HYDROMETEOROLOGICAL DESIGN STUDIES CENTER QUARTERLY PROGRESS REPORT

1 April 2010 to 30 June 2010

Office of Hydrologic Development

U.S. National Weather Service

National Oceanic and Atmospheric Administration

Silver Spring, Maryland

July 2010

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 the end of 2010 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.

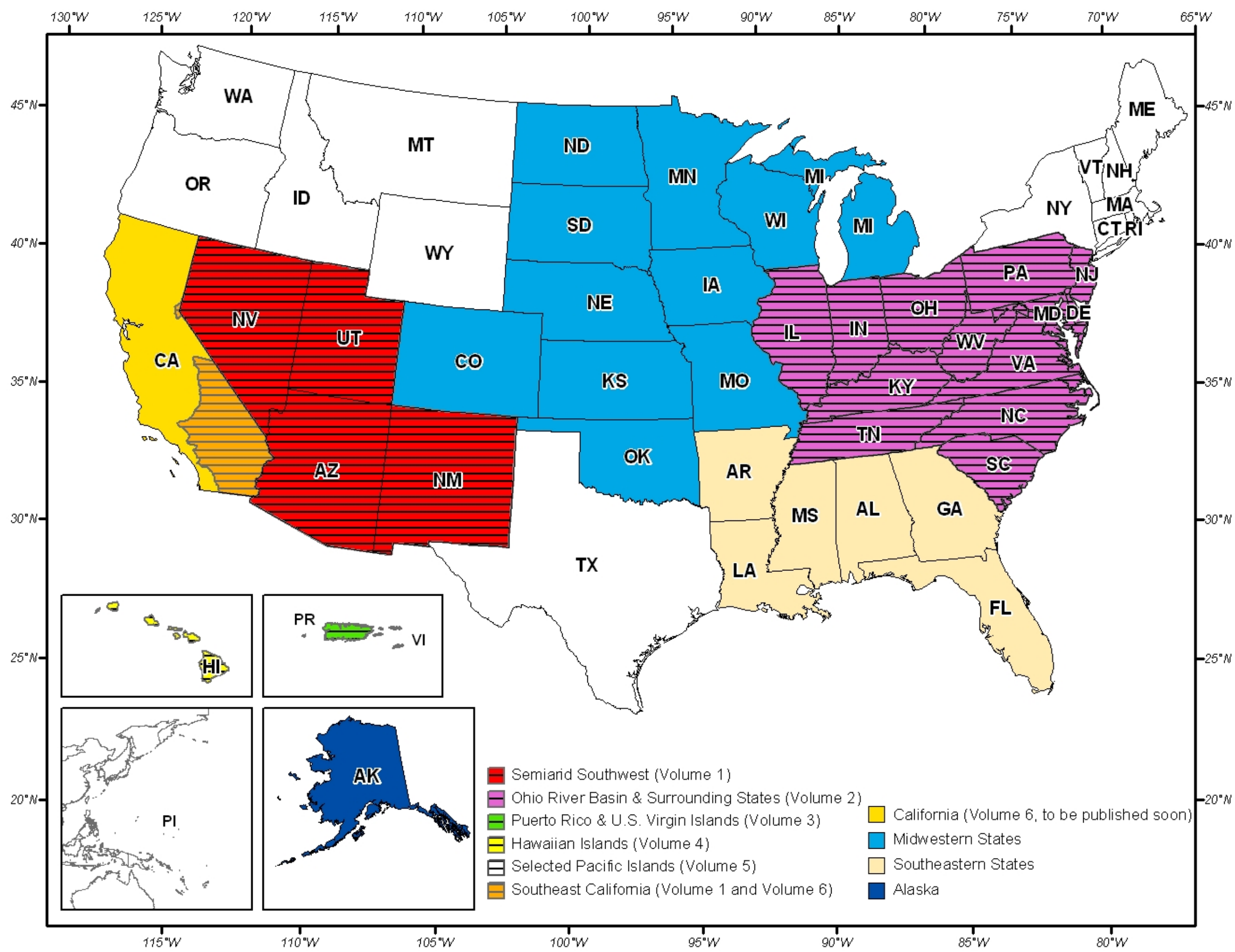

Figure 1. Map showing current project areas and project areas included in published NOAA Atlas 14, Volumes 1-5.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR CALIFORNIA

1.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2010)

1.1.1. Change in project scope

Project scope has recently changed to: a) include southeastern California that was previously published in NOAA Atlas 14 Volume 1, b) perform in parallel precipitation and rainfall-only frequency analysis for hourly durations between 1 and 24 hours, and c) explore if alternative parameterization and regionalization approaches produce more reliable precipitation frequency estimates. As a result, the publication date was modified from September to December 2010.

1.1.2. Final review of station metadata

Stations for which provided elevation differed more than 700 feet from the high resolution digital elevation model (DEM) elevation were investigated and corrected. Also, for stations with no seconds in provided latitudes and longitudes, coordinates were replaced with coordinates recommended during PRISM mean annual maximum interpolation (see Section 1.1.4).

1.1.3. Final review of at-station AMS

At-station AMS were screened spatially for the following conditions:

a) AMS at stations within 5-mile radius and less than 300ft elevation difference were screened to identify duplicate records. When the correlation coefficient between the AMS at two stations for a range of durations was at least 0.95 based on at least 25-years of overlap: i) stations were considered duplicate, ii) stations were merged to extend period of record, or iii) stations with shorter period of record, longer recording time, and/or less reliable data were removed from the dataset;

b) for stations that were found discordant within their homogeneous precipitation frequency regions delineated for the index-flood approach (see 1.1.6), AMS were compared to AMS at nearby stations. Discordant stations were either: i) removed from the dataset if their data were found to be unreliable due to data quality issues or period of record, ii) were assigned to be used in frequency analysis only for selected durations, or iii) kept in the dataset if it was established they have reliable data.

1.1.4. Spatial interpolation and review of mean annual maximum (MAM) estimates

Several iterations of at-station MAMs for 1-hour, 1-day, and 10-day durations were sent to the PRISM Group at Oregon State University for spatial interpolation. Each time, maps of the 1-hour, 1-day and 10-day results were reviewed for unreasonable local MAMs. In some cases so-called ‘pseudo-stations’ were added to anchor interpolation process.

At-station MAMs were also screened spatially for the following conditions:

a) Stations with MAMs that were inconsistent with MAMs at nearby stations at all or some durations were either: i) removed from the dataset if they were found to be unreliable due to data quality or period of record, or ii) were assigned to be used in frequency analysis only for selected durations and occasionally made co-located with nearby stations with longer recording time intervals, or iii) kept in the dataset if it was established they have reliable data.

b) Station MAMs were compared with corresponding PRISM-based MAMs. Whenever the difference between the two was more than +/- 10%, at-station AMS were carefully investigated. A decision was made for each case to: i) keep original MAM estimate, ii) modify MAM, or iii) adopt PRISM-based MAM.

1.1.5. Rainfall-only versus precipitation frequency analysis

Extraction and frequency analysis of rainfall-only AMS for 24-duration was accomplished during the last reporting period. While, information on type of precipitation is readily available for NCDC daily stations, there are a very limited number of hourly stations that provide similar information. Temperature measurements that could assist in distinction of precipitation type for the hourly durations are also available for a limited number of locations, and typically for less than 10 years. Because of that, we decided to investigate if modeled temperature could be used to distinguish between snow and rain events. Temperature grids at various pressure levels were extracted for the study area from the National Climatic Data Center's (NCDC) North American Regional Reanalysis (NARR) 3-hour gridded dataset. Validation of modeled vertical profiles of temperature is underway.

1.1.6. Regionalization for frequency analysis

A regionalization approach is typically used in frequency analysis, as it has been shown that regional frequency analysis yields more accurate quantile estimates than at-station analysis. In previous NOAA Atlas 14 volumes, the so-called 'index-flood' regional frequency approach was used. For the California project, two regionalization approaches are being used and compared: the index-flood approach, and a (modified) region-of-influence approach. Description of index-flood approach can be found in any NOAA Atlas 14 document (for example, see Section 4.5 in Volume 5; http://hydrology.nws.noaa.gov/oh/hdsc/PF_documents/NA14Vol5_PI.pdf).

For the index-flood approach, the initial 40 homogeneous regions developed using the combination of Wards and K-mean clustering algorithms were further refined based on combined results of statistical tests and consideration of the climatology of heavy precipitation events. This refinement resulted in 70 homogeneous regions. They are under further review to reduce variation in elevation within a region and to further capture local climate and transition zones.

For the region-of-influence approach, each station has its own region; regions are defined to consist of stations that have a similar frequency distribution to the station of interest. Station characteristics that were considered for construction of regions included distance, aspect and elevation. The maximum number of stations allowed per each region was 10.

The decision for the inclusion of an alternative regionalization approach was made after it was established that even after careful selection of stations for forming homogeneous regions and with additional station cleanup to exclude stations with highly correlated data (see Section 1.1.2), too many regions contained stations with highly positively correlated data, especially for daily durations. That is against one of the main assumptions for the index-flood approach that observations at stations that are forming a region are independent. Statistical tests have been used to test regional homogeneities. Performance of both regionalization approaches is still under assessment.

1.1.7. Estimation and choice of frequency distribution

In addition to the regional L-moment approach that has been used in previous NOAA Atlas 14 volumes, a regional maximum likelihood estimation (MLE) approach has been used for this project to estimate regional frequency distributions. New optimization algorithms for L-moments and MLE-based distribution parameters has been developed and applied to achieve smooth transition of precipitation frequency estimates across durations. Various statistical tests have been used to choose a method of parameterization and to choose a distribution. Although the investigation is still underway, preliminary results indicate that the GEV distribution with parameterization obtained through the maximum likelihood approach typically provides the most reliable quantile estimates.

N-minute frequency estimates. Initial precipitation frequency estimates for the 5, 10, 15, and 30 minute durations will be developed using ratios between annual maxima at those durations and corresponding 60-minute maxima. The ratios that will be used in California project were estimated to be 0.30, 0.43, 0.52, and 0.71 for 5-minute, 10-minute, 15-minute and 30-minute, respectively. Spatial analysis did not reveal any spatial patterns in the ratios; similarly no significant difference in the ratios was found for datasets from different sources. Initial precipitation frequency estimates for n-minute durations will further go through an optimization process with corresponding frequency estimates at longer durations to obtain final n-minute estimates.

1.1.8. Derivation of gridded precipitation frequency estimates

The HDSC-developed CRAB spatial interpolation procedure (described in more detail in on-line NOAA Atlas 14 documentation; see for example, Section 4.6 in http://hydrology.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume4.pdf) was customized for the California project area. The procedure derives gridded precipitation frequency estimates at different recurrence intervals and durations using the mean annual maximum grids and at-station precipitation frequency estimates as the base.

1.1.9. Preparation for peer review

The peer review for California is expected to start around July 20th and will close on August 27th. If you would like to participate in the review, please join the HDSC list-server (http://www.nws.noaa.gov/ohd/hdsc/listserver.html).. The review will include the following items:

a) a list of all stations used in the analysis. The list includes information on station name, state, source of data, assigned station ID, latitude, longitude, elevation, and period of record. It also shows information if the station was merged with another station and if metadata at the station were changed;

b) a list of all stations that were received by HDSC, but not considered in analysis. This list contains stations that were not used, either because there was another station with a longer period of record nearby, or station data were not reliable, or the station period of record was not long enough and it was not a candidate for merging with any nearby station;

c) at-station depth-duration-frequency curves for a range of durations for which AMS data were available;

d) spatially-interpolated AMS-based precipitation frequency estimates for 1-hour, 1-day and 10-day durations and for 1/2 and 1/100 annual exceedance probabilities (AEPs).

In addition, a new web interface was developed for the review and GIS template maps showing isopluvials for different AEPs and different durations were developed.

1.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2010)

During the next quarter, investigation of alternative regionalization and parameter estimation approaches will be finalized. Peer review of precipitation frequency estimates will be completed. Precipitation frequency estimates will be revised in consideration of peer review comments. Partial duration series based precipitation frequency estimates and confidence limits on precipitation frequency estimates will be computed.

1.3. PROJECT SCHEDULE

Due to the change in project scope, the schedule was revised. The project is now expected to be completed in December 2010.

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 PF estimates and consistency checks across durations [Complete]

Peer review [April 2010; revised to July 2010]

Revision of PF estimates [July 2010; revised to September 2010]

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

Web publication [September 2010; revised to December 2010]

2. PRECIPITATION FREQUENCY PROJECT FOR THE SOUTHEASTERN STATES

2.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2010)

The project includes the states of Alabama, Arkansas, Florida, Georgia, Louisiana and Mississippi 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 2).

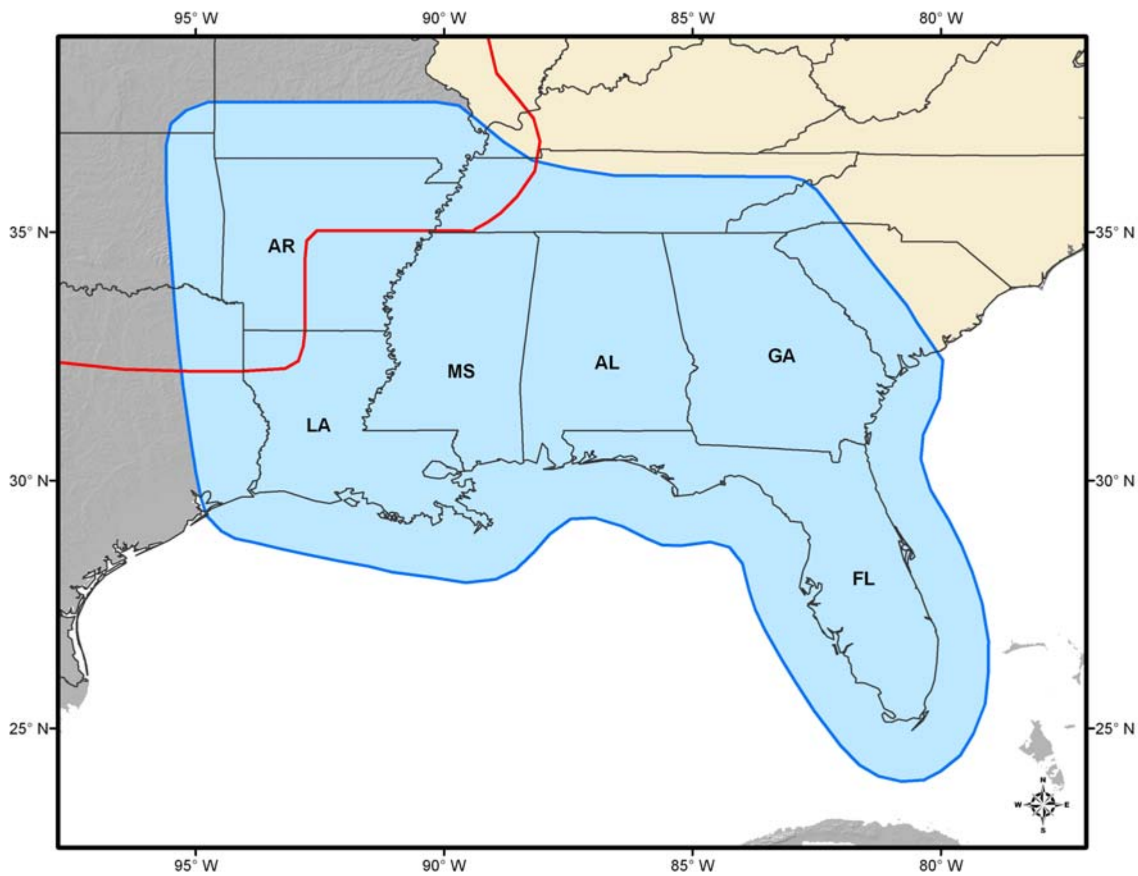

Figure 2. Southeastern precipitation frequency project area (shown in blue). Also shown is the border of the Midwestern precipitation frequency project area (red line).

2.1.1. Data collection and formatting

Various data providers were re-contacted regarding their data or metadata that was not yet received. Two new datasets were received or downloaded: 5-minute data from the Northwest Florida Water Management District and daily data from the Suwannee River Water Management District in Florida. During this reporting period, updating and formatting was completed for all datasets. Table 1 lists datasets that contain stations with potentially useful data for frequency analysis together with data reporting interval. Annual maximum series were extracted for all stations for durations equal or longer than data reporting interval.

Table 1. Precipitation datasets with number of stations per dataset and data reporting interval.

Data provider and dataset name (when applicable)	Data reporting interval	Number of stations formatted
National Climatic Data Center (NCDC) : DSI-3200, DSI-3240, DSI-3260, ASOS	1-day	2186
	1-hour	623
	15-min	343
	1-min	146
U.S. Geological Survey: National Weather Information System	1-day	710
Illinois State Water Survey: National Atmospheric Deposition Program (NADP)	1-day	32
Natural Resources Conservation Service: Soil Climate Analysis Network (SCAN)	1-hour	13
U.S. Forest Service: Remote Automated Weather Stations (RAWS)	1-hour	11
South Florida Water Management District: DBHYDRO	varies	831
Northwest Florida Water Management District	5-min	42
St. Johns River Water Management District, Palatka, FL	10day	54
Natural Resources Management Office, Brevard County, FL	1-day	2
City of Vero Beach, FL	1-day	1
NASA, TRMM Satellite Validation Office, MELB gauge network	1-min	410
University of Florida, Institute of Food and Agricultural Sciences, Florida Automated Weather Network (FAWN)	15-min	6
	1-hour	3
Georgia Forestry Commission, Fire Weather Station Network	1-hour	16
Southwest Florida Water Management District	15-min	53
	1-hour	51
Suwannee River Water Management District, FL	1-day	11

2.1.2. Dataset screening

a. Station merging

Stations that are reporting data at the same time interval within 5 miles distance and maximum 300ft elevation difference are being considered for merging to increase record lengths. Time series plots of the annual maximum series for station pairs that were considered for merging were reviewed, and merge candidates were identified. T-test and double-mass curve analysis will be used to ensure that the annual maximum series of stations considered for merging are from the same population. This work is underway for the 15-minute, 1-hour and 1-day datasets.

b. Co-located station clean-up

Co-located stations are defined as stations that have the same metadata (primarily geospatial data but may also have the same identification numbers as in the case of NCDC stations), but report data at different time intervals (15-minute, 1-hour, and 1-day). Co-located stations are being screened for duplicate records. When AMS from co-located stations overlap exactly, the station with the shortest reporting interval is always kept and stations reporting data at longer intervals are deleted. Consideration is given to cases where AMS at stations with longer reporting intervals can be extended by AMS from co-located stations with shorter reporting intervals. This work has begun for 15-minute and 1-hour NCDC datasets. There are 1,685 pairs of co-located NCDC stations in the Midwest and Southeast project areas combined.

2.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2010)

In the next reporting period, work on co-located station cleanup, station merging and examination of geospatial data will continue. The quality control of AMS outliers will commence.

2.3. 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) [July 2010; revised to September 2010]

Regionalization and frequency analysis [November 2010]

Initial spatial interpolation of 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 PD 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 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 3).

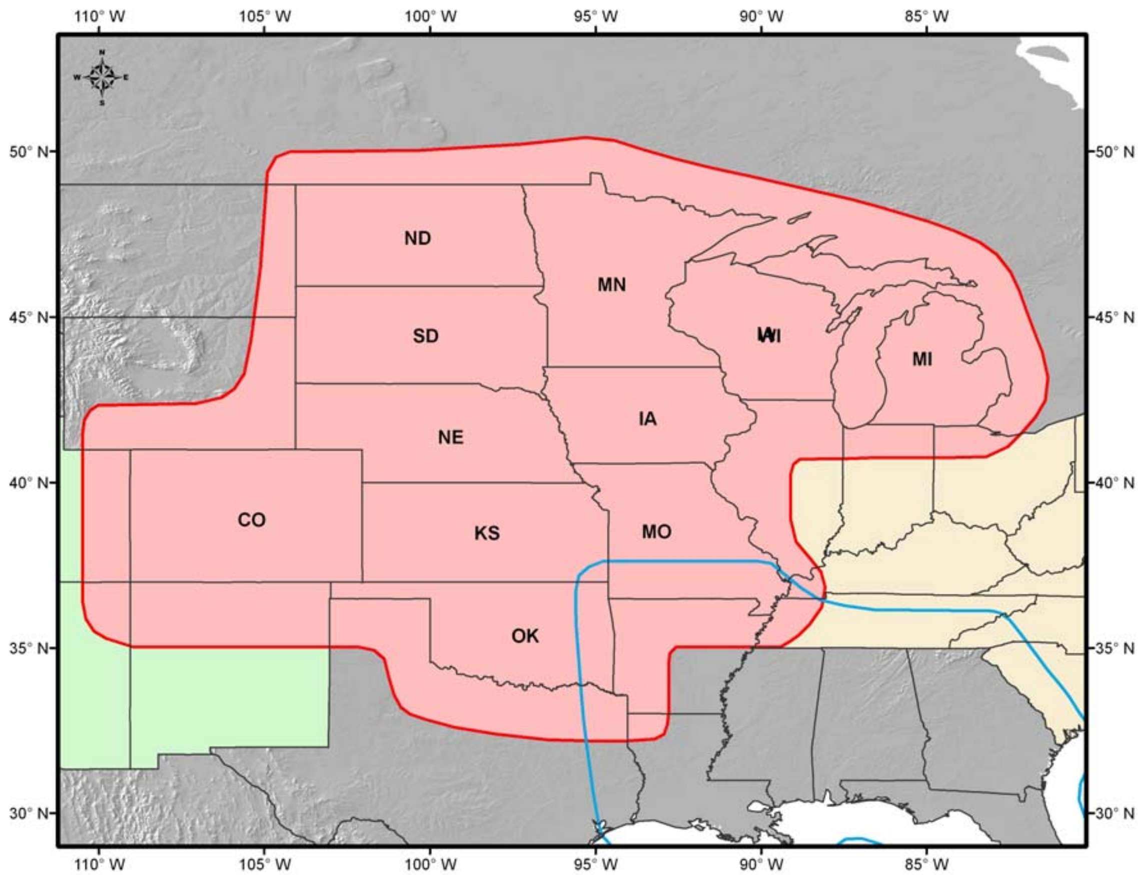

Figure 3. Midwestern precipitation frequency project area (shown in red). Also shown is the border of the Southeastern precipitation frequency project area (blue line).

3.1.1. Data collection and formatting

After reviewing the list of potential data sources, an additional hourly dataset was identified from the Southeast Michigan Council of Governments. Updating and formatting was completed for all datasets. Table 2 lists datasets that contain stations with potentially useful data for frequency analysis together with data reporting interval. Annual maximum series were extracted for all stations in datasets listed in Table 2 for all durations equal or longer than data reporting interval.

Table 2. Precipitation datasets with number of stations per dataset and data reporting interval.

Data provider and dataset name (when applicable)	Data reporting interval	Number of stations formatted
National Climatic Data Center (NCDC) : DSI-3200, DSI-3240, DSI-3260, ASOS	1-day	4110
	1-hour	1214
	15-min	757
	n-min	185
Environment Canada: DLY03, DLY04 and HLY03	1-day	284
	1-hour	35
U.S. Geological Survey: National Weather Information System	1-day	531
Illinois State Water Survey: National Atmospheric Deposition Program (NADP)	1-day	58
Natural Resources Conservation Service: SNOTEL	1-day	106
	1-hour	79
Natural Resources Conservation Service: Soil Climate Analysis Network (SCAN)	1-hour	7
U.S. Bureau of Reclamation datasets for Colorado, Kansas, Nebraska, North Dakota and South Dakota	1-day	41
U.S. Army Corps of Engineers, Omaha District Office	1-hour	44
US Army Corps of Engineers, St. Louis District Office	1-hour	64
U.S. Forest Service: Remote Automated Weather Stations (RAWS)	1-hour	86
High Plains Regional Climate Center: Automated Weather Data Network	1-day	144
	1-hour	143
Colorado Climate Center: Colorado Agricultural Meteorological Network (CoAgMet)	1-day	34
	1-hour	34
Colorado Climate Center: Community Collaborative Rain, Hail and Snow Network (CoCoRaHS)	1-day	71
Northern Colorado Water Conservancy District (NCWCD) Weather Station Network	1-day	14
Urban Drainage Flood Control District, Denver, CO: ALERT Weather Station Network	varies	131
Stormwater Utility, Fort Collins Utilities Department, City of Fort Collins, CO: ALERT System	varies	28
Colorado Springs Utilities Department Network	1-day	5
Southeast Michigan Council of Governments (SEMCOG)	1-hour	96
Kansas Department of Transportation, City of Overland Park: ALERT	varies	58

Precipitation Network		
Michigan Automated Weather Network (MAWN)	5-min	3
Minnesota Department of Natural Resources, State Climatology Office	1-day	344
Metropolitan Council Environmental Services, Minnesota: Metering and Alarm Rainfall Database	15-min	22
Commercial Agriculture Automated Weather Station Network	1-hour	17
North Dakota State Water Commission Precipitation Network	1-day	2890
North Dakota Agricultural Weather Network (NDAWN), North Dakota State University	1-day	53
	1-hour	49
Oklahoma Mesonet	1-day	127
	1-hour	13
Atmospheric Radiation Measurement: Southern Great Plains Surface Meteorological Observation System Network	1-min	21
Southeastern Wisconsin Regional Planning Commission, Milwaukee Metropolitan Sewerage District	1-hour	21

3.1.2. Dataset screening

a. Station merging

Stations that are reporting data at the same time interval within 5 miles distance and maximum 300ft elevation difference are being considered for merging to increase record lengths. Time series plots of the annual maximum series for station pairs that were considered for merging were reviewed, and merge candidates were identified. T-test and double-mass curve analysis will be used to ensure that the annual maximum series of stations considered for merging are from the same population. This work is underway for the 15-minute, 1-hour and 1-day datasets.

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b. Co-located station clean-up

Co-located stations are defined as stations that have the same metadata (primarily geospatial data but may also have the same identification numbers as in the case of NCDC stations), but report data at different time intervals (15-minute, 1-hour, and 1-day). Co-located stations are being screened for duplicate records. When AMS from co-located stations overlap exactly, the station with the shortest reporting interval is always kept and stations reporting data at longer intervals are deleted. Consideration is given to cases where AMS at stations with longer reporting intervals can be extended by AMS from co-located stations with shorter reporting intervals. This work has begun for 15-minute and 1-hour NCDC datasets. There are 1,685 pairs of co-located NCDC stations in the Midwest and Southeast project areas combined.

3.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2010)

In the next reporting period, work on co-located station cleanup, station merging and examination of geospatial data will continue. The quality control of AMS outliers will commence.

3.3. 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) [July 2010; revised to September 2010]

Regionalization and frequency analysis [November 2010]

Initial spatial interpolation of 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 PD 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 2010)

The University of Alaska, Fairbanks (UAF) is moving forward on the joint effort with NWS to update precipitation frequency estimates for Alaska.

4.1.1. Data collection and formatting

UAF has completed data collection and a review of the datasets. Table 3 provides basic information on dataset providers, data reporting interval, and number of stations in each dataset. Finalized formatted data were submitted to HDSC for extraction of annual maximum series.

Table 3. Precipitation datasets with number of stations per dataset and data reporting interval.

Data provider and dataset name (when applicable)	Data reporting interval	Number of stations formatted
National Climate Data Center (NCDC): DSI-3200, DSI-3240, DSI-3260, ASOS	1-day	606
	1-hour	71
	15-min	36
	n-min	36
NCDC: Integrated Surface Hourly (ISH) database	1-hour	138
Natural Resources Conservation Service: SNOTEL	1-day	63
Arctic-Long Term Ecological Research Site (LTER)	1-day	3
	1-hour	3
Bonanza Creek LTER	1-hour	11
Environment Canada: DLY03, DLY04 and HLY03	1-day	131
	1-hour	26
Alaska Department of Transportation: Road Weather Information System (RWIS)	1-day	15
	1-hour	15
UAF, Water & Environmental Research Center (WERC): North Slope stations	1-hour	26
U.S. Forest Service: Remote Automated Weather Stations (RAWS)	1-hour	129
UAF: Arctic Transitions in the Land-Atmosphere System (ATLAS)	1-hour	8

4.1.2. Rainfall under-catch correction

UAF made an attempt to quantify rainfall under-catch during extreme events and to apply a bias correction to the AMS data. Unfortunately, the only historical records on the instrumentation (type of gauge at a site, information on if and when it was instrumented with an Alter shield) that is crucial for bias correction work, received from the NOAA/NCDC office, did not contain sufficient information. An attempt will be made to quantify the potential impact of rainfall under-catch on the rainfall frequency analysis based on a very few stations that have adequate gage information.

4.1.3. Annual maximum series extraction

Precipitation versus rainfall frequency analysis. AMS will be extracted for precipitation and for rainfall-only events. The state was divided into 7 climate regions based on the regions used in Shulski and Wendler,*The Climate of Alaska, 2007*. Each climate region has been assigned a "rain season" that is intended to reflect the months during which liquid precipitation can reasonably be expected to occur. The following are the proposed regions and rain seasons:

Region	**Rain season**
Arctic	May 1 – September 30
Interior	April 1 – October 31
West Coastal	April 1 – Oct ober31
SW Islands	January 1 – December 31
Bristol Bay/Cook Inlet	March 1 – November 30
SE Panhandle	January 1 – December 31
Other (Canada)	April 1 – October 31

For rainfall-only analysis in extreme regions, such as the Arctic, it was decided to exclude any annual maxima from winter months. For moderate regions, snow measurements and/or temperatures will be used to differentiate rain versus snow events for analysis. After looking at AMS data for several stations and corresponding temperatures, it appears that the proposed rain seasons for the Arctic and Interior regions are reasonable. There are potentially sections of the West Coastal and Bristol Bay areas that may need to be moved to regions with longer rain seasons.

4.1.4. Dataset screening

a. Station merging

Stations that are reporting at the same time interval within 5 miles distance and maximum 300ft elevation difference are being considered for merging to increase record lengths. Time series plots of the annual maximum series data for station pairs that were considered for merging were reviewed, and merge candidates were identified. T-test and double-mass curve analysis will be used to ensure that the annual maximum series of stations considered for merging are from the same population. This work is underway for the 1-day datasets. There were no candidates for merging in the 15-minute and 1-hour datasets.

b. Co-located station clean-up

Co-located stations are defined as stations that have the same metadata (primarily geospatial data but may also have the same identification numbers as in the case of NCDC stations), but report data at different time intervals (15-minute, 1-hour, and 1-day). Co-located stations are being screened for duplicate records. When AMS from co-located stations overlap exactly, the station with shortest reporting interval is always kept and stations reporting data at longer intervals are deleted. AMS at station with longer reporting interval can often be extended by AMS from co-located station with shorter reporting interval data. This check has begun for the 36 cases of co-located 15-minute and 1-hour NCDC data.

4.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2010)

The main focus for the next reporting period will include co-located station cleanup, station merging, quality control of station metadata and AMS data, and generation of rainfall-only AMS using temperature data.

4.3. 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). [The schedule for this task has slipped due to delay in execution of data collection and formatting task. This will affect subsequent tasks, but the project is still expected to be completed on time.] [February 2010; revised to September 2010]

Regionalization and frequency analysis [September 2010, revised to December 2010]

Initial spatial interpolation of PF estimates and consistency checks across durations [January 2011]

Peer review [March 2011]

Revision of PF estimates [May 2011]

Remaining tasks (e.g., development of precipitation frequency estimates for PD series, seasonality, temporal distributions, documentation) [August 2011]

Web publication [September 2011]

5. AREAL REDUCTION FACTORS

5.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2010)

HDSC is developing geographically-fixed areal reduction factors that can be used to convert point precipitation frequency estimates into corresponding areal estimates in the United States. For a given average recurrence interval, rainfall duration and area size, the areal reduction factor (ARF) is defined as a ratio of average point depth and areal depth with the same recurrence interval.

HDSC continued a literature review and an assessment of past approaches. Radar data were downloaded and work has begun on methods to process these data efficiently.

5.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2010)

HDSC will continue development of ARF approach that utilizes radar-estimated precipitation.

5.3. PROJECT SCHEDULE

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

III. OTHER

1. PUBLIC OUTREACH

A major storm in Tennessee on May 1-2, 2010 led to widespread flooding in Tennessee and Kentucky. HDSC obtained precipitation data for the event from the NWS Weather Forecast Office in Nashville and developed a map of average recurrence intervals associated with the storm. This product was delivered to the Nashville office and is available on their web page: http://www.srh.noaa.gov/ohx/?n=may2010epicfloodevent.

2. PERSONEL

Three students joined the HDSC for the summer: Matisyahu Kleidman through the Hollings Scholar program, John Yarchoan through the Student Temporary Employment Program and Maria Perica, high school student, as a volunteer. They contributed to the co-located station analysis and station merging work for the Midwestern, Southeastern and Alaska projects. Matisyahu Kleidman also worked on processing and evaluation of NARR dataset.