SacPAS: A Real Time Decision Support System to Predict and Assess Operational Benefits and Risks to Central Valley Salmon

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Problem statement:

The volume of cold water is insufficient to protect all early life stages of temperature-sensitive Chinook salmon. Prior to the spawning season, Reclamation develops a water release schedule based on the weather forecasts. Currently, the forecasts and schedules are difficult to update over the fish spawning and rearing seasons and there are limited analytical tools and models to assess the impacts of their water schedules on fish survival and distribution.

Approach:

The work, funded by and in collaboration with Reclamation, is developing a decision support system that links a real-time data management system with models to forecast the progress and movement of salmon from spawning through smolt migration. Our immediate focus has been on winter-run Chinook salmon, but already there are applications which will be useful across multiple CVP-operated rivers. The web-accessible system has advanced through rapid prototyping and extensive interagency interaction to configure a system operating for Columbia River Salmon for over a decade.

Results:

In its first year, the project has established a website (http://www.cbr.washington.edu/sacramento/) with extensive operational queries and alert functions and models to predict egg emergence and smolt migration. Currently, forecasting complete egg to Delta movements is limited by the information available to define movement behavior of fish in fry and smolt stages. However, the current model will be able to identify critical uncertainties and their impact on forecasting fish movement and survival in their freshwater life stages.

Relevance:

This system provides a foundation for in-season predictions useful for adaptive management that will monitor fish response, integrate these new movement behavior data, and further quantify benefits and risks of management decisions on salmon populations.

Keywords: cold water management, Chinook salmon, forecast, spawning, rearing
Session Title: Environmental Models
Session Time: Thursday 3:15 PM – 4:55 PM, Room 314

Hydrodynamic Modeling of Flood Hazards for the Southern Eden Landing Portion of the South Bay Salt Pond Restoration Project

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The former Cargill Salt Ponds at southern Eden Landing are being restored to a combination of tidal wetlands and managed ponds. The Project objectives include enhanced wetland habitats, flood control, and wildlife-oriented public access. The project site is bordered by the Old Alameda Creek to the north and the federal Alameda Creek Flood Control Channel (ACFCC) to the south. The commercial and residential properties to the east are in a FEMA flood hazard area. Unlike some of the other former salt ponds being restored in the Bay Area, these flood hazard zones are subject to significant flooding from both riverine and tidal sources. An understanding of flooding from both these sources is a key component of the 2,269-acre restoration.

AECOM used the 2-dimensional MIKE21 Flexible Mesh model to design restoration features including levee breaches and channel dimensions, levee raising and lowering heights, and culvert sizes and quantities. Modeling results showed an unanticipated flood path where the 100-year return period flooding overtops the farthest downstream mile of the federal ACFCC levees. Flood waters travel back upstream along the backside of the ACFCC levee through existing Alameda County-owned wetlands and ponds outside of the restoration boundaries. Levee improvement configurations were chosen to avoid funneling the riverine flooding through non-project wetlands onto Alameda County or Cargill property; instead, the future wetlands will support detention of large riverine events reducing upstream flooding depth and extent.

Hydraulic connectivity was balanced with flood control objectives, especially in the selection of culvert sizes and locations along the ACFCC levee. Breaching of the federal ACFCC levee is not an option without federal de-authorization; however, connection to the ACFCC is critical for fish passage to the wetlands. Natural-bottom culverts are proposed to maximize restoration success, while preventing high flood volumes from entering the ponds and overtopping back levees.

Keywords: hydrodynamic modeling wetland restoration flood control recreation public access levee
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Session Time: Thursday 3:15 PM – 4:55 PM, Room 314

Seismic Hazard in Sacramento-San Joaquin River Delta using UCERF3 Source Models and NGA-West2 Ground Motion Models

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The Sacramento-San Joaquin Delta Region is host to a variety of critical infrastructure that may fail during an earthquake, however, the most recent seismic hazard analyses performed for the region utilized source and ground motion models (GMMs) now recognized as outdated. These analyses were performed for the Delta risk management strategy project (DRMS, 2007 and 2009). They used seismic source models (WGCEP, 2003; Cao et al., 2003) and GMMs (Power et al., 2008) that have since been replaced. These studies present conflicting findings regarding the dominant seismic sources for Delta hazard, in one case (DRMS, 2009) reporting distant sources (e.g. Hayward, Calaveras and San Andreas =faults) as controlling the hazard, whereas in another case (DRMS, 2007) relatively local faults (Northern Midland zone, and Southern Midland fault) were also listed as major contributors. Since that time, a number of the local faults near the Delta region have been better characterized, and GMMs have been improved significantly through the NGA-West2 project (Bozorgnia et al. 2014).

We have re-computed the seismic hazard for this important region. Hazard is computed at various return periods for the intensity measures of peak ground acceleration (PGA) and velocity (PGV). We use the UCERF3 (Uniform California Earthquake Rupture Forecast) model of Field et al. (2014). UCERF3 considers several faults not included in previous inventories, including the Dunnigan Hills and Clayton faults. PGAs at selected locations, for the 500-year return period exceed those from prior studies by about 15%. We show that relatively proximate faults (e.g. Pittsburg-Kirby Hills, Midland, Green Valley, and Dunnigan Hills) dominate the PGA and PGV hazard at the 500-year return period. These results are relevant for engineers and policy makers involved in risk assessment and development of mitigation strategies for this critical region.

Keywords: Hazard map, UCERF3 Source Models, NGA-West2 Ground Motion Models
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Modification of the WARMF Model to Track Pollutant Sources from the Delta to their Upstream Sources

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Natural resource managers must manage pollutant loads within the Delta and its tributary watersheds to maintain the suitability of surface waters for their designated uses. The Watershed Analysis Risk Management Framework (WARMF) is a comprehensive watershed model and decision support system which has been used to track the loading of salinity, organic carbon, nutrients, phytoplankton, and suspended sediment from the upstream watersheds to the Delta. A shortcoming of this type of analysis is that it is often difficult to accurately quantify the contribution of individual pollutant sources to concentrations in the Delta. Tabulating the loading to the river at the source does not account for processes which attenuate or magnify load before it reaches the Delta. Between upstream sources and the Delta, pollutants can be removed by diversion, decay, and settling. Resuspension of sediment can increase loads. Upstream phytoplankton loading can be magnified by growth. The WARMF model was recently upgraded with a postprocessor, called Gowdy Output, to address this shortcoming. The Gowdy Output algorithms track pollutant loads from their individual sources (tributaries, land catchments, and point sources) to a downstream location specified by the user, allowing managers to assess the relative impact of upstream loading sources on Delta water quality for each day of the simulation. From upstream to downstream along a reach of river, the fractions of loading from each upstream source are tracked with a mass-weighted average for every day of the simulation. The load is then attenuated based on the model output for the river segment. The calculation is repeated for each downstream river segment. This approach focuses load reduction strategies on those sources which have the greatest impact on downstream water quality. The presentation will focus on the use of Gowdy Output as part of the ongoing San Joaquin River real-time salinity loading management.

Keywords: WARMF, Watershed Modeling, Watershed Management, Water Quality, Pollutant Source Assessment
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Session Time: Thursday 3:15 PM – 4:55 PM, Room 314

Integrated Environmental Modeling of Estuarine Systems

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Models are essential in organizing scientific thinking and communicating the results in an unbiased and comprehensible way – with assumptions clearly stated and uncertainty quantified. Models encapsulate our current knowledge, give a framework for integrating new knowledge, aid in evaluating alternative futures, and should be regularly updated. This paper builds from a set of presentations, software demonstrations, and roundtable brainstorming during a three-day symposium on integrated modeling of estuarine systems. The symposium held in 2015 at UC Davis, brought expertise from around the world and across California. We explored how models could be advanced more rapidly, informing revisions of monitoring programs, accelerating knowledge discovery, and communicating model results to agencies and those responsible for making management decisions of large estuarine systems. The concept of a *collaboratory* is proposed that includes physical space, a virtual network and a structure that can draw together modeling experts from across disciplines, organizations and geographic areas to tackle identified problems. Examples could be refined algorithms, constructive comparisons of different modeling approaches or articulations of alternative futures.

Keywords: environmental modeling, data infrastructure, collaboratory, integration, hydrodynamics, estuarine systems management
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