HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
QUARTERLY PROGRESS REPORT

1 April 2009 to 30 June 2009

Office of Hydrologic Development

U.S. National Weather Service

National Oceanic and Atmospheric Administration

Silver Spring, Maryland

July 2009

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 selected average recurrence intervals (1-year to 1,000-years) accompanied by additional information (e.g., 90% confidence intervals, temporal distributions, seasonality) are published in NOAA Atlas 14. The Atlas is divided into volumes based on geographic sections of the country. 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 recently completed updating precipitation frequency estimates for the Hawaiian Islands (NOAA Atlas 14, Volume 4) and is currently updating estimates for the remainder of California (not included in NOAA Atlas 14, Volume 1), the U.S. Pacific Islands, 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, South Dakota, and Wisconsin. Figure 1 shows new project areas as well as project areas included in NOAA Atlas 14, Volumes 1 to 4.

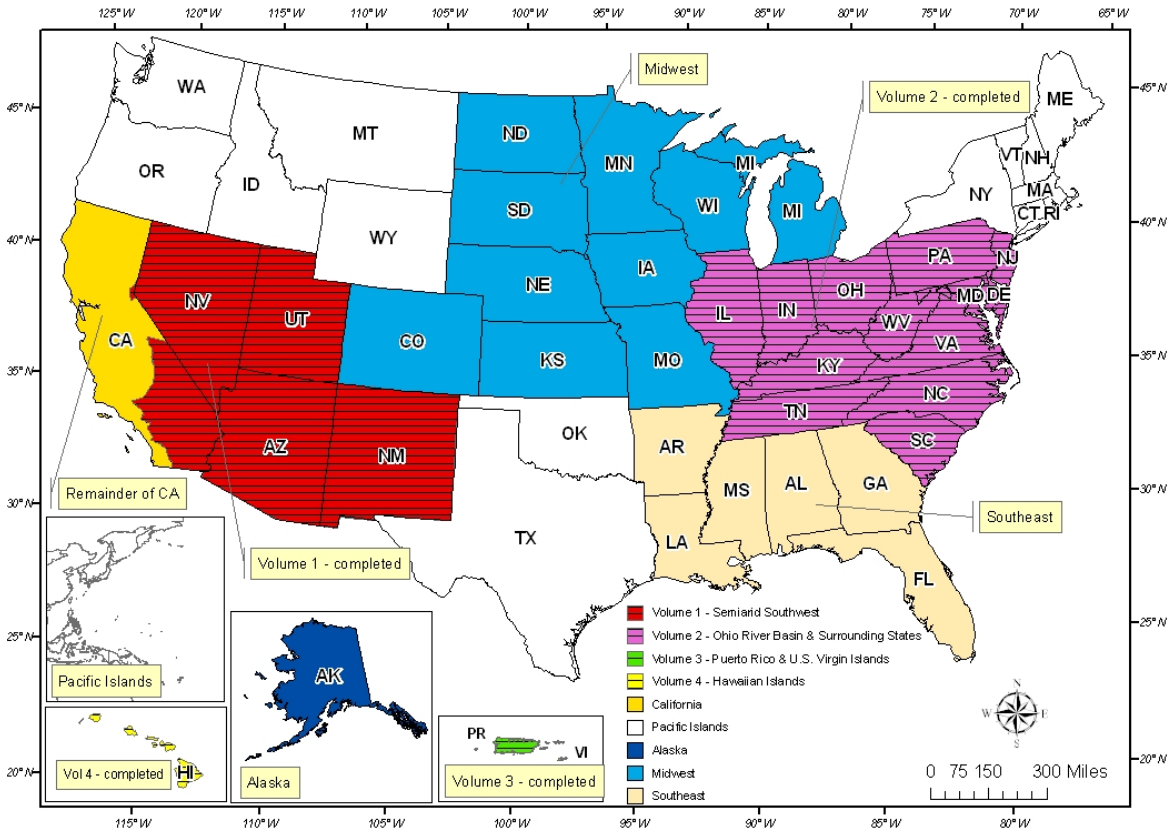

Figure 1. Map showing current project areas and project areas included in NOAA Atlas 14, Volumes 1-4.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR HAWAIIAN ISLANDS

1.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

1.1.1. Publication

On May 29th, HDSC released documentation accompanying NOAA Atlas 14, Volume 4: Precipitation-Frequency Atlas of the United States, Hawaiian Islands. The documentation includes detailed descriptions of the data, temporal distributions of heavy rainfall, seasonality analysis, annual maximum series extraction, quality control and trend analysis, computation of gridded precipitation frequency estimates with 90% confidence intervals, instructions for using Precipitation Frequency Data Server, comparisons with Technical Papers 43 and 51, etc.

The documentation and estimates are available through HDSC's Precipitation Frequency Data Server at http://hdsc.nws.noaa.gov/hdsc/pfds/. The reference for the work is

Perica, S., D. Martin, B. Lin, T. Parzybok, D. Riley, M. Yekta, L. Hiner, L.-C. Chen, D. Brewer, F. Yan, K. Maitaria, C. Trypaluk, G. M. Bonnin (2009). NOAA Atlas 14, Volume 4, Version 2.0: Precipitation-Frequency Atlas of the United States, Hawaiian Islands. NOAA, National Weather Service, Silver Spring, MD.

With the release of the documentation, the work on this project is concluded. This is the final update in the Quarterly Progress Reports.

1.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

This work is concluded and no more activity is planned for the project.

1.3. PROJECTED SCHEDULE

Web publication [Complete]

Web documentation [Complete]

2. PRECIPITATION FREQUENCY PROJECT FOR THE REMAINDER OF CALIFORNIA

2.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

2.1.1. Data collection and formatting

During the past quarter, Alameda County Flood Control District provided HDSC with additional daily, hourly, 5-minute and ALERT data from their county. Daily data from Alameda County, 5-minute data from Contra Costa Flood Control District and Water Conservation District, and 5-minute data from Riverside County Flood Control District were formatted during this quarter. Only the hourly, 5-minute and ALERT Alameda datasets remain to be formatted. Table 1 provides basic information on all datasets, including data type, data source, number of stations in each processed dataset, and current status of data formatting. The numbers of stations are subject to change as we further review the data (eliminate duplicate stations, impose a minimum number of years of data, merge appropriate stations, etc.).

Table 1. List of data types, data sources, number of stations in each processed dataset, and current status of formatting (ALERT data are Automated Local Evaluation in Real Time gauges that measure precipitation using tipping buckets in increments of 0.04 in).

Data Type	Data Source	Number of Stations	Status of Formatting
Daily	National Climatic Data Center (NCDC)	1,356	Complete
	CA Department of Water Resources	382	Complete
	U.S. Army Corps of Engineers	43	Complete
	Santa Barbara County Flood Control District	161	Complete
	LA County Dept. of Public Works	1,180	Complete
	San Diego County Flood Control District	67	Complete
	California Nevada River Forecast Center	553	Complete
	Ventura County Watershed Protection District	104	Complete
	City of Roseville, Dept. of Public Works	6	Complete
	Santa Clara Valley Water District	130	Complete
	U.S. Geological Survey	10	Complete
	Contra Costa Flood Control District and Water Conservation District	15	Complete
	SNOTEL	152	Complete
	NCDC's CLIMVIS Global Summary (Mexico)	33	Complete
	Alameda County Flood Control District	44	Complete
Hourly	National Climatic Data Center	540	Complete
	CA Department of Water Resources	345	Complete
	U.S. Army Corps of Engineers	43	Complete

Data Type	Data Source	Number of Stations	Status of Formatting
	Metro Flood Control District, Fresno	8	Complete
	Jim Goodridge, Retired State Climatologist	337	Complete
	RAWS	250	Complete
	City of Roseville, Dept. of Public Works	5	Complete
	USGS	6	Complete
	SNOTEL	64	Complete
	Alameda County Flood Control District	10	In progress
15-min	National Climatic Data Center	477	Complete
5-min	National Climatic Data Center	24	Complete
	Santa Barbara County Flood Control District	36	Complete
	LA County Dept. of Public Works	62	Complete
	Contra Costa Flood Control District and Water Conservation District	17	Complete
	Riverside County Flood Control District	38	In progress
	Alameda County Flood Control District	TBD	
ALERT	Orange County California Dept. of Parks & Recreation	45	Complete
	San Diego County Flood Control District	67	Complete
	Marin County Flood Control and Water Conservation District	5	Complete
	Alameda County Flood Control District	TBD	

2.1.2. Data quality control

a. Metadata

The quality control of metadata (latitude, longitude, elevation) is complete. We reviewed metadata for stations where the elevation was more than 900 feet different from a 90-meter resolution digital elevation model (DEM), where the latitude and longitude had no seconds, and where otherwise co-located daily and hourly stations had differing metadata. To verify the coordinates and elevations, we referred to the original metadata and data files sent to us, used on-line sources, and in some cases contacted the sources of the data. The effort resulted in 68 corrections. During this process we also identified and corrected a minor issue that occurred during the metadata extraction from the several data files and formatting.

b. Annual maximum series (AMS) extraction

As discussed in the last Progress Report, “wet seasons” are used in criteria for extracting annual maximum series from datasets to extract only reasonable annual maxima from years with missing or accumulated data. The preliminary “wet season” regions were confirmed by assessing monthly histograms of annual maximum events for each region. There are two regions assigned with different wet seasons for the daily data – nearly the entire project area is

November through April and primarily the buffer areas are the entire year. The wet seasons for the hourly data are divided into three regions – the majority of the project area is assigned October through April, the more semiarid areas in the southeast are July to March, and the northern areas are the entire year.

c. **Quality control of AMS**

The 1-day annual maximum series data for 2,026 daily stations with at least 10 years of data were reviewed. High and low outliers were identified and reviewed for consistency relative to data at nearby stations for the given event. Questionable maxima were flagged for further verification.

During the review, the majority of flagged cases came from a single data source, the Department of Water Resources (DWR). Correspondence with DWR suggested that the data had limited quality control and could be excluded in favor of the better quality controlled data received from Jim Goodridge, a former California State Climatologist. In an initial screening that compared station locations, periods of records, and general data quality, 137 out of the 345 hourly DWR stations and 140 out of 382 daily DWR stations were removed from the analysis.

High and low outliers for 1-hour annual maximum series data at 842 hourly stations with more than 10 years of data were also flagged. 780 flagged 1-hour maxima are under review.

2.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

2.2.1. Data formatting

The remaining Alameda data sets will be formatted, thus concluding the data formatting effort for the project.

2.2.2. Data quality control

A comprehensive review of station locations and overlapping periods of record for stations in close proximity for all data types (daily, hourly, 15-minute, and n-minute) will continue during this period. Effort will be made to eliminate remaining duplicate or auto-correlated data and to extend records by merging data from nearby stations. Daily, hourly and 15-minute stations that are in the same location will be evaluated to extend records by aggregating data from the smaller time-step into constrained observations.

AMS data at co-located stations will be investigated and quality controlled for consistency. The quality control for the AMS data for all durations will be completed.

2.3. PROJECTED SCHEDULE

Data collection, formatting and initial quality control [July 2009]

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) [September 2009]

Regionalization and frequency analysis [January 2010]

Initial spatial interpolation of PF estimates and consistency checks across durations [March 2010]

Peer review [April 2010]

Revision of PF estimates [July 2010]

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

Web publication [September 2010]

3. PRECIPITATION FREQUENCY PROJECT FOR SELECTED PACIFIC ISLANDS

3.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

3.1.1. Data collection

HDSC has completed data collection for the project. Previous Progress Reports provide details on the data collection effort. Table 2 provides basic information on the number of stations available in each territory/nation/state per duration that were used in the frequency analysis.

3.1.2. Metadata

Metadata for all stations were carefully investigated for accuracy. Due to a lack of precision in some coordinates, some stations plotted in the ocean rather on land. We made minor corrections to latitudes and longitudes to ensure all stations plotted on land and/or corresponded to metadata received from the PRISM Group.

14 pairs of stations were merged after statistical t-tests confirmed that the hypothesis that data were from the same population cannot be rejected. In addition, where possible, data records were extended at co-located 15-minute, hourly and daily stations by aggregating the shorter time-step to constrained longer durations.

3.1.3. Annual maximum series (AMS) extraction

The procedure for extracting an annual maximum series from a dataset uses a set of criteria designed to extract only reasonable annual maxima from years with missing or accumulated data. One of the criteria is based on comparisons of missing and/or accumulated data with the maximum allowable numbers during a “wet season”. The “wet season” is assigned for a climatologically homogeneous region and is defined as the months in which roughly two-thirds of annual maxima occur. For the entire Pacific Islands project area, a “wet season” of January to December was selected for all durations. The “wet season” was confirmed by assessing monthly histograms of annual maximum events.

To account for the likely failure of capturing the true-interval maxima from constrained (fixed-time) observations, AMS correction factors were calculated and applied to data for 60-minute, 120-minute, 24-hour and 48-hour durations.

3.1.4. AMS quality control

AMS data for all durations were quality controlled by identifying high and low statistical outliers. These outliers were reviewed for consistency relative to data at nearby stations for the given event. Low outliers were removed from the data set. Questionable high maxima were flagged and further investigated using other climatological data and in some cases by contacting local expertise. Any inconsistencies in AMS data at co-located daily and hourly stations were investigated and corrected.

Table 2. Number of stations available in each territory/nation/state per duration.

Abbr.	Territory or nation/state		Island/Atoll	Number of stations (after merge) with at least 10 years of data per duration			
				≥1 day	≥1 hour	≥ 15 min	< 15 min
AS	Territory of American Samoa		Tutuila	11	4	2	1
			Ta'u	1	0	0	0
CNMI	Commonwealth of the Northern Mariana Islands		Rota	2	1	1	0
			Saipan	5	2	2	0
			Tinian	1	0	0	0
FSM	Federated States of Micronesia	State of Chuuk	Lukunoch	1	0	0	0
			Polowat	1	0	0	0
			Weno	1	1	0	1
		State of Kosrae	Kosrae	4	0	0	0
		State of Pohnpei	Mokil Atoll	1	0	0	0
			Nukuoro Atoll	1	0	0	0
			Pingelap Atoll	1	0	0	0
			Pohnpei	6	1	1	1
		State of Yap	Gagil-Tamil	1	0	0	0
			Maap	1	0	0	0
			Rumung	1	0	0	0
			Ulithi Atoll	1	0	0	0
			Woleai Atolls	1	0	0	0
			Yap	4	1	0	1
GU	Territory of Guam		Cocos Island	1	0	0	0
			Guam	17	9	4	1
PW	Republic of Palau		Angaur	1	0	0	0
			Babelthuap	3	1	0	0
			Koror	1	1	0	1
			Malakal	1	0	0	0
			Peleliu	1	0	0	0
RMI	Republic of Marshall Islands		Majuro Atoll	2	1	0	0
			Mili Atoll	1	0	0	0
			Utirik Atoll	1	0	0	0
			Wotje Atoll	1	0	0	0
			Ailinglapalap Atoll	1	0	0	0
			Enewetak Atoll	1	0	0	0
			Kwajalein Island	1	0	0	0
			Jaluit Atoll	1	0	0	0
WAKE			Wake	1	1	0	0
TOTAL				**80**	**23**	**10**	**6**

3.1.5. Construction of homogeneous regions

Precipitation magnitude–frequency relationships at individual stations have been computed using an index-flood regional frequency analysis approach based on the L-moment statistics. Frequency analyses were carried out on annual maximum series (AMS) for durations of 15-

minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day and 60-day. AMS-based precipitation frequency estimates were then converted to partial duration series (PDS) based frequency estimates.

Nonhierarchical cluster method, K-mean algorithm, was used to initially group stations into regions. The set of prospective attribute variables included at-site (standardized) values of: latitude, longitude, elevation, mean annual precipitation, and mean annual maximum precipitation and maximum observed precipitation for duration of interest. Since cluster analysis did not result in significant differences in regional boundaries across durations, it was decided to construct a single set of regions applicable to all durations. Iterative modification of regions was done to reduce discordancy and heterogeneity measures that quantify homogeneity of proposed regions.

3.1.6. Development of at-site depth-duration-frequency curves

Generalized extreme value (GEV) distribution was selected as a representative distribution since according to a goodness-of-fit test based on L-moments suggested by Hosking and Wallis (1997), as well as visual inspection, it provided an acceptable fit to the AMS data across all durations in more regions than any other 3-parameter distribution tested. For a given duration, regional estimates of L-moments were calculated for each region from station specific L-moments weighted by record lengths. The regional L-moments were used to calculate parameters of a regional dimensionless GEV distribution and regional growth factors (RGFs) for selected frequencies. Depth-duration-frequency curves (DDF) of AMS results and of PDS results were then developed for stations by scaling the RGFs by at-site mean annual maximum values.

The precipitation frequency estimates were inspected for inconsistencies across durations and frequencies. Since precipitation frequency estimates at a given station are calculated independently for each duration, it could happen that an estimate for a given frequency is higher for a shorter duration than the next longer duration. Irrational frequency estimates were replaced with estimates that were assigned in proportion to frequency estimates at other durations that were judged reliable.

3.1.7. Spatial interpolation of precipitation frequency estimates

Work on spatial interpolation of precipitation frequency estimates across durations and frequencies started. HDSC acquired geographical information systems (GIS) boundary outlines and DEMs for most islands with stations in the project area. Mapping display issues around the meridian 180˚ were resolved. A working map for the web page was developed in anticipation of the upcoming peer review.

3.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

A peer review of point estimates and spatially interpolated maps for selected durations and frequencies will also be completed by mid-August. Final precipitation frequency estimates with accompanying information is expected to be published by October 1st, 2009.

3.3. PROJECTED 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 PF estimates and consistency checks across durations [July 2009]

Peer review [July 2009]

Revision of PF estimates [August 2009]

Remaining tasks (e.g., development of precipitation frequency estimates for PD series, seasonality, temporal distributions, documentation) [August 2009]

Web publication [September 2009]

4. PRECIPITATION FREQUENCY PROJECT FOR THE SOUTHEASTERN STATES

4.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

A formal agreement for this project with the Federal Highway Administration (FHWA) Pooled Fund Program was signed in April 2009. After funds were transferred to the NWS, the project officially commenced in June 2009. The project covers the states of Alabama, Arkansas, Florida, Georgia, Louisiana and Mississippi in the southeastern United States. An approximately 1-degree buffer around the core states was added to the project area to help homogeneous region delineation for frequency analysis (Figure 2).

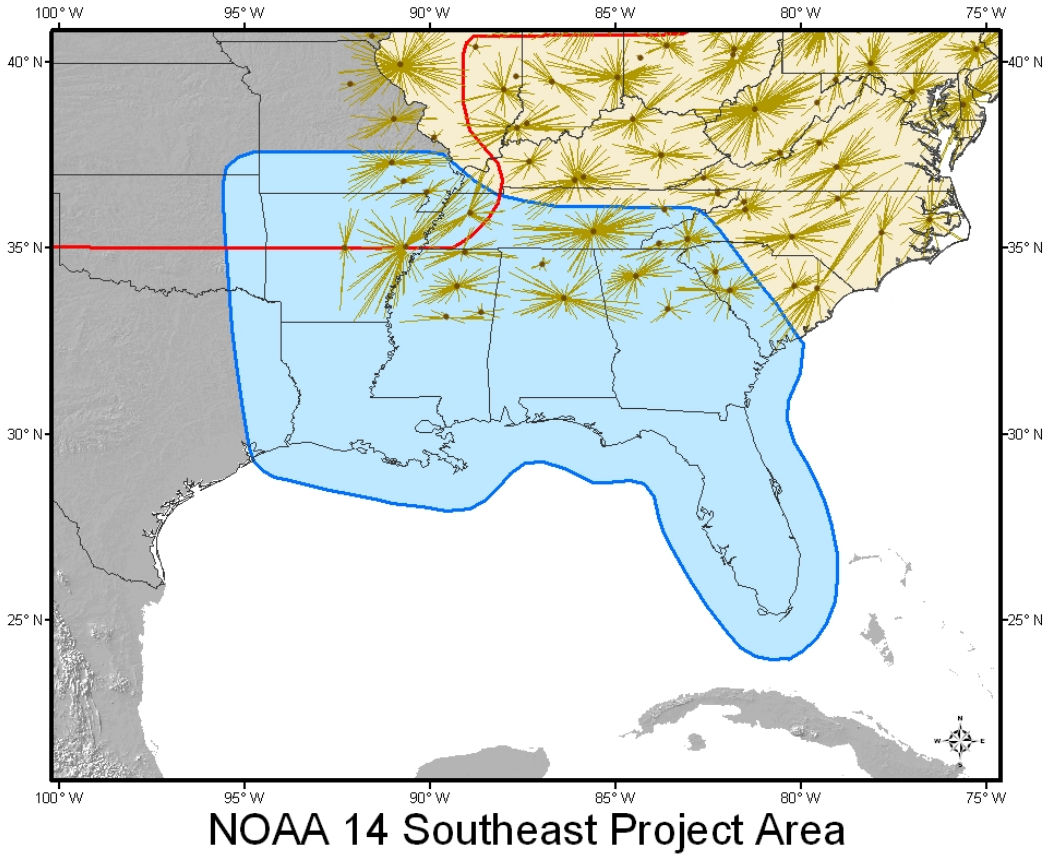

Figure 2. Map showing southeast project area and surrounding buffer. Also shown are regional groupings of stations from NOAA Atlas 14, Volume 2 and border of Midwest project area (red line).

Although the project officially did not start until June 2009, we began exploring potential data sources from responses to a data solicitation email sent on 22 August 2008 to the HDSC list server and other interested parties. Beginning in June 2009, more effort was put toward the project to search for and collect additional data sources. Table 3 provides a current list of potential data sources and their status. If you have or know of any other data sources that are not listed in Table 3, please let us know by email to HDSC.Questions@noaa.gov.

Table 3. Current list of potential precipitation data sources and data types.

Data Source	Data Type	Preliminary Number of Stations	Data Received So Far	Comments
National Climatic Data Center (NCDC)	n-min; 15-min; hourly; daily;	TBD		Downloaded
U.S. Climate Reference Network (NCDC)	15-min; hourly	TBD		
U.S. Geological Survey data	TBD	TBD		
USGS, Georgia Water Science Center	daily	212	Metadata and data	
National Atmospheric Deposition Program (NADP)	daily	89	Metadata and data	
Remote Automated Weather Stations (RAWS)	hourly	TBD	Metadata	
Commercial Agriculture Weather Station (CAWS) Network	TBD	TBD		
ALERT network	TBD	TBD		
Road Weather Information System (RWIS) network	TBD	TBD		
TRMM Satellite Validation Office	TBD	TBD		
Earth Science Office, NASA, Cooperative Huntsville Area Rainfall Measurements (Alabama) http://weather.msfc.nasa.gov/charm	daily	TBD		
Alabama Office of the State Climatologist	TBD	TBD		
Alabama Mesonet/NRCS Soil Climate Analysis Network (SCAN)	TBD	TBD		
Auburn University Mesonet	TBD	TBD		
Cooperative Huntsville Area Rainfall Measurements (CHARM)	TBD	TBD		
Florida Climate Center	TBD	TBD		
Florida Department of Transportation Network	TBD	TBD		
South Florida Water Management District (SFWMD)	15-min; daily	TBD		Contacted
Capital Area Flood Warning Network, Florida	TBD	TBD		
Florida Automated Weather Network (FAWN), University of Florida	15-min	35	Data	
University of Central Florida, Stormwater Academy	TBD	TBD		
Department of Barefoot Bay Water and Sewer District, Florida	monthly	TBD	Data	
Lake Okeechobee Lakewatch Rainfall Monitoring Program, Florida	TBD	TBD		
Natural Resources Management Office, Brevard County, Florida	daily	2	Metadata and data	
Brevard County Utility Services	daily	TBD	Data	

Data Source	Data Type	Preliminary Number of Stations	Data Received So Far	Comments
Department, Florida				
Public Waters and Utilities Administration, City of Melbourne, Florida	daily	TBD	Data	
Georgia State Climatology Office	TBD	TBD		
Georgia Automated Environmental Monitoring Network (GAEMN), University of Georgia	15-min; daily	29	Metadata	
Georgia Forestry Commission Weather Station Network	hourly	22	Metadata	
GeorgiaWx.net Mesonet System	TBD	TBD		
Mississippi State Climatologist	TBD	TBD		
Mississippi Mesonet	TBD	TBD		
Delta Research and Extension Center (DREC) Network, Mississippi	TBD	TBD		

4.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

The main focus will continue to be data acquisition, evaluation, and reformatting, as well as review of related literature.

4.3. PROJECTED SCHEDULE

Data collection, formatting, and initial quality control [August 2009]

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]

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]

5. PRECIPITATION FREQUENCY PROJECT FOR THE MIDWESTERN STATES

5.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Sep 2009)

A formal agreement for this project with the Federal Highway Administration (FHWA) Pooled Fund Program was signed in April 2009. After funds were transferred to the NWS, the project officially commenced in June 2009. The project covers the states of Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin in the central United States. An approximately 1-degree buffer around the core states was added to the project area to help homogeneous region delineation for frequency analysis (Figure 3).

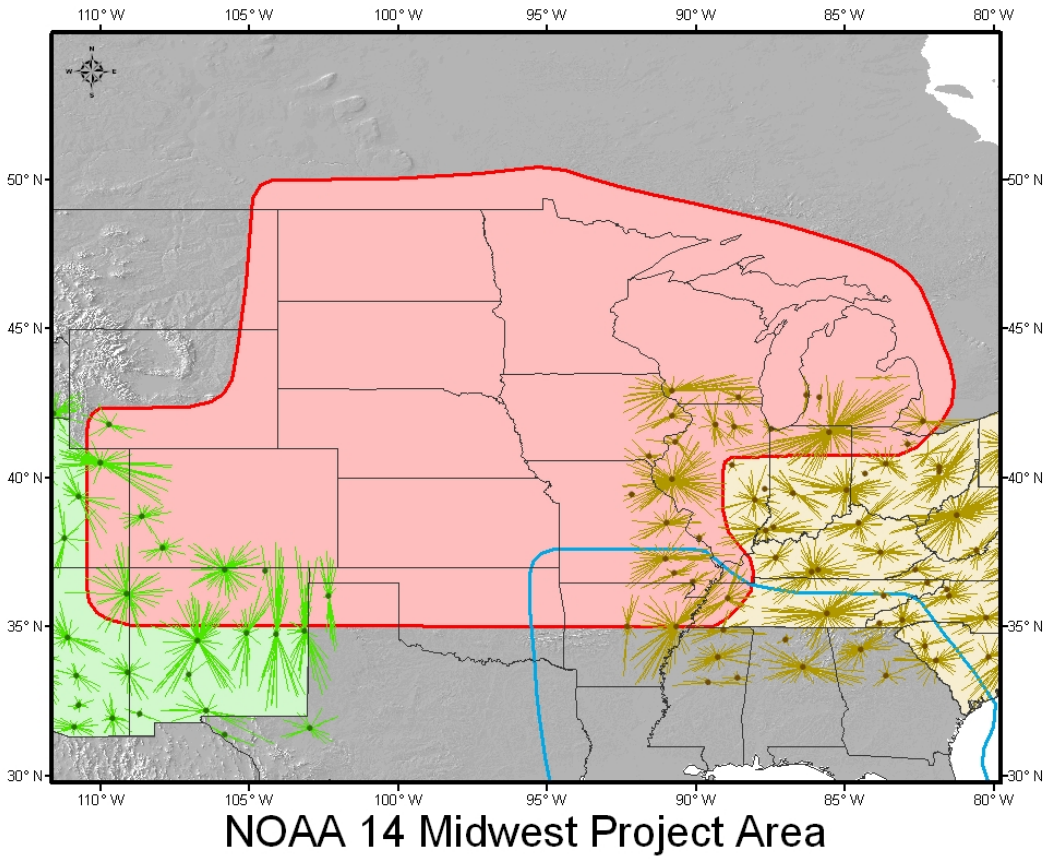

Figure 3. Map showing midwest project area and surrounding buffer. Also shown are regional groupings of stations from NOAA Atlas 14, Volumes 1 and 2 and border of Southeast project area (blue line).

Although the project officially did not start until June 2009, we began exploring potential data sources from responses to a data solicitation email sent on 22 August 2008 to the HDSC list server and other interested parties. Beginning in June 2009, more effort was put toward the project to search for and collect additional data sources. Table 4 provides a current list of potential data sources and their status. If you have or know of any other data sources that are not listed in Table 4, please let us know by email to HDSC.Questions@noaa.gov.

Table 4. Current list of potential precipitation data sources and data types.

Data Source	Data Type	Preliminary Number of Stations	Data Received So Far	Comments
National Climatic Data Center (NCDC)	n-min; 15-min; hourly; daily;	TBD		Downloaded
Canadian Daily Climate Data (CDCD)	hourly; daily	58	Metadata	15 years of data
U.S. Geological Survey data	TBD	TBD		
National Atmospheric Deposition Program (NADP)	daily	163	Metadata and data	
Natural Resource Conservation Service (NRCS) SNOTEL data	daily	109 for Colorado and 3 for South Dakota	Metadata	Downloadable from the internet
Bureau of Reclamation, Colorado, Kansas, Nebraska, North Dakota and South Dakota	daily	41	Metadata and data	
US Army Corps of Engineers, Omaha District Office	hourly; daily	60; 60		
Remote Automated Weather Stations (RAWS)	hourly	86	Metadata and data	
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS)	daily	TBD	Metadata	Expecting the data by July 15, 2009
High Plains Regional Climate Center (HPRCC) Automated Weather Data Network (AWDN)	hourly	160	Metadata	Downloadable from the internet
Commercial Agriculture Weather Station (CAWS) Network	TBD	TBD		6 years of data
ALERT network:				
Overland Park ALERT Precipitation Network (Kansas)	daily	58	Metadata and data	
Fort Collins Utilities Department ALERT System	TBD	TBD		
Urban Drainage Flood Control District (UDFCD) ALERT Weather Station Network	TBD	TBD		
RWIS network:				
Colorado Department of Transportation (DOT) Road Weather Information System (RWIS) Network	TBD	TBD		
Kansas Department of Transportation (DOT) Road Weather Information System (RWIS) Network	TBD	TBD		
North Dakota Department of Transportation (DOT) Road Weather Information System	TBD	TBD		

Data Source	Data Type	Preliminary Number of Stations	Data Received So Far	Comments
(RWIS) Network				
South Dakota Department of Transportation (DOT) Road Weather Information System (RWIS) Network	TBD	TBD		
Colorado Climate Center, Colorado State University				Fee for data; will not use
MesoWest Colorado	hourly	TBD		13 years of data; downloadable from the internet
Colorado Agricultural Meteorological Network (COAGMET)	hourly; daily	46	Metadata	Downloadable from the internet
Northern Colorado Water Conservancy District	TBD	TBD		
Denver Water Network	weekly	TBD		6 years of data
Colorado Springs Utilities Department Network	daily	5	Metadata	
Iowa Environmental Mesonet	TBD	TBD		
Iowa AgClimate Network	hourly; daily;	13		Downloadable from the internet
Kansas State University, State Climate Office	daily	500		Expecting data by August 15, 2009
Southwest Kansas Mesonet	TBD	TBD		7 years of data
Minnesota State Climatology Office, Department of Natural Resources	daily	1544	Sample data	Expecting data by July 31, 2009
Minnesota Department of Transportation	15-min	TBD	Metadata and data	
Metropolitan Council Environmental Services, Minnesota	15-min	TBD	Metadata and data	
Minnesota Climatology Group/High Spatial Density Precipitation Network (HIDEN)	daily	TBD		
University of Missouri, State Climate Office	daily; hourly	28	Metadata	
North Dakota State Water Commission (NDSWC) Precipitation Network	daily	TBD		Downloadable from the internet
North Dakota Agricultural Weather Network (NDAWN), North Dakota State University	10-min; hourly; daily	70; 70	Metadata and data	
Oklahoma Mesonet	5-min; hourly; daily	13 (hourly)	Metadata and hourly data	Downloadable from the internet
Atmospheric Radiation measurement (ARM) Southern Great Plains (SGP)	TBD	TBD		

Data Source	Data Type	Preliminary Number of Stations	Data Received So Far	Comments
Surface Meteorological Observation System (SMOS) Network				
Southeastern Wisconsin Regional Planning Commission, Milwaukee Metropolitan Sewerage District	hourly	21	Metadata and data	

5.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

The main focus will continue to be data acquisition, evaluation, and reformatting, as well as review of related literature.

5.3. PROJECTED SCHEDULE

Data collection, formatting, and initial quality control [August 2009]

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]

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]

6. PRECIPITATION FREQUENCY PROJECT FOR ALASKA

6.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

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

Data from all major reporting agencies have been collected. Three additional data sets were identified and data collection begun. UAF continues to make progress reformatting these datasets. Table 5 provides basic information on datasets: data type, data source, number of stations in each dataset, current status of data collection, and current status of data formatting. This table is subject to change as a result of the quality control process to be performed after all data is collected.

Table 5. List of data types, data sources, number of stations in each dataset, current status of collection, and current status of formatting.

Data Type	Data Source	Number of Stations	Status of Collection	Status of Formatting
Daily	Arctic-Long Term Ecological Research Site (LTER)	3	Complete	In Progress
	Environment Canada	59	Complete	
	Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry)	63	Complete	In Progress
	National Climate Data Center (NCDC)	674	Complete	In Progress
Hourly	Bonanza Creek LTER	2	Complete	Complete
	NCDC	92		
	Environment Canada	29	Complete	
	Arctic Transitions in the Land-Atmosphere System (ATLAS) - UAF	8	Complete	
	Road Weather Information System (RWIS) - Alaska Department of Transportation	13	Complete	In Progress
	Water & Environmental Research Center (WERC) - North Slope	12	Complete	In Progress
	United States Geological Survey (USGS)	TBD		
	Remote Automated Weather Station (RAWS)	142	Complete	In Progress
15-min	NCDC	38	Complete	In Progress
Other	Atmospheric Radiation Measurement (ARM) Program	2	In Progress	
	USGS-Benchmark Glaciers	2	In Progress	
	Circumpolar Active Layer Monitoring (CALM)	28	In Progress	

6.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

The main focus during the next reporting period will be reformatting of collected data and initial quality control.

6.3. PROJECTED SCHEDULE

Data collection, formatting, and initial quality control [September 2009]

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) [January 2010]

Regionalization and frequency analysis [September 2010]

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

Peer review [March 2001]

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]

7. AREAL REDUCTION FACTORS

7.1. PROGRESS IN THIS REPORTING PERIOD (Apr - Jun 2009)

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.

Insufficient time and resources have prevented this project from moving forward, but that is expected to change as HDSC expands its human resources.

7.2. PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jul - Sep 2009)

No progress is expected to be made on this project during the next reporting period. When additional resources become available, HDSC will investigate an approach that utilizes radar-estimated precipitation.

III. OTHER

1. MEETINGS AND PRESENTATIONS

On April 24, Geoff Bonnin and Sanja Perica attended the 124th Meeting of the Joint NOAA/USGS Committee on Hydrology in Silver Spring, MD. Geoff presented an update of HDSC projects during the meeting.

On June 2, members of HDSC attended an Extreme Storm Events Work Group teleconference which discusses probable maximum precipitation for the Advisory Committee on Water Information, Subcommittee on Hydrology.

2. PERSONNEL

On May 29, 2009, well-respected statistical hydrologist, Dr. Bingzhang Lin retired after a 40 year career in hydrology with 20 years at NOAA's National Weather Service and a significant number of those working on precipitation frequency for HDSC. HDSC is currently seeking qualified applicants to fill his position through University Corporation for Atmospheric Research (UCAR).