HYDROMETEOROLOGICAL DESIGN STUDIES CENTER QUARTERLY PROGRESS REPORT

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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with these projects. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended 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 NOAA's National Weather Service is updating its precipitation frequency estimates for various parts of the United States. The projects will determine precipitation frequencies for durations from 5 minutes to 60 days for selected average recurrence intervals. Project results will be published as Volumes of NOAA Atlas 14 on the Internet (http://www.nws.noaa.gov/ohd/hdsc) using the existing Precipitation Frequency Data Server with interactive web pages and with the ability to download digital files.

In addition, HDSC is developing geographically-fixed Areal Reduction Factors (ARFs) for area sizes up to 400 square miles and durations of 30-minutes to 96-hours for the United States. The results of this supplementary study will be applicable to all volumes of NOAA Atlas 14.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY FOR HAWAII

1.1. Progress in this reporting period

1.1.1. Data

a. Partial duration series (PDS) quality control (QC)

HDSC quality controlled partial duration series data using *QCseries*, a tool that identifies maximum precipitation values that are suspect relative to concurrent data at nearby stations using spatial techniques. We checked the 1-hour, 6-hour, 1-day, 7-day, and 60-day durations which will be used in the computation of ratios converting annual maximum series (AMS) based results to PDS based results. The check resulted in eleven data corrections.

b. Annual maximum consistency

At some daily stations, there can be annual maxima for a given year where a shorter duration maximum is greater than the subsequent longer duration value. This occurs as a result of the applied average 1-day to 24-hour and 2-day to 48-hour conversion factors or because there are missing data surrounding the events precluding the extraction of the longer duration. Leaving such cases unadjusted could lead to a negative bias in longer duration precipitation frequency estimates. Investigation suggested that some longer duration maximums did not require adjustment because the data in question were captured in the maximum for the next/previous year (i.e., the event was assigned to the next or previous year). Therefore, HDSC modified existing software to *not* apply the annual maximum consistency adjustment in these cases except where the inconsistency is the result of the conversion factor. We will check cases that are more than about 20% different for data quality before applying the adjustment.

c. Series Extraction

Evidence supports a decision to be stricter when accepting a maximum from an accumulation series (e.g., observers read precipitation gauges on a weekly or monthly basis). Therefore, HDSC is developing a new stricter rule which will likely be such that the accumulation series must be 100% of the duration of interest (i.e., equal or be shorter) to be considered as a potential maximum OR the value extracted from a longer accumulation series must exceed a given threshold by region and by duration.

d. Conversion Factors

HDSC computed conversion factors for 1-day constrained observations to 24-hour unconstrained observations and similarly for 2-day to 48-hour, 1-hour to 60-minute and 2-hour to 120-minutes. We used a weighted average of results at co-located stations from three methods: (1) ratios of 2-year quantiles derived from concurrent annual maximum series, (2) ratios of 2-year quantiles from concurrent monthly maximum series, and (3) regression analysis of the concurrent series. We computed the 1-day and 2-day ratios excluding any data pairs extracted from accumulated data. The results are consistent with expectations and previous studies.

Duration	**Conversion factor**
1hour to 60minute	1.153
2hour to 120minute	1.057
1day to 24hour	1.195
2day to 48hour	1.100

1.1.2. L-moment Analysis

a. Hourly supplemental

Supplemental hourly stations do not have sufficient data to be included in the L-moment computation of regional statistics. However, the means of their annual maximum series will be used to compute precipitation frequency estimates at those locations using the regional growth factors of the region in which they reside. HDSC developed and tested software to compute the estimates at hourly supplemental stations as well as adjust them for consistency with nearby stations.

b. Hourly distribution selection

HDSC reviewed the results from three goodness-of-fit tests for the1-hour, 3-hour, 6-hour and 12-hour durations. We then weighed the goodness-of-fit results against climatologic and geographic consistency considerations to select the most appropriate distribution to model all hourly durations. Sensitivity testing to ensure that results using the selected distribution were acceptable (i.e., changes in 100-year quantiles were less than 5%) supported the use of an alternate distribution. The investigation led to some minor re-regionalization of five stations. The generalized extreme value (GEV) distribution was selected for all four hourly regions.

c. Internal consistency adjustment

HDSC modified existing software to accommodate stations that may have enough data for some daily durations, but not all, due to accumulated data. These stations may drop in and out of durations and so the software that ensures internal consistency at a station through the durations required modification.

1.1.3. Temporal distributions

HDSC developed temporal distributions of heavy rainfall for 1-, 6-, 12-, 24- and 96-hour durations. Draft results and documentation will be available for the next Quarterly Progress Report.

1.2. Problems/concerns

The contract procurement for a spatial interpolation task has required more time than anticipated and may cause a delay in reaching the peer review phase of the project.

1.3. Projected activities for the next reporting period

1.3.1. 1-day AMS cross correlation

In the next reporting period, HDSC will investigate 1-day AMS data for cross correlation between stations to assess intersite dependence. Cases where annual maxima overlap (+/- 1 day) at nearby stations will be analyzed using a t-test for correlation coefficients that are statistically significant at the 90% confidence level.

1.3.2. Longer daily durations

HDSC will inspect annual maxima for a given year at a station for data quality if they are more than 20% different from one duration to the next.

The effort to extract meaningful maxima from accumulated daily data has proven difficult. It will be resolved in the next quarter. We will then evaluate the homogeneity of longer duration data in the daily regions and mitigate any heterogeneity as appropriate. Finally, we will select the distribution to model the daily and longer duration data for each region.

1.3.3. Spatial interpolation

HDSC will submit point 24-hour and 60-minute mean annual maxima to Oregon State University's PRISM Group for spatial interpolation. Once PRISM Group returns the spatially interpolated grids to HDSC, we will develop preliminary 100-year 24-hour and 100-year 60-minute maps for a Peer Review.

1.3.4. Projected schedule

Data quality control [August 2007]

L-moment analysis/Frequency distribution [September 2007]

Peer review of estimates [November 2007]

Spatial interpolation [November 2007]

Web publication [December 2007]

2. PRECIPITATION FREQUENCY FOR THE REMAINDER OF CALIFORNIA

2.1. Progress in this reporting period

2.1.1. Data

HDSC has nearly completed collecting all available precipitation data - daily, hourly, 15-minute, and n-minute. NCDC data have been downloaded. Remote Automated Weather Station (RAWS) Network and SNOTEL data will be obtained. The table below provides a list of local contacts and potential datasets received as of June 30th, 2007.

List of potential data sources, data types (where type of data can be monthly (Mly), daily (Dly) , hourly (Hly), 15-minute, n-minute, Automated Local Evaluation in Real Time (ALERT)) is given in the following table.

Contact	Data Type	Quality Control	Data Received	Format
U.S. Army Corps of Engineers, Sacramento District	Dly, Hly	Some	01/18/07	ASCII Text
Jim Goodridge, Retired State Climatologist	Dly, Hly	Some	02/06/07	ASCII Text
Ventura County Watershed Protection District	5-min	Good	02/14/07	ASCII Text
LA County Dept. of Public Works	Dly	Good	03/13/07	ASCII Text
California Nevada River Forecast Center	ALERT	Good	03/20/07	ASCII Text
County of San Diego Flood Control	ALERT	None	03/21/07	Micr. Access
County of San Diego Flood Control	Mly, Dly, Hly, 5-min	Good	03/21/07	Micr. Access
Riverside County Flood Control District	5-min	Good	TBD	ASCII Text
California Dept. of Parks and Recreation	ALERT	Some	5/22/2007	ASCII Text
Metro Flood Control District, Fresno	Hly,15-min	Good	5/8/2007	ASCII Text
Santa Barbara County Flood Control District	Dly, Hly, 5-min	Good	Early July	ASCII Text
CA Department of Water Resources, Division of Flood Management	Dly, Hly	Some	4/16/2007	ASCII Text

2.2. Problems/concerns

2.2.1. Contractual concerns

The formal agreement between HDSC and the California Department of Water Resources for this project is delayed. Once this is resolved, work can fully commence. Resolution is anticipated in the July-August timeframe 2007.

2.3. Projected activities for the next reporting period

2.3.1. Data

HDSC will compile metadata for each station and evaluate any data overlap, in which case we will use the dataset that has undergone the most quality control. We will format and prepare the data for quality control and begin a check of extreme values exceeding thresholds for the 1-day and 1-hour data.

2.3.2. Projected schedule

Data collection [September 2007]

Data quality control [December 2007]

Regionalization (24-hour and 60-min) [January 2008]

L-Moment analysis/Frequency distribution (all durations) [March 2008]

Peer review of estimates [June 2008]

Spatial interpolation [October 2008]

Web publication [November 2008]

3. AREAL REDUCTION FACTORS

3.1. Progress in this reporting period

3.1.1. Data

To compute areal reduction factors (ARFs) a dense network of rain gauges with a long period (10+ years) of concurrent hourly precipitation data is necessary. This allows the statistical calculation of both point and areal precipitation depths from which ARFs can be computed. HDSC has identified thirty-five potential networks across the United States, but only 18 have sufficient data (both spatially and temporally) to be considered usable ARF networks. Of these 18, we have preprocessed and begun the quality control for six networks.

3.1.2. L-moments

a. Methodology

HDSC is finalizing and testing a methodology to compute the ARFs. The method is an empirical method based on the annual maximum areal and point precipitation series. Based on these series, L-moments are used to compute the annual exceedance probabilities (AEPs) of the point and areal precipitation at each station. The ARF is simply the areal depth divided by the point depth at the same AEP. Based on this methodology, we computed preliminary results for Chicago, IL.

b. Consistency checks

As part of ongoing quality control, HDSC has undertaken consistency checks to ensure areal precipitation, point precipitation and relationships between them are consistent among durations, area sizes and AEPs.

3.2. Problems/concerns

3.2.1. Computational resources

The use of a geographical information system (GIS) to spatially distribute and analyze the precipitation for discrete events is among the many strengths of our ARF method, however it requires a lot of computer time/power. We are assessing our computer resources and developing a plan to process the networks efficiently.

3.3. Projected activities for the next reporting period

3.3.1. Data

HDSC will complete the processing and quality control ARF network data. We will seek additional networks if regional ARF differences are detected and need to be resolved.

3.3.2. L-moments

HDSC will finalize and optimize the ARF method, including the L-moment procedures during the next reporting period. We will compute and analyze ARF results for the various networks. Consideration will then be given to regional differences in ARFs.

3.3.3. Projected schedule

Data collection and quality control [October 2007]

L-Moment analysis/Frequency [December 2007]

Peer review [January 2008]

Web publication [March 2008]

III. OTHER

1. Meetings/Presentations

Geoff Bonnin presented a paper, *Updates to NOAA Precipitation Frequency Atlases*, (authors Geoffrey M. Bonnin, Deborah Martin, Bingzhang Lin, Tye Parzybok, Michael Yekta, David Riley, Lillian Hiner, Daniel Brewer) at the ASCE/EWRI World Environmental and Water Resources Congress in Tampa, Florida, in May 2007.

2. Personnel Changes

Some personnel changes have occurred within HDSC. As of June 1, 2007, Deborah Martin became an off-site contractor. She will still continue as an integral member of the team contributing to all facets of the precipitation frequency work. After nearly eight years with HDSC, on June 18th, David Riley moved to the

Hydrometeorology Group within the Hydrologic Science and Modeling Branch (HSMB) of the Office of Hydrologic Development (OHD). On June 18th, Dr. Sanja Perica became HDSC Group Leader with the title Director, Hydrometeorological Design Studies Center which was previously held by Geoff Bonnin, who remains as Branch Chief of HSMB. Dr. Perica is a civil engineer with an extensive practical, research and academic teaching background in hydrology, statistical hydrology and hydrometeorology.