Updating California Precipitation Frequency Estimates

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BIOGRAPHICAL SKETCH

Geoff Bonnin is Chief of the Hydrologic Science and Modeling Branch of the U.S. National Weather Service, Office of Hydrologic Development. He manages science and technique development for flood and stream flow forecasting and water resources services provided by the National Weather Service. The work of the group includes development and maintenance of U.S. precipitation frequency estimates. Geoff initiated the development of NOAA Atlas 14 and was lead author for the first three volumes.

Geoff Bonnin graduated B.E. (Civil) from the University of Queensland, Australia and M.S. (Engineering Management) from the University of Kansas. He is a Chartered Member of the Institution of Engineers Australia and a member of the American Society of Civil Engineers. He has extensive experience in flood forecasting and flood forecast systems development with the U.S. National Weather Service and the Australian Bureau of Meteorology. He also has extensive experience in software engineering and systems integration in private industry. His primary areas of expertise are in data management as the integrating component of end-to-end systems, the science and practice of real time hydrologic forecasting, estimation of extreme precipitation climatologies, and the management of hydrologic enterprises. Mr. Bonnin is one of the developers, and the primary implementer, of Standard Hydrometeorological Exchange Format (SHEF).

ABSTRACT

The rainfall frequency atlases and technical papers published by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) serve as de-facto national standards for rainfall intensity at specified frequencies and durations in the United States. This presentation reports on the status and schedule for updating frequency estimates for the part of California not currently included in NOAA Atlas 14 Volume 1. It includes a discussion of the user survey and decision to continue producing 1,000 year average recurrence interval estimates, the potential impact of climate change on the estimates, and a discussion of the status of Federal guidelines for probable maximum precipitation estimates for the United States.

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Hydrometeorological Design Studies Center

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NOAA's National Weather Service

Topics

- **NOAA Atlas 14 Intro and Status**
- **California Schedule**
- **Data Collection**
- **1,000 Year Estimates**
- **What About Climate Change?**
- **PMP Issues**

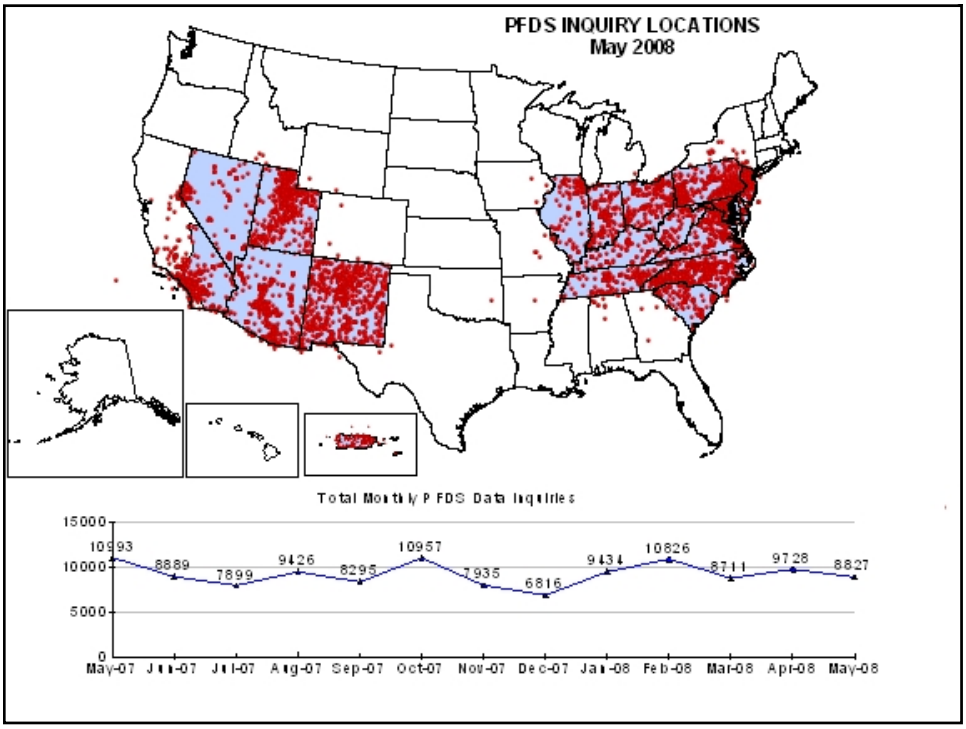
Precipitation Frequency Estimates

- **Durations**
  - ***5 minutes to 60 days***
- **Average Recurrence Interval**
  - ***1 to 1,000 years***
- **High Resolution Spatial Estimates**
  - ***30 arc second***
- **Confidence Limits**
  - ***upper and lower 90%***

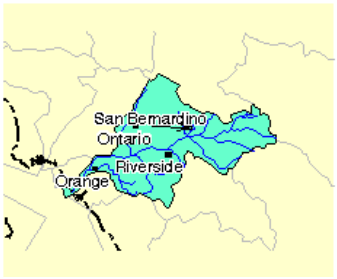
Web Based Products & Delivery

- **"Precipitation Frequency Data Server"**
  - **www.nws.noaa.gov/ohd/hdsc**
- **Interactive Tables and Charts**
- **High Quality Maps Produced Using GIS**
- **Base Grids**
  - ***Shapefiles, ASCII Grids, ArcInfo & STDS compatible***
- **Areal Reduction Factors**
- **Temporal Distributions**
- **Documentation**

NOAA Atlas 14 Status



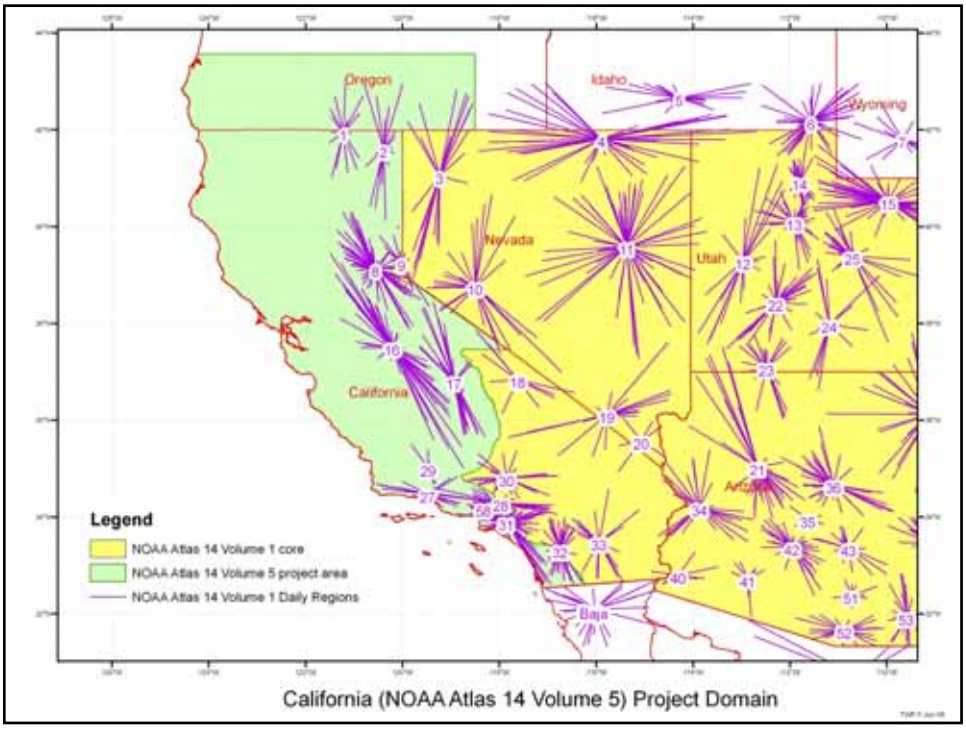
PFDS Example: Prado Dam



Input Page

Output Page

Confidence Intervals



California (NOAA Atlas 14 Volume 5) Project Domain

California Tasks/Schedule

- **Data quality control**
  - ***September 2008***
- **Regionalization and frequency analysis for 1-hr and 24-hr AMS**
  - ***December 2008***
- **Development of precipitation frequency grids for 1-hr and 24-hr durations based on PRISM**
- **Peer review of estimates**
  - ***February 2009***
- **Regionalization and frequency analysis for other durations**
  - ***February 2009***
- **Development of precipitation frequency grids for all durations based on PRISM deliverables**
  - ***April 2009***
- **Remaining tasks and web publication**
  - ***July 2009***

Daily Data Collected

Type of data	Data Sources	Number of Stations	Status of Formatting	Comments/Notes
Daily	NCDC	1225	Done	Data thru 2007 obtained.
	CA Department of Water Resources	411	Done	
	U.S. Army Corps of Engineers, Sacramento District	43	Done	
	U.S. Army Corps of Engineers, Oregon	61	In progress	
	Santa Barbara County Flood Control District	62	Done	
	LA County Dept. of Public Works	591	Done	
	Jim Goodridge, Retired State Climatologist	1	Done	
	County of San Diego Flood Control	91	Done	
	California Nevada River Forecast Center	650	Done	6-hour ALERT data were accumulated to daily.
	Ventura County Watershed Protection District	104	Done	
	SNOTEL	152	Done	

Hourly Data Collected

Type of data	Data Sources	Number of Stations	Status of Formatting	Comments/Notes
Hourly	NCDC	509	Done	Data thru 2006 so far
	CA Department of Water Resources	495	Done	
	U.S. Army Corps of Engineers, Sacramento District	43	Done	
	Metro Flood Control District, Fresno	8		
	Jim Goodridge, Retired State Climatologist			Metadata will be compiled as the data are formatted.
	RAWS	367 in CA; 72 in OR	In progress	
	USGS	11		Nevada only
	SNOTEL	66		

Sub-Hourly Data Collected

Type of data	Data Sources	Number of Stations	Status of Formatting	Comments/Notes
15-min	Metro Flood Control District, Fresno	8		
	County of San Diego Flood Control			
	USGS	12		3 from OR; 9 From CA
5-min	Ventura County Watershed Protection District	105		
	Santa Barbara County Flood Control District	49		
	LA County Dept. of Public Works	41	Done	
	Riverside County Flood Control District			
ALERT	California Dept. of Parks & Recreation (Orange Cnty)	45		
	County of San Diego Flood Control	70	50% done	

1,000 Year ARI Estimates

- **October, 2007 we asked:**
  - ***"HDSC is considering discontinuing the publication of 1,000-year precipitation frequency estimates because of the severe uncertainty associated with computing such extreme events. We'd like to get your opinion regarding the use and understanding of 500-year and 1,000-year precipitation frequency estimates. Are these estimates being used, and if so, for what purpose?"***
- **122 individuals responded**
- **November, 2007 we advised:**
  - ***".. there is enough demand for the estimates for us to continue to publish them. However, we do intend to expand upon our discussion of the uncertainties of these estimates and also provide more statistical uncertainty information."***
- **Responses published (anonymously)**
  - ***hdsc.nws.noaa.gov/hdsc/pfds/docs/1000-yr_responses.pdf***

Typical Comments

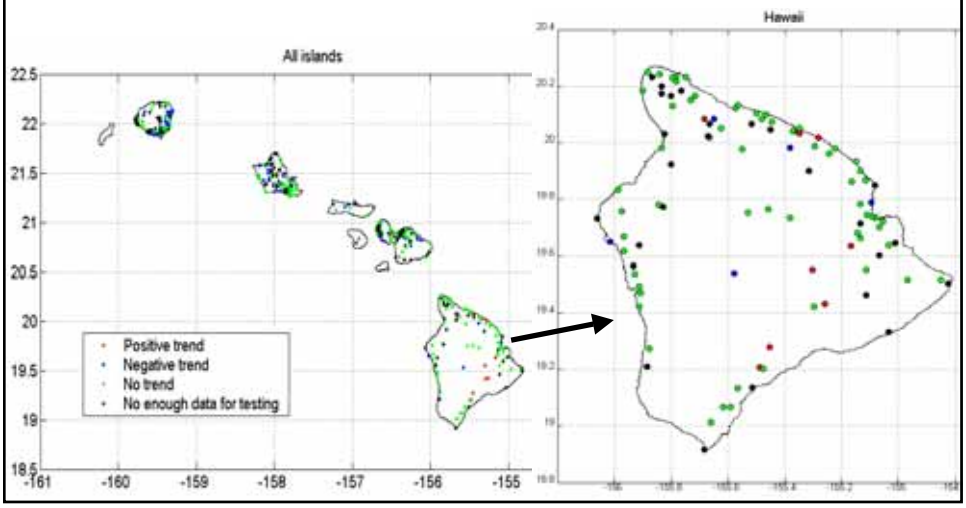
- **When the level of safety becomes an increasing concern, the 500 and 1000-yr events are the legitimate choice.**
- **For most Flood Insurance Studies and Flood Damage Reduction Studies, we have to provide 500-year flood profiles at a minimum with some Corps of Engineer Districts computing 1000-year or greater.**
- **The 500 and 1,000 year precipitation events are used commonly for the design of spillways and other flood control measures. This information is routinely utilized by civil engineers in the planning and operation of canals, spillways, flood walls, and other hydraulic structures. The Corp of Engineers, FEMA, and Bureau of Land Reclamation are among the Federal agencies that utilize the information in the publication of standards and design guidelines.**
- **The Flood Control District of Maricopa County would appreciate HDSC CONTINUING to publish the 1,000-year precipitation frequency estimates.**
- **In California, the Division of Safety of Dams (DSOD) requires a minimum design storm with a return period of 1:1,000 years for the dams under their jurisdiction.**
- **I [USACE] have polled our field offices and received a variety of opinions on this proposal. …. Based on the input I received the 500-year is absolutely critical and we need the weather service to continue to provide it and we would like to see precipitation estimates provided up to 1000 yr precipitation estimates.**

What about Climate Change?

- **Impact on PF from observations is small**
  - ***compared with error in estimation***
- **OHD studied point time series**
  - ***no spatial coherence***
- **NCDC studied groups (areas)**
  - ***clearer signal***
  - ***quite small***
- **Climate Models**
  - ***change is small through 50 years***
  - ***change is large in 100 years***
  - ***large difference between models and between forcings***
    - **swamps uncertainty**
    - **applies only down to 200 km resolution**
- **Use unadjusted historical data**
  - ***Continue study***

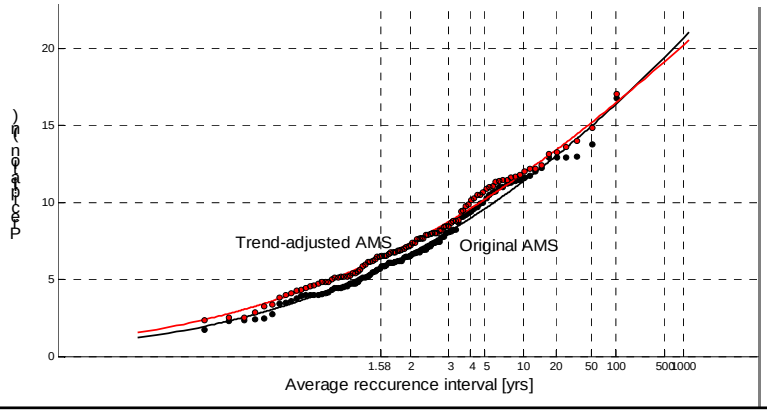
Trend Analysis

- **Nonparametric tests on annual max series**
  - ***Test at-site, but investigated spatial patterns***



Effect of Trend Removal

- **At site adjustment:**
  - ***Difficult to predict consequence***
    - **e.g.: for site 15-1303 estimates for T > 50 yr decreased after trend was removed (variability and skewness decreased)**
- **Regional adjustment for site 15-1303:**
  - ***Adjustment is minor***



PMP Issues

- **Funding for NWS PMP activity ceased**
  - ***~ late 1990s***
- **Funding was from Federal water agencies**
- **Last Publications were for California**
  - ***HMR 58 (1998) & 59 (1999)***
- **Federal water agencies now concerned**
  - ***Particularly USACE, BUREC & Nuclear Regulatory Commission***
- **Federal Advisory Committee on Water Information, Subcommittee on Hydrology**
  - ***Examining options***
  - ***No money has been forthcoming***