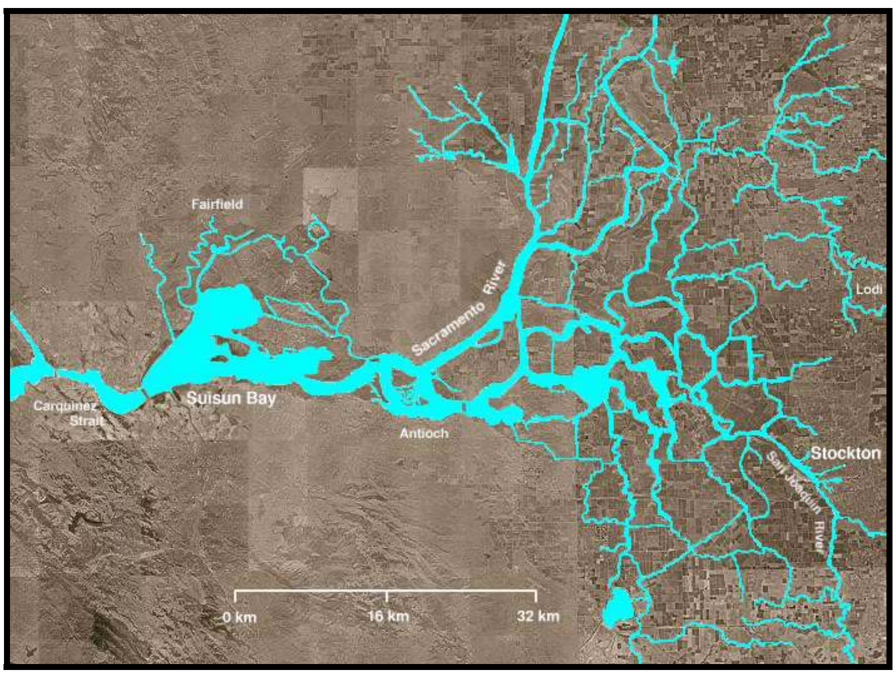
California Water and Environmental Modeling Forum

2009
Annual Meeting
Abstracts

"Droughts, Floods and In-Between: Modeling for a Changing Delta"



February 23-25, 2009

Asilomar Conference Grounds
800 Asilomar Boulevard
Pacific Grove, California

California Water and Environmental Modeling Forum ◆ P.O. Box 488, Sacramento, CA 95812 ◆ 916-607-0435 ◆ cwemf@cwemf.org ◆ www.cwemf.org

California Water and Environmental Modeling Forum
2009 Annual Meeting Summary of Sessions

Monday, February 23, 2009

Time	Session	Moderator	Location
10:15 am-12:00 pm	1: Delta Integrated Restoration and Water Supply Planning under Future Uncertainty - BDCP Modeling	Armin Munevar	Kiln
	2: Modeling for the California Water Plan Update 2009	Rich Juricich	Triton
12:00-1:00 pm	Lunch	---	Dining Hall
1:15-3:00 pm	3: 2008 Developments and Applications of CalLite	Nazrul Islam	Kiln
	4: WEAP Application to Analysis of Climate Change in the Central Valley	Andy Draper	Triton
3:00-4:00 pm	Registration I / Check-In	---	Social Hall
4:15-6:00 pm	5: Calsim 3.0 Development Updates	Hongbing Yin	Kiln
	6: Observed Data and Modeling for Climate Change	Jamie Anderson	Triton
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-10:00 pm	7: Evening Program: Reception I	---	Kiln
7:30-8:30 pm	Keynote Speaker: Daniel Dooley, U.C. ANR, "The San Joaquin River Accord: How Did it Happen?"	Peter Vorster	

Tuesday, February 24, 2009

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-9:15 am	8: CWEMF Activities / Annual Business Meeting	Tara Smith	Kiln
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: San Joaquin River Restoration Modeling I	Peter Vorster	Kiln
	11: 2008 DSM2 Developments and Applications	Tara Smith	Triton
12:00-1:00 pm	Lunch	---	Dining Hall
1:15-3:00 pm	12: San Joaquin River Restoration Modeling II	Peter Vorster	Kiln
	13: Hydrodynamic and PT Modeling for Delta Smelt	Pete Smith	Triton
3:00-4:00 pm	14: Pop-Up Talks II: 5-Minute Overviews of Modeling Work	Stacy Tanaka	Kiln
3:00-4:00 pm	Registration II	---	Social Hall
4:15-6:00 pm	15: Applications of Hydro-Meteorological Forecasting in Modeling Water and Environmental Management	Mike Tansey	Kiln
	16: Modeling the Delta: Three-Mile Slough Operable Gate in the Franks Tract Project	Marianne Guerin	Triton
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-10:00 pm	17: Evening Program: Reception II	---	Kiln
7:45-8:30 pm	Hugo B. Fischer Award / Presentation by Recipient	Nigel Quinn	
8:30-9:15 pm	Career Achievement Award / Presentation by Recipient	Rich Satkowski	

Wednesday, February 25, 2009

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-10:00 am	18: An Integrated Suite of Planning and Physical Process Models on the Sacramento River	Brian Van Lienden	Kiln
	19: Decision Analysis for the Delta: Modeling to Compare Water Export Strategies	Jay Lund	Triton
10:15 am-12:00 pm	20: Modeling Habitat Restoration in California	Mike Tansey	Kiln
	21: Overland and Underground Integrated Water Modeling	H. Morel-Seytoux	Triton
12:00-1:00 pm	Lunch / Check-Out	---	Dining Hall
1:15-3:00 pm	22: Modeling to Support Flood Emergency Operations	Michael Mierzwa	Kiln
	23: 2008 HydroGeoSphere Enhancements/Applications	George Matanga	Toyon

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Monday, February 23, 2009

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

Session One: Delta Integrated Restoration and Water Supply Planning - BDCP Modeling

Moderator: Armin Munevar (CH2M Hill)
Location: Kiln

Overview of BDCP Process, Conservation Measures, and Modeling Approaches, Armin Munevar (CH2M Hill)

The purpose of the Bay Delta Conservation Plan is to help recover endangered and sensitive species and their habitats in the Delta in a way that also will provide for sufficient and reliable water supplies. Conservation measures being considered by the BDCP include tidal marsh restoration, floodplain restoration, alternative ways for conveying water for exports, changes to operations of current facilities, and control of other stressors. BDCP modeling is seeking, through a stakeholder process, to integrate water operations, hydrodynamics and water quality, and restoration in order to evaluate benefits and impacts to various covered species and their habitat. An overview of the process, conservation measures, and modeling approaches will be presented.

Hydrodynamic Modeling of Delta Restoration Opportunity Areas, John DeGeorge (RMA)

The RMA Bay-Delta model has been used to evaluate changes in tidal flows and transport related to associated with potential large scale tidal marsh restoration considered in the Bay Delta Conservation Plan (BDCP). The restoration opportunity areas modeled include Suisun Marsh, Cache Slough, and South Delta regions. Restoration areas were represented as two-dimensional depth-averaged flow regions with bathymetry developed from the best available data including recent Delta LIDAR survey. In addition to the basic hydrodynamic and salt transport simulation results, analysis products included Mean Higher High Water, Mean Lower Low Water, Delta residence time, source water finger printing, and fate mapping.

Integrating Tidal Marsh and Potential North Delta Diversions, Chandra Chilmakuri (CH2M Hill)

Dual conveyance and large scale tidal marsh restoration in the Delta are being evaluated as potential key elements of the Bay Delta Conservation Plan conservation strategy. In the current analysis, preliminary operating rules were formulated for a proposed north Delta diversion and for changes to operations of the existing facilities. The DSM2 model was used to analyze the hydrodynamic and salinity changes resulting from the altered CVP and SWP operations and inclusion of the proposed tidal marsh restoration opportunity areas. The DSM2 PTM was used to study the impacts to the travel time, fate and residence time of neutrally buoyant particles in the Delta under the changed operations and the Delta configuration.

Fisheries and Habitat Integration in the Bay Delta Conservation Plan,
Chuck Hanson (Hanson Environmental)

The Bay Delta Conservation Plan (BDCP) Conservation Measures are being developed to achieve the dual goals of the plan. The development of draft conservation elements included fishery recovery and habitat restoration considerations incorporating hydrologic and hydrodynamic modeling results, observed fish surveys and salvage relationships, and conceptual models. A preliminary assessment of the BDCP Conservation Plan elements is being performed by Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) workgroups. This information will be incorporated into revisions to the Conservation Elements.

Session Two: Modeling for the California Water Plan Update 2009

Moderator: Rich Juricich (CA DWR)
Location: Triton

Overview of Scenarios Developed for California Water Plan Update 2009
Rich Juricich (CA DWR) (0.8 MB)

The Public Review Draft of the California Water Plan Update 2009 was released during January of 2009. An overview will be provided of how the Water Plan is applying the concept of Scenarios to quantify the uncertainties facing California water managers. Scenarios represent alternative plausible views of future baseline water management conditions. Scenarios describe factors like population growth, land use changes, and long term climate change that are beyond the control of water managers. Areas where additional research and funding is needed for long term improvement and integration of water resource analysis will also be highlighted.

Application of WEAP Model to Develop Future Water Scenarios for California Water Plan Update 2009 (2 MB)
Mohammad Rayej (CA DWR)

Draft results of 3 alternative future Water Plan Scenarios will be presented describing agricultural, urban, and unmet environmental water demands out to the year 2050. Improving on studies completed for California Water Plan Update '05, DWR has applied the WEAP model for high level analysis of agricultural and urban water uses for 10 hydrologic regions for Water Year 2005 and 3 alternative future scenarios out to Water Year 2050. We considered water use of 20 agricultural crops and for single-family and multi-family residential indoor/outdoor, commercial, industrial and public water uses. A major improvement for Update 2009 is the inclusion of 12 sequences of long term climate change consistent with those used by the Governor's Climate Action Team. These climate sequences consider the effect of different estimates of future precipitation, temperature, relative humidity, and wind speed on future water use and supplies.

Unmet Environmental Water Estimates for Water Plan Scenarios
Tom Filler (CA DWR) (83 KB)

Draft results and methods from Water Plan Update 2009 Scenarios are presented for future unmet objectives for instream flows and deliveries for managed wetlands. Unmet objectives are objectives that have been identified by regulatory agencies or pending court decisions, but are not yet required by law. For Update 2009 we updated information on historical values of unmet objectives to include information from 1998-2007 and used this information to estimate future unmet objectives under 3 alternative scenarios.

1:15-3:00 p.m.

Session Three: 2008 Developments and Applications of CalLite

Moderator: Nazrul Islam (CA DWR)
Location: Kiln

Latest Updates on the CalLite Screening Model Development
Nazrul Islam (CA DWR) (5.5 MB)

The California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (Reclamation) have been updating and maintaining the interactive model CalLite - Central Valley water management screening model. The model has recently been used for investigating different water management alternatives in different projects including Bay Delta Conservation Plan and Operation Criteria and Planning process. New functionalities emerged from these processes and future water management actions have been incorporated to the latest CalLite model. The presentation will focus on these updates especially on the Climate change options, sea level rise options, future potential water management alternative, Delta regulations, and alternative allocation procedures.

Analysis of Impacts of Climate Change using CalLite Simulations, Richard Chen (CA DWR)

CalLite model has adopted twenty four (24) climate changes scenarios in combination of six (6) different Atmosphere-Ocean General Circulation Models (AOGCM), two different greenhouse-gas emission scenarios, and two projection periods. The six AOGCM models were selected among those participating in the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report. The two selected emission scenarios are A2 and B1 of the IPCC Special Report on Emission Scenarios (SRES). The two climate-change projection periods are the middle of century (2030-2059) and the end of century (2070-2099). With this new capability in CalLite, compounding impacts of new facilities and/or new regulations under climate change conditions on State Water Project (SWP) and Central Valley Project (CVP) operations can be studied. Analysis of climate change impacts on the SWP and the CVP operations using the updated CalLite model will be presented elsewhere.

Sea Level Rise Impact on Delta Exports, Sanjaya Seneviratne (CA DWR)

Impacts of 1 ft and 2ft sea level rise on Delta salinity and exports are simulated over 82 year period (1922-2003). Delta Simulation Model (DSM2), developed by the California Department of Water Resources, has been used to simulate the salinity at some key locations in the Sacramento- San Joaquin Delta. Simulated Salinity data from DSM2 along with Delta boundary flows has been used to train Artificial Neural Networks (ANN) for each of the sea level rise scenarios. CalLite model links the trained ANNs dynamically to estimate salinity in terms of electrical conductivity (EC) derived from flow-salinity relationships at a given location. CalLite has been used to determine the extra cost of water to mitigate the sea level rise. In this study current operation rules specified in State Water Resources Control Board's Water Right Decision 1641 (D 1641) are assumed unchanged.

BDCP Water Management Screening Evaluations using CalLite

Derya Sumer (CH2M Hill) (4.6 MB)

The Bay Delta Conservation Plan (BDCP) is applying CalLite for exploring various water management actions as part of their development of a long-term conservation strategy. Two interactive CalLite exploratory sessions were conducted with stakeholders during which water management scenarios were developed and simulated interactively with the participants. Alternatives were explored for dual conveyance options involving a south delta and north delta diversions, water operations associated with modifications to Fremont Weir and the Yolo Bypass, changes to Delta inflows, outflows, and X2 to explore greater synchrony with unimpaired flows, increasing spring Delta outflow, and options to achieve water quality targets in the Delta. General observations were drawn from each exploratory scenario and combinations of these scenarios were also tested. CalLite is continuing to serve a useful role in the BDCP process as a swift screening tool for initial evaluations of changes to the Delta operations and educating stakeholders on the operations of the Central Valley system and tradeoff of future management options.

Session Four: WEAP Application to Analysis of Climate Change in the Central Valley

Moderator: Andy Draper (MWH Global)
Location: Triton

A Climate Driven Model of the Water Resources of The Sacramento and San Joaquin Hydrologic Regions: Model Structure and Data Inputs, Brian Joyce (SEI)

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.

A Climate Driven Model of The Water Resources of The Sacramento and San Joaquin Hydrologic Regions: Hydrologic and Demand Response to Climate Change, David Yates (UCAR)

The WEAP model of the Sacramento-San Joaquin Basins, previously presented, was used to simulate the hydrologic cycle in an attempt to track the overall mass balance of this large geographic region on a monthly timestep. The model contains physical descriptions of watersheds; reservoirs, including their general rules of operation; diversions; water demands (ag and urban); groundwater basins; in-stream flow requirements; refuge requirements; exports; etc. The ability of the model to represent key hydrologic observations such as streamflow, reservoir storage, export delivery, groundwater storage, aggregate urban and agricultural demands is presented.

Evaluating Statewide Climate Change Affects on California's Applied Water Demands, David Groves (Rand Corporation)

For the California Water Plan Update 2009, the WEAP system is being used to evaluate California water management response packages against a wide range of plausible future management conditions (or scenarios). Two models are being developed: (1) an integrated hydrologically-based simulation model of the Sacramento-San Joaquin River Basins (discussed in the two previous talks) and (2) a lower-resolution climate-driven model of applied water demand for California at the Hydrologic Region scale. This talk will report on the latter effort, which uses climatic inputs derived from global circulation models together with several alternative land-use projections to develop scenarios of applied water demand. These scenarios will be evaluated against independent estimates of future water supply availability and alternative water demand response options.

Introducing Climate Change Considerations into Water Resource Planning in the Sierra Nevada: Case Studies from the CABY Watersheds, David Purkey (SEI)

As a water management entity located in the Sierra Nevada Foothills, the El Dorado Irrigation District (EID) is keenly aware of projections related to changing patterns of the accumulation and melting of snow in its source water area under climate change. While the EID Board and Management understands that these changes can have profound implications for the manner in which EID manages its water supply, they are less clear on how to quantify specific impacts and to identify promising adaptation strategies. In order to explore these issues, EID has been working with the Stockholm Environment Institute-US Center to develop an analytical framework to support planning that takes climate change into consideration. This presentation will: 1. Introduce this framework, based upon the use of SEI's WEAP system 2. Describe its use in the EID context and in the wider Sierra Nevada.

4:15-6:00 p.m.

Session Five: CalSim 3.0 Development Updates

Moderator: Hongbing Yin (CA DWR)
Location: Kiln

Overview of CalSim 3.0 Development, Hongbing Yin (CA DWR)

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. For this reason alone, CalSim 3.0 will be a lot more useful and meaningful to local water agencies. Other improvements in CalSim 3.0 include more input from local agencies on hydrology and facilities operations, and improved groundwater representation. Once released to the public, CalSim 3.0 will replace its predecessor, CalSim-II.

CalSim 3.0 System Representation - Demystifying the CalSim Schematic, Andy Draper (MWH)

CalSim 3.0 represents a new level of detail, evolving from a model of the CVP/SWP system to a model of the water resources of the Central Valley. Key to this enhancement has been the development of a detailed representation of the water supply, water demand, and water conveyance system. The level of detail and spatial resolution makes the new schematic clear and transparent to both local and regional water resources planners, and both seasoned and neophyte system modelers. Central to the development of the model schematic has been the parallel effort of developing a georeferenced network that clearly relates model arcs and nodes to river and stream reaches, water control structures, gages, diversions, return flows, and demand units. This talk presents an overview of the Central Valley plumbing and its representation in the new georeferenced framework.

Discussion of CalSim 3.0

The participants will discuss the future of CalSim3.0.

Session Six: Observed Data and Modeling for Climate Change

Moderator: Jamie Anderson (CA DWR)
Location: Triton

Observed Relationship between the Pacific Decadal Oscillation (PDO) Phase Shift and California's Short-term Droughts, Messele Ejeta and Jamie Anderson (CA DWR)

An analysis of over 100 years of unimpaired streamflow data of California's eight major rivers shows a very strong correlation between two historical short droughts in California and the two known Pacific Decadal Oscillation (PDO) cycle changes from the cool phase to warm phase. The two short droughts on record in California, measured by the magnitude of unimpaired streamflow, occurred in water years 1924 and 1977. The two known PDO cycle shifts from the cool phase to the warm phase since 1891 occurred in 1924 and 1976. For seven of the eight rivers, the unimpaired flows in 1924 and 1977 are the two lowest on record since 1901 or 1906 when the records began. For all the eight rivers, the flow magnitudes during these two water years are mostly less than 25% compared to the corresponding long-term average flows. For the eighth river, the northern most river in the sample, the unimpaired flow data for 1924 and 1977 fall in the lowest three on record since 1906 when its record began. In hindsight, such a strong correlation between record short droughts and the PDO cycle change timing may provide valuable information for water resources planning and management. In addition, it may also provide some information to reduce the uncertainties in climate change modeling and its results. Thus, a better understanding of the underlying physical phenomenon causing the PDO and its phase shifts may provide important information for water resources planning and management in California.

Comparison of Long-Term Planning Hydrology based on Different Blends of Instrumental Record, Paleoclimate, and Projected Climate Information, Levi Brekke (USBR)

Water resources adaptation planning under climate change involves making assumptions about probabilistic water supply conditions, which are linked to a given climate context (e.g., instrument records, paleoclimate indicators, projected climate data, or blend of these). Methods have been demonstrated to associate water supply assumptions with any of these climate information types. Additionally, demonstrations have been offered that represent these information types in a scenario-rich (ensemble) planning framework, either via ensembles (e.g., survey of many climate projections) or stochastic modeling (e.g., based on instrument records or paleoclimate indicators).

If the planning goal involves using a hydrologic ensemble that jointly reflects paleoclimate (e.g., lower-frequency variations) and projected climate information (e.g., monthly to annual trends), methods are required to guide how these information types might be translated into water supply assumptions. However, even if such a method exists, there is lack of understanding on how such a hydrologic ensemble might differ from ensembles developed relative to paleoclimate or projected climate information alone.

This research explores two questions: (1) how might paleo and projected climate information be blended into an planning hydrologic ensemble, and (2) how does a planning hydrologic ensemble differ when associated with the individual climate information types (i.e. instrumental records, paleoclimate, projected climate, or blend of the latter two). Case study basins include the Gunnison River Basin in Colorado and the Missouri River Basin above Toston in Montana. Presentation will highlight ensemble development methods by information type, and comparison of ensemble results.

Project Co-Investigators: Jim Prairie and Tom Pruitt (Reclamation), Balaji Rajagopalan (Univ. of Colorado) and Connie Woodhouse (Univ. of Arizona)

Large Spatial Scale Water Temperature Modeling – Range-Wide Application to the Sierra Nevada, Stacy Tanaka (Watercourse Engr)

The Sierra Nevada Mountain Range (Sierra Nevada) is expected to experience hydrologic changes under global climate change. Future conditions may include different timing, quantities, and distribution of precipitation events (rain and snow), and/or warmer air temperatures leading to earlier runoff of snowmelt from the higher elevations. To assess the possible impacts of a future climatic change on water temperature, a conceptual model was formulated identifying the forcing function associated with water temperature conditions in streams and reservoirs. This conceptual model was subsequently developed into a numerical model representing water temperature conditions with varying elevation in the Sierra Nevada. The fundamental approach adopted was to develop a regional, equilibrium based temperature model (RTEMP) using regionally available meteorological data, outputs from a WEAP model of the Sierra Nevada (including air temperature, relative humidity, precipitation, snowmelt, and surface runoff volumes, groundwater base- and inter-flows, and solar radiation), and user specified values (including cloud cover, wind speed, initial groundwater and snowmelt temperatures, emissivity, water surface reflectivity, specific heat of water, a connectivity matrix, and basic basin information). The model utilized a simplified version of the advection dispersion equation, the full form of the heat budget, and retains critical geometric information about the system in question. This approach produced a time series of “dynamic equilibrium temperatures,” wherein water temperature may not achieve complete equilibrium with meteorological conditions over the specified time period due to travel times within each elevation “band.” The model was run for a for a base climate case (current conditions) and two climate change scenarios (+2 degC and +4 degC increase in air temperature). In general water temperatures increased with decreasing elevations and with increased climate warming. Climatic heating did not produce a uniform increase in water temperatures, but seemed to have a larger impact at higher elevations suggesting that the snowpack is diminished and precipitation as rainfall tends to dominate.

Climate Change and Hydrologic Uncertainty in Rainfall-Dominated Watersheds: A Texas Review, Armin Munevar (CH2MHill)

While much of the focus on climate change impacts to water resources in the western United States has been related to snow-dominated watersheds, lower elevation basins are dependent on rainfall as the predominant form of precipitation and source of supply. Water management in these basins has evolved to adapt to extreme climatic and hydrologic variability, but the impact of climate change is potentially more acute due to rapid runoff response and subsequent greater soil moisture depletion during the dry seasons. This talk will overview climate change analyses developed for a range of watersheds in Texas.

7:00-10:00 p.m.

Session Seven: Evening Program

Moderator: Peter Vorster (Bay Institute)
Location: Kiln

Keynote Speaker: Daniel Dooley, University of California Vice-President for Agriculture and Natural Resources, “The San Joaquin River Accord: How Did it Happen?"

The SJRRP is a direct result of a Settlement reached in September 2006 on an 18-year lawsuit to provide sufficient fish habitat in the San Joaquin River below Friant Dam near Fresno, California, by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council (NRDC), and the Friant Water Users Authority (FWUA). The Settlement received Federal court approval in October 2006. Federal legislation was re-introduced on January 4, 2007 to authorize Federal agencies to implement the Settlement. The Settlement is based on two goals: (1) Restoration: To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish; and (2) Water Management: To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement. The legislation has passed the U.S. Senate and is awaiting approval in the House of Representatives.

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Tuesday, February 24, 2009

8:15-9:15 a.m.

Session Eight: CWEMF Activities / Annual Business Meeting (2 MB)
Moderator: Tara Smith (CWEMF Convener / CA DWR)
Location: Kiln

The CWEMF will (1) report on 2008 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: Kiln

CA SWAMP Program (0.5 MB)

A Brief Look at ANN Sensitivity (0.9 MB)

Assessing Preference Among Surface Water Hydrologic Models for Studies Involving Climate Change (0.1 MB)

TSC Water Resources Planning and Operations Support Group: Climate Change Activity Highlights (0.3 MB)

Estimating Potential Supply Impacts of the Delta Smelt Biological Opinion – Some Considerations (0.6 MB)

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

Session Ten: San Joaquin River Restoration Modeling I (2.4 MB)
Moderator: Peter Vorster (Bay Institute)
Location: Kiln

San Joaquin River Restoration Program Overview
David Mooney (USBR) (13.2 MB)

In 1988, a coalition of environmental groups led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the

United States and the Central Valley Project Friant Division contractors (Friant Districts), NRDC et al. v. Kirk Rodgers et al. On September 13, 2006, after more than 18 years of litigation, NRDC, Friant Water Users Authority (FWUA), and the U.S. Departments of the Interior and Commerce agreed on terms and conditions for a Stipulation of Settlement. The Settlement establishes two goals:

- Restoration – To restore and maintain fish populations in “good condition” in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- Water Management – To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows.

To achieve the Restoration Goal, the Settlement establishes releases of water from Friant Dam and flow targets to the confluence of the Merced River. Additionally, the Settlement calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam and the reintroduction of Chinook salmon. The Water Management Goal includes diverting additional flood flows at Friant Dam into the Friant-Kern and Madera Canals and recapture and recirculation of restoration water after flows leave the restoration area.

The San Joaquin River Restoration Program, SJRRP consists of a multi-agency interdisciplinary team with a co-located office in Sacramento, CA. State and Federal agencies, led by the U.S. Bureau of Reclamation (Reclamation) formed the SJRRP to implement the Stipulation of Settlement. Implementing Agencies are Reclamation, the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), California Department of Water Resources (DWR), California Department of Fish and Game (DFG), and California Environmental Protection Agency (CalEPA).

Restoration Operations in CalSim, Walter Bourez and Dan Easton (MBK Engineers)

Various restoration scenarios were simulated with CalSim for EIR/EIS impact analyses. In this presentation, we will discuss associated CalSim developments such as the implementation of Friant-Kern Canal operations and cross valley connections with the California Aqueduct, modifications to Friant Division allocation logic, and split month San Joaquin River operations logic. Results will be presented with a focus on key study metrics such as Friant contractor deliveries, CVP Exchange contractor and refuge reliance on Delta exports, reservoir response on key San Joaquin River tributaries, San Joaquin River flow and water quality at Vernalis, and general SWP and CVP response.

Managing Restoration Releases in Real-Time
Jeffrey Payne (MWH) (2.5 MB)

The Settlement provides six incrementally release patterns for restoring the San Joaquin River salmon fisheries, related to an assessment of the San Joaquin Basin’s wetness. In addition, the Settlement defines provisions for the flexible management of those allocations. The details of implementation, including a ‘smoothing’ process for annual allocations, were deferred for later discussions and required mutual agreement by the Settling Parties by December, 2008. The compounded uncertainties in the hydrologic forecasts (used to set allocations) and anticipated ecological responses (the San Joaquin salmon fishery which has not existed in nearly seventy years) created considerable obstacles for agreement on the details of implementation. A series of meetings were held to discuss concerns about Settlement releases and to begin drafting an implementation document, referred to as the Restoration Flow Guidelines. Garnering agreement ultimately required the development of a ‘gaming’ tool that tied together the processes for setting annual allocations with an uncertain forecast, implementing provisions for flexibility in the flow schedules, and the likely implications of on both Millerton Lake's cold water pool and temperature profiles within the San Joaquin River, between its confluence with the Merced River and Friant Dam. This presentation reviews both the process used to draft the Restoration Flow Guidelines, and the gaming tool used to demonstrate how uncertainties could be managed within the proposed allocation and scheduling processes.

Ecosystem Diagnostics and Treatment Modeling for Fisheries Management in the San Joaquin River, Chip McConnaha (JSA) (1 MB)

The San Joaquin Fisheries Management Work Group is charged with developing the technical response to the Friant Dam settlement including flow management and other habitat restoration measures to restore extirpated spring Chinook. The work group has chosen Ecosystem Diagnosis and Treatment (EDT) model as its primary analytical tool to evaluate fish restoration actions. EDT has been extensively used in the Pacific Northwest by state, federal and tribal managers to develop ESA recovery plans, watershed management plans and to evaluate salmon restoration actions. EDT will be used to identify current limiting factors for spring Chinook and to compare restoration alternatives. EDT diagnoses fish habitat at a life stage/reach level using a library of species habitat relationships. These relationships calculate capacity and productivity of Chinook life stages based on the characteristics of habitat in each reach. Life stages are related across the life cycle through the mathematics of a Beverton-Holt stock recruitment relationship. Productivity and capacity of life stages in all stream reaches are “rolled-up” to compute fish performance along individual life history trajectories. EDT computes fish performance along thousands of these trajectories to diagnose habitat across time and space within the study stream. The result is an evaluation of habitat that can be related to the metrics of the NMFS Viable Salmonid Population (VSP) concept. Restoration alternative are modeled as changes to the habitat condition in specific reaches and are compared using the VSP metrics. San Joaquin EDT will include the capabilities to route trajectories along the complex hydrologic routing of the river below Friant Dam. This will allow the work group to evaluate operational alternatives that route portions of flow into both the East Side Bypass and the historic river channel. A customized front-end will facilitate use of the model by the work group. With the EDT model the work group will develop a collaborative, science-based response to the settlement agreement. The model, input data and results will be publicly accessible via a web interface.

Session Eleven: 2008 DSM2 Applications and Developments

Moderator: Tara Smith (CA DWR)
Location: Triton

Update of DSM2 User Group Activities, Tara Smith (CA DWR) (0.4 MB)

The 2008 DSM2 User Group Activities will be discussed.

Out of the Mokelumne: Analysis of Factors Influencing Travel Time to the San Joaquin River Using PTM, Marianne Guerin (RMA) (1.4 MB)

The objective of this study was to develop travel time vs. flow relationships for particles released on the Mokelumne River upstream of the fork and subsequently leaving the Mokelumne System and entering the San Joaquin River through Potato Slough and at the confluence of the two rivers. PTM particle tracking model runs were developed from 37 HYDRO flow models with steady boundary flows and with the Delta Cross Channel closed. PTM results were used to evaluate particle travel time out of the Mokelumne system. Multi-variable regression relationships were formulated for time to breakthrough and time to maximum particle concentration as a function of selected boundary flows.

Real-time DSM2 Simulation: Update 2009

Alan Ng (CA DWR) (6.5 MB)

The Delta Compliance and Modeling Section of the Project Operations Planning Branch of the Operations & Maintenance Division of DWR uses DSM2 simulation results to ensure compliance of State Water Project operations with regulatory Delta water quality, flow, and export restriction regulations, as well as with other requirements such as south Delta water level and water quality objectives during water transfers or use of Joint Point of Diversion. In the latter part of 2007, a process was initiated by the Delta Compliance and Modeling Section to simplify the steps to run DSM2 for real-time forecasting purposes, as well as to put in place an on-going procedure to periodically update documentation for real-time DSM2 simulation. During the 2008 CWEMF Annual Meeting, an update of these recent activities was provided to the DSM2 modeling community. The process of on-going simplification in conducting DSM2 simulations and improvement in DSM2 capabilities of the Delta Compliance and Modeling Section continues. This presentation provides a summary of the activities undertaken and completed during 2008 as well as the current status of the real-time DSM2 documentation.

Co-Authors: Tracy Hinojosa, Abdul Khan, and Amardeep Singh (CA DWR)

South Delta Barrier Operations Analysis Using DSM2 Simulations

Amardeep Singh (CA DWR) (4.6 MB)

The State Water Project (SWP) and Central Valley Project (CVP) are operated for optimizing water deliveries, while adhering to existing regulatory and environmental requirements. The SWP and the CVP also meet additional requirements such as south Delta water level and water quality objectives during water transfers or use of Joint Point of Diversion. Every year, during summer/fall irrigation season, temporary agricultural barriers are put in place at three locations in south Delta - Middle River (MR), Old River at Tracy (ORT), and Grant Line Canal (GLC). In recent years, the Projects strive to optimize water level and water quality conditions by managing the operations of the built-in culverts underlain in the barriers. Realizing that water flow conditions at the barriers may be improved by selectively raising and/or lowering the barrier heights, a study was undertaken to evaluate the potential of selected alternatives to improve flow conditions at the barriers. A DSM2 baseline simulation was first developed using July 1 through August 31, 2008 historical data. The simulated results at various locations at the Delta were compared with historical data to ensure that simulated flows and water levels reasonably matched the observed ones. A series of alternative scenarios with elevation changes among the various barriers, with increased number of culverts in the different barriers, etc. were then formulated and simulated using DSM2. This talk presents the results of the analysis, including identification of potential alternatives to improve the operations of the south Delta temporary barriers.

Co-Authors: Abdul Khan, Alan Ng and Tracy Hinojosa (CA DWR)

1:15-3:00 p.m.

Session Twelve: San Joaquin River Restoration Modeling II

Moderator: Peter Vorster (Bay Institute)
Location: Kiln

SRH-1D Mobile Boundary Modeling Capability and Application to SJJRP, Blair Greimann (USBR)

Sedimentation and River Hydraulics – One Dimension (SRH-1D) is a one dimensional hydraulic and sediment model used to simulate water surface profiles, sediment transport rates, and erosion and deposition within rivers and canals. The model is available for download at: www.usbr.gov/pmts/sediment. The basic model is structured very similar to HEC-RAS 4.0. Many of the modeling capabilities of HEC-RAS 4.0 are duplicated, but we have found it beneficial to have the flexibility to have our own source code. We use the tools available in HEC-RAS and HEC-GeoRAS to develop the geometry input for SRH-1D and generally a HEC-RAS model is first generated to test the hydraulic portion of the model. The SRH-1D model has many sediment transport equations available and is constantly being updated to include features that may be useful for our projects.

SRH-1D has been applied to the San Joaquin River and the flood bypasses from Friant Dam to the confluence with the Merced River to predict future erosion and deposition with and without the San Joaquin River Restoration Program (SJRRP). The model requires several inputs. Cross section information was taken from existing HEC-RAS models of the system. Bed material data was collected from field samples collected throughout the river and bypass system. The daily flows used in the simulations were generated by CALSIM II and a daily time step model described in Session 10: San Joaquin River Restoration Modeling I. We used the simulated daily flows under with and without SJRRP and we also simulated the erosion and deposition using historical stream gage data.

Some of the main concerns of the project include improving and maintaining anadromous fish habitat below Friant Dam and maintaining flood capacity in the project reaches. To this end, we analyzed the mobilization of gravel and also simulated changes to the bed elevations. The reach downstream of Friant is primarily gravel and cobble and we analyzed whether project flows will be able to mobilize this gravel to maintain salmon spawning beds. The other major concern is maintaining flood capacity in the reaches with levees. A particular striking feature of the San Joaquin is the rapid transition from a gravel bed to sand bed approximately 40 miles downstream of Friant Dam. Most of the leveed reaches are sand bed reaches. We analyzed the potential erosion and/or deposition in each reach.

SRH-1DV Modeling Vegetation Response to Dam Reoperations
Lisa Fotherby (USBR) (2.8 MB)

SRH-1DV integrates flow, sediment, and vegetation processes to provide quantitative and predictive estimates of change in river morphology and habitat. Sedimentation and River Hydraulics Group at the Technical Service Center in Denver began to develop 1D vegetation tools in 1999 for complex environmental concerns in river recovery projects. Flow and sediment transport computations are integrated with algorithms for plant germination, growth, mortality, and competition. Plant species are selected for their influence on channel morphology or are target species for study. Germination input for each species includes seed dispersal periods, viability, and moist ground requirements. Seeds can be dispersed by air or water, and colonization can occur by root spread with values entered for transport distance, initiation flow depths, and seed survival days. Rates and maximum values by vegetation type for root growth, stalk growth and canopy expansion are also specified. Plants persist unless eliminated by scour, desiccation, prolonged inundation, shading, competition between plants, and senescence. In addition, mortality by ice removal or burial can be options. Also input are specifications for plant removal and rules defining competition between plants.

For San Joaquin River studies, Fremont cottonwood (Populus fremontii), Goodings black willow (Salix gooddingii), narrow-leaved willow (Salix exigua), generic herbaceous and two invasive species, tall cane (Arundo donax), and red sespania (Sespania punicea) are modeled. Vegetation age, root growth and stem growth are tracked daily throughout 23 years, for each species at each data point in every cross section (300). Area of vegetated cover, plant removal and cause of death are computed for every alternative to aid complex evaluations of beneficial or harmful change in both native and non-native vegetation. In Platte River EIS studies, 1D flow-sediment-vegetation modeling is used to evaluate bird and fish habitat, defined by the presence or absence of vegetation and height of vegetation. Indicators include unobstructed view widths for cranes, unvegetated river widths, width to depth ratios and flow depths. Modeling is also used for developing management actions based on geomorphic response of the braided river system. The power of a 1D flow-sediment-vegetation tool for environmental studies rests in quantifying and comparing the differences in vegetation, habitat and geomorphology for river management alternatives.

SRH-2D Model Capability and Future Development, Yong Lai (USBR)

SRH-2D, Sedimentation and River Hydraulics – Two-Dimensional model, is a two-dimensional (2D) hydraulic, sediment, temperature, and vegetation model for river systems under development at the Bureau of Reclamation. SRH-2D solves the 2D dynamic wave equations, i.e., the depth-averaged St. Venant equations. In terms of modeling capabilities, SRH-2D is comparable to many existing models such as RMA-2 and MIKE21. SRH-2D possesses a few unique features. First, SRH-2D uses a flexible mesh that may contain arbitrarily shaped cells. In practice, the hybrid mesh of quadrilateral and triangular cells is recommended though purely quadrilateral or triangular elements may be used. A hybrid mesh may achieve the best compromise between solution accuracy and computing demand. Second, SRH-2D adopts very robust and stable numerical schemes with seamless wetting-drying algorithm. The resultant outcome is that few tuning parameters are needed to arrive at the final solution. The current version for public distribution only simulates the flow hydraulics. Future versions will add additional modules related to sediment, temperature and vegetation modeling.

SRH-2D has been applied on several rivers in the western United States to analyze effects of dam removal, assess fish habitat values, analyze levee setback alternatives, improve sediment management at diversion dams, predict water surface elevations around structures, and many other applications. SRH-2D has been applied on the San Joaquin to study the effects of vegetation roughness on water surface elevations during floods. It is also be used to assess fish habitat and gravel mobilization on the river. The details behind the application on the San Joaquin will be described in a companion paper by Abulaban in this session.

SRH-2D Application to SJRRP, Karim Abulaban (CA DWR)

The California Department of Water Resources (CDWR) has utilized the public version of the Bureau of Reclamation's SRH-2D hydrodynamic model to develop a two-dimensional (2-D) hydraulic model of the 25-mile reach of San Joaquin River right downstream of Friant Dam, designated as Reach 1A. SRH-2D is a depth-averaged 2-D, finite-element, transient hydraulic simulation model that uses an unstructured, boundary-fitted computational mesh. The 2-D model will be used to evaluate hydraulic conditions in the river to assist in evaluation of fish habitat, riparian vegetation, sediment transport and floodplains. The 25-mile reach was subdivided into two segments in order to reduce the size of the computational meshes and subsequently the run times to run the model. Seven roughness zones were delineated on 2007 imagery and assigned different Manning's n-values based on vegetation density. The 2-D model was run in steady mode to simulate a range of flows, including low flows of 350 and 500 cfs; intermediate flows of 1500 and 2500 cfs; a high flow of 4500 cfs; the objective flood of 8000 cfs; and controlled flood of 16000cfs. Model output includes water elevations, depths, flow velocity vectors, Froude Numbers, as well as bed shear stresses. Sample results will be presented to show the capabilities of the model and how it will be utilized for the San Joaquin River Restoration Project.

Session Thirteen: Hydrodynamic and Particle-Tracking Modeling for Delta Smelt

Moderator: Pete Smith (USGS-Retired)
Location: Triton

Use of a Particle Tracking Model to Determine the Advective or Dispersive Nature of the Delta, Vamsi K. Sridharan (Stanford University)

A quasi three-dimensional particle tracking model (PTM) has been developed in FORTRAN to study the transport of Delta Smelt Larvae in the Sacramento-San Joaquin Delta. The model uses flow and stage information from the DSM2-HYDRO model solution, and runs on the DSM-2 one-dimensional channel network. The PTM is capable of treating mixing between different channels at a junction either as a flow weighted randomizing condition or by following the streamlines the particles are on as they approach the junction. This feature can be used to determine the extent to which the entire delta is advective or dispersive in nature. This is because the flow weighted randomizing condition achieves complete mixing at the junctions and makes shear flow dispersion a suitable model in each channel. Estimating the degree to which such an approximation applies will give a better understanding of the dominant transport mechanism in the delta. Also, by selectively applying the streamline following junction model to junctions with successively increasing number of channels, the importance of junctions with more channels in the overall mixing in the delta can be established. Another point of view may be that in tidally forced systems such as the Delta, the randomizing condition introduces several more tidal cycles between each real cycle provided the tidal period is smaller than the time required for complete cross-sectional mixing. Thus, the effect of the tides can be understood by comparing simulations using both the tidal flows and de-tided flows for the time periods considered. This consideration becomes important for the following reason: if the flow were merely uni-directional, then even when shear flow dispersion does not apply, it may be effectively used in a one-dimensional model as a fitting parameter. However, in a tidal system, if shear flow dispersion does not apply, then any fitting of the transport mechanism to a shear flow dispersion may lead to increased artificial dispersion. The theoretical framework and model performance will be evaluated on a test period of one month in the year 1998 with simplified gate operations. Initial results will be presented for the annual year of 2000.

Co-authors: Derek Fong and Stephen Monismith, Stanford University

Particle Modeling of Adult Delta Smelt with Behavior based on EC and Turbidity Distributions, John DeGeorge (RMA)

Entrainment of adult delta smelt at the State Water Project and Central Valley Project has been linked to turbidity pulses that result from first flush storm events. A behavior algorithm based on salinity (represented as electrical conductivity, EC) and turbidity distributions has been implemented in the RMA particle tracking model in an attempt to simulate the distribution of adult delta smelt and entrainment by export pumps. The primary parameters governing the behavior algorithm are the preferred range of EC and turbidity. When particles are outside the preferred concentration range, they will utilize tidal flows to "surf" in the direction of improving conditions determined by local gradients of EC and turbidity. Model results are shown to compare favorably with observed entrainment in 2000, 2002, 2003, and 2004.

Hydrodynamic and Particle Tracking Simulations in Clifton Court Forebay, Michael MacWilliams (River Modeling)

Three-dimensional processes play an important role in the transport of salt and organisms in San Francisco Bay and the Sacramento-San Joaquin Delta. Important three-dimensional processes include gravitational circulation, lateral mixing due to secondary circulation, and wind driven circulation. As part of the Pelagic Organism Decline (POD) program, the three-dimensional unstructured San Francisco Bay-Delta UnTRIM model developed for the Delta Risk Management Strategy (DRMS) project has been extended throughout the entire Sacramento-San Joaquin Delta. The resulting model encompasses the entire San Francisco Estuary, from the coastal Pacific Ocean at Point Reyes through the entire legal Delta.

The three-dimensional San Francisco Bay-Delta UnTRIM model was developed and calibrated to resolve water levels, salinity, and flows throughout San Francisco Bay and the Sacramento-San Joaquin Delta. The model results have been used to assess the transport of particles and tracers throughout the Delta, and to increase the understanding of hydrodynamics, flow pathways, mixing at junctions and in open water bodies, and residence time in Clifton Court Forebay. This presentation presents an overview of the San Francisco Bay-Delta UnTRIM model and some preliminary hydrodynamic and particle tracking results demonstrating the importance of wind driven circulation on residence time in Clifton Court Forebay.

Co-author: Edward S. Gross, Bay Modeling

Delta Smelt Distribution and Entrainment Estimates from 3D Particle Tracking with Vertical Migration Behavior, Edward 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 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 a vertical swimming behavior that is consistent with field observations of delta smelt distribution.

3:00-4:00 p.m.

Session Fourteen: Pop-Up Talks II

Moderator: Stacy Tanaka (Watercourse Engr)
Location: Kiln

Probabilistic Analysis of Delta Hydrology and Water Levels		(0.2 MB)
Adaptation Planning in California: Preparing for Water Scarcity		(0.2 MB)
Trinity River Restoration Program Integrated Information Management System		(0.3 MB)
Real Time Water Quality Monitoring for Implementation of a Decision Support System		(1.9 MB)
Using Future Climate Projections to Support Water Resources Decision-Making in California		(0.4 MB)
DSM2 Modeling of the Effects of Island Levee Failures on Flow and Water Quality in the Delta		(0.9 MB)
3-D Hydrodynamic & Salinity Modeling of Sacramento & S.F. Bay to Stockton Deep Water Ship Channels		(1.4 MB)

4:15-6:00 p.m.

Session Fifteen: Applications of Hydro-Meteorological Forecasting in Modeling Water and Environmental Management

Moderator: Mike Tansey (USBR)
Location: Kiln

Forecasting 14- and 90-Day Evapotranspiration for California's Central Valley, David Yates (UCAR)

A website is being developed to provide real time daily forecasts of potential evapotranspiration across California's Central Valley at 14 day and 90 day lead times. The 14 day lead time is based on NOAA's Global Forecast Model output, while the 90 lead time is based on IRI outlooks use a non-parametric technique to generate several ensemble members. Site specific forecasts can generated based on interactive map selection or alternative, the website can be 'pinged' to automatically generate forecast output in either ASCII or DSS format for use in water management models like the Reclamation's Land Atmosphere Water Simulation (LAWS) tool.

Integrating Seasonal and Daily Forecasts of Agricultural Water Demands into the Central Valley Project Allocation Process, Brian Joyce and Chuck Young (SEI)

The Land Atmosphere Water Simulator (LAWS) is a tool designed for the management of large-scale multi-organizational water supply systems. LAWS simulates daily, field-scale land, crop, and water management practices and allows for the consideration of alternative methods for managing soil moisture on a daily basis during the irrigation season based on soil properties, crop type and growth stage. The LAWS tool was used to develop a model of the main agricultural areas in the San Joaquin and Tulare Basins that receive surface water deliveries from the Central Valley Project. The model is intended to complement the current set of tools used in the CVP allocation process, by improving demand forecasts through the use of a climate-driven, physically-based representation of agricultural demands.

Resource Applications for Forecasts Ranging from Daily to Seasonal, Michael Anderson (CA DWR)

Water resources engineering relies in part on forecasts of temperature, precipitation, and runoff on a multitude of space and time scales. Efforts from flood management to water supply allocation have information requirements that can be fulfilled in part by forecast information. This talk reviews forecast information from entities such as the National Oceanic and Atmospheric Administration and examines how this information is translated into water resources applications over a range of scales. Opportunities for advancement will also be covered.

Forecasting Pacific Coast Ocean Conditions Affecting Salmonid Survival-Based on ENSO and PDO Indices, Michael Tansey (USBR)

The Southern Oscillation produces wide ranging effects in the Pacific Ocean on sea surface temperatures and currents as well as changes in atmospheric circulation. These effects are commonly expressed in the form various indices such as the El Nino Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO) and others. The relationship between these indices and Pacific Ocean coastal conditions affecting the survival of salmonids are presented and opportunities for their use in the management of water resources are discussed.

Session Sixteen: Modeling the Delta: Three-Mile Slough Operable Gate in the Franks Tract Project (0.1 MB)

Moderator: Marianne Guerin (RMA)
Location: Triton

Franks Tract-Water Operations Model (FT-WOM): Analyzing and Redefining System Water Operations, Walter Bourez (MBK Engineers) (1.7 MB)

The purpose of an operable gate in Three Mile Slough (TMS) is to improve water quality and fisheries conditions in the Sacramento-San Joaquin River Delta (Delta). Proposed gate operations affect water quality conditions at compliance stations identified in the State Water Resources Control Board Decision 1641 (D-1641). Operation of upstream SWP/CVP reservoirs and export facilities would change in this case to meet D-1641 standards, resulting in modifications to Delta boundary conditions such as Sacramento River inflow and Delta exports. The Franks Tract-Water Operations Model (FT-WOM) is a spreadsheet model developed to assess changes in system operations based on changes in Delta water quality due operation of the TMS gate. It integrates model output from CalSim II and DSM2 to estimate changes to SWP/CVP operations based on the magnitude of the water quality change simulated in DSM2 under the proposed TMS gate operation.

Three Mile Slough Gate Operations: Implications for Delta Hydrodynamics and Water Quality, John DeGeorge and Richard Rachiele (RMA) (1.1 MB)

Modeling studies investigated two operational regimes for the gate proposed in Three Mile Slough, which conjoins the San Joaquin and Sacramento Rivers near Emmaton. The two regimes show marked differences in the changes their operation brings to Delta hydrodynamics and water quality. The “Flow Balance” gate operation is the standard gate operation for water quality benefit, as it provides substantial decreases in salinity in the central and south Delta. The “Fisheries Response” operational regime would be used on a strategic basis for fisheries protection January to May. Flexible timing of TMS gate operations mean multiple objectives can be accommodated.

For operations favoring an open-by-day/closed-by-night schedule, such as for recreational uses or for fisheries benefits, modeling results demonstrated that both water quality and fish benefit objectives could still be accommodated with modifications to the operational regime.

Modeling Adaptive Gate Operations to Protect At-Risk Fish Species with RMATRK
Marianne Guerin (RMA) **(1 MB)**

Three Mile Slough gate operations may be used adaptively to modify hydrodynamic conditions for fish species of concern, to influence their movement to favorable habitat and away from dangerous conditions. Particle tracking simulations using historical Delta conditions were developed in RMATRK to assess fish protection measures using adaptive TMS gate operations. The timing of the mixed-regime gate operations, combinations of Flow Balance and Fisheries Response modes, were designed to emulate potential real-time use of the TMS gate to protect early life stage delta smelt. Monitoring data for female delta smelt from the Spring Kodiak Trawl survey suggested times and places that spawning may have occurred from March 01 to May 31, 2004. Particles were inserted at ten locations in the Delta at selected times and their fate was analyzed over the model simulation period to assess the performance of alternative gate operations.

7:00-9:00 p.m.

Session Seventeen: Evening Program

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

8:00-8:45 p.m. Presentation of the Hugo B. Fischer Award (0.1 MB)

The CWEMF Hugo B. Fischer Award, which is made in honor of Dr. Hugo B. Fischer's pioneering work on water quality modeling for the Bay-Delta system, recognizes pioneering contribution(s) to the use of modeling for understanding or solving California water problems. More specifically, the award, which was conceived and endowed by Lyle Hoag, retired Executive Director of California Urban Water Agencies and a co-founder of the CWEMF, is given annually for (1) innovative development, refinement, or application of a computer model or (2) significant furtherance of the effective use of models in open forums for planning or regulatory functions that benefit California water stakeholders and decision makers.

Remarks by the Hugo B. Fischer Award Recipients

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

Using 3D Hydrodynamic and Particle-Tracking Models to Explore Fish Movements and Distributions, Dr. Pete Smith (USGS Ret.) (9.2 MB)

PTM Animation (.avi; 11.7 MB)

8:45-9:30 p.m. Presentation of the Career Achievement Award (0.1 MB)

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 Career Achievement Award Recipient

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

A Tale of Two Models, **Ray Hoagland** (96 KB)

2009
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Abstracts

Wednesday, February 25, 2009

8:15-10:00 a.m.

Session Eighteen: An Integrated Suite of Planning and Physical Process Models on the Sacramento River

Moderator: Brian Van Lienden (CH2M Hill)
Location: Kiln

Introduction to the Integrated Suite of Models, Mike Tansey (USBR)

This presentation provides a brief overview of the suite of modeling tools that has been developed to support analyses of the Sacramento River. The suite of tools includes component models to simulate SWP and CVP systems operations on a monthly and daily time step (CALSIM II and USRDOM), temperature responses (USRWQM), salmon production (SalMod), Colusa Basin water quality (CBWQM), sediment transport and geomorphology responses (SRH model package), riparian vegetation establishment (RHEM), salmon life cycle modeling (WRCLCM) and ecological effects (SAC-EFT). These tools have been developed under the Common Assumptions, Shasta Lake Water Resources Investigation (SLWRI), the North-of-the-Delta Off-stream Storage Investigation (NODOS) and The Nature Conservancy's ecological effects tool (SAC-EFT) efforts. The teams developing these models have exchanged information and worked together in a concerted effort to establish a comprehensive analysis of the Sacramento River and its water supply, water quality and ecosystem attributes. Many of these models will be presented in more detail in this and subsequent sessions of the CWEMF Annual Meeting.

Sacramento River Analysis using the Common Assumptions Common Model Package, Robert Leaf and Brian Van Lienden (CH2M Hill)

The Common Assumptions effort is a concerted effort by the Authority, Reclamation, and the Department to coordinate and implement an analytical framework to support the common needs of the CALFED Surface Storage investigations. As part of this framework a Common Model Package has been developed that includes component models to evaluate the water resource system (CALSIM II), Economics (LCPSIM, CVPM), Delta flow and salinity (DSM2), Sacramento River temperature (USRWQM), and salmon production (SalMod), and power generation and use (LTGen and SWP_Power). This presentation provides an overview of how the Common Model Package is applied to analyze the Sacramento River, including improvements that have been made to the CALSIM II representation of the Sacramento Valley and an overview of the Sacramento River salmon production model (SalMod). Model limitations and future model development needs are also presented.

A Daily Time Step Planning and Operations Model of the Upper Sacramento River, Chandra Chilmakuri and Brian Van Lienden (CH2M Hill)

The Upper Sacramento River Daily Operations model (USRDOM) was developed to simulate hydrologic, regulatory, and operational conditions of the upper Sacramento River on a daily time-step for the purpose of supporting the evaluation of potential benefits and impacts for alternatives developed for the North-of-the-Delta Off-stream Storage (NODOS) Investigation. The model is capable of simulating both low-flow (regulatory, CVP project system, water supply, water quality and ecosystem restoration) and high-flow (reservoir refill and flood) operations of the upper Sacramento River. In addition, the model simulates the operations of the Colusa Basin and can be used to analyze existing and proposed facilities related to the proposed Shasta Lake Water Resources Investigation (SLWRI) and the North-of-the-Delta Offstream Storage Investigation (NODOS) project alternatives, and provides the information needed by other models to assess and quantify temperature, salmon production and flow regime related impacts and benefits.

Temperature Analysis Using the Upper Sacramento River Water Quality Model, Mike Tansey (USBR)

The Upper Sacramento River Water Quality Model (USRWQM) was developed to simulate water temperature responses to changes in operations in the Upper Sacramento River. The model was calibrated using ambient flow temperature and reservoir temperature data from 1998-2002 and was validated using data from 1990-1997.The model is currently being used as part of the Common Assumptions Common Model Package (CACMP) to evaluate temperature changes that occur in the North-of-the-Delta Off-stream Storage and Shasta Lake Water Resources investigations. As part of the CACMP, the model provides seven-day average flow and temperature data for SalMod and provides metrics to assess the Sacramento River temperatures from Keswick to Knights Landing.

Sediment Transport and Geomorphology Responses to Changes in Flow Regulation on the Sacramento River, Blair Greimann (USBR)

The Sacramento River is a dynamic river responding to countless natural and manmade influences. Natural variation in the inputs to the Sacramento River such as tributaries flows and their sediment inputs can alter the meander patterns and sediment loads in the mainstem. Human influences such as reservoirs, hydraulic mining, gravel mining, diversions, bank stabilization, levees, and agricultural practices all play a role in shaping the sediment transport and geomorphology of the river. Defining the affect of the flow regulation requires that we also understand the current influences. We have developed sediment transport and river meander models to simulate the current meander rates and bed load transport in the system. SRH-Capacity was used to compute current tributary sediment loads and the sediment loads in the mainstem. We were able to identify reaches that were essentially armored downstream of Shasta, reaches there were in sediment balance, and reaches there were either aggradation or degradation due to a sediment imbalance. SRH-Meander was used to analyze current and future meander rates in the Sacramento River. We coupled this modeling analysis with the historical analyses of Larsen (2007) to determine the current trends in meandering and isolate potential cause and effects on the meander process. With models calibrated to the available historical data, we plan to analyze the influence of flow regulation. Also, we will analyze the future trends under baseline conditions, or without changes to flow regulation.

Session Nineteen: Decision Analysis for the Delta: Modeling to Compare Water Export Strategies

Moderator: Jay Lund (UC Davis)
Location: Triton

Risk-Based Decision Analysis for Delta Levees, Robyn Suddeth (UC Davis)

The inexorable and irresistible drivers of the future of the Delta are reviewed: sea level rise, land subsidence, changing hydrology, and earthquakes. The consequences of these changes are examined in the context of economic decisions for upgrading or maintaining various Delta islands from a statewide perspective.

Agricultural Effects of Delta Management, Josue Medellin (UC Davis)

The losses of agricultural revenues to farms in the southern Central Valley related to the salinity of export water are estimated for the year 2030. Reductions in these economic losses are estimated for several export alternatives.

Variability and Complexity in Delta Ecosystems, John Durand (UC Davis)

The future ecosystem of the Delta is discussed under conditions of sea level rise and permanent island failures. The viability of groups of fish under changed conditions is explored, with associated management and policy implications.

Economic Costs of Treating Delta Waters for Urban Uses, Wei-Hsiang Chen (UC Davis)

The additional drinking water treatment costs of using water from the Delta are estimated and compared with treatment costs for water drawn from the Sacramento River upstream of the Delta. These costs are estimated for present conditions, as well as with sea level rise and the permanent failure of some islands.

Delta Solutions Research Program, Jay Lund (UC Davis)

A formal economic and fish viability decision analysis is made of the Delta export management alternatives. The decision analysis allows for explicit analysis of uncertainties regarding fish recovery, sea level rise, and extensive levee failures as well as implicit incorporation of other uncertainties. UC Davis research extending beyond this strategic decision is outlined.

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

Session Twenty: Modeling Habitat Restoration in California

Moderator: Mike Tansey (USBR)
Location: Kiln

Three Examples of Modeling on the Trinity River - Water - Gravel - Adult Populations
Rod Wittler (USBR) (2.2 MB)

The purpose of modeling is insight, not numbers. Modeling exists in a continuum from conceptual to analytical to numerical. Modeling in the discipline of river restoration can be useful for developing an understanding of how a river system will react to various inputs, both natural and anthropogenic. The Trinity River Restoration Program was established with Adaptive Environmental Assessment and Management (AEAM) as the basis of its organization. Modeling was to be the hallmark of the program. Indeed, a few modeling efforts have had some success and impact on the program, namely water, gravel, and adult populations. The water model is HEC-RAS. RAS has been instrumental in the design of channel restoration projects, gravel injection projects, and associated permitting (FEMA). Analytics of gravel introductions resulted in specifications for the annual amounts, median sizes, and gradation of injected gravels that will result in a mobilized bed under the hydrologic regime of the program. Multivariate analysis of adult populations resulted in a statistically valid estimate of the impacts on adult populations due to in-river and ocean factors.

An Integrated Hydro-Biological Model for Simulating Cottonwood Seedling Establishment on the Sacramento River, Charles Young (SEI)

The Stockholm Environment Institute (SEI), Reclamation and UC Davis have been developing a model and conducting laboratory and field studies of cottonwood seedling growth for use in analysis of riparian habitat establishment on the Sacramento River. The Riparian Habitat Establishment Model (RHEM) is a modified version of the USDA's HYDRUS variably saturated flow model. This allows RHEM to simulate the effects of soil moisture content, atmospheric conditions, and plant responses to water stress during the seedling growth and establishment. In this talk the RHEM model algorithms, Sacramento River field studies, and calibration of the model are presented.

Modeling Effects of Sacramento River Flows on Riparian Habitat and Vegetation Survival, Blair Greimann (USBR)

A self-sustaining cottonwood population is essential to the riparian habitat along the Sacramento River. A model (SRH-1DV) for simulating the establishment, growth, and mortality of cottonwoods has been integrated into a one-dimensional hydraulic and sediment transport model by the addition of modules for vegetation and groundwater. Modes of plant mortality include desiccation, drowning, burial, scour, or age. With this approach, the SRH-1DV model can be used to simulate survival over large river reaches and long time scales. Opportunities for establishing riparian habitat along the Sacramento River between Red Bluff to Colusa are discussed.

Modeling Hydrodynamics, Morphology, and Habitat in Response to Restoration Alternatives for Elkhorn Slough, Matthew Brennan (PWA)

A hydrodynamic model coupled with an empirical erosion rate relationship and habitat projections was used to evaluate proposed restoration alternatives to mitigate erosion in an estuary. Because of land-use changes over the last 150 years, particularly the creation of a jettied harbor at the estuary's mouth, Elkhorn Slough is rapidly eroding along its main channel and also losing vegetated marsh plain habitat. In addition to the baseline option of taking no action, three restoration alternatives have been proposed to mitigate erosion in the estuary by reducing tidal exchange. To evaluate the impact of these alternatives on tidal flow, the estuary was modeled with a depth-averaged hydrodynamic model to provide water level, velocity, and bed shear stress predictions. The modeled bed shear stress also served as the independent variable for an empirical erosion rate relationship based on bathymetric surveys of the main channel. The output of these two physical process models was then used to predict changes to tidal habitat processes and habitat distributions. The hydrodynamic model, erosion rate relationship, and habitat projections are combined to predict morphologic and habitat changes after ten years and fifty years for each restoration alternative. Additional contributors: Steve Crooks and Jeff Haltiner (Philip Williams & Associates)

Session Twenty-One: Overland and Underground Integrated Water Modeling

Moderator: Hubert Morel-Seytoux (Hydroprose Consulting Int.)
Location: Triton

Simulation of Cutbacks in Surface Water Supply in Butte County
Brian Heywood (CDM) (4.1 MB)

As the regulatory environment in the Bay-Delta changes and the State is faced with the on-going impacts of drought, Butte County used their IWFM model to assess potential impacts to groundwater due to changes in surface water deliveries within the County. Following the completion of the County's IWFM integrated surface water/groundwater flow model in 2008, a simulation of potential cutbacks in State Water Project (SWP) deliveries to districts in the County was performed. The cutback scenario assumed a 50% cutback in settlement contract surface water deliveries to the Western Canal Water District and the Joint Water Districts during three critically dry years. Simulation results were analyzed for impacts to groundwater conditions assuming additional groundwater pumping would occur to offset a portion of the surface water deliveries that were not available. This presentation will review the procedure used to simulate the surface water cutback and the results of the simulation.

Co-Authors: Kristen McKillop (Butte County Dept. of Water and Resource Conservation) and Karilyn Heisen (CDM)

Application of Sub-timing and Sub-Gridding Schemes in an Integrated Surface and Subsurface Numerical Model, Mary Kang and Don DeMarco (HydroGeoLogic) and George Matanga (USBR) (.ppt; 14.7 MB)

Testing of sub-timing and sub-gridding schemes incorporated into HydroGeoSphere is undertaken by applying field hydrologic conditions from San Joaquin River Basin of California. 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. 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. Use of sub-timing and sub-gridding may improve computational efficiency of HydroGeoSphere and thereby broaden its utility. 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. Hence, the sub-timing and sub–gridding schemes will render HydroGeoSphere a valuable numerical tool for simulation of flow and thermal/solute transport processes in a rigorous and physically-based manner.

The Conductance Factor in Asymmetrical Stream-Aquifer Interaction
Hubert Morel-Seytoux (Hydroprose Consulting Int.) (0.1 MB)

A recent paper in Ground Water journal (Morel-Seytoux, 2008) presented a technique to simulate the 3-dimensional behaviour of the exchange flow between a stream and a hydraulically connected aquifer, while relying on a 2-dimensional horizontal model for the aquifer. This provides greater simplicity for the computations, especially when dealing with large regional systems. In the previous analysis it was assumed that the flow pattern in the vicinity of the stream was symmetrical. Assuming symmetry when in fact there is a strong lateral underground flow beneath the river (or canal) might lead to errors. However, in fact, the study shows that it is only the case when: (1) the wetted perimeter is quite small compared to the aquifer thickness and (2) the head drop between the "far sections" on the left and the right is at least of the same order of magnitude as the head drop between the river and the right "far section", defined as the side where the drawdown is the largest. This situation is most likely encountered when there is a well pumping in the vicinity of the river while initially there was almost equilibrium between the stream and the aquifer. (The "far section" is defined as the location away from the reach where the Dupuit-Forchheimer approximation first starts to hold within a given accuracy.)

1:15-3:00 p.m.

Session Twenty-Two: Modeling to Support Flood Emergency Operations

Moderator: Michael Mierzwa (CA DWR)
Location: Kiln

Setting the Baseline: Central Valley Flood Hydrology Study, John High (USACE) and Nathan Pingel (David Ford Consulting Engineers)

In late 2007, the California Department of Water Resources (DWR) estimated that 1.8 million Californians (5% of the State's population) lived in the so-called 100-year floodplain. A growing Californian population will increase this vulnerability to flooding, with more people and property moving into potentially inundated areas. A changing climate may expand the areas subject to inundation at a given risk level and may envelop more land and more people. Further, the flood control system that protects Californians in the Central Valley is aging and the information upon which floodplain management decisions must be made is incomplete or out of date.
In 2007 the state initiated the FloodSAFE California program, which aims to increase flood protection and improve flood preparedness and response. For the state to achieve its FloodSAFE goals, the data upon which it depends must be updated: the baseline must be set. In support of these efforts, DWR has tasked the US Army Corps of Engineers, Sacramento District (Corps) to complete a hydrologic analysis of the Sacramento and San Joaquin river basins, specifically focused at developing hydrologic input to assess the federal-state levee system. The results of the analysis will be used to support DWR's ongoing floodplain mapping effort. The goal of the hydrologic analysis is to develop the required frequency curves and associated volumes at key locations in the watershed. In this presentation, we will describe the requirements of the study, how it is being coordinated with other agencies and a hydrologic advisory committee, the technical challenges of such a study, and the approach for completing the analysis. We will also describe the secondary products of the study, such as the developed hydrologic models, and how those can be used for other DWR purposes.

Modeling & Mapping Overview of the Central Valley Floodplain Evaluation & Delineation Program, Glenn McPherson (PBS&J)

The Department of Water Resources (DWR) is leading a multifaceted initiative called FloodSAFE California to improve integrated flood management throughout California, with an extra emphasis on better managing flood risk related to the State-federal flood protection system in the Central Valley. The Central Valley Floodplain Evaluation and Delineation (CVFED) Program is one of several programs within the FloodSAFE Initiative. The CVFED Program has multiple goals, including improving the quality and accuracy of flood hazard data and mapping available to local communities. The CVFED Program is developing new topographic data and updating hydrologic and hydraulic data and models, which will be used to better understand the risk of flooding in the Central Valley, to support evaluation and design of potential actions and projects to help manage risk, and to support flood emergency operations. This presentation will provide an overview of the CVFED Program, including its objectives and anticipated deliverables.

Dancing Fast in Real-Time – Forecast Coordinated Operations on the Feather and Yuba Rivers, Matt Zidar (GEI Consultants)

Problem Statement: Real time flood forecasting is a complicated dance between local, state and federal partners, all of whom play important, albeit, different roles. Coordination during flood operations and making sure that everyone is dancing to the same sheet of music was the focus of a pilot and demonstration project on the Yuba-Feather River systems. The dance involves data capture and communications, data management and exchange, application of analysis tools to produce forecasts of reservoir inflows and downstream flow, scheduling reservoir releases to meet downstream flow constraints, and aggregating all of this into a coherent decisions support process that helps reduce risk and uncertainty and protects life and property.

Approach: Developing and implementing the F-CO program involved multiple dance partners. The participating agencies have a history of working together in preparing flood-related information, operating and maintaining the flood control structures, and serving the public during flood emergencies. The F-CO program has further enhanced working relationships as well as developing infrastructure for exchanging and sharing flood information. The Yuba Feather Forecast-Coordinated Operations Project (YF F-CO) involved the key agencies operating reservoirs on the river system, including the Yuba County Water Agency, which operates New Bullards Bar (NBB), the California Department of Water Resources (DWR) which operates Lake Oroville, DWR Flood Management- CDEC; NOAA California Nevada River Forecast Center, and the US Army Corp of Engineers. The consulting team included David Ford Engineer Consulting Engineers, MBK Engineers, and others.

Results: The YF F-CO program provided new information systems technologies, an enhanced reservoir simulation model (ResSIM), forecasting tools, communications protocols, and operational procedures. This improves the flow of information and allows operators to make better-informed decisions, and generate forecasts that are more timely and accurate. The YF F-CO Decision Support System (DSS) was developed for coordinated and informed decision making of reservoir operations between all the flood management agencies. The DSS provides for storage and data sharing, and is built around the California Data Exchange Center System (CDEC). It uses secure, Webbased technologies to ensure ease of use and rapid access to important flood information for the reservoir operators and public. The DSS improves data sharing and communications among participating agencies. Both forecasted and observed data are maintained in relational databases accessible through user friendly Web-based interfaces.

Relevance: The YF F-CO DSS has demonstrated how the local, state and federal agencies can coordinate the fast dance during real time flood operations, and can work together to better operate reservoirs, improve the ability to meet downstream objective flows, and provide additional level of protections downstream without impacting water supply of the projects. DWR is now working with the other partners to design strategies to apply these tools more broadly as part of the Flood Emergency Response Program.

All Along the Watchtower: Overview of Daily Federal-State River Forecasts, Michael Mierzwa (CA DWR)

The State of California and the National Weather Service (then the US Weather Bureau) began making use of short-term river forecasts in 1958 following the devastating 1955 floods. In order to better serve the public, the newly created CA Department of Water Resources (DWR) and NWS co-located and began issuing joint water level forecasts.

These initial forecasts were prepared by hand using known relationships and limited available real-time data. With improved data collection and understanding of meteorology and hydrology, the hand-based forecasts have been replaced by rainfall and runoff estimates based on a series of physical based models. Today precipitation, wind, and temperature forecasts covering most of California and Nevada from a series of global models are combined with observed river water levels, reservoir operations, watershed models, and antecedent conditions accounting for key parameters such as soil moisture and snow pack to produce real-time water level forecasts. With forecasts produced for hundreds of locations throughout two states twice each day, river forecasting meteorologists and hydrologists gain a unique understanding of both the natural and managed trends associated with California's water resources.

Both the parameters within these models and the actual models and tools used in the integrated National Weather Service River Forecasting System (NWSRFS) are constantly being updated. In addition to being used to support emergency response operations, the physically based NWSRFS has also been used to address longer-term water management and planning studies. This presentation will provide an overview of the suite of models and procedures used within the NWSRFS and highlight the future directions of real-time weather and watershed monitoring / forecasting.

Session Twenty-Three: 2008 HydroGeoSphere Developments and Applications

Moderator: George Matanga (USBR)
Location: Toyon

HydroGeoSphere: Ongoing Model Enhancements and Applications in Reclamation's MP Region, George Matanga (USBR)

Management of water resources requires consideration of complex surface/subsurface hydrological/ecological systems at basin-wide scale. The surface water regimes are closely interconnected and include aquatic systems (stream channels, wetlands, vernal pools, lakes, periodic floods and other surface-water bodies); riparian zones; lowlands; and uplands. Surface and subsurface water regimes are known to closely interact with each other. In HydroGeoSphere, the surface-water regimes are currently treated as 2D systems, while the subsurface-water regimes are handled as 3D systems. The physically-based HydroGeoSphere is based on a rigorous conceptualization of the hydrologic system comprising of surface- and subsurface-water regimes. This model is designed to take into account key components of the hydrologic cycle with various boundary conditions, such as rainfall, complex evapotranspiration, interception storage, land use, irrigation, and point sources and sinks. Success of conjunctive analyses of hydrological and ecological processes requires accurate characterization and quantification of fluid, energy and chemical exchange fluxes within and across the hydrologic-cycle components as well as ecosystems. The ongoing enhancements including subtiming, subgridding, and temperature simulations continue to improve on HydroGeoSphere's ability to accurately and efficiently characterize and quantify complex systems.

Predicting Stream Temperatures in a Fully-Integrated Surface/Subsurface Model, Young-Jin Park (Univ. of Waterloo)

Climate change has significant impacts on water availability in certain regions and may have a detrimental effect on thermal exchange fluxes between surface and subsurface flow regimes. Recently, there has been an increase in field-based research directed towards characterization of the exchange processes along surface/subsurface interface. On contrary, relatively little work has been undertaken to simulate these exchanges under fully-integrated surface/subsurface conditions. A fully-integrated, physically-based model, such as HydroGeoSphere, is needed to elucidate the roles of the various meteorological, surface/subsurface hydrological and thermal energy exchange processes in surface water bodies. To address this issue, HydroGeoSphere was enhanced to simulate water flow, evapotranspiration and advective-dispersive thermal transport over 2D surface and in 3D variably-saturated subsurface system. Results from high resolution numerical simulations are presented to illustrate the importance of explicitly accounting for temporal variations in incoming longwave/shortwave solar radiation and latent/sensible heat fluxes over the entire land surface when simulating the thermal processes. The need to account for these surface heat fluxes in a manner that preserves energy balances within both the surface and subsurface flow regimes highlights the importance of taking a holistic fully-integrated modeling approach when predicting the impacts of climate change on water resources.

Co-Authors: Andrea Brookfield and Ed Sudicky (University of Waterloo)

Linking HydroGeoSphere and CalSim, C. Mary Kang (HydroGeoLogic)

Computer models are frequently used to guide decisions pertaining to the operation, planning and management of the State Water Project (SWP) and the federal Central Valley Project (CVP) water storage and conveyance systems. CalSim, developed by California Department of Water Resources and the U.S. Bureau of Reclamation (BOR), is the standard reservoir-river basin simulation model for studies relating to the SWP/CVP system. HydroGeoSphere (HGS) is well suited for physically-based predictions of the impacts of climatic change with regard to surface-subsurface temperature, hydrology and water quality, and has been successfully applied at regional scales to the Central Valley. To benefit from functionalities of both HGS and CalSim, a dynamic linkage between HGS and CalSim with feedback is being developed to facilitate conjunctive simulation of hydrologic processes and multi-reservoir systems without oversimplified representation of key physical processes. The linked HGS-CalSim model provides a comprehensive tool for evaluating the impact of climate change on California's water resources in addition to analyzing water supply, water quality and ecosystem health issues in an integrated and optimal manner.

Co-Authors: George Matanga and Kirk Nelson (USBR)

HydroGeoSphere Application for Integrated Analyses of Mountainous Regions, Young-Jin Park (Univ. of Waterloo)

Hydrology in mountainous regions is difficult to characterize due to lack of adequate data and analyze due to the highly nonlinear nature of the physical processes in surface water flow on steep slopes, percolation through thick unsaturated zones, and interaction of surface and subsurface water regimes. HydroGeoSphere was applied to two well-defined, intensively characterized mountainous catchments in Korea. In order to understand physical hydrologic processes in mountainous terrains, detailed 3D numerical models were constructed for these catchments. Ability of the models to closely reproduce the field surface/subsurface hydrologic data was evaluated under steady and transient conditions. HydroGeoSphere has the capability to simulate a multitude of processes including stream generation with 2D overland flow, infiltration and exfiltration over the land surface, variably-saturated flow in 3D subsurface water regimes, and temporal and spatial variation of saturation-dependent evapotranspiration. Results indicate that consideration of evapotranspiration along with the effects of agricultural drainage/irrigation was essential for understanding the water cycle in such areas. It is furthermore concluded that a fully-integrated characterization and numerical analysis are necessary to delineate and reasonably predict hydrologic behavior in mountainous systems, such as the Sierra Nevada Mountains of California.

Co-Author: Ed Sudicky (University of Waterloo)