PUERTO RICO AND VIRGIN ISLANDS PRECIPITATION FREQUENCY PROJECT

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

Fourteenth Progress Report
1 October 2003 through 31 December 2003

Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
U.S. National Weather Service
National Oceanic and Atmospheric Administration
Silver Spring, Maryland

January 2004

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

TABLE OF CONTENTS

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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).

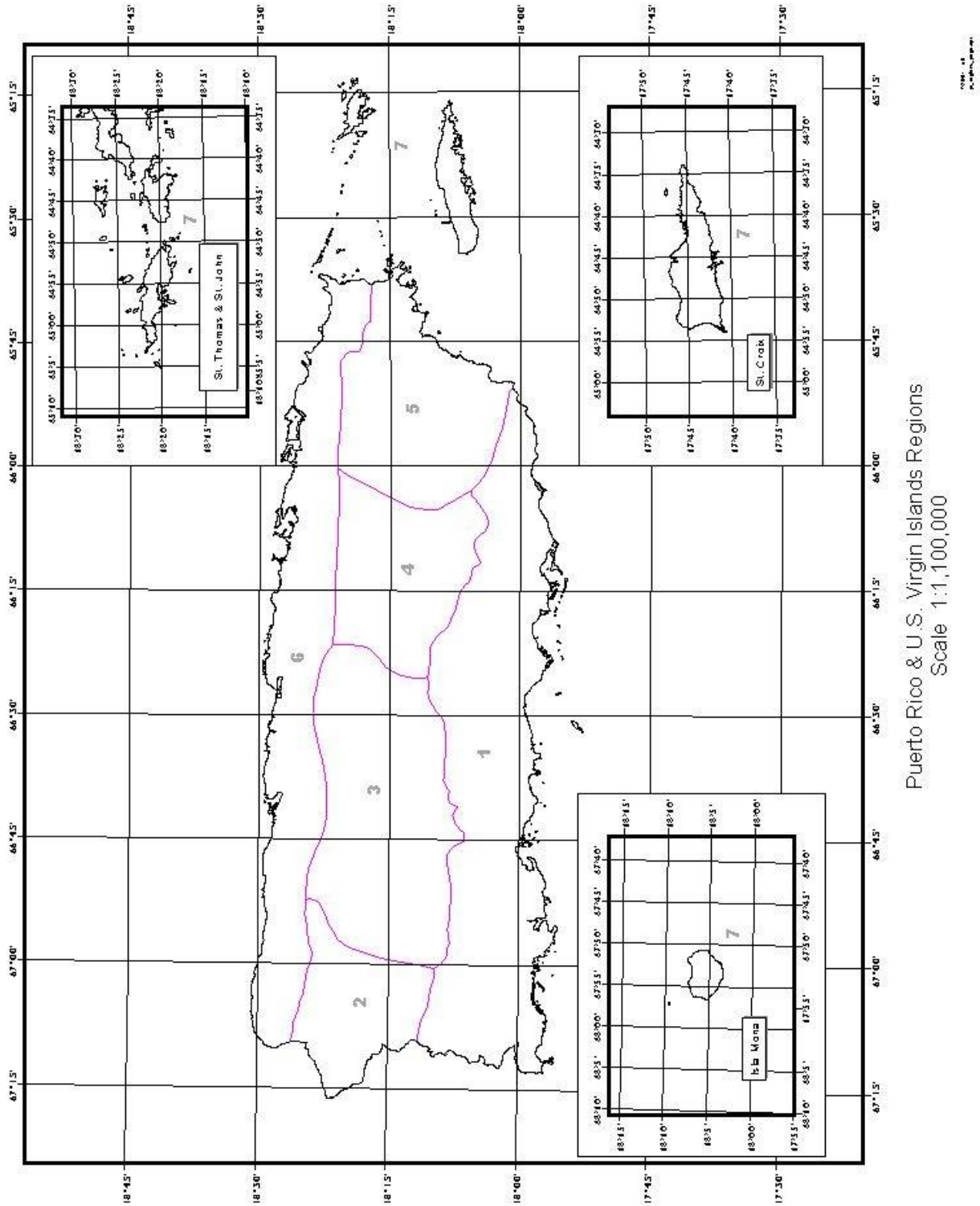

Figure 1. Puerto Rico Precipitation Frequency project area and region boundaries.

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.

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

Hourly data from 10/1998 through 12/2002 have been added to the hourly dataset and have been quality controlled. Additional information is provided in Section 3.1, Data Quality Control.

HDSC created a mean annual precipitation map using PRISM grids. A procedure for adjusting mean PRISM grids was developed and tested. The Cascade, Residual Add-back (CRAB) derivation procedure was modified to accommodate a conversion from results based on annual maximum series (AMS) to results based on partial duration series (PDS). Additional information is provided in Section 3.2, Software Updates/Spatial Interpolation.

The Precipitation Frequency Data Server (PFDS) underwent several modifications. In particular, the results provided by the PFDS will now be in terms of partial duration series as the default, rather than annual maximum series. Additional information is provided in Section 3.3, Precipitation Frequency Data Server.

Study areas to be used and tested in the areal reduction factor (ARF) development have been selected and are being quality controlled. Software development to process the data and ultimately generate the ARF curves is 90% completed. Additional information is provided in Section 3.4, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Quality Control

Hourly data from 10/1998 through 12/2002 have been added to the hourly dataset and have been quality controlled. Data through 12/2002 or as available will be added to the daily and 15-minute datasets and quality controlled in the next quarter. Additional n-minute data are not available.

3.2 Software Updates/Spatial Interpolation

HDSC created a hillshade grid of Puerto Rico and the Virgin Islands for displaying elevation in mapping. The hillshade grid was used in a cartographic map of mean annual precipitation that we created for the Commonwealth of Puerto Rico. The mean annual precipitation grids used for this purpose were originally created by the Spatial Climate Analysis Service at Oregon State University using PRISM technology and funded by the International Institute of Tropical Forestry.

In the Semiarid Southwest Precipitation Frequency Project, we learned that slight changes may occur in the mean annual maximum values at stations due to data quality corrections. Since it is not always cost effective to have the Spatial Climate Analysis Service at Oregon State University re-run the grids with our updated data, we have developed a process to adjust the PRISM mean annual maxima grids.

The procedure starts with the calculation of an adjustment factor: new mean divided by old mean at each station. Here the old mean is the mean that was used in creating the original PRISM mean grid. Both means are from the database and not interpolated from the PRISM mean grid. These point adjustment factors are then spatially distributed using an inverse-distance-weighting (IDW) algorithm. The resulting grid is then filtered to remove extraneous noise in the adjustment grid. The filtered adjustment grid is then multiplied by the original mean annual maxima grid to produce an adjusted PRISM mean annual maxima grid.

This simple approach allows fine-tuning of the PRISM mean annual maxima grid cell values, but it is not robust enough to accommodate new data points (i.e., stations not used in the original PRISM gridding), omissions of stations, or any major changes in the mean values. During the procedure, the software produces percent difference grids to evaluate differences between the previous grids and the adjusted grids.

During the last quarter, other spatial software, the Cascade, Residual Add-back (CRAB) derivation procedure, was modified to accommodate a conversion from AMS-based results to PDS-based results. AMS to PDS conversion factors will be calculated from the data for the final publication.

Finally, the software used to create vector (contour) shapefiles from the precipitation frequency grids was made more robust by incorporating logic to determine the best contour interval for the given grid. The software forces the number of contour intervals to be less than or equal to 30 and greater than 10. The contour intervals are forced to fall at convenient break points, yet provide as much spatial detail as possible.

3.3 Precipitation Frequency Data Server (PFDS)

The Precipitation Frequency Data Server (PFDS) underwent several modifications. In particular, the results provided by the PFDS will now be in terms of partial duration series, rather than annual maximum series, as the default. Results based on either series can be selected as a criterion from the state-specific web-page of the PFDS.

The state-specific input pages have been simplified by eliminating the radio buttons. The PFDS interface now detects which input type (via a click on the map, a click on a station, the pull-down list, static location, or by area) without the user having to indicate it.

In addition, reference information pages have recently been added. And we have also resolved legend color issues on the maps that we will be providing. A new color ramp was built to mimic the transparency color on maps.

3.4 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. 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, including an area in and around Orocovis, Puerto Rico. 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

4.1 Upcoming Presentations

Interest in the new estimates is increasing. As a result, Geoff Bonnin, representing HDSC, will give a presentation entitled Temporal Distributions of Heavy Rainfall Associated with Updated Precipitation Frequency Estimates at the Transportation Research Board Conference in Washington DC on January 15, 2004.

Geoff Bonnin will present "Recent Updates to NOAA/NWS Rainfall Frequency Atlases" at the American Association of Geographers Annual Meeting in Philadelphia, PA on March 18, 2004 and the Southeast Region meeting of the Association of State Dam Safety Officers in Norfolk, VA on April 19, 2004.

He will also present a paper, "Statistics of Recent Updates to NOAA/NWS Rainfall Frequency Atlases," at the World Water and Environmental Resources Congress 2004 to be held June 28-July 1, 2004 by the American Society of Civil Engineers.

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

5.1 Data Collection and Quality Control

During the next quarter, the quality control for updated daily and 15-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 2 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.

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