HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
QUARTERLY PROGRESS REPORT

1 April 2011 to 30 June 2011

Office of Hydrologic Development

U.S. National Weather Service

National Oceanic and Atmospheric Administration

Silver Spring, Maryland

July 2011

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 and affiliated territories. 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 (PFDS; http://hdsc.nws.noaa.gov/hdsc/pfds/index.html).

HDSC is currently updating estimates for 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 were published on April 8th, 2011 as NOAA Atlas 14, Volume 6. The funding for the following northeastern states: Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island and Vermont has been secured. Once the contract documents have been finalized we will begin the three year task of updating precipitation frequency estimates for the northeastern states. Figure 1 shows new project areas as well as updated project areas included in NOAA Atlas 14, Volumes 1 to 6.

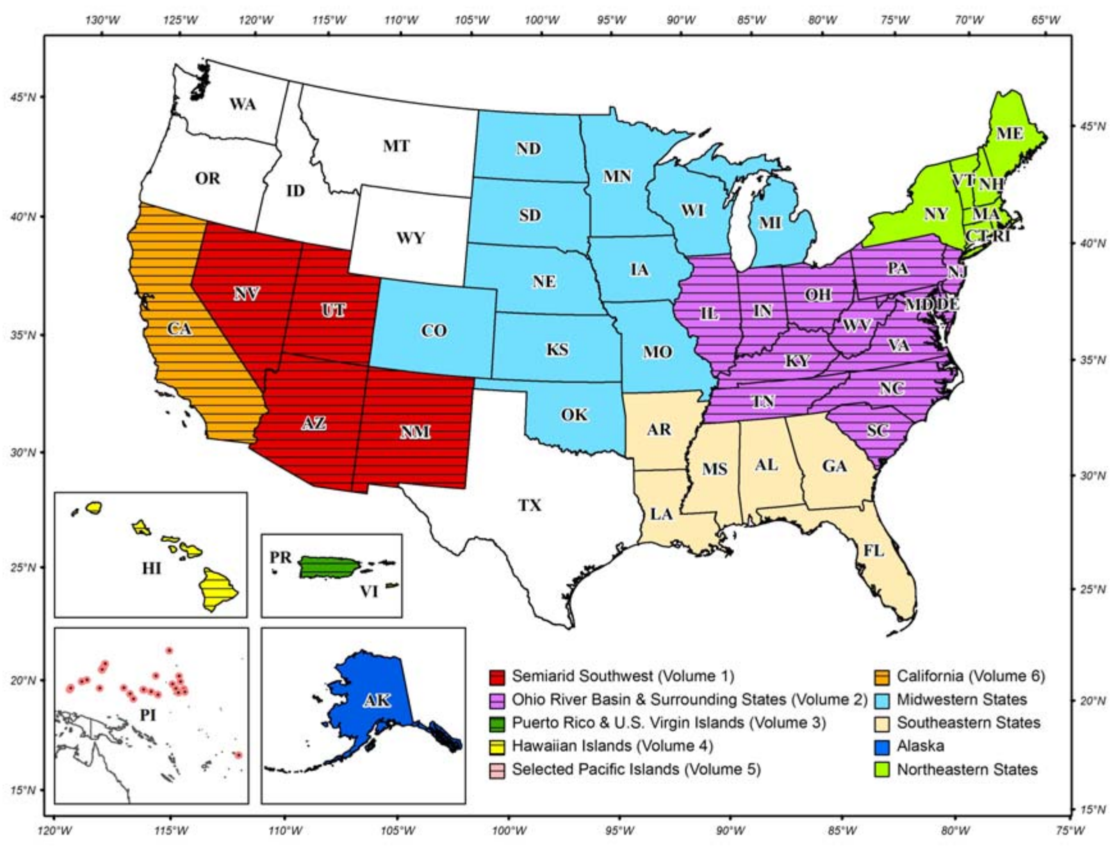

Figure 1. Current project areas and project areas included in published NOAA Atlas 14, Volumes 1-6.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR CALIFORNIA

1.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2011)

1.1.1. Documentation release

The NOAA Atlas 14 Volume 6 Version 2.0 document was published on June 6th, 2011. The document describes the data, metadata and methodology used for frequency analysis and supplemental information. It is available via the Precipitation Frequency Data Server and at http://www.weather.gov/oh/hdsc/PF_documents/Atlas14_Volume6.pdf.

1.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2011)

This project is complete. Based on recent discussions with the U.S. Army Corps of Engineers, Sacramento District, additional temporal distribution curves will be generated for more extreme events using the 5-year average recurrence interval (ARI) as a threshold. Updated documentation reflecting this change will be released as NOAA Atlas 14 Volume 6 Version 2.1.

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 [Complete]

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

Web publication of PF estimates [Complete]

Web publication of documentation [Complete]

2. PRECIPITATION FREQUENCY PROJECT FOR THE SOUTHEASTERN STATES

2.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2011)

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 characteristics of annual maximum precipitation used in frequency analysis (Figure 2). 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.

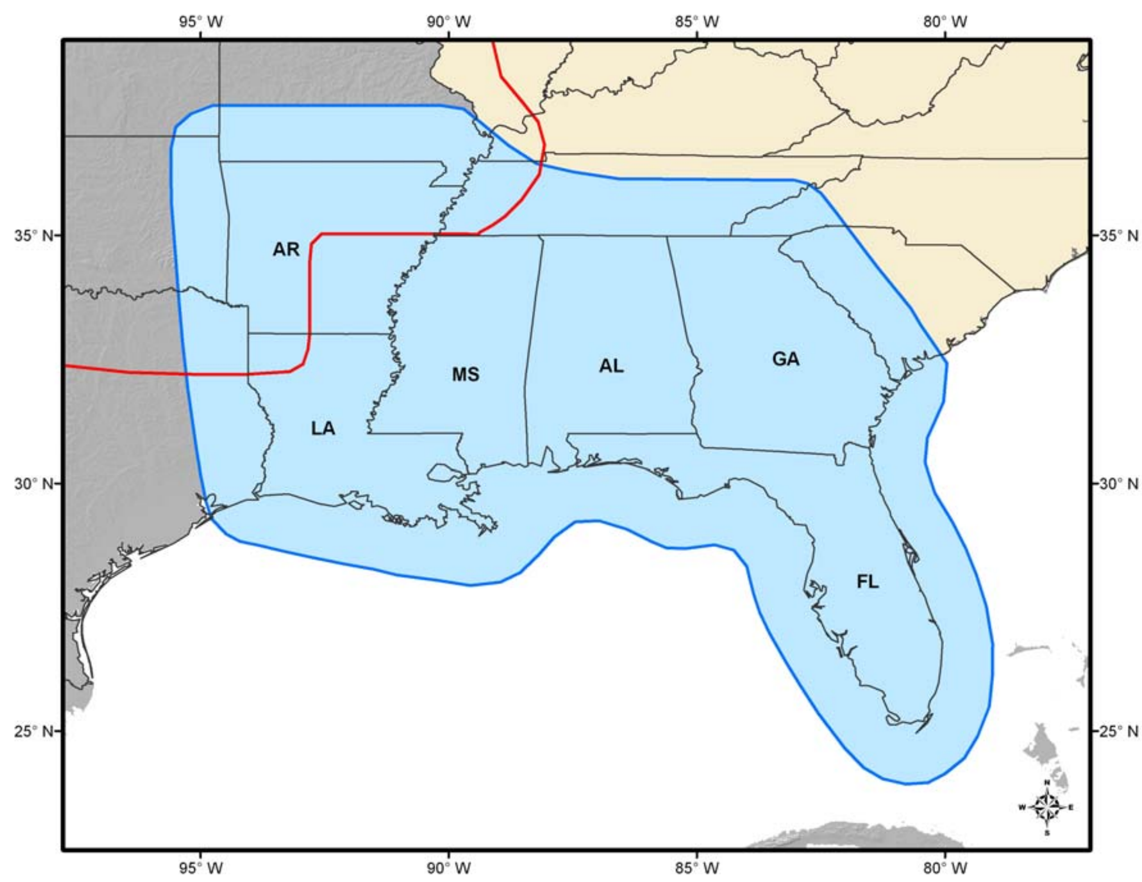

Figure 2. Southeastern precipitation frequency project area (shown in blue). Also shown is the border of the Midwestern precipitation frequency project area (red line).

2.1.1. Data collection and formatting

Potentially useful data from the Midwestern Region Climate Center (MRCC) were identified. MRCC is adding daily data to existing NCDC stations across the U.S. as part of the Climate Database Modernization Program's 19th Century Forts and Voluntary Observers Database

Build Project. HDSC is in the process of obtaining these data which will extend some records into the early 1800s.

In addition, 1-minute data for 189 stations from the Automated Surface Observing Systems (ASOS) in the Midwest-Southeast project area were obtained from NCDC and added to the data set. These data were formatted to a base duration of 15-minutes.

2.1.2. Review of station metadata and station screening

Metadata for SNOTEL and RAWS stations were updated, re-evaluated for location accuracy, and corrected where necessary.

Stations are being screened for (1) duplicate records from different data sources, (2) duplicate records at co-located daily, hourly, and/or 15-minute stations, (3) extending records using data from co-located stations, (4) merging records of nearby stations, and (5) removing shorter, less reliable records in station dense areas. Software to facilitate this screening was revised and updated to work with the large numbers of stations in the geographically expansive project area (which includes both the midwestern and southeastern states).

535 pairs of stations were merged and 1,676 stations were deleted during this reporting period. Hourly stations from the SNOTEL database and hourly stations from the USACE Omaha District were removed from the dataset because there were no stations with sufficient number of years with reliable data.

2.1.3. Extraction of AMS

During this reporting period, annual maximum series (AMS), needed for precipitation frequency analysis, were extracted for the following seventeen durations: 15-minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day and 60-day. The criteria used to extract annual maxima from the data were designed to exclude maxima if there are too many missing or accumulated data during the year and more specifically during critical months when precipitation maxima are most likely to occur ("wet season"). Regions, shown in Figure 3, were delineated to depict wet seasons by inspecting histograms of annual maxima for the 1-day and 1-hour durations and by assessing the periods in which two-thirds of annual maxima occurred at each station. Table 1 shows the wet season months that were assigned to each region for daily and sub-daily durations.

Table 1. Wet season months assigned to each region.

Region	**Wet season for daily durations**	**Wet season for sub-daily durations**
North	May-September	May-September
Western CO	March-November	May-October
Plains	April-October	May-September
Mississippi Valley	January-December	April-October
Southeast	March-October	May-October

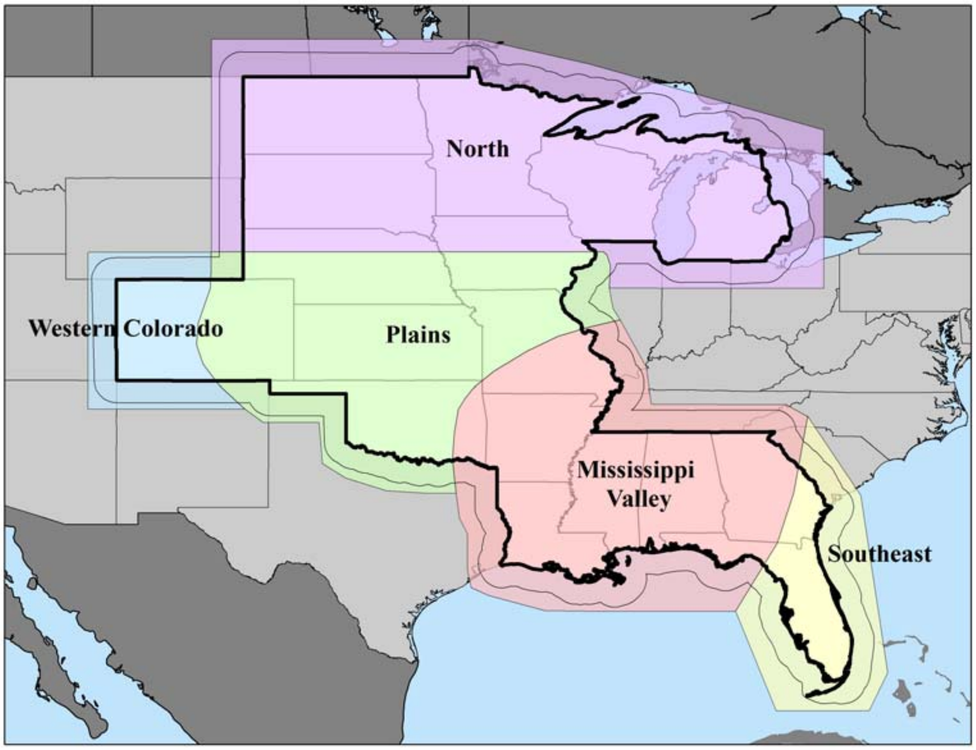

Figure 3. Regional delineation used in AMS extraction.

2.1.4. Quality control of AMS

High and low outliers were identified in the distribution of the at-station precipitation AMS and quality controlled. All identified outliers and any other questionable maxima are now being verified, corrected, or removed from the dataset.

Statistical tests for outliers are used to identify low and high outliers for all extracted durations (see an example of outlier examination in Figure 4). All values identified as high outliers are mapped with concurrent measurements at nearby stations. Questionable values that can not be confirmed by measurements at nearby stations are advanced for further investigation. Detailed investigation of flagged amounts is based on climatological observation forms, monthly storm data reports and other historical weather events publications, obtained primarily from the NCDC's Environmental Document Access and Display System (EDADS). Unfortunately, EDADS has been off-line for many months. When NCDC restores access to this database of climate publications and forms, any remaining suspicious amounts will be evaluated.

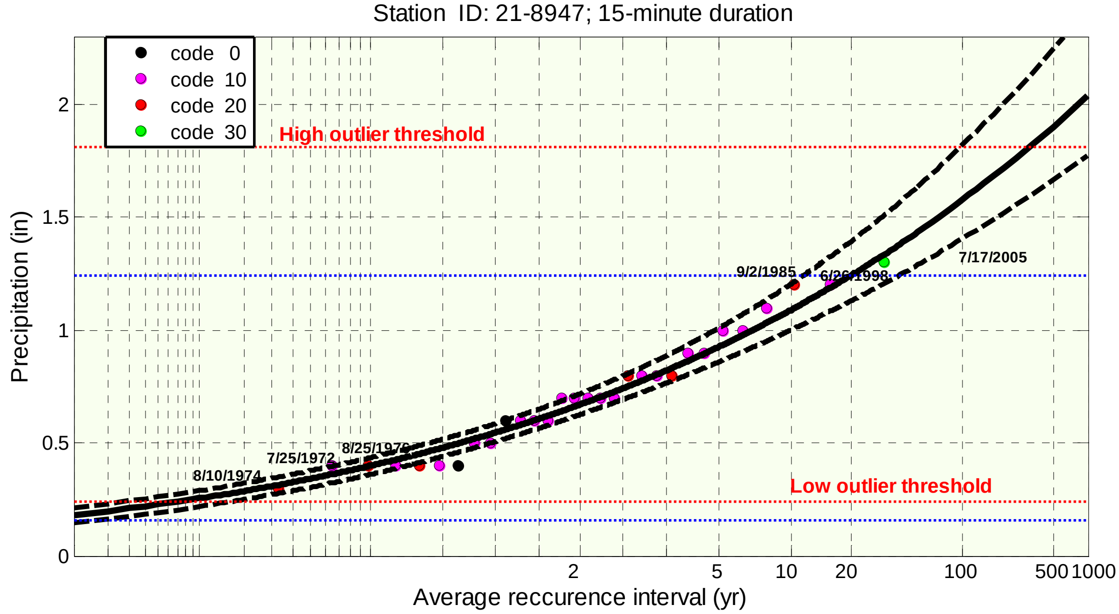

Figure 4. Outlier examination of 15-min AMS at station 21-8947. Data quality codes were assigned to all annual maxima during the extraction process.

2.1.5. Trend analysis of AMS

Precipitation frequency analysis methods used in NOAA Atlas 14 volumes are based on the assumption of a stationary climate over the period of observation. In NOAA Atlas 14, the parametric *t*-test and non-parametric Mann-Kendal test for trends are used to test stationarity in annual maximum series data for selected durations. Statistical tests on the 15-minute AMS data in this project did not show statistically significant trends. Trend analysis on hourly and daily AMS is in progress.

2.1.6. Precipitation frequency analysis

Precipitation magnitude-frequency relationships at individual stations have been computed using L-moment statistics computed from AMS for the seventeen extracted durations. The following distribution functions are analyzed in NOAA Atlas 14 with the aim to identify a distribution that will provide accurate precipitation frequency estimates for the project area across all frequencies and durations: 3-parameter Generalized Extreme Value (GEV), Generalized Normal, Generalized Pareto, Generalized Logistic and Pearson Type III distributions; 4-parameter Kappa distribution; and 5-parameter Wakeby distribution. For the initial analysis, Kolmogorov-Smirnov and χ^2-test were used to assess which of the selected distributions provide acceptable fit to the AMS data. Based on those tests, the GEV distribution, which is a distribution widely used in the analysis of extreme events, was suitable for at least 90% of stations across all durations. The final decision on distribution selection will be done based on analysis of precipitation frequency estimates computed from regional statistics.

2.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2011)

In the next reporting period, the following tasks will be completed: investigation of outliers in the AMS across all durations, trend analysis for 1-hour and 1-day durations, analysis of station dependence, regionalization and preliminary frequency analysis. Spatial patterns in mean annual maxima will be investigated in preparation for spatial interpolation by the PRISM Group.

2.3. PROJECT SCHEDULE

Completion date is revised 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 July 2011]

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

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [August 2011, revised to November 2011]

Peer review [September 2011, revised to January 2012]

Revision of PF estimates [December 2011, revised to February 2012]

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 (Apr - Jun 2011)

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 characteristics of annual maximum precipitation used in frequency analysis (Figure 5). To facilitate a more efficient process, Southeastern (see Section 2) and Midwestern precipitation frequency projects are being done simultaneously. Because of that, some of the results shown in this report apply for the both projects.

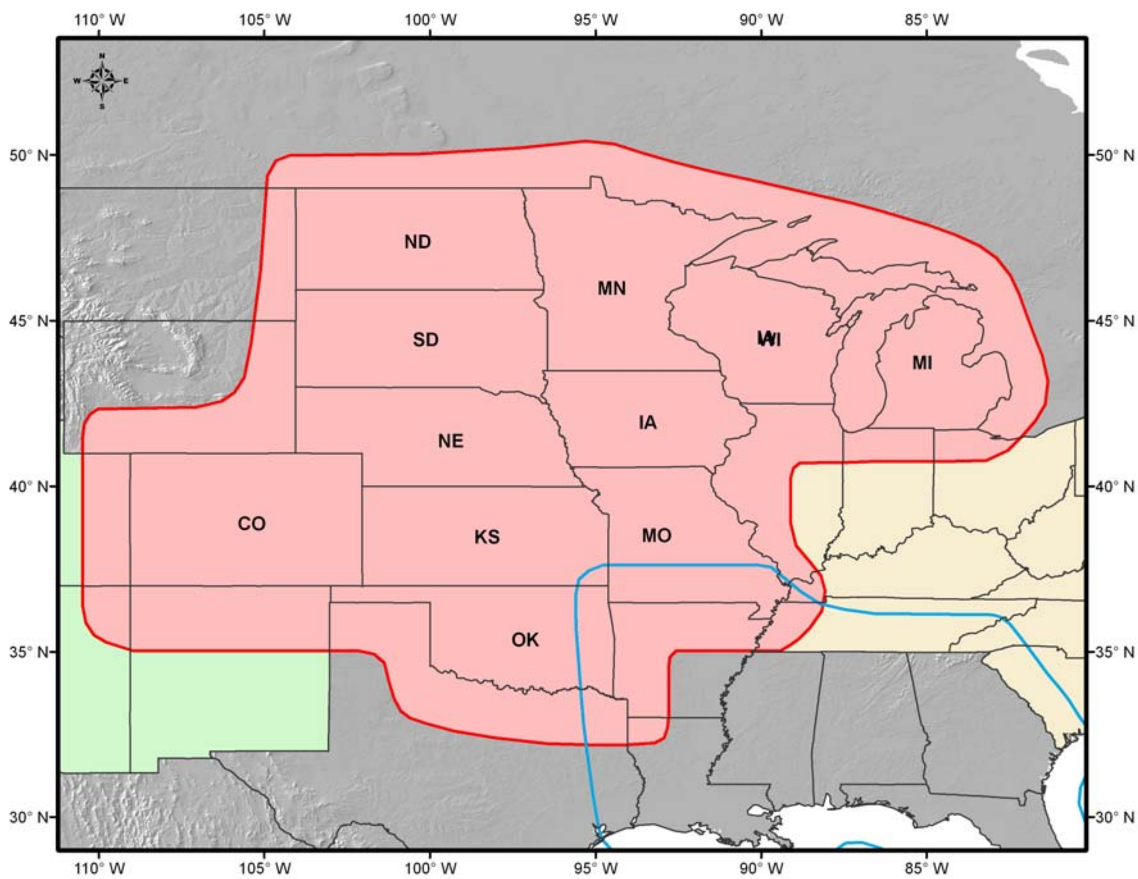

Figure 5. Midwestern precipitation frequency project area (shown in red). Also shown is the border of the Southeastern precipitation frequency project area (blue line).

3.1.1. Data collection

Potentially useful data from the Midwestern Region Climate Center (MRCC) were identified. MRCC is adding daily data to existing NCDC stations across the U.S. as part of the Climate Database Modernization Program's 19th Century Forts and Voluntary Observers Database Build Project. HDSC is in the process of obtaining these data which will extend some records into the early 1800s.

In addition, 1-minute data for 189 stations from the Automated Surface Observing Systems (ASOS) in the Midwest-Southeast project area were obtained from NCDC and added to the data set. These data were formatted to a base duration of 15-minutes.

3.1.2. Review of station metadata and station screening

The latitudes, longitudes, and elevations of recently added 15-minute USGS stations in South Dakota were converted to the horizontal datum NAD83 and the vertical datum NAVD88 to be consistent with other metadata in the project. Metadata for SNOTEL and RAWS stations were updated, re-evaluated, and corrected where necessary.

Stations are being screened for (1) duplicate records from different data sources, (2) duplicate records at co-located daily, hourly, and/or 15-minute stations, (3) extending records using data from co-located stations, (4) merging records of nearby stations, and (5) removing shorter, less reliable records in station dense areas. Software to facilitate this screening was revised and updated to work with the large numbers of stations in the geographically expansive project area (which includes both the midwestern and southeastern states).

535 pairs of stations were merged and 1,676 stations were deleted during this reporting period. Hourly stations from the SNOTEL database and hourly stations from the USACE Omaha District were found to have unreliable data and/or short records and were removed from the dataset because there were no stations with sufficient number of years with reliable data.

3.1.3. Extraction of AMS

During this reporting period, annual maximum series (AMS), needed for precipitation frequency analysis, were extracted for the following seventeen durations: 15-minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day and 60-day. The criteria used to extract annual maxima from the data were designed to exclude maxima if there are too many missing or accumulated data during the year and more specifically during critical months when precipitation maxima are most likely to occur ("wet season"). Regions, shown in Figure 6, were delineated to depict wet seasons by inspecting histograms of annual maxima for the 1-day and 1-hour durations and by assessing the periods in which two-thirds of annual maxima occurred at each station. Table 2 shows the wet season months that were assigned to each region for daily and sub-daily durations.

Table 2. Wet season months assigned to each region.

Region	**Wet season for daily durations**	**Wet season for sub-daily durations**
North	May-September	May-September
Western CO	March-November	May-October
Plains	April-October	May-September
Mississippi Valley	January-December	April-October
Southeast	March-October	May-October

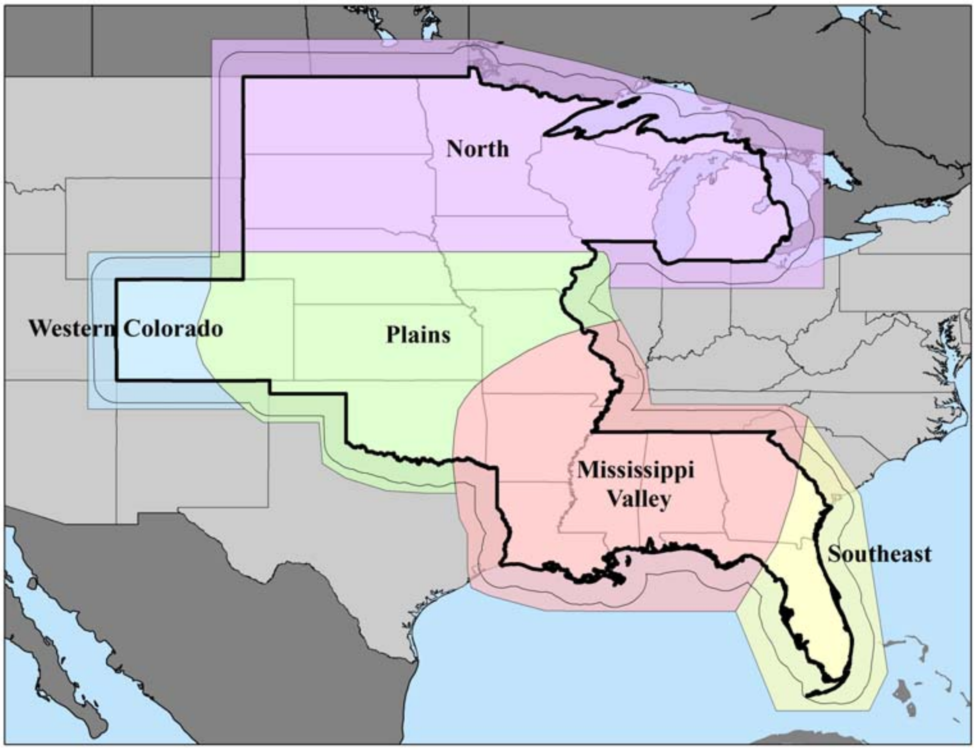

Figure 6. Regional delineation used in AMS extraction.

3.1.4. Quality control of AMS

High and low outliers were identified in the distribution of the at-station precipitation AMS and quality controlled. All identified outliers and any other questionable maxima are now being verified, corrected, or removed from the dataset.

Statistical tests for outliers are used to identify low and high outliers for all extracted durations (see an example of outlier examination in Figure 7). All values identified as high outliers are mapped with concurrent measurements at nearby stations. Questionable values that can not be confirmed by measurements at nearby stations are advanced for further investigation. Detailed investigation of flagged amounts is based on climatological observation forms, monthly storm data reports and other historical weather events publications, obtained primarily from the NCDC's Environmental Document Access and Display System (EDADS). Unfortunately, EDADS has been off-line for many months. When NCDC restores access to this database of climate publications and forms, any remaining suspicious amounts will be evaluated.

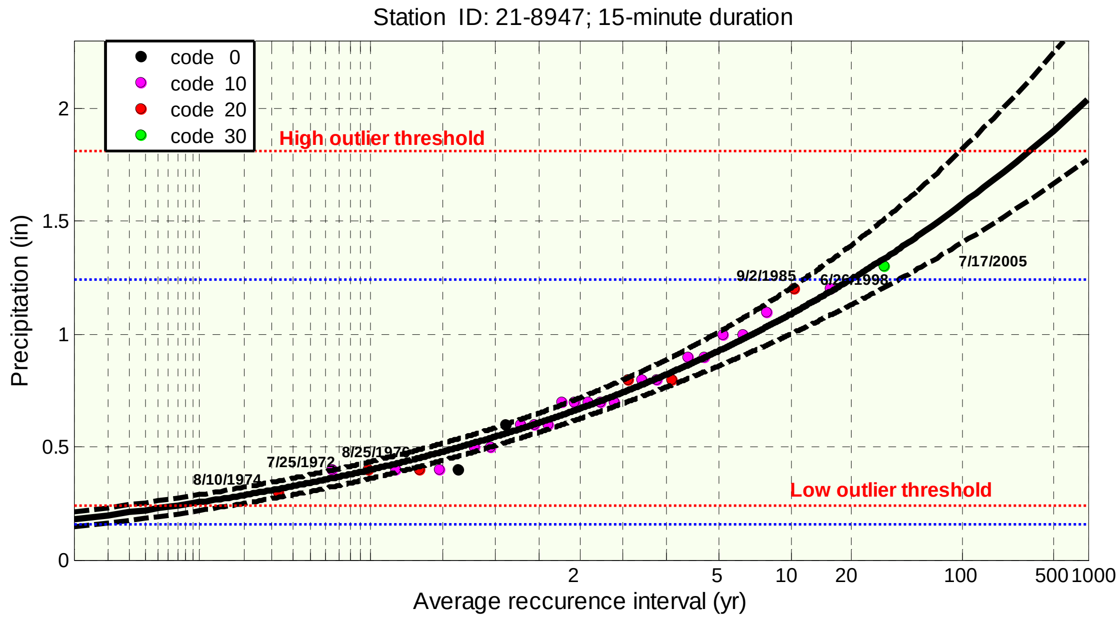

Figure 7. Outlier examination of 15-min AMS at station 21-8947. Data quality codes were assigned to all annual maxima during the extraction process.

3.1.5. Trend analysis of AMS

Precipitation frequency analysis methods used in NOAA Atlas 14 volumes are based on the assumption of a stationary climate over the period of observation. In NOAA Atlas 14, the parametric *t*-test and non-parametric Mann-Kendal test for trends are used to test stationarity in annual maximum series data for selected durations. Statistical tests on the 15-minute AMS data in this project did not show statistically significant trends. Trend analysis on hourly and daily AMS is in progress.

3.1.6. Precipitation frequency analysis

Precipitation magnitude-frequency relationships at individual stations have been computed using L-moment statistics computed from AMS for the seventeen extracted durations. The following distribution functions are analyzed in NOAA Atlas 14 with the aim to identify a distribution that will provide accurate precipitation frequency estimates for the project area across all frequencies and durations: 3-parameter Generalized Extreme Value (GEV), Generalized Normal, Generalized Pareto, Generalized Logistic and Pearson Type III distributions; 4-parameter Kappa distribution; and 5-parameter Wakeby distribution. For the initial analysis, Kolmogorov-Smirnov and χ^2-test were used to assess which of the selected distributions provide acceptable fit to the AMS data. Based on those tests, the GEV distribution, which is a distribution widely used in the analysis of extreme events, was suitable for at least 90% of stations across all durations. The final decision on distribution selection will be done based on analysis of precipitation frequency estimates computed from regional statistics.

3.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2011)

In the next reporting period, the following tasks will be completed: investigation of outliers in the AMS across all durations, trend analysis for 1-hour and 1-day durations, analysis of station dependence, regionalization and preliminary frequency analysis. Spatial patterns in mean annual maxima will be investigated in preparation for spatial interpolation by the PRISM Group.

3.3. PROJECT SCHEDULE

Completion date is revised 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 July 2011]

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

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [August 2011, revised to November 2011]

Peer review [September 2011, revised to January 2012]

Revision of PF estimates [December 2011, revised to February 2012]

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 (Apr - Jun 2011)

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

4.1.1. Data collection and formatting

Four new data sources were identified and added to the project.

1. HDSC identified potentially useful data from the Midwestern Region Climate Center's (MRCC) database. MRCC is adding daily data to existing NCDC stations across the U.S. as part of the Climate Database Modernization Program's 19th Century Forts and Voluntary Observers Database Build Project. HDSC obtained these data and extended the records of four stations into the 1800s.
2. HDSC obtained 1-minute data for 33 stations from the Automated Surface Observing Systems (ASOS) from NCDC and added to the data set. HDSC formatted the data to a base duration of 15-minutes. Most records were 6 to 11 years long.
3. HDSC obtained records for 167 hourly stations through the Iowa Environmental Mesonet - ASOS data archive. HDSC formatted the data to a base duration of 1-hour. Only 29 of these records had sufficient quality and minimum number of data years to be included in the analysis. Nine ASOS records were merged with existing stations to increase record lengths.
4. Two U.S. Geological Survey daily stations in remote locations were identified. UAF downloaded and formatted the data.

Several existing datasets were extended with more recent data through 2010: daily SNOTEL, hourly RAWS, hourly WERC, and hourly and daily Arctic LTER.

Investigation into hourly SNOTEL data continued. There were 54 stations that reported hourly precipitation; 12 of them have data for at least 10 years. Due to the poor quality of the data, UAF manually extracted reasonably reliable 1-hour annual maximum series; the data were not suitable to aggregate to longer durations.

4.1.2. Annual maximum series (AMS) extraction

During this reporting period, HDSC extracted annual maximum series (AMS), needed for precipitation frequency analysis, for the following seventeen durations: 15-minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day and 60-day. The criteria used during the extraction restrict the allowable percent of accumulated and missing data during the year and more specifically during critical months when precipitation maxima are most likely to occur ("wet season"). Regions, shown in Figure 8, were delineated to depict wet seasons by inspecting histograms of annual maxima for the 1-day and 1-hour durations and by assessing the periods in which two-thirds of annual maxima occurred at each station. Table 3 shows the wet season months that were assigned to each region for daily and sub-daily durations.

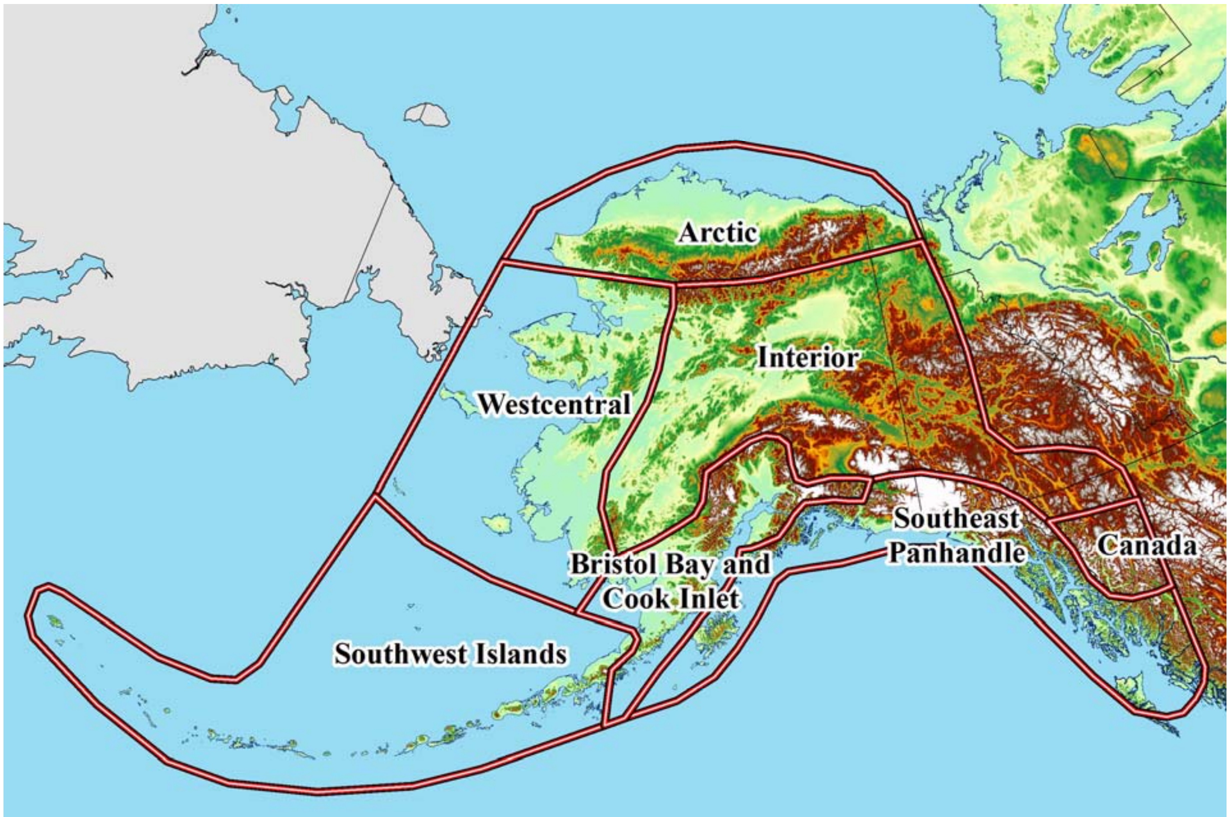

Figure 8. Regional delineation used for AMS extraction.

Table 3. Wet season months assigned to each climate region.

Region	Wet season for daily durations	Wet season for sub-daily durations
Arctic	June - September	June - August
Interior	June - October	June - August
Westcentral	June - October	June - September
Southwest Islands	June – February	July - November
Bristol Bay / Cook Inlet	July – December	July - December
Southeast Panhandle	August - January	August - December
Canada	June - January	June - August

4.1.3. Rainfall AMS extraction

For some applications it may be important to differentiate frequency estimates from liquid precipitation (i.e., rainfall) only. As discussed in previous Quarterly Progress Reports, rainfall-only observations are being segregated from existing datasets using co-located or nearby measurements of snow and/or temperature.

During this quarter, UAF completed rainfall extraction of several datasets: NCDC daily, SNOTEL daily, Arctic LTER daily and RAWS hourly. Work progresses on NCDC hourly, LTER hourly, and added ASOS hourly stations.

4.1.4. Station screening

a. Station cleanup

HDSC added back to the analysis several previously deleted stations that were found to have at least 10 years of data after wet season criteria were updated or after their records were extended with the newly added ASOS hourly data.

HDSC investigated co-located hourly and daily data (135 pairs of stations) for any inconsistencies in 1-day AMS. Data corrections were made where necessary. During the check, one pair of stations were merged, one station was deleted, hourly data were used to extend the records at their co-located daily stations in two cases, and one pair of stations from different data sources were identified to be treated as co-located for consistency purposes.

b. Review of station metadata

HDSC updated metadata for SNOTEL daily stations based on information received from the USDA-NRCS. UAF reviewed previous metadata corrections made by HDSC to improve location accuracy. All final metadata corrections were implemented.

4.1.5. Quality control of AMS

HDSC identified high and low outliers in the AMS of the base durations – 15-minute, 1-hour and 1-day. All outliers and any other questionable maxima were mapped with concurrent measurements at nearby stations. Questionable values that could not be confirmed by measurements at nearby stations were advanced for further investigation; both HDSC and UAF participated in this task. Detailed investigation of flagged amounts is based on use of climatological observation forms, monthly storm data reports and other historical weather events publications, obtained primarily from the NCDC's Environmental Document Access and Display System (EDADS). Unfortunately, EDADS has been off-line for many months. When NCDC restores access to this database of climate publications and forms, any remaining suspicious amounts will be evaluated.

4.1.6. Trend analysis of AMS

Precipitation frequency analysis methods used in NOAA Atlas 14 volumes are based on the assumption of a stationary climate over the period of observation. In NOAA Atlas 14, the parametric *t*-test and non-parametric Mann-Kendal test for trends are used to test stationarity in annual maximum series data at selected durations. HDSC performed statistical tests on 1-hour and 1-day AMS with at least 40 years of data. Tests did not indicate statistically significant trends in 95% of AMS data; no spatially coherent patterns were found.

4.1.7. Spatial interpolation of mean annual maxima

HDSC evaluated mean annual maxima (MAMs) for the 1-hour, 1-day and 10-day durations for any inconsistencies across the project area. Estimates in areas of varied terrain and/or where the lack of stations or short records unduly influenced expected spatial patterns were carefully examined. Mean annual maxima were adjusted for eleven hourly stations with short periods of record to better anchor the spatial interpolation. The amounts of the adjustments were determined by looking at the ratio between hourly and daily MAMs for a given location and comparing that to the overall pattern and nearby stations.

At-station MAM estimates were sent to Oregon State University's PRISM Group for spatial interpolation using their hybrid statistical-geographic approach for mapping climate data named Parameter-elevation Regressions on Independent Slopes Model (PRISM).

4.1.8. Regionalization for frequency analysis

For this project, it was decided to use the interactive "region-of-influence" approach developed for the California project (described in previous reports). In this 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) and by examination of similarities (or dissimilarities) in selected statistics across durations from 1-hour to 60-day at stations in the region. HDSC computed regional L-moment statistics at each station across all durations for which AMS data were available.

4.1.9. Precipitation frequency analysis

HDSC computed precipitation magnitude-frequency relationships at individual stations using regional L-moment statistics. Kolmogorov-Smirnov and χ^2-test were used to assess which of the following distributions provide adequate fit to the AMS data across all durations: 3-parameter Generalized Extreme Value (GEV), Generalized Normal, Generalized Pareto, Generalized Logistic and Pearson Type III distributions; 4-parameter Kappa distribution; and 5-parameter Wakeby distribution. GEV distribution, which is also a distribution commonly used in frequency analysis of extreme events, was also an optimal distribution for this project.

4.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2011)

In the next reporting period, the quality control of precipitation AMS outliers for all durations will be completed. Extraction of rainfall-only AMS and rainfall frequency analysis will also be completed. Precipitation frequency estimates will be spatially interpolated.

A peer review of precipitation frequency estimates will commence around August 1st. The review will include at-station depth-duration-frequency curves for the range of durations for which annual maximum series (AMS) data were extracted, spatially-interpolated maps of mean annual maxima for 60-minute, 24-hour and 10-day durations, and maps of 2-year and 100-year precipitation frequency estimates for the 60-minute, 24-hour and 10-day durations. All estimates will be re-visited based on the comments received during the review period.

4.3. PROJECT SCHEDULE

Delays occurred in the project schedule associated with the contracting of Oregon State University's PRISM Group to spatially interpolate the mean annual maxima. As a result the publication date was pushed to November 2011.

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

UAF and HDSC*: 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 July 2011]

HDSC: regionalization and frequency analysis [Complete]

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

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

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

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

HDSC: web publication [November 2011]

** The schedule for this task assigned to UAF slipped due to delay in execution of data collection and formatting task. HDSC has joined UAF in execution to speed up the work.*

5. AREAL REDUCTION FACTORS

5.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2011)

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.

No progress has been made during this reporting period.

5.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2011)

In the next quarter, the different methods will be tested using updated quality controlled data.

5.3. PROJECT SCHEDULE

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

III. OTHER

1. PERSONNEL

Three students joined the HDSC for the summer: Stefan Boskovic and Kandace Kea through NOAA's Educational Partnership Program - Undergraduate Scholarship Program and Maria Perica, high school student, as a volunteer. They contributed to the quality control of station data and preformed trend analysis for the Alaska, Midwestern and Southeastern projects. They also looked at the effects of changes in precipitation frequency estimates due to climate change and their effects on infrastructure design.