ANNOTATED BIBLIOGRAPHY OF NOAA PUBLICATIONS
OF HYDROMETEOROLOGICAL INTEREST

Silver Spring, Md.
April 1977
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 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 (Superseded by WBTM HYDRO 9)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 (Superseded by WBTM HYDRO 8)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 9 Elements of River Forecasting (Revised). Marshall M. Richards and Joseph A. Strahl, March 1969. (PB-185-969)


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**


(Continued on inside back cover)
NOAA Technical Memorandum NWS HYDRO-34

ANNOTATED BIBLIOGRAPHY OF NOAA PUBLICATIONS
OF HYDROMETEOROLOGICAL INTEREST

John F. Miller

Silver Spring, Md.
April 1977
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ANNOTATED BIBLIOGRAPHY OF NOAA PUBLICATIONS OF HYDROMETEOROLOGICAL INTEREST

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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.
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


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.


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 ≥ 0.10 and > 0.50, days with temperatures ≥ 90°F or ≤ 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.

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.


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.


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 Service 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.


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.

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.


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.


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.


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).

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)


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


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


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.


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.


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.


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.


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

Availability: NTIS (PB-178-071).


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


Available climatological data for the Alaskan North Slope are presented.


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).


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).


Average monthly and seasonal hourly radar echo frequencies are presented.

Availability: NTIS (PB-193-347).


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

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


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.


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).


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.
5. See "Precipitation, excessive and maximum observed," items 14.7 and 14.11.
8. See "Precipitation, mean and normal," item 17.1.
10. See "Relative humidity," item 23.4.
3. CLOUDS, LIQUID WATER CONTENT IN STORMS


The results obtained in flights on five thunderstorm days in Oklahoma are presented. The maximum value reported was 43.7 g/m³. A diagram, relating liquid water content to rainfall rate, indicates that 33 g/m³ 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).


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/m³.

Availability: NTIS (PB-168-411).


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

NOTE:

4. DEW POINTS, MAXIMUM PERSISTING

NOTE:
1. See "Climatological Data and Observations," items 1.1 and 1.9.

5. DROUGHT


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

Availability: NTIS (COM-71-00937).


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

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


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.


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


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/OGS).

NOTE:

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


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


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


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).


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

Availability: X.


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


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


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.

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

Availability: NTIS (COM-71-50269).


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/A).

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.


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.


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.


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.

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.
3. See "River and Flood Forecasting," items 24.5 and 24.22.

8. HYDROLOGIC CYCLE


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


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.


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.


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


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

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).


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).


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).


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

Availability: NTIS (PB-166-855).


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.

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).


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.


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


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


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).


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


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).
Wind data from a number of hurricanes are combined to obtain a composite of the hurricane circulation.
Availability: NTIS (PB-168-369).

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).

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).

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).

The processes that resulted in the dissipation of a tropical cyclone overland 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).

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.
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

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).


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).

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).


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:

2. See "Floods," item 7.2.
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


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.


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

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).


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).


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).


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.
11. PRECIPITATION, COMPUTED


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.


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

12. PRECIPITATION, DEPTH-AREA-DURATION ANALYSIS


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.


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).


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 mi² (259, 518, 2590, 12950, 25900 km²) for 6, 12, 24, and 48 hours. Rainfall values are on maps and tables.
13. PRECIPITATION, DISTRIBUTION: TIME AND SPACE


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

Availability: NTIS (PB-182-222).


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

Availability: NTIS (PB-194-389).


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).


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


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).


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,

Same description as above item but based on data for 1941-70.
Availability: NTIS (COM-73-11169).


Daily precipitation values were derived for the United States portion
of the Lake Ontario land basin for 1972 and 1973. Isohyetal maps are provid-
Availability: NTIS (COM 75-10589/OGA).

13.9. "Radar and Satellite Precipitation Analysis of a 5-Day BOMEX Data

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 immedi-
ately 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.
3. See "Precipitation, Distribution," item 15.16.

14. PRECIPITATION, EXCESSIVE AND MAXIMUM OBSERVED

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.

Data are presented in tables and on maps.

Availability: N.

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: N.


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

Availability: N.


The meteorological factors associated with this storm are discussed briefly.


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).


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).


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).


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 con-
junction 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 inter-
mountain region.

Availability: NTIS (PB 248 433).

14.11. "Greatest Known Areal Storm Rainfall for the Contiguous United

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-longi-
titude squares.


The report discusses the meteorological situation that accompanied a rain-
fall 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


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).


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).


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).


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).


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).


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.


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

Availability: NTIS (COM-72-11146).


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).


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

Availability: NTIS (COM-72-10432).


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,"

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

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

Availability: NTIS (PB-190-962).


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

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


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-

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

The percentage frequency and spatial distribution of cold season precip-
itation 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.
4. See "Snow," items 27.5 and 27.6.

16. PRECIPITATION, HURRICANE


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).


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

Availability: NTIS (PB-168-360).


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


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:

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.

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.


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).


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:

<table>
<thead>
<tr>
<th>State</th>
<th>Address</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>The University of Arizona, Room 102, West Stadium Bldg., Tucson, AZ 85717</td>
<td>$1.00 per set</td>
</tr>
<tr>
<td>Colorado</td>
<td>Colorado Water Conservation Board, 215 State Services Bldg., 1525 Sherman Street, Denver, CO 80203</td>
<td>$1.00 per set</td>
</tr>
<tr>
<td>New Mexico</td>
<td>State Engineer Office, State Capitol Bldg., Santa Fe, NM 87501</td>
<td>$1.00 per set</td>
</tr>
<tr>
<td>Utah</td>
<td>Utah State Engineer Office, State Capitol Bldg., Salt Lake City, UT 84114</td>
<td>$0.75 per map</td>
</tr>
</tbody>
</table>
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.
4. See "Snow," item 27.3.

18. PRECIPITATION MEASUREMENTS (EQUIPMENT)

Gages


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


The 2-yr test on this gage is discussed.

Availability: NTIS (PB-180-290).


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).


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


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).


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.

Availability: NTIS (COM-71-00897).


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).


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

Availability: NTIS (COM-71-00829).


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).


Same description as above item, 18.9.

Availability: NTIS (COM-71-00925).

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

Availability: NTIS (COM-73-11030).


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.


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.


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 propagation effects.

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


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).


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.

19. PRECIPITATION, PROBABILITY (FREQUENCY)

   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).

   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).

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

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

   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.

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.


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 mi² are included.


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 mi² are included. This Atlas is published in a separate volume for each of the 11 Western States.


The same type data described in item 19.7 are presented.


The same type data described in item 19.7 are presented.


The same type data described in item 19.7 are presented.

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.


The same type data described in item 19.12 are presented.


The same type data described in item 19.12 are presented.


The same type data described in item 19.12 are presented.


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


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).


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.


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

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.


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.


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.


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).


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.


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).

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 75-10650/00).


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 75-10428/00).


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 similar material published in Weather Bureau Technical Paper No. 40.

NOTE:
4. See "Precipitation, Forecasting," item 15.16.
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 mi². It will be available as Hydrometeorological Report No. 51, later in 1977.

Maps showing the 24-hr 200 mi² PMP and curves for adjusting those values for durations of 6, 12, and 48 hr and for areas from 10 to 1,000 mi² are presented.

Major storms are discussed and maps showing 1-, 6-, and 24-hr PMP for 10 mi² are presented. An interpolation diagram and area-reduction curves are provided for estimating values for intermediate durations and areas up to 400 mi². 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.


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).


Generalized estimates of PMP are presented for areas up to 5,000 mi² 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 mi² are provided.


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 mi² are presented.


The same data described in item 20.5 are presented.


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 mi².
Antecedent rainfall criteria are provided also for use as indices to soil moisture conditions and existing streamflows at the beginning of the critical rainfalls.


Generalized estimates of PMP are provided for durations from 6 to 72 hr and areas from 10 to 40,000 mi² 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.


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


Estimates for durations from 6 to 72 hr and for areas from 10 mi² to total basin area (24,100 mi²) are presented.


Estimates for durations from 6 to 72 hr for the total basin (21,400 mi²) and one subarea (7,980 mi²) are presented. Variation of PMP during March through September is also given.


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.


PMP and TVA precipitation estimates for 16,170- and 26,780 mi² basins in the Tennessee River drainage and 2,734- and 11,674 mi² 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.

Generalized estimates of PMP for 5,000- to 25,000-km² drainages for durations up to 3 days covering the Lower Mekong River Basin are determined.


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).


Provides procedures to compute estimates of PMP for any watershed up to 5,000 mi² and for durations to 72 hours. General storm and thunderstorm criteria are provided.


21. RADAR, HYDROLOGIC APPLICATIONS


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

Availability: NTIS (PB-183-510).


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.


The results of correlation studies between a dense network of rain gages in Oklahoma (175 recording gages in 1,100 mi²) 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.


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.
3. See "Precipitation Measurements," items 18.5 through 18.16.
4. See "River and Flood Forecasting," item 24.16.

22. RADIATION, SOLAR AND SKY


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


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


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


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

Availability: EDS.

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

Availability: NTIS (PB-191-741).


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.


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.

24. RIVER AND FLOOD FORECASTING


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.


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

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

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).


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


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).


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

Availability: NTIS (COM-71-00616).


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.


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).


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.


Linearized model equations of the quasi-linear differential equations of unsteady quadruply 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.


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.


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).

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).


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


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).


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.


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).


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).

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-mi² basin. Flash floods seem to exhibit similar relationship over larger areas.

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


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).


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-mi² 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).


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).

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).


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).


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:
2. See "Snow", item 27.9.

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

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

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

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,"

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).


Part I of this report describes the data processing system developed to obtain various meteorological variables from infrared and microwave radiometric 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).


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).


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).


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).


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).


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).


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:
2. See "Precipitation Measurements," items 18.15 and 18.16.
3. See "Snow," items 27.7 and 27.8.
27. SNOW


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.


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.


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).


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

Availability: NCC and EDS, official copies.


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

Availability: NTIS (COM-71-00369).


A climatological aid for forecasting snow in northwestern Nevada.

Availability: NTIS (COM-72-10338).


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).


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).


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.

28. STORMS, GENERAL


The phenomenon of lightning and safety rules are discussed.

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


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

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


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


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.


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.


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).


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).


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).


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).


Characteristics of outstanding storms are described.

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


Characteristics of outstanding storms are described.


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


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

Availability: NTIS (COM-74-10260).


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).


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.

29. STORM SURGES


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).


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).


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.


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).


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).


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).


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.


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).


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).


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).

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.


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).


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.


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.


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


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).


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).

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).


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).


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).


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).


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).

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.


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


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.


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


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.

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.


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


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


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 suppression, cloud and fog dissipation, atomic explosion effects, hurricane control, and large-scale climate modification are provided.

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


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/A9); EDS, official copies.


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).


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 gauges 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.


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.


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

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.


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 mi² 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.


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.


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).


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


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

Availability: NCC.


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.

35. WIND WAVES


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).


Deep water waves, including their characteristics, formation, height forecasting, and the effects of these waves on small craft are discussed.


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.
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