

SEMIARID PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 49* and *NOAA Atlas 2*

Twenty-eighth Progress Report
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Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
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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 has updated its precipitation frequency estimates for the Semiarid Southwestern United States. Updated precipitation frequency estimates contained in NOAA Atlas 14 Volume 1 "Precipitation Frequency Atlas of the United States" replace those found in *Technical Paper No. 49* "Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States" (Miller et al 1964), *NOAA Atlas 2* "Precipitation-Frequency Atlas of the Western United States" (Miller et al 1973), "Short Duration Rainfall Frequency Relations for California" (Frederick and Miller, 1979) and "Short Duration Rainfall Relations for the Western United States" (Arkell and Richards, 1986) for the Semiarid region. The project included data collection and quality control, dataset formatting, regional frequency analyses, frequency distribution selection and fitting techniques, and spatial interpolation with reports and other documentation to follow.

The project determined annual all-season precipitation frequencies for durations from 5 minutes to 60 days, for return periods from 2 to 1,000 years. For the project, HDSC reviewed and processed all available rainfall data for the Semiarid project area and used accepted statistical methods. In particular, the Semiarid Project was the pilot project in which decisions regarding the methods and format were made that affect subsequent projects. The project results are published as Volumes of *NOAA Atlas 14* on the internet (<http://hdsc.nws.noaa.gov/hdsc>) with the additional ability to download digital files.

The Semiarid Project includes estimates for 4 states completely, Arizona, Nevada, New Mexico, and Utah, and southeastern California. Additional data from 7 bordering states and Mexico (Figure 1) were included for continuity across state borders. The core and border areas and regional groups used for long duration (24-hour through 60-day) analyses are shown in Figure 1. Regional groups used for short duration (60-minute through 12-hour) analyses are shown in Figure 2.

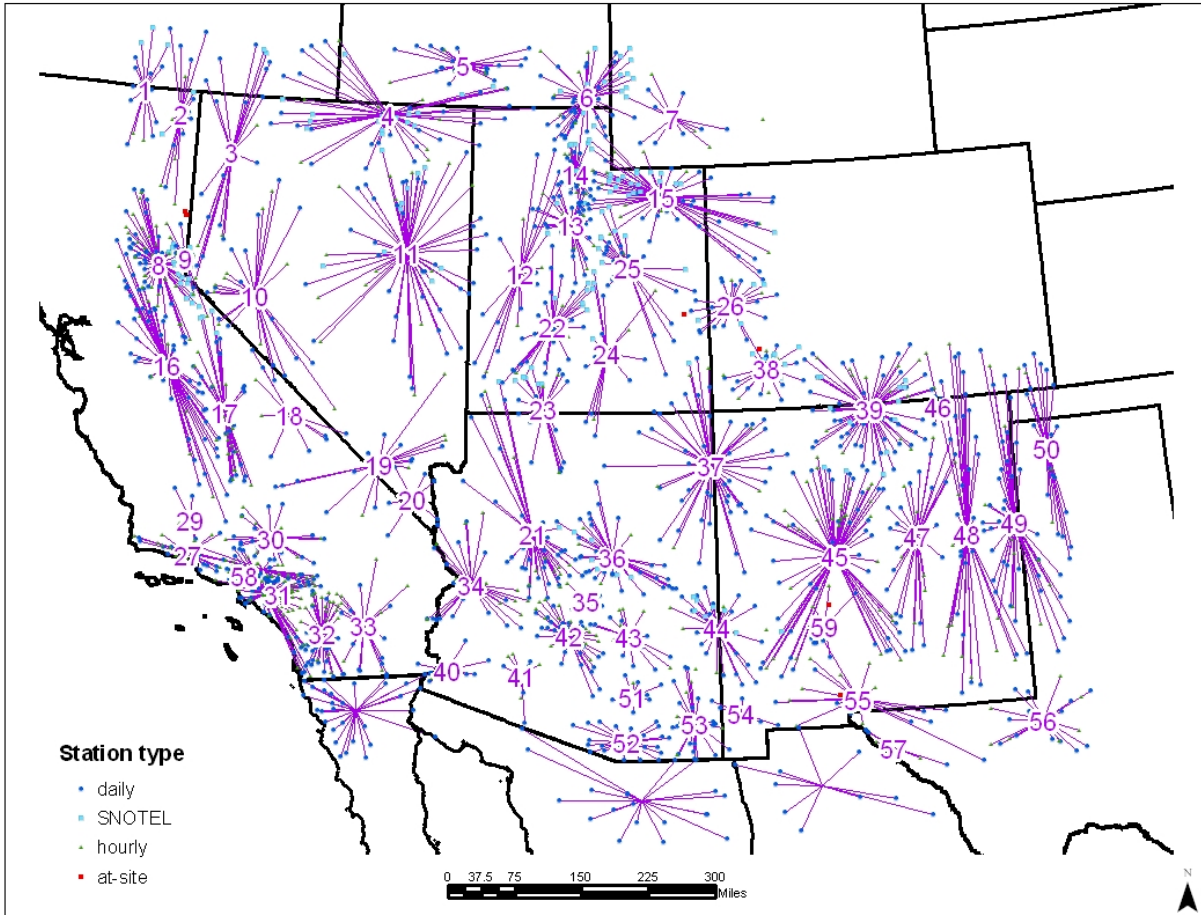


Figure 1. Semi-arid Precipitation Frequency project area and 59 regional groups for 24-hour and longer duration values.

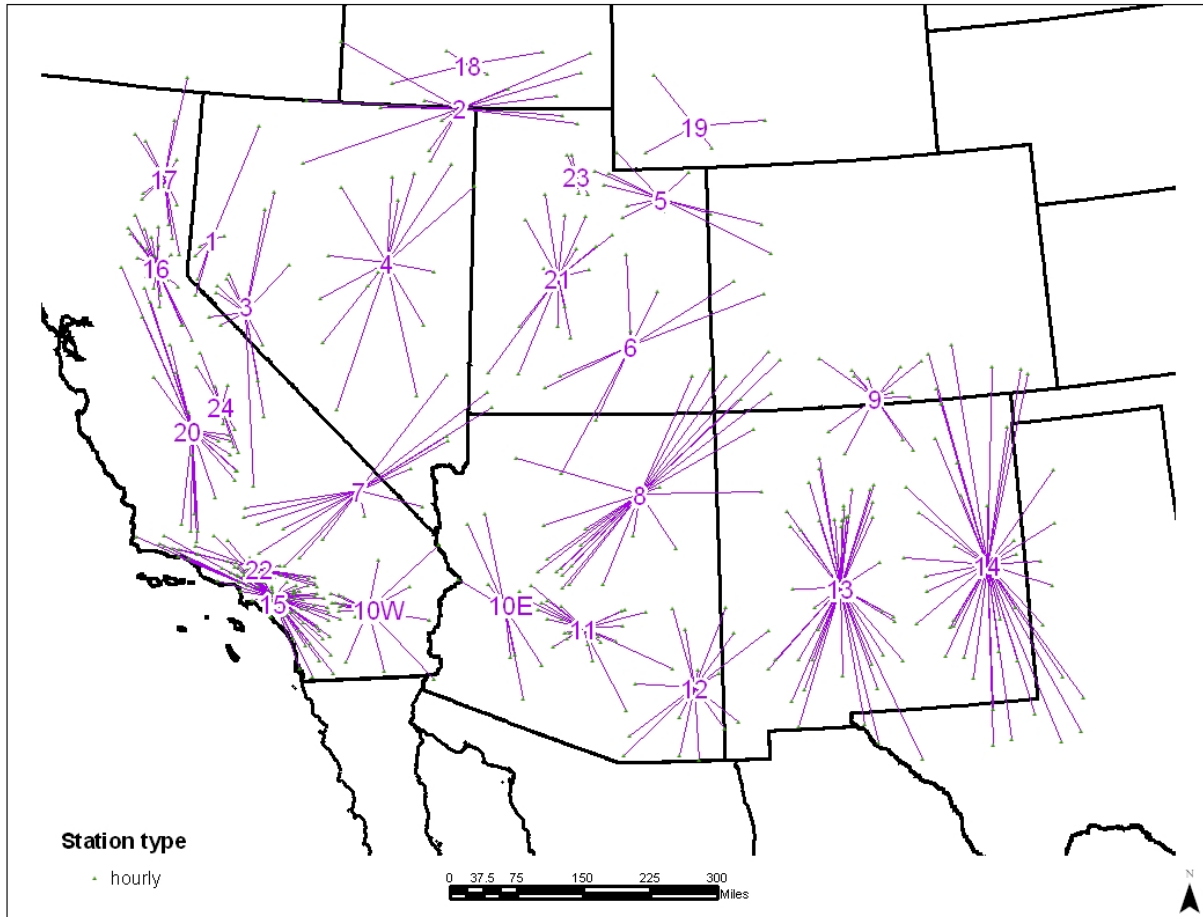


Figure 2. Semi-arid Precipitation Frequency 25 regional groups for 12-hour and shorter duration values.

2. Highlights

NWS published the updated NOAA Atlas 14 Volume 1 Version 3 precipitation frequency estimates for the Semiarid Southwestern United States on January 8, 2004. They are available via the Precipitation Frequency Data Server at <http://hdsc.nws.noaa.gov/hdsc/pfds>.

The annual maximum series used in this analysis have been posted on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html#Timeseries. Temporal distributions of heavy rainfall have been posted on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_temporal.html. All 810 cartographic maps showing all combinations of frequencies and durations have been posted on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html. The outline for the final documentation of NOAA Atlas 14 has been refined. Sections of the text have been written and some data has been compiled for final publication. Additional information is provided in Section 3.1, Final Documentation.

Conversion factors from annual maximum series (AMS) results to partial duration series (PDS) results were calculated from the 24-hour data and applied to all durations. The ratios are consistent with NOAA Atlas 2 and theoretical computations. Additional studies are being conducted to verify that the use of the 24-hour ratios is appropriate for shorter and longer durations. Additional information is provided in Section 3.2, Partial Duration Series.

Study areas to be used and tested in the areal reduction factor (ARF) development have been selected and all but one have been quality controlled. Three additional study areas were added. Software development to process the data and ultimately generate the ARF curves is complete. Additional information is provided in Section 3.3, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Final Documentation

On January 8, 2004, HDSC updated the Semiarid Southwest precipitation frequency (PF) estimates, known as NOAA Atlas 14 Volume 1, to incorporate dataset corrections. The previous version, Version 2, is superceded by Version 3. Differences between Version 2 and Version 3 are documented in the 27th Progress Report for the Semiarid Project. We believe Version 3 is more accurate than Version 2.

The quality controlled annual maximum series data used in this analysis have been posted on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html#Timeseries. Documentation describing the extraction of the annual maximum series and the format of the files is also found there.

Temporal distributions of heavy rainfall for the Semiarid Southwestern U.S. have been posted on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_temporal.html. The report includes information about temporal distributions designed for use with precipitation frequency estimates in NOAA Atlas 14. Documentation included there includes a description of the methodology and an interpretation of the results. Temporal distribution graphs for the 6-hour, 12-hour, 24-hour and 96-hour durations are provided.

The outline for the final documentation of NOAA Atlas 14 has been refined. Sections of the text, specifically the Preface, Introduction, and Methodology sections, have been written and some data has been compiled for final publication.

Cartographic maps showing all possible combinations of frequencies (2-year to 1,000-year) and durations (5-minute to 60-day) for each state in the Semiarid project area are now available in the PDF format in addition to the downloadable shapefiles and ArcInfo ASCII grids. The 810 color cartographic maps posted on the Precipitation Frequency Data Server (PFDS) are available via the GIS Data and Maps web page (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html). The maps were released in three batches: short duration (2/14/2004), mid duration (2/23/2004) and long duration (3/4/2004).

As a reminder, the following matrix (Table 1) illustrates the cartographic maps that are available for each state in the Semi-arid Project.

Table 1: Matrix of cartographic maps available on the PFDS for the Semi-arid Project.

Return Interval \ Duration	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year	1,000-year
5-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
15-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
120-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
3-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
6-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
12-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
24-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
48-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
4-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
7-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
20-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
45-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-day	✓	✓	✓	✓	✓	✓	✓	✓	✓

The PFDS receives about 1,800 individual inquiries per month for data in the Semi-arid Southwest. January, February and March received 1,851, 1,799 and 1,750 inquiries, respectively.

3.2 Partial Duration Series

Precipitation frequency results based on partial duration series (PDS) are available as cartographic maps, shapefiles and grids. Point estimates may be accessed via the PFDS based on either PDS or annual maximum series (AMS).

Precipitation frequency estimates were calculated using AMS data. Domain-wide conversion factors from AMS results to PDS results were calculated from the 24-hour data and applied to all durations. (For additional information see the 27th Progress Report.) The ratios (Table 2) are consistent with NOAA Atlas 2 and theoretical computations. The PDS based estimates are greater than the AMS-based estimates (at all durations) by 11.3% at the 2-year return period, reducing to 0.4% at return periods of 50-years and greater. This difference is consistent with generally accepted values.

Currently, additional studies are being conducted by HDSC to verify that the use of the 24-hour ratios is appropriate for shorter and longer durations. Case studies using the 1-hour and 6-hour durations are complete and consistent with the 24-hour results. A longer duration, 7-day, will also be examined.

Table 2: AMS to PDS ratio for Semiarid data.

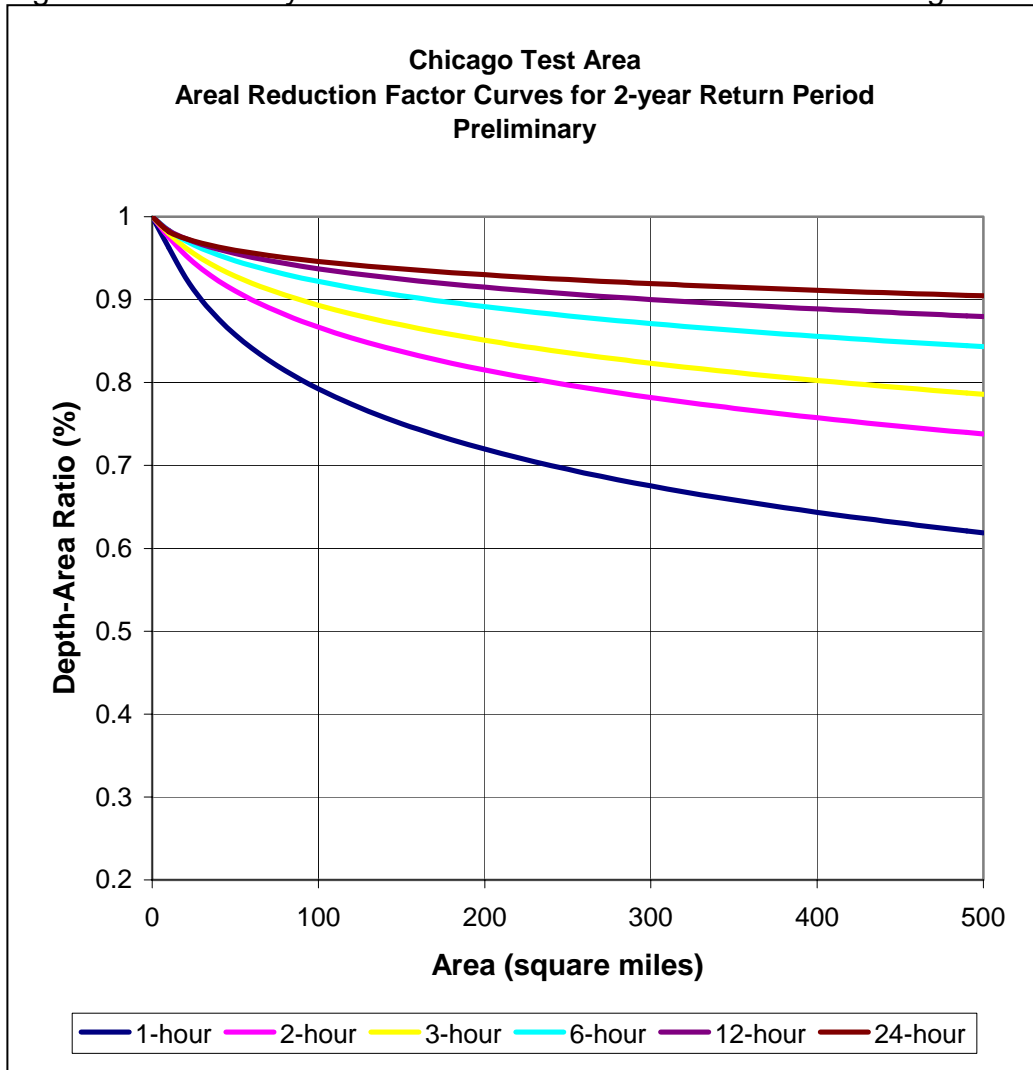
2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr	1,000yr
1.113	1.029	1.013	1.006	1.004	1.004	1.004	1.004	1.004

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 complete. A preliminary set of ARF curves for the 2-year return period for the Chicago, IL area study site has been generated (see Figure 3). They are consistent with results published in TR-24.

Three additional study areas (southeast Michigan, Albuquerque, and Seattle) have been identified and added to the list of areas used to develop the final set of ARF curves. Quality control on the Hawaiian hourly reporting data (covering the period 1960 through 2002) and additional Puerto Rico hourly reporting data (covering the period 1998 through 2002) has been performed and completed. Only the Seattle dataset remains to be quality controlled. A total of 15 study areas throughout the United States will be used in the study (see Figure 4). The “not used” study areas indicated in Figure 4 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.

Figure 3: Preliminary ARF curves based on test data in the Chicago area.



4. Issues

4.1 Recent and Upcoming Presentations

Past and future presentations by Geoff Bonnin, representing HDSC, include the following:

- “Temporal Distributions of Heavy Rainfall Associated with Updated Precipitation Frequency Estimates” at the Transportation Research Board Conference in Washington DC on January 15, 2004
- “Recent Updates to NOAA/NWS Rainfall Frequency Atlases” at the American Association of Geographers Annual Meeting in Philadelphia, PA on March 18, 2004
- “Recent Updates to NOAA/NWS Rainfall Frequency Atlases” at the Southeast Region meeting of the Association of State Dam Safety Officers in Norfolk, VA on April 19, 2004
- “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 28, 2004
- “Recent Updates to NOAA/NWS Rainfall Frequency Atlases” at the California Extreme Precipitation Symposium in Davis, CA on July 1, 2004

5. Projected Schedule and Remaining Tasks

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

Precipitation Frequency Maps [complete]
Final Report [May 2004]
Spatial Relations (Areal Reduction Factors) [June 2004]

5.1 Documentation

Final documentation will be completed during the next quarter and published on-line in association with the Precipitation Frequency Data Server.

5.2 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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