PUERTO RICO AND VIRGIN ISLANDS PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 42* and *Technical Paper No. 53*

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Hydrometeorological Design Studies Center
Hydrology Laboratory

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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk

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1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development, U.S. National Weather Service is updating its precipitation frequency estimates for Puerto Rico and the Virgin Islands. Current precipitation frequency estimates for the area are contained in *Technical Paper No. 42* "Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands" (U.S. Weather Bureau 1961) and *Technical Paper No. 53* "Two- to ten-day rainfall for return periods of 2 to 100 years in Puerto Rico and Virgin Islands" (Miller 1965). The new project includes collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project will determine annual precipitation frequencies for durations from 5 minutes to 60 days, for return periods from 2 to 1,000 years. The project will review and process all available rainfall data for the Puerto Rico and Virgin Island project area and use accepted statistical methods. The project results will be published as a Volume of NOAA Atlas 14 on the internet using web pages with the additional ability to download digital files.

The project area covers Puerto Rico and the U.S. Virgin Islands of St. Thomas, St. John and St. Croix. The project area is currently divided into 7 homogeneous climatic regions for analysis (Figure 1).

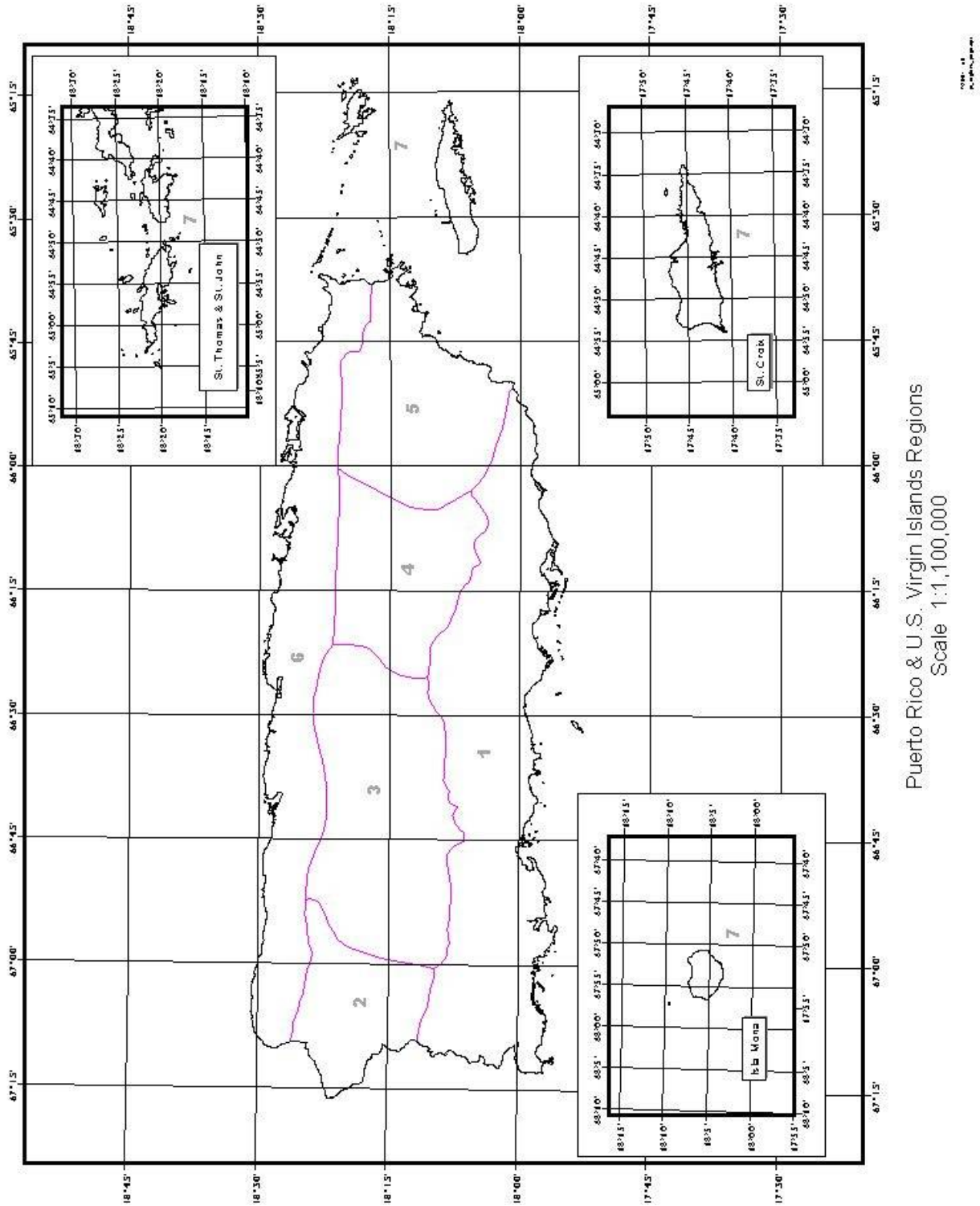


Figure 1. Puerto Rico Precipitation Frequency project area and region boundaries.

2. Highlights

NWS published NOAA Atlas 14 Volume 2 precipitation frequency estimates for the Ohio River Basin and surrounding states on June 29th, 2004. They were made available via the Precipitation Frequency Data Server at http://www.nws.noaa.gov/ohd/hdsc. With this release, HDSC is now able to devote more resources to the Puerto Rico and Virgin Islands Project and a more rapid progress is expected.

The hourly and daily datasets from the National Climatic Data Center were updated through 12/2003. The 15-minute dataset from the U.S. Geological Survey was also updated through 12/2003. Quality control continues on the daily and hourly datasets. Additional information is provided in Section 3.1, Data Quality Control.

Some highlights discussed below are lessons learned are therefore relevant to this project.

Hourly confidence limit software was modified to accommodate recent changes that ensure consistency between hourly-only stations and nearby co-located hourly/daily stations. Software that adjusts quantiles for the co-location of daily and hourly data was modified to identify cases where the ratios of daily region 100-year 24-hour RGF versus hourly region 100-year 24-hour RGF were less than 1.0 and creating inconsistencies in precipitation frequency curves at the 60-minute duration. Additional information is provided in Section 3.2, Software Updates

The Precipitation Frequency Data Server (PFDS) underwent several important changes. Additional information is provided in Section 3.3, Precipitation Frequency Data Server.

HDSC initiated a procurement for spatial interpolation work with Oregon State University's Spatial Climate Analysis Center. Additional information is provided in Section 3.4, Spatial Interpolation Procurement.

All study areas for the areal reduction factor (ARF) development have been selected have been quality controlled. A new site, Clark County, NV, has been identified and will be added to the list of sites to be used in the A-R-F curve development. There are currently 14 sites located throughout the conterminous US, Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis. Software development to process the data and ultimately generate the ARF curves is still underway. Additional information is provided in Section 3.5, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Quality Control

The hourly and daily datasets from the National Climatic Data Center were updated through 12/2003. The 15-minute dataset from the U.S. Geological Survey was also updated through 12/2003. Quality control continues on the daily and hourly datasets. In addition, daily data from the National Climate Data Center's TD3206 (pre-1948) dataset was added. The initial quality control of the daily data is complete except for three values which were sent to the state climatologist for review.

The quality control of the hourly dataset is about half complete. All 1 hour events greater than a threshold of 1.5 inches are being checked.

3.2 Software Updates

Hourly confidence limit software was modified to accommodate recent changes that ensure consistency between hourly-only stations and nearby co-located hourly/daily stations and thereby reduce bull's eyes in the hourly results. The software adjusts hourly confidence limits according to their co-located daily station and/or according to the daily regional characteristics from the 24-hour quantile through to the 2-hour quantile:

1. The site-specific co-located adjustment is applied to the co-located stations using ratios of the 24-hour station means and ratios of the daily and hourly regional growth factors (RGFs) for durations 24-hour down to 2-hour.
2. Hourly-only stations are adjusted using a regionally averaged ratio of the daily and hourly RGFs for all co-located stations within the hourly region for durations from 24-hour down to 2-hour.
3. 60-minute quantiles for both co-located and hour-only stations are adjusted using the regionally averaged adjustment ratios.

Software that adjusts quantiles for the co-location of daily and hourly data was modified to identify cases where the ratios of daily region 100-year 24-hour RGF versus hourly region 100-year 24-hour RGF are less than 1.0. The RGF ratios are based on each return interval, but the 100-year interval was used as the flag. In all identified cases, the co-located (i.e., station-specific) adjustment ratios rather than the regionally averaged ratios are applied from 24-hour through 60-minute to maintain consistency over all hourly durations. A comparable modification was made to the confidence limit software.

3.3 Precipitation Frequency Data Server

The Precipitation Frequency Data Server (PFDS) under went several subtle, but important changes. They include:

1. In order to be consistent and clear, we have adopted the standard terminology used by The Institution of Engineers, Australia in the 1987 edition of Australian Rainfall and Runoff for describing precipitation frequency estimates. Therefore, the PFDS output pages now indicate the frequency when using a partial duration series as Average Recurrence Interval (ARI) in units of years. Likewise, the output indicates frequency when using an annual maximum series as Annual Exceedence Probability (AEP) in units of 1 in Y, where Y is dimensionless; for instance, a 100-year frequency is indicated as "1 in 100," in other words there is a 1 in 100 chance of it being exceeded in any particular year.
2. The text describing the seasonality graphs was changed to be consistent with the new terminology and the 1 in 10 Annual Exceedence Probability (i.e., 10-year) curve was added.
3. The map of the United States on the opening screen of the PFDS, was changed to reflect the areas that have updated precipitation frequency estimates available.

3.4 Spatial Interpolation Procurement

NWS initiated a procurement with Oregon State University's Spatial Climate Analysis Center (SCAS). The goal of this procurement is to have SCAS perform spatial interpolation of mean annual maximum precipitation values at high resolution, for each duration, at each observing location. HDSC uses the spatially interpolated grids provided by SCAS to compute the final spatially interpolated precipitation frequency estimates. The estimated cost of this procurement is $25,000.

3.5 Areal Reduction Factors

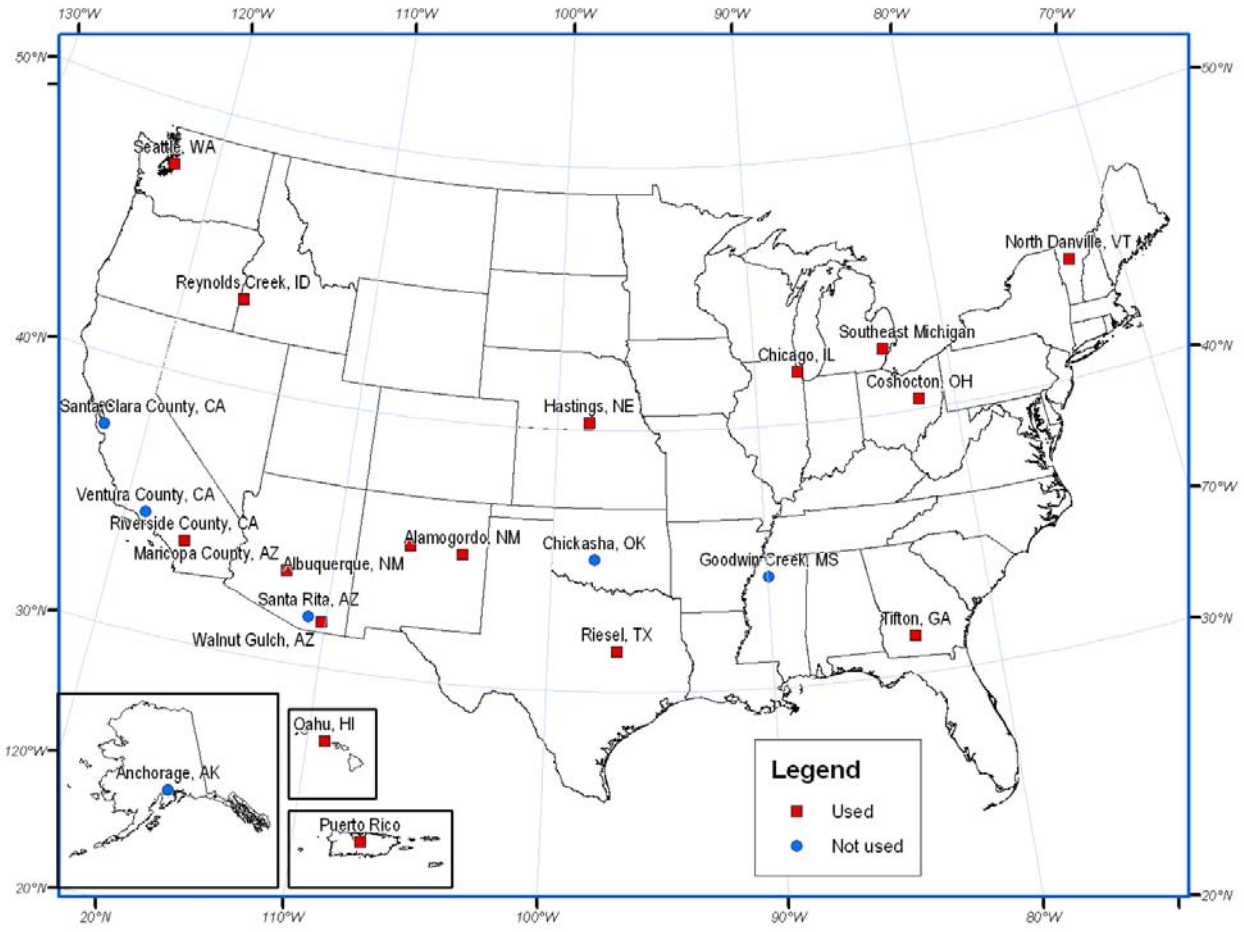
Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for area sizes of 10 to 400 square miles. Development and testing of software from the procedure described in NOAA Technical Report NWS 24 (TR-24) is still underway. A preliminary set of ARF curves for the 2-year return period for the Chicago, IL area study site are consistent with results published in TR-24.

A total of 15 study areas throughout the United States will be used in the study (see Figure 2). The "not used" study areas indicated in Figure 2 were considered but judged inadequate for the study due to poor data, limited or no metadata, or other problems. The set of ARF curves developed for each study area used will be tested for differences to determine if a single set of ARF curves can be used for the entire U.S. as is the case

today or whether separate curves for different regions of the country are more appropriate.

Quality control has been performed and completed on the precipitation data from the sites in the southeast Michigan, Albuquerque, and Seattle study areas. A new site, Clark County, NV, has been identified and will be shortly added to the current list of sites to be used in the A-R-F curve development. There are currently 14 sites located throughout the conterminous US, Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis.

Figure 2: Map of ARF study areas



4. Issues

4.1 Recent and Upcoming Presentations

Past and future presentations by HDSC, include the following:

- "Statistics of Recent Updates to NOAA/NWS Rainfall Frequency Atlases" at the American Society of Civil Engineers World Water and Environmental Resources Congress on June 29, 2004
- "Recent Updates to NOAA/NWS Rainfall Frequency Atlases" at the California Extreme Precipitation Symposium in Davis, CA on July 1, 2004
- An update of the Ohio River Basin and Surrounding States Precipitation Frequency Project progress at the 84th Meeting of the Ohio River Basin Commission on July 14, 2004
- "Regional Frequency Studies of Annual Extreme Precipitation in the United States Using Regional L-moments Analysis" at the International Ocean-Atmosphere Conference held by the Chinese-American Oceanic and Atmospheric Association (COAA) in Beijing, China on June 27-30, 2004

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks to be worked on are also included in this section.

Data Collection and Quality Control [August 2004]
Trend Analysis [September 2004]
Temporal Distributions of Extreme Rainfall [October 2004]
L-Moment Analysis/Frequency Distribution [October 2004]
Peer Review of Spatially Interpolated Point Estimates [November 2004]
Spatial Interpolation [December 2004]
Precipitation Frequency Maps [January 2005]
Web Publication [December 2004]
Spatial Relations (Areal Reduction Factors) [August 2004]

5.1 Data Collection and Quality Control

During the next quarter, quality control of the updated daily, hourly and 15-minute datasets will be completed. Stations will be checked for gaps in the data and some stations may be merged if the criteria are met. All durations will be extracted and longer durations will also be quality controlled.

5.2 L-Moment Analysis/Frequency Distribution

A comprehensive L-moment statistical analysis will be done on all durations and regions will be reassessed.

5.3 Trend Analysis and Temporal Distributions

Once the data have been quality controlled, an analysis for trends in the annual maximum series data and an analysis of the hourly temporal distributions of heavy rainfall can begin.

5.4 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 15 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

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