major storms are analyzed to determine relative influence of moisture, topography, and proximity of upper Lows or troughs on precipitation.

Availability: NTIS (PB-177-491).

28.10. "Meteorology of Flood-Producing Storms in the Mississippi River Basin," Hydrometeorological Report No. 34, 1956.

Characteristics of outstanding storms are described.

28.11. "Meteorology of Hypothetical Flood Sequences in the Mississippi River Basin," Hydrometeorological Report No. 35, 1959.

The meteorological situations associated with historical floods are described and hypothetical floods for design purposes by combining historical floods are derived.

28.12. "Meteorology of Hydrologically Critical Storms in California," Hydrometeorological Report No. 37, 1962.

Characteristics of outstanding storms are described.

28.13. "Meteorology of Flood-Producing Storms in the Ohio River Basin," Hydrometeorological Report No. 38, May 1961.

This report describes the metereorological characteristics of major flood-producing storms over the Ohio River Basin.

28.14. "Midwestern Snowstorm Models and the February 1973 Storm Over Georgia," NOAA Technical Memorandum NWS SR-74, Dec. 1973.

The record snowstorm over Southeastern United States in February 1973 is examined and compared with midwestern snowstorms.

Availability: NTIS (COM-74-10260).

28.15. "A Refinement of the Use of K-Values in the Forecasting of Thunderstorms," NOAA Technical Memorandum NWS WR-87, June 1973, 21 pp.

Average 1200 GMT K-values and 850-mb temperatures were used to develop an objective aid for making probability forecasts for afternoon and evening lightning occurrences in two target areas over Oregon and Washington.

Availability: NTIS (COM 73-11276).

28.16. "Eastern Pacific Cut-off Low of April 21-28, 1974," NOAA Technical Memorandum NWS WR-97, January 1976, 21 pp.

A Low aloft developed along the Oregon-northern California coast in April 1974. This cold low and associated upper level trough continued inland producing a variety of abnormal weather over the Western United States. Tropical moisture became involved with this system producing areas of locally heavy precipitation.

This paper summarizes events preceding, during and as the Low was weakening and moving northeast.

Availability: NTIS (PB 250-711/AS).

NOTE:

1. See "Climatological Data and Observations," items 1.2, 1.3 (annual), and 1.14.
2. See "Clouds, Liquid Water Content in Storms," items 3.4 and 3.2.
3. See "Floods," item 7.9.
4. See "Hurricanes," items 9.2, 9.3, 9.9, 9.11, 9.12, 9.13, 9.15, and 9.25.

5. See "Precipitation, Excessive and Maximum Observed," items 14.8 and 14.10.
6. See "Precipitation, Probability," item 19.27.
7. See "Satellite Meteorology," item 26.9.

29. STORM SURGES

29.1. "Some Problems Involved in the Study of Storm Surges," National Hurricane Research Project Report No. 4, Dec. 1956.

The various forces that affect the height of the sea and the response of the sea to these forces are reviewed.

Availability: H. NTIS (PB-166-838).

29.2. "Characteristics of the Hurricane Storm Surge," Weather Bureau Technical Paper No. 48, 1963.

The development of storm surges is described and data on outstanding hurricane-produced surges along the Gulf and Atlantic coasts are presented.

Availability: NTIS (COM-74-11424/AS).

29.3. "SPLASH (Special Program to List Amplitudes of Surges from Hurricanes) I. Landfall Storms," NOAA Technical Memorandum NWS TDL-46, Apr. 1972, 55 pp.

Two separate methods (based on dynamics) to estimate or forecast the surge are described. The first method, in which precomputed nomograms are used, is designed only to arrive at a peak surge value. In the second method, a dynamic model is used to compute surges along the entire coastline.

Availability: NTIS (COM-72-10807); EDS.

29.4. "SPLASH (Special Program to List Amplitudes of Surges from Hurricanes). Part 2. General Track and Variant Storm Conditions," NOAA Technical Memorandum NWS TDL-52, Mar. 1974, 62 pp.

An operational computer program is expanded to accommodate storms with generalized motions of not too great complexity. Examples are storms that move alongshore, recurve, remain stationary, accelerate, and landfall (exit). Also, storm strength and size are allowed to vary in a continuous monotonic manner with time.

Availability: NTIS (COM-74-10925/7GA); EDS, official copies.

29.4A. "Special Program to List Amplitudes of Hurricanes Program For SPLASH I and II."

A magnetic tape containing the storm surge programs and data base. Written for CDC 6600 SCOPE 3.3.

Availability: NTIS (COM 75-101-80/AS).

29.4B. "Users Guide for the SPLASH Programs."

A guide to the user, describing procedures for using the SPLASH program.

Availability: NTIS (COM 75-101-81/AS).

29.5. "Joint Probability Method of Tide Frequency Analysis Applied to Atlantic City and Long Beach Island, N.J.," ESSA Technical Memorandum WBTM HYDRO 11, Apr. 1970, 109 pp.

The frequency analysis of combined storm surges and periodic tides prepared by ESSA as part of the Long Beach Island study is described. These frequencies apply to the ocean beach. Studies of wave action and possible variations in water levels inshore from the ocean side of the island are not covered.

Availability: NTIS (PB-192-745).

29.6. "Storm Tide Frequencies on the South Carolina Coast," NOAA Technical Report NWS 16, June 1975, 79 pp.

The present NOAA procedures for determining open coast storm tide frequencies are described. A brief climatological summary of major hurricanes affecting the South Carolina coast is given.

Availability: NTIS (COM 75-11335).

29.7. "Storm Tide Frequency Analysis for the Coast of Georgia," NOAA Technical Memorandum NWS HYDRO-19, Sept. 1974, 28 pp.

Storm-tide height frequencies are developed for the Georgia coast. The procedures used are those described in 29.6.

Availability: NTIS (COM-74-11746/AS); EDS, official copies.

29.8. "Storm Tide Frequency for the Gulf Coast of Florida from Cape San Blas to St. Petersburg Beach," NOAA Technical Memorandum NWS HYDRO 20, April 1975, 34 pp.

Storm-tide height frequencies are developed for a portion of the Florida Gulf of Mexico coast. The procedures used are those described in 29.6.

Availability: NTIS (COM 75-10901/AS).

29.9. "Storm Tide Frequency Analysis for the Coast of Puerto Rico," NOAA Technical Memorandum NWS HYDRO 23, May 1975, 43 pp.

Storm-tide height frequencies are developed for the coast of Puerto Rico. The procedure used is a modification of that described in 29.6.

Availability: NTIS (COM 75-11001/AS).

29.10. "Estimation of Hurricane Storm Surge in Apalachicola Bay, Florida," NOAA Technical Report NWS 17, June 1975, 66 pp.

The adaptation of the Ried-Bodine bay model to provide tide frequency values in Apalachicola Bay is described. The model is adapted to accept as input the results of SPLASH.

Availability: NTIS (COM 75-11332).

29.11. "Joint Probability Method of Tide Frequency Analysis Applied to Apalachicola Bay and St. George Sound, Fla.," NOAA Technical Report NWS 18, November 1975, 43 pp.

The model developed by Overland (item 29.10) is used to develop storm-tide height frequencies for two bays along the Florida coast. The open coast storm-tide frequency values from item 29.8 were used for the outer coast values.

29.12. "A Mean Storm Surge Profile," ESSA Technical Memorandum WBTM SR-49, Dec. 1969, 2 pp., 4 figures.

Data from 19 great hurricanes (950-mb or lower) making landfall in the United States south of 35° latitude have been analyzed to show the variation and extremes in the heights of the water levels. A mean storm surge profile has been constructed.

Availability: NTIS (PB-188-422).

29.13. "A Preliminary View of Storm Surges Before and After Storm Modifications," NOAA Technical Memorandum ERL WMPO-3, May 1973.

A theoretical discussion of the effects of tropical storm modification on the resulting storm is presented. A two-dimensional dynamic surge model is used.

Availability: NTIS (COM-73-11304); ERL, official copies.

29.14. "Forecasting Extratropical Storm Surges for the Northeast Coast of the United States," NOAA Technical Memorandum NWS TDL-50, Jan. 1974.

Empirical forecast equations for 10 locations from Portland, Me., to Norfolk, Va., are given. Input to the equations are forecast sea level pressures at grid points.

Availability: NTIS (COM-74-10719); EDS, official copies.

29.15. "Criteria for a Standard Project Northeaster for New England North of Cape Cod," National Hurricane Research Project No. 68, Mar. 1967.

The criteria for storms producing severe tides along the New England coast between Provincetown, Mass., and the Canadian border are developed.

29.16. "An Example of Radar as a Tool in Forecasting Tidal Flooding," ESSA Technical Memorandum WBTM ER-24, Aug. 1967.

A procedure for using radar to detect echo lines associated with shifts and, therefore, to forecast tidal flooding is described.

Availability: NTIS (PB-180-613).

29.17. "Giant Waves Hit Hawaii," ESSA Technical Memorandum WBTM PR-8, Sept. 1970, 40 pp.

The successful prediction of the arrival time of storm-generated heavy waves in Hawaii during early December 1969 is described.

Availability: NTIS (COM-71-00021).

29.18. "A Lake Erie Storm Surge Forecasting Technique," ESSA Technical Memorandum WBTM TDL-24, Aug. 1969, 23 pp.

Two methods of forecasting storm surge on Lake Erie at Buffalo, N.Y., and Toledo, Ohio, are presented. One method is for manual use; the other is for computer use where numerical weather forecasts are available.

Availability: NTIS (PB-185-778).

29.19. "Climatology of Lake Erie Storm Surges at Buffalo and Toledo," NOAA Technical Memorandum TDL 54, December 1974, 27 pp.

For this study, storm surge is defined as the departure of the lake level from the mean monthly lake level. Thirty-three years of lake level data for Buffalo, N.Y., and Toledo, Ohio, have been processed. The occurrence of storm surges greater than 2 feet, both positive and negative, have been put into classes at half-foot intervals for each month of the year.

Availability: NTIS (COM 75-10587/AS).

29.20. "Storm Tide Frequency Analysis for the Coast of North Carolina, South of Cape Lookout," NOAA Technical Memorandum NWS HYDRO-21, May 1975, 44 pp.

Storm-tide height frequencies are developed for the southern portion of the North Carolina coast. The procedures described in 29.6 are used.

Availability: NTIS (COM 75-11000/AS).

29.21. "A Preliminary View of Storm Surges Before and After Storm Modifications for Alongshore Moving Storms," NOAA Technical Memorandum NWS TDL-58, October 1975, 16 pp.

Numerical means are used to compute storm surges in a standard basin of constant slope, bounded by a straightline coast. All storm tracks in this study are constrained to lie parallel to the coast. To illustrate peak surges on the coast, two nomograms are constructed: one considers variations in size and pressure of a storm with a fixed track and the other various tracks with a fixed storm. It is found, the peak surge in the coast is not always monotonically related to the parameter, maximum wind speed of a storm. In fact, the peak surge may increase or decrease according to the manner in which other storm parameters are affected by a change in maximum wind.

Availability: NTIS (PB 247-362/7GA).

29.22. "Storm Tide Frequency Analysis for the Coast of North Carolina, North of Cape Lookout," NOAA Technical Memorandum NWS HYDRO-27, November 1975, 46 pp.

Storm tide height frequencies are developed for the northern portion of the North Carolina coast. The procedures described in 29.6 are used.

Availability: NTIS (PB 247 900/AS).

29.23. "Storm Tide Frequency Analysis for the Open Coast of Virginia, Maryland and Delaware," NOAA Technical Memorandum NWS HYDRO 32, August 1976, 52 pp.

Storm-tide height frequencies are developed for the Virginia, Maryland and Delaware coasts, except for the mouth of Chesapeake Bay. The basic procedures used are those described in 29.6.

29.24. "A Sheared Coordinate System for Storm Surge Equations of Motion With a Mildly Curved Coast," NOAA Technical Memorandum NWS TDL-61, July 1976.

To improve numerical computations of coastal storm surges, a mildly curved coastline is shifted or sheared onto a straight "baseline." In the transformed system, the computational grid is cartesian, orthogonal, equally spaced, and the coast lies exactly on and not across a grid line. A surge model, incorporating the sheared system, is now fully operational from the Mexican-American border to the eastern end of Long Island, New York. The model can run with curvilinear storm track, changing storm celerity along the track, and changing storm parameters such as intensity and size.

NOTE:
See "Wind Waves," item 35.3.

30. STREAMFLOW FREQUENCY ANALYSIS

30.1. "Methods of Flow Frequency Analysis," Notes on Hydrologic Activities Bulletin No. 13, Interagency Committee on Water Resources, Subcommittee on Hydrology, 1966.

The five methods most commonly used by Federal agencies in making frequency studies of runoff at individual streamflow stations are described. Some of these methods are also used for analysis of rainfall frequency.

30.2. "Guidelines for Determining Flood Flow Frequency," Bulletin No. 17, Water Resources Council, Hydrology Committee, March 1976.

The log-Pearson Type III method for flood flow frequency analysis is recommended and its application is described.

NOTE:
Neither of the above is a NOAA publication, but NOAA is represented on the Hydrology Committee. For information, write to: Water Resources Council, 2120 L Street, NW., Suite 800, Washington, D.C. 20037.

31. WATER MANAGEMENT

31.1. "The National Weather Service and Water Management," 1973, 15 pp.

The National Weather Service's river and water supply forecasting services and hydrometeorological research for water management planning and design are described.

Availability: GPO; EDS.

31.2. "Effective Use of Non-Structural Methods in Water Management," ESSA Technical Memorandum WBTM CR-34, Mar. 1970, 12 pp.

The use of nonstructural methods, such as flood plain regulation, flood-proofing, flood forecasting, seasonal and annual forecasts of water supply, and weather modification, as an effective approach to attaining water management objectives is described.

31.3. "Meteor Burst Communication System - Alaska Winter Field Test Program," NOAA Technical Memorandum NWS HYDRO 30, 1976.

The Boeing Meteor Burst Communication System was tested in Alaska for a thirty-day period beginning February 14, 1975. This report describes the result of that test.

Availability: NTIS (PB 260-449/AS).

NOTE:
See "Snow," item 28.9.

32. WATER SUPPLY FORECASTS

32.1. "Water Supply Outlook for Northeastern United States," published monthly from October through September.

Issues are published the first of each month for the water year. Estimates of water-year flow to be expected from various watersheds in New England and New York are presented.

Availability: National Weather Service, River Forecast Center, Box 688, Hartford, Conn. 06101.

32.2. "Water Supply Outlook for Western United States," published monthly from January to May.

Issues are published the first of each month from January to May. Estimates of water-year flow to be expected from numerous watersheds west of 104°W. are presented.

Availability: EDS.

32.3. "Water Supply Outlook for the State of Alaska," published monthly from April through October.

Issues are published the first of each month from April through October. Estimates of water-year flow to be expected from selected watersheds in Alaska are presented.

Availability: National Weather Service, River Forecast Center, 632 Sixth Avenue, Anchorage, Ak. 99501.

33. WEATHER MODIFICATION

33.1. "An Annotated Bibliography on Weather Modification 1960-69," NOAA Technical Memorandum EDS ESIC-1, June 1972, 413 pp.

Annotated references on statistical evaluation of cloud seeding operations and potentialities, cloud seeding theories and experiments, legal aspects of weather modification, economic implications, hail control and lightning supression, cloud and fog dissipation, atomic explosion effects, hurricane control, and large-scale climate modification are provided.

Availability: NTIS (COM-72-11287); EDS, official copies.

33.2. "Bibliography of the Urban Modification of the Atmospheric and Hydrologic Environment," NOAA Technical Memorandum EDS-21, Feb. 1974.

A representative cross-section of the literature related to urban modification of climate is presented. Only those references to city climates that contain comparisons with adjacent rural climates are included. Among topics covered are precipitation, radiation, temperature, floods, ground water, runoff, sedimentation, stream temperature, and water quality.

Availability: NTIS (COM-74-10962/AS); EDS, official copies.

33.3. "Ground Rainfall Data for the 1968 Florida Cloud Seeding Experiment," ESSA Technical Memorandum EDS-17, Aug. 1970, 15 pp.

Maps of ground rainfall data are depicted for the Research Laboratories 1968 Florida cloud seeding experiment. These maps are for information only, and no conclusions are drawn.

Availability: NTIS (PB-194-366).

33.4. "Florida Cumulus Seeding Experiment for Drought Mitigation, April-May 1971," NOAA Technical Memorandum ERL OD-9, Nov. 1971, 165 pp.

In the spring of 1971, the Experimental Meteorology Laboratory undertook a dynamic cumulus seeding program in two target areas, one to the north and the other to the south of Lake Okeechobee, Fla. Evaluation was by rain gages and 10-cm radars, the WSR-57 of the National Weather Service, and the calibrated radar of the University of Miami (beginning May 10).

Availability: NTIS (COM-72-10149); ERL, official copies.

33.5. "Stormfury Cumulus Seeding Experiment 1965: Statistical Analysis and Main Results," ESSA Technical Memorandum IERTM APCL-3, Apr. 1967, 47 pp.

Basic and results of a randomized seeding experiment carried out on 23 tropical oceanic cumulus clouds on 9 days in the summer of 1965 are given.

33.6. "An Airborne Pyrotechnic Cloud Seeding System and Its Use," ESSA Technical Memorandum ERL TM APCL-5, May 1968, 27 pp.

The development, testing, and use of an airborne pyrotechnic cloud seeding system is described.

33.7. "Intensive Study of Three Seeded Clouds on May 16, 1968," ESSA Technical Memorandum ERLTM APCL-8, May 1969, 42 pp.

Three cumulus clouds were seeded over south Florida. Following seeding, one of the clouds dissipated without growth, while the other two grew explosively. This paper analyzes the history of each cloud with observations and with a numerical model. The model results predicted appropriately the variation in growth.

33.8. "Optimizing the Measurement of Convective Rainfall in Florida," NOAA Technical Memorandum NOAA TM ERL WMPO-18, July 1974, 106 pp.

The report discusses in five sections: (1) definition of the nature of Florida convective rains, (2) calculation of area-mass rainfall using gages developed over a 220 mi^2 area, (3) estimation of area rainfall using S-band radar with gages in small dense arrays serving as the basis for comparison, (4) definition of the gaging requirements to measure area-mass rainfall within a specified accuracy over large areas using gages, and (5) specification of the accuracy of a combined gage and radar system for the measurement of areal convective precipitation.

Availability: NTIS (COM-74-11554/4GA); ERL, official copies.

33.9. "A Case Study of Two Stormfury Cloudline Seeding Experiments," NOAA Technical Memorandum ERL WMPO-21, Feb. 1975, 45 pp.

Two cloudline seeding cases were selected for study from the Project STORMFURY cloudline exercises. One case involved clouds in a rather active convective environment while the other case was more isolated. Both cases showed more growth in seeded than unseeded clouds but no unbiased control clouds were monitored.

33.10. "The Florida Area Cumulus Experiment: Rationale, Design, Procedures, Results and Future Course," NOAA Technical Report ERL-354-WMPO-6, 204 pp.

The Florida Area Cumulus Experiment has developed as the logical extension of the successful series of single cloud experiments over the Caribbean and Florida. This report provides a historical overview and a discussion of the empirical and theoretical foundations for this experiment.

Availability: NTIS (PB 252 658).

33.11. "A Statistical Technique for Evaluating Hurricane Modification Experiments," NOAA Technical Memorandum ERL, WMPO-29, May 1976, 11 pp.

A statistical technique is developed for evaluating the non-randomized Project STORMFURY experiments. Modern principles of design and analysis use replication and randomization, which make it possible to attribute whatever effects are observed to the treatment only. However, in the STORMFURY Project it is planned to seed nearly all experimental units, leaving essentially no controls. With the concept of randomization in time, it is possible to develop an evaluation technique to quantitatively determine whether there is an association between a treatment and the event following the treatment.

Availability: NTIS (PB 258-028/AS).

NOTE:
See "Storm Surges," item 29.21.

34. WIND

34.1. "History of Weather Bureau Wind Measurements," Key to Meteorological Records Documentation No. 3.151, 1963.

The various types of anemometers that have been used are described.

Availability: NCC.

34.2. "Wind Persistence Probability," ESSA Technical Memorandum ERLTM ARL-10, Feb. 1969, 32 pp.

Wind persistence is evaluated based on 5-yr standard hourly reports from 61 weather stations in the United States. The probability that a wind direction would persist in a sector of given size for hourly time periods starting with 2 hr was computed by season, direction of the center of the sector, and wind speed.

NOTE:
1. See "Climatological Data and Observations," items 1.1 through 1.4, 1.8, 1.9, and 1.12.
2. See "Hurricanes," items 9.13, 9.17 through 9.20 and 9.24.

35. WIND WAVES

35.1. "Wave Climatology for the Great Lakes," NOAA Technical Memorandum NWS TDL-40, Feb. 1971, 61 pp.

This study is based upon 10 yr of wave observations, which are summarized for each of the lakes according to month of year. Also, all overall summary for all months together is given for each lake.

Availability: NTIS (COM 71-00368).

35.2. "Wind Waves on the Great Lakes," ESSA Technical Memorandum WBTM CR-21, May 1968, 15 pp.

Deep water waves, including their characteristics, formation, height forecasting, and the effects of these waves on small craft are discussed.

35.3 "Cause and Prediction of Beach Erosion," NOAA Technical Memorandum NWS ER-55, Dec. 1973.

The oceanographic and meteorological factors involved in beach erosion are discussed. Eleven cases in New Jersey and eight cases in Long Island were investigated and the results are summarized.

Availability: NTIS (COM 74-10036); EDS.

NOTE:
See "Storm Surge," items 29.16 and 29.18.

(Continued from inside front cover)

NWS HYDRO 15 Time Distribution of Precipitation in 4- to 10-Day Storms--Arkansas-Canadian River Basins. Ralph H. Frederick, June 1973. (COM-73-11169)

NWS HYDRO 16 A Dynamic Model of Stage-Discharge Relations Affected by Changing Discharge. D. L Fread, December 1973. Revised, September 1976.

NWS HYDRO 17 National Weather Service River Forecast System--Snow Accumulation and Ablation Model Eric A. Anderson, November 1973. (COM-74-10728)

NWS HYDRO 18 Numerical Properties of Implicit Four-Point Finite Difference Equations of Unsteady Flow. D. L. Fread, March 1974.

NWS HYDRO 19 Storm Tide Frequency Analysis for the Coast of Georgia. Francis P. Ho, September 1974 (COM-74-11746/AS)

NWS HYDRO 20 Storm Tide Frequency for the Gulf Coast of Florida From Cape San Blas to St. Petersburg Beach. Francis P. Ho and Robert J. Tracey, April 1975. (COM-75-10901/AS)

NWS HYDRO 21 Storm Tide Frequency Analysis for the Coast of North Carolina, South of Cape Lookout Francis P. Ho and Robert J. Tracey, May 1975. (COM-75-11000/AS)

NWS HYDRO 22 Annotated Bibliography of NOAA Publications of Hydrometeorological Interest. John F Miller, May 1975.

NWS HYDRO 23 Storm Tide Frequency Analysis for the Coast of Puerto Rico. Francis P. Ho, May 1975 (COM-11001/AS)

NWS HYDRO 24 The Flood of April 1974 in Southern Mississippi and Southeastern Louisiana. Edwin H Chin, August 1975.

NWS HYDRO 25 The Use of a Multizone Hydrologic Model With Distributed Rainfall and Distributed Parameters in the National Weather Service River Forecast System. David J. Morris, August 1975.

NWS HYDRO 26 Moisture Source for Three Extreme Local Rainfalls in the Southern Intermountain Region E. Marshall Hansen, October 1975.

NWS HYDRO 27 Storm Tide Frequency Analysis for the Coast of North Carolina, North of Cape Lookout Francis P. Ho and Robert J. Tracey. November 1975.

NWS HYDRO 28 Flood Damage Reduction Potential of River Forecast Services in the Connecticut River Basin. Harold J. Day and Kwang K. Lee, February 1976.

NWS HYDRO 29 Water Available for Runoff for 4- to 15-Days Duration in the Snake River Basin in Idaho Ralph H. Frederick and Robert J. Tracey, June 1976. (PB-258-427)

NWS HYDRO 30 Meteor Burst Communication System--Alaska Winter Field Test Program. Henry S. Santeford, March 1976. (PB-260-449)

NWS HYDRO 31 Catchment Modeling and Initial Parameter Estimation for the National Weather Service River Forecast System. Eugene L. Peck, June 1976.

NWS HYDRO 32 Storm Tide Frequency Analysis for the Open Coast of Virginia, Maryland, and Delaware Francis P. Ho, Robert J. Tracey, Vance A. Myers, and Normalee S. Foat, August 1976. (PB-261-969)

NWS HYDRO 33 Greatest Known Areal Storm Rainfall Depths for the Contiguous United States. Albert P. Shipe and John T. Riedel, December 1976.

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PB 268 846/AS