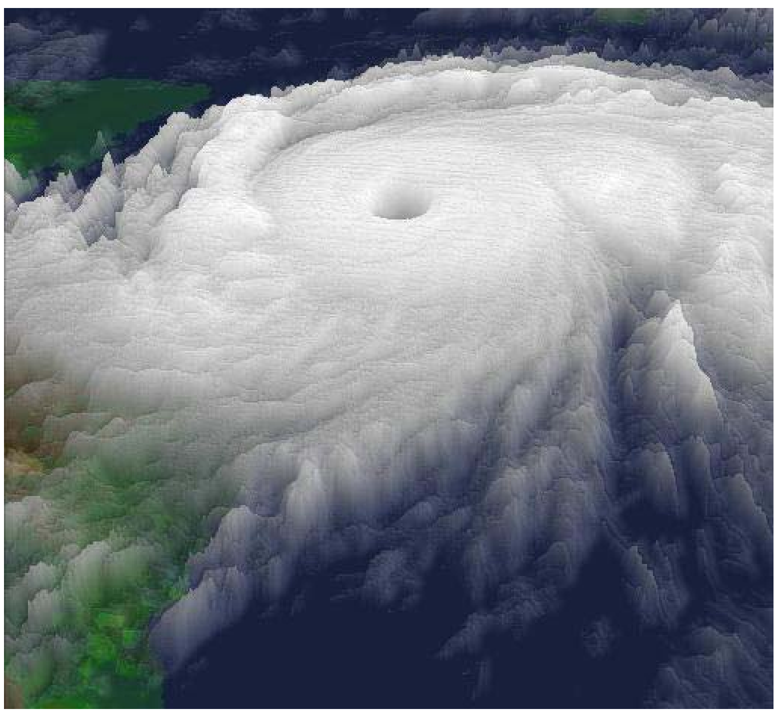
California Water and Environmental Modeling Forum

2010 Annual Meeting Abstracts

"Modeling in the Eye of the Storm"



February 22-24, 2010

Asilomar Conference Grounds
800 Asilomar Boulevard
Pacific Grove, California

California Water and Environmental Modeling Forum
2010 Annual Meeting Summary of Sessions

Monday, February 22, 2010

Time	Session	Moderator	Location
10:15 am-12:00 pm	1: Modeling for the California Water Plan	Rich Juricich	Fred Farr
	2: 2009 DSM2 Developments and Applications	Nicky Sandhu	Kiln
12:00-1:00 pm	Lunch	---	Dining Hall
1:15-3:00 pm	3: Water Management Responses to Climate Change, Delta Restoration and Drought	Rich Juricich	Fred Farr
	4: Apps of Multi-Dimensional Delta Models for Studies of the 2-Gates Project, Delta Smelt and Salinity Intrusion	Pete Smith	Kiln
3:00-4:00 pm	Registration I / Check-In	---	Social Hall
4:15-6:00 pm	5: Flood Modeling	Michael Mierzwa	Fred Farr
	6: Bay-Delta Conservation Plan Modeling Activiites	Parviz Nader	Kiln
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-10:00 pm	7: Evening Program: Reception I and Poster Session	---	Fred Farr
7:30-8:30 pm	Keynote Speaker: Ellen Hanak, PPIC, “Efficiency and Equity Considerations for the New Delta”	Jay Lund	

Tuesday, February 23, 2010

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-9:15 am	8: CWEMF Activities / Annual Business Meeting	Paul Hutton	Fred Farr
9:15-10:00 am	9: Pop-Up Talks I: 5-Minute Overviews of Modeling Work	Nigel Quinn	
10:15 am-12:00 pm	10: Climate Change: Eyeing the Storms of the Future I	Jamie Anderson	Fred Farr
	11: Water Temperature Modeling at Multiple Scales	Mike Deas	Kiln
12:00-1:00 pm	Lunch	---	Dining Hall
1:15-3:00 pm	12: Climate Change: Eyeing the Storms of the Future II	Jamie Anderson	Fred Farr
	13: Wetlands Modeling	Nigel Quinn	Kiln
3:15-4:00 pm	14: Pop-Up Talks II: 5-Minute Overviews of Modeling Work	Stacy Tanaka	Fred Farr
3:15-4:00 pm	Registration II	---	Social Hall
4:15-6:00 pm	15: Development Updates of CalSim 3.0	Sushil Arora	Fred Farr
	16: Remote Sensing and Synthetic Aperture Radar (SAR)	Ted Swift	Kiln
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-10:00 pm	17: Evening Program: Reception II	---	Fred Farr
7:30-8:30 pm	Career Achievement Award / Presentation by Recipient	Rich Satkowski	
8:30-9:30 pm	Special Speaker: Ralph Cheng, USGS—Retired, “Hydrodynamic Modeling used in Forensic Investigations”	Tara Smith	

Wednesday, February 24, 2010

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-10:00 am	18: Delta Solutions Modeling	Jay Lund	Fred Farr
	19: IWFM & IDC 2008-2009 Enhancements and Apps	Tariq Kadir	Kiln
10:15 am-12:00 pm	20: San Joaquin River Restoration: Modeling Tools for River Management	Peter Vorster	Fred Farr
	21: Techniques for Optimizing Conjunctive Use of Surface and Ground Waters	H. Morel-Seytoux	Kiln
12:00-1:00 pm	Lunch / Check-Out	---	Dining Hall
1:15-3:00 pm	22: HydroGeoSphere: 2009 Enhancements and Apps	George Matanga	Kiln

2010
Annual Meeting
Abstracts

Monday, February 22, 2010

10:15 a.m.-12:00 p.m.

Session One: Modeling for the California Water Plan

Moderator: Rich Juricich (CA DWR)
Location: Fred Farr Forum

What's New with the Water Portfolios **Todd Hillaire (CA DWR)** **7.4 MB**
The completion of California Water Plan Update 2009 marks a milestone in the ongoing development of the Water Portfolios with the 1998 through 2005 analyses now available. Update 2009's Water Portfolios contain a comprehensive data analyses and results for water year conditions in terms of developed supplies, uses, storage, and other factors characterizing the hydrologic picture. A discussion of the results in Update 2009 will help to identify the types of data and analysis characterizing these water year conditions. Looking ahead at Update 2013, new data analysis tools will consist of implementing an urban water model, a comprehensive agricultural and management wetland water use model, and a water supply database.

Results of Future Demand Scenarios using the WEAP Model for California Water Plan Update 2009
Mohammad Rayej (CA DWR) **0.7 MB**

In the past few years, the California Department of Water Resources has developed statewide future water demand scenarios using the Water Evaluation And Planning system model (WEAP) in support of California Water Plan Update 2009. Representation of 10 Hydrologic Regions, methodologies and assumptions were presented last year at the CWEMF Annual Meeting and at other venues. Results will be presented describing future agricultural, urban and environmental demand through year 2050 under 3 alternative growth scenarios. Change in future demand with a repeat of historical climate as well as range of impacts under the 12 climate change scenarios will be discussed. The 12 climate change scenarios used are consistent with those in Governor's Climate Action Team report.

A Climate Driven Model of the Water Resources of the Sacramento and San Joaquin Hydrologic Regions: Hydrologic and Demand Response to Climate Change **5.8 MB**
David Purkey (Stockholm Environment Institute)

The Water Evaluation And Planning (WEAP) system is an integrated water basin analysis tool. It is a simulation model that includes a robust and flexible representation of the main features of water management systems. The tool integrates hydrologic processes into a water resources modeling framework such that climatic inputs can be used to drive the model. This allows for the consideration of how changes in precipitation and temperature may impact water supplies (through changes in snow melt and runoff patterns) and water demands (through changes in crop evapotranspiration). The WEAP system was used to develop a model of the Sacramento and San Joaquin Hydrologic Regions. This talk will present the organization of this model in an effort to capture the major hydrologic flows, represent major demographic and land use trends, and evaluate the effects of water management responses.

Discussion: Analytical Improvements for Water Plan Update 2013 and Beyond 1.5 MB
Rich Juricich (CA DWR)

With California Water Plan Update 2009 headed to the printers, work begins on Update 2013. Proposed technical deliverables for Update 2013 will be presented and the process by which these deliverables will be vetted with stakeholders. The vision for these deliverables was developed after extensive discussion beginning with the Water Plan Update 2005 and continuing in Update 2009. Chapters 5 and 6 of Volume 1, Update 2009 provide a detailed discussion about desired technical improvements based on discussions with the Water Plan Steering Committee, Advisory Committee, Statewide Water Analysis Network (the technical advisory group for the Water Plan), and feedback from regional workshops conducted across the state. Time will be reserved to allow for CWEMF participants to provide recommendations for Update 2013 technical improvements.

Session Two: 2009 DSM2 Developments and Applications

Moderator: Nicky Sandu (CA DWR)
Location: Kiln

Calibration of DSM2 for the Bay Delta Conservation Plan, Chandra Chilmakuri (CH2M Hill)

Preliminary DSM2 modeling analyses for the Bay Delta Conservation Plan indicated a need for improving DSM2's capability of accurately simulating tidal flows in the Sacramento River near Cache Slough region. BDCP is considering the construction and operation of the new diversion intakes on the Sacramento River and large-scale restoration of tidal marsh in the Cache Slough region. The ability to accurately simulate tidal flows and salt transport in this region is of particular importance for the BDCP. The previous calibration of DSM2 did not include observed Liberty Island flooding which caused noticeable impact on the hydrodynamics in the north Delta. As part of this recalibration effort the DSM2 grid from the 2000 calibration was modified to incorporate flooded Liberty Island. DSM2 HYDRO and QUAL were successfully calibrated with the observed flow, stage and EC. The recalibration effort resulted in a marked improvement in the performance of DSM2-HYDRO and DSM2-QUAL throughout the Delta.

Nutrient Modeling with DSM2/QUAL: Historical Results 1990–2008 with a Focus on Ammonia, Marianne Guerin (RMA)

Ammonia is a nutrient of special interest and controversy in the Delta as some researchers have hypothesized a connection between ammonia dynamics and the pelagic organism decline (POD). Given its history of use in the Delta for modeling salinity and dissolved oxygen dynamics, DSM2/QUAL's nutrient model was a natural choice to develop as a tool for investigating the fate of ammonia and other nutrients in the Delta. QUAL's conceptual model incorporates eleven constituents – nine nutrients including ammonia, plus salinity and temperature – with 31 global parameters for nutrients, seven global parameters for meteorology, and 16 nutrient parameters set regionally. As waste water effluent is an important source of nutrients in the Delta, incorporating these new boundaries in addition to the standard boundaries for the 19 year model period was a herculean task - over 200 new boundary conditions were set, and regional nutrient parameters were set in six sub-regions. I'll show calibration results for selected nutrients and temperature, and discuss pros and cons in using QUAL for modeling nutrients in the Delta.

DSM2 Sediment Transport Model (STM): A Technical Overview, Fabian Bombardelli (UC Davis)

Obtaining a better understanding of transport phenomena in aquatic environments is not only an endeavor of academic interest, but also is motivated by a clear need for providing more reliable tools to assist engineers and decision makers in the water resources management arena. The Sacramento-San Joaquin Delta is facing an environmental "crisis," as a result of non-sustainable practices which date back to several decades. There are numerous proposals for the future Delta, some of which will involve changes to the flow and sediment transport in the network of rivers. DWR has special interest in providing answers to problems associated with sediment transport in the Delta, such as the assessment of turbidity distribution for fish, sediment motion due to levee breaches, transport of sediment-bound metals, etc. Based on that interest, a project is currently under way to provide the well-known DSM2 code with capabilities for simulating sediment transport. The new module will be called DSM2-Sediment Transport Module (DSM2-STM), which will add to current modules HYDRO, PTM and QUAL. STM is based on an Eulerian framework and is intended as a sediment and constituent transport module having second order of accuracy in space. Equations for sediment in suspension, and bed-load, including entrainment and deposition, are solved. The module will address both cohesive and non cohesive sediment transport, but it will be developed for the simulation of other constituents as well, with the expectation of replacing QUAL in a future time. In addition, the code development is assisted by a rigorous testing at the computational science level. This presentation discusses the essential theoretical/numerical components of the module, the tests developed to validate it, the tests developed for long-term code maintenance, and future work. Co-Authors: Jamie Anderson, Kaveh Zamani, Eli Ateljevich, Kevin Kao, Niky Sanhu (CA DWR)

DSM2 Version 8, Eli Ateljevich (CA DWR)

DSM2 Version 8 was released late last year. The model is faster and more robust, features user prescribed operating rules, has gates and for control of gates and inflows, uses a more readable format for transferring data between modules and an input system amenable to version control. The model is on a much faster release cycle, with an increasingly unified approach to deployment, version control and fixes. This talk is an update on new features, the areas of current enhancements and fixes, and some of our experiences with the new model.

1:15-3:00 p.m.

Session Three: Water Management Responses to Climate Change, Delta Restoration and Drought

Moderator: Rich Juricich (CA DWR)
Location: Fred Farr Forum

Water Management Lessons for California from Statewide Hydro-Economic Modeling using the CALVIN Model **Jay Lund (UC Davis)** **2.2 MB**

This paper presents the results of a decade of quantification and analysis of this system from a hydroeconomic perspective. The paper focuses on the general approach, management and policy insights, and promising directions that consistently emerge from these analyses. Limitations and suggestions for improving hydro-economic modeling for providing insights into contemporary and future water management problems in California also are presented.

Economic Impacts of Climate-Related Crop Yield Changes in California **1.5 MB**
Josué Medellin-Azuara (UC Davis)

Agriculture in California is driven by the interactions among technology, resources, and market demands. Production decisions result from the balance between the rates of change in these three factors. We estimate the economic effects of climate change on California crop farming. With dry climate warming yields may decline and costs increase. These effects may be partially offset by higher crop prices if California maintains its dominant market position. Although yield reductions vary, results show significant revenue losses for farming activity in California. The Statewide Agricultural Production Model (SWAP), was used to estimate revenue impacts. The base regional cropping pattern was established using geo-referenced data of land use in 26 regions of California. In 2050 dry climate change compared with historical conditions, results in reductions of water of 20%, in irrigated area from 17 to 28 percent, and in revenues from 10.5 to 16.3 percent. Changes in crop prices and productivity cause changes in total revenue counteracting climate and water availability related changes. Revenues across all regions are reduced under climate change, as is water usage. While the effect of climate change is manifest through yield changes, water supply and market shift effects dominate. Results on irrigated crop production are predominately from changes in aggregate land and water use. Rather than a projection, results should be considered probable outcome of the interaction of several uncertain driving forces.

[An Assessment of CVP-SWP System Performance Under Alternative Delta Regulations, Infrastructure and Climate Change Scenarios Using CalSim II]() **Francis Chung** **0.5 MB**

[Using CalSim II Climate Change Scenario Output for Regional Water Management Modeling Using the DWR Least Least-Cost Planning Simulation Model (LCPSIM)]() **Ray Hoagland** **0.5 MB**

This paper provides a preliminary assessment of the future performance of the CVP and SWP systems. Modeling tool used for the analysis is CalSim-II, CVP/SWP System Planning Simulation Model, developed jointly by DWR and USBR. The paper discusses and quantifies the effects of Delta health, climate change, and drought. The focus on current and future challenges is then followed by a discussion and quantification of potential facilities management responses. The paper focuses on potential effectiveness of two infrastructure improvements – new Delta conveyance and new storages. Due to uncertainty in climate change projections, twelve climate change scenarios, selected by Climate Action Team for their 2008 Report, have been investigated for one Future scenario under a dual conveyance system the Delta and new storages. Also vulnerability of the current system under an extreme climate change scenario has been presented. In addition, using DWR's urban economics model (LCPSIM), paper also discusses and quantifies potential water management responses in the South Coast Region. As formulation of future water management facilities evolves, assessment of system performance should be re-evaluated.

Session Four: Applications of Multi-Dimensional Delta Models for Studies of the 2-Gates Project, Delta Smelt, and Salinity Intrusion

Moderator: Pete Smith (USGS—Retired)
Location: Kiln

Overview of the Delta 2-Gates Project and the Scientific Underpinnings and Modeling, Pete Smith (USGS—Retired)

The 2-Gates Fish Protection Demonstration Project is a 5-year adaptive management experiment proposed by the Metropolitan Water District of Southern California and the San Luis & Delta-Mendota Water Authority to test the effectiveness of using two operable gates installed in the central Delta to reduce delta smelt entrainment at the federal and state pumps. Specific gate operations are proposed to manipulate flow and turbidity on Old and Middle Rivers during winter to protect adult delta smelt from entrainment, and to manipulate central Delta flows during March and June to protect larval/juvenile delta smelt from entrainment. The installation of the proposed gates, initially scheduled for 2010, has been postponed by the lead agency in the permitting process, the U.S. Bureau of Reclamation, to allow for further information to be obtained helping answer questions that were raised during peer reviews about the validity of some basic premises of the experiment and whether it will be cost effective. The presentation will include an overview of the proposed project and a discussion of the scientific underpinnings and modeling. Peer review comments prepared by a Department of Interior scientific evaluation team will be discussed. Some preliminary analyses of new turbidity and flow data collected during the winters of 2009 and 2010 will be presented to illustrate key points.

Modeling for the 2-Gates Project using Bootstrapping to Incorporate Uncertainty in Turbidity Predictions, John DeGeorge (RMA); Additional contributor: Ben Chacon (RMA)

With support from the Metropolitan Water District of Southern California, RMA has developed a particle behavior model that approximates the upstream migration behavior of adult delta smelt and associated entrainment at the SWP and CVP export facilities. The behavior model is based on the assumption that turbidity is a driving factor in determining the timing of upstream movement. The RMA Delta Model has been configured to simulate turbidity as a simple non-conservative constituent and calibrated to turbidity observations from the 2007-2008 water year. A bootstrap error analysis approach has been used to evaluate the uncertainty in predicted particle entrainment associated with errors in the predicted turbidity field. Bootstrap errors developed from comparison of computed and observed point turbidity data are incorporated in an interpolation algorithm to produce multiple realizations of a simulated turbidity field. The particle tracking model is run for each realization and the resulting entrainment traces are analyzed to produce confidence intervals.

Delta Smelt Distribution and Entrainment Estimates from 3D Particle Tracking and Vertical Migration Behavior, Ed Gross (Bay Modeling)

The motivation for this study is the observed decline of delta smelt and other pelagic organisms of the upper San Francisco Estuary. Three general factors identified to explain lower pelagic productivity are 1) toxic effects; 2) exotic species effects; and 3) water project effects (Resources Agency, 2007). For each of these factors the location and movement of delta smelt are likely to be critical for understanding the reasons for the pelagic organism decline (POD) and the efficacy of any actions taken to sustain pelagic fish populations. In order to investigate the location and movement of delta smelt within the Delta, a three-dimensional hydrodynamic model was applied to simulate hydrodynamics in the Sacramento-San Joaquin Delta, and the hydrodynamic results were used with a particle tracking model to investigate delta smelt distribution and behavior. The goals of these simulations are to evaluate the ability of the particle tracking model to estimate delta smelt distribution during the hatching season, to compare the FISH-PTM results to results of particle tracking models applied previously in the San Francisco Estuary and to estimate particle fate during the hatching season for different flow years. The particle tracking simulations are performed both for passive particles and for particles with vertical swimming behaviors that are consistent with field observations of delta smelt distribution. The annual percent loss of delta smelt to entrainment is estimated for the simulations. In addition, an intermodel comparison was performed to evaluate differences among particle tracking models currently applied in delta smelt related studies.

The Need for Speed: 3-D Hydrodynamic and Salinity Simulations using the UnTRIM Bay-Delta Model, Michael MacWilliams (River Modeling)

The UnTRIM Bay-Delta model is a three-dimensional hydrodynamic and salinity model of San Francisco Bay and the Sacramento-San Joaquin Delta, which extends from the Pacific Ocean through the entire Sacramento-San Joaquin Delta. The UnTRIM Bay-Delta model has been used in studies of San Francisco Bay and the Sacramento-San Joaquin Delta for California DWR, USBR, USGS, and the US Army Corps of Engineers. The model calibration and validation conducted as part of these studies demonstrate that the UnTRIM Bay-Delta model is accurately predicting flow, stage, and salinity in San Francisco Bay and the Sacramento-San Joaquin Delta under a wide range of hydrologic conditions.

Recent advances in processor, compiler, numerical, and grid generation technologies have resulted in significant speed-up of 3-D model simulations. The most recent version of the UnTRIM Bay-Delta model simulates 3-D hydrodynamics and salinity from the coastal ocean near Point Reyes through all of San Francisco Bay and the Sacramento-San Joaquin Delta at more than 30 times real time on a single desktop workstation computer, allowing for feasible year-long simulations. However, future conditions simulations for the Delta which incorporate sea level rise, flooded islands, and marsh restoration may require even faster 3-D modeling tools. By specifying high resolution bathymetry on a coarser computational grid using a sub-grid approach developed by Vincenzo Casulli (Casulli, 2008), the tools now exist to develop even more efficient 3-D Delta models using UnTRIM. Several examples of this approach will be presented. Preliminary results suggest that simulation Bay-Delta hydrodynamics at speeds approaching 365 times real time or more on a single desktop workstation computer are feasible. This presentation will focus on the salinity calibration results of the UnTRIM Bay-Delta model and present several applications which demonstrate the potential for even faster 3-D UnTRIM Bay-Delta models by applying a sub-grid approach to the Delta.

4:15-6:00 p.m.

Session Five: Flood Modeling

Moderator: Michael Mierzwna (CA DWR)
Location: Fred Farr Forum

Watershed-Scale Response to Climate Change: Feather River Basin, CA, Kate Koczpt (USGS) (7.7 MB)

The Feather River basin is at the headwaters of the California State Water Project (SWP), which distributes water throughout California for domestic use, irrigation, and hydropower production. The reservoir at the basin's outlet, Lake Oroville, holds 8% of California's reservoir capacity, and plays an important role in flood management, water quality, and fisheries, affecting areas downstream at least as far south as the Sacramento/San Joaquin River Delta. The climate is Mediterranean, with warm dry summers and cool wet winters. Spring snowmelt is relied upon to meet SWP's summer water demands. Precipitation Runoff Modeling System (PRMS) was constructed to simulate runoff-generating processes of the Feather River Basin. PRMS is a deterministic, distributed-parameter, watershed model developed to evaluate effects of various combinations of precipitation, temperature, and land use on streamflow and basin hydrology. The Feather PRMS is used by California Department of Water Resources for watershed management and reservoir operations. The Feather River basin is one of 14 evaluated in the USGS's Global Climate Change (GCC) study titled, "An integrated watershed scale response to climate change in selected basins across the United States". The goal of the GCC is to evaluate effects of climate-change on hydrology across the nation. The GCC study employs six General Circulation Models (GCM) and four GCM scenarios to simulate climate to year 2100 and develop inputs for PRMS. For the Feather River basin, results from GCMs indicate a gradual increase in temperature, and indicate multi-decadal cycles of predominantly wet and dry periods. Large uncertainties are associated with these projections. Results from GCM simulations were input into the Feather PRMS. The watershed response to simulated climate change in this basin includes: a reduction of annual snowpack accumulation; a reduction of snowmelt available to meet summer water demands; an increase of winter streamflow, which may contribute to flooding and threats to levees downstream; and, an earlier depletion of soil moisture and drying of native vegetation, which may lead to an increase in the threat of wildfires. These PRMS simulations have implications for watershed management and reservoir operations.

Using HAZUS for a Statewide Flood Assessment, **Steve Cowdin (CA DWR)** (1.7 MB)

California lacks consistent data concerning statewide flood risks—who is at risk? what is at risk? where is it at risk? This lack of data can be very frustrating because DWR and CAL EMA often receive requests from the Legislature and the Governor's Office concerning regional or statewide flood risks. One tool that can be used to assess statewide flood risks is FEMA's HAZUS-MH model. HAZUS is a GIS-based tool that estimates socioeconomic losses resulting from floods, earthquakes, and hurricane winds. This presentation explores how HAZUS could be used for a California statewide flood risk assessment, including levels of analysis, model methodology, and examples of HAZUS applications. In addition to assisting state flood planning programs, a statewide HAZUS flood risk assessment can also benefit federal and local flood mitigation planning programs.

Concurrent Flooding – Drainage-Area Ratio Analysis, **David Thompson (R.O. Anderson Engineering)** (1 MB)

Sometimes a drainage structure is required near the confluence of two or more streams. If the structure is on the smaller of the two watersheds, then a flood on the larger watershed may occur contemporaneously with flooding on the smaller watershed. If the structure is within the zone of influence of flow from the larger watershed, then a concurrent flooding problem exists and the design event is dependent on the relation between events on the two watersheds. This setting defines the concurrent flooding problem, which is not well-treated in either practice manuals or in the professional research literature. The purpose of this presentation is to overview the problem using a simplified modeling approach. The models presented herein are based on a pair of assumed watersheds to illustrate the problem. A pre-modeling analytic analysis was performed using the regional regression equations proposed by Thompson and Asquith (2005). In the pre-modeling analysis, it was determined that for Texas watersheds, a drainage-area ratio of 10:1 was such that the peak discharge from the runoff hydrograph on the tributary watershed passed the confluence before a discharge representing 10 percent of the peak discharge on the main watershed arrived at the confluence. For a drainage-area ratio in excess of 10:1, the hydrograph peak from the tributary would pass the confluence before an even smaller fraction of the peak discharge from the main watershed reached the confluence.
A tributary watershed drainage area of one square mile was assumed. Three sets of drainage-area ratios were considered: 10:1, 100:1, and 1,000:1 (with the main watershed being 10, 100, and 1,000 times the size of the tributary watershed). A simple hydrologic model was assembled to test the hypothesis that a drainage area ratio in excess of about 10:1 would result in the peak discharge from the tributary watershed passing the confluence before a significant fraction of the discharge from the main watershed reached the confluence. The simple models supported the assertion. Finally, the result of a rainfall-runoff modeling exercise was such that for a drainage-area ratio of 1,000:1 the tributary peak was a small "blip" in comparison to the discharge hydrograph from the main watershed.

Recent Developments in Numerical Simulations of Open Water, Gijs van Banning (Alkyon Hydraulics Consultancy & Research/ARCADIS Group)

Many estuaries and lower river reaches in the world face increasing problems in the balance between fresh and saline waters. This may either be caused by Sea Level Rise over the past ages or by anthropogenic influences. Deepening of access channels, land reclamation and reduction of river discharges due to dam construction and/or the use of fresh water for drinking, agriculture or industry, disturb the natural balance in these systems. In most of the cases the consequence is a further penetration of saline water, resulting in adverse effects for flora and fauna. As a majority of the world's population is living in these areas, many investigations focus on these balances.

Simulation systems help to understand the behavior of this interaction. The interaction is complex and involves not only the physics, but also biology, water quality, meteorology, morphology, chemistry, electricity etc. Nowadays computer power allows for more complex simulation systems. Techniques like domain decomposition, curvilinear grids, sigma transformations, staggered grids, volume of fluid techniques and parallel processing have been developed to optimize the use of these resources. We see more 3D simulations, including anisotropic turbulence modeling, interaction between waves, tidal and river flow, interaction between sediment and fluid. We see more operational real time systems. We see coupling between meteorological models, groundwater models and water quality models. We see better validation techniques and the reproduction of laboratory tests in numerical models. We see increasing attention for ensemble techniques, statistical evaluation of model results and confidence level intervals. At the same time much more measurements become available for driving and verifying model results. Satellite information, day to day measurements and world wide databases help to understand nature in more detail. We are now able to predict the most important deterministic parts of it. At the same time we do have predictions of the statistical part of it via wind and weather systems. Virtually, in hind cast mode we are able to simulate any day that occurred in the past. The time of unreliable code is slowly vanishing. Well controlled version systems and repositories help to improve the software.

On the output side, improving presentation tools and initiatives like Open Earth tools, GIS coupling and Google backgrounds enable a better understanding of the results. It is no longer sufficient to present the results in 2D plots on paper, no, 3D animations of results open the opportunity to deliver the client the results in such a way that he is able to see the results in his own office with a reality background and zoom in where he wants to see the results in more detail. Various results will be shown to highlight the capabilities of these systems, they concern 3D flow, a moving fresh salt water interaction, temperature and sediment plume dispersion, storm surge modeling etcetera.

Session Six: Bay-Delta Conservation Plan (BDCP) Modeling Activities

Moderator: Parviz Nader (CA DWR)
Location: Kiln

Overview of Modeling for BDCP, Armin Munevar (CH2M Hill)

Abstract Not Available.

Integration of Tidal Marsh Modeling for BDCP, John F. DeGeorge and Stacie Grinbergs (RMA)

Abstract Not Available.

Modeling of Dual Conveyance Operations, Chandra Chilmakuri (CH2M Hill)

Abstract Not Available.

Sea Level Rise Modeling from Bay to Delta, Michael MacWilliams (River Modeling)

Abstract Not Available.

7:00-10:00 p.m.

Session Seven: Evening Program

Moderator: Jay Lund (UC Davis)
Location: Fred Farr Forum

Efficiency and Equity Considerations for the New Delta, Ellen Hanak (Public Policy Institute of California)

Abstract Not Available.

2010
Annual Meeting
Abstracts

Tuesday, February 23, 2010

8:15-9:15 a.m.

Session Eight: CWEMF Activities / Annual Business Meeting 2.5 MB

Moderator: Paul Hutton (CWEMF Convener / MWDSC)
Location: Fred Farr Forum

The CWEMF will (1) report on 2009 model user groups, peer reviews, technical workshops, and administration activities and (2) hold its Annual Business Meeting.

9:15-10:00 a.m.

Session Nine: Pop-Up Talks I

Moderator: Nigel Quinn (LBNL/USBR)
Location: Fred Farr Forum

Pop-Up Talks I

Five-minute overviews summarizing California water and environmental modeling work.

10:15 a.m.-12:00 p.m.

Session Ten: Climate Change: Eyeing the Storms of the Future I

Moderator: Jamie Anderson (CA DWR)
Location: Fred Farr Forum

Changed States – Quantifying California's Future Storms for Today's Hydrologic Planning
Michael Anderson (CA DWR) 1.2 MB

Water resources planning from flood hydrology to water supply assessment are beginning to require some attention to climate change. This requirement necessitates some quantification of future hydrologic conditions suitable for the planning process. In the water supply arena, changes to monthly volumes have been computed based on GCM projections and associated downscaling products. Less attention has been given to developing projections for changes in event (individual) storm hydrology. As the Department of Water Resources moves forward with its planning efforts, it is developing a collection of different climate change hydrologies. This presentation will provide an overview of Department activities in this area and look at what work remains to improve existing products.

Preferences among Hydrologic Models for Studies involving Climate Change **Levi Brekke (USBR)**
Collaborators: Lauren Hay (USGS), Edward Clark (NWS CBRFC), Nancy Parker, Tom Pruitt, and Greg McCabe (USGS) 0.7 MB

Natural runoff response to climate change in the western United States can be simulated using various types of surface water hydrologic models. For longer-term planning evaluations, scoping teams must decide on which model-type to use, and ideally would be able to demonstrate whether that model-type is preferred among available options. Recent research suggests that model structure can significantly influence portrayal of runoff sensitivity to climate warming, particularly in arid basins where evapotranspiration is the dominant fate for precipitation.

This study considers four surface water hydrologic model types distinguished by process representation and basin characterization: SacSMA, PRMS, VIC, and Thornthwaite Monthly Water Balance. This research explores whether preference exists among these model types to simulate changes in natural runoff under climate. The objective is to show how and why model types are more or less robust for simulating runoff in a climate that is different than that underlying the period of model calibration.

The approach uses gridded applications of each model type at 4km resolution in three Colorado River tributary basins reflecting different basin settings distinguished by elevation variability and climate. A calibration and validation scheme was designed with focus on contrasting climates used in calibration versus validation (e.g., calibration on cool-wet years and validation on warm-dry years). Presentation will summarize basin application decisions for each model type, calibration/evaluation design, and key results.

Incorporating Climate Variability, Change, and Model Uncertainty in Scenarios in California Water Planning **Armin Munevar (CH2M Hill)** **1.4 MB**

Climate change projections derived from global climate models are becoming more widely used in basin-scale water planning and management. These model projections consistently indicate accelerated warming throughout the 21st century, but the degree of warming varies considerably between models and emission scenarios. For most of California, even greater uncertainty exists in projections of precipitation with some models indicating directionally inconsistent trends. Selection of appropriate representative scenarios of future climate variability and change is important for regional and basin-scale studies. Use of the multi-model ensemble has been shown to be superior to any individual model projection largely through reduction in the "noise" and mutidecadal variability inherent in individual projection. While these findings suggest that as many projections of the ensemble as is possible should be considered, for many applications it is impractical to simulate the impacts of tens to a hundred of climate projections on water resources involving hydrological, biological, estuarine, and fisheries studies for a broad suite of water management alternatives. This paper presents a hybrid technique for climate scenario selection that reflects the full range of uncertainty in climate projections through the use of sub-ensembles. The technique allows for the selection of statistically-representative climate scenarios, derived from over 100 downscaled climate projections, which maintain superiority over individual scenarios while reducing the number of projections needed for complex water management studies. This technique is being developed for use in planning studies for the Bay Delta Conservation Plan.

Downscaling Climate Change Projections: Implications of Multiple Scales on Hydrologic Investigations **Lorrie Flint (USGS)** **7.4 MB**

Climate change projections available as output from global climate models need to be downscaled to scales that appropriately reflect the environmental processes under consideration. Depending on the process of concern, this downscaling may range from spatial extents of kilometers to meters. As projections maintain their own set of uncertainties on the basis of the assumptions chosen for global climate models and greenhouse gas emissions scenarios, it is advisable to incur the least additional uncertainty attributable to the downscaling scheme itself. The approaches chosen here reflect high rigor and defensible error for the spatial downscaling method and the statistical downscaling method upon which it relies. The modified gradient-inverse-distance-squared spatial downscaling technique described here does not introduce additional uncertainty in the downscaling process, and may indeed improve the estimate of the climate parameter by incorporating the deterministic influence of location and elevation on climate. The fine-scale downscaling illustrated provides a suite of options for environmental analysis when climate projections are translated into hydrologic and environmental impacts via hydrologic modeling, from regional to site specific applications such as regional vegetation distributions, basin scale water availability studies, or water deficits on south facing hillslopes. Applications at multiple scales ranging from regional to site specific will be illustrated. Environmental impacts as a result of changing climate will be evident and require the tools to perform analyses at these multiple scales reflecting the environmental processes that are responding to climate.

Session Eleven: Temperature Modeling at Multiple Scales

Moderator: Mike Deas (WaterCourse Engineering)
Location: Kiln

Watershed Scale Flow and Temperature Modeling in the San Joaquin River Basin, Don Smith (RMA)

HEC-5Q and its graphical user interface is a comprehensive reservoir operations modeling system for predicting the thermal and water quality conditions within complex river and reservoir systems. The San Joaquin River model encompasses the rivers, bypass and reservoirs between Mossdale and the four major upstream reservoirs (Millerton, San Joaquin; McClure, Merced; Don Pedro, Tuolumne: New Melones, Stanislaus) plus the CVP and SWP conveyance facilities including San Luis Reservoir. The model was developed under the sponsorship of numerous public agencies to provide a tool for analyzing and managing thermal impacts of reservoir operation. The model has been calibrated to available temperature data with emphasis on the 1999 – 2007 period and the code has been modified to compute reservoirs release rates required to meet downstream temperature objectives. The presentation will focus on temperature and meteorology boundary specification, stream and reservoir calibration and an example operation study.

Thermal Modeling of Stevens Creek Reservoir and its Application in Multiport Outlet Structure Design, Lei Hong (SCVWD); Additional contributor: Liang Xu (SCVWD)

Stevens Creek is identified as one of the three streams in Santa Clara County where the Fish Habitat Management Plan (FHMP) is implemented. A multiport outlet structure at the Stevens Creek Dam was proposed as one alternative to increase the flow releases from the reservoir and to improve the fish migration conditions within Stevens Creek. The 2-dimensional, laterally averaged, hydrodynamic and water quality model CE-QUAL-W2 was used in this study to model the release water temperature from the reservoir for preserving fish habitat. The model was calibrated for vertical temperature profiles within the reservoir and for the release water temperatures into the creek. The model was then used to assist in designing a multiport outlet structure at the dam while in compliance with FHMP requirements. By coupling the reservoir modeling with the river temperature modeling (Stream Segment Temperature Model (SSTMP)), the impacts of various operation scenarios on creek temperature downstream of the reservoir were examined under two summer weather conditions. It was found from that additional 0.5 cfs of release water rate can be gained by utilizing a two-port system. The impacts of this two-port system on water temperatures in the reservoir and the creek are minimal during normal conditions.

Two-Dimensional Flow and Temperature Modeling for Restoration Strategies in Big Springs Creek, Siskiyou County, Ann Willis (Watercourse Engineering, Inc.)

Big Springs Creek is a spring-fed creek that supplies over half of the Shasta River's annual flow. The steady influx of cold (~12^{o}C) water makes this stream a prime rearing site for salmonids including coho salmon. However, decades of land use activities associated with cattle grazing in and around the stream channel has degraded in-stream and riparian habitat. Given the scope of habitat degradation and the limited funds available for immediate action, a hydrodynamic model was developed to help assess restoration alternatives and identify priority actions. Preliminary simulations examined potential water temperature response to passive and active restoration activities after 1, 5, and 20 years. A comparison of the model results with data gathered during the 2009 field season indicates that initial assumptions about the stream's restoration potential were conservative. Additional simulations will be used to examine the effectiveness of various vegetation configurations to guide active restoration activities. Overall, simulations of long-term restoration suggest that much of Big Springs Creek will experience thermal benefit from both passive and active actions taken on the Shasta Big Springs Ranch. Benefits of improved conditions in Big Springs Creek will extend into the Shasta River, expanding potential habitat for coho salmon and other salmonid species.

1:15-3:00 p.m.

Session Twelve: Climate Change: Eyeing the Storms of the Future II

Moderator: Jamie Anderson (CA DWR)
Location: Fred Farr Forum

Isolating the Effect of Seasonal Pattern Shift from General Climate Change Impact on Water Resources: California Case **Jianzhong (Jay) Wang (CA DWR); Additional Contributors: Hongbin Yin, and Francis Chung (CA DWR)** **1.1 MB**

While the population growth, the future land use change, and the desire for better environmental preservation and protection are adding up pressure on water resources management in California, California is facing an extra challenge of addressing potential climate change impacts on water supply and demand in California. The concerns on water facilities planning and flood control caused by climate change include modified precipitation patterns, changes in snow levels and runoff patterns due to increased air temperatures. Although long-term climate projections are largely uncertain, there appears to be a strong consistency in predicting the warming trend of future surface temperature, and the resulting shift in the seasonal patterns of runoff. However, projected changes in precipitation (wetting or drying), which control annual runoff, are far less certain. This paper attempts to separate the effects of warming trend from the effects of precipitation trend on water planning especially in California where reservoir operations are assumed to be more sensitive to seasonal patterns of runoff than to the total annual runoff. The water resources systems planning model, CALSIM2, is used to evaluate climate change impact on water resource management in California. Rather than directly ingesting estimated streamflows from climate model projections into CALSIM2, a three step perturbation ratio method is proposed to introduce climate change impact into the planning model. Firstly, monthly perturbation ratio of projected monthly inflow to simulated historical monthly inflow is applied to observed historical monthly inflow to generate climate change inflows to major dams and reservoirs. To isolate the effects of warming trend on water resources, a further annual inflow adjustment is applied to the inflows generated in step one to preserve the volume of the observed annual inflow. To re-introduce the effects of precipitation trend on water resources, an additional inflow trend adjustment is applied to the adjusted climate change inflow. Therefore, three CALSIM2 experiments will be implemented: (1) base run with the observed historic inflow (1921 to 2003); (2) sensitivity run with the adjusted climate change inflow through annual inflow adjustment; (3) sensitivity run with the adjusted climate change inflow through annual inflow adjustment and inflow trend adjustment. To account for the variability of various climate models in projecting future climates, the uncertainty in future emission scenarios, and the difference in different projection periods, estimated inflows from 6 climate models for 2 emission scenarios (A2 and B1) and two projection periods (2030-2059 and 2070-2099) are included in the CALSIM model experiments.

Potential Increase in Floods in California's Sierra Nevada under Future Climate Projections
Tapash Das (Scripps). Co-Authors: Michael Dettinger (USGS/Scripps), Daniel R. Cayan (USGS/Scripps), Hugo Hidalgo (Univ. of Costa Rica) **1.7 MB**

California's mountain topography, proximity to occasional heavy moisture-laden storm systems, and a variety of human development and infrastructure in low lying areas make it highly vulnerable to floods. An important question facing the state—in terms of both protecting the public and formulating water-supply management responses to climate change—is "how might future climate changes impact flood risk in California?" To help address this, we conduct an analysis of floods in the west slopes of the Sierra Nevada Mountains, the primary watershed of the State. This investigation is based upon downscaled daily precipitation and temperature simulations from three General Circulation Models (GCMs), which are fed into the Variable Infiltration Capacity (VIC) hydrologic model. The VIC model output, from historical and from projected climate change runs, allows us to evaluate possible changes in annual maximum 3-day flood magnitudes and frequencies of floods greater than selected historical thresholds. By the end of the 21st Century, all of the projections contain larger floods, for both the Northern Sierra Nevada (NSN) and for the Southern Sierra Nevada (SSN). The increases in flood magnitude are statistically significant (at $p <= 0.01$) for all the three GCMs in the period 2051-2099. The frequency of flood events increases in CNRM CM3 and NCAR PCM1 models projections, while in the third model GFDL CM2.1 remained constant or decreased slightly, owing to the drying trend in the GFDL. These increases appear to derive mainly from three different factors: increases in large-storm sizes, storm frequencies, and days with more precipitation falling as rain and less as snow. Increases in antecedent winter soil moisture also play a role in some areas. Thus, several mechanisms may conspire to cause increased flood hazards in California's complex western Sierra landscapes.

Constructing ARkStorm--An Extreme Storm Scenario for Emergency Preparedness in California **Michael Dettinger (USGS/Scripps), and Co-Authors Martin Ralph (USGS), Mimi Hughes (NOAA), Tapash Das (Scripps), Paul Neiman (NOAA), and Dale Cox (USGS)** **5.4 MB**

The USGS Multihazards Project is working with numerous agencies and experts to evaluate hazards that would be associated with a scientifically plausible series of extreme winter storms in California. The scenario consists of a storm sequence that impacts both Southern and Northern California in rapid succession, and that is more severe overall than any single 20th century storm, but that may rival the extreme storms of 1861-62. The atmospheric and hydrological characteristics of the storms are quantified to provide the basis for other teams to estimate human, infrastructure, economic, and environmental impacts. The scenario will be used to design emergency preparedness and flood planning exercises by federal, state and local agencies. Recent storm episodes were "stitched" together to describe a rapid sequence of several major storms over the state, yielding precipitation totals and runoff rates beyond any that occurred during the individual (unstitched) historical events. This stitching approach is a new strategy that allowed the scenario-design team to avoid arbitrary scalings to achieve much greater-than-historical storm and flood totals, by instead allowing for the very real occasions when storms stall over parts of the state and when extreme storms have followed each other into the state over short periods of time. The scenario—called the ARkStorm—is quantified by a dynamical (regional weather-model) downscaling of historical observations of extreme winter storms of January 1969 and February 1986 to 6-km and 2-km grids over California. The weather model outputs were used to force a hydrologic model to estimate runoff, for comparison with historical runoff. The methods used to build this scenario, and key results, could also be applied to other, nonemergency or non-California applications.

Computational Fluid Dynamics Modeling for Fish Passage Improvement including Temperature Effects: A Case Study for McNary Dam and Forebay on The Columbia River **Md. M. Haque (CA DWR)**

Many climate change models forecast warmer temperature, altered precipitation and runoff patterns, more droughts, severe flooding and sea level rise in future. One of the potential impacts of climate change on fish and aquatic ecosystem is the increased water temperature in streams, rivers and reservoirs due to severe atmospheric heating. Biological studies suggest that elevated water temperature may cause thermal stresses and negatively affect the fish growth, food supply, spawning, smoltification, stability, predation, virulence of diseases and mortality rates through direct lethal or long-term chronic effects. In addition to thermal stresses, fish is also subject to physical stresses associated with bypass system at dams and hydropower facilities. The cumulative stress in combination with chronic exposure to lethal or sub-lethal water temperature may reduce migration capability and increased mortality of salmon at hydropower dams.

To address the potential impact of climate change on fish migration and to improve fish passage at hydropower dams and other physical barriers, detailed analysis for hydrodynamics and temperature distribution is required for fish behavioral studies to propose structural and or operational modification of the dam and fish facilities to alleviate adverse conditions. Fully three dimensional (3D) computational fluid dynamics (CFD) models can be applied to accurately predict the flow and temperature distributions with complex domains that contain many hydraulic structures and rapidly varying channel geometry.

During summer months, high water temperature in the forebay, gatewells and juvenile fish collection channel is observed at McNary Dam on the Columbia River, one of the largest hydroelectric power generation facilities in the United States. The combination of high air temperatures, solar radiation, wind conditions and the rapid loading or drawdown of the turbine units contribute to the establishment of large thermal gradients in the forebay. It is speculated that this effect is pronounced in the shallower part of the forebay at the southern end near the dam where surface water is warmer. These factors contribute to warmer surface water drawn into the gatewells through which the diverted fish is collected and transported via fish orifices and the collection channel. Juvenile salmonids that enter these gatewells may be subject to large changes in water temperature over short distances that may prove harmful or fatal to them. This contribution focuses on the application of 3D CFD models to analyze flow and temperature dynamics for fish passage improvement at McNary Dam and forebay on the Columbia River.

Session Thirteeen: Wetlands Modeling

Moderator: Nigel Quinn (LBNL/USBR)
Location: Kiln

Application of a 1-D hydraulic and Salinity Model to a Managed Pond Restoration Design: Eden Landing Ponds E12/13, South Bay Salt Ponds **Justin Vandever (PWA)** **3.4 MB**

As part of the Phase 1 Actions of the South Bay Salt Pond Restoration Project, the 230-acre Eden Landing Ponds E12 and E13 will be reconfigured to create shallow water foraging habitat for migratory shorebirds, with a range of salinities, and a limited number of islands for nesting bird habitat. To inform the preliminary design of this project, PWA constructed a 1-D MIKE 11 hydraulic model with advection-dispersion module to simulate water levels, flows, and salinities within the ponds. The model was used to develop hydraulic design criteria, assess pond effluent water quality relative to permit requirements and inform the development water quality management approaches for salinity and dissolved oxygen.

Wetland Model Linkage to a Flood Early Warning System for Water Quality and System Morphology Assessments: Examples from Spain and Puget Sound on the Deschutes River **3.3 MB**
Edwin Welles (Deltares Inc.)

I would like to present two studies, one from Spain (wetlands in a national park near Valencia) and an example from up in Puget Sound on the Deschutes River. Both are intensive modeling studies focused on the impacts people have on the water quality and morphology of the systems. The models used in these studies can be linked to the Flood Early Warning System, (which despite the name is more general than floods) as we have been doing with the National Weather Service. By linking models to FEWS you create an operational environment for yourself that enables you to run your models in real time, use them to evaluate management scenarios or create a single arena in which to use and compare multiple models.

Wetland Response to Adaptive Salinity Drainage Management **2.9 MB**
Ric Ortega (Grassland Water District)

The results of a joint multiagency CALFED/SWRCB study (GWD, DFG, LBNL) are presented that examine the hydrological, water quality and biological impacts of adapting seasonal wetland management to improve salinity impacts in the San Joaquin River. The Central Valley Regional Water Quality Control Board adopted a conditional waiver of Waste Discharge Requirement for discharges from irrigated lands, which requires the characterization of wetland water quality, and a salt and boron Total Maximum Daily Load, limiting the amount of salt and boron that can be discharged into the San Joaquin River at times of limited assimilative capacity. Twelve impoundments from six properties were selected to represent the spectrum of swamp timothy managed wetlands in the study area. Treatment fields from each property were randomly selected to undergo a 4-6 week delay in spring drawdown and a subsequent lack of irrigation. The remaining six control fields were managed normally with a mid March drawdown and normal 4 week post drawdown irrigation. Despite the large variation found in annual swamp timothy seed and biomass production a significant treatment by time interaction was observed using a repeated measures analysis. Although a reduction in seed and biomass yield was observed in many fields over the study duration due to natural year to year production variation, delayed drawdown treatment fields declined to a greater magnitude than normally managed control fields at all properties.

Real-Time, Non-Point Source Salt Management: A Comparison of Applications in the Grasslands Ecological Area in California and the Hunter River Basin, Australia **1.4 MB**
Nigel Quinn (LBNL/USBR)

Innovative strategies for effective basin-scale salinity management have been developed in the Hunter River Basin of Australia and more recently in the San Joaquin River Basin of California. In both instances web-based stakeholder information dissemination has been a key to achieving a high level of stakeholder involvement and the formulation of effective decision support salinity management tools. A common element to implementation of salinity management strategies in both river basins has been the concept of river assimilative capacity for controlling export salt loading and the potential for trading of the right to discharge salt load to the river – the Hunter River in Australia and the San Joaquin River in California. Both rivers provide basin drainage and the means of exporting salt to the ocean. The paper compares and contrasts the use of monitoring, modeling and information dissemination in the two basins to achieve environmental compliance and sustain irrigated agriculture in an equitable and socially and politically acceptable manner.

Session Fourteen: Pop-Up Talks II

Moderator: Stacy Tanaka (Watercourse Engr)
Location: Fred Farr Forum

Pop-Up Talks I

Five-minute overviews summarizing California water and environmental modeling work.

4:15-6:00 p.m.

Session Fifteen: Development Updates of CalSim 3.0

Moderator: Sushil Arora (CA DWR)
Location: Fred Farr Forum

Development Status of CalSim 3.0, Hongbing Yin (CA DWR) and James Cornwell (USBR)

This presentation provides a brief overview of the CalSim 3.0 development and updates in 2009. CalSim 3.0 is a new and improved water resource systems model being developed jointly by the California Department of Water Resources (DWR) and the Mid-Pacific Region of the U.S. Bureau of Reclamation (Reclamation) to simulate much of the water resources infrastructure in the Central Valley of California and Sacramento San Joaquin Delta region. Development of this model started in December of 2005 in response to 2003 CALFED Science Peer Review on CalSim-II model. CalSim-II was developed to simulate the operation of the State Water Project (SWP) and the Central Valley Project (CVP) and has been widely used for a number of water facilities planning and operations. Compared to CalSim-II, one of the major advances in CalSim 3.0 is higher spatial resolution either for water supply or for water use. Other advances in CalSim 3.0 include more input from local agencies on hydrology and facilities operations, improved groundwater representation, model validation to recent historical stream gage flows and diversions, enhanced model output presentation and evaluation, and thorough model documentation. Once the final version is released to the public, DWR and USBR plan to replace its predecessor, CalSim-II.

CalSim 3.0 Model Validation, Richard Chen and Hongbing Yin (CA DWR)

The validation process is an essential part of the CalSim 3.0 development program, and ultimately it results in a better understanding of the model's capabilities and limitations in modeling the CVP and SWP operations and Sacramento-San Joaquin Delta. A preliminary validation of CalSim 3.0 is being carried out by the comparison of simulated stream flows and water diversions to historical data for the last 10 years (1997-2006) at major stream gages and diversion locations. Through the comparison process, the discrepancies between the simulated results and the historical data are detected. The revealed discrepancies are used to guide the model error detection and the model calibration. Both graphical and statistical methods were utilized for the model validation. The validation methods used and results will be discussed in the presentation.

CalSim 3.0 Model Schematic and Output Visualization Tool, Jonathan Goetz and Andy Draper (MWH)

The California Department of Water Resources (DWR) and the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) continue to jointly develop a new version of the California Simulation (CalSim) model of the State Water Project (SWP) and Central Valley Project (CVP) operations, known as CalSim 3.0. CalSim 3.0 replaces its predecessor, CalSim II, for conducting planning studies relating to the operation of the CVP and SWP, and managing water resources in the greater California Central Valley region. One of the characteristics of the new model is the vastly increased level of spatial detail.

One success factor of the CalSim 3.0 model is to have the modeling community and interested stakeholders embrace the model as the standardized planning tool for to the water resources of the Central Valley, albeit with a focus on CVP and SWP operations. As a result, there is a need for viewing the model structure, the model output data, and changes between differing model runs. The CalSim 3.0 Model Schematic and Output Visualization Application (SOVA) has been developed to achieve these goals. The SOVA improves model understanding by: 1.) developing a stand-alone “build and view” schematic application that adheres to strict naming conventions and coloring formats for identifying each elements purpose and relationship to connecting elements, and 2.) providing a platform to view time series data and to spatially apply the data over the model schematic domain based on a user-selected time settings and filters: monthly, average month, average year, and total average flow and storage amounts.

The SOVA is a user-friendly environment for viewing and editing the CalSim 3.0 schematic data and visualizing changes in model results between model scenarios or studies. The SOVA incorporates features to transfer the user to a Google Maps schematic application to locate model elements based on real world coordinates, and to view meta-data relating to each element. Future SOVA features will include reading and writing select CalSim 3.0 input files that are critical to the long-term use of the CalSim 3.0 model.

CalSim 3.0 San Joaquin River Basin Module Development, Nancy Parker (USBR)

Reclamation began re-development of the San Joaquin Valley portion of CalSim in 2007, following the protocols and methods used in the CalSim 3.0 representation of the Sacramento Basin. The first phase of this development was completed in 2009. Efforts are continuing to further refine system definition, operations, links to the C2VSIM groundwater module, and representation of water quality. Additional QA/QC is currently under way, and a validated model is targetted for release in mid-2010. The presentation will provide information on the physical representation of the San Joaquin Valley, both eastside and westside, and challenges encountered in the implementation of the groundwater module, water quality logic, and other operations.

Session Sixteen: Remote Sensing and Synthetic Aperture Radar (SAR)

Moderator: Ted Swift (CA DWR)
Location: Kiln

Using DifInSAR to Monitor Small-Scale Surface Changes in the Sacramento-San Joaquin Delta, Cathleen Jones (JPL)

Nearly a quarter of California’s freshwater supply flows through the Sacramento-San Joaquin Delta, an area comprised of tidal marshland and reclaimed land in the form of islands surrounded by levees. While the task of monitoring the levees is critical to the quality of the water supply, the extent of the levee system makes ground-based monitoring a daunting task. This is an application where radar remote sensing, which can image large areas with high spatial resolution in a single data collection, offers great potential improvement. Recently we began a pilot project to monitor the delta using the NASA UAVSAR airborne radar instrument. This instrument is designed to monitor changes in surface height with high precision, and we will use it to detect changes on and around the levees, in addition to measuring subsidence within the islands. In this talk, I will describe the differential interferometric process that we use for small-scale change detection and show results from the six months of imaging campaigns that have flown to date.

Field Monitoring Evapotranspiration to Determine Crop Coefficients, Richard Snyder (UC Davis)

The traditional method for estimating well-watered crop evapotranspiration is to calculate the product of reference evapotranspiration (ETo) and a crop coefficient (Kc) value. The ETo is assumed to account for weather factors, and the Kc accounts for differences between the crop and reference surface. Kc values change as a crop develops and ages, and they are mainly affected by crop canopy features that affect the albedo of short waveband radiation and the surface roughness that affects the aerodynamic resistance to sensible and latent heat flux above the surface. Wind speed climatology may differ from where the Kc values are developed and where they are applied, so wind can have some influence on the Kc values. In California, the California Irrigation Management Information System (CIMIS) provides near-real time weather and reference evapotranspiration (ETo) data for most agricultural regions of the State, where ETo is calculated using a modified Penman-type equation from Pruitt and Doorenbos (1977) and hourly weather data. The ASCE-EWRI (2005) recommended a standardized ETo equation for short canopies, which gives nearly identical values as the Pruitt-Doorenbos equation. In addition, ETo forecasts are now available from the National Weather Service. From 2007-2009, the University of California, Davis (UCD) and California

Department of Water Resources (DWR) initiated a joint project to measure crop evapotranspiration, using a combination of surface renewal and eddy covariance methods, and to upgrade crop coefficients. In this paper, the methodology will be briefly discussed and some results presented on comparisons using surface renewal, eddy covariance, lysimetry, and the ETo equation for a well-watered grass surface, table grapes, rice, and almond orchard. The results show that the less expensive and more mobile surface renewal and eddy covariance techniques offer a good alternative to using lysimeters.

Monitoring and Forecasting Crop Evapotranspiration in California with the Terrestrial Observation and Prediction System, Forrest Melton (CSU Monterey Bay / NASA Ames)
Co-Authors: Rama Nemani[2], Lee Johnson[1,2], Ed Sheffner[2], Andrew Michaelis[1,2], Petr Votava[1,2], Sam Hiatt[1,2], Hirofumi Hashimoto[1,2], Cristina Milesi[1,2], Lars Pierce[1], and Weile Wang[1,2;]
[1.] CSU Monterey Bay; [2.] NASA Ames Research Center

We present a prototype system for monitoring and optimization of agricultural water use that utilizes the NASA Terrestrial Observation and Prediction System (TOPS). The modeling system integrates satellite observations of crop conditions and meteorological observations with models parameterized for specific crop types to map crop coefficients, and produce forecasts of soil moisture, evapotranspiration (ET), and irrigation demand for multiple crop types in the San Joaquin Valley of California. The system employs wireless sensor networks to validate estimates from the modeling system and calibrate estimates of soil water balance. Irrigation forecasts and in-situ observations are distributed to water districts and agricultural producers via both SMS (text) messages delivered to hand-held devices, as well as via a browser-based irrigation optimization decision support system. A prototype system will be deployed, tested and evaluated in 2010.

Near-real Time Mapping of Evapotranspiration, Crop Coefficients and Biomass Production, Bryan P. Thoreson (Davids Engineering, Inc./SEBAL North America, Inc.)

Evapotranspiration (ET) is the single largest hydrologic flow path in California's Central Valley, as supported by the USGS's recent Central Valley aquifer budget (Reilly, et. al 2008). Relatively small uncertainties in evapotranspiration can lead to large uncertainties in other flow paths, such as net recharge to groundwater from precipitation and irrigation. Improved understanding of the hydrology of the Central Valley requires, in part, improved understanding of the overall magnitude of ET, as well as the variability of ET in space and time. Near-real time measurements are available for precipitation, reference evapotranspiration and surface water deliveries to agriculture. Additionally, near-real time measurements of actual ET can be made using a remotely sensed surface energy balance to quantify latent heat transfer. This presentation describes the application of the Surface Energy Balance Algorithm for Land (SEBAL®, version 2009) to map actual evapotranspiration in California's Central Valley on a weekly basis using a combination of MODIS satellite imagery and ground-based weather data. Actual ET is computed using SEBAL at a pixel resolution of 250 m by 250 m. The application of SEBAL has been proven to be an accurate, reliable, and efficient means of quantifying actual ET to support improved water management. In addition to actual ET, crop coefficients and biomass production for C3 plants are calculated. Maps of the average daily values of each parameter for the seven days ending Tuesday of each week are posted on the Internet (www.sebal.us) by Friday of the same week during the growing season. These maps will continue to be posted during the 2010 growing season. This presentation reviews the SEBAL® (Version 2009) algorithm and validation of the results; selected 2009 weekly maps of actual ET, crop coefficients, and biomass production for California's Central Valley; and potential uses of the information for water management. References: Reilly, T.E., Dennehy, K.F., Alley, W.M., and Cunningham, W.L., 2008, Ground-Water Availability in the United States: U.S. Geological Survey Circular 1323, 70 p., also available online at *http://pubs.usgs.gov/circ/1323/*

7:00-9:00 p.m.

Session Seventeen: Evening Program

Moderator: Tara Smith (Past-Convener/CA DWR)
Location: Fred Farr Forum

7:30-8:30 p.m. **Presentation of the Career Achievement Award** **250 KB**

The CWEMF Career Achievement Award is given annually to individuals for significant contributions over their career in developing, using or promoting computer modeling to analyze California's water-related problems. More specifically, the CWEMF Career Achievement Award recognizes sustained and significant contributions that (1) increase the usefulness of models in water management analyses in California, (2) promote sound quantitative analyses in water management decisions and (3) raise public awareness and improving public acceptance of the role of modeling.

Remarks by the Award Recipient **2.1 MB**

The recipient will discuss the modeling-related work associated with the award.

8:30-9:30 pm: Special Speaker: Ralph Cheng, U.S. Geological Survey (Retired), "Hydrodynamic Modeling used in Forensic Investigations"

This presentation discusses 3-D hydrodynamic and particle-tracking modeling that was used for (1) the Scott Peterson trial (to help locate Laci's body) and (2) the Discovery Channel's evaluation of whether is was possible for three prisoners to successfully escape from the prison on Alcatraz Island in 1962.

2010
Annual Meeting
Abstracts

Wednesday, February 24, 2010

8:15-10:00 a.m.

Session Eighteen: Delta Solutions Modeling
Moderator: Jay Lund (UC Davis)
Location: Fred Farr Forum

Policy Implications of Permanently Flooded Islands in the Sacramento-San Joaquin Delta, Robyn Suddeth (UC Davis)

The Sacramento-San Joaquin Delta is in a state of inevitable transition. Physical and financial pressures are likely to transform parts of the Delta into open water within the next 100 years. Because flooded islands have different habitat, water quality, and hydrodynamic implications depending on location, depth, orientation, and other physical factors, the state may decide to intentionally flood one or more Delta islands in an effort to better manage the Delta's ecosystem and valuable water supplies. This paper outlines three sets of near term actions the state would have to take to begin transitioning towards intentional island flooding, and discusses legal and political challenges to those actions. Several key findings include the following: (1) amendments to California's water code and revisions to the Delta Land Use and Resource Management Plan may help the state ensure the legal authority to differentiate levee policies within the Delta, (2) permits for a first, experimental flooded island will likely require the State Water Resources Control Board to revise the Delta Water Quality Control Plan to allow for more short-term flexibility and deal with conflicting ecosystem and water supply uses, and (3) the state may want to prepare mitigation plans for private landowners on neighboring islands whose levees could face new threats of erosion and/or seepage from a nearby flooded island in order to avoid inverse condemnation lawsuits. If the state decides to shift its levee policies in the Delta, serious consideration will need to be given these and additional common, regulatory, statutory, and constitutional laws.

Preliminary Methods and Estimates for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta with Peripheral Conveyance, William Fleenor (UC Davis)

A major issue facing the long-term management of the Sacramento-San Joaquin Delta is the development of flow prescriptions for supporting habitat conditions for desirable fishes in the Delta. To date, there has not been a systematic scientific attempt to establish flow prescriptions for the new Delta, and even less work has been done to explore desirable environmental flows responsive to major inevitable changes in the Delta. This work compares thre approaches for estimating how much water and habitat are needed for fish. This is not the definitive solution, but an attempt to organize the problem.

Physical Drivers of Biological Productivity Following Levee Breaches on Islands in the Sacramento-San Joaquin Delta, Laura Doyle (UC Davis)

The Sacramento-San Joaquin Delta is the heart of California's water supply system and the base of an important, but quickly declining, ecosystem that includes five native fish species listed as threatened or endangered. A number of factors including sea level rise, seismic activity, continued land subsidence and more extreme climate events will increase the frequency and costs of Delta island failures. Flooded Delta islands will have a direct and immediate impact on the water quality and ecology of the Delta system. However, with sufficient study, it is possible to manage flooded islands in a way that is beneficial to the ecosystem. In this study, we used a three-dimensional hydrodynamic and water quality model (SI3DWQ) to simulate virtual Delta islands and the surrounding channels. The goal of this study was to examine how the effect of breach location, area and depth of flooded island primary and secondary production and the rate of export to the adjacent channel. In order to improve the Delta ecosystem, it is ideal to increase the production of phytoplankton on shallow islands that can fuel zooplankton and fish production. The results from this study have identified several important points to consider in the future management of the system: (1) Flooded Delta islands can be either a source or sink of phytoplankton based on physical parameters; (2) Depth of flooded islands is important to consider as the more shallow (3m and 4m) flooded islands can support a greater population of phytoplankton; (3) The combination of prevailing wind direction and breach location makes breach location an important factor to consider when evaluating potential ecological benefit of flooded islands and (4) The orientation of the island with respect to the channel is an important factor to consider when deciding where to breach flooded islands.

Transitions in Structure of the Delta's Economy, Josue Medellin-Azuara (UC Davis)

Continued land subsidence, sea level rise, climate warming, and earthquakes will change the landscape of the Delta's primary zone, with permanent flooding of many of many subsided islands in the western and central Delta. In addition, sea level rise and changes in the management of Delta water exports will alter salinity levels of water drawn from the Delta, with implications for agricultural uses of islands that remain intact. These changes will affect Delta agriculture as well as recreation in the Delta, with regional employment and income effects. This project estimates potential economic outcomes for agriculture and recreation in the Delta's primary zone under different flooding and water quality scenarios, and the multiplier effects on the wider economy.

Prisoners and Chickens – Game Theory Insights on the Delta Problem,
Kaveh Madani (UC Riverside/UC Davis)

The Delta may not be a zero-sum problem and cooperative win-win resolutions may exist is stakeholders cooperate. Non-cooperative game theory concepts provide some insights on potential win-win solutions.

Session Nineteen: IWFM & IDC 2008-2009 Enhancements and Applications

Moderator: Tariq Kadir (CA DWR)
Location: Kiln

A Peer Review of IWFM and MODFLOW-Farm Process **Tariq Kadir (CA DWR) and Randall Hanson (USGS)**

1.4 MB

As part of the on-going collaborative effort between the USGS and CA DWR, a peer review process was initiated by the agencies to compare the MODFLOW-FarmProcess and IWFM. Four reviewers were selected by the agencies to review two documents prepared by the agencies: a DWR Technical Memorandum and draft journal paper comparing the two models in both theory and sample problem applications. This presentation will summarize the peer review process, key comments from the reviewers, and the responses by the agencies.

Enhancing Solver Performance in the Integrated Water Flow Model **Matthew Dixon (UC Davis)**

0.3 MB

This presentation describes the accuracy control and performance enhancement of linear solvers for IWFM. First explained are how multi-layer aquifer flow and stream-groundwater interaction affects the scaling, conditioning and sparsity structure of the linear systems in IWFM. These properties guide the choice of scaling which, together with preconditioning, not only offset the ill-conditioning effects of multi-scale flow, but improve the control of the linear solver forward error (necessary for data consistency). Next is the implementation of a preconditioned Krylov subspace linear solver based on the Generalized Minimum RESidual (GMRES) algorithm and demonstrating that (i) the scaling improves forward error control in IWFM and (ii) there is a 7.7x overall speedup compared to using the SOR method. Further performance profiling shows that the new linear solver removes a major performance bottleneck in IWFM.

Automated Mesh Generator for IWFM in ArcMap, Tom Heinzer and Diane Williams (USBR)

An ArcGIS based mesh generator has been developed to facilitate mesh generation for IWFM models. The software enables the user to place GIS features on the design surface (boundaries, streams, wells, faults, and holes) which are utilized in the mesh configuration. Interesting features include 'telescoping', automated stream ordering, screen caching for rapid display, and export utilities to IWFM ready files.

IWFM Demand Calculator (IDC) Version 4.0 Can Dogrul (CA DWR) **1.6 MB**

IWFM Demand Calculator Version 4.0 (IDCv4.0) is a new tool for the simulation of the root zone and land surface flow processes as well as the agricultural and urban water demands. IDCv4.0 uses methods employed by irrigation scheduling models used at farm scale for the routing of moisture through the root zone and the computation of water demands, and adopts them to a river basin scale. Water demands and flow processes can be modeled for a variety of agricultural crops including rice fields under user-specified climatic and farm management practices such as regulated deficit irrigation. It utilizes a finite-element or finite-difference type computational grid defined in the horizontal to represent the spatial distribution of the model parameters such as land-use types, precipitation, soil properties and farm management practices. The utilization of the computational grid also allows IDCv4.0 to be easily linked to integrated hydrologic models. This presentation will detail the simulation methods used in IDCv4.0 and demonstrate its performance through an example application.

10:15 a.m.-12:00 p.m.

Session Twenty: San Joaquin River Restoration: Modeling Tools for River Management **1.5 MB**

Moderator: Peter Vorster (Bay Institute)
Location: Fred Farr Forum

Introduction to the San Joaquin River Restoration Hydrographs, Peter Vorster (Bay Institute)

Abstract Not Available.

Temperature Modeling for San Joaquin River Restoration Bill Smith (MWH Americas) **2.2 MB**

The San Joaquin River Restoration Program's (SJRRP) purpose is to reintroduce a self sustaining salmon population in the San Joaquin River. A key factor in the success of this project is establishing and maintaining appropriate water temperatures. CalSim was used to model the monthly operations and flows throughout the system for impact analysis. These monthly flows derived from the CalSim modeling are not suitable for temperature evaluation purposes, temperature evaluations require a shorter time step in order to account for short term variations that may be biologically important. A method was developed to break the monthly CalSim operations and flows into a daily time step. This data was then used in a CE-QUAL-II based temperature model of Millerton Lake and an HEC-5Q based temperature model of the San Joaquin River from Millerton Lake to the confluence with the Merced River. This presentation will cover these tools and some results that illustrate the potential temperature conditions in the San Joaquin River.

San Joaquin River Vegetation Modeling for Analysis and Design of Management Actions **1.7 MB**
Lisa Fotherby (USBR)

Vegetation studies for the San Joaquin River Restoration Program are focused in three areas: to promote the establishment of native vegetation for fisheries benefit, restrain the spread of invasive vegetation, and maintain channel capacity. Vegetation was modeled in Reaches 1-5 of the San Joaquin River study area using SRH-1DV. Channel geometry, hydraulics and sediment transport are linked in the SRH-1DV model with estimates of groundwater elevation and plant growth and mortality. Five vegetation types, in addition to age and physical dimensions are tracked at every point of the 300 cross sections representing the system. Results from a comparative analysis, completed for the Programmatic EIS, indicated Program flows .should increase native vegetation establishment system wide, although the increases vary by reach. This study also provided initial feedback on beneficial flow management and desirable floodplain geometry. Capabilities recently added to the model better represent scrub and sparsely vegetated areas through plant density assignments, link vegetation growth to channel resistivity for channel capacity studies, and improve estimates of seedling release based on a spring degree-day count. These advances will be applied in a model verification of Reach 2B, and flow analysis and channel design of Reach 4B1.

Groundwater Modeling Tools and Future Applications for the San Joaquin River Restoration Program
Steve Phillips (USGS) **2.4 MB**

A primary goal of the SJRRP, led by the U.S. Bureau of Reclamation, is to restore fish populations to the San Joaquin River from Friant Dam to the Merced River confluence. The increased river flows designed to accomplish this goal will result in increased seepage losses to the aquifer system, potentially exacerbating existing drainage problems in adjacent agricultural lands underlain by a shallow water table (within 15 ft of land surface). Groundwater modeling will play a key role, coupled with monitoring, in estimating seepage losses and associated effects on the water table, establishing monitoring criteria to protect crops, and evaluating management alternatives to reduce or avoid crop loss. The new USGS Central Valley Hydrologic Model (CVHM), with its explicit representation of agricultural processes and routing of surface-water flow, will be used by the USGS and others to support these and other aspects of the SJRRP. The regionally-scaled CVHM grid will be spatially refined within 5 mi of the river, and a detailed analysis of sediment texture in the region will be incorporated to better represent the natural heterogeneity of aquifer-system materials and their effects on groundwater movement.

Using Fish Life-History Models to Guide Management Decisions in River Restoration Programs
Shannon Brewer (USFWS) **3.5 MB**

Development of effective restoration strategies for riverine systems requires the use of tools to evaluate alternative actions. Fish life-history models provide a means to organize and communicate information, generate hypotheses, and identify critical data needs. Several modeling approaches offer something useful to policy makers, provided they understand the associated limitations and assumptions of each approach. The Fisheries Management Work Group was tasked with choosing a Chinook salmon life-history model to conduct structured, quantitative analyses that would be in line with the adaptive management philosophy of the San Joaquin River Restoration Program (SJRRP). Eight models were evaluated using the following criteria: ability to simulate population-level responses, includes all salmon life-history stages, applicable to large-scale river restoration, ability to simulate existing and restored habitat, reviewed and considered credible by the scientific community, compatible with the SJRRP timeline, and provides transparent fish-habitat relations. The Ecosystem Diagnostic and Treatment Model (EDT) was chosen based on the above criteria, and because other models could be incorporated into the EDT structure. Several examples are provided depicting how EDT will be used to evaluate restoration actions, and what types of restoration actions will be evaluated.

Session Twenty-One: Techniques for Optimizing Conjunctive Use of Surface and Ground Waters

Moderator: Hubert Morel-Seytoux (Hydroprose International Consulting)
Location: Kiln

Integrating Groundwater and Surface Water Management to Optimize for Water Supply Reliability and Restoration of Aquatic Ecosystems, Gregory A. Thomas (Natural Heritage Institute)

An extinction crisis of Pleistocene proportions is emerging in freshwater ecosystems at the global scale. Among the many causes, alteration and depletion of natural flows due to some 50,000 large dams and diversion projects are predominant. Half of these are irrigation projects. To restore a semblance of natural flows and their associated ecosystems (and riverine livelihoods) in these rivers, it is necessary to counteract both the depletions and alterations. Water available for environmental flows can be augmented by reducing physical losses in the irrigation system (the scope here is large), by capturing a portion of the annual runoff that is currently uncontrolled (contrary to the myth that there is no unappropriated water left in arid river systems such as California's Central Valley), and by integrating the groundwater system with the surface water system (called "conjunctive use"). This supplemental water can be used to both improve the reliability of irrigation water supplies and to enable environmental flow releases if this "new" water can be managed to restore some degree of the natural variability in the downstream flow pattern. That can be facilitated by using surface water deliveries conjunctively with groundwater extractions in the irrigation command area. Implementing these techniques in concert opens up the prospect for restoring ecosystem processes in rivers that have been harnessed for irrigation on scale never before envisioned. There is a global dam reoptimization project underway to investigate the potential. Components are being organized or are already underway in California, Nigeria, China and India, with others to come.

Experience in Conjunctive Management within Water Rights, Hubert Morel-Seytoux (Hydroprose International Consulting)

A variety of experiences in developing good strategies of planning and operations of a system involving interconnected surface and ground waters are presented. Sometimes the motivation for the investigation is (purely) political (the "Carter study"), purely legal (Groundwater Appropriators of the South Platte), mostly agronomic (Rio Grande in Colorado; Wadi Jizan in Saudi Arabia) or administrative (Seine River Basin above Paris, France). In all cases the existence and use of an adequate river basin model were absolutely necessary to find the best management strategy given the context, climate, political system and geographical location of the area.

Optimality Conditions for Conjunctive Management of Surface and Ground Waters in Continuous Time, Hubert Morel-Seytoux (Hydroprose International Consulting)

One needs to address the matter of how well to use the two sources of water conjunctively and, more ambitiously, how best to do it. Thus the goal is to find efficient ways (1) to define the objectives and (2) to solve the problem once it has been formulated. There is a tendency in planning for such conjunctive use to emphasize the spatial dimension at the expense of the temporal distribution of the resource. Typically in planning exercises the time interval used is at best the month. Yet the State Engineer of Colorado, responsible for the administration of the water rights, would never fail to remind the modeling fraternity that operational decisions are made on a day to day basis. Thus the techniques of optimization must be so efficient as to solve the problem sufficiently accurately at both a small scale of space and time (practically the day). A technique is presented that allows one to achieve this objective. Because it is fairly mathematical it will be presented through a succession of cases with gradually increased complexity. Thus the simplest case one can think of, that still involves both surface and ground waters, will be used as a starting point in the presentation of the approach. For the simplest case it is possible to solve the problem analytically. Progressively cases of greater and more realistic complexity are introduced and solved through a programmed numerical algorithm.

1:15-3:00 p.m.

Session Twenty-Two: HydroGeoSphere: 2009 Enhancements and Applications

Moderator: George Matanga (USBR)
Location: Kiln

HydroGeoSphere in Evaluation of Predevelopment Hydrologic Conditions in San Joaquin Basin of California, G.B. Matanga (USBR); Co-Author: B.L. Bolger

The San Joaquin Valley (SJV) in Central California has significant water management concerns given the high water demand for an increasing state population and for intense irrigation. The groundwater-surface water system in the area has undergone drastic changes since the employment of groundwater and surface water extractions for irrigation and mining, and is still responding to past and present stresses. The only certain stable initial condition must therefore be that of the natural system before development. The physically-based surface-subsurface numerical HydroGeoSphere model is used to examine the regional-scale hydrologic budget of the SJV at pre-development conditions circa 1848, constrained by available historical data. As results, complex hydrologic processes, including groundwater-surface water interaction along the major rivers and within wetland areas formed by flooded surface water, as well as evapotranspiration and impacted root zone processes were identified in the area. The presence and path of the major rivers in the domain are well defined in the model output. The general location, formation, and hydrologic processes of major wetlands simulated by the model have a fair agreement with historical records. There is also a fair match between simulated and estimated water table elevations. Evapotranspiration is a significant sink of both surface water and groundwater (44.8 % of the water balance input). Successful simulation of the complex hydrologic processes and features, and the water balance of the natural system underscores the importance and necessity of using an integrated model, especially when available data is limited for input and calibration. This steady-state model should serve as a reasonable initial condition for future transient runs that bring the model up to current hydrologic conditions capable of estimating present and future water budgets.

Status of HGS and Groundwater Modeling System GMS) Integration, Lorri Peltz-Lewis (USBR)

A status update will be provided on the integration of the Groundwater Modeling System (GMS) and HydroGeoSphere (HGS), such that GMS could be used as a pre- and post-processor for the HGS model. The full report is available upon request. This factsheet provides a brief review of the recommendations for future incorporation efforts. Incorporating HGS into this system can effectively integrate the Reclamations efforts into a widely accepted package and support the efforts to distribute this to numerous users. Due to the highly-sophisticated nature of HGS and the large number of physical processes that it can simulate, HGS requires a complex set of inputs, including grid geometry (structured and unstructured), material properties, and boundary conditions. Phase I of this effort has started. This paper provides an update on that process.

Testing Sub-timing and Sub-gridding Schemes using an Integrated Surface and Subsurface Numerical Model of the San Joaquin Valley, Don DeMarco (HydroGeoLogic); Co-Author: George Matanga (USBR)

An integrated surface-subsurface model of the San Joaquin River Basin of California was developed to demonstrate the sub-timing and sub-gridding techniques. These advanced methods can improve computational efficiency, thereby lending utility for challenging problems such as models of watersheds or other regional and large scale problems. Implicit sub-time stepping applies smaller sub-time steps only to the sub-domain where the flow processes are relatively rapid. In the integrated surface and subsurface flow domains, smaller sub-time steps are applied in the case of surface-water flow. For subsurface-water flow, large time steps that encompass surface-water sub-times are applied, since subsurface water flow is more sluggish than surface-water flow. The sub-gridding technique allows a relatively coarse numerical finite element or finite difference grid to be used for the entire model domain with finer grid resolution only where needed. This three-dimensional technique thus achieves optimal spatial grid resolution throughout the model domain. Furthermore, use of the sub-gridding scheme may enhance accuracy of handling flow and thermal/solute transport processes in, for example, stream channels and vicinity as well as well fields. The results of further testing of these techniques are presented using a simplified model of the San Joaquin River Basin. Application of sub-timing and sub-gridding broadens the utility of HydroGeoSphere as a valuable numerical tool for simulation of flow and thermal/solute transport processes in a rigorous and physically-based manner.

Simulation and Optimization of Regional Integrated Ground and Surface Water Resource Systems
Larry M. Deschaine (HydroGeoLogic); Co-Authors: Don DeMarco (HydroGeoLogic), Dua Guvanasen (HydroGeoLogic), Xinyu Wei (HydroGeoLogic), Janos D. Pinter (Ozyegin Univ, Turkey), Kirk E. Nelson and George Matanga (USBR)

Regional water-resource managers are increasingly looking for tools to provide answers to planning issues related to the impact of groundwater on surface-water conditions, and vice versa. These issues include the competing aspects of water allocation to agriculture, reservoirs, ecological aspects, recreational activities and others, as well as potential future IPCC planning scenarios involving climate change. Hence, there is a need for integrated simulation - optimization computer software products that have the capability to handle the comprehensive physics of the fully-coupled surface and subsurface water systems, as well as an advanced optimization approach that honors the physics. Our presentation focuses on such a tool. The physics of water flow and transport is solved using the integrated surface water - groundwater simulator HydroGeoSphere. This simulator is utilized to perform comprehensive conjunctive analyses of surface-water and groundwater systems. The optimization is performed using an extension of the Lipchitz Global Optimization (LGO) software that can use HydroGeoSphere in its entirety in the optimization calculations. LGO is a robust and efficient derivative-free global optimization tool to handle non-linear models which are "expensive" to calculate. The presentation discusses our integrated software, and the value of optimizing the fully integrated physics based flow system. This is an advancement over other approaches such as those that treat the physics as either individual parts (such as only groundwater resources), or those that use simplified (linearization or lumped parameter) representations of the underlying physical processes, and those approaches which apply only local optimization tools. The simulators and optimization tools have been or are being developed or enhanced (they are in various stages) through collaboration among the Bureau of Reclamation (USA), HydroGeoLogic (USA), the University of Waterloo (Canada), Chalmers University of Technology (Sweden), and Ozyegin University (Turkey).

2010
Annual Meeting
Poster Session Titles

Monday, February 22, 2010

Integrated Water Operations and Ecosystem Decision Support Modeling: The Sacramento River–Delta Ecological Flows Tool (Sac-DeltaEFT),
Clint Alexander (ESSA Technologies Ltd) and Ryan Luster (The Nature Conservancy)

The Nature Conservancy and partners continue to develop multi-species, multi-habitat tools for identifying ecological flow requirements, building on the results of the Sacramento River Ecological Flows Study. The Sacramento Ecological Flows Tool (SacEFT) component of this Study links flow management actions to multiple focal species (chinook salmon, steelhead, green sturgeon, western pond turtle, bank swallow, and Fremont cottonwood) outcomes to help improve the ecological representativeness of Sacramento River water operations. Both the Public Policy Institute of California's Comparing Futures report and CALFED Science Program reviewers have supported this approach.

TNC's current effort to extend EFT to the Delta emphasizes leverage of pre-existing functional relationships (e.g. DRERIP, BDCP, POD) and existing physical models (e.g. CALSIM, DSM2), which were extensively reviewed by the project team and further vetted using a multi-disciplinary workshop in January 2009. Focal species and focal habitat indicators were prioritized based on workshop assessments of importance, understanding (clarity), rigor (predictability), and feasibility. Sac-DeltaEFT can provide guidance on both target flows (to maximize ecological benefits) and avoidance flows (to minimize negative consequences), bracketing the range of discharges to be evaluated experimentally, and improve the ability to assess the ecological consequences of Bay-Delta alternatives. The presentation and poster will summarize DeltaEFT's spatial scale (Keswick Dam to the south Delta), "eco plug-in" design, the scenarios that it can address and the traffic light roll-up approach to summarizing the hierarchy of indicators at different temporal/spatial scales.

California Environmental Data Exchange Network Karl Jacobs and George Nichol (SWRCB) **12.7 MB**

The goal of the California Environmental Data Exchange Network (CEDEN) is to promote collaboration and interaction among data providers and provide integration, standardization and access to the State's ambient monitoring data. CEDEN provides data management and sharing infrastructure using combinations of three major components: Data architecture, Standards, and Applications. Data architecture includes a distributed network of data sets. These data sets reside with the groups that collect them and/or at regional data centers located throughout the State. Data standards include naming conventions for monitored attributes and database objects in addition to standardization of QA/QC procedures and monitoring protocols. Applications that convert CEDEN data into information can be developed by the many groups who need to analyze ambient monitoring data, within the State, comprehensively. Data query tools have been developed and additional query tools are being developed.

California's Water Supply: Adaptation to Climate Change **0.6 MB**
Christina R. Connell, Josué Medellín-Azuara, and Jay Lund (UC Davis)

A hydro-economic optimization model (CALVIN) is applied to explore economic effects and adaptation of California's water supply for three climate change scenarios. The independent and combined effects of temperature and precipitation on the state's water supply and scarcity are compared among three climate scenarios: historical hydrology, warmer, as well as warmer and drier. Results include water supply response, regional changes in water supply portfolios, reservoir operation adaptations, and comparison of water scarcity for each climate condition. The study concludes that water scarcity tends to be more sensitive to decreased precipitation and warming compared to increased temperatures alone. Excess storage capacity exists in the system statewide under warmer-drier conditions, and integrated resource management serves well to mitigate water scarcity under all scenarios.

Delta Island Subsidence Reversal: A Criteria-Based Approach to Modeling and Evaluation
Matthew E. Bates and Jay Lund (UC Davis) **3.4 MB**

Elementary modeling is used to estimate the probability distribution of elevations and water depths at failure for thirty-six subsided islands in the California Sacramento-San Joaquin River Delta, with a potential subsidence reversal rate of 4 cm yr. Given estimated annual probabilities of failure, potential elevation gains are expected to be limited to one to two meters, before flooding. While, in many scenarios, this may be insufficient to justify project investment, we can also envision criteria where one to two meter gains are significant. As an example, we evaluate the implications depth-at-flooding has for the subsequent aquatic habitat. For some islands, even modest gains in elevation promote ecological benefits, moving islands out of the depth range favored by unwanted invasive species such as *Egeria densa*. We introduce a method providing an initial evaluation of which islands might be promising candidates for subsidence reversal, by comparing the annual probabilities of failure with estimated elevations in each year, and then predicting the likelihood of specific islands flooding within the *Egeria densa* range and recommending relevant subsidence reversal strategies based on this criteria. This method and approach might be useful for better integrating subsidence reversal activities into long-term solutions for the Delta.

Water 2.0 Calendar **Josué Medellín-Azuara (UC Davis)** **1.9 MB**

Water resources modelers and practitioners require to effectively communicating a wide array of aspects of research or practice to a broad audience. At the same time, getting informed on current science, practice and policy on water resources is fundamental. The World Wide Web and the mobile computing industry offer a diverse set of tools to communicate both ways including social networking, blogging, newsletters other resources. Herein we present a compilation of the most influential communications tools in water resources. Social networks offer the possibility of interact directly and indirectly with other water professionals and join larger groups of members our causes. Forms of interaction are not limited to bookmark sharing, and expressing opinions. Networks of this kind include Facebook, LinkedIN and Twitter. Blogs may share news or other links selectively and often express opinions of the moderator and have room for follower comments from its members. Newsletters compile and post links and news from in-site newsrooms other websites. Using some of the described communication tools in water resources, facilitates the flow of information and ideas among academics, practitioners, policymakers and layman audiences adding new information elements to both technical and no-technical conversations on water resources.

Water Maps of California, Jay Lund (UC Davis)

Various new and old thematic maps of water and water management in California for educational purposes. In some months, these will become available for general use, but this is an opportunity to give us comments on how to improve them.

Integrated Reservoir Re-operation and Floodplain Management to Improve Ecosystem, Mokelumne River Case **Patrick Ji and Nate Burley (UC Davis)** **0.3 MB**

Ecosystem value has gained more attention for water management. Re-allocation of reservoir flood pool storage might improve the downstream floodplain's ecosystem values. This presentation shows a framework model to optimize re-allocated storage for the tradeoff of loss of flood damage and gains for ecosystem value from an enlarged floodplain. An application of the method is Lower Mokelumne River floodplain in California's Central Valley.

RMA2, DSM2, and WAM: A Theoretical, Numerical, and Scenario-Driven Comparison **0.8 MB**
Fabian Bombardelli, James Kohne, and Dane Behrens (UC Davis), and Mark Gowdy

The social and economic importance of the Sacramento-San Joaquin Delta has led to the development and application of several numerical models to predict hydrodynamic and water quality conditions. Yet future challenges to the Delta will require even more demanding applications of these models to simulate climate change, water management, habitat, island failures, and land development conditions. This report provides a rigorous and independent framework for the analysis of several Delta-specific models developed by Resource Management Associates (RMA) and the Department of Water Resources (DWR). The report starts with a thorough analysis of the models from the theoretical and numerical point of view. Subsequently, it includes a scenario-driven comparison of each model to historical data and investigates model accuracy and sensitivity to varying levels of export pumping and DICU values, each within extreme dry and wet water years.

Groundwater Database for California 0.3 MB

Christina R. Connell, Josué Medellín-Azuara, Shannon Brown, Joshua Viers, Will Sicke, Matthew Bates, Daniel Nover, Marsha Sukardi, David Rheinheimer, Rachel Ragatz, Kevin Fung, Eleanor Bartolomeo, Pradnya Khimsara, Daphne Korth, and Jay Lund (UC Davis)

Groundwater basin information for California varies by region and is often scant. Identifying and displaying data availability and data needs can be helpful for organizing data collection and documentation efforts. In this work we present information collected from Bulletin 118- Update 2003 on groundwater basins in California as a georeferenced database displaying each basin and subbasin and its available data. Individual documents on more than 500 subbasins in the Bulletin were reviewed to populate the database with information on groundwater level trends, capacity and storage estimates, water budget components (inflows, outflows, recharge sources), and a range and average of total dissolved solids (TDS). Some of the information in the database was then used to create three maps presented here: A data inventory map, groundwater capacity map, and groundwater quality map (using TDS average). These help to identify and visualize existing groundwater data for California's subbasins and regions where information is less abundant or lacking.

Salinity Intrusion in the Western Sacramento – San Joaquin Delta and Suisun Bay 1.6 MB

Deanna M. Sereno and Gregory Gartrell (CCWD)

From 1908 through about 1929, the California & Hawaiian Sugar Refining Corporation (C&H) obtained its fresh water supply from barges traveling up the Sacramento and San Joaquin Rivers (DPW, 1931). C&H recorded both the distance traveled by its barges to reach fresh water and the quality of the water they obtained, providing the most detailed salinity record available prior to the intensive salinity monitoring by the State of California, which started in 1920. The distance traveled by the C&H barges serves as a surrogate for the prevailing salinity conditions in the western Delta and Suisun Bay. This analysis compares the fluctuating salinity observations of C&H with recent monitoring data (from the IEP data vault) and modeling results (from DSM2 historical simulations) to determine how the current, managed salinity regime compares to the regime of the early 1900's.

Calibration of a Three-Dimensional Model of San Francisco Bay Using SUNTANS 0.9 MB

Vivien P. Chua and Oliver B. Fringer (Stanford University)

The unstructured-grid SUNTANS model is applied to San Francisco Bay to resolve tidal hydrodynamics on a grid that extends from the Pacific Ocean to the western portion of the Delta region, the flow through which is approximated with two rectangular boxes as a "false delta". A detailed calibration is performed and the model accuracy is assessed via comparison of tidal heights, currents and salinity to observations at several locations throughout the Bay. We apply a high-resolution formulation for the advection of scalars and compare salinity predictions with this formulation to those obtained with the first-order upwind scheme.

Using the Potential Entrainment Index Tool for Assessment of Los Vaqueros Reservoir Expansion Project Operational Alternatives, Brett T. Kawakami, David Pene and Deanna Sereno (CCWD)

The Potential Entrainment Index (PEI) developed by DWR is a useful tool for incorporating information about the spatial distribution and timing of delta smelt in the Delta into particle tracking model (PTM) simulations using DSM2. We adapted the PEI to assess the fisheries effects of alternatives being considered for the Los Vaqueros Reservoir Expansion Project. We used historical 20mm survey data to weight PTM release locations, and accounted for entrainment at Contra Costa Water District intakes as well as at the State Water Project and Central Valley Project export facilities. The PEI was expanded to include effects on striped bass and longfin smelt. The PEI proved a useful tool in developing quantitative estimates of effects of operational alternatives on larval and juvenile stages in the context of observed fish patterns.

The Community Hydrologic Prediction System (CHPS),
Alan Haynes (NOAA NWS), Peter Gijsbers (Deltares USA Inc.), Lee Cajina, Christine Dietz, Jon Roe, Edwin Welles (OHD, NOAA NWS)

NOAA's National Weather Service (NWS) is responsible for producing flood forecasts and warnings in support of the protection of life and property and enhancement of national commerce. For the past thirty years, NWS hydrologists have used the NWS River Forecast System (NWSRFS) as the core infrastructure for their hydrologic operations. While NWSRFS met the needs of the NWS for a long time, its structure makes it difficult to add new models and techniques and inhibits transferring research to operations. Thus, the NWS has chosen to retire NWSRFS and introduce the Community Hydrologic Prediction System (CHPS). CHPS has been developed by the NWS in collaboration with Deltares (formerly Delft Hydraulics) in the Netherlands. The Delft-Flood Early Warning System (FEWS) serves as the infrastructure for CHPS with NWS hydrologic models and United States Army Corps of Engineers (USACE) hydraulic models providing the science used in forecasts.

NOAA's California Nevada River Forecast Center (CNRFC) is in the process of migrating from NWSRFS to CHPS and expects to be fully operational on the new system by October of 2010. Capitalizing on the flexibility of the CHPS architecture, the CNRFC expects to greatly improve its ability to collaborate with other agencies and infuse new models and techniques into its operations. One forecast area of great interest in the CNRFC domain is the Sacramento/San Joaquin Delta. Effectively improving hydrologic and hydraulic modeling and forecasts for the Delta will require a relatively large collaborative effort between various stakeholders along with the application of dedicated resources on a scale well beyond normally funded operations. CHPS will provide the foundation to build such a collaborative effort.

Using Remote Sensing Observations to Improve Water Resource Forecasting,
S. Granger. N. Molotch, D. Waliser, S. Kaki (JPL NASA)

This poster describes a pilot project funded by NASA to develop information and modeling solutions addressing issues faced by water managers in California. Elements of this pilot project will use remote sensing observations from NASA satellites and improved forecast models to estimate snow water equivalent for the Sierra Nevada range. We will also present plans to develop diagnostic tools that use remote sensing observations to validate and compare outputs of regional climate models.

Myth-Conceptions about California Water,
Robyn Suddeth (California Center for Applied Mythology, UC Davis)

"The great enemy of the truth is very often not the lie - deliberate, contrived and dishonest - but the myth - persistent, persuasive and unrealistic." - John F. Kennedy

Due to budget cuts in California's university systems, researchers in the humanities have been forced to explore applied topics in research. This has led to the establishment of the California Center for Applied Mythology. One of our first efforts was to examine the potential of myth to improve the management and myth-understanding of the mythsteries of California water. However, upon getting into the subject, we have found that California water is already widely myth-understood and that many of those involved in California water problems already have well-developed myth-conceptions which are commonly myth-applied. Indeed, some policy proposals already seem to be myth-led and would involve many myth-deeds and classical myth-appropriations. We present some early findings in the hope that they will not be myth-taken for myth-characterization and will help relieve the widespread mythery of the water community in recent years.

A 3-Dimensional Model of the Sacramento-San Joaquin Delta using Poster Foam and Thermoplastic Figurines, Rachel E. Ragatz, Scott T. Ligare, and David E. Rheinheimer (UC Davis)

While recent advances in 3-D hydrodynamic modeling have enabled sophisticated studies of mass transport in the Sacramento-San Joaquin Delta, they consume significant computational energy and grueling human labor. Inspired by the U.S. Army Corps of Engineers Bay Model, we developed a down-scaled, fits-in-a-pickup 3-D model of the Delta using polyhydrocarbon poster foam to represent Delta morphology and thermoplastic figurines for multi-stakeholder management practices. Results indicate that short-term external anthropogenic forcings could induce long-term regional stability in the agricultural sector.

Price Schreiner: 1939-2009, Tariq Kadir (CA DWR)

Price Schreiner, a long time CA-DWR employee and a key figure in the development and application of the tools for estimating Cenral Valley future water supplies used in the planning of the SWP/CVP systems passed away in July of 2009. Price retired from the CA-DWR in 1994 and continued as a Retired Annuitant until 2008. Price was admired by his colleagues, peers, and management within and outside CA-DWR for his extensive knowledge of California's natural, structural and institutional water resources system; his legacy lives on through the work of others he has influenced.

Delta Corridors Project Russ Brown (ICF International) **2.3 MB**

The Delta Corridors Plan would connect the San Joaquin River (SJR) with the estuary at Franks Tract, and would separate the SJR salt and fish from export pumping. The entire SJR flow would be diverted into Old River and down Grant Line Canal to Old River. Old River between Grant Line Canal and Coney Island would be divided to separate the SJR flow from the water supply flow to the CVP and SWP exports. The SJR flow would cross over the Victoria Canal water supply corridor at the north end of Coney Island. Four barriers would be constructed with boat locks to separate the Middle River water supply corridor from the SJR-estuary corridor in Old River. The CVP and SWP fish facilities would continue to operate, although with fewer fish and much less debris because of the separation of the SJR. The primary louver bypass flows (of about 250 cfs) from each facility would be pumped into Old River, to allow the salvaged fish to return to the SJR-estuary corridor, improving the salvage efficiency by about 25% for all fish. The Delta Cross Channel (DCC) would be opened and fish screens would be installed at DCC and Georgiana Slough. Potential benefits of the Delta Corridors Project would be: (1) reduced salinity at the exports, (2) wastewater discharges would be separated from drinking water intakes, (3) full exports during the VAMP period, (4) Sacramento fish would be separated from the water supply corridor, (5) Delta smelt spawning in the lower San Joaquin River or along Old River would no longer be subject to entrainment losses, and (7) The risk of water supply interruption from levee failure events would be reduced.