HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
QUARTERLY PROGRESS REPORT

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Office of Hydrologic Development

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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 these projects. 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 other purpose does so at their own risk.

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I. INTRODUCTION

The Hydrometeorological Design Studies Center (HDSC) within the Office of Hydrologic Development of National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) is updating precipitation frequency estimates for various parts of the United States. Updated precipitation frequency estimates for durations from 5 minutes to 60 days and average recurrence intervals between 1- and 1,000-years, accompanied by additional relevant information (e.g., 95% confidence limits, temporal distributions, seasonality) are published in NOAA Atlas 14. The Atlas is divided into volumes based on geographic sections of the country and affiliated territories. NOAA Atlas 14 is a web-based document available through the Precipitation Frequency Data Server (http://hdsc.nws.noaa.gov/hdsc/pfds/index.html).

HDSC is currently updating estimates for California, Alaska, the following southeastern states: Alabama, Arkansas, Georgia, Florida, Louisiana and Mississippi, and the following midwestern states: Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Wisconsin. California precipitation frequency estimates are expected to be published by February 2011 in NOAA Atlas 14, Volume 6. Figure 1 shows new project areas as well as updated project areas included in NOAA Atlas 14, Volumes 1 to 5.

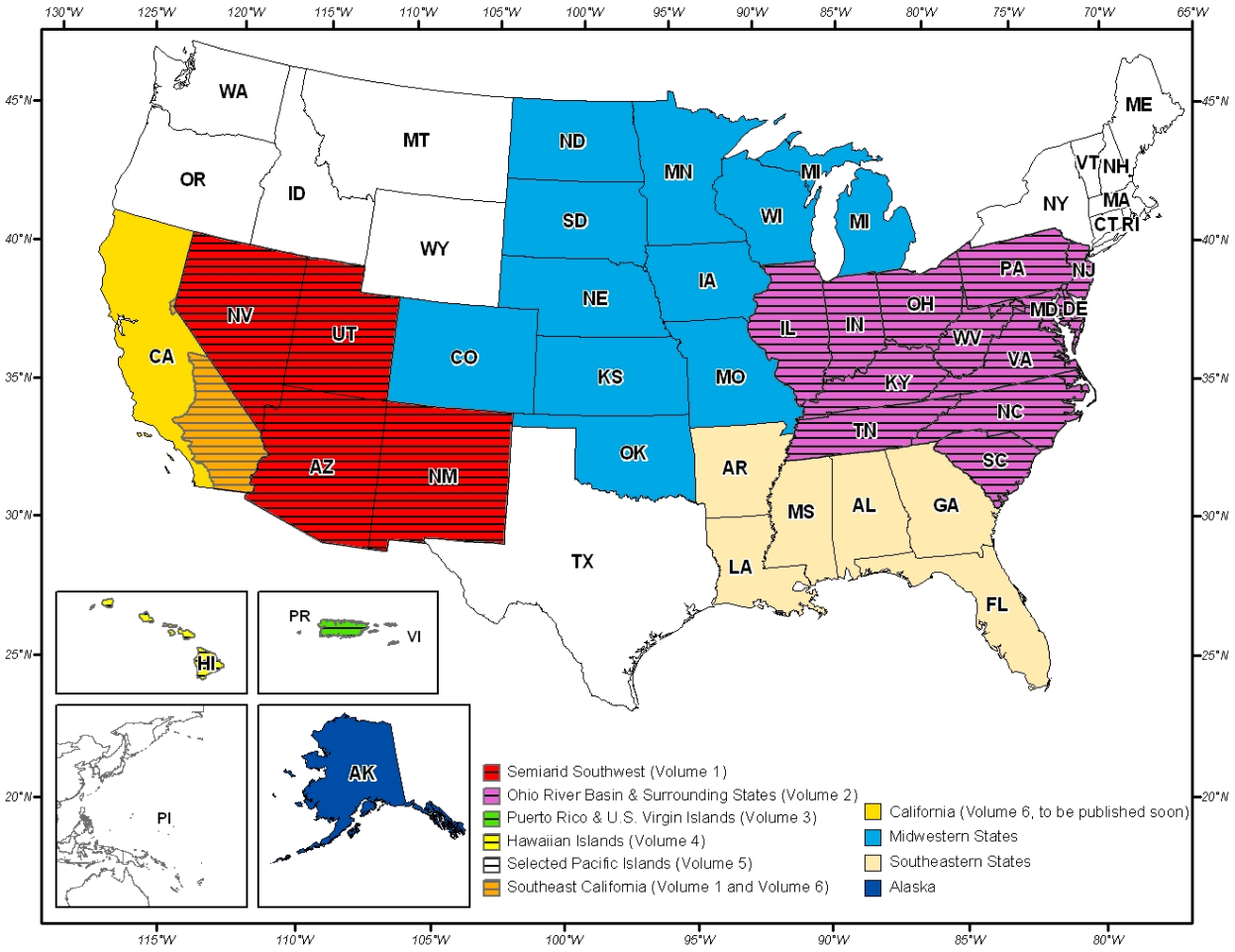


Figure 1. Map showing current project areas and project areas included in published NOAA Atlas 14, Volumes 1-5.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR CALIFORNIA

1.1. PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2010)

1.1.1. Review and update of precipitation data used in frequency analysis

a. Data update

After the peer review, that concluded on September 15, 2010, it was decided to update records to include the most recent data for daily, hourly and 15-minute National Climatic Data Center (NCDC) stations, as well as the daily Snow Telemetry (SNOTEL) stations from the Natural Resources Conservation Service (NRCS).

During the update process, a considerable number of daily stations were found in the NCDC database that were not initially available for the download. Additionally, the updated periods of record for some of the daily stations used in the initial frequency analysis did not match periods of record initially obtained. New stations and stations with updated periods of record, with at least 30 years of data, were added to the analysis.

Since the completion of the peer review, several additional data sets were received, formatted, and included in the analysis. In this quarter, we received: ALERT stations from the Santa Clara Valley Water District and San Bernardino County Flood Control District, annual maximum series (AMS) data for stations from Marin County Department of Public Works, and daily data from a private citizen for a location near Honeydew on Wilder Ridge.

In total, precipitation data for more than 500 additional stations were added to the analysis. All ALERT data that were originally formatted to 15-minute reporting intervals and then aggregated to constrained 1-hour and 1-day intervals were re-formatted directly to 15-minute, 1-hour and 1-day intervals to better distribute small event-based amounts. For similar reasons, data previously received from San Diego County Flood Control District as a mixture of reporting intervals were segregated by reporting interval and re-formatted.

b. Station screening

Stations within 3 miles of all added stations were identified. Where appropriate, station records were merged (same data type) or extended (different data types) to produce a longer record or deleted if duplicated data. In addition, stations deleted in the before-review cleanup effort were revisited as potential candidates for merging or extending data at added stations. Some stations were also added back to the analysis since the recently adopted regionalization procedure can accommodate spatial correlation in precipitation data (see Sections 1.1.5 and 1.1.6).

Stations were deleted based on the number of years of data since a sufficient number of years are necessary to allow for meaningful statistical analysis. 15-minute and hourly stations with less than 20 years of data were deleted regardless of elevation or location. Daily stations with less than 30 years of data were deleted unless they were located at higher elevations or in data-sparse areas and had at least 25 years of data.

1.1.2. Review of station metadata

Metadata for any added station where the provided elevation differed by more than 700 feet from an extracted high resolution digital elevation model (DEM) elevation were investigated and corrected, as needed.

1.1.3. Extraction and quality control of updated annual maximum series (AMS)

Per request of local U.S. Army Corps of Engineers office, a 3-day duration was added to the analysis. Also, it was decided that for some stations in the Los Angeles area, data from the extreme December 2010 storm will be added to the analysis.

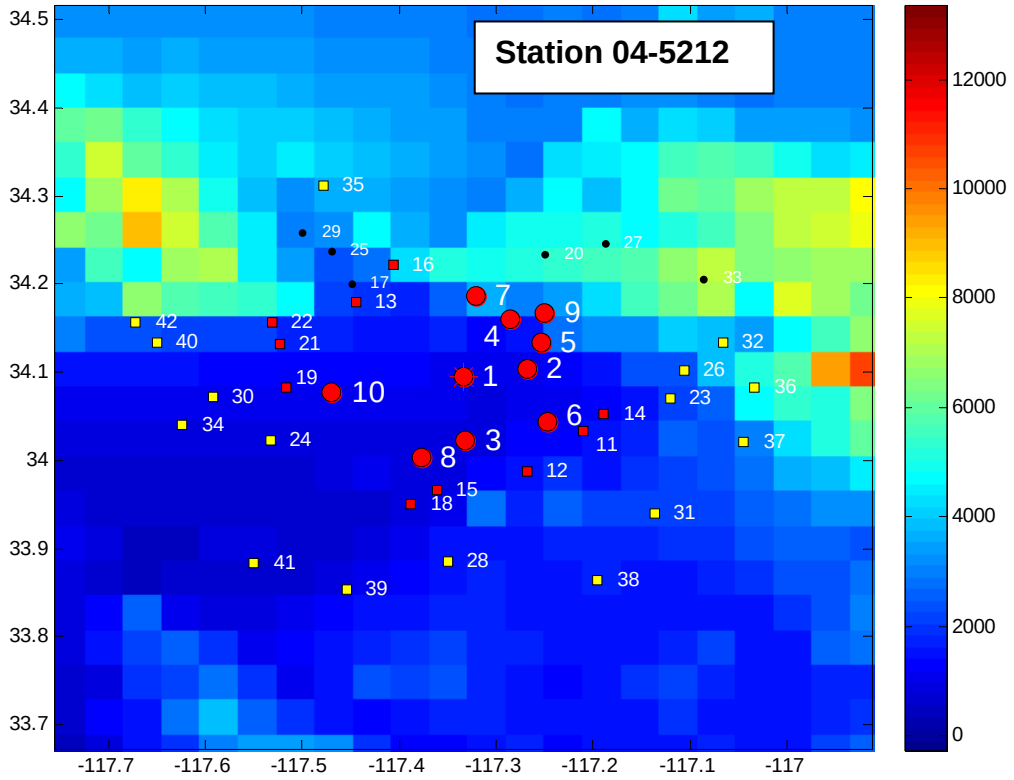
High and low outliers and other suspicious values were identified in the distribution of the at-station AMS for all data for the 3-day duration and for all added data (over 500 stations) for all durations (15-minute through 60-day). Questionable maxima were flagged and verified by reviewing spatial plots, raw data, scanned observation forms found on NCDC's Environmental Document Access and Display System (EDADS), and other storm information from various resources. All identified outliers were verified, corrected, or removed from the data set.

1.1.4. Mean annual maxima analysis

Mean annual maxima (MAMs) for all durations between 15-minute and 60-day were sent to the PRISM Group at Oregon State University for spatial interpolation on December 17th. Prior to sending them to the PRISM, MAM spatial patterns were carefully reviewed. Stations where the ratio of the new 1-day MAM to the corresponding MAM used during the peer review was less than 0.85 or greater than 1.15 were reviewed. Inconsistent stations that had less reliable sampling (shorter record or missed several heavy events) relative to nearby stations were removed from the analysis. MAMs were also estimated for three locations in areas where the lack of station density unduly influenced expected spatial patterns to anchor the spatial interpolation.

1.1.5. Regionalization for frequency analysis

Starting with this project, a modified region-of-influence regionalization approach will be used in place of the "index-flood" regionalization approach used in previous Atlas 14 volumes. Based on the careful evaluation of results of the initial regionalization algorithm developed during the previous report period, the regionalization algorithm was enhanced to better handle regional definition and refinement and it was made interactive. In the new approach, each station has its own region. Regions are initially defined to consist of nearby stations that have similar elevation and 1-day mean annual maximum to the station of interest. Initial regions are then refined based on inspection of spatial maps with associated tables (to investigate locations of stations in the region with respect to mountain ridges, etc.; see an example in Figure 2) and by examination of similarities/dissimilarities in selected statistics across durations from 15-minute to 60-day at stations in the region (see Figure 3).



i	Site id	distance (mi)	elev (ft)	elev_diff (ft)	MAM (in)	MAM_diff (in)	n_dly	n_hly
Selected stations (red circles)								
1	**04-5212**	0.00	1160	0	2.36	0.00	61	61
2	79-2001	3.84	1047	-113	1.88	-0.48	51	51
3	79-2222	4.96	945	-215	1.72	-0.64	44	44
4	79-2357	5.33	1288	128	2.74	0.39	31	30
5	04-7723	5.37	1140	-20	2.39	0.04	105	30
6	79-3355	6.13	1193	33	1.70	-0.66	26	26
7	79-2893	6.42	1525	365	2.78	0.42	27	27
8	90-0178	6.84	800	-360	1.86	-0.49	45	45
9	79-2015	6.97	1747	587	2.84	0.49	46	46
10	79-2996	7.81	1115	-45	2.27	-0.09	32	33
Backup stations (red and yellow squares)								
11	79-3023	8.28	1285	125	2.01	-0.34	45	46
12	90-0155	8.32	1910	750	1.85	-0.51	51	51
…								
Stations in 40-mile radius that did not pass criteria (black dots):								
17	04-5215	9.81	2251	1091	5.31	2.95	52	0
20	04-8476	10.72	5243	4083	6.01	3.66	78	20
…								

Enter index *i* for station you want to remove:

Enter index *i* for station you want to add:

Figure 2. An example of spatial plot with accompanying table for station 04-5212 for regionalization.

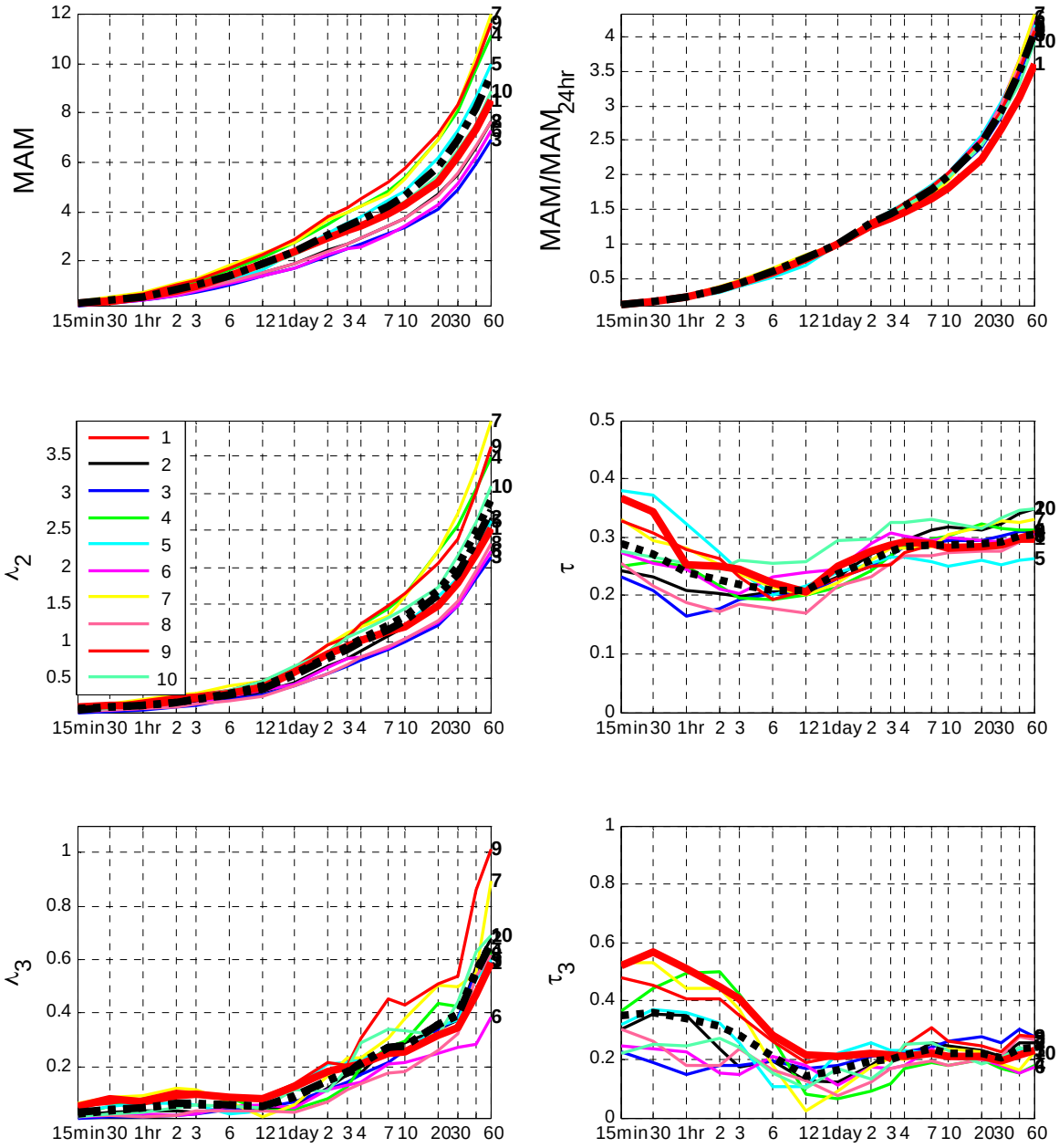


Figure 3. An example of plots of L-moments, L-moment ratios, and MAM/MAM_24hr ratios across durations for a region. Thick red lines show statistics for station under consideration (station 04-5212); thin colored lines show statistics for stations in its region; thick black lines show corresponding regional estimates.

1.1.6. Frequency and confidence interval analysis for correlated data

Significant positive correlation was observed in the annual maximum series data from nearby stations across durations. That was especially an issue in several areas with high density stations (e.g., Los Angeles area). Existing programs used for derivation of precipitation frequency estimates and their accompanying confidence limits, were adjusted to allow for inter-station dependence.

1.1.7. Rainfall-only frequency analysis

Since there are not enough hourly stations with direct snowfall measurements with a sufficient number of data years to allow for meaningful statistical analysis of rainfall-only data, a temperature threshold of 0° Celsius was chosen to distinguish between liquid and solid precipitation. Because hourly temperature data were available at only a handful of stations, minimum daily temperature was used if an observation occurred at night, maximum daily temperature was used if it occurred during peak daytime hours, and average daily temperature was used for all other times. Rainfall-only AMS were extracted from 1-hour data for selected hourly durations (1-, 3-, 6-, and 12-hour) and added to the rainfall-only AMS data set for 24-hour that was extracted during the previous reporting period.

Frequency estimates were calculated from rainfall-only and from total precipitation AMS using Generalized Extreme Value (GEV) distribution based on L-moment statistics. Empirical equations that relate precipitation and rainfall frequency estimates were developed in consideration of duration and elevation (Yan, Zhao and Perica, 2010).

1.1.8. Web page enhancements

Work continues to enhance the web interface for the Precipitation Frequency Data Server (PFDS). The PFDS pages for this project area will be interactive and will make use of custom created Google Maps. Newly designed pages will increase download speed and provide precipitation frequency estimates with supplementary information much faster than the current version.

1.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2011)

During the next quarter, all remaining tasks will be completed. Precipitation frequency estimates and accompanying documentation will be published on the newly updated PFDS web page.

1.3. PROJECT SCHEDULE

Data collection, formatting and initial quality control [Complete]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, trend analysis, independence, consistency across durations, duplicate stations, candidates for merging) [Complete]

Regionalization and frequency analysis [Complete]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [Complete]

Peer review [Complete]

Revision of PF estimates [July 2010; revised to November 2010; near completion]

Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [August 2010; revised to February 2011]

Web publication [September 2010; revised to February 2011]

2. PRECIPITATION FREQUENCY PROJECT FOR THE SOUTHEASTERN STATES

2.1. PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2010)

The project includes the states of Alabama, Arkansas, Florida, Georgia, Louisiana and Mississippi and an approximately 1-degree buffer around the core states included to assist in the delineation of homogenous regions with respect to heavy precipitation characteristics (Figure 4). To facilitate a more efficient process, Southeastern and Midwestern (see Section 3) precipitation frequency projects are being done simultaneously. Because of that, some of the results shown in this report apply for the both projects.

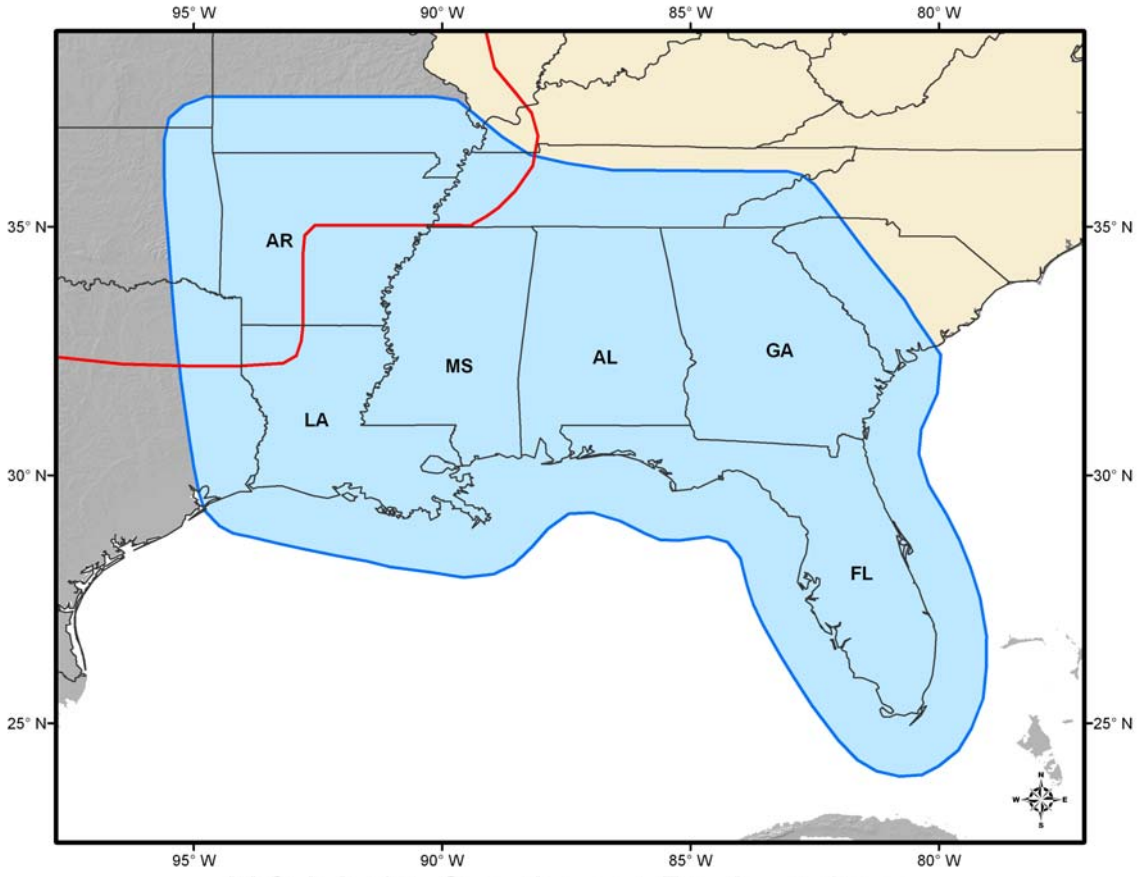


Figure 4. Southeastern precipitation frequency project area (shown in blue). Also shown is the border of the Midwestern precipitation frequency project area (red line).

2.1.1. Data collection and formatting

Table 1 shows the number of stations in both projects for each data reporting interval before and after screening (described in Section 2.1.3).

Table 1. Number of precipitation stations in the Midwestern and Southeastern projects per reporting interval before and after data screening.

Data reporting interval	Number of stations formatted	Number of stations after screening
n-min*	331	TBD
variable	1,519	TBD
15-min	1,748	1,572
1-hour	3,909	3,162
1-day	16,358	15,523

* n-min stations are National Climatic Data Center's (NCDC) stations for which data are provided as monthly maxima for various n-minute durations (5-minute, 10-minute, 15-minute, etc.).

Data from South Florida Water Management District's DBHYDRO database were reviewed since some stations consisted of data with multiple reporting intervals and re-formatted during this quarter.

2.1.2. Review of station metadata

Metadata for all stations are being reviewed for location accuracy. Elevations for the coordinates of a station were extracted from a high resolution digital elevation model (DEM). Metadata at stations where the provided elevation differs by more than 300-500 feet from the DEM elevation will be investigated and corrected as needed.

2.1.3. Station screening

Stations that report data at the same time interval that were within 5 miles distance were considered for merging to increase record lengths in the 15-minute, hourly and daily datasets. The merging effort for the 15-minute and hourly stations is complete. Merged stations were checked using a double mass analysis approach during this quarter. The work for daily stations is in progress with 4,282 potential pairs considered for merging. So far, 375 station pairs have been merged and 438 stations have been deleted.

Tools to more efficiently screen stations were developed during this quarter. First, code was written to facilitate merging that was previously done manually – replacing only specified periods within a record or replacing data where one station has missing data. Secondly, code was written that will facilitate the review of each station relative to stations within a given mile radius. The code identifies all stations regardless of data type (15-minute, hourly or daily), plots time series for inspection, interactively removes duplicate stations or stations with short period of record, and interactively runs a t-test and double mass curve analysis for merge candidates.

2.1.4. Frequency analysis algorithms enhancements

During this reporting period, significant effort was made to improve various components of precipitation frequency analysis. More notable examples of the enhancements are:
a) newly developed regionalization approach that allows for careful investigation of various statistical measures across durations and regional adjustment in the iterative process (more details provided in Section 1.1.5); b) newly developed codes for frequency analysis and construction of confidence intervals on frequency estimates that account for spatial correlation in AMS data and allow for alternative approaches for estimation of distribution parameters (L-moments and maximum likelihood); c) newly developed codes for development of frequency

estimates for liquid precipitation for 1-hour to 24-hour durations; d) significantly improved algorithms for station cleanup and quality control of AMS (described in 2.1.3).

2.1.5. Web page enhancements

Work continues to enhance the web interface for the Precipitation Frequency Data Server (PFDS). The PFDS pages will be interactive and will make use of custom created Google Maps. Newly designed pages will increase download speed and provide precipitation frequency estimates with supplementary information much faster than the current version.

2.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2011)

In the next reporting period, work on daily station merging, co-located station cleanup, and examination of geospatial data will be completed.

Investigation of high and low outliers in the AMS will be completed across all base durations. All questionable maxima at stations will be further investigated by reviewing spatial plots, raw data, scanned observation forms found on NCDC's Environmental Document Access and Display System (EDADS), and other storm information from various resources. Confirmed outliers will be removed from the data set.

A review of mean annual maxima will commence.

2.3. PROJECT SCHEDULE

Completion date is revised slightly for some tasks but will not impact the final publication date.

Data collection, formatting, and initial quality control [Complete]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, trend analysis, independence, consistency across durations, duplicate stations, candidates for merging) [July 2010; revised to February 2011]

Regionalization and frequency analysis [November 2010; revised to April 2011]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [May 2011]

Peer review [July 2011]

Revision of PF estimates [October 2011]

Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [April 2012]

Web publication [May 2012]

3. PRECIPITATION FREQUENCY PROJECT FOR THE MIDWESTERN STATES

3.1. PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2010)

The project area includes the states of Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Wisconsin and an approximately 1-degree buffer around the core states is included to assist in the delineation of homogenous regions with respect to heavy precipitation characteristics (Figure 5). To facilitate a more efficient process, Southeastern and Midwestern (see Section 3) precipitation frequency projects are being done simultaneously. Because of that, some of the results shown in this report apply for the both projects.

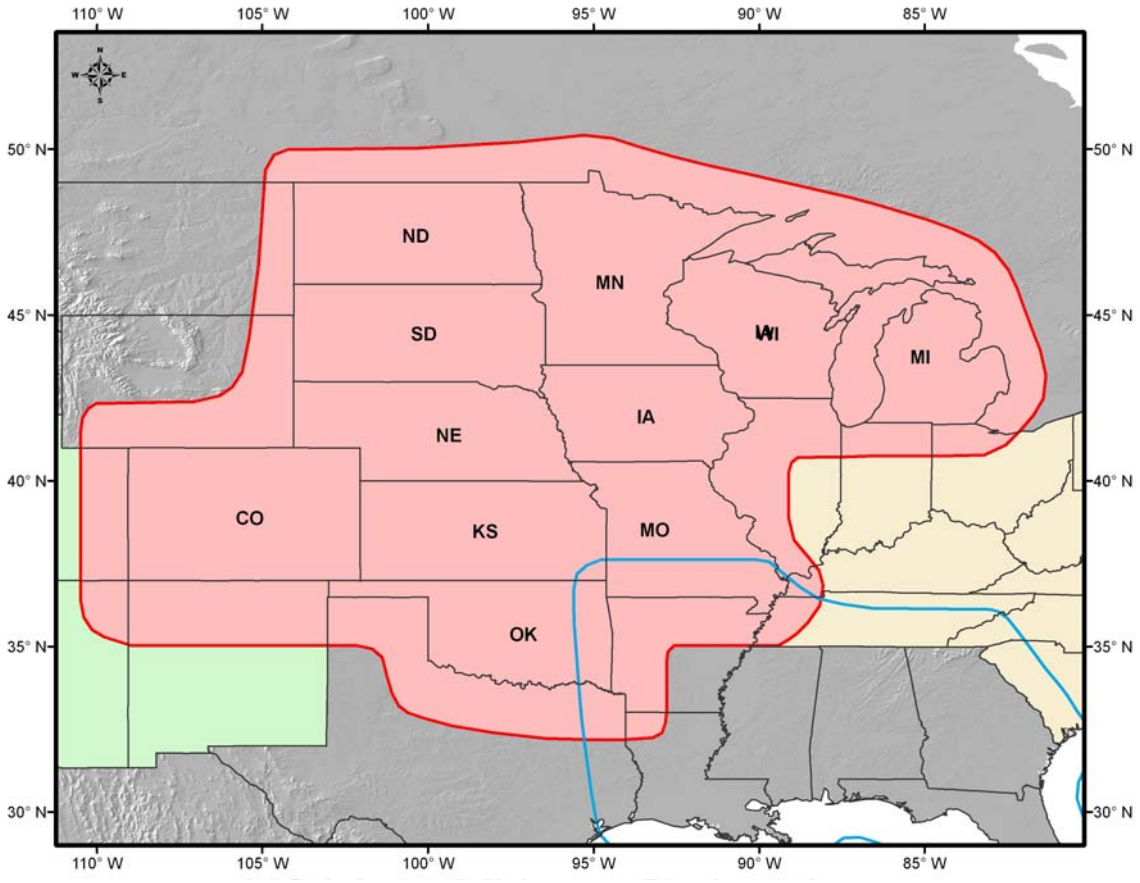


Figure 5. Midwestern precipitation frequency project area (shown in red). Also shown is the border of the Southeastern precipitation frequency project area (blue line).

3.1.1. Data collection and formatting

Table 2 shows the number of stations in both projects for each data reporting interval before and after screening (described in Section 3.1.3).

Table 2. Number of precipitation stations in the Midwestern and Southeastern projects per reporting interval before and after data screening.

Data reporting interval	Number of stations formatted	Number of stations after screening
n-min*	331	TBD
variable	1,519	TBD
15-min	1,748	1,572
1-hour	3,909	3,162
1-day	16,358	15,523

* n-min stations are National Climatic Data Center's (NCDC) stations for which data are provided as monthly maxima for various n-minute durations (5-minute, 10-minute, 15-minute, etc.).

3.1.2. Review of station metadata

Metadata for all stations are being reviewed for location accuracy. Elevations for the coordinates of a station were extracted from a high resolution digital elevation model (DEM). Metadata at stations where the provided elevation differs by more than 300-500 feet from the DEM elevation will be investigated and corrected as needed.

3.1.3. Station screening

Stations that report data at the same time interval that were within 5 miles distance were considered for merging to increase record lengths in the 15-minute, hourly and daily datasets. The merging effort for the 15-minute and hourly stations is complete. Merged stations were checked using a double mass analysis approach during this quarter. The work for daily stations is in progress with 4,282 potential pairs considered for merging. So far, 375 station pairs have been merged and 438 stations have been deleted.

Tools to more efficiently screen stations were developed during this quarter. First, code was written to facilitate merging that was previously done manually – replacing only specified periods within a record or replacing data where one station has missing data. Secondly, code was written that will facilitate the review of each station relative to stations within a given mile radius. The code identifies all stations regardless of data type (15-minute, hourly or daily), plots time series for inspection, interactively removes duplicate stations or stations with short period of record, and interactively runs a t-test and double mass curve analysis for merge candidates.

3.1.4. Frequency analysis algorithms enhancements

During this reporting period, significant effort was made to improve various components of precipitation frequency analysis. More notable examples of the enhancements are:
a) newly developed regionalization approach that allows for careful investigation of various statistical measures across durations and regional adjustment in the iterative process (more details provided in Section 1.1.5); b) newly developed codes for frequency analysis and construction of confidence intervals on frequency estimates that account for spatial correlation in AMS data and allow for alternative approaches for estimation of distribution parameters (L-moments and maximum likelihood); c) newly developed codes for development of frequency estimates for liquid precipitation for 1-hour to 24-hour durations; d) significantly improved algorithms for station cleanup and quality control of AMS (described in 3.1.3).

3.1.5. Web page enhancements

Work continues to enhance the web interface for the Precipitation Frequency Data Server (PFDS). The PFDS pages will be interactive and will make use of custom created Google Maps. Newly designed pages will increase download speed and provide precipitation frequency estimates with supplementary information much faster than the current version.

3.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2011)

In the next reporting period, work on daily station merging, co-located station cleanup, and examination of geospatial data will be completed.

Investigation of high and low outliers in the AMS will be completed across all base durations. All questionable maxima at stations will be further investigated by reviewing spatial plots, raw data, scanned observation forms found on NCDC's Environmental Document Access and Display System (EDADS), and other storm information from various resources. Confirmed outliers will be removed from the data set.

A review of mean annual maxima will commence.

3.3. PROJECT SCHEDULE

Completion date is revised slightly for some tasks but will not impact the final publication date.

Data collection, formatting, and initial quality control [Complete]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, trend analysis, independence, consistency across durations, duplicate stations, candidates for merging) [July 2010; revised to February 2011]

Regionalization and frequency analysis [November 2010; revised to April 2011]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [May 2011]

Peer review [July 2011]

Revision of PF estimates [October 2011]

Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [April 2012]

Web publication [May 2012]

4. PRECIPITATION FREQUENCY PROJECT FOR ALASKA

4.1. PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2010)

The University of Alaska, Fairbanks (UAF) and HDSC are jointly working on this project.

4.1.1. Data collection and formatting

Table 3 shows the number of stations for each data reporting interval before and after initial data screening and quality control described in Section 4.1.5.

Table 3. Number of precipitation stations in the Alaska project per reporting interval before and after data screening.

Data reporting interval	Number of stations formatted	Number of stations after screening
n-min*	36	TBD
15-min	36	29
1-hour	427	306
1-day	818	571

* n-min stations are National Climatic Data Center's (NCDC) stations for which data are provided as monthly maxima for various n-minute durations (5-minute, 10-minute, 15-minute, etc.).

An assessment of data currently available from National Climatic Data Center (NCDC) and from Natural Resources Conservation Service (NRCS) suggests that updated data are now available. The differences between initially downloaded and currently available datasets are under investigation and the datasets will be updated in the next quarter.

4.1.2. Rainfall under-catch correction

UAF completed a study of bias correction for rainfall under-catch on the single station with wind shield information, Annette Island. For this station, the bias correction for the gauge without a wind shield would be an average increase of 15% in measured annual maximum precipitation. However, Annette Island is a windy location and bias correction would likely vary for inland locations. Also, bias correction depends on gauge type and gauge shield. UAF's assessment is that the bias correction cannot be done accurately for the whole state because there are no data regarding the installation of wind shields; therefore, bias corrections will not be applied.

4.1.3. Precipitation versus rainfall annual maximum series (AMS) extraction

Annual maximum series (AMS) will be extracted for both precipitation and for rainfall-only events. In order to distinguish between snowfall and rainfall, the project area was first divided into 7 climate regions based on the regions used in Shulski and Wendler (2007). Each climate region has been assigned an "extended warm season" that reflects the months during which liquid precipitation can reasonably be expected to occur. For stations that do not have information on type of precipitation, temperature data will be used to distinguish between the two types.

UAF completed formatting daily snow and air temperature data for NCDC stations. They also received and formatted Environment Canada daily and hourly rainfall-only datasets.

Temperature thresholds to distinguish rain versus solid precipitation were assigned for each climate region. During this assessment, the climate regions were revised slightly.

4.1.4. Review of station metadata

Metadata for all stations are being reviewed for location accuracy. Elevations for the coordinates of a station were extracted from a high resolution digital elevation model (DEM). Metadata at stations where the provided elevation differs by more than 500 feet from the DEM elevation are currently being investigated and will be corrected.

4.1.5. Station screening

a. Station merging

Nearby stations with similar elevation are considered for merging to increase record lengths in the 15-minute, hourly and daily datasets. 84 merges were identified and implemented in the daily dataset and 1 in the hourly dataset. HDSC reviewed double mass curves for merged stations and UAF also independently reviewed the daily merged stations; several cases were identified as needing further scrutiny.

b. Co-located station clean-up

Co-located stations are defined as stations that have the same metadata (or very similar) but report data at different time intervals (15-minute, 1-hour, and 1-day). HDSC screened co-located 15-minute/ hourly and daily NCDC stations for duplicate records. When AMS from co-located stations overlapped exactly, the daily station was deleted; this led to 26 deleted daily stations. Cases where a 1-day annual maximum was significantly different from the 15-minute or hourly 1-day maximum for the same year were flagged for further quality control.

4.1.6. Frequency analysis algorithms enhancements

During this reporting period, significant effort was made to improve various components of precipitation frequency analysis. More notable examples of the enhancements are:
a) newly developed regionalization approach that allows for careful investigation of various statistical measures across durations and regional adjustment in the iterative process (more details provided in Section 1.1.5); b) newly developed codes for frequency analysis and construction of confidence intervals on frequency estimates that account for spatial correlation in AMS data and allow for alternative approaches for estimation of distribution parameters (L-moments and maximum likelihood); c) newly developed codes for development of frequency estimates for liquid precipitation for 1-hour to 24-hour durations; d) significantly improved algorithms for station cleanup and quality control of AMS.

4.1.7. Web page enhancements

Work continues to enhance the web interface for the Precipitation Frequency Data Server (PFDS). The PFDS pages will be interactive and will make use of custom created Google Maps. Newly designed pages will increase download speed and provide precipitation frequency estimates with supplementary information much faster than the current version.

4.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2011)

In the next reporting period, NCDC and SNOTEL data will be updated. Work on station merging, co-located station cleanup and an examination of geospatial data will be completed. The quality control of precipitation AMS outliers at all durations will be completed and a review of mean annual maxima will begin. Extraction of rainfall-only AMS using temperature data will also be completed.

4.3. PROJECT SCHEDULE

UAF: data collection, formatting, and initial quality control [Complete]

UAF: extraction of annual maximum series (AMS) for precipitation and rainfall; additional quality control and data reliability tests (e.g., outliers, trend analysis, independence, consistency across durations, duplicate stations, candidates for merging). [February 2010; revised to January 2011*]

HDSC: regionalization and frequency analysis [September 2010, revised to March 2011]

HDSC: initial spatial interpolation of PF estimates and consistency checks across durations [January 2011, revised to April 2011]

HDSC: peer review [March 2011, revised to May 2011]

HDSC: revision of PF estimates [May 2011, revised to July 2011]

HDSC and UAF: remaining tasks (e.g., development of precipitation frequency estimates for PD series, seasonality, temporal distributions, documentation) [August 2011]

HDSC: web publication [September 2011]

** The schedule for this task slipped due to delay in execution of data collection and formatting task. HDSC has joined UAF in execution of this task to speed up the work. This will affect subsequent tasks, but the project is still expected to be completed on time.*

5. AREAL REDUCTION FACTORS

5.1. PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2010)

Areal reduction factors (ARFs) are needed to convert average point precipitation frequency estimates to areal estimates with the same recurrence interval for any area of interest. HDSC is testing two existing methods and developing a new method for calculating ARF. Please see the July – September 2010 Quarterly Report (http://www.nws.noaa.gov/ohd/hdsc/current-projects/pdfs/HDSC_PR_Oct10.pdf) for more information on the methods.

5.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2011)

HDSC will continue development and evaluation of selected ARF approaches.

5.3. PROJECT SCHEDULE

This project began on April 1, 2010. It is expected to take 2 years to complete.

III. OTHER

1. MEETINGS AND PRESENTATIONS

On November 15, HDSC group hosted a group of 20 hydrology students and their professor from the Department of Civil Engineering, George Washington University. The students toured the NWS central communications data switching and monitoring facility, and were informed on the NWS and OHD organization and mission and the role HDSC products play in the engineering design.

On December 13th to 17th, two HDSC group members and Geoff Bonnin, Chief of the Hydrologic Science and Modeling Branch, attended the American Geophysical Union's Fall 2010 meeting in San Francisco, CA. Mr. Bonnin presented his work on the impact of climate change on the frequency of extreme rainfall. Fenglin Yan and Tan Zhao presented their work on the rainfall versus precipitation frequency analysis.

REFERENCES

Yan, F., T. Zhao, and S. Perica, 2010. Statistical model for converting precipitation to rainfall frequency estimates. 2010 AGU Fall meeting, San Francisco, CA.

Shulski, M and G. Wendler, 2007. *Climate of Alaska*, University of Alaska Press, 208 pp.