Future Colorado Basin Observing System

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Western Water Assessment

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Outline

- Previous gaps analyses
- Common threads?
- Where do we go from here?

Previous Gaps Analyses

Several studies have examined the Colorado Basin observing system:

- Proposed Enhancements to the Colorado River Basin Data Network (NWS, 1983)
- Western States Watershed Study (2009)
- Analysis of Watersheds Monitored by the USGS streamflow-gaging station Network in the Upper Colorado River Basin (USGS, 2011)
- A Vision of Future Observations for Western US Extreme Precipitation Events and Flooding: Monitoring, Prediction, and Climate (NOAA, 2011)
- NRCS Studies

1983 Studies

- "describes the requirements analysis made by the NWS for the design and implementation of an automated real-time data network… In today's fast-paced, high-tech environment, it is quite difficult to describe accurately…"
- "To improve [CBRFC forecasts requires models] that require real-time data from the entire basin to produce the best possible river forecasts… in two parts:"
  - Lower elevation NWS GOES data sites
  - Higher elevation SNOTEL
- CBRFC conceptual models "used in a limited sense" include "Extended Streamflow Prediction" for Lake Powell inflow forecasts.
- **"The sparse real-time data network is a primary deficiency found by the CBRFC in using conceptual models"**

NWS/SCS COST SUMMARY

I. Implement an Automated Real-time Data Network:

		ONE-TIME COST	RECURRING COST
1.	Site Survey Costs	$ 60,875.	
2.	Equipment Procurement	2,023,604.	
3.	Equipment Installation	110,405.	
4.	Maintenance Recurring Costs	117,162.	$ 182,762.
5.	Training	4,165.	
	Total	$2,316,211.	
	Recurring Each Year		$ 182,762.

II. Implement Modern Physical Hydrologic Forecasting System:

		ONE-TIME COST	RECURRING COST
1.	Increase staff at CBRFC from 5 to 8 Professional Hydrologists (3 people)		$ 97,500.
2.	Data Analysis		$ 150,000.
	Total		$ 247,500.
	Grand Total Capital Cost	$2,316,211.	
	Grand Total Recurring Cost		$ 430,262.

	ONE-TIME COST	RECURRING COST
III. Option for Procuring a Direct Readout Ground Station	$ 50,000.	$ 10,000.

Western States Watershed Study, 2009

USACE led compilation of data collection system requirements for networks important for western water issues including:

- Streamgage
- Ground Water
- Precipitation
- Snow
- Evapotranspiration

Recommends sustaining support for key networks including USGS stream gaging, NWS COOP, snow remote sensing, and ET networks and leveraging new technologies where appropriate.

Also recommends establishment of a water data portal or hydrologic information system (HIS) through CUAHSI.

USGS 2011

Analyzed stream gage network for representative of gaged watersheds to all watersheds in the UCRB. Found:

- Unregulated watersheds well represented by gage network but not underrepresented by active network
- Regulated watersheds well represented by gage network

Gage network includes 1,053 stream gages of which 223 were active in 2010.

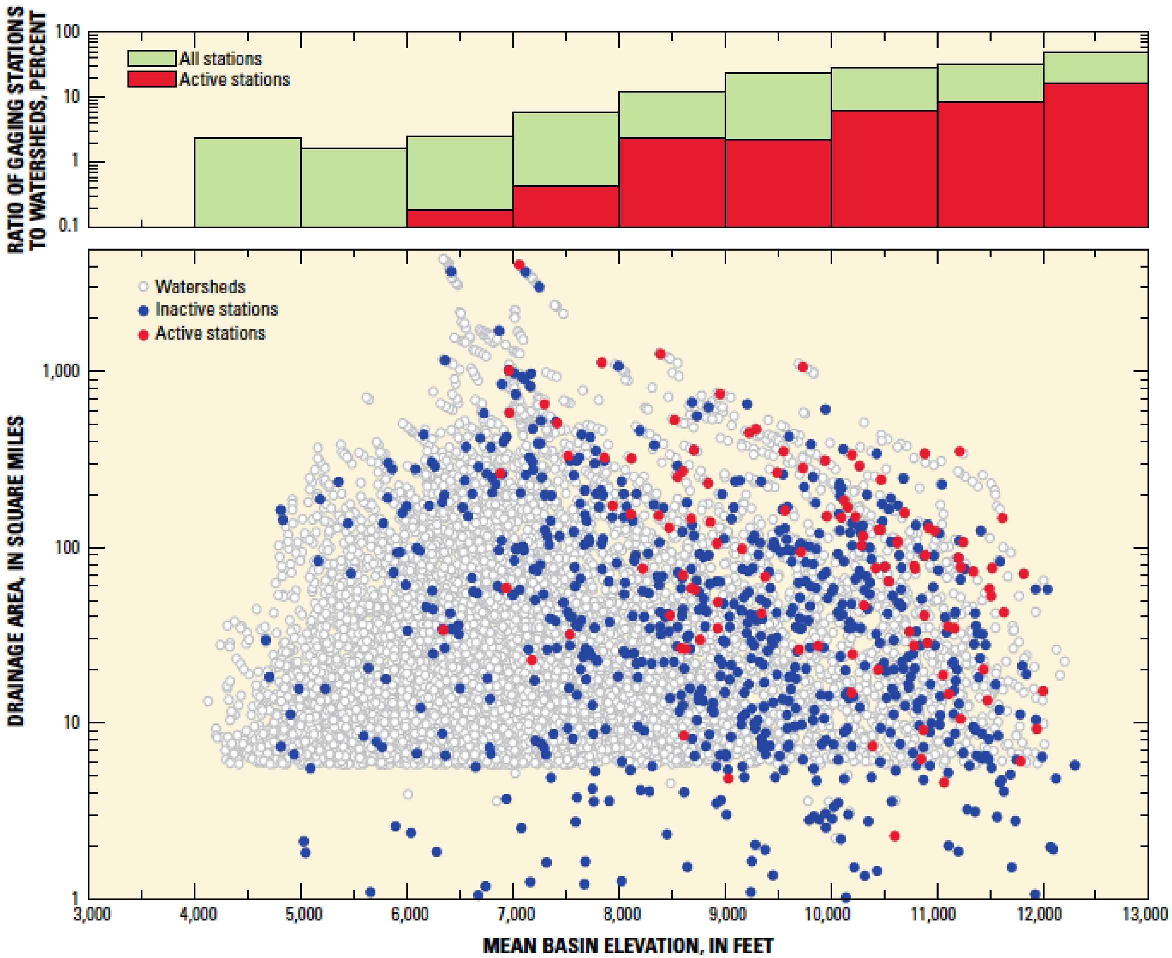


Figure 11. Mean drainage basin elevation for watersheds and U.S. Geological Survey streamgage locations in the Upper Colorado River Basin that are unaffected by reservoir regulation.

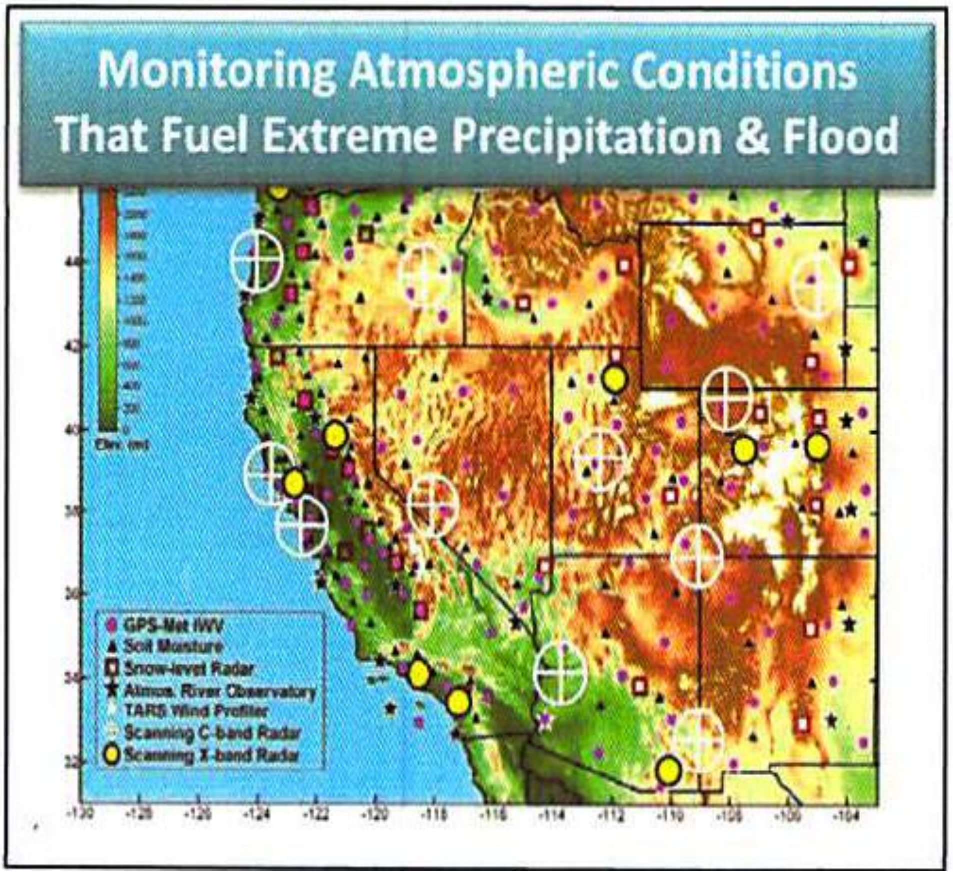
Table 2. Watershed and climatic characteristics.

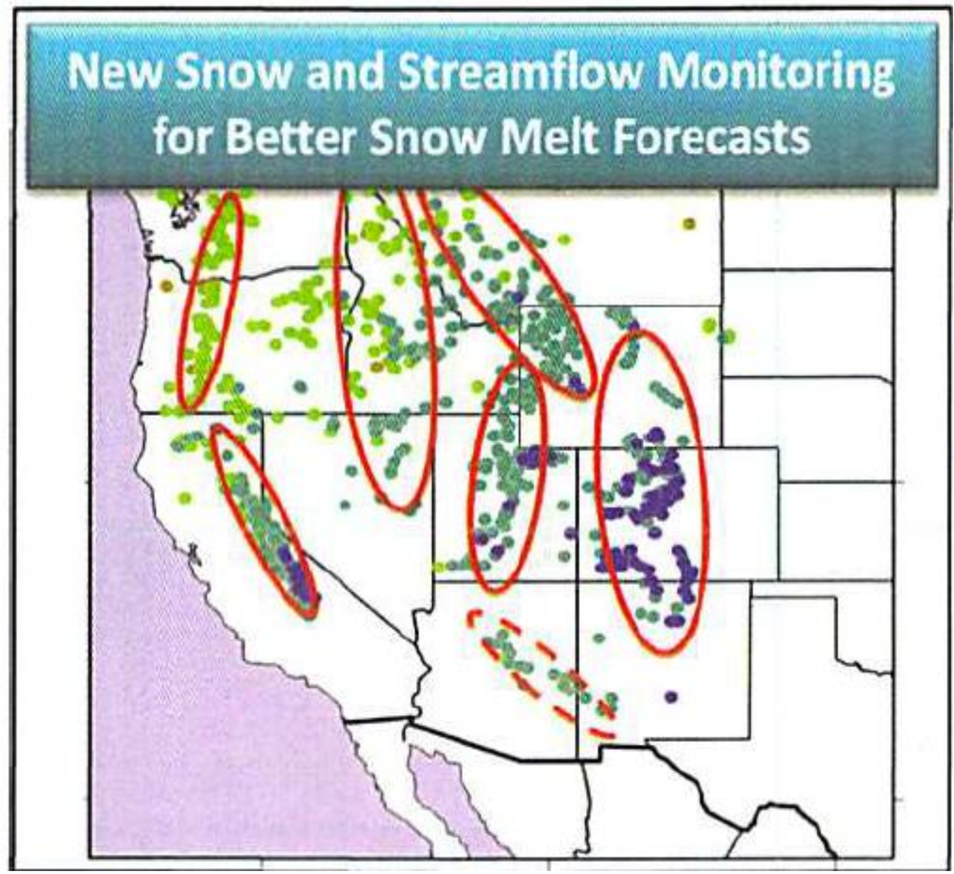
[NED, National Elevation Dataset; PRISM, Parameter-elevation Regressions on Independent Slopes Model; NLCD, National Land Cover Dataset]

Characteristic	Units	Datasets used
Mean basin elevation	Feet	NED
Mean basin average annual precipitation	Inches	PRISM 1971–2000 annual averages
Land Cover		
Area covered by developed land	Percent	2001 NLCD
Area covered by barren land	Percent	2001 NLCD
Area covered by deciduous forest	Percent	2001 NLCD
Area covered by evergreen forest	Percent	2001 NLCD
Area covered by mixed forest	Percent	2001 NLCD
Area covered by shrubs, young or stunted trees	Percent	2001 NLCD
Area covered by grass or herbaceous land	Percent	2001 NLCD
Lithologic classification		
Igneous and metamorphic	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
Sedimentary, basin fill (continental)	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
Sedimentary, carbonate (marine)	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
Sedimentary, clastic, Mesozoic	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
Sedimentary, clastic (continental), Tertiary	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
Sedimentary, mixed (continental and marine)	Percent	Geologic map of United States, 1:500,000-scale digital geologic maps of Arizona, Colorado, New Mexico, Utah, and Wyoming.
2000 population density	People per square mile	U.S. Geological Survey, 2000 population density by block group for the conterminous United States
Road density	Miles per square mile	U.S. Geological Survey, The National Map: Transportation

NOAA 2011 (Ralph et al)

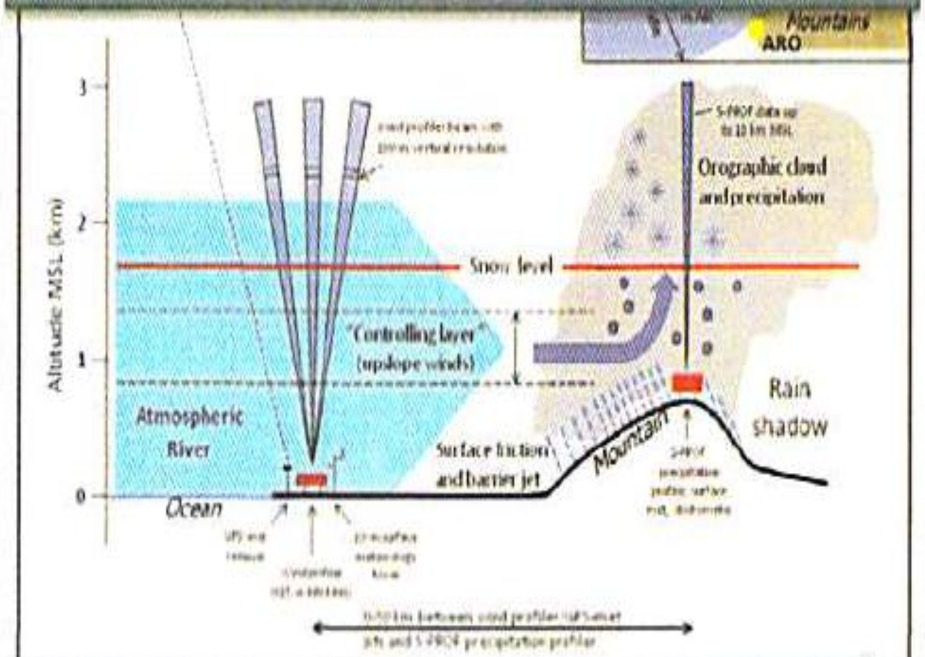
A Vision of Future Observations for Western U.S. Extreme Precipitation and Flooding: Monitoring, Prediction and Climate





Offshore Monitoring to Extend Forecast Lead Times for Extreme Precipitation

Atmospheric River Observatories to Fill Largest Single Monitoring Gap



NRCS

- New software developed with Portland State (PSU) to help identify data deficient areas for new site location, with an eye towards more physically based hydrology models
- Automation of existing manual snow course network yields hourly vs. monthly data, decrease in travel costs
- Automating aerial markers with snowdepth and temperature
- Developing new automated daily QC program with PSU to improve timeliness and consistancy

Common Threads

- Importance of observing systems – especially snow and streamflow
  - Maintenance
  - Strategic expansion to address representativeness
  - New technology (e.g. snow remote sensing)
  - Enhanced sensors (solar, soil moisture, wind)
- Monitoring atmospheric conditions overland and sea critical to shorter lead forecasting
- Efforts are not cheap
- Major events (e.g. 1983) can be powerful motivators

Discussion

- To what extent is the current observing system sufficient?
- Can prolonged drought (e.g. 2000s) be as powerful a motivator as flooding (e.g. 1983)?
- Is there critical mass for addressing observing system deficiencies? If so, where to go from here?