PUERTO RICO AND VIRGIN ISLANDS PRECIPITATION FREQUENCY PROJECT

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

Thirteenth Progress Report
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Hydrometeorological Design Studies Center
Hydrology Laboratory

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DISCLAIMER

The data and information presented in this report should be considered as preliminary and 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 1000 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).

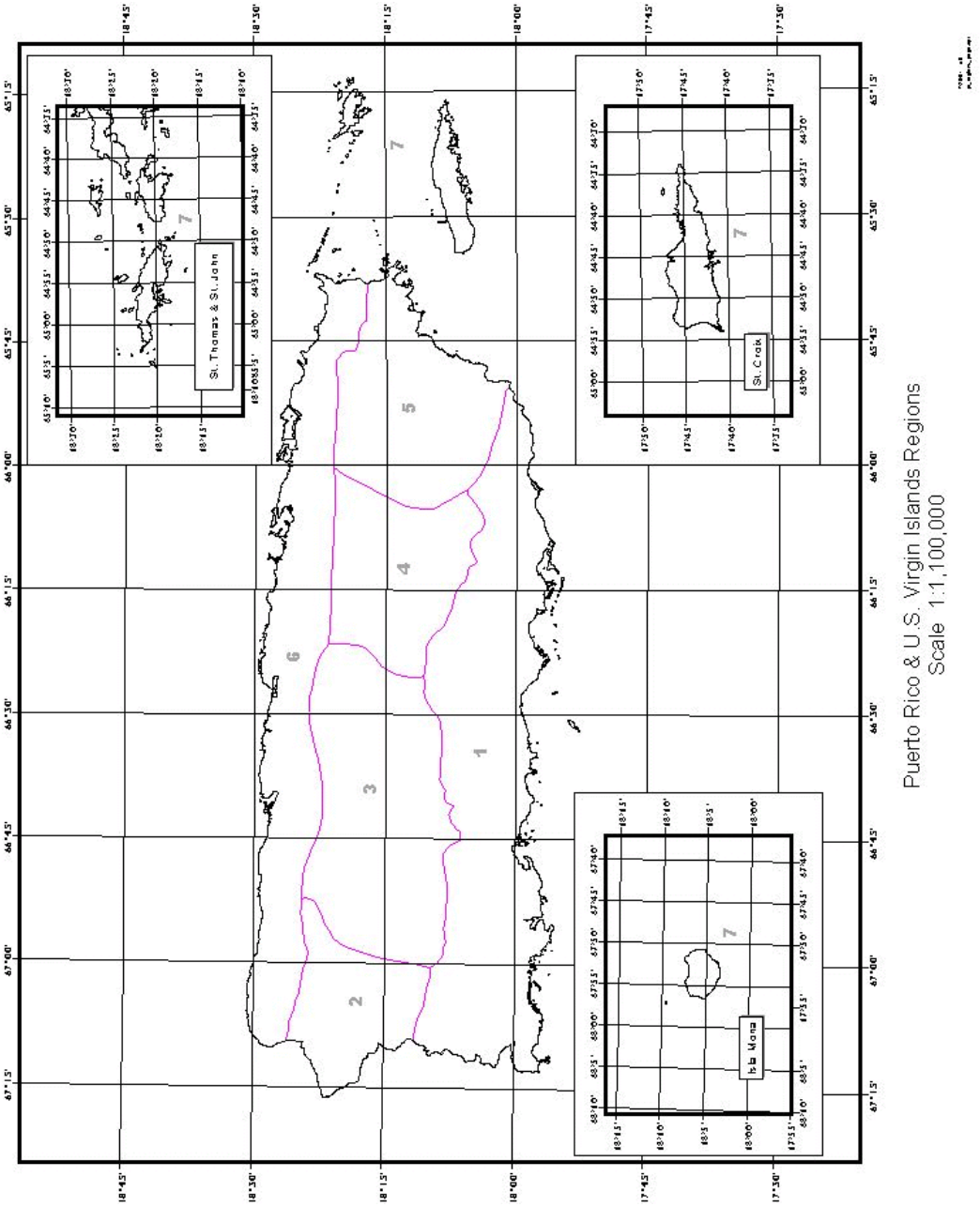

Figure 1. Puerto Rico Precipitation Frequency project area and region boundaries.

2. Highlights

As noted in previous progress reports, work on this project has been delayed (see Section 5, Projected Schedule). However lessons learned from both the Semiarid Southwest project and the Ohio River Basin and Surrounding States project are being applied to the production system that will be used for this project.

Precipitation frequency updates for the Semiarid Southwest U.S. were published via the Precipitation Frequency Data Server (PFDS) (www.nws.noaa.gov/oh/hdsc) on August 6. The peer review of precipitation frequency updates for the Ohio River Basin and Surrounding States was concluded on September 14.

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

Inconsistencies from one duration to the next in a given year were observed in the annual maximum series for some stations. Therefore, an annual maximum consistency check will be conducted as an added QC procedure. Additional information is provided in Section 3.1, Data Quality Control.

Software that automates adjustment procedure for co-located stations was modified to accommodate the use of different distributions for different regions. Software was also written to conduct an annual maxima consistency check and adjustment and a check for intersite dependency. Additional information is provided in Section 3.2, Software Updates.

The Precipitation Frequency Data Server underwent a few modifications in our continuing effort to make it as user friendly as possible. Additional information is provided in Section 3.3, Precipitation Frequency Data Server.

Quality control continues on data from study areas to be used in the areal reduction factor (ARF) curve development, and software development to process the data and ultimately generate the ARF curves is nearly complete. The name of this project, formerly Depth Area Reduction (DAR), has been officially changed to reflect new nomenclature. Additional information is provided in Section 3.4, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Quality Control

We found inconsistencies in the annual maximum series in a number of cases in Semiarid Southwestern U.S. and Ohio River Basin data and developed new quality control software to test for the problem. The problem manifests itself as an annual maximum of a shorter duration that is greater than longer durations in a given year. This can happen when the data has too many missing values immediately adjacent to the accumulation period of the shorter duration for the accumulation of the longer duration to be acceptable. In these cases we were rejecting the accumulation completely rather than accepting the shorter duration accumulation as a minimum value for the longer duration. It can also happen when average adjustment factors that account for different sampling intervals are applied (e.g. 24-hour vs. 1-day data.)

The new annual maximum consistency check identifies occurrences where shorter duration annual maxima are higher than longer duration annual maxima. If the difference is small (<10%), the longer duration annual maxima will be set equal to the shorter duration for that year. Differences of 10% or more will be flagged and examined more closely for data quality issues. The 10% cutoff was chosen as a convenient indicator above which the cause is generally missing data. This will be conducted as an additional QC procedure.

3.2 Software Updates

Software that automates the adjustment procedure that ensures consistency from shorter durations through longer durations for co-located stations was modified to accommodate the use of different distributions for different regions.

Software was written to conduct an annual maxima consistency check (see Section 3.1 Data Quality Control). This software documents cases where a shorter duration is greater than a longer duration for further investigation. Software has also been written to automatically adjust annual maxima in the time series after the investigation is complete.

Software was written to check for intersite dependency by computing cross-correlation between stations. The software identifies cases where stations within 50 miles of each other have appreciable cross-correlation in annual maxima occurring at the same time.

3.3 Precipitation Frequency Data Server (PFDS)

We modified the Precipitation Frequency Data Server in our continuing effort to make it more user friendly. The modifications include:

a) a greater density of grid lines on the graphs to assist in picking values from the graph,

b) when point estimates are requested for a location by selecting a specific observing location, the station name now appears in the downloadable text table.

We also re-arranged the web pages used for selecting bulk data for downloading. The pages are designed to provide access to huge volumes of data, including spatial (GIS) data, in a clear and organized manner.

3.4 Areal Reduction Factors

The name of this project, formerly Depth Area Reduction (DAR), has been officially changed to reflect new nomenclature. Progress continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for area sizes of 10 to 400 square miles. We have successfully completed testing and evaluation of the software through Chapter 5 of TR-24 by looking at the statistical results for Chicago, IL data. We are now working on the remaining chapters.

We have completed quality control on the data for Chicago, IL; Walnut Gulch, AZ; Tifton, GA; North Danville, VT; and Hastings, NE. Quality control work is continuing on the remaining study areas. We have added Riverside, CA and Maricopa, AZ to the list of areas we are studying. It is anticipated that a total of 15 study areas throughout the United States will be used in the study. The set of ARF curves developed for each study area 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.

4. Issues

No issues.

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 [January 2003]
Trend Analysis [February 2004]
Temporal Distributions of Extreme Rainfall [February 2004]
L-Moment Analysis/Frequency Distribution [March 2004]
Spatial Interpolation [April 2004]
Peer Review of Spatially Interpolated Point Estimates [May 2004]
Precipitation Frequency Maps [June 2004]
Web Publication [June 2004]
Spatial Relations (Areal Reduction Factors) [December 2003]

5.1 Data Collection and Quality Control

During the next 2 quarters, the quality control for updated daily, hourly, and n-minute datasets will occur. All durations will be extracted upon the completion of the initial quality control process. Once begun, the complete update and quality control of the data should take no longer than 4 weeks of working time.

5.2 L-Moment Analysis/Frequency Distribution

A comprehensive L-moment statistical analysis will be done on all durations and regions will be reassessed. The tasks involved with the precipitation frequency analysis will take roughly two months for the Puerto Rico and Virgin Islands project area.

5.3 Areal Reduction Factors (ARF)

Software for the ARF computations will be completed in the next quarter and the computations will be performed 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.

References

Hershfield, D.M., 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years, *Weather Bureau Technical Paper No. 40*, U.S. Weather Bureau. Washington, D.C., 115 pp.

Hosking, J.R.M. and J.R. Wallis, 1997: *Regional frequency analysis, an approach based on L-moments*, Cambridge University Press, 224 pp.

Huff, F. A., 1990: Time Distributions of Heavy Rainstorms in Illinois, *Illinois State Water Survey*, Champaign, 173, 17pp.

Lin, B. and J.L. Vogel, 1993: A comparison of L-moments with method of moments, *Engineering Hydrology Symposium Proceedings*, ASCE, San Francisco, CA, July 25-30, 1993.

Miller, J.R., 1965: Two- to ten-day rainfall for return periods of 2 to 100 years in Puerto Rico and Virgin Islands. *Technical Paper No. 53*, U.S. Weather Bureau, Govt. Printing Office, Washington, D.C., 35 pp.

U.S. Weather Bureau, 1961: Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands. *Technical Paper No. 42*, U.S. Govt. Printing Office, Washington, D.C., 94 pp.

Myers, V.A. and R.M. Zehr, 1980: A Methodology for Point-to-Area Rainfall Frequency Ratios, *NOAA Technical Report NWS 24*, Office of Hydrology, National Weather Service, Silver Spring, MD.