WATER SECTOR EXTREME EVENTS
Research Topics List for Priority Setting

October 29–30, 2012

Instructions:
The objective of the workshop will be to develop research plans for the selected topics that can then be used to prepare grant proposals, plan budgets, develop collaborations, and other actions. We would like to leave the meeting with solid plans for advancing viable research on extreme events that can inform resource management.

To get to this end, we will focus discussions on about 6 topics (more/less depending on time). At the beginning of the workshop, we will collectively decide on which of these topics we will focus. We have compiled a started list of potential topics (listed and categorized below) from recent meetings with resource managers and researchers. Some of the topics may be best addressed in combination or modified, and therefore further grouping or subdividing may be needed. Also, this is not an exhaustive list. We encourage you to propose new topics. Base your selections on the following criterion:

- Research that is currently feasible
- Research that is currently relevant and timely for resource managers
- Research that is fundable
- Research where a clear path forward can be developed
- Research that needs more visibility and that may be currently overlooked

Potential Research Topics

Atmospheric rivers (ARs)

- Investigate the impacts of AR durations and trajectories on precipitation and streamflows (flooding), as well as the conditions that allow ARs to penetrate inland.
- Develop capacity in forecasting which ARs will make landfall and where, as well as their landfall duration and velocity.
- Develop capacity in predicting ARs. (i.e. Can we predict the number of AR events and the number of those striking land in a given year; can we identify thresholds or boundary conditions for the occurrences of ARs?)
- Design an offshore AR observing network(s) to improve forecast lead times, among other related research interests.
- Investigating the role of ARs as drought-busters, or conversely, their absence as an indicator/predictor of drought.

Climate variability and extreme events

- Better characterize the atmospheric patterns that have historically produced extreme events and investigate these patterns' relationships to the Pacific Decadal Oscillation (PDO), the El Niño–Southern Oscillation (ENSO); also investigate if natural patterns constrain the magnitude, timing, and frequency of extreme events.

- Enhance understanding of the relationship between the Arctic Oscillation and the Madden Julian Oscillation (MJO) and West Coast weather; investigate how MJOs and other tropical waves influence West Coast extremes.
- Diagnose the cause of the apparent regime shift in the frequency of large floods in the Sacramento River Basin that occurred at approximately 1950, drawing, perhaps, on information from other river basins that exhibit similar patterns (e.g. American River Basin and other northern Sierra basins) and/or from rivers outside the Sacramento Basin (e.g. Coast Range drainages, Great Basin/intermountain West).
- What are the reasons behind the wet and dry periodicity (detected at lower frequencies) observed in the 1,000+ year reconstructed Colorado River streamflow record; can these periodicities be exploited for streamflow prediction.

Coastal

- Develop studies and models that analyze the effects of sea-level rise, storm surges, and tides on estuarine inundation during winter storm events in the Sacramento Bay Delta.

Floods, flood frequency analysis

- Develop an extreme event Testbed that would be used to test alternative methodologies for flood frequency analysis.
- Evaluate the use of alternative frequency distributions (other than Log Pearson Type III) and extreme value theory as potentially better approaches than the LPTIII methodology prescribed in the federal Bulletin 17B for flood frequency analysis. The shortcomings of Bulletin 17B with respect to non-stationary hydrology and outliers in the distribution are well known. [See the discussion on flood frequency analysis in *Improving American River Flood Frequency Analysis*, NRC 1999].
- Characterize the conditions needed to produce extreme floods in rivers draining the Sierra Nevada.

Forecasting (all time scales)

- Update and develop statistical models for climate forecasts at intraseasonal to interannual time scales [next to improvements in weather forecasting this action would be one of the most useful near-term outcomes for resource managers; the availability of reanalysis data back to the 1870s roughly doubles the historical record that could be used for analysis].
- Improve predictability of winter season dry periods (e.g. blocking highs off the West Coast).
- Develop metrics for early detection of climate regime shifts, thresholds, or tipping points [e.g. at what point are empirical regression equations for snowmelt runoff no longer valid in a particular basin of basins].

Observations

- Pilot ways to incorporate satellite-based estimation of precipitation, in conjunction with ground-based observations, into existing water operations applications [applications could be to augment station coverage for real-time flood forecasting or to develop gridded data sets for watershed model simulations].
- Develop approaches that facilitate the use of remotely-sensed estimates of snow-covered area and/or snow water content in operational water supply forecasting—the use of satellite images can help overcome limitations imposed by sparse high elevation monitoring stations.

Probable Maximum Precipitation (PMP)

- Examine how climate change might be incorporated into PMP analyses.