

# HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

Thirteenth Progress Report  
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Hydrometeorological Design Studies Center  
Hydrology Laboratory

Office of Hydrologic Development  
U.S. National Weather Service  
National Oceanic and Atmospheric Administration  
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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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# HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

## 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 Hawaii. Current precipitation frequency estimates for Hawaii are contained in *Technical Paper No. 43*, "Rainfall-Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years" (U.S. Weather Bureau 1962). The update 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 average recurrence intervals from 2 to 1,000 years. The Project will review and process rainfall data for the Project area and use accepted statistical methods. The Project results will be published as a Volume of NOAA Atlas 14 on the internet (<http://www.nws.noaa.gov/ohd/hdsc>) using web pages with the ability to download digital files.

The Project area covers the Hawaiian Islands including Hawaii, Maui, Lanai, Molokai, Oahu, and Kauai. The Project area including preliminary regions is shown in Figure 1.

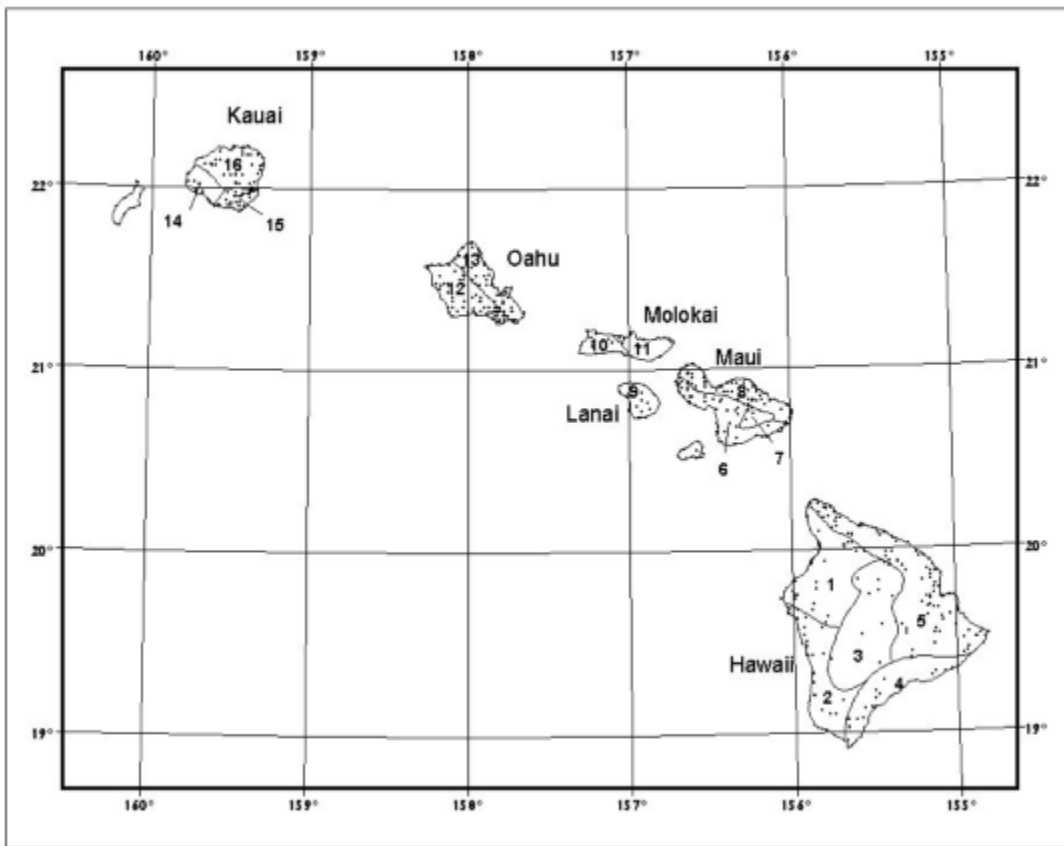


Figure 1. Hawaii Precipitation Frequency Project area, regional divisions and daily station locations.

## 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.

Dr. Pao-Shin Chu visited with the HDSC staff on June 16, 2004 during his trip to Silver Spring, MD. We discussed the fact that the project is on hold until we can obtain funding. Additional information is provided in Section 4.1, Meeting with Dr. Pao-Shin Chu on Funding for the Project

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 3.1, Software Updates

The Precipitation Frequency Data Server (PFDS) underwent several important changes. Additional information is provided in Section 3.2, Precipitation Frequency Data Server.

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 3.3, Areal Reduction Factors.

### 3. Progress in this Reporting Period

#### 3.1 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.

#### 3.2 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.

### 3.3 Areal Reduction Factors

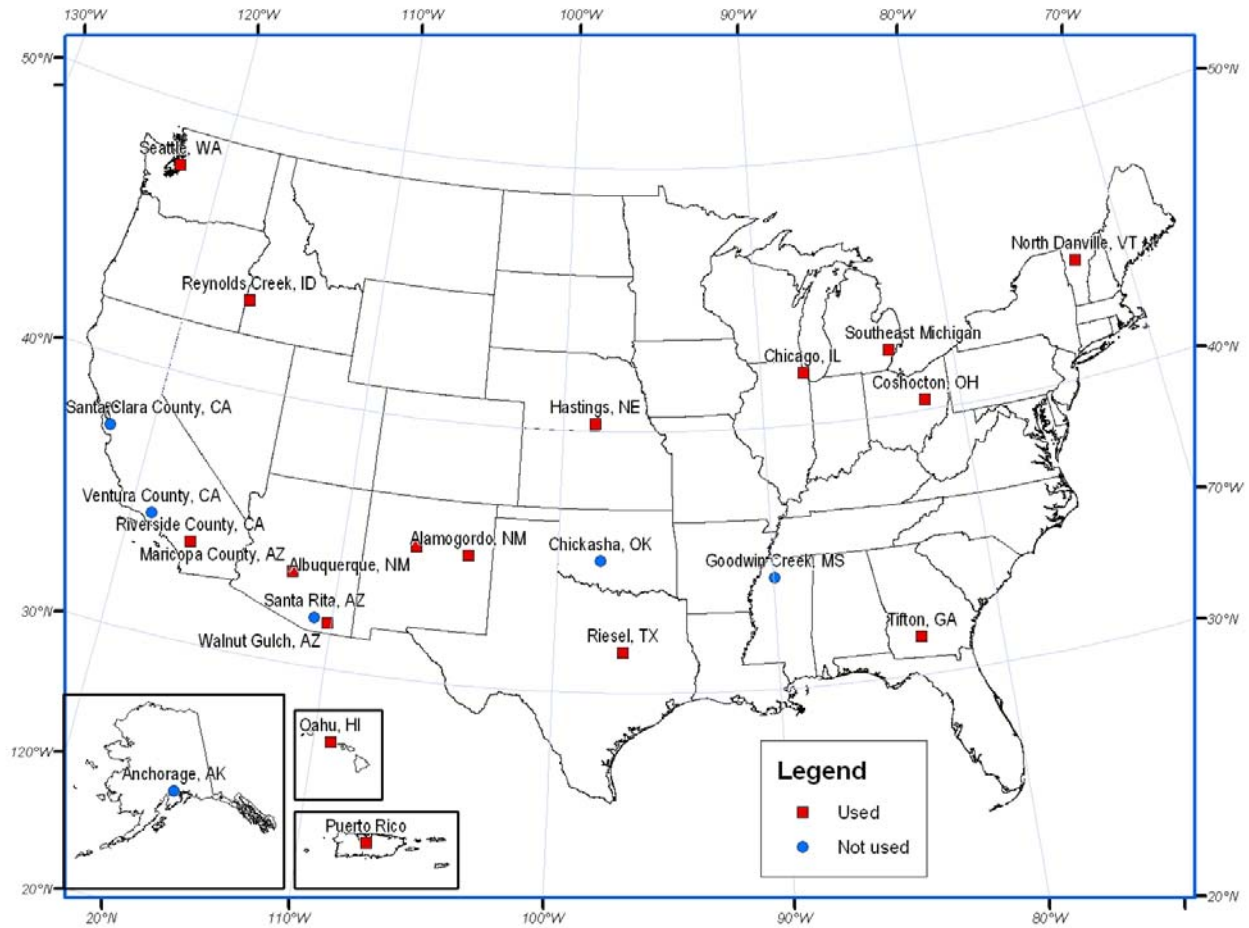
Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for area sizes of 10 to 400 square miles. Development and testing of software from the procedure described in NOAA Technical Report NWS 24 (TR-24) is still underway. A preliminary set of ARF curves for the 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 Meeting with Dr. Pao-Shin Chu on Funding for the Project

Dr. Pao-Shin Chu, Hawaii State Climatologist and Professor at the University of Hawaii, visited with HDSC staff on June 16, 2004 during his trip to Silver Spring, MD. We discussed the status of the project. The project is on hold until we can obtain funding. We perform our work at the request of and with funds provided by other federal, state and local government agencies. To date, funding to complete the project has not been secured.

We stand ready to resume the Hawaii Precipitation Frequency Project as soon as funding becomes available. We asked Dr. Chu to contact all relevant local agencies with interest in seeing an updated PF project completed for Hawaii to make them aware of our need for funding. We have been attempting to obtain funds through the Federal Interagency Committee on Water Information's Subcommittee on Hydrology. They have endorsed the idea that a full national PF update needs to be done and that the NWS should do it. We are also pursuing the possibility that funding may become available in Fiscal Year 2007 through the NOAA Climate Program.

### 4.2 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 84<sup>th</sup> 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 that will be worked on during the next few quarters are also included in this section.  $M_0$  indicates the date when funding becomes available.

Data Collection and Quality Control [ $M_0 + 3$  months]

L-Moment Analysis/Frequency Distribution [M<sub>0</sub> + 7 months]  
Trend Analysis [M<sub>0</sub> + 5 months]  
Temporal Distributions of Extreme Rainfall [M<sub>0</sub> + 8 months]  
Spatial Interpolation [M<sub>0</sub> + 10 months]  
Peer Review of Spatially Distributed Estimates [M<sub>0</sub> + 11 months]  
Precipitation Frequency Maps [M<sub>0</sub> + 13 months]  
Web Publication [M<sub>0</sub> + 13 months]

Areal Reduction Factors [August 2004]

### 5.1 Data Collection and Quality Control.

Once funding becomes available we will obtain appropriate NCDC and other available data and then start the quality control and testing of the regionalization. The estimation of the appropriate probability distribution functions and the parameterization of these functions as well as the spatial interpolation steps will be done for all islands as a group to ensure consistency in this part of the process.

### 5.2 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 15 areas including Hawaii. 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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