

HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

Nineteenth Progress Report
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Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
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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 of NOAA's National Weather Service plans to update 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 1 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.

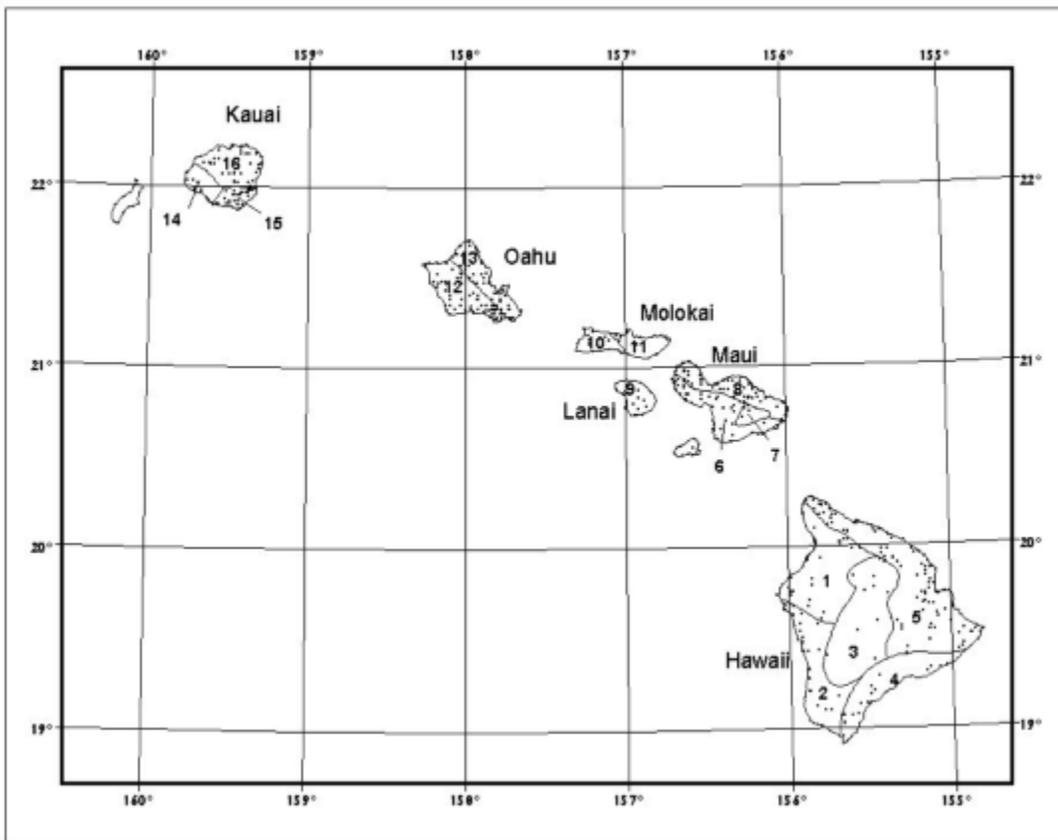


Figure 1. Hawaii Precipitation Frequency Project area, regional divisions and daily station locations.

2. Highlights

Daily data (TD3200 and TD3206) have been obtained from the National Climatic Data Center (NCDC) and are being quality controlled. Many cases where accumulated values were entered as missing were found. There is also concern regarding the usefulness of data primarily comprised of monthly accumulations for durations shorter than 30-day. Daily monthly maximums hand-entered previously by HDSC were formatted and added to the data set. Also, daily monthly maximums hand-entered at the Hawaii Climate Office were reviewed by HDSC and additional corrections were provided by the state. Hourly data have also been obtained from NCDC. Additional information is provided in Section 3.1, Data Collection and Quality Control.

The 100-year 1-hour and 100-year 24-hour precipitation frequency maps in Technical Paper Number 43 were digitized and converted into GIS rasters for quality control and future comparison purposes. Additional information is provided in Section 3.2, Spatial Interpolation.

HDSC continuously monitors the hits, integrity and performance of the Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information. Additional information is provided in Section 3.3, PFDS.

Progress on the development of areal reduction factors remains slow. Additional information is provided in Section 3.4, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Collection and Quality Control

Daily Data. Daily data (TD3200 and TD3206) through 12/2004 have been obtained from the National Climatic Data Center (NCDC), formatted, and are being quality controlled. The TD3206 data are data before 1948 and will be appended to the TD3200 data where available. There are some stations in the TD3206 data set that are not found in the TD3200 data set.

Each station was assigned into one of the sixteen preliminary regions (Figure 1). Table 1 shows the number of stations in each region. These stations will be screened for number of years of data and some stations may be merged based on physical proximity and statistical consistency to produce longer records.

Table 1. Number of stations in each of the preliminary regions.

Region	# of daily stations	# of state stations	# of hourly stations
1	28	11	6
2	32	9	7
3	11	11	3
4	18	5	3
5	98	27	21
6	41	32	11
7	6	11	1
8	55	31	15
9	9	11	5
10	7	2	3
11	9	11	5
12	71	48	22
13	43	26	23
14	10	14	2
15	30	28	5
16	32	23	11
total	500	300	143

Initial quality control includes a check of extreme values above thresholds and evaluation of output from in-house quality control software, *QCseries*. The thresholds for the extreme value check were established for the 1-day values based on climatological factors and previous precipitation frequency estimates from Technical Paper 43 in a given region. Observations above these thresholds are currently being checked against nearby stations, original observation records and published climatological data (the latter two are available via the on-line “Web Search Store Retrieve Display”, a.k.a. WSSRD, at <http://noaa.imcwg.com/> which is maintained through the Climate Database Modernization Program of NCDC).

QCseries, spatially-based software that screens data series to identify maximum precipitation values that are suspect relative to concurrent data at nearby stations, will be used for further quality control of the annual maximum series and partial duration series data for all daily and hourly durations. Output from *QCseries* has been generated for the annual maximum data sets for all durations. The software calculates an objectively-computed measure (called "score," ranging from 1 to 10) of the spatial consistency of each annual maximum value. A lower score indicates that a value was less consistent with nearby stations and requires scrutiny. Cases where the score was between 0 and 3 will be verified for data accuracy. Scores of 4 may also be checked initially but previous work has shown that such a score indicates data which are reasonable with no data errors. Another measure computed in the output, a ratio of the station of interest to the station within the evaluated distance with the highest concurrent value, may also be used to screen the data. Very high ratios and very low ratios will be checked.

The main error found so far in the daily data are accumulated values entered as missing. If left uncorrected, very high values would be treated as 1-day values when actually the rain fell over several or more days. Some of these errors could be caught automatically as an accumulated flag followed by a missing flag in the raw data, but most may require manual verification. There is concern regarding the usefulness of data primarily comprised of such monthly accumulations in the analysis of durations shorter than 30-day. Without information on how those accumulations were distributed throughout the period, the accumulated value is divided equally among each of the days. This can create 1-day values lower than the actual maximum 1-day rainfall. The percentage of data accumulated is being assessed and this issue is being given careful consideration.

Monthly 1-day maximums hand-entered previously by HDSC were formatted and added to the data set. These data were added to existing NCDC records to extend the period of record for the 24-hour analysis. The data set consisted of 164 stations with hand-entered data from the early 1900s through 1949.

State-entered Data. Daily monthly maximums hand-entered at the Hawaii Climate Office were received. After an initial review and correspondence with the state climatologist office additional corrections were provided by the state. There are 300 additional stations ranging in data length from 1 to 46 years. Two stations are missing metadata, such as latitudes and longitudes. These data were assigned to the preliminary 16 regions (Table 1). They will be quality controlled and included in the daily analysis.

Hourly Data. Hourly data through 12/2004 have been obtained from NCDC, formatted, and assigned to the 16 preliminary regions (Table 1). 1-hour extreme values over an established threshold were extracted for each region and will be quality controlled. Annual maximum series for all hourly durations (1-hour through 24-hour) were extracted for quality control using *QCseries*.

3.2 Spatial Interpolation

The 100-year 1-hour and 100-year 24-hour precipitation frequency maps in Technical Paper Number 43 (TP-43) were digitized and converted into GIS rasters for purposes of quality controlling the daily annual maximum series for NOAA Atlas 14. Later in the project the digitized versions of TP-43 will be used for making objective comparisons and assessments of the spatially interpolated NOAA Atlas 14 precipitation frequency estimates.

3.3 PFDS

The Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information, did not undergo any changes this quarter.

HDSC continuously monitors the hits, integrity and performance of the PFDS, which continues to receive an increasing number of hits per month. The graph (Figure 2) below summarizes the number of individual data inquires made since April 2004, while the map (Figure 3) indicates the locations of inquires during the past quarter.

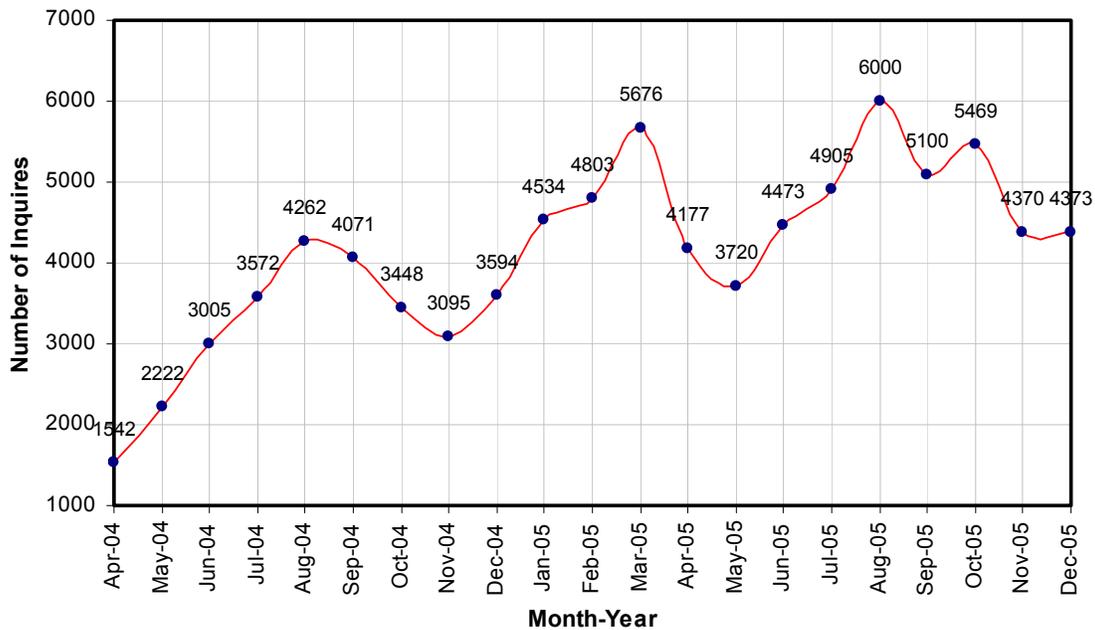


Figure 3: Number of individual PFDS data inquires per month.

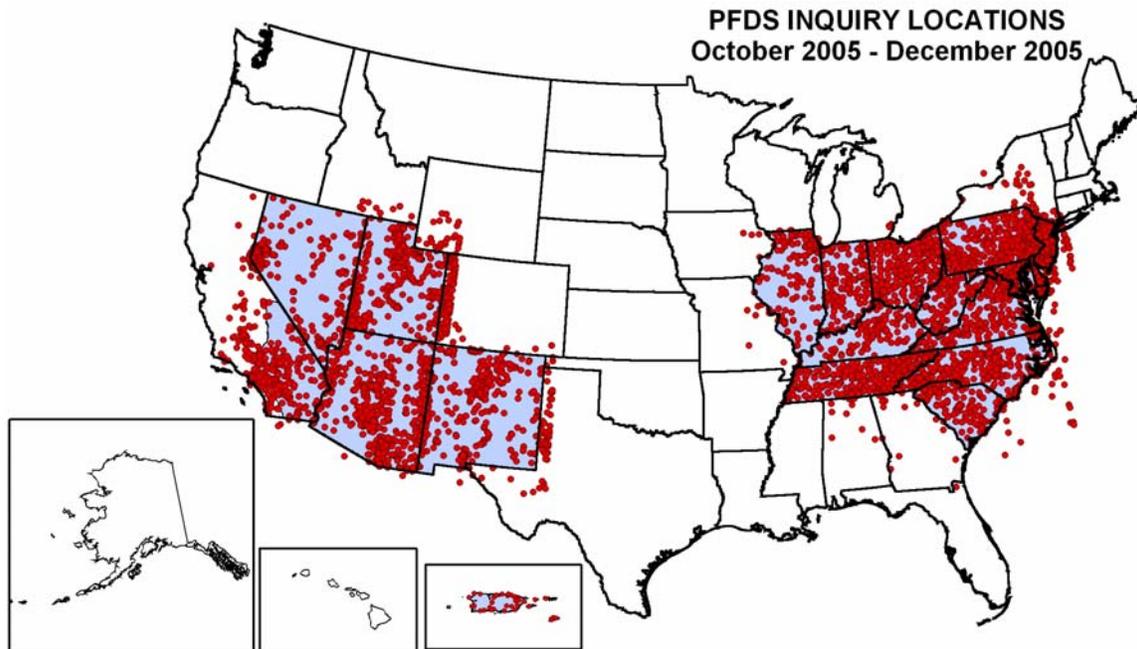


Figure 4: Map of 14,212 PFDS data inquiry locations during the period October-December 2005.

3.4 Areal Reduction Factors

Work continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Progress has been slow due to difficulties in completing the software related to the general fit of the underlying ARF curves.

Additional work to locate possible additional basins for use in the ARF project continues. No new sites have been found thus far due to a lack of available and sufficiently dense data.

4. Issues

4.1 Funding for Hawaii Project

The U.S. Army Corps of Engineers (USACE) has asked NWS to proceed with the Hawaii project following completion of precipitation frequency updates for Puerto Rico. We have begun work on the project as resources become available without impacting the schedule of the Puerto Rico project. We anticipate funding during FY06 will be less than is required to meet the schedule below. We will make schedule adjustments when the funding situation becomes clearer.

4.2 HDSC List-server

HDSC has created a list-server to send e-mail to a list of subscribers. It will replace our current process for announcements of progress reports, data updates, documentation and publications. Only HDSC personnel will be able to send messages through the server. The address list will not be available to the public. The list-server is not meant to serve as a discussion forum, but is meant to be a tool for HDSC to distribute information. Details on how to subscribe and un-subscribe from our list server are accessible through the HDSC homepage at http://www.nws.noaa.gov/ohd/hdsc_. Be aware, if you unsubscribe you will no longer receive announcements of progress reports, documentation or data updates from HDSC.

4.3 Personnel

Ed Zurndorfer, who is the Areal Reduction Factor Project Leader, will be retiring from HDSC in January 2006. Due to budget constraints, his position will not be re-filled. There should be no delay in the release of the Areal Reduction Factors due to this transition.

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.

- Data Collection and Quality Control [April 2006]
- L-Moment Analysis/Frequency Distribution [July 2006]
- Trend Analysis [June 2006]
- Temporal Distributions of Extreme Rainfall [August 2006]
- Peer Review of Spatially Distributed Estimates [October 2006]
- Spatial Interpolation [November 2006]
- Precipitation Frequency Maps [January 2007]
- Web Publication [January 2007]

- Areal Reduction Factors [April 2006]

5.1 Data Collection and Quality Control.

During the next quarter, quality control of the daily and hourly data sets will continue. Stations that meet certain criteria will be considered for merging. Records will be checked for statistical consistency if large gaps in time exist. Testing of the regionalization will begin to develop homogeneous regions for the L-moment analysis.

5.2 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 14 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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